2009-2010 Feasibility and Market Research Study For Commercial Hop Production in New England

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Executive Summary

The Vermont Agency of Agriculture Food and Markets and the Massachusetts Department of Agricultural Resources commissioned this research project to study the economic and logistic feasibility of commercial hop production in New England. The goal is to expand opportunities for New England growers to generate a profitable income from their land. This report has determined that is feasible to grow a commercial hop crop in New England:

A. There is sufficient demand from the brewing community to support a minimum of 100 acres in production.
B. There is sufficient price point elasticity to afford producers an ability to generate a profit, and a reasonable time frame for return on investment.
C. The information, technology, and equipment now exist for smaller scale, 1-10 acre commercial hop operations.
D. Aside from potential limitations of topsoil depth to bedrock, New England's growing climate and conditions are well suited to hop production.

The four scenarios in which a grower could yield a positive net income from growing hops are as follows:

Scenario 1: Participating in a value-share growing program with Atlantic Hops

Scenario 2: Selling whole hops, minimally processed direct to brewers

Scenario 3: Using Atlantic Hops for processing services and selling pelletized hops direct to brewers

Scenario 4: Selling do-it-yourself pelletized hops direct to brewers

Income Potential and Return On Investment

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Average Yield Per Acre	1,500 dried lbs	1,500 dried lbs	1,500 dried lbs	1,500 dried lbs
Average Net Income Per Acre	$4,640	$5,090	$5,090	$12,910
Average Return On Investment for 1st Acre	5 years	5 years	6 years	4 years
Level of Individual Risk	Low	Moderate	Moderate	High
assuming a $10/lb price point for whole dried hops, $15/lb for pelletized hops, and $9/lb return from the value-share program				

While the potential to generate net income per acre is highest in scenario four, in which the grower creates the value-added finished product on site, the ultimate recommendation is to adopt scenario one, in which growers participate in a value-share growing program with Atlantic Hops. This is because scenario one represents the least risk while still presenting a strong potential for financial return.

In all instances, in order to reach a reasonable income and rate of return on investment, a commercial grower will need to utilize mechanical harvesting and sorting. In order to minimize risk from crop failure, and to stagger harvest times for logistical ease, it is highly recommended that the grower also divide the hopyard into thirds and adopt a 3 variety planting.

Background

New England was home to a vibrant hop trade through the beginning of the Twentieth Century. In fact in 1900, New York was the largest producer of American hops, generating 49% of the entire U.S. yield. By the end of Prohibition, however, much of the hop industry had migrated to the Pacific Northwest. This was due to advances in mechanization that made larger scale farming a reality, complementing West Coast geography, and the decimation of the Eastern crops by a disease known as downy mildew. Downy mildew is a crippling disease because it can cause short and long term damage, impacting a specific year's harvest, and potentially killing the plants themselves.[1] The potential to kill the plant is a significant issue with a crop such as hops, because they are a perennial plant and take three to four years to establish.

Why is there an interest in the commercial viability of growing New England hops, and why now?

1. The beer industry is a mature industry with demonstrated longevity and stable consumption. This translates into stable market demand for raw ingredients such as hops. Even in the midst of one of the worst recessions in history, 2009 U.S. beer sales only decreased 2.2%.[2]

2. In the 1970's a segment of the brewing industry, craft brewing, began to develop popularity in the Northeast, particularly in New England and Quebec. Craft brewers, originally considered fringe, are now accepted in the mainstream beer

[1] Barth, H.J., Klinke, C., Schmidt, C. The Hop Atlas. 1994. Nuremberg, Germany. Joh, Barth & Sohn. pp12-14.
Jason Perrault. Perrault Farms. Guest Speaker. 2010 Winter Hops Conference. UVM Extension. 3/26/2010.
[2] http://www.brewersassociation.org/pages/business-tools/craft-brewing-statistics/facts

industry and make up 5% of the total US beer market share.[3] Not only does the category now make up a respectable share of overall beer sales, it continues to rise as the shift in consumption trends away from consuming volume quantities of mass-marketed, low cost beer, to selective, smaller quantities of higher quality products.[4]

A 2007 report expressed this trend as follows:

> The Brewers Association, the trade association that tabulates industry data for craft brewers, reports craft beer sales and growth continue to break records. The volume of craft beer sold in the first half of 2007 rose 11% compared to this same period in 2006 and dollar growth increased 14%. For the first time ever craft beer has exceeded more than a 5% dollar share of total beer sales.
>
> Overall, the U.S. beer industry sold one million more barrels in the first half of 2007 compared to 2006, with 400,000 of these new barrels produced by craft breweries. This equates to 3.768 million barrels of craft beer sold in the first two quarters of 2007 compared to 3.368 million barrels sold in the first half of 2006.
>
> Scan data from Information Resources, Inc. provide additional data points that confirm strength for the segment. Craft beer sales in the supermarket channel through July 15, 2007 showed a 17.4% increase in dollar sales compared to the same period in 2006. This growth in sales was higher than any other alcohol beverage category.
>
> "The 1,400 small, independent and traditional craft brewers in the U.S. have hit their stride," said Paul Gatza, Director of the Brewers Association. "United States craft brewers are making many of the world's best beers, and the marketplace is responding."
>
> Coupled with the growth statistics has been a tidal wave of media coverage in the first half of 2007 including NBC's Today Show on July 3 stating, "Beer is the new wine and can go with just about any food." Additionally, Gallup, in its latest poll on alcohol beverages, announced for the second straight year that "Beer Again Edges Out Wine as Americans' Drink of Choice."
>
> Julia Herz, Director of Craft Beer Marketing for the Brewers Association, concluded, "Craft beer market share is steadily and consistently growing. A grassroots movement is responsible for this success as appreciators continue to trade up."[5]

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[3] http://www.thefreelibrary.com/Craft+Beer+Segment+Continues+to+Set+the+Pace+for+the+Beer+Category...-a0167648025

[4] François Biron. Agronomiste. Ministère de l'Agriculture des Pêcheries et de l'Alimentation Québec. Guest Speaker. 2010 Winter Hops Conference. UVM Extension. 3/26/2010.

[5] http://www.thefreelibrary.com/Craft+Beer+Segment+Continues+to+Set+the+Pace+for+the+Beer+Category...-a0167648025

To further express this point, while overall beer sales were down 2.2% in 2009, craft beer sales rose 10.3%.[6]

3. The nature of the craft beer industry is built on product differentiation, tradition, innovation, quality, integrity, and community.[7] These qualities all lend themselves to supporting a local commercial hop production effort. Craft brewers' desire for freshness and quality, their support of local economies, their interest in uniqueness as opposed to ubiquity all help influence their purchasing decision making, and thus they are not solely buying on price. This support has been researched and quantified through this feasibility study.

4. The size and scale of the micro and craft breweries (they must produce less than 2 million barrels per year[8]) place them in a position to be able to work with smaller scale local commercial hop production. They can more easily adapt to incorporating local hops into their production and recipes, and their volume needs, or a portion of their volume needs, are of a size and scale that would be feasible for New England producers to attain and supply on a consistent basis.

What has been done to date?
In 1988, the Vermont Department of Agriculture initiated hop production trials with Catamount Brewing Co. of Windsor, Vermont. Those trials were expanded by Dr. Leonard Perry at the University of Vermont. Reports on those trials are available at http://www.uvm.edu/~pass/perry/hops.html.

In September 2008, a small team from Vermont and Massachusetts traveled to Germany, the Czech Republic and Belgium to learn more about equipment used there for harvesting and processing hops. The team met with numerous farmers who produced, harvested, and processed hops and with manufacturers of hop harvesting and processing equipment.[9]

In 2009 the Vermont Agency of Agriculture Food and Markets and the Massachusetts Department of Agricultural Resources secured USDA Specialty Crop Block grants for this feasibility study to be conducted and for UVM Extension to develop and establish an organic hopyard trialing 20 hop varieties and different cover cropping techniques.

[6] http://www.brewersassociation.org/pages/business-tools/craft-brewing-statistics/facts
[7] http://www.brewersassociation.org/pages/business-tools/craft-brewing-statistics/craft-brewer-defined
[8] http://www.brewersassociation.org/pages/business-tools/craft-brewing-statistics/craft-brewer-defined
[9] Information provided by Steve Justis, Vermont Agency of Agriculture, Food and Markets, August 2009.

Methodology

To complete the feasibility study, the first step was to research market demand and product specifications for the finished product. Craft brewers, brew pubs and homebrew supply stores in ME, MA, NH, and VT were identified as the direct prospective target market for a New England grown hop.

A survey questionnaire was developed (see appendices). The questionnaire was available by Survey Monkey, as an e-mail attachment, and as a telephone interview. 72 brewers were contacted and requested to participate. Follow up was made by telephone and e-mail. 47 responses were received, a 65% response rate.

The intent of the survey was:

- to determine what varieties of hops these brewers use
- what volume of these hops they use
- what they pay
- how these prices fluctuate
- what purchasing relationships they are engaged in
- what the parameters or limiting factors of these relationships are
- what they would find most valuable in influencing their purchasing decision for New England hops
- what the finished product would need to be for them to consider using a New England hop
- what they would consider a fair price for a New England hop

After conducting the market research, the study turned to hop production feasibility. Could hops grow in New England, what are the bottlenecks to commercial production? Bottlenecks researched included:

- access to and cost of raw materials for hopyard establishment
- access to and cost of mechanized harvesting equipment
- access to and cost of secondary processing
- growing conditions
- issues affecting crop yield

Following research on the bottlenecks, production models for a 1 to 10 acre hopyard were explored. Four production models were developed that could present a financially and logistically feasible commercial hop growing venture.

The information was then summarized into this final report.

Initial findings

Brewers who responded to this study were universally interested in buying New England hops: 94%, 44 out of 47 respondents indicated an interest in purchasing New England hops. This conclusion is supported by research conducted in 2009 by Duncan Hilchey of New Leaf Publishing and Consulting, Ithaca, NY.[10]

While the brewers who responded to this feasibility study may not be representative of the entire New England brewing community, their responses did achieve the market research goals of the study which were to

A. Determine if there is sufficient demand to absorb a minimum of 100,000 lbs of dried, New England aroma hops per year, and at what price point
B. Develop a highly qualified prospect list

The highly qualified prospect list is composed of those brewers who asked to remain involved as the project as research and development, unfolds. They are highlighted in **Bold** under the brewers consulted in the appendices.

Key purchasing decision making factors

Price

Brewers are highly price sensitive. While they are interested in buying local hops, price will be a key factor. The primary price ranges considered as acceptable price points at which brewers would purchase local hops if they met their other requirements were: \$5/lb, \$8-10/lb, and \$10-15/lb. At the \$5-10/lb brewers would consider sourcing 100% of their hops from New England producers if the finished product was interchangeable with their existing supply in terms of product deliverable.

Product Quality

Making beer is both a science and an art form. There are many nuances that can affect the final product. Because of this, the ultimate achievement of a brewer is when they can consistently produce the same finished product in taste, aroma, appearance, and mouth-feel, brew after brew, from brewhouse to brewhouse. Because hops create a signature aroma and flavor profile for a beer, hops are a key ingredient in any beer recipe. Because the chemical make up of hops may change from harvest to harvest depending on growing conditions and geographic region, the more the brewer knows about the make up of each

[10] Hilchey, D. *The Market Potential for Northeastern-Grown Hops.* New Leaf Publishing and Consulting, Inc. 2009.

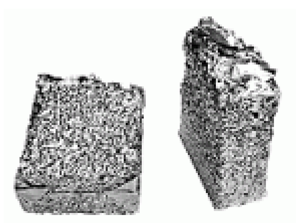
shipment of hops he receives the more he can adjust his recipe so that the end result will be consistent with prior brews.

To meet product quality requirements, New England hops will need to be submitted to a lab for chemical analysis and a chemical analysis will need to accompany each hop shipment.

Product Specifications

While the brewer can't control the chemical makeup of a hop from harvest to harvest, he has come to expect his hops to look and perform a certain way.

In order to meet product specifications to be considered a viable alternative, a New England hop would need to be pelletized to a T-90 standard, packaged in Nitrogen flushed, vacuum sealed, foil laminated pouches, and encased in cardboard boxes. There are two standard offerings, four 11lb pouches to a 44 lb box, or one 44lb pouch to a 44lb box.



11lb pouches of vacuum sealed, nitrogen flushed hop pellets.
Photo courtesy http://hops-extracts.com

T-90 Pellets.
Photo courtesy http://hopunion.com

Purchasing Decision Influencers in buying "local" (New England grown) hops

Stable price point

Brewers are frustrated and increasingly vulnerable to volatile price points and product scarcity of hops on the spot market. This is especially disconcerting to them as the craft beer category continues to grow and brewers of all scale and size compete for access to hops to meet their growing and existing market demand.

Personal relationships

Brewers, similar to bakers and chefs, take their craft seriously and personally. They appreciate having connections to those providing their ingredients because they know that the quality of the ingredients will ultimately impact the quality of the finished product. Having growers that they can develop a long lasting, personal relationship with will help supersede price as the ultimate purchasing decision making factor.

Environmental awareness

New England's craft brewers are well aware that the majority of the inputs into their products currently originate from the Mid-West, West Coast, and Europe. Anything they can do to help reduce their carbon foot print by being able to purchase inputs from closer sources would be appreciated.

Local economic stimulation

New England craft brewers also understand the notion of local economy. Most of our craft brewers are local or regional producers whose products stay in New England, therefore keeping their purchasing dollars in New England further reinforces the likelihood that their own products will be purchased.

Marketing

Craft brewers often tightly wrap their geographic locations into their corporate identity, leveraging "a sense of place" as a distinguishing attribute in their sales and marketing. By purchasing local ingredients they can further strengthen this marketing message.

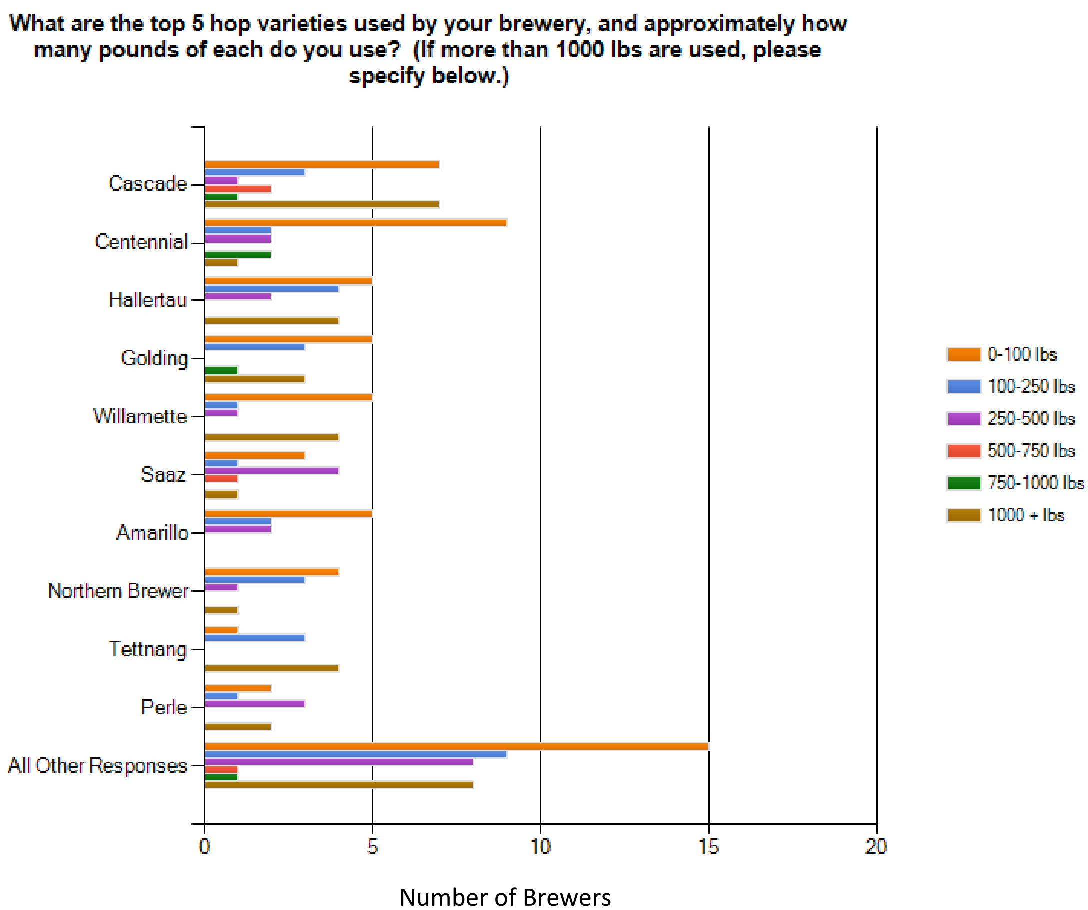
Market Research Survey Details

Of the 72 brewers, brew pubs, and home brew supply stores surveyed, 34 responded, for a total response rate of 47%. From the responses given, total barrels (bls) brewed (from 26 respondents) came to 370,970 bls per year, with an average of 14,268 bls per brewery. The smallest brewer claimed 210 bls per year, while the largest brewer cited 100,000 bls per year.

Hop Varieties & Volume

The most prevalent hop used by the brewers was Cascade, followed by Hallertau, Centennial, Golding, and Willamette, see chart below.

Total volume of hops used annually by 21 breweries reporting came to 126,482 lbs of dried hops per year, and 2,600 lbs of wet hops per year.



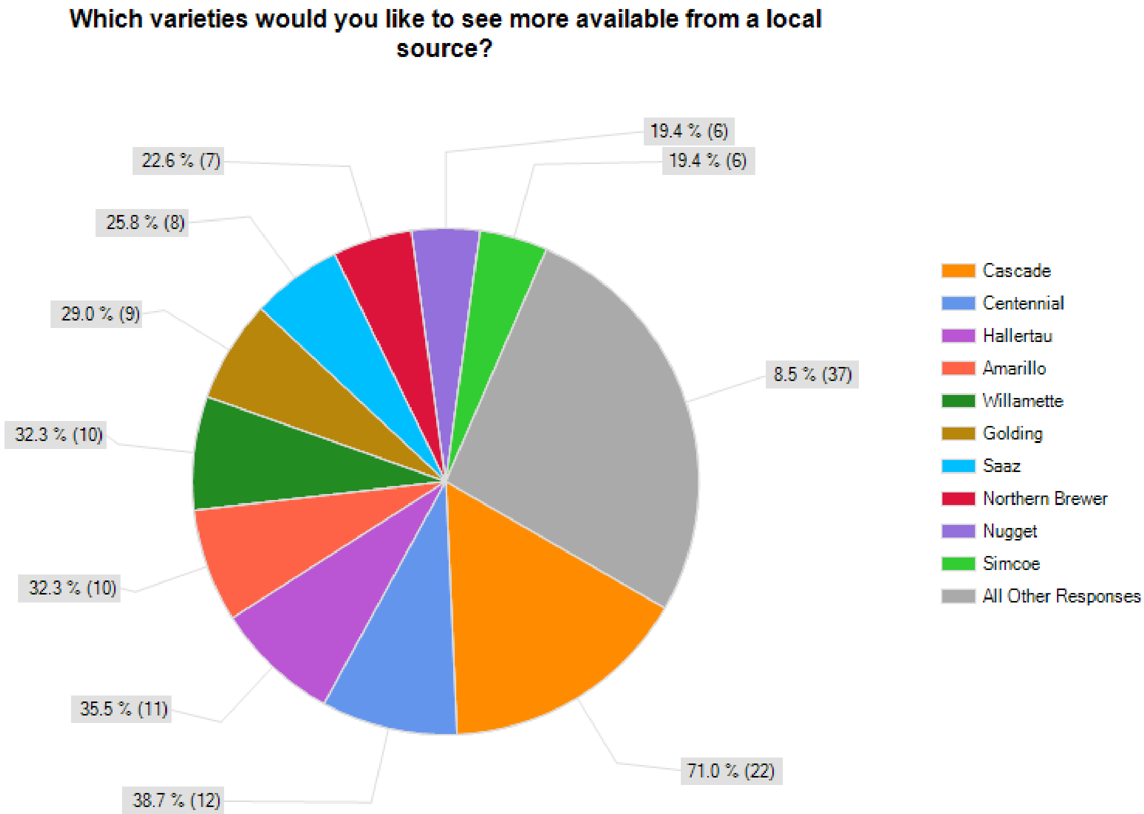
The total volume of Cascade hops used by 30 reporting breweries came to 81,860 lbs per year. Volumes of the next nine most prevalent hops were as follows:

Hallertau 6,436 lbs/yr from 15 respondents
Centennial 5,400 lbs/yr from 16 respondents
Golding 5,250 lbs/yr from 12 respondents
Willamette 5,250 lbs/yr from 11 respondents
Tettnang 4,850 lbs/yr from 8 respondents
Perle 3,950 lbs/yr from 8 respondents
Saaz 3,550 lbs/yr from 9 respondents
Magnum 3,250 lbs/yr from 5 respondents
Nugget: 2,750lbs lbs/yr from 4 respondents
Northern Brewer 2,650 lbs/yr from 9 respondents
Columbus 2,000 lbs/yr from 8 respondents
Glacier 1,850 lbs/yr from 3 respondents

In addition to seeking to understand the brewers' current hop usage and volume, the study asked their preference in what varieties they would be more interested in seeing from a New England source, see chart on page 12.

Cascade topped the list with 71%, 22 of 31 respondents, demonstrating an interest in a New England Cascade. Centennial was the next most requested with 39%, 12 of 31 respondents, asking for it. The brewer responses present themselves favorably in terms of the logistical feasibility of being able to meet their variety preferences because Cascade and Centennial happen to be two of the varietals that outperform other varieties in New England.[11]

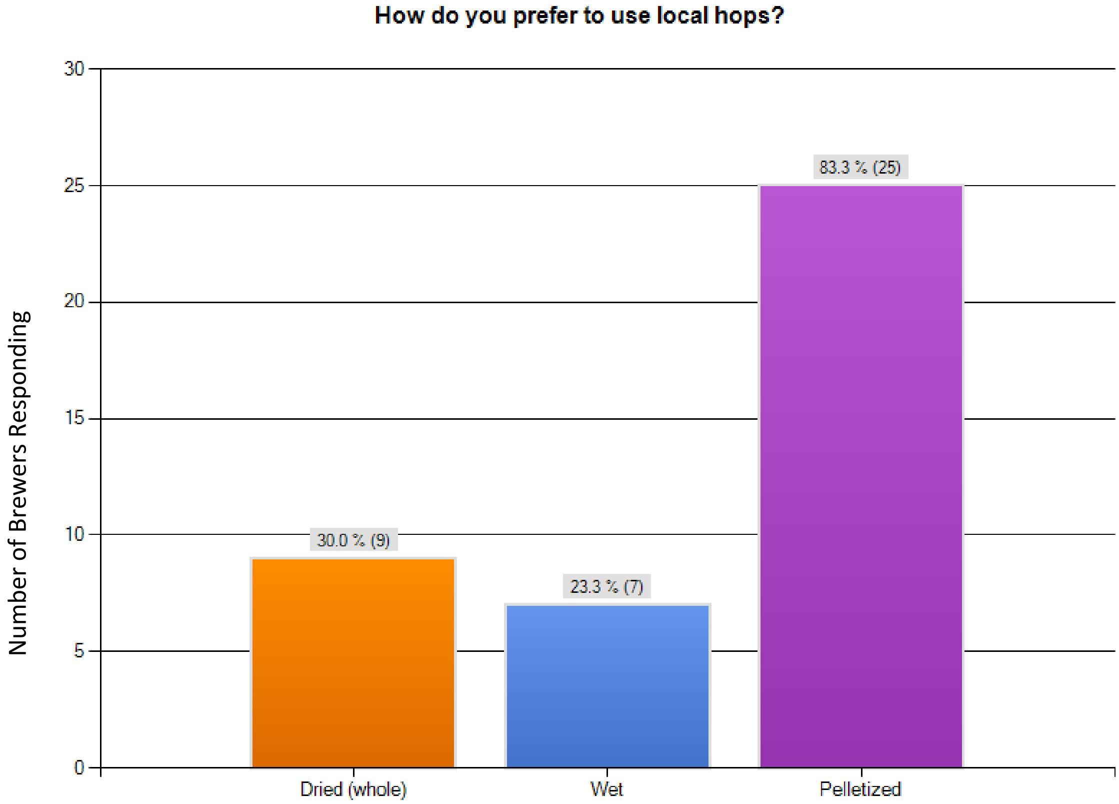
[11] Information derived from current New England hop growers including Eugene L'Etoile, 1997 UVM Extension Hops Trials, and UVM Extension Grower Survey.



Whole Leaf vs Pelletized Hops

83%, 25 of 30 respondents, said they required pelletized hops. 30%, 9 of 30 respondents, said they use or could use dried whole hops. 23%, 7 of 30 respondents, said they could use wet whole hops. The total volume of wet, whole leaf hops used annually by these 7 respondents came to 2,600lbs. The total volume of dried whole leaf hops used annually by these 8 respondents came to 3,750 lbs, and the total volume of pelletized hops used by the 24 respondents came to 122,732 lbs (see chart on page 13).

At these volumes, wet hops could support less than one acre of commercial production, dry whole hops could support up to 4 acres, and pelletized hops could support up to 120 acres.



Aroma vs Bittering

The feasibility of commercial hop production in New England will need to focus on aroma hops, or dual purpose hops over bittering hops from New England. This is because:

1. Price: Bittering hops function as their name says, they provide bitterness to a beer, the backbone upon which aroma hops then layer complexity, flavor and aroma. Because of this, bittering hops have evolved into a highly commoditized product with a non-elastic, price point averaging $1-3/lb. Only large scale operations focused on efficiencies of scale can compete in this market. Aroma hops, on the other hand, maintain product differentiation capabilities that add value and can command a higher, and more elastic, price point. Aroma hops price points can range as high as $25+/lb.
2. Contracts: Brewers typically lock in multi-year contracts for bittering hops. While they will also lock in contracts for certain quantities of aroma hops they know they need, they tend to reserve some of their budget for unexpected purchases, enabling them flexibility to experiment and innovate. This opens the door for them to purchase a New England hop.

3. Growing Conditions: Bittering hops are high alpha acid hops which are known to be difficult to grow in New England. Having a high alpha acid content is not a prerequisite to an aroma hop.
4. Craft Brewer Audience: Craft brewers are more likely to explore with new beer offerings, and seek out new, different or unusual aroma hop varieties. Craft brewers are more likely to appreciate the value of terroir, unique traits in a hop that are derived from the region in which it was grown, in an aroma hop.
5. Product Specifications: Because aroma hops can be added at different stages during the brewing process, there are opportunities for non-pelletized hops so even small scale commercial growers interested in selling whole dried or wet hops could participate.
6. Certain aroma hop varieties are particularly well suited to growing in New England and are also in high demand from the craft brewing community. These include Cascade, Centennial, Willamette, Chinook, and Nugget.

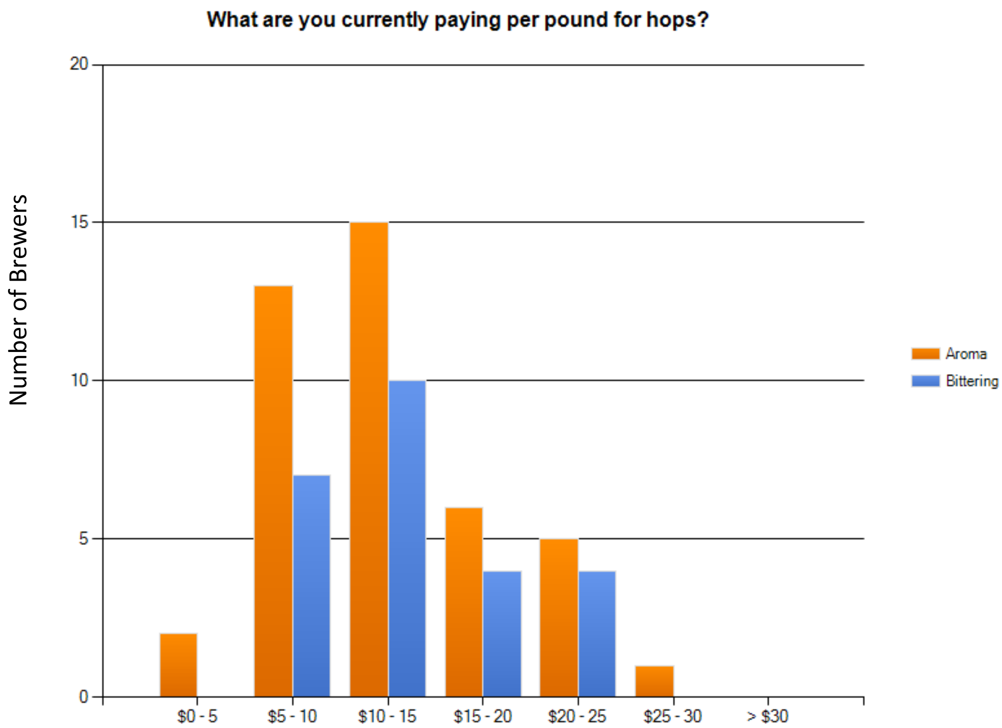
Price Points

In terms of pricing the issue is complex. The historical average price for dried hops from 1991-2006 was $1.80/lb, see chart below. However, in 2007, failed European crops, declining acreage worldwide, a Yakima warehouse fire and other factors conspired to send spot prices soaring from $2 and $3 a pound to $30 or more.[12]

(source: NASS)

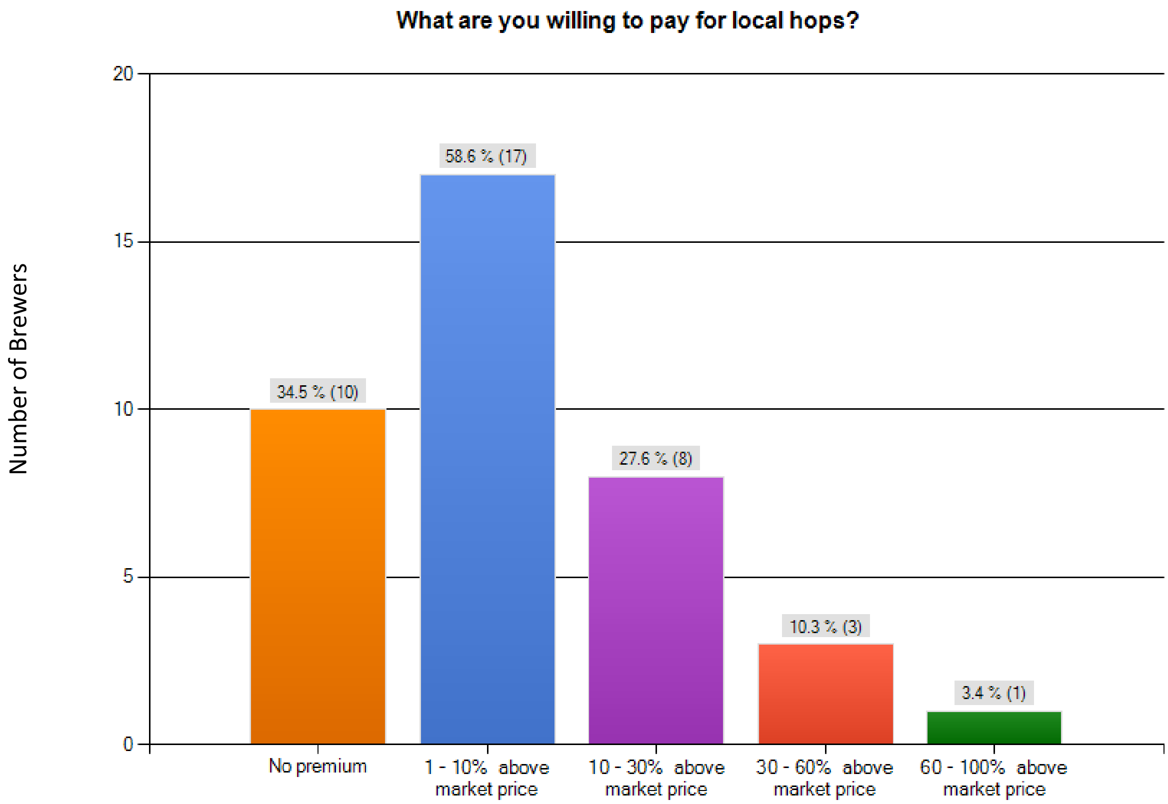
[12] Fayston, J. *"The 2007 hops shortage is over, the glut of '09 is here..."* The Oregonian.10/28/2009.

Brewers reacted by entering into multi-year contracts at the height of the crisis simply to ensure they would be guaranteed a supply of hops. In some cases this has tied brewers into 3-5 year contracts at a $15-30/lb price point, not necessarily including shipping, even though the shortage is now over and the spot market pricing is back down to $5/lb.

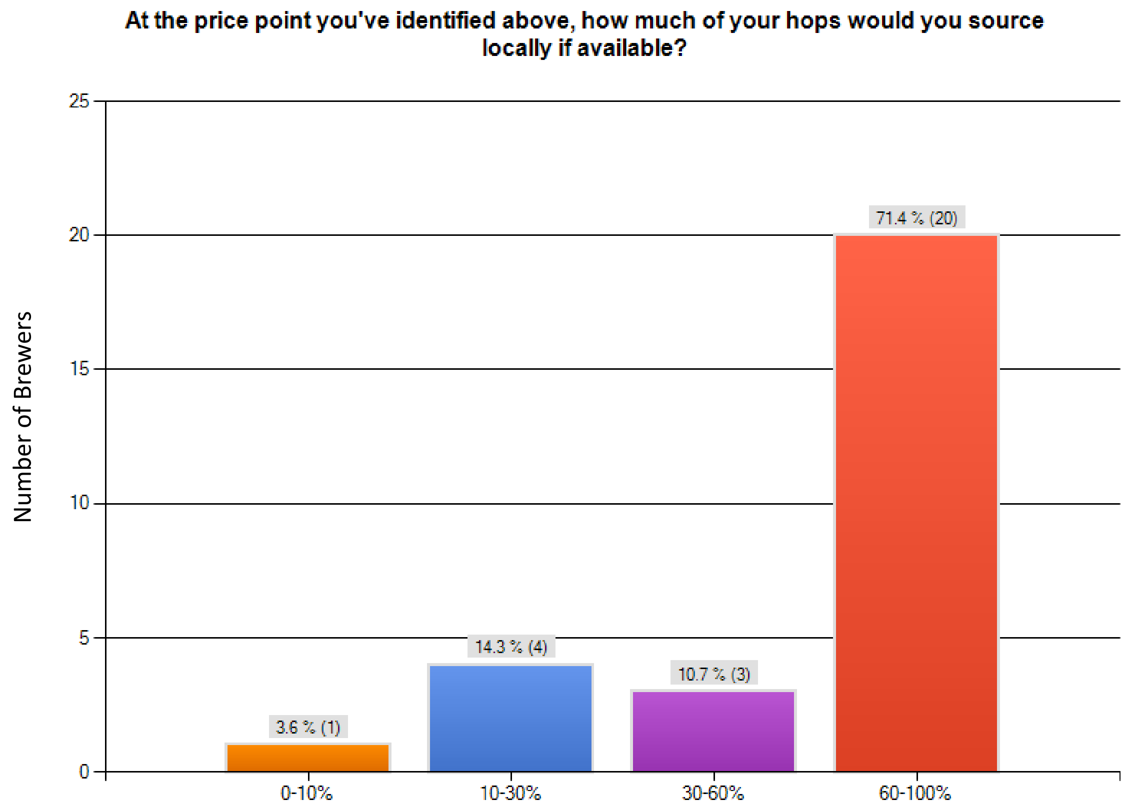


Because of the severe volatility in commodity pricing and product shortage that the brewing industry experienced, the majority of brewers surveyed reported that they would elect long term commitments with local growers over commodity contracts and spot market purchasing, and would be willing to pay a consistent price for this to happen even if the price were higher than the spot market price, as long as both parties felt they were being well served.

Following is a chart demonstrating what brewers have suggested they would consider a fair price for New England hops. Note that the current spot market price is averaging $5-8/lb.



A few of the brewers considered $5/lb a fair price point and believed that was still favorable even though it's equivalent to current spot market pricing because historically spot market pricing has averaged $1.80/lb and the spot market could easily slip back to this level. The majority felt that $8-10/lb for New England hops would be reasonable.



Percentage of a brewer's total hop needs they would consider sourcing locally

At the price point brewers identified as a price they felt fair for local hops, the study then asked how much of the total percentage of their hop needs they would source locally if it were available. The majority of brewers said they would be interested in sourcing 100% of their hop needs locally if the quality matched their expectations and the price point fell within $5-10/lb. Above this price point brewers would still consider buying local hops but only as a percentage of their total hop needs.

Production Feasibility

The first question to ask regarding production feasibility is, “can a New England grower grow what the brewers want?” As noted earlier in the research, the answer to this is: yes. Cascade is the most requested hop, and is a variety that grows well in New England. In addition to Cascade there are several other varieties that could grow well here and would be of interest to the brewing community. Brewers have also expressed an interest in experimenting with any new, unique cultivars the region can come up with. Having a hop unique to our region could strengthen the element of “terroir,” piquing global industry interest, and providing a reason to justify a premium price point.

Growing Conditions

According to the Hops Atlas[13] optimal conditions for growing hops are as follows:

- a latitude between 35-55 degrees
- average temperature from April through September between 10-19^{o}C
- average precipitation from April through September of 64 -569 mm
- average daylight during these months between 10-19 hrs/day

These findings were derived by taking the climate data for top hop growing regions in the world: George, South Africa; Tasmania and Victoria Australia; Rio Negro Argentina; Oregon and Yakima, US; Hallertau, Germany; Saaz, Czech; and Wye England.

In addition, the atlas identified well draining sandy loam as the best soil for growing hops.

Given these parameters, it looks like New England has every capability to compete for commercial hop growing. From a very basic feasibility capacity, the right growing conditions do exist:

- the average latitude is in the 40's
- the average temperature from April through September 15.5^{o}C (60^{o}F)
- the average precipitation from April through September is 525-550 mm
- the average hours of daylight from April through September is 13.5hrs/day
- the Farmland Classifications System for VT Soils highlights Franklin, Addison and Rutland counties as counties with sandy loam soils. Massachusetts soils in Franklin and Worcester Counties are also known to be well-drained, sandy loam soils.

[13] Barth, Joh Heinrich, Klinke, Christiane, Schmidt, Claus. The Hop Atlas. Joh Barth & Sohn, Nuremberg, Germany. 1994.

A key caveat for growing hops in New England, however, will be the issue of bedrock. To erect the hopyard trellis, the poles need to be seated at least 3-4' in the ground, which means one needs 3-4' of top soil before hitting bedrock. In much of New England the bedrock lies less than 3' below the surface. While it is possible to adapt and improve a poor growing medium, it is not so easy or cost effective to blast through bedrock. So care will need to be given to evaluating the bedrock situation for each prospective site prior to any decision being made on desire to establish a hopyard.

Now that parameters required for growing hops have been established, what will it cost to build a hopyard and grow hops, and is it cost effective?

Infrastructure

As commercial hop growing moved West in the early 20th century, infrastructure for value added processing of hops in the Northeast died. In order to develop a resurgence of a commercially viable hop crop, tools, techniques, equipment, and services will be required to help growers establish their hopyards cost effectively, and provide them with the ability to transform their raw hops into the finished product brewers need.

At present, there are few hopyard suppliers growers can turn to for small scale commercial operations. Growers are often forced to pay retail prices for supplies such as rhizomes, cables, and the simple thought of being able to source up to one hundred 22-24' poles can be daunting. While accessibility is already a weakness, it can be exacerbated by the issue of quality. The sourcing of quality rhizomes in particular can be very difficult, even when buying from supposedly trusted sources. Both local growers and UVM Extension have received hops that were diseased, infested or otherwise of less than ideal quality.[14]

In addition to the difficulties involved in locating materials and supplies, the cost of establishing a hopyard can vary dramatically based on the design being used. Different designs will require more or less poles, more or less rhizomes, and so on. To provide an example of this, please refer to the appendices for a comparison of the supplies required and cost to establish a sampling of different hopyard designs.

Infrastructure Solution

Gorst Valley Hops, was established in 2005 in Wisconsin to alleviate barriers to entry for small scale hop growers. The business has focused on identifying and solving the bottlenecks, and developing "best practices" for small scale hop growers to employ so that they can be commercially successful. Gorst Valley Hops has become a reputable source small mid-west growers interested in commercially growing hops can turn to.

[14] Phone conversations with Gene L'Etoile, Four Star Farm, and Rosalie Madden, UVM Extension, August, 2010.

The commercial model Gorst Valley has developed works such that all three parties- the brewer, the processor, and the grower- benefit.[15] The Gorst Valley model is based on a "value-share" charter grower program, in which the growers agree to send their annual hops harvest to Gorst Valley. In return, Gorst Valley provides them with their researched and tested high density hopyard design, technical assistance to implement it, ongoing technical support during the growing season for the first four years, direct sourcing and wholesale pricing of all the source materials required to establish their hopyard, access to equipment innovations and research and development, and a marketing outlet that strives for a fair and profitable price for 100% of their harvest. In this model Gorst Valley shares the proceeds of the hop sales 60-40 with 60% going back to the growers.

The ability for growers to have access to a replicable, proven design for optimal yield and productivity for a small scale commercial hopyard, complete with access to commercially available source materials at wholesale pricing, with quality assured rhizomes is the first requirement to creating a commercially viable hop crop. To this end, Atlantic Hops, a new venture being launched by Michael Roffman, in partnership with Gorst Valley Hops will be opening in the Northeast in 2011. Atlantic Hops intends to establish a Northeast value-share grower program and act as a distributor of Gorst Valley products and services to New England commercial hop growers.[16]

<u>Secondary Processing</u>

Even with barriers to entry removed from the growing operation, issues persist. Access to secondary processing is the next hurdle. Brewers are looking for a T-90 pellet product, packaged in vacuum sealed, nitrogen flushed foil laminated pouches.

What is a T-90 Pellet, how is it made, and how is it packaged?

> "T-90 Pellets (are) a milled and pelletized preparation from whole leaf hops… T-90 hop pellets are prepared from leaf hops which have been hammer-milled into a powder and the powder subsequently pelletized by passing through a conventional pellet die. They contain all the vegetative and lupulin material of raw leaf hops and can be used as a full replacement for leaf hops in the brewing process. Baled hops are broken up and passed into an air-stream which delivers them to a hammer-mill. Heavy foreign materials drop out and metal fragments are removed using magnets. The cone hops are milled until they pass through a sieve which is commonly of a 9-12 mm mesh. The powder from many bales is mixed and homogenized in a blender and then conveyed to a pellet die, most commonly 4 or 6 mm in diameter. The pellets are immediately cooled, normally to a temperature of between 1 - 7º C. Cooled pellets pass over a shaker where dust is removed and re-circulated through the plant. The "clean" pellets are packaged in

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[15] Phone conversation with James Altwies, founder, Gorst Valley Hops, September 7, 2010.
[16] Phone conversation with Michael Roffman, founder, Atlantic Hops, August, 2010.

> laminated, plastic/aluminum foil pouches, evacuated and boxed. The packs may be back-flushed with carbon dioxide or nitrogen gas to produce a soft pack container."[17]

While it is possible to conduct this secondary processing on farm, many farms may not be interested in doing more than growing the crop, and many are finding it difficult to source and obtain satisfactory results with their secondary processing equipment.[18] Atlantic Hops will provide commercial processing of New England hops that will ensure secondary processing is no longer a barrier to entry, and that New England can produce a consistent, professional grade finished product. Atlantic Hops will offer its value-share grower program for growers who are simply interested in growing the crop, it will also offers it services for hire to growers who would like to grow and sell their own hops but would like to pay for the secondary processing services.

Critical Mass

Even if each farm produces its own T-90 pelletized product that has been chemically analyzed, and packaged in a nitrogen flushed, vacuum sealed foil laminated pouch, the fact remains that most growers will be looking at an average size of a one acre hopyard, at least initially. A one acre hopyard is expected to yield an average of 1,500 dried pounds of finished product. This yield will limit the prospective target market because larger craft brewers will require more product than a single farmer can produce. Given the product of a single varietal will differ from farm to farm, a brewer cannot easily combine them, even if he adapts his recipe. According to Michael Gerhart, head brewer at Otter Creek Brewing, "We try to buy all our hops at one time and from the same crop so we know the information per hops will be standard for the whole crop we are buying and the recipe we will be making for that year."[19]

By combining hops from multiple New England farms together, Atlantic Hops will be able to develop critical volume of each varietal it offers so that craft brewers of all size and scale can purchase from a homogeneous product. In combining multiple farms' hops together, idiosyncrasies from each grower are also minimized, thus creating a product that is more consistently in line with the standard profile for that hop variety. By having critical mass, and a regional product that brands the region first and foremost, Atlantic Hops can attract awareness for the region's efforts, which in the end will facilitate the marketing efforts of individual producers.

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[17] http://www.hopunion.com/hoppowderpellets.html

[18] Conference Call with Roger Rainville, Borderview Farm and Ag Research Facility, 9/17/2010.

[19] Conference Call with Michael Gerhart, Head Brewer, Otter Creek Brewing Company, 7/6/2010.

Cash flow

The final requirement is cash flow. Once the infrastructure is in place, can the hopyards operate in a manner that is financially feasible?

To assist its growers in becoming financially viable, Gorst Valley Hops, has researched growing and harvesting techniques to optimize yield, and is developing equipment for small scale acreage that optimizes efficiency. In the summer of 2010, for example, Gorst Valley Hops conducted harvesting studies to determine the most advantageous techniques for hand harvesting on a commercial scale. They also began testing a mechanical picker they designed.

According to estimates provided by local New England growers, UVM Extension, and a commercial grower in Washington, manual harvesting on average yields 1 lb of dried hops per hour,[20] see table below.

Manual harvesting estimates given

Rick Pedersen, Pedersen Farms, NY	1 lb dried hops (1 bine) per hour (1lb/hr)
Jason Perrault, Perrault Farms, Inc, WA	100 people, 30 days, 13 acres (1.08lbs/hr)
Gene L'Etoile, Four Star Farm, MA	1 lb dried hops (1 bine) per hour(1lb/hr)
Leonard Perry, UVM Extension, VT	24 man hours to pick 5 lbs of dried hops, (0.21lbs/hour)

At a rate of 1 lb of dried hops per hour, it will be near to impossible to generate a positive cash flow for a commercial hop venture.

In the Gorst Valley Hops trials, however, they determined that if the grower cut the entire bine but only harvested the top one third of the bine, where 94% of the hop cones resided, the grower would reduce picking time by 42%, to 35 minutes per dried lb. By going a step further and "stripping the bine, and sorting the cones on a mesh screen," the grower could reduce picking time to 20 minutes per dried lb. Using a mechanized picker and mechanized sorter, the grower can reduce the time to 3 minutes per dried lb, a 95% efficiency gain.[21]

If a grower were to employ Gorst Valley Hops harvesting techniques, and utilize a mechanical harvester and sorter, the hop feasibility equation can be transformed into a financially rewarding outlook for commercial hop growing in New England. Please refer to the attached cash flows for details.

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[20] Information provided by Rick Pedersen, Pederson Farm, NY, 3/26/2010, Jason Perrault, Perrault Farms, WA, 3/26/2010, Gene L'Etoile, Four Star Farms, MA, 8/20/2010, and http://www.uvm.edu/~pass/perry/hops.html.

[21] E-mail communication from James Altwies, founder, Gorst Valley Hops, 9/14/2010.

Note that in all four scenarios of sales and distribution (participating in the value-share program; selling whole dried hops; using Atlantic Hops processing services; or doing on-farm pelletizing), only the cash flow models that employ “stripping and sorting” and “mechanized harvesting” offer a positive return on investment, and only the mechanized harvesting cash flow models offer the possibility of a substantial annual net income.

To develop the cash flows, the study assumed the following:

Income
price points for dried whole hops: $10/lb
price point for pelletized hops: $15/lb
income to grower from value-share program: $9/lb (60% of $15/lb)

Expense
operating expenses not including labor and processing: $2,500/acre per year[22]

Infrastructure Expense
Growers involved in the value-share program can expect to pay approximately $10,000 to establish a one acre hopyard. Growers not in the value-share program can expect to pay approximately $12,000 to establish a one acre hopyard, see appendices for sample hopyard infrastructure budgets.

Yield
A yield of 1,500 dried pounds per acre was used as the average expected yield. This number was derived from historic average yields from Gorst Valley Hops growers from average yielding varieties.

[22] Conservative estimated derived from historic actual data from Gorst Valley Hops growers

Other Issues Affecting Growing Capability and Commercial Production

According to experienced grower, Rick Pedersen, Pedersen Farms, NY, while hops may be a high maintenance crop, this is true of any field crop. In Rick's experience, hops are similar to field corn. If you know how to grow field corn successfully, you should be able to do well with hops.[23] Following are certain specific elements of the operation that can affect the success of commercial hop growers.

Disease & Pests

Hops have been notorious as a crop that grows well in the wild but whose commercial cultivars tend to be problematic. Hops are easily susceptible to downy mildew, powdery mildew, aphids, and spider mites. A rigorous pest and disease management regime will be a required element of any commercial growing operation.

Nutrients

Nutrients and soil amendments can both boost a plant's productivity and alleviate disease and pest pressure. Hops prefer a pH of 6.0-6.2, or a mildly acidic soil. Growers should test their fields annually and amend their soils to provide the ideal growing medium for their plants. Note that amending soils based on their specific needs is critical because over application of Nitrogen based fertilizer will cause "sappy growth" that is particularly susceptible to disease and pests.[24]

In addition to amending the soil for fertility, there are also amendments being designed to assist with disease and pest control. A new product from Germany for example, Biplantol Mykos V, is an organic amendment that is absorbed by the capillary root system and fortifies a plant's resistance to bacteria and fungal infestation including powdery and downy mildew. The result is a healthy and vital plant, which can more readily withstand pest and disease pressure.[25] UVM Extension is trialing other soil amendments and ground covers to be able to provide further recommendations for New England hop growers.

Irrigation

Hops, similar to Cucurbitaceae enjoy, and require, watering, but overhead watering will encourage and spread disease. Therefore installation and use of drip irrigation is recommended for commercial growers. The bines also need good airflow and spacing between them to encourage a dry, disease free environment. Hop roots prefer a well

[23] *Hopping to It! Conference*, Rick Pedersen Presentation, March 26, 2010.
[24] Kneen, Rebecca. *Small Scale Organic Hop Production*. Left Fields BC. 2004.
[25] https://www.biplantol.com/produkte.php?content=3

drained soil. If a grower has heavy soil, installing a drainage system will be an important factor to help ensure a successful hopyard.

Timing of Events in the Growing Season

Hops require specific timely attention to plant pruning, irrigation, and harvesting. Hops must be picked when fully ripe. Early harvesting can hinder lupulin development and lower alpha acid content by up to 20%. Late harvesting can lower them by as much as 10%.[26] In essence this is typical of any field crop. Experienced growers learn to understand the nuances of each crop they grow, and with a little experience and effort, especially being able to benefit from the knowledge of other small scale hop growing experts who have undergone recent trial and error such as the growers from Gorst Valley, bringing our New England growers up to speed is possible.

Yield

Yield can vary greatly by variety, by weather conditions, and by individual farm growing practices, philosophies, and goals. As an example, a plant's individual yield can vary by as much as 40% depending on what time the irrigation was run prior to harvest. Because of this, James, at Gorst Valley Hops, has found it beneficial for farms to develop production goals and production metrics based on individual plant productivity instead of overall yield per acre. "When farms focus on helping each plant reach its full potential, they see an increase in overall yield because they identified with each plant growth stage, working to maximize the potential at each step, which in turn equates to more consistent yield. When growers measure crop inputs and production based on pounds per acre they tend to overlook the nuances of productivity. At our size and scale, a focus on efficiency over productivity negatively impacts financial return."[27]

At Gorst Valley Hops, an average producing hop variety can produce a low yield of 1,000 lbs of dried hops; an average yield of 1,500 lbs of dried hops, and a strong yield of 2,000 lbs of dried hops. Using the Gorst Valley Hops hopyard design and participating in the Atlantic Hops value-share grower program it is likely New England growers can achieve similar results.[28] Existing Northern grower Rick Pedersen, Pedersen Farm, NY averages 800-1,200 lbs of dried hops per acre (4,000-6,000 wet hops), however he acknowledged that his growing system is not fully optimized and he has not been able to provide individualized plant attention.[29] Gene L'Etoile

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[26] Virant, Majda, Majer, Dusica. *Hop Storage Index – Indication of a Brewing Quality*. Institute of Hop Research and Brewing Zalec. January 2006.
[27] Email communication with James Altwies, founder, Gorst Valley Hops, 9/27/2010.
[28] Conference Call with James Altwies, founder, Gorst Valley Hops, 9/7/2010.
[29] *Hopping to It!* Conference, Rick Pedersen Presentation, March 26, 2010.

harvested 100 lbs of dried hops from 70 plants.[30] If this is extrapolated to the 1,283 plants per acre that Gorst Valley Hops recommends, this would extrapolate to a yield of 1,832 dried pounds per acre, which is in line with Gorst Valley Hops yield projections.

In estimating wet to dry yields, expect a shrinkage ratio of 1:5, therefore every wet lb harvested will yield 1/5th of a pound of dried hops.[31]

Time to Maturity

When will hop plants reach full maturity?
It takes approximately four years for a hop bine to reach full maturity. In the first year expect no harvest, in the second year expect 40% of a full harvest, in the third year expect 90%, and in the 4th year plan on full production.[32]

1st year	=	0% harvest
2nd year	=	40% harvest
3rd year	=	90% harvest
4th year	=	100% harvest

Low Trellis Systems/Curb Appeal

Another angle this research was to investigate was the interest or need for growing low trellis hops and the feasibility of doing so.

Traditionally grown hops are trained up strands of twine rigged across an 18-foot-high trellis system and then hand-tied at the top to a series of overhead cross wires. Come harvest, the hop-bearing vines are cut and hauled to picking and cleaning stations. With low trellis systems, plants train themselves up and across plastic mesh, or netting, on a 10-foot-high trellis system. Hops are harvested in the field by hand or using a mobile low-trellis hop picker. The vines are left on the mesh where they die off over the winter and re-grow the next spring.

The potential benefits of a low-trellis system include:

1. Better “curb appeal” especially for farms located in more urban environments such as Massachusetts. A low trellis system would be less visible from a distance and, being shorter in height, any spraying activities would draw less attention.

[30] Conference Call with Gene L’Etoile, Four Star Farm, 7/13/2010.
[31] *Hopping to It!* Conference, Rick Pedersen Presentation, March 26, 2010.
[32] E-mail correspondence from James Altwies, founder, Gorst Valley Hops, 9/23/2010.

2. Lower operating expenses. Lower trellises eliminate the need for stringing, in which twine is tied to the trellis wires, and training, in which the strongest shoots of each hop plant are trained up the string. They can also be easier to harvest. These changes could reduce annual labor expense by up to 30% per year.[33] Annual supplies expense can also be diminished because the mesh nets remain intact from year to year with a 10 year lifespan, unlike coir twine which needs to be replaced each year at an average cost of $125/acre.[34] Low-trellis production systems also enable growers to apply pesticides with directed or covered sprayers that lower the amount of pesticides required, and they use less fertilizer, further reducing operating costs.[35]
3. Environmental benefits. Given the pesticides can be applied in a more targeted and direct effort, a lower amount of pesticides is required, thus lessening the amount of pesticide added to the environment and the risk for pesticide drift.[36] Conversely, however, this theory is questioned by Edward Page who notes that higher chemical use is required for tilling and pruning.[37]
4. Lower start up expenses/easier to establish. It is easier and less expensive to source and install 10-12' poles and nylon mesh than to purchase and install 20-24' poles and steel cabling. According to Edward Page, who did a cost comparison between high trellis and low trellis, it costs about half as much to set up a low trellis hopyard, $6,000/acre.[38]

Despite these excellent benefits there are several issues affecting the commercial feasibility of growing low trellis hops in New England at this time.

1. Commercial low trellis harvesting equipment is cost prohibitive, ranging between $200,000-$400,000 per harvester.
2. Increased incidence of disease. According to Julien Venne, Project Manager at Québec's Centre de Recherche et de Développement Technologique Agricole de L'Outaouais, there is strong concern that in the Northeast's rainy, humid, and disease-prone climate, having bines over-winter would encourage disease if the spores of fungal diseases over winter on hop crowns and ligneous tissues. This could keep high levels of disease inoculums in the field and exacerbate the disease control process.[39] In the Pacific North West they are

[33] USDA-ARS. Lower Hop Trellises for Higher Profits. Crop Management. 21 January 2008.
[34] Ward, L. Yakima Herald-Republic. Some plastic mesh could save state hop farms. New technique has potential for the beer-making crop. May 30, 2005.
[35] USDA-ARS. Lower Hop Trellises for Higher Profits. Crop Management. 21 January 2008.
[36] http://www.ars.usda.gov/is/AR/archive/jan08/hops0108.htm
[37] Page, E. B. *Hop Trellising & Budgets*. 7/26/2008.
[38] Page, E. B. *Hop Trellising & Budgets*. 7/26/2008.

[39] Email Communication Julien Venne, Project Manager at Québec's Centre de Recherche et de Développement Technologique Agricole de L'Outaouais, 5/25/2010.

experimenting with using disease resistant varieties and beating the bines off the mesh once they have frozen over in winter to counter this issue.

3. Limited varieties. Not all hops are suited to low-trellis management and many of the low trellis varieties that do exist are not in high-demand by the brewers.[40]
4. Patents. Many low-trellis system and hop varieties are patented. This may present more difficulties and expense in sourcing varieties and hopyard supplies.
5. Lower Yields. According to research conducted by Jason Perrault, Godin & Page, and John Henning, hops grown on a low trellis system will have a lower yield than high trellised hops. Yields could range anywhere from 20-50% less.[41][42] Because of this, geneticist John Henning is researching what gene or genes are responsible for shorter growth to aid in selection of hops varieties that may respond more favorably to low trellis systems.[43]

The conclusion regarding low trellis systems is that while it would be interesting to investigate, the clear path towards an immediate commercially viable hop crop would be to continue down the traditional high trellis hops path. The advent of more commercially available mobile harvesting machinery coupled with more research into low trellis hop varieties and the validation or refutation with respect to disease issues given the overwintering of hop crowns and ligneous tissues in New England winters will help further the discussion on the long term potential of a low trellis system. In the appendices is an expired patent for a mobile, low trellis harvester.

<u>On Farm/Do It Yourself Techniques</u>

Given growers in New England have had to rely on their own ingenuity, trial and error, and personal expense to grow, harvest, and process hops in recent decades, several do-it-yourself, low cost solutions have been developed to solve production bottle necks.

Do-It-Yourself Hop Pickers

At present there are no commercially available hop pickers for 1-10 acre hopyards. Some farms have tried importing older machines from Eastern Europe, but access to parts and reliability are an issue. Because 1- 10 acre commercial hopyards were common in the early twentieth century, Germany alone had 80,000-100,000 hopyards that were one acre or less, and New York and Oregon operations of the time were

[40] Email communication with Rosalie Madden, UVM Extension, 5/25/2010.
[41] Page, E. B., Godin, R. "Hopyard Construction: Budgeting and Economics." CSU Ag Exp. Station.
[42] Email communication with Rosalie Madden, UVM Extension, 5/25/2010.
[43] http://www.ars.usda.gov/is/AR/archive/jan08/hops0108.htm.

comparable in size, yield, and production to these farms,[44] several patents for machines do exist for these scale operations. This study researched and re-circulated these patents in hopes new designs or machinists would be interested in building prototype machines that could be tested, and if effective, replicated and sold today. Copies of these patents are attached as appendices to this report. Three designs did emerge from this effort, two by local fabricator Hugo Gervais, and a third by Jeffery Cox. These designs would range in price from $3,900 to $27,000, the lower cost models handling approximately 1/3 of an acre and the more expensive models being able to handle multiple acres. Gorst Valley Hops is also designing and testing a small scale picker that will be able to manage up to an acre per hop variety, therefore a total of three acres if following the three variety hop planting. They plan to have the hop picker and a hop sorter combination available for sale through Atlantic Hops by 2012 for $15,000 or less. All of these options are well under the $250,000 expense of a picker designed for the large fields out West, and all able to provide a reasonable time frame for return on investment, of 5 years or less.

Note: When evaluating hop pickers it is essential to search for a design that will minimize “shatter” or damage to the hop. The average rate of damage experienced during hand harvesting hovers around 2%. Ideally one would want a mechanized picker to equal or improve on that rate. The Gorst Valley Hops picker is currently experiencing a shatter rate of below 2%.[45]

Do-It-Yourself Oasts

Oasts can be built economically from materials around the farm. A five gallon pail with a 3” diameter computer fan and a mesh screen can dry up to a half pound of dried hops at a time (~2 hours worth of hand picking). A 30 gallon barrel garbage can with a 6” fan would further increase the volume of drying capacity; and a 16’x24’x8’ rectangle built out of wood or other materials, with an 18” to 2’ fan and a nylon mesh secured midway down could dry up to ¼ of an acre at a time.[46]

In addition to self-made options, Atlantic Hops will offer Gorst Valley Hops oast designs and oast kits for New England hop growers. The cost of a Gorst Valley Hops Oast will be highly dependent on the fan size needed as their design uses an inverse blowing technique, rather than blowing air into the hops, it is sucking air through the hops. An oast for a one acre hopyard oast will run approximately $5,000, an oast for 2-5 acres will run approximately $10,000 and an oast for 5+ acres will run approximately $17,500.

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[44] Barth, Joh Heinrich, Klinke, Christiane, Schmidt, Claus. The Hop Atlas. Joh Barth & Sohn, Nuremberg, Germany. 1994.
[45] Phone Conversation with James Altwies, founder, Gorst Valley Hops, 9/7/2010.
[46] Phone Conversation with New England hop grower Jonathan Blumberg, August 8, 2010.

Exterior view of a home made oast. Supplies are simple 2x4's to create the frame, 1x2's to affix the screen, a 4'x8' screen, tyvek to form the walls, and a circular fan. Picture of Gene L'Etoile's Four Star Farms, MA. Photo credit r.wilson

Inside of a home made oast, note the mesh screen installed partway up to allow air to circulate below and above the hops. Note the series of oasts in the background, enabling more volume to be drying simultaneously. Picture of Gene L'Etoile's Four Star Farms, MA. Photo credit r.wilson

Do-It-Yourself Sorting

Sorting mechanisms enable a grower to go from hand picking hops one by one off the bine to stripping them into a pile on a sorting table and quickly extricating the hops from the chaff. Sorting is an area of the harvesting process that can greatly increase a grower's efficiency. James Altwies, founder of Gorst Valley Hops, notes that to be commercially viable, growers can't overly concern themselves with removing 100% of the stems and leaves. According to Altwies, the national industry standards allow for up to 2.5% of stem and leaf substance to remain attached to a hop and still be called hops. So one can leave up to an inch of stem attached to a hop and have it still approved as a hop. A homemade sorting system can be achieved through creating a series of sorting tables out of meshed screens affixed to a rectangular frame. A 1" screen would be used first to sort out big leaves, allowing the hops to fall onto a second .25" mesh screen that can then be used to sort out final debris and allow a sorter to remove any excess detritus from a hop before ushering the cones into boxes that can then be sent to dry.

For optimal efficiency, mechanizing one's sorting system is advised. Gorst Valley Hops offers a mechanized, angled, oscillating sorting system that has capacity for one acre per hop variety. The Gorst Valley Hops sorter combined with the Gorst Valley Hops hop picker is expected to be available from Atlantic Hops in 2012 at a total price point of $15,000 or less.[47]

Do-It-Yourself Compacting

Ideally hops should be compacted down to 10lbs per cubic foot and bailed. This will make them easier to transport and help retain their storage quality.[48] Once compacted and bailed the hops can remain in refrigerated storage until sold or pelletized. At present there are no known commercially available compressors specifically designed for small scale hop growers. Existing growers have suggested using a trash compactor, or pressing down on a bag of hops using a screw auger plate, as relatively effective means to compress their hops.[49]

Gorst Valley Hops is currently investigating the need for compressing mechanisms for small scale hop growers.

[47] Conference call with James Altwies, Founder, Gorst Valley Hops, 9/7/2010.
[48] Phone Conversation with New England hop grower Jonathan Blumberg, August 8, 2010.
[49] Phone Conversation with New England hop grower Jonathan Blumberg, August 8, 2010.

Do-It-Yourself Pelletizing

As demonstrated in the market research, an overwhelming number of brewers prefer or can only use pelletized hops. A low cost solution to creating one's own pellets is to grind hops into a powder using a kitchen meat grinder,[50] or ideally, a hammer mill, and sending them into a small scale pellet mill equipped with a ¼" die. A ¼" die will produce the 6mm (T-90) pellet that brewers are accustomed to.

Small sized hammer mills can be purchased for $1,700 or less, and small scale pellet mills can be found for under $2,400, see PelletPros under additional persons consulted for more information. [51][52]

Small Scale Pellet Pros Hammermill. 130lb/hr capacity

[50] Conference call with Roger Rainville, UVM Extension hop research farm, 9/17/2010.
[51] http://www.pleasanthillgrain.com/hammer_mill_pulverizer.aspx; http://www.meadowsmills.com/forsalehm.htm
[52] http://www.pelletpros.com/id68.html

Small Scale Pellet Pros Pellet Mill. 80lb/hr capacity

Note: The key concern to remember when pelletizing is that heat created during the process can damage the hops. Take care to process slowly and stop as often as needed to allow the machines to cool down. The hops and hop pellets should not reach a temperature higher than 112°F. To keep an eye on the temperature you can use an infrared thermometer, which can be found at most hardware stores, for approximately $20. You can also alleviate how quickly the pellets heat up by pouring fewer hops in at a time. According to Roger Rainville, if you keep the feed slow you can keep the temperature down and process an average of 10 pounds every few minutes.[53]

Do-It-Yourself Chemical Lab Analysis

Several laboratories offer chemical analysis services, an in-exhaustive list is provided in the appendices. At a minimum, growers will need to have an analysis for alpha and beta acids completed on their hops. Information on moisture and oil content, will also be a requirement from some brewers. Gorst Valley also does a physical exam of their hops using the guidelines provided by the American Society of Brewing Chemists and the USDA. A copy of the completed analysis should accompany each package of hops sold.

[53] Conference call with Roger Rainville, UVM Extension hop research farm, 9/17/2010.

Do-It-Yourself Vacuum Seal Packaging

While it will be difficult to achieve a nitrogen flush on a budget, one can at a minimum vacuum seal their pelletized and whole dried hops at home with simple tools such as the FoodSaver, home use food grade vacuum seal systems, that cost under $200,[54] or by using vacuum seal Space Bags that are a larger solution and could meet the brewers requests for 11 lb and 44 lb packages.[55]

Note: Packaging and equipment needs to be food safe.

Do-It-Yourself Nitrogen/CO2 flushing and Vacuum Sealing

For a more professional and commercial operation one can invest in a food grade nitrogen flushing, vacuum sealing machine for less than $30,000. Several models of small scale machines that combine flushing with nitrogen and vacuum sealing are available from India, such as the two shown here by Fuji Impulse America[56] and Indvac[57]. The providers of the machines can also supply the foil laminated pouches required for packaging. The Fuji Impulse VG-602 which can provide up to a 600 mm length seal, ranges from $21,000-24,000 and a set of 200 foil laminated pouches that would fit 11 lb/pouch run $330/order. The complete product specifications for the Fuji Impulse VG-402/602 series are located in the appendices.

Fuji Impulse VG-402/602 Series Micro-Computer Controlled Nozzle type Vacuum and Gas Flushing Impulse Sealer.

Indvac nozzle type flushing and sealing machine.

[54] http://www.foodsaver.com/Category.aspx?id=c&cid=87
[55] https://www.spacebag.com/10/PriceList.dtm
[56] http://fujiimpulseamerica.thomasnet.com/viewitems/impulse-sealers-vacuum-gas-flush-sealing-/-controlled-nozzle-type-vacuum-gas-flushing-sealer
[57] http://www.indvacindia.com/nozzle-type-flushing-sealing-machines.htm

Do-It-Yourself Climate Control

Hops need to be kept between 26-32°F. This can be achieved through any regular household freezer, or growers can invest in walk-in freezer/cooler storage units. Growers can also lease space from commercial climate controlled warehouses such as Vermont Refrigerated Storage.[58]

Conclusions

This report has determined that is feasible to grow a commercial hop crop in New England. There is sufficient demand, there is sufficient price elasticity, and there is now the information, technology, supplies, and equipment available to meet the needs of a 1-10 acre commercial hopyard.

There are four ways that appear commercially feasible for growing hops in New England:

Scenario 1: Participating in a value-share growing program with Atlantic Hops

Scenario 2: Selling whole hops, minimally processed direct to brewers

Scenario 3: Using Atlantic Hops for processing services and selling pelletized hops direct to brewers

Scenario 4: Selling do-it-yourself pelletized hops direct to brewers

In all instances, the best potential for return on investment and net income exists when the grower utilizes mechanical harvesting and sorting.

[58] For contact info see Barney Hodges, Vermont Refrigerated Storage, under additional persons consulted.

Income Potential and Return On Investment

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Average Yield Per Acre	1,500 dried lbs	1,500 dried lbs	1,500 dried lbs	1,500 dried lbs
Average Net Income Per Acre	$4,640	$5,090	$5,090	$12,910
Average Return On Investment for 1st Acre*	5 years	5 years	6 years	4 years
Level of Individual Risk	Low	Moderate	Moderate	High

While the potential to generate net income per acre is highest in scenario four, in which the grower creates the value-added finished product on site, the ultimate recommendation is to adopt scenario one, in which growers participate in a value-share growing program with Atlantic Hops. This is because scenario one represents the least risk while still presenting a strong potential for financial return.

1. **<u>Best Solution:</u> Participate in Atlantic Hops value-share growing program**

   <u>Benefits:</u>
   - Least Infrastructure Expense
   - Unlimited access to Gorst Valley Hops Technical Assistance and Resources
   - Applicable to All Growers
   - No secondary processing or sales and marketing required of the grower
   - Lowest Risk

   Encourage growers to participate in the Atlantic Hops value-share grower program. The Atlantic Hops Value Share Grower program will seek to minimize risk to its growers at every stage in the growing, production, and sales and marketing process by providing them with technical, logistical, and infrastructure support. Farms in the value-share program will benefit from wholesale pricing on hopyard supplies, complimentary technical assistance, tried and tested hopyard designs and production techniques – these efforts as designed to assist in optimizing production efficiency and yield. Then Atlantic Hops will use its expertise and equipment to process a high quality finished product that meets the product specification and volume needs of the brewing community, and market and sell the product at a price that returns a fair profit to its growers.

Hopyard:
Recommend starting with one acre and expanding up to ten acres. Use a 3 variety planting, with 1/3 of hopyard per variety to stagger harvest times and minimize threat to entire crop from weather, pest or disease issues that may affect a particular variety.

Economic feasibility:
Anticipated hopyard infrastructure expense per acre: $10,000

Anticipated harvesting infrastructure expense:

Oast (Year 2):	$5,000 for 1st acre $10,000 for 2-5 acres $17,500 for 5+ acres
Mechanical Picker (Year 3)	$5,000 for up to 3 acres
Mechanical Sorter (Year 3)	$5,000 for up to 3 acres

Total Infrastructure Expense for First Acre: $25,000

Total Operating Expense Per Acre: $8,860

Total Gross Income at 100% Production: $13,500
(assuming receiving $9/lb for whole dried hops from Atlantic Hops)

Net Income Per Acre: $4,640
Return on Investment for First Acre: 5 years

2. <u>Good Solution:</u> Sell whole hops, minimally processed direct to brewers

<u>Concerns:</u>
- Limited access to Gorst Valley Hops knowledge and resources
- Market demand can only sustain a few growers
- Growers will need outgoing sales personality
- Growers will need to make time for sales and marketing
- Lack of sufficient climate controlled storage- space could be an issue.
- Moderate risk

Encourage growers to invest in mechanical harvesting and sorting, use a high hop trellis system, send hops to a lab for chemical analysis and sell dried, whole hops directly to brewers. This solution does present a solid potential for profit and return on investment with minimal secondary processing required. The issues will be potential issues with quality of the finished product; limited demand for a whole hop product; limited storage space unless the product is compacted, or significant climate controlled warehouse space can be leased; and reliance on the grower's ability to secure sales of his product.

Hopyard:
Recommend starting with one acre and expanding up to ten acres. Use a 3 variety planting, with 1/3 of hopyard per variety to stagger harvest times and minimize threat to entire crop from weather, pest or disease issues that may affect a particular variety.

Economic feasibility:
Anticipated hopyard infrastructure expense per acre: $12,000

Anticipated harvesting infrastructure expense:

Oast (Year 2):	\$5,000 for 1st acre \$10,000 for 2-5 acres \$17,500 for 5+ acres
Mechanical Picker (Year 3)	\$5,000 for up to 3 acres
Mechanical Sorter (Year 3)	\$5,000 for up to 3 acres

Total Infrastructure Expense for First Acre: $27,000

Total Operating Expense Per Acre: $9,910

Total Gross Income at 100% Production: $15,000
(assuming selling whole dried hops at $10/lb)

Net Income Per Acre: $5,090
Return on Investment for First Acre: 5 years

3. **<u>Good Solution:</u> Use Atlantic Hops processing services, sell pelletized hops direct to brewers**

<u>Concerns:</u>

- Limited access to Gorst Valley Hops knowledge and resources
- Individual farm volume could be a limitation on market demand
- Growers will need outgoing sales personality
- Growers will need to make time for sales and marketing
- Moderate risk

Encourage growers to adopt mechanical harvesting and sorting, utilize a high trellis hops system, and contract processing and packaging of their hops from Atlantic Hops. Retrieve the finished product and sell individual farm hops directly to brewers. In this solution growers can take advantage of processing services to produce the finished product brewers are looking. This enables the grower to focus his attention on his core competency- growing the raw product, and engaging others for their core competencies. This helps ensure everyone's time is best used, and that risk to quality of the finished product is minimized.

Hopyard:
Recommend starting with one acre and expanding up to ten acres. Use a 3 variety planting, with 1/3 of hopyard per variety to stagger harvest times and minimize threat to entire crop from weather, pest or disease issues that may affect a particular variety.

Economic feasibility:
Anticipated hopyard infrastructure expense per acre: $12,000
Anticipated harvesting infrastructure expense:

Oast (Year 2):	$5,000 for 1st acre $10,000 for 2-5 acres $17,500 for 5+ acres
Mechanical Picker (Year 3)	$5,000 for up to 3 acres
Mechanical Sorter (Year 3)	$5,000 for up to 3 acres

Anticipated processing infrastructure expense:
2 Chest freezers (Year 2): $2,000

Total Infrastructure Expense for First Acre: $29,000

Total Operating Expense Per Acre: $17,410

Total Gross Income at 100% Production: $22,500
(assuming selling pelletized hops at $15/lb)

Net Income Per Acre: $5,090
Return on Investment for First Acre: 6 years

4. **<u>Risky Solution:</u> Selling do-it-yourself pelletized hops direct to brewers**

<u>Concerns:</u>

- Limited access to Gorst Valley Hops knowledge and resources
- Issues with processing could impact success
- Volume and product quality could be a limitation on market demand
- Growers will need outgoing sales personality
- Growers will need to make time for processing, sales and marketing
- High risk

Encourage growers to adopt mechanical harvesting and sorting, utilize a high trellis hops system, purchase a hammer mill, pellet mill and vacuum, nitrogen flush sealing machine. This solution represents the greatest potential for income and return on investment, and also the greatest risk to the grower. The grower will be on his own for all aspects of growing, harvesting, producing, and selling a finished product that meets the product specifications of the brewing community, at a volume and price point that generates a positive return. If the grower can maintain an average yield of 1,500lbs of dried finished product, achieve the quality standards of the brewing industry, and develop the sales and marketing skills to market the product, the grower can stand to generate up to $12,910 in net income per acre.

Hopyard:
Recommend starting with one acre and expanding up to ten acres. Use a 3 variety planting, with 1/3 of hopyard per variety to stagger harvest times and minimize threat to entire crop from weather, pest or disease issues that may affect a particular variety.

Economic feasibility:
Anticipated hopyard infrastructure expense per acre: $12,000
Anticipated harvesting infrastructure expense:

Oast (Year 2):	$5,000 for 1st acre
	$10,000 for 2-5 acres
	$17,500 for 5+ acres
Mechanical Picker (Year 3)	$5,000 for up to 3 acres

Mechanical Sorter (Year 3) $5,000 for up to 3 acres

Anticipated processing infrastructure expense:

2 Chest freezers (Year 2): $2,000

Vacuum-Nitrogen Flush Sealer (Year 2): $24,000

Pellet Mill (Year 2): $2,400

Hammer Mill (Year 2): $1,700

Total Infrastructure Expense for First Acre: $57,100

Total Operating Expense Per Acre: $9,590

Total Gross Income at 100% Production: $22,500
(assuming selling pelletized hops at $15/lb)

Net Income Per Acre: $12,910
Return on Investment for First Acre: 4 years

Next Steps

It is evident there is strong demand for local hops, and good potential for the ability to grow hops profitably in New England. The infrastructure, which was originally a key barrier to market, is now being developed to support small scale commercial growers in New England.

If producers go through the effort of investing time and capital into starting a commercial hop venture, but lack the support they need to develop their business plan and gain access to necessary technical expertise, the effort may well be lost.

Following is a recommendation for how Vermont Agency of Agriculture, Food and Markets and the Massachusetts Department of Agricultural Resources could ensure that such an endeavor is given its best opportunity for success:

1. Assist Atlantic Hops in establishing its operation.

   New England needs the processing capabilities to produce a professional product that will meet market expectations. It also needs access to the equipment, and technical expertise Gorst Valley Hops has already developed and tested for its small scale Mid-West farmers. Having a processing facility that is willing to process the product and partner with the farms with a mission of providing a good product at a fair value to brewers and returning a fair, profitable income to the producers is a win-win.

2. Outreach to existing growers/farmers

   The agencies will need to reach out to existing growers. Some of the many reasons hops are cited as difficult to grow are because they are being grown by people who don't grow crops for a living. Most of the basic issues with hops are the same basic issues you will find with any other crop (they need well drained soil, they need fertilizer, they need pest control, they need dedicated timing- the harvest is everything…). Producers who grow acres of corn, vegetables, and grains already know and understand the fundamental elements of what it takes to grow a crop successfully. Existing and experienced growers and farmers need to be the target audience if growing hops is to de developed as a commercial enterprise.

3. Business Planning & Coordination with the state Farm Viability Programs.

   With each farm, given this is a new venture and unexplored territory for them, and also a new crop for the region, having them go through the business planning process for implementing the new crop and evaluating its impact on the farm business and family quality of life will be essential. This will help ensure that each farm can map out on paper how they would go about implementing the new crop, understand what it would take on their particular farm, what it would cost, and what the potential return would be. They must be able to understand and evaluate how it might impact other areas of the farm and whether the net return would be better than continuing with their current production or not. It is important that this step be done while still in planning mode, so a decision on whether implementing the plan is in their best interest or not is made before any additional resources, time, and effort have been allocated.

4. Implementation and Business Planning Technical Assistance

   Provide ongoing support for the farms for 4 years after initial implementation to help assist with analyzing, planning, and decision making for the new venture and the overall farm operation. This includes business plan review, analysis and updating, and technical expertise specific to areas of concern- production, processing, sales and marketing, etc. This third party, objective support will help ensure concerns are addressed proactively thus providing a larger degree of likelihood of success for each farm, and their long term commitment to the project.

Action Items

1. Identify 10 growers in MA & VT who would be interested in participating in Atlantic Hops Value-Share Grower Program
2. Vet farm sites
   a. Conduct a site visit to evaluate the logistical feasibility of each farm. At a minimum the site will need 3' of top soil before reaching bedrock. Atlantic Hops will also assess each farm's site for additional attributes such as soil structure, water holding capacity, and seasonal wind loads.
3. Work with the growers to explain the opportunity, and enroll them in the program. This will require a commitment of establishing a one acre hopyard at an expense of $10,000 and the purchase of a picker, sorter, and oast, for an additional expense of $15,000 over years two and three.
4. Potentially finding funding to offset cost of capital infrastructure expense for the first ten growers, or for dairy farmers wishing to participate.
5. Begin Farm Viability business planning and Atlantic Hops Value-Share Growing Program technical assistance with each farm.
6. Atlantic Hops will provide oversight and guidance with Technical Assistance during establishment of the hopyard, and growing and harvest for first four years.

7. Maintain communication loop with the brewing community. Let the brewers in the highly qualified prospect list (see brewers in **Bold** in the appendices) know of the plan, engage them in the R&D phase, and leverage their input and feedback to develop a finished product that will meet their approval and be ready for sale by year 3.

8. Provide on going Farm Viability business planning and technical assistance services

    a. Provide an annual business plan review, analysis and plan for the upcoming year. For first four years

    b. Provide ongoing annual Technical Assistance in specific areas of expertise as needed for each farm. For first four years

Budget

10 farms

Year 1	Per Farm	#Farms	Total
Hopyard Infrastructure	$10,000	10	$100,000
Business Plan	$4000	10	$40,000
Technical Assistance in Areas of Expertise	$3000	10	$30,000
		Total Budget Year 1	**$170,000**

Years 2-4	Per Farm/Year	#Farms	Years	Total
Harvest/Drying Infrastructure	$15,000	10		$150,000
Annual Business Plan Review and Analysis	$2000	10	3	$60,000
Annual Technical Assistance In Areas of Expertise	$2000	10	3	$60,000
	Total Budget Next Three Years			**$270,000 ($90,000/year)**

Appendix A- Sources of Information

Barth, H.J., Klinke, C., Schmidt, C. The Hop Atlas. 1994. Nuremberg, Germany. Joh, Barth & Sohn.

Fayston, J. *"The 2007 hops shortage is over, the glut of '09 is here..."* The Oregonian. 10/28/2009.

Hilchey, D. *The Market Potential for Northeastern-Grown Hops.* New Leaf Publishing and Consulting, Inc. 2009.

Kneen, Rebecca. *Small Scale Organic Hop Production*. Left Fields BC. 2004.

Neve, R. A. Hops. Champman & Hall. 1991.

Page, E. B. *Hop Trellising & Budgets*. 7/26/2008.

Page, E. B., Godin, Ron. "Hopyard Construction: Budgeting and Economics." CSU Ag Exp. Station.

Tomlan, M. Tinged With Gold Hop Culture In The united States. University of Georgia Press. Georgia. 1992

USDA-ARS. Lower Hop Trellises for Higher Profits. Crop Management. 21 January 2008.

Virant, Majda, Majer, Dusica. *Hop Storage Index – Indication of a Brewing Quality*. Institute of Hop Research and Brewing Zalec. January 2006.

Ward, L. Yakima Herald-Republic. Some plastic mesh could save state hop farms. New technique has potential for the beer-making crop. May 30, 2005.

Internet Resources

http://www.brewersassociation.org/
http://www.thefreelibrary.com/Craft+Beer+Segment+Continues+to+Set+the+Pace+for+the+Beer+Category...-a0167648025
http://hops-extracts.com
http://hopunion.com
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http://fujiimpulseamerica.thomasnet.com/viewitems/impulse-sealers-vacuum-gas-flush-sealing-/-controlled-nozzle-type-vacuum-gas-flushing-sealer
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https://www.biplantol.com/produkte.php?content=3
http://www.ars.usda.gov/is/AR/archive/jan08/hops0108.htm
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http://www.central-vt.com/climate/climate.htm
http://www.lindemanarchives.com/LA%20History.html
http://www.rssweather.com/climate/Vermont/Burlington/
http://maps.google.com/maps/ms?hl=en&ie=UTF8&msa=0&msid=114006202269755079477.00048524ed0b04bf595d6&ll=42.366662,-71.235352&spn=2.840979,5.767822&z=7&source=embed
http://www.massbrewersguild.org/craft-beer/index.php/member-breweries/
http://groups.google.com/group/vermont-hops/topics
http://www.indiehops.com/
http://www.freshops.com/
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http://www.examiner.com/hops-in-madison/hops-growing-business-2007-shortage-revisited
http://www.examiner.com/beer-in-national/top-ten-hop-varieties-used-by-american-craft-brewers
http://vermontbrewers.com/
http://www.lewbryson.com/nyprogress.htm
http://www.freepatentsonline.com/
http://www.czhops.cz/tc/bibliography/bibliography10.html
http://www.youtube.com/user/cohopsfarmer#p/a
http://www.northeasthopalliance.org/
http://www.wolf-heiztechnik.de/en/pkp/unternehmen/historie.html
http://meeting.asbcnet.org/default.cfm

Appendix B – List of Persons Consulted

Growers and Hop Experts

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Puterbaugh Farms
Hops Direct, LLC
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http://www.hopsdirect.com/

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Steve Parks
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Anthony (Tony) Palmiero
Tractor Logging
345 East Church St.
East Hardwick, VT 05836
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ajpalmiero@vtlink.net

Brewers/Brew Pubs/Homebrew Suppliers

MAINE

Allagash Brewing
Jason Perkins, head brewer
100 Industrial Way
Portland, ME 04103
(800) 330-5385
jasonperkins@allagash.com

Andrews Brewing Company
Andy and Ben, brewers/owners
4975 High St.
Lincolnville, ME 04849
(207) 763-3305
andrewsbrewingco@tidewater.net

Atlantic Brewing Company
Doug, brewer
15 Knox Road
Bar Harbor, ME 04609
(207) 288-9513
doug@atlanticbrewing.com

Bar Harbor Brewing Co
8 Mount Desert Street
Bar Harbor,ME 04609
(207) 288-4592

Belfast Bay Brewing Company
100 Searsport Ave.
Belfast, ME 04915
(207) 338-4216
www.belfastbaybrewing.com

Black Bear MicroBrewery
Tim Gallon, owner/brewer
19 Mill Street, Suite 4
Orono, ME 04473
207-949-2880
tim@blackbearmicrobrew.com

Bray's Brewpub & Eatery
Rob, brewmaster
678 Roosevelt Trail
Naples, ME 04055-0548
(207) 693-6806

Casco Bay = Shipyard, see Shipyard

Federal Jacks Brewpub & Restaurant
8 Western Avenue
Kennebunk, ME 04043
(207) 967.4322

Geary's
Steve Spear, head brewer
38 Evergreen Drive
Portland, ME 04103
(207) 878-2337

Gritty McDuff's
Andrew Heyner & Jake, brewers
396 Fore Street
Portland, ME 04101
(207) 772-BREW

Inn on Peak's Island
33 Island Ave
Peaks Island, ME 04108
(207) 766-5100

Kennebec River Brewery
Jim, head brewer
Forks Resort Center
The Forks, ME 04985
800-765-7238

Liberal Cup Public House & Brewery
115 Water St.
Hallowell, ME 04347
(207) MAD-BREW

Maine Coast Brewing Company
102 Eden Street
Bar Harbor, ME 04609
(207) 288-4914

Peak Organic Brewing Co.
Jon Cadoux, owner/brewer
110 Marginal Way #802
Portland, ME 04101
(207) 586-5586
jcadoux@peakbrewing.com

Oak Pond Brewery
101 Oak Pond Rd
Skowhegan, ME 04976
(207) 474-3233

Sea Dog Brewing Co.
26 Front Street
Bangor, ME 04401
(207) 947-8009

Sebago Brewing Company
Tom, brewer
48 Sanford Drive
Gorham, ME 04038
(207) 856-2537

Shipyard Brewing Co
Alan Puglsey, owner
David Hall, head brewer
86 Newbury St.
Portland, ME 04101
(207) 761-0807
apugsley@shipyard.com
dhall@shipyard.com

Sunday River Brewery
Stu Mason, brewer
1 Sunday River Road
Bethel, ME 04217
(207) 824-4ALE

Note: call on Mondays

<u>MASSACHUSETSS</u>
Boston Beer Works
Tim Morse, Corporate Brewer
61 Brookline Ave
Boston, MA 02215
(617) 896-2300

Berkshire Brewing Company Inc.
Gary A. Bogoff, owner
12 Railroad Street
South Deerfield, MA 01373
Tel (413) 665-6600
BBC@berkshirebrewingcompany.com

Blue Hills Brewery
Todd, sales
1020 Turnpike Street #3B
Canton, MA 02021
(781) 821-2337
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The Boston Beer Company
Jennifer Granville
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BrewBank

Cambridge Brewing
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617-494-1994
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Cambridge Commons Brewery
Ginger, owner
Cambridge, MA
(978) 551-6477

Cape Ann Brewing
Jeremy Goldberg, brewer
27 Commercial Street
Gloucester, MA 01930
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Jeremy@capeannbrewing.com

Cape Cod Beer
Beth & Todd Marcus, owners/brewers
1336 Phinney's Lane
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Cisco Brewers
Jay, brewer
P.O. Box 2928
Nantucket MA 02584
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jay@ciscobrewers.com

BYOB (Cody) Brewing Company
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36 Main St.
Amesbury, MA 01913
(978) 378-3424
sean@codybrewing.com

Gardner Ale House
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7 Parker St.
Gardner, MA 01440
(978) 669-0122
dave@gardnerale.com

Harpoon Brewery
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Sean Cornelius, assistant V.P. Operations
306 Northern Ave.
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(888) HAR-POON
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Haverhill Brewery
John Curtis, brewer
100 Washington Street
Haverhill, MA 01832-5500
(978) 373-2337
tapbrewpub.com

Mayflower Brewing Company
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12 Resnik Rd
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Mercury Brewing Company
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Northampton Brewery Bar-Grille (John Harvard's Brew House)
Maria Poulinas, brewer
11 Brewster Court
Northampton, MA 01060-3801
(508) 875-2337
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Opa Opa Steakhouse & Brewery
Themis, owner
169 College Highway
Southampton, MA 01073-9320
(413) 527-0808
opaopasteakhousebrewery.com

Pittsfield Brew Works
34 Depot Street
Pittsfield, MA 01201-5130
(413) 997-3506
pittsfieldbrewworks.com

Rock Bottom Restaurant & Brewery
Scott Brunelle, brewmaster
115 Stuart Street
Boston, MA 02116
(617) 742-2739
rockbottom.com
Note: Best time to call is 9-10 am.

Wachusett Brewing Company
Dave Howard, "Howie" head brewer
175 State Road East
Westminster, MA 01473
(978) 874-9965 x 30
howie@wachusettbrew.com

Watch City Brewing Company
Jocelyn and Frank, owners
Aaron Mateychuck, brewer
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NEW HAMPSHIRE
Granite Cask
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Mount Washington Home Brew Supply
A Division of Merrill's Agway
678 Meadow Street
Littleton, NH 03561
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Portsmouth, NH 03801
603-431-1115
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Smuttynose Brewing Co
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Seven Barrel Brewery
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Tuckerman Brewing Company, LLC
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White Birch Brewing
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VERMONT
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23 South Main Street
Waterbury, VT 05676
(802) 244-4120

Bobcat Cafe & Brewery
Mark Magiera, brewer
5 Main Street
Bristol, VT
(802) 453-3311

Brewery at the Trapp Family Lodge
Alan Van Anda, brewer
700 Trapp Hill Road
PO Box 1428
Stowe, VT 05672
802-253-8511

Hill Farmstead Brewery
Shaun Hill, owner/brewer
403A Hill Road
Greensboro Bend, VT 05842
(802) 533-7450

Jasper Murdock's Alehouse/Norwich Inn
Patrick Dakin, brewer
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Lawson's Finest Liquids
Sean Lawson, owner/brewer
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Long Trail
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Madison Brewing
428 Main Street
Bennington, VT 05201
(802) 442-7397

Magic Hat Brewing Company
Todd Haire, brewer
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McNeill's Pub & Brewery
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Northshire Brewery
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Bennington, VT 05201
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Otter Creek Brewing
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mgerhart@ottercreekbrewing.com

Rock Art
Renee and Matt Nadeau, owners/brewers
234 Wilkens Street
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South Royalton Market
Scott Russell, homebrew manager
105 Chelsea St
South Royalton, VT 05068
(802) 763-2400

Switchback Brewing Co.
Bill Cherry, owner/brewer
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Burlington, VT 05401
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The Perfect Pear
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The Shed Brewery
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Three Needs Brewery
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Burlington, VT 05401
(802) 658-0889

Trout River Brewery
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Vermont Homebrew Supply
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Winooski, VT 05404
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vtbrew@myfairpoint.net

The Vermont Pub & Brewery
144 College Street
Burlington, VT 05401
(802) 865-0500

Zero Gravity Craft Brewery
Destiny, brewer
15 St. Paul Street
Burlington, VT 05401
(802) 861-2999

Additional Persons Consulted

Allen Matthews
Center for Sustainable Agriculture
106 High Point Center- Room 312
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Atul Kant Verma
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Elegant Engineers, An ISO 9001:2008 Certified Company
C- 82, Sector - 10, Noida - 201301 (U.P.)
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E-mail: elegant11@satyam.net.in
elegant117@gmail.com
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Barney Hodges III
Vermont Refrigerated Storage
1287 North Bingham St.
Cornwall, Vermont
bhodges@shoreham.net
www.sunriseorchardsvt.com
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Dauenhauer Manufacturing, Inc.
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Fuji Impulse America
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Macy Mullican
Shelburne Vineyard
The Vermont Food Project, refrigerated warehouse
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Steve Justis
Vermont Agency of Agriculture Food, and Markets
116 State St.
Montpelier, VT 05620
(802) 828-3829

Appendix C – Brewer Questionnaire Template

What is the name of your brewery?

How many barrels do you brew per year?

What are the top five hops you use?
1.

2.

3.

4.

5.

How much of each do you use per year? (in lbs)
1.

2.

3.

4.

5.

How much total aroma hops do you use per year? (in lbs)

How much total bittering hops do you use per year? (in lbs)

Which varieties of hops (if not listed in the five above) would you like to see available more locally?

How do you prefer to use hops (whole, pelletized)? Please describe

What are the product specifications and quality requirements we would need to be able to meet for you to consider buying from a local source? Please describe (ie packaging, lab analysis, pelletized vs whole, etc, etc)

How do your hops come packaged and shipped?

Are you under contract for your hops?

If so would/could you consider buying local hops and when does your contract come up for renewal? Could you buy local hops even if you are under contract and if so up to how much of your total volume of hop usage?

What is your current source for hops? Please list suppliers and state/country.

What are you currently paying for your hops?

Does this include shipping?

If not, what do you pay for shipping?

How much of your total hop volume would you be willing to buy locally if it met your quality requirements and product specifications?
Would you prefer a stable price for local hops that may or may not reflect the market rate but is a stable price that you and the grower can both depend on? Or would you prefer the hops compete at market rate?

If you would prefer to be able to rely on a known price for a known product, what would you see as a fair rate that you would consistently be willing to agree to?
If the product were to compete at market rate what would you say is the average rate we should expect to charge (if this differs from the fair rate you list above)?

Would you be willing to pay a premium for local hops?

If yes, how much would you be willing to pay above what you are currently paying? 10%, 20%, 50%, 100%, etc?

If you were willing to pay a premium for local hops, would this change the volume of local hops you would buy (ie if you pay more you might buy less?) Is this so and if so, how would the volume of local hops you purchase change?

Why are you interested in buying hops locally?

Are you interested in organic hops?

What is the best way to communicate with you?

Other thoughts/comments/suggestions?

Appendix D – Cash Flow Scenarios

Scenario 1: Grower participating in the Atlantic Hops Value-Share Grower Program, Growing 1 Acre

Cash flow 1: demonstrating cash flow if no efficiencies in production are utilized

Cash flow 2: demonstrating cash flow if grower harvests only top 1/3 of the bine

Cash flow 3: demonstrating cash flow if grower harvests only top 1/3 of the bine, and manually strips and sorts

Cash flow 4: demonstrating cash flow if grower harvests only top 1/3 of the bine, and mechanically strips and sorts

Courtesy: Vermont Farm Viability Enhancement Program

CASH FLOW PROJECTION

Scenario: Participating in Atlantic Hops Value Share Grower Program

No Optimization in Harvesting

	Projection	Projection	Projection	Projection
Production Information	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Number of acres	1	1	1	1
Production Level	0%	40%	90%	**100%**
Quantity of dried hops sold (lbs/year)	0	600	1350	1500
Pounds of dried hops per acre per year	0	600	1350	1500
Average price paid to grower per dried pound	**9**	**9**	**9**	**9**
Return on Investment in Years	**(2)**			
Annual Net Income at 100% Production	**$ (9,610)**			
Cash Receipts				
Hops Sold	$ -	$ 5,400	$ 12,150	$ 13,500
TOTAL CASH RECEIPTS	**$ -**	**$ 5,400**	**$ 12,150**	**$ 13,500**
Cash Expenses				
Variable Expenses:				
Chemicals	$ -	$ -	$ -	$ -
Conservation expense	$ -	$ -	$ -	$ -
Custom hire	$ -	$ -	$ -	$ -
Trellising supplies- twine, w clips, etc.	$ -	$ -	$ -	$ -
Fertilizer	$ -	$ -	$ -	$ -
Fuel and oil	$ -	$ -	$ -	$ -
Labor hired (incl. FICA, workers comp, etc.)	$ -	$ -	$ -	$ -
Repairs, maintenance	$ -	$ -	$ -	$ -
Electricity for drying				
Supplies	$ -	$ -	$ -	$ -
Sub total Variable Expenses	**$ 2,500**	**$ 2,500**	**$ 2,500**	**$ 2,500**
Labor	$ -	$ -	$ -	$ -
Spring/Summer Labor 500 hrs/acre @ $10/hr	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Harvest Labor 1 hr/dried lb 1,500hrs @ $10/hr	$ 15,000	$ 15,000	$ 15,000	$ 15,000
Sub total Labor	**$ 20,000**	**$ 20,000**	**$ 20,000**	**$ 20,000**
Other Variable Expenses				
Freight/Shipping estimating 2,000lbs NMFC classification 100	$ 610	$ 610	$ 610	$ 610
Other:	$ -	$ -	$ -	$ -
Sub total Other Variable Expenses	**$ 610**	**$ 610**	**$ 610**	**$ 610**
Total Variable Expenses:	**$ 23,110**	**$ 23,110**	**$ 23,110**	**$ 23,110**
Fixed Expenses:				
Auto & truck	$ -	$ -	$ -	$ -
Interest, farm share	$ -	$ -	$ -	$ -
Insurance, farm share	$ -	$ -	$ -	$ -
Property tax, farm share	$ -	$ -	$ -	$ -
Rents paid—land, buildings	$ -	$ -	$ -	$ -
Rents paid—equipment, livestock	$ -	$ -	$ -	$ -
Utilities, farm share	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Total Fixed Expenses	**$ -**	**$ -**	**$ -**	**$ -**
TOTAL CASH EXPENSES	**$ 23,110**	**$ 23,110**	**$ 23,110**	**$ 23,110**
RECEIPTS MINUS EXPENSES	**$ (23,110)**	**$ (17,710)**	**$ (10,960)**	**$ (9,610)**
Plus CAPITAL CONTRIBUTIONS				
grants	$ -	$ -	$ -	$ -
loans	$ -	$ -	$ -	$ -
off-farm income	$ -	$ -	$ -	$ -
other	$ -	$ -	$ -	$ -
Plus CAPITAL SALES				
equipment	$ -	$ -	$ -	$ -
Less CAPITAL EXPENSE				
mechanical harvester	$ -	$ -	$ -	$ -
sorter	$ -	$ -	$ -	$ -
oast 1 phase, 3/4 hp	$ -	$ 5,000	$ -	$ -
one acre hop yard- Atlantic Hops Value-Grower Set Price	$ 10,000	$ -	$ -	$ -
Total Capital Expense	$ 10,000	$ 5,000	$ -	$ -
Less DEBT SERVICE				
List Loan Principal Payments				
Plus STARTING CASH	$ -	$ (33,110)	$ (55,820)	$ (66,780)
NET RETAINED CASH EARNINGS (DEFICIT)	**$ (33,110)**	**$ (55,820)**	**$ (66,780)**	**$ (76,390)**
- Income Taxes (estimate at 33%)		$ -	$ -	$ -
Less Family Living	$ -	$ -	$ -	$ -
- Capital Reserve				
NET AFTER CAPITAL RESERVE, FAMILY LIVING AND INCOME TAX ALLOCATION	$ (33,110)	$ (55,820)	$ (66,780)	$ (76,390)

Courtesy: Vermont Farm Viability Enhancement Program

CASH FLOW PROJECTION

Scenario: Participating in Atlantic Hops Value Share Grower Program

Optimized Manual Harvesting, Harvesting Only Top 1/3 of Bine

	Projection	Projection	Projection	Projection
Production Information	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Number of acres	1	1	1	1
Production Level	0%	40%	90%	**100%**
Quantity of dried hops sold (lbs/year)	0	600	1350	1500
Pounds of dried hops per acre per year	0	600	1350	1500
Average price paid to grower per dried pound	**9**	**9**	**9**	**9**
Return on Investment in Years	**(4)**			
Annual Net Income at 100% Production	**$ (3,360)**			
Cash Receipts				
Hops Sold	$ -	$ 5,400	$ 12,150	$ 13,500
TOTAL CASH RECEIPTS	**$ -**	**$ 5,400**	**$ 12,150**	**$ 13,500**
Cash Expenses				
Variable Expenses:				
Chemicals	$ -	$ -	$ -	$ -
Conservation expense	$ -	$ -	$ -	$ -
Custom hire	$ -	$ -	$ -	$ -
Trellising supplies- twine, w clips, etc.	$ -	$ -	$ -	$ -
Fertilizer	$ -	$ -	$ -	$ -
Fuel and oil	$ -	$ -	$ -	$ -
Labor hired (incl. FICA, workers comp, etc.)	$ -	$ -	$ -	$ -
Repairs, maintenance	$ -	$ -	$ -	$ -
Electricity for drying				
Supplies	$ -	$ -	$ -	$ -
Sub total Variable Expenses	**$ 2,500**	**$ 2,500**	**$ 2,500**	**$ 2,500**
Labor	$ -	$ -	$ -	$ -
Spring/Summer Labor 500 hrs/acre @ $10/hr	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Harvest Labor harvesting only top 1/3 of the bine 35 min/lb1,500lbs/acre (875 hrs) @ $10/hr	$ 8,750	$ 8,750	$ 8,750	$ 8,750
Sub total Labor	**$ 13,750**	**$ 13,750**	**$ 13,750**	**$ 13,750**
Other Variable Expenses				
Freight/Shipping estimating 2,000lbs NMFC classification 100	$ 610	$ 610	$ 610	$ 610
Other:	$ -	$ -	$ -	$ -
Sub total Other Variable Expenses	**$ 610**	**$ 610**	**$ 610**	**$ 610**
Total Variable Expenses:	**$ 16,860**	**$ 16,860**	**$ 16,860**	**$ 16,860**
Fixed Expenses:				
Auto & truck	$ -	$ -	$ -	$ -
Interest, farm share	$ -	$ -	$ -	$ -
Insurance, farm share	$ -	$ -	$ -	$ -
Property tax, farm share	$ -	$ -	$ -	$ -
Rents paid—land, buildings	$ -	$ -	$ -	$ -
Rents paid—equipment, livestock	$ -	$ -	$ -	$ -
Utilities, farm share	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Total Fixed Expenses	**$ -**	**$ -**	**$ -**	**$ -**
TOTAL CASH EXPENSES	**$ 16,860**	**$ 16,860**	**$ 16,860**	**$ 16,860**
RECEIPTS MINUS EXPENSES	**$ (16,860)**	**$ (11,460)**	**$ (4,710)**	**$ (3,360)**
Plus CAPITAL CONTRIBUTIONS				
grants	$ -	$ -	$ -	$ -
loans	$ -	$ -	$ -	$ -
off-farm income	$ -	$ -	$ -	$ -
other	$ -	$ -	$ -	$ -
Plus CAPITAL SALES				
equipment	$ -	$ -	$ -	$ -
Less CAPITAL EXPENSE				
mechanical harvester	$ -	$ -	$ -	$ -
sorter	$ -	$ -	$ -	$ -
oast 1 phase, 3/4 hp	$ -	$ 5,000	$ -	$ -
one acre hop yard- Atlantic Hops Value-Grower Set Price	$ 10,000	$ -	$ -	$ -
Total Capital Expense	$ 10,000	$ 5,000	$ -	$ -
Less DEBT SERVICE				
List Loan Principal Payments				
Plus STARTING CASH	$ -	$ (26,860)	$ (43,320)	$ (48,030)
NET RETAINED CASH EARNINGS (DEFICIT)	**$ (26,860)**	**$ (43,320)**	**$ (48,030)**	**$ (51,390)**
- Income Taxes (estimate at 33%)		$ -	$ -	$ -
Less Family Living	$ -	$ -	$ -	$ -
- Capital Reserve				
NET AFTER CAPITAL RESERVE, FAMILY LIVING AND INCOME TAX ALLOCATION	$ (26,860)	$ (43,320)	$ (48,030)	$ (51,390)

Courtesy: Vermont Farm Viability Enhancement Program

CASH FLOW PROJECTION

Scenario: Participating in Atlantic Hops Value Share Grower Program

Optimized Manual Harvesting, Harvesting Only Top 1/3 of Bine, Manual Stripping & Sorting

	Projection	Projection	Projection	Projection
Production Information	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Number of acres	1	1	1	1
Production Level	0%	40%	90%	**100%**
Quantity of dried hops sold (lbs/year)	0	600	1350	1500
Pounds of dried hops per acre per year	0	600	1350	1500
Average price paid to grower per dried pound	**9**	**9**	**9**	**9**
Return on Investment in Years	**38**			
Annual Net Income at 100% Production	**$ 390**			
Cash Receipts				
Hops Sold	$ -	$ 5,400	$ 12,150	$ 13,500
TOTAL CASH RECEIPTS	**$ -**	**$ 5,400**	**$ 12,150**	**$ 13,500**
Cash Expenses				
Variable Expenses:				
Chemicals	$ -	$ -	$ -	$ -
Conservation expense	$ -	$ -	$ -	$ -
Custom hire	$ -	$ -	$ -	$ -
Trellising supplies- twine, w clips, etc.	$ -	$ -	$ -	$ -
Fertilizer	$ -	$ -	$ -	$ -
Fuel and oil	$ -	$ -	$ -	$ -
Labor hired (incl. FICA, workers comp, etc.)	$ -	$ -	$ -	$ -
Repairs, maintenance	$ -	$ -	$ -	$ -
Electricity for drying				
Supplies	$ -	$ -	$ -	$ -
Sub total Variable Expenses	**$ 2,500**	**$ 2,500**	**$ 2,500**	**$ 2,500**
Labor	$ -	$ -	$ -	$ -
Spring/Summer Labor 500 hrs/acre @ $10/hr	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Harvest Labor harvesting top 1/3 of the bine, stripping and sorting 20 min/lb 1,500lbs/acre (500 hrs) @ $10/hr	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Sub total Labor	**$ 10,000**	**$ 10,000**	**$ 10,000**	**$ 10,000**
Other Variable Expenses				
Freight/Shipping estimating 2,000lbs NMFC classification 100	$ 610	$ 610	$ 610	$ 610
Other:	$ -	$ -	$ -	$ -
Sub total Other Variable Expenses	**$ 610**	**$ 610**	**$ 610**	**$ 610**
Total Variable Expenses:	**$ 13,110**	**$ 13,110**	**$ 13,110**	**$ 13,110**
Fixed Expenses:				
Auto & truck	$ -	$ -	$ -	$ -
Interest, farm share	$ -	$ -	$ -	$ -
Insurance, farm share	$ -	$ -	$ -	$ -
Property tax, farm share	$ -	$ -	$ -	$ -
Rents paid—land, buildings	$ -	$ -	$ -	$ -
Rents paid—equipment, livestock	$ -	$ -	$ -	$ -
Utilities, farm share	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Total Fixed Expenses	**$ -**	**$ -**	**$ -**	**$ -**
TOTAL CASH EXPENSES	**$ 13,110**	**$ 13,110**	**$ 13,110**	**$ 13,110**
RECEIPTS MINUS EXPENSES	**$ (13,110)**	**$ (7,710)**	**$ (960)**	**$ 390**
Plus CAPITAL CONTRIBUTIONS				
grants	$ -	$ -	$ -	$ -
loans	$ -	$ -	$ -	$ -
off-farm income	$ -	$ -	$ -	$ -
other	$ -	$ -	$ -	$ -
Plus CAPITAL SALES				
equipment	$ -	$ -	$ -	$ -
Less CAPITAL EXPENSE				
mechanical harvester	$ -	$ -	$ -	$ -
sorter	$ -	$ -	$ -	$ -
oast 1 phase, 3/4 hp	$ -	$ 5,000	$ -	$ -
one acre hop yard- Atlantic Hops Value-Grower Set Price	$ 10,000	$ -	$ -	$ -
Total Capital Expense	$ 10,000	$ 5,000	$ -	$ -
Less DEBT SERVICE				
List Loan Principal Payments				
Plus STARTING CASH	$ -	$ (23,110)	$ (35,820)	$ (36,780)
NET RETAINED CASH EARNINGS (DEFICIT)	**$ (23,110)**	**$ (35,820)**	**$ (36,780)**	**$ (36,390)**
- Income Taxes (estimate at 33%)		$ -	$ -	$ -
Less Family Living	$ -	$ -	$ -	$ -
- Capital Reserve				
NET AFTER CAPITAL RESERVE, FAMILY LIVING AND INCOME TAX ALLOCATION	$ (23,110)	$ (35,820)	$ (36,780)	$ (36,390)

Courtesy: Vermont Farm Viability Enhancement Program

CASH FLOW PROJECTION

Scenario: Participating in Atlantic Hops Value Share Grower Program

Optimized Manual Harvesting, Harvesting Only Top 1/3 of Bine, Mechanized Stripping, Picking, & Sorting

	Projection	Projection	Projection	Projection
Production Information	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Number of acres	1	1	1	1
Production Level	0%	40%	90%	**100%**
Quantity of dried hops sold (lbs/year)	0	600	1350	1500
Pounds of dried hops per acre per year	0	600	1350	1500
Average price paid to grower per dried pound	**9**	**9**	**9**	**9**
Return on Investment in Years	**5**			
Annual Net Income at 100% Production	**$ 4,640**			
Cash Receipts				
Hops Sold	$ -	$ 5,400	$ 12,150	$ 13,500
TOTAL CASH RECEIPTS	**$ -**	**$ 5,400**	**$ 12,150**	**$ 13,500**
Cash Expenses				
Variable Expenses:				
Chemicals	$ -	$ -	$ -	$ -
Conservation expense	$ -	$ -	$ -	$ -
Custom hire	$ -	$ -	$ -	$ -
Trellising supplies- twine, w clips, etc.	$ -	$ -	$ -	$ -
Fertilizer	$ -	$ -	$ -	$ -
Fuel and oil	$ -	$ -	$ -	$ -
Labor hired (incl. FICA, workers comp, etc.)	$ -	$ -	$ -	$ -
Repairs, maintenance	$ -	$ -	$ -	$ -
Electricity for drying				
Supplies	$ -	$ -	$ -	$ -
Sub total Variable Expenses	**$ 2,500**	**$ 2,500**	**$ 2,500**	**$ 2,500**
Labor	$ -	$ -	$ -	$ -
Spring/Summer Labor 500 hrs/acre @ $10/hr	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Harvest Labor harvesting only top 1/3 of the bine 3 min/lb- 1 min to pick, 2 min to sort 1,500lbs/acre (75 hrs) @ $10/hr	$ 750	$ 750	$ 750	$ 750
Sub total Labor	**$ 5,750**	**$ 5,750**	**$ 5,750**	**$ 5,750**
Other Variable Expenses				
Freight/Shipping estimating 2,000lbs NMFC classification 100	$ 610	$ 610	$ 610	$ 610
Other:	$ -	$ -	$ -	$ -
Sub total Other Variable Expenses	**$ 610**	**$ 610**	**$ 610**	**$ 610**
Total Variable Expenses:	**$ 8,860**	**$ 8,860**	**$ 8,860**	**$ 8,860**
Fixed Expenses:				
Auto & truck	$ -	$ -	$ -	$ -
Interest, farm share	$ -	$ -	$ -	$ -
Insurance, farm share	$ -	$ -	$ -	$ -
Property tax, farm share	$ -	$ -	$ -	$ -
Rents paid—land, buildings	$ -	$ -	$ -	$ -
Rents paid—equipment, livestock	$ -	$ -	$ -	$ -
Utilities, farm share	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Total Fixed Expenses	**$ -**	**$ -**	**$ -**	**$ -**
TOTAL CASH EXPENSES	**$ 8,860**	**$ 8,860**	**$ 8,860**	**$ 8,860**
RECEIPTS MINUS EXPENSES	**$ (8,860)**	**$ (3,460)**	**$ 3,290**	**$ 4,640**
Plus CAPITAL CONTRIBUTIONS				
grants	$ -	$ -	$ -	$ -
loans	$ -	$ -	$ -	$ -
off-farm income	$ -	$ -	$ -	$ -
other	$ -	$ -	$ -	$ -
Plus CAPITAL SALES				
equipment	$ -	$ -	$ -	$ -
Less CAPITAL EXPENSE				
mechanical harvester	$ -	$ -	$ 5,000	$ -
sorter	$ -	$ -	$ 5,000	$ -
oast	$ -	$ 5,000	$ -	$ -
one acre hop yard- Atlantic Hops Value-Grower Set Price	$ 10,000	$ -	$ -	$ -
Total Capital Expense	$ 10,000	$ 5,000	$ 10,000	$ -
Less DEBT SERVICE				
List Loan Principal Payments				
Plus STARTING CASH	$ -	$ (18,860)	$ (27,320)	$ (34,030)
NET RETAINED CASH EARNINGS (DEFICIT)	**$ (18,860)**	**$ (27,320)**	**$ (34,030)**	**$ (29,390)**
- Income Taxes (estimate at 33%)		$ -	$ -	$ -
Less Family Living	$ -	$ -	$ -	$ -
- Capital Reserve				
NET AFTER CAPITAL RESERVE, FAMILY LIVING AND INCOME TAX ALLOCATION	$ (18,860)	$ (27,320)	$ (34,030)	$ (29,390)

Scenario 2: Grower growing hops to sell as whole dried hops

Cash flow 1: demonstrating cash flow if no efficiencies in production are utilized

Cash flow 2: demonstrating cash flow if grower harvests only top 1/3 of the bine

Cash flow 3: demonstrating cash flow if grower harvests only top 1/3 of the bine, and manually strips and sorts

Cash flow 4: demonstrating cash flow if grower harvests only top 1/3 of the bine, and mechanically strips and sorts

Courtesy: Vermont Farm Viability Enhancement Program

CASH FLOW PROJECTION

Scenario: Selling Direct to Brewer, Whole Hops

No Optimization in Harvesting

	Projection	Projection	Projection	Projection
Production Information	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Number of acres	1	1	1	1
Production Level	0%	40%	90%	**100%**
Quantity of dried hops sold (lbs/year)	0	600	1350	1500
Pounds of dried hops per acre per year	0	600	1350	1500
Average price per dried pound needed to break even	**15.51**	**16.11**	**16.11**	**16.11**
Projected Sale Price to Brewers	**10.00**	**10.00**	**10.00**	**10.00**
Return on Investment in Years	**(2)**			
Annual Net Income at 100% Production	**$ (9,160)**			
Cash Receipts				
Hops Sold	$ -	$ 6,000	$ 13,500	$ 15,000
TOTAL CASH RECEIPTS	**$ -**	**$ 6,000**	**$ 13,500**	**$ 15,000**
Cash Expenses				
Variable Expenses:				
Chemicals	$ -	$ -	$ -	$ -
Conservation expense	$ -	$ -	$ -	$ -
Custom hire	$ -	$ -	$ -	$ -
Trellising supplies- twine, w clips, etc.	$ -	$ -	$ -	$ -
Fertilizer	$ -	$ -	$ -	$ -
Fuel and oil	$ -	$ -	$ -	$ -
Labor hired (incl. FICA, workers comp, etc.)	$ -	$ -	$ -	$ -
Repairs, maintenance	$ -	$ -	$ -	$ -
Electricity for drying				
Supplies	$ -	$ -	$ -	$ -
Sub total Variable Expenses	**$ 2,500**	**$ 2,500**	**$ 2,500**	**$ 2,500**
Labor	$ -	$ -	$ -	$ -
Spring/Summer Labor 500 hrs/acre @ $10/hr	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Harvest Labor 1 hr/dried lb 1,500hrs @ $10/hr	$ 15,000	$ 15,000	$ 15,000	$ 15,000
Sub total Labor	**$ 20,000**	**$ 20,000**	**$ 20,000**	**$ 20,000**
Other Variable Expenses				
Freight/Shipping estimating 2,000lbs NMFC classification 100	$ 610	$ 610	$ 610	$ 610
Chemical Analysis	$ 150	$ 150	$ 150	$ 150
Processing (pelletizing and packaging)	$ -	$ 100	$ 100	$ 100
Climate Controlled Storage- rented climate controlled space	$ -	$ 700	$ 700	$ 700
Sales & Marketing	$ -	$ 100	$ 100	$ 100
Other:	$ -	$ -	$ -	$ -
Sub total Other Variable Expenses	**$ 760**	**$ 1,660**	**$ 1,660**	**$ 1,660**
Total Variable Expenses:	**$ 23,260**	**$ 24,160**	**$ 24,160**	**$ 24,160**
Fixed Expenses:				
Auto & truck	$ -	$ -	$ -	$ -
Interest, farm share	$ -	$ -	$ -	$ -
Insurance, farm share	$ -	$ -	$ -	$ -
Property tax, farm share	$ -	$ -	$ -	$ -
Rents paid—land, buildings	$ -	$ -	$ -	$ -
Rents paid—equipment, livestock	$ -	$ -	$ -	$ -
Utilities, farm share	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Total Fixed Expenses	**$ -**	**$ -**	**$ -**	**$ -**
TOTAL CASH EXPENSES	**$ 23,260**	**$ 24,160**	**$ 24,160**	**$ 24,160**
RECEIPTS MINUS EXPENSES	**$ (23,260)**	**$ (18,160)**	**$ (10,660)**	**$ (9,160)**
Plus CAPITAL CONTRIBUTIONS				
grants	$ -	$ -	$ -	$ -
loans	$ -	$ -	$ -	$ -
off-farm income	$ -	$ -	$ -	$ -
other	$ -	$ -	$ -	$ -
Plus CAPITAL SALES				
equipment	$ -	$ -	$ -	$ -
Less CAPITAL EXPENSE				
mechanical harvester	$ -	$ -	$ -	$ -
sorter	$ -	$ -	$ -	$ -
oast	$ -	$ 5,000	$ -	$ -
one acre hop yard	$ 12,000	$ -	$ -	$ -
Total Capital Expense	$ 12,000	$ 5,000	$ -	$ -
Less DEBT SERVICE				
List Loan Principal Payments				
Plus STARTING CASH	$ -	$ (35,260)	$ (58,717)	$ (69,674)
NET RETAINED CASH EARNINGS (DEFICIT)	**$ (35,260)**	**$ (58,420)**	**$ (69,377)**	**$ (78,834)**
- Income Taxes (estimate at 33%)		$ 297	$ 297	$ 297
Less Family Living	$ -	$ -	$ -	$ -
- Capital Reserve				
NET AFTER CAPITAL RESERVE, FAMILY LIVING AND INCOME TAX ALLOCATION	$ (35,260)	$ (58,717)	$ (69,674)	$ (79,131)

