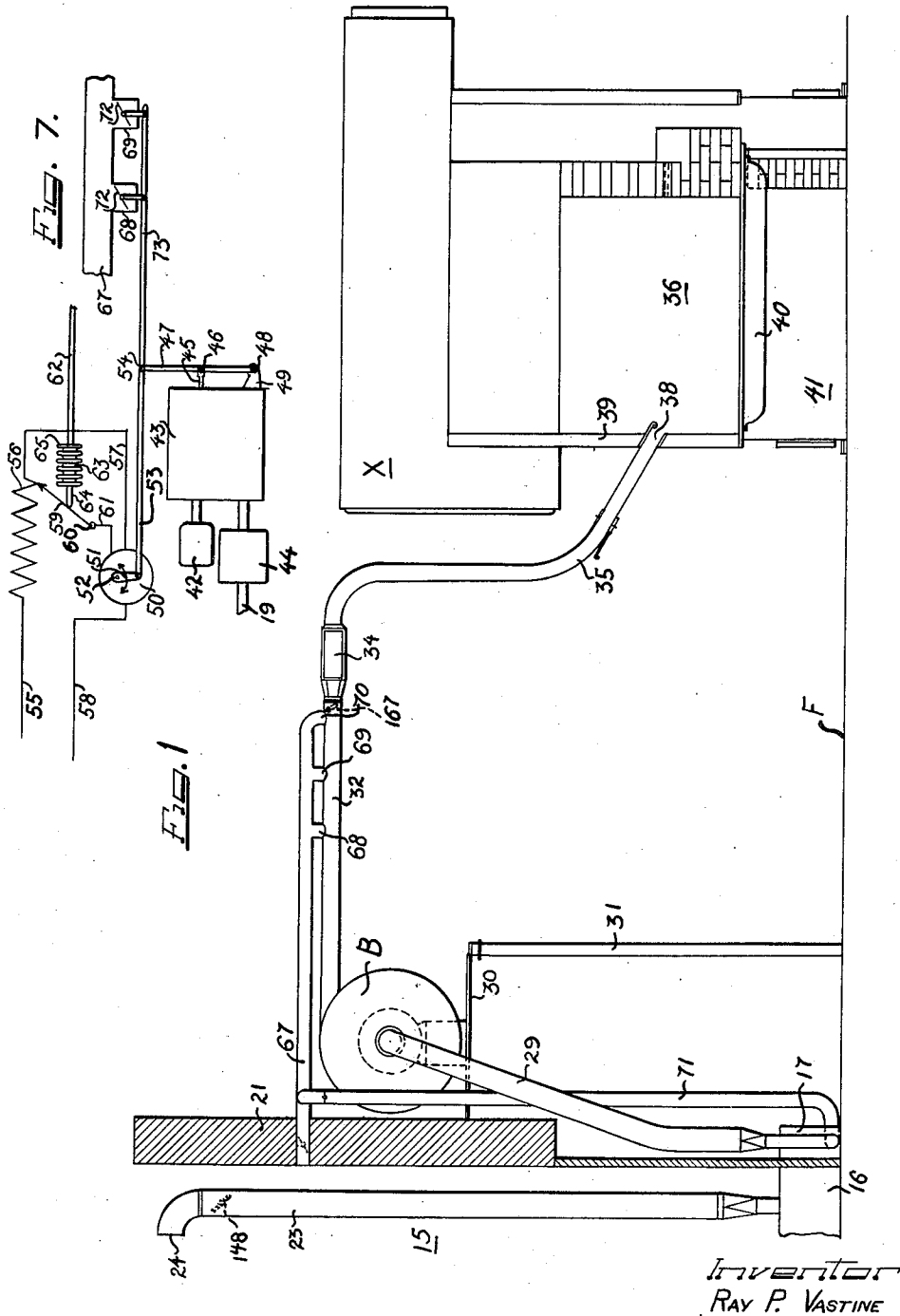


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The Son of Charles Mills

Aug. 27, 1957

