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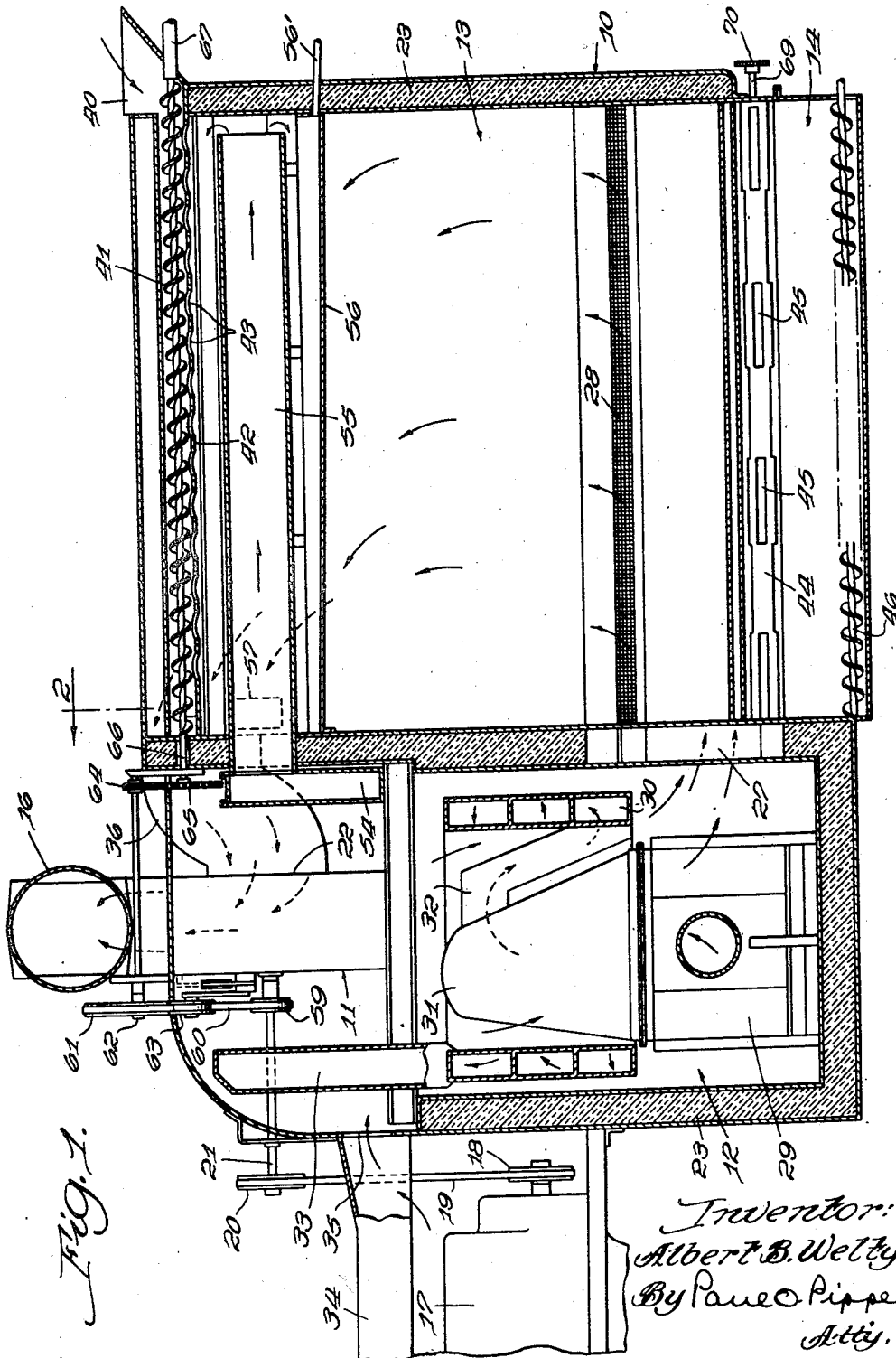
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SUCTION-TYPE GRAIN DRYER AND COOLER