Courtesy: Vermont Farm Viability Enhancement Program

CASH FLOW PROJECTION

Scenario: Selling Direct to Brewer, Whole Hops

Optimized Manual Harvesting, Harvesting Only Top 1/3 of Bine

	Projection	Projection	Projection	Projection
Production Information	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Number of acres	1	1	1	1
Production Level	0%	40%	90%	**100%**
Quantity of dried hops sold (lbs/year)	0	600	1350	1500
Pounds of dried hops per acre per year	0	600	1350	1500
Average price per dried pound needed to break even	**12.51**	**13.11**	**13.11**	**13.11**
Projected Sale Price to Brewers	**10.00**	**10.00**	**10.00**	**10.00**
Return on Investment in Years	**(4)**			
Annual Net Income at 100% Production	**$ (4,660)**			
Cash Receipts				
Hops Sold	$ -	$ 6,000	$ 13,500	$ 15,000
TOTAL CASH RECEIPTS	**$ -**	**$ 6,000**	**$ 13,500**	**$ 15,000**
Cash Expenses				
Variable Expenses:				
Chemicals	$ -	$ -	$ -	$ -
Conservation expense	$ -	$ -	$ -	$ -
Custom hire	$ -	$ -	$ -	$ -
Trellising supplies- twine, w clips, etc.	$ -	$ -	$ -	$ -
Fertilizer	$ -	$ -	$ -	$ -
Fuel and oil	$ -	$ -	$ -	$ -
Labor hired (incl. FICA, workers comp, etc.)	$ -	$ -	$ -	$ -
Repairs, maintenance	$ -	$ -	$ -	$ -
Electricity for drying				
Supplies	$ -	$ -	$ -	$ -
Sub total Variable Expenses	**$ 2,500**	**$ 2,500**	**$ 2,500**	**$ 2,500**
Labor	$ -	$ -	$ -	$ -
Spring/Summer Labor 500 hrs/acre @ $10/hr	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Harvest Labor harvesting only top 1/3 of the bine 35 min/lb1,500lbs/acre @ $10/hr	$ 10,500	$ 10,500	$ 10,500	$ 10,500
Sub total Labor	**$ 15,500**	**$ 15,500**	**$ 15,500**	**$ 15,500**
Other Variable Expenses				
Freight/Shipping estimating 2,000lbs NMFC classification 100	$ 610	$ 610	$ 610	$ 610
Chemical Analysis	$ 150	$ 150	$ 150	$ 150
Processing (pelletizing and packaging)	$ -	$ 100	$ 100	$ 100
Climate Controlled Storage- rented climate controlled space	$ -	$ 700	$ 700	$ 700
Sales & Marketing		$ 100	$ 100	$ 100
Other:	$ -	$ -	$ -	$ -
Sub total Other Variable Expenses	**$ 760**	**$ 1,660**	**$ 1,660**	**$ 1,660**
Total Variable Expenses:	**$ 18,760**	**$ 19,660**	**$ 19,660**	**$ 19,660**
Fixed Expenses:				
Auto & truck	$ -	$ -	$ -	$ -
Interest, farm share	$ -	$ -	$ -	$ -
Insurance, farm share	$ -	$ -	$ -	$ -
Property tax, farm share	$ -	$ -	$ -	$ -
Rents paid—land, buildings	$ -	$ -	$ -	$ -
Rents paid—equipment, livestock	$ -	$ -	$ -	$ -
Utilities, farm share	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Total Fixed Expenses	**$ -**	**$ -**	**$ -**	**$ -**
TOTAL CASH EXPENSES	**$ 18,760**	**$ 19,660**	**$ 19,660**	**$ 19,660**
RECEIPTS MINUS EXPENSES	**$ (18,760)**	**$ (13,660)**	**$ (6,160)**	**$ (4,660)**
Plus CAPITAL CONTRIBUTIONS				
grants	$ -	$ -	$ -	$ -
loans	$ -	$ -	$ -	$ -
off-farm income	$ -	$ -	$ -	$ -
other	$ -	$ -	$ -	$ -
Plus CAPITAL SALES				
equipment	$ -	$ -	$ -	$ -
Less CAPITAL EXPENSE				
mechanical harvester	$ -	$ -	$ -	$ -
sorter	$ -	$ -	$ -	$ -
oast	$ -	$ 5,000	$ -	$ -
one acre hop yard	$ 12,000	$ -	$ -	$ -
Total Capital Expense	$ 12,000	$ 5,000	$ -	$ -
Less DEBT SERVICE				
List Loan Principal Payments				
Plus STARTING CASH	$ -	$ (30,760)	$ (49,717)	$ (56,174)
NET RETAINED CASH EARNINGS (DEFICIT)	**$ (30,760)**	**$ (49,420)**	**$ (55,877)**	**$ (60,834)**
- Income Taxes (estimate at 33%)		$ 297	$ 297	$ 297
Less Family Living	$ -	$ -	$ -	$ -
- Capital Reserve				
NET AFTER CAPITAL RESERVE, FAMILY LIVING AND INCOME TAX ALLOCATION	$ (30,760)	$ (49,717)	$ (56,174)	$ (61,131)

Courtesy: Vermont Farm Viability Enhancement Program

CASH FLOW PROJECTION

Scenario: Selling Direct to Brewer, Whole Hops

Optimized Manual Harvesting, Harvesting Only Top 1/3 of Bine, Manual Stripping & Sorting

	Projection	Projection	Projection	Projection
Production Information	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Number of acres	1	1	1	1
Production Level	0%	40%	90%	**100%**
Quantity of dried hops sold (lbs/year)	0	600	1350	1500
Pounds of dried hops per acre per year	0	600	1350	1500
Average price per dried pound needed to break even	**8.84**	**9.44**	**9.44**	**9.44**
Projected Sale Price to Brewers	**10.00**	**10.00**	**10.00**	**10.00**
Return on Investment in Years	**26**			
Annual Net Income at 100% Production	**$ 840**			
Cash Receipts				
Hops Sold	$ -	$ 6,000	$ 13,500	$ 15,000
TOTAL CASH RECEIPTS	**$ -**	**$ 6,000**	**$ 13,500**	**$ 15,000**
Cash Expenses				
Variable Expenses:				
Chemicals	$ -	$ -	$ -	$ -
Conservation expense	$ -	$ -	$ -	$ -
Custom hire	$ -	$ -	$ -	$ -
Trellising supplies- twine, w clips, etc.	$ -	$ -	$ -	$ -
Fertilizer	$ -	$ -	$ -	$ -
Fuel and oil	$ -	$ -	$ -	$ -
Labor hired (incl. FICA, workers comp, etc.)	$ -	$ -	$ -	$ -
Repairs, maintenance	$ -	$ -	$ -	$ -
Electricity for drying				
Supplies	$ -	$ -	$ -	$ -
Sub total Variable Expenses	**$ 2,500**	**$ 2,500**	**$ 2,500**	**$ 2,500**
Labor	$ -	$ -	$ -	$ -
Spring/Summer Labor 500 hrs/acre @ $10/hr	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Harvest Labor harvesting top 1/3 of the bine, stripping and sorting 20 min/lb 1,500lbs/acre (500 hrs) @ $10/hr	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Sub total Labor	**$ 10,000**	**$ 10,000**	**$ 10,000**	**$ 10,000**
Other Variable Expenses				
Freight/Shipping estimating 2,000lbs NMFC classification 100	$ 610	$ 610	$ 610	$ 610
Chemical Analysis	$ 150	$ 150	$ 150	$ 150
Processing (pelletizing and packaging)	$ -	$ 100	$ 100	$ 100
Climate Controlled Storage- rented climate controlled space	$ -	$ 700	$ 700	$ 700
Sales & Marketing		$ 100	$ 100	$ 100
Other:	$ -	$ -	$ -	$ -
Sub total Other Variable Expenses	**$ 760**	**$ 1,660**	**$ 1,660**	**$ 1,660**
Total Variable Expenses:	**$ 13,260**	**$ 14,160**	**$ 14,160**	**$ 14,160**
Fixed Expenses:				
Auto & truck	$ -	$ -	$ -	$ -
Interest, farm share	$ -	$ -	$ -	$ -
Insurance, farm share	$ -	$ -	$ -	$ -
Property tax, farm share	$ -	$ -	$ -	$ -
Rents paid—land, buildings	$ -	$ -	$ -	$ -
Rents paid—equipment, livestock	$ -	$ -	$ -	$ -
Utilities, farm share	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Total Fixed Expenses	**$ -**	**$ -**	**$ -**	**$ -**
TOTAL CASH EXPENSES	**$ 13,260**	**$ 14,160**	**$ 14,160**	**$ 14,160**
RECEIPTS MINUS EXPENSES	**$ (13,260)**	**$ (8,160)**	**$ (660)**	**$ 840**
Plus CAPITAL CONTRIBUTIONS				
grants	$ -	$ -	$ -	$ -
loans	$ -	$ -	$ -	$ -
off-farm income	$ -	$ -	$ -	$ -
other	$ -	$ -	$ -	$ -
Plus CAPITAL SALES				
equipment	$ -	$ -	$ -	$ -
Less CAPITAL EXPENSE				
mechanical harvester	$ -	$ -	$ -	$ -
sorter	$ -	$ -	$ 5,000	$ -
oast	$ -	$ 5,000	$ -	$ -
one acre hop yard	$ 12,000	$ -	$ -	$ -
Total Capital Expense	$ 12,000	$ 5,000	$ 5,000	$ -
Less DEBT SERVICE				
List Loan Principal Payments				
Plus STARTING CASH	$ -	$ (25,260)	$ (38,717)	$ (44,674)
NET RETAINED CASH EARNINGS (DEFICIT)	**$ (25,260)**	**$ (38,420)**	**$ (44,377)**	**$ (43,834)**
- Income Taxes (estimate at 33%)		$ 297	$ 297	$ 297
Less Family Living	$ -	$ -	$ -	$ -
- Capital Reserve				
NET AFTER CAPITAL RESERVE, FAMILY LIVING AND INCOME TAX ALLOCATION	$ (25,260)	$ (38,717)	$ (44,674)	$ (44,131)

Courtesy: Vermont Farm Viability Enhancement Program

CASH FLOW PROJECTION

Scenario: Selling Direct To Brewer, Whole Hops

Optimized Manual Harvesting, Harvesting Only Top 1/3 of Bine, Mechanized Stripping, Picking, & Sorting

	Projection	Projection	Projection	Projection
Production Information	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Number of acres	1	1	1	1
Production Level	0%	40%	90%	**100%**
Quantity of dried hops sold (lbs/year)	0	600	1350	1500
Pounds of dried hops per acre per year	0	600	1350	1500
Average price per dried pound needed to break even	**6.01**	**6.61**	**6.61**	**6.61**
Projected Sale Price to Brewers	**10.00**	**10.00**	**10.00**	**10.00**
Return on Investment in Years	**5**			
Annual Net Income at 100% Production	**$ 5,090**			
Cash Receipts				
Hops Sold	$ -	$ 6,000	$ 13,500	$ 15,000
TOTAL CASH RECEIPTS	**$ -**	**$ 6,000**	**$ 13,500**	**$ 15,000**
Cash Expenses				
Variable Expenses:				
Chemicals	$ -	$ -	$ -	$ -
Conservation expense	$ -	$ -	$ -	$ -
Custom hire	$ -	$ -	$ -	$ -
Trellising supplies- twine, w clips, etc.	$ -	$ -	$ -	$ -
Fertilizer	$ -	$ -	$ -	$ -
Fuel and oil	$ -	$ -	$ -	$ -
Labor hired (incl. FICA, workers comp, etc.)	$ -	$ -	$ -	$ -
Repairs, maintenance	$ -	$ -	$ -	$ -
Electricity for drying				
Supplies	$ -	$ -	$ -	$ -
Sub total Variable Expenses	**$ 2,500**	**$ 2,500**	**$ 2,500**	**$ 2,500**
Labor	$ -	$ -	$ -	$ -
Spring/Summer Labor 500 hrs/acre @ $10/hr	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Harvest Labor harvesting only top 1/3 of the bine 3 min/lb- 1 min to pick, 2 min to sort 1,500lbs/acre (75 hrs) @ $10/hr	$ 750	$ 750	$ 750	$ 750
Sub total Labor	**$ 5,750**	**$ 5,750**	**$ 5,750**	**$ 5,750**
Other Variable Expenses				
Freight/Shipping estimating 2,000lbs NMFC classification 100	$ 610	$ 610	$ 610	$ 610
Chemical Analysis	$ 150	$ 150	$ 150	$ 150
Processing (pelletizing and packaging)	$ -	$ 100	$ 100	$ 100
Climate Controlled Storage- rented climate controlled space	$ -	$ 700	$ 700	$ 700
Sales & Marketing		$ 100	$ 100	$ 100
Other:	$ -	$ -	$ -	$ -
Sub total Other Variable Expenses	**$ 760**	**$ 1,660**	**$ 1,660**	**$ 1,660**
Total Variable Expenses:	**$ 9,010**	**$ 9,910**	**$ 9,910**	**$ 9,910**
Fixed Expenses:				
Auto & truck	$ -	$ -	$ -	$ -
Interest, farm share	$ -	$ -	$ -	$ -
Insurance, farm share	$ -	$ -	$ -	$ -
Property tax, farm share	$ -	$ -	$ -	$ -
Rents paid—land, buildings	$ -	$ -	$ -	$ -
Rents paid—equipment, livestock	$ -	$ -	$ -	$ -
Utilities, farm share	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Total Fixed Expenses	**$ -**	**$ -**	**$ -**	**$ -**
TOTAL CASH EXPENSES	**$ 9,010**	**$ 9,910**	**$ 9,910**	**$ 9,910**
RECEIPTS MINUS EXPENSES	**$ (9,010)**	**$ (3,910)**	**$ 3,590**	**$ 5,090**
Plus CAPITAL CONTRIBUTIONS				
grants	$ -	$ -	$ -	$ -
loans	$ -	$ -	$ -	$ -
off-farm income	$ -	$ -	$ -	$ -
other	$ -	$ -	$ -	$ -
Plus CAPITAL SALES				
equipment	$ -	$ -	$ -	$ -
Less CAPITAL EXPENSE				
mechanical harvester	$ -	$ -	$ 5,000	$ -
sorter	$ -	$ -	$ 5,000	$ -
oast	$ -	$ 5,000	$ -	$ -
one acre hop yard	$ 12,000	$ -	$ -	$ -
Total Capital Expense	$ 12,000	$ 5,000	$ 10,000	$ -
Less DEBT SERVICE				
List Loan Principal Payments				
Plus STARTING CASH	$ -	$ (21,010)	$ (30,217)	$ (36,924)
NET RETAINED CASH EARNINGS (DEFICIT)	**$ (21,010)**	**$ (29,920)**	**$ (36,627)**	**$ (31,834)**
- Income Taxes (estimate at 33%)		$ 297	$ 297	$ 297
Less Family Living	$ -	$ -	$ -	$ -
- Capital Reserve				
NET AFTER CAPITAL RESERVE, FAMILY LIVING AND INCOME TAX ALLOCATION	$ (21,010)	$ (30,217)	$ (36,924)	$ (32,131)

Scenario 3: Grower sending hops to Atlantic Hops for processing

Cash flow 1: demonstrating cash flow if no efficiencies in production are utilized

Cash flow 2: demonstrating cash flow if grower harvests only top 1/3 of the bine

Cash flow 3: demonstrating cash flow if grower harvests only top 1/3 of the bine, and manually strips and sorts

Cash flow 4: demonstrating cash flow if grower harvests only top 1/3 of the bine, and mechanically strips and sorts

Courtesy: Vermont Farm Viability Enhancement Program

CASH FLOW PROJECTION

Scenario: Selling Pelletized Direct To Brewer Using Atlantic Hops Processing Services

No Optimization in Harvesting

	Projection	Projection	Projection	Projection
Production Information	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Number of acres	1	1	1	1
Production Level	0%	40%	90%	**100%**
Quantity of dried hops sold (lbs/year)	0	600	1350	1500
Pounds of dried hops per acre per year	0	600	1350	1500
Average price per dried pound needed to break even	**15.00**	**17.81**	**20.56**	**21.11**
Projected Sale Price	**15.00**	**15.00**	**15.00**	**15.00**
Return on Investment in Years	**(2)**			
Annual Net Income at 100% Production	**$ (9,160)**			
Cash Receipts				
Hops Sold	$ -	$ 9,000	$ 20,250	$ 22,500
TOTAL CASH RECEIPTS	**$ -**	**$ 9,000**	**$ 20,250**	**$ 22,500**
Cash Expenses				
Variable Expenses:				
Chemicals	$ -	$ -	$ -	$ -
Conservation expense	$ -	$ -	$ -	$ -
Custom hire	$ -	$ -	$ -	$ -
Trellising supplies- twine, w clips, etc.	$ -	$ -	$ -	$ -
Fertilizer	$ -	$ -	$ -	$ -
Fuel and oil	$ -	$ -	$ -	$ -
Labor hired (incl. FICA, workers comp, etc.)	$ -	$ -	$ -	$ -
Repairs, maintenance	$ -	$ -	$ -	$ -
Electricity for drying				
Supplies	$ -	$ -	$ -	$ -
Sub total Variable Expenses	**$ 2,500**	**$ 2,500**	**$ 2,500**	**$ 2,500**
Labor	$ -	$ -	$ -	$ -
Spring/Summer Labor 500 hrs/acre @ $10/hr	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Harvest Labor 1 hr/dried lb 1,500hrs @ $10/hr	$ 15,000	$ 15,000	$ 15,000	$ 15,000
Sub total Labor	**$ 20,000**	**$ 20,000**	**$ 20,000**	**$ 20,000**
Other Variable Expenses				
Freight/Shipping estimating 2,000lbs NMFC classification 100	$ -	$ 610	$ 610	$ 610
Chemical Analysis	$ -	$ 150	$ 150	$ 150
Processing (pelletizing)	$ -	$ 3,300	$ 7,425	$ 8,250
Packaging				
Climate Controlled Storage		$ 50	$ 50	$ 50
Sales & Marketing		$ 100	$ 100	$ 100
Other:	$ -	$ -	$ -	$ -
Sub total Other Variable Expenses	**$ -**	**$ 4,210**	**$ 8,335**	**$ 9,160**
Total Variable Expenses:	**$ 22,500**	**$ 26,710**	**$ 30,835**	**$ 31,660**
Fixed Expenses:				
Auto & truck	$ -	$ -	$ -	$ -
Interest, farm share	$ -	$ -	$ -	$ -
Insurance, farm share	$ -	$ -	$ -	$ -
Property tax, farm share	$ -	$ -	$ -	$ -
Rents paid—land, buildings	$ -	$ -	$ -	$ -
Rents paid—equipment, livestock	$ -	$ -	$ -	$ -
Utilities, farm share	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Total Fixed Expenses	**$ -**	**$ -**	**$ -**	**$ -**
TOTAL CASH EXPENSES	**$ 22,500**	**$ 26,710**	**$ 30,835**	**$ 31,660**
RECEIPTS MINUS EXPENSES	**$ (22,500)**	**$ (17,710)**	**$ (10,585)**	**$ (9,160)**
Plus CAPITAL CONTRIBUTIONS				
grants	$ -	$ -	$ -	$ -
loans	$ -	$ -	$ -	$ -
off-farm income	$ -	$ -	$ -	$ -
other	$ -	$ -	$ -	$ -
Plus CAPITAL SALES				
equipment	$ -	$ -	$ -	$ -
Less CAPITAL EXPENSE				
2 chest freezers		$ 2,000	$ -	$ -
mechanical harvester	$ -	$ -	$ -	$ -
sorter	$ -	$ -	$ -	$ -
oast	$ -	$ 5,000	$ -	$ -
one acre hop yard	$ 12,000	$ -	$ -	$ -
Total Capital Expense	$ 12,000	$ 7,000	$ -	$ -
Less DEBT SERVICE				
List Loan Principal Payments				
Plus STARTING CASH	$ -	$ (34,500)	$ (59,210)	$ (69,795)
NET RETAINED CASH EARNINGS (DEFICIT)	**$ (34,500)**	**$ (59,210)**	**$ (69,795)**	**$ (78,955)**
- Income Taxes				
Less Family Living	$ -	$ -	$ -	$ -
- Capital Reserve				
NET AFTER CAPITAL RESERVE, FAMILY LIVING AND INCOME TAX ALLOCATION	$ (34,500)	$ (59,210)	$ (69,795)	$ (78,955)

Courtesy: Vermont Farm Viability Enhancement Program

CASH FLOW PROJECTION

Scenario: Selling Pelletized Direct To Brewer Using Atlantic Hops Processing Services

Optimized Manual Harvesting, Harvesting Only Top 1/3 of Bine

	Projection	Projection	Projection	Projection
Production Information	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Number of acres	1	1	1	1
Production Level	0%	40%	90%	**100%**
Quantity of dried hops sold (lbs/year)	0	600	1350	1500
Pounds of dried hops per acre per year	0	600	1350	1500
Average price per dried pound needed to break even	**12.51**	**14.81**	**17.56**	**18.11**
Projected Sale Price	**15.00**	**15.00**	**15.00**	**15.00**
Return on Investment in Years	**(4)**			
Annual Net Income at 100% Production	**$ (4,660)**			
Cash Receipts				
Hops Sold	$ -	$ 9,000	$ 20,250	$ 22,500
TOTAL CASH RECEIPTS	**$ -**	**$ 9,000**	**$ 20,250**	**$ 22,500**
Cash Expenses				
Variable Expenses:				
Chemicals	$ -	$ -	$ -	$ -
Conservation expense	$ -	$ -	$ -	$ -
Custom hire	$ -	$ -	$ -	$ -
Trellising supplies- twine, w clips, etc.	$ -	$ -	$ -	$ -
Fertilizer	$ -	$ -	$ -	$ -
Fuel and oil	$ -	$ -	$ -	$ -
Labor hired (incl. FICA, workers comp, etc.)	$ -	$ -	$ -	$ -
Repairs, maintenance	$ -	$ -	$ -	$ -
Electricity for drying				
Supplies	$ -	$ -	$ -	$ -
Sub total Variable Expenses	**$ 2,500**	**$ 2,500**	**$ 2,500**	**$ 2,500**
Labor	$ -	$ -	$ -	$ -
Spring/Summer Labor 500 hrs/acre @ $10/hr	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Harvest Labor harvesting only top 1/3 of the bine 35 min/lb1,500lbs/acre @ $10/hr	$ 10,500	$ 10,500	$ 10,500	$ 10,500
Sub total Labor	**$ 15,500**	**$ 15,500**	**$ 15,500**	**$ 15,500**
Other Variable Expenses				
Freight/Shipping estimating 2,000lbs NMFC classification 100	$ 610	$ 610	$ 610	$ 610
Chemical Analysis	$ 150	$ 150	$ 150	$ 150
Processing (pelletizing)	$ -	$ 3,300	$ 7,425	$ 8,250
Packaging	$ -	$ -	$ -	$ -
Climate Controlled Storage		$ 50	$ 50	$ 50
Sales & Marketing		$ 100	$ 100	$ 100
Other:	$ -	$ -	$ -	$ -
Sub total Other Variable Expenses	**$ 760**	**$ 4,210**	**$ 8,335**	**$ 9,160**
Total Variable Expenses:	**$ 18,760**	**$ 22,210**	**$ 26,335**	**$ 27,160**
Fixed Expenses:				
Auto & truck	$ -	$ -	$ -	$ -
Interest, farm share	$ -	$ -	$ -	$ -
Insurance, farm share	$ -	$ -	$ -	$ -
Property tax, farm share	$ -	$ -	$ -	$ -
Rents paid—land, buildings	$ -	$ -	$ -	$ -
Rents paid—equipment, livestock	$ -	$ -	$ -	$ -
Utilities, farm share	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Total Fixed Expenses	**$ -**	**$ -**	**$ -**	**$ -**
TOTAL CASH EXPENSES	**$ 18,760**	**$ 22,210**	**$ 26,335**	**$ 27,160**
RECEIPTS MINUS EXPENSES	**$ (18,760)**	**$ (13,210)**	**$ (6,085)**	**$ (4,660)**
Plus CAPITAL CONTRIBUTIONS				
grants	$ -	$ -	$ -	$ -
loans	$ -	$ -	$ -	$ -
off-farm income	$ -	$ -	$ -	$ -
other	$ -	$ -	$ -	$ -
Plus CAPITAL SALES				
equipment	$ -	$ -	$ -	$ -
Less CAPITAL EXPENSE				
2 chest freezers		$ 2,000	$ -	$ -
mechanical harvester		$ -	$ -	$ -
sorter		$ -	$ -	$ -
oast		$ 5,000	$ -	$ -
one acre hop yard	$ 12,000	$ -	$ -	$ -
Total Capital Expense	$ 12,000	$ 7,000	$ -	$ -
Less DEBT SERVICE				
List Loan Principal Payments				
Plus STARTING CASH	$ -	$ (30,760)	$ (52,109)	$ (60,693)
NET RETAINED CASH EARNINGS (DEFICIT)	**$ (30,760)**	**$ (50,970)**	**$ (58,194)**	**$ (65,353)**
- Income Taxes (estimate at 33%)		$ 1,139	$ 2,500	$ 2,772
Less Family Living	$ -	$ -	$ -	$ -
- Capital Reserve				
NET AFTER CAPITAL RESERVE, FAMILY LIVING AND INCOME TAX ALLOCATION	$ (30,760)	$ (52,109)	$ (60,693)	$ (68,125)

Courtesy: Vermont Farm Viability Enhancement Program

CASH FLOW PROJECTION

Scenario: Selling Pelletized Direct To Brewer Using Atlantic Hops Processing Services

Optimized Manual Harvesting, Harvesting Only Top 1/3 of Bine, Manual Stripping & Sorting

	Projection	Projection	Projection	Projection
Production Information	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Number of acres	1	1	1	1
Production Level	0%	40%	90%	**100%**
Quantity of dried hops sold (lbs/year)	0	600	1350	1500
Pounds of dried hops per acre per year	0	600	1350	1500
Average price per dried pound needed to break even	**8.84**	**11.14**	**13.89**	**14.44**
Projected Sale Price	**15.00**	**15.00**	**15.00**	**15.00**
Return on Investment in Years	**29**			
Annual Net Income at 100% Production	**$ 840**			
Cash Receipts				
Hops Sold	$ -	$ 9,000	$ 20,250	$ 22,500
TOTAL CASH RECEIPTS	**$ -**	**$ 9,000**	**$ 20,250**	**$ 22,500**
Cash Expenses				
Variable Expenses:				
Chemicals	$ -	$ -	$ -	$ -
Conservation expense	$ -	$ -	$ -	$ -
Custom hire	$ -	$ -	$ -	$ -
Trellising supplies- twine, w clips, etc.	$ -	$ -	$ -	$ -
Fertilizer	$ -	$ -	$ -	$ -
Fuel and oil	$ -	$ -	$ -	$ -
Labor hired (incl. FICA, workers comp, etc.)	$ -	$ -	$ -	$ -
Repairs, maintenance	$ -	$ -	$ -	$ -
Electricity for drying				
Supplies	$ -	$ -	$ -	$ -
Sub total Variable Expenses	**$ 2,500**	**$ 2,500**	**$ 2,500**	**$ 2,500**
Labor	$ -	$ -	$ -	$ -
Spring/Summer Labor 500 hrs/acre @ $10/hr	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Harvest Labor harvesting top 1/3 of the bine, stripping and sorting 20 min/lb 1,500lbs/acre (500 hrs) @ $10/hr	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Sub total Labor	**$ 10,000**	**$ 10,000**	**$ 10,000**	**$ 10,000**
Other Variable Expenses				
Freight/Shipping estimating 2,000lbs NMFC classification 100	$ 610	$ 610	$ 610	$ 610
Chemical Analysis	$ 150	$ 150	$ 150	$ 150
Processing (pelletizing)	$ -	$ 3,300	$ 7,425	$ 8,250
Packaging		$ -	$ -	$ -
Climate Controlled Storage		$ 50	$ 50	$ 50
Sales & Marketing		$ 100	$ 100	$ 100
Other:	$ -	$ -	$ -	$ -
Sub total Other Variable Expenses	**$ 760**	**$ 4,210**	**$ 8,335**	**$ 9,160**
Total Variable Expenses:	**$ 13,260**	**$ 16,710**	**$ 20,835**	**$ 21,660**
Fixed Expenses:				
Auto & truck	$ -	$ -	$ -	$ -
Interest, farm share	$ -	$ -	$ -	$ -
Insurance, farm share	$ -	$ -	$ -	$ -
Property tax, farm share	$ -	$ -	$ -	$ -
Rents paid—land, buildings	$ -	$ -	$ -	$ -
Rents paid—equipment, livestock	$ -	$ -	$ -	$ -
Utilities, farm share	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Total Fixed Expenses	**$ -**	**$ -**	**$ -**	**$ -**
TOTAL CASH EXPENSES	**$ 13,260**	**$ 16,710**	**$ 20,835**	**$ 21,660**
RECEIPTS MINUS EXPENSES	**$ (13,260)**	**$ (7,710)**	**$ (585)**	**$ 840**
Plus CAPITAL CONTRIBUTIONS				
grants	$ -	$ -	$ -	$ -
loans	$ -	$ -	$ -	$ -
off-farm income	$ -	$ -	$ -	$ -
other	$ -	$ -	$ -	$ -
Plus CAPITAL SALES				
equipment	$ -	$ -	$ -	$ -
Less CAPITAL EXPENSE				
2 chest freezers		$ 2,000	$ -	$ -
mechanical harvester		$ -	$ -	$ -
sorter	$ -	$ -	$ 5,000	$ -
oast	$ -	$ 5,000	$ -	$ -
one acre hop yard	$ 12,000	$ -	$ -	$ -
Total Capital Expense	$ 12,000	$ 7,000	$ 5,000	$ -
Less DEBT SERVICE				
List Loan Principal Payments				
Plus STARTING CASH	$ -	$ (25,260)	$ (41,109)	$ (49,193)
NET RETAINED CASH EARNINGS (DEFICIT)	**$ (25,260)**	**$ (39,970)**	**$ (46,694)**	**$ (48,353)**
- Income Taxes (estimate at 33%)		$ 1,139	$ 2,500	$ 2,772
Less Family Living	$ -	$ -	$ -	$ -
- Capital Reserve				
NET AFTER CAPITAL RESERVE, FAMILY LIVING AND INCOME TAX ALLOCATION	$ (25,260)	$ (41,109)	$ (49,193)	$ (51,125)

Courtesy: Vermont Farm Viability Enhancement Program

CASH FLOW PROJECTION

Scenario: Selling Pelletized Direct To Brewer Using Atlantic Hops Processing Services

Optimized Manual Harvesting, Harvesting Only Top 1/3 of Bine, Mechanized Stripping, Picking, & Sorting

	Projection	Projection	Projection	Projection
Production Information	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Number of acres	1	1	1	1
Production Level	0%	40%	90%	**100%**
Quantity of dried hops sold (lbs/year)	0	600	1350	1500
Pounds of dried hops per acre per year	0	600	1350	1500
Average price per dried pound needed to break even	**6.01**	**8.31**	**11.06**	**11.61**
Projected Sale Price	**15.00**	**15.00**	**15.00**	**15.00**
Return on Investment in Years	**6**			
Annual Net Income at 100% Production	**$ 5,090**			
Cash Receipts				
Hops Sold	$ -	$ 9,000	$ 20,250	$ 22,500
TOTAL CASH RECEIPTS	**$ -**	**$ 9,000**	**$ 20,250**	**$ 22,500**
Cash Expenses				
Variable Expenses:				
Chemicals	$ -	$ -	$ -	$ -
Conservation expense	$ -	$ -	$ -	$ -
Custom hire	$ -	$ -	$ -	$ -
Trellising supplies- twine, w clips, etc.	$ -	$ -	$ -	$ -
Fertilizer	$ -	$ -	$ -	$ -
Fuel and oil	$ -	$ -	$ -	$ -
Labor hired (incl. FICA, workers comp, etc.)	$ -	$ -	$ -	$ -
Repairs, maintenance	$ -	$ -	$ -	$ -
Electricity for drying				
Supplies	$ -	$ -	$ -	$ -
Sub total Variable Expenses	**$ 2,500**	**$ 2,500**	**$ 2,500**	**$ 2,500**
Labor	$ -	$ -	$ -	$ -
Spring/Summer Labor 500 hrs/acre @ $10/hr	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Harvest Labor harvesting only top 1/3 of the bine 3 min/lb- 1 min to pick, 2 min to sort 1,500lbs/acre (75 hrs) @ $10/hr	$ 750	$ 750	$ 750	$ 750
Sub total Labor	**$ 5,750**	**$ 5,750**	**$ 5,750**	**$ 5,750**
Other Variable Expenses				
Freight/Shipping estimating 2,000lbs NMFC classification 100	$ 610	$ 610	$ 610	$ 610
Chemical Analysis	$ 150	$ 150	$ 150	$ 150
Processing (pelletizing)	$ -	$ 3,300	$ 7,425	$ 8,250
Packaging	$ -	$ -	$ -	$ -
Climate Controlled Storage		$ 50	$ 50	$ 50
Sales & Marketing		$ 100	$ 100	$ 100
Other:	$ -	$ -	$ -	$ -
Sub total Other Variable Expenses	**$ 760**	**$ 4,210**	**$ 8,335**	**$ 9,160**
Total Variable Expenses:	**$ 9,010**	**$ 12,460**	**$ 16,585**	**$ 17,410**
Fixed Expenses:				
Auto & truck	$ -	$ -	$ -	$ -
Interest, farm share	$ -	$ -	$ -	$ -
Insurance, farm share	$ -	$ -	$ -	$ -
Property tax, farm share	$ -	$ -	$ -	$ -
Rents paid—land, buildings	$ -	$ -	$ -	$ -
Rents paid—equipment, livestock	$ -	$ -	$ -	$ -
Utilities, farm share	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Total Fixed Expenses	**$ -**	**$ -**	**$ -**	**$ -**
TOTAL CASH EXPENSES	**$ 9,010**	**$ 12,460**	**$ 16,585**	**$ 17,410**
RECEIPTS MINUS EXPENSES	**$ (9,010)**	**$ (3,460)**	**$ 3,665**	**$ 5,090**
Plus CAPITAL CONTRIBUTIONS				
grants	$ -	$ -	$ -	$ -
loans	$ -	$ -	$ -	$ -
off-farm income	$ -	$ -	$ -	$ -
other	$ -	$ -	$ -	$ -
Plus CAPITAL SALES				
equipment	$ -	$ -	$ -	$ -
Less CAPITAL EXPENSE				
2 chest freezers		$ 2,000	$ -	$ -
mechanical harvester		$ -	$ 5,000	$ -
sorter		$ -	$ 5,000	$ -
oast		$ 5,000	$ -	$ -
one acre hop yard	$ 12,000	$ -	$ -	$ -
Total Capital Expense	$ 12,000	$ 7,000	$ 10,000	$ -
Less DEBT SERVICE				
List Loan Principal Payments				
Plus STARTING CASH	$ -	$ (21,010)	$ (32,609)	$ (41,443)
NET RETAINED CASH EARNINGS (DEFICIT)	**$ (21,010)**	**$ (31,470)**	**$ (38,944)**	**$ (36,353)**
- Income Taxes (estimate at 33%)		$ 1,139	$ 2,500	$ 2,772
Less Family Living	$ -	$ -	$ -	$ -
- Capital Reserve				
NET AFTER CAPITAL RESERVE, FAMILY LIVING AND INCOME TAX ALLOCATION	$ (21,010)	$ (32,609)	$ (41,443)	$ (39,125)

Scenario 4: Grower sells pelletized hops direct to brewer, using Do-It-Yourself pelletizing

Cash flow 1: demonstrating cash flow if no efficiencies in production are utilized

Cash flow 2: demonstrating cash flow if grower harvests only top 1/3 of the bine

Cash flow 3: demonstrating cash flow if grower harvests only top 1/3 of the bine, and manually strips and sorts

Cash flow 4: demonstrating cash flow if grower harvests only top 1/3 of the bine, and mechanically strips and sorts

Courtesy: Vermont Farm Viability Enhancement Program

CASH FLOW PROJECTION

Scenario: Selling Direct to Brewer D-I-Y Pelletized

No Optimization in Harvesting

	Projection	Projection	Projection	Projection
Production Information	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Number of acres	1	1	1	1
Production Level	0%	40%	90%	100%
Quantity of dried hops sold (lbs/year)	0	600	1350	1500
Pounds of dried hops per acre per year	0	600	1350	1500
Average price per dried pound needed to break even	**15.51**	**15.89**	**15.89**	**15.89**
Projected Sale Price to Brewers	**15.00**	**15.00**	**15.00**	**15.00**
Return on Investment in Years	**(35.15)**			
Annual Net Income at 100% Production	**$ (1,340)**			
Cash Receipts				
Hops Sold	$ -	$ 9,000	$ 20,250	$ 22,500
TOTAL CASH RECEIPTS	**$ -**	**$ 9,000**	**$ 20,250**	**$ 22,500**
Cash Expenses				
Variable Expenses:				
Chemicals	$ -	$ -	$ -	$ -
Conservation expense	$ -	$ -	$ -	$ -
Custom hire	$ -	$ -	$ -	$ -
Trellising supplies- twine, w clips, etc.	$ -	$ -	$ -	$ -
Fertilizer	$ -	$ -	$ -	$ -
Fuel and oil	$ -	$ -	$ -	$ -
Labor hired (incl. FICA, workers comp, etc.)	$ -	$ -	$ -	$ -
Repairs, maintenance	$ -	$ -	$ -	$ -
Electricity for drying				
Supplies	$ -	$ -	$ -	$ -
Sub total Variable Expenses	**$ 2,500**	**$ 2,500**	**$ 2,500**	**$ 2,500**
Labor	$ -	$ -	$ -	$ -
Spring/Summer Labor 500 hrs/acre @ $10/hr	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Harvest Labor 1 hr/dried lb 1,500hrs @ $10/hr	$ 15,000	$ 15,000	$ 15,000	$ 15,000
Sub total Labor	**$ 20,000**	**$ 20,000**	**$ 20,000**	**$ 20,000**
Other Variable Expenses				
Freight/Shipping estimating 2,000lbs NMFC classification 100	$ 610	$ 610	$ 610	$ 610
Chemical Analysis	$ 150	$ 150	$ 150	$ 150
Processing (pelletizing)	$ -	$ 100	$ 100	$ 100
Packaging		$ 330	$ 330	$ 330
Climate Controlled Storage		$ 50	$ 50	$ 50
Sales & Marketing		$ 100	$ 100	$ 100
Other:	$ -	$ -	$ -	$ -
Sub total Other Variable Expenses	**$ 760**	**$ 1,340**	**$ 1,340**	**$ 1,340**
Total Variable Expenses:	**$ 23,260**	**$ 23,840**	**$ 23,840**	**$ 23,840**
Fixed Expenses:				
Auto & truck	$ -	$ -	$ -	$ -
Interest, farm share	$ -	$ -	$ -	$ -
Insurance, farm share	$ -	$ -	$ -	$ -
Property tax, farm share	$ -	$ -	$ -	$ -
Rents paid—land, buildings	$ -	$ -	$ -	$ -
Rents paid—equipment, livestock	$ -	$ -	$ -	$ -
Utilities, farm share	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Total Fixed Expenses	**$ -**	**$ -**	**$ -**	**$ -**
TOTAL CASH EXPENSES	**$ 23,260**	**$ 23,840**	**$ 23,840**	**$ 23,840**
RECEIPTS MINUS EXPENSES	**$ (23,260)**	**$ (14,840)**	**$ (3,590)**	**$ (1,340)**
Plus CAPITAL CONTRIBUTIONS				
grants	$ -	$ -	$ -	$ -
loans	$ -	$ -	$ -	$ -
off-farm income	$ -	$ -	$ -	$ -
other	$ -	$ -	$ -	$ -
Plus CAPITAL SALES				
equipment	$ -	$ -	$ -	$ -
Less CAPITAL EXPENSE				
2 chest freezers	$ -	$ 2,000	$ -	$ -
vacuum, nitrogen flush sealer	$ -	$ 24,000	$ -	$ -
pellet mill	$ -	$ 2,400	$ -	$ -
hammer mill	$ -	$ 1,700	$ -	$ -
mechanical harvester	$ -	$ -	$ -	$ -
sorter	$ -	$ -	$ -	$ -
oast	$ -	$ 5,000	$ -	$ -
one acre hop yard	$ 12,000	$ -	$ -	$ -
Total Capital Expense	$ 12,000	$ 35,100	$ -	$ -
Less DEBT SERVICE				
List Loan Principal Payments				
Plus STARTING CASH	$ -	$ (35,260)	$ (85,391)	$ (89,173)
NET RETAINED CASH EARNINGS (DEFICIT)	**$ (35,260)**	**$ (85,200)**	**$ (88,981)**	**$ (90,513)**
- Income Taxes (estimate at 33%)		$ 191	$ 191	$ 191
Less Family Living	$ -	$ -	$ -	$ -
- Capital Reserve				
NET AFTER CAPITAL RESERVE, FAMILY LIVING AND INCOME TAX ALLOCATION	$ (35,260)	$ (85,391)	$ (89,173)	$ (90,704)

Courtesy: Vermont Farm Viability Enhancement Program

CASH FLOW PROJECTION

Scenario: Selling Direct to Brewer D-I-Y Pelletized

Optimized Manual Harvesting, Harvesting Only Top 1/3 of Bine

	Projection	Projection	Projection	Projection
Production Information	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Number of acres	1	1	1	1
Production Level	0%	40%	90%	100%
Quantity of dried hops sold (lbs/year)	0	600	1350	1500
Pounds of dried hops per acre per year	0	600	1350	1500
Average price per dried pound needed to break even	**12.51**	**12.89**	**12.89**	**12.89**
Projected Sale Price to Brewers	**15.00**	**15.00**	**15.00**	**15.00**
Return on Investment in Years	**14.91**			
Annual Net Income at 100% Production	**$ 3,160**			
Cash Receipts				
Hops Sold	$ -	$ 9,000	$ 20,250	$ 22,500
TOTAL CASH RECEIPTS	**$ -**	**$ 9,000**	**$ 20,250**	**$ 22,500**
Cash Expenses				
Variable Expenses:				
Chemicals	$ -	$ -	$ -	$ -
Conservation expense	$ -	$ -	$ -	$ -
Custom hire	$ -	$ -	$ -	$ -
Trellising supplies- twine, w clips, etc.	$ -	$ -	$ -	$ -
Fertilizer	$ -	$ -	$ -	$ -
Fuel and oil	$ -	$ -	$ -	$ -
Labor hired (incl. FICA, workers comp, etc.)	$ -	$ -	$ -	$ -
Repairs, maintenance	$ -	$ -	$ -	$ -
Electricity for drying				
Supplies	$ -	$ -	$ -	$ -
Sub total Variable Expenses	**$ 2,500**	**$ 2,500**	**$ 2,500**	**$ 2,500**
Labor	$ -	$ -	$ -	$ -
Spring/Summer Labor 500 hrs/acre @ $10/hr	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Harvest Labor harvesting only top 1/3 of the bine 35 min/lb1,500lbs/acre @ $10/hr	$ 10,500	$ 10,500	$ 10,500	$ 10,500
Sub total Labor	**$ 15,500**	**$ 15,500**	**$ 15,500**	**$ 15,500**
Other Variable Expenses				
Freight/Shipping estimating 2,000lbs NMFC classification 100	$ 610	$ 610	$ 610	$ 610
Chemical Analysis	$ 150	$ 150	$ 150	$ 150
Processing (pelletizing)	$ -	$ 100	$ 100	$ 100
Packaging		$ 330	$ 330	$ 330
Climate Controlled Storage		$ 50	$ 50	$ 50
Sales & Marketing		$ 100	$ 100	$ 100
Other:	$ -	$ -	$ -	$ -
Sub total Other Variable Expenses	**$ 760**	**$ 1,340**	**$ 1,340**	**$ 1,340**
Total Variable Expenses:	**$ 18,760**	**$ 19,340**	**$ 19,340**	**$ 19,340**
Fixed Expenses:				
Auto & truck	$ -	$ -	$ -	$ -
Interest, farm share	$ -	$ -	$ -	$ -
Insurance, farm share	$ -	$ -	$ -	$ -
Property tax, farm share	$ -	$ -	$ -	$ -
Rents paid—land, buildings	$ -	$ -	$ -	$ -
Rents paid—equipment, livestock	$ -	$ -	$ -	$ -
Utilities, farm share	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Total Fixed Expenses	**$ -**	**$ -**	**$ -**	**$ -**
TOTAL CASH EXPENSES	**$ 18,760**	**$ 19,340**	**$ 19,340**	**$ 19,340**
RECEIPTS MINUS EXPENSES	**$ (18,760)**	**$ (10,340)**	**$ 910**	**$ 3,160**
Plus CAPITAL CONTRIBUTIONS				
grants	$ -	$ -	$ -	$ -
loans	$ -	$ -	$ -	$ -
off-farm income	$ -	$ -	$ -	$ -
other	$ -	$ -	$ -	$ -
Plus CAPITAL SALES				
equipment	$ -	$ -	$ -	$ -
Less CAPITAL EXPENSE				
2 chest freezers	$ -	$ 2,000	$ -	$ -
vacuum, nitrogen flush sealer	$ -	$ 24,000	$ -	$ -
pellet mill	$ -	$ 2,400	$ -	$ -
hammer mill	$ -	$ 1,700	$ -	$ -
mechanical harvester	$ -	$ -	$ -	$ -
sorter	$ -	$ -	$ -	$ -
oast	$ -	$ 5,000	$ -	$ -
one acre hop yard	$ 12,000	$ -	$ -	$ -
Total Capital Expense	$ 12,000	$ 35,100	$ -	$ -
Less DEBT SERVICE				
List Loan Principal Payments				
Plus STARTING CASH	$ -	$ (30,760)	$ (76,391)	$ (75,673)
NET RETAINED CASH EARNINGS (DEFICIT)	**$ (30,760)**	**$ (76,200)**	**$ (75,481)**	**$ (72,513)**
- Income Taxes (estimate at 33%)		$ 191	$ 191	$ 191
Less Family Living	$ -	$ -	$ -	$ -
- Capital Reserve				
NET AFTER CAPITAL RESERVE, FAMILY LIVING AND INCOME TAX ALLOCATION	$ (30,760)	$ (76,391)	$ (75,673)	$ (72,704)

Courtesy: Vermont Farm Viability Enhancement Program

CASH FLOW PROJECTION

Scenario: Selling Direct to Brewer D-I-Y Pelletized

Optimized Manual Harvesting, Harvesting Only Top 1/3 of Bine, Manual Stripping & Sorting

	Projection	Projection	Projection	Projection
Production Information	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Number of acres	1	1	1	1
Production Level	0%	40%	90%	100%
Quantity of dried hops sold (lbs/year)	0	600	1350	1500
Pounds of dried hops per acre per year	0	600	1350	1500
Average price per dried pound needed to break even	**8.84**	**9.23**	**9.23**	**9.23**
Projected Sale Price to Brewers	**15.00**	**15.00**	**15.00**	**15.00**
Return on Investment in Years	**5.44**			
Annual Net Income at 100% Production	**$ 8,660**			
Cash Receipts				
Hops Sold	$ -	$ 9,000	$ 20,250	$ 22,500
TOTAL CASH RECEIPTS	**$ -**	**$ 9,000**	**$ 20,250**	**$ 22,500**
Cash Expenses				
Variable Expenses:				
Chemicals	$ -	$ -	$ -	$ -
Conservation expense	$ -	$ -	$ -	$ -
Custom hire	$ -	$ -	$ -	$ -
Trellising supplies- twine, w clips, etc.	$ -	$ -	$ -	$ -
Fertilizer	$ -	$ -	$ -	$ -
Fuel and oil	$ -	$ -	$ -	$ -
Labor hired (incl. FICA, workers comp, etc.)	$ -	$ -	$ -	$ -
Repairs, maintenance	$ -	$ -	$ -	$ -
Electricity for drying				
Supplies	$ -	$ -	$ -	$ -
Sub total Variable Expenses	**$ 2,500**	**$ 2,500**	**$ 2,500**	**$ 2,500**
Labor	$ -	$ -	$ -	$ -
Spring/Summer Labor 500 hrs/acre @ $10/hr	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Harvest Labor harvesting top 1/3 of the bine, stripping and sorting 20 min/lb 1,500lbs/acre (500 hrs) @ $10/hr	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Sub total Labor	**$ 10,000**	**$ 10,000**	**$ 10,000**	**$ 10,000**
Other Variable Expenses				
Freight/Shipping estimating 2,000lbs NMFC classification 100	$ 610	$ 610	$ 610	$ 610
Chemical Analysis	$ 150	$ 150	$ 150	$ 150
Processing (pelletizing)	$ -	$ 100	$ 100	$ 100
Packaging		$ 330	$ 330	$ 330
Climate Controlled Storage		$ 50	$ 50	$ 50
Sales & Marketing		$ 100	$ 100	$ 100
Other:	$ -	$ -	$ -	$ -
Sub total Other Variable Expenses	**$ 760**	**$ 1,340**	**$ 1,340**	**$ 1,340**
Total Variable Expenses:	**$ 13,260**	**$ 13,840**	**$ 13,840**	**$ 13,840**
Fixed Expenses:				
Auto & truck	$ -	$ -	$ -	$ -
Interest, farm share	$ -	$ -	$ -	$ -
Insurance, farm share	$ -	$ -	$ -	$ -
Property tax, farm share	$ -	$ -	$ -	$ -
Rents paid—land, buildings	$ -	$ -	$ -	$ -
Rents paid—equipment, livestock	$ -	$ -	$ -	$ -
Utilities, farm share	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Total Fixed Expenses	**$ -**	**$ -**	**$ -**	**$ -**
TOTAL CASH EXPENSES	**$ 13,260**	**$ 13,840**	**$ 13,840**	**$ 13,840**
RECEIPTS MINUS EXPENSES	**$ (13,260)**	**$ (4,840)**	**$ 6,410**	**$ 8,660**
Plus CAPITAL CONTRIBUTIONS				
grants	$ -	$ -	$ -	$ -
loans	$ -	$ -	$ -	$ -
off-farm income	$ -	$ -	$ -	$ -
other	$ -	$ -	$ -	$ -
Plus CAPITAL SALES				
equipment	$ -	$ -	$ -	$ -
Less CAPITAL EXPENSE				
2 chest freezers	$ -	$ 2,000	$ -	$ -
vacuum, nitrogen flush sealer	$ -	$ 24,000	$ -	$ -
pellet mill	$ -	$ 2,400	$ -	$ -
hammer mill	$ -	$ 1,700	$ -	$ -
mechanical harvester	$ -	$ -	$ -	$ -
sorter	$ -	$ -	$ -	$ -
oast	$ -	$ 5,000	$ -	$ -
one acre hop yard	$ 12,000	$ -	$ -	$ -
Total Capital Expense	$ 12,000	$ 35,100	$ -	$ -
Less DEBT SERVICE				
List Loan Principal Payments				
Plus STARTING CASH	$ -	$ (25,260)	$ (65,391)	$ (59,173)
NET RETAINED CASH EARNINGS (DEFICIT)	**$ (25,260)**	**$ (65,200)**	**$ (58,981)**	**$ (50,513)**
- Income Taxes (estimate at 33%)		$ 191	$ 191	$ 191
Less Family Living	$ -	$ -	$ -	$ -
- Capital Reserve				
NET AFTER CAPITAL RESERVE, FAMILY LIVING AND INCOME TAX ALLOCATION	$ (25,260)	$ (65,391)	$ (59,173)	$ (50,704)

Courtesy: Vermont Farm Viability Enhancement Program

CASH FLOW PROJECTION

Scenario: Selling Direct To Brewer D-I-Y Pelletized

Optimized Manual Harvesting, Harvesting Only Top 1/3 of Bine, Mechanized Stripping, Picking, & Sorting

	Projection	Projection	Projection	Projection
Production Information	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Number of acres	1	1	1	1
Production Level	0%	40%	90%	**100%**
Quantity of dried hops sold (lbs/year)	0	600	1350	1500
Pounds of dried hops per acre per year	0	600	1350	1500
Average price per dried pound needed to break even	**6.01**	**6.39**	**6.39**	**6.39**
Projected Sale Price to Brewers	**15.00**	**15.00**	**15.00**	**15.00**
Return on Investment in Years	**4**			
Annual Net Income at 100% Production	**$ 12,910**			
Cash Receipts				
Hops Sold	$ -	$ 9,000	$ 20,250	$ 22,500
TOTAL CASH RECEIPTS	**$ -**	**$ 9,000**	**$ 20,250**	**$ 22,500**
Cash Expenses				
Variable Expenses:				
Chemicals	$ -	$ -	$ -	$ -
Conservation expense	$ -	$ -	$ -	$ -
Custom hire	$ -	$ -	$ -	$ -
Trellising supplies- twine, w clips, etc.	$ -	$ -	$ -	$ -
Fertilizer	$ -	$ -	$ -	$ -
Fuel and oil	$ -	$ -	$ -	$ -
Labor hired (incl. FICA, workers comp, etc.)	$ -	$ -	$ -	$ -
Repairs, maintenance	$ -	$ -	$ -	$ -
Electricity for drying				
Supplies	$ -	$ -	$ -	$ -
Sub total Variable Expenses	**$ 2,500**	**$ 2,500**	**$ 2,500**	**$ 2,500**
Labor	$ -	$ -	$ -	$ -
Spring/Summer Labor 500 hrs/acre @ $10/hr	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Harvest Labor harvesting only top 1/3 of the bine 3 min/lb- 1 min to pick, 2 min to sort 1,500lbs/acre (75 hrs) @ $10/hr	$ 750	$ 750	$ 750	$ 750
Sub total Labor	**$ 5,750**	**$ 5,750**	**$ 5,750**	**$ 5,750**
Other Variable Expenses				
Freight/Shipping estimating 2,000lbs NMFC classification 100	$ 610	$ 610	$ 610	$ 610
Chemical Analysis	$ 150	$ 150	$ 150	$ 150
Processing (pelletizing)	$ -	$ 100	$ 100	$ 100
Packaging		$ 330	$ 330	$ 330
Climate Controlled Storage		$ 50	$ 50	$ 50
Sales & Marketing		$ 100	$ 100	$ 100
Other:	$ -	$ -	$ -	$ -
Sub total Other Variable Expenses	**$ 760**	**$ 1,340**	**$ 1,340**	**$ 1,340**
Total Variable Expenses:	**$ 9,010**	**$ 9,590**	**$ 9,590**	**$ 9,590**
Fixed Expenses:				
Auto & truck	$ -	$ -	$ -	$ -
Interest, farm share	$ -	$ -	$ -	$ -
Insurance, farm share	$ -	$ -	$ -	$ -
Property tax, farm share	$ -	$ -	$ -	$ -
Rents paid—land, buildings	$ -	$ -	$ -	$ -
Rents paid—equipment, livestock	$ -	$ -	$ -	$ -
Utilities, farm share	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -
Total Fixed Expenses	**$ -**	**$ -**	**$ -**	**$ -**
TOTAL CASH EXPENSES	**$ 9,010**	**$ 9,590**	**$ 9,590**	**$ 9,590**
RECEIPTS MINUS EXPENSES	**$ (9,010)**	**$ (590)**	**$ 10,660**	**$ 12,910**
Plus CAPITAL CONTRIBUTIONS				
grants	$ -	$ -	$ -	$ -
loans	$ -	$ -	$ -	$ -
off-farm income	$ -	$ -	$ -	$ -
other	$ -	$ -	$ -	$ -
Plus CAPITAL SALES				
equipment	$ -	$ -	$ -	$ -
Less CAPITAL EXPENSE				
2 chest freezers	$ -	$ 2,000	$ -	$ -
vacuum, nitrogen flush sealer	$ -	$ 24,000	$ -	$ -
pellet mill	$ -	$ 2,400	$ -	$ -
hammer mill	$ -	$ 1,700	$ -	$ -
mechanical harvester	$ -	$ -	$ 5,000	$ -
sorter	$ -	$ -	$ 5,000	$ -
oast	$ -	$ 5,000	$ -	$ -
one acre hop yard	$ 12,000	$ -	$ -	$ -
Total Capital Expense	$ 12,000	$ 35,100	$ 10,000	$ -
Less DEBT SERVICE				
List Loan Principal Payments				
Plus STARTING CASH	$ -	$ (21,010)	$ (56,891)	$ (56,423)
NET RETAINED CASH EARNINGS (DEFICIT)	**$ (21,010)**	**$ (56,700)**	**$ (56,231)**	**$ (43,513)**
- Income Taxes (estimate at 33%)		$ 191	$ 191	$ 191
Less Family Living	$ -	$ -	$ -	$ -
- Capital Reserve				
NET AFTER CAPITAL RESERVE, FAMILY LIVING AND INCOME TAX ALLOCATION	$ (21,010)	$ (56,891)	$ (56,423)	$ (43,704)

Appendix E - Sample Hopyard Designs

1. ***Hopyard Design*** from Crannóg Ales, Left Fields
   Crannog Ales Hops Update, 2007
   Rebecca Kneen

   Hopyard size: 1 acre, 209'/side

	Plants	***Poles***	***Beds***	***Cable main***	***Cable secondary***
spacing (foot)	3.5	25	15	25	3.5
per bed or row (#)	60	9			
Total ea	900	81		3,762	12,540

Obviously, considerable variation can be expected with clever use of scrounged materials or found materials.

Annual Activities
• Crowning or digging rhizomes
• Irrigation maintenance
• Topdressing with compost
• Mulching plants
• Stringing plants
• Cover crop/green manure maintenance
• Inspections/cleanup and IPM
• Harvest & packaging

All of these activities take person hours and machinery of some description, whether it's your pocketknife or more complex tools. The major activities take place in early spring, as soon as the ground is open, and in the fall at harvest. We find that it takes 2-5 person days to dig rhizomes over 1/2 acre – but if you are only root pruning rather than digging rhizomes, this time would be cut by at least half if not 3/4. Stringing time depends on the efficiency of your system. By far the most cost effective method on larger holdings is to use a cherry-picker or some such device to run down the rows, tying strings to the trellising at each plant, followed by a ground person anchoring the strings and twining the vines. Summer work is relatively light,

depending on your weed-control methodology and Integrated Pest Management (IPM) use. Harvest and packaging
vary widely, with considerations including use of machinery to harvest and to pull plants down, speed of hand pickers and dryer efficiency.

It should be clear from this that there is considerable potential in organic hops production. We strongly recommend small scale production for the new grower and direct liaison with your brewery customers. Capital costs can be amortized over the lifetime of the yard, with poles being replaced as needed during that time. A group of small hop growers can also take advantage of group dryers and vacuum sealers, as well as creating a trained and mobile workforce.

2. ***Hopyard Design*** from "*Hopyard Construction: Budgeting and Economics*"
Edward B. Page, Ph.D. CSU Extension
Ron Godin, Ph.D. CSU Ag Exp. Station

Hopyard
• 18' to 20' high
• Plant spacing 7'x7'
• Population: 889
• 21' posts
• 2' to 3' in ground
• Various spacings
• 14' x 42'
• 15'x 30'
• 30' x 30'
• Equilateral triangle at end posts
• 15' base
• Poles connected within rows only
• Top training wire is free floating
• High labor input
• High production

Methodology
- Steel Anchor Embedded in Concrete
    New auger type anchors (not for sandy soils)
Wire Clamp for Anchor Wire
Clamping Cable
Corner end with triple anchors

Hop Growth on High Trellis
• Coir twine is tied to clip placed in soil next to hill
• Twine is tied to top wire

• Trained hop vine winds its way to top
• Harvesting: cuts top and bottom and remove for picking & processing

3. ***Hopyard Design*** from UVM Extension
Rosalie Madden, Heather Darby, Roger Rainville

Per Acre (60'x660')

1320 bines

33 60' Rows spaced 20' apart, 1 row every 10' on either side of a pole. Then within the row, 2 rhizomes per hill, maintain at least at least 3.5' between hills, and at least 7' (15' is better) between varieties, 40 rhizomes per row x 33 rows.

Typical spacing in the Pacific NW is between 42-50 sq ft per plant, with a spacing of either 3.5' x 14', or 7'x7', for approximately 900 bines/ac.[1]

110 20-24' poles

1 pole every 20 ft
4-5 plants per pole

Note that general pole spacing recommendations are 30'x30', or 30'x15', or 14'x42'. UVM spaced theirs at 20'x35' because it made it easier to delineate between varieties and repetitions for trialing purposes.[2]

110 post protection plates- metal plates to protect the poles

Main cable to be strung between poles- 2,178' of 3/8 steel cable (~3 rows of 660')

Anchor, clamps and wire holding poles (2 anchors and 40' cable per pole)

Wire every 10' between the three rows (3,960')

Hop stringer "trailer" or some mechanism such as a fork lift, bucket loader, back of pick up truck, or ladders, to get people high enough off the ground to string the wire and the coir twine.

[1] Information provided by Rosalie Madden, UVM Extension, July 2010.
[2] Information provided by Rosalie Madden, UVM Extension, July 2010.

4. ***High Density Hopyard Design*** from Gorst Valley
James Altwies

Per Acre

Trellis Materials

Structure	Qty	Units
End Poles	22	each
Line Poles	66	each
Deadmen	26	each

Supplies	Qty	Units
Droplines	1283	each
Clover	20	lbs
Rhizomes	1283	each

Hardware	Qty	Units
Turnbuckles	22	each
eyebolts	132	each
3/16 GAC	4235	lin. Ft
1/4 GAC	484	lin. Ft
3/16 clips	44	each
1/4 clips	88	each
3/16 thimb	22	each
1/4 thimb	44	each
lowline	4235	lin. Ft

Irrigation Materials

Irrigation Tube	Qty	Units
Dripline	4235	lin. Ft
Valves	2	each
Main line	200	lin. Ft
Branch line	500	lin. Ft

Tees	Qty	Units
1.25"x1.25"x1.25"	1	each
1.25"x0.5"x1.25"	11	each

Couplers	Qty	Units
0.5"x0.5"	10	each

End Caps	Qty	Units
0.5"	11	each

Hose Clamps	Qty	Units
0.5"-1.0"	20	each

Distrb. & Control	Qty	Units
Pump	1	each
Filter	1	each
Controller	1	each
Sensors	1	each
Shut-off valve	1	each
Check valve	1	each
5 strand wire	250	lin. Ft
Valve box	2	each

Appendix F - Hopyard Establishment Costs Per Acre

Sample budgets from:

Crannog Ales

Edward B. Page and Glenn Fuller, Colorado Extension

University of Vermont Extension

Gorst Valley Hops Value-Share Grower Program

High Density Gorst Valley Hopyard Standard Trellis Establishment Cost per Acre

Data Courtesy of James Altwies

Trellis Materials				
Structure	*Qty*	*Units*		
End Poles	22	each		
Line Poles	66	each		
Deadmen	26	each		
		Sub Total Structure	**$**	**2,942**
Supplies				
Droplines	1283	each		
Clover	20	lbs		
Rhizomes	1283	each		
		Sub Total Supplies	**$**	**444**
Hardware				
Turnbuckles	22	each		
eyebolts	132	each		
3/16 GAC	4235	lin. Ft		
1/4 GAC	484	lin. Ft		
3/16 clips	44	each		
1/4 clips	88	each		
3/16 thimb	22	each		
1/4 thimb	44	each		
lowline	4235	lin. Ft		
		Sub Total Hardware	**$**	**1,394**
Irrigation Materials				
Irrigation Tube				
Dripline	4235	lin. Ft		
Valves	2	each		
Main line	200	lin. Ft		
Branch line	500	lin. Ft		
tees 1.25"x1.25"x1.25"	1	each		
tees 1.25"x0.5"x1.25"	11	each		
Couplers 0.5"x0.5"	10	each		
End caps 0.5"	11	each		
Hose clamps 0.5"-1.0"	20	each		
Distrb. & Control				
Pump	1	each		
Filter	1	each		
Controller	1	each		
Sensors	1	each		
Shut-off valve	1	each		
Check valve	1	each		
5 strand wire	250	lin. Ft		
Valve box	2	each		
		Sub Total Irrigation	**$**	**1,274**
Plants			**$**	**2,053**
Labor	150	hrs	**$**	**1,500**
Machine Hours	50	hrs	**$**	**500**
Establishment Cost per Acre			**$**	**10,107**
Establishment Cost Not Including Labor per Acre			**$**	**8,107**

Hopyard Standard Trellis Establishment Cost per Acre

Data Courtesy of Glen Fuller (Colorado)

Rhizomes (4' x 12')	1040	1.21	$	1,260
Misc. Hardware & Supplies			$	1,260
Poles (21' untreated, lodge pole pine)	52	20.57	$	1,070
D5 Dozer Work			$	600
Bob Cat & Auger (holes for poles)			$	550
7-Strand Wire (carries floating wires)			$	800
#9 Wire (floating – top wire)			$	250
Hop Twine (coir: coconut husk fiber)			$	140
48" Ground Anchors	48	8.33	$	400
Drip Irrigation Materials			$	1,500
30 hrs. Tilling			$	300
40 hrs. Pole Setting			$	400
Gallows (for work on top wires)			$	140
Labor			$	3,750
Total Establishment Cost			**$**	**12,420**
Establishment Cost Not Including Labor per Acre			**$**	**8,670**

Left Fields Hopyard Standard Trellis Establishment Cost per Acre

Rebecca Kneen Crannóg Ales, Left Fields	Qty	$/Unit	$ Total
Poles	81	25	2,025
Cabling - Primary	3762	0.4	1,505
Cable - Secondary	12540	0.26	3,260
String - 2/plant	1800	0.02	36
Anchors, cable	26	9	234
Cable clamps	194	0.29	56
pass-throughs (loops)	63	1.5	95
Cable eyes	26	0.32	8
Klein-Haven Grip	1	160	160
Rhizomes	900	3.5	3150
Total			**10,529**

Standard Trellis Establishment on 4 Acres

By Edward B. Page, Data Courtesy of Glen Fuller

Rhizomes	4160	1.21	$	5,040
Potting Soil			$	750
Pots (6" square)	5000	0.46	$	2,300
Misc. Hardware & Supplies			$	5,026
Poles (21' untreated, lodge pole pine)	210	20.38	$	4,280
D5 Dozer Work			$	2,400
Bob Cat & Auger (holes for poles)			$	2,150
7-Strand Wire (carries hop wires)			$	3,146
#9 Wire (floating –top wire)			$	997
Hop Twine (coir: coconut husk fiber)			$	556
48" Ground Anchors	188	8.4	$	1,580
Drip Irrigation Materials			$	5,980
30 hrs. Tilling			$	1,200
40 hrs. Pole Setting			$	1,600
Gallows (for work on top wires)			$	556
Labor			$	15,000
Total Establishment Cost			$	52,561
Establishment Cost per Acre			**$**	**13,140**
Establishment Cost Not Including Labor per Acre			**$**	**9,390**

UVM Extension Hopyard standardized to 1 acre

Data Courtesy Rosalie Madden, Roger Rainville	#	Each		Sum
Poles				
22 ft locust poles	30	42	$	1,260
22 ft cedar poles	53	25	$	1,325
Sub total Poles			**$**	**2,585**
Wire				
5/16" x 5000 ft			$	1,733
5/16" x 1000 ft			$	347
5/16" x 250 ft			$	107
3/8" x 500 ft			$	280
3/4"x12 eye/hook turnbuckle	34	15.92	$	721
cable cutters	1		$	66
5/16" x 10 pcs forged w/r clips	200	0.64	$	171
3/8" x 10 pcs forged w/r clips	50	0.94	$	63
3/8" x 10 pcs forged w/r clips	50	0.94	$	25
5"x46" anchor	40	9	$	360
Earth auger anchor, 5"x46"	40	5	$	267
Screws			$	159
2 Haven Grips cable pullers			$	166
Sub total Wire			**$**	**4,465**
Supplies				
10 yards stone			$	460
Rhizomes fresh hops/hops union bulk price	1,778 rhyzomes 2/hill	3	$	5,334
Drip Irrigation Supplies and Installation			$	-
Sub total Supplies			**$**	**5,794**
Labor				
Dig test holes	3		$	30
Install poles, digging, stone, 2 tractors & loader	18	10	$	180
Install poles, labor	25	10	$	250
set poles, labor	5	10	$	50
tractor and dump wagon	9.5	10	$	95
labor	65	10	$	650
tractor and auger to set anchors	4	10	$	40
labor to set anchors	2	10	$	20
tractor and lift	32	10	$	320
till	4	10	$	40
Plant rhyzomes	16	10	$	160
tractor and loader to set poles	13	10	$	130
Tractor and auger to set anchors	3	10	$	30
Sub total Labor			**$**	**1,995**
Equipment Rent				
transport digger			$	150
rent rototiller			$	88
rental for pole digger			$	339
Sub total Equipment Rent			**$**	**577**
Total Hop Yard Cost Per Acre			**$**	**15,416**
Total Hop Yard Cost Per Acre Not Including Labor			**$**	**13,421**
Total Hop Yard Cost Per Acre Estimating $20/pole and Not Including Labor			**$**	**12,496**

Appendix G - Laboratory Analysis Service Providers

Brewing and Distilling Analytical Services, LLC (BDAS, LLC)
128 Shady Lane
Lexington, KY 40503
Tel: 859-278-2533
http://www.alcbevtesting.com/

BDAS partners with Tom Shelhammer at Oregon State University to offer the following analyses

- Oils (Cohumulone and Humulone)
  HPLC high performance liquid chromatography test $100/sample
- Alpha and Beta Acids
  toluene extraction test $50/sample
- Reduced Alpha Acids for light struck prevention
  Light struck prevention test $100/sample
  (for clear bottled beer, to study hops that might react to light) Corona clear bottles have a skunky smell but Miller clear bottles do not and this is because Miller specially selects hops bred to be light struck reduced

BrewLaboratory
J. Frizzell
18223 Crestview Circle
Holt, MO 64048
service@brewlaboratory.com

BrewLaboratory is offering a High Performance Liquid Chromatographic (HPLC) analysis of your whole leaf or pellet hops for:

- Alpha Acid % (cohumulone and adhumulone + humulone)
- Beta Acid % (colupulone and adlupulone + lupulone)
- Cohumulone % (% cohumulone contributes of the total Alpha Acid %)

We will analyze your hops for $24.00 per sample.

Siebel Institute of Technology
Laboratory Services
Head Office: 1777 N Clybourn Avenue Chicago, IL 60614
Phone: 312-255-0705 Fax: 312-255-1312
E-Mail: laboratory@siebelinstitute com
Web: www siebelinstitute com
Sample delivery only:
Siebel Laboratories
7564 Trade Street

San Diego, CA 92121, USA
(888) 593-2785

HOP ANALYSES

Options	Price $	Quantity
#3000 Moisture (International method)	22	200 g pellets
#3010 Alpha acids (spectrophotometric)	55	200 g pellets
#3020 Alpha acids (conductometric)	65	200 g pellets
#3030 Alpha and beta acids (HPLC)	131	200 g pellets
#3060 Hop Oil Profile (GC)	158	200 g pellets
#3070 Hop Tea Flavor Evaluation	89	200 g pellets
#3080 Humulene-2-ol	110	200 g pellets
#3090 Iso, tetra, dihydro, hexa- humulones	POR	200 g pellets
#3100 Nitrate (HPLC)	POR	200 g pellets
#3110 Total Essential Oils	23	200 g pellets
#3120 Variety Profile (trueness to type)	POR	200 g pellets
All individual analysis / other analysis	POR	

Appendix H – Expired Hop Harvester Patents

High Trellis Patents

Mobile Patents

Low Trellis Patent

Jan. 2, 1951 P. E. GRISWOLD 2,536,927

HOP-PICKING MACHINE

Filed Jan. 19, 1946 2 Sheets-Sheet 1

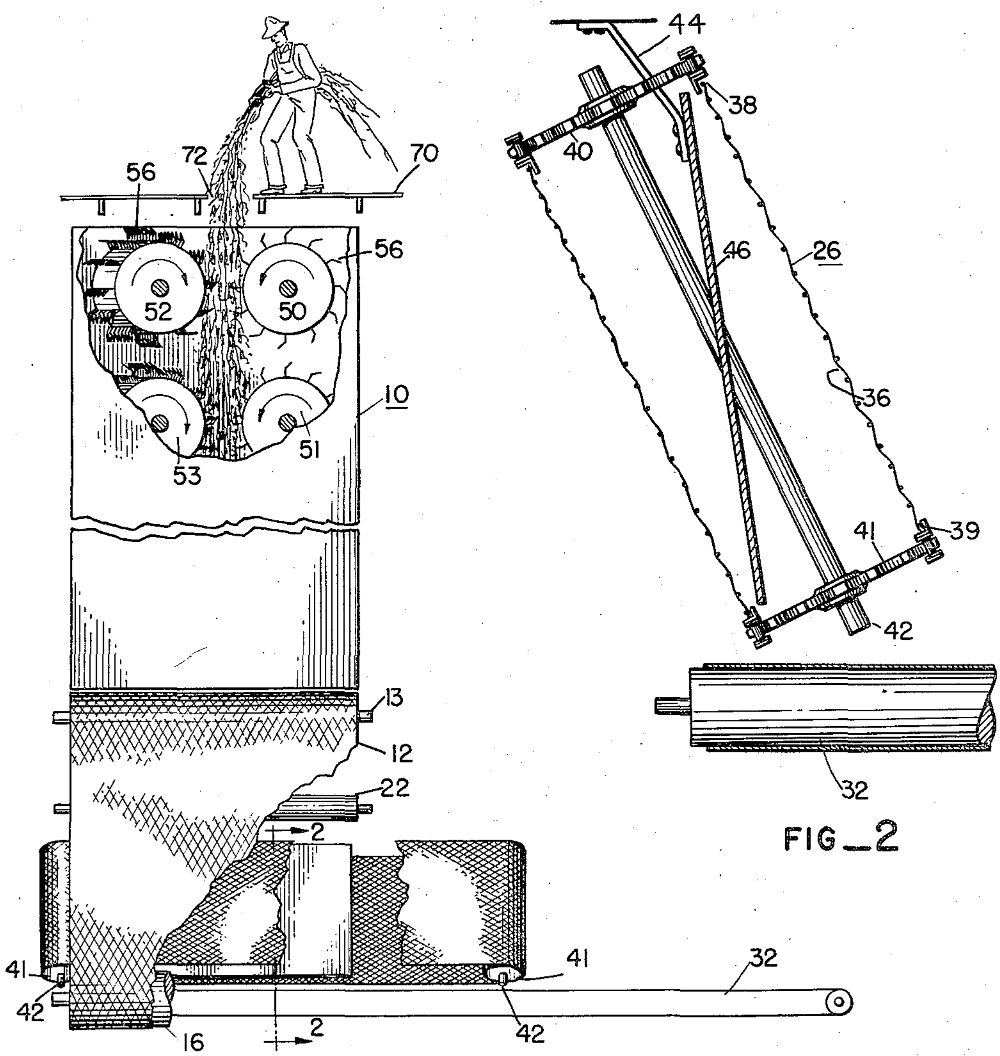

FIG_1

FIG_2

PORTER E. GRISWOLD
INVENTOR

BY Smith & Tuck

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Jan. 2, 1951 P. E. GRISWOLD 2,536,927

HOP-PICKING MACHINE

Filed Jan. 19, 1946 2 Sheets-Sheet 2

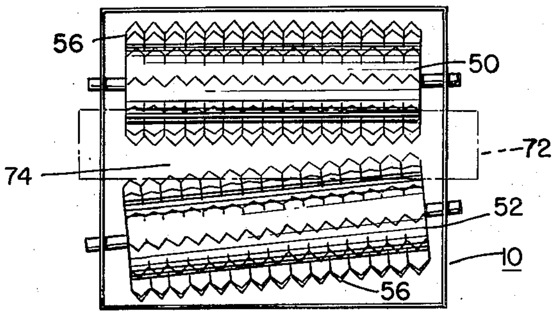

FIG_3

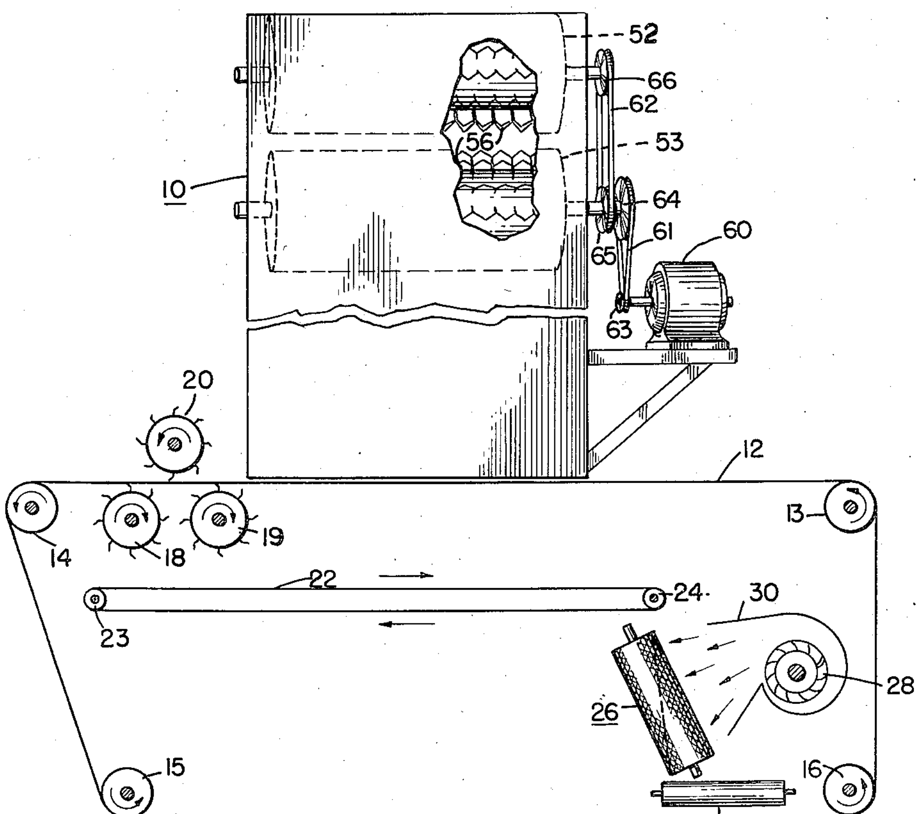

FIG_4

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Patented Jan. 2, 1951 2,536,927

UNITED STATES PATENT OFFICE

2,536,927

HOP-PICKING MACHINE

Porter E. Griswold, Yakima, Wash.

Application January 19, 1946, Serial No. 642,249

3 Claims. (Cl. 130—30)

1

This invention relates to a hop-picking machine and, more particularly, to a machine for stripping hops from their vines when manually-fed thereto.

Hop-picking has heretofore been largely a matter of employing great amounts of manual labor to hand pick the flowers from the stems and arms, or it has been done by large and expensive machines requiring the investment of much capital and the use of excessive amounts of maintenance labor. In the present stationary machines it is customary to provide horizontal series of rotating drums having picking fingers thereon and to mechanically draw the vine over one such series and between two such series whereby the vine is stripped. Such an operation, left entirely to the mechanism, is without "feel" or judgment and usually results in the production of great quantities of trash intermingled with the hops. Of course, this has to be carefully separated therefrom. Also, because it is common to employ great numbers of these drums, each of which has approximately five hundred picking fingers, there is always much maintenance and repair work required on prior machines because of the many broken fingers that result during a day's operation. In addition, such machines are too large and too expensive for the smaller growers to own or operate, because they are not economically operated unless run to full capacity throughout the whole picking season.

Having these and other well-known defects of the prior art in mind, it is an important object of this invention to provide a hop-picking machine which can be manually fed and which is kinder to the hops and produces less trash in the stripped material.

Another object of this invention is the provision of a hop-picking machine which permits the operator to variably and progressively strip hops with judgment in accordance with conditions as he encounters them when the crop is brought from the fields, in order that the minimum of loading is applied to the machine and its parts during the operation.

Still another object of the invention is to provide, in machine as described, hop-picking elements which will variably accommodate the vines and foliage fed thereto so that longer or shorter picking periods can be had.

A further and more specific object of the invention is the provision, in a machine of the type described, of a first and a second series of hop-picking elements disposed in a substantially horizontal plane but with angular relation to each

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other, and both movable toward and away from an intermediate upright plane whereby the hop vines may be gravitationally delivered to the picking elements during initial picking and, in a reverse direction, be withdrawn therefrom during final stripping stages of the operation to insure even loading of the picking elements and avoid excessive wear and tear upon the equipment.

The foregoing objects and advantages of the invention and others ancillary thereto I prefer to accomplish as follows:

According to a preferred embodiment of the invention, I provide an upright frame housing within which is mounted opposed picking elements to which, from above, the vines are fed. It is preferable that the picking elements be angularly disposed with relation to each other so that the operators may first feed the full and bushy vine to elements spaced relatively far apart, and then move the vine and its appendages into more restricted areas between the picking elements to complete the picking operation. Specifically, the picking elements comprise V-shaped fingers mounted in series on bars carried by revolving drum heads that are mounted for the application of power. The hops that have been stripped from the vines fall below the picking elements to a conveying and screening means and thence pass to further mechanism for separating the clusters that may have been stripped as a bunch. By the use of suitable separating mechanism and conveying means the hops are moved through a winnow-cleaning process and finally to storage or driers.

The novel features that I consider characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof will best be understood from the following description of a specific embodiment when read in connection with the accompanying drawings in which

Fig. 1 is an upright schematic view of a mechanism embodying my invention;

Fig. 2 is a cross-sectional view taken on line 2—2 of Fig. 1;

Fig. 3 is a plan view showing the relative arrangement of the picked elements; and

Fig. 4 is a side elevational schematic view of the machine of Fig. 1.

A hop-picking machine to overcome the defects hereinbefore mentioned must have at least two totally distinct characteristics; it must be capable of operation with a most simple construction and the minimum of attention; and it must provide satisfactory hop picking with a minimum of damage to the crop and the production of a minimum of trash. Accordingly, a preferred embodiment of the invention, referring to Figures 1 and 3 of the drawings, is constituted by a frame in which is mounted the hop-picking elements. The housing and frame **10** is of right-rectangular cross-section and stands upright above an endless conveyor belt **12** which passes around rollers **13**, **14**, **15** and **16**. The belt is shown as being formed of wire mesh and travels in a right-to-left direction as shown in Fig. 4. One of the rollers, preferably roller **13**, has power applied thereto in a conventional manner to cause movement of the belt as indicated. The housing rises from closely adjacent the upper surface of the belt **12**.

Picker elements mounted upon revoluble drums **18**, **19** and **20** operate upon both sides of belt **12** to break and tear clusters of hops that may have been carried thereto by the belt. The hops fall through the interstices of the belt and are collected by conveyor belt **22** that passes around rollers **23** and **24** in the directions indicated by arrows in Figure 4.

Hops carried by conveyor **22** drop off the end in a cascade that falls toward separator **26** through an air current induced by fan **28** and through its nozzle **30**. At this point the hops are separated from the leaves and petals on a screening surface and drop onto the lateral conveyor belt **32** for disposal to storage or additional processing.

The screening surface or separator **26** fully shown in Figures 2 and 4, comprises the endless belt **36** formed of wire mesh of a size in the range of ¼" to ¾" to the openings of the belt. The belt is carried by upper and lower link belts **38** and **39**, respectively, which travel on, and are moved by, sprockets as **40** and **41** on shafts **42**. The shafts **42** are mounted in suitable bearings and empowered all in a conventional manner to produce continuous movement of the belt **36** in an inclined plane substantially as shown. Between the flights of belt **36** is mounted, by means of bracket **44**, a deflector blade or plate **46**, which functions as a petal-saver and gathers and directs the petals which escape through belt **36** downward toward the conveyor belt **32** where they are deposited.

As I have mentioned before, the arrangement of the picking elements is an important part of this invention because it simplifies and facilitates both picking and the operation of the machine. The preferred form of these elements is to provide an endless series of picking fingers as is embodied in a picking drum although there are other forms that are equally useful. Within housing **10** I mount for revolution the rollers or drums **50** and **52** in an angular relationship, as shown in Figures 1 and 3, so that their respective axes are non-parallel. The drums are each provided with longitudinally extending rows of V-shaped picking fingers **56** of conventional form well-known in this art. Circumferentially of the drums, the fingers **56** form an endless series of picking elements as the drums are revolved. At one end the drums are positioned close enough together so that the fingers will just about touch during operation, but at the other end the drums are separated to a greater extent. Thus, between the drums there is a V-shaped space **74** into which the vine is fed for stripping.

I have found it advisable to speed the operation to include a second pair of drums **51** and **53** below the others, as can be seen in the drawings. The drums **52**, **53** are turned by means such as motor **60** from which power is transmitted through the instrumentality of belts **61** and **62** and the sheaves **63**, **64**, **65** and **66**. Drums **50** and **52** are similarly driven.

Each upper or lower pair of drums is driven so that the fingers **56** or other picking elements are carried in a circular path that is opposite for each drum. The two paths tend to approach, from the top downward, a common plane that is upright therebetween. This is indicated in Figure 1 by suitably placed arrows on the ends of the drums.

Above the drums is a platform **70** having an opening **72** that lies longitudinal of the space **74** between the drums of a pair. An operator standing on this platform manually lowers a vine-end through the opening and into space **74**. At the beginning of the operation, when the vine is full and bushy with hops and leaves, he does so at the wider end of space **74**. As the fingers **56** strip the hops from the stems and arms of the vine the operator works the vine up and down and progressively moves it into the narrower portions of the V-space **74**. In this manner, as the vine reduces in size due to the removal of hops therefrom, it can at all times be kept in contact with the rapidly rotating picking fingers. When the vine has been fully stripped it is raised by the operator and cast aside.

Such hops as are picked from the vine fall below the drums onto and through the meshes of belt **12**. If there be clusters deposited upon belt **12** they are carried to picker drums **18**, **19** and **20** where they are torn apart and then delivered to conveyor **22**.

Such material as is delivered to the screen belt **26** falls through the air from fan **28** onto belt **32**. The air currents are usually such that the round and fairly solid hops fall straight down, with but slight contact with belt **26**, but the leaves and petals are blown toward the belt. The leaves are held to the moving belt by the air currents and, as they turn the end around sprockets **40**, **41**, are permitted to fall away and be collected for disposal. The petals pass through the belt and are deflected toward belt conveyor **32**.

During vine stripping the operator at all time has both visual and physical contact with the stripping operation and can, thereby, more or less control the manner in which the picking elements have material delivered thereto. If the vines are excessively full and bushy they will be picked longer in the wider portions of picking area **74** and then be moved slowly into the more restricted areas. If lean vines are being brought to the machine the picker may more quickly move into the more restricted areas and thus shorten the time such a vine is in the machine. This materially increases efficiency of picking over that performed by machines where the vine must move through a constant and unvariable path for a fixed and predetermined time period.

While I have shown and described particular embodiments of my invention, it will occur to those skilled in the art that various changes and modifications may be made without departing from the invention, and I, therefore, aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

Having thus described my invention, I claim:

1. In a hop-picking machine, first and second picking drums having longitudinal rows of V-shaped picking fingers thereon; said picking drums being disposed substantially horizontal and side-by-side with their adjacent rows of picking fingers in progressively greater spaced-apart relationship to each other in a manner that defines an open-end unobstructed, horizontally tapered picking zone in which hop vines, being picked, may be suspended and moved from the wider to the narrower portions of the zone for the performance of the picking operation; means supporting said picking drums in said relationship; and means for rotating said picking drums oppositely so that the paths of travel of the rows of fingers of each drum pass said picking zone from above downward.

2. In a hop-picking machine, first and second picking devices, each having an endless series of V-shaped picking fingers thereon; said picking devices being disposed side-by-side with their respective rows of picking fingers in progressively greater spaced-apart relationship to each other in a manner that defines an open-end, unobstructed, horizontally tapered picking zone when viewed from above in which hop vines, being picked, may be suspended and moved from the wider to the narrower portions of said zone for the performance of the picking operation; means supporting said picking devices in said relationship; and means for actuating said devices so that the rows of picking fingers of each of said devices travel in paths that pass said picking zone from above downward.

3. In a hop-picking machine, first and second picking devices, each having an endless series of rows of V-shaped hop-engaging elements thereon; said picking devices being disposed side-by-side with their respective rows of picking fingers in progressively greater spaced-apart relationship to each other in a manner that defines an open-end, unobstructed, horizontally tapered picking zone when viewed from above in which hop vines, being picked, may be suspended and moved from the wider to the narrower portions of the zone for the performance of the picking operation; means supporting said picking devices in said relationship; and means for actuating said devices so that the rows of V-shaped picking elements of each of said devices travel in paths that pass said picking zone from above downward.

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METHOD AND APPARATUS FOR PICKING HOPS

Filed Aug. 16, 1950 6 Sheets-Sheet 1

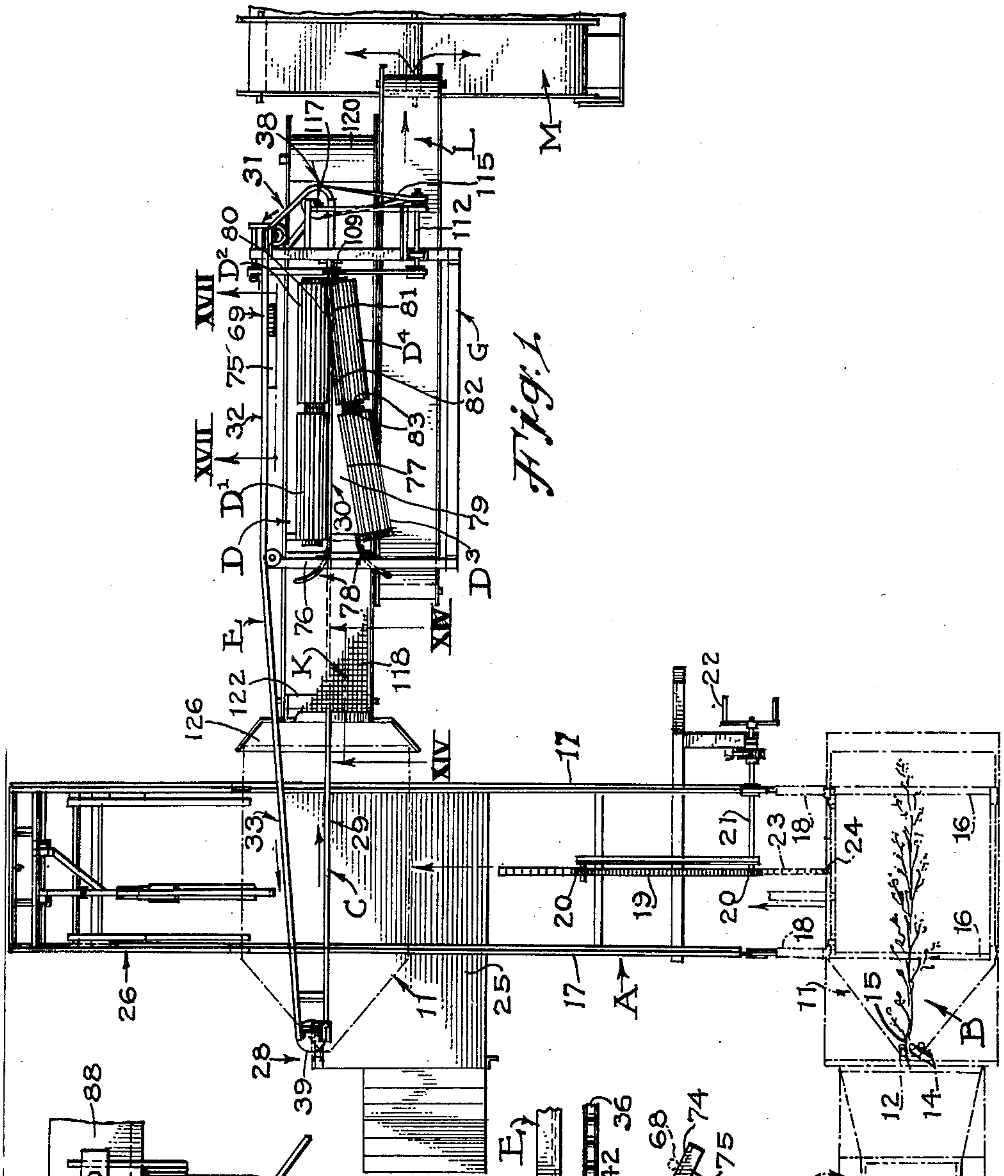

Fig. 1

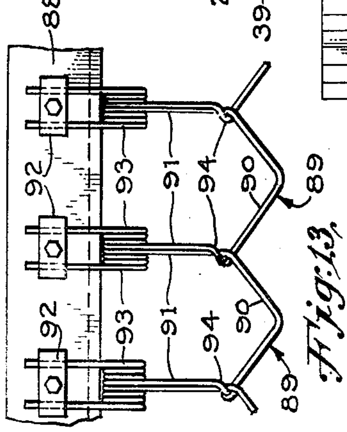

Fig. 13

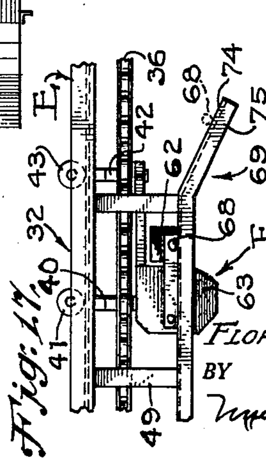

Fig. 17

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METHOD AND APPARATUS FOR PICKING HOPS

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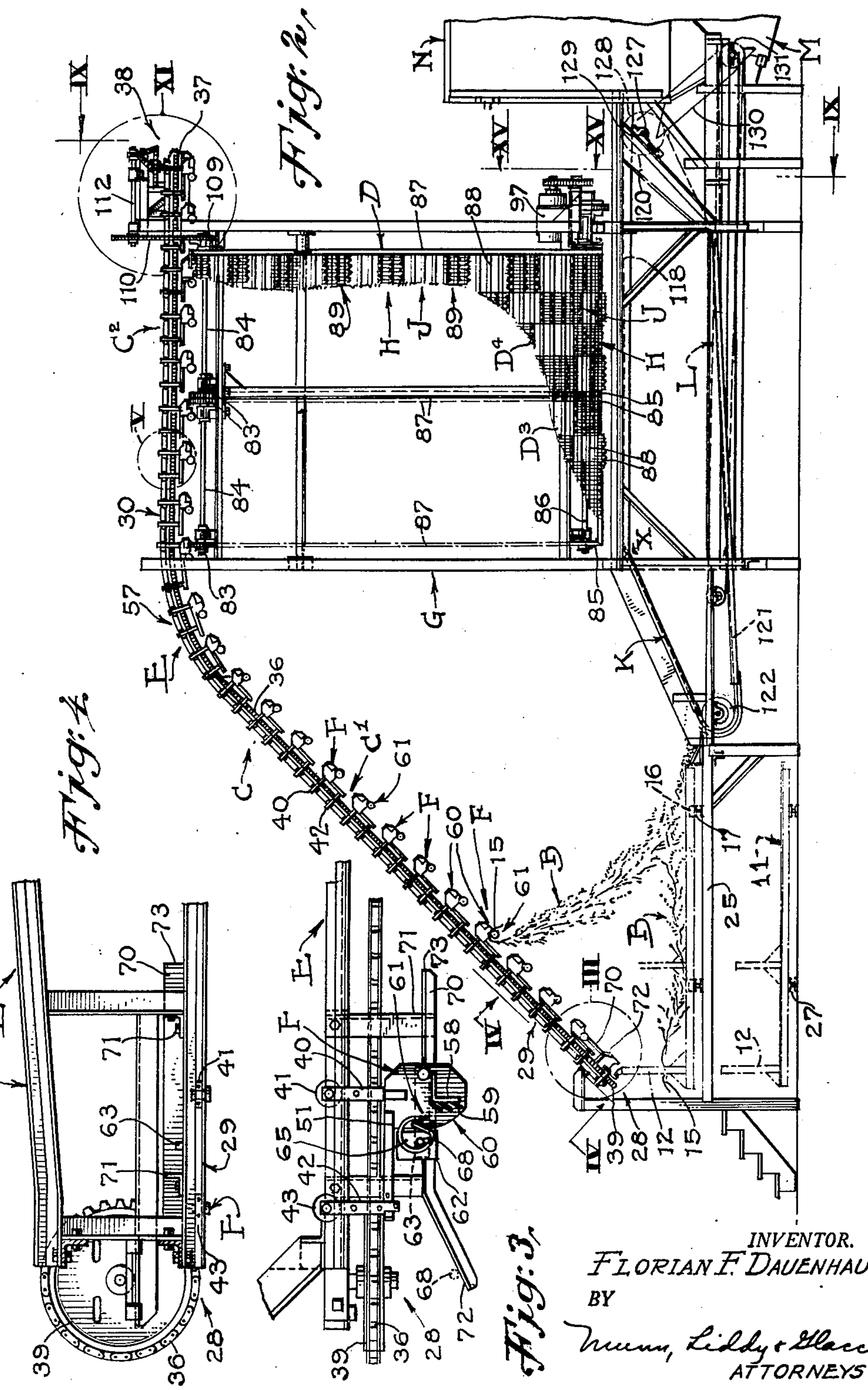

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METHOD AND APPARATUS FOR PICKING HOPS

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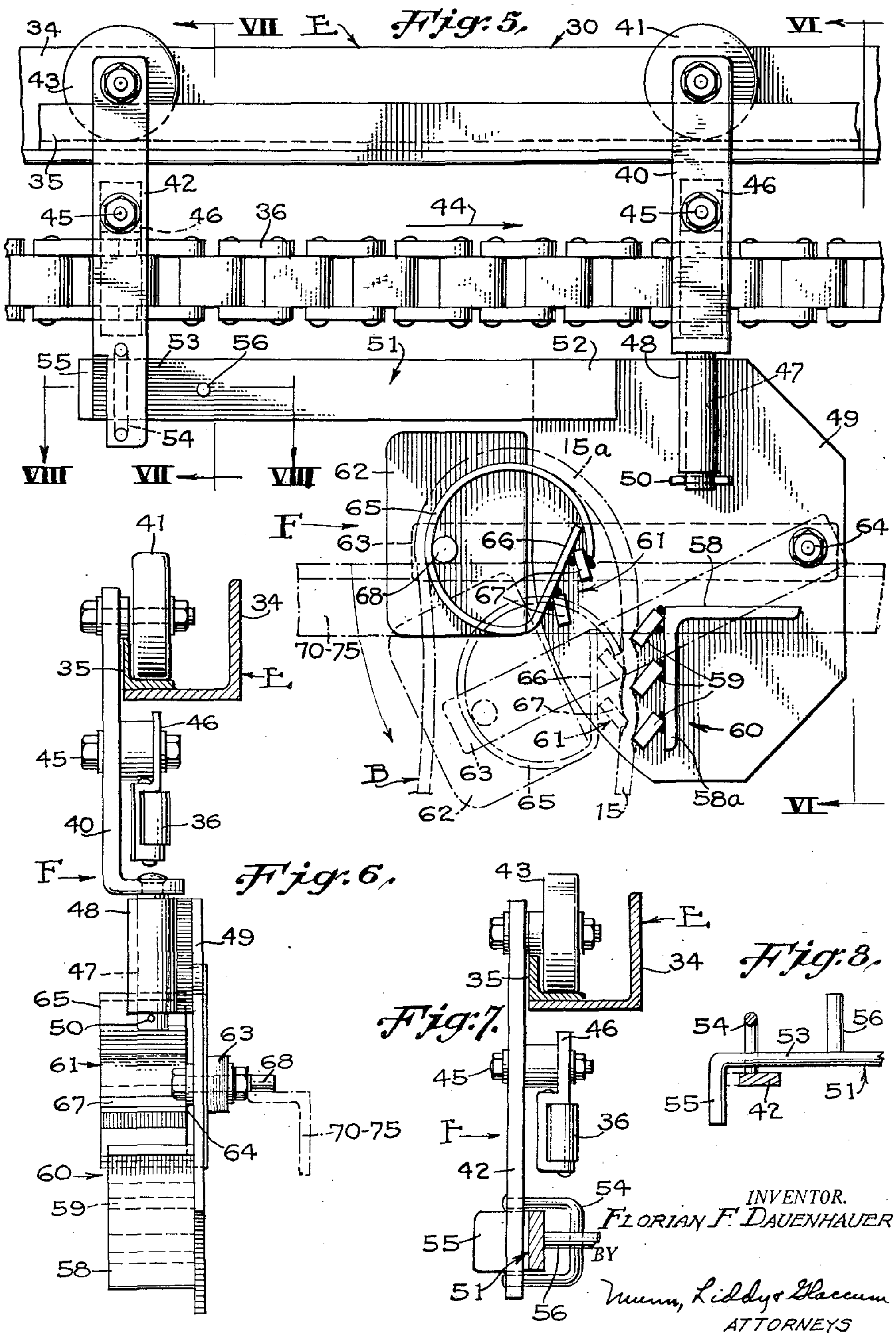

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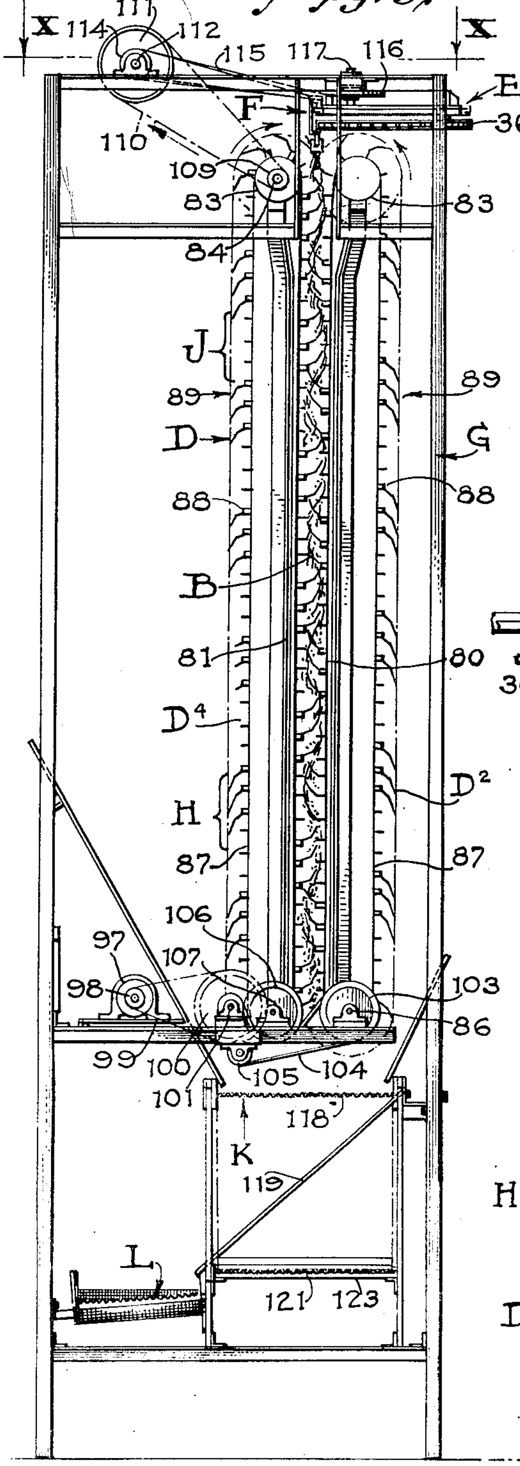
Fig. 9.



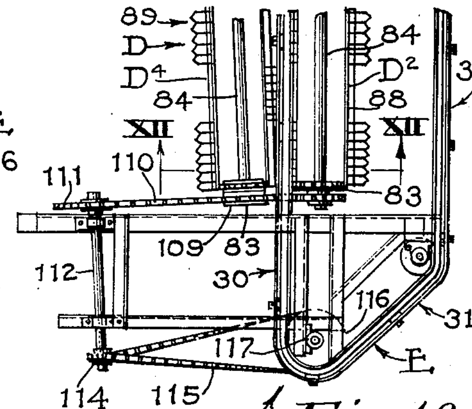


Fig. 10.

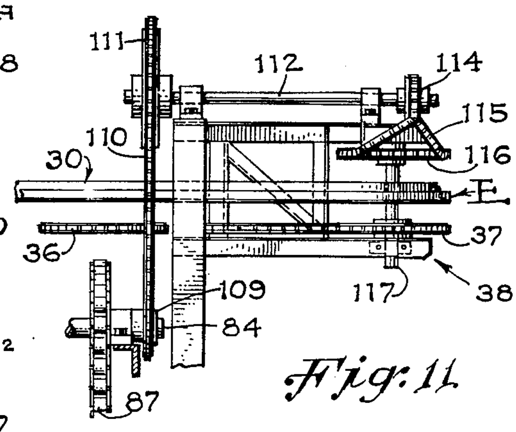
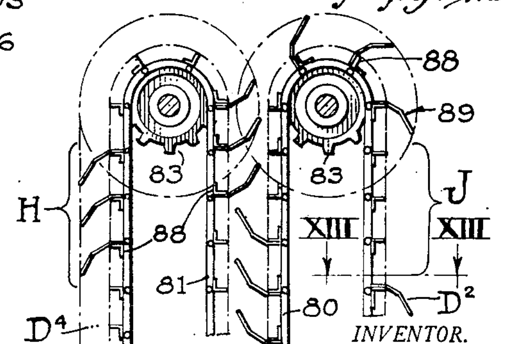


Fig. 11.

Fig. 12.



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METHOD AND APPARATUS FOR PICKING HOPS

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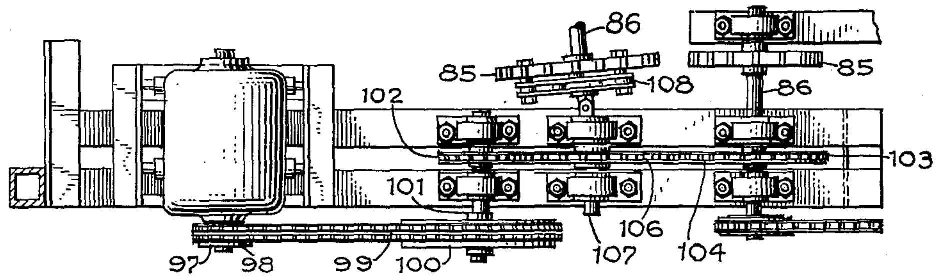

Fig. 16.

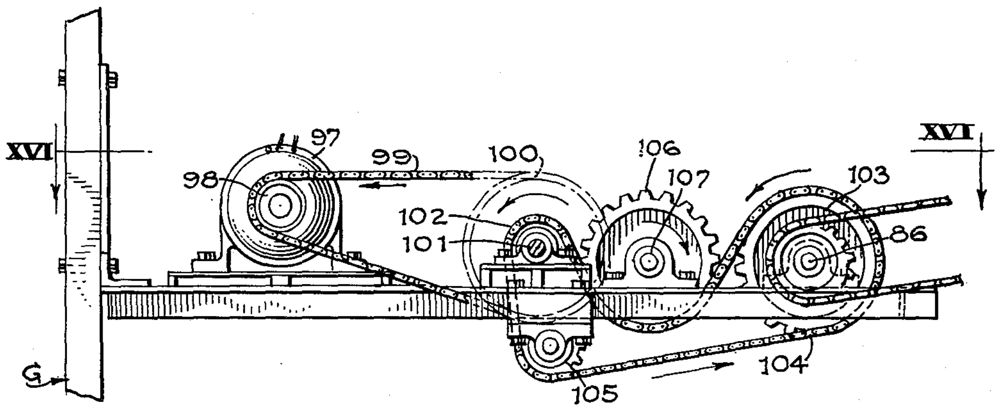

Fig. 15.

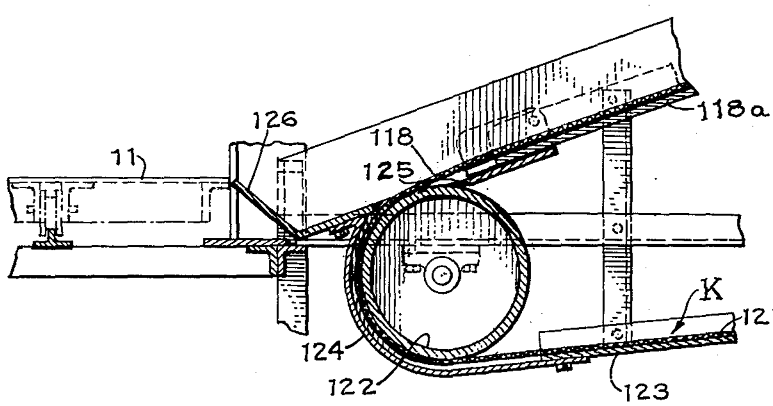

Fig. 14.

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METHOD AND APPARATUS FOR PICKING HOPS

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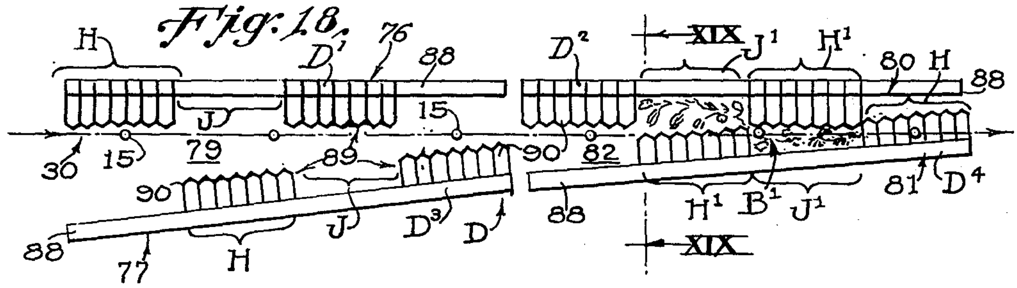
Fig. 18.



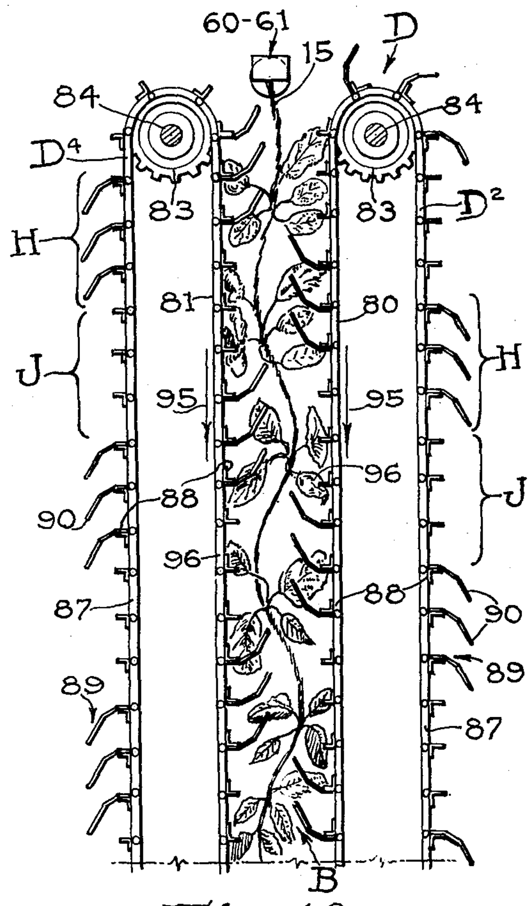


Fig. 19.

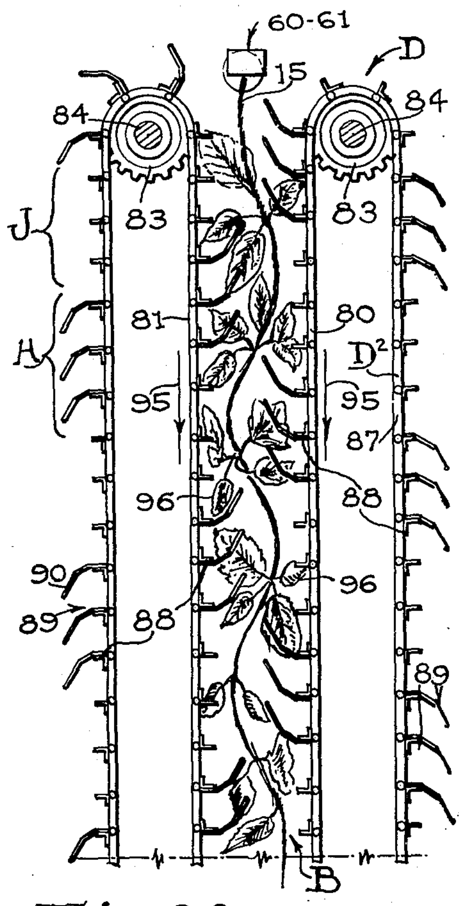


Fig. 20.

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Patented May 4, 1954 2,677,378

UNITED STATES PATENT OFFICE

2,677,378

METHOD AND APPARATUS FOR PICKING HOPS

Florian F. Dauenhauer, Santa Rosa, Calif.

Application August 16, 1950, Serial No. 179,722

10 Claims. (Cl. 130—30)

1

The present invention relates to improvements in a method and apparatus for picking hops. It embodies improvements over the stationary type hop-picking machine disclosed in my United States patent, Reissue No. 22,889, dated June 17, 1947.

An object of this invention is to provide an improved method of picking hops from vines, assuring a thorough removal of the hops, without damaging the hops. More specifically stated, the vines are formed into wave-like configurations, defining alternate crests and valleys extending lengthwise of the vines.

The waves thus formed are advanced lengthwise of the vines to continually replace crests by valleys and vice versa, thereby undulating the vines in first one direction and then the other for causing pendulum-like movements and exposure of the hops by the continual weaving of the vines. The hops are removed during the undulating of the vines.

Moreover, the method employs the progressive increasing of the amplitudes of the waves as the hops are picked. Also, crests and valleys of the waves are interchanged abruptly as the picking of the hops continue, and the branches of the vines are spread out laterally to expose hops and preclude the vines from matting.

As a further object of the invention, I provide an apparatus for carrying out the foregoing method in a continuous process.

Another object of this invention is to provide an apparatus in which the butt ends of the vines are anchored to an endless carrier. As these vines are advanced through the machine, the vines are suspended from overhead. Picking units are arranged to undulate and spread the suspended vines, producing the continual reversing of the waves during the hop-picking operation.

Moreover, the vines are anchored to the endless carrier at a convenient working height for the operator; and as the carrier advances, the vines are elevated to the height necessary to allow them to depend freely from the carrier. This arrangement produces an apparatus that occupies far less horizontal space than the machine shown in my Reissue Patent No. 22,889, above identified.

Another object is to provide a hop-picking unit adapted to commence removing hops as soon as the vines enter the unit. As the vines are advanced farther into the unit, the amplitudes of the waves formed in the vines are progressively increased, exposing more hops for removal.

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Other objects and advantages will appear as the specification continues, and the novel features of the invention will be set forth in the claims hereunto appended.

Drawings

For a better understanding of this invention, reference should be had to the accompanying drawings, in which:

Figure 1 is a top plan view of my improved hop-picking apparatus, and diagrammatically illustrates the incoming hop vines being transferred from a vehicle to the picking apparatus;

Figure 2 is a side elevational view of Figure 1;

Figure 3 is an enlarged view of that portion of the vine-feed end of the apparatus included within the circle III of Figure 2;

Figure 4 is a fragmentary plan view at the feed end of the apparatus, as seen from the plane IV—IV of Figure 2;

Figure 5 is an enlarged side view of a vine-grasping and feeding unit, as enclosed by the circle V in Figure 2;

Figures 6 and 7 are vertical transverse sectional views taken along the lines VI—VI and VII—VII, respectively, of Figure 5;

Figure 8 is a longitudinal sectional view taken along the line VIII—VIII of Figure 5;

Figure 9 is a transverse sectional view as seen from the plane IX—IX of Figure 2;

Figure 10 is a fragmentary top plan view at the delivery end of the apparatus, as indicated by the line X—X of Figure 9;

Figure 11 is an enlarged view of the portion of the driving mechanism enclosed by the circle XI in Figure 2, the vine-grasping and feeding units being omitted;

Figure 12 is a vertical transverse sectional view at the delivery end of the apparatus, and taken along the line XII—XII of Figure 10;

Figure 13 is a fragmentary plan view illustrating the hop-picking fingers secured to an angle bar of the picking unit, as seen from the plane XIII—XIII in Figure 12;

Figure 14 is a vertical longitudinal sectional view taken along the line XIV—XIV of Figure 1, showing a portion of a screen for conveying branches and clusters of hops to a trommel;

Figure 15 is an end elevational view of the drive mechanism for operating the picking unit, as observed from the line XV—XV of Figure 2;

Figure 16 is a top plan view of Figure 15, as suggested by the plane XVI—XVI in the latter;

Figure 17 is a vertical longitudinal sectional view taken at the vine-releasing station, as indicated by the line XVII—XVII in Figure 1;

Figure 18 is a diagrammatic plan view illustrating the confronting reaches of the hop-picking unit, and disclosing hop vines being advanced therebetween;

Figure 19 is a vertical transverse sectional view taken along the line XIX—XIX of Figure 18, illustrating a hop vine formed into a wave-like configuration by the active fingers on the confronting reaches of the hop-picking units; and

Figure 20 is a view similar to Figure 19, but showing the picking fingers advanced to reverse the wave defined by the undulating vine.