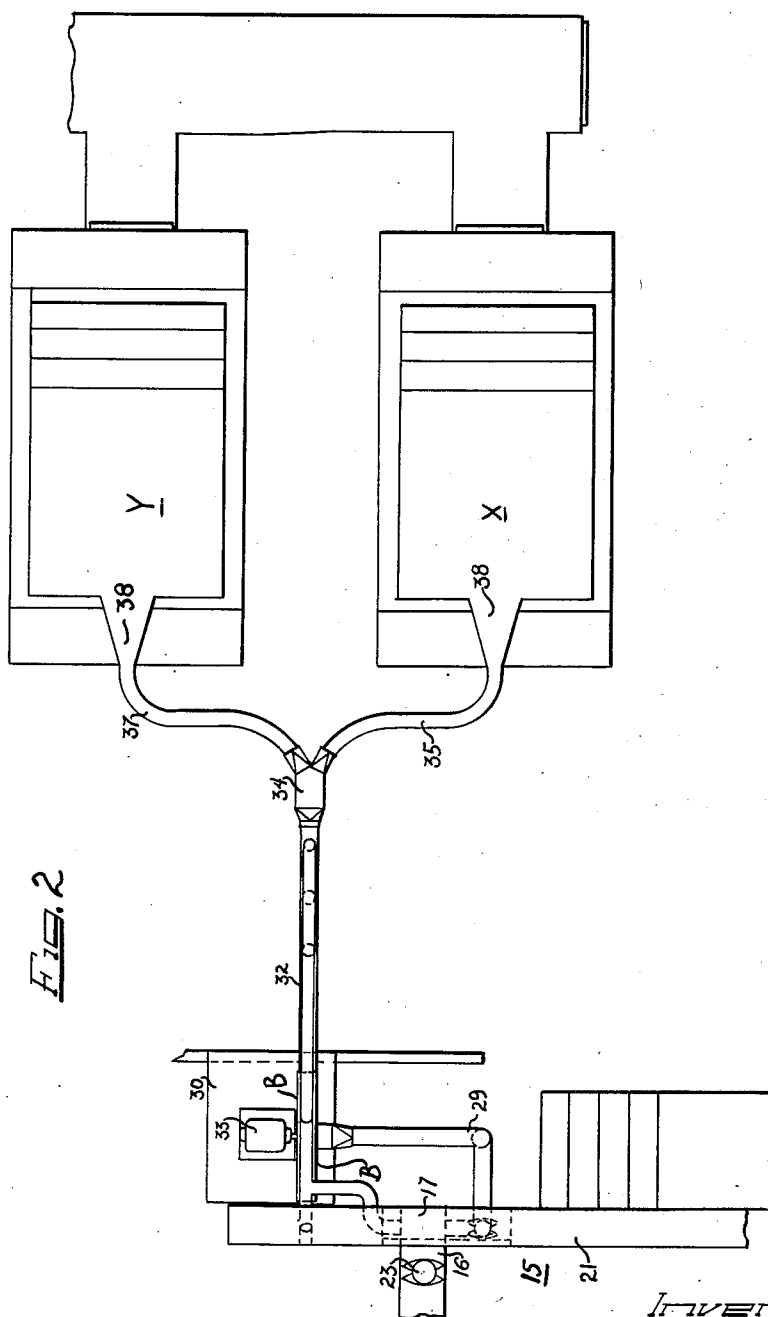
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FLUID CURRENT CONVEYOR SYSTEM FOR SAWDUST-LIKE MATERIAL

