E. C. HORST.
APPARATUS FOR PICKING HOPS.
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1,054,119.
To all whom it may concern:

Be it known that I, Emil Clemens Horst, a citizen of the United States, residing at San Francisco, in the county of San Francisco, in the State of California, have invented certain new and useful Improvements in Apparatus for Picking Hops, of which the following is a specification.

Hops are raised on a trellis, sixteen to eighteen feet in height. When ripe, the vines are cut about four feet from the ground, the strings supporting their upper ends to the wire or trellis overhead being either broken by pulling on the vines or cut.

Prior to my invention, hopping was universally performed by hand. Hand picking, owing to the conditions surrounding the growing of hops, the shortness of the season, scarcity of labor and the like, is very expensive and the best hand picking leaves a large percentage of foreign material in the hops and the necessary sacking, boxing and delay in getting hand picked hops to the dry house often results in the discoloring, bruising and flattening of the hops themselves and entails many objectionable incidents.

I have devised a complete system for mechanically picking hops from the vines and separating them from the leaves and stems with which they are commingled and delivering them to dryers by machinery. I have claimed various parts and mechanisms entering into the construction of such complete automatic apparatus or plant in separate applications for Letters Patent of the United States, the present application illustrating an improvement in the form of picker shown in my application Serial Number 238,112, filed June 18, 1908.

My present invention comprises the combination of various essential elements of a hop picking machine, that is, a machine for separating the hops from the vines, and also various mechanisms combined with said essential elements, whereby the picked hops are cleaned or separated from the leaves and stems and the cleaned-hop are delivered to the dryers, all tending to the automatic handling of hops at a low cost and the securing of the product in the best condition possible for the market.

To the attainment of these and other desirable results, which will be hereinafter more particularly described, the method and apparatus which I prefer to employ and the several elements which are comprehended in the scope of this application, either singly or in combination are: First: Means arranged adjacent to the pickers for receiving the hops, said means comprising a receiving platform whereon the vines are delivered directly from the wagons. Second: Endless conveyers traveling around the pickers and extending to the receiving platform and having vine graspers to which the vines are secured. Third: Pickers for removing the hops from the vines, said pickers being mounted upon rotating drums, preferably arranged in two parallel series and each vine being caused to traverse both series of drums and being completely turned over and reversed in its travel, thereby effecting a complete presentation of all surfaces to the action of the picking drums. Fourth: Means for separating the picked hops from the clusters of hops, the leaves and other extraneous material which is removed from the vines by the pickers, said separators being arranged beneath the pickers so as to receive the hops by gravity therefrom as they are picked, and effect the separation thereof from the leaves and clusters without massing the hops. Fifth: Suitable conveyers for taking the leaves and clusters of hops to a cluster stemming apparatus, and suitable conveyers for taking the partly cleaned hops to a secondary separating and grading apparatus. Sixth: Secondary separating and grading mechanism comprising preferably a rotating perforated cylinder into the interior of which the partially cleaned hops are passed and through and under which the final separating is effected. Seventh: Means for destemming any hop clusters that may have been picked and thrown out by first separation and means for further separating the hops thus destemmmed from the leaves and trash with which they are commingled. Eighth: Means for elevating the clean hops to the drying floors where they are cured and then baled ready for market.

In separate applications I have claimed various novel features of construction and several integral elements are included in a complete apparatus, and it will be understood that while in the present application I have shown a complete apparatus for performing all of the various operations between the wagon on which the hops are drawn from the field to the dry house, yet some of these auxiliary mechanisms may be...
dispensed with and some only of the operations which I have above indicated may be performed in a machine, while other operations may be carried out by different apparatus or even by hand. So too, the specific character of some of the mechanism above indicated may be changed without departing from the scope of my present invention, which has to do with the associated mechanisms and combinations of mechanism for performing the most important of the steps in separating the hops from the vines and cleaning the picked hops. Many of the instrumentalities which are included in this present application are novel within themselves, as for example, the arrangement of the pickers whereby they are made self-cleaning, and other instrumentalities whereby the clusters of hops are effectively broken up so as to be more readily amenable to the action of the pickers.

These and other features of the invention will be hereinafter more fully described.