Filed June 19, 1944

3 Sheets-Sheet 1



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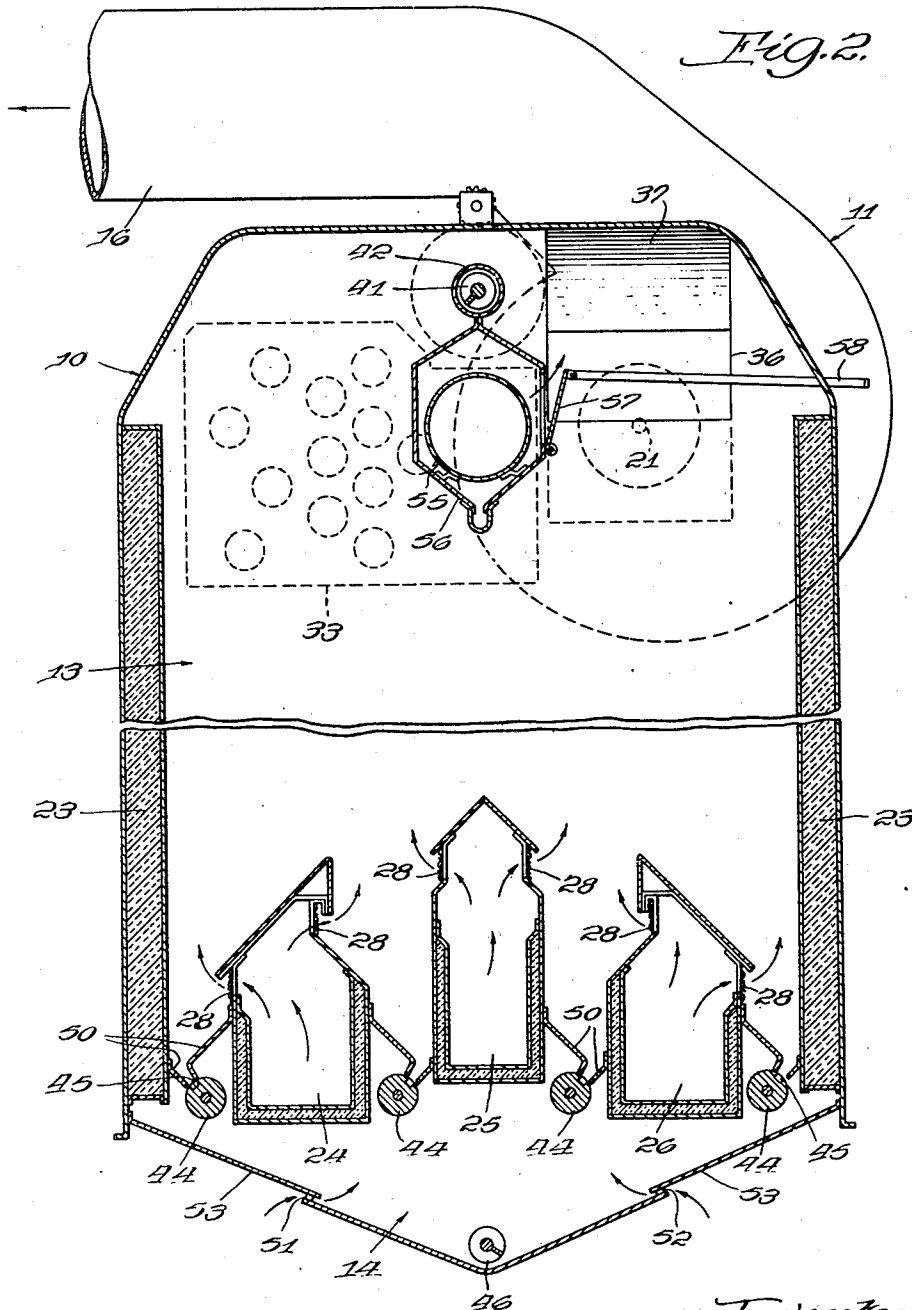
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3 Sheets-Sheet 2