While I have shown only the preferred form of my invention, it should be understood that various changes, or modifications, may be made within the scope of the appended claims without departing from the spirit thereof.

Detailed description of hop vine-transferring mechanism

Referring to Figure 1, I disclose a hop vine-transferring mechanism indicated generally at A, which forms the subject matter of my copending application on a Hop-transporting Mechanism, Ser. No. 179,721, filed in the United States Patent Office on August 16, 1950. Accordingly, this mechanism has been shown somewhat schematically in the present case.

As shown, a vehicle 10 has a carriage 11 demountably mounted thereon for the purpose of transporting hop vines B from the field. Uprights 12 project above this carriage to define slots 14 therebetween into which the butt ends 15 of the hop vines are inserted. After the carriage has been loaded with vines, the vehicle is driven into a position where rails 16 on the underneath side of the carriage are in registration with upper feed tracks 17 forming part of the transferring mechanism A.

Upper bridging members 18 are employed between the rails 16 and the tracks 17 to serve as supports for the carriage 11 when the latter is pulled from the vehicle body. Transfer of the carriage 11 to the tracks 17 is accomplished by an endless chain 19, which is trained around sprockets 20. Rotary motion is imparted to one of these sprockets by a shaft 21 and a crank 22. A pull chain 23 has one end thereof anchored to the chain 19, while its free end is engaged with a hook 24 on the carriage.

Thus the carriages 11 with their loads of vines are moved one at a time onto the upper feed tracks 17. The carriages are slid over these tracks onto a working platform 25. An operator standing on this platform transfers the hop vines B to an endless vine-carrier designated generally at C, forming part of the present invention.

After the vines are removed from each carriage 11, the latter is transferred by a switch 26 (see Figure 1) to a lower return track 27 (see Figure 2), from which it is reloaded again on the vehicle 10. The foregoing mentioned copending application discloses the details of the switch 26 and the mechanism for reloading the empty carriages on the vehicle.

Vine-carrier

It will be noted from Figure 2 that the feed end 28 of the vine-carrier C is arranged near the platform 25 so as to facilitate the work of the operator in attaching the hop vines onto this carrier. However, this carrier has an inclined section C1 that travels along a rather steep grade, as shown in Figure 2, so as to bring the butt ends 15 of the vines to a horizontal upper level section C2 of the carrier.

At this point, I shall mention the fact that the hop vines B are suspended from their butt ends, and pass through a hop-picking unit D, as the vines are advanced by the upper section C2 of the carrier. This unit will be described in detail as the specification continues.

The vine-carrier C is guided for movement along a substantially endless supporting rail indicated generally at E. This rail has an ascending section 29, which starts at the feed end 28 of the vine-carrier and leads to an upper horizontal section 30 (see Figures 1, 2, 4, 10 and 11). As shown in Figures 1 and 10, the rail section 30 is connected by a curved end portion 31 to a rear horizontal rail section 32. The latter connects to a descending rail section 33 leading back to the feed end 28 of the vine-carrier.

In actual practice, the supporting rail E is fashioned from an angle iron 34 having a smaller angle iron 35 secured thereto, producing a fabricated rail having a channel-shaped cross-section (see Figures 5–7, inclusive).

An endless conveyor chain 36 is mounted immediately below the rail E and follows the same path as the latter. This chain is trained over a drive sprocket 37 disposed at the upper rear end 38 of the endless vine-carrier C (see Figures 2 and 11). The lower end of the chain 36 passes around a tail or reversing sprocket 39 arranged at the feed end 28 of the vine-carrier (see Figures 1–4, inclusive).

Referring to Figures 2–7, inclusive, 9 and 17, I provide a plurality of vine-grasping and feeding units designated generally at F, which form part of the endless vine-carrier C previously mentioned. The units F are identical with one another. As disclosed in Figures 5 and 6, the vine-grasping and feeding unit F includes a main hanger 40 having a wheel 41 at its top, which rides along the smaller angle iron 35 of the supporting rail E. A guide hanger 42 is provided with a wheel 43 at the upper end thereof, which rides over the angle iron 35 as the unit F is advanced in the direction of the arrow 44 in Figure 5.

The hangers 40 and 42 are attached by bolts 45 to lugs 46 that are fixed to and project from the chain 36. Also, these lugs prevent the wheels 41 and 43 from jumping the angle bar 35.

As shown in Figures 5 and 6, the main hanger 40 has a journal rod 47 that telescopes through a tubular boss 48 fixed to a plate 49. A pin 50 is anchored to the lower end of the rod 47 to retain the boss 48 on this rod. Thus the plate 49 is supported by the hanger 40 with freedom of swinging movement therebetween.

It will be noted that a bar 51 has its end 52 fixed to the plate 49, while the free end 53 of this bar projects loosely through a U-shaped bracket 54 anchored to the lower end of the guide hanger 42. An angular end 55 on the bar 51 and a transverse pin 56 on the latter limit longitudinal movement of the hanger 42 relative to the length of this bar.

As the chain 36 passes around a portion of a circle, such as the sprockets 37 or 39, the plate 49 is permitted to swing on its journal rod 47. Likewise, the guide hanger 42 can move lengthwise relative to the bar 51. This will allow the vine-grasping and feeding unit F to negotiate a curve during its travel along the supporting rail E. Moreover, the unit can pass along the arced portion 57 disposed between the ascending and front horizontal rail sections 29 and 30, respectively, or along a corresponding arced portion between the rear horizontal and descending rail sections 32 and 33, respectively, all without binding action.

In Figures 5 and 6, I show an angle bar 58 fixed to the plate 49 so as to project therefrom. A series of inclined teeth 59 are welded or otherwise secured to this angle bar and also to the plate 49. The angle bar 58 and teeth 59 define a stationary vine-grasping jaw designated generally at 60.

As clearly shown in Figure 5, a movable jaw 61 coacts with the fixed jaw 60 to grip the butt end 15 of the hop vine B therebetween when the jaw 61 is lowered and occupies the dot-dash line position disclosed in this view. In its structural details, this movable jaw includes a plate 62, which is fixed to one end of a lever 63. The opposite end of this lever is swingably mounted by a bolt 64 to the plate 49.

In turn, the plate 62 has a curved saddle 65 fixed thereto over which the butt end of the hop vine is adapted to be draped, forming this end of the vine into a curved portion 15*a* (see Figure 5). This saddle has a straight extension 66 to which inclined teeth 67 of the movable jaw are welded.

It will be observed from Figure 5 that upon swinging the plate 62 and its teeth 67 into the lowered or dot-dash line position in this view, the extension 66 will parallel the vertical leg 58*a* of the angle bar 58. At this time, the butt end 15 of the hop vine will be firmly gripped from opposite sides by the teeth 59 and 67 of the two jaws. However, upon raising the plate 62 into the full-line position in Figure 5 (also see Figures 3 and 17), the vine will be released.

The weight of the hop vine B is sufficient to pull the plate 62 downwardly until its teeth 67 engage with the butt end 15 of the vine, it being noted that the curved end 15*a* of the vine is disposed over the saddle 65. The plate 62 and lever 63 have a pin 68 projecting therefrom, which is adapted to raise the movable jaw 61 when a new hop vine B is to be placed between the jaws 60—61 at the feed end 28 of the endless vine-carrier, or the remaining stalk of the vine is to be removed at the vine-release station 69 (see Figures 1 and 17).

Turning now to Figures 2, 3, 5 and 6, it will be seen that a fixed cam track 70 is suspended from the rail E by brackets 71 at the feed end 28 of the endless vine-carrier. This track has an inclined end 72 over which the pin 68 rides as the vine-grasping and feeding unit F passes through the feed end.

As illustrated in Figure 3, the pin 68 has moved up the incline of the cam track 70 and raised the movable jaw 61 clear of the stationary jaw 60. At this time, the operator inserts the butt end 15 of a new hop vine B over the saddle 65, with this butt end presented between the jaws 60—61. As soon as the pin 68 rides off the end 73 of the track (see Figure 3), the jaw 61 will move downwardly, thus gripping the vine between the two jaws. Figure 2 shows the butt end 15 of a hop vine B as being anchored to one of the units F, and being raised along the ascending section 29 of the supporting rail E for entry into the hop-picking unit D.

After passing through the unit D, the vine-grasping and feeding units F bring the stripped hop stems to the vine-release station 69 (see Figures 1 and 17. As each unit F enters this station, the projecting pin 68 rides up an inclined end 74 of a fixed cam track 75. Thus the plate 62 and lever 63 are raised to free the jaws from their grip on the butt end of the remaining hop vine.

Hop-picking unit

Broadly speaking, the hop-picking unit D includes four vertically-arranged picking conveyors D1 to D4, inclusive. These conveyors are identical with one another. As shown in Figures 1 and 18, the picking conveyors D1 and D2 are disposed on one side of the front horizontal rail section 30, while the picking conveyors D3 and D4 are arranged on the opposite side thereof.

The depending hop vines B that are advanced by the endless vine-carrier C initially pass between the confronting reaches 76 and 77 of the picking conveyors D1 and D3, which are arranged in horizontal angular relation relative to each other. Curved plates 78 (see Figure 1) guide the hop vines into the converging throat 79 defined between the reaches 76 and 77 (also see Figure 18). Likewise, the confronting reaches 80 and 81 of the picking conveyors D2 and D4 converge toward each other to define a gradually-diminishing throat 82 through which the depending hop vines must pass.

It will be noted from Figures 1 and 18 that the horizontal rail section 30 is arranged close to and parallel with the conveyor reaches 76 and 80. However, the reaches 77 and 81 are spaced from the rail section 30 in angular relation therewith. The angularity and spacing of the reach 81 with respect to the rail section 30 is somewhat less than is the case with the reach 77.

The picking conveyors D1 to D4, inclusive, are supported by a framework designated at G in Figures 1, 2 and 9. In their structural features, each of these conveyors include a pair of upper sprockets 83, which are mounted on horizontal shafts 84. Moreover, a pair of lower sprockets 85 are mounted on shafts 86 at the bottoms of each of these picker conveyors (see Figures 2 and 16). Endless chains 87 are trained around the upper and lower sprockets 83 and 85, respectively (see Figures 2, 9, 19 and 20).

Finger-carrying bars 88 are provided for each picking conveyor, and extend horizontally between the endless chains 87 thereof. The bars are secured to these chains so as to be advanced by the latter when rotary motion is imparted to the lower shaft 86 in the manner to be set forth later.

Reference is made to Figure 13, wherein the construction of picking fingers 89 is disclosed. Each finger includes a V-shaped outer end 90 having parallel shanks 91 extending therefrom. These shanks are anchored by clips 92 to the bars 88. Coils 93 are fashioned in the shanks of the fingers adjacent to the bars 88. In order to resist lateral strain on the picking fingers, the adjacent shanks are twisted together, as indicated at 94.

As the confronting reaches 76—77 and 80—81 are moved downwardly, as suggested by the arrows 95 in Figures 19 and 20, hops 96 are stripped from the vines B by the V-shaped ends 90 of the picking fingers.

Particular attention is called to the fact that the fingers 89 are arranged in a checker-board formation on the bars 88, as will clearly appear by reference to Figure 2. The rectangular groups H of picking fingers alternate with similarly-shaped spaces J on the checker-board design.

Contacting corners of the rectangular groups of fingers are arranged on the diagonal.

As shown in Figure 18, the groups of fingers H on the conveyor reach **76** are disposed opposite to the spaces J of the conveyor reach **77**. In the same manner, the finger groups H on the reach **80** are arranged opposite to the spaces J of the reach **81**. Actually the finger groups H on the confronting reaches toward the right-hand end of Figure 18 overlap one another (also see Figure 12).

Figure 19 clearly discloses the fact that the hop vine B will be formed into a wave-like configuration by the picking fingers on the confronting reaches of the conveyors. These waves define alternate crests and valleys extending along the length of the vine. Inasmuch as the butt end **15** of the vine is anchored between the overhead jaws **60**—**61**, the waves will be advanced lengthwise of the vine, continually replacing crests by valleys and vice versa. Accordingly, the vine will be undulated in first one direction and then the other, causing pendulum-like movements of the hops **96**. This will swing and expose the hops for removal by the descending picking fingers.

During the undulating of the hop vines, the latter are advanced to the right in Figures 1 and 18 by the vine carrier C. Since the throats **79** and **82** converge toward the right in Figure 18, the amplitudes of the waves will be progressively increased, causing greater undulating of the vines. Moreover, as the vine is moved along the rail section **30** in Figure 18, from one group H of fingers to the next group, the crests must be converted abruptly into valleys, and vice versa, at regular intervals.

It will be noted further that the hop vines are advanced along the rail section **30** in close proximity relative to the picking fingers on the conveyor reaches **76** and **80**. This will insure immediate picking of hops along one side of the suspended vines. The reaches **77** and **81** in Figure 18 define a double taper, in which the picking fingers are gradually brought into picking operation as the hop vine is advanced toward the right in this view.

As the space in the throats **79** and **82** narrows, pendulum-like movements are imparted to the hops **96** from both sides. This will result in better picking, because the hops will swing into the V-shaped ends **90** of the fingers. If the vines were not undulated back and forth, the tendency of the fingers would be to strip petals from one side of the hops. Such action would be undesirable, since the full hop is wanted—not broken ones.

Turning now to the right-hand portion of Figure 18, I have shown a hop vine B**1** by way of special illustration. This vine has its branches spread out laterally by the groups H**1** of fingers into the spaces J**1**. This separating action on the hop vine is due to the groups of fingers on one side of the vine being followed by the groups of fingers on the opposite side.

As the hop vine B**1** moves between two horizontally-spaced groups of fingers, the horizontal wave set up in the vine is brought to a stop or dampened. Then in moving into the next vertical rows of opposed groups of alternating fingers the vine is separated longitudinally. This aids the flattening effect and obviates any tendency of the vine to mat or merely be compressed. As the vine continues to move to the right, a wave motion opposite to the previous wave motion is set up.

Drive mechanism

Next I shall describe the mechanism for driving the vine carrier C and the hop-picking unit D. In this connection, reference is made to Figures 1, 2, 9, 10 and 11 for details.

Power is derived from a motor **97** having a drive pulley **98** thereon. The latter is connected through a belt **99**, or the like, so as to rotate a driven pulley **100** in a counter-clockwise direction in Figure 15. The pulley **100** is secured to a shaft **101** on which a drive sprocket **102** is fixed. This sprocket operates a driven sprocket **103** on the shaft **86** of the conveyors D**1** and D**2** by means of a chain **104**. The latter passes around an idler sprocket **105**, with the upper reach of this chain being trained under a lower section of a driven sprocket **106** fixed to a stub shaft **107**.

Figure 16 illustrates the shaft **107** as being connected by a flexible coupling **108** to one of the sprockets **85** on a lower shaft **86**. It will be observed that the latter extends at an angle corresponding with the angularity of the picking conveyor D**4** in Figure 18. In Figure 15, I show the chain **104** turning the sprocket **103** in a counter-clockwise direction, while the sprocket **106** rotates clockwise. This will move the reaches **76**—**77** and **80**—**81** of the picking conveyors downwardly in the directions of the arrows **95** in Figures 19 and 20 during operation of the machine.

The shaft **84** of the picking conveyor D**4** is utilized for driving the endless vine-carrier C. In Figures 9 to 11, inclusive, this shaft has a drive sprocket **109** fastened thereto. This sprocket is connected by a chain **110** to a driven sprocket **111** fixed to a shaft **112**. It will be seen from Figure 11 that the shaft **112** carries a sprocket **114** that is connected by a chain **115** to a sprocket **116** mounted on a vertical shaft **117**. On the latter shaft is fastened the main drive sprocket **37** around which the chain **36** of the vine-carrier C is trained. This completes the drive to the vine-carrier.

Hop-receiving conveyors

The hops **96** picked from the vines fall directly upon an upper reach **118** of a discharge screen conveyor K, which extends lengthwise of the machine beneath the hop-picking unit D (see Figures 1, 2, 9 and 14). Individual hops will pass through the mesh of the screen, falling onto an inclined chute **119**. The latter will deflect these hops into a discharge conveyor L.

It may be pointed out at this time that small branches torn from the hop vines and leaves will pass through the reach **118**, and will gravitate from the chute **119** into the conveyor L. This material, along with the individual hops, are discharged into a separating conveyor designated generally at M in Figures 1 and 2.

Clusters of hops and larger branches, which fail to pass through the mesh of the screen of the conveyor K are carried forward by the upper reach **118**, and are discharged over a drum **120** into a trommel N (see Figure 2). The details of the separating conveyors M are shown in my copending application on an Apparatus for Separating Picked Hops from Leaves and Stems, Ser. No. 179,723, filed August 16, 1950.

Referring now to Figures 2 and 14, any clusters, branches or the like, hanging onto the mesh of the upper reach **118** of the screen conveyor K may have a tendency to be carried along the lower reach **121** of this conveyor. This material is pulled along by the reach 121 to a drum 122, and is retained against dropping downwardly by an apron 123 disposed beneath this reach. A curved shield 124 is spaced from the drum 122 to provide a space through which this returned material may move onto the upper reach 118.

As the returned material, such as clusters and branches, again enter upon the upper reach 118 in Fig. 14, a hinged lip 125 prevents the material from dropping downwardly due to the free end of the lip riding on the periphery of the drum. This material is carried by the upper reach 118 of the screen K over an upwardly inclined stationary apron 118a that extends to the point X in Fig. 2. At this point, the material on the upper reach 118 is free to fall onto the inclined chute 119, see Figure 9. An idler roller is placed at the point X where the upwardly inclined portion of the upper reach 118 is changed into a horizontal portion that extends throughout the length of the machine.

It will be noted that a trough 126 is arranged adjacent to the carriage 11 when the latter is disposed on the platform 25. Thus hops, clusters, broken pieces of vines, etc., may be swept off the carriage 11 by the operator directly into this trough. The reach 118 of the screen conveyor K will transfer such material to the trommel N for further separation.

Any suitable means may be provided for driving the conveyors K and L. For this purpose, I have shown the drum 120 being rotated by a sprocket 127, the latter being turned by a chain drive. As shown in Figure 2, the drum is mounted on a shaft 129, and the latter is connected by another chain drive 130 to the head drum 131 around which the screen L is trained.

Summary of operation

While the vehicle 10 is in the field, the cut hop vines B are placed on the carriage 11, which is demountably mounted on the body of the vehicle. Upon arrival of the hop-transferring mechanism A, the pull chain 23 is engaged with the hook 24 on the carriage, and the endless chain 19 is operated by turning the crank 22 to draw the carriage and its vines toward the platform 25. Several of these carriages may be accommodated by upper feed tracks 17 of the transferring mechanism at one time.

Assuming that the motor 97 is running, with the vine-carrier C being advanced upon the ascending section 29 of the supporting rail E, toward the hop-picking unit D, the vine-grasping and feeding units F will enter the feed end or station 28 of the machine one at a time. As each unit F travels through this feed station, the pin 68 will ride upwardly along the inclined end 72 of the track 70 (see Fig. 3). This will serve to lift the movable vine-gripping jaw 61 away from the stationary jaw 60.

Now the operator standing on the platform 25 takes one of the hop vines, and places the butt end 15 thereof over the curved saddle 65 as suggested in Figure 5. The butt end is introduced between the teeth 59 and 67, with the curved end 15a of the vine overlying the saddle. As soon as the pin 68 clears the end 73 of the cam track 70, the movable jaw will gravitate downwardly to grip the butt end of the vine between the two jaws; of course, the weight of the vine will exert a downward pull on the movable jaw.

As the unit F moves upwardly along the ascending rail section 29, the hop vine carried thereby will depend from the vine-carrier in the manner illustrated in Figure 2. This vine-grasping and feeding unit F will convey the hop vine B into the throat 79 defined between the downwardly-moving reaches 76 and 77 of the picking conveyors D1 and D3, respectively. At this time the fingers 89 on the reach 76 will become active in removing hops from one side of the vine. During advancement of the vine along the rail section 30, the fingers on the reach 77 will remove hops from the opposite side of the depending vine.

The endless-vine-carrier C will continue to advance the unit F to the right in Figure 18, and will move the hop vine through the gradually-diminishing throat 82 provided between the reaches 80 and 81 of the picking conveyors D2 and D4, respectively. The fingers on these reaches will pick hops from both sides of the laterally-advancing vine.

Referring to Figures 19 and 20, it will be observed that the hop vine is formed into a wave-like configuration, with the waves being moved lengthwise of the vine toward the lower end of the latter. The crests and valleys of these waves are interchanged continually, with the amplitudes of the waves increasing as the vine is moved to the right in Figure 18. This will impart pendulum-like movements of the hops 96, swinging them into the paths of the descending picking fingers. Also, the branches of the vine will be spread out laterally, as suggested by the vine B1 in Figure 18, further exposing the hops for picking, and preventing the vine from being compressed into a mat.

The hops, clusters, leaves and branches stripped from the vine will fall downwardly to the upper reach 118 of the screen conveyor K (see Figures 2 and 9). Individual hops and smaller material will gravitate through the mesh of this reach, and will be deflected by the inclined chute 119 onto the discharge conveyor L. These hops and material are advanced to the separating conveyor M. The clusters, larger leaves and branches will be advanced by the screen conveyor K and discharged into the trommel N for further hop-picking operation.

I claim:

1. In the herein described method of picking hops from a vine, the steps of: forming the vine into a configuration having longitudinal waves, which define alternate crests and valleys extending along the length of the vine; advancing these longitudinal waves lengthwise of the vine to continually replace crests by valleys and vice versa, thereby undulating the vine in first one direction and then the other for causing pendulum-like movements of the hops and expose them for picking operations; simultaneously with the foregoing steps forming the branches extending laterally from the main part of the vine into configurations having waves extending lengthwise thereof which provide alternate crests and valleys extending crosswise relative to the general length of the vine, while at the same time advancing these branch waves laterally to undulate the branches of the vine crosswise; the longitudinal and branch waves crossing one another, thereby causing the vine to spread to expose hops and prevent it from matting by reversal of the amplitudes at the intersections of these crossing waves; and picking the hops from the vine during the longitudinal and crosswise undulatings and spreading of the vine.

2. The combination of steps as defined in claim 1, in which the amplitudes of both the longitudi-

nal and branch waves are progressively increased as the mass of the vine is reduced, thereby swinging other hops into position for picking operations.

3. The combination of steps as defined in claim 1, in which the crests of the branch waves are abruptly converted into valleys and vice versa to impart sudden spreading action to the vine and swinging of hops at the points of intersections of the longitudinal and branch waves.

4. In the herein described method of picking hops from a vine, the steps of: suspending the vine from one end thereof; imparting successive wave-like configurations to the vine, extending vertically throughout the entire length of the suspended vine; these vertical waves defining alternate crests and valleys; advancing these vertical waves downwardly of the vine, continually replacing crests by valleys and vice versa, thereby undulating the vine in first one direction and then the other for causing pendulum-like movement of the hops and expose them for picking operations; simultaneously with the foregoing steps forming the branches extending laterally from the main part of the suspended vine into configurations having horizontal waves, which provide alternate crests and valleys extending crosswise relative to the general length of the vine, while at the same time advancing the horizontal waves laterally to undulate the branches of the vines crosswise; the vertical and horizontal waves crossing one another, thereby causing the vine to spread to expose hops and prevent it from matting by reversal of the amplitudes of these crossing waves; and picking the hops from the vine during the vertical and horizontal undulatings and spreading of the vine.

5. The combination of steps as defined in claim 4, in which the amplitudes of both the vertical and horizontal waves are progressively increased as the mass of the vine is reduced, thereby swinging other hops more violently into positions for picking operations.

6. In a hop-picking apparatus: picking conveyors having upright reaches mounted in confronting relation with one another; means for moving these reaches in a downward direction; means for advancing a hop vine horizontally in a lateral direction between these reaches, with the vine depending therebetween; and hop-picking fingers carried by the conveyors to strip hops from opposite sides of the vine; the fingers on each conveyor being mounted thereon in groups, with spaces provided between adjacent groups on each conveyor; each group having a plurality of fingers arranged in each of a plurality of rows; each group being spaced horizontally and vertically from adjacent groups in the same reach by a distance equal to the dimension of the group and being arranged opposite the space between horizontally and vertically spaced groups on the other reach.

7. In a hop-picking apparatus: picking conveyors having reaches mounted in confronting relation with one another; means for moving these reaches for hop-picking operations; means for advancing a hop vine laterally between these reaches, with the vine extending therebetween; and hop-picking fingers carried by the conveyors to strip hops from opposite sides of the vines; the fingers on each conveyor being arranged in groups, with spaces provided between adjacent groups on each conveyor; each group having a plurality of fingers arranged in each of a plurality of rows; each group being spaced in directions extending at substantially right angles to one another by a distance equal to the dimension of the group and being arranged opposite the space between groups on the other reach.

8. In a hop-picking apparatus, means for advancing vertically suspended hop vines in a horizontal predetermined path, hop picking fingers disposed on opposite sides of said path and projecting into the path of the vine so as to engage a vine being advanced along said path, said hop-picking fingers being mounted on movable elements and being movable in a direction normal to said path and longitudinally of the vine by said elements so as to strip hops from vines engaged thereby, said fingers being mounted on said elements in groups, each group being a plurality of fingers arranged in each of a plurality of rows, each group being spaced horizontally and vertically from adjacent groups on the same side by a distance equal to the dimension of the group and being arranged opposite the space between the horizontally and vertically spaced groups on the opposite side of the path.

9. In a hop-picking apparatus, means for advancing vertically suspended hop vines in a horizontal predetermined path, hop picking fingers disposed on opposite sides of said path and projecting into the path of the vine so as to engage a vine being advanced along said path, said hop-picking fingers being mounted on movable elements and being movable in a direction normal to said path and longitudinally of the vine by said elements so as to strip hops from vines engaged thereby, said fingers being mounted on said elements in groups of substantially equal extent along transverse axes, each group having a plurality of fingers arranged in each of a plurality of rows, each group being spaced horizontally and vertically from adjacent groups on the same side by a distance equal to the dimension of the group and being arranged opposite the space between the horizontally and vertically spaced groups on the opposite side of the path.

10. In a hop-picking apparatus, means for advancing suspended hop vines in a predetermined horizontal path, two opposing planes of picking elements, said path extending between said planes, said picking elements projecting into the path of the vines and being disposed so as to engage vines being advanced along said path, said elements being movable in a direction normal to said path and longitudinally of the vines so as to strip hops therefrom, said elements being mounted in groups forming a checkerboard-like arrangement on both of said planes, each group having a plurality of fingers arranged in each of a plurality of rows, each group being spaced horizontally and vertically from adjacent groups on the same plane by a distance equal to the dimension of the group and being arranged opposite the space between the horizontally and vertically spaced groups on the opposite plane.

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MACHINE FOR STRIPPING HOP VINES

Filed May 16, 1950 6 Sheets-Sheet 1

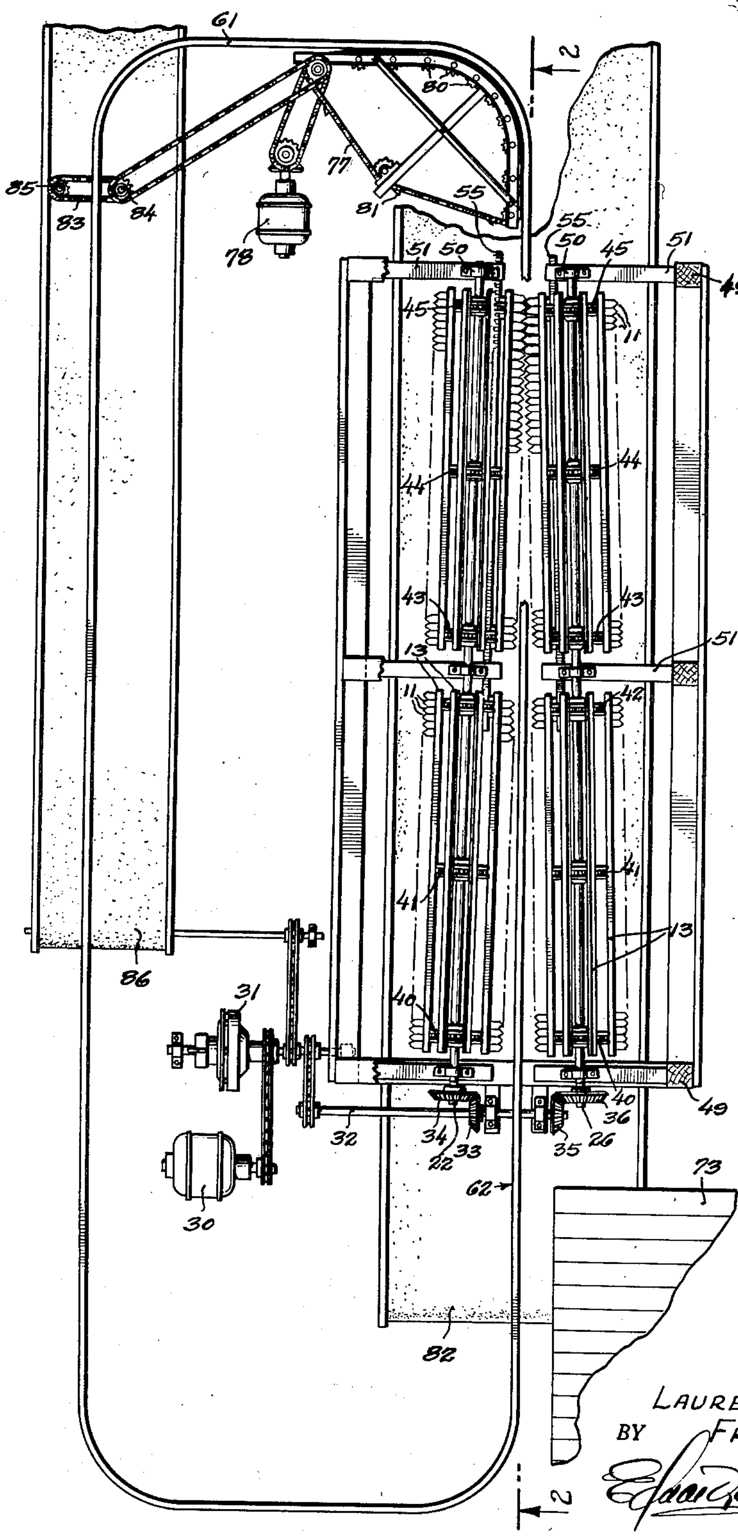

FIG. 1

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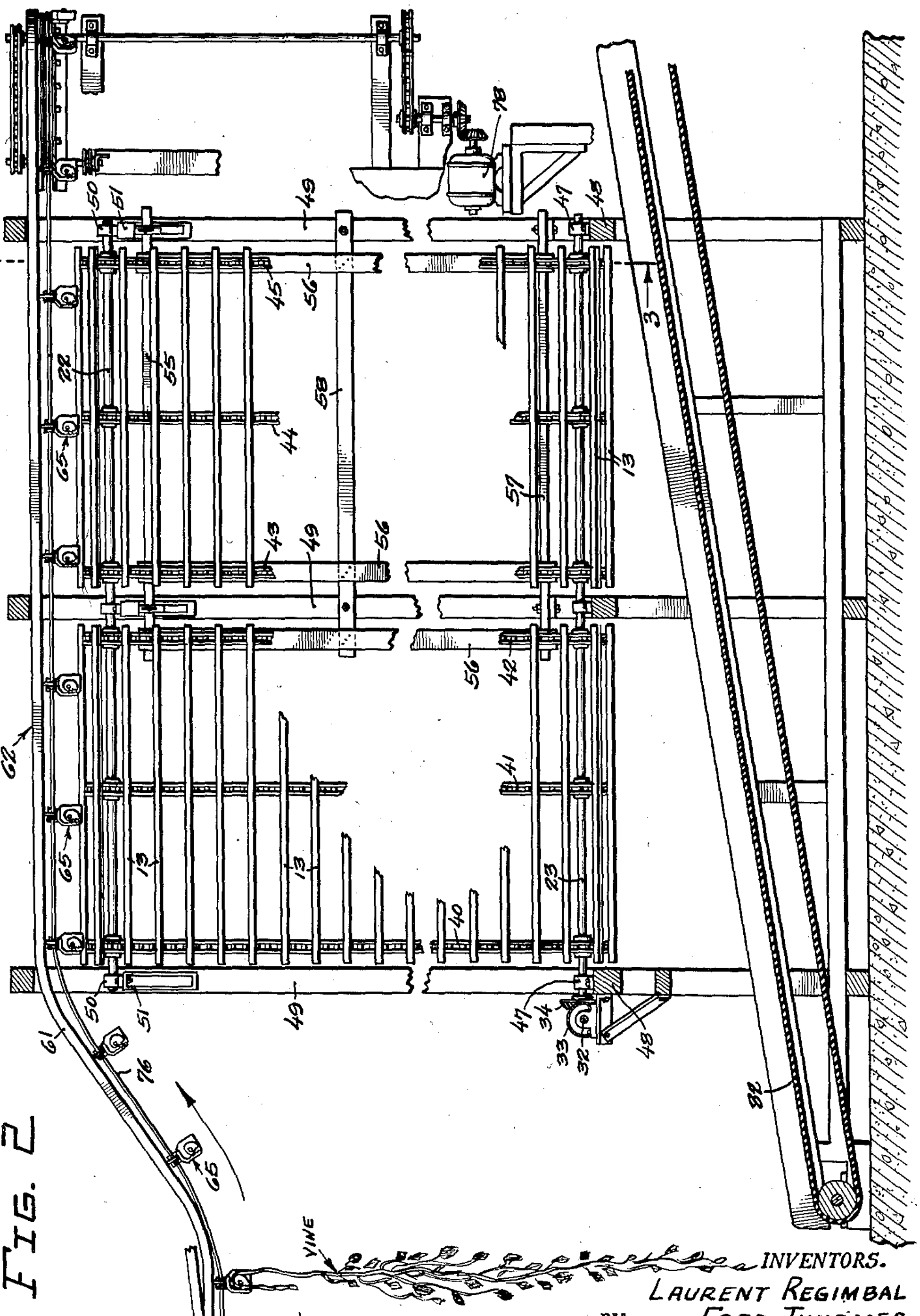

FIG. 2

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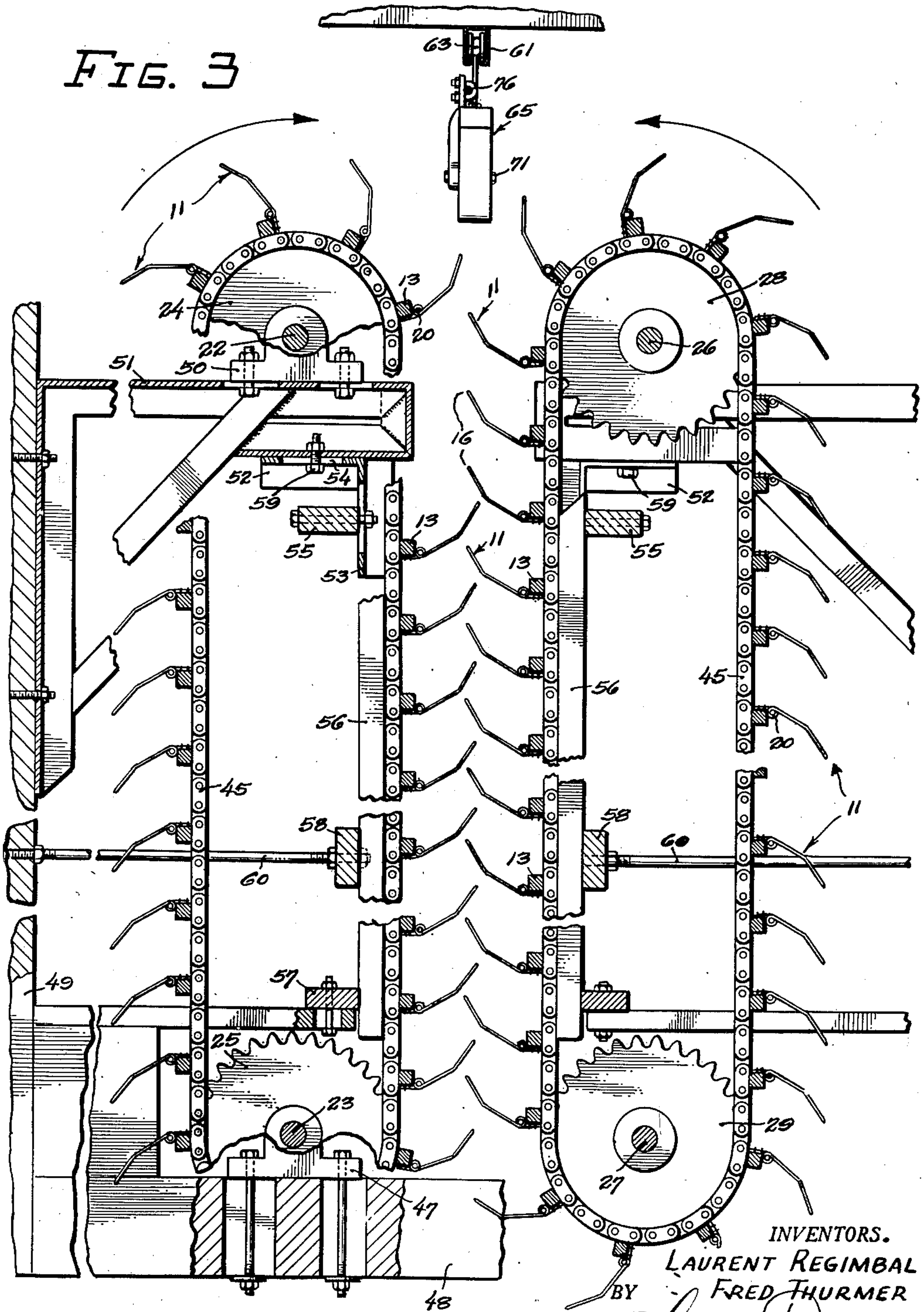
FIG. 3



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MACHINE FOR STRIPPING HOP VINES

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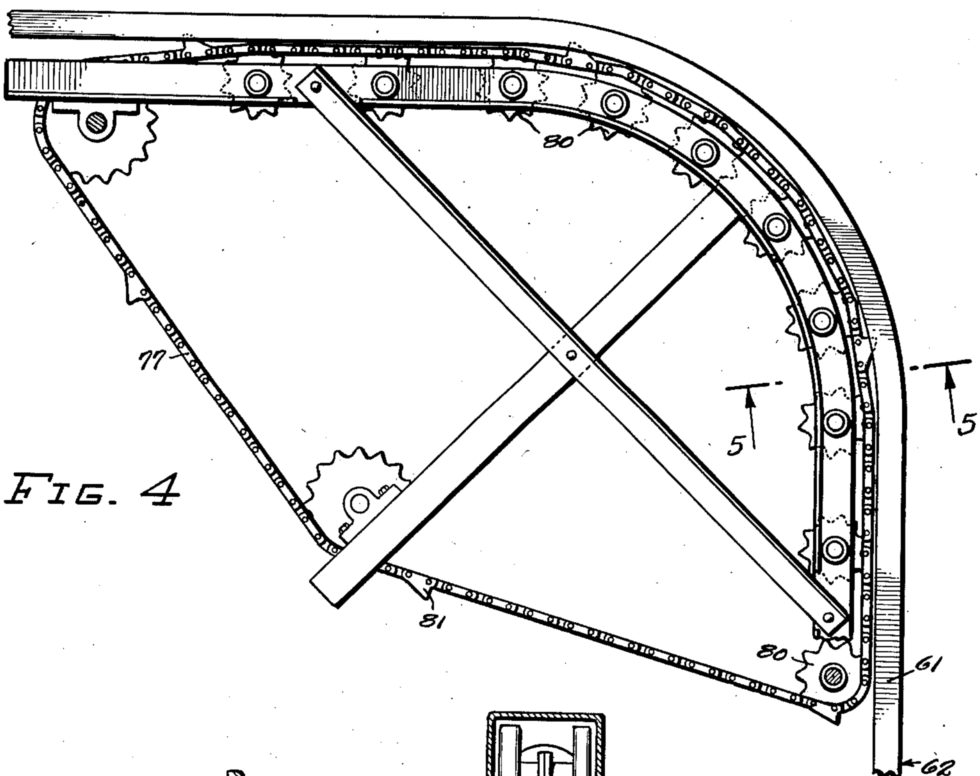

FIG. 4

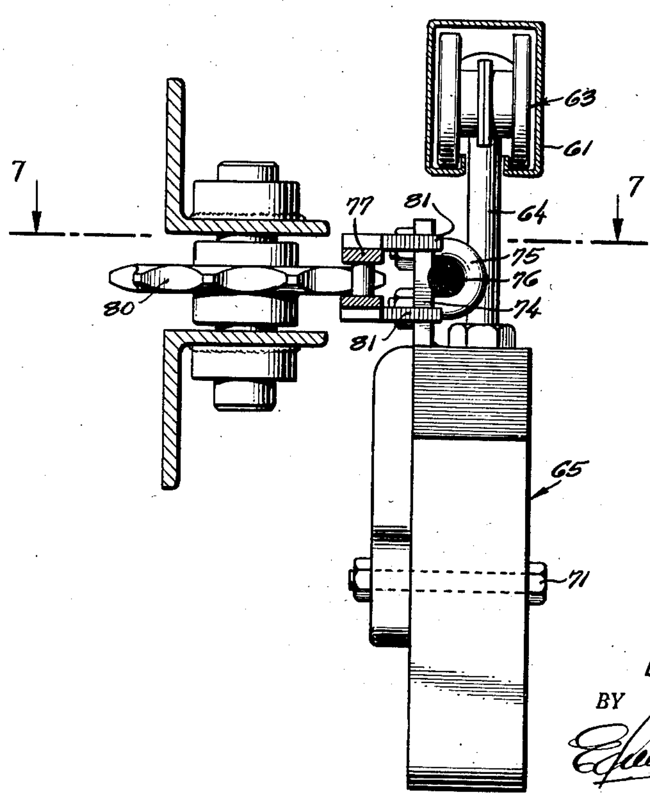

FIG. 5

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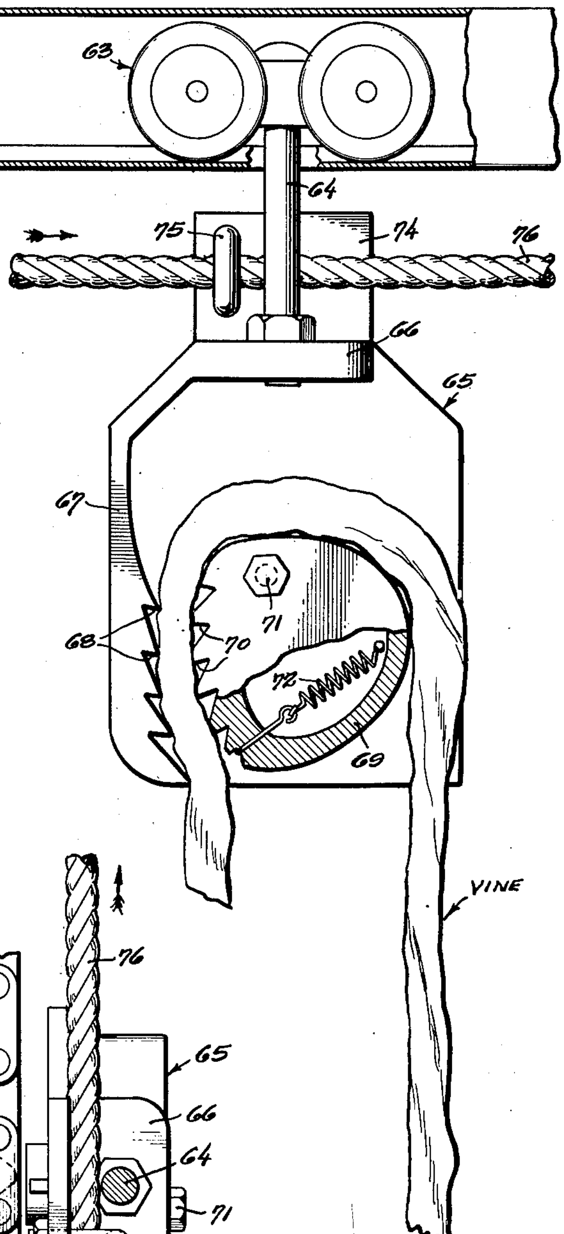
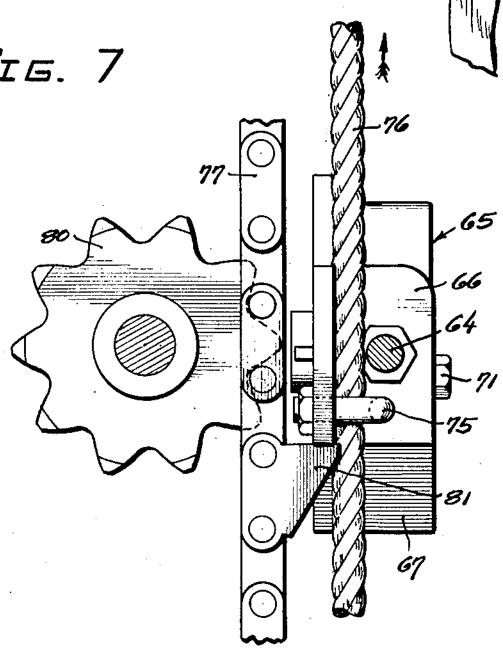


FIG. 6

FIG. 7



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MACHINE FOR STRIPPING HOP VINES

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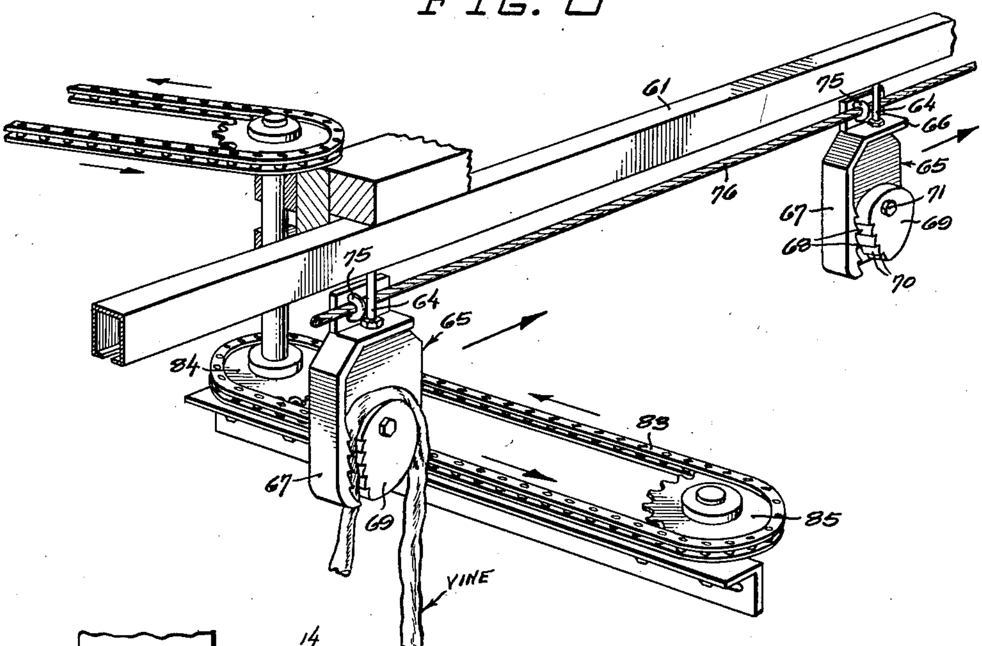
FIG. 8



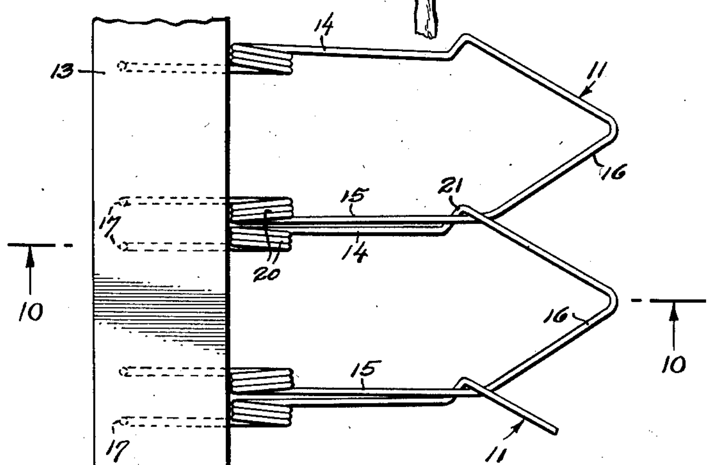
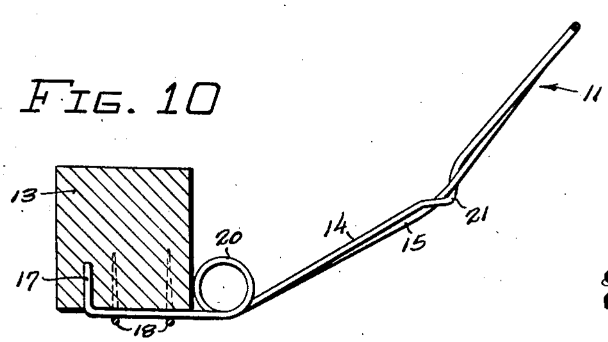


FIG. 9

FIG. 10



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MACHINE FOR STRIPPING HOP VINES

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Application May 16, 1950, Serial No. 162,173

13 Claims. (Cl. 130—30)

This invention relates to the hop-picking art, and especially pertains to a machine for stripping hop vines to divest the same of substantially all the foliage. This is to say that the present invention is concerned with a machine for stripping leaves and branches as well as the hop-bearing flowers from the main stem of the vine and leaving little more than an occasional tributary limb upon the latter. Within the hop-picking art this stripping procedure has developed separate status from the later steps of separating the stripped matter to largely segregate the flowers from twigs and leaves.

The principal object of our invention is to devise a machine in which the vines to be stripped are given continuous travel through a picking zone and wherein fingers working in this zone and which perform a raking function upon opposite sides of the advancing vine move continuously in paths at cross-angles to the directional travel of the vines.

It is a further and particular object to devise a machine for stripping a hop vine characterized in that the vine hangs pendant as it moves through the picking zone and the picking fingers are arranged in horizontal rows with their directional travel downwards.

As a further object still the invention aims to provide a machine in which the downwardly moving columns of rows lying at opposite sides of the advancing vine occupy converging vertical planes to define a flared picking throat which narrows progressively in the direction of the vine's travel, and wherein the rows of fingers disposed at the two sides of the throat are vertically staggered and made to lap one another as they approach the egress end.

The invention has the yet further and important object of devising a hop picking machine embodying the described features and which additionally permits the span across the ingress end of the throat to be adjusted for width in compensation of varying conditions of growth which are found in different runs of hop vines.

As a further object still, the invention aims to provide a hop picking machine of the described character peculiarized in that the suspended free ends of the vines are allowed to readily enter the throat with no tendency to hang back as the forward progress brings the foliage into contact with the downwardly moving fingers.

A yet further object is to provide an improved endless overhead carrier for the hop vines as well as to perfect associated grasper devices for securely holding the butt ends of hop vines.

The invention has the yet further and important object of devising means by which each of the vine-carrying grasper blocks, following its traversal of the picking throat, is caused to be automatically freed of the stripped vine before again reaching a point in the block's endless travel where a fresh vine is hung therefrom.

With these and still other more particular objects and advantages in view, the invention consists in the new method of stripping foliage from the hop vine, and in the novel construction, adaptation, and combinations of the parts of a machine for performing said method.

In the accompanying drawings:

Figure 1 is a top plan view with parts broken away illustrating our new preferred embodiment of a hop-picking machine constructed according to the teachings of the present invention.

Fig. 2 is a fragmentary longitudinal vertical sectional view on line **2—2** of **Fig. 1.**

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Fig. 3 is a fragmentary transverse vertical sectional view drawn to an enlarged scale on line **3—3** of Fig. 2.

Fig. 4 is a fragmentary top plan view employing a scale corresponding to that of Fig. 3 and detailing the drive mechanism for giving continuous travel to the overhead carrier and the vine-engaging grasper blocks which are carried thereby.

Fig. 5 is a transverse vertical sectional view drawn to an enlarged scale on line **5—5** of Fig. 4.

Fig. 6 is an enlarged fragmentary side elevational view, partly broken away and in section, portraying one of the trolley-carriers and its associated grasper block.

Fig. 7 is a fragmentary horizontal sectional view on line **7—7** of Fig. 5.

Fig. 8 is an enlarged perspective view showing a fragmentary part of the endless track on which the trolley-carriers ride and illustrating mechanism by which we automatically disengage the stripped hop vines from the grasper blocks as the latter progress beyond the picking throat in their endless travel along the overhead track.

Fig. 9 is an enlarged-scale fragmentary top plan view illustrating the picking fingers which we employ; and

Fig. 10 is a transverse vertical sectional view on line **10—10** of Fig. 9.

The work of stripping the vines is accomplished in the present invention, as with the more successful of the prior machines devised for this purpose, by subjecting the vines to the stripping influence of successive rows of flexible fingers designated generally by the numeral **11.** The multiple fingers in each row give much the appearance and perform their intended office in the manner of a comb or rake and it is by the former term that I will hereinafter refer to each row. Arranged in sets, the combs derive support from an endless catepillar-type picker belt and occur as substantial flights running transversely at right angles to the travel path and placed at fairly close equidistantly spaced intervals about the circumference of the belt. The belts preferably comprise spaced chains connected by cross-slats **13**, and the comb-forming fingers are secured to these slats. The fingers which we employ are each produced from a length of spring-wire bent upon itself to present spaced parallel shank sections **14—15** joined by a V-shaped tongue extremity **16** and presenting a prong **17** at the free extremity of each limb, the prongs being bent approximately at right angles to the plane occupied by the two shanks. These prongs are driven into the cross-slat and are anchored by complementing staples **18.** Each shank contains a spring-forming coil **20** within its length. At the point of juncture between the terminal tongue and one of the two shanks of each finger there is provided a deforming offset **21** and this enables adjoining fingers to be interlocked in a manner clearly apparent from an inspection of Figs. 9 and 10. The fingers are so made and mounted as to cause the V-shaped tongues to slope retrogressively in relation to the direction of travel.

According to the present invention the chains of the said belts are trained about upper and lower sets of sprocket wheels fixedly carried upon axles which are journaled for rotation about spaced vertically aligned horizontal axes, and the belts are employed in pairs with the two belts of each pair being opposingly placed at opposite sides of a longitudinal vertical plane. This is to say that the axles **22** and **23** which carry the sprocket wheels **24** and **25** for one belt of the pair are journaled to lie in vertically spaced parallel relation at one side of the machine and the axles **26** and **27** which carry the sprocket wheels **28** and **29** for the other belt of the pair are journaled to lie in vertically spaced relation at the other side of the machine. The vertical planes occupied by the related upper and lower axles converge toward the rear or tail end of the machine. Viewed from above, a longitudinal throat is described between the inner runs of the belts and from the fact that the two sets of axles lie in converging vertical planes it perforce follows that the throat narrows toward the tail end. Moreover, at the tail end of the machine the extreme inner ends of the combing fingers lap one another. and in compensation of this lapping the successive combs of one belt are staggered in relation to the combs of the other belt whereby each comb, as it travels along its inner run, finds interfitting registration with the interstices which occur between the combs of the other belt.

An electric motor **30** or other suitable source of power common to both belts drives the same in concert, although in different directions of travel, the drive being carried through a clutch **31** to a cross-shaft **32** and thence by intermeshing bevel gears **33—34** and **35—36** to the two axles **23** and **27**. The direction in which the belts are driven causes the combs of both belts to move downwardly along the inner run of the related belt's travel. As will appear in the course of the following description, the vines to be picked are supported from an overhead conveyor and, hanging pendant therefrom, move uninterruptedly in a horizontal direction longitudinally of the throat hence causing the combs to rake downwardly along the length of each vine as the latter traverse the throat.

We indicate our machine as having two in-line belts at each side of the throat, but a single said belt or a ganged greater number of belts could feasibly be employed. The illustrated arrangement is one in which three endless chains are provided for each belt, located one chain at each end and the other chain intermediate the two end chains. For each set of two in-line belts there are consequently provided six chains and inasmuch as parts hereinafter to be described are related to certain of said chains the six chains are designated, in the order of the occurrance from front to rear of the machine, by **40, 41, 42, 43, 44** and **45**. The axles, which are made common to all six chain-carrying sprocket wheels, run the full length of the machine, and are carried by pillow blocks placed at the two end extremities of the machine and at a center point lying between the in-line belts.

It should be here pointed out that the foliage may be quite heavy on some runs of hop vines and comparatively light on others, and it becomes desirable, therefor, that provision be made for setting the admission end of the throat to either a wide or a narrow opening in order that the combing fingers will be effective upon the vines throughout substantially the full length of the throat. We attain this end by slidably mounting the center pillow blocks and the front-end pillow blocks for transverse adjustment. The rear-end pillow block is or may be stationary. In compensation of such adjustment the bearings proper are set in rubber to make the same self-aligning. The lower-level pillow blocks, designated by **47**, rest upon and are adjustably bolted to transverse spanning timbers **48** extending between side posts **49** of a suitable framework, and the upper-level blocks **50** rest upon and are adjustably bolted to a respective inwardly directed bracket **51** secured to said posts. By this token it will be seen that three such brackets are provided at each side of the machine, one at the center and the other two at the ends. Both the rear-end bracket and the center bracket have an angle-shaped fitting secured to the underside of its free inner end, and such fitting is made transversely adjustable toward or from the throat. The fitting which we employ is fabricated from two lengths of joined channel-iron stock and has the web section of each of its two legs **52** and **53** longitudinally slotted. The leg **52** underlies the bracket arm and is secured thereto by a bolt **59** received through the slot **54**. The other leg **53** serves as a pendant hanger, and gives support to a horizontal stringer **55** which runs longitudinally and extends somewhat more than half the length of the machine from the rear-end limit thereof to and slightly beyond the transverse vertical plane occupied by the chain **42**. This chain, as well as the chains **43** and **45**, are each given a backing support as they move along their inner-run travel by being caused to ride upon vertical shoes **56** spiked or otherwise attached at their upper ends to the described stringer and localized at their lower ends by a second longitudinal stringer **57** which, like the stringer **55**, is secured for transverse adjustment to the framework of the machine. In addition to these top and bottom connections the shoes **56** may, if desired, be also localized at the center by a stringer **58** stabilized by a stay-rod **60** which is made adjustable for length.

Proceeding now to describe the conveyor system by which we feed the hop vines in a pendant condition through the foliage-stripping throat, the overhead track which we employ is or may be a standard barn-door channel track, designated by **61**. Considered in top plan this track is endless and traces a more or less rectangular pattern with one side or section **62** of the rectangle, hereinafter termed the feed side, coinciding with the longitudinal vertical center line of the throat and the two ends lying well beyond the front and rear end limits of the picker proper. These ends merge with the sides by comparatively gradual bends. A connected train of trolley-carriages **63** rides along the track, with the carriages placed at equidistantly spaced intervals of the circumference, and each of these carriages presents a pendant hanger-bolt **64** to which a grasper block **65** is rigidly secured.

Made as a special casting, this block presents a bolt-engaging horizontal web **66** at the top and along the rear edge provides a vertical flange **67** prolonged as a continuation of this web, and formed in the back face of this flange are a series of downwardly-pointing ratchet-like teeth **68** serving as a stationary jaw. As a complement to this stationary jaw there is eccentrically pivoted upon the block a hollow disc **69** having in its perimeter a series of ratchet-like teeth **70** opposed to the teeth **68**. The eccentric pivot **71** lies above the horizontal center of the jaws and the jaws hence close by a clock-wise swing of the disc. An extension spring **72** is housed within the hollow center of the disc and attaches by one end to the disc and by its other end to the block body in such a manner as normally to effectuate a counter-clockwise jaw-opening movement of the disc. The disc presents a rather wide rim and a vine which is to be grasped by the grasper block is looped by an operater over this rim. The operator performing such work stands upon an upper-level platform **73** located at the front end of the machine and bends the root or butt end of the vine to form the loop, placing the loop over the rim of the disc and then pressing the movable jaw inwardly to initiate a bite whereupon the pendant weight of the long or foliage-carrying end of the vine tightens the movable jaw upon the vine.

Each of the said grasper blocks presents an upstanding lug **74** located to the rear of the hanger-bolt **64**, and a saddle-notch is grooved horizontally along the front face of this lug. A flexible cable **76** acting to couple the multiple grasper blocks in an endless train seats in this notch and is made secure to the lug by a shackle-bolt **75**.

Continuous travelling energy is given to the connected train of grasper blocks by an endless drive chain **77** powered in any suitable manner, as by an electric motor **78**, and this chain is so guided by sprocket wheels **80** as to cause one run of the chain to trace a curving path parallel to and alongside the bend of the track which occurs at the tail end of the track's feed side **62**. The horizontal plane occupied by this chain coincides with that of the cable **76**. Pairs of vertically spaced ears **81** are carried by separated links of the chain to occur at spaced intervals corresponding to the spacing of the grasper blocks, and these ears straddle the cable and take a purchase against the back edge of the lugs **74**.

From the foregoing it will be understood that the operator loads the empty grasper blocks as the same successively pass before him in their continuous travel to the picker proper, and as the hanging vines are then carried into the throat and move progressively from the open to the closed end of the latter the downwardly moving combs rake the vines, initially picking only the outside foliage and then penetrating continually deeper until finally substantially the entire vine is stripped as the travelling grasper blocks are caused to traverse the full length of the picker belts. At the wide ingress end of the throat the belts are free to partake of a slight outward bellying in order to freely admit the travelling vines, and contrary to what might be expected it is a peculiarity of the present machine that the hanging free end of the vine, once the same has been engaged by the combing fingers, tends to slightly lead rather than follow the grasped butt end.

Distinguished from hop-picking machines as they have been heretofore known and which cause the hop-picking fingers to penetrate the full depth of the foliage throughout substantially the entire picking operation, the fact that the present invention initially works on only the side-edge portion of the foliage and then causes the fingers to penetrate with progressive travel of the vines is found to be especially advantageous as protection against mutilation of the hop-bearing flowers and a greater separation of the picked foliage, and which is to say that the flowers, leaves and twigs which fall from the bottom end of the throat are separated into smaller clusters and the later segregation of the flowers is considerably facilitated. While the machine by which we accomplish the work of separating the flowers from other stripped foliage embodies several distinct improvements the same is no part of the present invention and suffice it to here say that the stripped foliage falls from the throat onto a subjacent endless conveyor belt **82** whence it is carried to the separator.

A feature of the present invention is the provision of a means by which the grasper blocks are freed of the stripped vines automatically as they travel beyond the picking belts. Said means comprises an endless chain **83** extending transverse to the track and trained about driving and idler sprocket wheels **84—85** for movement in a horizontal plane located slightly below the travel path of the grasper blocks. The run of the chain which lies proximal to the advancing blocks travels in an outward direction and as the hanging long end of the vine which is draped over the front edge of the grasper disc **69** comes into contact with the outwardly moving chain links the vine is frictionally caught by the links and slipped thereby off the top rim of the disc, the weight center then shifting to the back edge of the disc. This shift of the weight center is self-sufficient to open the jaws and release the vine, the spring **72** serving only to yieildingly maintain the jaws in an open condition as the blocks move beyond the vine-releasing chain in their travel to the loading platform **73**. In the rare circumstance that a vine should by chance resist the frictional pull of the chain and fail to slip off the rim of the disc **69**, there is still no liability of the same hanging up on the chain in that it will simply move outwardly with the latter and pass with the chain around the tail sprocket wheel, thence proceeding with the moving grasper block and allowing the operator to manually remove the vine as the block reaches the loading platform. We find that there is no need for any lugs or other projections upon the chain, friction alone being sufficient to effectively slip the vines off the rims. The released vines drop onto an endless conveyor **86** which carries the same to a chopper (not shown).

The invention and the manner of its operation should be clear from the foregoing description of our now preferred illustrated embodiment. Changes in the details of construction may be resorted to without departing from the spirit of the invention and we accordingly intend that no limitations are to be implied and that the hereto annexed claims will be given a scope fully commensurate with the broadest interpretation to which the employed language admits.

What we claim is:

1. In a hop picking machine, a machine frame, two sets of upper and lower axles journal-mounted from the frame one alongside the other for rotation about horizontal axes in two converging vertical planes, a like plurality of sprocket wheels on each axle placed at the two ends and at intervals of the length, endless chains trained about vertically aligned upper and lower sprocket wheels of each of said sets of axles, horizontally extending cross-slats connecting the chains of each set and placed to have the cross-slats of one set of the chains vertically staggered in relation to the cross-slats of the other set of chains, a row of resilient V-shaped picking fingers rigidly secured to extend as substantial flights from each cross-slat, the placement of the chain sets being such that said rows of picking fingers are transversely spaced from one another at the wide end and lap one another at the narrow end of the converging throat defined between the chain sets, correlated means for continuously driving one axle of each set to cause the rows of picking fingers to move downwardly at a corresponding speed as they are carried by the chains along the inner run of the chains, and means for giving continuous horizontal travel to a succession of suspended hop vines to cause the vines to completely traverse the throat working without interruption progressively from the wide to the narrow end of the latter.

2. The hop picking machine of claim 1 in which the axles admit of being swingably adjusted for increasing or decreasing the width of the throat at the admission end thereof.

3. The hop picking machine of claim 2 in which the chains which lie at the wide admission end of the throat

are free to belly outwardly by force of pressure from foliage of hop vines as the latter enter the throat and wherein vertical frame-carried backing bars are applied behind the inner runs of the remaining chains to resist said pressure and force the picking fingers to penetrate the foliage, said backing bars being adjustably mounted to allow the same to be bodily shifted inwardly and outwardly in compensation of swing adjustment given to the axles.

4. In a hop picking machine, a machine frame, two sets of vertically aligned upper and lower axles supported from the frame to lie at opposite sides of a longitudinal median and journaled for rotation about horizontal axes, sprocket wheels on the two ends of each axle, endless chains trained about upper and lower sprocket wheels of each of said sets of axles, cross-slats connecting the chain which lies at one end with the chain which lies at the other end of each of said axle sets and placed to have the slats of one set of chains vertically staggered in relation to the cross-slats of the other set of chains, said connected chains each serving as an endless belt, a row of resilient V-shaped picking fingers rigidly secured as a substantial flight to each cross-slat and projecting therefrom such that the reach of the fingers along the inner runs of said belts is short of said longitudinal median at one end of the belts and progressively nears and ultimately laps said median at the other end of the belts, and means for giving continuous horizontal travel to a suspended hop vine to pass the vine between the opposing fingers working completely from the wide to the narrow end limit of the converging throat which is defined between the latter.

5. In a machine for stripping hop vines, a pair of endless spaced belts supported with a respective pair of runs thereof occupying converging vertical planes to define a narrow stripping throat between said opposing runs and provided at spaced intervals of the circumference with transversely extending rows of stripping fingers, means for driving the belts to have the fingers along the two sides of the throat move in a downward direction, a fixed endless track supported to have one section thereof extend along a generally horizontal plane immediately overlying the throat on the substantial median line of the latter, a plurality of conveyor blocks movably supported on the track and each providing means for releasably grasping the butt end of a hop vine to suspend the vine therefrom, drive means functional upon the grasper blocks to cause the same to continuously travel about the track, and means occupying a position along the path travelled by the conveyor blocks and operating automatically by progressive movement of each block beyond the throat to release the stripped vine from the block.

6. In a machine for stripping hop vines, a pair of endless spaced belts supported with a respective pair of runs thereof occupying converging vertical planes to define a narrow flared stripping throat between said runs, each said belt being provided at equidistantly spaced intervals of the circumference with transversely extending rows of stripping fingers, means for driving the belts to have the fingers along the two sides of the throat move in a downward direction, a fixed endless track supported to have one section thereof extend along a generally horizontal plane in immediate overlying relation to the throat on the substantial median line of the latter, a plurality of conveyor blocks movably supported on the track and each providing means for releasably grasping the butt end of a hop vine to suspend the vine therefrom, drive means functional upon the grasper blocks to cause the same to continuously travel about the track, the direction of travel being such as to cause the hanging vine to enter the wide end and leave the narrow end of the stripping throat, and means occupying a position along the path travelled by the conveyor blocks and operating automatically by progressive movement of the block beyond the throat to release the stripped vine from the block.

7. In a machine for stripping hop vines, a pair of endless spaced belts supported with a respective pair of runs thereof occupying converging vertical planes to define a narrow flared stripping throat between said runs, each said belt being provided at spaced intervals of the circumference with transversely extending rows of stripping fingers, means for driving the belts to have the fingers move in a downward direction along the

said opposing runs of the belts, a fixed endless track supported to have one section thereof lie horizontally in overhead relation to the belts and in vertical alignment with the longitudinal median line of the throat, a connected train of trolley-carriages riding on the track, a respective grasper block suspended from each carriage to lie below the track, means for giving continuous travel to said train of carriages and their suspended blocks, each of said block members presenting opposed jaws arranged to releasably grip the butt end of a hop vine and allow the vine proper to hang freely therefrom, a loading platform permitting foliage-laden vines to be manually hung from successive blocks in the train as the blocks approach the ingress end of the stripping throat, and means acting upon the stripped vines automatically in response to their travel beyond the throat and before reaching said loading platform for automatically freeing the vines from the jaws.

8. In a hop picking machine, a pair of endless picker belts each provided at spaced intervals of the circumference with transversely extending picking combs and supported one said belt in opposition to the other to define a picking throat therebetween, means for driving the belts to have the combs on adjacent surfaces thereof continuously travel in the same direction, and conveyor means movable in continuous travel progressively from one to the other end limit of said throat along a travel path outside the throat which is at approximate right angles to the path continuously travelled by said combs, means being provided by said conveyor means for engaging and giving travel to a hop vine so that the vine will move with the conveyor and completely traverse said throat moving without interruption progressively from one to the other end extremity of said throat along a travel path which is at approximate right angles to the path continuously travelled by said combs and with the foliage-bearing stem of the vine being disposed within the throat and approximately at right angles to the direction of its own travel.

9. In a hop picking machine, a pair of endless picker belts each provided at spaced intervals of the circumference with transversely extending picking combs, said belts being supported with one run of one belt opposing a run of the other belt and with said opposing runs converging in a direction transverse to the directional travel of the belts as they move along said opposing runs thus defining a flared picking throat between said opposing runs which narrows in a direction endwise to the rotary axes of the belts, means for driving the belts to have the combs continuously travel in the same direction as they move along the said opposed runs, and means for giving continuous travel to a hop vine to cause the vine to completely traverse said throat moving without motion endwise to its own axis progressively from one to the other end extremity of said throat entering at the wide end and leaving at the narrow end extremity thereof with the foliage-bearing stem of the vine, during said traversal, being positioned within the throat and at cross-angles to the direction of its own travel.

10. In a hop picking machine, a pair of endless picker belts each provided at spaced intervals of the circumference with transversely extending picking combs, said belts being supported with a run of one belt opposing a run of the other belt and with said opposing runs being disposed in vertical planes which converge horizontally to define a flared picking throat between the belts having a substantially uniform width from top to bottom and narrowing in a horizontal direction, means for driving the belts to have the combs along the two sides of the throat move in a downward direction, and means for giving continuous travel to a suspended hop vine to cause the vine to completely traverse the throat working without interruption progressively from one to the other extreme end limit of the throat with the direction of travel being from the wide to the narrow end of the latter.

11. In a hop picking machine, a pair of endless belts supported with a run of one belt opposing a run of the other belt with said opposing runs occupying converging vertical planes so as to define a flared throat therebetween, said belts being provided at equidistantly spaced intervals of the circumference with transversely extending picking combs which are vertically staggered as between said opposing runs of the two belts and lap one another at the narrow end of the throat, means for driving the belts to have the combs along the two sides of the throat move in concert at a uniform speed in a downward direction, and means for giving continuous travel to a succession of suspended hop vines to cause the vines to move through the full length of the throat working progressively without interruption toward the narrow end of the latter.

12. A hop picking machine according to claim 11 having means for adjusting the width of the throat at the wide admission end thereof without disturbing the spacing of the belts at the narrow end.

13. In a hop picking machine, a pair of endless belts each comprised of a plurality of endless chains trained top and bottom about sprocket wheels journaled for rotation about vertically spaced horizontal axes and mounted one belt alongside the other with the opposing inner runs of the belts occupying converging vertical planes to describe a flared picking throat therebetween, said belts being each provided at equidistantly spaced intervals of the circumference with transversely extending picking combs which are vertically staggered as between the two belts and lap one another at the narrow end of the throat, means for driving the belts to have the combs move in a downward direction along said opposing inner runs of the belts, means for giving continuous travel to a succession of suspended hop vines to cause the vines to move without interruption progressively through the picking throat entering at the wide end and leaving the narrow end of the latter, and supporting means bearing against portions of the outer sides of said opposing inner runs to resist outward bellying of the latter as the vines approach and traverse the narrow end of the throat.

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Sept. 22, 1959 F. W. THURMER 2,905,183

HOP PICKING MACHINE

Filed Aug. 18, 1953 3 Sheets-Sheet 1

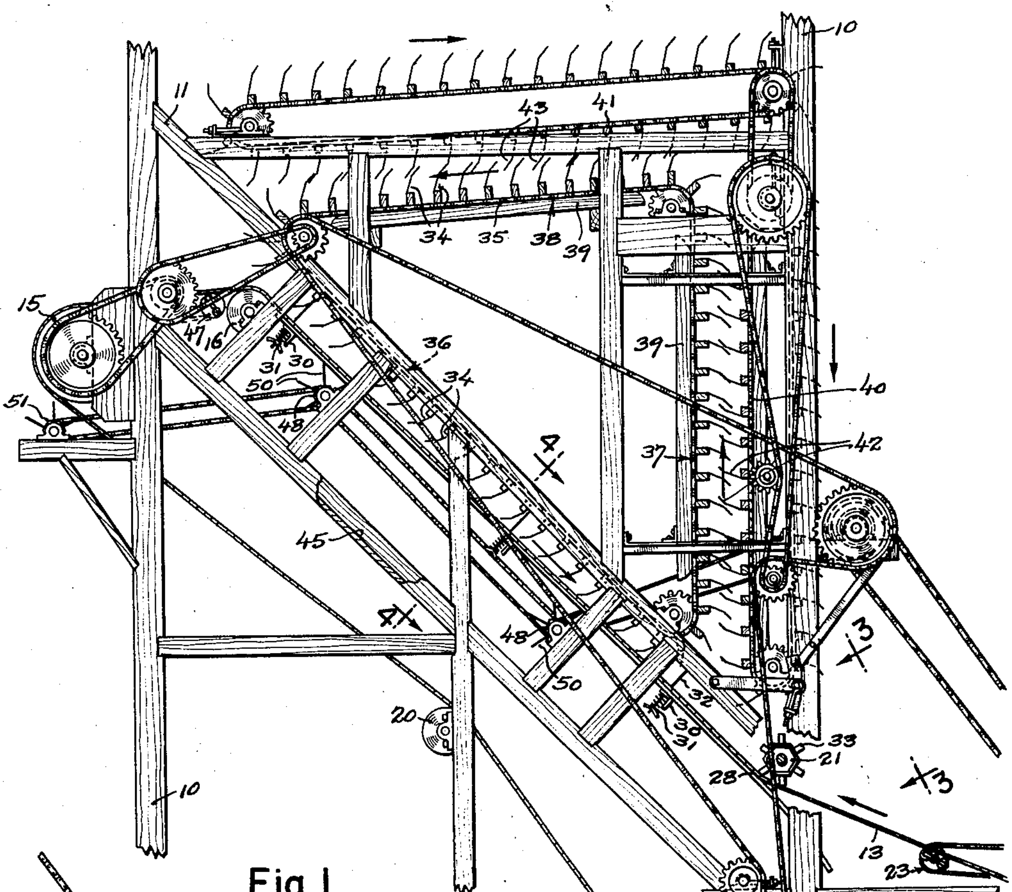

Fig. 1

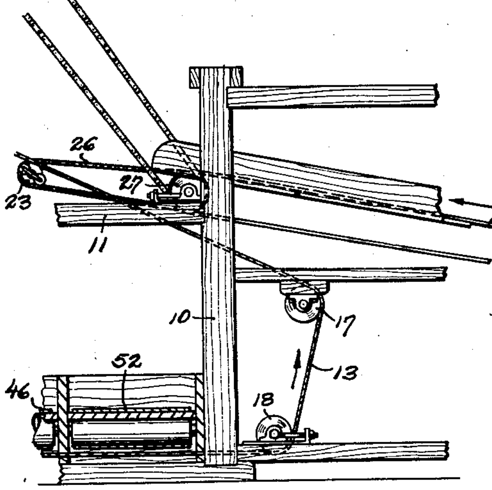

Fig. 2

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HOP PICKING MACHINE

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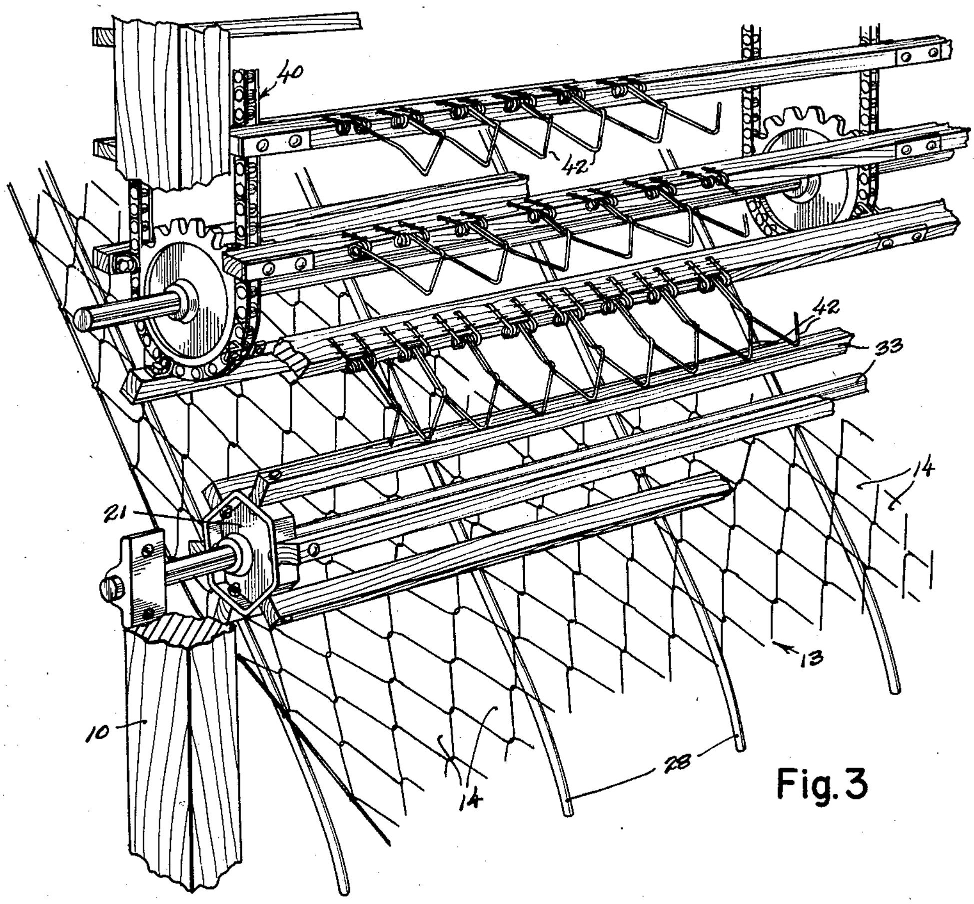
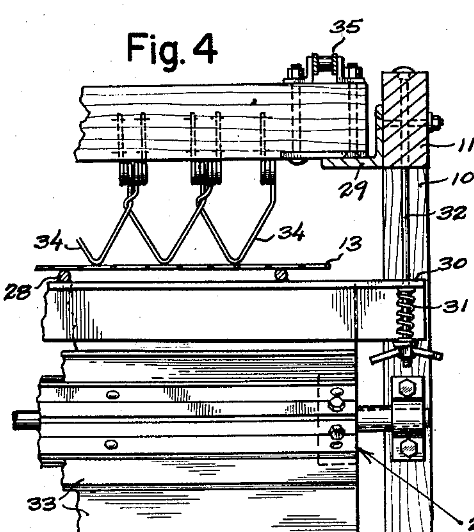


Fig. 3

Fig. 4



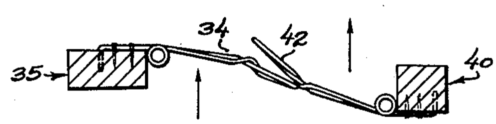


Fig. 6

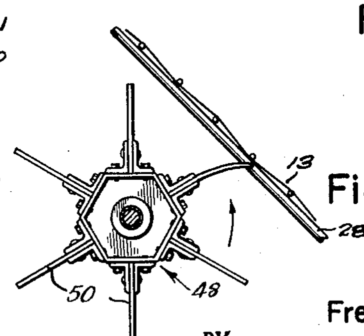


Fig. 5

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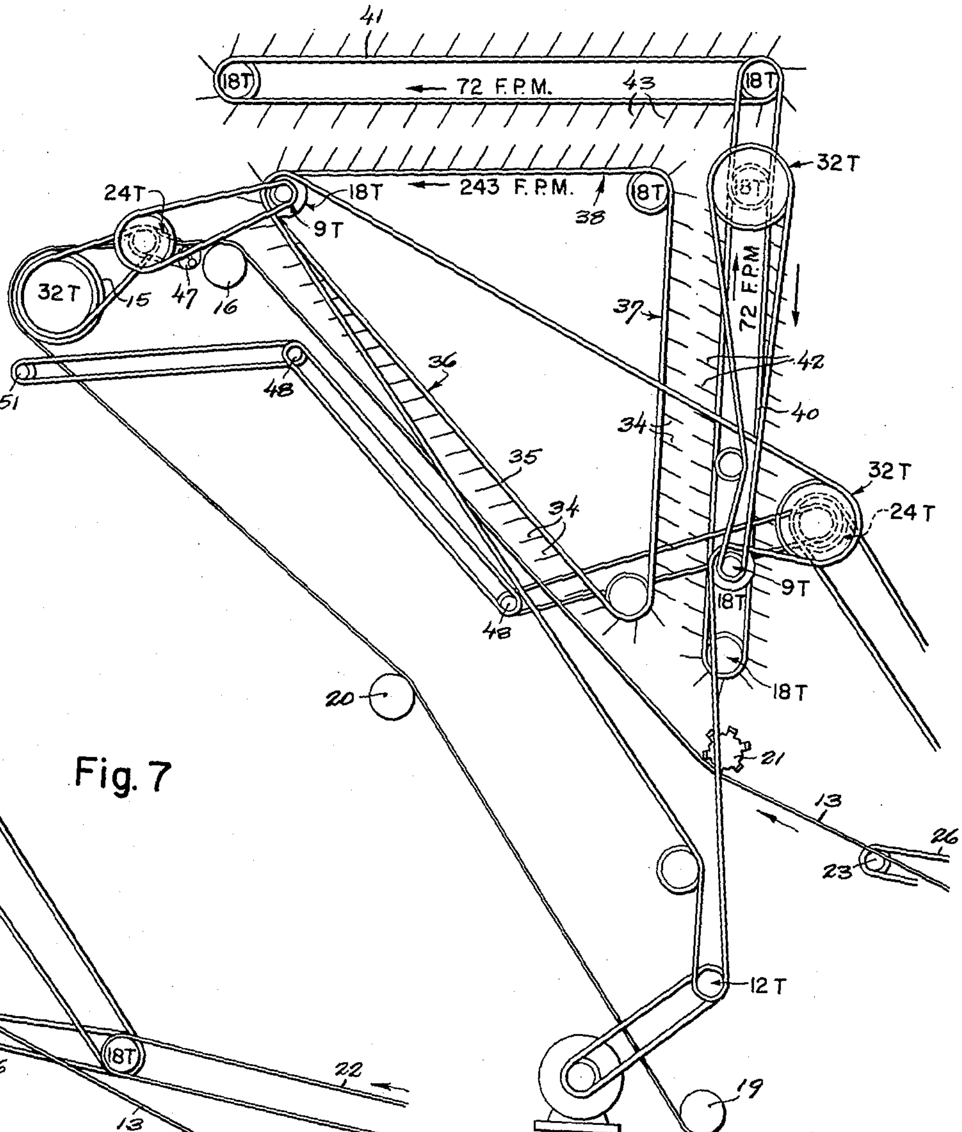

Fig. 7

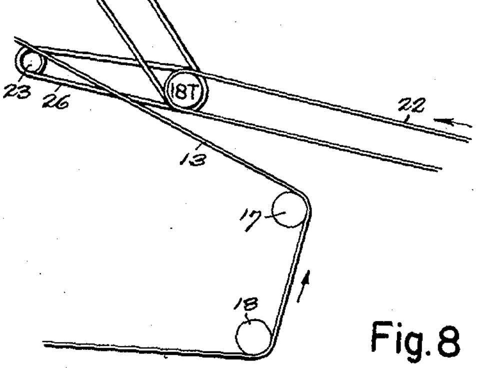

Fig. 8

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2,905,183

HOP PICKING MACHINE

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Application August 18, 1953, Serial No. 374,880

18 Claims. (Cl. 130—30)

This invention relates to the hop picking art, and pertains especially to that step of picking, commonly known as "arm picking," which is concerned with breaking down clusters to free the hop flowers from other contained matter—leaves, twigs, and the like—and which is distinguished from a step usually performed in advance of the arm picking, and namely the step of combing or stripping foliage-laden hop vines to divest the latter of substantially all its foliage. The arm-picking procedure has developed separate status within the art inasmuch as it is commonly performed by a separate machine peculiary designed to accomplished the one particular function of picking hop flowers from the branches or arms of the hop vines and separating clustered flowers.

I and Laurent Regimbal have jointly perfected a machine intended particularly for performing the stripping work, and an application directed thereto has matured as U.S. Pat. No. 2,699,172, issued January 11, 1955. The present application has for its general object the provision of a perfected machine and method which, while it may be used to strip as well as pick and hence may be used independently of a vine-stripping machine, is primarily intended to complement a vine-stripping machine and pick the flowers after the foliage has been first stripped from the parent vine.

The present invention provides an endless open-mesh belt serving as a conveyor for the stripped foliage and employs in conjunction therewith a stripping mill composed of multiple opposed picking fingers to which the foliage is conveyed and which perform the function of breaking up clusters of flowers contained in the progressively moving foliage. Openings in the mesh belt are of a size to permit individual flowers to drop through the same. However, tributary twigs which remain attached to the floral stems of some of the flowers hang up on the wire strands of the belt and preclude the flowers from falling free. The prevailing practice has been to dislodge these hung-up flowers by providing below the belt substantial counterparts of the above-belt picking fingers, a procedure which has not been too satisfactory from the fact that when the flowers are caught in the openings of the belt they become localized in relation to the belt and should they evidence any major resistance to dislodgment the fingers then tend to tear the flowers and pull the petals away from the normally invested hop pistil.

A particular object of the present invention is to provide a machine embodying means by which these hung-up flowers which protrude below the belt are knocked free without, in so doing, subjecting the petals to any noticable tearing effect.

As a still further and particular object the invention aims to provide a hop-picking machine having the conveyor belt so trained as to describe a generally horizontal platform at the head end thereof operating as a receiving station for the foliage which is to be picked, and utilizing in conjunction with this platform a vibrating means functioning to shake down the foliage and accomplish two important ends, firstly that of reducing the bulk matter carried to the picking fingers by largely screening out such matter including free flowers as is already of a size admitting to passage through the openings in the mesh belt and secondly that of distributing the foliage more or less evenly upon the conveyor as a step preliminary to the conveyed travel of the foliage to the picking mill.

With the above and still additional objects and advantages in view looking in general to the perfecting of a machine for the described purpose, the invention consists in the novel construction and in the adaptation and combination of parts hereinafter described and claimed.

In the accompanying drawings:

Figure 1 is a fragmentary side elevational view illustrating a machine constructed to embody the preferred teachings of the present invention.

Fig. 2 is a fragmentary side elevational view portraying a head portion of the machine not visible in Fig. 1.

Fig. 3 is a fragmentary enlarged-scale perspective viewing a portion of the machine from the vantage point shown by the lines 3—3 of Fig. 1.

Fig. 4 is a fragmentary vertical sectional view drawn to an enlarged scale on line 4—4 of Fig. 1.

Fig. 5 is a fragmentary enlarged-scale elevational view detailing one of several brush-heads which perform a sweeping function upon the open-mesh belt which carries hop-laden foliage.

Fig. 6 is an enlarged-scale view illustrating the manner in which opposed picking fingers, provided along the opposite sides of a working throat suggesting a substantial "mill race," complement one another in performing their intended function of breaking up clusters of flowers and picking such flowers as well as leaves from tributary branches of a hop vine; and

Figs. 7 and 8 are diagrammatic views illustrating the driving lay-out of the machine's moving parts.

Referring to said drawings, the framework of the machine is made rigid and is or may be of a skeletonized nature providing, along each side, a plurality of upright pieces designated by the numeral **10** connected one to another by longitudinal stringers **11** and also having suitable transverse ties extending from the uprights at one side to the uprights at the other side of the frame. While the teachings of the invention adapt themselves to use in a portable unit, the machine here illustrated is one intended as a permanent installation and is housed within a shed or the like from which it takes such added support as may be necessary or desirable to firmly anchor the frame.

The principal conveyor belt **13**, and namely the belt which initially receives and gives travel to the bulk mass of stripped foliage, is of that nature commonly termed a "diamond-mesh," fabricated from wire to present rather wide openings **14** of a size admitting to the projection of hop flowers therethrough. The belt is endless and trained about a series of drums receiving a journal support from frame-carried bearing boxes for rotation about transverse horizontal axes, and of these drums one drum **15** is a live drum located at the tail-end extremity of the belt's upper-run travel while the others, indicated as five in number and designated by **16**, **17**, **18**, **19** and **20**, are idler drums. Special significance is attached to only the idler drums **16** and **17** which act one in complement with the other and with a freely journaled wheel **21** to guidably determine the upper-run travel of the belt. Drum **17** lies at the initiating or head end limit of said upper-run travel and occupies a level considerably below that of the live roller. The wheel **21**, which will be hereinafter more particularly described, occupies a position overlying the belt between drums **16** and **17** in a horizontal plane well below that of the idler drum **16** but only slightly higher than that of the idler drum **17**. The run of the belt between the drum **17** and the wheel **21** thus has only a minor slope and this moderately sloped section serves as a receiving platform and performs a primary screening function in respect of stripped foliage deposited thereon from a driven endless conveyor belt **22**. The run of the belt from the idler drum **16** to the driving drum **15** is or may be horizontal, and this horizontal section, in a manner hereinafter described, performs a tertiary screening function and will be so termed. In contact with the underside of such receiving platform at a point more or less central to its length there is provided a vibrator or shaker device **23** comprised of a pair of transversely extending rollers carried by power-driven rotary end plates to occupy positions at diametrically opposite sides of the rotary axis. The rotary end plates receive their journal from the machine frame. A chain **26** working off a power-driven sprocket wheel **27** drives said shaker. The shaker's function is to shake down deposited bulk foliage and level and spread the latter upon the platform.

Proceeding beyond said receiving platform as the open-mesh belt passes under the wheel **21** and works toward the idler drum **16**, the belt is given underlying support from a plurality of rather widely spaced longitudinal rails **28**, and this section of the belt's travel will be hereinafter referred to as the secondary screening platform. Composed by preference of spring steel, said rails extend from substantially the head end to the extreme tail end of the sloped run, and receive yielding support from a plurality of transverse angle-iron bars **30** seating by their ends upon spring bumpers **31** carried by hanger rods **32**. Now in reference to the wheel **21**, the same suggests a substantial lantern pinion. The trundles **33** which it presents bear upon the upper surface of the belt and by friction of the latter impart turning motion to the wheel. The foliage, working under the lantern wheel and reaching the secondary screening platform, is there brought under the influence of multiple rows of V-shaped wire picking fingers **34** carried by the links of an endless chain **35** trained so as to move in a triangular orbit one sloped leg **36** of which overlies the secondary screening platform and converges slightly toward the latter so that the fingers are moderately spaced from the platform at the tail end thereof and brush the latter toward the head end thereof. A second leg **37** of the triangle rises more or less vertically from a point removed somewhat beyond the lantern wheel, and the remaining leg **38** runs in an approximately horizontal plane. The chain **35** travels at a relatively rapid rate of speed and in such a direction as causes the picking fingers to move counter to the travel of the screening belt as they pass over said belt in their traversal of the sloping leg **36**. Substantial counterparts of the wire picking fingers **34** are carried by two other endless chains **40** and **41**, and these latter chains are so trained that picking fingers **42** of the chain **40** oppose and lap the fingers **34** as the latter travel vertically along the leg **37**, and picking fingers **43** of the chain **41** oppose and brush the fingers **34** as the latter travel horizontally along the leg **38**. The picking fingers of the chains **40** and **41** travel in the same direction as the fingers **34** at a considerably lesser speed and I find it to be desirable that the rows of such slower moving fingers be given a wider spacing than that of the fast-moving fingers, say 6″ c. to c. in respect of the rows of fingers **42** and **43** and 5″ c. to c. in respect of the rows of fingers **34**. The schematic disclosure of Fig. 7 indicates travelling speeds which I have found to be particularly satisfactory but such speeds are in no sense critical. Clarity in an understanding of the functioning of the picking fingers will perhaps be advanced by here stating that clumps of hop flowers moving beyond the lantern-wheel spreader **21** are caught up by the influence, both separately and combined, of the picking fingers **34** and **42**, and fed thereby to the lower or entrance end of the vertical mill race described between the chains **35** and **40**. The over-running travel of the spring-wire picking fingers **34** relative to the spring-wire fingers **42** produces continual loading and re-active unloading of the spring forces, snapping the fingers against the captive foliage to break clusters free from tributary limbs and separate the clusters into their component flowers. The action continues with lessened severity as the foliage clears the vertical mill race and enters the horizontal mill race described between the chains **35** and **41**. At the discharge end of such horizontal mill race the separated parts of the foliage, and namely flowers, leaves and twigs, drop onto the tertiary screening platform. Twigs progress therefrom with the open-mesh belt and at the tail end of the tertiary screening platform drop off the latter onto a trash conveyor (not shown). The flowers pass through the openings **14** of the belt to the head end of a chute **45** which underlies both the tertiary and the secondary screening platforms and discharges from its lower end onto a belt conveyor **46** which runs transverse to the belt **13**. There is provided below the tertiary screening platform a shaker **47** which is a substantial counterpart of the shaker **23**.

As the mesh conveyor belt moves under the rows of picking fingers through that portion of its travel comprising the secondary screening platform, individual flowers are pulled free from the clusters and additional free flowers drop from the two mill races onto the secondary screening platform. These flowers together with a certain amount of leaves and twig fragments fall freely through the relatively wide openings in the mesh belt onto the chute **45**. Other of the flowers will protrude through the openings in the belt but will not fall through, hanging up by reason of being still attached to short twig ends which catch upon the wire strands of the belt. To free these protruding flowers there are provided below the belt a spaced succession of power-driven rotary brush-heads **48**, two being shown, each journaled to turn about a transverse horizontal axis and each carrying a plurality of circumferentially spaced radial sweeper-vanes **50** composed of soft rubber or other pliable material. The radial projection of these flaps is such that the tips graze the underside of the belt. Turning in directional correspondence but at an accelerated speed relative to the mesh conveyor the vanes extend substantially the full width of the mesh conveyor and are or may be unbroken throughout their length. A brush-head **51** similar to the heads **48** beats against the exposed face of the mesh conveyor belt after the latter has passed the power drum **15**, this latter brush-head, however, being powered to turn in a direction converse to the belt. It will be noted that the conveyor **46** underlies only an after-part of the primary screening platform. Under the fore-part of this platform there is provided a separate conveyor **52**. The significance of these two conveyors is that matter dropping through the openings of the mesh conveyor belt without traversing the picking fingers will contain less leaves and twigs so consequently will be graded higher if it is kept apart, for separate baling, from the product delivered by the chute **45** to the conveyor **46**.

The invention and the manner of its operation should be apparent from the foregoing description of my now-preferred illustrated embodiment. Considerable changes in the details of construction can be resorted to without departing from the spirit of the invention and it is accordingly my intention that no limitations be implied and that the hereto annexed claims be given a construction fully commensurate with the broadest interpretation to which the employed language admits.

What I claim is:

1. In a hop picking machine, an endless mesh belt the openings in which are of a size to permit passage of hop flowers therethrough, said belt serving as a conveyor for foliage stripped from a hop vine and being trained about supporting drums to cause the upper run of the belt to travel an angular path one stretch of which is moderately sloped and the other stretch of which is steeply

sloped, means for driving said belt to cause the belt in its upper-run travel to work progressively rising first along the moderately sloped stretch and then along the steeply sloped stretch, means for delivering the stripped foliage onto said moderately sloped stretch of the belt, means for vibrating the belt as it moves along said moderately sloped stretch for shaking down the delivered foliage, a procession of transverse rows of picker fingers overlying the steeply sloped stretch of the mesh belt and engaging stripped foliage travelling with the belt along said stretch, and brush means disposed below the mesh belt along said steeply sloped stretch acting upon the belt to break off foliaceous matter hanging through the meshes of the belt.

2. In a hop picking machine, an endless mesh belt the openings in which are of a size to permit passage of hop flowers therethrough, said belt serving as a conveyor for foliage stripped from a hop vine and being trained about supporting drums to cause the upper run of the belt to travel an angular path one stretch of which is moderately sloped and the other stretch of which is steeply sloped, means for driving said belt to cause the belt in its upper-run travel to work progressively rising first along the moderately sloped stretch and then along the steeply sloped stretch, means for delivering the stripped foliage onto said moderately sloped stretch of the belt, means for vibrating the belt as it moves along said moderately sloped stretch for shaking down the delivered foliage, a procession of transverse rows of picker fingers overlying the steeply sloped stretch of the mesh belt and engaging stripped foliage travelling with the belt along said stretch, picking throat rising vertically from above the lower or head end of said steeply inclined stretch, a picking throat extending horizontally from the upper end of said vertical picking throat to the tail end of said steeply sloped stretch of the belt, each of said throats being defined between opposed processions of forwardly moving picking fingers, and brush means disposed below the mesh belt along said steeply sloped stretch acting upon the belt to break off foliaceous matter hanging through the meshes of the belt.

3. In a hop picking machine, an endless mesh belt the openings in which are of a size to permit passage of hop flowers therethrough, said belt serving as a conveyor for foliage stripped from a hop vine and being trained about supporting drums to cause the upper run of the belt to travel an angular path one stretch of which is moderately sloped and the other stretch of which is steeply sloped, means for driving said belt to cause the belt in its upper run travel to work progressively rising first along the moderately sloped stretch and then along the steeply sloped stretch, means for delivering the stripped foliage onto said moderately sloped stretch of the belt, means for vibrating the belt as it moves along said moderately sloped stretch for shaking down the delivered foliage, a procession of transverse rows of picker fingers overlying the steeply sloped stretch of the mesh belt and engaging stripped foliage travelling with the belt along said stretch, a picking throat rising vertically from above the lower or head end of said steeply inclined stretch, and a picking throat extending horizontally from the upper end of said vertical picking throat to the tail end of said steeply sloped stretch of the belt, each of said throats being defined between opposed processions of forwardly moving picking fingers.

4. In a hop picking machine, an endless mesh belt the openings in which are of a size to permit passage of hop flowers therethrough, said belt being power-driven to serve as a conveyor for hop-bearing foliage and being trained about supporting drums for movement of an upper run of the belt along a given travel path, means for driving the belt, means for delivering the hop-bearing foliage onto the belt at the head end of said travel path, a procession of overhead picker fingers moving in a direction converse to the travel of the belt and engaging said foliage as it moves with the belt along said travel path, and a picking throat rising from above the belt at substantially one end of said procession of picker fingers and returning to the belt at substantially the other end of said procession of picker fingers, said picking throat being defined between opposed processions of forwardly moving picker fingers.

5. The hop picking machine of claim 4, means being provided by which the procession of picking fingers moving along one side of the picking throat are caused to travel at a speed accelerated from that of the procession of picking fingers moving along the other side of the throat.

6. The hop picking machine of claim 5 in which the processions of picking fingers are arranged in tranversely extending rows with the several rows in each procession spaced apart at uniform distances, and wherein the spacing between the procession of rows along one side of the throat differs from the spacing between the procession of rows along the other side of the throat.

7. A machine according to claim 1 in which residual matter lying loosely upon the belt after the belt has cleared said procession of picking fingers is caused to drop by its own weight off the belt as the belt initiates its lower-run travel, and brush means acting upon the belt in course of such lower-run travel to free foliaceous matter clinging to the belt.

8. Structure according to claim 7 in which the brushing elements of the recited brush means are comprised of pliable flap-like radial vanes.

9. In a hop picking machine, an endless mesh conveyor belt the openings in which are of a size to permit passage of hop flowers therethrough and arranged to have hop-bearing foliage delivered onto the head or initiating end of its upper run, means for driving said belt to give continuous unidirectional travel thereto, means for vibrating said foliage-receiving head end of the belt for shaking down the delivered foliage, a procession of transverse rows of picker fingers overlying the belt and moving in a direction converse to the travel of the belt and acting upon the foliage as the latter moves with the belt beyond said vibrating means, and opposing processions of transverse rows of picker fingers defining therebetween a picking throat rising from above the belt at substantially one end of said first-named procession of picker fingers and returning to the belt at substantially the other end of said first-named procession of picker fingers.

10. The machine of claim 9 having a substantial lantern wheel journaled for rotation between the vibrating means and the first-named procession of picker fingers and caused to be turned by frictional engagement of the belt with the trundles of said lantern wheel.

11. In a hop picking machine, an endless mesh conveyor belt the openings in which are of a size to permit passage of hop flowers therethrough and arranged to have hop-bearing foliage delivered onto its upper run, an endless driven carrier carrying a succession of transverse rows of picker fingers and trained for movement in a triangular orbit one leg of which so closely overlies the mesh belt as to bring the picker fingers into approximate brushing engagement with the belt, the fingers moving along the length of said leg in a direction converse to the travel of the belt and thence first rising from the belt as they traverse a second leg of the triangle and then returning to the belt as they traverse the third leg of the triangle, two complementing endless driven carriers each carrying a succession of transverse rows of picker fingers and trained so that one run of one said complementing carrier parallels the second leg of the triangle with its picker fingers substantially lapping the fingers moving with the first-named carrier along said second leg and so that one run of the other said complementary carrier parallels the third leg of the triangle with its picker fingers approximately brushing the fingers moving with the first-named carrier along said third leg.

12. The machine of claim 11, means being provided by

which said fingers of the complementing carriers move in the same direction but at a speed slower than the fingers of the first-named carrier.

13. The machine of claim 11, means being provided by which the fingers of the complementing carriers move in the same direction as the fingers of said first-named carrier with the speeds being in the ratio of approximately 1 to 3.

14. In a hop picking machine, an endless mesh conveyor belt the openings in which are of a size permitting passage of hop flowers therethrough and trained to cause the upper run of the belt to slope upwardly, means for driving said belt to cause the belt to ascend said slope, means for delivering hop-carrying foliage onto said belt at the lower end of the slope, means for shaking down the foliage as it is delivered to the belt, a conveyor belt underlying said shaking means and running in a direction transverse to the belt for picking up foliaceous matter shaken through the meshes of the mesh belt, picking means acting upon the foliage as it moves with the belt up said slope for breaking up the foliage, means disposed below said picking means and acting upon the underside of the mesh belt to break off foliaceous matter hanging through the meshes of the mesh belt, and a collecting chute located below said last-named means.

15. The machine of claim 14 having a transversely disposed conveyor belt located alongside and independent of the first-named transversely disposed conveyor belt for receiving foliaceous matter collected by the chute.

16. In a hop picking machine, an endless mesh conveyor belt the openings in which are of a size to permit passage of hop flowers therethrough and trained so that its upper run traverses first a moderately sloped stretch, then a more steeply sloped stretch, and finally a comparatively flat stretch, means for driving the belt, a receiving conveyor belt extending transverse to the mesh belt below said moderately sloped stretch, a chute underlying both the steeply sloped and moderately flat stretches and feeding to said receiving conveyor belt, means delivering hop-carrying foliage onto said moderately sloped stretch of the mesh belt, an endless driven carrier carrying a succession of transverse rows of picker fingers and trained for movement in a triangular orbit one leg of which closely overlies the steeply sloped stretch of the mesh belt with the fingers approximately brushing the mesh belt, the fingers moving along said steeply sloped stretch in a direction converse to the travel of the mesh belt and thence rising from the belt as they traverse a second leg of the triangle and then returning to the flat stretch of mesh belt as they traverse the third leg of the triangle, two complementing endless driven carriers each carrying a succession of transverse rows of picker fingers and trained so that one run of one said complementing carrier parallels the second leg of the triangle with its picker fingers substantially lapping the fingers moving with the first-named carrier along said second leg and so that one run of the other said complementary carrier parallels the third leg of the triangle with its picker fingers approximately brushing the fingers moving with the first-named carrier along said third leg.

17. The method of picking hop flowers from hop-carrying foliage which comprises providing a picking throat defined between paralleling runs of two endless belts each carrying a succession of transverse rows of picking fingers and with the fingers of the two belts being in lapping opposition along the length of the throat, feeding the foliage into one end of the throat, and powering the two belts to cause the opposing fingers to both travel along the throat toward the other end but at different speeds, thus tumbling the foliage while at the same time conveying the same from the one to the other said end of the throat.

18. The method of picking hop flowers from hop-carrying foliage which comprises providing a picking throat defined between runs of two endless belts and with the throat interrupted by opposing picking fingers carried by the belts, feeding the foliage into one end of the throat, and giving such travelling motion to the two belts as will cause the belts to move at different speeds toward the other end of the throat.