In the accompanying drawings; Figures 1 and 2, read together, represent my improved hop picking machine in side elevation, with the central portion thereof broken away. Fig. 3 shows at the left, an elevation of the receiving end of the machine with vines entering, and at the right, the cluster stemmer and a separating cylinder. Fig. 4 is a cross-section of the machine on the line 4—4 of Fig. 3, omitting various details. Fig. 5 is a side elevation. Figs. 6 and 7 are transverse sections of the perforated separating cylinder on the lines 6—6 and 7—7 of Fig. 5. Figs. 8 and 9 are detail views of the picking drum, Fig. 8 being a longitudinal section and Fig. 9 a transverse section. Fig. 10 is an enlarged fragmentary end elevation, showing part of the grilling drum and the drive thereon. Fig. 11 is a side elevation of the drum shown in Fig. 10, the same being mounted for oscillation. Fig. 12 is a perspective view of the picking fingers, Fig. 13 a detail plan view of the vine grasper and its associate parts, showing the vine grasper member and the moment of engaging with the automatic release. Fig. 14 is a similar view showing the vine graspers in the released position, and Fig. 15 is a fragmentary end elevation of Fig. 13.

It will be understood that each hop picking unit comprises a receiving platform, an endless conveyor including a vine grasper, a series of picking drums and a series of separators arranged beneath the picking drums, with the necessary conveyors for receiving the hops, leaves and clusters and conveying them to the destemming and grading apparatus for taking the cleaned hops to the drying floors and the vines, leaves and other refuse away from the machine. It will be further understood that in large fields, several of these machines will be arranged in battery formation and that the destemming and grading apparatus may serve several picking machines. Each machine may also be of duplex construction; that is to say, it may comprise two receiving tables and two series of picking drums and separators, the latter delivering the picked hops to conveyers at the outer sides of the machines and the leaves and stems to a common conveyer between the machines.

Since I contemplate the complete automatic handling of the hops from the vine wagons to the dry house, the machines will preferably be located at the dry house and the vines will be brought from the fields on wagons.

Each machine is supported on a suitable frame work or supporting structure, 15, which in actual practice is from sixty to eighty feet in length, ten feet wide and eighteen feet high. At the receiving end of each machine is a receiving table or platform, 16. Extending to each receiving table is an endless carrier composed of a pair of spaced, parallel sprocket chains, 17, 18, traveling over suitable direction sprockets, 19, 20, at the receiving end and over large sprockets, 21, at the opposite end. At suitable intervals, usually about twelve feet apart, these chains are connected by angle bars, 22, which constitute a part of the vine grasper. These vine graspers, (see Figs. 13, 14 and 15) comprise pivoted members, 23, between the inner ends of which and the leg of the angle bar, the ends of the vines are clamped, the parts being normally held in clamping relation by means of coiled springs, 24, and thrust collars, 25. Springs, 26, acting on the grasping levers outside their pivots, cause them to release the vines when the pressure of the springs, 24, is counteracted by the hinged arms, 27, which are provided with hinged fingers, 28, depending in the path of the collars and held in position to engage them by the counterweighted cables, 29. The pivots, 30, of the hinged arms being fixed, and the bars, 22, continuously moving, the collars will be forced out releasing the graspers, which will then be carried on their pivots, as shown in Fig. 14, releasing the vines and held open until a new vine is inserted, at which time the arms are manually withdrawn from engagement with the spring pressed collar, 25. The depending fingers, 28, are held against displacement by the squared end of the pivoted rod, 27, and are held against movement until the bar, 22, has carried the rod, 27, to the dotted line position of Fig. 14, when the opposite side of the depending finger, 28, will be presented to the bar, 22, and will be allowed to spring outwardly, thus releasing it from the member, whereupon the arms, 27, will be restored to the position of Fig. 13.
by the counterweighted cables, 29, ready to engage the collars of the next pair of graspers.

The carrier and vine grasper travel through the machine, first over the upper series of fixed picking drums, 31, and above the auxiliary drums, 32, which latter are mounted on swinging frames, 33, for a purpose hereinafter described. The vines are thus drawn, but end first, over the upper series of drums, 31, thence around the reversing drum, 34, and back over the lower series of picker drums, 35. Power to drive the carrier is applied to the reversing drum, 34, by the belt, 36. The several picker drums are rotated in a direction opposite to the travel of the vines by means of sprocket chains, 37, passing over sprockets, 38, on the drum shafts, 39.

