APPARATUS FOR TREATING HOPS AND THE LIKE

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The object of this invention is to provide in a convenient form apparatus for treating hops or the like.

Apparatus according to the invention comprises in combination a chamber, a perforated endless conveyor extending across the upper part of the chamber, means for supplying hot air under pressure to the conveyor, adjustable means for determining the proportion of the conveyor through which the hot air can escape from the chamber and means responsive to the temperature of the air above the conveyor for determining the setting of said adjustable means.

An example of the invention as applied to apparatus for treating hops will now be described with reference to the accompanying drawings in which:

FIGURE 1 is a diagrammatic side view of the apparatus with parts broken away.

FIGURE 2 is a diagrammatic part sectional end view of FIGURE 1 as seen from the left hand end of that figure, with some of the parts omitted.

FIGURES 3 and 4 respectively are enlarged end and plan views showing the reciprocating feed conveyor.

FIGURE 5 is an enlarged part-sectional side view of the final treating conveyor and its associated mechanism.

FIGURE 6 is an enlarged side view of an alternative construction to that shown in FIGURE 5, and FIGURE 7 is a wiring diagram of the automatic control apparatus.

In the illustrated example of the invention the hops are delivered by a conveyor 10 and chute 11 from picking apparatus (not shown) to a feed conveyor generally designated 12.

Referring particularly to FIGURES 3 and 4 this feed conveyor 12 is in the form of a horizontally extending endless belt 13 which is mounted on a horizontally reciprocating frame 14. The frame 14 has rollers 15 whereby it is supported upon tracks 16 extending parallel to the run of the feed conveyor, and at one side of the frame 14 is a vertically disposed channel 17, in which is engaged a roller 18 extending from one side of an endless chain 19. This chain is mounted on sprocket wheels which are carried by fixed supports on the frame of the apparatus, and one sprocket wheel is mounted on a shaft 20 driven from any convenient source. Thus as the chain 19 is driven the frame 14 together with the belt 13 will be reciprocated longitudinally by the interengagement of the roller 18 with the channel 17.

Beneath the discharge end of the feed conveyor 12 is the charging end of the first of a plurality of endless and perforated conveyors 21, 22, 23 and 24 (herein termed treating conveyors) which are arranged in line, and relative to which the feed conveyor 12 is transversely disposed. Moreover, the reciprocations imparted to the feed conveyor 12 are such that its discharge end moves backwards and forwards across the first treating conveyor 21 to speed the hops evenly thereon.

The first treating conveyor 21 extends through a chamber 25 having a closed top and wherein the hops upon it are treated with sulphur dioxide. The sulphur dioxide is admitted from any convenient source (not shown) through inlets 26 above the conveyor and is drawn downwarly through the hops by a fan 27, the fans located within a duct 28 or ducts below the conveyor and through which the sulphur dioxide is extracted.

At the charging end of the first treating conveyor 21 is an inclined baffle 29 the effective height of which can be adjusted. Also above this conveyor is a positively driven rotary levelling device 30 under which the hops must pass, this device conveniently being in the form of a roller having a plurality of angularly spaced and radially extending vanes. The levelling device 30 is also adjustable for height and is conveniently adjustable with the baffle by a common manually operable means. Thus, the levelling device and the baffle may be carried by a common support 29a which is vertically adjustable by screws 29b.

In use the hops delivered from the discharge end of the feed conveyor 12 on to the charging end of the first treating conveyor 21 tend to build up into a heap from which excess hops flow over the upper edge of the baffle 29 and roll down its outer side on to a return conveyor 31 which delivers them back to the source from whence they came. The remainder are conveyed under the levelling device 30, which spreads them as an even blanket and through the chamber 25 to the discharge end of the first treating conveyor 21 from whence they fall freely on to the charging end of the second treating conveyor 22 situated below.

The second treating conveyor extends horizontally across the top of a chamber 32 to which heated air is admitted under pressure through an inlet 33 from an oil heater (not shown). Thus the hops whilst on the second treating conveyor are dried by the hot air being forced through them from below. From the discharge end of the conveyor 22 the hops fall freely on to the charging end of the third treating conveyor 23 which extends across the top of a chamber 34 to which air is admitted under pressure from a separate oil heater through an inlet 35. The temperature and pressure in the two chambers 32, 34 can thus be varied independently to accord with a predetermined drying cycle.

From the discharge end of the conveyor 23 the hops fall freely on to the charging end of the fourth treating conveyor 24 from whence they are delivered on to a transversely extending delivery conveyor 36 for traversing them to a store or bagging apparatus.