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HOP PICKING MACHINES

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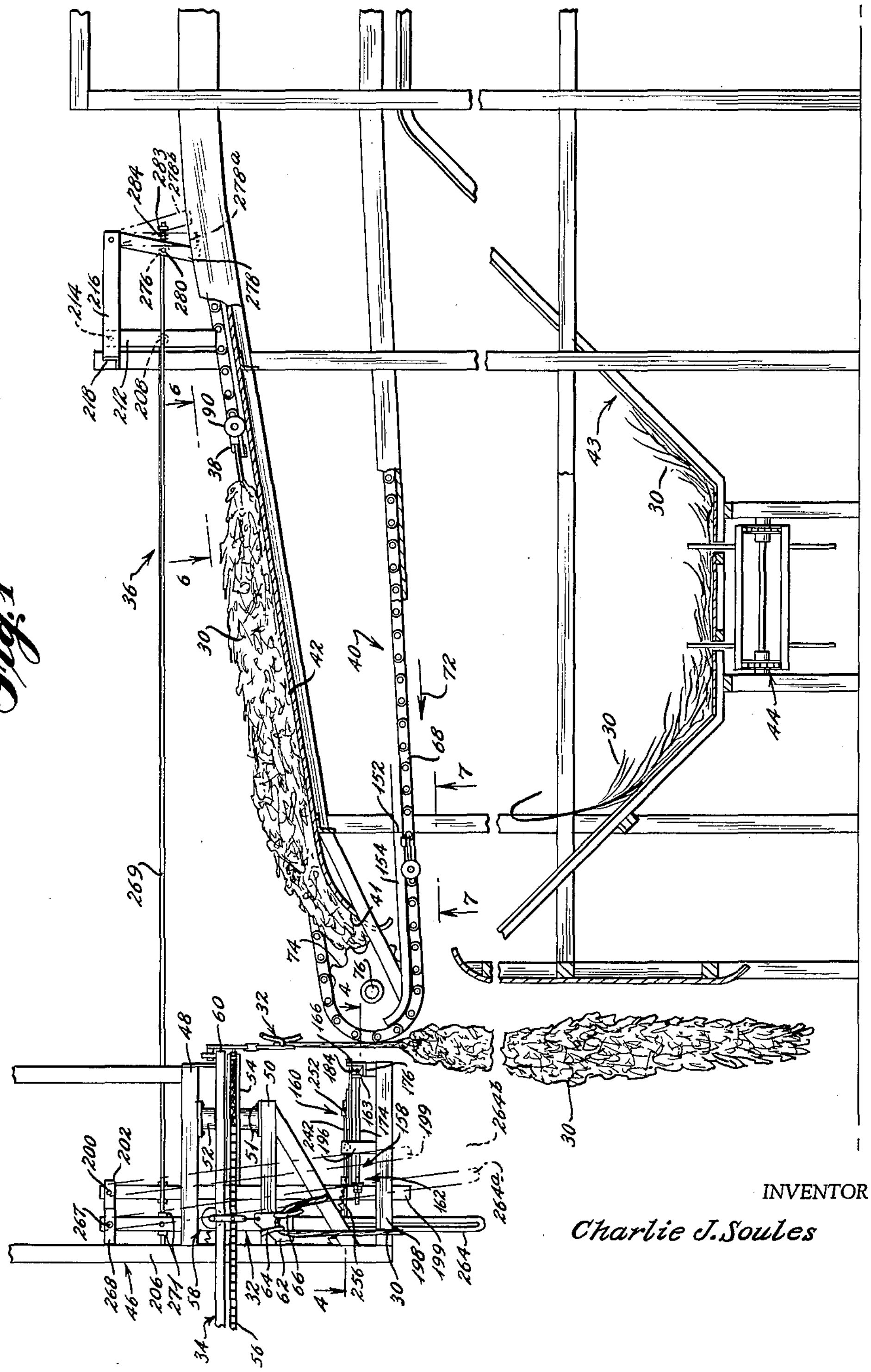

Fig. 1

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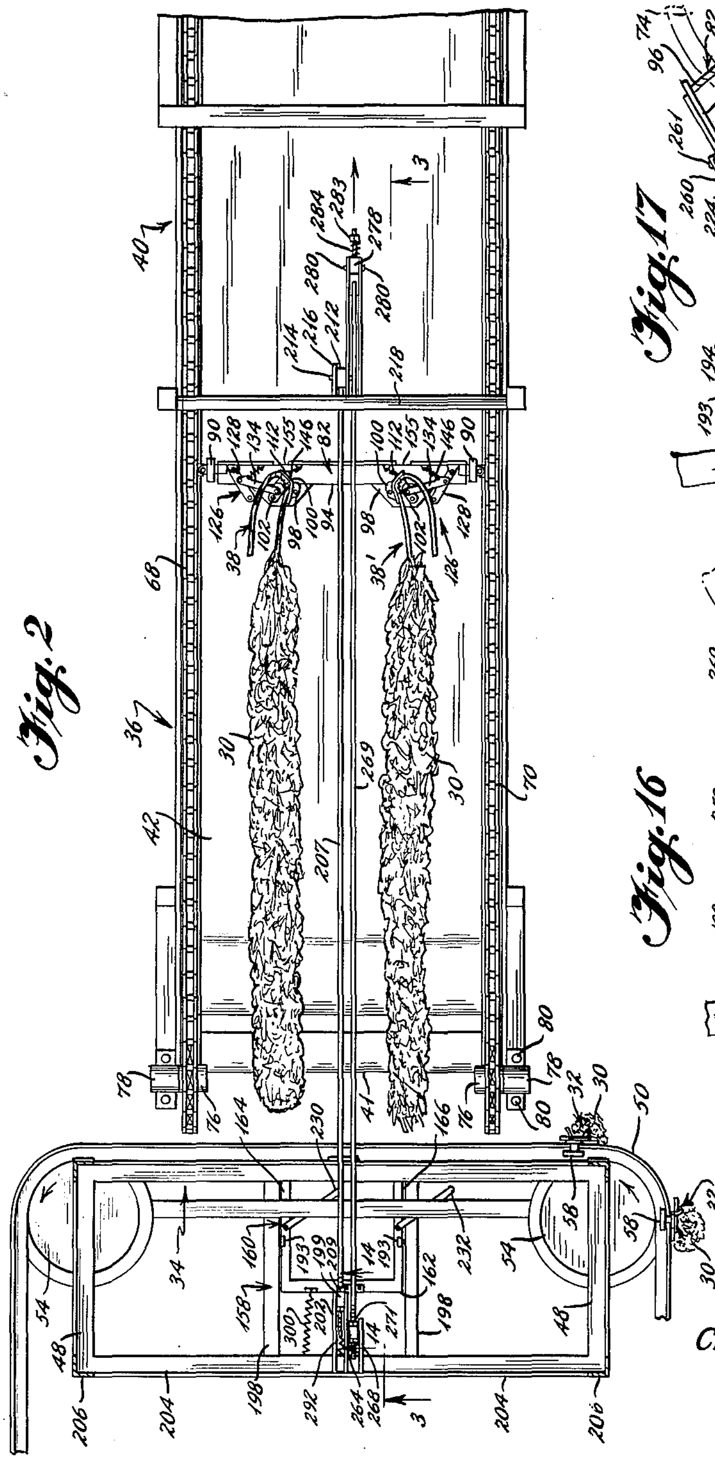

Fig. 2

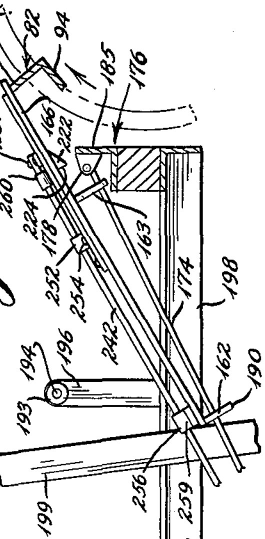

Fig. 17

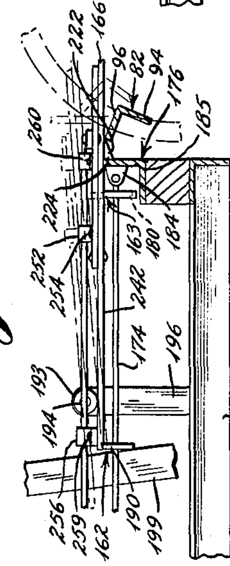

Fig. 16

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HOP PICKING MACHINES

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Fig. 5

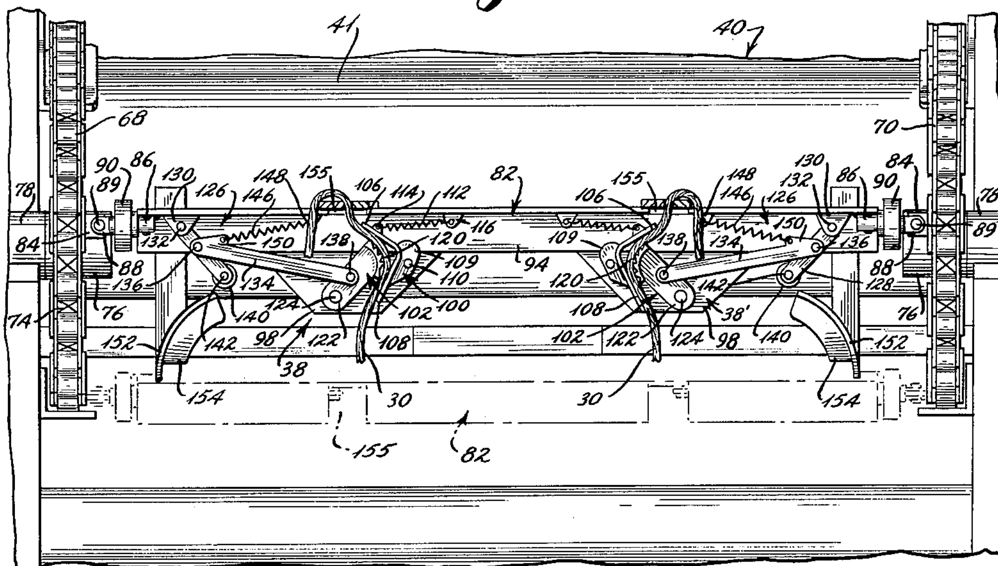

Fig. 3

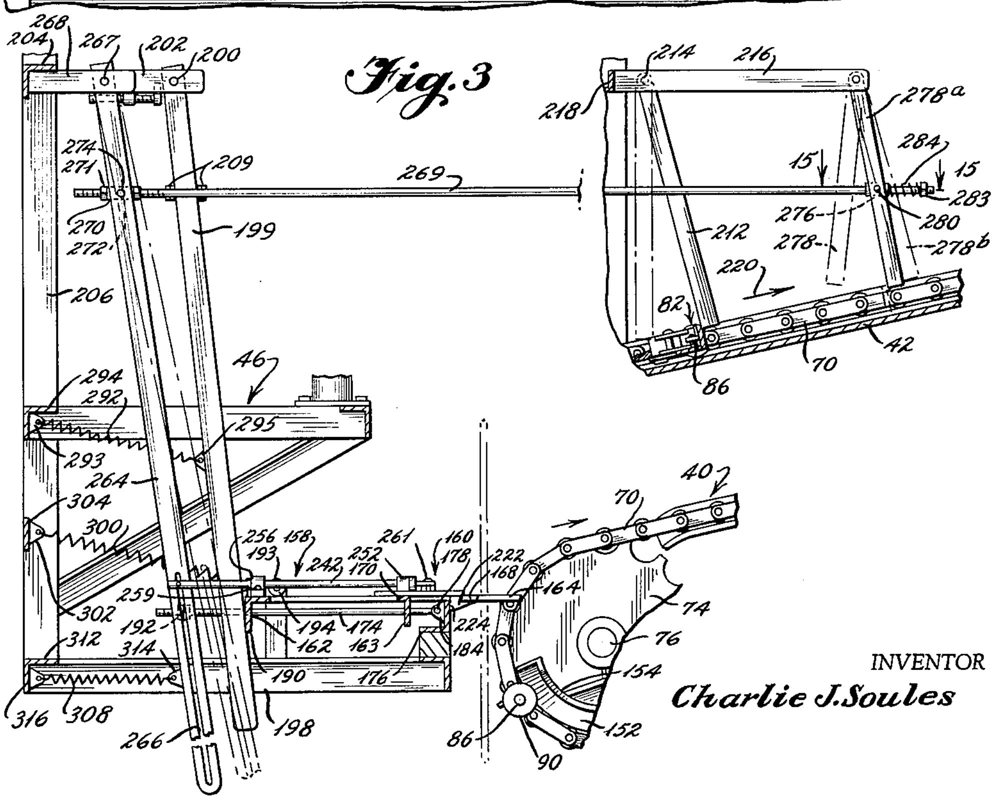

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Fig. 4

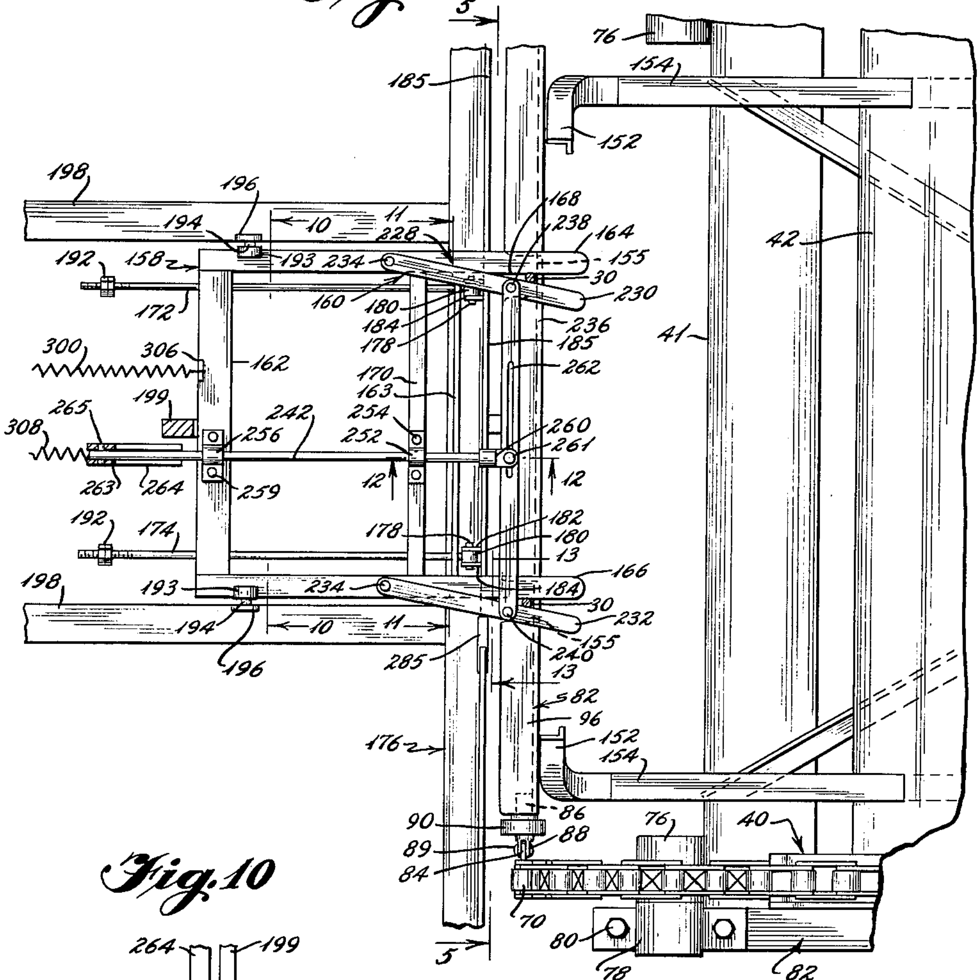

Fig. 10

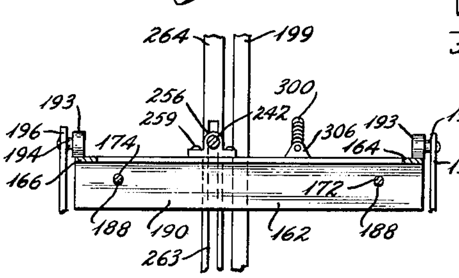

Fig. 11

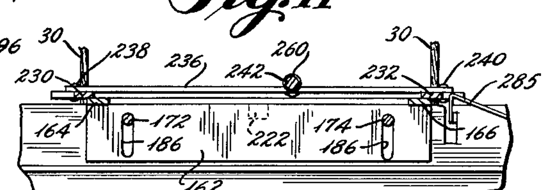

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Fig. 6

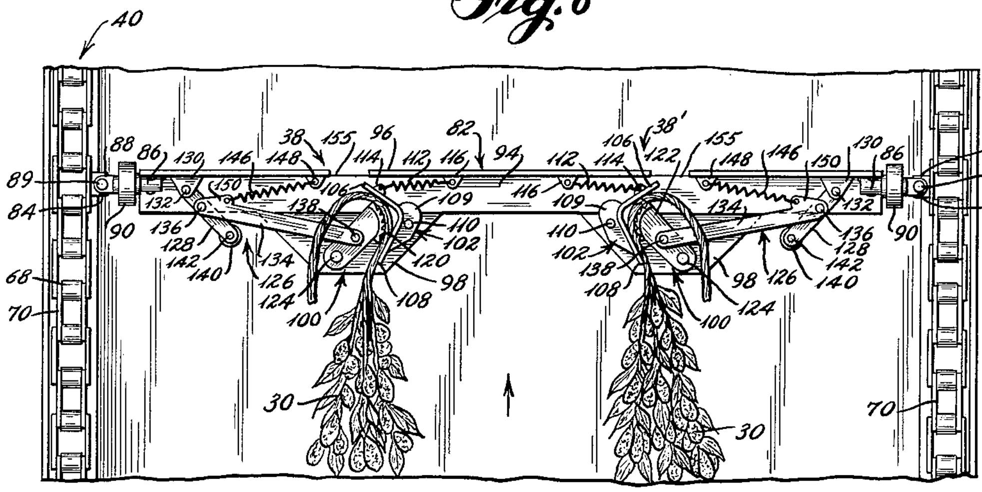

Fig. 7

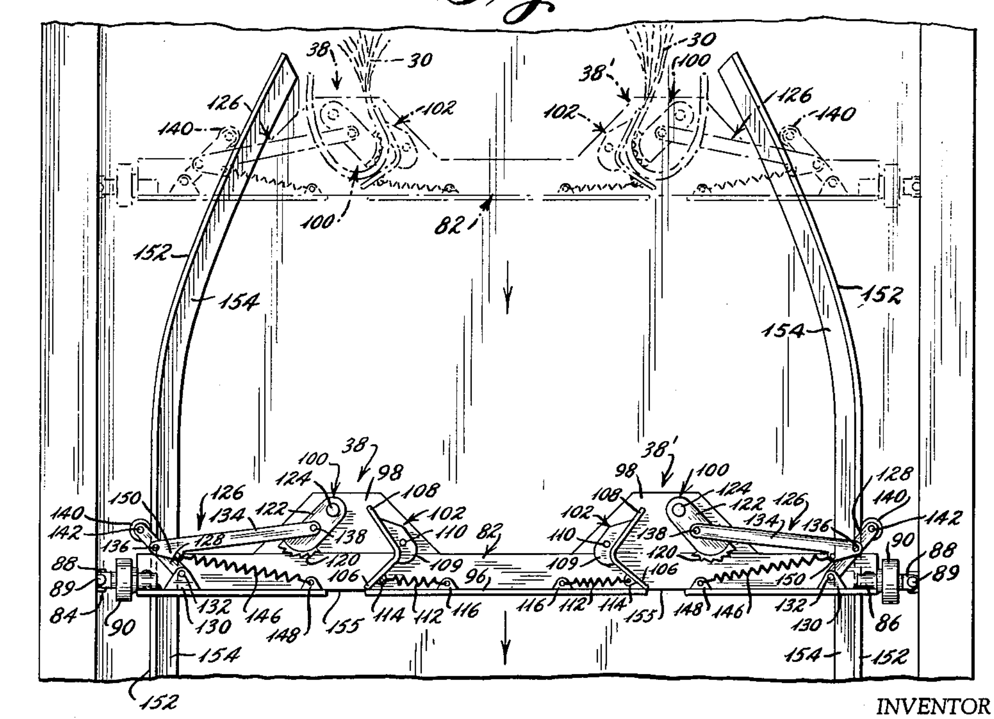

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Fig. 8

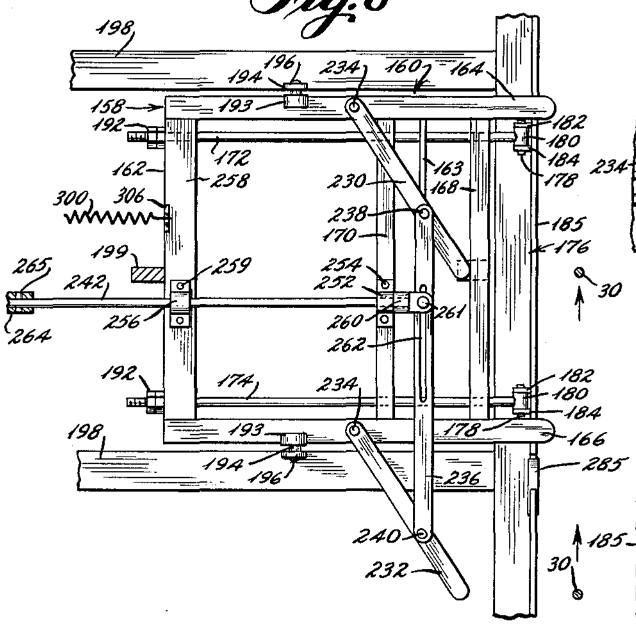

Fig. 12

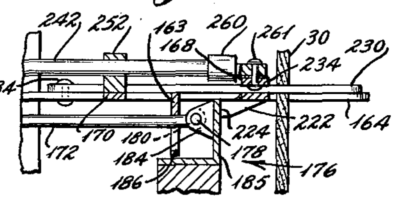

Fig. 13

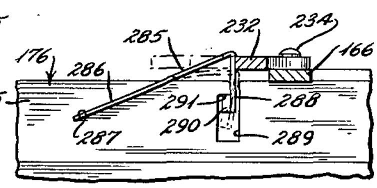

Fig. 9

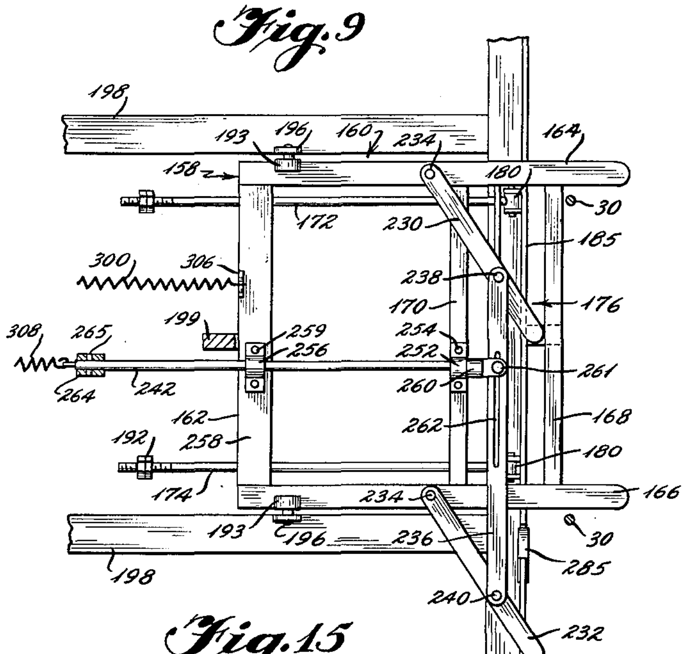

Fig. 14

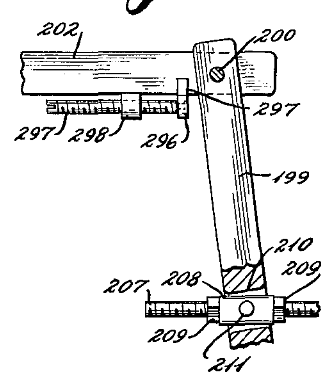

Fig. 15

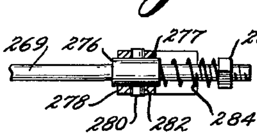

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Fig. 18

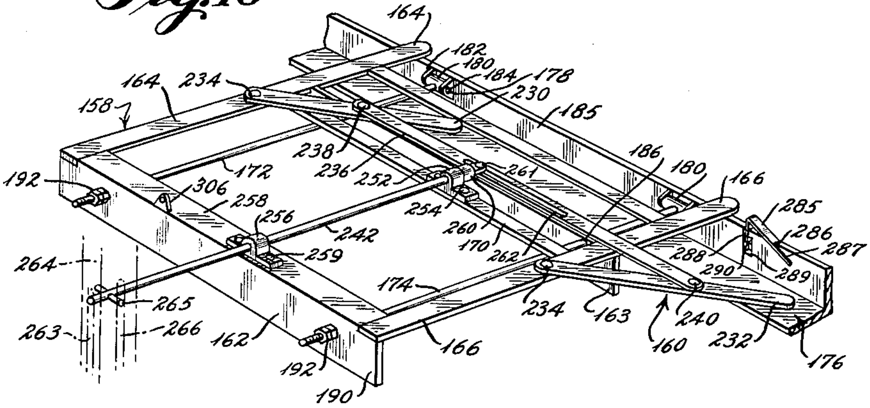


Fig. 19

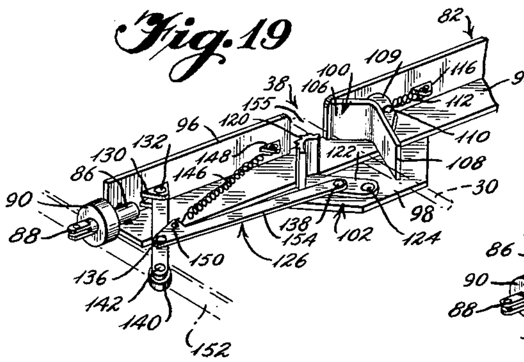


Fig. 20

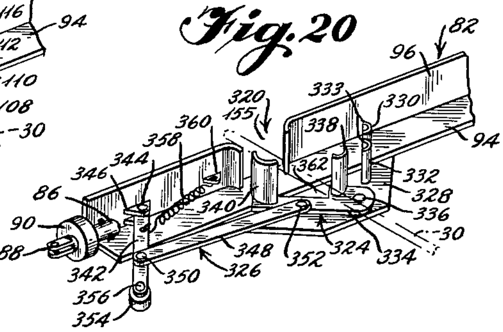
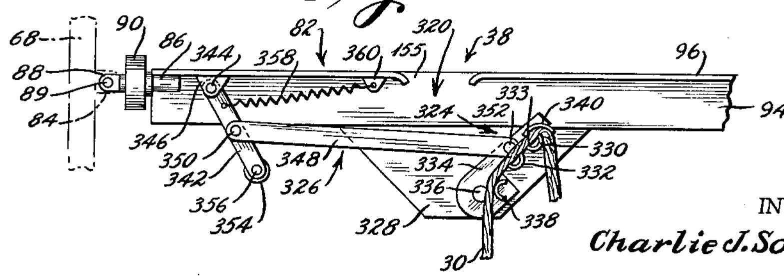


Fig. 21



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3,204,748
HOP PICKING MACHINES

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Filed July 18, 1962, Ser. No. 210,650
14 Claims. (Cl. 198—24)

This invention relates to hop picking machines and, more specifically, to hop picking machines in which the hop vines are automatically transferred from a Pomona conveyor to graspers carried by an endless conveyor which pulls the vines into the hop picking machine.

Hops are raised on trellises which are generally sixteen to eighteen feet in height and the hop vines attain substantially this height. When ripe, the hops have heretofore been picked by hand. However, because of conditions appurtenant to the growing of hops, the brevity of the picking season, the scarcity of labor, and other factors, hand picking of hops is unduly expensive. In addition, the most careful hand picking results in the accumulation of large quantities of leaves and other foreign material in the hops and the handling and delay involved in sacking or boxing the hops and transporting them to the drying house often results in discoloration, flattening, and bruising of the hops.

The difficulties and disadvantages attending the hand picking of hops has led to the development of hop picking machines. Such machines are of two general types, vertical and horizontal. It is with the latter type that the present invention is concerned.

When machine picking is employed, the hop vines are severed a short distance above the ground, taken down from the trellises, and transported to the hop picking machine. There, the vines are hooked onto a Pomona conveyor which is an endless chain conveyor equipped with specially designed hooks around which the ropelike ends of the hop vines may be looped. The Pomona conveyor, which travels in a horizontal path, carries the vertically hanging hop vines to the feed end of the picking machine. In the prior art machines, the vines are removed manually from the Pomona conveyor, generally by two men, and the ends of the vines are inserted between the jaws of graspers carried by the conveyor of the picking machine and the jaws are closed to grip the vines in the graspers. The conveyor drags the vines into the machine where the hops are stripped from the vines. Typical of the prior art machines described above are those disclosed in United States Letters Patent No. 2,139,029 issued to G. E. Miller December 6, 1938, for "Hop Picking Machine" and in United States Letters Patent No. 2,802,562 issued to W. J. Wissemann, August 13, 1957, for "Hop Vine Grasper."

The main objection to the prior art hop picking machines is the necessity of employing human operators or feeders to remove the vines from the hooks of the Pomona conveyors and insert and clasp them in the graspers carried by the conveyor of the hop picking machine. Not only is the labor cost high, especially as two operators are generally required, but hand feeding is relatively inefficient with the resulting waste generally costing even more than the necessary labor.

The present invention represents an improvement in horizontal hop picking machines and eliminates the need for human operators for disengaging the hop vines from the hooks of the Pomona conveyor and engaging them in the graspers of the hop picking machine conveyor. In the hop picking machine of the present invention, the hop picking machine and Pomona conveyor are positioned so that the Pomona conveyor will carry the hop vines into close proximity to the graspers on the hop picking machine. Each of the graspers (which are normally mounted in pairs in side-by-side relationship) is

equipped with a simple, cam-type operator which opens the grasper jaws and then snaps them shut on the vine after the Pomona conveyor has positioned it in the jaws. Continued movement of the hop picking machine conveyor unhooks the vines from the Pomona conveyor and drags them up a ramp onto a horizontal deck and into the picking machine.

One important requisite to successful operation of a hop picker which will automatically transfer the vines from a Pomona conveyor is that the movement of the Pomona conveyor be timed to the movement of the graspers so that the hop vines will be between the jaws of the graspers when they are closed. For this purpose, a novel simple mechanical timing and positioning mechanism operated by the movement of the graspers is employed.

Another criteria for successful operation of a hop picking machine arranged to automatically remove the hop vines from the Pomona conveyor is that the hop vines clasped in the graspers quickly move out of the way of the following vines delivered by the Pomona conveyor. This is particularly necessary in view of the fact that the sixteen to eighteen foot long hop vines are quite shaggy or bushy throughout most of their length and, if they are not quickly moved out of the way, will become entangled in the conveyor of the hop picking machine. In contrast to the prior art machines such as that disclosed in the Wissemann patent referred to above, where the hop vines are dragged onto a horizontal deck from a position in front of the picking machine, the novel machine of the present invention is arranged to clasp the hop vines while they are hanging vertically from the Pomona conveyor and move them forward a substantial distance in the vertical position to almost immediately get them out of the way of the incoming vines.

Another criteria in the successful operation of a hop picking machine of the type provided by the present invention and, indeed, any horizontal hop picker, is that the graspers firmly clasp the hop vines. Numerous attempts have been made to construct a satisfactory grasper as evinced by the numerous patents directed to such graspers including those to Miller and Wissemann, referred to above, and United States Letters Patent No. 2,193,354 issued to E. Thys March 12, 1940, for "Vine Grasper Bar." The present invention also provides improved graspers which are simpler and yet operate more effectively than those of the prior art.

A primary object of the present invention resides in the provision of improved hop picking machines of the horizontal type.

It is another object of the present invention to provide horizontal type hop pickers which will automatically transfer hop vines from a Pomona or other delivery conveyor to graspers carried by the conveyor of the hop picking machine, thereby eliminating the need for human operators.

In conjunction with the preceding object, it is another object of the present invention to provide novel mechanical timing and positioning mechanisms which will accommodate variations in the relative movement of the Pomona conveyor and the graspers carried by the conveyor of the hop picking machine and insure that, regardless of such variations, the vines are properly aligned with the graspers.

In conjunction with the preceding object, it is a further object of the present invention to provide novel timing and positioning mechanisms which, if the mechanism malfunctions, will be operated to prevent it from damaging the grasper bar on which the graspers are mounted as the grasper bar moves into proximity with and engages the timing and positioning mechanism.

Another object of the present invention resides in the provision of novel hop picking machines of the horizontal type which will automatically clasp hop vines delivered in a vertical hanging position to the machine by a Pomona conveyor in graspers carried by the picking machine conveyor, unhook the vines from the Pomona conveyor, and then move the vines forward still in the vertical hanging position to automatically clear the way for succeeding vines delivered by the Pomona conveyor.

A further object of the present invention is the provision of improved graspers for hop picking machines.

Yet another object resides in the provision of graspers for hop picking machines equipped with cam-type operators for automatically opening the grasper jaws and snapping them shut on a vine inserted between the jaws.

Other and further objects of the present invention will become fully apparent from the appended claims and as the ensuing detailed description and discussion proceeds in conjunction with the accompanying drawing, in which:

FIGURE 1 is a side view of the novel hop picking machine provided by the present invention together with a Pomona conveyor provided for delivering hop vines to the picking machine;

FIGURE 2 is a top plan view of the hop picking machine and Pomona conveyor of FIGURE 1;

FIGURE 3 is a fragmentary side view, to an enlarged scale, of the hop picking machine taken substantially along line 3—3 of FIGURE 1 and illustrates the novel mechanism provided by the present invention for transferring hop vines from the Pomona conveyor to the hop picking machine without the intervention of human operators;

FIGURE 4 is a top plan view of the mechanism illustrated in FIGURE 3, looking in the direction of arrows 4—4 in FIGURE 1;

FIGURE 5 is an elevational view of the feeding end of the hop picking machine looking substantially along line 5—5 of FIGURE 4;

FIGURE 6 is a top plan view of a portion of the hop picking machine and is taken substantially along line 6—6 of FIGURE 1;

FIGURE 7 is a bottom plan view of a portion of the hop picking machine and is taken looking upwardly substantially in the direction of arrows 7—7 of FIGURE 1;

FIGURE 8 is a top plan view of the vine positioning and aligning mechanism in the retracted position;

FIGURE 9 is a view similar to FIGURE 8 with the vine stopping fingers extended to their operative position;

FIGURE 10 is a sectional view of the vine positioning and aligning mechanism and is taken substantially along line 10—10 of FIGURE 4;

FIGURE 11 is a sectional view of the vine positioning and aligning mechanism and is taken substantially along line 11—11 of FIGURE 4;

FIGURE 12 is a further sectional view of the vine positioning and aligning mechanism and is taken substantially along line 12—12 of FIGURE 4;

FIGURE 13 is another sectional view of the vine positioning and aligning mechanism and is taken substantially along line 13—13 of FIGURE 4;

FIGURE 14 is a sectional view of the hop vine aligning and positioning mechanism taken substantially along line 14—14 of FIGURE 2;

FIGURE 15 is a plan view, to an enlarged scale, of an override mechanism employed in the hop vine positioning and aligning mechanism;

FIGURE 16 is a side view of a portion of the hop vine aligning and positioning mechanism, illustrating the manner in which it is released from its extended, latched position by the passage of a grasper bar carried by the conveyor of the hop picking machine;

FIGURE 17 is a view similar to FIGURE 16, illustrating the manner in which the mechanism is operated if it fails to unlatch in the normal manner;

FIGURE 18 is a perspective view of a portion of the hop vine positioning and aligning mechanism;

FIGURE 19 is a perspective view of a preferred form of the grasper;

FIGURE 20 is a perspective view of an alternate form of grasper; and,

FIGURE 21 is a top plan view of the grasper of FIGURE 20.

Referring now to FIGURE 1 of the drawings, hop vines **30** are unloaded from a truck or other conveyance (not shown) and attached to the hooks **32** of a Pomona conveyor **34** which transports them to the feed end of a novel hop picking machine **36** provided by the present invention. There the vines are automatically transferred to graspers **38** and **38'** (see also FIGURE 6) carried by an endless conveyor **40** and pulled up a ramp **41** and along a substantially horizontal deck **42** into the interior of the machine (not shown) where the hops are plucked from the vines. The stripped vines are discharged into a trough **43** from which they are removed by an endless conveyor **44**.

As shown in FIGURES 1 and 2, Pomona conveyor **34** includes a framework assembled from structural members and identified by reference character **46**. Fastened to horizontally extending members **48** and **50** of this framework as by bolts **51** are two vertically extending shafts **52** on which idler pulleys **54** are rotatably mounted by appropriate bearings (not shown). Passed around pulleys **54** is a chain **56** which is moved in the direction of the arrow in FIGURE 1 by a driven pulley (not shown) at the other end of the Pomona conveyor. Fixed to chain **56** at equal intervals are trolleys **58** from which Pomona hooks **32** are suspended. Trolleys **58** ride on a horizontally extending track **60** supported by the Pomona conveyor framework **46**.

Pomona hooks **32** each include a base plate **62** and a pair of fingers **64** and **66**, fixed to base plate **62**, over which the rope-like ends of the hop vines **30** are looped. As is conventional, fingers **64** and **66** are so formed that upward vertical movement of the hop vines will release their ends from the Pomona hook.

Since Pomona conveyor **34** is of conventional construction and since its details form no part of and are not essential to an understanding of the present invention, a more detailed description of the Pomona conveyor is not deemed necessary.

As discussed above, it is one of the novel features of the present invention that the hop vines **30** are automatically transferred from Pomona conveyor **34** to the graspers **38** and **38[1]** carried by the endless conveyor **40** of hop picking machine **36**. Referring now to FIGURES 1, 2, 5 and 6, conveyor **40** includes two endless flexible members **68** and **70** such as roller chains which travel in the direction of arrow **72** in FIGURE 1 and are supported at the feed end of the machine by idler sprockets **74** (only one of which is shown). At the forward end of the hop picking machine, roller chains **68** and **70** extend over driven sprockets (not shown) which may be rotated by any suitable power source.

As is best shown in FIGURES 2 and 4, idler sprockets **74** are fixed to stub shafts **76** which are journalled in suitable bearings **78** fixed by bolts **80** to the hop picking machine's structural framework.

Extending between and fixed at their opposite ends to roller chains **68** and **70** are a plurality of grasper bars **82** spaced at equal intervals along the path of the conveyor. As is shown in FIGURE 6, the mechanism employed to attach grasper bars **82** to roller chains **68** and **70** include inwardly directed lugs **84** fixed to the roller chains in any desired manner and so positioned that they are aligned on a line normal to the direction of movement of conveyor **40**. Pivotally fixed to each of the lugs **84** is a cylindrical pin **86** having a pair of bifurcated arms **88** embracing the associated lug **84** and secured to it by a pin **89**. The inward ends of cylindrical pins **86** are fixed to the opposite ends of the grasper bars 82 as by welding or brazing. Rollers 90, journalled on pins 86 between the ends of grasper bar 82 and lug 84, space grasper bar 82 above and prevent it from rubbing on the deck 42 of the hop picking machine.

Grasper bars 82 are fashioned from angle iron disposed to provide a horizontal leg 94 and a vertical leg 96. Welded to the lower surfaces of the horizontal angle iron legs 94 are the base plates 98 of graspers 38 and 38^1.

Each of the graspers 38 and 38^1 (which are identical) has two pivotally mounted jaws 100 and 102. Referring now specifically to FIGURE 19, jaw 100 is a metal bar of appropriate thickness bent intermediate its ends to provide a pair of angularly disposed legs 106 and 108 extending upwardly from base plate 98. Jaw 100 is pivotally mounted on grasper bar 82 by a horizontal disposed arm 109 fixed to the outer side of the jaw and a bolt or pivot stud 110 which extends through arm 109 and base plate 98.

A tension spring 112, attached at its opposite ends to a lug 114 (see FIGURE 5) fixed to arm 109 of jaw 100 and to a lug 116 fixed to the vertical leg 96 of grasper bar 82, biases jaw 100 in a clockwise direction (looking down on the grasper bar) about pivot stud 110.

Pivotal jaw 102 is an upwardly extending, arcuately sectioned member on which a plurality of parallel teeth 120 with their biting edges directed toward the vertical leg 96 of grasper bar 82 are formed. At its lower end, jaw 102 is fixed to one end of a horizontally extending mounting arm 122, the other end of which is pivotally fixed as by a bolt or pivot stud 124 to base plate 98.

The jaws 100 and 102 of grasper 38 are opened and closed by an operator 126 which is controlled by the movement of a grasper bar 82. Operator 126 includes a horizontally extending operator arm 128 pivotally fixed to the vertical leg 96 of grasper bar 82 by a pair of brackets 130 between which one end of operator arm 128 extends and a bolt or pivot stud 132 which extends through the mounting brackets and the operator arm. Extending between and pivotally connected to operator arm 128 and the arm 122 carrying jaw 102 is a rigid connecting link 134 which is fixed to operator arm 128 by a bolt or pivot stud 136 and to arm 122 by a bolt or pivot stud 138.

Fixed to the end of operator arm 128 opposite its connection to grasper bar 82 is a cam roller 140 which is rotatably mounted on a shaft 142 fixed to operator arm 128 as by welding. Jaw 102 is biased in a clockwise direction (looking downwardly) by a tension spring 146 attached at one end to a lug 148 fixed as by welding to grasper bar vertical leg 96 and at the other to a projection 150 formed on connecting link 134.

Cam rollers 140 cooperate with generally vertical cam surfaces 152 provided by parallel, spaced, generally horizontal angle irons 154. As is best shown in FIGURES 1, 5, and 7, angle irons 154 are fixed to the framework of the hop picking machine adjacent the end sprockets 74 over which the roller chains 68 and 70 travel and extend from the feed end of the machine a point above trough 43. The portions of angle irons 154 remote from the feed end of the hop picking machine are horizontal and at substantially the level of the lower run of the conveyor 40. In the vicinity of sprockets 74, angle irons 154 curve upwardly and inwardly (as is best shown in FIGURES 5 and 7), terminating slightly below the centers of sprockets 74.

In the ensuing description of the manner in which the graspers 38 and 38^1 operate, only the operation of grasper 28 will be described since grasper 38^1 operates in an identical manner, although in the opposite sense.

As conveyor 40 moves in the direction indicated by arrow 72 in FIGURE 1, cam roller 140 of a grasper 38 engages the ends of the associated angle iron 154 remote from the feed end of the machine and rides onto cam surface 152 which pivots operator arm 128 in a clockwise direction, pulling the associated connecting link 134 toward roller chain 68 and pivoting arm 122 in a counterclockwise direction. This moves jaw 102 away from jaw 100 and releases the stripped hop vine 30 which falls into hopper 43. As the grasper bar 82 moves toward the feed end of the hop picking machine and sprockets 74, cam roller 140 will reach the inwardly and upwardly curved portion of angle iron 154. At the same time, the Pomona conveyor 34 will move a hop vine 30 to a position such that, as the grasper 38 moves upwardly over the end sprockets, the upper, rope-like end portion of the vine will be positioned between grasper jaw 100 and 102. A notch 155, formed in the upper leg 96 of the grasper bar (which will become horizontal as the grasper bar moves up over end sprockets 74), permits the hop vine to move freely between the grasper jaws.

As the grasper 38 continues upwardly with the cam roller 140 riding on the converging, inwardly directed portion of the cam surface 152, tension spring 146 will pull connecting link 134 to the right, pivoting arm 122 in a clockwise direction and moving jaw 102 toward jaw 100. As jaw mounting arm 122 pivots in a clockwise direction, jaw 102, pressing against the end of hop vine 30, tends to pivot jaw 100 in a clockwise direction about pivot stud 110, tightly clamping the vine end between the jaws 100 and 102. Further upward movement of grasper 38 unhooks the hop vine 30 from the Pomona conveyor hook 32 to which it was attached. As the grasper 38 then travels over the top of sprockets 74 and travels forwardly along the upper reach of the conveyor, it moves the still vertically hanging hop vine 30 forward and out of the way of the incoming vines on the Pomona conveyor. Forward of sprockets 74, the hop vine is dragged up ramp 41 and along deck 42 to the interior of the hop picking machine.

The movement of the incoming hop vines must be accurately timed relative to the movement of the grasper bars 82 so that the ends of the hop vines will be positioned between the open jaws 100 and 102 of the graspers 38 and 38^1 as the grasper bar 82 carries the graspers up and over the end sprockets 74 of the hop picking machine. The hop vine guiding and aligning mechanism employed for this purpose, as best shown in FIGURE 4, includes a hop vine stop assembly 158 and a hop vine aligning assembly 160.

With continued reference to FIGURE 4 and with reference also to FIGURE 18, hop vine stop assembly 158 includes a transversely extending angle iron 162 and a transversely extending bar 163 to which a pair of forwardly extending, parallel, spaced fingers 164 and 166 are fixed as by welding. Transverse braces 168 and 170 are fixed between fingers 164 and 166 adjacent their ends opposite angle iron 162 and between angle iron 162 and bar 163 respectively, to strengthen the assembly.

Stop assembly 158 is mounted for forward and backward reciprocal movement between the positions shown in FIGURES 8 and 9 on a pair of parallel, spaced apart support rods 172 and 174. Support rods 172 and 174 are pivotally fixed to a transversely extending channel 176 in the hop picking machine framework 46 by pivot studs 178 which extend through sleeves 180 fixed to the forward ends of the support rods and aligned apertures in lugs 182 and 184 which are disposed on opposite sides of each sleeve and fixed to the vertical leg 185 of angle iron 176. Support rods 172 and 174 extend rearwardly through vertically elongated apertures 186 in transverse bar 163 (see FIGURES 11 and 12) and apertures 188 (see FIGURE 10) in the vertical leg 190 of angle 162. Nuts 192, threaded on the rear end of support rods 172 and 174, provide stops and limit the rearward movement of the stop assembly.

As it moves back and forth, the stop assembly is maintained substantially level by rollers 193 which engage the upper surfaces of fingers 164 and 166 and are rotatably mounted on stub shafts 194. Brackets 196 (see FIGURE 3), which extend upwardly from horizontally disposed, longitudinally extending channels 198 in the hop picking machine framework, support the stub shafts 194 to which the rollers are attached. Stop assembly 158 is moved forward from the position shown in FIGURE 8 to the position shown in FIGURE 9 in timed relation to the movement of Pomona conveyor 32 so that as a grasper bar 82 carrying graspers 38 and 38[1] moves along the lower run of conveyor 40 and approaches end sprockets 74, a hop vine 30 will be carried by the Pomona conveyor against each of the fingers 164 and 166. In their finger-engaging position, the ends of the hop vines 30 are properly positioned so that, as the grasper bar 82 travels upwardly around end sprockets 74, the ends of the vines will be positioned between the jaws 100 and 102 of the graspers 38 and 38[1] carried by the grasper bar. Referring now to FIGURES 2–4, stop assembly 158 is moved forwardly by an operating lever 199, the lower end portion of which bears against the vertical leg 190 of the transversely extending angle iron 162. At its upper end, operating lever 199 is fixed by a pivot stud 200 to a horizontally extending bracket 202. Bracket 202 is supported on a horizontally extending channel 204 in the hop picking machine framework which extends between vertical channels 206 (see also FIGURE 2). Pivotally fixed to operating lever 199, adjacent its upper end, is a rigid, forwardly extending, connecting link 207.

Referring now specifically to FIGURE 14, the end of connecting link 207 extends through a sleeve 208 to which it is fixed by nuts 209, threaded on the connecting link, which engage the opposite ends of the sleeve. Sleeve 208 is pivotally mounted in a slot 210 in operating lever 199 by pivot studs 211 which are fixed to the opposite sides of the sleeve and extend through aligned apertures (not shown) in the operating lever. The forward end of connecting link 207 is fixed to a vertically depending actuating lever 212 connected by a pivot stud 214 to a bracket 216 which, in turn, is fixed as by welding to a horizontally extending channel 218 in the hop picking machine framework. Actuating lever 212 is so dimensioned that, as the grasper bars 82 move in the direction of the arrow 220 (see FIGURE 3) along the upper run of conveyor 40, the lower end of actuating lever 212 will be engaged by the vertical legs 96 of the grasper bars. As the engaged grasper bar 82 then continues to move forwardly in the direction of the arrow, it will pivot actuating lever 212 from the position shown in phantom lines in FIGURE 3 to the position shown in solid lines, pulling link 207 forwardly and pivoting operating lever 199 in a counterclockwise direction, thereby moving stop assembly 158 forward from the position shown in FIGURE 8 to the position shown in FIGURE 9.

Referring now specifically to FIGURE 3, a latch 222 is welded or otherwise fixed to the lower side of the transverse brace 168 in stop assembly 158. When operating lever 199 has moved the assembly forward to the FIGURE 9 position, the vertical rear edge 224 of latch 222 will engage the forward surface of the vertical leg 185 of the angle iron 176 to which support rods 172 and 174 are attached to retain the stop assembly in the position shown in FIGURES 3 and 9.

It will often happen that the movement of the Pomona conveyor relative to the grasper bars 82 of the hop picking machine conveyor 40 is so slow that hop vines 30 will not have moved against fingers 164 and 166 of stop assembly 158 by the time that the grasper bars 82 are proceeding upwardly over the end sprockets 74 of the conveyor 40 so that the hop vine ends will not be properly aligned between the jaws of the graspers 38 and 38[1]. To preclude this from happening, the hop vine aligning

assembly 160 (see FIGURES 4, 8 and 9) is employed. Assembly 160 includes a pair of hop vine gathering and pushing fingers 230 and 232 pivotally fixed, respectively, to the fingers 164 and 166 of stop assembly 158 by pivot studs 234. Fingers 230 and 232 are connected by a transversely extending, rigid link 236 pivotally connected to fingers 230 and 232 by pivot studs 238 and 240 respectively.

In operation, the hop vine gathering and pushing fingers 230 and 232 are moved from the position shown in FIGURES 8 and 9 in a counterclockwise direction to the position shown in FIGURE 4 to push the ends of the hop vines 30 against the stop fingers 164 and 166 so that the hop vine ends will be properly aligned between the jaws of the graspers 38 and 38[1] as the latter move upwardly on a grasper bar 82 over end sprockets 74. The mechanism provided for moving the fingers 230 and 232 to the position of FIGURE 4 includes an operating rod 242 reciprocably mounted in a bushing 252 fixed to the transverse brace 168 of stop assembly 158 as by rivets 254 and in a bushing 256 fixed to the horizontal leg 258 of stop assembly angle iron 162 as by rivets 259. Fixed to the forward end of operating rod 242 is coupling 260 which is slidably fixed to the rigid link 236 connecting the fingers 230 and 232 by a pin 261 which extends through the coupling and a transversely extending, elongated slot 262 in the connecting link.

The rear end of operating rod 242 extends through an elongated slot 263 adjacent the lower end of an operating lever 264 and is slidably connected to the lever by a pin 265 which extends through the operating rod and through elongated slots 266 in the operating lever (which intersect slot 263). The upper end of operating lever 264 is pivotally connected by a pivot stud 267 to a horizontal bracket 268 fixed to horizontally extending angle 204 adjacent the bracket 202 from which operating lever 199 is supported. Pivotally connected to operating lever 264 below its upper end is a forwardly extending, rigid connecting rod 269. The end of connecting rod 269 extends through a sleeve 270 identical to the sleeve 208 described above (and shown in FIGURE 14) to which it is fastened by nuts 271 threaded on the rod and engaging the opposite ends of the sleeve. Sleeve 270 is mounted in a slot 272 in operating lever 264 and pivotally connected to the lever by pivot pins 274 (only one of which is shown) which are fixed to the opposite sides of the sleeve and extend through aligned apertures (not shown) in the lever.

Referring now specifically to FIGURE 15, the forward end of connecting rod 268 extends through a sleeve 276 which is disposed in a slot 277 in an actuating lever 278 and pivotally connected to the lever by pivot studs 280 which are fixed to opposite sides of the sleeve and extend through aligned apertures 282 in the lever.

Journalled on connecting rod 268 between sleeve 276 and a nut 283 threaded on the end of the rod is a relatively stiff override spring 284. In normal operation, override spring 284 acts as a solid link between connecting rod 269 and the sleeve 276 fixed to actuating lever 278.

As was pointed out above, the movement of a grasper bar 82 along the upper reaches of conveyor 40 in the direction of the arrow 220 (see FIGURE 3) moves stop assembly 158 forward from the position shown FIGURE 8 to the position shown in FIGURE 9. As is best shown in FIGURES 1 and 9, the hop vine aligning assembly moves forwardly with the stop assembly, its operating and actuating levers 264 and 278 moving from the positions shown in solid lines in FIGURE 1 to the positions shown in dotted lines and identified by reference characters *264a* and *278a*.

As shown in FIGURES 1 and 3, the actuating lever 278 of aligning assembly 160 is spaced forwardly of the actuating lever 212 of the stop asesmbly 158. The spacing is so arranged that stop assembly 158 will be moved forward and latched in its operative position before grasper bar 82 reaches the actuating lever 278 of assembly 160.

When the latter lever is reached by grasper bar **82**, its lower end will be engaged by the vertical leg **96** of the grasper bar and pivoted in a counterclockwise direction from the position identified by reference character **278*a*** to the position identified by reference character **278*b***, pulling connecting rod **269** forwardly and pivoting operating lever **264** (see FIGURE 1) counterclockwise from the position identified by reference character **264*a*** to that identified by reference character **264*b***. As operating lever **264** pivots, it moves operating rod **242** forwardly, rotating the fingers **230** and **232** of the hop vine aligning assembly **160** counterclockwise about pivot studs **234** from the position shown in FIGURE 8 to the position shown in FIGURE 4.

When the fingers reach the latter position, they are latched by the latch **285** shown in FIGURE 13 which is a spring member having an inclined leg **286** fixed in a slot **287** in the vertical leg **185** of angle iron **176** as by welding or brazing. Leg **286** extends above aligning assembly finger **232** and terminates in a vertically depending leg **288** which extends into a slot **289** formed in the vertical leg of the angle. A stop **290**, fixed to the lower end of depending leg **288**, normally engages a horizontally extending edge **291** in slot **289** and prevents latch **285** from springing out of the slot.

As finger **232** pivots from the position of FIGURE 9 to the position of FIGURE 4, it rides over the inclined leg **286** of latch mechanism **285**, depressing the latch to the position shown in dotted lines in FIGURES 13. After the finger reaches the FIGURE 4 position, latch **285** will spring upwardly to the position shown in full lines, its vertically extending leg **288** engaging finger **232** and preventing it from rotating in the clockwise direction. Thus, vines **30** which otherwise would not be properly positioned by the Pomona conveyor against stop assembly fingers **164** and **166** due to variations in the relative movement of the Pomona and hop picking machine conveyors will, by the pivotal movement of aligning assembly fingers **230** and **232**, be pushed against the stop assembly fingers and held in this position as the graspers **38** and **38**[1] move upwardly over end sprockets **74** of the hop picking machine conveyor.

With continued operation, the relation of actuating lever **278** and grasper bars **82** may become altered so that the grasper bars move the actuating lever through an increased stroke, tending to pivot aligning assembly fingers **230** and **232** counterclockwise beyond the positions shown in FIGURE 4. The hop vines **30**, however, will prevent movement of the fingers beyond the FIGURE 4 positions and override spring **284** will, at the same time, permit continued counterclockwise movement of actuating lever **278** without damage to the hop vine aligning assembly operating mechanism.

Referring now to FIGURE 16, as a grasper bar **82** moves upwardly over end sprockets **74** past the position where hop vines **30** are clamped in graspers **38** and **38**[1], the vertical leg **96** of the grasper bar will engage the lower surfaces of stop fingers **164** and **166**, lifting them from the position shown in full lines in FIGURE 16 to the position shown in dotted lines, the elongated slots **186** in stop assembly bar **163** permitting the fingers to move upwardly relative to the rods **172** and **174** on which they are normally supported. As the stop assembly fingers **164** and **166** move upwardly, stop assembly latch **222** is raised above the vertical leg **185** of channel **176** and finger **232** of the hop vine aligning assembly **160** is raised above latch **285**.

Referring now to FIGURE 3, the hop vine stop assembly operating lever **199** is then returned to its normal inoperative position by a tension spring **292** attached at one end to a bracket **293** fixed to a horizontally extending channel **294** in the hop picking machine framework and, at its opposite end, to a lug **295** fixed to operating lever **199**. At the sime time stop assembly **158** is returned to its inoperative, retracted position by a tension spring

300 attached, at one end, to a lug **302** fixed to a horizontally extending brace **304** in the hop picking machine framework and, at the other end, to a vertically extending lug **306** fixed as by welding to the horizontal leg **258** of stop assembly channel **162**.

As is shown in FIGURE 14, the clockwise movement of operating lever **199** to its inoperative position is terminated by the engagement of the lever with a stop **296**. Stop **296** has bifurcated arms **297** which engage the opposite sides of bracket **202** and prevent the stop from rotating. Stop **296** may be adjusted by rotating an adjusting screw **297** which is rotatably fixed to the stop and extends through an internally threaded adjusting screw support **298** fixed to the lower edge of bracket **202**.

Simultaneously with the above-described return movement of operating lever **199** and stop assembly **158**, the fingers **230** and **232** of the hop vine aligning assembly **160** are rotated in a clockwise direction from the position shown in FIGURE 4 to the normal, inoperative position shown in FIGURES 8 and 9 by a tension spring **308** connected, at one end, to a bracket **310** fixed to a horizontally extending channel **312** in the hop picking machine framework. The opposite end of spring **308** is attached to a lug **314** fixed to operating lever **264** adjacent its lower end whereby the spring pivots the operating lever in a clockwise direction about pivot stud **267**.

Referring now especially to FIGURE 17, if the fingers **164** and **166** of stop assembly **158** are not released in the normal manner described above, continued upward movement of grasper bar **82** around end sprockets **74** to the position of FIGURE 17 will tilt the hop vine stop assembly **158** and the hop vine aligning assembly **160** in a counterclockwise direction about pivot studs **178**, releasing the stop assembly fingers **164** and **166** and the aligning assembly fingers **230** and **232**. These assemblies will then be pivoted in a clockwise direction about the pivot studs to the normal position in which the upper surfaces of fingers **164** and **166** bear against rollers **193** by tension spring **300**.

FIGURES 21 and 22 illustrate an alternate embodiment of grasper **320** constructed in accordance with the principles of the present invention. Grasper **320** includes what may be termed a fixed jaw **322**, a movable jaw **324**, and an operating mechanism **326** and is mounted on a base plate **328** which is identical to the base plate **98**, described above. The grasper bar **82** to which base plate **328** is fixed is identical to the grasper bar **82** described above.

Fixed jaw **322** consists of a pair of arcuately sectioned jaw members **330** and **332** fixed to and extending upwardly from base plate **328** and disposed so that their flat edge surfaces **333** are aligned in the same plane. Movable jaw **324** includes an arm **334** pivotally fixed to base plate **328** by pivot stud **336**. Fixed to and extending vertically upward from arm **334** are a pair of arcuately sectioned members **338** and **340**, similar to the arcuately sectioned members **330** and **332** described above.

Operating mechanism **326** includes an operating lever **342** fixed at one end by a pivot pin **344** between a pair of mounting lugs **346** attached to the vertical leg **96** of grasper bar **82**. Extending between operating lever **342** and the pivotable arm **334** of movable jaw **324** is a rigid connecting link **348** pivotally connected to the operating lever and arm **334** by pivot studs **350** and **352**. Fixed to the end of operating lever **342** opposite its connection to mounting lugs **346** is a cam roller **354** rotatably mounted on a shaft **356** which may be fixed to operating lever **342** in the same manner that shaft **140**, described above, is fixed to operating lever **128**.

As in the grasper **38** described above, the jaws of grasper **320** are spread apart by the cooperation of cam rollers **354** and a member providing a suitable cam surface such as the angle irons **154** described above. As the roller **354** rides over the jaw closing portion of the cam surface, the jaws are closed by a tension spring **358** attached at one end to operating lever **342** and at the other to a lug **360** fixed to the vertical leg **96** of the grasper bar **82**. When grasper **320** is closed, the hop vine end is securely clamped between member **330** of the fixed jaw and the concave surface of member **340** of the movable jaw.

It is to be understood that graspers **38** and **320** are not limited in application to hop picking machines providing automatic transferral of the hop vines from the Pomona conveyor to the conveyor of the hop picking machine. On the contrary, the operators **128** and **342** of these graspers may be manually operated where automatic transferral of the hop vines is not desired. To facilitate manual operation of graspers **38** and **320**, the cam roller **140** (or **354**) and its supporting structure may be deleted and a handle of conventional construction formed integrally on or fixed to the end of the operator.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by Letters Patent is:

1. A hop picking machine comprising:

(a) a delivery conveyor;

(b) an endless conveyor, said endless conveyor having a pair of end sprockets supporting a pair of spaced apart, parallel, endless members and at least one grasper bar extending between and fixed at its opposite ends to said members, said endless conveyor further being substantially horizontal providing an upper and lower run and having a direction of travel such that said grasper bar moves along the lower run of said conveyor, upwardly around said end sprockets, and along the top run of said conveyor;

(c) at least one grasping device connected to said grasper bar, said grasping device having a pair of relatively movable jaws adapted to grasp a vine therebetween;

(d) means including a cam follower for first opening and then snapping shut said jaws;

(e) means fixed to the frame of said machine providing a stationary cam surface operatively associated with said cam follower, said cam surface-providing means being positioned to open the jaws of said grasper device as said grasper bar approaches said end sprockets and to snap said jaws shut as said grasper bar passes over said end sprockets;

(f) alignment means adjacent the feed end of said endless conveyor for guiding hop vines into the jaws of said grasping device, said alignment means including a slidably mounted member having a pair of fingers automatically movable from retracted positions into operative positions adjacent said grasping device and means for moving said fingers between the inoperative and operative positions including actuating means positioned in the path of movement of said grasper bar for operation thereby and means operatively connecting said actuating means and said slidably mounted member.

2. The hop picking machine as defined in claim **1**, wherein said endless conveyor has a plurality of grasper bars and wherein said means for moving said fingers to their operative positions comprises a pivotable lever adapted to engage said slidably mounted member, an operating lever pivoted to the frame of said machine, with its free end disposed in the path of said grasper bars as they move along the upper run of said conveyor, and a rigid link pivotably connected at one end to said pivotable lever and at the other to said operating lever.

3. The hop picking machine as defined in claim **1** including resilient biasing means for returning said fingers to their inoperative positions.

4. The hop picking machine as defined in claim **1** including means for pushing hop vines against the fingers of said aligning means including a lever pivotably fixed to each of said fingers, a rigid link pivoted at its opposite ends to said levers, and means for rotating said levers from inoperative positions to operative positions wherein said levers form small acute angles with said fingers.

5. The hop picking machine as defined in claim **4** including means for latching said pivotable levers in the operative position and means for automatically unlatching said levers after the hop vines held by said levers have been grasped by the grasping devices on a passing grasper bar.

6. The hop picking machine as defined in claim **4**, wherein the means for rotating said levers to their operative positions comprises a movable member pivotably fixed at one end to said rigid link, a pivoted closing lever pivotably fixed to the opposite end of said movable member, and means operated by the movement of said grasper bars along the upper run of said conveyor for pivoting said closing lever.

7. The hop picking machine as defined in claim **6** including resilient biasing means for returning said pivotably mounted members to their inoperative positions.

8. The hop picking machine as defined in claim **1** including means for latching said fingers in the operative positions, said means being unlatched by said grasper bar following the snapping shut of the grasping devices carried by said bar.

9. The hop picking machine as defined in claim **8**, including means mounting said slidable member for pivotal movement about a horizontal axis whereby, if said latching means fails to unlatch, said member will be tilted by said grasper bar as it moves upwardly, allowing passage of said bar around said sprockets.

10. In a hop picking machine; a delivery conveyor; an endless conveyor; grasping devices carried by said endless conveyor; means operated solely by said machine for sequentially opening and closing said grasping devices to secure in said devices hop vines delivered to said endless conveyor; retractable alignment means adjacent the feed end of said endless conveyor for guiding hop vines into said grasping devices; actuating means for said alignment means; and means incorporated in said endless conveyor for operating said actuating means.

11. The combination as defined in claim **10**, including means for pushing and holding the hop vines against said aligning means to insure that said vines are properly positioned in relation to said grasping devices, operation of said pushing and holding means being automatically effected by the movement of said endless conveyor.

12. The hop picking machine as defined in claim **10**, including means for pushing hop vines against said alignment means to accommodate variations in the rate at which the hop vines are delivered to said endless conveyor, actuating means for said alignment means; and means incorporated in said conveyor for operating said actuating means.

13. In the combination of a hop picking machine having an endless conveyor, a delivery conveyor for delivering hop vines to said endless conveyor, and grasping devices at intervals along said endless conveyor for receiving and grasping vines delivered to said endless conveyor by said delivery conveyor; the improvement of means for automatically transferring hop vines from said delivery conveyor to said endless conveyor and securing them in said grasping devices, comprising: cooperating stationary means and means incorporated in said grasping devices for periodically actuating said grasping devices to secure the hop vines therein; and aligning means adjacent the feed end of said endless conveyor for guiding said vines into said grasping devices including movable guiding members and means for effecting vine guiding movement of said members in timed relation with the actuation of said grasping devices including an actuator and means incorporated in said conveyor for operating said actuator.

14. In a hop picking machine; a delivery conveyor; a continuously operated endless conveyor; sequentially operated grasping devices on said endless conveyor; means to sequentially operate said grasping devices; and retractable alignment means adjacent the feed end of said endless conveyor for receiving hop vines from said delivery conveyor and guiding them into said grasping devices.

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Aug. 13, 1940.

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2,211,357

HOP PICKING MACHINE

Filed Oct. 12, 1938

Fig. 1.

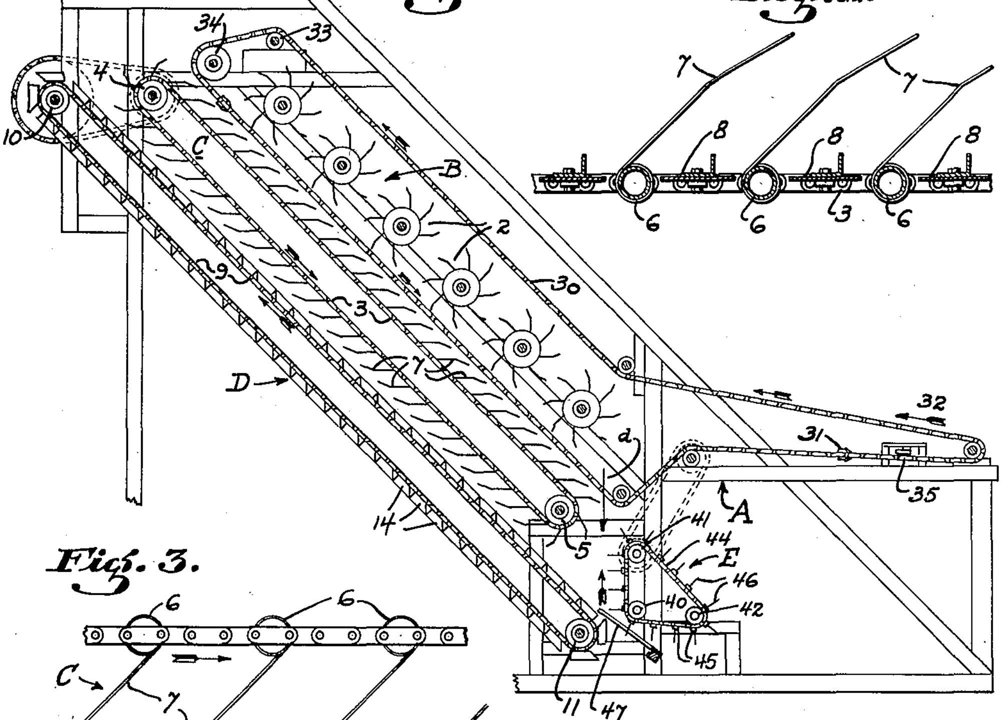


Fig. 2.

Fig. 3.

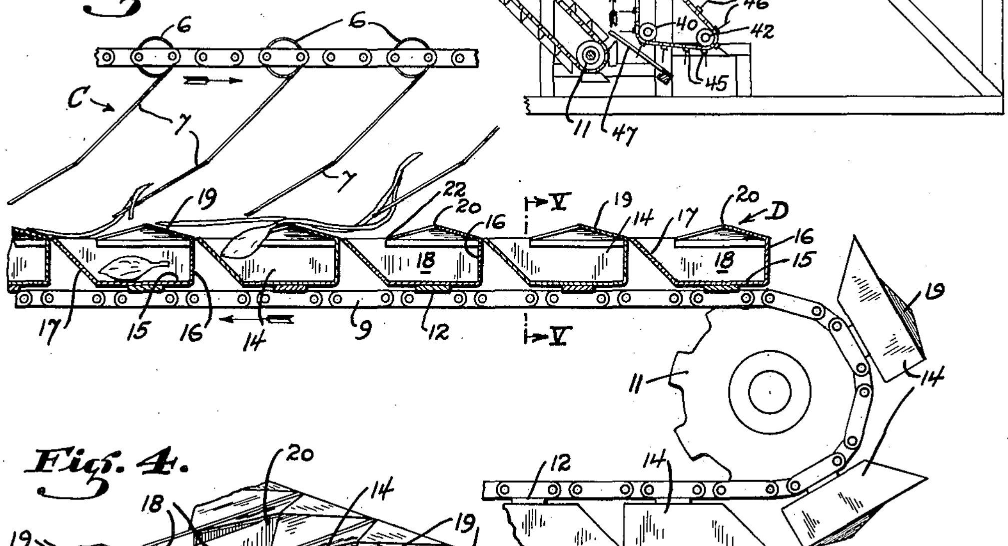


Fig. 4.

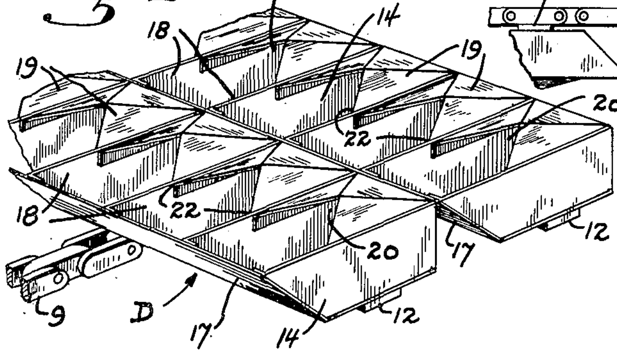
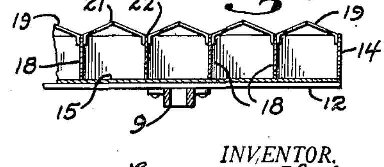


Fig. 5.



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Patented Aug. 13, 1940 2,211,357

UNITED STATES PATENT OFFICE

2,211,357

HOP PICKING MACHINE

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Application October 12, 1938, Serial No. 234,589

6 Claims. (Cl. 130—30)

This invention relates to a hop picking machine, and particularly to a bucket-shaped member which serves both as a picker and as a conveyor for the picked hops.

In the picking of hops by machinery, the vine which is picked is pulled through the machine, and during its passage it is combed or stripped both of hops and of leaves by literally thousands of continuously moving V-shaped wire fingers secured on bars, which in turn are supported by revolving drums or endless belts. The vine when entering the machine will first pass in one direction over certain groups of picking or stripping fingers, and a quantity of hops will be removed. The path taken by the vine is then reversed, and it will next pass below said fingers and over another set of fingers, and so on. The hops, in other words, are gradually removed, and with their removal, clusters of hops together with arms, stems and portions of vines, are stripped and broken off and are deposited on a conveyor, from which the clusters, arms, and broken portions of the vines are picked off by workers ranged along the conveyor, while the hops, leaves and stems continue on and are delivered to a separator. The arms, clusters and broken portions of vines are delivered to another machine known as an arm picker. The arm picker discharges through another separator, helped by manual sorting, and all hops are finally gathered on a common conveyor lined with manual workers to remove stems and leaves missed by the several separators.

An attempt has been made to do away with the many manual workers and to combine in a single machine mechanism for breaking up the clusters and for removing the hops from the vines and broken portions thereof. Such a machine is disclosed in my co-pending application entitled "Hop picking machine," filed June 30, 1937, Serial No. 151,142, and while the machine there disclosed has been fairly successful, improvements have been made, and form the subject matter of this application.

The object of the present invention is to improve hop picking machinery of the type disclosed in the co-pending application, and particularly that part of the mechanism whereby the clusters, arms and broken parts of vines are picked.

The improvements are shown by way of illustration in the accompanying drawing, in which

Fig. 1 is a diagrammatic side elevation of a hop picking machine;

Fig. 2 is an enlarged longitudinal cross section of a portion of the picker belt;

Fig. 3 is an enlarged cross section of a portion of the pocketed conveyor and the picker belt cooperating therewith;

Fig. 4 is a perspective view of a portion of the pocketed conveyor; and

Fig. 5 is a cross section taken on line V—V of Fig. 3.

Referring to the drawing in detail, and particularly to Fig. 1, A indicates the main frame of a hop picking machine; B an upper picker unit; C an intermediate and D a lower picker unit. The upper unit B consists of a plurality of continuously revolving drums which are provided with radially projecting V-shaped wire fingers 2. The intermediate unit, hereinafter to be referred to as the picker belt, consists of a pair of spaced sprocket chains 3 supported and driven by pairs of upper and lower sprocket gears 4 and 5. Secured between the chains and crosswise thereof are tubular bars 6, and carried thereby are rows of V-shaped wire picking fingers 7. Also secured between the chains 3 are bars or strips 8 which form fillers between the bars 6 so as to present a continuous floor-like surface to receive and convey picked hops and leaves, as will hereinafter appear.

The lower unit D, which will hereinafter be referred to as the pocketed conveyor, consists of a pair of spaced sprocket chains 9 supported and driven by upper and lower pairs of sprocket gears 10 and 11. These chains are connected by crossbars 12 and they in turn secure rows of buckets 14 which function first of all to pick hops, secondly to receive and protect them after they have been picked, and last but not least to convey and deliver the hops to a separator not here shown. The pocket members are arranged side by side in rows crosswise of the chains 9; each row of pockets is formed by a single member substantially channel-shaped in cross section, that is, it has a bottom portion 15, a right-angular rear flange 16, and a sloping front flange 17. This channel-shaped member is divided into pockets or buckets by a series of cross-plates 18 welded or otherwise secured thereon, and each pocket or bucket is partially covered by a plate 19 in the forward edge of which is formed a V-shaped recess or notch 20. These plates will hereinafter be referred to as "picker plates." They could be horizontally disposed across the pockets, but actual practice has shown that they should, preferably, be V-shaped in cross section, as indicated at 21 in Figs. 4 and 5. By such a formation, V-shaped recesses 22 are formed between the plates, and these recesses are swept by the fingers 7 as will hereinafter appear. The channel-shaped members with the pockets formed therein are riveted or welded to the cross-bars 12, and they are closely spaced as shown in Figs. 3 and 4 to present a substantially continuous pocketed surface.

An endless conveyor consisting of a pair of spaced sprocket chains 30 is employed to receive and pull the vines to be picked through the machine. Vine grasper bars such as indicated at 31 are secured crosswise between the chains, and travel therewith. Gripping means are mounted on the grasper bars, to which the vines are attached, and when attached the vines will travel from the point 32 in the direction of the arrow, upwardly over the picker drums B. The conveyor chains and the bar 31 will then pass around the sprocket gears indicated at 33 and 34, when the direction of travel will be reversed and the vines will be pulled downwardly between the drums and the picker belt C, and when the vines have finally passed between them, they will finally be discharged at the point 35.

All the hops and most of the leaves are removed or stripped from the vines during the passage through the machine. Clusters of hops are removed, and arms and parts of the vine are broken from the vine or pulled off. The clusters must be broken up into individual hops, and the hops must be picked from the arms and the broken portions of the vines, as there would otherwise be a considerable loss. In the present instance, the upper side of the picker belt functions not only as a picker but also as a conveyor, as the hops removed by the drums and the picking fingers 7 will settle downwardly between the fingers upon the filler plates 8. The leaves will also settle at this point, while broken arms and clusters will be carried by the fingers upwardly in the direction of the arrow, and will be discharged at the upper end of the unit D, and as the upper side of this unit travels in the direction of the arrow, the hops and leaves will be carried over and discharged into a separator not shown. The clusters, the arms, and the broken portions of the vines will, however, adhere to the fingers 7 and will be pulled by them downwardly between the unit C and the unit D. The clusters are there broken up by the notched picker plates, and the hops are at the same time removed from the arms and vines. The hops forming the individual clusters will deposit in the pockets, and so will the hops which are removed from the arms, and when the pickers pass over the upper sprockets 10 they will be inverted and the hops and leaves will be discharged by gravity. The vines and arms, on the other hand, will continue downwardly with the fingers 7 and will finally reach a discharge member generally indicated at E. This member consists of three shafts indicated at 40, 41 and 42 on each of which are mounted a pair of sprocket gears. The sprocket gears are spaced apart approximately the width of the machine and the sprockets on each shaft align and support and drive chains 44 to which are secured cross bars 45 from the faces of which project pins or spikes 46 which engage the picked arms and vines and discharge them from the machine. Below the sprocket 40 is placed a plurality of spaced slots 47 which function as a guard to prevent individual hops from escaping at the lower end of the belt or conveyor D. A considerable number of hops fall down in the direction of arrow *d* and while most of them are gathered or fall into the pockets 14 of the conveyor D a few have a tendency to escape, but this is prevented by the slots 47 as the spikes 46 are constantly combing or passing between the spaced slots and any hops reaching the slots are thus engaged by the spikes and thrown back on to the conveyor. It will be noted that there is a considerable spacing between the sprockets 40 and 42. This is important, as any vines which have a tendency to adhere to the spikes will be in a condition of suspension when travelling from the sprockets 42 to the sprockets 40. There is always considerable vibration in a machine of this character and this together with the pull of gravity will free the vines and permit them to drop.

To insure downward movement of the clusters and arms between the picker belt and the pocketed conveyor, the picker belt must travel at a greater speed, as gravity alone is not sufficient. That is, the upper side of the pocketed conveyor travels in an upward direction, while the lower side of the cooperating picker belt travels in a downward direction. If they both travel at the same rate of speed, an object placed between them would merely tend to ball up and rotate. It is for this reason that the speed of the picker belt is greater than that of the pocketed conveyor, and it is due to this greater speed that the clusters and vines are pulled downwardly.

In the machine here shown every attempt is made to bring the picked hops to a state of rest, and to protect them from breakage, the moment they are picked. When the vine first passes over the drums B, a certain proportion of hops and leaves are removed, and the moment they are removed they drop by gravity in a downward direction and are deposited between the fingers on the picker belt. They are there protected to a great extent by the fingers, and are discharged from the upper end of the picker belt onto the upper end of the pocketed conveyor, and by this conveyor are discharged into the separator. All hops obtained by breaking up clusters and by picking arms and broken portions of vines are also protected, and even more so, as they are immediately deposited in the pockets or buckets 14, and once they reach these pockets they can not be broken as they are covered by the picker plates 19, and they will remain in these pockets until they are discharged by the inversion of the pockets when they pass around the upper sprockets 10. In this manner, a better grade of hops is obtained, and hand labor is substantially eliminated. It will be noted that the construction of the picker drums B and the picker belt C, the vine grasper bar and they conveyor, have been only briefly referred to. This is due to the fact that the picker belt per se is completely described and shown in detail in my co-pending application previously referred to. The picker drums are shown in detail in a number of issued patents; and the vine grasper bar and the conveyor whereby it is carried are shown in detail in my co-pending application entitled "Vine grasper bar," filed September 27, 1938, Serial No. 231,909.

Having thus described and illustrated my invention, what I claim and desire to secure by Letters Patent is:

1. In a hop picking machine a picker belt composed of V-shaped picking fingers, a conveyor disposed below and in close proximity to said fingers and presenting to the fingers a plurality of pocket-

ed receptacles, a picker plate partially covering each receptacle, each plate having its forward edge V-shaped to receive and pull hops from a vine, said pockets receiving, conveying and protecting the picked hops, and means for imparting continuous movement to the picker belt and the pocketed conveyor, in a direction opposite to each other.

2. In a hop picking machine a picker belt composed of V-shaped picking fingers, a conveyor disposed below and in close proximity to said fingers and presenting to the fingers a plurality of pocketed receptacles, a picker plate partially covering each receptacle, each plate having its forward edge V-shaped to receive and pull hops from a vine, said pockets receiving, conveying and protecting the picked hops, means for imparting continuous movement to the pocketed conveyor in one direction and means for imparting continuous movement to the picker belt in an opposite direction and at a greater speed.

3. In a hop picking machine a picker belt composed of V-shaped picking fingers, a conveyor disposed below and in close proximity to said fingers and presenting to the fingers a plurality of pocketed receptacles, a picker plate partially covering each receptacle, each plate having its forward edge V-shaped to receive and pull hops from a vine, said pockets receiving, conveying and protecting the picked hops, means for imparting continuous movement to the pocketed conveyor in one direction and means for imparting continuous movement to the picker belt in an opposite direction and at a greater speed, to cause vines or portions thereof to be fed between the picker belt and the pocketed conveyor in the direction of travel of the picker belt.

4. In a hop picking machine a picker belt composed of V-shaped picking fingers, a conveyor disposed below and in close proximity to said fingers and presenting to the fingers a plurality of pocketed receptacles, a picker plate partially covering each receptacle, each plate having its forward edge V-shaped to receive and pull hops from a vine, said pockets receiving, conveying and protecting the picked hops, means for imparting continuous movement to the pocketed conveyor in one direction, means for imparting continuous movement to the picker belt in an opposite direction, and at a greater speed, to cause vines or portions thereof to be fed between the picker belt and the pocketed conveyor in the direction of travel of the picker belt, and means for removing vines and portions thereof when picked.

5. In a hop picking machine a picker belt composed of V-shaped picking fingers, a conveyor disposed below and in close proximity to said fingers and presenting to the fingers a plurality of pocketed receptacles, a picker plate partially covering each receptacle, each plate having its forward edge V-shaped to receive and pull hops from a vine, said pockets receiving, conveying and protecting the picked hops, means for imparting continuous movement to the pocketed conveyor in one direction, means for imparting continuous movement to the picker belt in an opposite direction, and at a greater speed, to cause vines or portions thereof to be fed between the picker belt and the pocketed conveyor in the direction of travel of the picker belt, a conveyor disposed adjacent the end of the pocketed conveyor, and projecting pins on said conveyor for engaging and removing vines and portions thereof when picked.

6. In a hop picking machine an endless conveyor disposed on an incline to present an upper and a lower end, a plurality of pocketed receptacles disposed in rows transverse of the conveyor and secured thereto, a picker plate covering a portion of the open top of each pocketed receptacle, each plate having its forward edge V-shaped to receive and pull hops from a vine, said receptacles receiving and protecting the picked hops and said picker plates being V-shaped in cross section and extending above the open ends of the receptacles, means for imparting continuous movement to the conveyor so that hops picked thereby will be delivered to the upper end thereof and discharged by gravity from the receptacles, and means for feeding hop vines or portions thereof over the surface presented by the pocketed receptacles in a direction opposite to their travel.

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March 12, 1940. E. THYS 2,193,354

VINE GRASPER BAR

Filed Sept. 27, 1938 2 Sheets-Sheet 1

Fig. 1.

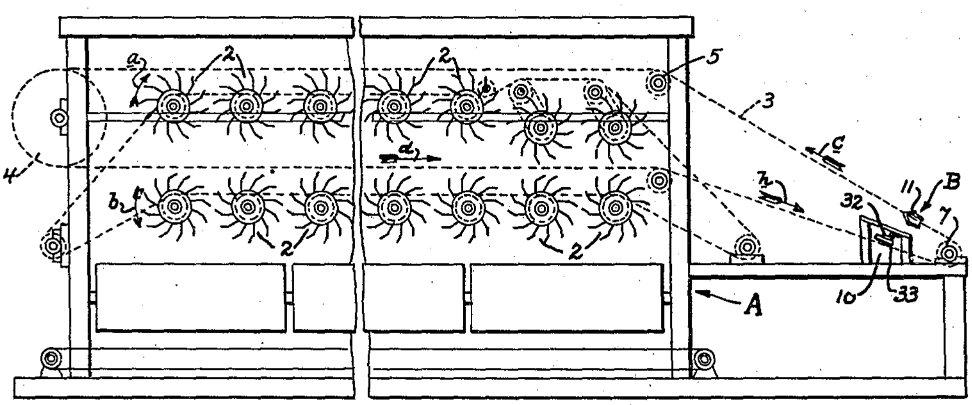


Fig. 2.

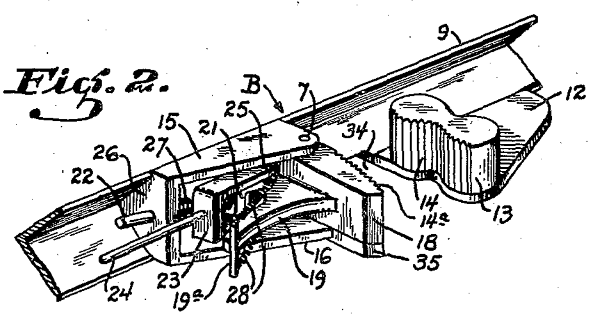


Fig. 3.

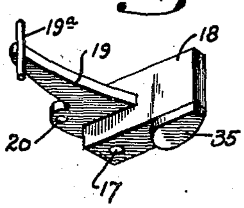


Fig. 4.

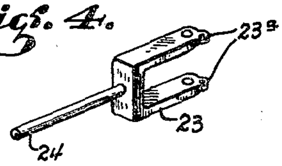


Fig. 5.

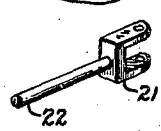
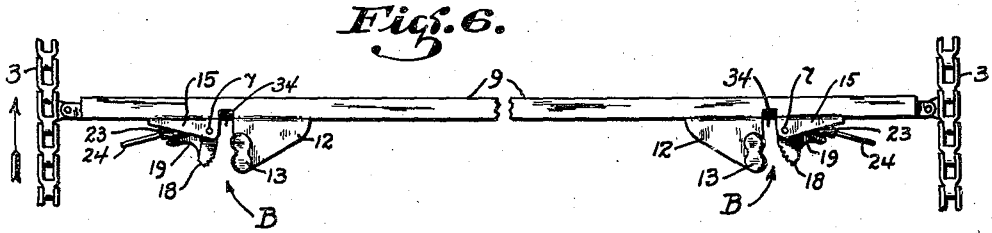


Fig. 6.



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VINE GRASPER BAR

Filed Sept. 27, 1938 2 Sheets-Sheet 2

Fig. 7.

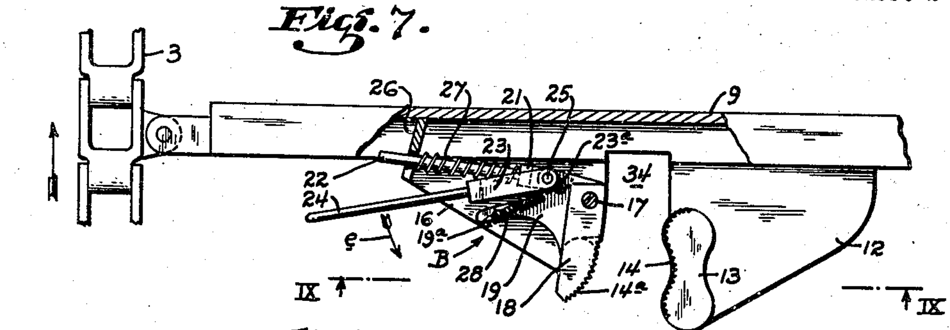


Fig. 8.

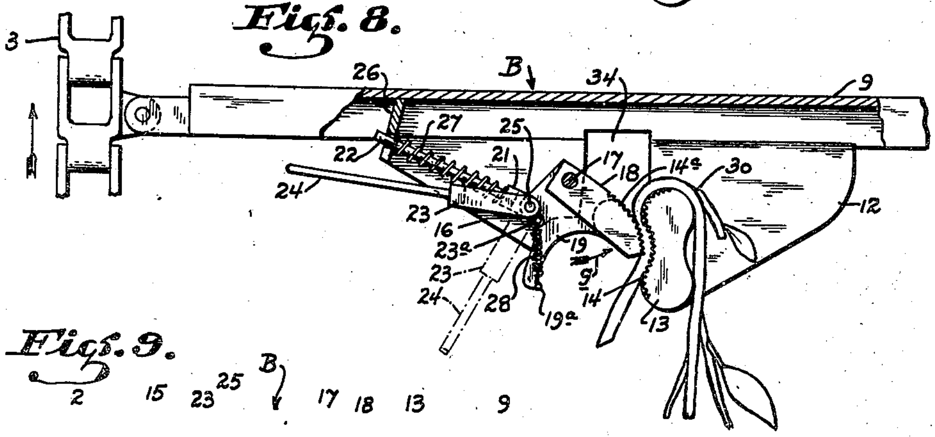


Fig. 9.

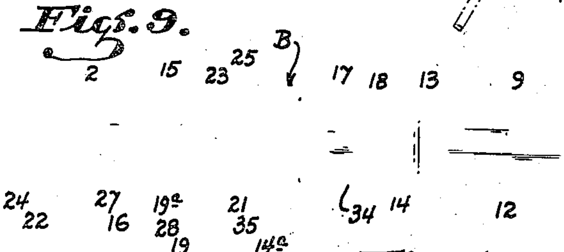


Fig. 10.

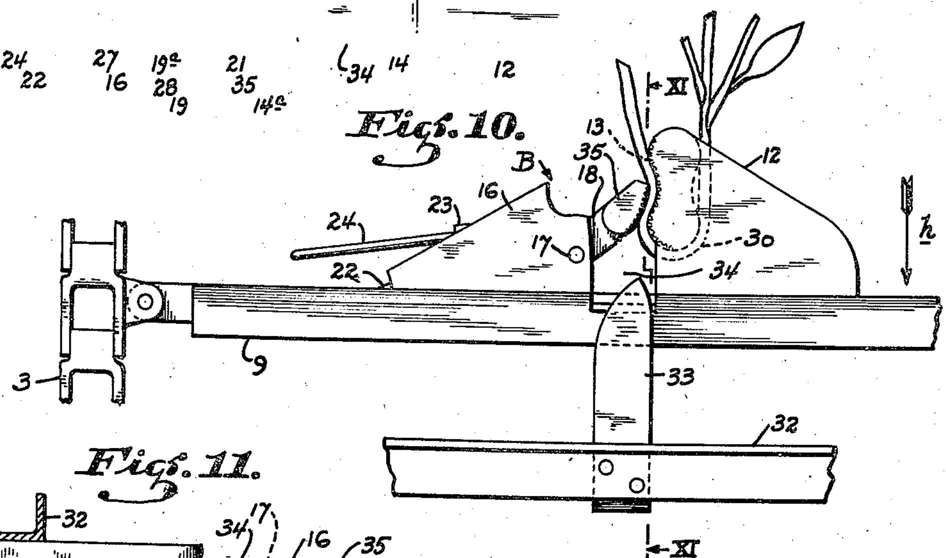
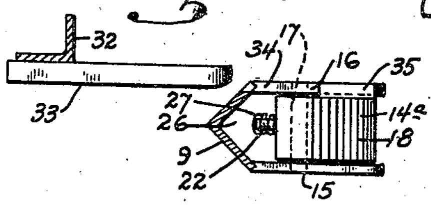


Fig. 11.



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2,193,354

UNITED STATES PATENT OFFICE

2,193,354

VINE GRASPER BAR

Edouard Thys, Sacramento, Calif., assignor to E. Clemens Horst Company, San Francisco, Calif., a corporation of New Jersey

Application September 27, 1938, Serial No. 231,909

3 Claims. (Cl. 130—30)

This invention relates to an apparatus for grasping and holding one end of a hop vine while it is being fed or pulled through a hop picking machine, this application being a continuation in part of the vine grasper structure disclosed in my co-pending application entitled "Hop picking machine," filed June 30, 1937, Serial No. 151,142.

The object of the present invention is generally to simplify and improve the construction and operation of vine grasper bars of the type described; to provide a grasping mechanism which automatically increases its grip on the vine as the pull on the vine increases; and further, to provide a grasping mechanism from which the vine is readily released and removed when the picking operation is completed.

The vine grasper bar is shown by way of illustration in the accompanying drawings, in which:

Fig. 1 is a diagrammatic side elevation of a hop picking machine;

Fig. 2 is a perspective view of the vine grasping mechanism;

Fig. 3 is a perspective view of the pivoted grasper jaw;

Fig. 4 is a perspective view of the releasing lever;

Fig. 5 is a perspective view of the spring-actuated push rod;

Fig. 6 is a plan view of a complete vine grasper bar;

Fig. 7 is a plan view partially in section of one end of a vine grasper bar, showing the grasping mechanism in open position;

Fig. 8 is a view similar to Fig. 7 showing the grasping mechanism in closed or grasping position;

Fig. 9 is a side view of Fig. 7, looking in the direction of the arrows IX—IX;

Fig. 10 is a bottom view of one end of a grasper bar and the grasping mechanism carried thereby, said view showing the stationary cam whereby the pivoted grasping jaw is automatically opened to release a vine; and

Fig. 11 is a cross section taken on line XI—XI of Fig. 10.

Referring to the drawings in detail, and particularly to Fig. 1, A indicates an elongated frame in which are mounted upper and lower rows of picker drums such as indicated at 2. These drums are provided with spaced rows of V-shaped picking fingers constructed of resilient spring wire, and as the upper drums rotate in the direction of arrow *a*, and the lower drums in the direction of arrows *b*, a hop vine when passed between the drums will be combed by the fingers, and the hops will be removed. To accomplish this, a pair of spaced endless sprocket chains 3 are employed. These chains pass over a driving sprocket 4 and idlers such as indicated at 5, 6, and 7. The vine grasper bars shown at 9 are secured at spaced intervals between the sprocket chains 3, and if vines are attached thereto, they will first pull the vines upwardly in the direction of arrows *c* over the upper row of drums, then pass around the driving sprocket 4, and finally pull the hop vines between the drums in the direction of arrow *d*. Thereafter, the vines are released at the point 10, and new vines to be picked are applied.

A platform, not shown, is disposed in front of the idler sprockets 7. Two operators are stationed on this platform; they grasp the butt or root ends of the hop vines and secure them to the grasper bar indicated by dotted lines at 11, and when secured the vines will take the path through the machine which has previously been described, and when they reach the point 10 they will be automatically released. The mechanism for securing the vines and for releasing them forms the subject matter of the present application, and is best illustrated in Figs. 2 to 11 inclusive.

Each grasper bar is constructed of angle iron (see Fig. 2). At each end thereof is placed a grasping mechanism generally indicated at B. As each grasping mechanism is like all the others, a description of one will suffice. Referring to Figs. 2 to 8 inclusive, 9 indicates the angle bar, and 12 a plate welded or otherwise secured thereto. Supported by the plate is a stationary-gripping jaw 13, and formed on the inner face thereof are serrations or teeth 14. Also welded or similarly secured to the angle bar are a pair of plates 15 and 16, and pivotally mounted as at 17 is a gripping jaw 18, which is also provided with serrations or teeth 14a. Means are provided for automatically opening, or in other words, swinging the pivoted jaw 18 from the closed position shown in Fig. 8 to the open position shown in Fig. 7, and means are also provided for manually closing or swinging the jaw 18 from its open position to the closed or gripping position shown in Fig. 8. This latter means is constructed as follows: Formed on the rear side of the pivoted gripping jaw 18 is an arm 19, and pivoted to said arm at the point 20 is a form 21 which terminates in a rod 22, and also a fork 23 which terminates in a handle 24. A pin 25 extends through the eyes of the forks 23 and 21, and the pivot 20 formed in the arm 19, and the rod 22 extends through an end plate 26 whereby the plates 15 and 16 are connected. The rod is freely slidable in this end plate, and a spring 27 is interposed between said plate and the fork 21. On the fork 23 are formed a pair of lugs 23a, and on the outer end of the arm 19 is a cross-arm 19a. A pair of springs 28 connects the cross-arm 19a with the extensions 23a of the fork; and the function of the gripping mechanism as a whole will be as follows.

If reference is made to Fig. 7, it will be noted that spring 27 will normally function to hold the pivoted jaw 18 in open position, as the pivot pin 25 which connects the fork 21 with the arm 19 of the pivoted jaw is offset with relation to a center line drawn between the pivot point 17 and the hole in the end plate 26 through which the rod extends. Plainly speaking, the connection is an off-center toggle, which is spring-actuated and for that reason normally holds the jaw open. If it is desired to close the jaw, it is only necessary to swing the pivotal point 25 on the opposite side of the imaginary center line drawn between the point 17 and the hole in the plate 26, as the spring will then act to close the jaws. In order to do this, lever 24 is provided. By grasping the lever 24 and swinging it in the direction of the arrow *e*, the upper end of the fork 23 will engage the cross-arm 19a of the arm 19, and thus swing the jaw about the pivot 17, and the moment it has swung sufficiently far to permit the pivot pin 25 to swing to the other side of the imaginary center line, spring 27 will immediately close or swing the pivoted jaw 18 into contact with the stationary jaw 14. The handle 24 will, during this period, swing from the full line position shown in Fig. 7 to the dotted line position shown in Fig. 8, but when it is released, springs 28 will pull the lever back to the full line position shown in both Figs. 7 and 8, where it is substantially parallel with the angle bar 9 and in a position where it is not affected by the vines or picking fingers of the machine.

In actual operation, it was previously stated that the operator or operators who feed the vines to the machine are stationed on the platform disposed in front of the sprocket 7. The operator, when he is going to apply a vine, grasps it at its butt or root end and forms a loop 30 which he places over the stationary jaw as shown in Fig. 8. He then grasps the lever 24 and swings it to the dotted line position, and thereby closes the jaw 18, and when he releases the lever 24, it automatically swings back to the full line position shown in Figs. 7 and 8, or, practically speaking, into parallelism with the bar 9. When this is done, the vine is secured and will be pulled through the machine as previously described. As it is being pulled through the machine, the pull on the vine increases, particularly when it passes between the upper and lower rows of drums, or in the direction of arrow *d* (see Fig. 1). Such increased pull will not release the vine or permit it to be pulled from between the jaws, as any increase in pull will simply cause the jaw 18 to swing in the direction of arrow *g* and thereby increase the pressure and grip on the vine. Thus accidental release due to increased pull or otherwise is not liable to effect release or pulling loose of the vine from the grasping mechanism.

After the vine has completed its circuit through the picking machine it reaches the point 10, which is below but adjacent the feeding position. At this point a cross-bar 32 extends across the machine. On this bar are a pair of cam fingers 33, and these cam fingers align with slots 34 formed between the plates 12 and 16. On the lower face of the pivoted jaw 18 is a lug or plate 35. This extends into the slot 34; hence as the grasper bar is moving in the direction of arrow *h* (see Figs. 1 and 10) and the cam finger 33 enters the slot 34, it will engage the plate or lug 35 and thereby swing the jaw 18 about its pivot 17 back to open position, and it will there be held in open position until it is again closed by means of the lever 24.

When the grasping mechanism is in the feeding position, the stationary jaw 13 points upwardly and thereby permits the loop formed by the operator or feeder of the vine to be hooked over it, but when the grasper bar is returning, and approaching the bar 32 and cam finger 33, it is turned upside down; hence when the jaw 18 is opened, the loop formed around the stationary jaw 13 will fall off, and the vine is entirely clear and free of the grasping mechanism.

The broad idea of a grasping mechanism of this character is old, as it is fully disclosed in Patent No. 1,054,360, issued to George E. Miller on February 25, 1913. He discloses a hop picking machine of the character here shown; he discloses the use of grasper bars and a grasping mechanism which is manually operated when the vine is hooked on, and which is automatically opened when the vine is picked. This mechanism has been extensively used since the issuance of the patent, and no improvement was made thereon until just recently, when the structure here disclosed was developed and put into use. It has proven superior due to the ease with which the vine is released and removed; and it has also proven superior due to the automatic gripping action of the jaw 18 as the pull on the vine increases.

Structurally, the grasping mechanism here shown differs from that disclosed in the patent to Miller, and in actual operation it is superior due to the advantages just set forth.

Having thus described and illustrated my invention, what I claim and desire to secure by Letters Patent is:

1. A vine grasper mechanism comprising a bar, a stationary jaw on the bar adapted to receive and to be encircled by the looped end of a vine, a pivotally mounted jaw disposed at one side of the stationary jaw and presenting a gripping surface substantially parallel to one side of the stationary jaw when open, and an angular position when swinging about the pivot to a closed or gripping position, so that the grip exerted by the pivoted jaw will increase in proportion to a pull exerted on the vine, a rod pivotally connected to the pivoted jaw, and a spring surrounding the rod, said spring and rod exerting a pressure on the pivoted jaw on one side of the pivot about which the pivoted jaw swings, to retain said jaw in open position, and swinging to the other side of the pivot when said jaw is swung to gripping position, and thereby also retaining said jaw in gripping position.

2. A vine grasper mechanism comprising a bar, a stationary jaw on the bar adapted to receive and to be encircled by the looped end of a vine, a pivotally mounted jaw disposed at one side of the stationary jaw and presenting a gripping surface substantially parallel to one side of the stationary jaw when open, and an angular position when swinging about the pivot to a closed

or gripping position, so that the grip exerted by the pivoted jaw will increase in proportion to a pull exerted on the vine, a spring actuated toggle member connected with the pivoted jaw for normally retaining the jaw either in open or closed position, a hand operated lever pivotally mounted adjacent one side of the pivoted jaw, said lever normally assuming a position substantially parallel to the bar but adapted, when grasped, to be swung to a position substantially at right angles to the bar, and during said movement engaging the pivoted jaw and swinging it to gripping position, and means for automatically returning the hand lever when released to normal position.

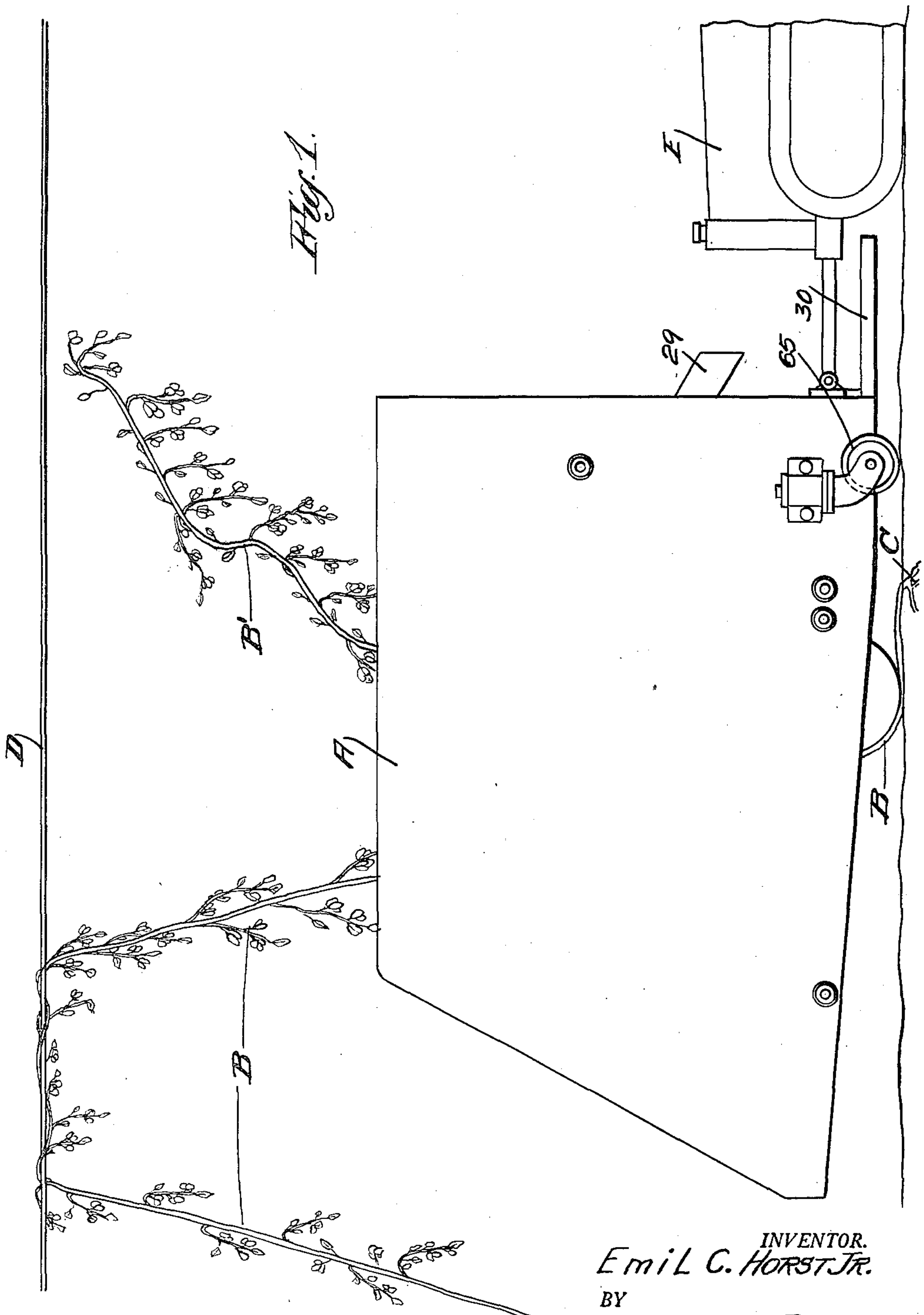
3. A vine grasper mechanism comprising a bar, a stationary jaw on the bar adapted to receive and to be encircled by the looped end of a vine, a pivotally mounted jaw disposed at one side of the stationary jaw and presenting a gripping surface substantially parallel to one side of the stationary jaw when open, and an angular position when swinging about the pivot to a closed or gripping position, so that the grip exerted by the pivoted jaw will increase in proportion to a pull exerted on the vine, a rod pivotally connected to the pivoted jaw, and a spring surrounding the rod, said spring and rod exerting a pressure on the pivoted jaw on one side of the pivot about which the pivoted jaw swings, to retain said jaw in open position, and swinging to the other side of the pivot when said jaw is swung to gripping position, and thereby also retaining said jaw in gripping position, a handle pivotally mounted on the jaw for swinging the jaw about its pivot toward gripping position, and a spring connected with the handle for swinging it when released to a position substantially parallel to the bar.

EDOUARD THYS.

Aug. 17, 1948. E. C. HORST, JR 2,447,122

HOP PICKING MACHINE

Filed Sept. 6, 1943 4 Sheets-Sheet 1



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HOP PICKING MACHINE

Filed Sept. 6, 1943 4 Sheets-Sheet 2

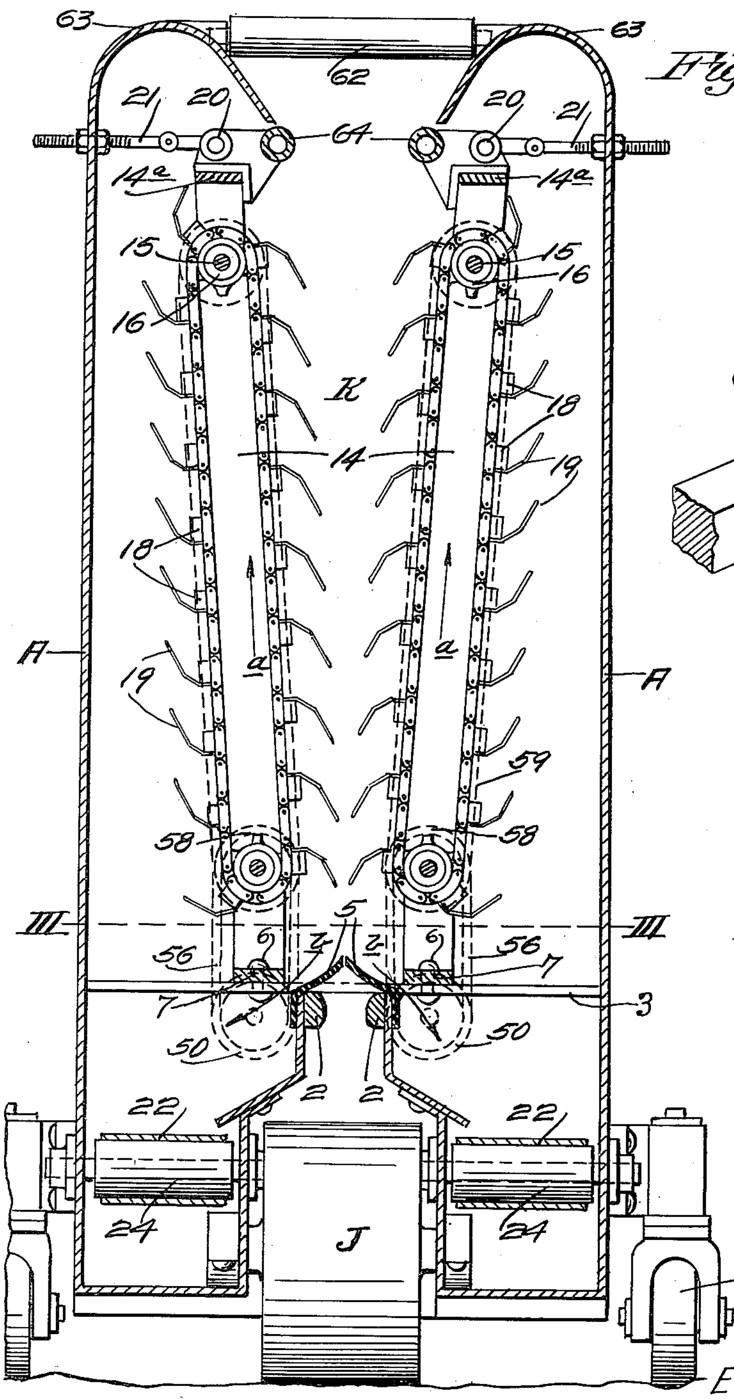

Fig. 2.

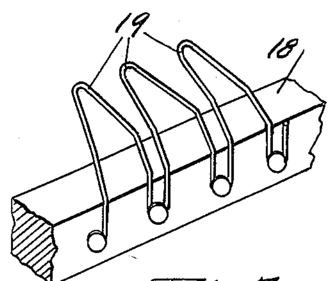

Fig. 5.

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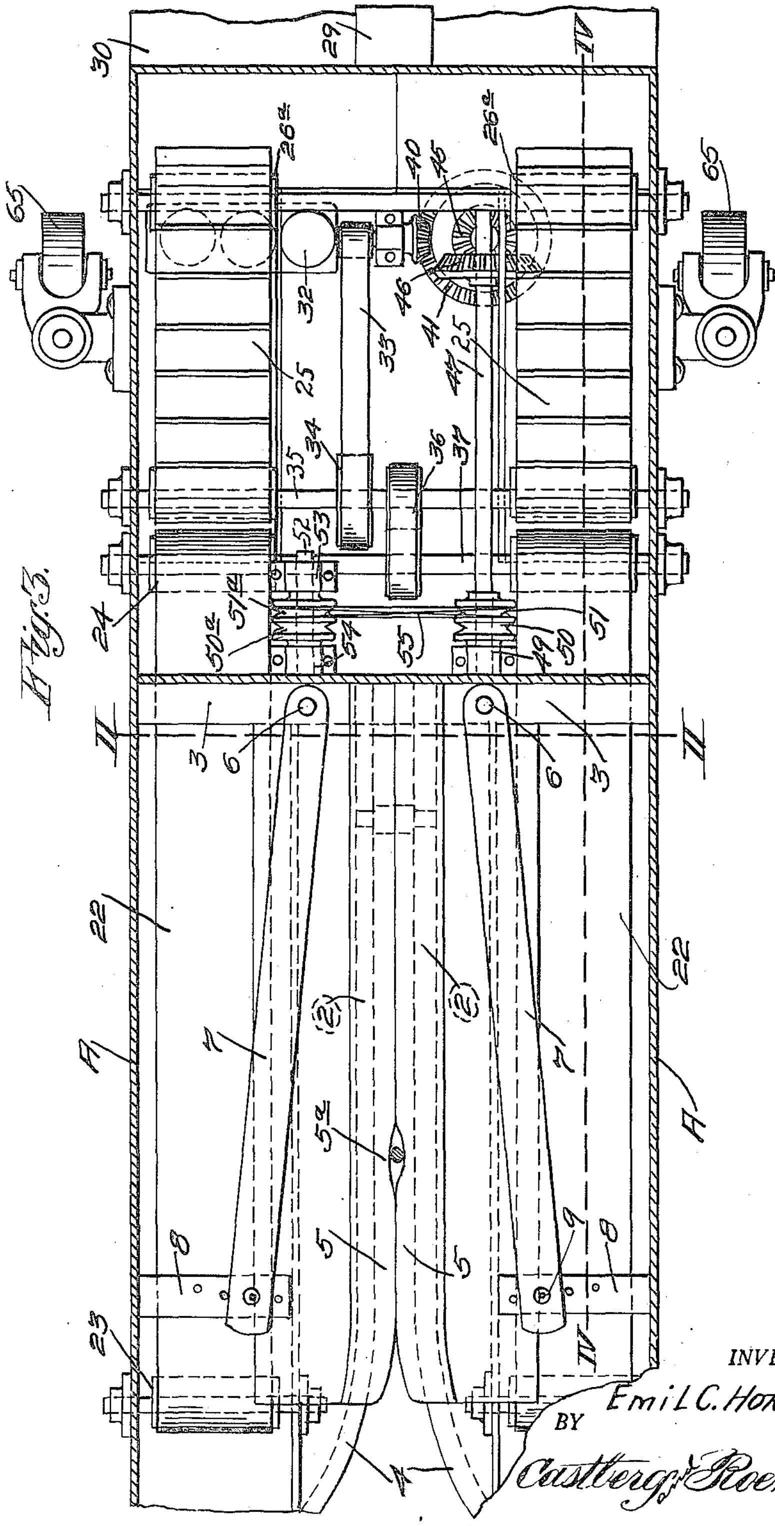

Fig. 3.

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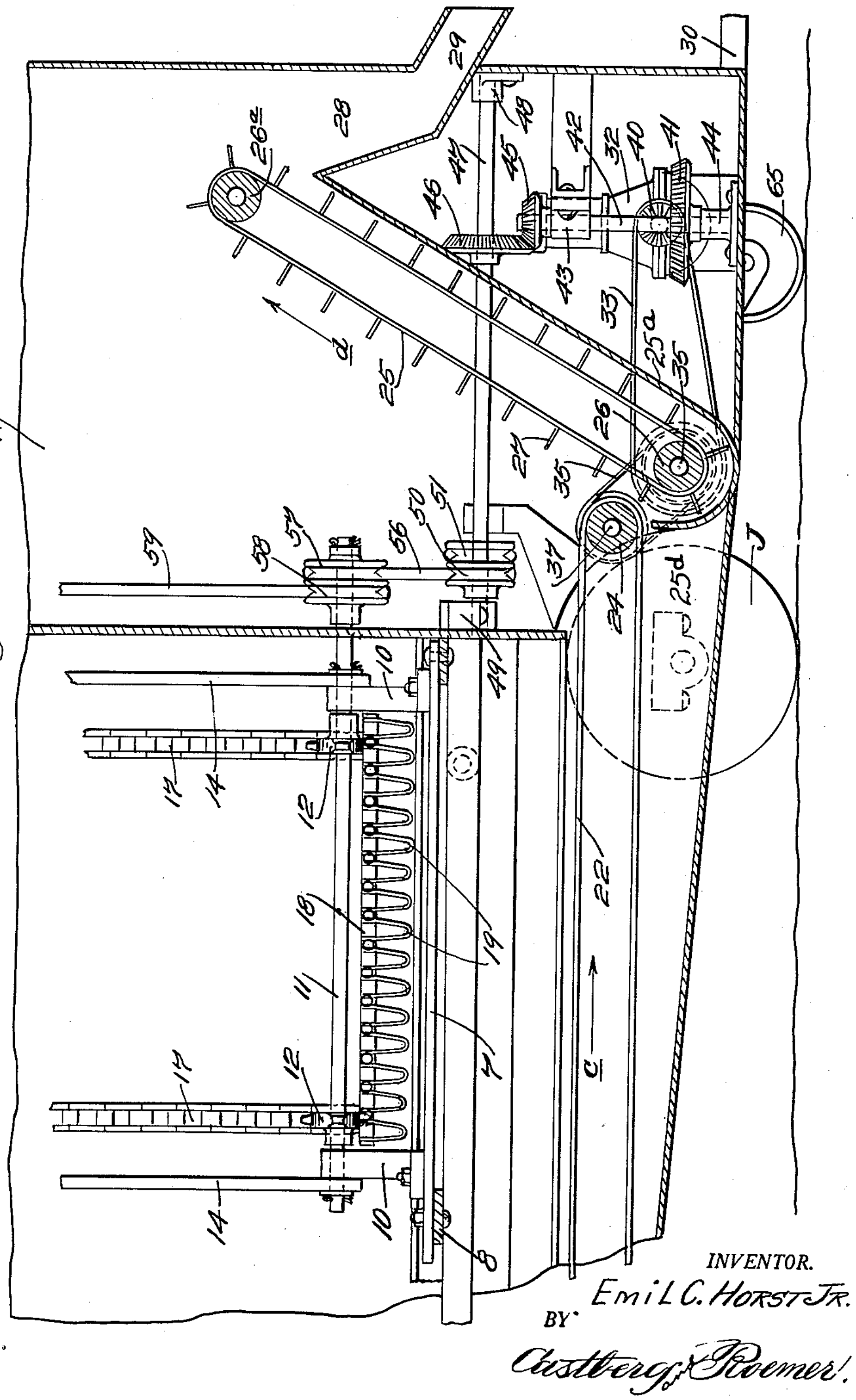
Fig. 4.



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UNITED STATES PATENT OFFICE

2,447,122

HOP PICKING MACHINE

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Application September 6, 1943, Serial No. 501,446

9 Claims. (Cl. 56—130)

1

This invention relates to a method and a machine for picking hops and especially to a method and a machine whereby hops may be picked directly from the hop vines in the fields in which they grow.

There are two types of hop picking machines in general use at the present time, to wit, a stationary and a portable type. Where stationary machines are used, the hop vines are cut off in the fields and loaded on trucks or wagons and hauled into the stationary machine where they are removed and attached to grasper bars which pull the hop vines between revolving drums or travelling belts equipped with V-shaped wire fingers which comb the vines and strip or remove the hops and most of the leaves. The picked hops and leaves are then delivered to separator belts where the leaves and stems and other foreign material are separated from the hops, and clean hops are finally obtained.

The portable type of machine operates in substantially the same manner, the principal difference being that the portable machine travels in the fields where the hops grow, and as the machine advances, the hop vines are cut down and attached directly to grasper bars which pull the vines through the machine with the result that the hops and leaves are stripped off and then delivered to separators to finally obtain the clean hops.

From the foregoing, it will be noted that whether a portable or stationary machine is employed, the hop vines must be cut off and attached to grasper bars in order to feed or pull them through the machines where the stripping or picking operation takes place.

The object of the present invention is to provide a new method and machine whereby hops may be picked directly from the vines in the field without the necessity of cutting the vines free from the plant or root from which they grow; to provide a portable machine which straddles and travels along a row of hop vines and as it travels, combs the hop vines in an upward direction thereby more efficiently removing the hops which hang singly and in clusters generally beneath the leaves and arms of the hop vines; and further, to provide a machine in which grasper bars together with associated mechanism is entirely eliminated and the machine proper very materially simplified, this being accomplished by providing a roller which rolls over the stalk of the vine and with sufficient traction to pull the vine downwardly through the combing or picking fingers of the machine as the machine advances.

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The machine and the method of operating the same is shown by way of illustration in the accompanying drawings, in which:

Fig. 1 is a side elevation of the hop picking machine showing it straddling and travelling along a row of hop vines;

Fig. 2 is a vertical transverse section of the machine taken on line 2—2 of Fig. 3;

Fig. 3 is a horizontal section taken on line 3—3 of Fig. 2;

Fig. 4 is a longitudinal section partially broken away taken on line 4—4 of Fig. 3; and

Fig. 5 is a perspective view of a portion of a picker bar showing the shape and construction of the picking fingers.

Referring to the drawings in detail, and particularly Fig. 1, A indicates the housing of the hop picking machine forming the subject matter of the present application. The machine is designed to straddle and travel along a row of hop vines such as indicated at B, said hop vines growing from a root system C and extending upwardly to an overhead trellis or wire D. The machine may be propelled in any suitable manner or it may be pushed along a row of hop vines by means of a tractor such as indicated at E.

A pair of spaced guide rails 2—2 (see Figs. 2 and 3) extend longitudinally of the machine. Their inner ends are supported by a cross-bar 3. They extend forwardly from this cross-bar and are parallel for a considerable distance, but at their outer ends they are bent outwardly as indicated at 4 to spread them considerably at least to an extent that the outer ends form a mouth which may be four to six feet wide. Overlaying the guide rails and extending substantially from end to end thereof are a pair of rubber flaps 5—5, the function of which will hereinafter be described. Pivotally mounted on each side of each guide rail as at 6 is a frame bar 7. The forward ends of said frame bars are supported by cross arms 8—8. These cross arms have a number of perforations formed therein and thereby permit the arms 7 to be swung about their pivots 6 and to be secured when swung or adjusted to or away from each other by means of bolts 9. Secured on each bar 7, and adjacent opposite ends thereof (see Fig. 4) are bearing blocks 10—10. Extending through said bearings and parallel to the bar 7 are shafts 11 on which are secured sprocket gears 12—12. Pivotally mounted on the shaft 11 are upwardly extending frame arms 14—14 and extending through the upper ends of said vertical bars and journalled therein are shafts 15—15 on which are secured pairs of sprocket gears 16—16. Endless chains such as shown at 17—17 connect the respective pairs of sprocket gears. The chains in turn form supports for cross-bars 18 and these in turn support V-shaped picking fingers 19, the function of which will hereinafter be described. The sprockets 12 and 16, and the chains 17 connecting them form supports for the cross bars 18 and the picking fingers 19, and as the cross bars are fairly closely spaced, as shown in Fig. 2, a pair of endless picking belts are formed, one of which is disposed on one side of the guide rails 2, and the other of which is disposed on the other side of the opposite guide rail 2. The upper ends of the vertical bars 14 are connected by top bars 14*a* and these in turn carry brackets 30 to which are attached adjusting rods 21 whereby the vertical angle of the endless picker belts may be adjusted, that is the upper ends may be moved inwardly or away from each other as the case may be. The bottom bars 7, the bearing boxes 10 secured thereto, the vertical bars 14 pivoted on the shafts 11 and the top cross bars 14*a*, constitute rectangular shaped frames in which the endless picker belts are supported. These frames are pivoted at the lower ends as at 6, so that the outer ends may be swung to or away from each other, and as the upper ends of the frames are connected to the adjustable rods 21, their vertical inclination can also be adjusted.

The endless picking belts when operating travel upwardly or in the directions indicated by arrows *a* in Fig. 2. As the fingers 19 are constructed of spring steel wire or the like, and are more or less V-shaped as shown in Fig. 5, it is obvious that if a hop vine is disposed in the space K (see Fig. 2) formed between the endless belts, that as the V-shaped fingers travel upwardly, they are combing the vines and arms in an upward direction, and thereby efficiently remove the hops as these hang singly or in clusters on the underside of the vines and arms and generally under the leaves. As the hop vines are being combed in the manner described by the wire picking fingers, the hops fall downwardly in the space K and on top of the rubber flaps 5. These flaps direct the hops laterally or side-ways as indicated by the arrow *b* (see Fig. 2) on two endless conveyor belts 22—22. They are supported by rollers or pulleys 23 and 24 at opposite ends, and carry the hops rearwardly in a continuous flow. An elevating conveyor consisting of an endless belt 25 is disposed at the inner end of each conveyor belt 22. These elevating belts are supported by rollers or pulleys 26 and 26*a*, and the belts are provided with lifts or flights 27 which receive the hops and carry them upwardly in the direction of arrows *d* a trough having a bottom section 25*a* in an upturned end 25*d* cooperating with the belt to prevent spilling or loss of hops. At the upper end they discharge into a hopper 28 which in turn discharges into a spout 29. A sack may here be applied and the hops and leaves are sacked by a sacker standing on a rear platform 30. As each sack is filled, it is tied and thrown to one side where it may later be picked up and hauled in by a truck or wagon for further treatment as will hereinafter be described.

Power to operate the endless picking belts, the conveyors 22 and the elevators 25 may be supplied from any suitable source. For instance, from an engine such as indicated at 32 (see Figs. 3 and 4). Power from this engine may be transmitted through a belt 33 to a pulley 34 secured on the shaft 35 which carries the pulleys 26 of the respective elevator belts 25. These elevators will accordingly be continuously driven from the engine. In order to impart power to drive the endless conveyors 22, power may be transmitted from shaft 35 through a belt 36 to a shaft 37 on which is mounted the pulleys 24. In this manner the conveyors 22 are continuously driven. Power also must be transmitted to the endless picking belts and this is accomplished as follows:

Secured on the outer end of the engine shaft is a bevel gear 40 which meshes with a bevel gear 41 secured on a vertical shaft 42. This shaft is journalled in upper and lower bearings 43 and 44 and carries a bevel gear 45 at its upper end which meshes with a bevel gear 46 secured on a shaft 47. This shaft extends longitudinally of the machine and is journalled in bearings 48 and 49. Secured on the shaft 47 are two pulleys 50 and 51 and secured on a shaft 52 journalled in bearings 53 and 54 are a pair of complementary pulleys 50*a* and 51*a*. A cross belt 55 transmits power from shaft 47 to shaft 52. The pulley 50 transmits power through a belt 56 to a pair of pulleys 57 and 58. These pulleys are loosely mounted on the shaft 11 of one of the picker belts. Pulley 58 in turn transmits power through a belt 59 to a pulley on shaft 15, complementary to the shaft 11 and thus drives one picker belt. The picker belt on the opposite side is driven from the pulley 59*a* in the same manner as clearly shown in Fig. 2 and continuous movement to the respective picker belts is thus transmitted.

In actual operation, the machine here disclosed is pushed forward by means of a tractor or the like as shown in Fig. 1. The machine is steered to straddle a row of growing hop vines and as it travels forwardly, the main stalk or vine of a hop vine will be engaged by the outwardly flaring ends 4 of the respective guide rails, and will be directed inwardly between them and the rubber flaps 5 which will yield as the stalk or vine moves inwardly between the guide rails, or in other words, as the machine advances. The manner in which the rubber flaps yield is indicated at 5*a* in Fig. 3. That is, they spread apart around the stalk of the vine as the machine advances and they again come together behind the stalk or vine. Thus comparatively little, if any, space is left for hops to fall through when the machine is picking.

As the hop vines enter between the picking belts and as these travel in an upward direction as indicated by the arrows *a*—*a*, it is obvious that the V-shaped fingers will comb the hop vines in an upward direction thereby efficiently removing the hops and permitting them to drop either through the picking belt on down through the space K on to the rubber flaps 5 which directs them side-ways or laterally to the conveyors 22. As the hop vines enter between the forward ends of the picker belts, the belts are comparatively widely separated as the vines are full of hops and are bulky. As the machine advances and the hops are picked off, the vine is reduced in diameter and bulk, and it is for this reason that the inner ends of the picker belts are disposed closely together, in fact, so close as shown in Fig. 2, that the picking fingers practically contact. In other words, as the vine reaches the inner ends of the endless picking belts, all hops are practically removed, and the final combing or stripping is given at the innermost end.

In the stationary and portable machines heretofore referred to, grasper bars are required to feed the hop vines through the machine and it is furthermore required that the vines be cut free from the roots or plants from which they grow in order that they may be attached to the grasper bars. In this machine, grasper bars and all associated mechanism and the power required to operate them is entirely eliminated. This is made possible by providing the roller generally indicated at J. That is, as the machine advances along a row of hop vines, the roller will roll over the root portion C and on to the stalk B of the vine (see Fig. 1). As the roller rides on the ground and exerts considerable pressure thereon, sufficient traction is provided to pull the vine downwardly between the picking belts as the machine advances.

In the beginning of the season twine is strung from points adjacent the root up to an overhead trellis wire D and the hop vines as they grow climb up the twine leaders. Hence, the only portion of the hop vine that needs to be released is the upper portion which together with the twine is attached to the overhead trellis wire. This may, when necessary, be accomplished by poles having a hook shaped knife at its upper end which merely hooks on to and cuts the vines free. Many vines will pull free without use of a knife. They are freed in this manner, as the machine advances, and they thus fall downwardly as indicated by the vine at B' in Fig. 1. When freed, they fall rearwardly over the housing and in that case are guided downwardly between the picking belts by a rear roller 62 (see Fig. 2). On the other hand, if the vine falls to either side of the housing, the upper end of the housing will be rounded as indicated at 63 on each side of the space K and guide rollers 64 are provided at the upper ends of the picker belt frames and extend longitudinally thereof. Hence, guiding surfaces and rollers are provided no matter in what direction the vines fall when finally released, and little drag or resistance is encountered as the machine advances. This also releaves the root system C of any pull as most of the traction is taken up by the roller J. All hops and leaves which are stripped off during the picking operation are carried rearwardly as previously stated by the endless belts 22 and then delivered to the elevating belts 25 which in turn deliver them to the hopper 28 and the spout 29 where they are sacked. After sacking, the sacked hops may be hauled into a separating plant where the hops are separated from the leaves and stems but it is obvious that separator belts may be applied to the present machine, if so desired, so that a complete clean product may be obtained.