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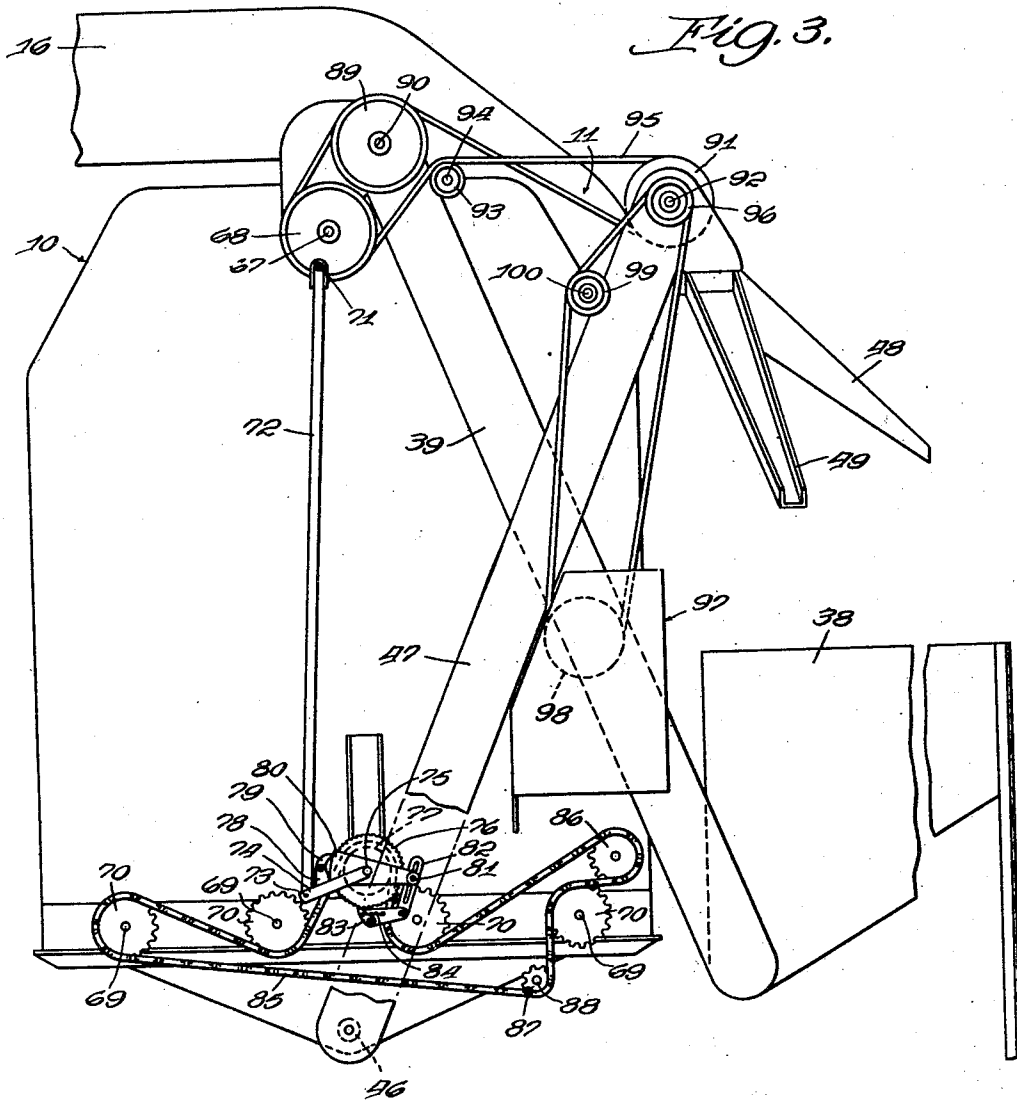
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SUCTION-TYPE GRAIN DRYER AND COOLER

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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SUCTION-TYPE GRAIN DRYER AND COOLER

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4 Claims. (Cl. 34—65)

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This invention relates to a new and improved suction-type grain dryer and is a modification of my grain dehydrator application having Serial No. 528,254, filed March 27, 1944 now Patent No. 2,410,851.

An important object of this invention is to provide for the drying of freshly picked grains by the particular means of drawing heated air up through a column of grain.

In my prior grain dehydrator device, I provided a means for blowing air over a furnace and thereupon upwardly through a column of grain to be dried. Numerous problems arose whereby it was necessary to employ special complex mechanisms in order that the dehydrating device should operate efficiently. It is an object of the present device to overcome the need for the special mechanisms employed in my previous device, to provide a grain dryer with a minimum of operating parts, and to still maintain the high standard of operating efficiency.