Filed Aug. 7, 1946

4 Sheets-Sheet 2



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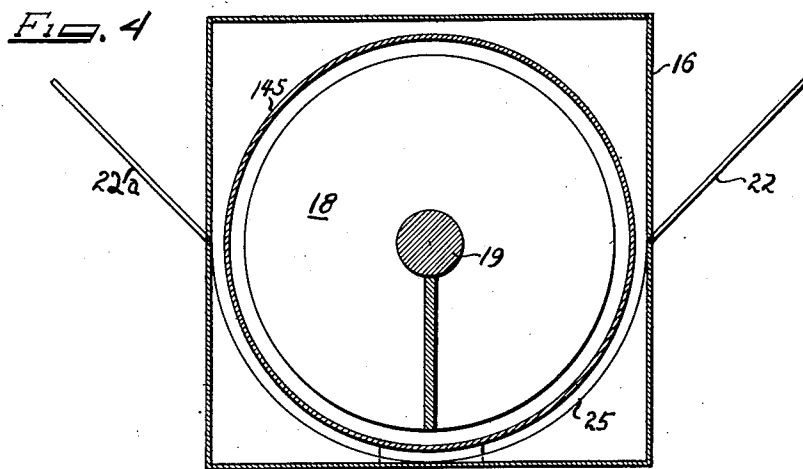
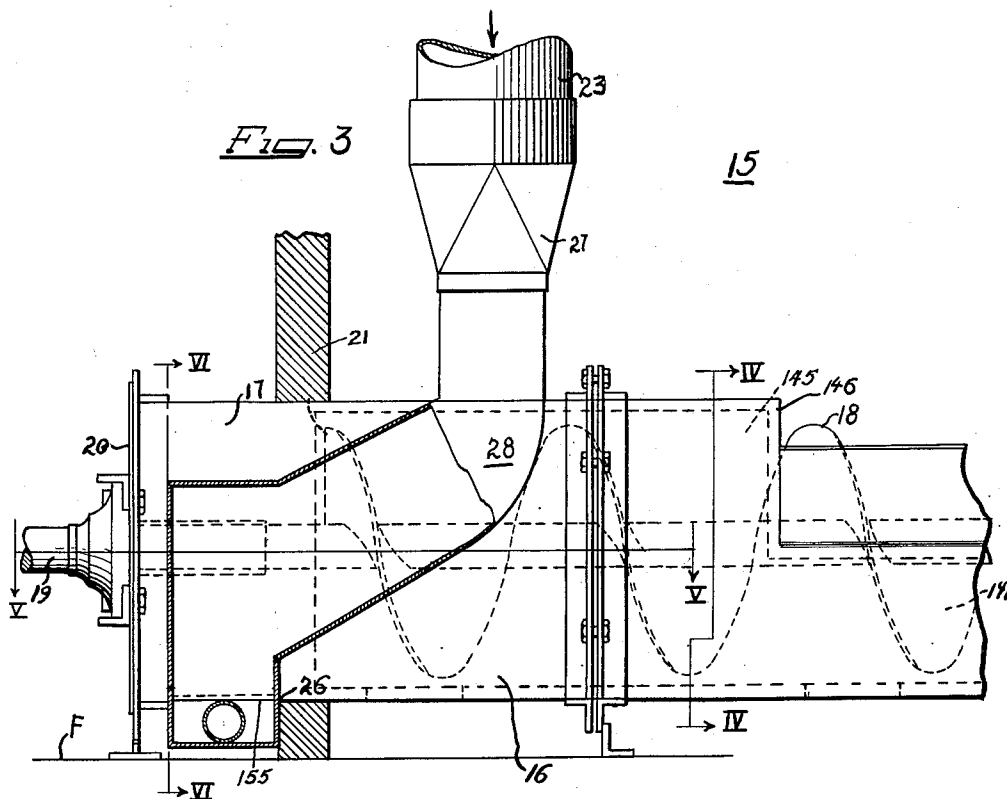
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FLUID CURRENT CONVEYOR SYSTEM FOR SAWDUST-LIKE MATERIAL