It will be noted from Fig. 4 that the heavier parts of the machine such as the engine 32, etc., are positioned toward the rear; caster wheels 65 are accordingly provided to take part of the weight or load and also to make it easy to steer. While this and other features of the invention have been more or less specifically described and illustrated, I wish it understood that various changes in form, construction and proportion may be resorted to within the scope of the appended claims, and that the materials and finish of the parts employed may be such as the experience and judgment of the manufacturer may dictate or varying uses may demand.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A machine for removing hops directly from vines in a field, comprising a frame having a pair of spaced guide rails extending a substantial

length of the frame, said guide rails adapted to straddle a row of hop vines and said guide rails being flared outwardly at their forward ends to engage and guide hop vines between the rails, a picker frame disposed one adjacent each guide rail, an endless vertically disposed picker belt carried by each picker frame, means for adjusting said picker belts and frames to assume a horizontal angle with relation to the guide rails, other means for adjusting the picker belts to assume a vertical angle with relation to hop vines entering between the guide rails, means for imparting continuous upward movement to the picker belts to comb the vines in an upward direction to remove the hops, means for advancing the machine longitudinally of the row of hop vines while the picking belts are in operation, a roller carried by the machine and in contact with the ground, said roller aligning with the space formed between the guide rails and overriding the vines so as to pull them downwardly between the picking belts when the machine is advancing, a rubber flap extending longitudinally of each guide rail, said rubber flaps extending over the guide rails and being sufficiently yielding to permit a hop vine to pass between them, said flaps forming a cover over the space formed between the guide rails to prevent hops from dropping through and an endless continuously moving conveyor belt below each hop picking belt to gather and remove the picked hops.

2. A machine for removing hops directly from the vines in the field, comprising a frame having a pair of spaced guide rails extending a substantial length of the frame, said guide rails adapted to straddle a row of hop vines and said guide rails being flared outwardly at their forward ends to engage and guide hop vines between the rails, a picker frame disposed one adjacent each guide rail, an endless vertically disposed picker belt carried by each picker frame, means for adjusting said picker belts and frames to assume a horizontal angle with relation to the guide rails, other means for adjusting the picker belts to assume a vertical angle with relation to hop vines entering between the guide rails, means for imparting continuous upward movement to the picker belts to comb vines in an upward direction to remove the hops, means for advancing the machine longitudinally of the row of hop vines while the picking belts are in operation, a roller carried by the machine and in contact with the ground, said roller aligning with the space formed between the guide rails and overriding the vines so as to pull them downwardly between the picking belts when the machine is advancing, a rubber flap extending longitudinally of each guide rail, said rubber flaps extending over the guide rail and being sufficiently yielding to permit a hop vine to pass between them, said flaps forming a cover over the space formed between the guide rails to prevent hops from dropping through, an endless continuously moving conveyor belt below each hop picking belt to gather and remove the picked hops, and a roller journalled between the inner ends of the guide rails to guide the hop vine down towards the first-named roller.

3. A machine for removing hops directly from vines in a field, comprising a frame having a pair of spaced guide rails extending a substantial length of the frame, said guide rails adapted to straddle a row of hop vines and said guide rails being flared outwardly at their forward ends to engage and guide hop vines between the rails, hop picking combing members disposed one ad-

jacent each guide rail and extending upwardly therefrom in spaced opposed vertical planes and engaging opposite sides of a hop vine entering between the guide rails, means for imparting continuous upward movement to the hop picking members in said opposed planes to comb the vines cooperatively in an upward direction to remove the hops, means for advancing the machine longitudinally of a row of hop vines while the picking members are in operation, means for pulling the hop vines in a downward direction between the picking members while the machine is advancing and while the picking members are moving in said opposed planes, flexible flaps completely covering the space between the guide rails to prevent hops when removed from the vines from falling through the space formed between the guide rails, said flaps being yieldable to permit the vines to pass between them and automatically closable around the vines, and means cooperating with said flaps for gathering the removed hops.

4. A machine for removing hops directly from vines in a field, comprising a frame having a pair of spaced guide rails extending a substantial length of the frame, said guide rails adapted to straddle a row of hop vines and said guide rails being flared outwardly at their forward ends to engage and guide hop vines between the rails, a picker frame disposed one adjacent each guide rail and extending upwardly therefrom, an endless vertically disposed picker belt carried by each picker frame and arranged in opposed vertical planes, means for adjusting said picker belts and frames on a vertical axis to assume a horizontal angle with relation to the guide rails to arrange the picker belts in forwardly diverging planes, other means for adjusting the picker belts to assume a vertical angle with relation to hop vines entering between the guide rails with the planes of the belts diverging upwardly, means for imparting continuous upward movement to the picker belts to comb vines cooperatively in an upward direction to remove the hops, means for advancing the machine longitudinally of a row of hop vines while the picking belts are in operation, and means actuated by the advance movement of a machine along the row of hops for pulling the vines downwardly between the upwardly moving picker belts.

5. A machine for removing hops directly from vines in a field, comprising a frame having a pair of spaced guide rails extending a substantial length of the frame, said guide rails adapted to straddle a row of hop vines and said guide rails being flared outwardly at their forward ends to engage and guide hop vines between the rails, a picker frame disposed one adjacent each guide rail and extending upwardly therefrom, an endless vertically disposed picker belt carried by each picker frame and operating in opposed vertical planes, means for adjusting said picker belts and frames to assume a horizontal angle with relation to the guide rails with the planes of the belts diverging forwardly, other means for adjusting the picker belts to assume a vertical angle with relation to hop vines entering between the guide rails with the planes of the picker belts diverging upwardly, means for imparting continuous upward movement to the picker belts to comb the vines cooperatively in an upward direction to remove the hops, means for advancing the machine longitudinally of the row of hop vines while the picking belts are in operation, and a roller carried by the machine and maintained in contact with the ground by the weight of the machine, said roller aligning with the space formed between the guide rails and overriding the vines so as to maintain the roots of the vines in the ground and pull the vines downwardly between the picking belts when the machine is advancing and the belts are moving upwardly in said planes.

6. A machine for removing hops from vines in a field, comprising a frame having a vertical passageway therethrough, said passageway opening through the forward end of said frame and extending rearwardly therefrom whereby hop vines taller than said frame may enter said passageway through the said forward end, vertically disposed endless picker belts carried by said frame adjacent laterally opposite sides of said passageway to engage vines therein, means for moving the vine engaging portions of said belts upwardly, and a supporting roller having a tread width at least equal to the width of the narrowest portion of said passageway journalled on a transverse axis on said frame adjacent the bottom thereof and supporting at least a portion of the weight of said frame, said roller being in longitudinal alignment with said passageway and adjacent the rearmost portion thereof whereby to override the vines in said passageway as said frame is advanced to pull the tops of said vines downwardly through the space between said picker belts.

7. A machine for removing hops from vines in a field, comprising a frame having a vertical passageway therethrough, said passageway opening through the forward end of said frame and extending rearwardly therefrom whereby hop vines taller than said frame may enter said passageway through the said forward end, upwardly movable picker means carried by said frame adjacent laterally opposite sides of said passageway to engage vines therein and pick hops therefrom, and a supporting roller having a tread width at least equal to the width of the narrowest portion of said passageway journalled on a transverse axis on said frame adjacent the bottom thereof and supporting at least a portion of the weight of said frame, said roller being in longitudinal alignment with said passageway and adjacent the rearmost portion thereof whereby to override the vines in said passageway as said frame is advanced to pull the tops of said vines downwardly through the space between said picker means.

8. A machine for removing hops from vines in a field, comprising a frame having a vertical passageway therethrough, said passageway opening through the forward end of said frame and extending rearwardly therefrom whereby hop vines taller than said frame may enter said passageway through the said forward end, upwardly movable picker means carried by said frame adjacent laterally opposite sides of said passageway to engage vines therein and pick hops therefrom, means supporting said frame for steerable movement over the ground, and means carried by said frame in fixed position therebelow and substantially in contact with the ground when in operative position and being in longitudinal alignment with said passageway and adjacent the rear end thereof, said means being of lateral extent at least equal to the width of the space between said picker means whereby to override vines in said passageway as said frame is advanced to pull the tops of said vines downwardly through the space between said picker means.

9. A machine for removing hops from vines in

a field, comprising a frame having a vertical passageway therethrough, said passageway opening through the forward end of said frame and extending rearwardly therefrom whereby hop vines taller than said frame may enter said passageway through the said forward end, upwardly movable picker means carried by said frame adjacent laterally opposite sides of said passageway to engage vines therein and pick hops therefrom, and ground engaging supporting means of substantial width carried by said frame in fixed position thereon adjacent the rear end of said passageway and in longitudinal alignment therewith, said means supporting at least a portion of the weight of said frame whereby to over-

ride vines in said passageway as said frame is advanced to pull the tops of said vines downwardly through the space between said picker means.

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United States Patent

[11] 3,594,995

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[21] Appl. No. 738,990
[22] Filed June 21, 1968
[45] Patented July 27, 1971

[54] **HOP-PICKING MACHINE**
20 Claims, 23 Drawing Figs.

[52] U.S. Cl. **56/10.7,** 56/130, 56/14.5
[51] Int. Cl. **A01d 45/30**
[50] Field of Search .... 56/19, 126—130, 153, 330

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Primary Examiner—Louis G. Mancene
Assistant Examiner—J. N. Eskovitz
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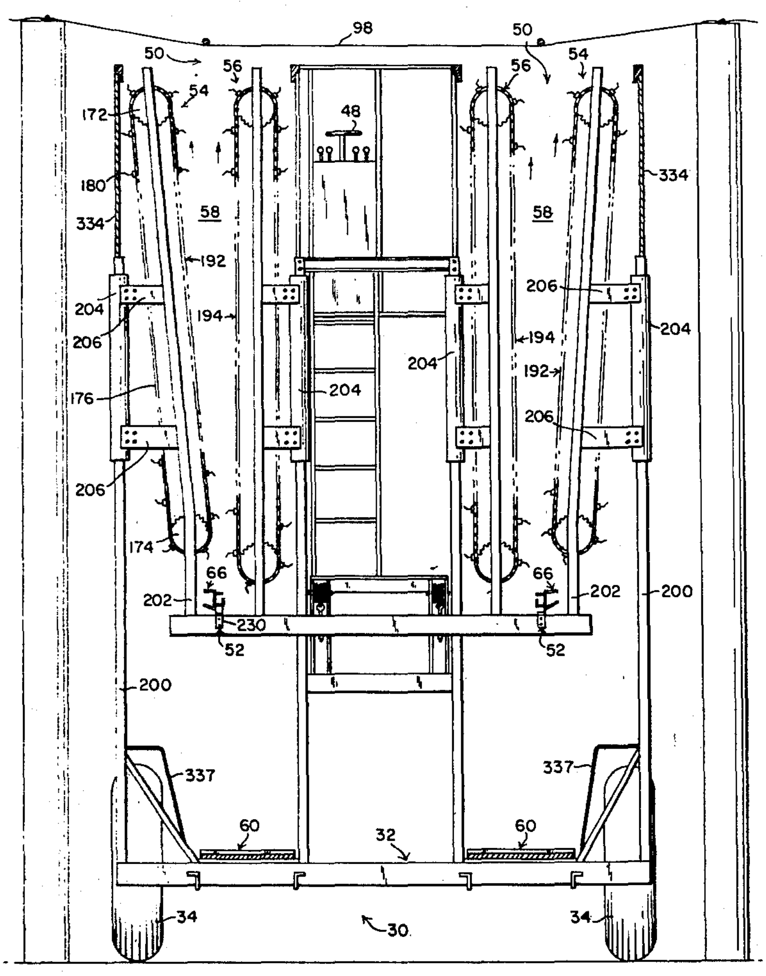
ABSTRACT: A machine for field picking hops from vines hanging from overhead supports which includes graspers for maintaining the vines in picking position as they move through the machine, picking cats for stripping the hops from the vines, a conveyor arrangement for carrying the hops away, a cutter for severing the vines to free them from the supports, and an arrangement for expelling picked vines from the machine.



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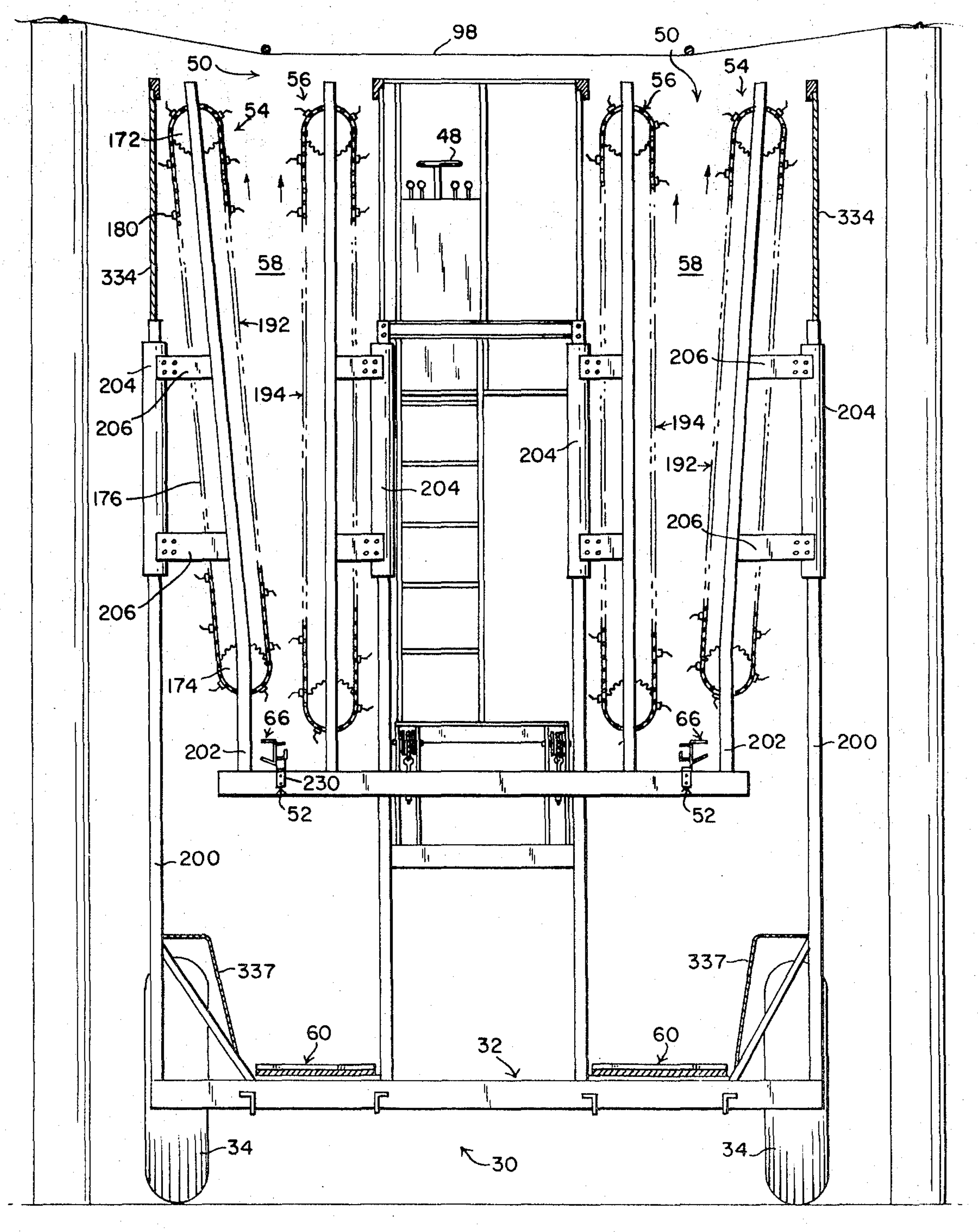

FIG. 1

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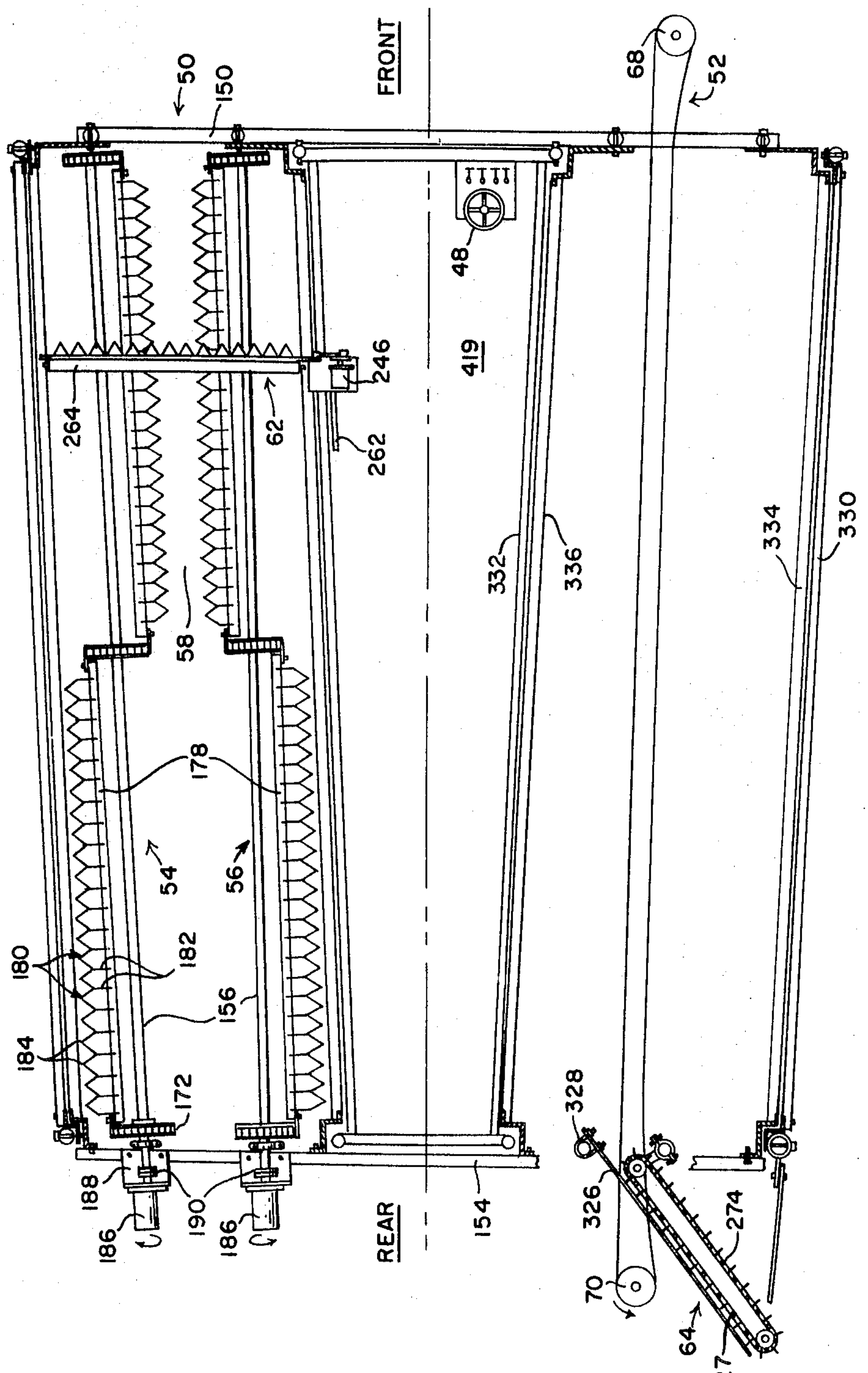

FIG. 2

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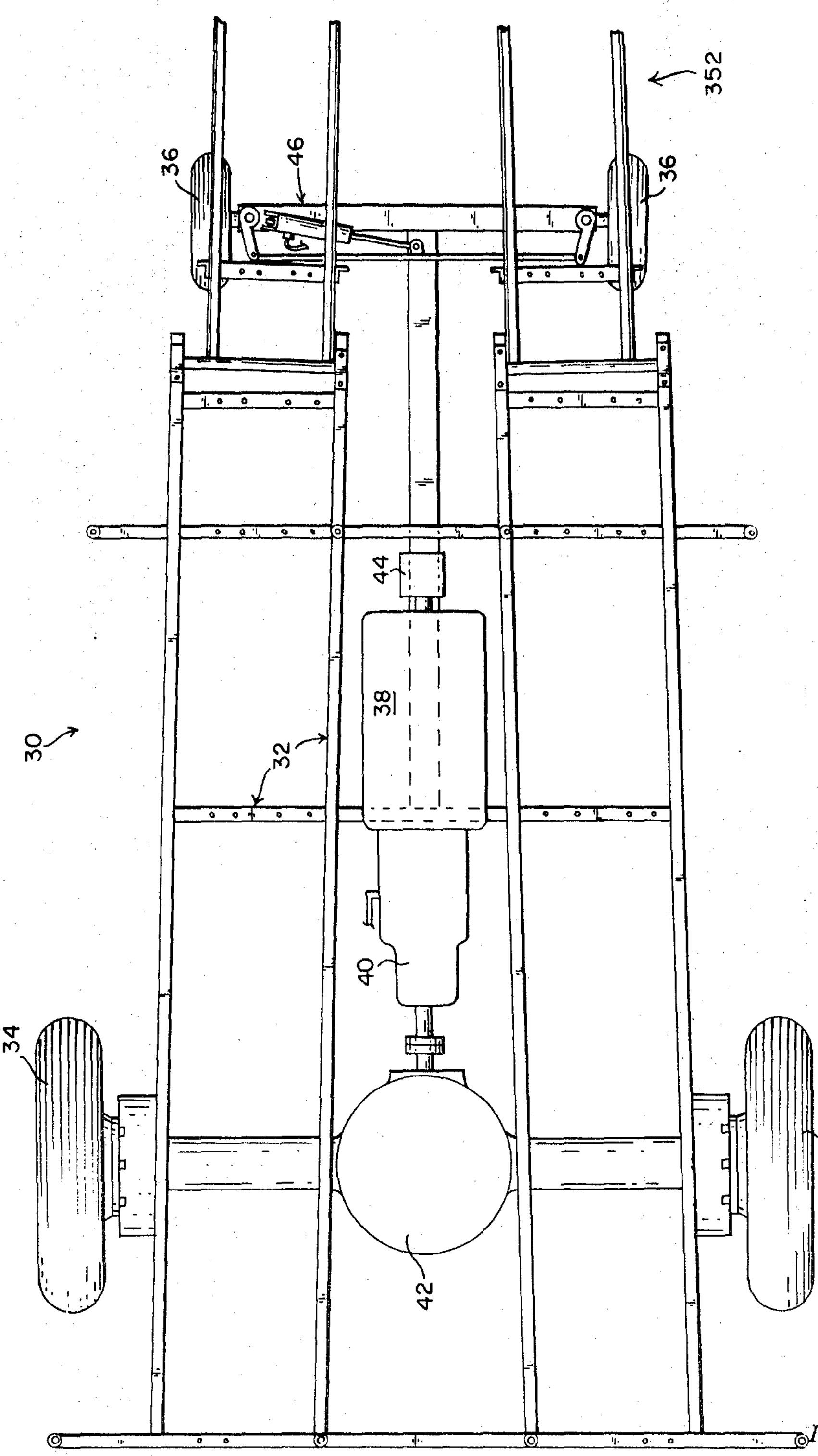

FIG. 3

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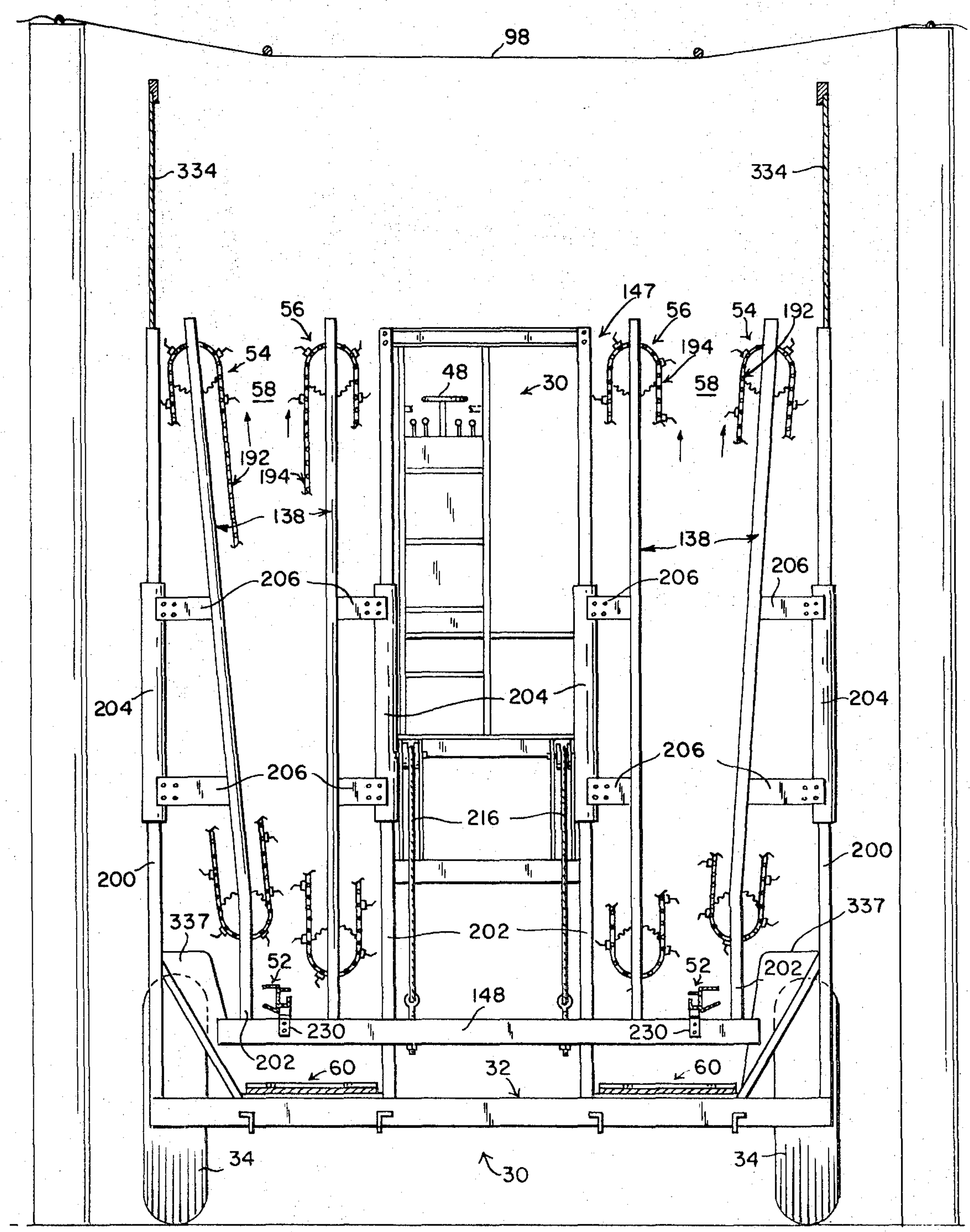

FIG. 4

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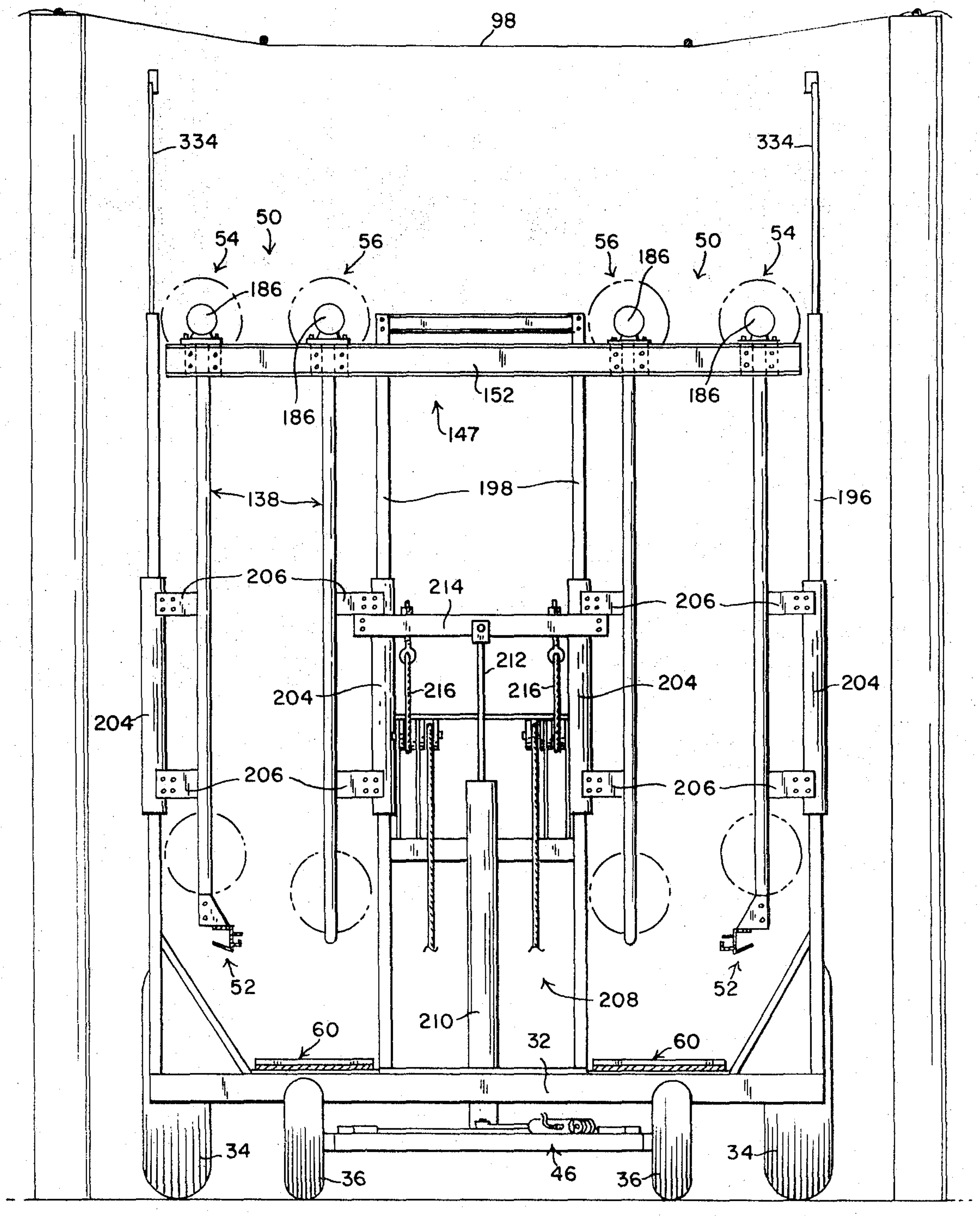

FIG. 5

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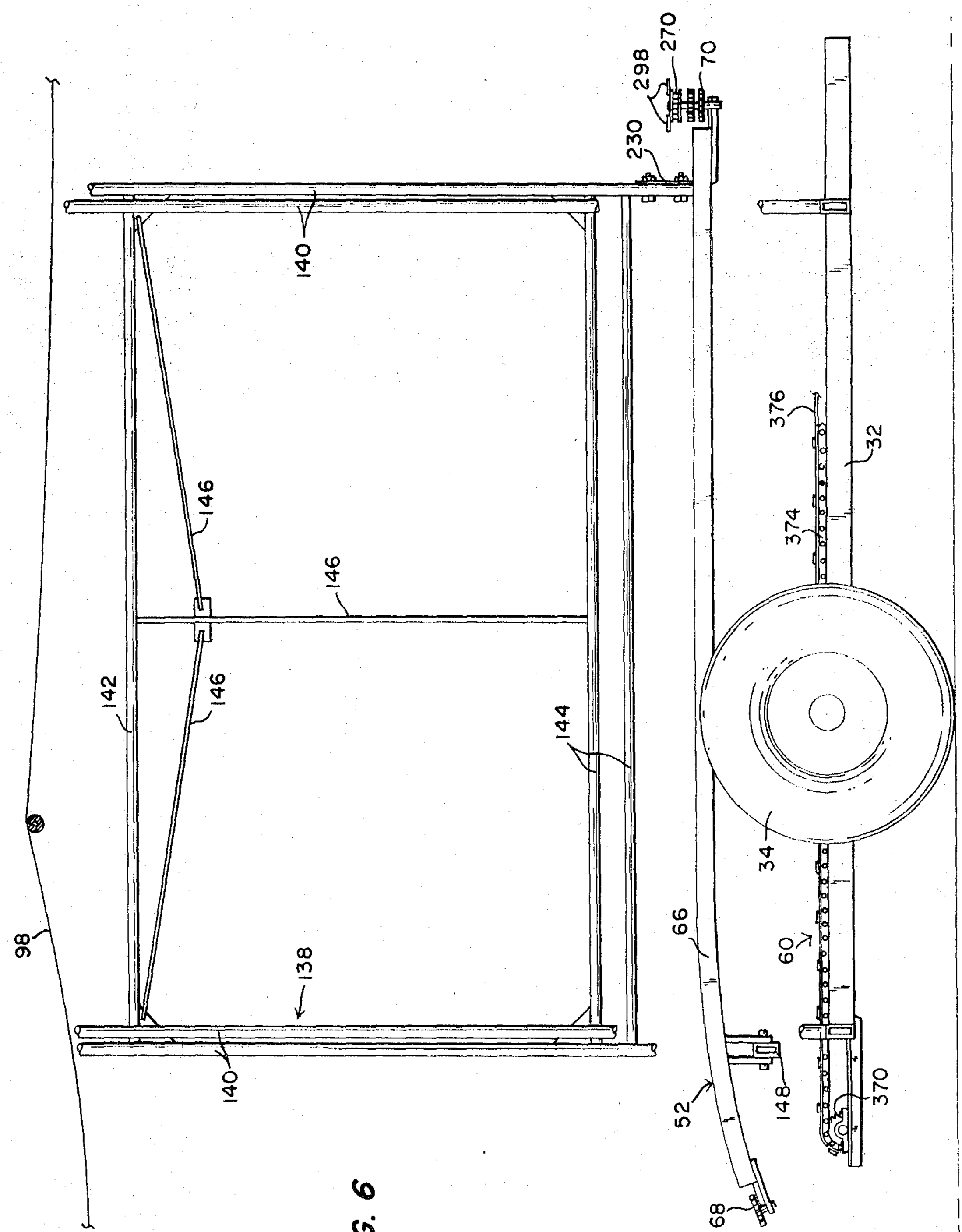

FIG. 6

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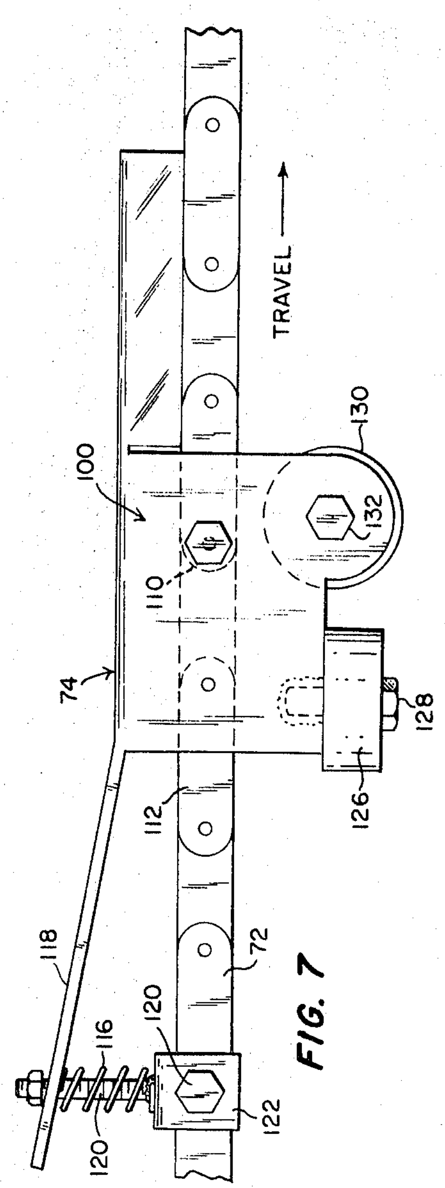

FIG. 7

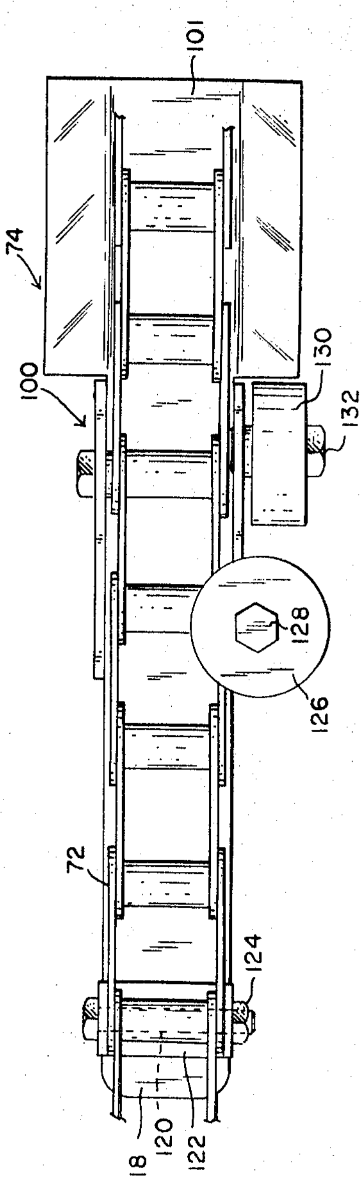

FIG. 8

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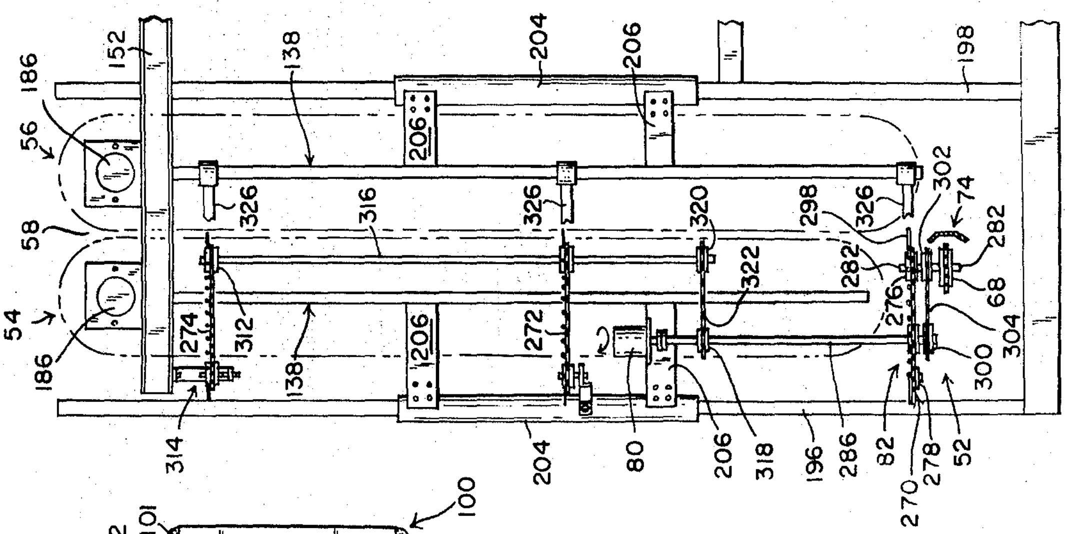

FIG. 17

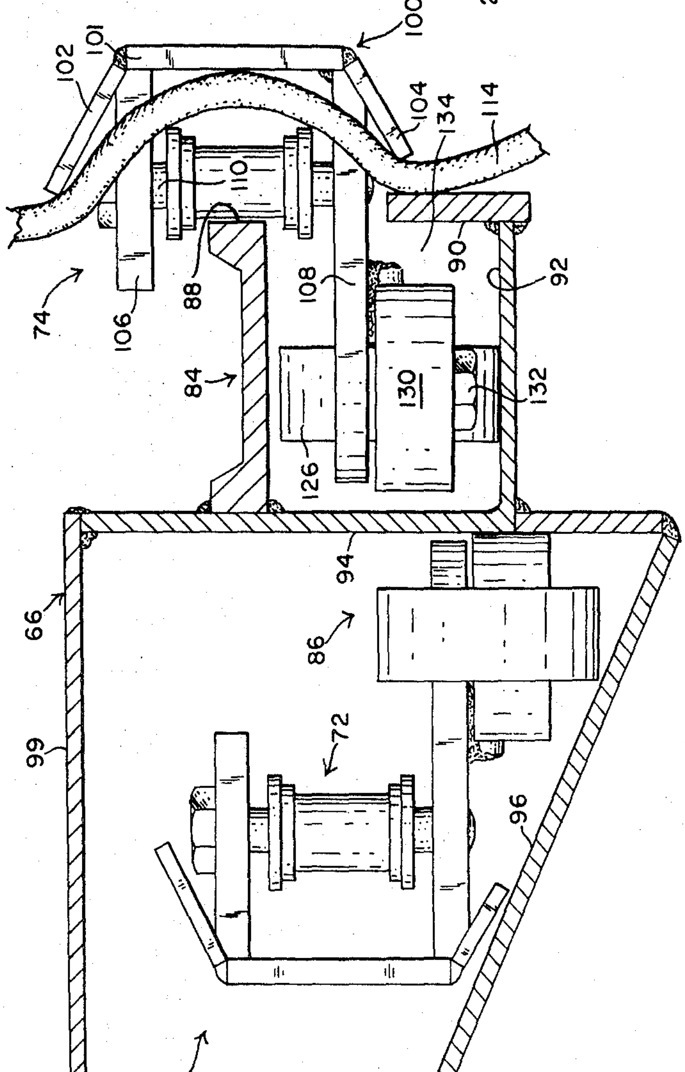

FIG. 9

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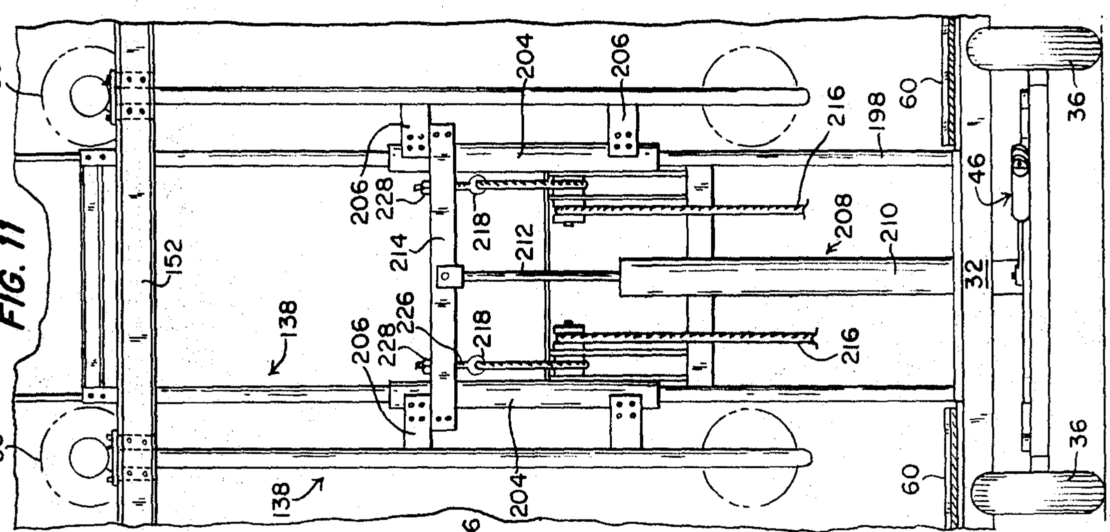

FIG. 11

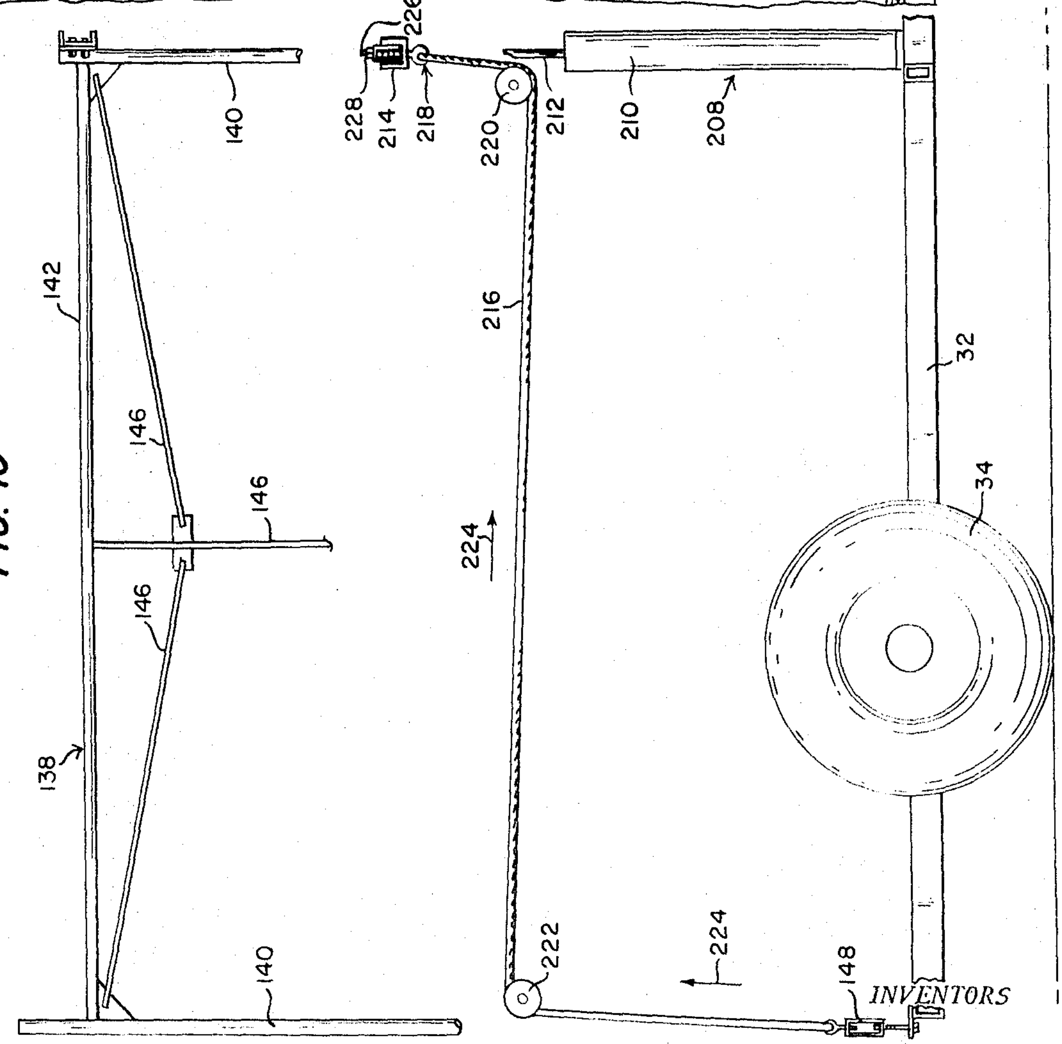

FIG. 10

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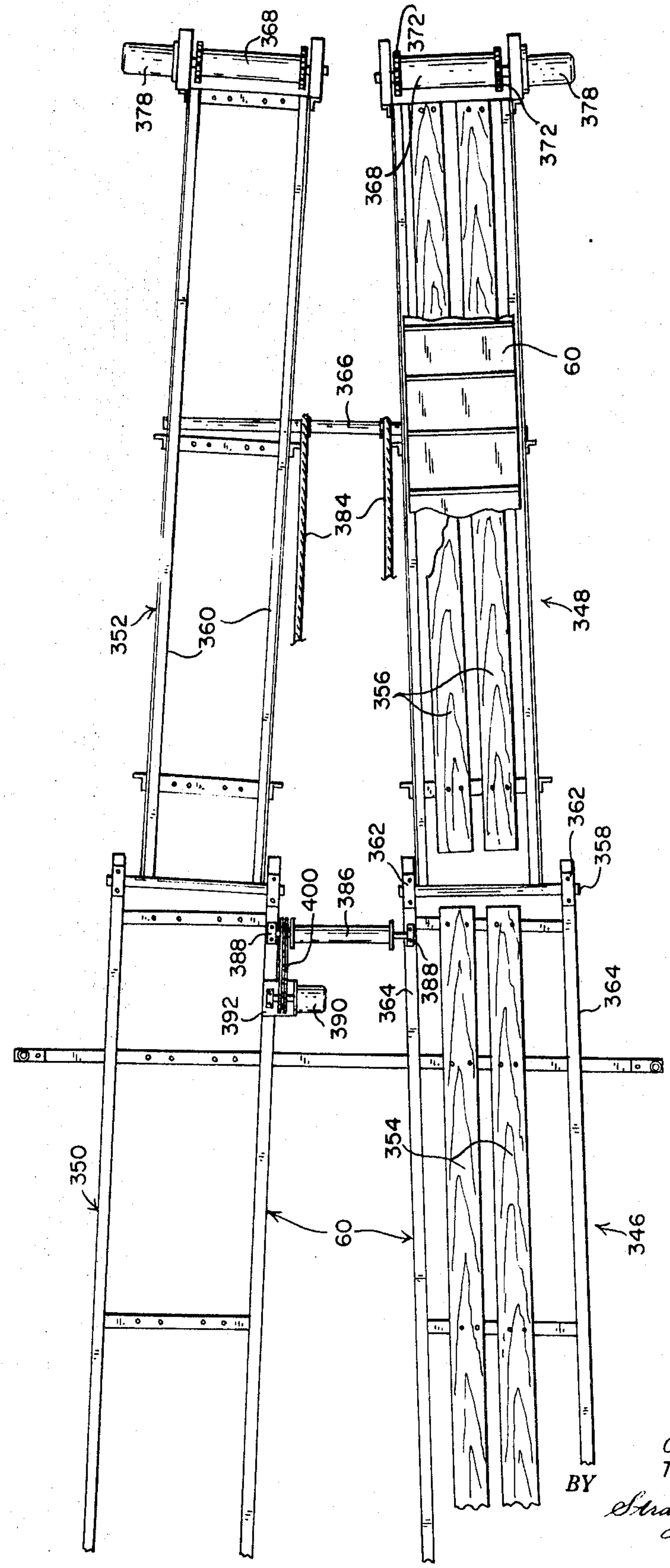

FIG. 12

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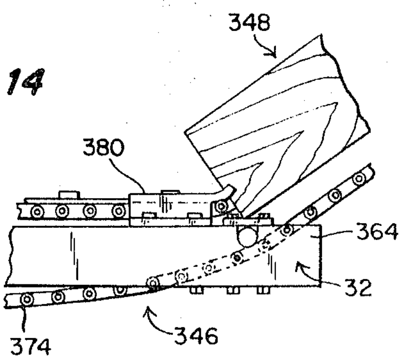
FIG. 14



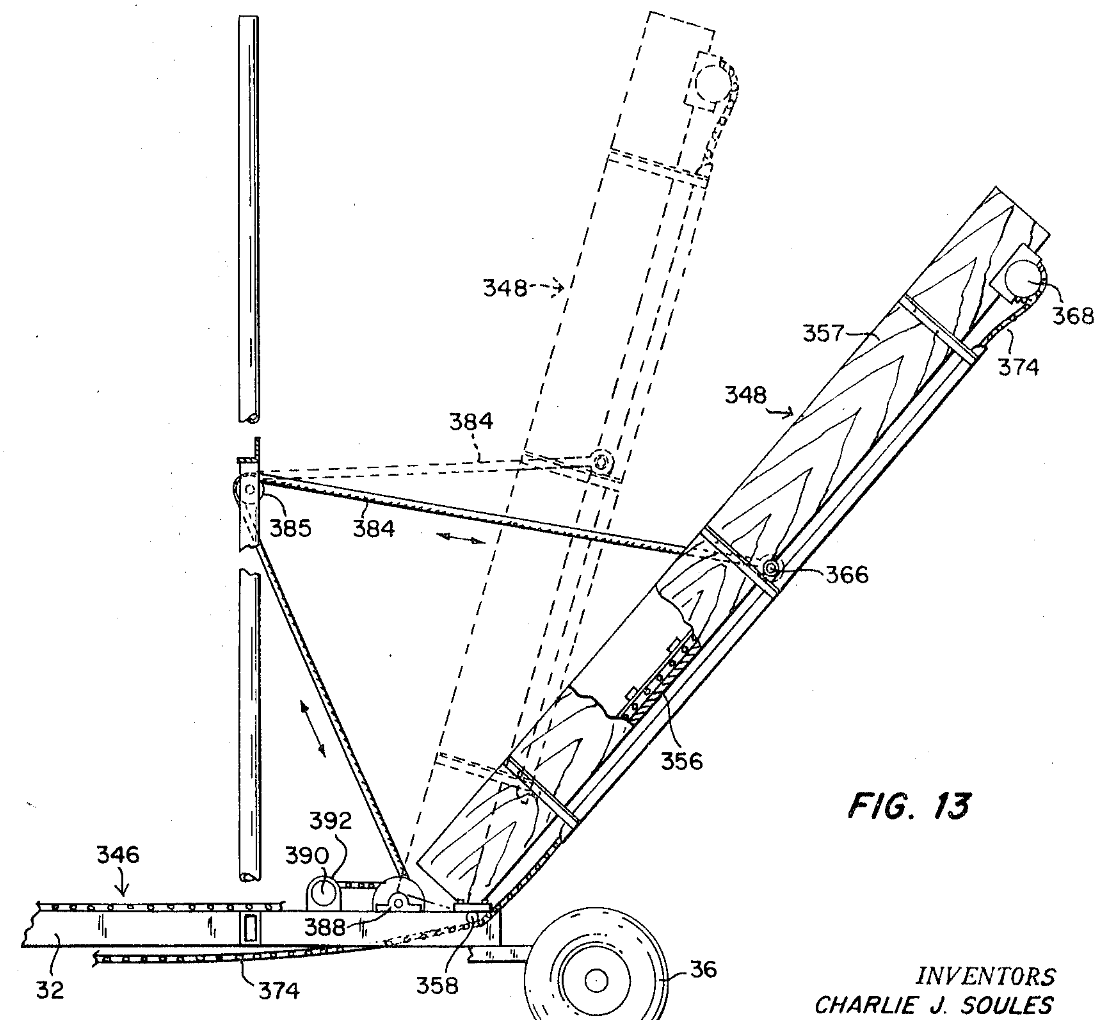


FIG. 13

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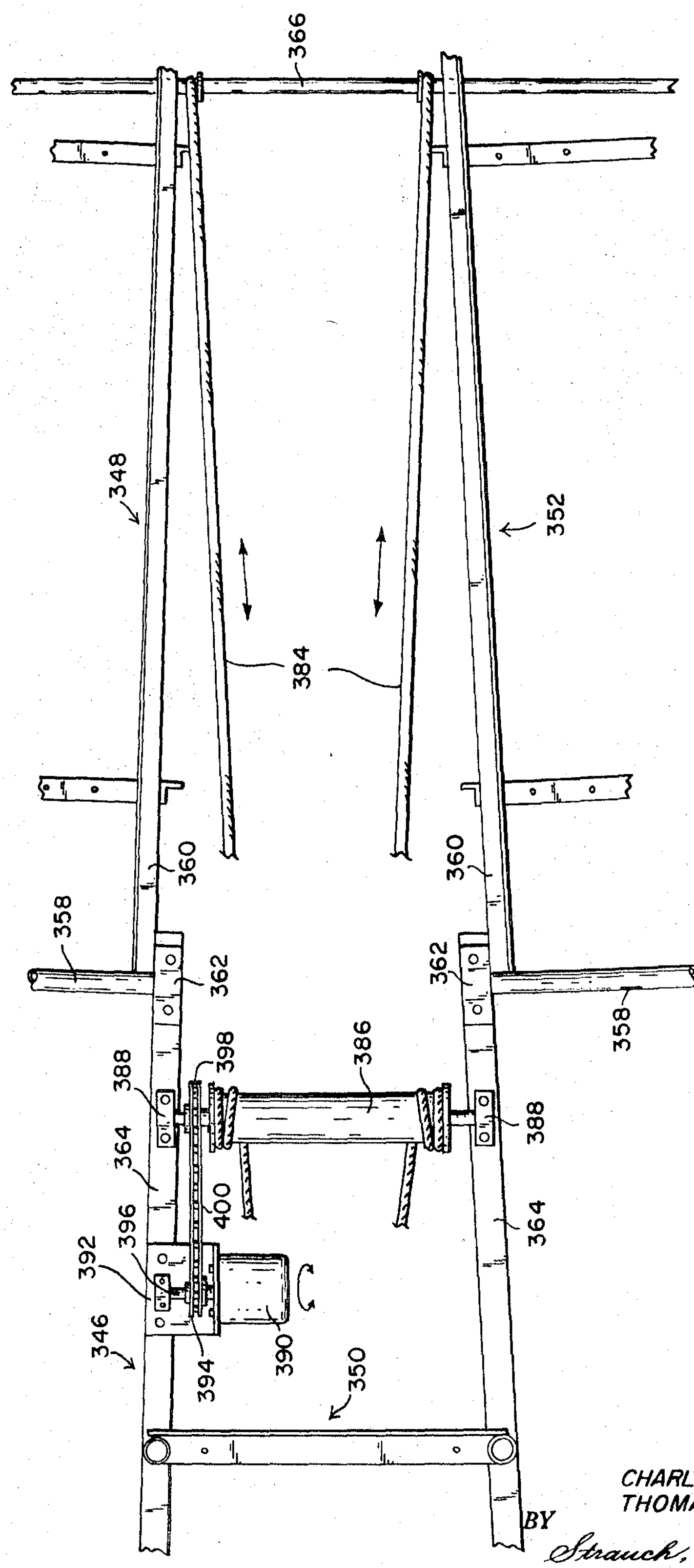

FIG. 15

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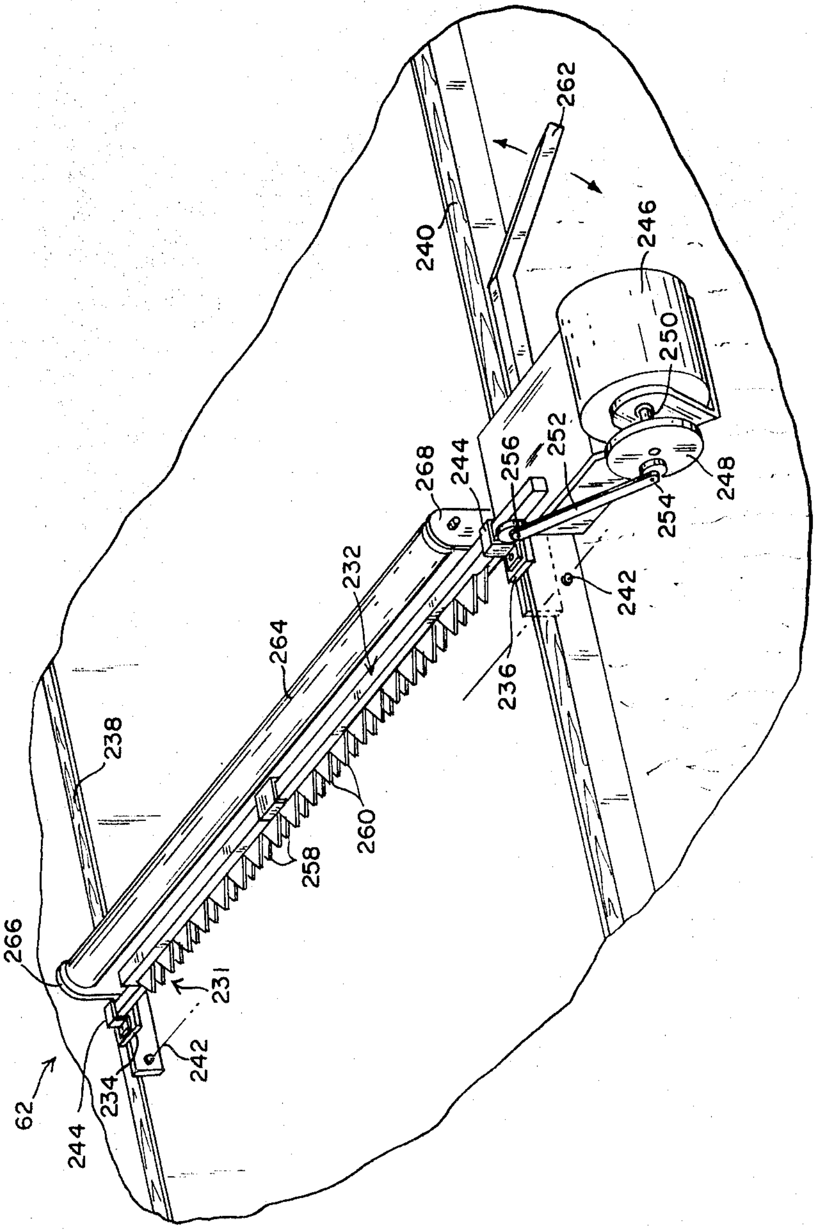

FIG. 16

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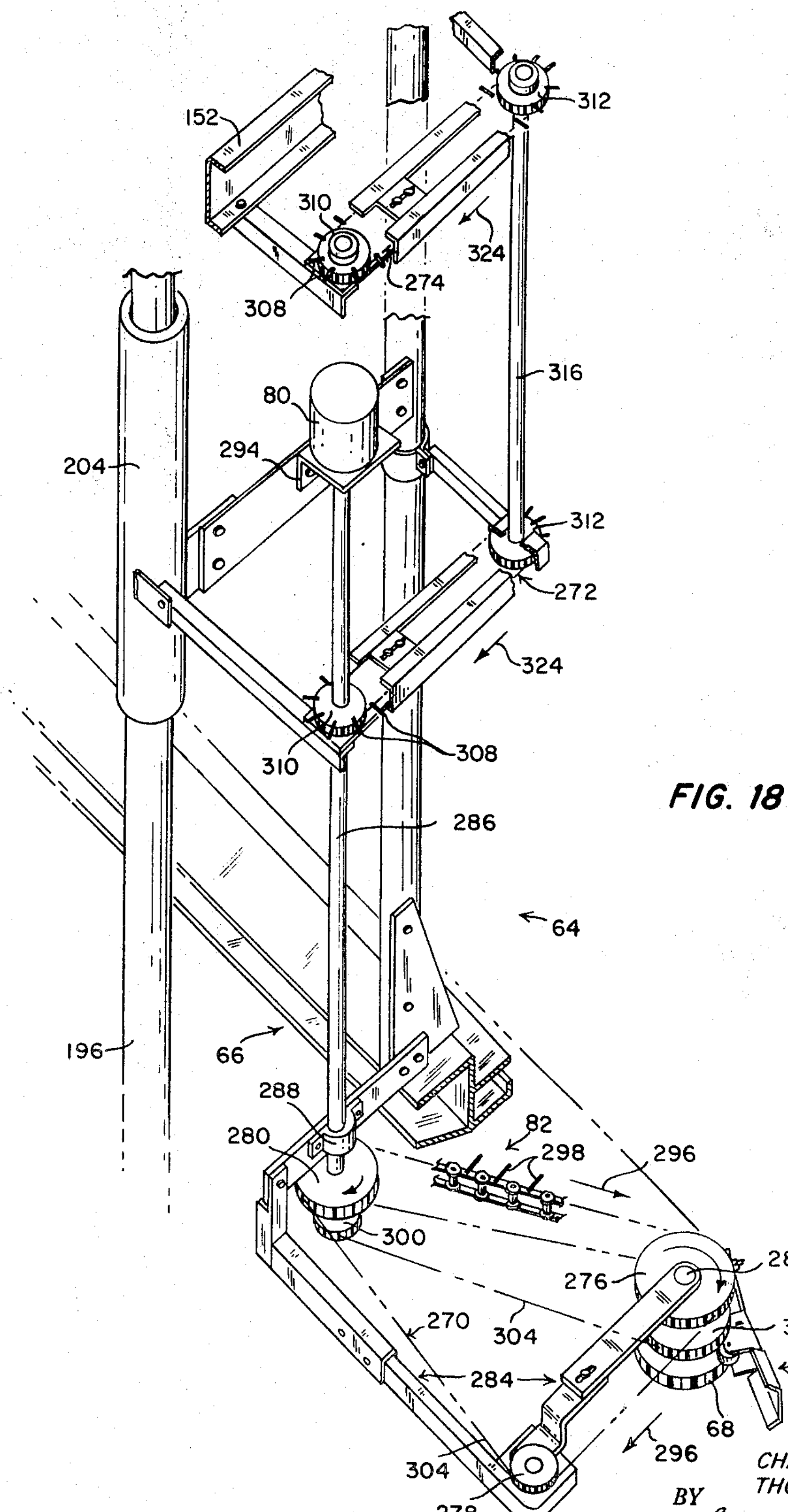

FIG. 18

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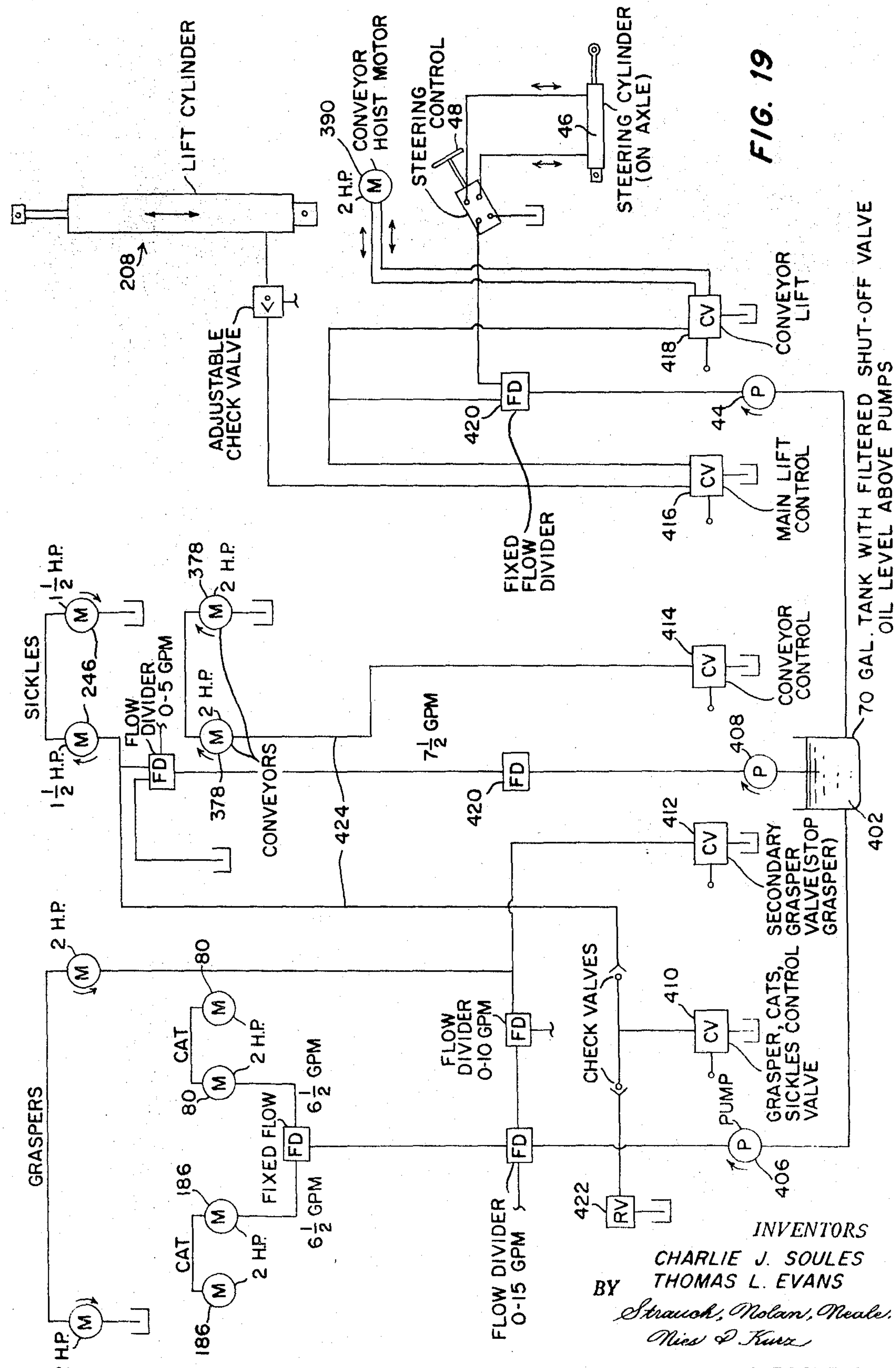

FIG. 19

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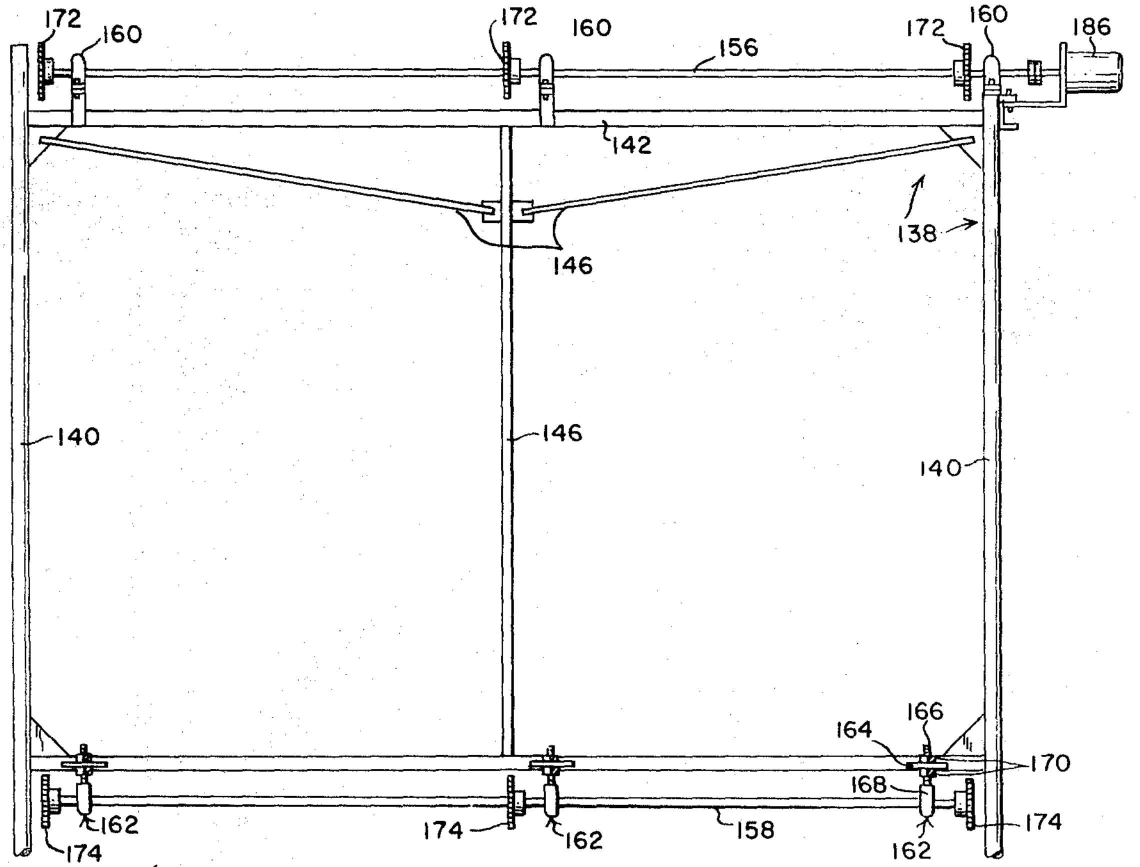

FIG. 21

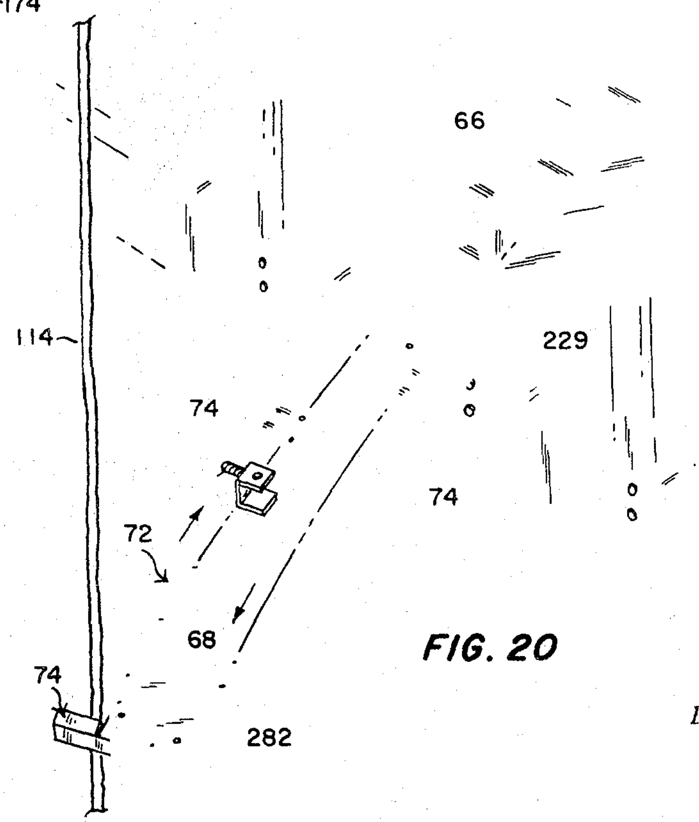

FIG. 20

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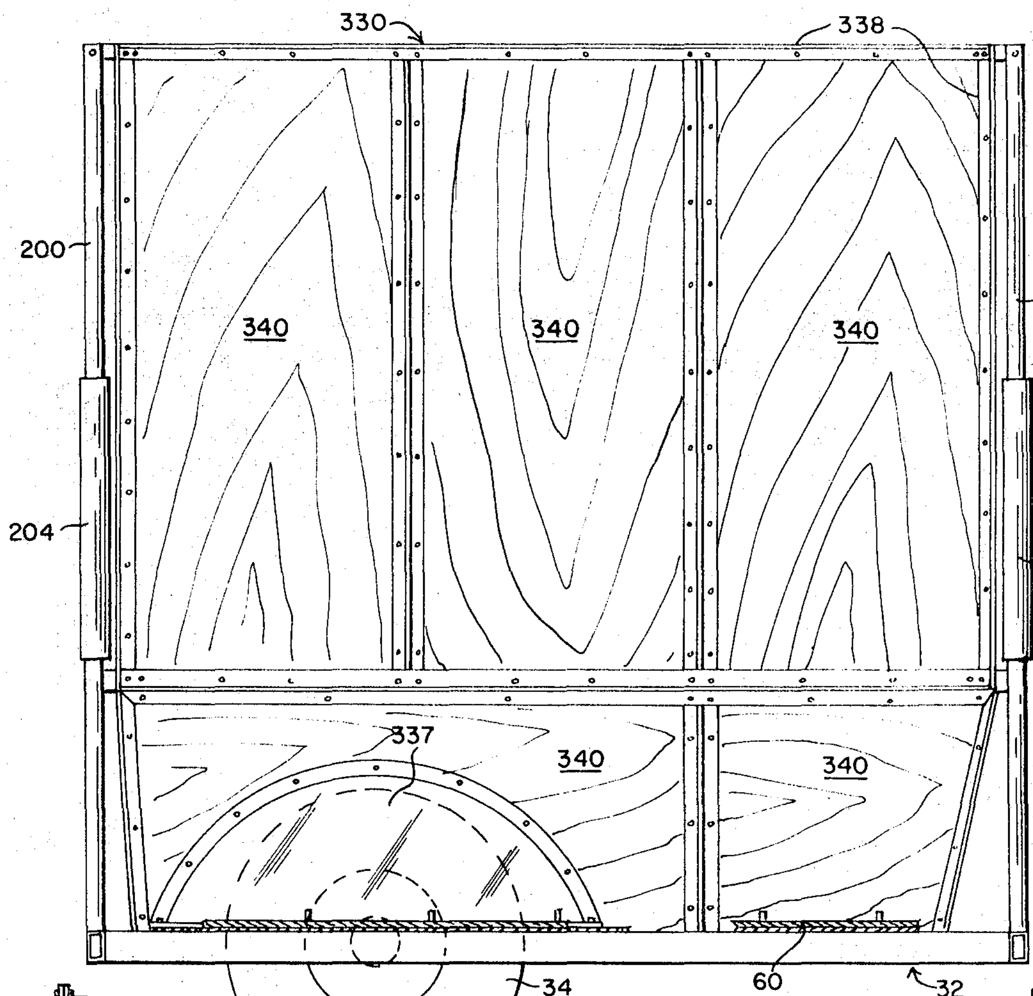

FIG. 22

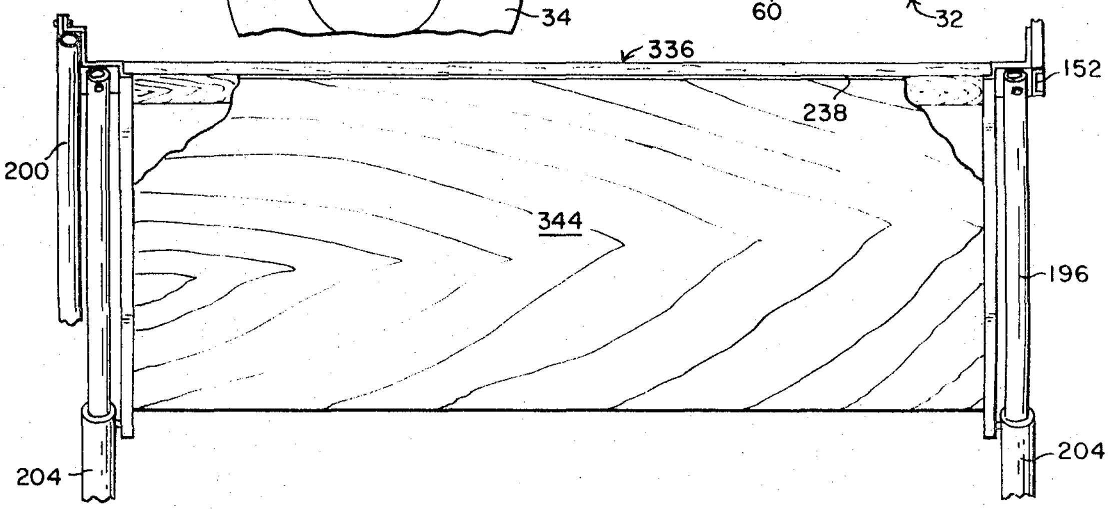

FIG. 23

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HOP-PICKING MACHINE

This invention relates to hop-picking machines and, more particularly, to novel, improved machines for field picking hops from vines hanging from overhead wires or trellises or other supports.

Until recent years hops were hand picked from the vines by field workers. In the last several years, however, machine picking has supplanted hand picking to a considerable extent. The machine pickers hereto fore in use are of the stationary-type shown, for example, in U.S. Pat. No. 2,669,172 to Regimbal. While stationary hop-picking machines reduce the amount of hand labor involved, a considerable number of individuals are still required since the vines must be cut from their trellises, loaded into trucks and hauled to the picking machine, and hand fed into the machine.

To further reduce the labor required in picking hops, it has been suggested that the hips be machine picked from the vines in the field itself. Machines proposed for picking hops in this manner are described in U.S. Pat. Nos. 2,447,122 and 2,645,893 to Horst. Hop-picking machines of the type disclosed in the Horst patents have a number of drawbacks and have not been used to any appreciable extent to field pick hops and in fact could not be used in a present day field because of the manner in which the vines are fastened to the overhead supports.

We have now developed a novel, improved machine for filed picking hops which does not have the drawbacks of machines heretofore proposed for this purpose and accordingly represents a significant advance in the art over the latter. The novel hop-picking machines of the present invention are preferably self-propelled and, generally speaking, include graspers for engaging the lower ends of the vines and maintaining them in picking position as they move through the machine, picking cats for stripping the hops from the vines, a conveyor arrangement for carrying the hops away, a cutter for severing the vines to free them from the supports, and an arrangement for expelling picked vines from the machine.

One of the important advantages of the novel hop-picking machine described herein is that, being self-propelled, it can be maneuvered through a field more easily and much faster than the cumbersome "pushed-type" picker described in the Horst patents identified above and is accordingly capable of picking hops at a much higher rate. Another advantage, also resulting in increased capacity, is that the machines of the present invention are capable of picking two rows of vines simultaneously in contrast to the patented Horst machines which are single-row pickers.

In the Horst machines, the vines are pulled down through the machine as they are picked. Accordingly, a field hand must accompany the machine and cut the vines free from the trellises as they move into the machine. Applicant's novel machine in contrast does not depend on downward movement of the vines they are picked; and, moreover, it is provided with its own cutter for severing the vines to free them from the trellises. Accordingly, the necessity of employing hand labor for this purpose is eliminated by the present invention together with the attendant expense.

In conjunction with the foregoing, another novel and important feature of the present invention is that the picking cats are vertically adjustable. This makes it possible to quickly adjust the cats as the heights of the overhead supports change so that the vines can be picked clean up to the supports.

Another important feature of the present invention is a novel conveyor for the hops stripped from the vines which normally discharges into a truck or the like but can be employed to store picked hops so that the machine can continue to pick while a loaded truck is being replaced or the machine is turning at the end of a row, etc. In similar circumstances the picking operation would have be stopped in heretofore proposed machines such as those described in the Horst patents, for example.

Yet another important feature of the present invention is a novel grasper line for holding the vines in the proper position for picking in which the grapsers are moved at a speed matching the ground speed of the picking machine. Further, the grapser line is configured to compensate for sagging vine-supporting wires, thereby ensuring that the vines are grasped at the proper location.

Other important features of the invention are a novel cutter mechanism for severing the vines and freeing them from the trellises and a novel mechanism for expelling the picked vines from the machine. Yet another novel and important feature of the invention is that the operating mechanisms are powered entirely by hydraulic motors, substantially eliminating belt and chain and similar drives. This makes the novel machines disclosed herein significantly simpler than comparable prior art harvesters.

From the foregoing it will be apparent that one important and primary object of the present invention is the provision of novel, improved machines for field picking hops.

A related and important but more specific object of this invention resides in the provision of novel, improved mobile machines for field picking hops from vines hanging from overhead supports.

Other even more specific but important objects of the invention reside in the provision of hop-picking machines in accord with the preceding objects which:

1. require the use of significantly less hand labor than heretofore proposed hop-picking machines of the same general character;

2. are self-propelled and can accordingly be maneuvered through a field more readily and faster than heretofore proposed mobile hop-picking machines;

3. are adapted for use in modern day fields;

4. are capable of picking hops at a much higher rate than heretofore proposed machines of the same general character;

5. are much more versatile than heretofore proposed machines of the same general character; and

6. are comparatively uncomplicated and, accordingly, economical to construct and to maintain.

Other important objects, additional novel features, nd further advantages of the present invention will become apparent from the appended claims and as the ensuing detailed description and discussion of a preferred embodiment of the invention proceeds in conjunction with the accompanying drawing.

In the drawing:

FIG. 1 is a front view of a hop-picking machine constructed in accord with the principles of the present invention a number of components having been deleted for the sake of clarity;

FIG. 2 is a partial plan view of the hop-picking machine of FIG. 1;

FIG. 3 is a plan view of the chassis of the hop-picking machine;

FIG. 4 is a view similar to FIG. 1 with the picking assembly of the machine in a lowered or retracted position;

FIG. 5 is a view similar to FIG. 4 but looking from the rear toward the front of the machine;

FIG. 6 is a fragmentary side view of the machine showing details of a conveyor and grasper line incorporated in it as well as structural details of the picking cats;

FIG. 7 is a top view of a grasper device employed in the hop-picking machine of FIG. 1;

FIG. 8 is a side view of the grasper device;

FIG. 9 is a section through the grasper line;

FIG. 10 is a fragmentary side view of the hop-picking machine illustrating details of the mechanism provided to raise and lower the picking assembly;

FIG. 11 is a fragmentary rear view of the machine illustrating much the same type of details as FIG. 10;

FIG. 12 is a plan view of the conveyors provided in the hop-picking machine of FIG. 1 for receiving and carrying away hops stripped form the vines being picked;

FIG. 13 is a partial side view of the conveyors illustrated in FIG. 12;

FIG. 14 is a fragment of FIG. 13 redrawn to an enlarged scale to more clearly illustrate certain details of the conveyor mechanism;

FIG. 15 is a plan view of mechanism provided for raising and lowering the hop-discharging sections of the conveyors;

FIG. 16 is a perspective of a cutter mechanism provided to sever the hop vines from their overhead supports;

FIG. 17 is a fragmentary rear view of the hop-picking machine designed to illustrate the details of mechanism incorporated in the machine for ejecting vine from which the hops have been stripped;

FIG. 18 is a perspective view of a portion of the mechanism shown in FIG. 17;

FIG. 19 is a schematic representation of a hydraulic system incorporated in the machine of FIG. 1;

FIG. 20 is a perspective of the front section of a grasper line incorporated in the machine of FIG. 1;

FIG. 21 is a side view of a picking cat incorporated in the machine of FIG. 1 with a number of components omitted to show the cat operating mechanism in more detail;

FIG. 22 is a fragmentary side view of the machine with a number of components deleted to show certain housing members provided to guide the stripped hops onto the conveyors; and

FIG. 23 is a view similar to FIG. 22 provided to show still other of the housing members.

Referring now the the drawing, FIGS. **1** and **2** depict in generally diagrammatic form a self-propelled hop-picking machine **30** constructed in accord with the principles of the present invention. Machine **30** includes a chassis or framework **32** supported by running gear including traction wheels **34** and dirigible wheels **36** at the front and rear of the machine, respectively. A conventional gasoline engine **38**, provided to propel the machine, is drive connected to traction wheels **34** through an automatic transmission **40** and a differential **42**. The motor also drives a hydraulic pump **44** which supplies the operating fluid for a conventional power steering unit **46** by which the dirigible wheels **36** of the machine are turned as the operator manipulates steering wheel **48**. The foregoing components may be of any appropriate conventional construction and will accordingly not be described further herein except as required to explain other aspects of the invention.

With continued reference to FIGS. **1** and **2**, the chassis **32** of machine **30** also supports two substantially identical hop-picking lines identified by reference character **50**. This provision of two picking lines is an important feature of the present invention. First, it doubles the picking capacity of an otherwise comparable single-row picker. In addition, because of the manner in which the vines are planted and tied to the overhead supports, it is necessary to cut the lower ends of the vines of two adjacent rows loose before picking the vines with a machine of the general type described herein. With a one-row picker the vines in the second row will sometimes wilt before they can be picked. This is disadvantageous since the hops are more difficult to remove from wilted vines. This problem is of course completely eliminated by the present invention.

Referring now to FIGS. **2** and **3**, each of the two identical picking lines **50** includes a grasper line **52** for engaging the lower ends of the vines and maintaining the vines in a vertical picking position as the machine moves past them and a pair of cooperating picking cats **54** and **56** for stripping the hops from the vines as they move through the passage **58** between the cats. The hops thus stripped from the vines fall onto chassis-supported conveyors **60** which carry the hops away and discharge them into a truck or other vehicle.

Also supported from chassis **32** is a novel sickle-bar-type cutter mechanism **62** for each picking line **50**. This mechanism severs the vines from their overhead supports as they move through the passage **58** between the picking cats **54** and **56**.

The final major subsystems of machine **30** are vine-expelling mechanisms identified generally by reference character **64**. As the stripped vines are released from the grasper lines, the associated expelling mechanisms engage the picked vines and expel them from the machine.

As best shown in FIGS. **6—9**, each of the two grasper lines **52** includes an elongated track **66** extending longitudinally of machine **30**, a pair of sprockets **68** and **70** rotatably mounted on the front and rear ends of track **66**, respectively, an endless roller chain **72** trained around the sprockets, and grasper devices **74**, fixed to the endless chain **72** at predetermined fixed intervals therealong. Roller chain sprocket **70** is driven by a fluid-operated, preferably hydraulic, motor **80** through a drive train identified generally by **82** (see FIG. **17**). As the sprocket rotates, it drives roller chain **72**, moving grasper devices **74** from the front toward the rear of the machine along an inner run **84** and returning them to the front of the machine along an outer run **86**. The movement of the roller chain and grasper devices **74** is timed to the ground speed of the hop-picking machine, Accordingly, the graspers maintain the vines being picked in a vertical picking position as they are traversed by the machine and the vines move through the passage **58** between the picking cats **54** and **56**.

Elongated track **66**, which will typically be fabricated from conventional structural shapes, the details of which are not critical, has vertical bearing surfaces **88** and **90** and a horizontal bearing surface **92** on inner run **84** and, on outer or return run **86**, a vertical bearing surface **94** and an upwardly and outwardly inclined lower bearing surface **96**. These bearing surfaces are provided to position the grasper devices laterally and in the vertical plane as they are carried along the inner and outer runs by roller chain **72**.

In conjunction with the foregoing it will be noted from FIG. **6** that track **66** is curved downwardly at the front end of the hop-picking machine. This is to accommodate sags in the overhead wires **98** from which the vines are supported so that the distance between the grasper devices **74** and the overhead wire will remain substantially constant.

Track **66** also includes a laterally extending member or cover **99** spanning outer run **86**. This member cooperates with the track member on which vertical bearing surface **88** is formed to keep track **66** clean of hops, leaves, and other debris.

Referring now specifically to FIGS. **7—9**, the devices **74** include jaws **100** fabricated from common structural shapes and including an elongated vertical jaw member **101**, an upwardly inclined upper jaw member **102**, a downwardly inclined lower jaw member **104**, and laterally extending jaw-mounting members **106** and **108**. The jaw **100** is fixed to roller chain **72** by a pin **110** which extends through upper mounting member **106** and a link **112** of roller chain **72** and is threaded into lower grasper-jaw-mounting member **108**.

As shown in FIG. **9**, the grasper device is adapted to clamp a hop vine stem **114** between the grasper jaw **100** and roller chain **72**. Clamping force is supplied by a compression spring **116** disposed between the roller chain and the tail end **118** of jaw member **101** and supported by a stud **120** fixed to the roller chain by a bracket **122**. A nut **124** on the outer end of the stud maintains the components in assembled relationship and can be threaded up and down the stud to accommodate the grasper jaw to vines of different sizes.

Referring again to FIGS. **7—9**, the grasper devices also include a roller **126** rotatably journaled on a transversely extending member **128** fixed to support member **108** and a roller cam **130** journaled for rotation about a vertical axis on a member **132** also fixed to member **108**. As best shown in FIG. **9**, roller **126** supports member **108** and, accordingly, roller chain **72** and grasper jaw **100** from bearing surface **92** of inner run **84** and bearing surface **96** of outer run **86** as the grasper devices move therealong. At the same time roller chain **72** and roller cam **130** cooperate with vertical track-bearing surfaces **88** and **90**, respectively (see FIG. **9**), to properly laterally position the jaws **100** of the grasper devices as they move down inner runs **84**.

In this conjunction as shown in FIG. 9, there is a gap **134** between roller cam **130** and vertical bearing surface **90** when roller chain **72** is engaged with bearing surface **88**. This gap is purposely provided so that grasper devices **74** may move laterally relative to the track to accommodate vines of different sizes.

Referring now to FIG. **20**, as a grasper device **74** approaches the front end of hop-picking machine **30** and travels around the front grasper sprocket **68**, the grasper jaw **100** swings away from roller chain **72** and engages the stem **114** of a hop vine to be picked between the jaw and roller chain **72**. Thereafter, as the grasper device starts down the inner run **84** of track **66** toward the rear of machine **30**, it swings back against the roller chain as shown in FIG. **20**, firmly clamping the stem **114** of the vine between the jaw and chain.

As the grasper devices **74** reach the rear end of picking machine **30**, their jaws **100** swing away from roller chain **72** in the same manner that they do at the front of the machine, releasing the stems of the vines **114**. Also, at this point, the vine expelling mechanisms **64** engage the vines and eject them from the hop-picking machine.

Referring now primarily to FIGS. **1**, **2**, **4—6**, **10**, and **11**, it will be remembered that there are two picking lines **50** with a pair of cooperating picking cats **54** and **56** in each line. Each of these four picking cats is of generally the same construction and includes a framework **138** fabricated of vertical tubular members **140**, upper and lower horizontal tubular members **142** and **144**, and braces **146** (see especially FIG. **6**). The four cat frames **138** are joined into a unitary structure or picking assembly **147** by transversely extending beams **148** and **150** at the back of hop-picking machine **30** and transversely extending beams **152** and **154** at the front of the machine.

As best shown in FIGS. **1**, **2**, and **21**, elongated, longitudinally extending shafts **156** and **158** are rotatably journaled in and supported from each cat frame **138** adjacent the upper and lower horizontal frame members **142** and **144**, respectively by stationary bearing assemblies **160** and adjustable bearing assemblies **162**. The latter include flanges **164** fixed to bottom frame member **144**, threaded members **166** extending through flanges **164** and fixed at their lower end to bearings **168**, and nuts **170** on the opposite side of each flange **164** by which the associated member **166** may be maintained in a vertically adjusted position relative to the associated flange.

Fixed to upper and lower shafts **156** and **158** are three pairs of cooperating upper and lower sprockets **172** and **174** with an endless chain **176** being trained around the sprockets in each pair. Fastened between the intermediate one of the three chains **176** and each of the two end chains are a series of parallel, spaced-apart bars or slats **178**, there accordingly being two sets of such bars. Fixed to bars **178** are picking fingers **180** which have generally parallel legs **182** and V-shaped end portions **184** bent at an angle such that they are upwardly inclined when the fingers are located on the facing, vertical sides of the cooperating cats. This arrangement is illustrated and described in more detail in, for example, U.S. Pat. No. 2,447,122 to Horst, which hereby incorporated by reference herein.

The elongated shafts **156** at the tops of the picking cat frames are rotated by rotary-type, fluid-operated, preferably hydraulic motors **186** supported from the transversely extending beam **154** connecting the upper rear ends of the picking cat frames by mounting brackets **188**, which may be of any desired configuration. Motors **186** are drive-connected to the associated shafts **156** through conventional couplers **190**.

As shafts **156** rotate, chains **176**, together with bars **178** and picking fingers **180**, move upwardly in facing vertical flights **192** and **194** in each pair of cooperating picking cats **54** and **56** with the fingers extending into the passage **58** between the cooperating picking cats. As the fingers move upwardly, they strip the hops from the vines moving through the passage **58** between the cooperating picking cats in each pair with the hops picked from the vines falling by gravity onto conveyors **60**. As discussed in detail above, the hop vines are maintained in the proper position during this picking operation by grasper devices **74** of the two grasper lines **52**.

As mentioned previously, one of the novel and important features of the present invention is that the picking cats just described are vertically adjustable to accommodate variations in the height of the overhead supports from which the vines to be picked are suspended. More specifically, the unitary assembly **147** of the four picking cats and the transversely extending beams by which their frames are connected is supported for vertical sliding movement on outer and inner uprights **196** and **198** of picking machine framework **32** at the rear of the machine and similar uprights **200** and **202** at the front of the machine by tubular members **204** mounted for vertical sliding movement on the uprights and fixed to the picking cat frames by transversely extending supports **206**.

The four cat frames may be elevated from the "down" position shown in FIG. **4** to the "up" position shown in FIG. **1** by energizing a fluid-operated, preferably hydraulic motor **208** which includes a hydraulic cylinder **210** mounted on the picking machine framework **32** and a connecting rod **212** fixed between the piston of the motor (not shown) and a transversely extending beam **214** connected between and to the two innermost slides **204** of picking assembly **147** at the back of hop-picking machine **30**. Admission of operating fluid to the lower end of hydraulic cylinder **210** drives the piston of the motor and connecting rod **212** upwardly, thereby elevating the rear end of picking assembly **147**.

To insure that the front end of the assembly moves upward at the same rate as the rear end, cables **216** are connected to transverse beam **214** by adjustable connectors **218**, trained around pulleys **220** and **222**, which are rotatably supported in any convenient fashion from picking machine framework 32, and fastened to the transversely extending lower beam **148** at the front end of the picking assembly. Accordingly, as the rear end of the picking assembly is elevated by motor **208** and beam **214** moves upwardly, cables **216** move the direction shown by arrows **224** in FIG. **10**, causing the front end of the assembly to move upward at the same rate at its rear end. Adjustable connectors **218**, which will typically include threaded members **226** extending through beam **214** and nuts **228** threaded on members **226** above the beam, are provided so that the tension in cables **216** can be adjusted to the point where the front and rear ends of picking assembly **147** will move upwardly in unison.

As best shown in FIG. **6**, the two tracks **66** of grasper lines **52** are supported from the lower , transverse beam **148** at the front of picking assembly **147** by brackets **229** and are fixed to the rear uprights **140** of the frames of outer graspers **54** by brackets **230**. Accordingly, the grasper lines move up and down with the picking cats, thereby maintaining a constant vertical relationship between the grasper lies and picking cats.

Once the vines being picked have entered the passages **58** between the cooperating cats in the picking lines **50**, they are vertically supported by the upwardly moving picking fingers **180** and may accordingly be cut loose from the overhead supports. This is accomplished by the cutting mechanisms **62** referred to briefly above. As best shown in FIGS. **2** and **16**, each cutting mechanism **62** includes a stationary sickle bar **231** and a cooperating reciprocable sickle bar **323**, both of which face the front of hop-picking machine **30**. Stationary sickle bar **231** is welded at its opposite ends to end brackets **234** and **236**, which are pivotally fixed to wall members **238** and **240** adjacent the outer flights of the picking cats **54** and **56** in the associated picking line **52** by horizontally extending pivot members **242**. The reciprocating sickle bar **232** is journaled in mounts **244** also fixed to supports **234** and **236** with the sickle bar **232** being slidable back and forth in these mounts.

Movable sickle bar **232** is reciprocated by a mechanism including a rotary, fluid-operated, preferably hydraulic motor **246** mounted on sickle bar support **236**. The rotary motion of the motor is converted to rectilinear motion to reciprocate the sickle bar by a disc **248** fixed to the motor output shaft **250** and a crank **252** connected to the periphery of disc **248** by a pivot pin **254** and to one end of the sickle bar by a pivot pin **256**. Accordingly, as motor **246** rotates, sickle bar **232** is reciprocated to sever vines engaged between the teeth **258** of the stationary sickle bar and the teeth **260** of the movable sickle bar. A handle **262** is fixed to sickle bar support **236** permits the operator to tilt the sickle bars upwardly and downwardly as required to cut the vines closely adjacent the overhead supports.

As best shown in FIG. **16**, the vine-cutting mechanism also includes a transversely extending roller **264** rotatably supported from supports **234** and **236** in brackets **266** and **268**. The periphery of roller **264** extends above the sickle bars **231** and **232** and, accordingly, prevents the wires or other supports from which the vines are suspended from becoming entangled in the cutting mechanism.

As discussed previously, the stripped hop vines are released from grasper devices **74** at the rear end of hop-picking mach.ne **30** and the ejected or expelled from the machine by vine-expelling mechanism **64**. As best shown in FIGS. **2**, **17**, and **18**, there is an ejecting mechanism **64** associated with each of the picking lines **50**, and each of these includes three endless toothed chains **270**, **272**, and **274** for engaging the stripped vines and ejecting them from the machine.

The vine-ejecting chain **270** is trained around three sprockets **276**, **278**, and **280**. Sprocket **276** is rotatably supported on the same fixed, vertical shaft **282** as the sprocket **68** around which the roller chain **72** of the associated grasper mechanism **52** extends. Sprocket **278** is rotatably supported from the associated grasper line **52** and the frame **138** of the picking cat **54** in the associated line **50** by a bracket assembly, which may be of any desired construction, and is identified generally by reference character **284** in FIG. **18**.

The third sprocket **280** is fixed to the lower end of a vertically extending drive shaft **286** which is rotatably supported in a bearing **288** fixed to bracket assembly **284** at its lower end and by the rotary-type hydraulic motor **80** referred to above at its upper end.

Shaft **286** is rotated during the operation of machine **30** by motor **80**, which is supported from brace **206** by a suitable bracket **294**. This motor drives endless chain **270** in the direction shown by arrows **296** in FIG. **18**. As the endless chain follows the path shown by arrows **296** around sprocket **276**, fingers **298** welded or otherwise fixed to the links of the chain engage the vines released by the grasper device jaw **100** as they open and eject them from the machine.

As mentioned above, motor **80** also drives the endless chain **72** of the associated grasper line **52** through a drive train **82**. This drive train includes a sprocket **300** fixed to the lower end of shaft **286** below sprocket **280**, a sprocket **302** fixed to or integral with the sprocket **68** around which grasper line chain **72** is trained, and a drive chain **304** trained around sprockets **300** and **302**. Typically, the various sprockets in the drive trains of the grasper lines and ejecting mechanism will be so selected that the sprocket **276** of the ejecting mechanism will turn twice as fast the sprocket **68** of the grasper line. This has been found to be the most effective for efficient ejection of the stripped vines from machine **30**.

Referring now primarily to FIGS. **17** and **18**, the intermediate and upper vine-ejecting chains **272** and **274** are similar, each including vine-ejecting fingers **308** of the type just discussed in conjunction with chain **270** and being trained around sprockets **310** and **312**. The two sprockets **310** and **312** are supported from various structural components of the picking assembly **147** by bracket assemblies identified generally by reference character **314**. Sprockets **312** are fixed to a vertical, rotatable shaft **316** drive connected at its lower end to motor driven shaft **286** by sprockets **318** and **320** on shafts **286** and **316** and a drive chain **322** trained around the sprockets. Accordingly, motor **80** drives the intermediate and upper vine-expelling chains in the direction shown by arrow **324** in FIG. **18**. This causes fingers **308** to engage and assist fingers **298** in ejecting the stripped vines from machine **30**.

As shown in FIGS. **2** and **17**, elongated flat springs **326** are mounted adjacent the vine-expelling legs **327** of intermediate and upper chains **272** and **274** by brackets **328** connecting the springs to vertically extending members **196** of picking machine framework **32**. Springs **326** hold the stripped vines between the fingers **308** of the intermediate and upper chains **272** and **274** as they expel the stripped vines from machine **30**.

Referring now to FIGS. **2**, **22**, and **23**, the hops stripped from the vines being picked fall by gravity onto conveyors **60** associated with the two picking lines **50**. To guide the hops onto the conveyors, each of the two picking lines **50** is provided with stationary outer walls **330** and **332**, inner walls **334** and **336** which move up and down with the picking cat assembly **147**, and wheel housings **337**.

The details of these wall structures are not critical and may be varied as desired. Typically, as shown in the Figures just mentioned, however, the two stationary walls **330** and **332** will include an angle iron or similar framework **338** fixed to the main framework **32** of the hop-picking machine and plywood or similar panels **340** fastened to the framework.

The vertically moveable inner walls **334** and **336** may typically be varied in detail. In the exemplary application of the principles of the present invention disclosed herein, these walls include structural members **342** fixed to picking cat guides **204** and to transversely extending beams **150** and **154** to which the longitudinally extending, horizontal structural members **238** and **240** mentioned previously are fixed and plywood or similar panels **344** attached in any convenient fashion to the horizontal and vertical structural members.

Referring primarily now to FIGS. **1**, **6**, **12**, **13**, and **15**, the conveyors **60** on which the stripped hops fall by gravity each include a fixed hop-receiving conveyor section **346** and a vertically elevatable hop delivery section **348**.

As best shown in FIGS. **6**, **12**, and **13**, each of the two conveyor sections **346** and **348** includes a framework **350** and **352** fabricated of structural shapes to which floor members **354** and **356** and sidewalls **357** are attached. The framework **350** of each conveyor is incorporated in the main frame **32** of the hop-picking machine. The hop delivery sections **348** of conveyors **60** are pivotally fixed to the associated fixed sections **346** by pivot members **358** (see FIG. **12**). The pivot members are attached to the longitudinal members **360** of delivery section framework **352** and are journaled in bearings **362** mounted on the longitudinal members **364** of fixed conveyor section framework **350** at the rear end thereof. This makes the delivery sections **348** of the conveyors pivotable from the position shown in full lines in FIG. **13** to the positions shown in dotted lines in the same Figure. As they pivot, both delivery sections **34** are made to move in unison by a transversely extending member **366** extending between and fixed to the two conveyor section frameworks **352**.

Referring now to FIGS. **6** and **12**, rotatably mounted at the front end of fixed conveyor section framework **350** and at the rearmost end of pivotal conveyor section framework **352** are transversely extending rolls **367** and **368** provided with sprockets **370** and **372** around which endless, roller-type chains **374** are trained. Extending between and fastened to each cooperating pair of endless chains **374** are cleated conveyor belts **376** by which the hops stripped from the vines being picked are moved along conveyor sections **346** and **348** and into a truck or other vehicle at the discharge end of conveyor sections **348**.

The endless chains **374** and conveyor belts **376** are driven by rotating sprockets **372** via rotary-type, fluid-operated, preferably hydraulic motors **378** mounted on discharge section frameworks **352** adjacent the rear ends of longitudinal framework members **360**. As shown in FIG. **12**, motors **378** are coupled to the rolls **368** to which sprockets **372** are attached.

To insure that endless chains **374** track properly, the lower or return legs of the chains are trained under the pivot shafts **358** by which the discharge conveyor sections **348** are attached to fixed sections **346**. The upper legs of the runs are trained under guides **380** fixed to longitudinal members **364** of fixed conveyor section framework **346** for the same purpose.

As indicated above, rear conveyor sections **348** can be pivoted about shafts **358** to raise or lower their discharge ends between the limit positions shown in full and dotted lines in FIG. **13**. This is an important feature of the present invention since it permits the discharge height of the conveyors to be readily adjusted to accommodate hop-receiving vehicles of different types. This arrangement also provides another, less obvious advantage. Specifically, as discussed above, the sides of the two hop-picking lines **50** are enclosed by cooperating sets of walls **332**, **336** and **330**, **334**. By raising conveyor sections **348** to the dotted line position of FIG. **13**, the conveyor sections can be made to cooperate with the sidewalls just mentioned to form enclosed, hop-storing compartments. This is advantageous when machine **30** is making a turn at the end of a row or vehicles into which the hops are being discharged are switched, for example, as the hops being stripped while this is taking place can be temporarily stored in the compartment formed by the sidewalls and conveyor discharge sections. Thus, it is not necessary to stop the operation of the picking cats during such circumstances as has heretofore been required.

The mechanism by which conveyor discharge sections **348** are raised and lowered, best shown in FIGS. **12**, **13**, and **15**, includes cables **384** trained around pulleys **385** and fixed to the transverse member **366** connecting the two discharge sections **348** to one end to a transversely extending drum **386** at the other. As shown in FIG. **15**, drum **386** is rotatably supported from the longitudinal members **364** of fixed conveyor section framework **350** by bearings **388**. By rotating drum **386** to respectively wind cable thereon or to unwind the cable therefrom, cables **384** can either be taken in or payed out to respectively elevate and lower the discharge ends of conveyor sections **348** by pivoting them upwardly and downwardly about shafts **358**.

Drum **386** is rotated by a rotary-type, fluid-operated, preferably hydraulic motor **390**, which is supported from one of the longitudinal framework members **364** by motor mount **392**. Motor **390** is drive connected to drum **386** by a sprocket **394** on its output shaft **396**, a sprocket **398** rotatably fixed to drum **386** for rotation therewith, and an endless chain **400** trained around the two sprockets.

As will be a parent from the foregoing, the various operating mechanisms of hop-picking machine **30** are operated by hydraulic motors of either the rotary or reciprocating type. FIG. **19** shows in schematic form the hydraulic system in which these motors are incorporated. In addition to the several hydraulic motors described above, the hydraulic system includes a reservoir **402**, three conventional hydraulic pumps **44** (mentioned above), **406**, and **408** and controllers **410—418** of the conventional valve type, which are located adjacent steering control **48** above the operator's platform **419**. The components just mentioned, together with a number of conventional flow dividers **420**, relief valves **422**, and other conventional circuit components are interconnected by hydraulic lines designated generally by reference character **424**.

It is believed that the operation of the control system shown in FIG. **19** is apparent from the drawing and from the foregoing detailed description of the various operating mechanisms. Briefly, however, by way of summary, to begin the picking operation, control **410** is opened, allowing hydraulic fluid to be pumped from reservoir **402** to the motors **186** of the four picking cats **54** and **56**, to the motors **80**, which drive the grasper lines **52** and the vine-ejecting mechanisms **64**, and to the tow motors **246** which operate the sickle bar cutters **62**. At the same time valve **414** is opened allowing fluid to flow to motors **378** to operate conveyors **60**. The machine is then essentially ready to begin picking except for raising the two cat lines **50**. This is accomplished by opening valve **416**, allowing hydraulic fluid to flow to lift cylinder **208** to elevate the picking cats.

The machine continues to operate in this manner until the end of a row is reached, for example. At the end of the row the operator will typically close valve **414** to stop the conveyors, and open valve **418** to allow fluid to flow to the motor **390** of the conveyor lift mechanism. As discussed above, this elevates the delivery sections of the conveyors to the position shown in dotted lines in FIG. **13**. With the conveyors stopped, the picked hops are stored on the conveyor until the turn is completed. At this point, the conveyors may be restarted and the discharge end of conveyor sections **348** lowered to accommodate the height of the carrier into which the picked hops are being discharged.

The remaining control **412** is provided so that the grasper lines **52** may be stopped, when desired, without stopping the picking cats and the cutter mechanisms.

From the foregoing description of an exemplary embodiment of the present invention, it will be apparent that many modifications may be made without departing from the scope or principles of the present invention. For example, it is not essential that that a hydraulic operating system be employed although this is preferable from the standpoint of simplicity. Moreover, it will be obvious to those of ordinary skill in the relevant arts that many of the novel features of the present invention are equally applicable to single-row pickers or to machines capable of picking more than two rows. Accordingly, to the extent that such applications of the principles of the invention are not expressly excluded from the appended claims, they are fully intended to be covered therein.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come withing the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What we claim and desire to be secured by Letters Patent is:

1. A machine for field picking hops from vines hanging from overhead supports comprising: frame means; running gear for movement through the field in which the hops are to be picked; means supported by said frame means for grasping the lower ends of said vines to maintain said vines in a picking position; means supported by said frame means for stripping the hops from said vines; conveyor means supported from said frame means for the hops stripped from the vines; means for severing said vines to free them from the overhead supports, said means for severing said vines comprising cooperating fixed and reciprocable cutter bars extending transversely across said machine, said fixed and reciprocable bars having cooperating cutter teeth thereon and said cutter teeth facing the front of the machine, and means for reciprocating the reciprocable cutter bar; and means for expelling the stripped vines from the machine.

2. The hop-picking machine of claim **1**, wherein the means for reciprocating the reciprocable cutter bar comprises a rotary-type fluid-operated motor supported from the frame of the machine and means connected between the motor and said reciprocable cutter bar for converting the rotary motion of the motor to reciprocatory motion of the cutter bar.

3. The hop-picking machine of claim **1**, wherein the cutter bars are fixed to the picking machine by means providing a pivot axis extending transversely of said machine whereby said cutter bars can be tilted up and down to vary the height of cut.

4. The hop-picking machine of claim **1**, together with a rotatably mounted member extending transversely across said machine adjacent said cutter bars and protruding upwardly therebeyond to prevent the vine supports from becoming entangled in said cutter bars.

5. A machine for field picking hops from vines hanging from overhead supports comprising: frame means; running gear supporting said frame means, whereby said machine is made mobile for movement through the field in which the hops are to picked; means supported by said frame means for grasping the lower ends of said vines to maintain said vines in a picking position, said grasping means comprising a track extending longitudinally of said machine and supported from the frame thereon, at least one grasper device including support means adapted to run along said track, and jaw means fixed to said support means and adapted to open as the grasper device reaches the front end of the machine to receive a hop vine stem and to then close to secure said vine as the grasper device is carried toward the rear of the machine and the hops are stripped from the vine; means supported by said frame means for stripping the hops from said vines, conveyor means supported from said frame means for the hops stripped from the vines; means for severing said vines to free them from the overhead supports; and means for expelling the stripped vines from the machine.

6. The hop picking machine of claim 5, wherein said track is curved downwardly at the front end of the machine to accommodate sagging vine supports.

7. The hop-picking machine of claim 5, wherein said support means comprises an endless flexible member and said grasper device further includes means biasing said jaw means toward said endless member to clamp a hop vine stem thererbetween.

8. The hop-picking machine of claim 7, wherein said track has a horizontal and first and second vertical bearing surfaces, one of said vertical bearing surfaces being adapted to be engaged by said endless flexible member, and wherein said support means further comprises a support member, a first roller mounted on said support member and adapted to engage said horizontal bearing surface, a second roller mounted on said support member and adapted to engage the other of said bearing surfaces, and means fixing said endless flexible member to said support member, whereby said endless flexible member is supported from said track and is laterally positioned by said vertical bearing surfaces as it moves therealong.

9. The hop-picking machine of claim 5, wherein said track has a laterally extending flange member of the upper side thereof to shield said track from hops, leaves, and other debris.

10. A machine for field picking hops from vines hanging from overhead supports comprising: at least one pair of picking means for stripping hops from vines passed therebetween; means for grasping the lower ends of said vines to maintain said vines in a picking position as they move through the passage between the picking means; means incorporated in said grasper means for engaging said vines at the entry to the passage between said picking means and for releasing said vines at the exit from said passage; and means for expelling from said machine vines from which the hops have been picked including at least one endless flexible member adjacent said exit having thereon fingers engageable with said vines to pull said vines from said grasping means and eject them from the machine.

11. The hop-picking machine of claim 10, wherein there are a plurality of said vine-expelling members, said members being disposed in vertically spaced apart relationship.

12. A machine for field picking hops from vines hanging from overhead supports comprising: at least one pair of picking means for stripping hops from vines passed therebetween; means for grasping the lower ends of said vines to maintain said vines in a picking position as they move through the passage between the picking means; means incorporated in said grasper means for engaging said vines at the entry to the passage between said picking means and for releasing said vines at the exit from said passage; means for expelling from said machine vines from which the hops have been picked including at least one endless flexible member adjacent said exit having thereon fingers engageable with said vines to pull said vines from said grasping means and eject them from the machine; and a single fluid-operated motor for effecting continuous movement of said grasper means and the endless flexible member of said vine-expelling means.

13. A machine for picking hops from vines hanging from overhead supports comprising: a frame; a pair of picking means, said picking means including endless belts having vertical legs disposed in generally parallel, spaced relationship to define a passage through which the hop vines are adapted to pass, picking fingers carried by said belts, and means for driving said belts to effect vertical movement of said fingers and cause said fingers to strip the hops from vines moving through the passage between said picking means; means joining said pair of picking means into a unitary assembly; means supporting said unitary assembly from the frame of the machine for up and down movement relative to said frame; and means for raising and lowering said unitary assembly relative to said frame to thereby raise and lower said picking means to compensate for variations in the height of the overhead supports from which the vines are suspended.

14. The hop-picking machine of claim 13, wherein the means joining said pair of picking means into a unitary assembly comprises transversely extending beams at the front and rear of the machine, both of said picking means being supported from said front beam and from said rear beam, and wherein the means for raising and lowering said unitary assembly comprises a hydraulic motor for raising and lowering in one of said beams and means so linking the other beam to said one beam that both beams move upwardly and downwardly simultaneously as said one beam is raised and lowered by said hydraulic motor.

15. A self-propelled machine for picking vines suspended from overhead supports comprising: frame means; running gear supporting said frame means which comprises dirigible wheels; and traction wheels; motor means supported from said frame and drive connected to said traction wheels for propelling the machine through the field in which the hops are to be picked; means for grasping the lower ends of said vines to maintain said vines in a picking position; means for stripping the hops from said vines; means for receiving the hops stripped from said vines; means for severing said vines to free them from said overhead supports; and means for discharging the stripped vines from the machine; said grasping means comprising a track extending longitudinally of said machine and supported from the frame thereof, at least one grasper device including support means adapted to run along said track and jaw means fixed to said support means and adapted to open as the grasper device reaches the front end of the machine to receive a hop vine stem and to then close to secure said vine as the grasper device is carried toward the rear of the machine and the hops are stripped from the vine; the means for stripping hops from the hop vines comprising a pair of picking means including endless belts having vertical flights disposed in parallel spaced relationship to define a passage through which the hop vines are adapted to pass, picking fingers carried by said belts, and means for driving said belts to effect vertical movement of said fingers and cause said fingers to strip the hops from vines moving through the passage between said picking means; and the means for severing said vines comprising cooperating fixed and reciprocable cutter bars extending transversely across said machine and having cutter portions facing the front of the machine and means for reciprocating the reciprocable cutter bar.

16. The hop-picking machine of claim 15, wherein the means for receiving the hops stripped from the vines comprises a conveyor below and extending the length of picking means for carrying away hops stripped from said vines and falling thereonto, said conveyor means comprising endless belt means and drive means for effecting movement of said belt means, and said machine further comprising wall means cooperating with said conveyor to provide a compartment and selectively operable means for interrupting the drive means and thereby stopping said belt means, whereby hops may be accumulated in said compartment.

17. The hop-picking machine of claim 16, wherein said conveyor comprises rotatably mounted supports on the front and rear of said machine, said endless belt means being trained around said support means, and wherein said motor is of the fluid-operated type and is directly drive connected to one of said rotatably mounted supports.