Another important object of the present invention is to provide a means for drawing air over a furnace and up through a column of grain to be dried.

Another and still further important object is to provide a grain dryer including a column of grain and means for drawing heated air in at one level of the column and means for drawing cool air in at another level of the column.

A still further important object is to provide a suction-type grain dryer wherein the supply of heat is completely utilized.

Other and further important objects of the present invention will become apparent from the disclosures in the following specification and accompanying drawings, in which:

Figure 1 is a longitudinal sectional view of the grain dryer of this invention;

Figure 2 is a sectional view taken on the line 2—2 of Figure 1; and

Figure 3 is an end view of the device as shown in Figures 1 and 2.

As shown in the drawings:

The reference numeral 10 indicates generally a housing for a grain dryer which comprises several units, namely, a fan housing 11, a heat-producing chamber 12, a grain chamber 13, and a cooling chamber 14.

The principle of the present grain dryer is to draw air through the heat-producing chamber up through the grain chamber and thereupon discharge it to the atmosphere. Contrary to my previous device which forced air through a similar path of travel, the present device employs

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a suction fan within housing 11 for pulling or drawing heated air up through the column of grain to be dried and from there into the fan and discharged through an exhaust conduit 16, as best shown in Figures 1 and 2.

An engine 17 is mounted at one end of the grain dryer housing 10 and is adapted, by means of a pulley 18 and belt 19, to drive the pulley 20 which is keyed or otherwise fastened directly to the fan shaft 21. It is evident that the fan, not shown but positioned within the fan housing 11, will be driven by the fan shaft 21 and create a suction on a side opening 22. This opening in the fan housing 11 communicates with the top of the grain chamber section 13 and is adapted to establish a suction on the top of a column of grain within the section 13.

As best shown in Figures 1 and 2, the chamber 13 is surrounded with insulated walls 23 which prevent the escape of heat used in the grain-drying process. A series of plenum chambers 24, 25, and 26 extend longitudinally of the chamber 13 and communicate at one end with the heat producing chamber 12, as shown at 27. The upper portions of the side walls of the plenum chambers are equipped with screened apertures 28. The suction fan is adapted to draw air through the heat-producing chamber through the passage 27 into the plenum chambers 24, 25, and 26 and thereupon up and out through the screened apertures 28.

The heat producing chamber is supplied with a furnace 29 which may be any one of several types, such as oil, gas, coal or the like. This furnace 29 is a sealed unit and exhaust gases are not allowed to escape into the heat producing chamber 12 but rather are confined within heat exchange conduits 30, which progress spirally upwardly around the furnace 29 and communicate with the furnace dome 31 through a conduit 32. The heat exchange conduits 30 extend upwardly and include a bank of heat exchange conduits 33 shown in dash lines in Figure 2. There is no communication between the suction opening 22 of the fan and the heat producing chamber 12 except indirectly through the grain chamber 13.

The engine 17 is surrounded with a housing 34 which is fastened to the grain dryer housing 10. An opening 35 is formed in the grain dryer housing 10 and permits direct communication from the interior of the engine housing 34 to the heat producing chamber 12 of the grain dryer. It is apparent that the longitudinal positioning of the engine 17 is conducive to easy power take-off drive through the pulley 18 and belt 19 and fur-

ther is conducive to the utilization of heat created by the engine 17 which complements the heat created by the furnace 29 to effect a drying of the grain. The forward end of the engine 17 may be equipped with a radiator or the like, but in any event, there is some opening at the fore end of the engine housing 34 to permit air to be drawn in over the engine 17 and back through the housing communicating opening 35 and thereupon to progress downwardly over the furnace dome 31 and around the heat exchange conduits 30 and 33, so that the air admitted to the plenum chambers 24, 25, and 26 through the passage 27 is quite hot. With the suction fan drawing this hot air upwardly through a column of grain in the chamber 13, this column of grain will be dried to enable it to be stored without fear of spoilage. It will be understood, of course, that a sealed conduit 36 covers the opening 22 in the suction fan housing 15 and joins with the grain chamber 13 through the opening 37. This prevents the fan from short-circuiting the travel of heated air and makes it impossible for heat to be drawn off the furnace 29 up to the fan housing 15 without first circulating up through the grain chamber 13. The arrows indicate the direction of air travel.