Each of the main picker drums is composed of a series of flanged heads, 40, mounted to turn with the shafts, 39, and a series of transverse slats, 41, held to the flanges of the drum heads by U-clips and a series of picker fingers mounted on the slats.

The picker fingers are preferably composed of wire, each finger having parallel body portions, 42, with bent ends, 43, entering openings in the vertical side of the slit and clamped thereto by the bar, 41a, which is also embraced by the clips. The picker fingers are formed as shown in Fig. 12, thus inclosing a V-shaped space open at the rear and closed at the apex, and the adjacent fingers are suitably connected, as by the sleeves, 44. The specific construction of the picking fingers may be varied, and means for guarding the points thereof to prevent them from penetrating or bruising the hops may be employed. Whatever may be the specific construction of the picker fingers or the material of which they are composed, it is desired that they should have the V-shape and be open at their receiving sides so that as the drums conveying them are revolved in one direction, as for example clockwise, the vines moving in the opposite direction over the periphery of the drums, the clusters of hops will depend into the path of the fingers and entering their open sides, will be drawn into their converging portions and stripped from the vines, the latter, as indicated diagrammatically in Fig. 9, due to their length and the mass of leaves the carriers being supported by the revolving surfaces, while the picking fingers engage the depending clusters and strip them. The path of the vines being tangential to the path of the finger, this severing is better performed than if the paths were parallel and entanglement of the vines is prevented.

The vines are turned completely over as they pass around the reversing drum, 34, and as they are conducted over the lower set of drums, 35, and clusters which were left unsevered by the action of the upper drums will be caught. In this traverse also, any hops which still lie on the upper side of the vines will be likely to contact with the fingers on the lower side of the upper drums and be severed thereby, especially since the action of the drums imparts a vibratory movement to the vines, thus causing all of its branches to come into contact with the picking members and prevents the bunching and twisting of the vines. It will also be observed that the two series of drums are so positioned that their fingers are almost in contact, only sufficient space for the passage of the vines intervening and as the several sets of fingers pass each other tangentially, any hops which may be carried by branches broken or detached from the main vine will be caught and pulled off and any broken vines, clusters of hops or masses of leaves that are caught or entangled in one set of fingers will be removed by the set on the opposite drum passing tangentially thereto, whereby the pickers are made self-cleaning. The smaller auxiliary drums, 32, are so arranged that their fingers contact with the fingers on the immediately adjacent lower drums, except as they are held apart by the intermediate vines. The swinging frames, 33, (see Fig. 11) which carry the auxiliary drums, have counterweights, 35a, and their shafts carry disks, 35b, which are contacted and raised by the angle bars to allow the vine grasppers to pass. These auxiliary drums are preferably run at greater speed than the large drums and are particularly effective owing to that fact and their free or floating mounting in removing any remaining hops.

The speed at which the main drums are driven may vary with different kinds of hops and usually the drums near the receiving end are preferably driven at a slower speed than those at the opposite end of the machine, while the auxiliary drums are driven at a much higher speed. The desired speed will be determined by the size of the sprocket used.

Passing the last of the drums, the stripped stalks are released by the hinged tripping arms at the point X, Fig. 2, beneath the extension of the carrier. The picked hops and the severed leaves and trash, falling from the drums, are received on upwardly traveling separator belts, 45, arranged transversely beneath the drums, the round, clean hops rolling down the belt into a conveyor trough, 46, located parallel to the outside of the machine, the leaves, trash and hop clusters being carried upwards by the belt and discharged into a conveyor, 47, on the opposite side of the machine. This latter conveyor may serve two machines when the duplex arrangement is followed. The hops
falling down the primary separator belts and falling into the conveyer, 46, sometimes contain a small percentage of leaves as the large picking capacity of the drums sometimes overpowers them. On this account the partially cleaned hops are automatically conveyed to a secondary separating and grading apparatus, consisting preferably of a perforated hollow cylinder, 48, set on an incline and revolved slowly so as to allow the hops to drop through the perforations while the leaves and stems find their way out of the lower end of the cylinder and are deposited there to be removed later as trash.