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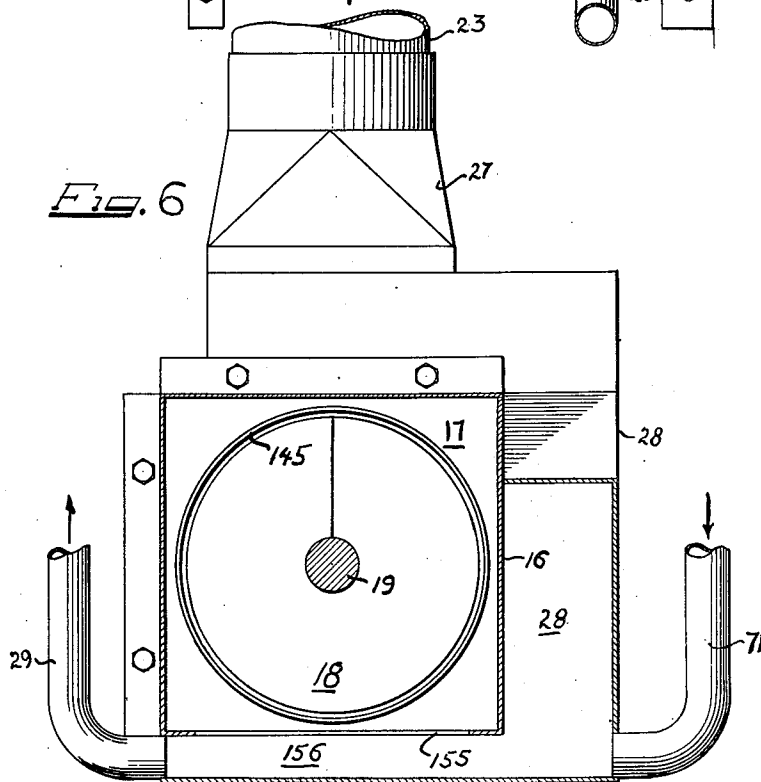
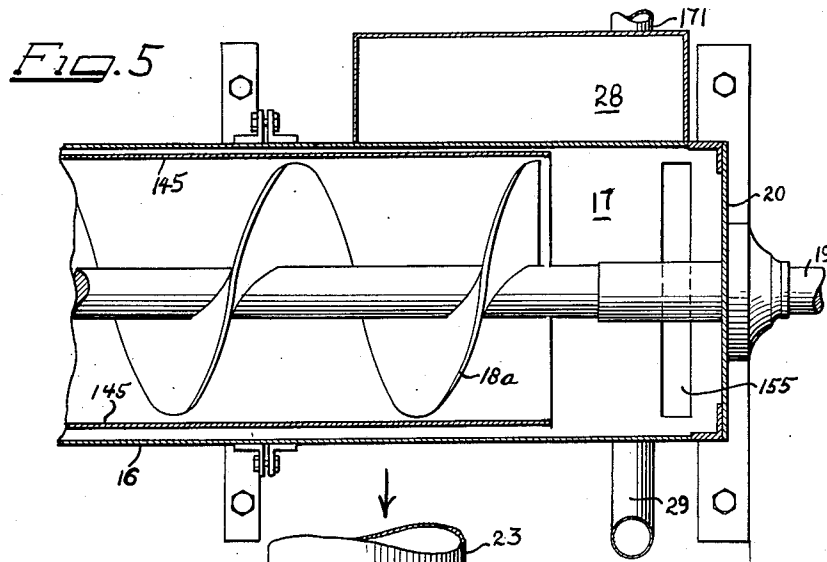
The Sun of Cedar Mill.

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FLUID CURRENT CONVEYOR SYSTEM FOR SAWDUST-LIKE MATERIAL

Filed Aug. 7, 1946

4 Sheets-Sheet 4



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2,804,350

FLUID CURRENT CONVEYOR SYSTEM FOR SAWDUST-LIKE MATERIAL

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Application August 7, 1946, Serial No. 689,015

1 Claim. (Cl. 302—50)

The present invention relates to a sawdust burning system and involves a method of, as well as for, burning sawdust as a fuel in a furnace, efficiently and without smoke.

The present invention has for an object the provision of a method of efficiently burning sawdust as a fuel in a furnace.

Another object of the invention is to provide a system for burning sawdust and the like as a fuel in a furnace which system operates automatically in accordance with steam pressure conditions in the boiler.

Another object of the present invention is to provide means for efficiently burning sawdust in a furnace without the creation of smoke.

A further object of the present invention is to provide a sawdust burning system in which the sawdust is charged into a furnace in a spread condition so that all of the sawdust will be ignited and burn efficiently and smokelessly.

Another object of the present invention is to provide a sawdust fuel burning system in which the sawdust is withdrawn from a source of supply by suction and delivered under pressure into a furnace.

A still further object of the present invention is to provide a sawdust fuel burning system in which the rate of delivery of the sawdust to a boiler furnace is regulated in accordance with the steam pressure conditions in the boiler.

Another and further object of the present invention is to provide a sawdust burning method in which sawdust is withdrawn from a supply and agitated. The agitated sawdust is removed by suction and delivered in a suspended condition in an air stream under positive pressure into a furnace.

The invention has for a further object the provision of a nozzle for spreading the sawdust as it is discharged into the furnace.

Another and yet further object of the present invention is to provide a system as just described in which automatically functioning controls are provided for operating the system in accordance with pressure conditions in the boiler.

Generally speaking, the invention involves the provision of a supply of sawdust, means for withdrawing portions of the sawdust of the supply and delivering it to a pickup compartment wherein air under negative pressure picks up the sawdust and withdraws it in suspension by means of a suction stream. The suction stream with the suspended sawdust in it is converted to a positive pressure stream and delivered with the sawdust into a furnace. A single instrumentality is employed for creating the suction and the positive pressure. Because of the fact that a high positive pressure is necessary to create suction sufficient to withdraw the sawdust from the compartment, means are provided for venting the duct which carries the sawdust in the positive air pressure stream so that the air pressure and velocity in the duct will be reduced to a value sufficient to carry the sawdust

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in suspension into the furnace. Also a nozzle is employed which spreads the dust as it enters the furnace to thereby prevent the sawdust from piling upon the floor of the furnace, which spread delivery enables ready combustion of the sawdust without creating smoke, as the dust is burned before reaching the floor of the furnace.