The grain to be dried is put into the hopper 38 whereupon it is raised from the bottom thereof by means of an elevator 39 which carries the grain upwardly to a point where it discharges into the grain dryer inlet hopper 40, as best shown in Figure 1. A centrally located, longitudinally extending worm 41 carries the grain fed to the hopper 40 along the entire length of the grain chamber 13. As best shown in Figure 2, the worm 41 is positioned within a trough-like housing 42. This housing 42 is equipped with regularly spaced openings 43 on the under side thereof so that the grain may be discharged downwardly into the chamber 13 along the entire length of the chamber. The grain is adapted to extend from a point at the bottom of the plenum chamber up to the bottom of the tubular housing 42. Discharge rolls 44 are positioned adjacent the sides of the plenum chambers 24, 25, and 26, so that the column of grain moves continuously downwardly and the dried grain discharges at the bottom. The discharge rolls 44 are equipped with alternate intermittent slots 45 within which the grain deposits, and as the rolls rotate, the deposited grain is discharged into the cooling compartment 14 whereupon a worm 46 extending lengthwise of the compartment will carry the grain to a discharge elevator 47, as best shown in Figure 3, whereupon the dried and cooled grain is elevated and discharged through either of two spouts 48 and 49. The trough-like frame structure 50 adjacent the discharge rolls 44 is so designed that the grain descending within the chamber 13 is concentrated on one portion of the rolls, in order that the grain pockets or slots 45 may be filled on the upper side and may be discharged into the compartment 14 as the rolls 44 rotate.

The compartment 14 is termed a cooling chamber, for the reason that it assists in bringing the heated grain down to normal temperatures before it is removed from the dryer and stored. There is the possibility that storing of grain of very high temperatures will cause moisture to be condensed thereon. The bottom of the cooling compartment 14 is opened to the atmosphere through the longitudinal passages 51 and 52. In this suction type of dryer construction, the discharge rolls 44 are not sealed to prevent passage of air from the cooling chamber to the grain-drying

chamber 13, but rather they are designed to permit atmospheric air at room temperature to be drawn in through the passages 51 and 52 up around the loose-fitting discharge rolls 44 and up through the column of grain by reason of the suction created by the fan. Of course, this will tend to reduce the temperature of the heated air as the cool room-temperature air combines with the heated air at the plenum chamber outlets 28, but this is not detrimental to the effective operation of the machine. The suction fan draws hot air into the chamber 13 at the level defined by the plenum chamber outlets 28 and draws cool air into the chamber 13 at the level defined by the discharge rolls 44 which is below the level of the hot air entrance. As the grain to be dried descends within the compartment 13, its temperature increases until it reaches the hot air openings 28 in the plenum chambers, and after passing that point, the cool room-temperature air acts on the grain to reduce its temperature so that, in fact, the cooling chamber begins immediately below the openings 28 in the plenum chambers. Cooling continues as the grain discharges downwardly through the rolls 44 and as it falls down the inclined V-shaped bottom 53 of the cooling compartment 14.

The exhaust furnace gases are more completely utilized by extending the bank of heat exchange conduits 33 around the fan to a vertical conduit 54, which communicates with the longitudinally extending conduit 55 buried within the column of grain within the compartment 13. This conduit 55 does not extend completely to the end of the housing 10 but rather falls short and permits the exhaust gases to pass outwardly into a superimposed housing 56 and thereupon is directed back through the outer housing 56 and thence discharged through the suction fan. It is possible that some of these exhaust gases will condense within this housing 56, and for that reason a drain 56' is provided at the end thereof and extends through the housing 10. It is necessary to supply the exhaust gases with some suction to maintain a continual flow of the gases, and in order to effect this suction, a valve gate 57 in the outer housing 56 and communicating with the suction fan, shown in Figures 1 and 2, may be adjusted at any degree of opening to obtain greater or less suction as necessary. The position of the gate 57 is such that the exhaust gases are above the column of grain and pass directly to the fan rather than proceeding down into the grain and thus contaminating it. The particular valve gate shown has an operating handle 58 extending out through the housing 10 in order that the opening of the gate 57 may be adjusted. It is, of course, obvious that the valve may be any one of several types such as a sliding valve or some other suitable type.

