

March 1, 1966

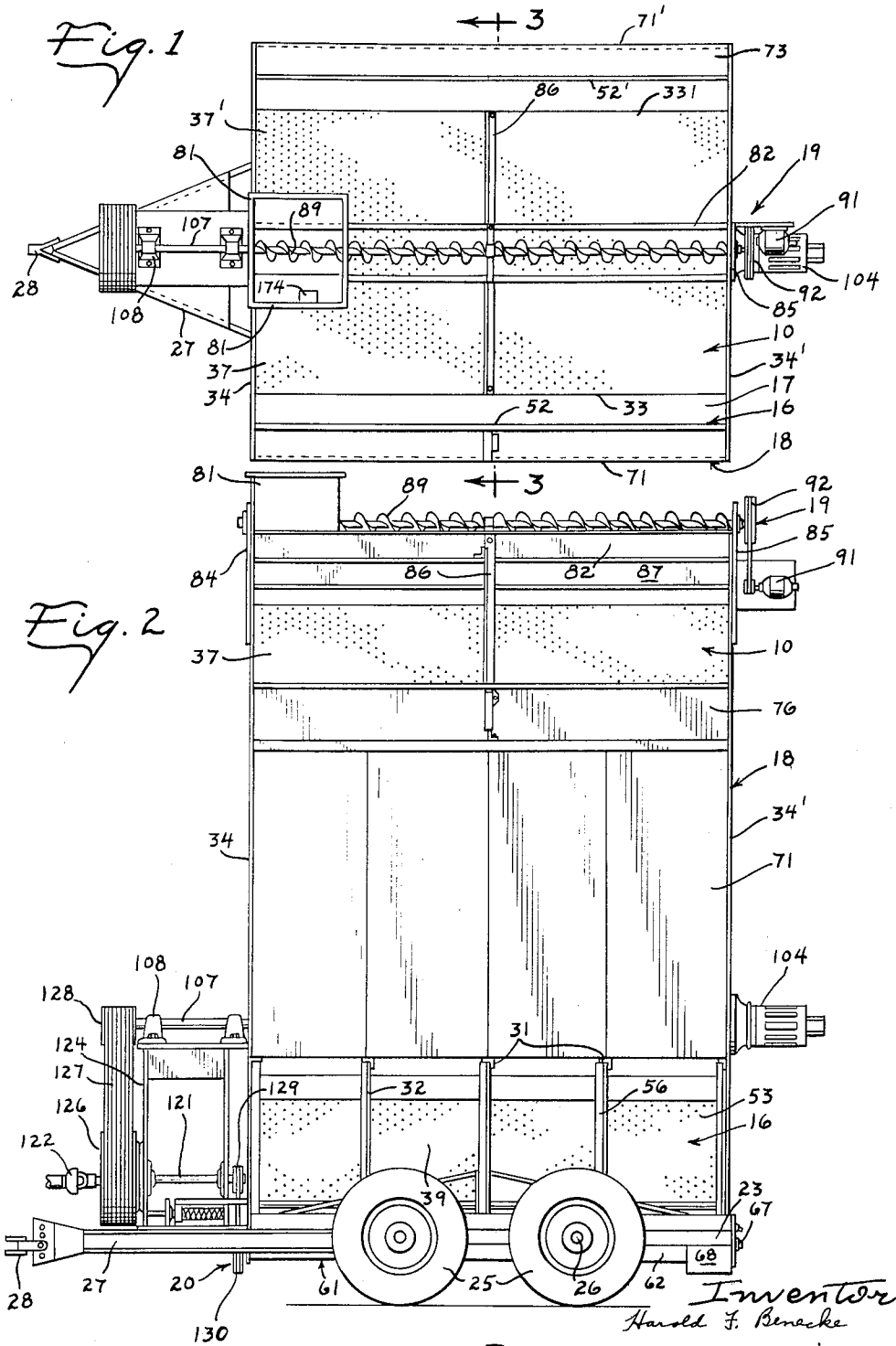
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GRAIN DRYER