The conveyor 24 extends across the upper side of a chamber 37 to which heated air is admitted under pressure through an inlet 38 from a separate oil heater. The chamber 37 is relatively long and (as shown by FIGURE 5) incorporates a longitudinally movable barrier 39 whereby the effective length of the chamber can be varied to accord with the condition of the hops. The inlet 38 is disposed nearer the charging end of the third treating conveyor, thus by moving the barrier 39 nearer to the charging end, the hops upon the conveyor are subjected to drying for a shorter time if the conveyor is moving at a constant speed. Conversely by moving the barrier on the opposite direction the hops on the conveyor are subjected to a drying treatment for a longer time.

It will be appreciated that, if the speed of the conveyor 24 and the temperature and pressure in the chamber 37 are both constant, the temperature of the air immediately above the hops on this conveyor will vary with the moisture content of the hops, and this fact is used to effect an automatic control of the setting of the barrier 39.

The barrier 39 is connected to the one run of an endless chain 40 which is driven by a reversible electric motor 41 through a chain 42. The motor 41 also drives another endless chain 43, one run of which is connected to a carriage 44 mounted on tracks 45, and moves the barrier 39. On the carriage 44 is a resistance type thermometer 46 which is connected to a known piece of apparatus indicated at 47 containing a three-electrode mercury switch 48 which is set to the position shown when the temperature is above a preset value and is changed automatically to the alternative position when the tem-
perature falls below the preset value. In series with the switch 48 is a time controlled switch 49 which is closed for a short time (for example, 2 seconds) at predetermined intervals.

The switch 48 controls the direction of rotation of the motor 41, and the arrangement is such that when the switch 48 is closed with the switch 49 in the position shown, the electromagnet 50 of the contactor 51 is energised to cause the motor to operate for a short time in a forward direction, and thereby move the barrier 39 and carriage 44 a predetermined distance to the left as viewed in FIGURE 5. This distance is equal to the distance between a pair of adjacent partitions dividing the area between the runs of the conveyor 24 into a plurality of cells. The effect of this will be to reduce the time for which the hops are subjected to a drying treatment. If the temperature above the hops now falls below the preset value the switch 48 will be moved automatically to the alternative position, so that when the switch 49 next closes the electromagnet 52 will be energised to cause the motor 41 to operate in the reverse direction, and thereby move the barrier to the right as viewed in FIGURE 5 by an equal distance.

As illustrated in FIGURE 5 a cable 46a for connecting the thermometer 46 to the apparatus to be controlled is supported by insulators 46b slidingly mounted on another cable 46c, the latter being supported under tension above the chamber 37.

The event that the barrier 39 is moved by successive steps to the limit of its travel to the left without lowering the temperature a the thermometer 46 below the preset value, the barrier will actuate a limit switch 53 to break the circuit to the electromagnet 50 and make the circuit to a warning bell or lamp 54. Similarly, in the event that the barrier 39 is moved to the limit of its travel to the right it will actuate a limit switch 55 which will break the circuit of the electromagnet 52, complete the circuit of the warning device 54, and at the same time break the circuit to the coil 56 of a contactor 57 controlling a motor 58 for driving the conveyors 21, 22, 23 and 24.

In addition a pair of manually operable switches 59, 60 are provided whereby the electromagnets 50 and 52 respectively may be energised independently of the position of the switches 48, 49.

In order to effect an overall control upon the apparatus to accord with hops of different varieties the speed of the conveyors 21, 22, 23 and 24 can be adjusted. Moreover, as previously described the depth of the blanket of hops on these conveyors can be adjusted by means of the baffle 29 and the levelling device 30.

In the modified construction illustrated in FIGURE 6, instead of using a barrier 39 the area between the runs of the conveyor 24 is divided into a plurality of separate cells each containing its own valve 61. Each valve 61 is mounted on a spindle to which is secured a radial arm 62, carrying a roller 63 at its outer end. Alternate arms 62 are laterally offset from one another, and each arm is loaded by a spring 64 in a direction to hold its roller 63 against the under surface of abutment pieces 65 secured to an endless chain which is the equivalent to the chain 49 in the previously described construction, and the movement of which is controlled in a similar manner. Between one pair of adjacent abutment pieces 65 is formed a relative gap 66 into which the rollers 63 can enter.

The arrangement is such that as the gap 66 is traversed to the left as viewed in FIGURE 6 each roller in turn will enter the gap, and its associated arm will be moved angularly to close the associated valve 61, whilst movement of the gap to the right will result in the opening of each valve 61 in turn. Moreover, the time switch 49 is so set in relation to the motor 41 that for each closing of the switch 49 actuation of one of the valves 61 will result.