18. The hop picking machine of claim 16, wherein said conveyor includes a first, fixed section below and extending generally the length of said picking means for receiving the hops stripped from said vines, a second section pivotally fixed at its forward end to said first section at the rear of said machine and extending beyond the rear of the machine for transferring the hops from the first conveyor section to a vehicle or the like, and selectively operable means for pivoting said second conveyor section to raise and lower the rearward end of said second conveyor section to thereby adjust the discharge height of the second conveyor section.

19. A hop-picking machine comprising: at least one pair of vertically extending picking means for stripping the hops from vines passed therebetween and a conveyor for carrying away the hops stripped from said vines, said conveyor including a first, fixed section below and extending generally the length of said picking means for receiving the hops stripped from said vines and a second section pivotally fixed at its forward end to said first section at the rear of said machine and extending beyond the rear of the machine for transferring the hops from the first conveyor section to a vehicle or the like and selectively operable means for pivoting said second conveyor section to raise and lower the rearward end of said second conveyor section to thereby adjust the discharge height of the second conveyor section which comprises a rotatable drum, at least one flexible link trained around said drum and connected to said second conveyor section, a motor drive connected to said drum for rotating said drum, and selectively operable means for energizing said motor in forward and reverse directions to thereby so rotate said drum as to wind the link on said drum or unwind it therefrom to respectively raise and lower the rear end of said second conveyor section.

20. A hop-picking machine comprising: at least one pair of vertically extending picking means for stripping the hops from vines passed therebetween and a conveyor for carrying away the hops stripped from said vines, said conveyor including a first, fixed section below and extending generally the length of said picking means for receiving the hops stripped from said vines; a second section pivotally fixed at its forward end to said first section at the rear of said machine and extending beyond the rear of the machine for transferring the hops from the first conveyor section to a vehicle or the like; an endless belt means spanning said first and second conveyor sections; a fluid-operated motor mounted on said second conveyor section for effecting movement of said belt means; and selectively operable means for pivoting said second conveyor section to raise and lower the rearward end of said second conveyor section to thereby adjust the discharge height of the second conveyor section.

United States Patent [19]

Ferraro

[11] **4,276,738**

[45] **Jul. 7, 1981**

[54] HOP PICKING MACHINE

[75] Inventor: **Dominick Ferraro**, Walla Walla, Wash.

[73] Assignee: **Chisholm-Ryder Co., Inc.**, Niagara Falls, N.Y.

[21] Appl. No.: **145,868**

[22] Filed: **May 1, 1980**

[51] **Int. Cl.**³ **A01D 46/02**

[52] **U.S. Cl.** **56/130**; 56/330

[58] **Field of Search** 56/126–130, 56/330, 27.5, 33–35

[56] **References Cited**

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2,447,122	8/1948	Horst, Jr.	56/130
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Primary Examiner—Jay N. Eskovitz

Attorney, Agent, or Firm—Wells, St. John & Roberts

[57] **ABSTRACT**

A picking machine is described for harvesting hops from vines that have been trained over a low profile trellis. The machine includes two sets of vertical picking conveyors that straddle the vines. The conveyor sets are transversely adjustable toward or away from the vine. A forward picking conveyor set includes picking fingers that move continuously downwardly, stripping hops down from opposite sides of the vine downwardly onto horizontal receiving conveyors. A rearward set of picking conveyors follow the forward set with picking fingers moving upwardly. The upwardly moving picking fingers lift the vine, "stringing" the vine vertically and stripping the remaining hops so they will fall downwardly onto receiving conveyors below.

7 Claims, 3 Drawing Figures

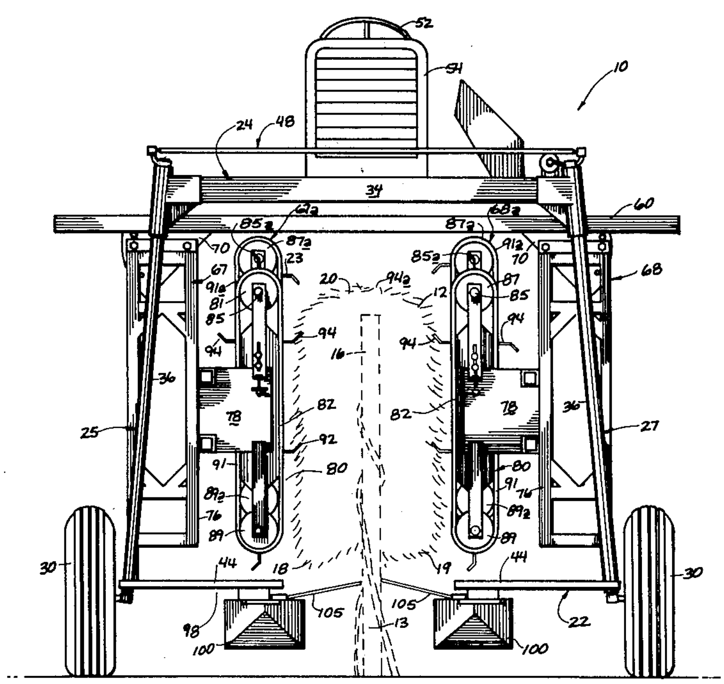

FIG. 1

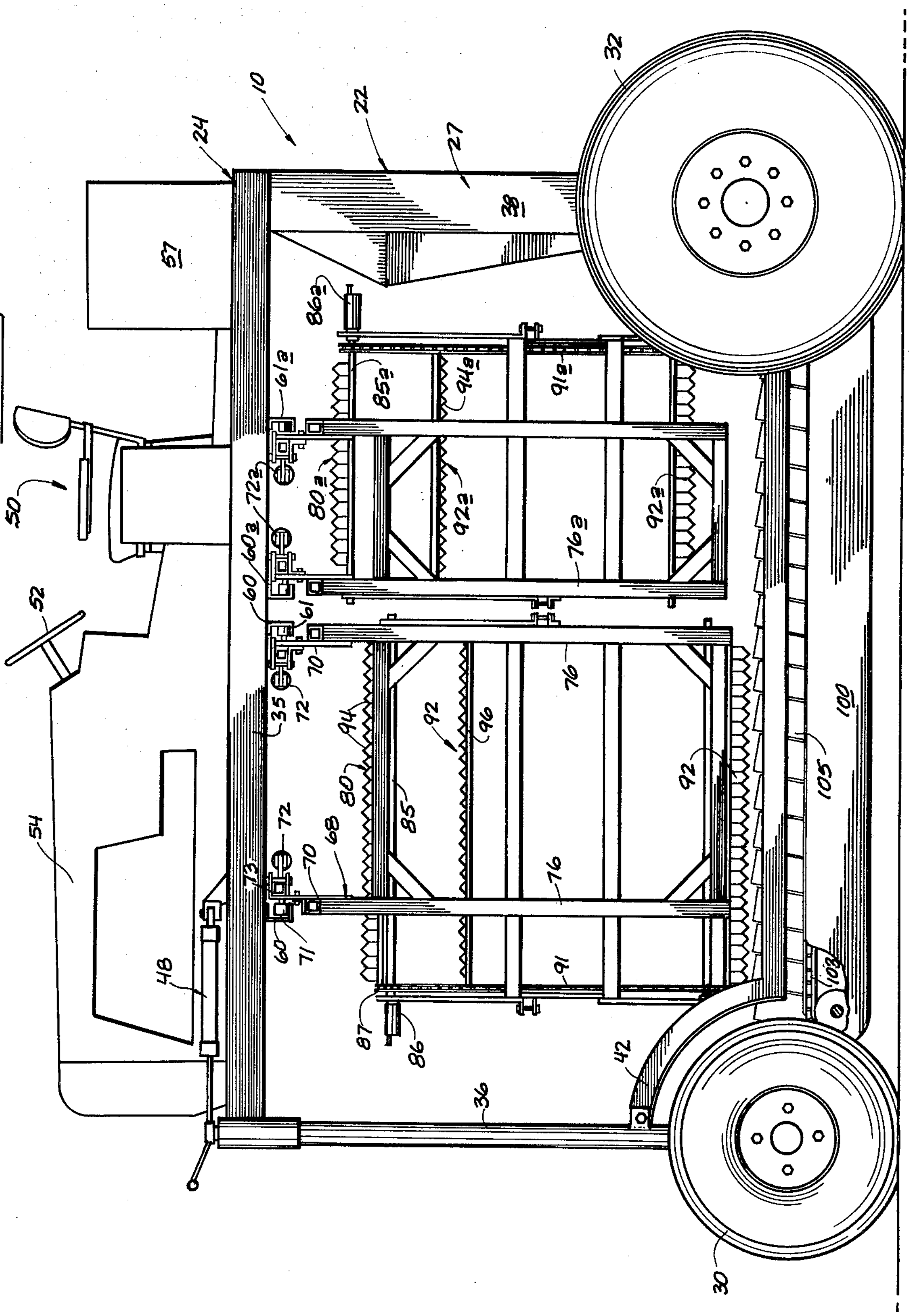
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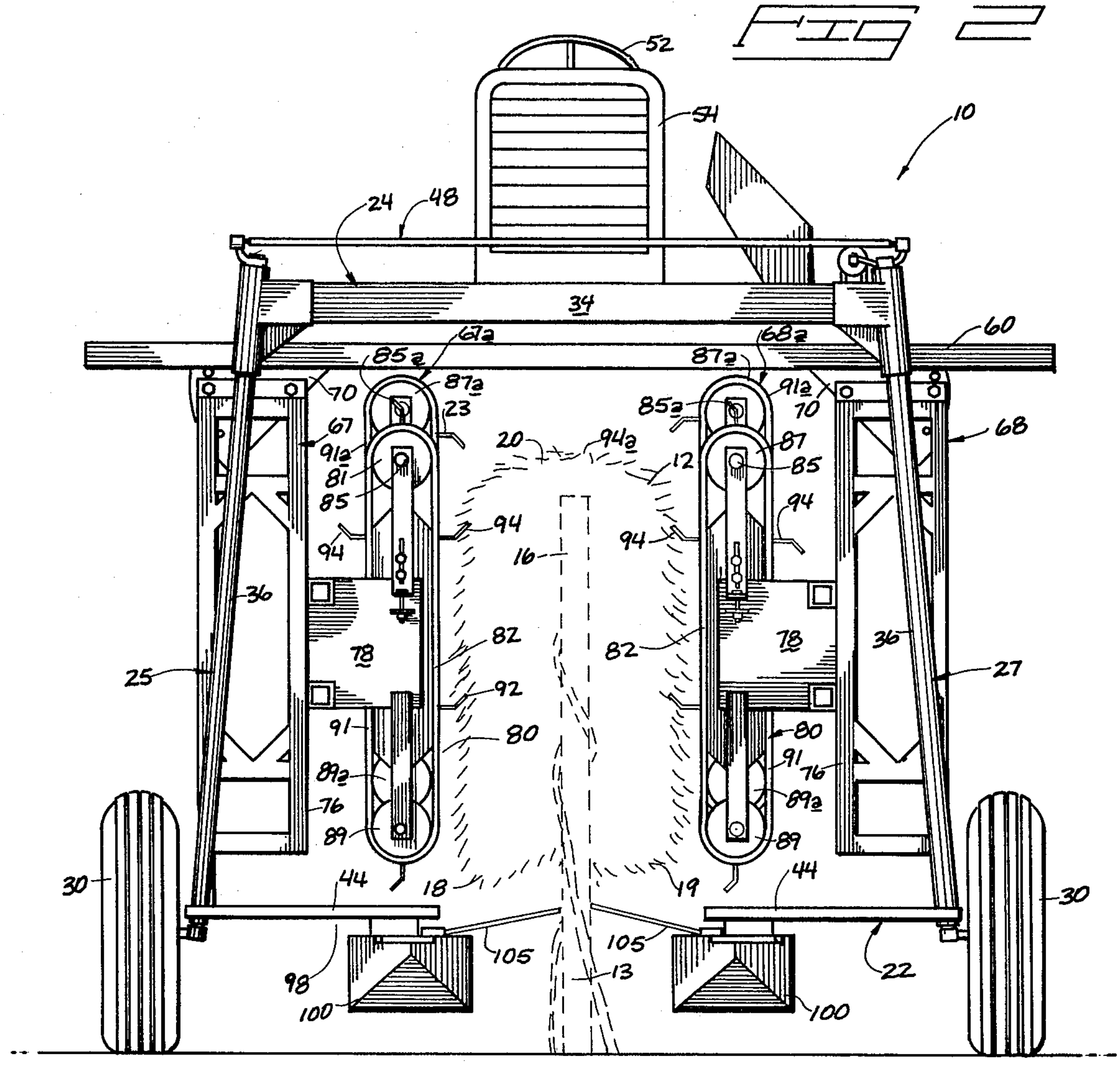
FIG. 2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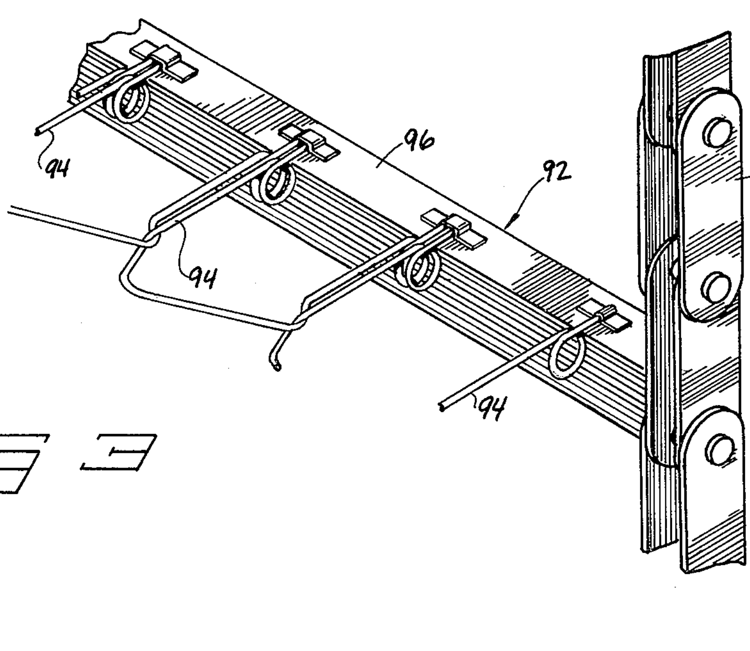
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FIG. 3

HOP PICKING MACHINE

BACKGROUND OF THE INVENTION

The present invention relates to machines for automatically picking hops from hop vines.

Hops are leafy knotted flowers that grow on vines. Hop vines can grow to a substantial height and will train themselves over any upright support. Commercial growing of hops, therefore, takes advantage of the climbing capability of the vines by allowing the vines to grow up trellises in low rows. The unusual height of the hop vine led, in the past, to a harvest technique of simply cutting the vine at its base and pulling it downwardly off the trellis to gain access to the hops along the full length of the vines. Leaving the vine intact on the trellis, however, is known to favorably affect the yield of the following years crop. Therefore, attempts have been made to produce hop picking machines that will automatically harvest hops from vines still remaining on the trellis.

U.S. Pat. No. 2,447,122 granted to Horst, Jr. et al in 1948 discloses a machine that will move along a row of hop vines to strip hops from the vines. The Horst machine, however, provides a roller that moves along the ground surface, engages the lines at the base, and pulls them downwardly through hop picking fingers. The vines are pulled downwardly and smashed against the ground by the heavy roller. As the vines move downwardly, upwardly moving fingers are used to strip the hops as the vines are pulled downwardly. The hops fall onto a skirting and roll onto substantially horizontal hop collecting conveyors.

There has been recent interest in attempting to harvest hops from vines grown on low profile trellises rather than the tall, traditional hop trellis. A machine developed through conversion of a grape harvesting machine for this purpose included paired, opposed upright hop picking conveyors with outwardly protruding picking fingers. The machine would be driven over the trellis and vine with the picking conveyors situated on opposite sides of the vine. The inwardly facing flights were powered to move the picking fingers continuously upward, lifting the leaves and vines upwardly and stripping the hops from the vines. Such apparatus had many disadvantages. The long hop vines would often wrap over the top of the picking conveyors and the entire hop plant could be forceably uprooted, causing serious harm to the following year's crop. The problem remained, then, of providing an automatic hop picking machine that could effectively clean hops from the hop vines entrained on low profile trellises without doing substantial damage to the vine structure or the trellis.

The present invention is a hop picking machine that enables picking of hops entrained on low profile trellis hop vines without injuring the vine structure or the trellis. The present picking machine includes two sets of picking conveyors. A first longitudinal set of fingers on the first picking conveyor engages the opposite sides of the hop plants and pulls downwardly, stripping hops from the vines in a downward motion. A second set of conveyors follows the first set with upwardly moving fingers. The upwardly moving fingers move along paths that extend above the top of the trellis so the full length of the hop vine can be vertically "strung out" while the hops are being removed therefrom. The vines thus are not capable of wrapping over the top of the picking conveyors and so cannot become entangled and uprooted between the working flights.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the present invention is illustrated in the accompanying drawings in which

FIG. **1** is a side elevation view of a hop picking machine embodying the principal features of the present invention;

FIG. **2** is a front elevation view of the machine illustrated in FIG. **1**; and

FIG. **3** is an isometric fragmentary view of a picking finger assembly used by the present machine.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

The present hop picking machine is generally designated in the drawings with the reference numeral **10**. The present machine **10** is specifically designed for the picking of hops from hop vines **12** (FIG. **2**). The hops grow and entrain themselves on a low profile trellis **16** along a row. The height of trellis **16** resembles that of a grape trellis and is substantially lower than the standard top trellis. The foliage of the hop vines is supported on the trellis **16** and includes row sides **18** and **19** that extend upward to the trellis top **20**.

It is not unusual for hop vines to grow over the top of relatively low trellises **16**. As this happens, the vines have nothing above the trellis top to cling to. They therefore start growing back down the opposite side of the trellis, clinging to part of the vine that previously grew up the opposite side. The actual length of the vine may therefore be substantially greater than the apparent height of the vine on the trellis.

The present hop picking machine **10** includes an inverted U-shaped frame **22**. Frame **22** defines an open longitudinal passage **23** that extends through the frame from front to rear. The frame is intended to straddle a row of hops as they grow on trellis **16**.

The mobile frame **22** includes an overhead frame structure **24** that extends elevationally over the hop line row to clear the top **20** and to clear a vine that has been "strung out" or stretched to its maximum length above the ground surface. The overhead frame structure **24** is therefore spaced substantially above the apparent top elevation of the vines.

The mobile frame **22** includes side frame structures **25** and **27**. The structures **25** and **27** extend downwardly from the overhead frame structure **24**. The side frame structures **25** and **27** straddle the support trellis **16**.

Wheel assemblies are provided at lower extremities of the side frame structures **25** and **27**. They enable the mobile frame **22** to be propelled along the row, parallel to the line represented by the trellis and hop vines growing thereon. The overall wheel assembly includes a pair of front steerable wheels **30** that are selectively turned about vertical axes. The front steerable wheels enable the hop picking machine to be guided in a desired direction, providing alignment of the picking machine **10** with respect to the hop row. The wheel assembly also includes rearward drive wheels **32** that are situated adjacent the rear of the frame **22**. The drive wheels **32** are driven through appropriate driving mechanisms to propel the vehicle along the hop vine row.

Transverse beams **34** (FIG. **2**) are provided on the overhead frame structure **24**. The beams **34** extend transverse to the longitudinal direction of the machine

10. Longitudinal beams 35 (FIG. 1) extend in the longitudinal direction. Together, the beams 35 and 34 form a rectangular support structure upon which various driving and control components are situated.

The side frame structures 25 and 27 extend downwardly from the overhead frame structure 24, each including front leg elements 36 and rear leg elements 38. The legs 36 and 38 extend downward from opposed ends of the overhead frame structure to the front steerable wheels 30 and the rear drive wheels 32 respectively. The side frames 25 and 27 include bottom side frame beams 42 (FIG. 1) that extend longitudinally to interconnect the front leg elements 36 and the rear leg elements 38.

The mobile frame 22 also includes a front deflector guide 44 for each side frame structure 25 and 27 (FIG. 2). The guides 44 extend from the front frame leg elements 36 in and rearwardly toward the center of the frame. The guides 44 serve to deflect any foliage from the front of the vehicle inwardly toward the center of the vehicle to pass through the longitudinal passageway 23.

The present machine 10 includes a steering mechanism 48 that is operatively connected to the front steerable wheels 30. The mechanism 48 enables selective turning of the wheels 30. Mechanism 48 is positioned on the overhead frame structure 24 and is interconnected between the front steerable wheels 30 so the wheels 30 may be turned in unison.

The present machine 10 also includes an operator station 50 (FIG. 3) that is located on the overhead frame structure 24. A steering control means 52 is located at the operator's station 50. The steering control means 52 is operatively connected to the steering mechanism 48 for turning wheels 30 in response to operation by the drive of the machine. The steering control means 52 includes a typical steering wheel that may be easily handled by the operator at an operator station 50. The station 50 is situated at the top of the machine to afford greatest visibility for the operator as he controls the machine to move along successive rows of the hop plants.

Adjacent the operator station is an engine 54 used for driving the machine along the ground surface. The engine 54 is operatively connected to the rear driving wheels by conventional drive mechanisms (not shown). The engine 10 may perform the additional function of driving a hydraulic pump 57 that can be used for operating other systems of the machine. The engine 54 may be mounted on the overhead frame structure 24 forward of the operating station 50 and overlying the trellis. Alternately, the engine can be situated along the outward side of either side frame structure 25 or 27.

The overhead frame structure 24 further includes a first pair of transverse carriage rails 60 and 61 that extend substantially perpendicular to the intended direction of travel of the machine adjacent the forward portion of the structure 24. A first pair of picking carriages 67 and 68 are movably mounted to the transverse carriage rail 60 and 61 respectively. The rails 60 and 61 enable picking carriages 67 and 68 to move transversely inward or outward with respect to each other to vary the gap or distance between them.

Each picking carriage 67 or 68 includes a carriage bed 70 that has rollers 71 mounted thereon for rolling on the carriage rail 60 and 61. Each of the carriage beds 70 is attached to a cylinder assembly 72 that functions as an adjustment means for enabling the carriages to be adjustably moved in a transverse direction along the carriage rails 60 and 61. The selected transverse distance between the picking carriages 67 and 68 is determined with respect to the fullness of the hop vine. The effective distance between the carriages 67 and 68 can be selectively changed by appropriate controls situated at the operator's station. Such controls will selectively vary the flow of hydraulic fluid to the cylinder assembly 72, affecting their extension or retraction and simultaneously adjusting the lateral distance between the carriages 67 and 68.

Each of the carriages 67 and 68 include side frames 76 (FIG. 2) that extend downward from the carriage bed 70. The side frames 76 each include conveyor brackets 78 (FIG. 1) that may extend inward from the side frames to support elongated vertical picking conveyors 80. Each of the picking conveyors 80 is vertically oriented to provide an inner picking flight 82. The bottom ends of the vertically oriented conveyors 80 is situated to be adjacent the bottom foliage of the hop plants. The top of the upright conveyors 80 is elevationally adjacent to the apparent top 20 of the vine when growing over the trellis 16.

Each of the picking conveyors 80 includes a drive shaft 85, having chain drive sprockets 87 mounted thereon. Lower ends of the picking conveyors include idle sprockets 89. Sprocket chains 91 are supported between the drive sprockets 87 and idle sprockets 89. The chains 91 support finger stripping assemblies 92 (FIGS. 1 and 3). The stripping assemblies 92 are positioned at desired intervals along lengths of the chains so they will move with the chains to engage the hop vine sides 18 and 19.

Each of the finger stripping assemblies 92 have spring loaded stripping fingers 94. The fingers are best illustrated in FIG. 3 which illustrates several of the fingers extending outward from a cross tube 96. The fingers 94 extend into the sides 18 and 19 of the hop row for engaging the foliage and stripping the hops from the vines. Hydraulic motors 86 are operatively connected to the drive shaft 85 to drive the inner picking flight 82 downwardly.

The present hop picking machine further includes a second pair of picking carriages 67*a* and 68*a* that are positioned behind the carriages 67 and 68 with respect to the forward direction of travel for the machine 10. The second carriages 67*a* and 68*a* are movably mounted to transverse carriage rails 60*a* and 61*a*. The rails 60*a* and 61*a* enable transverse movement of the carriages independently of the first carriages 67 and 68. The second carriages 67*a* and 68*a* are attached by cylinder assembly 72*a* across the framework. They can be operated to vary spacing between the second carriages without affecting spacing of the first carriages. Similar controls are provided for the operator adjacent his operating station to cause independent movement of the second pair of picking carriages 67*a* and 68*a* relative to similar movement of the first carriage pair. It may be preferable to locate the second pair of picking carriages 67*a* and 68*a* more closely together than are the first pair of carriages 67 and 68.

Both carriages 67*a* and 68*a* include side frames 76*a* that extend downwardly from roller supported carriage beds 70*a*. The frames 76*a* each include conveyor brackets that are not shown in the drawings but are substantially identical to the conveyor brackets shown in FIG. 1. A second pair of elongated picking conveyors 80*a* are supported on the conveyor brackets. The conveyors

80*a* are vertically oriented, like conveyors **80**, and provide inward picking flights **82**. The elevation of conveyors **80***a* is substantially above the first conveyors **80**.

Drive sprockets **87***a* and drive shafts **85***a* are elevated from the corresponding sprockets **87** and shafts **85** of the first conveyors. The elevational positions of the drive sprockets **87***a* correspond with or are slightly greater than the actual height of the vines when they are "strung out" vertically to their full length above the trellis. The lower ends defined by idler sprockets **89***a* might be at the same elevation as the corresponding sprockets **89** of the first conveyors or may be slightly elevated therefrom as shown in FIG. **1**.

The conveyor chains **91***a* on sprockets **87***a* and **89***a* support second sets of finger stripping assemblies **92***a*. The assemblies **92***a* are inverted in relation to the forward assemblies **92**. Motors **86***a* are operated to drive the conveyors **80***a* so that the inner picking flights **82** thereof will move upwardly, with associated fingers **94***a* stripping the hops upwardly. The vines engaged by the fingers **94***a* will be drawn upwardly and any part of the vine that overlaps the top of the trellis will be drawn on upwardly by the fingers **94***a* and stretched to their actual height.

Longitudinal, substantially horizontal receiving conveyors **100** are positioned below the picking conveyors **80** and **80***a* for receiving the stripped hops and for conveying the hops outwardly from beneath the vines. Each of the receiving conveyors has an upper horizontal flight **103** (FIG. **1**) for moving in a longitudinal direction and for conveying the stripped hops to a desired location for further processing.

A deflector pan or tray **105** extends inward and upward from each of the receiving conveyors **100**. The pans **105** receive falling hops and direct their downward movement onto the working upper flight **103** of the receiving conveyors **100**. The deflector pans **105** may overlap each other and are biased continuously inwardly. The pans **105** will deflect upon engaging a vine or trellis post while still providing means for preventing the hops from falling onto the ground as they are stripped off the vines. Deflector pans of metal or other rigid material are shown in the drawings. However, it is well understood that rubber or other flexible material can be used effectively for the same purpose in directing falling hops onto the longitudinal conveyors **100**.

The picking conveyors **80** and **80***a* as noted above are driven by hydraulic motors **86** and **86***a*. The motors **86** and **86***a* are operatively connected to the drive shafts **85** and **85***a* respectively. Motors **86** and **86***a* are connected to the hydraulic pump **57**. The horizontal conveyors are also driven by hydraulic motors (not shown) that are connected to the hydraulic pump **57**. During the harvesting operation, the picking conveyors **80** and **80***a* are continuously operated with the inner picking flights **82** and **82***a* moving vertically in opposite directions and continuous motion for stripping the hops from the vines as the machine is propelled along the hop vine row.

As the machine progresses forwardly, the first picking conveyors **80** come into engagement with hop vines. The downwardly moving picking fingers **94** engage the strip hops downwardly from the vines. The fingers **94** move downwardly against the vines through a vertical distance equal to the height of the vine on the trellis. The fingers **94**, because they are moving downwardly, do not become entangled with the vines nor uproot the vines.

Lateral spacing between the conveyors **80** can be adjusted from time to time to accommodate vines of different fullness or growth rate. Hops stripped from the outer surfaces on the sides of the vine rows will fall onto the deflector pans **105** and roll on downwardly onto the working flights of the receiving conveyors **100**.

The width of the first hop picking conveyors is greater than the corresponding width of the second conveyors **80***a* so the first conveyors will perform the bulk of the picking operation with no chance of the vines being "wound" around the conveyors and uprooted. The second narrower set of conveyors **80***a* are provided to complete the picking operation. Here, the fingers **94***a* are moving upwardly, lifting the leaves combed down by the fingers **94** and picking the hops not reached by the downwardly moving fingers **94**. The upwardly moving fingers **94***a* lift the hop vine upwardly, pulling any overlapping ends of the vines that have grown over the top of the trellis upwardly and "stringing" them out to their actual height above the ground surface. The under sides of the overgrown vine parts are therefore exposed to the upwardly moving fingers. The elevated conveyors **80***a* can therefore strip extra hops from the area and substantially strip the vine. This is done without uprooting the vines. The vine hops are not pulled over the top ends of the conveyors because the conveyors **80***a* extend above the vines. However, the continued upward pull on the vines could eventually work the roots loose. Therefore, the widths of picking conveyors **80***a* is substantially less than the width of conveyors **80**.

Lateral adjustment between the conveyors **80***a* can be accomplished independently of conveyors **80** by selective operation of the cylinders **72***a*. Typically, the rearward conveyors will be spaced closer together than the first, forward conveyors, since the forward conveyors will have substantially thinned the vines. The two cooperating pairs of conveyors substantially funnel the vines inwardly during the picking operation, "stringing" the vines upwardly to their full height and subsequently allowing them to fall back down over the trellis intact, without significant damage being done to the vine structure.

It should be noted that throughout the above operation, the vines are not completely removed from the trellis nor are the vines cut before the hops are removed. Instead, the vines are simply combed free of hops, first downwardly, then upwardly into a straightened condition so they stand upright irrespective of the support ordinarily provided by the trellis.

The present machine has proved to be very effective in harvesting hops in an efficient manner, requiring considerably fewer manhours and personnel than was established with prior machines. With such a machine the cost of hop harvesting has been substantially reduced.

The above described embodiment is simply illustrative of the principals of this invention. It is understood that numerous other embodiments can be readily devised without deviating from the intended scope of the invention. Therefore, the following claims are presented to more precisely define the scope of the invention.

What is claimed is:

1. A hop picking machine for harvesting hops from a row of hop vines entrained over a low profile trellis wherein the trellis height may be less than the full straightened length of the vines, said machine comprising:

an inverted "U" shaped mobile frame having a longitudinal passageway therethrough to enable the mobile frame to straddle the trellis and move longitudinally along the row;

said frame having an overhead frame structure spaced above the ground surface a distance greater than the full straightened length of a hop vine, to extend transversely over the trellis with spaced leg frame structures that extend downward from the overhead frame structure to ground engaging wheel assemblies;

a first pair of hop picking conveyors spaced apart transversely on the frame, each having an inner vertically oriented picking flight continuously movable in a downward direction from a top elevation substantially equal to the height of the trellis on opposite sides of the row of hop vines;

a first combing finger assembly mounted on each of the first hop picking conveyors for engaging the hop vines and stripping hops downwardly from the vines as the finger assemblies move downwardly along their inner picking flights;

a second pair of hop picking conveyors spaced apart transversely on the frame and longitudinally spaced from the first pair of hop picking conveyors, each having a second inner vertically oriented picking flight continuously movable in an upward direction from a top elevation substantially equal in height to the full, straightened length of a hop vine above the top elevation of the first conveyors on opposite sides of the row of hop vines;

a second combing finger assembly mounted on each of the second hop picking conveyors for engaging the hop vines and stripping hops upwardly from the vines as the second finger assemblies move upwardly along their inner picking flights, and for lifting and straightening the hop vines upwardly to their full length over the trellis;

transversely spaced longitudinal receiving conveyors on the frame below the first and second pairs of hop picking conveyors for receiving the hops stripped from the vines; and

drive means operatively connected to the first and second hop picking conveyors, the receiving conveyors, and the wheel assemblies for (a) moving the mobile frame along a row; (b) moving the first and second combing finger assemblies with their respective picking flights to move in opposite directions and strip hops from the vines; and (c) operating the receiving conveyors to remove the stripped hops from below the picking conveyors.

2. The hop picking machine as defined in claim **1** wherein the overhead frame structure includes:

spaced overhead carriage rails that extend transverse to the longitudinal direction of travel;

opposing first and second picking carriages mounted on the overhead carriage rails and extending downward from the overhead carriage rails along opposite sides of the trellis;

wherein the first picking conveyors are mounted on first picking carriages with their inner vertically oriented picking flights facing each other and wherein the second picking conveyors are mounted to the second picking carriages with their picking flights facing each other.

3. The hop picking machine as defined in claim **2** wherein each picking carriage is adjustably movable on the overhead carriage rail with adjustment means for enabling the transverse distance between the inner flights of the picking conveyors to be adjusted.

4. The hop picking machine as defined in claim **1** wherein the first pair of hop picking conveyors extend longitudinally along the mobile frame a first distance and the second pair of hop picking conveyors extend longitudinally along the mobile frame a second distance less than the first distance.

5. The hop picking machine as defined in claim **4** wherein the overhead frame structure includes:

spaced overhead carriage rails that extend transverse to the longitudinal direction of travel;

opposing first and second picking carriages mounted on the overhead carriage rails and extending downward from the overhead carriage rails along opposite sides of the trellis;

wherein the first picking conveyors are mounted on first picking carriages with their inner vertically oriented picking flights facing each other and wherein the second picking conveyors are mounted to the second picking carriages with their picking flights facing each other.

6. The top picking machine as defined in claim **5** wherein each picking carriage is adjustably movable on the overhead carriage rail with adjustment means for enabling the transverse distance between the inner flights of the picking conveyors to be adjusted.

7. The hop picking machine as defined by claim **6** wherein the adjustment means is comprised of a cylinder for each pair of picking carriages, oriented transversely and interconnecting an associated picking carriage with the mobile frame so selective extension and retraction of the cylinders will cause corresponding transverse movement of the picking conveyors.

* * * * *

United States Patent [19]

Desmarais

[11] **Patent Number: 4,913,680**

[45] **Date of Patent: Apr. 3, 1990**

[54] **LOW-TRELLIS MOBILE HOP PICKER**

[76] Inventor: **Donald A. Desmarais,** P.O. Box 125, Mabton, Wash. 98935

[21] Appl. No.: **79,588**

[22] Filed: **Jul. 30, 1987**

[51] **Int. Cl.**[4] **A01D 46/02**

[52] **U.S. Cl.** **460/129;** 56/130; 56/330; 56/14.7; 180/140

[58] **Field of Search** .... 56/10.9, 11.9, 14.7, 56/16.5, 330, 328.1, 329, 130, 35, 16.6, 214; 130/30 P; 280/6 H, 263; 180/140, 24, 23, 41

[56] **References Cited**

U.S. PATENT DOCUMENTS

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3,594,995	7/1971	Soules	56/130
3,983,950	10/1976	Fabian	180/41
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Attorney, Agent, or Firm—Seed and Berry

[57] **ABSTRACT**

A mobile hop picking machine is provided with independently elevatable wheels. The picker straddles a trellis to position opposing picking cats on either side of the vines. Front and rear banks of picking hooks move upwardly to pick the hops. A bank of resilient raking tines comb the vines upwardly between the picking banks. The picking cats are pivoted about their front edges and are supported for transverse movement on their rear edges. Cylinders urge the rear of the cats toward the vines. A contact member connected to the cat moves the cat transversely, to avoid cat contact with poles, against a biased mounting provided for the hydraulic cylinder. Longitudinal conveyors transport the hops rearwardly and upwardly. A squeeze conveyor floats on a top support over the elevating end of the longitudinal conveyors. An alternate arrangement intersperses the raking tines and picking hooks.

16 Claims, 5 Drawing Sheets

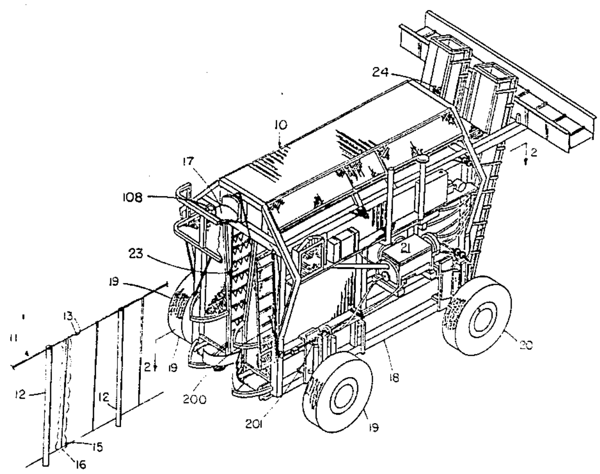


FIG. 1

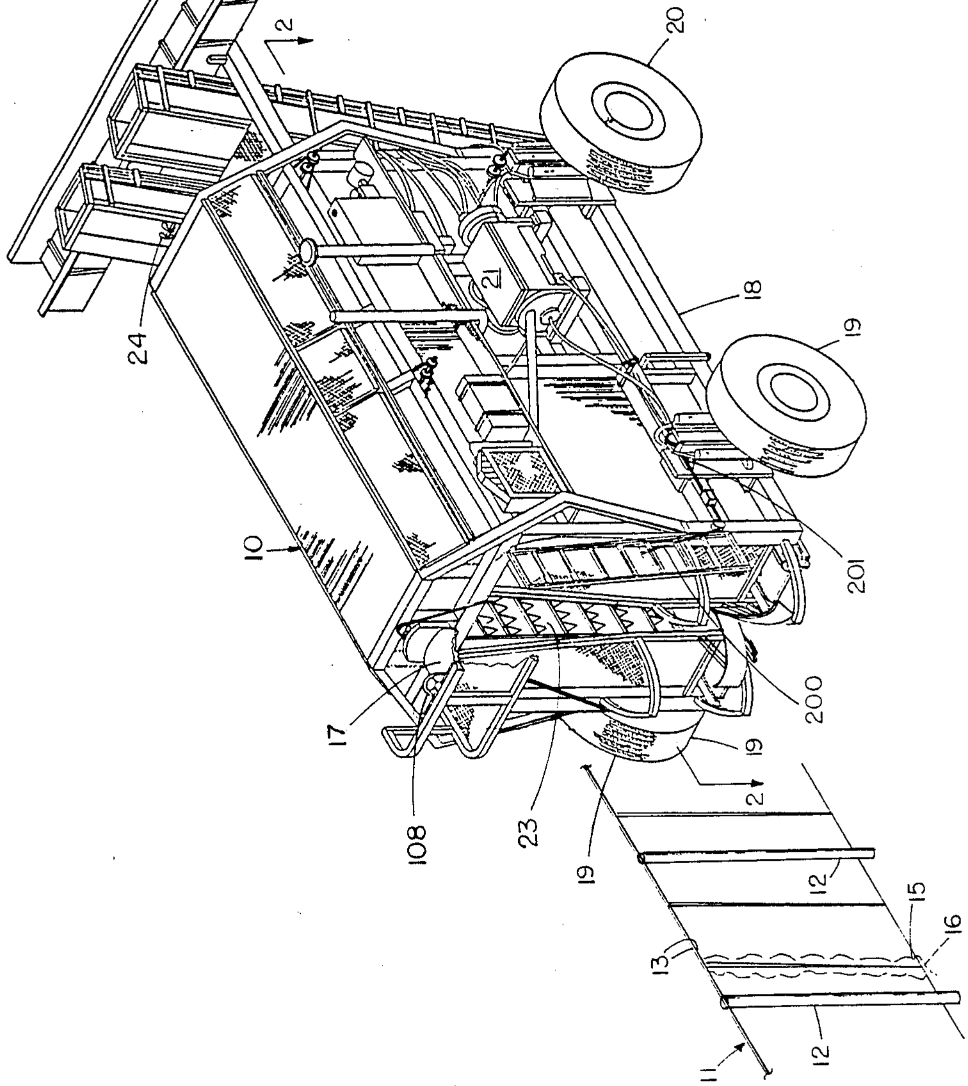


FIG.2

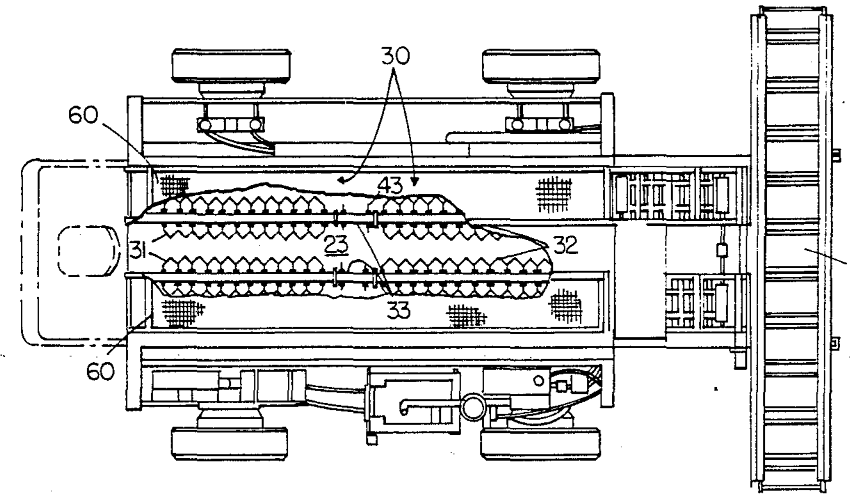


FIG.3

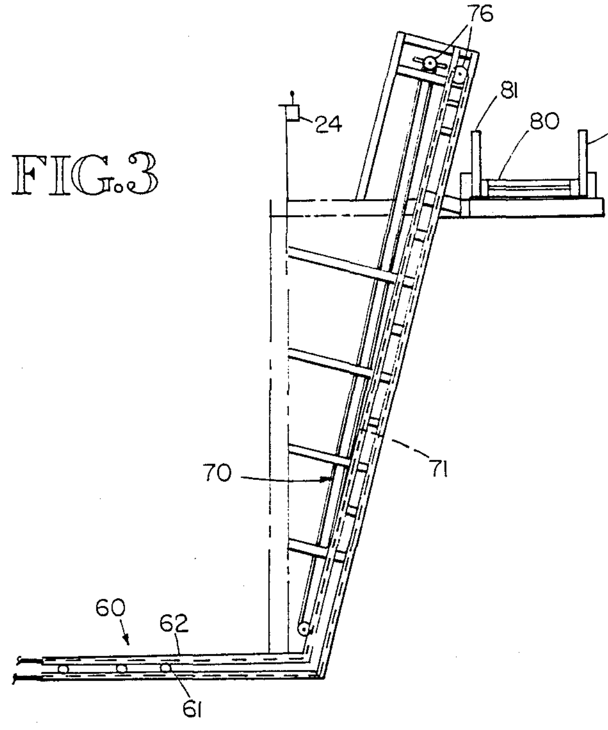


FIG. 4

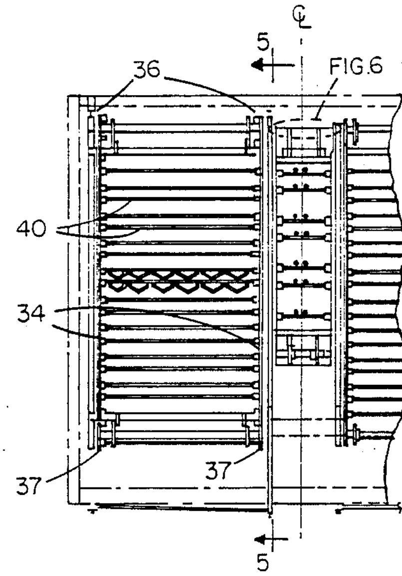


FIG. 5

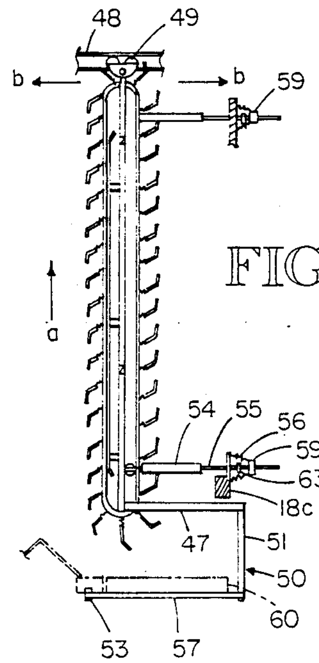


FIG. 6

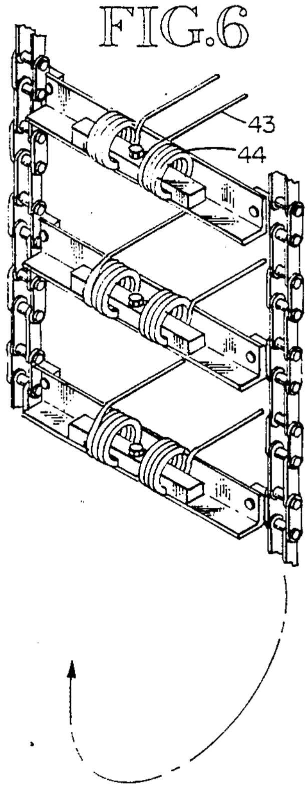
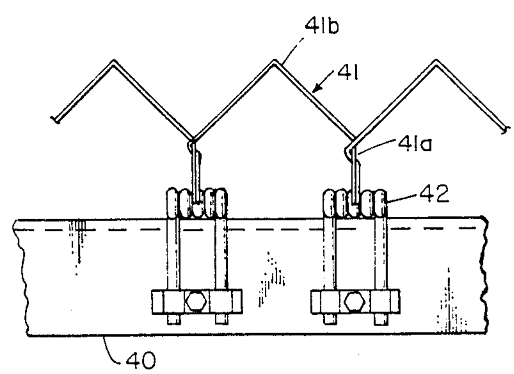


FIG. 7



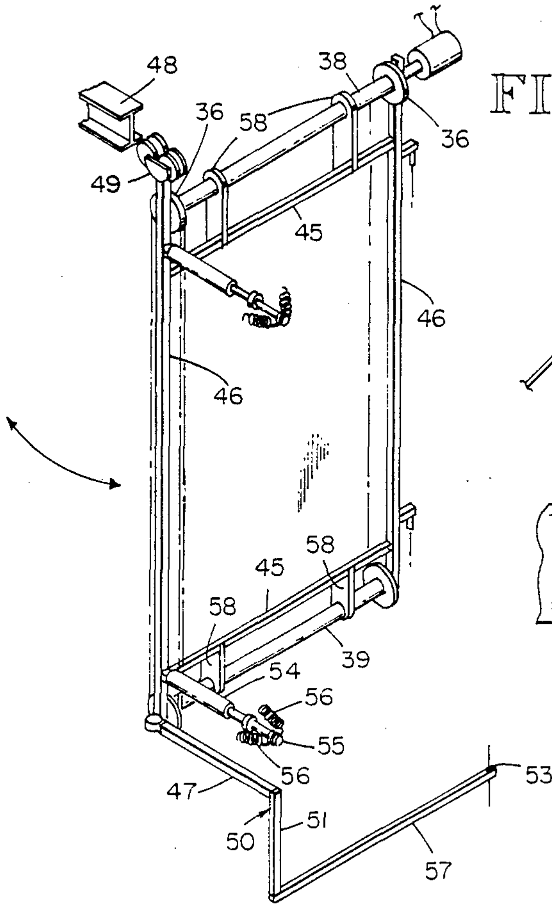


FIG. 8

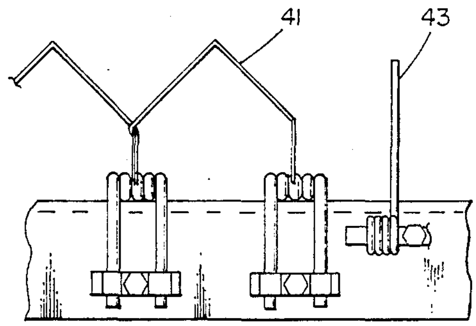


FIG. 9

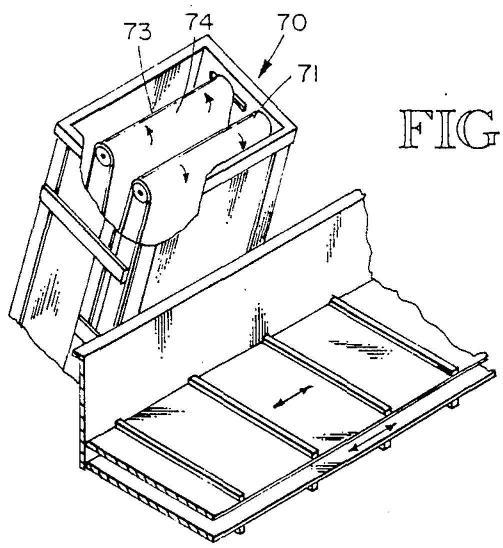


FIG. 10

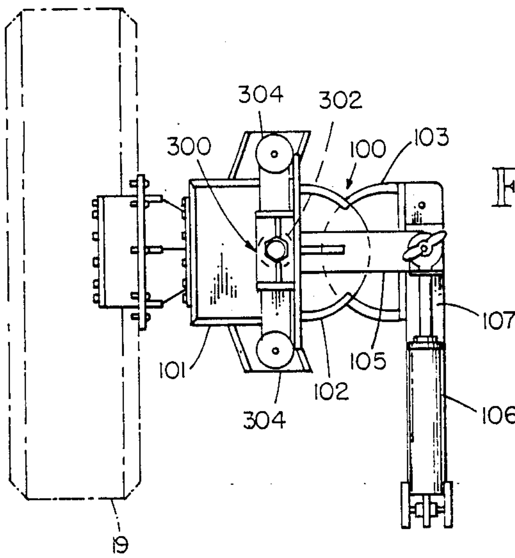


FIG. 11

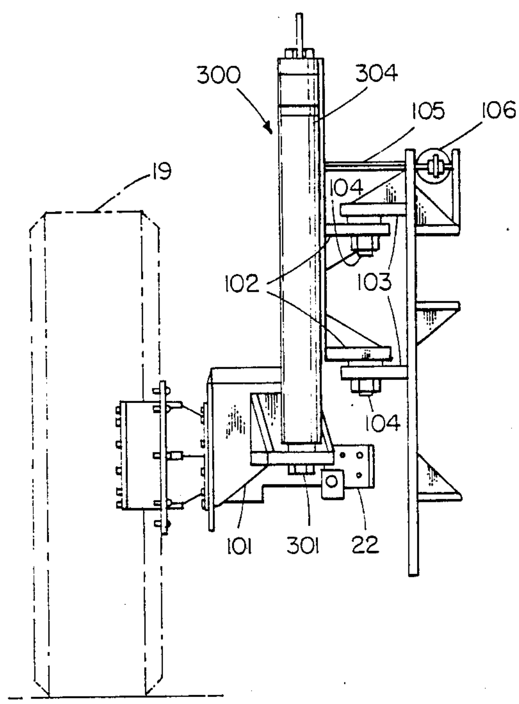
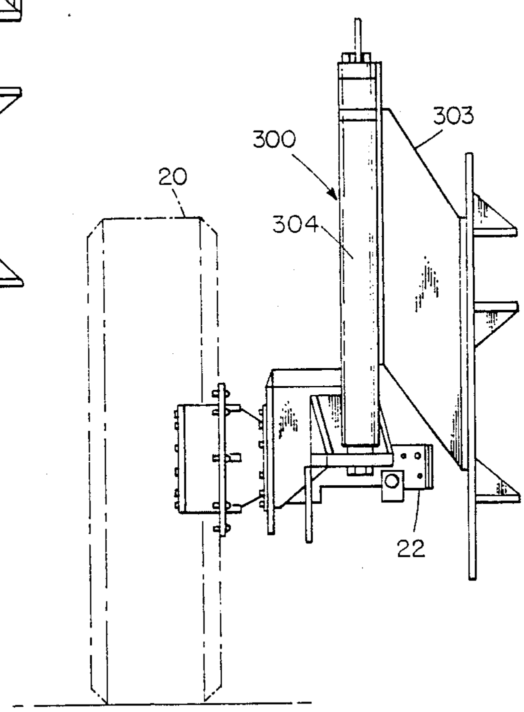


FIG. 12

FIG. 13



LOW-TRELLIS MOBILE HOP PICKER

DESCRIPTION

1. Technical Field

The present invention relates to machines for picking hops from trellised vines which remain attached to the hop crown and trellis. More particularly, the hop picker of the invention relates to a mobile hop picker that is capable of picking hops from rows of low-trellis hop plantings leaving the plant intact and leaving the trellis intact.

2. Background of the Invention

Conventionally, hop vines have been grown on tall trellis arrangements consisting of spaced vertical poles which support spaced horizontal tie wires. The wires are positioned on the order of 15–18 feet above the ground. The hop vines are supported on strings extending from the hop crown at ground level to the top wires.

Hops grown on such trellis arrangements were, in the past, picked by hand or by means of a stationary hop picking machine through which the vines, cut at the base from the hop crown, were fed after being transported to the machine. Later hop picking machines were developed which could be towed along the rows of hops, engaging the vines and pulling them from their supporting overhead wires. Such towed hop pickers are described by Horst in U.S. Pat. No. 2,447,122 and Siebol in U.S Pat. No. 3,527,036.

Hops are picked from the vines in many machines, including Horst and Siebol, by placing the vines into contact with at least one picking bank. A picking bank typically includes a pair of opposed, rotating conveyors each having surfaces that support a plurality of parallel bars upon which hop picking hooks are mounted. The hooks comb the hops from the vines.

Self-propelled pickers have been developed, an example of which is described by Soules in U.S. Pat. No. 3,594,995. The Soules picker includes two sets of hop picking banks similar to those described above. Soules also includes a mechanism for cutting and grasping the basal portion of the vine and a mechanism for cutting the vines free at the top supporting wire of the trellis. The picked hops are collected by horizontal conveyors that discharge into a conveyor section that pivots vertically for elevating and dumping the picked hops into transporting vehicles. A mechanism for coordinating the height of the picking hooks with the height of the vines is also provided.

More recently, hop pickers have been designed to pick hops from a low profile hop trellis, limited to a 2 meter height. The picking machine straddles and picks without cutting the vines at the base or cutting the vines from the supporting trellis. Such a machine is shown by Ferraro in U.S. Pat. No. 4,276,738. The Ferraro picker includes two sets of conventional picking banks. This machine is a modified grape harvestor. The grape vine shaker rods were replaced with picking banks. The picking banks may be moved transversely with respect to the machine and into contact with the vines growing on both sides of the trellis. A key feature of the Ferraro picker is that the picking hooks of the first set of picking banks move downwardly, while the picking hooks of the second set move upwardly. The picked hops fall downwardly onto two horizontal transport conveyers positioned below the picking carriages.

The prior art devices have left some problems unsolved. There is always variability in terrain or vertical misalignment of the trellis system. The prior art machines cannot be leveled to compensate for sloping terrain, for example. Since trellis posts are conventionally set in vertically, the picking banks of previous machines may strike the posts on sloped or uneven ground damaging the picking banks and/or trellis. If the posts are not vertical on level ground, or normal to a sloped surface, the picking banks may likewise strike the posts and be damaged or damage the trellis.

The dimensions of the hop plants vary in an irregular manner along the trellis as well as at different heights above the hop crown. Prior hop picking machines provided limited adaptability to the variations in thickness of the plants along the trellis.

Each hop cone includes some 15,000 lupulin glands containing the liquid resins and oils that are the essential contents of hops. Harvesting and handling which ruptures the lupulin gland membranes, exposes their essential contents to oxidation, resulting in an unacceptable product. A picking system that employs a downwardly directed picking action imparts velocity to the picked hop cones that causes significant damage to the picked product.

For optimum picking, the picking force is exerted to move the hop cone upward when the hop vine is in its natural position on a growing vine.

Prior hop picking machines have relatively poor picking effectiveness because many of the hop cones are covered by foliage during the picking process. The covering foliage prevents the cones from being picked.

Additionally, prior hop picking machines generally provide transport conveyors which elevate the picked cones to facilitate their discharge into a collecting receptacle. The elevating conveyors often permit the cones to tumble, which causes damage to the glands.

Conveyors on prior hop picking machines often included transport conveyors that attempted to transfer hops from a first conveyor to a second conveyor at right angles to the first. The light hop cones often piled up at the intersection of the two conveyors blocking the conveyors and spilling the hops.

DISCLOSURE OF THE INVENTION

It is an object of the invention to provide a mobile hop picking machine that is particularly suitable for picking hops from low vertical height trellis arrangements up to 3 meters or 10 feet for maximum yield. The hop picker of the invention is characterized by greater flexibility in the field than prior machines with respect to its ability to align its picking banks with the trellis supported hops and avoiding damage to the trellises, vines and hop picker.

It is a further object of the invention to provide a hop picking machine which avoids imparting velocity to the hop cones to avoid damage to the lupulin glands and that is characterized by providing an improved yield of hops from the vines by providing a number of raking tines in addition to hop picking fingers. The raking tines overcome the tendency of the vines to mat together, in response to initial contact with the picking fingers, and to limit hop recovery.

It is a further object of the invention to provide conveyor handling of the picked hops that avoids significant damage to the hops in collecting and elevating them for discharge from the machine. The hop cone, picked and delivered from the field by the hop picker of the invention is less likely to be crushed or otherwise damaged.

The hop picker machine of the invention includes a wheel-mounted frame that is designed and sized to straddle the trellis. An engine is mounted upon the frame and drives a hydraulic system that provides power to hydraulic drive motors on each wheel for propelling the picker along the trellis row. The hydraulic system also powers other parts of the hop picker. The hop picker includes two hop picking banks mounted upon the frame one behind the other. Each bank includes a pair of vertical picking cats, one positionable on each side of the straddled trellis. The picking cats are adjustably spaced from one another to accommodate the trellis and contact the straddled hop vines. Each picking cat includes upward-moving, centrally facing surfaces upon which are mounted a plurality of hop picking fingers that pull the hops from the vines. Also preferably included are a plurality of tines projecting from the surfaces of the cats or mounted on an intermediately positioned raking cat structure to rake and separate the vines during picking. The tines act to prevent matting of the vines in response to the action of the picking fingers, and improve overall recovery of the hops.

A pair of hop collecting conveyors are mounted upon the frame, each below and in alignment with the picking cat on the same side of the row. The collecting conveyors collect the hops as they fall downwardly after being picked and transport the collected hops rearwardly with respect to picker. A pair of elevating conveyors receive the hops from the collecting conveyors and elevate them substantially vertically for transfer from the hop picker via a horizontal conveyor, typically into a dumpster located in the adjacent row. Each elevating conveyor comprises a pair of closely spaced conveyors having flexible surface conveyor belts such that the hops are elevated while squeezed between the two conveyor belts in a manner that prevents tumbling and loss of lupulin gland content.

The hop picker of the invention includes two hydraulic systems designed to accommodate variations of the hop growing terrain that allow proper alignment of the picking banks into good picking contact with the hop vines.

First of all, the hop picker frame is adjustable vertically at each wheel by means of separately controllable hydraulic cylinders. Each wheel includes a wheel support upon which the wheel is rotationally mounted. A hydraulic cylinder interconnects the wheel support to the hop picker frame. In combination, the separately adjustable hydraulic wheel cylinders allow substantial vertical adjustment of the hop picking frame, and, thus, the picking banks, to permit adjustment for terrain or trellis orientation variations preferably of up to 3 meters.

The second system allowing adjustment of the hop picking banks with respect to the hop vines and trellis includes pivotably mounting the forward portion of each picking cat to the hop picker frame and connecting the rearward portion of said cats to the frame by means of hydraulic cylinders that provide transverse adjustment of picking surfaces into contact with the trellis supported hop vines. Preferably, the upper rearward portion of each picking cat is supported by a trolley fitted into a track supported on the frame for transverse adjustment.

The upper and lower rearward portions of each picking cat are adjustably connected to the hop picker frame by means of hydraulic cylinders attached to the picking cat and having a piston rod extending adjacent a hop picker frame member. The piston rod is attached to the frame member by springs. Actuation of the hydraulic cylinder causes the piston rod to adjust the picking cat transversely into contact with the hop vines. The springs hold the piston rod fixed with respect to the frame member except where the picking cat strikes a solid object, such as a trellis post, with sufficient force to overcome the resistance of springs interconnecting the piston rod and hop picker frame.

The hop picker of the invention is provided with hydraulic steering. Each front wheel includes a wheel support member upon which the wheel is mounted for rotation. Each support member includes pivot supports for rotating the wheels about a vertical axis. Complementary pivot supports are fixed to the picker frame and the wheel support member pivots are pinned thereto for rotation about the vertical axis. The forward wheel pair, pivoting in parallel alignment, provides steering for the hop picker. A hydraulic steering cylinder is fixed to the picker frame. The cylinder connects to a lever arm which extends from the wheel support member. Actuating the steering cylinder causes pivoting of the wheel about the vertical pivot within limits suitable for steering the picker. A steering wheel control assembly includes a manually operated steering wheel. The control hydraulically interconnects the pair of hydraulic steering arm cylinders and provides synchronized operation of the cylinders in response to steering wheel rotation. The machine further includes a cable of fixed length that interconnects the outer portion of the wheel support members. The cable passes through frame-mounted pulleys and insures that the wheels always remain in parallel alignment in response to steering control. A hydrostatic drive is provided which gives adjustable speed control preferably between 0 and 5 m.p.h.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an isometric view of the hop picker of the invention showing the forward operator station and a portion of a typical low-profile trellis and hop vine.

FIG. **2** is a section view, taken on line **2–2'** from FIG. **1**, with portions broken away showing the lower section of the machine to illustrate collecting conveyors and a preferred hop picking bank arrangement.

FIG. **3** is a schematic side elevation view showing the arrangement of the hop collecting and elevating conveyors.

FIG. **4** is a partial sectional view taken along the center line of the hop picker machine showing a preferred hop picking cat and raking cat arrangement.

FIG. **5** is a partial front elevational view showing a preferred arrangement for adjusting the picking banks into picking contact with the hop vines.

FIG. **6** shows a partial, elevation view of a preferred central bank, shown in FIG. **4**, that includes raking tines for dematting the hop vines during picking.

FIG. **7** is a schematic view of a conventional hop picking hook as utilized in the invention.

FIG. **8** is a schematic diagram of the picking cats and raking cats further illustrating the preferred arrangement for adjusting the picking banks into picking contact with the hop vines and avoiding damage resulting from the striking of a trellis support post.

FIG. 9 is an alternative embodiment of the picking cats which includes interspersed raking tines.

FIG. 10 is a partial view of the top of the elevating conveyors.

FIG. 11 is a partial, top plan view showing the front wheels of the hop picker including a portion of the hydraulic steering system.

FIG. 12 is a partial, front elevation view showing the hydraulic steering system of the invention.

FIG. 13 is a partial, front elevation view showing a rear wheel assembly including the hydraulic cylinders interconnecting the wheel support members and hop picker frame.

BEST MODE FOR CARRYING OUT THE INVENTION

Referring to FIG. **1**, the hop picking machine **10** of the invention is shown adjacent a low-profile hop trellis **11**. The trellis **11** consists of a row of vertically aligned poles **12** which support a pair of top horizontal wires **13** positioned about ten feet above the ground. A lower wire **14** extends between supports about nine inches above the ground. A number of intermediate tie strings (not shown) are attached between the lower wire and the top wires at spaced intervals, corresponding to hop plant spacing, for supporting the vines during their early stages of growth. The hop vines **15** are planted below the trellis and grow upwards on the trellis, forming a thick, bushy growth including, at maturity, hops on both sides of the trellis. Since the hop plant is a perennial, care must be taken to avoid damaging the plant crown during picking. The hop picker **10** requires no cutting of the vines and, after picking, the vines remain supported on the trellis.

The hop picker **10** includes a structural frame **18** upon which front wheels **19** and rear wheels **20** are mounted. A power system such as an internal combustion on engine-hydrostatic drive pump system **21** delivers hydraulic fluid under pressure to a hydraulic motor **22** (shown in

FIGS. **11–13**) mounted at and driving each wheel **19**, **20**. The hydraulic system **21** also powers all of the picking system components and certain other components of the machine **10** described below.

The hop picker frame **18** is provided with a longitudinal central opening **23** of such height and width that the machine **10** may be driven along the hop trellis **11** straddling the trellis and hop vines **15** without disturbing the crowns **16** of the vines on either side of the trellis or contacting the trellis or posts **12**. The hop picking machine **10** includes an elevated, forward operating station **17** from which a machine operator steers the machine **10** along the hop rows **11**.

As shown in FIGS. **2** and **4**, the hop picker includes banks **30** of hop picking and vine raking cats. Each bank is comprised of pairs of vertically aligned picking cats spaced apart to accommodate the hop vine and trellis with each cat urged into contact with the hop vines **15** during picking operations. The cats are substantially self-adjusting with respect to the vines, as described below, and are designed to accommodate inadvertent contact with poles and other immovable objects. The picked hops travel over the top of the cats and drop downwardly onto collecting conveyors **60** and are transported to the rear of the machine where a pair of elevating conveyors **70** elevate and dump the hops onto a horizontal conveyor **80** for discharge into a dumpster for transporting the hops from the field.

Referring to FIGS. **2**, **4** and **5**, a preferred arrangement of hop picking and raking banks **30** is shown. The preferred arrangement includes two picking banks **31**, **32**. Each bank **31**, **32** includes a pair of substantially vertical hop picking cats, spaced from one another transversely with respect to the machine to accommodate the hop vines and trellis between them. Each conveyor of the picking banks **31**, **32** is transversely adjustable so that the bank may be placed into picking engagement with the hop vines **15**. Each picking cat is supported on a horizontal frame member **18***a* and a vertical frame member **18***b* on each side of the hop row **11**.

The picking banks **31** and **32** are formed of two pairs of juxtaposed picking cats. Each cat is formed by a pair of endless chains **34** which are mounted upon an upper sprocket pair **36** and a lower sprocket pair **37**. The sprockets are fixed to a rotating drive shaft **38** and a rotatable idler shaft **39**. Each pair of chains **34** is joined together by a plurality of aligned, transverse support bars **40**. The bars are spaced approximately ten inches apart. Each bar **40** is fitted with a number of conventional hop picking fingers **41**, as shown in FIG. 7, mounted upon springs **42**. The picking fingers preferably are made of spring steel wire and include straight sections **41***a* about one inch in length spaced about three inches apart. The ends of the straight sections are joined by two converging straight sections **41***b* forming an apex about two inches from the outer end of the straight sections **41***a*. Preferably the straight sections of the hooks trail the base of the hooks with reference to the direction of travel of the hooks at an angle of approximately 30° from the normal to the surface of the cat. The tips of the hooks trail at an angle of about 80° from the normal to the surface of the cat. The picking fingers are intertwined with adjacent picking fingers. The vertical array of picking hooks **41** engage substantially the entire productive vertical height of the hop vine growing on the trellis.

The preferred bank arrangement also includes a raking bank **33**, located between the two picking banks **31**, **32**. The raking bank is similar in general structure to the picking banks but is designed to aid and enhance the picking bank operation, as discussed below.

The center raking bank **33** includes a pair of raking cats that are similar in general structure to the picking cats. However, in place of picking fingers, a plurality of raking tines **43**, as shown in FIG. **6**, are arranged and spaced in longitudinal alignment along the conveyor cross bars **40**. Preferably, there are two tines on each cross bar spaced about five inches apart. The raking tines **43** are preferably straight wires of spring steel that are mounted upon spring elements **44**. The tines are preferably hay turning tines. The cross bars supporting the tines are preferably spaced 10 inches apart along the supporting chain. The tines extend sufficiently to engage and penetrate the hop vines. The tines are typically on the order of five inches in length. The tines function is to rake the vines to separate them and expose hops for picking that otherwise would not be accessible to the second bank of picking hooks.

In operation, all of the picking cats and the raking cats rotate with the surfaces adjacent the vines moving upwardly, as shown by arrows in FIG. **5**, such that picking fingers engage the hops and separate them from the vines. The picking action of the conventional picking finger tends to cause the vines to mat together, reducing recovery of those hops that get covered by vine foliage and missed by the first picking bank. Thus, the central raking bank rakes the vines to separate the foliage and expose the hops remaining after the first bank has passed. The second bank of upwardly moving picking fingers then contacts the vines and removes the remaining hops. The combination of the picking fingers with the raking tines improves overall recovery with minimal damage of hops. The upward picking motion also tends to lessen damage to the picked hops since they fall onto the collecting conveyors only under the influence of gravity.

Each picking and raking cat is independently driven and provided with a substantially rectangular support frame, such as that shown in FIG. 4, which includes horizontal frame members **45** and vertical frame members **46**. The horizontal frame members **45** support the idler shaft **39** and drive shafts **38** that carry the picking cat structure by means of bearings and bearing brackets **53**. The raking cats are each preferably rigidly fixed to the associated rearward vertical frame member **46** in planar alignment with the associated picking cat of picking bank **31**. The arrangement is such that the raking cats move transversely in concert with the picking cats of picking bank **31**.

The picking cats of banks **31** and **33** are all suspended from the hop picker framework **18***a* by means of the rearward vertical members **46**. As shown in FIG. 5, the upper, rear portion of the vertical frame **46** of each bank is suspended from a track member **48**, mounted transversely with respect to the machine **10**. A wheeled trolley **49**, connected to the rearward frame member **46**, rolls in the track member **48**. Thus, the top rear of the picking cats are transversely adjustable to permit movement of the cats into contact with the hop vines.

The top front or lead portion of each picking cat is pivotally connected to the hop picker framework for movement about a vertical axis at the front of each picking cat.

A control arm **50** is provided for each cat in the picking banks **31** and **32**, as shown in FIGS. 4 and 5, to control the engagement of each picking cat by allowing the rearward portion to adjust transversely into close contact with the hop vines to be picked under the influence of the hydraulic load cylinders, such as hydraulic cylinder **54**. The arm extends around the horizontal hop conveyors, described below, which are positioned under the cats. The arm **50** includes a top horizontal arm **47** pivotally connected for rotation about a vertical axis to frame member **46**. Arm **47** is rigidly connected to offset vertical member **51** extending downward. The lower end of arm **47** is pivotally connected, with a vertical axis of rotation, to a horizontal member **52**. Horizontal member **52** is pivotally connected, with a vertical axis of rotation, to contact member **57**. Contact member **57** extends forward to a point below and inboard of the front corner of the picking cat where it is pivotally connected with a vertical axis of rotation to the frame **18***a* by means of pin **53**.

The upper and lower rearward corners of the picking cats are transversely adjustable by means of hydraulic cylinder systems interposed between the picking bank frames and the hop picking machine frame. A preferred adjusting system, shown in FIG. 5, includes pivotably connecting a hydraulic cylinder **54** between the picking cat frame **46** and the hop picker main frame member **18***c*. A biasing mechanism, such as a pair of springs **56** are connected between a collar **59** that is fixed to the piston rod element **55** and the main frame member **18***c*. A second collar mounted on the piston rod limits the extent to which the springs may be compressed. Preferably, there is an upper and lower cylinder/spring assembly connected to the rear edge of each picking cat. Activating the hydraulic cylinder extends the piston, swings the rear of the cat inward toward the hops, and urges the picking cat into contact with the hop vines on the trellis. Thus, in operation the rear portions of the picking cats in each picking bank are swung inward toward the opposite picking bank by operation of the hydraulic cylinder. This movement of the picking cats inward under the influence of the hydraulic cylinders causes the arms **47** and **51** to move transversely. In turn, this causes the rear end of contact member **57** to extend inwardly. If the contact member engages a post, the control arm **50** causes the rear of the associated picking cat to swing away from the post to avoid damage to the structure.

Referring to FIG. 2, collecting conveyors **60**, substantially horizontally oriented, are provided on each side of the straddled hop trellis for collecting the hops as they fall downwardly from the picking banks **31**, **32**. Preferably, a pair of conventional, inwardly biased, flexible, closing flaps extend across the lower central opening to divert hop cones that fall downward onto the collecting conveyors. The flaps are of the type disclosed in U.S. Pat. No. 4,276,736, incorporated herein by reference. The conveyors are provided with a plurality of supporting rollers **61**. In addition, each conveyor is provided with an endless flexible conveyor belt **62** turning about end rollers. The belt is driven such that the top surface of the belt moves rearwardly. The hops are caught on the upper surface of the belt **62** which transports them to the rear of the machine.

An elevating squeeze conveyor pair **70** receives hops collected from each of the two horizontal collecting conveyors **60** and elevates them for discharge from the hop picker. Each elevating conveyor includes a lower conveyor portion **71** (which is a continuation of the horizontal collecting conveyor) fitted with a smooth, flexible conveyor belting **72**. The under surface of the top run of the conveyor belting is supported by a structure which limits deflection of the belting. The elevating conveyor **70** also includes a top squeeze conveyor **73** that includes a conveying surface **74** of smooth, flexible belting that is arranged sufficiently close to the conveyor belt **72** such that the collected hops are gently squeezed between the juxtaposed conveyor belts. The top squeeze belt runs on a head pulley and tail pulley and is unsupported between the pulleys so that the belting can flex. The spacing of the conveyors is preferably adjustable at the top and the bottom is allowed to float. The juxtaposed surfaces of the elevating conveyors are in contact at the lower end and adjustable from 2 to 5 inches at the upper end. The hops are squeezed between belts, but are not damaged in the elevating process, in contrast to the prior art. The conveyors are interconnected by means of a drive chain that is contacted with driving sprockets **76** whereby the juxtaposed surfaces of the conveyors rotate in the same direction at the same synchronized speed. This elevating conveyor **70**, including the squeeze belt arrangement avoids tumbling of the hops, as occurs in a conventional bucket-type elevator or projecting flight conveyor arrangement and which results in damage to the hop lupulin gland. Damage may result in exposure of the essential contents of the gland to degradation by oxidation. The elevating conveyor **70** dumps the picked hops onto a transverse transfer conveyor **80** for transfer to a dumpster or transporting vehicle for removal from the field. The transfer conveyor includes side boards **81** providing a convenient holding capacity, permitting intermittent discharge, if desired.

Referring to FIGS. **1**, **11** and **12**, the hydraulic steering capability of the hop picking machine of the invention is depicted. The hydraulic steering system allows the operator to maneuver the hop picker along the straddled hop trellis. Each of the front wheels **19** of the picker are provided with a hydraulic steering control system. Each wheel includes a wheel support member **101** upon which a wheel **19** is rotatably mounted and a pair of supporting pivots **102** is fixed. A longitudinal frame member **18***e* adjacent to the front wheel is provided with a pair of pivoting supports **103** that are complimentary to the wheel support pivots **102**. The two pivot supports **102** and **103** are provided with a pin fastener **104** such that the wheel support member **101** and the wheel **19** pivot about a vertical axis centered on pins **104**. The wheel support member **101** includes a lever arm **105** that is fixed thereto and projects therefrom substantially perpendicularly, and adjacent to the longitudinal hop picker frame member **18***e* when the wheels are aligned with the frame member. A hydraulic cylinder **106** is connected to the frame member and includes a piston rod **107** element that is pivotably connected to the wheel support lever arm **105**. Actuation of the hydraulic cylinder **106** in positioning the piston rod **107** results in positioning the wheel **19**. The hydraulic cylinders **106** on each wheel are interconnected through a manual steering wheel **108** and hydraulic controls to cooperate to provide a steering response to the wheels in response to an operator turning the manual steering wheel **108**. To insure that the wheels always act in synchronization and remain parallel to one another during steering, a fixed length cable **200**, shown in FIG. **1**, is connected at each end to an outer surface **201** of each wheel support member. The mechanical tie prevents the steering wheels from loosing their alignment.

Referring to FIGS. **10** and **11**, each wheel **19**, **20** is provided with a hydraulic cylinder **300** that permits vertical adjustment of the frame **18** with respect to the ground whereby the operator may orient the machine and the hop picking banks to accommodate the alignment of the trellis or the vines with respect to the ground. As noted above, each wheel includes a wheel support member **101** upon which it is mounted and fixed to the machine frame **18**. Hydraulic cylinder **300** includes a piston element **301** connected to the support member **101**. The cylinder housing portion **302** of the hydraulic cylinder **300** is fixed by means of the pivots **102**, **103** and pins **104** on the front wheel or a pair of fixed brackets **303** on the rear wheel to the frame **18** of the hop picker. Actuating any one of the hydraulic cylinders **300** causes a change in elevation of the associated portion of frame **18** with respect to the ground. A pair of guiding supports **304** are provided to guide and support the hydraulic piston **301** during elevation of the frame. An operating station (not shown in detail) is provided with controls that permit independent adjustment of each one of the cylinders **300** so that the machine may be tilted in substantially any direction from the vertical to align the picking banks with the hop trellis and vine independently of the configuration of the terrain or variation of the hop trellis system from the vertical.

As an alternative to the picking bank arrangement shown in FIG. **4**, the central raking bank may be eliminated by including the raking tine elements on the individual picking cats. In such an arrangement, the raking tines are interspersed amongst the picking hooks as necessary to achieve efficient removal of the hops by the hooks and the vine-separating action of the raking tines necessary to achieve the enhanced picking efficiency of the present invention. See FIG. **9**.

In use, the machine is controlled by one operator who steers the machine and controls the speed from the front operator's station **17**. A second operator, working at the rear operating station **24** controls the other operation, such as picking cat positioning, conveyor operation, and levels the machine.

From the foregoing, it will be appreciated that, although embodiments of the invention have been described herein for purposes of illustration, various modifications may be made without deviating from the spirit and scope of the invention. Accordingly, the invention is not limited except as by the appended claims.

I claim:

1. A machine for picking hops from vines growing in a row on a relatively short trellis, said trellis rows including vertical posts and joining horizontal wires for supporting the hop vines growing upwardly on both sides of said trellis, said hop picker machine, comprising:

a wheel-mounted frame that straddles a portion of a hop vine trellis row;

an engine mounted upon said frame for propelling said picker along said trellis row and operating said hop picker;

a hop picking bank mounted upon said frame, said picking bank comprising a pair of substantial vertically oriented conveyors adjustably spaced from one another to accommodate said trellis and contact hop vines straddled by said frame, each picking bank conveyor including upwardly moving surfaces upon which are fixed a plurality of hop picking hooks that pull hops from the vines and a plurality of tines projecting from said surfaces to rake and separate the vines to prevent matting of the vines during picking;

a pair of hop collecting conveyors mounted upon said frame, each below and in alignment with a picking conveyor, said collecting conveyors collecting hops as they fall downwardly after being picked,-said conveyors transporting the collected hops rearwardly with respect to said hop picker; and

a pair of elevating conveyors that receive the hops from the collecting conveyors and elevate them substantially vertically for transfer from said hop picker.

2. The hop picker machine of claim **1** wherein sad engine generates hydraulic pressure that operates a hydraulic drive motor mounted upon each wheel that propels said hop picker.

3. The hop picker machine of claim **1** wherein said engine generates a hydraulic pressure that operates a hydraulic steering system for said hop picker from an elevated operating station.

4. The hop picker machine of claim **3** wherein said hydraulic steering system comprises:

wheel support members upon which each forward wheel is rotationally mounted, each said support member including pivot means for rotating about a vertical axis;

pivot supports fixed to said trellis straddling frame to which said wheel support member means are pinned for rotation about said vertical axis such that said forward wheel pair, pivoting in parallel alignment, permits steering of said hop picker;

a hydraulic steering arm cylinder for each forward wheel fixed to and aligned with a longitudinal frame member, said cylinder including a piston extending adjacent to, but transversely spaced from, said frame member;

a hydraulic steering arm for each forward wheel fixed to and extending substantially perpendicularly from said wheel support member adjacent to and pivotally pinned to said steering arm cylinder piston such that actuating said steering arm cylinder causes said piston to change position, moving said steering arm and pivoting said wheel about said vertical pivot within limits suitable for steering said picker; and

a steering wheel control assembly, including a manually operated steering wheel, said control assembly hydraulically interconnecting said hydraulic steering arm cylinders and providing synchronized operation of the cylinder arms in response to steering wheel rotation.

5. The hop picker machine of claim 4 wherein said machine steering system further includes a cable of a fixed length that interconnects the outer portion of said wheel support members, said cable passing through frame-mounted pulleys, such that the wheels always remain in parallel alignment, in response to steering wheel rotation.

6. The hop picker machine of claim 1 wherein said hop picker frame is adjustable vertically at each wheel, providing overall adjustment of said picking bank into parallel alignment with said hop vines independently of ground configuration or hop trellis orientation with respect to said ground, said wheel-mounted frame including an individually adjustable hydraulic cylinder interposed between said wheel and said hop picker frame at each wheel.

7. The hop picker machine of claim 6 wherein the hop picker frame is hydraulically adjustable vertically at each wheel, each wheel including a wheel support member upon which said wheel is rotationally mounted, a hydraulic cylinder interconnecting said wheel support member and said hop picker frame, whereby actuating each said hydraulic cylinder causes said hop picker frame to change elevation with respect to said wheel and ground level, said hop picker further including controls for actuating individually each of said hydraulic cylinders such that the picking banks may be oriented in parallel contact with said hop vines.

8. The hop picker machine of claim 1 wherein said hop picker includes two picking banks upon which a plurality of picking hooks are mounted upon for upwardly advancement and a raking bank comprising a pair of vertical conveyors aligned with and between said picking banks, said raking conveyors including surfaces upon which a plurality of substantially single wire tines are mounted for upwardly advancement such that, after said first picking bank picks hops from said vines, such tines rake and separate the matted vines providing picking access for the second picking bank to hops remaining on said vines.

9. The hop picker machine of claim 1 wherein each picking bank conveyor includes a forward portion pivotably mounted upon said frame to pivot about a vertical axis and a rearward portion that is adjustable traversely with respect to said machine such that, for a pair of picking bank conveyors, the forward portions of the pair are fixedly spaced one from the other at a distance greater than the maximum expected width of said trellis and hop vines and the rearward portion of the banks may be pivotably adjustable into picking contact with said hop vines, accommodating various thicknesses of growth.

10. The hop picker machine of claim 1 wherein the upper rearward portion of each picking bank conveyor is supported from said hop picker frame by a trolley and track means for transverse adjustment of said picking banks.

11. The hop picker machine of claim 1 wherein the rearward portion of each picking bank conveyor is adjustably connected to the hop picker frame, including a hydraulic cylinder attached to said picking bank having a piston rod extending adjacent a hop picker frame ember, said piston rod attached to said frame member by an interconnecting spring such that actuation of said hydraulic cylinder causes said piston rod to adjust the picking bank conveyor transversely into contact with said trellis supported hop vines, said spring holding said piston rod fixed with respect to said frame member except where the picking bank conveyor strikes a solid object with sufficient force to overcome the spring interconnecting the piston rod and the hop picker frame member.

12. The hop picker machine of claim 11 wherein both the upper and lower rearward portions of said picking bank conveyors are transversely adjustable by said hydraulic cylinders.

13. The hop picker machine of claim 11 wherein the forward portion of each hop picking bank conveyor is pivoted about a vertical axis by a pin connection to said hop picker frame member.

14. The hop picker machine of claim 1 wherein said collecting and elevating conveyors are provided with substantially solid endless conveyor belts for supporting said hops.

15. The hop picker machine of claim 1 wherein said elevating conveyor includes a first endless belt that supports the vertical elevation of said hops and a second endless vertical conveyor belt closely adjacent said first conveyor belt such that said hops are squeezed between said belts during elevation.

16. The hop picker machine of claim 1 wherein said elevating conveyors, with the hops squeezed therebetween, release the elevated hops onto a intermittently operating horizontal conveyor which discharges the picked hops therefrom into a transporting container.

* * * * *

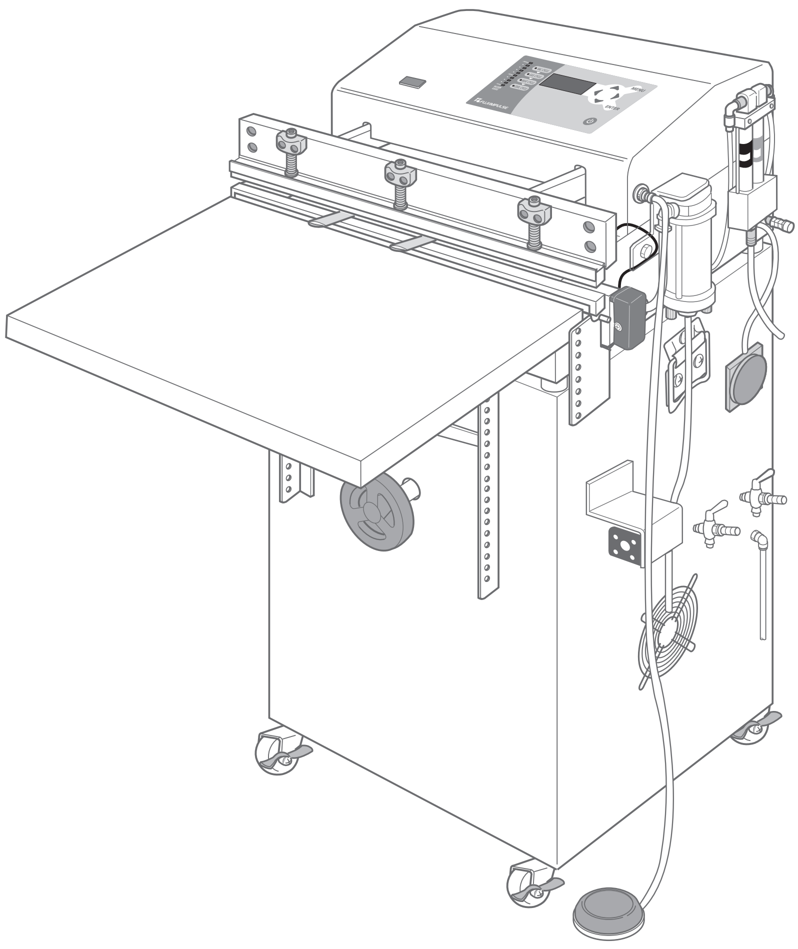
Appendix I - Fuji Impulse Nitrogen Flush- Vacuum Sealer Product Information

Printed JUL 2009
3rd Edition 3.02E

Microcomputer-controlled
Nozzle-type vacuum / gas flushing sealer

VG -602 / -402 series
Operating Instructions

110/220V Specification



FUJI IMPULSE CO.,LTD.

Thank you for your purchasing of VG-602/402 series sealer.

VG-602/402 series sealer is microcomputer controlled.
This model has the specification in which various set up is possible.
So there are many things that the customer should understand at the beginning of use.

This manual has explanation of terms and reference function like a dictionary.
Please utilize the manual, and understand the following matters.

1. Set up the pattern of operation.
   Two patterns sealing method is set at the shipping from manufacture's factory.
   But please set up the sealing condition as you need at first.
   If set up would not be done, you could not use except standard patterns.
   Set up is easy if you proceed in according to this manual.

2. Verification and setting of optimum value.
   There are various pattern of package material and content in customer's use environment.
   Please set the optimum value in heating temperature, time, cooling temperature, Vacuum time, degree which matches your needs after the sufficient test and verification.

   Please refer to the following table.
   It shows the temperature of dissolution.
   But this value is influenced by the environment, thickness of package material and other condition.

Kind of packing material	Temperature of dissolution (°F)
HDPE	266-275
HPLDPE	221-248
LLDPE	248-266
PP	320

Kind of packing material	Temperature of dissolution (°C)
HDPE	130-135
HPLDPE	105-120
LLDPE	120-130
PP	160

Foreword

Please read all of the safety and operating instructions before operating this machine. Periodic maintenance and proper operation are necessary to ensure safety when using this impulse sealer.
Keep this manual on hand when operating the sealer.
Set the heating time according to the material and thickness of the film.
As a result of research to further improve, some details in the operating instructions may differ from your actual machine. For operating problems or product information, please contact your local dealer or Fuji Impulse.

About the warning labels

The following marks are used in this manual to easily identify the conditions of risks, damages, or some tips for the optimal use of your unit.

⚠ Caution Minor injuries or damages to the unit may occur when the instruction is ignored.

⚠ Warning Severe injuries or fatal accidents may occur when the instruction is ignored.

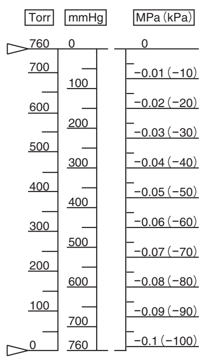
⚠ Danger Critical injuries or fatal accidents will almost certainly occur when the instruction is ignored.

Attention! Important Notes and Restrictions - Read the directions in order to avoid misuse of the unit.

TIPS Great Tips and References when using the unit - Highly recommend reading through the information.

SI units

The International System of Units (SI) is a consistent system that ordinary people as well as professionals can use. This logical unit system is used in every field from science to industry to education and even daily life.
As the SI unit system is gradually replacing the standard pressure unit, this manual primarily uses SI to indicate pressure. (As a reference, however, we have also listed the previous notations.)



This manual is designed to cover machines of various voltages and plug configurations

Before using, always verify the voltage specification of your particular unit and operate it at the correct voltage.
Please note the following:

1) The voltage specification of your unit is listed on the label (or in some cases an aluminum plate) which displays the serial number. This label can be found on the machine body.
2) The explanations and illustrations in this operators' manual utilize the following standard plug configurations most common in Japan. However, due to the various configurations in use worldwide, these may not necessarily correspond with the one attached to your specific unit.

⚠ Warning Voltages and plug configurations differ according to various worldwide specifications.
A verify those of your particular unit before beginning operation.
Connecting the power cord to an outlet of a different specification is extremely hazardous.

Table of Contents

1 Package contents

Please check the following after opening the package:

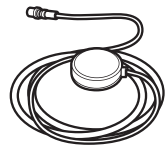
Is the machine model the same as you have ordered?

Has any damage occurred during shipment? Are there any screws loose or any foreign objects mixed in machine?

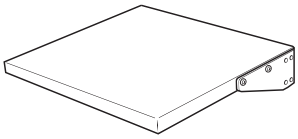
Please to make sure that all of the accessories described below are included.

1 Machines body-----------1

2 Foot switch-----------1
for operation

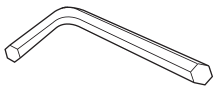


3 Table-----------1

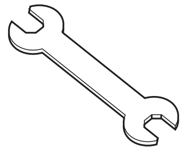


4 Accessories set

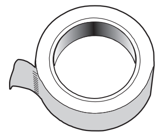
Hexagonal wrench (2.5 mm)
-----1



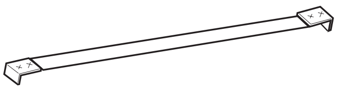
Double head wrench(10/13mm)
-----1



Glass tape (19mm width x 5m)
-----1

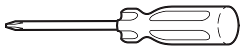


Heating element (heater)
The accessories set will vary with the machine type,
Please refer to the table on the below.

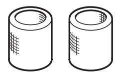


type	5mm heater	10mm heater
VG-602/402	5pcs.	5pcs.
VG-602/402-10D	—	10pcs.

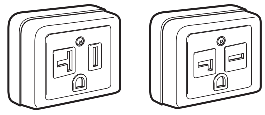
Phillips screwdriver
-----1



Filter element
-----2



Power outlet-----1

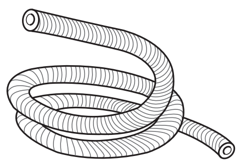


110V 220V

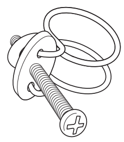
Vacuum pump oil
-----1

Only for AE,CE model

Low pressure gas hose (3meters)
-----1



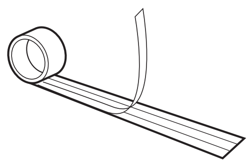
Hose band(dia.14)
-----1



Hose band(dia.12)
-----1

Only for
CH,CD,CE,CG
model

For VG-602/402-10D
Teflon center dry tape
(40mm width x 5m)-----1



These illustrations are not reduced equally.

5 Others

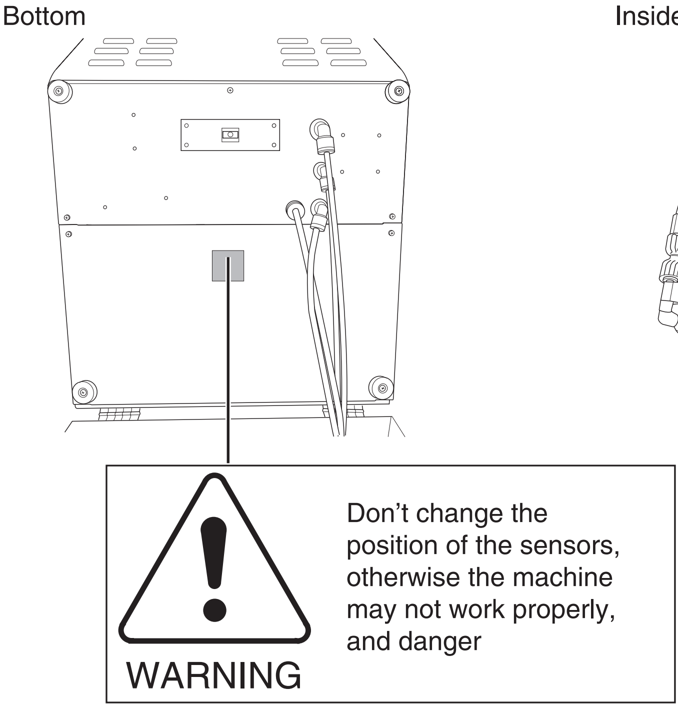
Certificate of inspection, Vacuum pump instruction manual, Air compressor instruction manual, Dry filer instruction manual(except CH,CD,CE,CG) ----- one each.

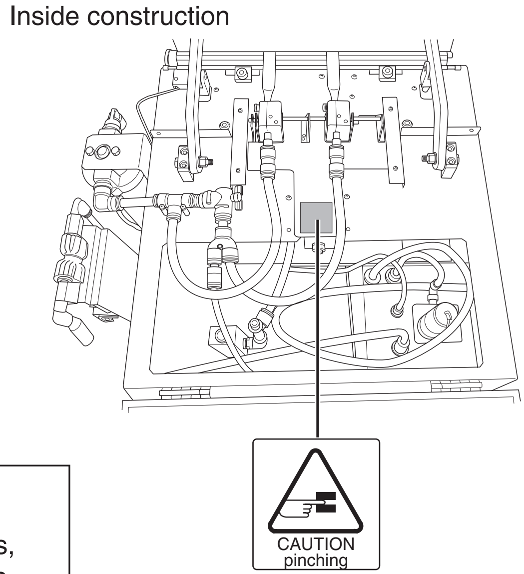
If the items in package are not same with above list, please contract to our company or your local dealer.

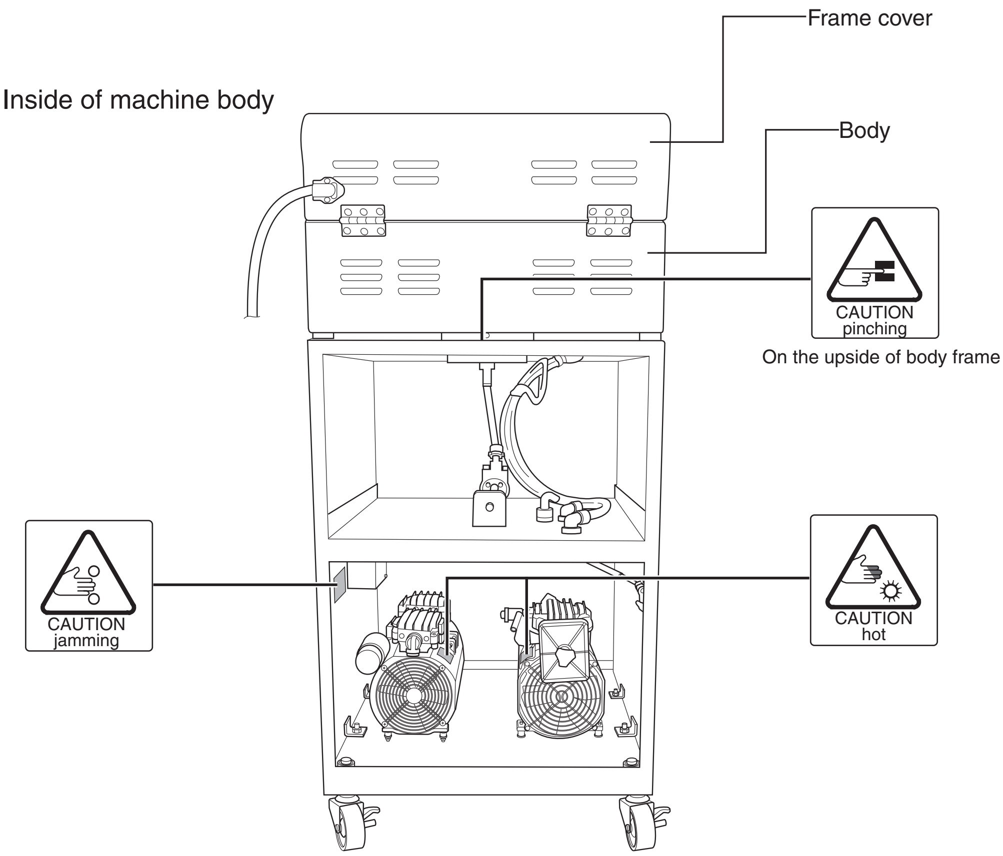
Before using , to verify that the circuit breaker is in the "OFF" position. If not so, turn it to the "OFF" before plug in.

2 Warning-Caution label location and content

Warning - Caution labels are placed in locations where there is a danger of injury to a person or damage to the machine. Label location details are illustrated below. Please check them before beginning operation. Labels not readily apparent are indicated by dotted lines.



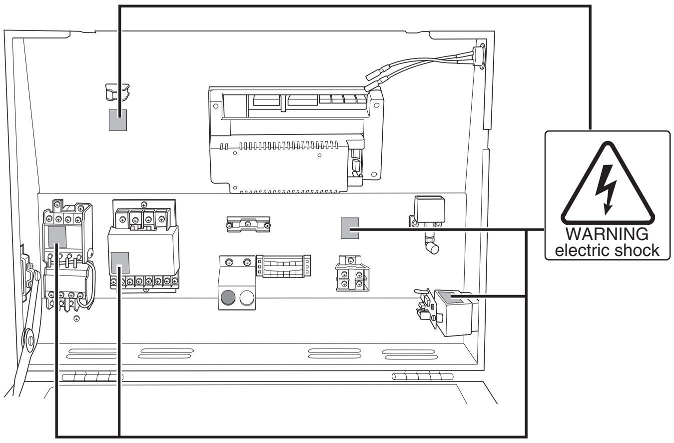




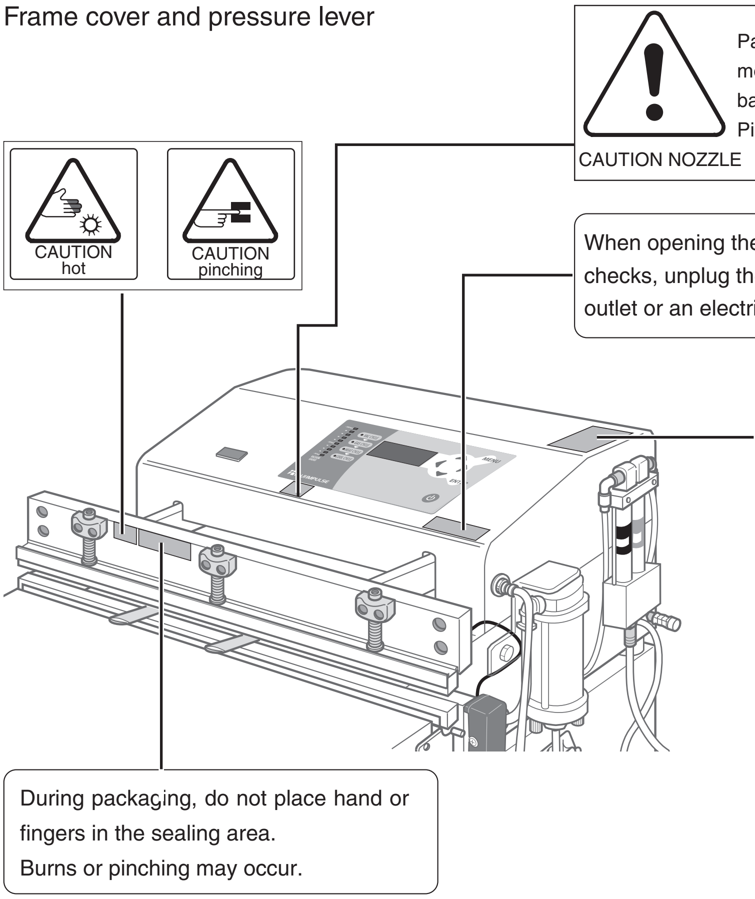
If Warning - Caution labels peel off or are lost, please purchase the proper labels and place them in the appropriate location.

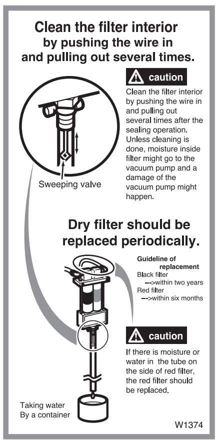
Warning-Caution label location and content

Inside construction / top view



Frame cover and pressure lever





Except CH,CD,CE,CG model

Caution

This label indicates very important contents on the maintenance of this sealer.
Ref. page 18

If Warning - Caution labels peel off or are lost, please purchase the proper labels and place them in the appropriate location.

3 Operating precautions

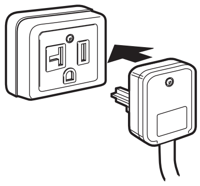
3-1 For safety operating

⚠ Warning In an emergency, unplug the power cord immediately.

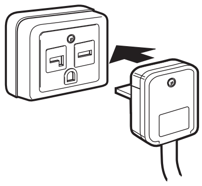
This sealer incorporates a number of safety devices and is carefully designed to prevent fires or other malfunctions. However, should all of the safety devices fail simultaneously, there is a possibility of the teflon catching fire due to a failure of the heating circuit's tripping mechanism that results in the heating element overheating. Should smoke or fire appear from the teflon, immediately turn OFF the power or unplug the power cord from the outlet.

⚠ Warning The power consumption varies according to the machine type. Check that the capacity of the outlet is larger than the power consumption of the sealer, and plug it firmly into the outlet.

Use of an outlet with a smaller capacity or an extension cord causes a drop in voltage, resulting in malfunction or even fire, be sure to use an appropriate outlet.



110V specification



220V specification

⚠ Warning Do not use for packaging liquids since machine is not waterproof.

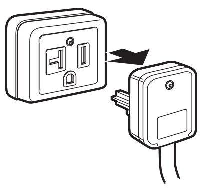
Do not splash water on the machine or use machine for packaging liquids. There is a danger of electrocution or malfunction of the machine.

⚠ Warning Do not insert any metal objects into the sealing section

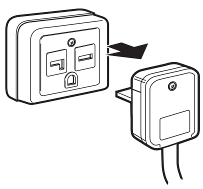
Please do not place any metal objects into the sealing section during operation. This could cause electrocution.

⚠ Warning When replacing routine parts, unplug the power plug

Routine maintenance parts will wear as you use your sealer. Perform periodical checks of them and set-up an appropriate maintenance schedule. Parts should be replaced in accordance with "Parts Replacement" on the page of instruction manual and perform the steps correctly. Before replacing parts, unplug the machine from the power source otherwise, it may cause electrocution.



110V specification



220V specification

⚠Warning Do not modify the machine

Please do not tamper with the machine without the guidance or permission of our engineers. Accidents or damage caused by modification by the customer is the sole responsibility of the customer.

⚠Warning Do not try to use the sealer if the circuit breaker automatically turns to the OFF position.

Trying to use the sealer when the circuit breaker automatically turns to the OFF position may cause electrocution. Do not operate the machine until the cause of the shut down is ascertained and the problem has been addressed.

⚠Caution Be careful of nozzle motion

Nozzle comes out automatically after several seconds from the finish of operation at the mode except "SEALING ONLY".
Please be careful of advance of a nozzle.
If you bring face or hand close to the sealing area, you might bump against a nozzle.
Or if a bag is left in the front of a seal part, the goods in the bag might be damaged.
Please take out a bag soon after pressure lever open (Sealing is finished).

⚠Caution Do not operate machine under high humidity; Do not expose the machine to water vapor; and do not use it for powder applications or in a dusty location.

To operating the machine in a place with high humidity or water vapor, The machinery parts will become rusty; Electric insulation reduces. Electrocution and malfunction may occur.
To operate the machine for powder packaging or use it in a dusty location, The powder and dusty may flow inside the sealer body, Electric insulation reduces. Electrocution and malfunction may occur.

⚠Caution Do not place hands in the sealing section.

With prolonged use, the sealing section will retain heat and become hot. If you place your fingers in this area, there is a possibility of burns.
Pressing the foot switch applies press to the sealing section. Take sufficient care so that your fingers are not caught while the power is on.
An operation by two operators may increase the possibility of your fingers being caught. Take sufficient.

⚠ Caution Read the operating instructions carefully and operates sealer correctly.

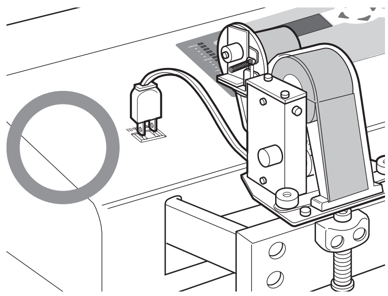
Accidents or damages caused by misuse of the machine not in accordance with the operating instructions are the sole responsibility of the customer.

⚠ Caution Perform sufficient tests headband when you require a particularly strong vacuum seat.

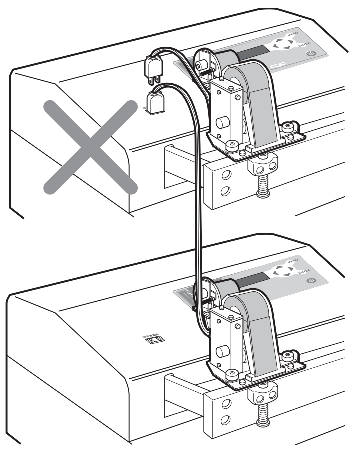
Sealing results vary according to heating, cooling, and pressure. A certain type of film may greatly affect the necessary sealing settings. Perform a number of sealing tests to find the most suitable heating cooling time and pressure setting for your film before start sealing operation.

⚠ Caution Socket for the optional printer (FEP-V-N1)

There is a socket to install the optional printer (FEP-V-N1) on the top of a sealer.



Don't connect the other electrical appliances to this socket.
To start it is very dangerous.



3-2 For smooth operation

Heating time should be set at a minimum

Set sealer so that an acceptable seal is completed in the least amount of heating time. Excessively long heating times (increasing the heat setting unnecessarily) will damage the Teflon, glass tape and other consumables, as well as result in heating element breakage. This will lead to decreased work productivity and unnecessary power consumption.

Allow sufficient cooling time

Cooling temperature is important when using an impulse sealer. After the film is heated, the film must be cooled with the frame and pressure lever in the closed position. If cooling temperature is extremely lower, the working efficiency will come down. So please set the appropriate cooling temperature according with the film.

When abnormalities arise in a temperature sensor

Since the temperature sensor detected the temperature of a heater portion directly and has controlled it, if the tip part of a temperature sensor separates from a heater, an error message "Poor heating" will be displayed on a screen and a lever will return to the initial state.
Please be careful to set the temperature sensor exactly after the replacement of parts in the sealing area.

When the teflon, silicone rubber becomes damaged

The teflon, silicone rubber will start to wear with use. Once they are damaged, it will be difficult to achieve smooth and strong seals.
Thoroughly read how to replace the parts and be careful when doing so.

Dust in the sealing section

Dust will prevent attainment of a smooth seal. It could also cause damage to heating element and/or other routine maintenance parts. Before using the machine, clean the sealing section.

3-3 Other safeguards

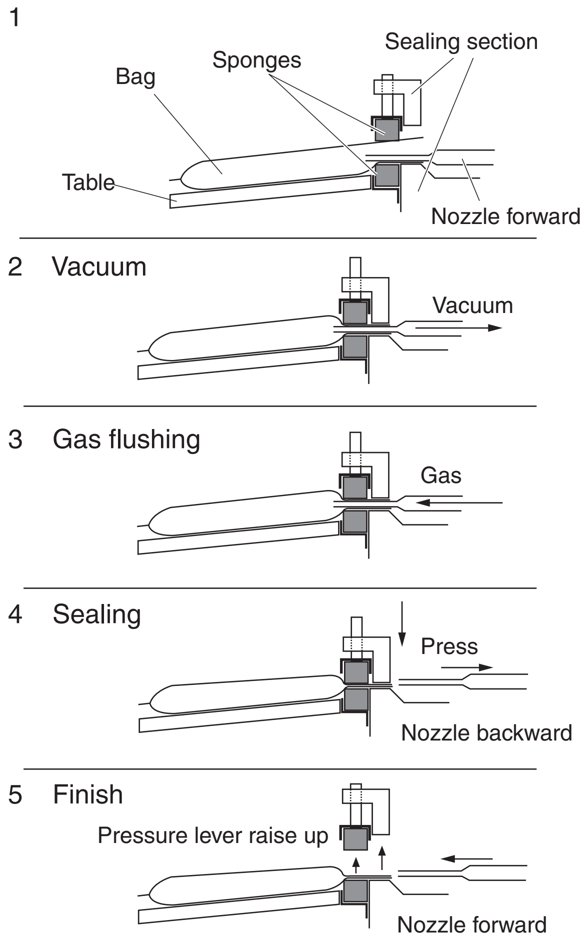
Fuji Impulse sealers utilize an impulse heating system, meaning that the heater section does not become hot simply because the power has been turned on.
It is programmed so that the heating element is heated only during the heating cycle, after a sensor switch and micro processor have been activated. (Please note, however, the sealing section may become hot after prolonged operation.)

4 Outline of structure

■ VG-602/402 series is an impulse sealer with sponges located on the sealing section to secure the nozzle prior to air removal. The air in a pouch is exhausted by built-in vacuum pump, and after the gas flushing process, sealing starts.

■ Built-in air compressor (another air source for some models) moves each part.

■ The operation process is controlled by control unit and performed just simply by depressing the foot switch.



5 Purpose usage of the sealer

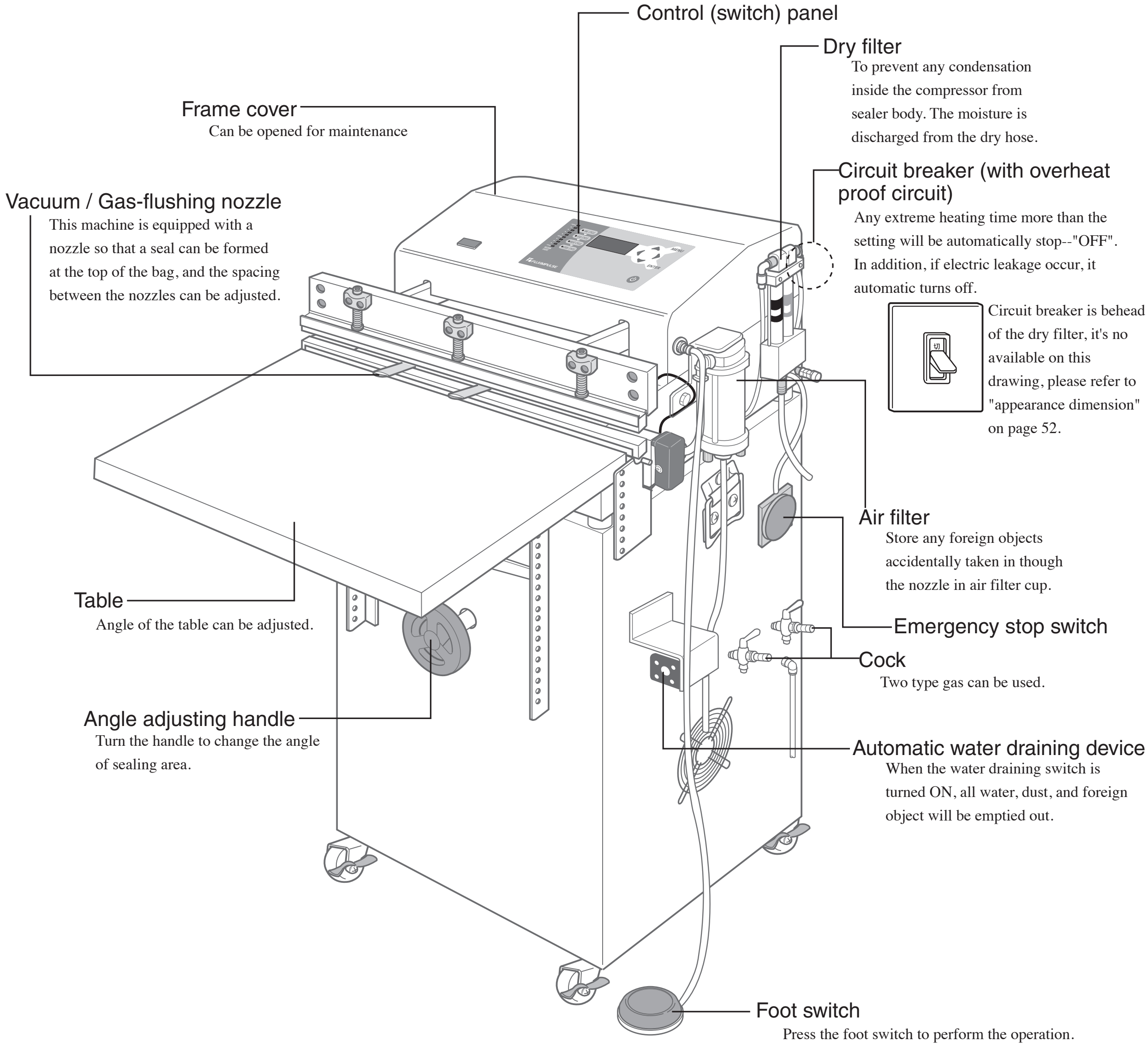
1 The impulse sealer is a machine that sends strong electric current quickly to the thin ribbon heater, which presses against the film and instantly heat-seals the package. Though this machine yields superior quality sealing, it is not compatible with films thicker than that indicated in the diagram below, sponge-like sheets, and materials that are not able to withstand high heat. In addition according to difference of film thickness and martial, the heating temperature is different. Please verify the optimum sealing conditions before operation.

2 Film thickness limits for VG-602/402 series are described below. The machine can't seal films that are thicker than that indicated.

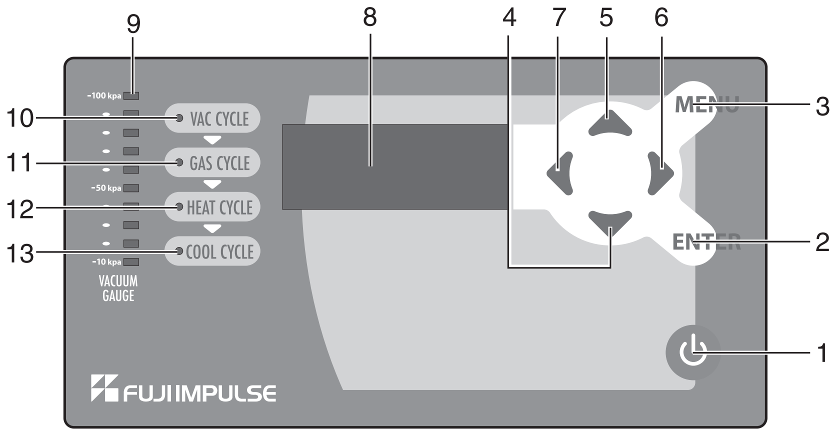
The machine may malfunction if you try to exceed the limits of the machine.

Heating type	Heater width	Thickness of material (combined total of two sheets)
Single side heating(VG-602 / 402)	5mm	Single layer film with thickness of 0.3 mm, or less or thin laminated film
Single side heating(VG-602 / 402)	10mm	Thin gusset film with thickness of 0.4 mm or less Laminated film with thickness of 0.4 mm or less
Double side heating(VG-602 / 402-10D)	10mm	Thin gusset film with thickness of 0.5 mm or less Laminated film with thickness of 0.5 mm or less

6 Major parts and function



Control (switch) panel



1. POWER BUTTON
2. ENT BUTTON
3. MENU BUTTON
4 5 6 7. ARROW BUTTON
8. LIQUID CRYSTAL DISPLAY
9. VACUUM GAUGE
10. VACUUMING LAMP
11. GAS LAMP
12. HEATING LAMP
13. COOLING LAMP

7 Preparation

7-1 Securing the work place

For safety and efficiently operation, please set the sealer in suitable environment.

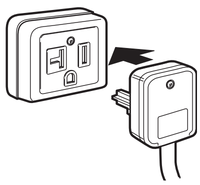
⚠Warning Do not use the VG-602/402 on a tilting, uneven, or unstable place. The sealer may fall and become damaged or cause injuries. Be sure it uses the sealer on a flat stable surface.

⚠Warning Do not use the sealer on a wet floor. Do not expose the sealer to water drops or vapor. This may cause a failure and a short circuit.

⚠Warning To operating the machine in a place with high humidity or water vapor, the compressor draw the air obtain more moisture, It's worse to machinery parts. Life of dry filter will be shorten.

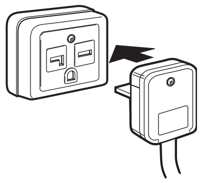
7-2 Connect the power source

Be sure to connect the power plug directly into an outlet with an appropriate capacity, which stated on "10 Specification".
Insert the plug fully into the outlet.



110V specification

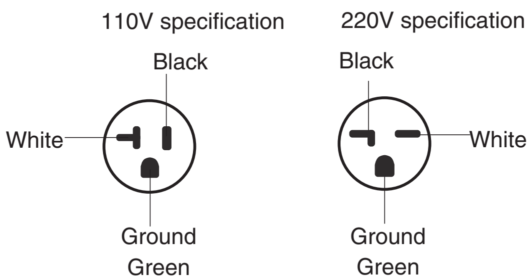
Wiring must be performed by an engineer authorized by the electric, power company.
(Wiring and 3rd level grounding requires proper qualification.)