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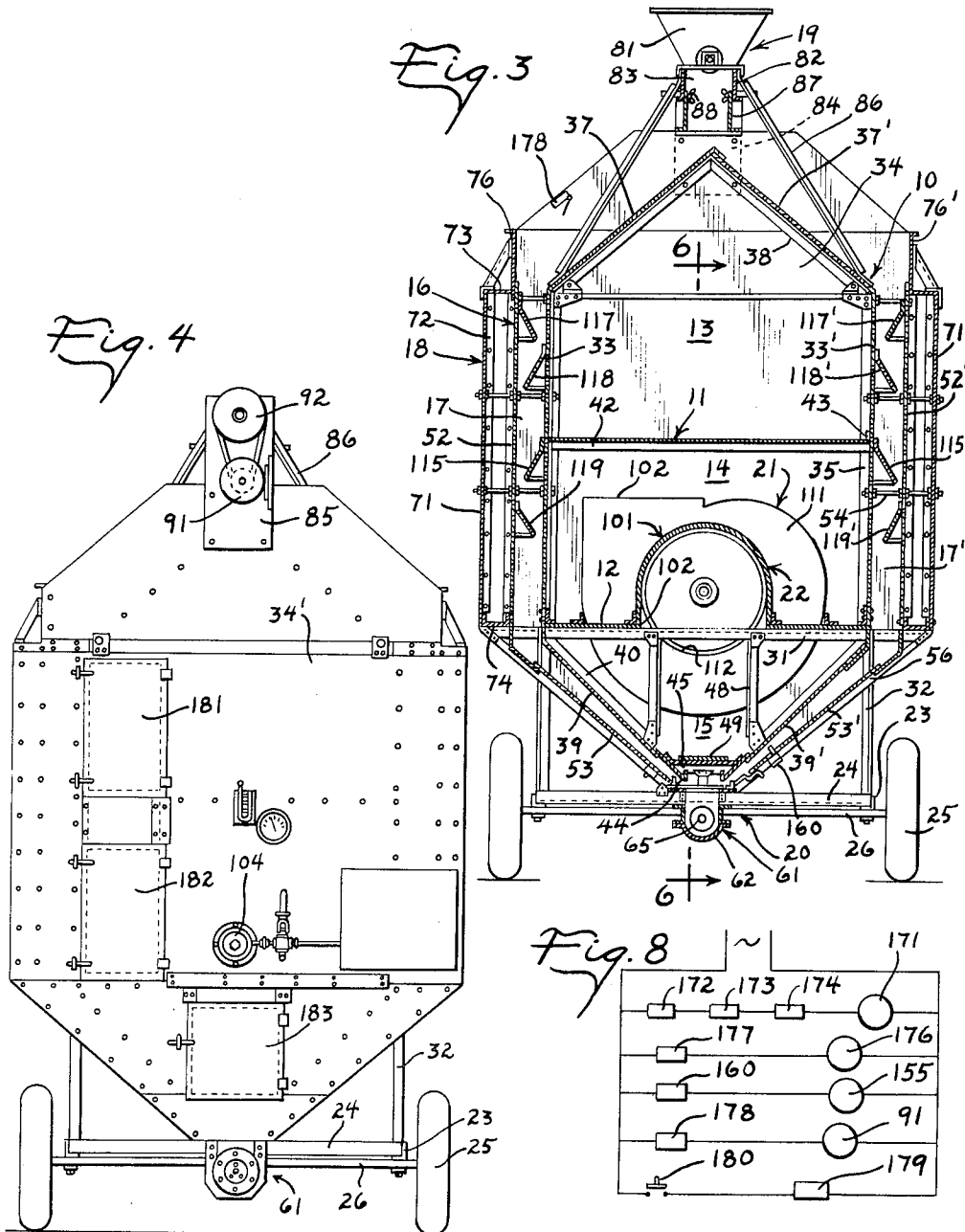
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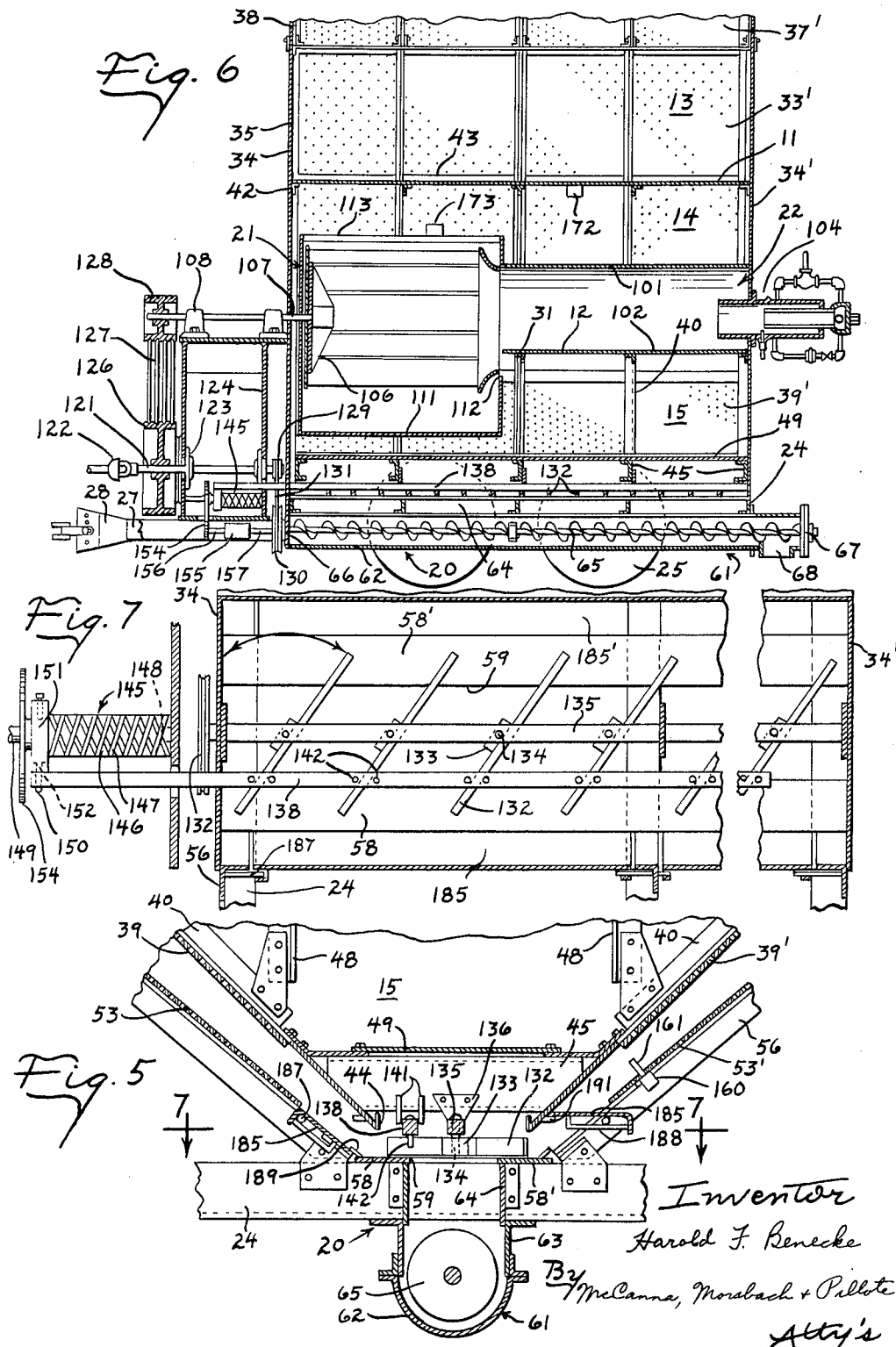
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GRAIN DRYER