In order to adjust the supply of hot air to accord with the area of the conveyor 24 through which the air can escape, and thereby maintain a substantially constant air pressure in the chamber 37, the inlet 38 may have associated with it a valve 67. This valve is operable by a cord 68 which is connected to a roller 69 on the spindle of one of the sprocket wheels of the chain carrying the abutment pieces 65, and the arrangement is such that as the chain is moved to close the valves 61, the cord 68 is wound into the drum 69 and serves to close the valve 67 proportionally, whilst movement of the chain in the opposite direction will have an opposite effect.

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

1. Apparatus for treating hops and the like, comprising in combination a horizontally disposed perforated endless conveyor for carrying the hops or the like to be treated, an elongated chamber through the interior of which said conveyor extends longitudinally in spaced relationship to the top and bottom of said chamber, and which is provided adjacent one end with an inlet for admitting hot air under pressure to the part of said chamber beneath said conveyor, air-flow obstructing means situated in said chamber beneath a part of said conveyor and movable for varying the extent of said conveyor through which hot air can flow, a horizontal track mounted above and parallel with said conveyor, a carrier movable along said track, a temperature responsive device mounted on said conveyor and movable thereby along a path, situated above and extending in the same direction as said conveyor, for enabling said conveyor to be exposed to the heating effect of the hot air flowing through said conveyor, a reversible electric motor, means through the medium of which said motor is controllable by said temperature responsive device, and transmission mechanism connected to and operable by said motor for actuating said air-flow obstructing means and moving said carrier along said track.

2. Apparatus according to claim 1, wherein said air-flow obstructing means comprises a barrier extending transversely across said chamber beneath said conveyor, and movable relatively to said conveyor towards and away from the air inlet of said chamber under the action of said motor, said transmission mechanism being constituted in part by a member connected to said barrier for imparting movement to the latter under the action of said motor.

3. Apparatus according to claim 1, wherein said air-flow obstructing means is constituted by a plurality of valves having in combination therewith means dividing a space between the runs of said conveyor into a plurality of cells which are situated side by side throughout a part of the length of said conveyor, and through which hot air can flow under the control of said valves, said transmission mechanism being constituted in part by an endless chain which is disposed parallel with said conveyor, and which is provided with abutment pieces, and said valves being provided with actuating members which are operable in sequence by said abutment pieces.

4. Apparatus according to claim 1, wherein said means through the medium of which said motor is controllable by said temperature responsive device, includes a first switch connected to, and operable under the control of, the temperature responsive device, and a time-controlled switch which is connected in series with said first switch, and which closes automatically for short periods at predetermined intervals.

5. Apparatus according to claim 1, and comprising a plurality of additional horizontally disposed perforated endless conveyors for carrying the hops or the like to be treated, which additional conveyors, and the first mentioned conveyor, are arranged in stepped formation with the first mentioned conveyor lowermost, and with a charging end of each successive conveyor disposed below a discharge end of the preceding conveyor to receive hops or the like therefrom.

6. Apparatus according to claim 1, and comprising in
combination a plurality of additional horizontally disposed perforated endless conveyors for carrying the hops or the like to be treated, which additional conveyors, and the first mentioned conveyor, are arranged in stepped formation with the first mentioned conveyor lowermost, and with a charging end of each successive conveyor disposed below a discharge end of the preceding conveyor to receive hops or the like therefrom, a horizontally disposed endless feed conveyor extending transversely over the charging end of the uppermost additional conveyor, mechanism whereby said feed conveyor is reciprocable longitudinally to cause a discharge end thereof to move backwards and forwards relative to the charging end of the uppermost additional conveyor, and a baffle which is situated at the charging end of said uppermost additional conveyor, and over which excess hops or the like can pass from the last mentioned conveyor.

7. Apparatus according to claim 1, and comprising in combination a plurality of additional horizontally disposed endless conveyors for carrying the hops or the like to be treated, which additional conveyors, and the first mentioned conveyor, are arranged in stepped formation with the first mentioned conveyor lowermost, and with a charging end of each successive conveyor disposed below a discharge end of the preceding conveyor to receive hops or the like therefrom, a horizontally disposed endless feed conveyor extending transversely over the charging end of the uppermost additional conveyor, mechanism whereby said feed conveyor is reciprocable longitudinally to cause a discharge end thereof to move backwards and forwards relative to the charging end of the uppermost additional conveyor, a rotary levelling device adjustably mounted above the charging end of the uppermost additional conveyor to act on the hops or the like received by the last mentioned conveyor from said feed conveyor, a baffle which is adjustably mounted at the charging end of said uppermost additional conveyor, and over which excess hops or the like can pass from the last mentioned conveyor, and a further conveyor for receiving the hops or the like passing over said baffle.

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