220V specification

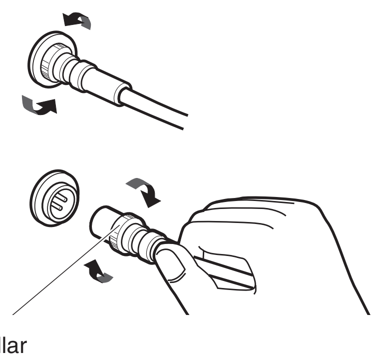
⚠Warning The power consumption varies according to the machine type. Check that the capacity of the outlet is larger than the power consumption of your machine, and plug it directly to the outlet.
Using an outlet with a smaller capacity or an extension cord will cause a drop in voltage, resulting in malfunction and even fire because of overheating of the cable and outlet. Be sure to use an appropriate outlet.

⚠Warning When you have changed the standard plug provided, check the connection.
The wires are connected as shown in the figure. When the ground wire is not connected to the correct terminal, a short on the power source side or an electric leakage is caused.



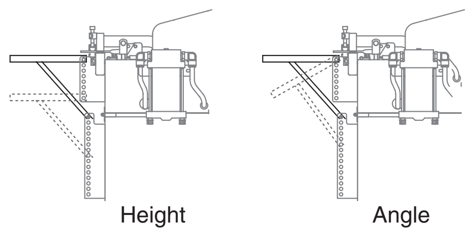
7-3 Installing the foot switch

Insert the foot switch that comes with into the plug in the right side machine body.
Turn and push the collar to lock it in place.



7-4 Adjusting the height and angle of the table

The height and angle of the table can be adjusted through the rod holes located on the front both ends of machine.



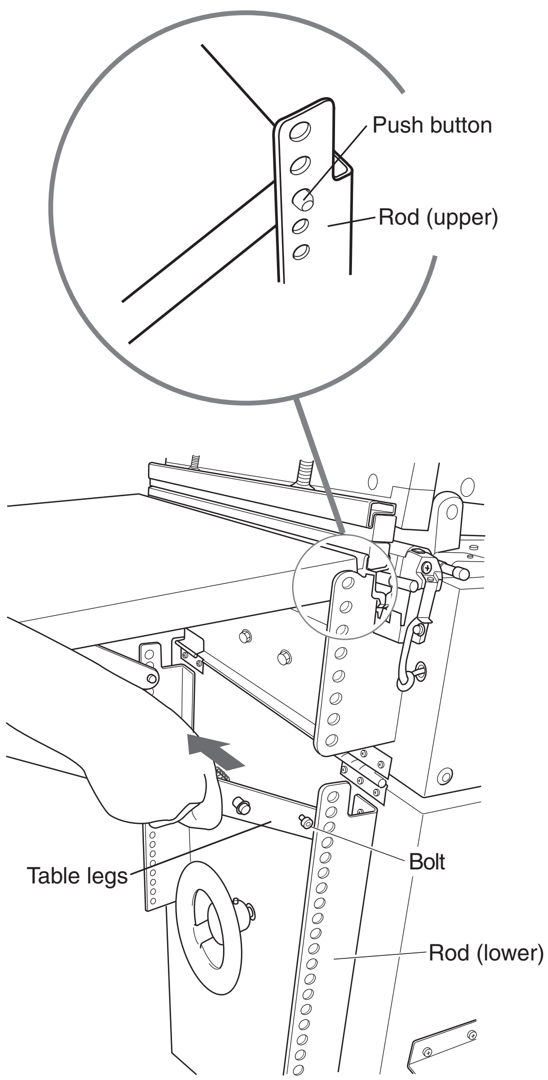
Attaching / Taking off the table

To attach the table, hold the table on both ends, push the buttons in and push the table into the rod.
To take off the table, do the opposite.
While pushing the buttons on both ends, pull the table towards you.
The table will come off the rod.

Attaching / Taking off the legs

This works best if it is done one side at a time.
To attach the legs, select a hole so that the table is at an appropriate angle and place the hooks in the holes, with pushing the legs inside as the illustration.
Be careful so that legs are the same angle.
To take the legs out, lift the table slightly and take the hooks out of the holes.

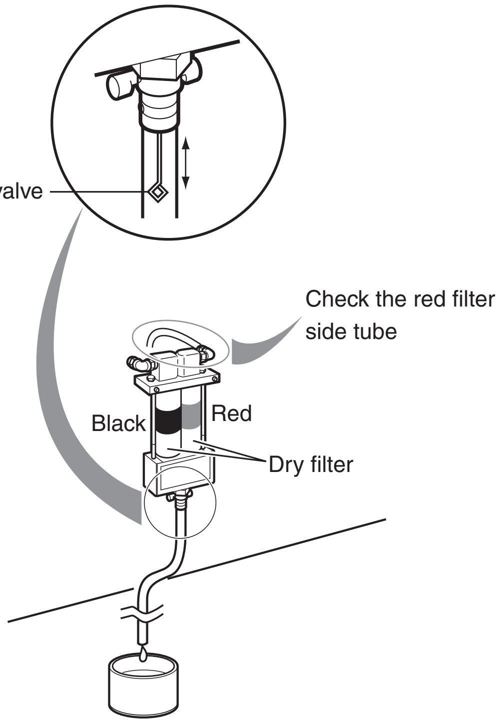
⚠ **Caution** Make sure the hooks are securely in the holes so that the table is stable.
If the table is unstable, a little shock or movement of the table can cause the table to fall off or slant, causing injuries.



7-5 Check the dry filter

Two dry filters on the side of frames need to be exchanged regularly.
Especially check the red filter side tube when the beginning and finishing the sealing operation.
When the tube becomes cloudy or water-drops is attached inside, please exchange the filter regardless of the standard of exchange.

Standard of exchange
Black filter-----2 years
Red filter----- Half a year



7-6 Cleaning by the weeping valve

(Not necessary at the initial use of the sealer)
At the beginning and finishing the sealing operation, clean the filter interior by pushing the weeping valve in and out several times.
For details information, refer to " dry filter instruction manual".

⚠ Caution If the filter would be left clogging up, the moisture flow into the vacuum pump and causes damage of pump.

7-7 Taking water by the drain hose

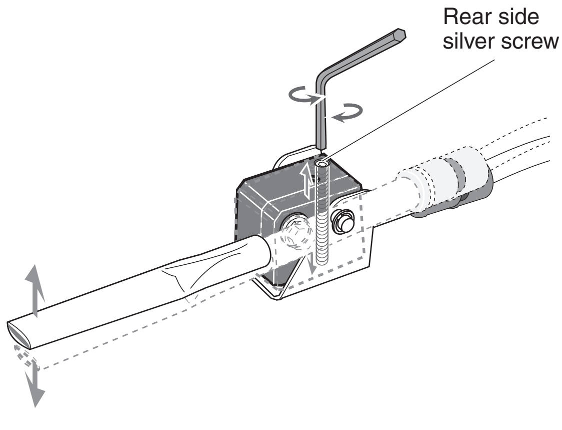
The dry filter is of auto-drain construction.
The moisture in the dry filter is mixed with little exhaust air and discharged as drain.
It will be released from the underside of the unit frame by the drain hose.
Take water from the drain hose by a container (drain tank or empty can).

7-8 Adjusting the nozzle position

Take off the frame cover.

■ Adjusting the height of the nozzle

Turn the screw on the inner left of the nozzle supporter (seen from the table side) by the 2.5mm six angle wrench.
To lower = Turn clockwise
To raise = Turn counterclockwise



■ Adjusting the spacing between two nozzles

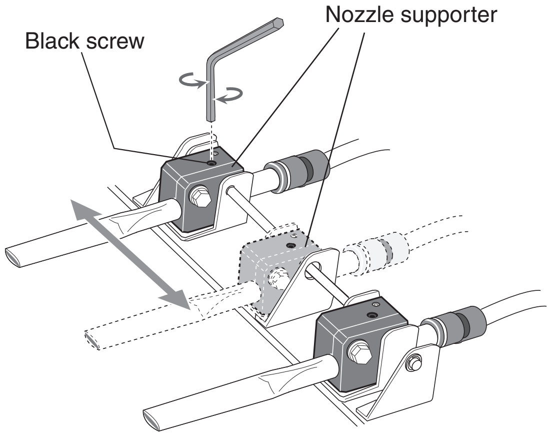
Nozzles can be moved to a comfortable working position, according to the width of your bag.

How to adjust

1 Loosen the black screw on the nozzle supporter with the allen wrench (2.5mm).

2 Slide the nozzle supporter and make the appropriate adjustments depending on the width of the bag that you are using.
(Nozzle spacing is max. 157mm, min 57mm)
Secure the black screw.

3 Confirm the spacing is correct and close the frame cover.



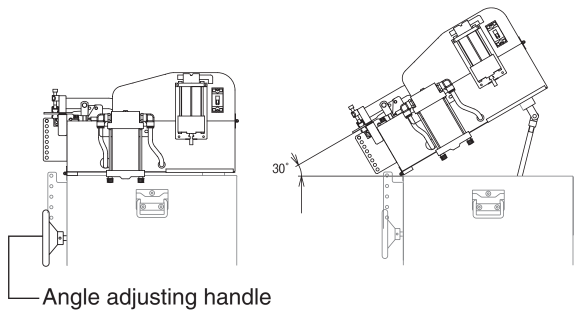
7-9 Adjusting the angle of sealing area

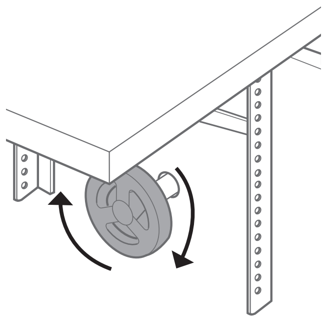
The angle of sealing area can be adjusted from 0 to 30 degrees.

How to adjust

Turn the black handle located on the front of machine.
Angle of sealing area can be selected freely.

Turn clockwise = to 0 degree
Turn counter-clockwise = to 30 degrees





7-10 Emergency stop switch

Before operating the machine, press the switch and make sure that it is working.

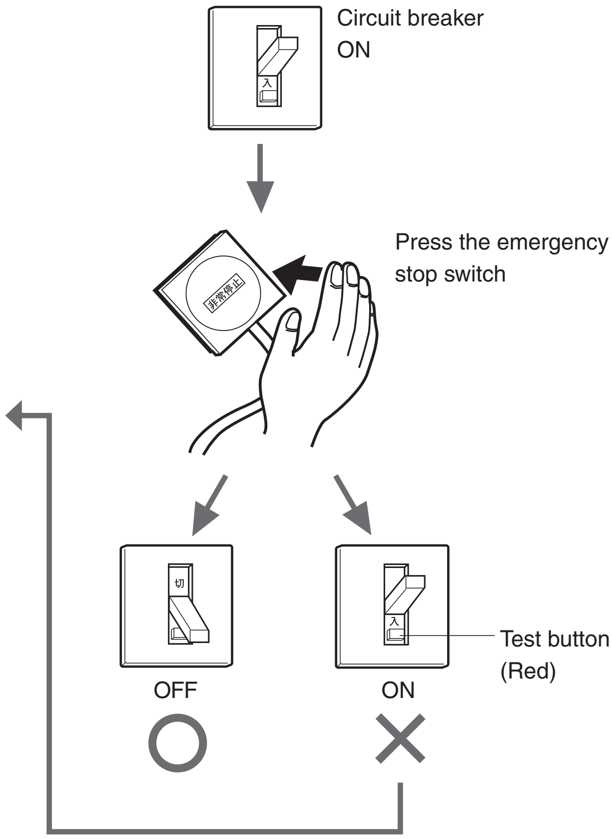
1 Turn the circuit breaker ON.
2 Press the emergency stop switch.
3 If the circuit breaker turned OFF, the emergency stop switch is working normally.

Warning
If the circuit breaker does not shut down, please try as follows and contact your dealer of our company. (Ref. the right illustration)

Push the red test button on the circuit breaker.

<Circuit breaker turns OFF>
=Emergency stop switch may be damaged.

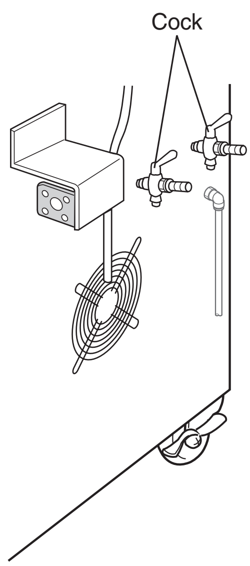
<Circuit breaker turns ON>
=Circuit breaker may be damaged.



7-11 Attaching the gas tank and gas adjuster

Gas tank and adjuster is not attached to the machine. Please attach as necessary.

1 Attach the gas adjuster (with reducing valve and flow meter) to the tank.
2 Attach the gas flow meter to the cock with vinyl hose.
When using only one cock, close the other cock certainly. (Both cocks can be connected.)
If two types gas are used, attach the another hose to the each cock.
When gas flushing process is not necessary, always close the gas cock.



8 Proper use of the sealer

This chapter is composed as follows.

8-1 Operation by the initial set up

= Standard operation

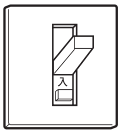
Please get used to this sealer by initial two patterns.

8-2 Entry

Let's enter the new operation pattern.

TIPS Explanations in 8-1 and 8-2 are started after the following operations (1 and 2).

1 Turn the circuit breaker on.



2 Turn the power switch on.

The below message is displayed for 3 seconds.

VG English ℉ Verx.x FUJI IMPULSE.CO	VG English ℃ Verx.x FUJI IMPULSE.CO

8-3 Explanation of the terms

Explanation about the display message or term in this manual.

Please use as dictionary.

8-4 Reference

Explanation of each operations and set-up.

8-5 Operation procedure

Work flow of 13 patterns combination of sealing method.

Please use 8-3 and 8-4 as your dictionary (data file)

8-1 Operation by the initial set up = Standard operation

Four kinds of sealing methods are entered into VG-602/402 series at the shipment from factory.

> **Attention!**
> The following four patterns will be changed when customer set up heating temperature, cooling temperature, vacuum time, gas flushing time etc...
> If you need the initial patterns, please re-register it.

*At first, get used to the machine by these four patterns.
*Terms are explained in page 31, 8-3.
*Other sealing methods are shown in page 50, 8-5.

● Seal only (page 21)

= Operation No. [01] SEALING ONLY
Initial value
HT (Heating Temperature) : 284°F (140°C), CT (Cooling Temperature) : 212°F (100°C)
Ref. 8-5-1 (page 50)

● Vacuum and seal - Operator decide the finish of vacuum by seeing (page 22)

= Operation No. [02] VAC & SEAL manual
Initial value
HT (Heating Temperature) : 284°F (140°C), CT (Cooling Temperature) : 212°F (100°C)
Ref. 8-5-2 (page 52)

● Gas flushing and seal - by initial set up vacuum and gas flushing time (page 24)

= Operation No. [03] 1-GAS / Timer
Initial value
HT (Heating Temperature) : 284°F (140°C), CT (Cooling Temperature) : 212°F (100°C)
VT (Vacuuming Time) : 1.0second, GT (Gas flushing Time) : 2.0seconds
Ref. 8-5-6 (page 60)

● Two times gas flushing and seal - by initial vaccum and gas flushing time (page 26)

= Operation No. [04] 2-GAS / Timer
Initial value
HT (Heating Temperature) : 284°F (140°C), CT (Cooling Temperature) : 212°F (100°C)
1-VT (1st Vacuuming Time) : 1.0second, 2-VT (2nd Vacuuming Time) : 1.0seconds,
1- GT (1st Gas flushing Time) : 2.0seconds, 2-GT (2nd Gas flushing Time) : 2.0seconds
Ref. 8-5-6 (page 60)

Operation No. can be changed by ▲ , ▼ key on the following display.

```
[01] SEALING ONLY
 ▼ ▲ Change (number)
 ◀ ▶ Change (item)
 COUNTER     xxxxx
```

Sealing only

Operation No. [01] SEALING
HT : 284ºF (140ºC), CT : 212ºF (100ºC)
Ref. 8-5-1

TIPS

The following explanation is for the first use. (by the initial set-up)

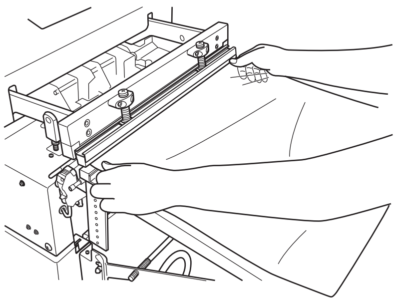
At first, turn the circuit breaker and power switch on. (in page 19, 1 and 2)

3 Operation No. [01] is displayed.

```
[01] SEALING ONLY
 ▼ ▲ Change (number)
 ◀ ▶ Change (item)
 COUNTER    xxxxx
```

4 Check the heating and cooling temperature. When you change the value, please look at 8-4 in page 32.

5 Set a pouch on the sealing position.



6 Step on the foot switch (1st)

Pressure lever descends and fasten a pouch with sponge rubber. (Please keep on stepping until the pressure lever close.)

Attention!

If leg is separated from the foot switch in the middle of downward, the pressure lever will open for the safe mechanism.

7 Step on the foot switch (2nd)

By the second step on the foot switch, the following process (from 7-1 to 7-5) will be performed automatically.

7-1 Sealing starts.

7-2 Heating lamp is turned on.

7-3 After the heating is finished (Heating lamp is turned off), cooling lamp is turned on.

7-4 Cooling is finished.
(Cooling lamp is turned off.)

7-5 Sealing process is completed.
(Pressure lever open.)

8 Sealing is finished.

Please check whether sealing performed certainly.

If you will not use for a long time, please work in following order.

1. Shut off the power switch.
2. Shut off the circuit breaker.
3. Pull out the cord from the wall socket.

● Vacuum and seal - Operator decide the finish of vacuum by seeing

Operation No. [02] VAC & SEAL

HT : 284°F (140°C), CT : 212°F (100°C)

Ref. 8-5-2

TIPS

The following explanation is for the first use. (by the initial set-up)

At first, turn the circuit breaker and power switch on. (in page 19, 1 and 2)

3 Operation No. [01] is displayed.

```
[01] SEALING ONLY
 ▼ ▲ Change (number)
 ◀ ▶ Change (item)
 COUNTER     xxxxx
```

4 Select No. [02]

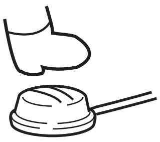
Operation number is changed by ▼, ▲ button.

Select number [02].

```
[02] VAC&SEAL  manual
 ▼ ▲ Change(number)
 ◀ ▶ Change(item)
 COUNTER     xxxxx
```

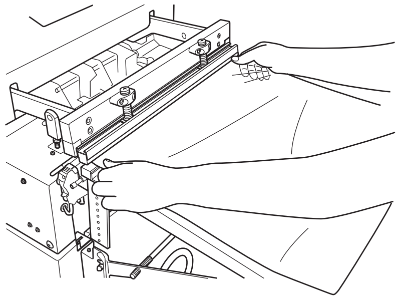
5 Check the heating and cooling temperature. When you change the value, please look at 8-4 in page 32.

6 Step on the foot switch (1st)



Nozzle come forward.

7 Insert the nozzle in a pouch, and set it on the sealing position.



8 Step on the foot switch (2nd)

Pressure lever descends and fasten a pouch with sponge rubber. (Please keep on stepping until the pressure lever close.)

Attention!

If leg is separated from the foot switch in the middle of downward, the pressure lever will open for the safe mechanism.

9 Step on the foot switch (3rd)

Vacuum start. (Vacuum lamp is turned on.)

10 When you could see the sufficient vacuum is done, step on the foot switch (4th).

By fourth step on the foot switch, the following process (from 10-1 to 10-6) will be performed automatically.

10-1 Vacuum finish.

(Vacuum lamp is turned off.)

10-2 Nozzle return.

(8-1-2)

10-3 Pressure lever fasten a pouch and sealing starts. (Heating lamp is turned on.)

10-4 After the heating is finished (Heating lamp is turned off), cooling lamp is turned on.

10-5 Cooling is finished.
(Cooling lamp is turned off.)

10-6 Sealing process is completed.
(Pressure lever return and nozzle come forward)

11 Sealing is finished.
Please check whether sealing performed certainly.
If you will not use for a long time, please work in following order.

1. Shut off the power switch.
2. Shut off the circuit breaker.
3. Pull out the cord from the wall socket.

● Gas flushing and seal - by initial set up vacuum and gas flushing time

Operation No. [03] 1-GAS / Timer

HT : 284°F (140°C), CT : 212°F (100°C), VT : 1.0sec, GT : 2.0sec

Ref. 8-5-6

TIPS

The following explanation is for the first use. (by the initial set-up)

At first, turn the circuit breaker and power switch on. (in page 19, 1 and 2)

3 Operation No. [01] is displayed.

```
[01]  SEALING  ONLY
  ▼  ▲ Change (number)
  ◀  ▶ Change (item)
  COUNTER     xxxxx
```

4 Select No. [03]

Operation number is changed by ▼, ▲ button.

Select number [03].

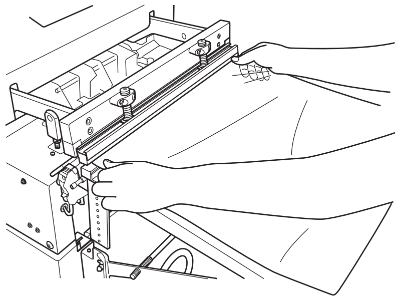
```
[03] 1-GAS  timer
  ▼  ▲ Change(number)
  ◀  ▶ Change(item)
  COUNTER     xxxxx
```

5 Check the heating and cooling temperature. When you change the value, please look at 8-4 in page 32.

6 Step on the foot switch (1st)

Nozzle come forward.

7 Insert the nozzle in a pouch, and set it on the sealing position.



8 Step on the foot switch (2nd)

Pressure lever descends and fasten a pouch with sponge rubber. (Please keep on stepping until the pressure lever close.)

Attention!

If leg is separated from the foot switch in the middle of downward, the pressure lever will open for the safe mechanism.

9 Step on the foot switch (3rd)

By third step on the foot switch, the following process (from 9-1 to 9-9) will be performed automatically.

9-1 Vacuum start. (Vacuuming lamp is turned on.)

9-2 When set up time is passed, vacuum finish. (Vacuuming lamp is turned off.)

9-3 Gas flushing start.
(Gas flushing lamp is turned on.)

(8-1-3)

9-4 When set up time is passed, gas flushing finish. (Gas flushing lamp is turned off.)

9-5 Nozzle return.

9-6 Pressure lever fasten a pouch and sealing starts. (Heating lamp is turned on.)

9-7 After the heating is finished (Heating lamp is turned off), cooling lamp is turned on.

9-8 Cooling is finished.
(Cooling lamp is turned off.)

9-9 Sealing process is completed.
(Pressure lever return and nozzle come forward)

10 Sealing is finished.
Please check whether sealing performed certainly.
If you will not use for a long time, please work in following order.

1. Shut off the power switch.
2. Shut off the circuit breaker.
3. Pull out the cord from the wall socket.

● Two times gas flushing and seal - by initial set up vacuum and gas flushing time

Operation No. [04] 2-GAS / Timer

HT : 284°F (140°C), CT : 212°F (100°C), 1-VT : 1.0sec, 2-VT : 1.0sec, 1-GT : 2.0sec, 2-GT : 2.0sec

Ref. 8-5-9

TIPS

The following explanation is for the first use. (by the initial set-up)

At first, turn the circuit breaker and power switch on. (in page 19, 1 and 2)

3 Operation No. [01] is displayed.

```
[01] SEALING ONLY
  ▼ ▲ Change (number)
  ◀ ▶ Change (item)
  COUNTER    xxxxx
```

4 Select No. [04]

Operation number is changed by ▼, ▲ button.

Select number [04].

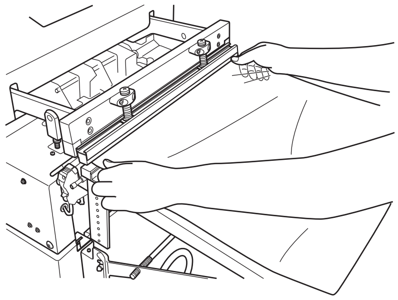
```
[04] 1-GAS timer
  ▼ ▲ Change(number)
  ◀ ▶ Change(item)
  COUNTER    xxxxx
```

5 Check the heating and cooling temperature. When you change the value, please look at 8-4 in page 32.

6 Step on the foot switch (1st)

Nozzle come forward.

7 Insert the nozzle in a pouch, and set it on the sealing position.



8 Step on the foot switch (2nd)

Pressure lever descends and fasten a pouch with sponge rubber. (Please keep on stepping until the pressure lever close.)

Attention!

If leg is separated from the foot switch in the middle of downward, the pressure lever will open for the safe mechanism.

9 Step on the foot switch (3rd)

By third step on the foot switch, the following process (from 9-1 to 9-13) will be performed automatically.

9-1 Vacuum start (1st).

(Vacuuming lamp is turned on.)

9-2 When set up time is passed, the first vacuum finish.

(Vacuuming lamp is turned off.)

9-3 Gas flushing start (1st).

(Gas flushing lamp is turned on.)

(8-1-4)

9-4 When set up time is passed, the first gas flushing finish.
(Gas flushing lamp is turned off.)

9-5 Vacuum start (2nd).
(Vacuuming lamp is turned on.)

9-6 When set up time is passed, the second vacuum finish.
(Vacuuming lamp is turned off.)

9-7 Gas flushing start (2nd).
(Gas flushing lamp is turned on.)

9-8 When set up time is passed, the second gas flushing finish.
(Gas flushing lamp is turned off.)

9-9 Nozzle return.

9-10 Pressure lever fasten a pouch and sealing starts. (Heating lamp is turned on.)

9-11 After the heating is finished (Heating lamp is turned off), cooling lamp is turned on.

9-12 Cooling is finished.
(Cooling lamp is turned off.)

9-13 Sealing process is completed.
(Pressure lever return and nozzle come forward)

10 Sealing is finished.
Please check whether sealing performed certainly.
If you will not use for a long time, please work in following order.

1. Shut off the power switch.
2. Shut off the circuit breaker.
3. Pull out the cord from the wall socket.

8-2 Entry

Attention! Maximum ten operation numbers can be entered in this machine.
If the eleventh operation pattern is going to be entered, "Entry No' is full Please delete an unnecessary entry No' " message is displayed on a liquid crystal screen.
You cannot input the new pattern unless either of already entered operation number would be deleted.

Attention! The biggest number is automatically assigned to the new entry.
*If there are 4 operation numbers, the new entry becomes 05.

Two kinds of examples for the new entry are explained in 8-2.
Please get used to enter and try on another sealing pattern.

● Entry for sealing only (page 29)

Operation No. [05] SEALING ONLY
Setting value : Heating temperature 284°F (140°C), Heating time 0.3seconds
Cooling temperature 212°F (100°C)

● Entry for 1 time vacuum and gas flushing by timer (page 30)

Operation No. [06] 1-Gas / Timer
Setting value : Heating temperature 284°F (140°C), Heating time 0.3seconds
Cooling temperature 212°F (100°C), Vacuum time 12.0seconds, Gas flushing time 8.0seconds

● Entry for sealing only

Attention! The following explanation is for the first use. (by the initial set-up)

To register "Sealing only" in operation number [05].
Setting value : Heating temperature 284°F (140°C), Heating time 0.3seconds, Cooling temperature 212°F (100°C)

At first, turn the circuit breaker and power switch on. (in page 19, 1 and 2)

3 Operation No. [01] is displayed.

```
[01] SEALING ONLY
▼ ▲ Change (number)
◀ ▶ Change (item)
COUNTER    xxxxx
```

4 Push the MENU.

```
MENU /◀ ▶/ MENU=Back
1 Entry       2 Change
3 Delete      4 Circulate
5 Drain       6 Maintain
```

5 Select "1 Entry" Register by ◀ , ▶

```
MENU /◀ ▶/ ENT=OK
1 Entry       2 Change
3 Delete      4 Circulate
5 Drain       6 Maintain
```

(~part is blinking.)

6 Push ENTER, display changes to

```
[05] METHOD ◀ ▶ Select
1 SEAL        2 VAC & SEAL
3 1-GAS       4 n-GAS
5 CIRCULATE
```

(5 CIRCULATE is displayed only in effect)

7 Select "1 SEAL" by ◀ , ▶

```
[05] METHOD ◀ ▶ Select
1 SEAL        2 VAC & SEAL
3 1-GAS       4 n-GAS
5 CIRCULATE
```

(~part is blinking.)

8 Push ENTER, display changes to

```
[05]▼▲ Change  ◀ ▶ Move

HT140°F      0.0s
```

(~ part is blinking.)

```
[05]▼▲ Change  ◀ ▶ Move

HT  60°C      0.0s      CT
```

(~ part is blinking.)

9 Set the heating temperature 284°F (140°C). Look at "Set the heating temperature" in page 34.

10 Set the heating time to 0.3seconds by ▶ .

Look at "Set the heating time "in page 34.

11 Set the cooling temperature 212°F (100°C) by ▶ .

Look at "Set the cooling temperature" in page 43.

● Entry for 1 time vacuum and gas flushing by timer

Attention! The following explanation is for the first use. (by the initial set-up)

To register "1 time vaccum and gas flushing by timer" in operation number [05].
Setting value : Heating temperature 284°F (140°C), Heating time 0.3seconds, Cooling temperature 212°F (100°C)
Vacuum timer 12.0seconds, Gas flushing time 8.0seconds

At first, turn the circuit breaker and power switch on. (in page 19, 1 and 2)

3 Operation No. [01] is displayed.

```
[01] SEALING  ONLY
  ▼  ▲ Change (number)
  ◀  ▶ Change (item)
  COUNTER     xxxxx
```

4 Push the MENU.

```
MENU /◀ ▶/ MENU=Back
1 Entry       2 Change
3 Delete      4 Circulate
5 Drain       6 Maintain
```

5 Select "1 Entry" Register by ◀ , ▶

```
MENU /◀ ▶/ ENT=OK
1 Entry       2 Change
3 Delete      4 Circulate
5 Drain       6 Maintain
```

(~part is blinking.)

6 Push ENTER, display changes to

```
[05] METHOD  ◀ ▶ Select
1 SEAL        2 VAC & SEAL
3 1-GAS       4 n-GAS
5 CIRCULATE
```

(5 CIRCULATE is displayed only in effect)

7 Select "3 1-GAS" by ◀ , ▶

```
[05] METHOD  ◀ ▶ Select
1 SEAL        2 VAC & SEAL
3 1-GAS       4 n-GAS
5 CIRCULATE
```

(~part is blinking.)

8 Push ENTER, display changes to

```
[05] VAC TYPE ◀ ▶ Select
1-GAS

1 Manual    2 Time    3 Gauge
```

(~part is blinking.)

9 Select "2 Time" by ◀ , ▶

```
[05] VAC TYPE ◀ ▶ Select
1-GAS

1 Manual    2 Time    3 Gauge
```

(~part is blinking.)

10 Push ENTER, display changes to

```
[05] ▼▲ Change  ◀ ▶ Move
1VT10.0sec   G10.0sec

   HT140°F        0.0s
```

(~part is blinking.)

```
[05] ▼▲ Change  ◀ ▶ Move
1VT10.0sec   G10.0sec

   HT   60°C        0.0s        CT
```

(~part is blinking.)

11 Set the vacuum timer to 12.0seconds.
Look at "Set the vacuum time" in page 41.

12 Push ▶ , and set the gas flushing timer to 8.0seconds.
Look at "Set the 1 time gas flushing timer"in page 45.

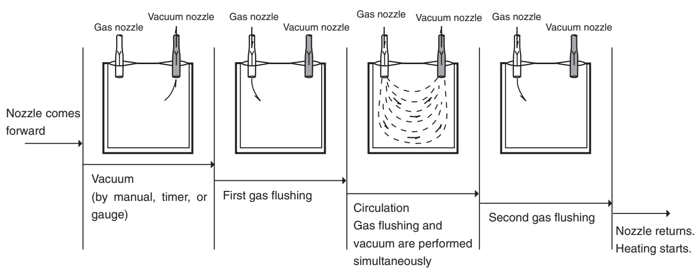
13 Push ▶ , and set the heating temperature 280°F (140°C).
Look at "Set the heating temperature" in page 34.

14 Push ▶ , and set the heating time to 0.3seconds.
Look at "Set the heating time "in page 34.

15 Push ▶ , and set the cooling temperature 212°F (100°C).
Look at "Set the cooling temperature" in page 43.

8-3 Explanation of the terms

Impulse sealer	The machine which carries out the seal of plastic film package is named sealer. The sealer which carries out the seal by heat is called heat sealer. There are four heat sealing technology generally used. 1 Impulse sealer, 2 Heat plate sealer 3 Ultrasonic sealer, 4 High frequency sealer Impulse sealer passes large current momentarily at the ribbon-like heating element, and heat up it to the sufficient temperature to seal by heat conduction. Package material is put between sealing parts of machine, pressed by the lever and melted by the heating element. After that, cooling process is needed with pressure kept on.
Temperature sensor	It can detect the temperature of sealing part directly.
Vacuum (gauge)	Vacuum is performed to the set-up degree by vacuum gauge.
Seal Sealing	Seal (Sealing) means to adhere the opening part of plastic film package material. The machine which perform "Seal" is called sealer.
Sealing only	Only seal is performed. If this pattern is set-up, vacuum or gas flushing function will not work.
Sealing method (on the liquid crystal screen)	"METHOD" appears on the liquid crystal screen of VG-602/402 series when operator select the sealing method. (Sealing only / Vacuum and Seal / Vacuum, Gas flushing and seal) Sealing method generally means "Impulse style", "Ultrasonic style", "High frequency style" etc... Please understand it as the shortage of expression.
Vacuum (timer)	Vacuum is performed to the setting time by timer.
Vacuum (manual)	Operator judges the suitable vacuum degree by seeing, and finish the vacuum by stepping on a foot switch.
n-times (Gas flushing) (Vacuum)	In VG-602 / 402 series, gas flushing can be set max.99 times. "n" expresses the unspecified number of times which user would choose from 1 time to 99 times.
NC(piping)	Circulated vacuum and gas flushing mode is called "NC". When user choose this mode,piping needs to be changed. Piping for circjlated vacuum and gas flushing mode is "NC piping".

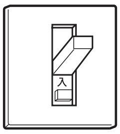


8-4 Reference

● For operation

Starting of use

1 Turn on the circuit breaker.

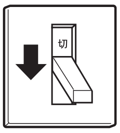


2 Push the power button (ON).
Compressor and cooling fan start.

Finishing of use

1 Push the power button (OFF).
Compressor and cooling fan stop.

2 Shut off the circuit breaker.
All function is finished.



3 Check the maintenance items.
Ex. Cleaning of Filter element.
Look at page 97 for periodical maintenance items.

4 Pull out the plug.
If machine won't be worked for a long time, pull out the plug from the wall socket.

Foot switch

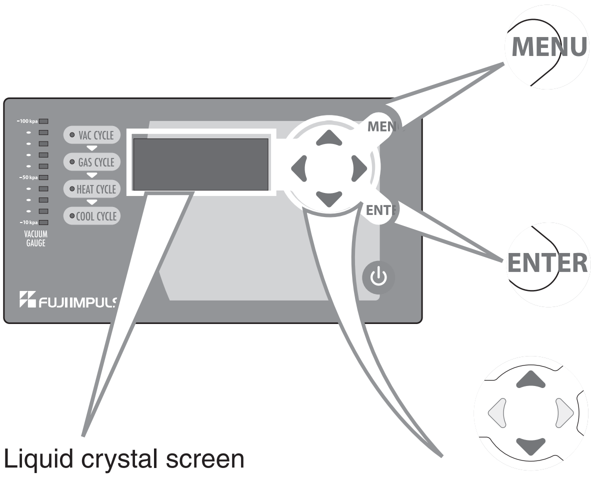
In VG-602/402 series, sealing process is done by the foot switch.

Attention!

Please step on the foot switch certainly.
If not, machine may not work to the next process.
If leg is separated from the foot switch in the middle of downward, the pressure lever will open for the safe mechanism.

● For set-up

Explanation of each button on the control panel



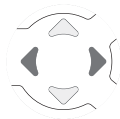
Liquid crystal screen
Please refer 8-5

MENU button
= To display the menu mode

1 Entry	2 Change
3 Delete	4 Circulate
5 Drain	6 Maintain

ENT button
= To decide the each setting item

Arrow button / Upward, Downward
= To move the setting display
= To increase or decrease the setting value



Arrow button / Rightward, Leftward
= To move the setting display
= To move the cursor to objective position

Foreword

1 The following explains as the circuit breaker ON and power button ON.
2 The numeric position which can be changed is expressed by xx in the illustration.
3 The blinking cursor position is expressed by ~ (down side) and ▒ (background).
4 ● shows different contents by each operation number.

Counter

Reset the counter value :

Push ENTER for 3 seconds on the following initial display.

```
[01]  SEALING  ONLY
  ▼  ▲ Change (number)
  ◀  ▶ Change (item)
 COUNTER     xxxxx
```

Reduce one count from the counter value :

Push ENTER one time.

Set the heating temperature

1-1 Change the heating temperature of the current displayed operation number :

Push ▶ , display changes to

```
[xx]▼▲ Change  ◀▶ Move
 ●●●●●●●●●●

 HT   xx°F    x.xs    CT
 ~
```

(~part is blinking.)

```
[xx]▼▲ Change  ◀▶ Move
 ●●●●●●●●●●

 HT   xx°C    x.xs    CT
 ~
```

(~part is blinking.)

->Read 2

1-2 Change the heating temperature of another operation number :

Refer to "Select the operation number" in page 36.

After select the objective number, push ▶ and read 2.

2 Right side of "HT" is blinking.

In this condition, adjust the value by ▲ ▼ button.

One degree is changed by one time push ▲ ▼.

If kept on pushing, numeral change at high speed.

(Setting range 140 ～ 480°F)

(Setting range 60 ～ 250°C)

TIPS

Suitable temperature is different with each packing materials.

Please set the lowest temperature which can seal. Seal speed will increase and useless consumption of parts can be lost.

Set the heating time

1-1 Change the heating time of the current displayed operation number :

Push ▶ display changes to

```
[xx]▼▲ Change  ◀▶ Move
 ●●●●●●●●●●

 HT   xx°F▒   x.xs    CT
          ~
```

(~ part is blinking.)

```
[xx]▼▲ Change  ◀▶ Move
 ●●●●●●●●●●

 HT   xx°C▒   x.xs    CT
          ~
```

(~part is blinking.)

->Read 2

1-2 Change the heating time of the another operation number :

Refer to "Select the operation number" in page 36.

After select the objective number, push ▶ and read 2.

2 Right side of "HT" is blinking.

Push ▶ and cursor move to the heating time position [x.xs].

Adjust the time by ▲, ▼.

0.1second is changed by one time push ▲, ▼. If kept on pushing, numeral change at high speed.

(Setting range 0.0 ～ 2.0second)

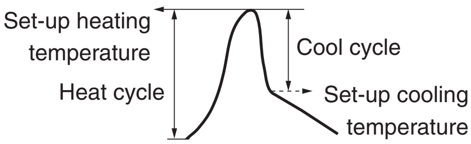
TIPS

In temperature control system, heating time means the time which maintains the set-up temperature.

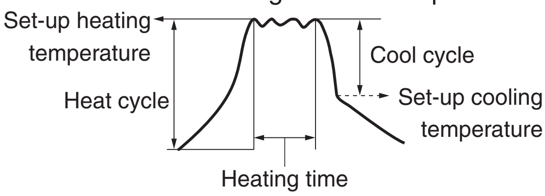
Usually seal can be made even if heating time doesn't set (0.0sec).

In the case that thickness of packing material causes the poor sealing, or the film is received the damage, setting of heating time might be effective.

In the case that heating time is not set up.



In the case that heating time is set up.



Delete the operation number

TIPS

Deletion can be stopped by pushing MENU button, if step 4- ENTER has not been pushed.

1 When screen displays operation No. (ex. [01] SEALING ONLY)

[01] SEALING ONLY
▼ ▲ Change (number)
◀ ▶ Change (item)
COUNTER xxxxx

Push MENU and display changes to

MENU /◀ ▶/ MENU=Back
1 Entry 2 Change
3 Delete 4 Circulate
5 Drain 6 Maintain

2 Put the cursor to 3 Delete by ◀, ▶ and push ENTER to decide. Display changes to

[xx] ●●●●●●●
▼ ▲ Select(number)
ENT / Delete

3 Select the operation number to delete by ▲, ▼.

4 Push ENTER button to delete the selected number.

TIPS

As once deleted number cannot be returned, please be careful at the deletion.

TIPS

When the operation number is deleted, the next number is automatically moved one forward.

(Sample)

Before

No.1 = SEALING ONLY
No.2 = VAC&SEAL timer
No.3 = 1-GAS manual

After deleting No.1, Display changes to

No.1 = VAC&SEAL timer
No.2 = 1-GAS manual
No.3 = Not registered

TIPS

If the registered number is only [01], you cannot delete it.
When you try to delete a message "You can not delete all" is displayed.

Select the operation number

1 When screen displays operation No.
(ex. [01] SEALING ONLY)

```
[01]  SEALING  ONLY
  ▼  ▲ Change (number)
  ◀  ▶ Change (item)
  COUNTER    xxxxx
```

Push ▲ or ▼ button.

Select / Enter / Change the sealing method

1 When screen displays operation No.
(ex. [01] SEALING ONLY)

```
[01]  SEALING  ONLY
  ▼  ▲ Change (number)
  ◀  ▶ Change (item)
  COUNTER    xxxxx
```

Push MENU and display changes to

```
MENU  /◀ ▶/  MENU=Back
1 Entry        2 Change
3 Delete       4 Circulate
5 Drain        6 Maintain
```

2-1 Entry : Put the cursor to "1 Entry" by ◀ , ▶ and push ENTER
The next operation is 3.

2-2 Change of contents : Put the cursor to "2 Change" by ◀ , ▶ and push ENTER
Display changes to the for selecting the operation number. Then select the number by ▲ , ▼ and push ENTER.

3 Display changes to

```
[xx]  METHOD  ◀ ▶  ENT=OK
1 SEAL        2 VAC & SEAL
3 1-GAS       4 n-GAS
5 CIRCULATE
```

4 Put the cursor on 1 SEALING ONLY, 2 VAC&SEAL, 3 1-GAS, 4 n-GAS or 5 CIRCULATE, by ◀ , ▶ and push ENTER
Then display changes to the one for setting heating temperature, time and cooling temperature.

TIPS

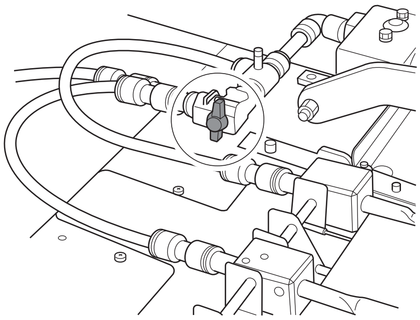
When select 2~4 (except), please refer to "Select the vacuum pattern" in page 42.

Select the gas circulation

Process 1-3 is necessary only at the first set of gas circulation, or in the state of circulation / off.

1 Open the flame cover.

2 Turn the circulation switching knob to the vertical position as following illustration.



3 Close the frame cover to the initial position.

4 When the operation number is displayed,

```
[01]  SEALING  ONLY
  ▼  ▲ Change (number)
  ◀  ▶ Change (item)
  COUNTER    xxxxx
```

Push the MENU button, display changes to

```
MENU /◀ ▶/ MENU=Back
1 Entry        2 Change
3 Delete       4 Circulate
5 Drain        6 Maintain
```

5 Put the cursor to "4 Circulate" by ◀ , ▶ and push ENTER.

6 Display changes to the one for selecting the gas circulation.

Put the cursor to "2 ON" by ▶ and push ENTER.

```
CIRCULATE      ◀ ▶Select
          ENT=Go
1 OFF        2 ON
             ~
```

(Brinking number (~) is selected now.)

(At the first set of gas circulation, cursor is under the "1 OFF")

7 Then display changes to the one for selecting the vacuum method.

Select to one from 3 pattern :

1 Manual, 2 Time,3 Gauge.

```
[xx]  VAC TYPE ◀ ▶Select
CIRCULATE

1 Manual   2 Time   3 Gauge
```

8 About the next setting, please refer to the following page

1 Manual : page 38

2 Time : page 39

3 Gauge : page 40

Set the gas circulation / vacuum by manual

1 Refer "Select the gas circulation" (page 37). After the process of 6, put the cursor to "1 Manual" by ▶ and push ENTER.

```
[xx] VAC TYPE ◀ ▶ Select
CIRCULATE

1 Manual    2 Time    3 Gauge
```

2 Display change to

```
[xx]▼▲ Change  ◀ ▶ Move
   1V   MANUAL    G   xx.xsec
   GCT   xx.xsec    G   xx.xsec
   HT   xx°F    x.xs    CT
```

(～part is blinking.)

```
[xx]▼▲ Change  ◀ ▶ Move
   1V   MANUAL    G   xx.xsec
   GCT   xx.xsec    G   xx.xsec
   HT   xx°C    x.xs    CT
```

(～part is blinking.)

Cursor is under the position for setting the first gas flushing time.

Adjust the value by ▲, ▼.
(Setting range : 0.1 ～ 99.9seconds)

3 Then set the gas circulating time.

Put the cursor to "GCT xx.xsec" by ▶ , and set the time by ▲, ▼.
(Setting range : 0.1 ～ 99.9seconds)

```
[xx]▼▲ Change  ◀ ▶ Move
   1V   MANUAL    G   xx.xsec
   GCT   xx.xsec    G   xx.xsec
   HT   xx°F    x.xs    CT
```

(～part is blinking.)

```
[xx]▼▲ Change  ◀ ▶ Move
   1V   MANUAL    G   xx.xsec
   GCT   xx.xsec    G   xx.xsec
   HT   xx°C    x.xs    CT
```

(～part is blinking.)

4 Set the second gas flushing time.

Put the cursor to "Gxx.xsec" by ▶ and set the time by ▲, ▼.
(Setting range : 0.1 ～ 99.9seconds)

```
[xx]▼▲ Change  ◀ ▶ Move
   1V   MANUAL    G   xx.xsec
   GCT   xx.xsec    G   xx.xsec
   HT   xx°F    x.xs    CT
```

(～part is blinking.)

```
[xx]▼▲ Change  ◀ ▶ Move
   1V   MANUAL    G   xx.xsec
   GCT   xx.xsec    G   xx.xsec
   HT   xx°C    x.xs    CT
```

(～part is blinking.)

Set the gas circulation / vacuum by timer

1 Refer "Select the gas circulation" (page 37).

After the process of 6, put the cursor to "2 Time" by ▶ and push ENTER.

```
[xx] VAC TYPE ◀ ▶ Select
CIRCULATE

1 Manual    2 Time    3 Gauge
```

2 Display changes to

```
[xx]▼▲ Change  ◀ ▶ Move
   1VT▮  xx.xsec    G   xx.xsec
   GCT   xx.xsec    G   xx.xsec
   HT   xx°F    x.xs    CT
```

(～part is blinking.)

```
[xx]▼▲ Change  ◀ ▶ Move
   1VT▮  xx.xsec    G   xx.xsec
   GCT   xx.xsec    G   xx.xsec
   HT   xx°C    x.xs    CT
```

(～part is blinking.)

Cursor is under the position for setting the vacuum time.

"1 VT" = 1st Vacuum Time

Adjust the value by ▲, ▼.

(Setting range : 0.1 ～ 99.9seconds)

3 Then set the first gas flushing time.

Put the cursor to "Gxx.xsec" by ▶ and set the time by ▲, ▼.

(Setting range : 0.1 ～ 99.9seconds)

```
[xx]▼▲ Change  ◀ ▶ Move
   1VT   xx.xsec  ▮ G   xx.xsec
   GCT   xx.xsec    G   xx.xsec
   HT   xx°F    x.xs    CT
```

(～part is blinking.)

```
[xx]▼▲ Change  ◀ ▶ Move
   1VT   xx.xsec  ▮ G   xx.xsec
   GCT   xx.xsec    G   xx.xsec
   HT   xx°C    x.xs    CT
```

(～part is blinking.)

4 Then set the gas circulating time.

Put the cursor to "GCTxx.xsec" by ▶ and set the time by ▲, ▼.

(Setting range : 0.1 ～ 99.9seconds)

```
[xx]▼▲ Change  ◀ ▶ Move
   1VT   xx.xsec    G   xx.xsec
   GCT▮  xx.xsec    G   xx.xsec
   HT   xx°F    x.xs    CT
```

(～part is blinking.)

```
[xx]▼▲ Change  ◀ ▶ Move
   1VT   xx.xsec    G   xx.xsec
   GCT▮  xx.xsec    G   xx.xsec
   HT   xx°C    x.xs    CT
```

(～part is blinking.)

5 Set the second gas flushing time.

Put the cursor to "Gxx.xsec" by ▶ and set the time by ▲, ▼.

(Setting range : 0.1 ～ 99.9seconds)

```
[xx]▼▲ Change  ◀ ▶ Move
   1VT   xx.xsec    G   xx.xsec
   GCT   xx.xsec  ▮ G   xx.xsec
   HT   xx°F    x.xs    CT
```

(～part is blinking.)

```
[xx]▼▲ Change  ◀ ▶ Move
   1VT   xx.xsec    G   xx.xsec
   GCT   xx.xsec  ▮ G   xx.xsec
   HT   xx°C    x.xs    CT
```

(～part is blinking.)

Set the gas circulation / vacuum by gauge

1 Refer "Select the gas circulation" (page 37). After the process of 6, put the cursor to "3 Gauge" by and push ENTER.

```
[xx] VAC TYPE ◀ ▶ Select
CIRCULATE

1 Manual    2 Time    3 Gauge
```

2 Display changes to

```
[xx]▼▲ Change   ◀ ▶ Move
   1VG  – xxxkpa     G   xx.xsec
   GCT   xx.xsec     G   xx.xsec
   HT   xx°F     x.xs     CT
```

(～part is blinking.)

```
[xx]▼▲ Change   ◀ ▶ Move
   1VG  – xxxkpa     G   xx.xsec
   GCT   xx.xsec     G   xx.xsec
   HT   xx°C     x.xs     CT
```

(～part is blinking.)

Cursor is under the position for setting the vacuum degree.
"1VG" = 1st Vacuum Gauge
Adjust the value by ▲, ▼.
(Setting range : -1 ～ -100kpa)

3 Then set the first gas flushing time.
Put the cursor to "Gxx.xsec" by ▶ and set the time by ▲, ▼.
(Setting range : 0.1 ～ 99.9seconds)

```
[xx]▼▲ Change   ◀ ▶ Move
   1VG  – xxxkpa     G   xx.xsec
   GCT   xx.xsec     G   xx.xsec
   HT   xx°F     x.xs     CT
```

(～part is blinking.)

```
[xx]▼▲ Change   ◀ ▶ Move
   1VG  – xxxkpa     G   xx.xsec
   GCT   xx.xsec     G   xx.xsec
   HT   xx°C     x.xs     CT
```

(～part is blinking.)

4 Then set the gas circulating time.
Put the cursor to "GCTxx.0sec" by ▶ and set the time by ▲, ▼.
(Setting range : -1 ～ -100kpa)

```
[xx]▼▲ Change   ◀ ▶ Move
   1VG  – xxxkpa     G   xx.xsec
   GCT   xx.xsec     G   xx.xsec
   HT   xx°F     x.xs     CT
```

(～part is blinking.)

```
[xx]▼▲ Change   ◀ ▶ Move
   1VG  – xxxkpa     G   xx.xsec
   GCT   xx.xsec     G   xx.xsec
   HT   xx°C     x.xs     CT
```

(～part is blinking.)

5 Set the second gas flushing time.
Put the cursor to "Gxx.xsec" by ▶ and set the time by ▲, ▼.
(Setting range : 0.1 ～ 99.9seconds)

```
[xx]▼▲ Change   ◀ ▶ Move
   1VG  – xxxkpa     G   xx.xsec
   GCT   xx.xsec     G   xx.xsec
   HT   xx°F     x.xs     CT
```

(～part is blinking.)

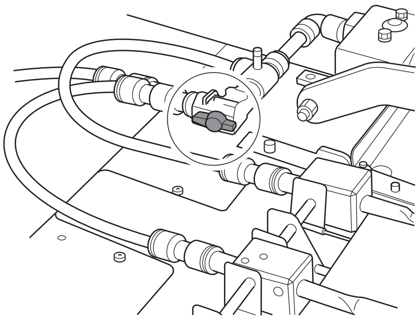
```
[xx]▼▲ Change   ◀ ▶ Move
   1VG  – xxxkpa     G   xx.xsec
   GCT   xx.xsec     G   xx.xsec
   HT   xx°C     x.xs     CT
```

(～part is blinking.)

Reset the gas circulation

1 Open the flame cover.

2 Turn the circulation switching knob to the horizontal position as following illustration.



3 Close the frame cover to the initial position.

4 When the operation number is displayed,

```
[01] SEALING ONLY
  ▼  ▲ Change (number)
  ◀  ▶ Change (item)
  COUNTER    xxxxx
```

Push the MENU button, display changes to

```
MENU /◀ ▶/ MENU=Back
1 Entry       2 Change
3 Delete      4 Circulate
5 Drain       6 Maintain
```

5 Put the cursor to "4 Circulate" by ◀ , ▶ and push ENTER.
Display change to

```
CIRCULATE      ◀ ▶Select
          ENT=Go
1 OFF          2 ON
               ~
```

(Brinking number (~) is selected now.)

6 Display changes to the one for selecting the gas circulation.

Put the cursor to "1 OFF" by ◀ and push ENTER.

```
CIRCULATE      ◀ ▶Select
          ENT=Go
1 OFF          2 ON
~
```

(Brinking number (~) is selected now.)

Set the vacuum degree

Refer to "Select the vacuum pattern" in page 42. Select "2 VAC&SEAL". Put the cursor to "3 Gauge" and push ENTER. Display changes to

```
[xx]▼▲ Change   ◀ ▶ Move
1VG -xxxkpa
    ~
  HT   xx°F    x.xs    CT
```

(~ part is blinking.)

```
[xx]▼▲ Change   ◀ ▶ Move
1VG -xxxkpa
    ~
  HT   xx°C    x.xs    CT
```

(~ part is blinking.)

Cursor is under the position of vacuum degree.

Adjust the value by ▲, ▼.
(Setting range : -1 ~ -100kpa)

Set the vacuum time

Refer to "Select the vacuum pattern" in page 42, and select "VAC&SEAL".

Put the cursor to "2 Time" and push ENTER.
Display changes to

```
[xx]▼▲ Change   ◀ ▶ Move
1VT xx.xsec
    ~
  HT   xx°F    x.xs    CT
```

(~ part is blinking.)

```
[xx]▼▲ Change   ◀ ▶ Move
1VT xx.xsec
    ~
  HT   xx°C    x.xs    CT
```

(~ part is blinking.)

Adjust the value by ▲, ▼.
(Setting range : 0.1 ~ 99.9seconds)

Select the vacuum pattern

1 When screen displays operation No.
(ex. [01] SEALING ONLY)

```
[01]  SEALING  ONLY
  ▼  ▲  Change (number)
  ◀  ▶  Change (item)
 COUNTER      xxxxx
```

Push MENU and display changes to

```
MENU  /◀ ▶/  MENU=Back
1  Entry          2  Change
3  Delete         4  Circulate
5  Drain          6  Maintain
```

2-1 Entry : Put the cursor to "1 Entry" by ◀ , ▶ and push ENTER.
The next operation is 3.

2-2 Change the contents : Put the cursor to "2 Change" by ◀ , ▶ and push ENTER.

3 Display changes by ◀ , ▶ to

```
[xx]  METHOD  ◀ ▶  ENT=OK
1  SEAL        2  VAC & SEAL
3  1-GAS       4  n-GAS
5  CIRCULATE
```

(5 CIRCULATE is displayed only in effect)

4 Put the cursor to "2 VAC&SEAL" and ENTER.
Display changes to

```
[xx]  VAC  TYPE  ◀ ▶ Select
VAC & SEAL

1  Manual    2  Time    3  Gauge
```

Select the one from 1Manual, 2 Time, 3 Gauge by ◀ , ▶ and decide by ENTER.

Then display changes to the one for setting the heating temperature, time, and cooling temperature. Please set them at the suitable value.

Set the drain ON / OFF

1 When screen displays operation No.
(ex. [01] SEALING ONLY)

```
[01]  SEALING  ONLY
  ▼  ▲  Change (number)
  ◀  ▶  Change (item)
 COUNTER      xxxxx
```

Push MENU and display changes to

```
MENU  /◀ ▶/  MENU=Back
1  Entry          2  Change
3  Delete         4  Circulate
5  Drain          6  Maintain
```

2 Put the cursor to "5 Drain" by and push ENTER to decide.

```
DRAIN       ◀ ▶Select
            ENT=Go
1  OFF        2  ON
~
```

(Brinking number (~) is selected now.)

3 Put the cursor to 1 OFF or 2ON by and push ENTER to decide.

Select the maintenance mode

1 When screen displays operation No.
(ex. [01] SEALING ONLY)

```
[01] SEALING ONLY
 ▼ ▲ Change (number)
 ◀ ▶ Change (item)
COUNTER     xxxxx
```

Push MENU and display changes to

```
MENU /◀ ▶/ MENU=Back
1 Entry        2 Change
3 Delete       4 Circulate
5 Drain        6 Maintain
```

2 Put the cursor to "6 Maintain" by ◀ , ▶ .
Press ENTER and display changes to the one for selecting maintenance mode. ON or OFF.
(Initial state OFF as the following illustration.)

```
[xx] MAINTENANCE
 ◀ ▶ Select
 ENT=Go
1 OFF        2 ON
```

(Brinking number (～) is selected now.)

3 Put the cursor to 2 ON by ◀ , ▶ and press ENTER.

Display changes to maintenance mode.

```
[xx]●●●●●●●●●
 MAINTENANCE
X ■□□□□ □□□□□□□□□□
Y □□□□□ □□□□□□□□□□
```

(■means ON □means OFF)

Refer to page 110 about the message of maintenance mode.

Set the cooling temperature

1-1 In the present operation number :

Press ▶ display changes to the one for setting each value and read 2.

```
[xx]▼▲ Change  ◀ ▶ Move
 ●●●●●●●●●●
 HT  xx°F   x.xs   CT
```

(～part is blinking.)

```
[xx]▼▲ Change  ◀ ▶ Move
 ●●●●●●●●●●
 HT  xx°C   x.xs   CT
```

(～part is blinking.)

1-2 In the another operation number :
Refer to "Select the operation number" in page 36, and select the number.
Then press ▶ and read 2.

2 Right side of "HT" is blinking.

In this condition, push ▶ two times.
Cursor moves to the right side of "CT" (blinking).
Adjust the value by ▲ , ▼ .

One degree is changed by one time push.
If kept on pushing, numeral change at high speed.
(Setting range 100°F ～ heating temperature)
(Setting range 40°C ～ heating temperature)

TIPS

If cooling temperature is set extremely highly, strong and beautiful seal cannot be made.
Please set the temperature suitable for the film.

⚠ Warning

If the extreme setting is going to be made, the following warning is displayed on a liquid crystal screen for 4 seconds.

```
WARNING!
Set cool temp
low enough
```

Select the 1 time gas flushing

1 When screen displays operation No. (ex. [01] SEALING ONLY)

```
[01]  SEALING  ONLY
  ▼ ▲ Change (number)
  ◀ ▶ Change (item)
  COUNTER     xxxxx
```

Push MENU and display changes to

```
MENU /◀ ▶/ MENU=Back
1 Entry        2 Change
3 Delete       4 Circulate
5 Drain        6 Maintain
```

2-1 Entry : Put the cursor to "1 Entry" by and push ENTER.

The next operation is 3.

2-2 Change of contents : Put the cursor to "2 Change" by ◀ , ▶ and push ENTER.

Display changes to the one for selecting the operation number. Then select the number by ▲ , ▼ and push ENTER.

3 Display changes to

```
[xx]  METHOD  ◀ ▶  ENT=OK
1 SEAL        2 VAC & SEAL
3 1-GAS       4 n-GAS
5 CIRCULATE
```

(5 CIRCULATE is displayed only in effect)

4 Put the cursor to "3 1-GAS" by ◀ , ▶ and push ENTER.

Display changes to

```
[xx]  VAC  TYPE  ◀ ▶ Select
VAC & SEAL

1 Manual   2 Time   3 Gauge
```

5 Select the vacuum method from 1 Manual, 2 Time, 3 Gauge by ◀ , ▶ and push ENTER.

Display changes to the one for setting the heating temperature, time and cooling temperature.
Please set the suitable value.

TIPS

Please refer "Select the vacuum pattern" in page 42.

Set the 1 time gas flushing timer

1 Refer the explanation in page 44 and select the 1 time gas flushing.
Then select the vacuum pattern as the instruction in page 42.

2 Put the cursor to the position for setting the gas flushing time.

2-1 When you select "1 Manual",the cursor is already under the position for setting the gas flushing time.

```
[xx]▼▲ Change   ◀ ▶ Move
  1V   MANUAL    G   xx.xsec

  HT   xx°F     x.xs    CT
```

(～part is blinking.)

```
[xx]▼▲ Change   ◀ ▶ Move
  1V   MANUAL    G   xx.xsec

  HT   xx°C     x.xs    CT
```

(～part is blinking.)

2-2 When you select "2 Time" or "3 Gauge", put the cursor is under the position for setting the flushing time by ◀ , ▶ .

In the case of "2 Time"

```
[xx]▼▲ Change   ◀ ▶ Move
  1VT   xx.xsec  █ G   xx.xsec

  HT   xx°F     x.xs    CT
```

(～part is blinking.)

```
[xx]▼▲ Change   ◀ ▶ Move
  1VT   xx.xsec  █ G   xx.xsec

  HT   xx°C     x.xs    CT
```

(～part is blinking.)

3 Set the gas flushing time by ▲ , ▼ .

(Setting range : 0.1 ～ 99.9 seconds)

Select the n-times gas flushing

1 When screen displays operation No.
(ex. [01] SEALING ONLY)

```
[01]  SEALING  ONLY
  ▼  ▲ Change (number)
  ◀  ▶ Change (item)
  COUNTER     xxxxx
```

Push MENU and display changes to

```
MENU /◀ ▶/ MENU=Back
1 Entry        2 Change
3 Delete       4 Circulate
5 Drain        6 Maintain
```

2-1 Entry : put the cursor to "1 Entry" by ◀ , ▶ and push ENTER.

The next operation is 3.

2-2 Change of contents : Put the cursor to "2 Change" by ◀ , ▶ and push ENTER.

Display changes to the one for selecting the operation number. Then select the number by ▲ , ▼ and push ENTER.

3 Display changes to

```
[xx]  METHOD   ◀ ▶ ENT=OK
1 SEAL        2 VAC & SEAL
3 1-GAS       4 n-GAS
5 CIRCULATE
```

(5 CIRCULATE is displayed only in effect)

4 Put the cursor to "4 n-GAS" by ◀ , ▶ and push ENTER.

Display changes to

```
[xx]  VAC TYPE  ◀ ▶ Select
n-GAS

1 Manual   2 Time   3 Gauge
```

5 Select the vacuum method from 1 Manual, 2 Time, 3 Gauge by ◀ , ▶ and push ENTER.

6 About the next setting, please refer "Set the n-time gas flushing timer" in page 45.

Set the n-times gas flushing timer

TIPS

Two pattern's gas flushing time can be set.
1 : from the first time to (n-1) time
2 : n (the last) time

Ex. 5 times gas flushing :
1st and 5th time can be set.
2nd, 3rd, 4th time are same with 1st

1 Refer the explanation in page 45 and select the n-times gas flushing.
Then select the vacuum pattern as the instruuction in page 42.

2-1 When you select "1 Manual"

2-1-1 Set the 1st (to n-1th) gas flushing time.

```
[xx]▼▲ Change  ◀ ▶ Move
   1V   MANUAL     G    xx.xsec
  xxV   MANUAL     G    xx.xsec
   HT   xx°F     x.xs     CT
```

(～part is blinking.)

```
[xx]▼▲ Change  ◀ ▶ Move
   1V   MANUAL     G    xx.xsec
  xxV   MANUAL     G    xx.xsec
   HT   xx°C     x.xs     CT
```

(～part is blinking.)

Set the gas flushing time by ▲, ▼.

(Setting range : 0.1 ～ 99.9 seconds)

2-1-2 Put the cursor (by ▶), to the position

for setting the number of vacuum and gas flushing times. (the left of VT)

```
[xx]▼▲ Change  ◀ ▶ Move
   1V   MANUAL     G    xx.xsec
  xxV   MANUAL     G    xx.xsec
   HT   xx°F     x.xs     CT
```

(～part is blinking.)

```
[xx]▼▲ Change  ◀ ▶ Move
   1V   MANUAL     G    xx.xsec
  xxV   MANUAL     G    xx.xsec
   HT   xx°C     x.xs     CT
```

(～part is blinking.)

Set the number of vacuum and gas flushing times by ▲, ▼.

(Setting range : 2 ～ 99 times)

2-1-3 Put the cursor (by ▶), to the position

for setting the n th (last) gas flushing time.

```
[xx]▼▲ Change  ◀ ▶ Move
   1V   MANUAL     G    xx.xsec
  xxV   MANUAL     G    xx.xsec
   HT   xx°F     x.xs     CT
```

(～part is blinking.)

```
[xx]▼▲ Change  ◀ ▶ Move
   1V   MANUAL     G    xx.xsec
  xxV   MANUAL     G    xx.xsec
   HT   xx°C     x.xs     CT
```

(～part is blinking.)

Set the gas flushing time by ▲, ▼.

(Setting range : 0.1 ～ 99.9 seconds)

2-2 When you select "2 Time"

2-2-1 Set the 1st (to n-1th) vacuum time.

```
[xx]▼▲ Change  ◀ ▶ Move
   1VT   xx.xsec    G    xx.xsec
  xxVT   xx.xsec    G    xx.xsec
   HT    xx°F     x.xs     CT
```

(～part is blinking.)

```
[xx]▼▲ Change  ◀ ▶ Move
   1VT   xx.xsec    G    xx.xsec
  xxVT   xx.xsec    G    xx.xsec
   HT    xx°C     x.xs     CT
```

(～part is blinking.)

Set the vacuum time by ▲, ▼.

(Setting range : 0.1 ～ 99.9 seconds)

2-2-2 Set the 1st (to n-1th) vacuum time.

```
[xx]▼▲ Change  ◀ ▶ Move
   1VT   xx.xsec    G   xx.xsec
 xxVT   xx.xsec    G   xx.xsec
   HT   xx°F     x.xs    CT
```

(～part is blinking.)

```
[xx]▼▲ Change  ◀ ▶ Move
   1VT   xx.xsec    G   xx.xsec
 xxVT   xx.xsec    G   xx.xsec
   HT   xx°C     x.xs    CT
```

(～part is blinking.)

Set the gas flushing time by ▲, ▼.

(Setting range : 0.1 ～ 99.9 seconds)

2-2-3 Put the cursor (by ▶), to the position

for setting the n th (last) gas flushing time. (the left of VT)

```
[xx]▼▲Change   ◀ ▶Move
   1VT   xx.xsec    G   xx.xsec
 xxVT   xx.xsec    G   xx.xsec
   HT   xx°F     x.xs    CT
```

(～part is blinking.)

```
[xx]▼▲Change   ◀ ▶Move
   1VT   xx.xsec    G   xx.xsec
 xxVT   xx.xsec    G   xx.xsec
   HT   xx°C     x.xs    CT
```

(～part is blinking.)

Set the number of vacuum and gas flushing times by ▲, ▼.

(Setting range : 2 ～ 99 times)

2-2-4 Set the n th vacuum time.

```
[xx]▼▲Change   ◀ ▶Move
  1VT  xx.xsec   G   xx.xsec
 xxVT  xx.xsec   G   xx.xsec
  HT   xx°F   x.xs   CT   xx°F
```

(～part is blinking.)

```
[xx]▼▲ Change  ◀ ▶ Move
   1VT   xx.xsec    G   xx.xsec
 xxVT   xx.xsec    G   xx.xsec
   HT   xx°C     x.xs    CT
```

(～part is blinking.)

Set the vacuum time by ▲, ▼.

(Setting range : 0.1 ～ 99.9 seconds)

2-2-5 Set the n th gas flushing time.

```
[xx]▼▲ Change  ◀ ▶ Move
   1VT   xx.xsec    G   xx.xsec
 xxVT   xx.xsec    G   xx.xsec
   HT   xx°F     x.xs    CT
```

(～part is blinking.)

```
[xx]▼▲ Change  ◀ ▶ Move
   1VT   xx.xsec    G   xx.xsec
 xxVT   xx.xsec    G   xx.xsec
   HT   xx°C     x.xs    CT
```

(～part is blinking.)

Set the gas flushing times by ▲, ▼.

(Setting range : 0.1 ～ 99.9 seconds)

2-3 When you select "3 Gauge"

2-3-1 Set the 1st (to n-1th) vacuum degree.

```
[xx]▼▲ Change  ◀ ▶ Move
   1VG — xxxkpa    G   xx.xsec
 xxVG — xxxkpa    G   xx.xsec
   HT   xx°F     x.xs    CT
```

(～part is blinking.)

```
[xx]▼▲ Change  ◀ ▶ Move
   1VG — xxxkpa    G   xx.xsec
 xxVG — xxxkpa    G   xx.xsec
   HT   xx°C     x.xs    CT
```

(～part is blinking.)

Set the vacuum degree by ▲, ▼.

(Setting range : －1 ～ －100 kpa)

2-3-2 Set the 1st (to n-1th) gas flushing time.

```
[xx]▼▲ Change  ◀ ▶ Move
   1VG — xxxkpa   █G   xx.xsec
 xxVG — xxxkpa    G   xx.xsec
   HT   xx°F     x.xs     CT
```

(～part is blinking.)

```
[xx]▼▲ Change  ◀ ▶ Move
   1VG — xxxkpa   █G   xx.xsec
 xxVG — xxxkpa    G   xx.xsec
   HT   xx°C     x.xs     CT
```

(～part is blinking.)

Set the gas flushing time by ▲, ▼.

(Setting range : −1 ～ −100 kpa)

2-3-3 Put the cursor (by ▶), to the position

for setting the n th (last) gas flushing time. (the left of VT)

```
[xx]▼▲ Change  ◀ ▶ Move
   1VG — xxxkpa    G   xx.xsec
█xxVG — xxxkpa    G   xx.xsec
   HT   xx°F     x.xs     CT
```

(～part is blinking.)

```
[xx]▼▲ Change  ◀ ▶ Move
   1VG — xxxkpa    G   xx.xsec
█xxVG — xxxkpa    G   xx.xsec
   HT   xx°C     x.xs     CT
```

(～part is blinking.)

Set the number of vacuum and gas flushing time by ▲, ▼.

(Setting range : 2 ～ 99 times)

2-3-4 Set the n th vacuum degree.

```
[xx]▼▲ Change  ◀ ▶ Move
   1VG — xxxkpa    G   xx.xsec
 xxVG█— xxxkpa    G   xx.xsec
   HT   xx°F     x.xs     CT
```

(～part is blinking.)

```
[xx]▼▲ Change  ◀ ▶ Move
   1VG — xxxkpa    G   xx.xsec
 xxVG█— xxxkpa    G   xx.xsec
   HT   xx°C     x.xs     CT
```

(～part is blinking.)

Set the vacuum degree by ▲, ▼.

(Setting range : −1 ～ −100 kpa)

2-3-5 Set the n th gas flushing time.

```
[xx]▼▲ Change  ◀ ▶ Move
   1VG — xxxkpa    G   xx.xsec
 xxVG — xxxkpa   █G   xx.xsec
   HT   xx°F     x.xs     CT
```

(～part is blinking.)

```
[xx]▼▲ Change  ◀ ▶ Move
   1VG — xxxkpa    G   xx.xsec
 xxVG — xxxkpa   █G   xx.xsec
   HT   xx°C     x.xs     CT
```

(～part is blinking.)

Set the gas flushing time by ▲, ▼.

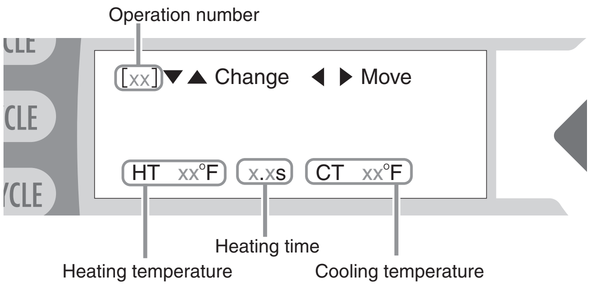
(Setting range : 0.0 ～ 99.9 seconds)

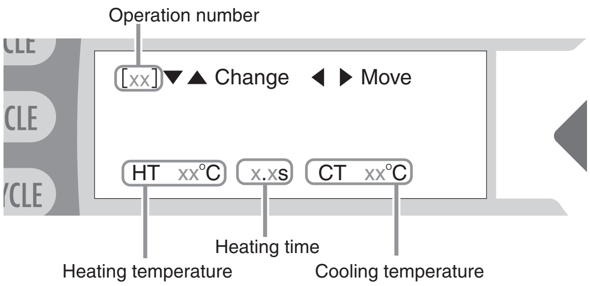
3 Display change to the one for setting the heating temperature, time and cooling temperature.
Please set the suitable value.

8-5 Operation procedure

In this chapter, the flow of 13 kinds operations are explained.
Please check the flow of how to use after setting up the controller.

● Sealing only

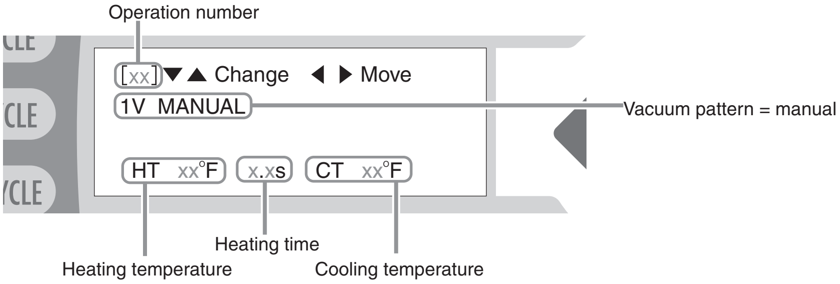


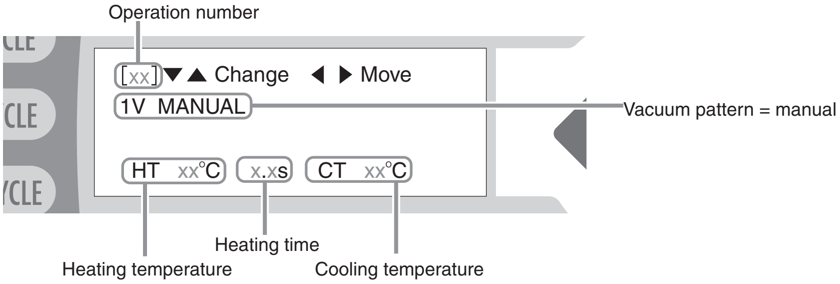


	Procedure	Reference page or Description
1	Circuit breaker ON.	"Starting of use" in page 34.
2	Power button ON.	"Starting of use" in page 34.
3	3-1 Already entered, select the operation number of "SEALING ONLY". 3-2 No entry :	3-1 "Select the operation number" in page 38. 3-2 "Select the sealing method" in page 38. ="1 SEAL"
4	Set the heating temperature. (Setting range 140 ～ 480°F) (Setting range 60 ～ 250°C)	"Set the heating temperature" in page 36.
5	Set the heating time. (Setting range 0.0 ～ 2.0seconds)	"Set the heating time" in page 36.
6	Set the cooling temperature. (Setting range 100°F ～ heating temperature) (Setting range 40°C ～ heating temperature)	"Set the cooling temperature" in page 45.
7	Set a pouch on the sealing position.	Prepare both ends of a pouch for a seal position.

8	Depress the foot switch (1st).	Pressure lever descends and fasten a pouch with sponge rubber. (Keep on stepping until the pressure lever close.) Attention! If leg is separated from the foot switch in the middle of downward, the pressure lever will open for the safe mechanism.
9	Depress the foot switch (2nd).	By the second depressing the foot switch, the following process (from 9-1 to 9-5) is performed automatically. 9-1 Sealing starts. 9-2 Heating lamp is turned on. HEAT CYCLE 9-3 After the heating is finished (heating lamp is turned off), cooling lamp is turned on. HEAT CYCLE COOL CYCLE 9-4 Cooling is finished. (Cooling lamp is turned off.) COOL CYCLE 9-5 Sealing process is completed. (Pressure lever open.)
10	Sealing process is completed.	If you will not use this sealer for a long time, please work as indicated in "Finishing of use" in page 34.

Vacuum (manual) and Sealing

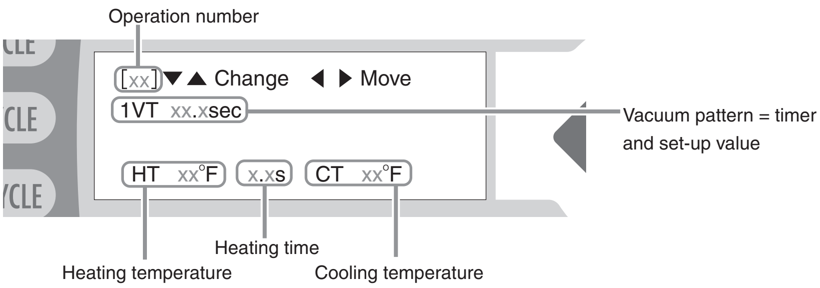


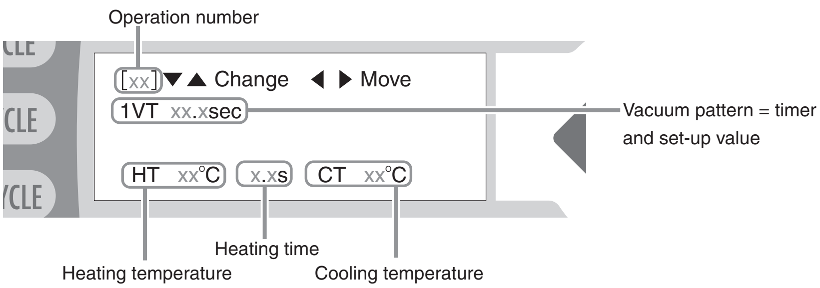


	Procedure	Reference page or Description
1	Circuit breaker ON.	"Starting of use" in page 34.
2	Power button ON.	"Starting of use" inpage 34.
3	3-1 Already entered, select the operation number of "VAC&SEAL manual". 3-2 No entry :	3-1 "Select the operation number" in page 38. 3-2 "Select the sealing method" in page 38 = "2 VAC&SEAL" "Select the vacuum pattern" in page 44. = "1 Manual"
4	Set the heating temperature. (Setting range 140 ~ 480°F) (Setting range 60 ~ 250°C)	"Set the heating temperature" in page 36.
5	Set the heating time. (Setting range 0.0 ~ 2.0seconds)	"Set the heating time" in page 36.
6	Set the cooling temperature. (Setting range 100°F ~ heating temperature) (Setting range 40°C ~ heating temperature)	"Set the cooling temperature" in page 45.
7	Depress the foot switch (1st)	Nozzle comes forward.
8	Set a pouch on the sealing position.	Insert the nozzle in a pouch, and set it on the sealing position.

9	Depress the foot switch (2nd).	Pressure lever descends and fasten a pouch with sponge rubber. (Keep on stepping until the pressure lever close.) Attention! If leg is separated from the foot switch in the middle of downward, the pressure lever will open for the safe mechanism.
10	Depress the foot switch (3rd).	Vacuum process starts.Vacuum lamp is turned on. 
11	When the sufficient vacuum is done, depress the foot switch (4th).	By the fourth depressing the foot switch, the following process (from 11-1 to 11-6) will be performed automatically. 11-1 Vacuum is finished.  11-2 Nozzle returns. 11-3 Pressure lever close and sealing starts. Heating lamp is turned on.  11-4 After the heating is finished (heating lamp is turned off), cooling lamp is turned on.  11-5 Cooling is finished. (Cooling lamp is turned off.)  11-6 Sealing process is completed. (Pressure lever opens and nozzle comes forward.)
12	Sealing process is completed.	If you will not use this sealer for a long time, please work as indicated in "Finishing of use" in page 34.

Vacuum (timer) and Sealing

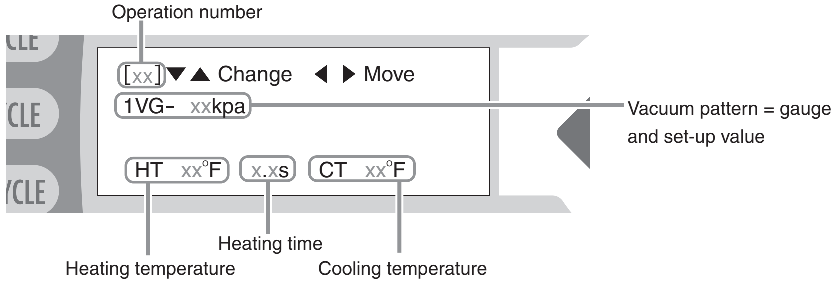


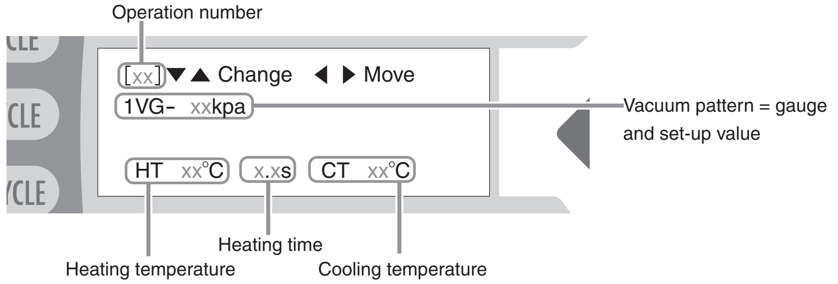


	Procedure	Reference page or Description
1	Circuit breaker ON.	"Starting of use" in page 34.
2	Power button ON.	"Starting of use" in page 34.
3	3-1 Already entered, select the operation number of "VAC&SEAL timer". 3-2 No entry :	3-1 "Select the operation number" in page 38. 3-2 "Select the sealing method" in page 38. = "2 VAC&SEAL" "Select the vacuum pattern" in page 44. = "2 Time"
4	Set the vacuum time. (Setting range 0.1 ～ 99.9seconds)	"Set the vacuum time" in page 43.
5	Set the heating temperature. (Setting range 140 ～ 480°F) (Setting range 60 ～ 250°C)	"Set the heating temperature" in page 36.
6	Set the heating time. (Setting range 0.0 ～ 2.0seconds)	"Set the heating time" in page 36.
7	Set the cooling temperature. (Setting range 100°F ～ heating temperature) (Setting range 40°C ～ heating temperature)	"Set the cooling temperature" in page 45.
8	Depress the foot switch (1st)	Nozzle comes forward.
9	Set a pouch on the sealing position.	Insert the nozzle in a pouch, and set it on the sealing position.

10	Depress the foot switch (2nd).	Pressure lever descends and fasten a pouch with sponge rubber. (Keep on stepping until the pressure lever close.) Attention! If leg is separated from the foot switch in the middle of downward, the pressure lever will open for the safe mechanism.
11	Depress the foot switch (3rd).	By the third depressing the foot switch, the following process (from 11-1 to 11-7) will be performed automatically. 11-1 Vacuum starts. Vacuum lamp is turned on. VAC CYCLE 11-2 When the set-up time is passed, vacuum is finished. Vacuum lamp is turned off. VAC CYCLE 11-3 Nozzle returns. 11-4 Pressure lever close and sealing starts. Heating lamp is turned on. HEAT CYCLE 11-5 After the heating is finished (heating lamp is turned off), cooling lamp is turned on. HEAT CYCLE COOL CYCLE 11-6 Cooling is finished. (Cooling lamp is turned off.) COOL CYCLE 11-7 Sealing process is completed. (Pressure lever opens and nozzle comes forward.)
12	Sealing process is completed.	If you will not use this sealer for a long time, please work as indicated in "Finishing of use" in page 34.

Vacuum (gauge) and Sealing

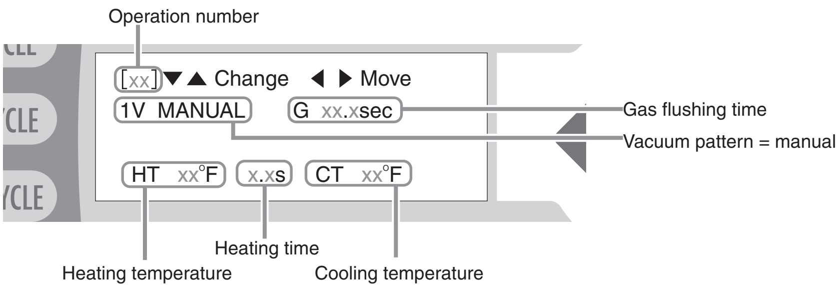


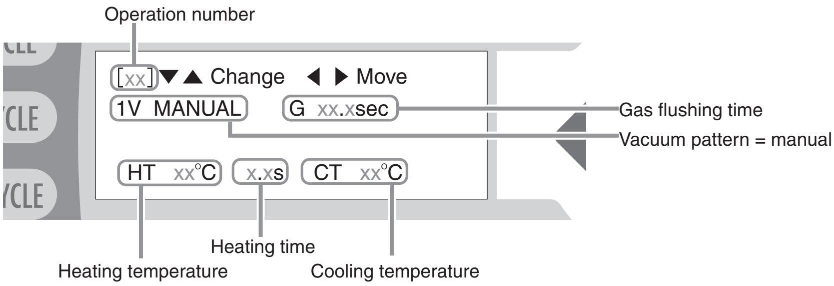


	Procedure	Reference page or Description
1	Circuit breaker ON.	"Starting of use" in page 34
2	Power button ON.	"Starting of use" in page 34.
3	3-1 Already entered, select the operation number of "VAC&SEAL gauge". 3-2 No entry :	3-1 "Select the operation number" in page 38. 3-2 "Select the sealing method" in page 38. = "2 VAC&SEAL" "Select the vacuum pattern" in page 44. = "3 Gauge"
4	Set the vacuum degree. (Setting range −1 ~ −100kpa)	"Set the vacuum degree" in page 43.
5	Set the heating temperature. (Setting range 140 ~ 480°F) (Setting range 60 ~ 250°C)	"Set the heating temperature" in page 36
6	Set the heating time. (Setting range 0.0 ~ 2.0seconds)	"Set the heating time" in page 36.
7	Set the cooling temperature. (Setting range 100°F ~ heating temperature) (Setting range 40°C ~ heating temperature)	"Set the cooling temperature" in page 45.
8	Depress the foot switch (1st)	Nozzle comes forward.
9	Set a pouch on the sealing position.	Insert the nozzle in a pouch, and set it on the sealing position.

10	Depress the foot switch (2nd).	Pressure lever descends and fasten a pouch with sponge rubber. (Keep on stepping until the pressure lever close.) Attention! If leg is separated from the foot switch in the middle of downward, the pressure lever will open for the safe mechanism.
11	Depress the foot switch (3rd).	By the third depressing the foot switch, the following process (from 11-1 to 11-7) will be performed automatically. 11-1 Vacuum starts. Vacuum lamp is turned on. VAC CYCLE 11-2 When the vacuum degree reaches to the set-up time, vacuum is finished. Vacuum lamp is turned off. VAC CYCLE 11-3 Nozzle returns. 11-4 Pressure lever close and sealing starts. Heating lamp is turned on. HEAT CYCLE 11-5 After the heating is finished (heating lamp is turned off), cooling lamp is turned on. HEAT CYCLE COOL CYCLE 11-6 Cooling is finished. (Cooling lamp is turned off.) COOL CYCLE 11-7 Sealing process is completed. (Pressure lever opens and nozzle comes forward.)
12	Sealing process is completed.	If you will not use this sealer for a long time, please work as indicated in "Finishing of use" in page 34.

● [1 time] Vacuum (manual), Gas flushing and Sealing

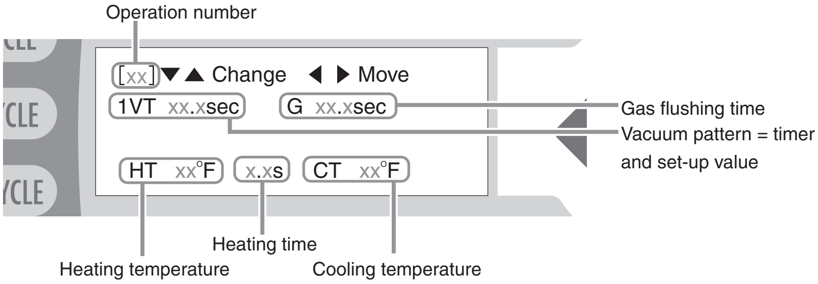


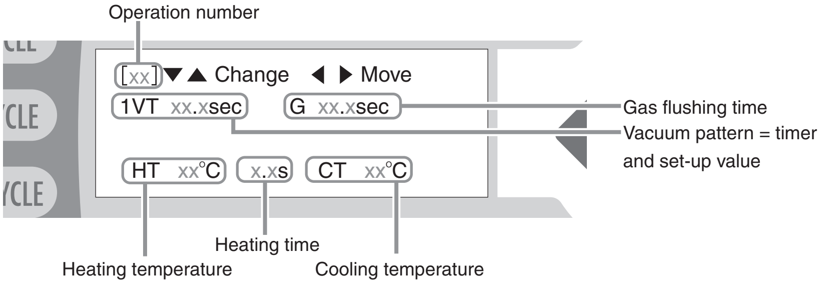


	Procedure	Reference page or Description
1	Circuit breaker ON.	"Starting of use" in page 34.
2	Power button ON.	"Starting of use" in page 34.
3	3-1 Already entered, select the operation number of "1-GAS manual". 3-2 No entry :	3-1 "Select the operation number" in page 38. 3-2 "Select the 1 time gas flushing" in page 46. = "3 1-GAS" "Select the vacuum pattern" in page 44. = "1 Manual"
4	Set the gas flushing time. (Setting range 0.1 ~ 99.9seconds)	"Set the 1 time gas flushing timer" in page 47.
5	Set the heating temperature. (Setting range 140 ~ 480°F) (Setting range 60 ~ 250°C)	"Set the heating temperature" in page 36.
6	Set the heating time. (Setting range 0.0 ~ 2.0seconds)	"Set the heating time" in page 36.
7	Set the cooling temperature. (Setting range 100°F ~ heating temperature) (Setting range 40°C ~ heating temperature)	"Set the cooling temperature" in page 45.
8	Depress the foot switch (1st)	Nozzle comes forward.
9	Set a pouch on the sealing position.	Insert the nozzle in a pouch, and set it on the sealing position.

10	Depress the foot switch (2nd).	Pressure lever descends and fasten a pouch with sponge rubber. (Keep on stepping until the pressure lever close.) Attention! If leg is separated from the foot switch in the middle of downward, the pressure lever will open for the safe mechanism.
11	Depress the foot switch (3rd).	Vacuum process starts.Vacuum lamp is turned on. VAC CYCLE
12	When the sufficient vacuum is done, depress the foot switch (4th).	By the fourth depressing the foot switch, the following process (from 12-1 to 12-8) will be performed automatically. 12-1 Vacuum is finished.Vacuum lamp is turned off. VAC CYCLE 12-2 Gas flushing starts. Gas flushing lamp is turned on. GAS CYCLE 12-3 Gas flushing is finished when set-up time is past. Gas flushing lamp is turned off. GAS CYCLE 12-4 Nozzle returns. 12-5 Pressure lever close and sealing starts. Heating lamp is turned on. HEAT CYCLE 12-6 After the heating is finished (heating lamp is turned off), cooling lamp is turned on. HEAT CYCLE COOL CYCLE 12-7 Cooling is finished. (Cooling lamp is turned off.) COOL CYCLE 12-8 Sealing process is completed. (Pressure lever opens and nozzle comes forward.)
13	Sealing process is completed.	If you will not use this sealer for a long time, please work as indicated in "Finishing of use" in page 34.

[1 time] Vacuum (timer), Gas flushing and Sealing

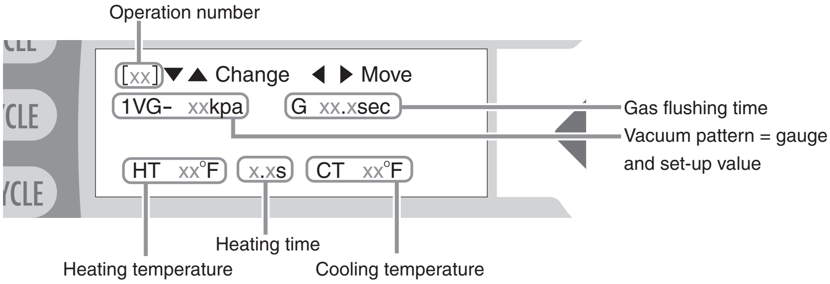


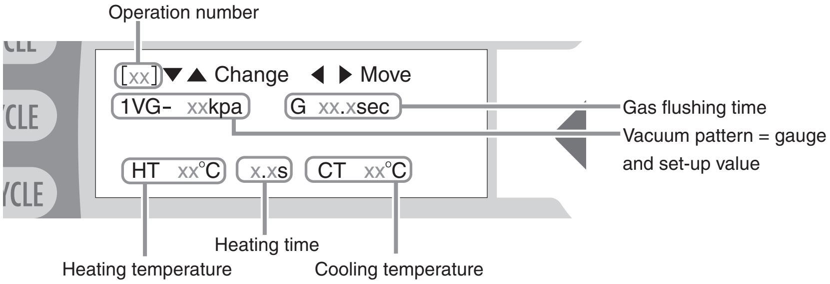


	Procedure	Reference page or Description
1	Circuit breaker ON.	"Starting of use" in page 34.
2	Power button ON.	"Starting of use" in page 34.
3	3-1 Already entered, select the operation number of "1-GAS timer". 3-2 No entry :	3-1 "Select the operation number" in page 38. 3-2 "Select the 1 time gas flushing" in page 46. = "3 1-GAS" "Select the vacuum pattern" in page 44. = "2 Time"
4	Set the vacuum time. (Setting range 0.1 ～ 99.9seconds)	"Set the vacuum time" in page 43.
5	Set the gas flushing time. (Setting range 0.1 ～ 99.9seconds)	"Set the 1 time gas flushing timer" in page 47.
6	Set the heating temperature. (Setting range 140 ～ 480°F) (Setting range 60 ～ 250°C)	"Set the heating temperature" in page 36.
7	Set the heating time. (Setting range 0.0 ～ 2.0seconds)	"Set the heating time" in page 36.
8	Set the cooling temperature. (Setting range 100°F ～ heating temperature) (Setting range 40°C ～ heating temperature)	"Set the cooling temperature" in page 45.
9	Depress the foot switch (1st)	Nozzle comes forward.

10	Set a pouch on the sealing position.	Insert the nozzle in a pouch, and set it on the sealing position.
11	Depress the foot switch (2nd).	Pressure lever descends and fasten a pouch with sponge rubber. (Keep on stepping until the pressure lever close.) Attention! If leg is separated from the foot switch in the middle of downward, the pressure lever will open for the safe mechanism.
12	Depress the foot switch (3rd).	By the third depressing the foot switch, the following process (from 12-1 to 12-9) will be performed automatically. 12-1 Vacuum starts. Vacuum lamp is turned on. VAC CYCLE 12-2 Vacuum is finished when set-up time is past. Vacuum lamp is turned off. VAC CYCLE 12-3 Gas flushing starts. Gas flushing lamp is turned on. GAS CYCLE 12-4 Gas flushing is finished when set-up time is past. Gas flushing lamp is turned off. GAS CYCLE 12-5 Nozzle returns. 12-6 Pressure lever close and sealing starts. Heating lamp is turned on. HEAT CYCLE 12-7 After the heating is finished (heating lamp is turned off), cooling lamp is turned on. HEAT CYCLE COOL CYCLE 12-8 Cooling is finished. (Cooling lamp is turned off.) COOL CYCLE 12-9 Sealing process is completed. (Pressure lever opens and nozzle comes forward.)
13	Sealing process is completed.	If you will not use this sealer for a long time, please work as indicated in "Finishing of use" in page 34.

[1 time] Vacuum (gauge), Gas flushing and Sealing

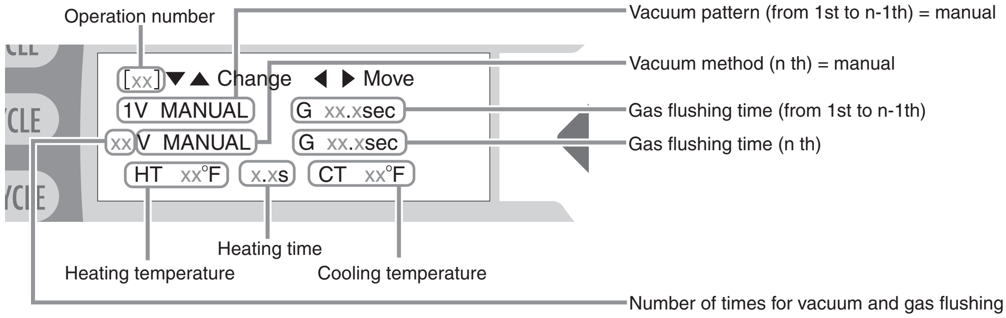


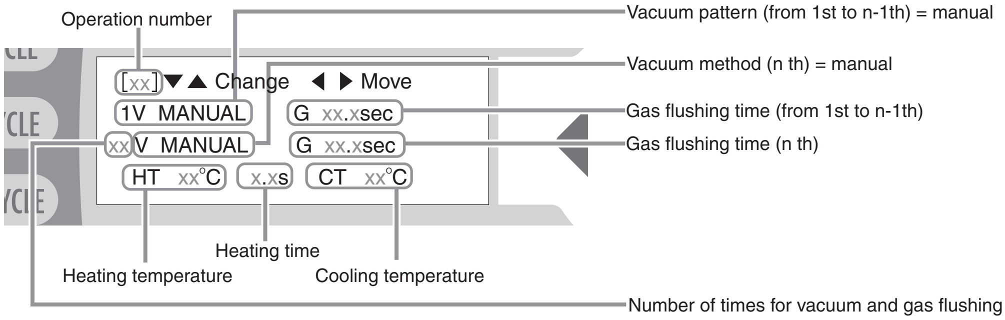


	Procedure	Reference page or Description
1	Circuit breaker ON.	"Starting of use" in page 34.
2	Power button ON.	"Starting of use" in page 34.
3	3-1 Already entered, select the operation number of "1-GAS gauge". 3-2 No entry :	3-1 "Select the operation number" in page 38. 3-2 "Select the 1 time gas flushing" in page 46. = "3 1-GAS" "Select the vacuum pattern" in page 44. = "3 Gauge"
4	Set the vacuum degree. (Setting range −1 ~ −100kpa)	"Set the vacuum degree" in page 43.
5	Set the gas flushing time. (Setting range 0.1 ~ 99.9seconds)	"Set the 1 time gas flushing timer" in page 47.
6	Set the heating temperature. (Setting range 140 ~ 480°F) (Setting range 60 ~ 250°C)	"Set the heating temperature" in page 36.
7	Set the heating time. (Setting range 0.0 ~ 2.0seconds)	"Set the heating time" in page 36.
8	Set the cooling temperature. (Setting range 100°F ~ heating temperature) (Setting range 40°C ~ heating temperature)	"Set the cooling temperature" in page 45.
9	Depress the foot switch (1st)	Nozzle comes forward.

10	Set a pouch on the sealing position.	Insert the nozzle in a pouch, and set it on the sealing position.
11	Depress the foot switch (2nd).	Pressure lever descends and fasten a pouch with sponge rubber. (Keep on stepping until the pressure lever close.) Attention! If leg is separated from the foot switch in the middle of downward, the pressure lever will open for the safe mechanism.
12	Depress the foot switch (3rd).	By the third depressing the foot switch, the following process (from 12-1 to 12-9) will be performed automatically. 12-1 Vacuum starts. Vacuum lamp is turned on. VAC CYCLE 12-2 Vacuum is finished when set-up time is past. Vacuum lamp is turned off. VAC CYCLE 12-3 Gas flushing starts. Gas flushing lamp is turned on. GAS CYCLE 12-4 Gas flushing finished when set-up time is past. Gas flushing lamp is turned off. GAS CYCLE 12-5 Nozzle returns. 12-6 Pressure lever close and sealing starts. Heating lamp is turned on. HEAT CYCLE 12-7 After the heating is finished (heating lamp is turned off), cooling lamp is turned on. HEAT CYCLE COOL CYCLE 12-8 Cooling is finished. (Cooling lamp is turned off.) COOL CYCLE 12-9 Sealing process is completed. (Pressure lever opens and nozzle comes forward.)
13	Sealing process is completed.	If you will not use this sealer for a long time, please work as indicated in "Finishing of use" in page 34.

● [n times] Vacuum (manual), Gas flushing and Sealing



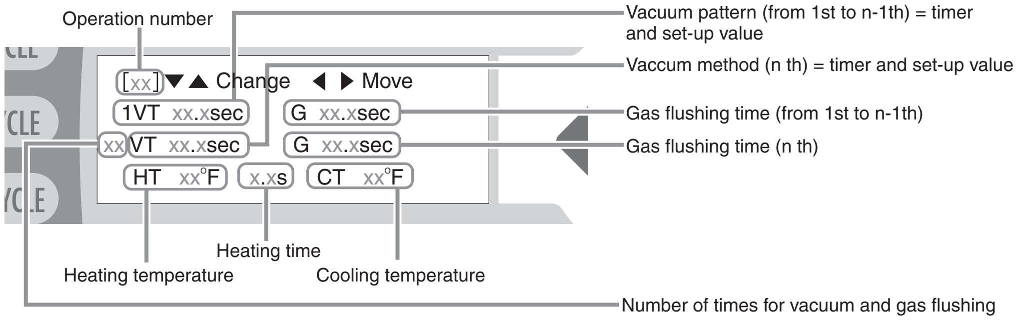


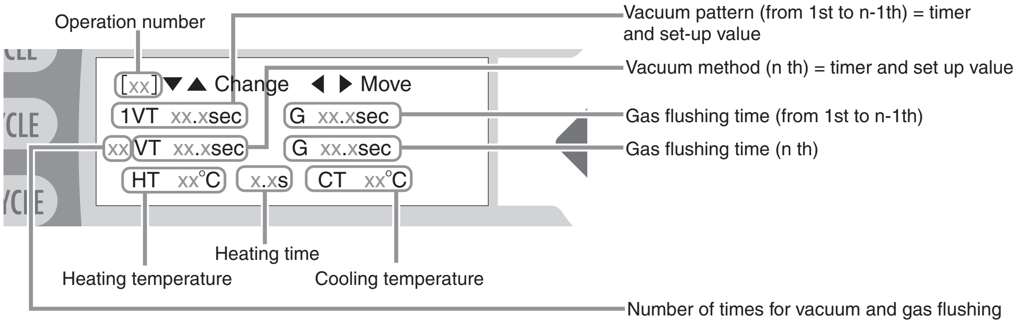
	Procedure	Reference page or Description
1	Circuit breaker ON.	"Starting of use" in page 34.
2	Power button ON.	"Starting of use" in page 34.
3	3-1 Already entered, select the operation number of "n-GAS manual". 3-2 No entry :	3-1 "Select the operation number" in page 38. 3-2 "Select the n-times gas flushing" in page 47. = "4 n-GAS" "Select the vacuum pattern" in page 44. = "1 Manual"
4	Set the 1st to n-1th gas flushing time. (Setting range 0.1 ～ 99.9seconds)	
5	Set the number of time for vacuum and gas flushing. (Setting range 2 ～ 99times)	"Set the n-times gas flushing timer" in page 48.
6	Set the n-th gas flushing time. (Setting range 0.1 ～ 99.9seconds)	
7	Set the heating temperature. (Setting range 140 ～ 480°F) (Setting range 60 ～ 250°C)	"Set the heating temperature" in page 36.
8	Set the heating time. (Setting range 0.0 ～ 2.0seconds)	"Set the heating time" in page 36.

9	Set the cooling temperature. (Setting range 100°F ～ heating temperature) (Setting range 40°C ～ heating temperature)	"Set the cooling temperature" in page 45.
10	Depress the foot switch (1st)	Nozzle comes forward.
11	Set a pouch on the sealing position.	Insert the nozzle in a pouch, and set it on the sealing position.
12	Depress the foot switch (2nd).	Pressure lever descends and fasten a pouch with sponge rubber. (Keep on stepping until the pressure lever close.) Attention! If leg is separated from the foot switch in the middle of downward, the pressure lever will open for the safe mechanism.
13	Depress the foot switch (3rd).	Vacuum process starts.Vacuum lamp is turned on. VAC CYCLE
14	When the sufficient vacuum is done, depress the foot switch (4th).	By the fourth depressing the foot switch, the following process (from 14-1 to 14-3) will be performed automatically. 14-1 Vacuum is finished when set-up time is past. Vacuum lamp is turned off. Gas flushing starts. Gas flushing lamp is turned on. VAC CYCLE GAS CYCLE 14-2 Gas flushing is finished when set-up time is past. Gas flushing lamp is turned off. GAS CYCLE 14-3 The second vacuum starts.Vacuum lamp is turned on. VAC CYCLE
15	When the sufficient vacuum is done, depress the foot switch (5th).	Process from 14-1 to 14-3 is repeated n-1 times.
16	Depress the foot switch (n-th).	By the n-th depressing the foot switch, the following process (from 16-1 to 16-7) will be performed automatically. 16-1 Vacuum is finished when set-up time is past. Vacuum lamp is turned off. n-th Gas flushing starts. Gas flushing lamp is turned on. VAC CYCLE GAS CYCLE

16		16-2 n-th Gas flushing is finished when set-up time is past. Gas flushing lamp is turned off. GAS CYCLE 16-3 Nozzle returns. 16-4 Pressure lever close and sealing starts. Heating lamp is turned on. HEAT CYCLE 16-5 After the heating is finished (heating lamp is turned off), cooling lamp is turned on. HEAT CYCLE COOL CYCLE 16-6 Cooling is finished. (Cooling lamp is turned off.) COOL CYCLE 16-7 Sealing process is completed. (Pressure lever opens and nozzle comes forward.)
17	Sealing process is completed.	If you will not use this sealer for a long time, please work as indicated in "Finishing of use" in page 34.

[n times] Vacuum (timer), Gas flushing and Sealing



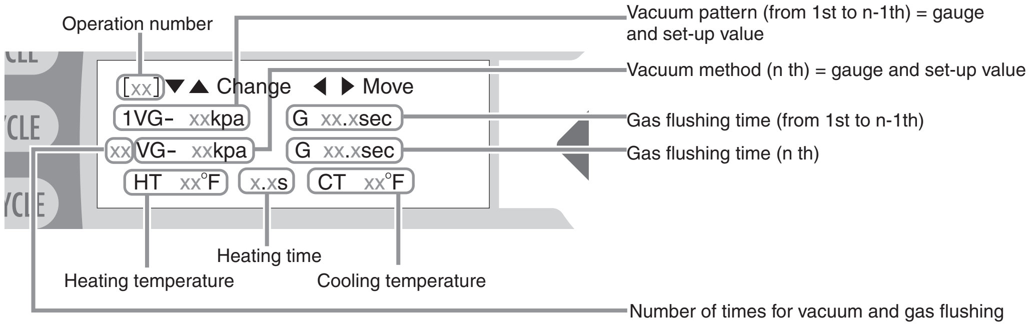


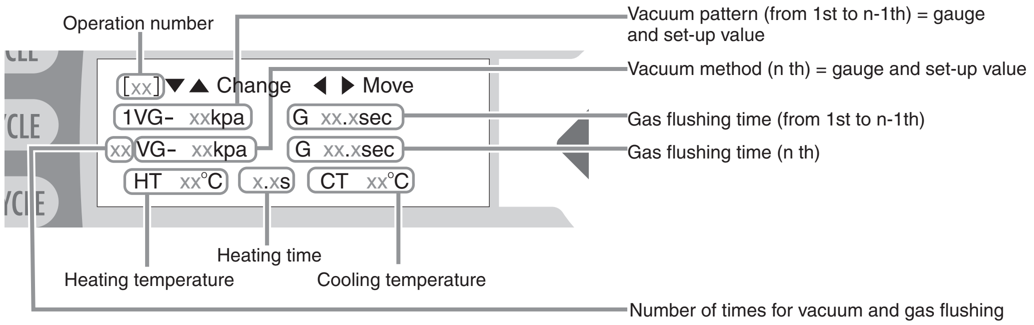
	Procedure	Reference page or Description
1	Circuit breaker ON.	"Starting of use" in page 34.
2	Power button ON.	"Starting of use" in page 34.
3	3-1 Already entered, select the operation number of "n-GAS timer". 3-2 No entry :	3-1 "Select the operation number" in page 38. 3-2 "Select the n-times gas flushing" in page 47. = "4 n-GAS" "Select the vacuum pattern" in page 44. = "2 Time"
4	Set the 1st to n-1th vacuum time. (Setting range 0.1 ～ 99.9seconds)	
5	Set the 1st to n-1th gas flushing time. (Setting range 0.1 ～ 99.9seconds)	
6	Set the number of times for vacuum and gas flushing (Setting range 2 ～ 99times)	"Set the n-times gas flushing timer" in page 48
7	Set the n-1th vacuum time. (Setting range 0.1 ～ 99.9seconds)	
8	Set the n-1th gas flushing time. (Setting range 0.0 ～ 99.9seconds)	
9	Set the heating temperature. (Setting range 140 ～ 480°F) (Setting range 60 ～ 250°C)	"Set the heating temperature" in page 36.

10	Set the heating time. (Setting range 0.0 ～ 2.0seconds)	"Set the heating time" in page 36.
11	Set the cooling temperature. (Setting range 100°F ～ heating temperature) (Setting range 40°C ～ heating temperature)	"Set the cooling temperature" in page 45.
12	Depress the foot switch (1st)	Nozzle comes forward.
13	Set a pouch on the sealing position.	Insert the nozzle in a pouch, and set it on the sealing position.
14	Depress the foot switch (2nd).	Pressure lever descends and fasten a pouch with sponge rubber. (Keep on stepping until the pressure lever close.) Attention! If leg is separated from the foot switch in the middle of downward, the pressure lever will open for the safe mechanism.
15	Depress the foot switch (3rd).	By the third depressing the foot switch, the following process (from 15-1 to 15-13) will be performed automatically. 15-1 Vacuum starts (1st). Vacuum lamp is turned on. VAC CYCLE 15-2 Vacuum is finished when set-up time (for 1st ～ n-1th vacuum) is past. Vacuum lamp is turned off. VAC CYCLE 15-3 Gas flushing starts (1st). Gas flushing lamp is turned on. GAS CYCLE 15-4 1st gas flushing is finished when set-up time (for 1st ～ n-1th gas flushing) is past. Gas flushing lamp is turned off. GAS CYCLE 15-5 Process 15-1 ～ 15-4 is repeated n-1 times. 15-6 The last (n-th) vacuum starts. Vacuum lamp is turned on. VAC CYCLE

15		15-7 Vacuum is finished when set-up time is past. Vacuum lamp is turned off and n-th gas flushing starts. Gas flushing lamp is turned on.  15-8 n-th gas flushing is finished when set-up time is past. Gas flushing lamp is turned off.  15-9 Nozzle returns. 15-10 Pressure lever close and sealing starts. Heating lamp is turned on.  15-11 After the heating is finished (heating lamp is turned off), cooling lamp is turned on.  15-12 Cooling is finished. (Cooling lamp is turned off.)  15-13 Sealing process is completed. (Pressure lever opens and nozzle comes forward.)
16	Sealing process is completed.	If you will not use this sealer for a long time, please work as indicated in "Finishing of use" in page 34.

[n times] Vacuum (gauge), Gas flushing and Sealing



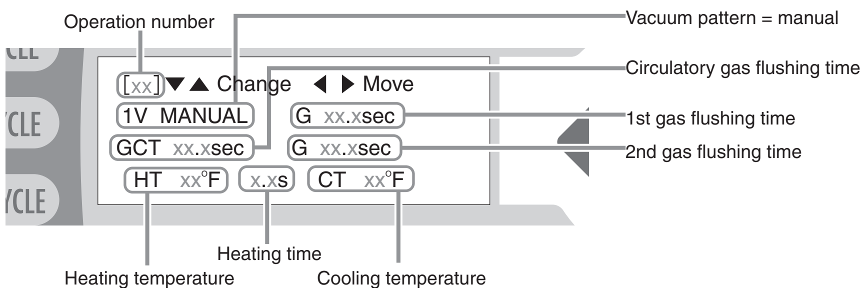


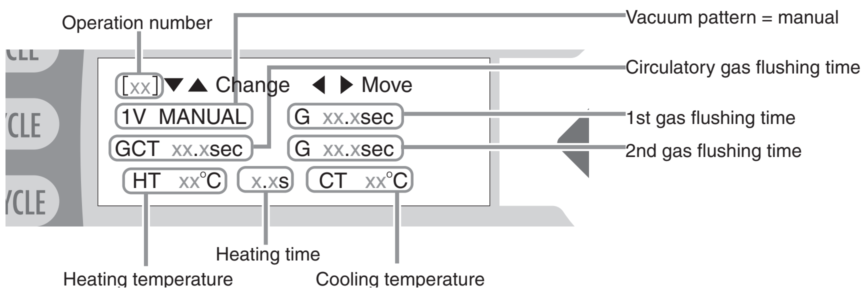
	Procedure	Reference page or Description
1	Circuit breaker ON.	"Starting of use" in page 34.
2	Power button ON.	"Starting of use" in page 34.
3	3-1 Already entered, select the operation number of "n-GAS gauge". 3-2 No entry :	3-1 "Select the operation number" in page 38. 3-2 "Select the 1 time gas flushing" in page 47 = "4 n-GAS" "Select the vacuum pattern" in page 44. = "3 Gauge"
4	Set the 1st ～ n-1th vacuum degree. (Setting range −1 ～ −100kpa)	"Set the n-times gas flushing timer" in page 48.
5	Set the 1st ～ n-1th gas flushing time. (Setting range 0.1 ～ 99.9seconds)	
6	Set the number of times for vacuum and gas flushing (Setting range 2 ～ 99times)	
7	Set the n-th vacuum degree. (Setting range −1 ～ −100kpa)	
8	Set the n-th gas flushing time. (Setting range 0.0 ～ 99.9seconds)	
9	Set the heating temperature. (Setting range 140 ～ 480°F) (Setting range 60 ～ 250°C)	"Set the heating temperature" in page 36.

10	Set the heating time. (Setting range 0.0 ～ 2.0seconds)	"Set the heating time" in page 36.
11	Set the cooling temperature. (Setting range 100°F ～ heating temperature) (Setting range 40°C ～ heating temperature)	"Set the cooling temperature" in page 45.
12	Depress the foot switch (1st)	Nozzle comes forward.
13	Set a pouch on the sealing position.	Insert the nozzle in a pouch, and set it on the sealing position.
14	Depress the foot switch (2nd).	Pressure lever descends and fasten a pouch with sponge rubber. (Keep on stepping until the pressure lever close.) Attention! If leg is separated from the foot switch in the middle of downward, the pressure lever will open for the safe mechanism.
15	Depress the foot switch (3rd).	By the third depressing the foot switch, the following process (from 15-1 to 15-13) will be performed automatically. 15-1 Vacuum starts (1st). Vacuum lamp is turned on. VAC CYCLE 15-2 Vacuum is finished when set-up time (for 1st ～ n-1th vacuum) is past. Vacuum lamp is turned off. VAC CYCLE 15-3 Gas flushing starts (1st). Gas flushing lamp is turned on. GAS CYCLE 15-4 1st gas flushing finished when set-up time (for 1st ～ n-1th gas flushing) is past. Gas flushing lamp is turned off. GAS CYCLE 15-5 Process 15-1 ～ 15-4 is repeated n-1 times. 15-6 The last (n-th) vacuum starts. Vacuum lamp is turned on. VAC CYCLE

15		15-7 Vacuum is finished when set-up time is past. Vacuum lamp is turned off and n-th gas flushing starts. Gas flushing lamp is turned on. VAC CYCLE GAS CYCLE 15-8 n-th gas flushing is finished when set-up time is past. Gas flushing lamp is turned off. GAS CYCLE 15-9 Nozzle returns. 15-10 Pressure lever close and sealing starts. Heating lamp is turned on. HEAT CYCLE 15-11 After the heating is finished (heating lamp is turned off), cooling lamp is turned on. HEAT CYCLE COOL CYCLE 15-12 Cooling is finished. (Cooling lamp is turned off.) COOL CYCLE 15-13 Sealing process is completed. (Pressure lever opens and nozzle comes forward.)
16	Sealing process is completed.	If you will not use this sealer for a long time, please work as indicated in "Finishing of use" in page 34.