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11 Claims. (Cl. 34-65)

This invention relates to a grain drying apparatus and particularly to a continuous-type grain dryer.

An important object of this invention is to provide a continuous-type grain drying apparatus having an air heater and blower for circulating the air through the grain, which apparatus will efficiently and rapidly dry the grain as it passes therethrough and which is quiet in operation.

Another object of this invention is to provide a continuous grain drying apparatus of the type wherein grain is fed into the top of the apparatus and flows downwardly by gravity through the apparatus to a discharge outlet adjacent the lower end, which apparatus has an improved arrangement for passing drying air through the grain to efficiently and rapidly dry the grain in a relatively short column, and thereby enable the apparatus to have a sufficiently low overall height to permit ready transportation of the dryer from place to place.

A more particular object of this invention is to provide a continuous-type grain dryer in which the grain is fed into the upper end of the apparatus and passes downwardly by gravity to a discharge outlet adjacent the lower end, and in which heated air is directed in successive passes through the grain as it flows downwardly through the apparatus to efficiently heat and dry the grain, and cooling air is passed through the grain before it leaves the lower end of the apparatus to cool and further dry the grain.

A further object of this invention is to provide an improved grain drying apparatus in accordance with the foregoing object and in which the air heater and blower are enclosed within the grain drying apparatus for more efficient heating and circulation of air through the grain, and to provide a more compact overall apparatus.

Yet another object of this invention is to provide a grain drying apparatus in which the grain fed to the top of the apparatus is divided into two separate streams which flow downwardly at opposite sides of the apparatus and converge to a common outlet adjacent the bottom, and which grain drying apparatus has a single feed control for regulating the flow of grain in both streams to equalize the rate at which the grain flows downwardly at each side of the apparatus.

Still another object of this invention is to provide an improved feed control apparatus for regulating the rate of flow of grain and the like from a hopper, which feed control apparatus accurately and uniformly controls the feeding of grain along the entire length of the hopper.

These, together with other objects and advantages of this invention will be more readily appreciated as the invention becomes better understood by reference to the following detailed description when taken in connection with the accompanying drawings wherein:

FIG. 1 is a top plan view of the grain drying apparatus;

FIG. 2 is a side elevational view of the grain drying apparatus;

FIG. 3 is a vertical sectional view through the grain drying apparatus taken on the plane 3-3 of FIG. 1;

FIG. 4 is an end elevational view of the grain drying apparatus;

FIG. 5 is a fragmentary transverse sectional view taken on the plane 3-3 of FIG. 1 and illustrating the lower portion of the grain drying apparatus on a larger scale;

FIG. 6 is a longitudinal sectional view through the grain drying apparatus, taken on the plane 6-6 of FIG. 3;

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FIG. 7 is a fragmentary horizontal sectional view taken on the plane 7-7 of FIG. 5, and illustrating the feed control mechanism; and

FIG. 8 is a schematic diagram of the electrical controls for the dryer.

The apparatus of the present invention is generally adapted for drying grain, seeds, beans and the like, hereinafter generally referred to as grain. The grain drying apparatus of the present invention is of the continuous-type and as best shown in FIG. 3, includes an inner cage 10 which is divided by partitions 11 and 12 into an upper compartment 13, and intermediate compartment 14 and a lower compartment 15. An outer cage 16 is disposed alongside the inner cage and defines grain passages 17 and 17' at opposite sides of the dryer. An air plenum chamber 18 extends alongside a portion of the outer cage and is arranged in relation to the upper and intermediate compartments in the inner cage to effect multiple passes of the air through the grain as it flows through the passages 17. A grain distributing apparatus 19 is provided adjacent the upper end of the grain drying apparatus for feeding and distributing grain along the upper end of the inner cage, and a discharge control mechanism 20 is provided at the lower end of the grain drying apparatus for regulating the flow of grain from the dryer. A blower 21 is provided for circulating air through the grain and a heater 22 for heating the air as it passes through the dryer.