Drive for the worms 41 and 46 and the discharge rolls 40 is taken from the fan driving shaft 21 by means of the pulley 59, belt 60, and a pulley 61 mounted on a shaft 62. An idler pulley 63 is adapted to be angularly adjustably positioned so that the tension of the belt 60 may be fixed as desired. The pulley 63 may be moved away from the belt to cause the belt to completely disengage from the pulley 59, thus acting as a clutch to stop motion of pulley 61 and shaft 62. The shaft 62 extends rearwardly of the grain dryer housing 10 and has mounted thereon a small gear 64 which engages the gear 65 keyed or otherwise fastened to the shaft 66 of the worm 41. The drive for the discharge rolls 44 and the

worm 46 is taken from a rear extension 67 of the shaft 66. Mounted on this rear extension 67 is a pulley 68. The discharge rolls 44 have rearwardly extending shafts 69, the outer ends of which support sprockets 70.

It is a requirement of this grain dryer that the discharge rolls 44 rotate very slowly, and to effect that result the particular drive as indicated in Figure 3 is employed. The pulley 68 is equipped with a crank pin 71 to which is attached a pitman 72. It will be evident that as the pulley 68 rotates, the pitman 72 will reciprocate vertically. The lower end of the pitman is attached at 73 to an arm 74 which is pivoted on a shaft 75. A ratchet wheel 76 is mounted on this shaft 75 and carries with it a sprocket 77 in a common plane with the sprockets 70. The arm 74 is equipped with a projection 78 to which is pivoted a pawl 79 for engagement with the ratchet wheel 76. As the pitman 72 is lifted upwardly, the pawl 79 engaging the ratchet teeth causes the ratchet wheel 76 to rotate in a clockwise direction as viewed in the device of Figure 3. The effective movement of the pawl 79 may be curtailed by the member 80. This member 80 is in the form of a circular segment and is pivoted on the shaft 75. The vertex 81 of the segment 80 is adjustably positioned within the slotted bracket 82. The outer arcuate end of the segment 80 is adapted to coincide with the arcuate periphery of the ratchet wheel 76. The pawl 79, as shown in Figure 3, is thus prevented from contacting the ratchet teeth, and movement of the ratchet wheel 76 is thereby delayed until the pawl 79 passes beyond the upper limit of the segment 80. The segment 80 may be pivoted about its center 75 and fixed in any desired position within the slotted bracket 77 to effect any rate of ratchet rotation that is permissible between the limits of movement of the pitman 72. A second pawl 83 is resiliently held against the bottom of the ratchet wheel 76 by means of a spring 84. This ratchet wheel prevents rearward or counter-clockwise rotation of the ratchet wheel 76 when the pawl 79 no longer is engaged with the ratchet teeth. A chain 85 is wrapped around each of the sprockets 70 as well as the drive sprocket 77, an idler sprocket 86, and the sprocket 87. The sprocket 87 is mounted on a stub-shaft 88 and acts as an idler sprocket in order to secure the proper direction of rotation of the sprockets 70 driving the discharge rolls 44.

The upper end of the intake elevator is equipped with a pulley 89 mounted on a shaft 90 which extends within the elevator and drives the elevator fighting. A similar pulley 91 is mounted at the top of the discharge elevator 47 on a shaft 92. A further pulley 93 is mounted on a stub-shaft 94 and is in the same plane with the pulleys 89, 90, and 91. A belt 95 encircles these pulleys in the manner shown wherein the small pulley 93 acts as an idler. It is evident from this arrangement of pulleys and belt 95 that drive is imparted from the pulley 89 to the elevators 39 and 47. The driving of the elevator 47 causes a driving of the worm 46 which carries the grain from the cooling chamber to the discharge elevator. A second pulley 96 is fastened to the shaft 92 and is adapted to drive a moisture testing device 97 operable by means of the pulley 98. An idler pulley 99 is mounted on a stub-shaft 100 affixed to the housing 10.