In practice this perforated cylinder is about eighteen feet long, forty inches in diameter and made up of a light frame work of timbers twenty feet long, fastened at the lower end to a spider, 49, to which is affixed the shaft, 50, which acts as one point of support for the cylinder frame and by which the cylinder is rotated. About six feet from the upper end of the cylinder, its timbers are held in place by a suitable ring, which at the same time acts as a cylindrical guard upon which the screen frame is revolved; two idle pulleys or roller bearings, 52, being placed under the ring and these act as bearings for the revolving screen. The walls of the cylinder are composed of perforated sheet metal plates, the upper one-third having perforations of \( \frac{3}{4} \) of an inch to one inch, the second \( \frac{1}{2} \) to \( \frac{3}{4} \) inch perforations and the lower third \( \frac{3}{4} \) to \( \frac{1}{2} \) inch perforations.

This leaves about two feet at the lower end of the screen frame work entirely open, this space being necessary to allow the leaves and trash to fall out of the cylinder. The perforations above mentioned must be changed as to size according to the kind of hops to be handled, the above sizes being given as an illustration. The screen is revolved at suitable speed varying with the kind of hops and percentage of leaves but usually about forty to sixty revolutions per minute. The partially cleaned hops from the primary separators are conveyed into the upper end of the cylinder in a steady stream and as the perforated cylinder slowly revolves, the smaller hops and any hop petals there may be practically all fall through the first six feet of the perforations, and as these hops are absolutely clean and free from leaves, they are diverted into a clean hop conveyer by means of a chute of any suitable construction. Separator belts, similar to those placed under the picking machine, are placed directly under the remaining portions of the revolving perforated cylinder to receive the hops as they fall through the perforations and remove any leaves that might have been carried along this far in the process. These last mentioned traveling separators may be dispensed with but are preferably employed in case of heavy picking. The action of the separators is the same as that of the similar belts under the picking machine, the hops rolling downwardly into the clean hop conveyer, while the leaves, because of their different nature and flatness and lesser rolling tendency, travel upwardly with the separator belt, to be discharged as rubbish and removed either continuously by conveyers, or at intervals as they accumulate. The bulk of the leaves, stems and other rubbish picked off the vines, slowly work down the inclined cylinder and are discharged at the lower end onto a conveyer or accumulate to be removed at intervals. The action of the perforated cylinder, with its various sets of perforations in such that if desired, the hops can be graded as to size, and the chute taking the hops falling through the perforations can be diverted in any direction, and the setting of the upwardly traveling belt separators, may be so arranged as to discharge the cleaned hops at either side so that this apparatus may be used as a hop grader as well as a hop separator. The hops, after passing through the perforated cylinder and down the separators underneath same, are now absolutely clean and in condition to be conveyed to the drying kilns.

The hop clusters and leaves discharged over the top of the separator belts which are placed immediately under the hop picking machine are conveyed into a cluster stemming apparatus, which is fully described in the separator application of George E. Miller. The portion of this device is indicated in Fig. 8, and it comprises two conical drums concentrically disposed so as to provide a passage way between them, each of the drums being provided with picker teeth which break up the clusters and release the hops from the stems. The clusters are fed by gravity into the interspace and rotary motion is imparted to one or both of the drums. The cluster stemmer handles both the hop clusters from the machine and also any clusters or small branches that may have been broken in handling from the wagons or in loading vines into the machine. The hops, after having been de-stemmed, are discharged around the base of the two conical drums, then by means of a funnel like hopper are deposited upon a rising conveyer to be discharged into a set of secondary separating apparatus which may be a duplicate of the perforated cylinder separator previously described. This perforated cylinder removes the last of the hops from the leaves and trash and the clean hops are automatically conveyed from the separating belts below the second separator to the clean hop conveyer which delivers them to the drying apparatus, where they are cured, later to be baled for market.