The grain drying apparatus is mounted on a base frame including spaced side members 23 and a plurality of cross members 24. Wheels 25 are preferably provided and mounted on axles 26 attached to the base frame to enable ready transportation of the dryer from place to place for drying grain at different locations. A trailer tongue 27 having a hitch 28 is attached to the base frame for the grain dryer, to facilitate hauling of the dryer by a truck, tractor or the like.

The inner cage 10 is supported on a plurality of cross members 31, herein shown in the form of angle irons, which are mounted on the base frame by upright posts 32. The inner cage includes spaced perforate side walls 33 and 33', and imperforate front and rear walls 34 and 34' which are joined to the side walls as by angle irons 35. The inner cage also includes upwardly converging perforate top panels 37 and 37' which are joined to the end walls 34 and 34' as by angle irons 38, and downwardly converging perforate bottom panels 39 and 39' which are joined to the end walls as by angle irons 40. The lower partition 12 is conveniently supported on the cross members 31 and is attached to the inner cage adjacent the juncture of the side walls 33, 33' with the bottom panels 39 and 39', and the upper partition 11 is attached to the side and end walls of the inner cage at a position intermediate the upper and lower ends of the side walls 33', as by angle irons 42 and flange 43. As best shown in FIGS. 3 and 5, the lower ends of the bottom panels 39 and 39' are spaced apart to provide a channel 44 therebetween, and the lower ends of the panels are interconnected by cross members 45 which extend therebetween above the lower ends of the bottom panels. The bottom panels are supported on the cross members 31 as by braces 48, and the channel 44 between the lower ends of the bottom panels is closed as by an imperforate closure panel 49. The channel 44 between the lower ends of the bottom panels provides a space for the operating mechanism of the feed control apparatus 20 to be described hereinafter, and the closure panel 49 seals the lower ends of the bottom panels against the entrance of air through the channel 44.

The outer cage 16 includes spaced perforate side walls 52 and 52' which are respectively spaced from the side

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walls 33 and 33' of the inner cage, and downwardly converging perforate bottom panels 53 and 53' which are spaced below the bottom panels 39 and 39' of the inner cage to define grain passages at each side of the apparatus. The side walls 52 and 52' of the outer cage are attached to the end walls 34 and 34' and are conveniently maintained in proper spaced relation to the inner cage as by spacing bolts 54. The bottom panels 53 and 53' are herein shown supported on angle iron braces 56 attached to the ends of the cross members 31 and to the base frame. The lower ends of the bottom panels 53 and 53' of the outer cage are spaced apart and generally horizontal ledges 58 and 58' are provided at the lower ends of the bottom panels. The ledges project inwardly of the lower ends of the bottom panels 39 and 39' of the inner cage a distance somewhat greater than the normal angle of repose of the grain, so that the ledges normally support the column of grain in the flow passages. The adjacent edges of the ledges are spaced apart to provide an elongated discharge opening 59 therebetween, and which discharge opening communicates with a conveyor 61 which conveys the grain to one end of the dryer. As best shown in FIG. 5, the conveyor includes a channel member 62 which is supported by angulated plates 63 of the underside of the cross members 24, and guide plates 64 are provided between the adjacent cross members at opposite sides of the discharge opening 59 for guiding the grain into the channel. A screw type conveyor 65 is disposed in the channel and rotatably mounted in bearings 66 and 67 at opposite ends of the grain dryer for conveying the grain to a discharge opening 68, herein shown located adjacent the rear end of the grain dryer. A means, described hereinafter, is provided for rotating the auger.

The plenum chamber 18 is disposed along the side walls 52 and 52' of the outer cage and includes imperforate side walls 71 and 71' as best shown in FIG. 5. The side walls 71 and 71' are attached to the end walls 34 and 34' as by angle iron strips 72, and are sealed at the top and bottom to the side walls 52 and 52' as by plates 73 and 74. The side walls 71 and 71' of the plenum chamber are conveniently maintained in proper spaced relation to the side walls 52 and 52' of the outer cage by the aforementioned spacer bolts 54. Upwardly projecting plates 76 and 76' are provided at the upper ends of the side walls 52 and 52' of the outer cage to project to a level above the lower ends of the inclined top panels 37 and 37' of the inner cage. As will be seen, the plates 76 and 76' guide the grain which flows down the top panels 37 and 37' into the grain passages 17 and 17' at opposite sides of the grain dryer.

The grain distributing apparatus 19 is provided at the upper end of the grain dryer for distributing the grain along the length of the top panels 37 and 37'. The distributing apparatus includes a hopper 81 for receiving the grain to be dried and spaced members 82 which define a distributing channel 83 therebetween that communicates with the hopper 81 and extends lengthwise of the dryer. The members 82 are supported at their ends by brackets 84 and 85 attached to the end walls 34 and 34', and are supported intermediate therein by braced brackets 86 which, as shown in FIG. 3, conveniently extend downwardly to engagement with the inner cage 10. Downwardly extending plates 87 are attached to the members 82, for vertical adjustment relative thereto as by thumb screws 88. The plates terminate at the lower ends in spaced relation to the upwardly converging panels 37 and 37' of the inner cage and are vertically adjustable with respect to the inner cage to regulate the depth of the layer of grain which is deposited on the top panels. A grain leveling screw 89 is mounted on the end brackets 84 and 85 and extends from the hopper 81 lengthwise between the members 82 to

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distribute the grain from the hopper along the length of the top panels of the inner cage. The screw may be driven in any desired manner and, as shown herein, is driven by a motor 91 through a speed reducing belt and pulley assembly 92.