The novel cooling method employed in this grain dryer is believed to be quite distinct from any cooling method heretofore employed. The

drawing of hot air in at one level of the grain and a simultaneous drawing in of cooler air at a lower level of the grain contributes to an efficient operating system. The entire system is greatly facilitated in its efficiency by a complete use of exhaust gases by means of a plurality of heat transfer conduits. It is foreseeable that combustion may eventually be so complete that exhaust gases may be mixed with warm air in the direct drying of the grain without fear of any contamination. This would, of course, result in a simpler and more economic machine. In furtherance of the system efficiency, the incoming air is preheated by the engine 17 as heretofore described. However, if the quantity of air taken in over the engine 17 is insufficient to satisfy the demand of the dryer, an opening may be employed in the side wall of the device at a point above the furnace which will augment the supply of air taken in through the engine.

What is claimed is:

1. A grain dehydrator having an insulated housing comprising an engine, a vertical grain chamber, an auger for feeding grain along the top of said grain chamber, grain discharge rolls at the bottom of said grain chamber, said auger and discharge rolls rotatably driven by said engine, a heating plant requiring a supply of air, an air intake positioned over said engine, whereby air utilized by the heating plant is preheated, a communicating passage between the heating plant and the grain chamber, and suction means for drawing air in over the engine, through the heating plant and up through the grain chamber, said grain chamber having an auxiliary air entrance located beneath the discharge rolls and bypassing the heating plant and entering said grain chamber at a level beneath the level of the entrance of the hot air communicating passage and whereby the suction means draws cool air up from the auxiliary air entrance around the discharge rolls to mingle with the heated air in the lower portion of the grain chamber.

2. A grain dryer having a housing including a heating plant having an air inlet and a hot air outlet, said heating plant having its gases of combustion maintained separately from said air inlet and outlet, a grain chamber, a communicating passage between said hot air outlet and said grain chamber, heat exchange conduits carrying the gases of combustion around the air inlet and through a longitudinally extending sealed compartment within said grain chamber, said sealed compartment having a port providing communication between the compartment and the top of the grain chamber, valve means in the port for regulating passage of exhaust combustion gases, and a suction fan at the top of said grain chamber drawing air into and through the heating plant, through the grain chamber and out a discharge through the suction fan and drawing out exhaust combustion gases in an amount dependent upon the position of the valve means.

3. In a grain dryer having a housing including a vertical grain chamber, means for heating and cooling grain in said chamber, said grain chamber having an opening intermediate the top and bottom for the entrance of hot air, and said grain chamber having an opening in the bottom thereof for the entrance of cool air, suction means on the top of the grain chamber for drawing both hot and cool air upwardly through the grain, whereby the cool air at the bottom of the grain chamber cools the grain therein and the hot air tempered by the cool air heats the grain in the

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chamber above the opening for the hot air, means for moving grain downwardly through said grain chamber, a grain discharge at the bottom of the grain chamber whereby grain originally heated at the top is cooled before being discharged, said discharge including a plurality of rolls having spaced pockets adapted to receive a quantity of grain and upon rotation of the rolls to empty the grain beneath the grain chamber, a housing structure adjacent the rolls providing sufficient space for passage of air, and a V-shaped bottom for said grain chamber, said cool entrance opening located in the sides of the V-shaped bottom in a manner to permit grain emptied from the pockets of all the rolls to flow down over the opening to the apex of the V-shaped receptacle.

4. In a grain dryer having a housing including a vertical grain chamber, means for heating and cooling grain in said chamber, said grain chamber having an opening intermediate the top and bottom for the entrance of hot air, and said grain chamber having an opening in the bottom thereof for the entrance of cool air, suction means on the top of the grain chamber for drawing both hot and cool air upwardly through said grain chamber, whereby the cool air at the bottom of the grain chamber cools the grain therein and the hot air tempered by the cool air heats the grain in the chamber above the opening for the hot air, a grain discharge at the bottom of the grain chamber whereby grain originally heated at the top is cooled before being discharged, said discharge including a plurality of rolls having

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spaced pockets adapted to receive a quantity of grain and upon rotation of the rolls to empty the grain beneath the grain chamber, a housing structure adjacent the rolls providing sufficient space for passage of air, a V-shaped receptacle beneath said grain chamber whereby the grain emptied from the pockets of all the rolls will flow down to the apex of the V-shaped receptacle, and a longitudinally extending worm within the apex of the receptacle for moving the grain to one end thereof.

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