● [Circulate] Vacuum (manual), Gas flushing and Sealing



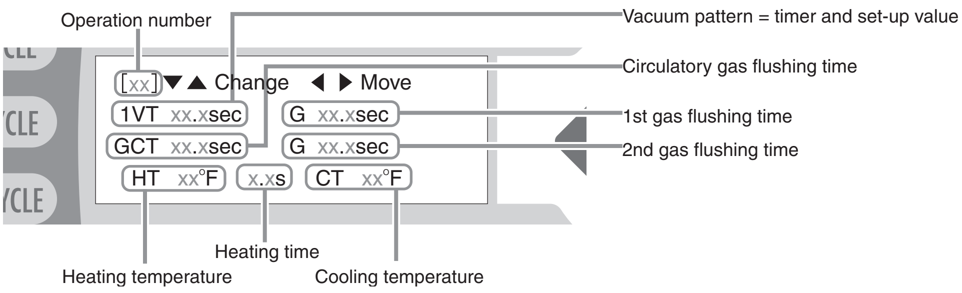


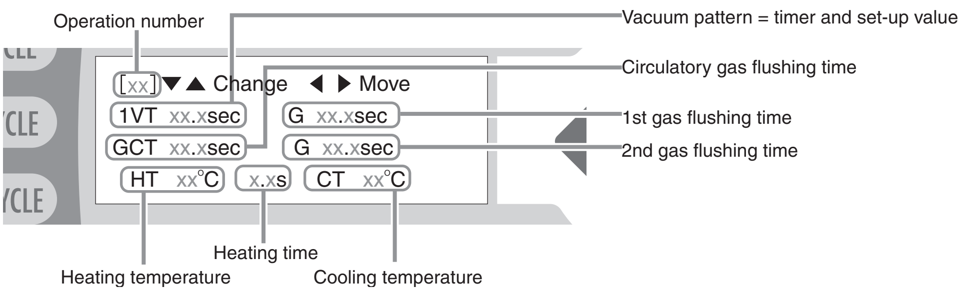
	Procedure	Reference page or Description
1	Circuit breaker ON.	"Starting of use" in page 34.
2	Power button ON.	"Starting of use" in page 34.
3	3-1 Already entered, select the operation number of "Circulation manual". ⚠ Caution Check the piping for gas circulation (Switch to NC piping) 3-2 No entry :	3-1 "Select the operation number" in page 38. 3-2 "Select the gas circulation " in page 39.
4	Set the 1st gas flushing time. (Setting range 0.1 ～ 99.9seconds)	"Set the gas circulation / vacuum by manual" in page 40.
5	Set the circulate gas flushing (Setting range 2 ～ 99times)	
6	Set the 2nd gas flushing time. (Setting range 0.1 ～ 99.9seconds)	
7	Set the heating temperature. (Setting range 140 ～ 480°F) (Setting range 60 ～ 250°C)	"Set the heating temperature" in page 36.
8	Set the heating time. (Setting range 0.0 ～ 2.0seconds)	"Set the heating time" in page 36.

9	Set the cooling temperature. (Setting range 100°F ～ heating temperature) (Setting range 40°C ～ heating temperature)	"Set the cooling temperature" in page 45.
10	Depress the foot switch (1st)	Nozzle comes forward.
11	Set a pouch on the sealing position.	Insert the nozzle in a pouch, and set it on the sealing position.
12	Depress the foot switch (2nd).	Pressure lever descends and fasten a pouch with sponge rubber. (Keep on stepping until the pressure lever close.) Attention! If leg is separated from the foot switch in the middle of downward, the pressure lever will open for the safe mechanism.
13	Depress the foot switch (3rd).	Vacuum process starts. Vacuum lamp is turned on. VAC CYCLE
14	When the sufficient vacuum is done, depress the foot switch (4th).	By the third depressing the foot switch, the following process (from 14-1 to 14-12) will be performed automatically. 14-1 Vacuum is finished. Vacuum lamp is turned off. VAC CYCLE 14-2 1st gas flushing starts. Gas flushing lamp is turned on. GAS CYCLE 14-3 1st gas flushing is finished when set-up time is past. Gas flushing lamp is turned off. GAS CYCLE 14-4 Circulation starts. Vacuum lamp and gas flushing lamp are turned on. VAC CYCLE GAS CYCLE 14-5 Circulation is finished when set-up time is past. Vacuum lamp and gas flushing lamp is turned off. VAC CYCLE GAS CYCLE 14-6 2nd gas flushing starts. Gas flushing lamp is turned on. GAS CYCLE

14		14-7 2nd gas flushing is finished when set-up time is past. Gas flushing lamp is turned off.  14-8 Nozzle returns. 14-9 Pressure lever close and sealing starts. Heating lamp is turned on.  14-10 After the heating is finished (heating lamp is turned off), cooling lamp is turned on.  14-11 Cooling is finished. (Cooling lamp is turned off.)  14-12 Sealing process is completed. (Pressure lever opens and nozzle comes forward.)
15	Sealing process is completed.	If you will not use this sealer for a long time, please work as indicated in "Finishing of use" in page 34.

[Circulate] Vacuum (timer), Gas flushing and Sealing



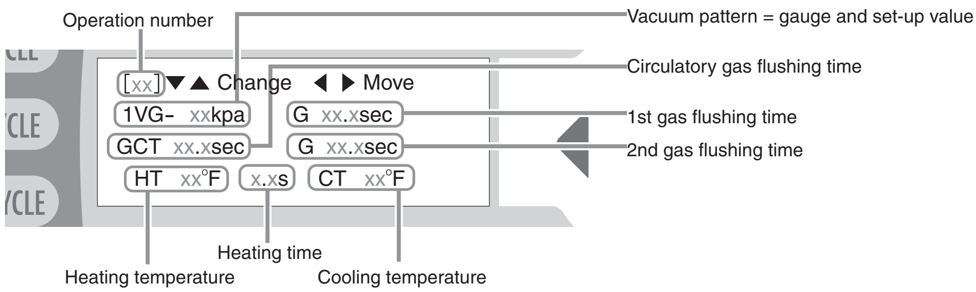


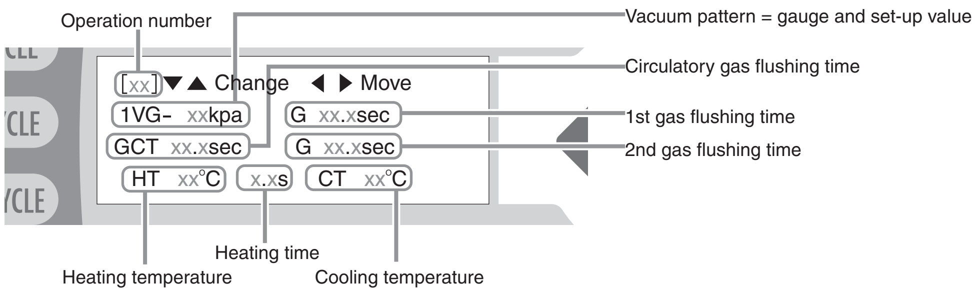
	Procedure	Reference page or Description
1	Circuit breaker ON.	"Starting of use" in page 34.
2	Power button ON.	"Starting of use" in page 34.
3	3-1 Already entered, select the operation number of "Circulation timer". ⚠ Caution Check the piping for gas circulation (Switch to NC piping) 3-2 No entry :	3-1 "Select the operation number" in page 38. 3-2 "Select the gas circulation " in page 39."
4	Set the vacuum time. (Setting range 0.1 ~ 99.9seconds)	"Set the gas circulation / vacuum by timer" in page 41.
5	Set the 1st gas flushing time. (Setting range 0.1 ~ 99.9seconds)	
6	Set the circulate gas flushing (Setting range 2 ~ 99times)	
7	Set the 2nd gas flushing time. (Setting range 0.1 ~ 99.9seconds)	
8	Set the heating temperature. (Setting range 140 ~ 480°F) (Setting range 60 ~ 250°C)	"Set the heating temperature" in page 36.
9	Set the heating time. (Setting range 0.0 ~ 2.0seconds)	"Set the heating time" in page 36.

10	Set the cooling temperature. (Setting range 100°F ～ heating temperature) (Setting range 40°C ～ heating temperature)	"Set the cooling temperature" in page 45.
11	Depress the foot switch (1st)	Nozzle comes forward.
12	Set a pouch on the sealing position.	Insert the nozzle in a pouch, and set it on the sealing position.
13	Depress the foot switch (2nd).	Pressure lever descends and fasten a pouch with sponge rubber. (Keep on stepping until the pressure lever close.) Attention! If leg is separated from the foot switch in the middle of downward, the pressure lever will open for the safe mechanism.
14	Depress the foot switch (3rd).	By the third depressing the foot switch, the following process (from 14-1 to 14-13) will be performed automatically. 14-1 Vacuum process starts. Vacuum lamp is turned on. VAC CYCLE 14-2 Vacuum is finished when set-up time is past. Vacuum lamp is turned off. VAC CYCLE 14-3 1st gas flushing starts. Gas flushing lamp is turned on. GAS CYCLE 14-4 1st gas flushing is finished when set-up time is past. Gas flushing lamp is turned off. GAS CYCLE 14-5 Circulation starts. Vacuum lamp and gas flushing lamp are turned on. VAC CYCLE GAS CYCLE 14-6 Circulation is finished when set-up time is past. Vacuum lamp and gas flushing lamp is turned off. VAC CYCLE GAS CYCLE 14-7 2nd gas flushing starts. Gas flushing lamp is turned on. GAS CYCLE

14		14-8 2nd gas flushing is finished when set-up time is past. Gas flushing lamp is turned off. GAS CYCLE 14-9 Nozzle returns. 14-10 Pressure lever close and sealing starts. Heating lamp is turned on. HEAT CYCLE 14-11 After the heating is finished (heating lamp is turned off), cooling lamp is turned on. HEAT CYCLE COOL CYCLE 14-12 Cooling is finished. (Cooling lamp is turned off.) COOL CYCLE 14-13 Sealing process is completed. (Pressure lever opens and nozzle comes forward.)
15	Sealing process is completed.	If you will not use this sealer for a long time, please work as indicated in "Finishing of use" in page 34.

[Circulate] Vacuum (gauge), Gas flushing and Sealing





	Procedure	Reference page or Description
1	Circuit breaker ON.	"Starting of use" in page 34.
2	Power button ON.	"Starting of use" in page 34.
3	3-1 Already entered, select the operation number of "xx-Circulation gauge". ⚠ Caution Check the piping for gas circulation (Switch to NC piping) 3-2 No entry :	3-1 "Select the operation number" in page 38. 3-2 "Select the gas flushing circulation" in page 39.
4	Set the vacuum degree. (Setting range −1 ～ −100kpa)	"Set the gas circulation / vacuum by gauge" in page 42.
5	Set the 1st gas flushing time. (Setting range 0.1 ～ 99.9seconds)	
6	Set the circulate gas flushing (Setting range 2 ～ 99times)	
7	Set the 2nd gas flushing time. (Setting range 0.1 ～ 99.9seconds)	
8	Set the heating temperature. (Setting range 140 ～ 480°F) (Setting range 60 ～ 250°C)	"Set the heating temperature" in page 36
9	Set the heating time. (Setting range 0.0 ～ 2.0seconds)	"Set the heating time" in page 36.

10	Set the cooling temperature. (Setting range 100°F ～ heating temperature) (Setting range 40°C ～ heating temperature)	"Set the cooling temperature" in page 45.
11	Depress the foot switch (1st)	Nozzle comes forward.
12	Set a pouch on the sealing position.	Insert the nozzle in a pouch, and set it on the sealing position.
13	Depress the foot switch (2nd).	Pressure lever descends and fasten a pouch with sponge rubber. (Keep on stepping until the pressure lever close.) Attention! If leg is separated from the foot switch in the middle of downward, the pressure lever will open for the safe mechanism.
14	Depress the foot switch (3rd).	By the third depressing the foot switch, the following process (from 14-1 to 14-13) will be performed automatically. 14-1 Vacuum process starts. Vacuum lamp is turned on. VAC CYCLE 14-2 Vacuum is finished when set-up time is past. Vacuum lamp is turned off. VAC CYCLE 14-3 1st gas flushing starts. Gas flushing lamp is turned on. GAS CYCLE 14-4 1st gas flushing is finished when set-up time is past. Gas flushing lamp is turned off. GAS CYCLE 14-5 Circulation starts. Vacuum lamp and gas flushing lamp are turned on. VAC CYCLE GAS CYCLE 14-6 Circulation is finished when set-up time is past. Vacuum lamp and gas flushing lamp is turned off. VAC CYCLE GAS CYCLE 14-7 2nd gas flushing starts. Gas flushing lamp is turned on. GAS CYCLE

14		14-8 2nd gas flushing is finished when set-up time is past. Gas flushing lamp is turned off. GAS CYCLE 14-9 Nozzle returns. 14-10 Pressure lever close and sealing starts. Heating lamp is turned on. HEAT CYCLE 14-11 After the heating is finished (heating lamp is turned off), cooling lamp is turned on. HEAT CYCLE COOL CYCLE 14-12 Cooling is finished. (Cooling lamp is turned off.) COOL CYCLE 14-13 Sealing process is completed. (Pressure lever opens and nozzle comes forward.)
15	Sealing process is completed.	If you will not use this sealer for a long time, please work as indicated in "Finishing of use" in page 34.

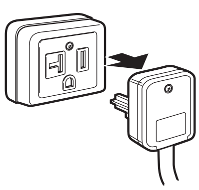
9 Replacing the routine maintenance parts

Replace parts according to the following directions in order to maintain your machine in optimum operating condition.

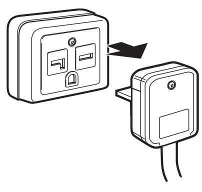
⚠Warning Always unplug power plug before replacing any parts. There is a danger of electrocution if conducted with the plug still inserted.

⚠Warning Do not replace parts according to other methods not described in the operating instructions. It is dangerous if incorrect methods are used.

⚠Warning When replacing parts, always use only specified parts sold through Fuji Impulse. Otherwise malfunction may occur.



110V specification



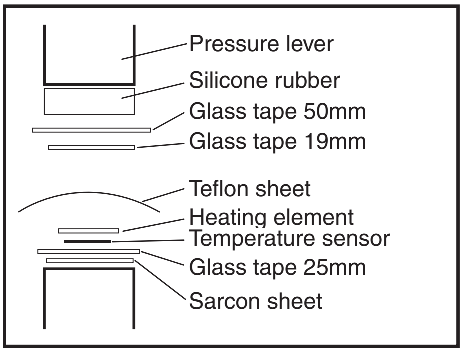
220V specification

Always unplug power plug from the wall outlet before conducting any maintenance.

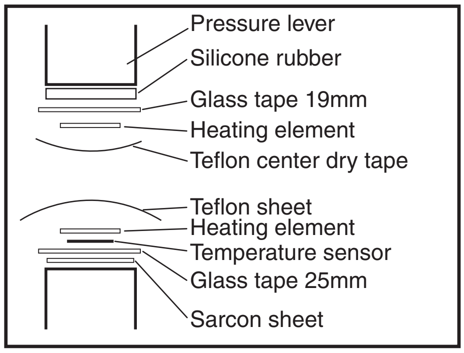
Construction of the sealing section

The sealing section is constructed with parts illustrated in the diagram at left. When replacing parts, be careful to arrange the parts in the same exact order.

1 VG-602/402 sealing section structure



2 VG-602/402-10D sealing section structure



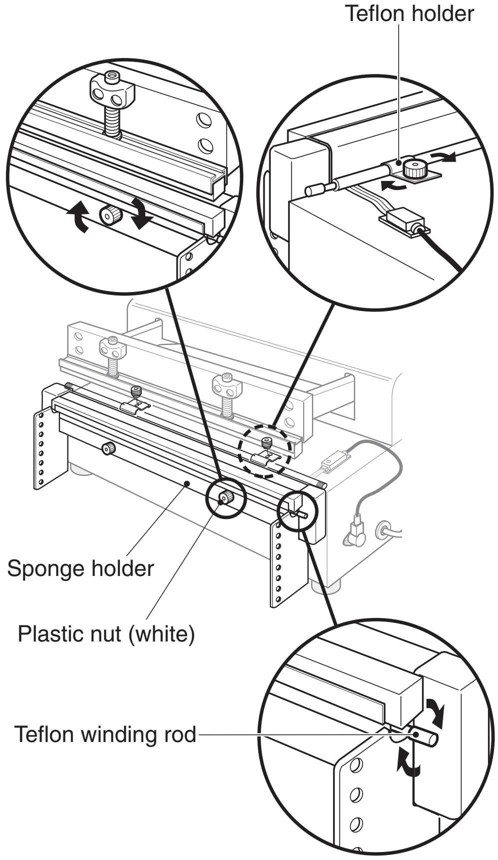
Routine maintenance parts

As you use the sealer, the parts wear, sealing result worst., to continues operate with damage part will cause malfunction, so please replace the wear parts on time with space parts always in hands.
The routine maintenance parts are selling by the unit described below
Order from your dealer, specifying the name of your machine, the name and quantity of parts you need.

Parts name	Selling unit
Heating element (5mm,10mm)	10pcs. per set / 20pcs. per set
Teflon sheet	2sheets per set
Silicone rubber	2pcs. per set
Glass tape	5M roll or 10M roll
Sarcon sheet	2sheets per set or 5M roll
Plastic nut (white)	5pcs. per set
Teflon center dry tape	5M roll

9-1 Sliding teflon sheet

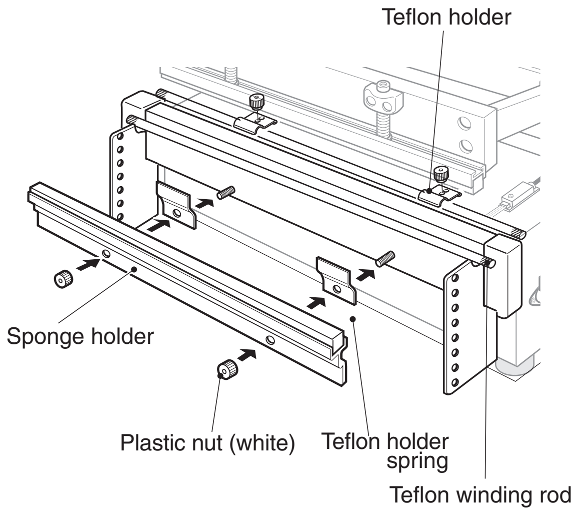
[Replace when]
When the teflon sheet is torn, burnt or sealing is dirty
[Essential tools]
Scissors



1 Loose the four resin nuts (white) securing the teflon holder and sponge holder.
2 Turn the teflon sheet winding rod. Wind the damaged teflon sheet forward or backward for 15mm.
3 When the teflon sheet is loosen, hold the teflon winding rod and tight the resin nuts to fix the teflon holder and sponges holder.
When the teflon sheet is sticking to the heater wire, peel it off before winding. 25 to 30cm of teflon sheet is wound for a space, if the sheet remain a little or consumed, refer "changing the teflon sheet" to change the teflon sheet.

9-2 Replacing teflon sheet

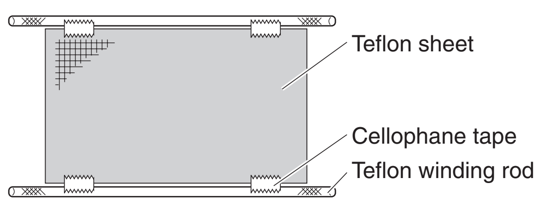
[Replace when]
When the teflon sheet is torn, burnt or sealing is dirty
[Essential tools]
Scissors



1 Unscrew the resin nuts (white) securing the teflon holder and sponge holder.

2 Remove the teflon holder and sponge holder, then peel off teflon sheet from the teflon winding rod.

3 Strike the new teflon sheet by cellophane tape on teflon sheet.



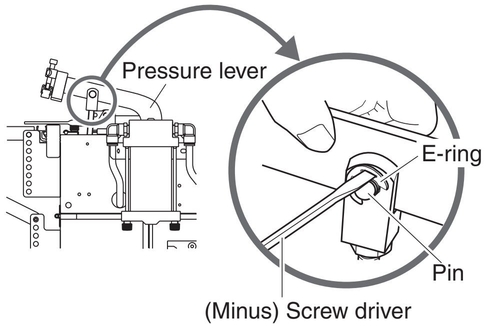
4 Screw the 4pcs. resin nut (white) lightly. Hold the teflon winding rod by sponge holder and teflon holder.

5 To avoid wrinkles of teflon sheet above the heating element, winding the teflon rod to smooth the teflon sheet.

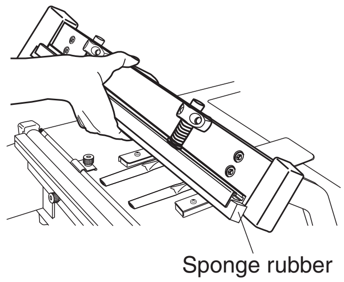
6 Screw the 4pcs. resin nut (white) to push the teflon holder to fix the teflon winding rod.

9-3 Replacing center-dry tape on the upper lever (object : double side heating model)

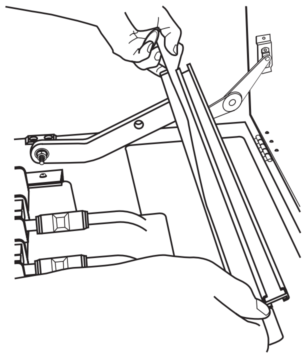
To change the teflon center dry tape attached on the pressure plate.



1 Take off the frame cover.
2 Remove the both right and left side E-ring of the pressure lever by (minus) screwdriver, and pull out the pin.

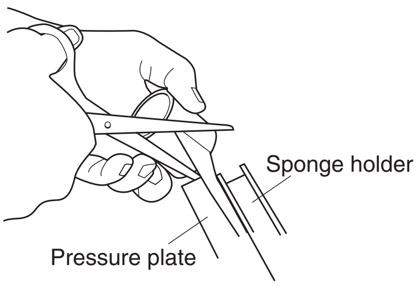


3 Raise up the pressure lever and remove the sponge rubber.

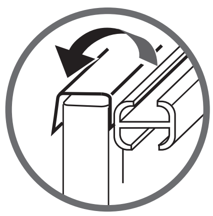


4 Remove the teflon center dry tape.
Direct paste the new one's adhesive tape to the pressure lever.
Insert one side of the center dry tape into the gap that in between the pressure lever and sponge holder.

Attention! When you could not paste smoothly, insert thin ruler between the sponge holder and pressure plate. Then slide the center dry tape with pushing it on the pressure plate.



5 Cut excess by scissors.



6 Fold the other side of the tape that attached adhesive tape to the opposite side of sponge holder.

Attention! Caution when replace the tape:
Place the center space of the tape on the heating element.
If the wrinkles remain on the dry tape, it will be printed on the seal bag.

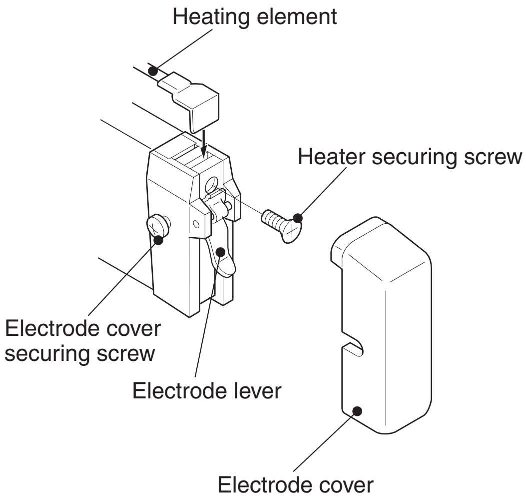
9-4 Replacing heating element

[Replace when]

The heating element has burned out. Sealing is dirty or uneven.

[Essential tools]

Phillips screwdriver



1 The heating element is covered with the teflon sheet. Remove the teflon sheet, referring to "changing the teflon sheet"

2 The electrode cover is screwed on the side. Loosen the screw with a Phillips screwdriver and pull to remove it.

3 Raise the electrode lever up to loosen the heating element. Loosen the heater securing screw with a Phillips screwdriver.

4 Loosen the screw and remove the wearied heating element.

5 When the electrode lever is raised, insert the new heating element into the groove of electrode, tighten the securing screw to secure the element while pressure the heating element so that it does not slip from the electrode. After tighten the securing screw, push down the electrode lever.

⚠ Caution For your safety always reattach the electrode cover after installing the heating element.
Use a heating element specified for this model. Using a different element may cause transformer failure.

When heating element is exchanged to another width

This machine is shipped with 10mm width heating element, and set up to the optimal sealing conditions (heating temperature, heating time, cooling temperature).

Since seal conditions change when the width is changed, please set up again, perform a seal test, and adjust to the optimal value.

Conversely, when 5mm width is changed into 10mm width, please work similarly.

9-5 Replacing glass tape(19mm width, 25mm width), sarcon sheet

[Replace when]

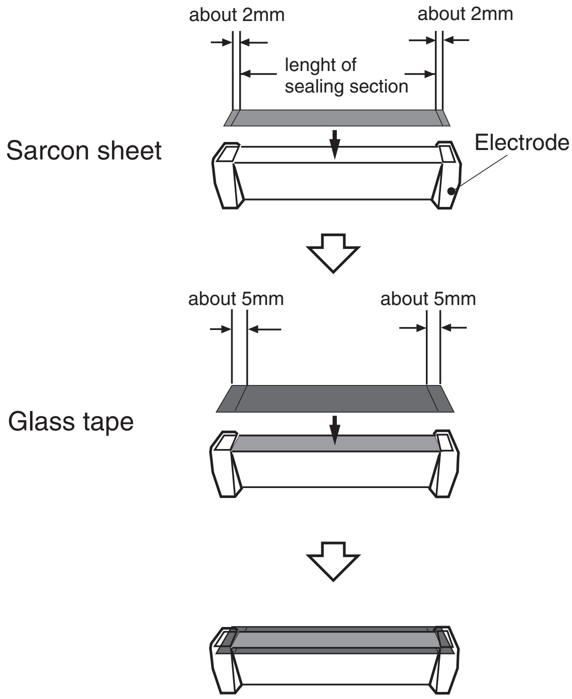
The heating element is often burnt out. Sealing is dirty

[Essential tools]

Phillips screwdriver; Scissors; Alcohol (Ethanol)

Caution If the glass tape or sarcon sheet blow the heating element is burnt, the heater wire itself may short circuit and melt or proper seals may not be attained. Inspect them when replacing heating element, if necessary change them.

1 Remove the teflon sheet and heating element.
2 Peel the glass tape and sarcon sheet located below the heating element completely off.
3 Some adhesive remain will uneven the sealing surface, and has an adverse effect, please clean the surface thoroughly before applying the glass tape and sarcon sheet.
4 Attaching a new sarcon sheet along the length of sealing section. (One sheet)
5 Attaching a glass tape on the sarcon sheet, the glass tape must be about 5mm longer than the sealing section. (One sheet)



9-6 Replacing silicone rubber (object single side heating model)

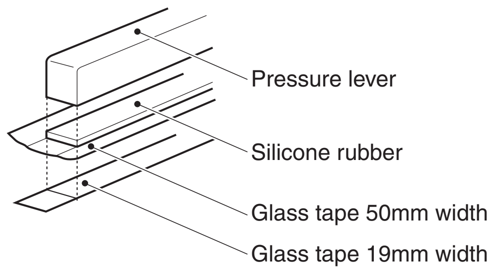
[Replace when]

Silicone rubber is uneven

[Essential tools]

Alcohol (Ethanol)

1 Remove two glass tape attached on the pressure lever.
2 Remove the silicone rubber. Wipe the adhesive tape off the pressure lever with alcohol (Ethanol). Attaching the silicone rubber on the top of remained adhesive will has an adverse effect to sealing.
3 The silicone rubber has an adhesive tape on it, peel the paper and attach the new silicone rubber carefully, starting from one end.
4 After attaching the silicone rubber, attach two pieces of glass tape (50mm 19mm width) on it.



9-7 Replacing silicone rubber (object : double side heating model)

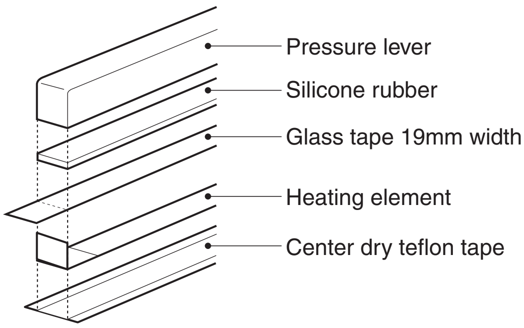
[Replace when]

Silicone rubber is uneven

[Essential tools]

Alcohol (Ethanol)

1 Remove the center dry tape, heating element, and glass tape according to the each instructions.
2 Remove the silicone rubber, and wipe the adhesive tape off the pressure lever with alcohol (Ethanol).
   Attaching the new silicone rubber on the remained adhesive tape will has an adverse effect to sealing.
3 The silicone rubber has an adhesive tape on it. Peel the paper and attach the new silicone rubber carefully, starting from one end.
4 After attaching the Silicone rubber, attach on it in order of the sarcon sheet, glass tape (19mm width), heating element and center dry tape.



9-8 Replacing 50mm width glass tape (object single side heating model)

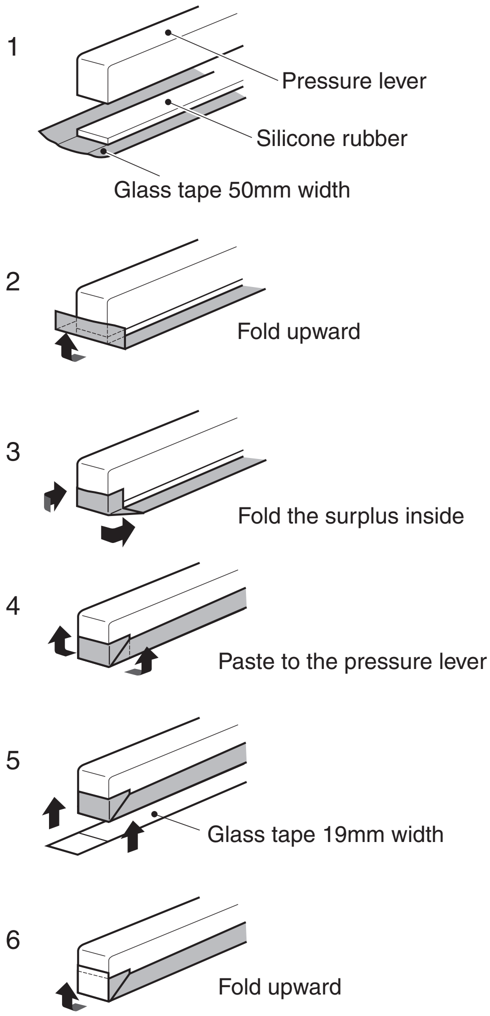
[Replace when]

The heating element is often burn out. Sealing is dirty.

[Essential tools]

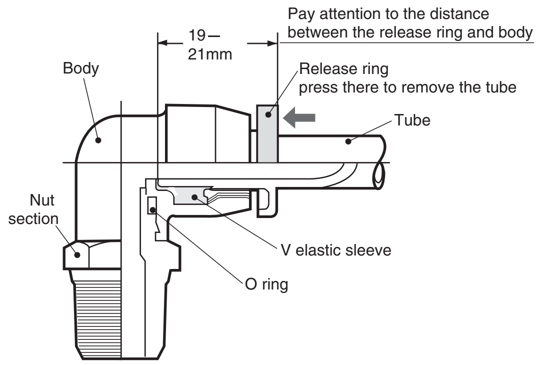
Scissors

1 After attaching the silicone rubber, attach a 50mm width piece of glass tape on the silicone rubber so that the glass tape extend about 2cm from the end of the pressure lever.
2 Fold this excess upward.
3 Fold the corners inward as shown in the figure.
4 Attach the tape onto the sides of the pressure lever.
5 Attaching the 19mm width glass tape from above as shown in the illustration.
6 Fold the excess 2mm upward onto the pressure lever.



9-9 Connecting and removing tube

When remove the tube, press the release ring while pushing the tube.

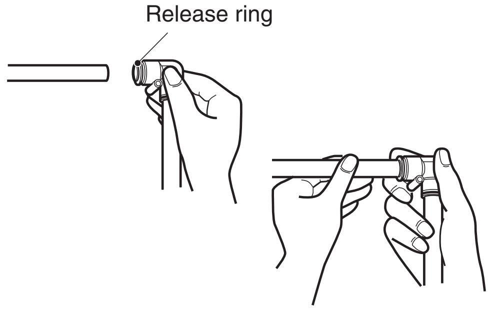


How to remove the tube

If you press the release ring while pushing the tube in at the same time, you can remove the tube quite easily.

How to connect the tube

Insert the tube fully to the tube end of the joint.



Attention! To avoid the air leakage, please verify the tube is jointed firmly.

9-10 Replacing microswitch

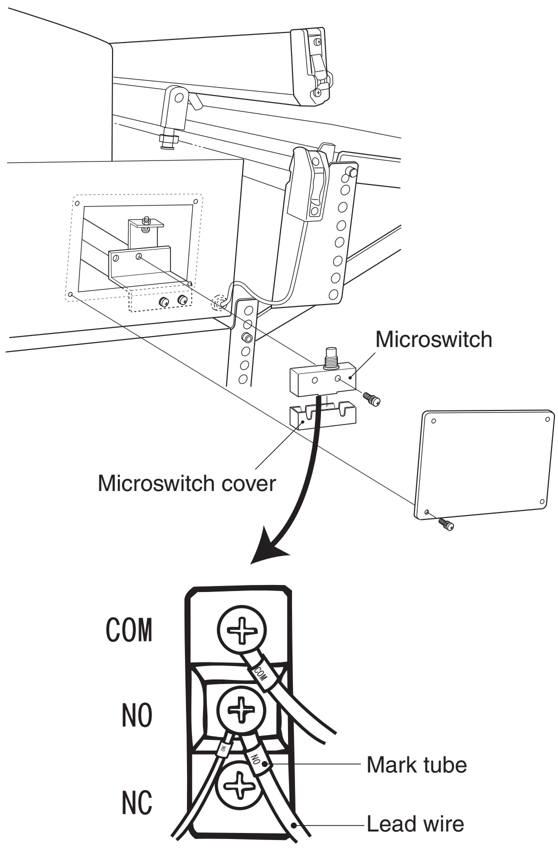
[Essential tools]

Phillips screwdriver

1 Take off the cover on the left side of frame by a Phillips screwdriver.

2 Remove the two screws which fasten the microswitch, and pick up microswitch.

3 Take off the microswitch cover.
Remove the wiring with a Phillips screwdriver and exchange the microswitch.



Caution Connect the wiring so that the display on microswitch (COM, NO) accord to the display on the mark tube of lead wire.

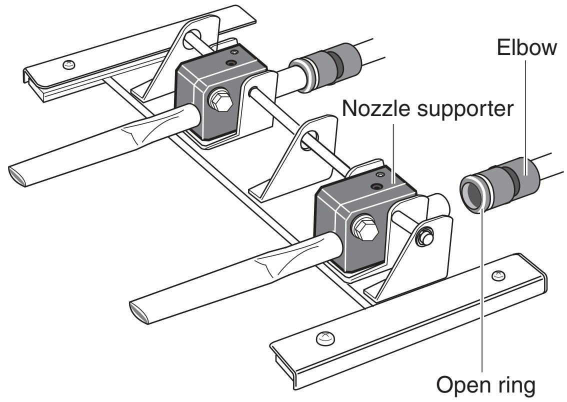
9-11 Replacing nozzle

[Essential tools]

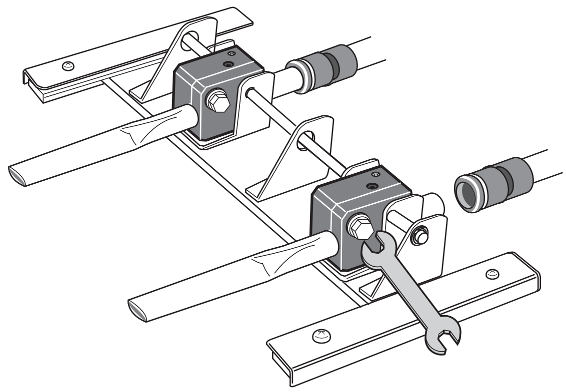
Spanner

1 Take off the frame cover.

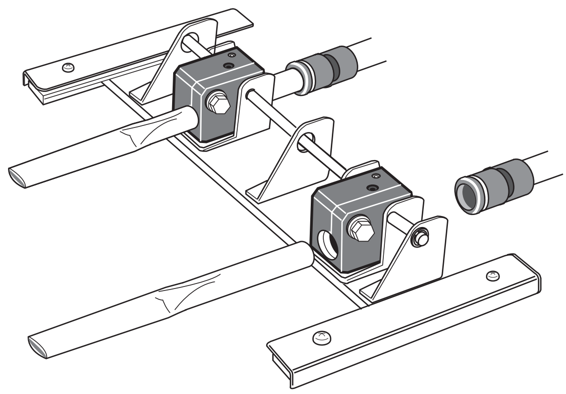
2 Remove the elbow from the nozzle.
Push the open ring to horizontal direction with nozzle, then lock will be cancelled.



3 Loosen the bolt on the of nozzle supporter by the spanner.



4 Extract the nozzle from the nozzle supporter.

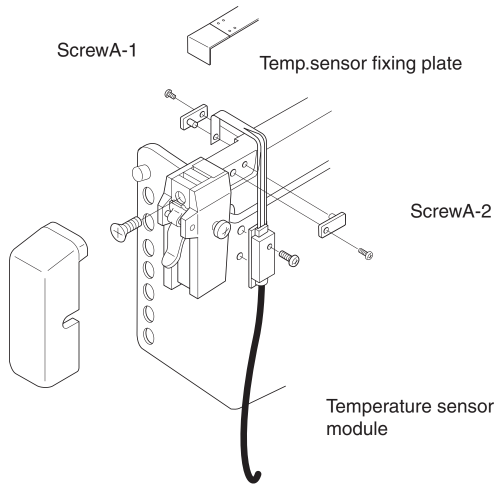


9-12 Replacing temperature sensor for VG-602 series

[Replace when] Temperature sensor is damaged.

[Essential tools] Phillips screwdriver

Temperature sensor is set between glass tape and heating element, and located to the right-hand end of the seal- receiving plate.



1 Remove the teflon sheet.

2 Remove the heating element. (Refer to page 85.)

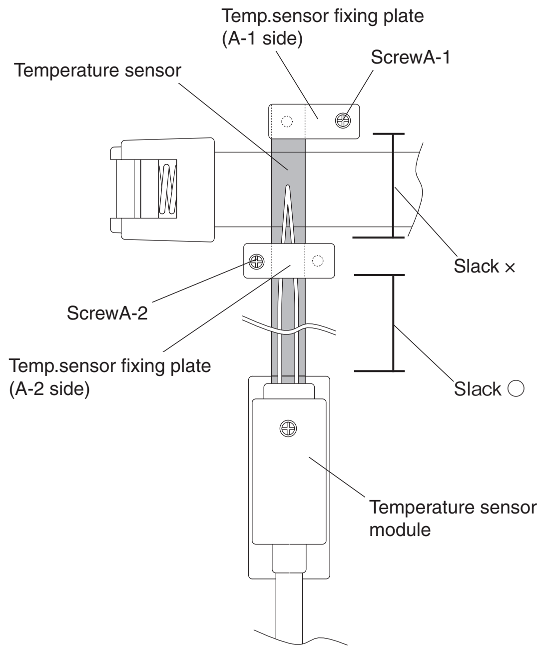
3 Unfasten the screw A-1, A-2 to remove the temperature sensor fixing plate, and unfasten the screw B. Temperature sensor can be removed.

4 Insert the protuberance of sensor fixing plate (screw A-1 side) into the tip (hole) of new temperature sensor and seal frame's hole.

Then fasten screw A-1.

5 Set the other sensor fixing plate and temporarily fasten the screw A-2.

(Refer to the right illustration.)



Caution Please take care not to make a slack of sensor between screw A-1 and A-2.

6 Pull the temperature sensor module lightly to keep the tension of temperature sensor and fix the plate by screw A-2.

Caution If the temperature sensor module would be pulled strongly, sensor might be broken.

7 Fix the temperature sensor module by screw B.

8 Re-attach the heating element. (Refer to page 85.)

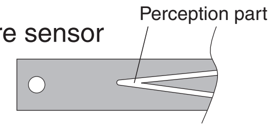
Caution If the temperature sensor isn't installed on the proper position, seal function might not work.

Attention! Install the new temperature sensor so that the perception part touches with the center of heating element. (Refer to the right illustration.)

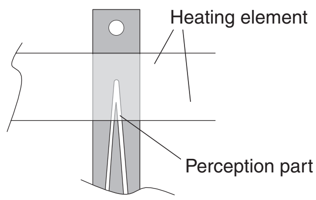
If the perception part is slipped off, temperature could not be detected exactly.

Proper position of temperature sensor

▪Temperature sensor



▪Position



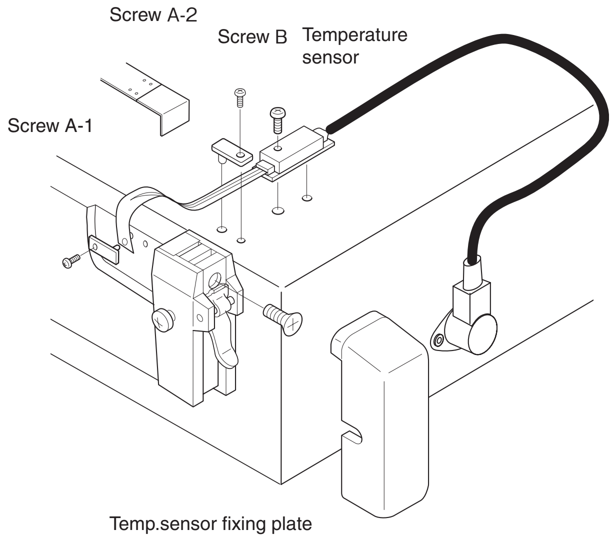
(Install the sensor under the heating element)

9-13 Replacing temperature sensor for VG-402 series

[Replace when] Temperature sensor is damaged.

[Essential tools] Phillips screwdriver

Temperature sensor is set between glass tape and heating element, and located to the right-hand end of the seal- receiving plate.



1 Remove the teflon sheet.

2 Remove the heating element. (Refer to page 85.)

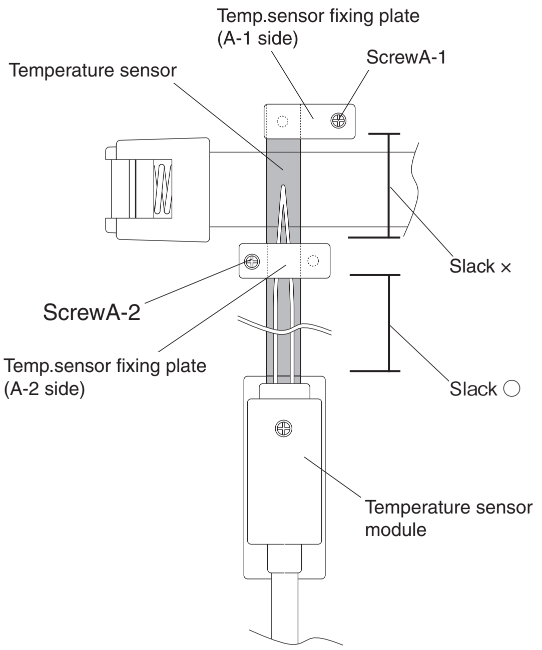
3 Unfasten the screw A-1, A-2 to remove the temperature sensor fixing plate, and unfasten the screw B. Temperature sensor can be removed.

4 Insert the protuberance of sensor fixing plate (screw A-1 side) into the tip (hole) of new temperature sensor and seal frame's hole.

Then fasten screw A-1.

5 Set the other sensor fixing plate and temporarily fasten the screw A-2.

(Refer to the right illustration.)



Caution Please take care not to make a slack of sensor between screw A-1 and A-2.

6 Pull the temperature sensor module lightly to keep the tension of temperature sensor and fix the plate by screw A-2.

Caution If the temperature sensor module would be pulled strongly, sensor might be broken.

7 Fix the temperature sensor module by screw B.

8 Re-attach the heating element. (Refer to page 85.)

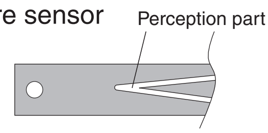
Caution If the temperature sensor isn't installed on the proper position, seal function might not work.

Attention! Install the new temperature sensor so that the perception part touches with the center of heating element. (Refer to the right illustration.)

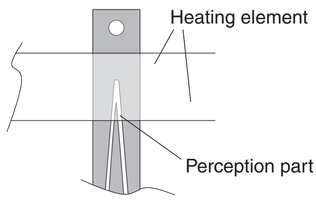
If the perception part is slipped off, temperature could not be detected exactly.

Proper position of temperature sensor

- Temperature sensor



- Position



(Install the sensor under the heating element)

10 Specification

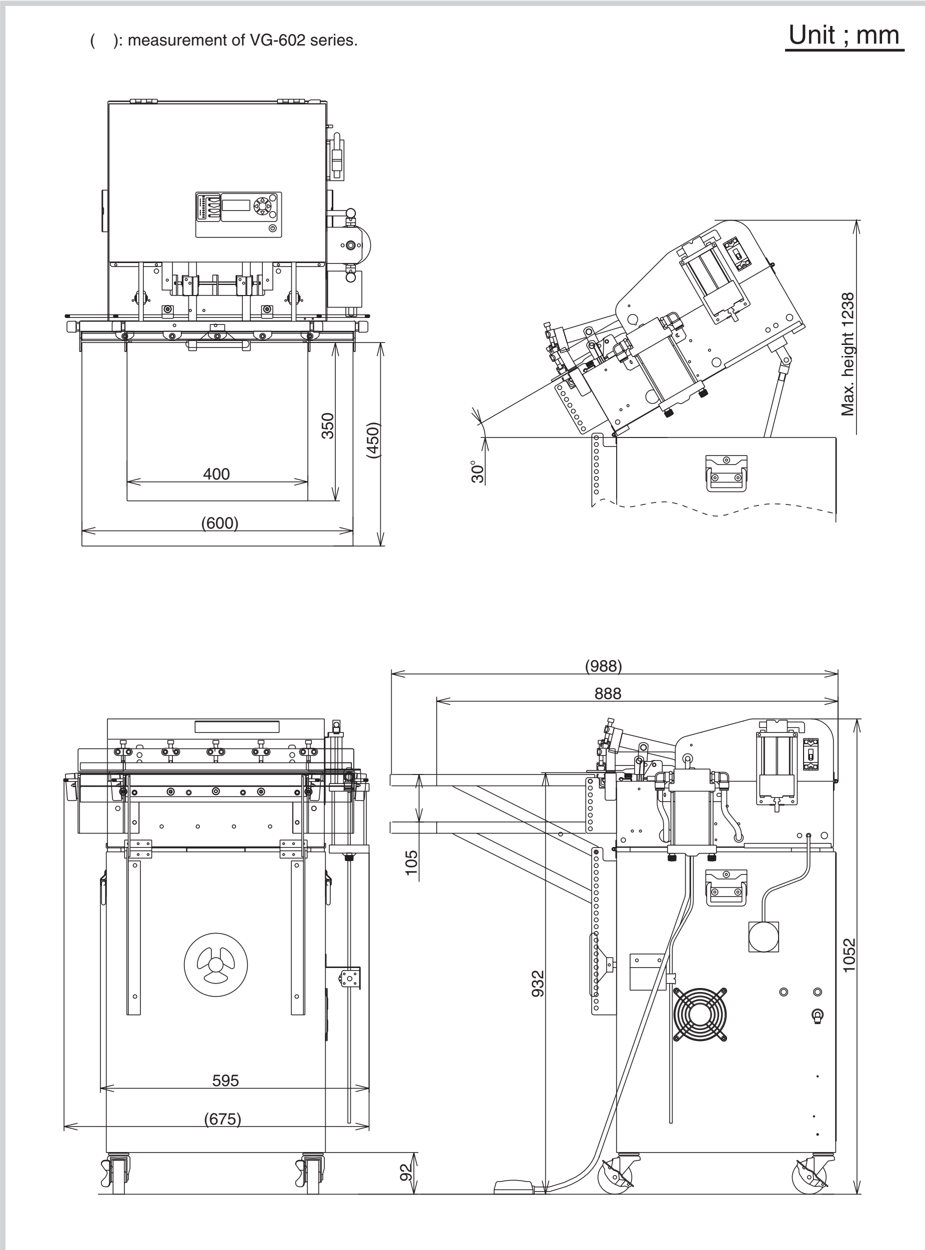
10-1 Safety mechanism specifications

	VG-402-xx	VG-402-xx-10D	VG-602-xx	VG-602-xx-10D
Power source	110V	220V	220V	220V
Maximum power consumption	2.0KW (10m heater) 1.1KW (5mm heater)	2.6KW	3.0KW (10m heater) 1.9KW (5mm heater)	3.1KW
Power cord	CT.2x3x5M 3P 20A125V	CT.2x3x5M 3P 20A250V		
Vacuum degree	-1～-100Kpa			
Vacuum method	By nozzle (Method can be selected from vacuum gauge, timer or manual.)			
Vacuum time	0.1～99.9sec			
Gas flushing time	0.1～99.9sec			
Driving style	Air cylinder			
Plug				
Sealing style	Single heating	Dual heating	Single heating	Dual heating
Sealing length	400mm		600mm	
Sealing width	5 or 10mm	10mm	5 or 10mm	10mm
Height of sealing surface	932mm (from bottom to sealing surface)			
Sealing angle	0～30 degree			
Driving style for sealing	Air cylinder ϕ63mm X 2			
Sealing heating temperature	140～480°F / 60～250°C			
Sealing heating time	0.0～2.0seconds			
Sealing cooling temperature *Note1	100°F (40°C)～ set up heating temperature			
Machine weight *Note2	93kg	98kg	100kg	105kg
Outside dimensions *Note3	W595 X L555 X H1052mm		W675 X L555 X H1052mm	
Table dimensions	W400 X L315mm		W600 X L450mm	
*Note1	Please set lower value than heating temperature. If it is near the heating temp, cooling process is insufficent and teflon is damaged too much.			
*Note2	Machine weight doesn't contain the one of table and options. (Vacuum pump and air compressor / standard type)			
*Note3	When sealing suface is horizontal position.			

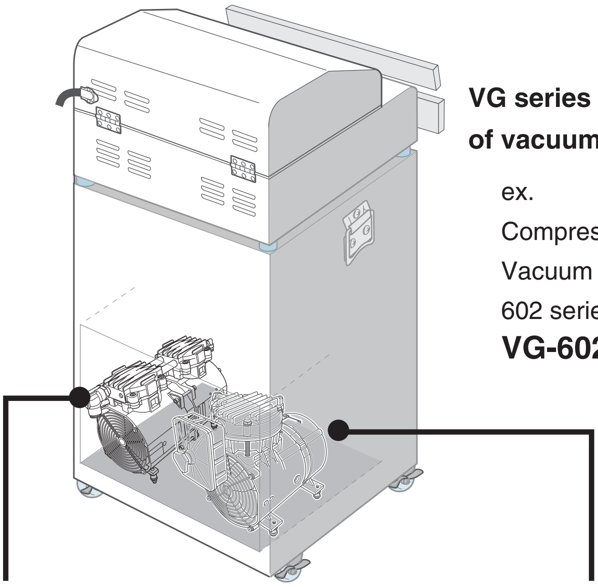
10-2 Safety mechanism specifications

Overheating proof mechanism	a) Circuit breaker automatically turn OFF when heater has been heated over 3.5seconds. b) When heating temperature doesn't reach to set-up value within 3seconds, the electricity is stopped and error message appears on the display.
Lever driving style	Spring guides the lever when it is closing ; 63 cylinder guides when sealing.
Reset in emergency	The lever opens when foot switch is released while the lever is closing.
Abnormality response	In the foreign object (ex. fingers) prevent the sealer to act next movement when lever is closing, automatically reset the sealer, after 1second the sealer is in initial state.
Emergency stop	In emergency stop switch is pushed when abnormality might generate, the circuit breaker is turned OFF, power supply is intercepted and lever returns to the initial state.
Heating signal	Heating when levers closed ; microswitch guides the lever to going down (double safety structure).

10-3 Appearance dimensions drawing



10-4 Combination of vacuum pump and air compressor



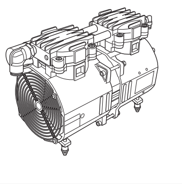
VG series sealer is named by the combination of vacuum pump and air compressor.

ex.
Compressor : MP-40 (called A)
Vacuum pump : DOP-80 (called H)
602 series dual heating type
VG-602-AH-10D

Vacuum pump / 4 types

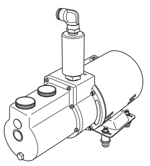
H.

DOP-80SA : Piston type
For standard
Pumping speed : 80L/min
Ultimate pressure : -96KPa
Pump weight : 7kg



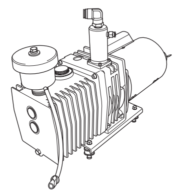
D.

G-50SA : Oil rotation type
For high vacuum degree
(small size pouch)
Pumping speed : 50L/min
Ultimate pressure : -101.3KPa
Pump weight : 11kg



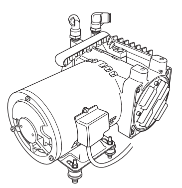
E.

G-100S : Oilrotation type
For high vacuum degree
(large size pouch)
Pumping speed : 100L/min
Ultimate pressure : -101.3KPa
Pump weight : 22kg



G.

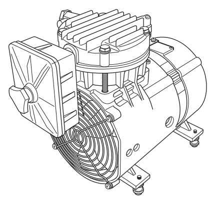
DA-60S : Diaphragm type
For clean room
(clean degree : about 10,000)
Pumping speed : 60L/min
Ultimate pressure : -80KPa
Pump weight : 12kg



Air compressor / 3 types

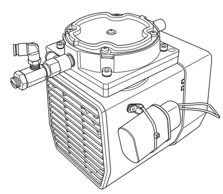
A.

MP-40 : Piston type
For standard
Pumping speed : 28L/min
Usual pressure : 310-330 KPa
Relief valve set-up pressure
Weigh : 8kg



B.

DOA-P108-DB :
Diaphragm type
For clean room
(clean degree : about 10,000)
Pumping speed : 31L/min
Usual pressure : 310-330 KPa
Relief valve set-up pressure
Weigh : 7kg



C.

Air is provided by the out side compressor

Suitable compressor specification
0.75kw (80L/min) above 480KPa

10-5 Specifications by the combination of vacuum pump and air compressor

Specifications by the combination of vacuum pump and air compressor

Standard VG series sealer has MP-40 compressor and DOP-80SA pump.

Ultimate pressure : 0 torr = -101.3kpa

Vacuum pump capacity is measured before it is assembled.

Air compressor : MP-40 pumping speed : 33L/min usual pressure : 3.1kgf/cm² relief valve set-up pressure weight : 8kg

Standard type

Model	Vacuum pump	Pumping speed	Ultimate pressure	Pump weight
VG-602-AH VG-402-AH	DOP-80SA	80L/min	−96KPa	7kg
VG-602-AH-10D VG-402-AH-10D	DOP-80SA	80L/min	−96KPa	7kg
VG-602-AD VG-402-AD	G-50SA	50L/min	−101.3KPa	11kg
VG-602-AD-10D VG-402-AD-10D	G-50SA	50L/min	−101.3KPa	11kg
VG-602-AE VG-402-AE	G-100S	100L/min	−101.3KPa	22kg
VG-602-AE-10D VG-402-AE-10D	G-100S	100L/min	−101.3KPa	22kg
VG-602-AG VG-402-AG	DA-60S	60L/min	−80KPa	12kg
VG-602-AG-10D VG-402-AG-10D	DA-60S	60L/min	−80KPa	12kg

Air compressor : DOA-P108-DB pumping speed : 33L/min usual pressure : 3.1kgf/cm² relief valve set-up pressure weight : 7kg

Clean room type

Model	Vacuum pump	Pumping speed	Ultimate pressure	Pump weight
VG-602-BH VG-402-BH	DOP-80SA	80L/min	−96KPa	7kg
VG-602-BH-10D VG-402-BH-10D	DOP-80SA	80L/min	−96KPa	7kg
VG-602-BD VG-402-BD	G-50SA	50L/min	−101.3KPa	11kg
VG-602-BD-10D VG-402-BD-10D	G-50SA	50L/min	−101.3KPa	11kg
VG-602-BE VG-402-BE	G-100S	100L/min	−101.3KPa	22kg
VG-602-BE-10D VG-402-BE-10D	G-100S	100L/min	−101.3KPa	22kg
VG-602-BG VG-402-BG	DA-60S	60L/min	−80KPa	12kg
VG-602-BG-10D VG-402-BG-10D	DA-60S	60L/min	−80KPa	12kg

Air compressor : out side suitable compressor specification : 0.75kw (80L/min), 490kpa above

Suitable compressor should be purchased separately

Model	Vacuum pump	Pumping speed	Ultimate pressure	Pump weight
VG-602-CH VG-402-CH	DOP-80SA	80L/min	−96KPa	7kg
VG-602-CH-10D VG-402-CH-10D	DOP-80SA	80L/min	−96KPa	7kg
VG-602-CD VG-402-CD	G-50SA	50L/min	−101.3KPa	11kg
VG-602CD-10D VG-402-CD-10D	G-50SA	50L/min	−101.3KPa	11kg
VG-602-CE VG-402-CE	G-100S	100L/min	−101.3KPa	22kg
VG-602-CE-10D VG-402-CE-10D	G-100S	100L/min	-101.3KPa	22kg
VG-602-CG VG-402-CG	DA-60S	60L/min	−80KPa	12kg
VG-602-CG-10D VG-402-CG-10D	DA-60S	60L/min	−80KPa	12kg

11 Specifications of accessories

11-1 Air parts

Parts name	Type	Standard life and remarks
Lever cylinder (big) X2pcs	Cylinder CDQ2B63-30D-F9BVS	500,000 times or 3 years
Lever cylinder (small)	Cylinder CDQ2B32-25	500,000 times or 3 years
Vacuum nozzle cylinder	Cylinder CDM2BZ25-75A-H7BS	500,000 times or 3 years
Lever cylinder electro-magnetic valve	Valve VK3120-1H-01	500,000 times or 3 years
	Valve VK332-1H-01	500,000 times or 3 years
Nozzle cylinder electro-magnetic valve	Valve VK3120-1H-01	500,000 times or 3 years
Gas nozzleelectro-electro-magnetic valve	Valve 126E1-21	500,000 times or 3 years
Air electro-magnetic valve	Valve 200E1-21	500,000 times or 3 years
Dry filter	Dry filter M-103 (first) : black	2 years
	Dry filter M-103 (second) : red	Half a year

11-2 Electric parts

Name	Type and model	Standard life and remarks
Circuit breaker with S-6	Circuit breaker GB-2Z	10,000 times (6 times / min)
	S-6 safety circuit board	500,000 times or more (relay on board)
SSR-03 relay	SSR-03	10 hours or more (on contact)
Relay in micro computer	FTR-F3AA024E-HA5A	5,000,000 times or more
Lever lower position MS	Microswitch BA-2RQ1-T4-J	100,000 times or more (on contact)
Cooling fan	Fan 4715MS-10T-B50	Average life 3,000 hours (consecutive operation)
Sealing transformer	Transformer V-400-5/10	Out of rating
Power cord (110V)	CT2X3X5M 3P 20A125V	Out of rating
Power cord (220V)	CT2X3X5M 3P 20A250V	Out of rating
Foot switch	Switch OFL-V-SP	500,000 times or more

Other

1 Although life of sealing portion or slide portion in the machine differs by frequency of use, exchange is needed every three or four year.

2 Piping tube discolor and harden by surrounding temperature or humidity.
As it cause an air leak, please replace the tube regularly.

3 In addition to the standard life, when surroundings are dusty, please clean or exchange valve and filter.

4 Also about the electric parts, cleaning or exchange is needed with surrounding situation (humidity, dust, or usage) in addition to the standard life.

12 Regular check and maintenance

For longer the sealer life and normally operation, it is necessary to check and maintain the sealer regularly. Please perform the checking and maintenance on time after purchased the sealer.

12-1 Regular check

Checking items for every day	
Sealing surface	Veryfy that teflon sheet and silicone rubber are not dirty or damaged.
Air filter	Remove the filter cup and clean it. (Ref. next page)
Checking items for every week	
Teflon sheet	If it is damaged or color is changed, slide the teflon or replace with new one.
Heating element	If it is damaged or color is changed, replace with new one.
Air filter element	If it is dirty, clean by flowing air.
Dry filter	If it is dirty, clean the clogging. (Ref. related instruction)
Checking item for every month	
Glass tape	If it is damaged or color is changed, replace with new one.
Sarcon sheet	If it is not damaged or color is changed,replace with new one.
Vacuum tube section	Verify that there is no any foreign object in joint and horse.
Checking items per year	
Silicone rubber	If it is not burned or damaged, replace with new one.
Relief valve	Verify the initial pressure setting is 320kpa. If not so, adjust it.
Cylinder	Verify the cylinder action is smooth. Otherwise, replace it.
Valve	Verify the valve action is smooth. Otherwise, replace it.
Temperature sensor *1	Verify the sensor's tape color is not changed.
Checking main parts every three years	
Air parts	Cylinder, Valve, Air tube, Air filter, Relief valve, Speed control valve
Electric parts	SSR-03 relay, circuit beaker, electrode

*1 Temperature which sensor recognize is adjusted to the actual heating temperature at the shipment from our factory. But the error may occur for long time use, so please check it.

Ref. "Replacing the routine maintenance parts in page 82

12-2 Cleaning the air filter

The air filter is located in-between the nozzle and the vacuum pump, stores any foreign objects accidentally taken in though the nozzle in filter cup.

Be sure to check and clean cup everyday before the operation.

Only in the case of a liquid (water), it drains automatically if auto-drain system is turned on.

This drainage process is performed at each sealing, so cup is not covered with water. However, the amount of suction for one time is about 100ml (about 1/3 of cup). If the foreign objects reaches to 1/3 line (in Figure 1), please exhaust them and clean the cup.

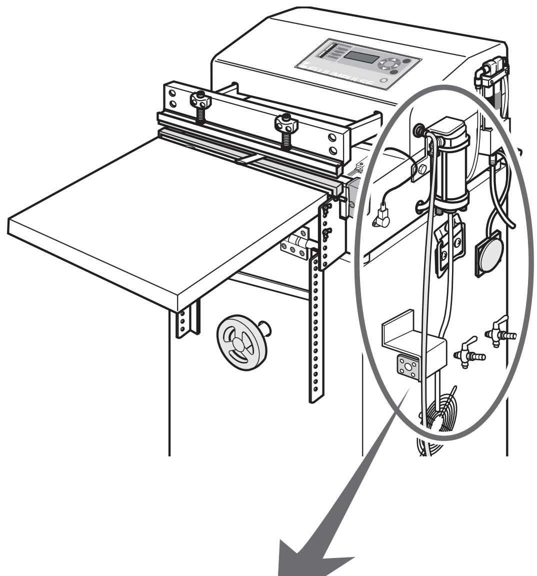
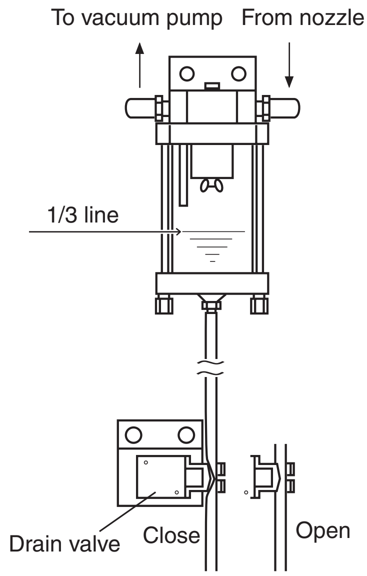


Figure 1



Removing the filter cup

Take off two plastic nut (black) and pull the cup flange downward.

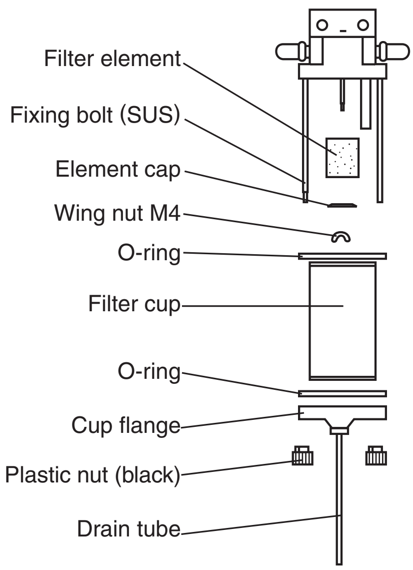
Filter cup can be removed.

(Filter cup and is stuck to cup flange by o-ring.)

Taking apart and clean the air filter

If the filter element or filter cup becomes dirty, wash them and install again after making them dry fully.

Please exchange for the new filter element every three months (on the standard).



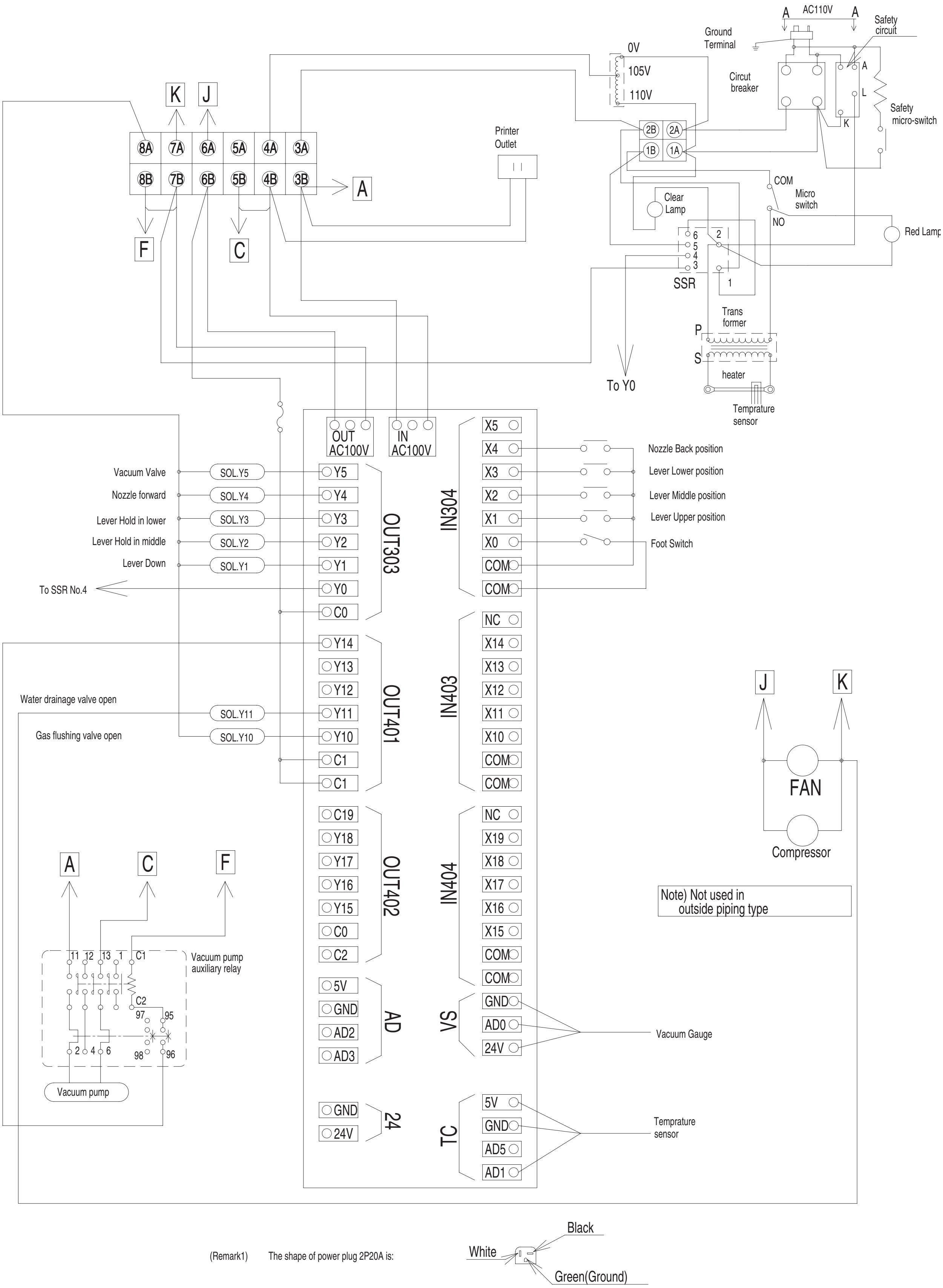
⚠ Caution If too liquid is taken in, the liquid will overflow the filter element and spill into the vacuum pump, which may cause damage of the pump.
Be careful not to take in over 100ml (about 1/3 of cup) at once.
If the overflow might occur, please exchange the vacuum pump oil.

13 Electric diagram

13-1 Electric diagram for 110V

Object : VG-402-xx

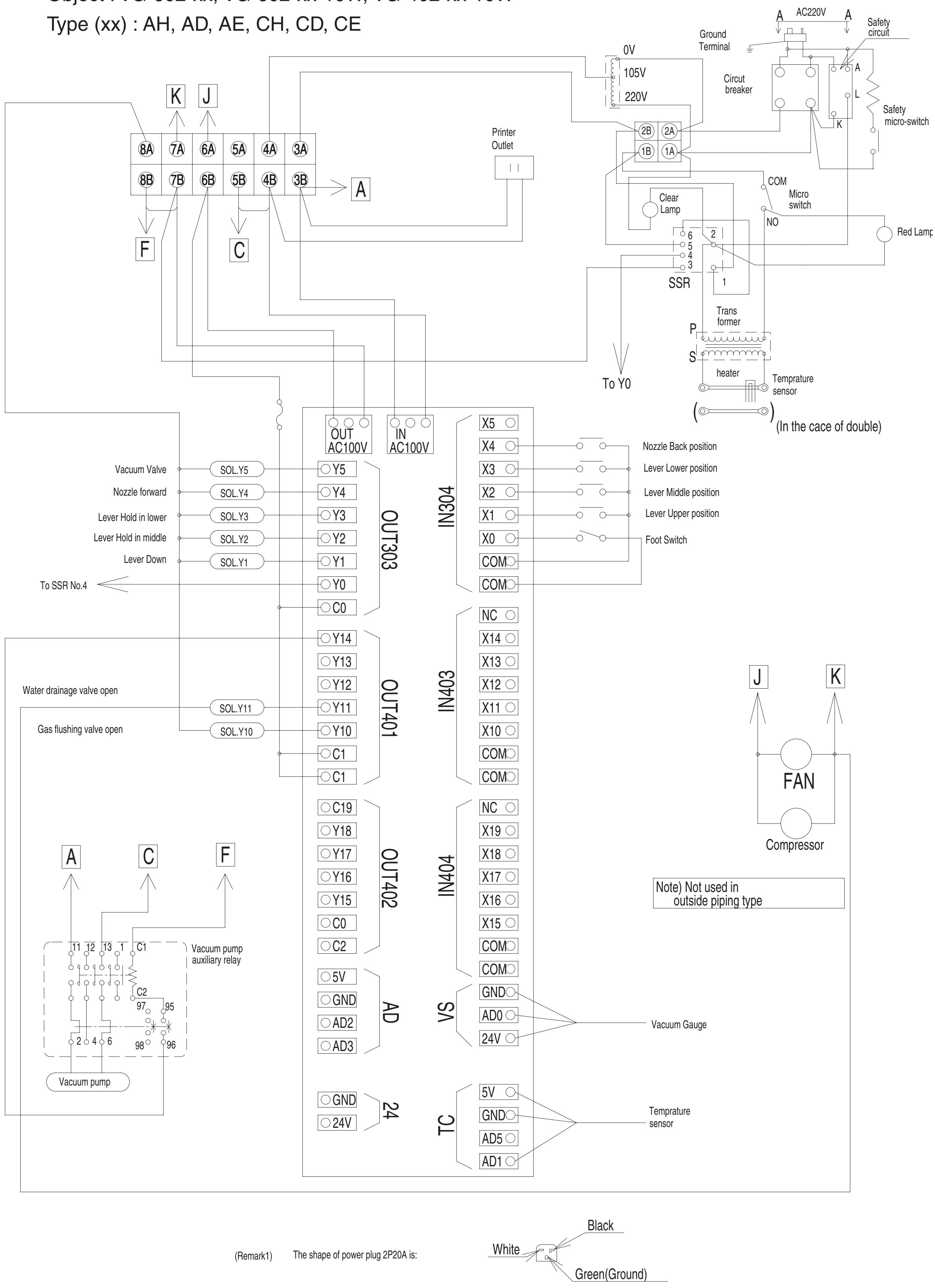
Type (xx) : AH, AD, AE, CH, CD, CE



13-2 Electric diagram for 220V

Object : VG-602-xx, VG-602-xx-10W, VG-402-xx-10W

Type (xx) : AH, AD, AE, CH, CD, CE

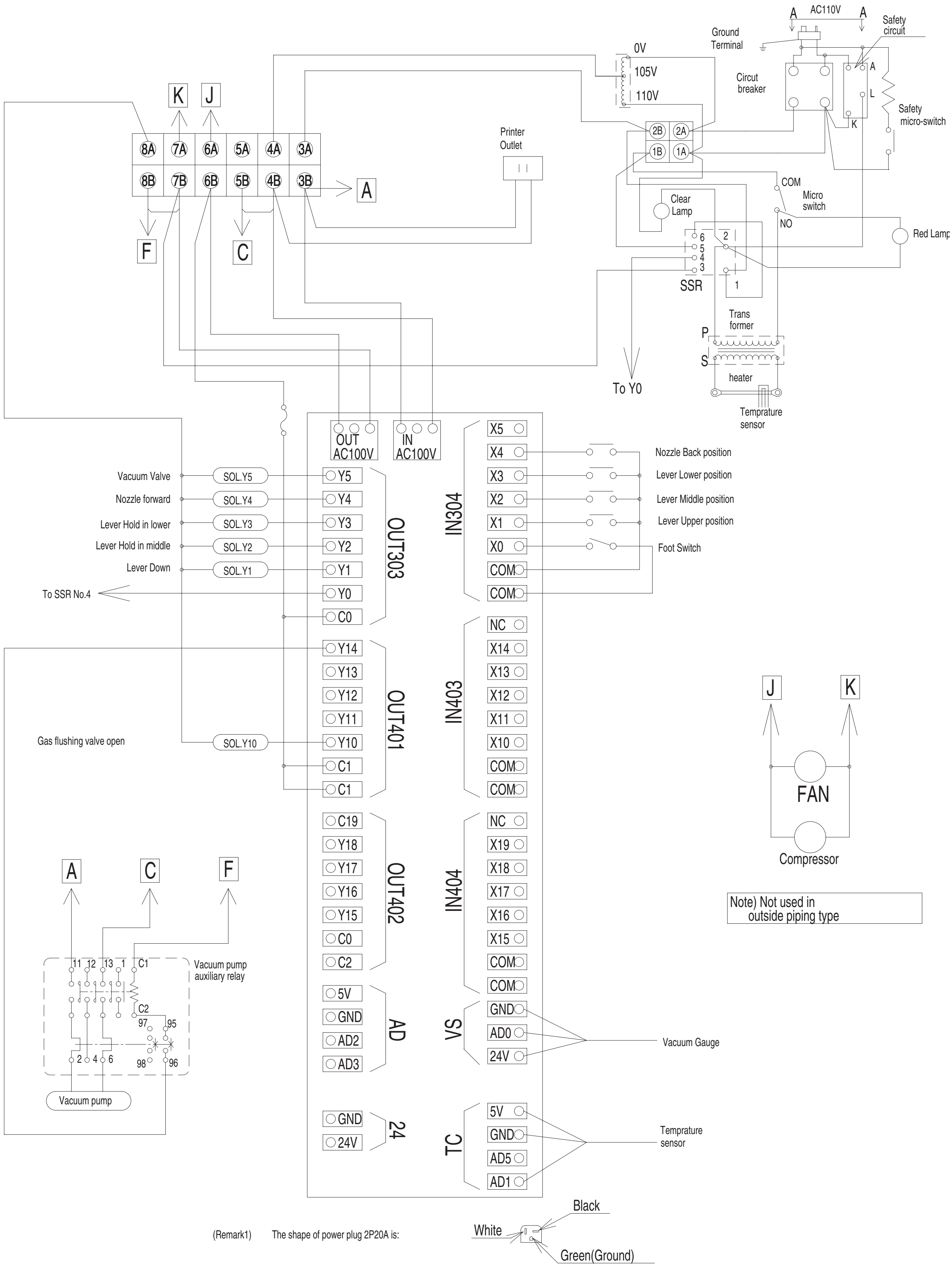


(Remark1) The shape of power plug 2P20A is:

13-3 Electric diagram for 110V (without draining device)

Object : VG-402-xx

Type (xx) : AG, BG, CG

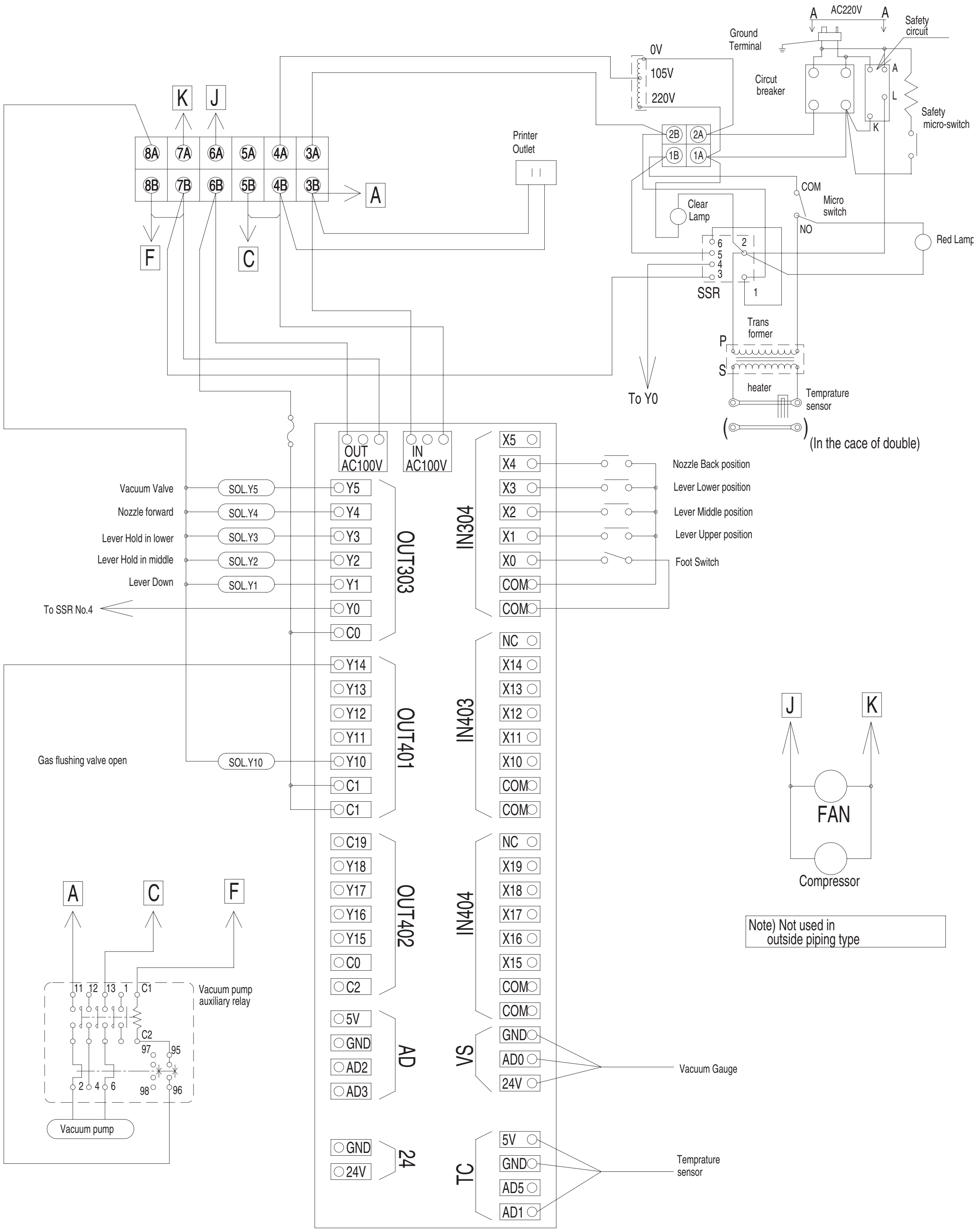


(Remark1) The shape of power plug 2P20A is:

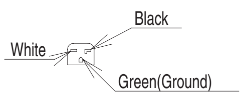
13-4 Electric diagram for 220V (without draining device)

Object : VG-602-xx, VG-602-xx-10W, VG-402-xx-10W

Type (xx) : AG, BG, CG



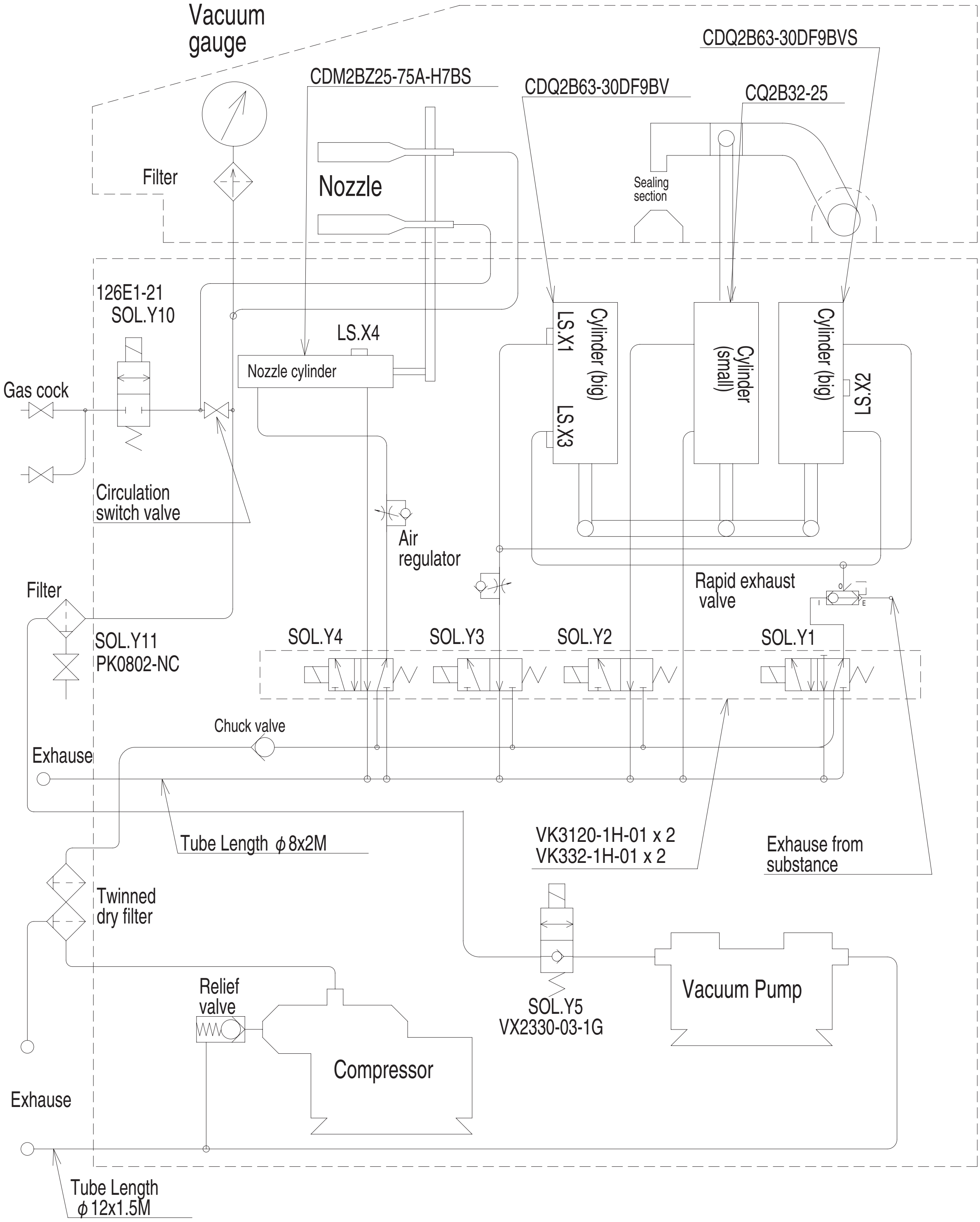
(Remark1) The shape of power plug 2P20A is:



14 Piping diagram

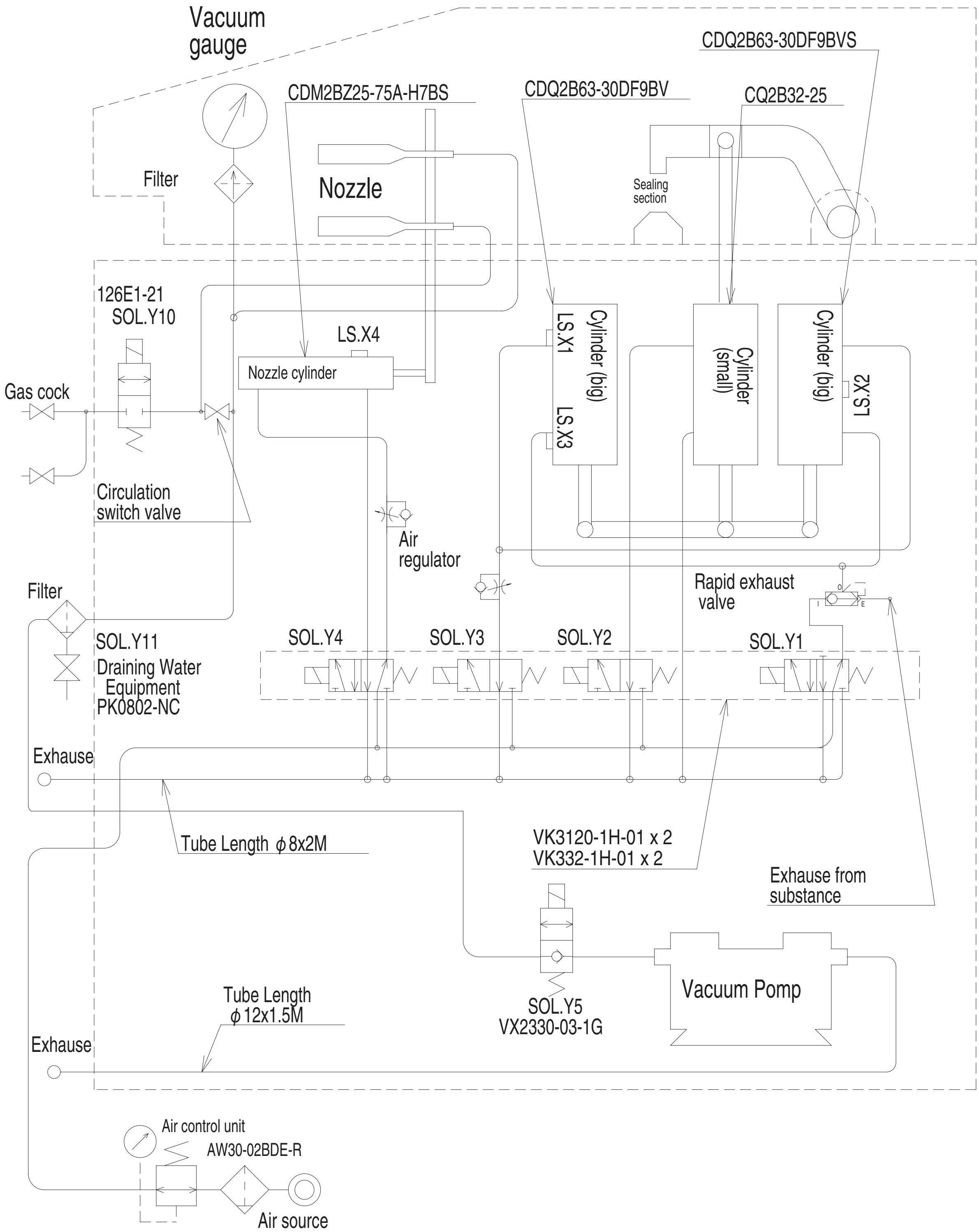
14-1 Piping diagram for VG-602/402 series with air compressor and vacuum pump

Type : AH, AD, AE



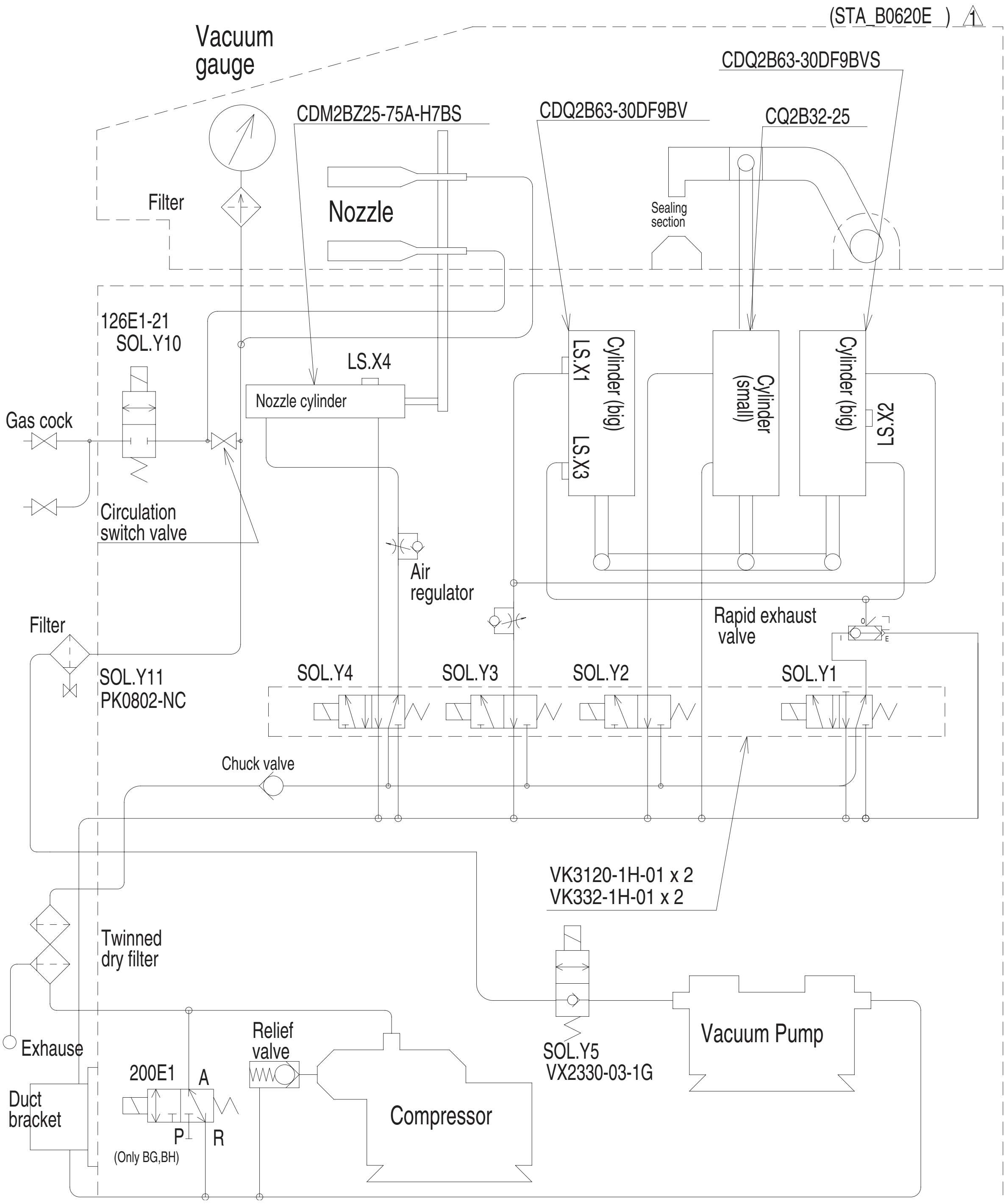
14-2 Piping diagram for VG-602/402 series with air compressor and vacuum pump (Air is provided by the outside compressor)

Type : CH, CD, CE



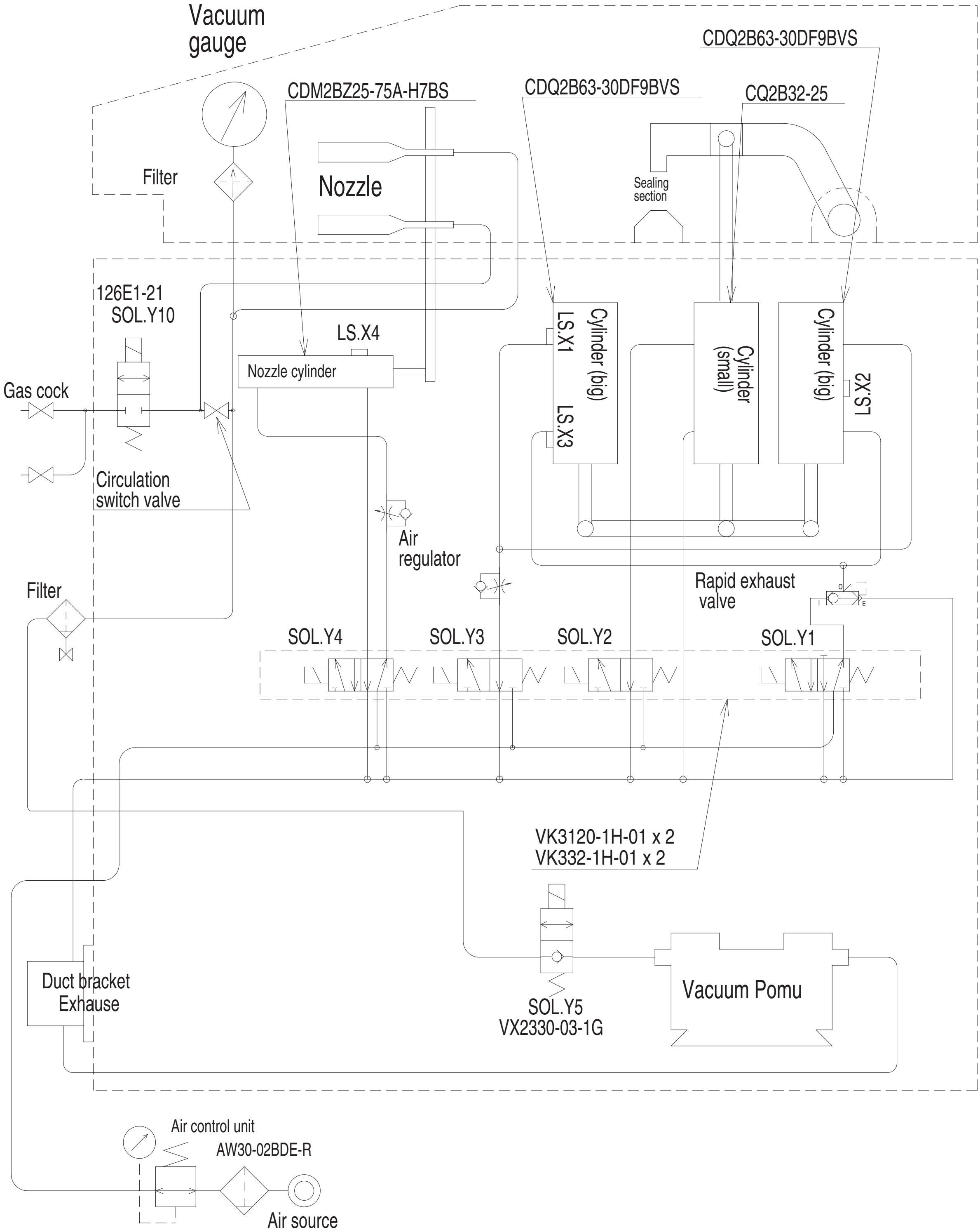
14-3 Piping diagram for VG-602/402 series with air compressor and vacuum pump (with duct bracket)

Type : AG, BG, BH



14-4 Piping diagram for VG-602/402 series with vacuum pump (Air is provided by the outside compressor) (with duct bracket)

Type (xx) : CG



15 Common problems and solutions

If you are experiencing problems with the machine, please refer to the chart below.
Carefully follow the directions in the operating instructions when replacing parts.
Please consult your dealer or Fuji Impulse if after referring to the chart, the problem cannot be resolved.
Please refer any questions regarding replacement of parts not listed in the operating instructions or adjustment of such parts to your dealer or Fuji Impulse.
Items marked with an asterisk in the Solutions column refer to the fact that these problems should be addressed by an electrician. If there are any problems, please contact your dealer or Fuji Impulse.

Warning When replacing parts, be sure to unplug power cord from the wall outlet.

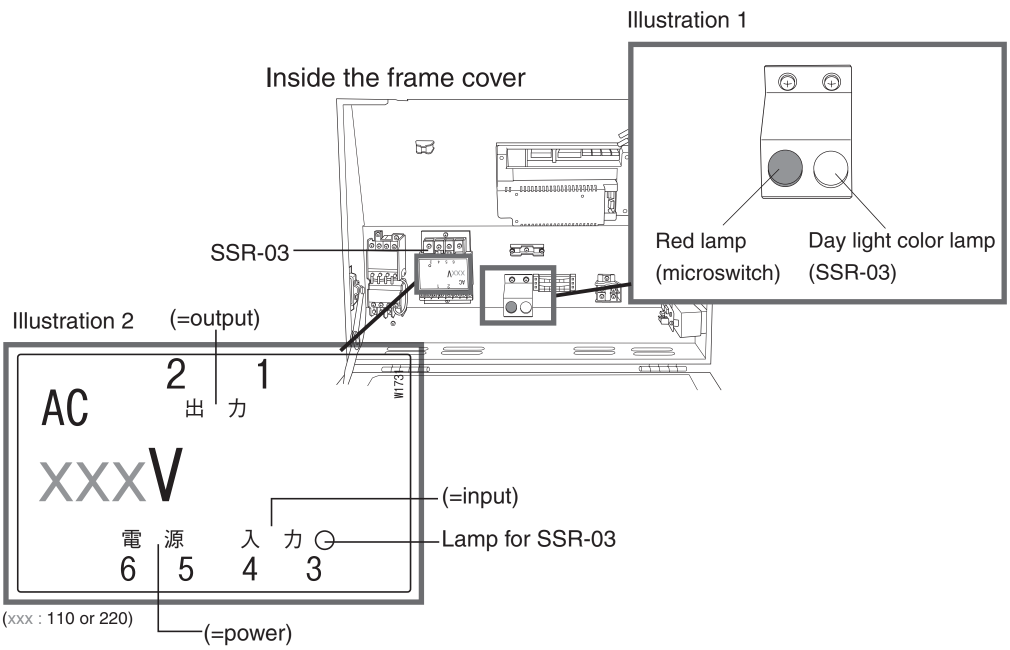
Service questions should be addressed to your local dealer.

Problems	Check	Solution
Seal result is unsatisfactory.	Heating element, teflon sheet or silicone rubber (white) is dusty.	Wipe with clean cloth.
	Teflon sheet is damaged.	Slide the teflon sheet.
	Silicone rubber is damaged.	Replace the silicone rubber (white).
	Glass tape is damaged.	Replace the glass tape.
	Heating temperature is too high.	Set the heating temperature to the lowest in which sealing is possible.
	Cooling temperature is too high.	Lower the cooling temperature.
Seal result is uneven at the right and left sides.	Silicone rubber is damaged.	Replace the silicone rubber (white).
Heating element is bent and risen in the center.	Electrode is damaged.	* Replace the electrode.
	Silicone rubber (white) is exhausted and becomes uneven.	Replace the silicone rubber (white).
Heating element is burnt out easily.	Heating temperature is too high.	Set the heating temperature to the lowest in which sealing is possible.
	Cooling temperature is too high.	Lower the cooling temperature.
	Glass tape is damaged.	Replace the glass tape.
	Electrode is damaged.	Replace the electrode.
Although the heating lamp is on, heating element does not heat up.	Heating element is broken.	Replace the heating element.
	Electrode does not touch with heating element.	Scour the metal contact part of electrode and heating element with a sand paper.
	Electric wire / black (or blue) from the transformer is not connected with electrode.	* Attach the electric wire / black (or blue) to the electrode certainly.
	SSR input lamp is off.	* Control unit may be damaged. Replace the control unit.
	SSR input lamp is on.	* SSR may be damaged. Replace the SSR.
Heating continues (heating lamp being on), and heating element and teflon sheet are burnt out.	SSR input lamp is off.	* Control unit may be damaged. Replace the control unit.

Items marked with an asterisk in the Solutions a column refer to the fact that these problems should be addressed by an electrician. If there are any problems, please contact your dealer or Fuji Impulse.

Error message

Error message	Check	Solution
Poor heating	Is heating element broken?	Replace the heating element
	Is electrode damaged, rustted, or temperature sensor slipped, or not installed?	If the temperature sensor is not installed, it doesn't sense the rising temperature and the pressure lever return to the initial state. Be sure to install the sensor (Refer to P.90)
When the error is not solved with the above-mentioned solution, please check the lamp of the lower illustration 1, with operating a machine. (Usually both two lamps are turned on during heating.)	Are two red and daylight color lamps turned off during heating? (Ref. illustration 1) If turned off Is SSR-03 lamp of the lower illustration 2 turned on during heating?	If SSR-03 lamp is turned off, control unit may be troubled. If SSR-03 lamp is turned on,SSR-03 may be troubled. *Consult with your dealer or our company.
	Is only the red lamp turned off during heating?	Microswitch may be troubled. Replace it with reference to P.88



Items marked with an asterisk *in the "Solutions" column refer to the fact that these problems should be addressed by an electrician. If there are any problems, please contact your dealer or Fuji Impulse.

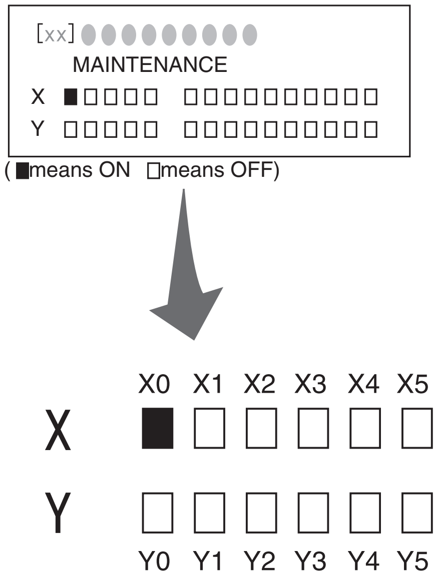
Error message on display

Error message	Problems	Solution
NG! X1 lever-upper	Upper lever position cannot be recognized	Adjustment or replacemrent of cylinder sensor is necessary. Please consult with your local dealer
NG! X4 nozzle-back	Nozzle back position cannot be recognized	
NG! X2 lever	lever sponge position cannot be recognized	
NG! X3 lever-lower	Lower lever position cannot be recognized	

Error massge	Check	Solution
Heat contorol can't function! Don't operate until it removes a trouble	Is SSR-03 lamp in the frame cover turned on?	If SSR-03 lamp is turned on, control unit may be troubled. If SSR-03 lamp is turned off, SSR-03 may be troubled. *Consult with your dealer or our company.
Over heating If the temperature does not reach to the setting within 3.5 seconds at heating, this message is displayed.	Is the temperature sensor slipped or not installed?	If the temperature sensor is not installed exactly, it doesn't sense the rising temperautre and the pressure lever return to the initial state. Be sure to install the sensor. (Refer to P.90)
	Transformer	*Transformer may be troubled. Consult with your dealer or our company.

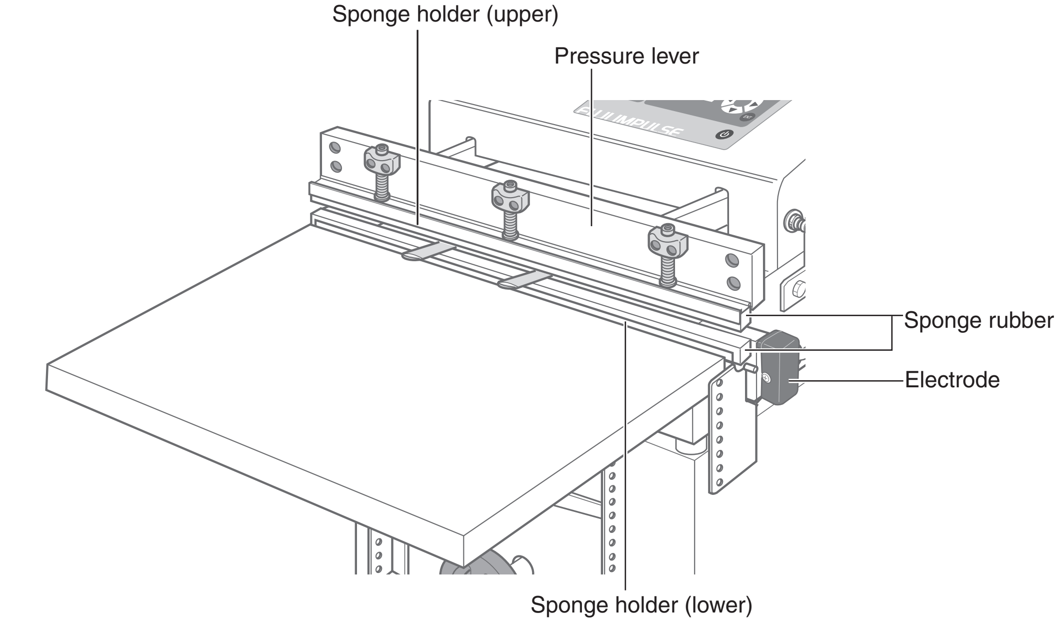
Recommendation of the maintenance mode

The state of a machine is found by display in the maintenance mode.
When the trouble occurs, we recommend to display the maintenance mode.
The position of black marked X and Y told operator the trouble pattern.
Please tell your dealer or our company the result.
(Ref. "Select the maintenance mode" in page 43)
Each working of X0---, Y0--- is described in electric diagrams (page 100 ～ 103) as IN (X) side and OUT (Y) side.

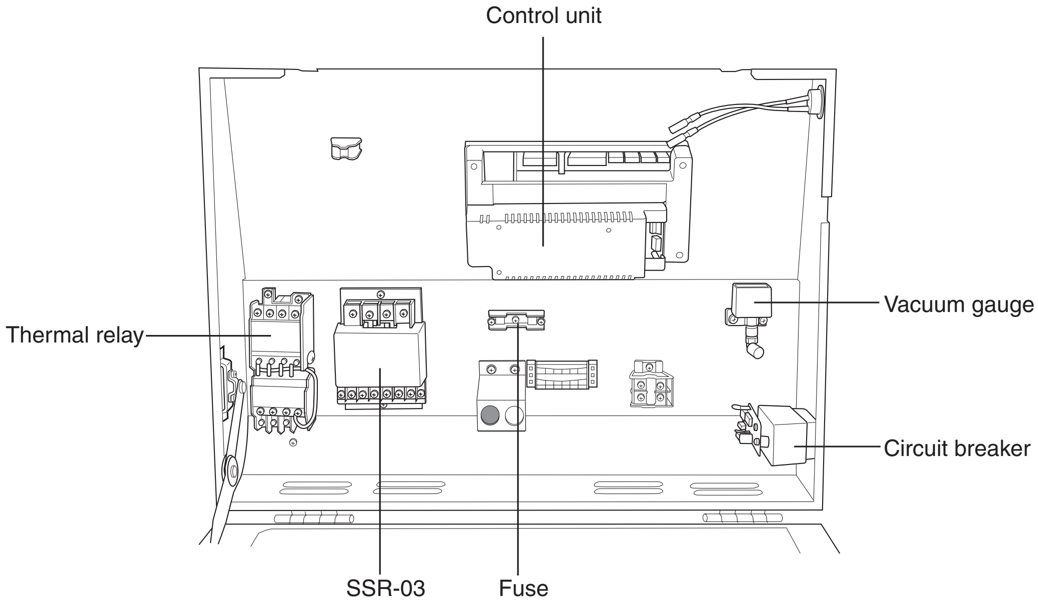


16 Exploded view of major parts

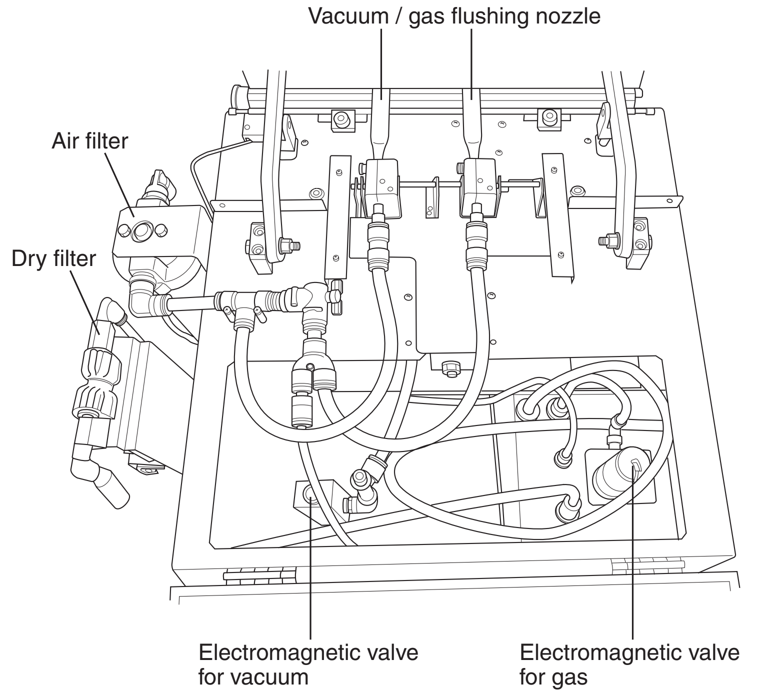
16-1 Sealing section



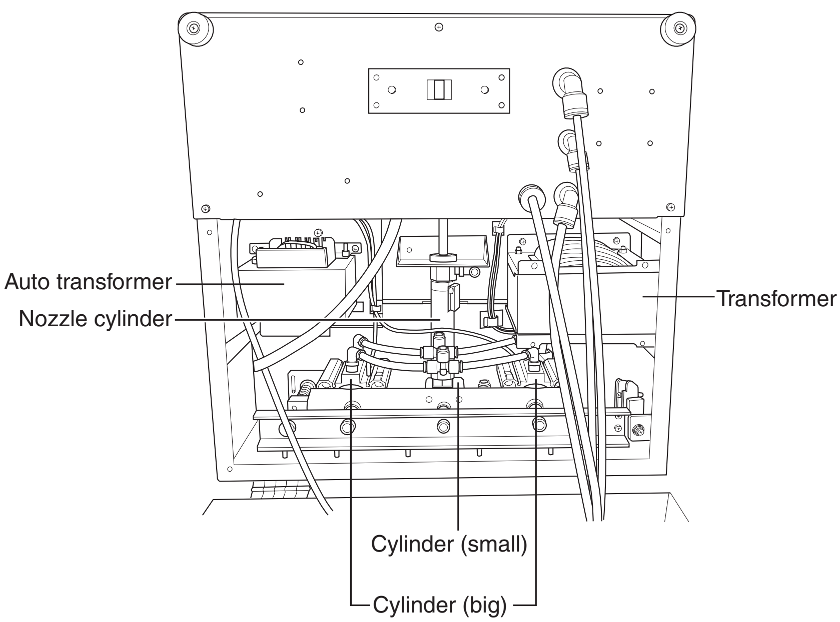
16-2 Inside of the frame cover



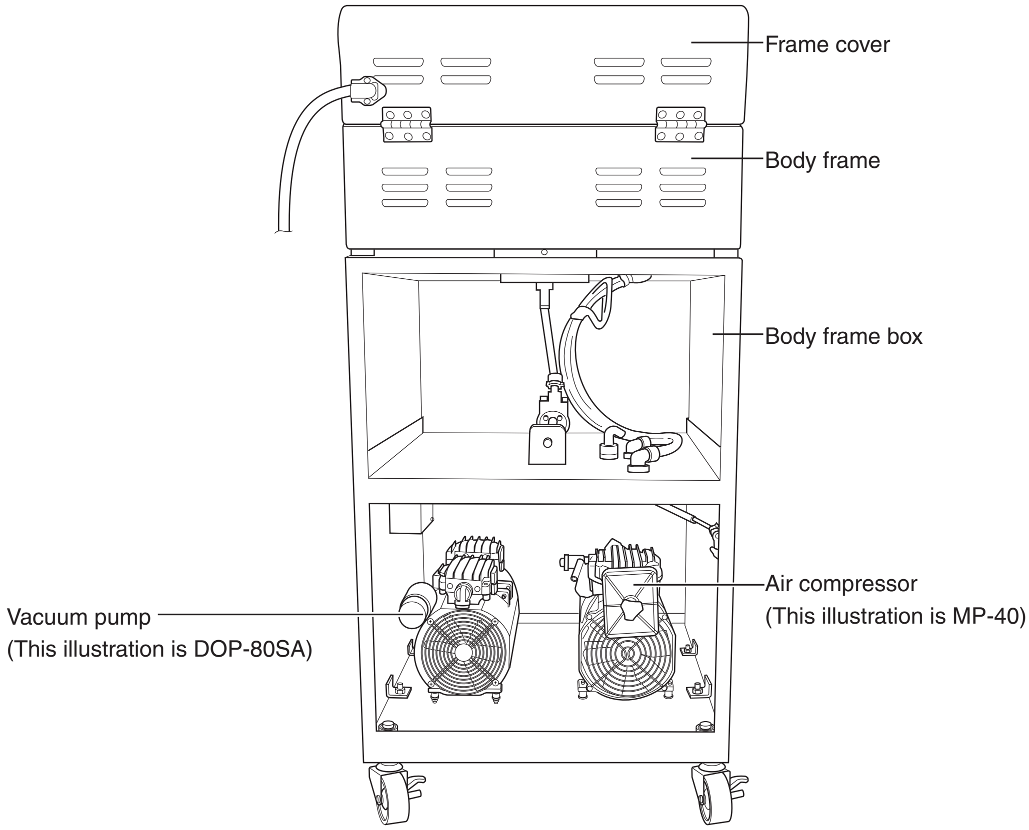
16-3 Nozzle unit section



16-4 Inside of the bottom plate



16-5 Inside of the body frame box



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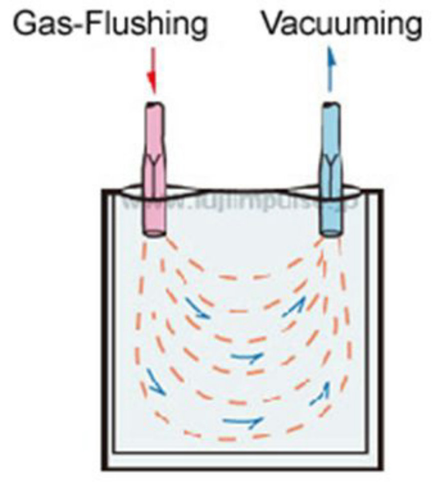
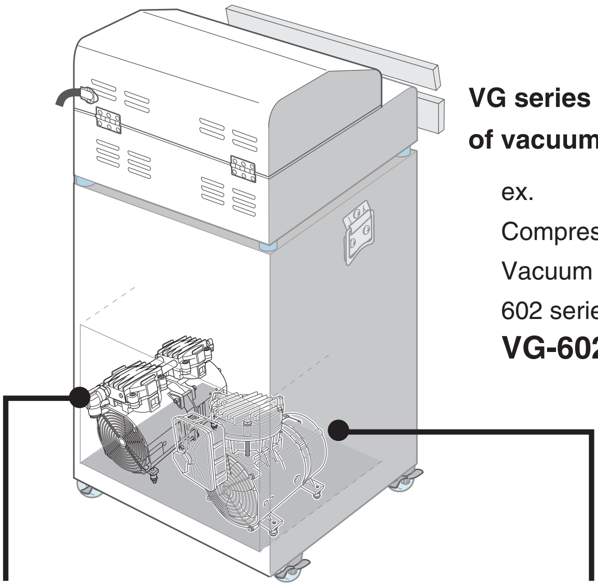

Gas-Flushing
Vacuuming

10-4 Combination of vacuum pump and air compressor



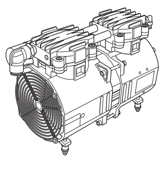
VG series sealer is named by the combination of vacuum pump and air compressor.

ex.
Compressor : MP-40 (called A)
Vacuum pump : DOP-80 (called H)
602 series dual heating type
VG-602-AH-10D

Vacuum pump / 4 types

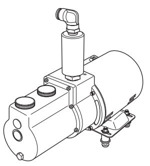
H.

DOP-80SA : Piston type
For standard
Pumping speed : 80L/min
Ultimate pressure : -96KPa
Pump weight : 7kg



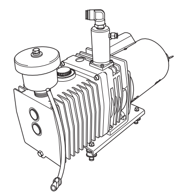
D.

G-50SA : Oil rotation type
For high vacuum degree
(small size pouch)
Pumping speed : 50L/min
Ultimate pressure : -101.3KPa
Pump weight : 11kg



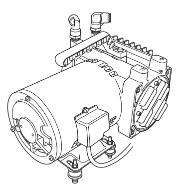
E.

G-100S : Oilrotation type
For high vacuum degree
(large size pouch)
Pumping speed : 100L/min
Ultimate pressure : -101.3KPa
Pump weight : 22kg



G.

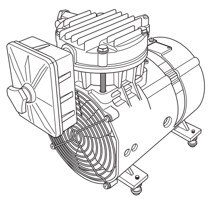
DA-60S : Diaphragm type
For clean room
(clean degree : about 10,000)
Pumping speed : 60L/min
Ultimate pressure : -80KPa
Pump weight : 12kg



Air compressor / 3 types

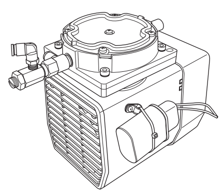
A.

MP-40 : Piston type
For standard
Pumping speed : 28L/min
Usual pressure : 310-330 KPa
Relief valve set-up pressure
Weigh : 8kg



B.

DOA-P108-DB :
Diaphragm type
For clean room
(clean degree : about 10,000)
Pumping speed : 31L/min
Usual pressure : 310-330 KPa
Relief valve set-up pressure
Weigh : 7kg



C.

Air is provided by the out side compressor

Suitable compressor specification
0.75kw (80L/min) above 480KPa