The blower 21 for circulating the air through the grain, and the heater 22 for heating the air are advantageously located within the inner cage for more efficient and quiet operation. As best shown in FIGS. 3 and 6, the heater 22 includes a generally U-shaped heater casing 101 which is conveniently supported on the cross members 31 in the inner cage. The casing is open at the under side and communicates through an opening 102 in the lower partition 12, with the lower chamber 15. As shown in FIG. 6, the casing extends from one end wall 34' to a point intermediate the ends of the inner cage and a fuel burner assembly 104, of conventional construction, is mounted on the end wall 34' to direct a flame into the burner casing 101. This heats the air in the burner casing and the blower is so arranged as to draw air in from the lower compartment 15 through the burner casing, and to discharge heated air into the intermediate compartment 14.

The blower 21 is advantageously of the centrifugal type and includes a cage-type impeller 106 which is mounted on a shaft 107 supported in bearings 108. The shaft 107 extends longitudinally of the grain drying apparatus and a volute shaped impeller casing 111 is disposed around the impeller. The impeller casing has an inlet opening 112 that communicates with the end of the burner casing 101 and hence with the lower compartment 15. The casing also has an outlet opening 113 which is preferably directed upwardly against the upper partition 11. The centrifugal type blower 22 thus reduces the air pressure in the lower chamber 15 so that cooling air from outside the apparatus passes through the perforate panels 53, 53', and 39, 39' of the outer and inner cages to cool and dry the grain as it passes therebetween, and before the grain is discharged from the dryer. The blower draws the air past the burner casing and pressurizes the air in the intermediate chamber so that the heated air flows outwardly through the grain passages 17 and 17' defined by the inner and outer cages, in the region below the upper partition 11. The plenum chamber 18, which is disposed along the side walls 52 and 52' of the outer cage, directs the heated air back through the grain passages 17 and 17' defined by the inner and outer cages, in the region above the partition 11, and back into the upper chamber 13. The air from the upper chamber then flows outwardly through the converging top panels 37 and 37' of the inner cage, and through the grain as it passes over these top panels. In order to minimize by-passing of the air between the intermediate and upper compartments, preferably imperforate baffles 115 and 115' are attached to the side walls 33 and 33' of the inner cage, to extend downwardly and outwardly from the upper partition 11. The baffles terminate at their outer ends in spaced relation to the side walls 52 and 52' of the outer cage to permit passage of grain therepast and operate to deflect the heated air from the intermediate compartment 14 through the grain passage 17 and into the plenum chamber 72. A plurality of agitating baffles 117, 117'; 118, 118'; and 119, 119' are also preferably provided for agitating and turning the grain as it flows through the grain passages 17 and 17', respectively. As shown, the baffles 117, 117' and 119, 119' are attached to the outer cage and the baffles 118, 118' is attached to the inner cage at a point intermediate the baffles 117, 117' and 119, 119'. The baffles 118, 118' and 119, 119' are preferably perforate to facilitate circulation of air therepast, and the baffles 117, 117' are preferably imperforate to direct the air back through the grain passages.

Any suitable arrangement may be provided for driving the blower and for driving the discharge screw 65. As

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shown, both the blower and the discharge screw are driven from a common shaft 121 which is adapted for connection by a coupling 122 to the power takeoff of a truck or tractor, or to a prime mover, as desired. The shaft 121 is supported in bearings 123 mounted on brackets 124 attached to the main frame. A main drive pulley 126 on the shaft 121 is connected through belts 127 to a pulley 128 on the blower shaft 107. A second pulley 129 on the shaft 121 is connected through a belt 131 to a pulley 130 on the discharge screw 65. Although the blower and screw are shown as being driven from a common drive, it is understood that separate drives could be provided, if desired.