While some of the specific mechanisms...
hereinabove described are not novel per se, and others of them are not of my invention, I believe myself to be the first to organize and associate the several instrumentalities as a whole and in their various combinations, all to the end and purpose of mechanically picking and cleaning hops, thus dispensing with all of the most laborious and expensive parts of hand labor heretofore employed, and also securing a better quality of product. The result achieved, when considered in its entirety, is obviously important and since I believe such result to be wholly new, I do not wish to limit my claims to the exact structural means employed, but desire to cover not only the specific means, which I have shown and which are the best known to me, but also by the broader claims hereinafter made, any equivalent means. I also wish to be understood that some of the instrumentalities which I have described are not essential to the performance of the work of picking hops mechanically and may not only be substituted by other or equivalent means or may be omitted. For example, the rough picking of hops may be accomplished by the employment only of the pickers and the carrier, while relatively clean picking may be attained by the use of the preliminary separators alone. To the attainment of greater perfection, the auxiliary devices, such as the movable picker drums, the cylindrical separator and the cluster stemmer are useful and obviously the vine grasper and system of conveyers increase the capacity and lower the cost. It is obvious also that some of the instrumentalities herein described might be substituted by others on a specifically different construction and yet cooperate in the same general combination. As for example, I have shown the pickers mounted on revolving drums, but obviously, the pickers might be stationary and instead of drums the several picker mechanisms might be mounted in the same plane, the bars presented to the vines at any given time by the series of drums indicating the position of said stationary pickers. The revolving pickers are present because in their rotation, they act tangentially to the mass of moving vines and they also, by their rotation, clean themselves.

I claim:
1. In a hop picker, two series of rotating pickers, in combination with means for moving the vines over said series consecutively and means for inverting the vines at an intermediate stage of the operation, substantially as described.
2. In a hop picker, the combination of upper and lower series of revolving pickers, of a vine carrier adapted to carry the vines first over the upper series of pickers and thence over the lower series of pickers, the carrier being adapted to reverse the direction of travel of the vines and also to invert them as to position intermediate said series, substantially as described.
3. In a hop picker, the combination with upper and lower picker drums arranged in proximity to each other and rotating in opposite directions, of an endless vine carrier adapted to move the vines over the upper surfaces of the upper series of drums, and then between the drums of the said two series, the travel of the vines being in a direction opposite to the direction of movement of the drums over which they are traveling, substantially as described.
4. In a hop picker, the combination with a series of stationarily positioned rotary picker drums, of one or more auxiliary drums mounted in proximity to the first mentioned pickers and adapted to move toward and from the path of movement of the vines and adjacent pickers, substantially as described.
5. In a hop picker, the combination of two series of rotating pickers arranged parallel to each other and separated at their continuous surfaces to permit the passage of the vines therebetween, the pickers of the one series being rotated in a direction opposite to that of the other series and a vine carrier adapted to move the vines between the two series of rotating pickers and in a direction contrariwise to the direction of rotation of one of said series, substantially as described.
6. A hop picker, comprising, in combination, a series of picker drums, an endless vine carrier provided with vine graspers and arranged to travel at a tangent to said drums, some of said picker drums being geared to rotate at a greater speed than the remainder thereof, substantially as described.
7. In a hop picker, the combination of a series of rotatable drums, picker fingers on the peripheries of said drums, and means for passing a vine over said drums in a direction opposite to that of the peripheral travel of the drums, said picker fingers being of substantially V-shape, the inner point of the V being rounded whereby to engage and remove hops but not to remove leaves, substantially as described.
8. In a hop picking machine, the combination of a series of rotatable drums, picker fingers mounted on said drums, said fingers being of substantially V-shape, the inner point of the V being rounded whereby to engage and remove hops but not to remove leaves, means for passing a hop vine over said drums, and means for shifting said hop vine whereby all parts thereof are exposed to the action of the picker fingers, substantially as described.
9. In a hop picking machine, the combina-
tion of a series of rotatable drums, picker fingers mounted on said drums, said fingers being of substantially V-shape, the inner point of the V being rounded whereby to engage and remove hops and have substantially no effect on foliage, and a carrier adapted to engage and move a hop vine over said drums in a direction opposite to that of the peripheral travel of the drums, substantially as described.

10. In a hop picking machine, the combination of a series of rotatable drums having skeleton picker fingers, means for passing a hop vine directly over said skeleton fingers, said fingers being of substantially V-shape, the inner point of the V being rounded whereby to pass through the foliage of a vine and remove only the hops therefrom, substantially as described.

EMIL CLEMENS HORST.

Witnesses:

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