It will thus be seen that the grain fed to the upper end of the dryer, is divided into two separate streams and passes downwardly along opposite sides of the dryer. The converging panels 53 and 53' of the outer cage forms a hopper which conveys the material to the central discharge opening 59. The downwardly converging walls 39 and 39' of the inner cage maintain the grain streams separate until they are discharged through the outlet opening 59 and, in accordance with the present invention, a common discharge control apparatus 20 is provided for withdrawing grain from both grain passages at a like rate, to equalize the flows of grain through the separate grain passes 17. This discharge control apparatus is best shown in FIGS. 5 and 7 and includes a plurality of elongated flow promoting members which are positioned at substantially uniformly spaced points along the length of the outlet opening 59, and which extend crosswise of the outlet opening in overlying relation to the ledges 58 and 58'. The flow promoting members are supported for swinging movement about individual upright axes spaced apart lengthwise of the ledges and extending transverse to the plane of the ledges, and means is provided for swinging the flow promoting members about their axes to sweep the grain off the ledges and into the discharge opening 59. As best shown in FIG. 7, the flow promoting members are conveniently in the form of an elongated bar 132 having a pivot block 33 intermediate its ends. The bars 132 are pivotally mounted by a pin 134 on a rail 135 which extends longitudinally of the discharge opening. As shown in FIG. 5, the rail 135 is mounted, as by brackets 136 on the cross members 45, and the rail is conveniently disposed in the channel 44 defined by the lower ends of the inner cage. The flow promoting members 132 are oscillated in unison about their pivot axis by a common actuator, herein shown in the form of a link 138. The link conveniently overlies the flow promoting members 132, as is clearly shown in FIG. 5, and is guided for rectilinear reciprocation by guide fingers 141 attached to the cross pieces 45 on the inner cage. The link 138 is operatively connected to the feed members by spaced pins 142 which straddle the bars 132. Power operated mechanism is provided for reciprocating the link and, as shown in FIG. 7, a reversing screw 145 having right and left hand relatively crossing grooves 146 and 147, is rotatably supported on stub shafts 148 and 149 on the brackets 124 adjacent one end of the dryer. A follower sleeve 151 is slidably supported on the screw 145 and has a follower 152 that engages the grooves 146 and 147 to reciprocate the sleeve as the screw is rotated. The link 138 is operatively connected to the sleeve 151 as by a fastener 150 to oscillate the link 138 and the feed members 132 at a speed correlative with the speed of the screw 145.

Any suitable means may be provided for driving the reversing screw 145. In a continuous type dryer; it is necessary to regulate the rate of flow of grain through the dryer to control the drying of the grain. In the present apparatus, this is conveniently achieved by either a variable speed drive or an intermittently operated drive for the reversing screw 145. As shown in FIG. 6, the reversing screw 145 is connected through a chain and sprocket drive 154 to a shaft 156 driven under the con-

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trol of a clutch 155. The clutch input shaft 156 is conveniently connected to the feed screw 65 and driven in timed relation therewith.

The clutch 155 which controls oscillating of the feed members, is preferably automatically operated to provide the desired rate of flow grain. For this purpose, the clutch 155 can conveniently be of the electrically operated type, actuation of which is under the control of a switch 160 operated by a humidity responsive device 161 (see FIG. 5) disposed in the lower end of the grain passage. The humidity responsive device 161 operates to detect the moisture content of the grain just before it leaves the dryer, and, if the grain which reaches the outlet is not dried to the desired degree as determined by the device 161, the humidity responsive device operates the switch 160 to disengage the clutch and stop the grain feed apparatus 20. The blower 21 continues to circulate air through the grain until it dries the grain, at which time the humidity responsive device 161 operates the switch 160 to reengage the clutch 155.

In order to provide safe operation of the burner, an electrically actuated safety valve 171 (FIG. 8) is provided for shutting off the flow of fuel to the burner. The safety valve is operated under the control of normally closed, series connected switches 172, 173 and 174. Switch 172 is a temperature sensing switch positioned at a suitable location such as in the intermediate chamber 14 to sense overheating of the burner. Switch 173 is provided for shutting off the safety valve if the blower fails to operate properly and, conveniently, can be in the form of a conventional pressure or flow responsive switch for detecting air flow from the blower. Switch 174 is provided for shutting off the burner in the event the supply of grain to the dryer is interrupted. This switch can conveniently be located at the inlet hopper 81 as shown in FIG. 1 to detect when the supply of grain is interrupted. The flow of fuel to the burner is also controlled by a conventional electrically actuated control valve 176 operated by a thermostatic switch 177 suitably positioned in the path of flow of the heated air from the blower to maintain proper air temperature. The infeed grain drive motor is controlled by a switch 178 conveniently positioned above the upper panel 37 of the inner cage to engage the grain as it passes thereover and to start and stop the infeed drive motor as required to maintain the dryer filled with grain. An igniter 179 for the burner is operated under the control of a manually operated switch 180.

As best shown in FIG. 4, access doors 181, 182 and 183 are provided in the end wall 34' to provide access to the upper, intermediate and lower chambers 13-15 for cleaning or repairs. In addition, it is sometimes necessary to clean the discharge control apparatus 20 to remove large foreign objects such as nails, etc. that may enter the dryer. For this purpose, gates designated 185 and 185' are provided on the lower ends of the bottom panels 53 to provide access to the feed members 132. The gates are conveniently supported by pins 187 on adjacent angle iron members 56, for sliding and swinging movement between a normal position shown at the left in FIG. 5 and a position such as shown at the right in FIG. 5. Guide straps 188 retain the gates in assembled relation on the pins 187 while permitting the aforementioned sliding and swinging of the gates. The gates are releasably retained in their normal position by keepers 189 and can be retracted from the keepers and then pushed crosswise through the grain between the inner and outer panels 39, 39' and 53, 53' to the position shown at the right in FIG. 5, to shut off the flow of grain while providing access to the feed members 132. Keepers 191 are provided to hold the gates in the position shown at the right in FIG. 5, during cleaning.

From the foregoing it is thought that the operation and construction of the device will be readily understood. The grain to be dried is fed into the upper end of the

dryer and passes over the downwardly inclined panels 37 and 37' into the separate grain passages 17 and 17' at opposite sides of the dryer. The depth of the grain at the top panels may be selectively controlled by adjustment of the position of the plates 87. The rate of flow of grain through the grain passages is regulated by the discharge control mechanism at the bottom of the dryer and, since a single feed mechanism is provided for controlling flow through both grain passages, equal flow of grain through both passages is assured. The heater and blower 22 and 21 are both disposed inside the inner cage and the blower operates to draw cooling air through the portion of the grain passage defined by the downwardly converging panels 53, 53' and 39, 39'. The heated air is delivered under pressure to the intermediate compartment and flows outwardly through the lower portions of the side walls of the inner cage, then upwardly through the plenum chamber and back through the upper portions of the side walls of the inner and outer cages into the upper compartment, and from there the heated air flows outwardly through the converging upper panels 37 and 37'. Thus, the cool air is drawn through the grain just before it leaves the dryer to cool and further dry the grain and the heated air is passed three times through the grain as it flows through the machine. The present arrangement achieves the multiple passes of the air through the grain, for efficient and rapid drying of the grain, in a relatively short vertical grain column so that the overall height of the machine is sufficiently low to enable easy transportation of the grain dryer to different locations.

I claim:

1. A grain dryer comprising, spaced imperforate end wall means, an enclosed inner cage extending between said end wall means and including laterally spaced generally upright perforate side walls; perforate upwardly converging upper panels on the upper ends of said side walls; and perforate downwardly converging bottom panels on the lower ends of said side walls, an outer cage extending between said end wall means and including upright perforate side walls and perforate downwardly converging bottom panels respectively spaced from the side walls and bottom panels of the inner cage to define a grain passage therebetween, means including imperforate outer wall means spaced laterally outwardly from each of said sidewalls of said outer cage and sealed to said end wall means and to said side walls of the outer cage adjacent the upper and lower ends of the latter defining an air plenum chamber along the outside of each of said side walls of said outer cage, said inner cage having a lower partition extending thereacross adjacent the lower ends of its side walls and an upper partition extending thereacross intermediate the ends of its side walls separating the inner cage into a lower air intake compartment below the lower partition; an intermediate compartment between the lower and upper partitions; and an upper compartment above the upper partition, air heater means, blower means operatively associated with said heater means to pass air thereover and having an air inlet communicating with said lower compartment to draw air into the lower compartment through the grain passages between the bottom panels of the inner and outer cages and an outlet communicating with said intermediate compartment to discharge air into the intermediate compartment for passage outwardly through the grain passages between the side walls of the inner and outer cages in the region below the upper partition into said plenum chambers, said plenum chambers directing the heated air back through the grain passages between the side walls of the inner and outer cages into the upper compartment for flow therethrough and out through the upper panels of the inner cage, means adjacent the upper end of the inner cage for feeding grain to said upper panels, and means adjacent the lower end of the outer cage defining a grain outlet.

2. The combination of claim 1 wherein the heater means and the blower means are disposed inside the inner cage.

3. A grain dryer comprising, spaced imperforate end wall means, an enclosed inner cage extending between said end wall means and including laterally spaced generally upright perforate side walls; perforate upwardly converging upper panels on the upper ends of said side walls; and perforate downwardly converging bottom panels on the lower ends of said side walls, an outer cage extending between said end wall means and including upright perforate side walls and perforate downwardly converging bottom panels respectively spaced from the side walls and bottom panels of the inner cage to define a grain passage therebetween, means including imperforate outer wall means spaced laterally outwardly from each of said sidewalls of said outer cage and sealed to said end wall means and to said side walls of the outer cage adjacent the upper and lower ends of the latter defining an air plenum chamber along the outside of each of said side walls of said outer cage, said inner cage having a lower partition extending thereacross adjacent the lower ends of its side walls and an upper partition extending thereacross intermediate the ends of its side walls separating the inner cage into a lower air intake compartment below the lower partition; an intermediate compartment between the lower and upper partitions; and an upper compartment above the upper partition, an air heater means, a centrifugal blower disposed in said inner cage and including a cage type impeller and a blower casing around the impeller, said blower casing having an inlet disposed adjacent the axis of the cage type impeller in communication with said lower compartment to draw air into the lower compartment through the grain passages between the bottom panels of the inner and outer cages and an outlet communicating with said intermediate compartment and directed upwardly toward said upper partition for passage outwardly through the grain passages between the side walls of the inner and outer cages into the plenum chambers, said plenum chambers directing the heated air back through the grain passages between the side walls of the inner and outer cages into the upper compartment for flow therethrough and out through the upper panels of the inner cage, means adjacent the upper end of the inner cage for feeding grain to said upper panels, and means adjacent the lower end of said outer cage defining a grain outlet.

4. A grain dryer comprising, spaced imperforate end wall means, an enclosed inner cage extending between said end wall means and including laterally spaced generally upright perforate side walls; perforate upwardly converging upper panels on the upper ends of said side walls; and perforate downwardly converging bottom panels on the lower ends of said side walls, an outer cage extending between said end wall means and including upright perforate side walls and perforate downwardly converging bottom panels respectively spaced from the side walls and bottom panels of the inner cage to define a grain passage therebetween, means including imperforate outer wall means spaced laterally outwardly from each of said sidewalls of said outer cage and sealed to said end wall means and to said side walls of the outer cage adjacent the upper and lower ends of the latter defining an air plenum chamber along the outside of each of said side walls of said outer cage, said inner cage having a lower partition extending thereacross adjacent the lower ends of its side walls and an upper partition extending thereacross intermediate the ends of its side walls separating the inner cage into a lower air intake compartment below the lower partition; an intermediate compartment between the lower and upper partitions; and an upper compartment above the upper partition, heater means including a heater casing disposed in said inner cage and communicating with said lower compartment, a centrifugal blower in said inner cage including a cage type im-

PELLER mounted for rotation about a horizontal axis generally paralleling said side walls of the inner cage and a blower casing around the impeller, said casing having an inlet communicating with said heater casing to draw air therethrough from said lower compartment through the grain passages between the bottom panels of the inner and outer cages and an outlet communicating with said intermediate compartment for passage outwardly through the grain passages between the side walls of the inner and outer cages into the plenum chambers, said plenum chambers directing the heated air back through the grain passages between the side walls of the inner and outer cages into the upper compartment for flow therethrough and out through the upper panels of the inner cage, means for feeding grain to the upper end of said inner cage, and means adjacent the lower end of said outer cage defining a grain outlet.

5. A grain dryer comprising, first and second pairs of perforate inner and outer walls defining first and second laterally spaced grain passages, means for feeding grain to said grain passages, means for passing air crosswise through said grain passages to dry the grain as it flows therethrough, said outer walls of said first and second pairs having downwardly converging portions at their lower ends, said downwardly converging portions of said outer walls having a generally horizontal ledge extending along the lower edge thereof, an elongated panel member disposed above each of said ledges and each having its lower edge spaced above the respective ledge, said ledges on said outer walls projecting toward each other below the lower edge of the respective panel member and having their adjacent edges spaced apart to define a discharge opening therebetween, a grain discharge apparatus for controlling the flow of grain through said first and second grain passages, said discharge apparatus including a plurality of elongated flow promoting members extending crosswise of said ledges at spaced points therealong with the ends of the members overlying the ledges, means supporting the members for oscillating movement about individual axes spaced apart in a direction lengthwise of said ledges, said axes being located intermediate the ends of the members and extending transverse to the plane of said ledges, and means connected to said members for cyclically oscillating the members about said axes to sweep grain off the ledges and into the discharge opening therebetween.

6. The combination of claim 5 wherein said last mentioned means includes a link operatively connected to each of said members at a point offset from said axis, and means for reciprocating said link.

7. The combination of claim 5 wherein said last mentioned means includes a link operatively connected to each of said members at a point offset from said axis, a reversing screw mounted for rotation about an axis extending lengthwise of said ledges, and a follower engaging said reversing screw and operatively connected to said link for reciprocating said link.

8. In an apparatus for handling grain and the like, the combination of a hopper including first and second downwardly converging panels each having a generally horizontally extending ledge on the lower end thereof, said ledges projecting toward each other and having their adjacent edges spaced apart to define a discharge opening therebetween, a grain feed apparatus for controlling the flow of grain from the hopper, said feed apparatus including a plurality of elongated feed members extending crosswise of said ledges at spaced points therealong with the ends of the feed members overlying the ledges, means for supporting the feed members for oscillatory movement about an axis intermediate their ends and transverse to the plane of said ledges, and means operatively connected to each of said feed members for oscillating

the same about their axis to sweep grain off the ledges and into the discharge opening therebetween.

9. In an apparatus for handling grain and the like, the combination of a hopper including a first downwardly inclined panel having a generally horizontal ledge at its lower end and a second panel spaced from the first panel and having its lower edge positioned above said ledge to define a feed opening therebetween, a grain feed apparatus for controlling the flow of grain from the hopper, said feed apparatus including a plurality of elongated feed members extending crosswise of said ledge at spaced points therealong with one end of each feed member overlying the ledge, means supporting the feed members for swinging movement about an axis spaced from said one end and disposed transverse to the plane of said ledge, and means operatively connected to each of said feed members for swinging the same about said axes to sweep grain off the ledge.

10. The combination of claim 9 wherein said last mentioned means includes a reversing screw mounted for rotation about an axis extending lengthwise of said ledge, and a follower engaging said screw and operatively connected to each of said feed members.

11. A grain dryer comprising, first and second pairs of perforate inner and outer walls defining first and second laterally spaced grain passages, means for feeding grain to said grain passages, means for passing air crosswise through said grain passages to dry the grain as it flows therethrough, said outer walls of said first and second pairs having downwardly converging outer panels at their lower ends, an elongated inner panel member disposed above each of said downwardly converging outer panels and having its lower edge spaced above the respective downwardly converging outer panel to define a discharge opening therebetween, power operated discharge control means for controlling the flow of grain from said discharge openings, said outer panels each including a movable gate forming a part of the outer panel and located adjacent said discharge control means, means mounting said gate for sliding and swinging movement between a first position generally paralleling the respective outer panel to guide grain to the discharge opening and a second position extending crosswise between the respective outer panel and the adjacent inner panel at a level above the discharge control means to shut off the flow of grain to the respective discharge opening and to provide access to the discharge control means, and means for selectively supporting said gates in said first and second positions thereof.

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