The above, other and further objects of the present invention will be apparent from the following description and accompanying drawings.

10 An embodiment of the present invention is illustrated in the accompanying drawings and the views thereof are as follows:

Figure 1 is a side elevational view, somewhat schematically illustrated, of the system of the present invention as arranged for supplying sawdust to the furnace of a boiler;

Figure 2 is a top plan view of the arrangement of Figure 1 showing the manner of supplying sawdust to the furnaces of two boilers;

20 Figure 3 is a fragmental side elevational view of the pick-up compartment, with a part in section, showing in dotted lines a screw conveyor for moving sawdust from a bin to the compartment;

25 Figure 4 is a vertical sectional view taken in the plane of line IV—IV of Figure 3;

Figure 5 is a horizontal sectional view, taken in the plane V—V of Figure 3, with some parts in elevation;

30 Figure 6 is an end view of the pick-up compartment, in section, with some parts in elevation, taken in the plane of line VI—VI of Figure 3; and

Figure 7 is a schematic wiring diagram for the reversing motor showing connections of the reversing motor to certain of the operating elements of the system.

The drawings will now be explained.

35 A bin 15 is provided for containing a supply of sawdust. Extending from or formed as a part of the bin is a duct 16 terminating in a pick-up compartment 17.

Means are provided for moving sawdust from the bin 15 to the pick-up compartment 17. The means herein illustrated comprises a spiral or screw conveyor 18 mounted on a horizontal axis having its rear end somewhere within the bin 15 and its front end 18a in the pick-up compartment 17. A shaft 19 supports the conveyor and projects through the front wall 20 of the pick-up compartment to which projecting end of the shaft driving means are connected, as will be later described.

Referring to Figure 4 it will be observed that the duct 16 is preferably rectangular in cross section. The duct, including the pick-up compartment 17, is closed on four sides for a distance from the front wall 20 through the bin wall 21 and for a short distance into the bin (thereby defining a closed intermediate portion of the casing). Rearwardly of the covered inward portion of the duct the top is open (so as to define a material receiving opening) and inclined side wings 22 and 22a are formed along the conveyor for receiving sawdust from the bin to direct it to the conveyor 18. The duct 16 and pickup compartment 17 thus comprise a casing or housing having a material receiving opening adjacent one end, a closed intermediate portion, and a restricted material discharge opening at the other end, which discharge opening 155 will be described in detail hereinafter.

In order to compact the sawdust about the conveyor 18 to prevent the sawdust from falling away along the upper portion of the conveyor a tube 145 surrounds the conveyor 18 from its front end 18a to a point 146 adjacent the rear end of the cover of the duct 16 (Figure 3) from that point, rearwardly the tube becomes a semi-cylindrical trough 147, terminating adjacent the inner end of the conveyor. The interior of the tube 145 is radially spaced from the periphery of the conveyor 18 but a slight distance which is sufficient to allow pieces of

wood, which may be in the sawdust, to pass along the trough to the pick-up compartment 17.

By compacting the sawdust in the tube 145, as long as there is ample sawdust in the bin, the sawdust in the tube fills it completely, thereby preventing any from falling away along the top of the tube, which falling away would result in air channels through the sawdust in the tube which would disrupt the effectiveness of the suction air stream in withdrawing sawdust from the pick-up compartment, as the suction air stream passes underneath the bottom of the pick-up compartment.

An air duct 23 is erected behind the bin wall 21 and near it, in vertical position, and has its open upper end 24 communicating with the interior of the bin above the supply of sawdust in the bin. A damper 148 is arranged within the duct 23 to control flow of air through the duct. The damper is set at the time of installation of the duct.

Referring to Figure 4, it will be noted that the bottom of the conveyor trough 25 is arcuate, which bottom extends from the inner end of the conveyor to the point 26 (Figure 3) adjacent the pick-up compartment. As will be noted in Figure 3, the point 26 is slightly ahead of the front end 18a of the conveyor. From the point 26 to the front wall 20 of the pick-up compartment the bottom of the compartment is open, as at 155, as may be observed in Figures 3 and 6.

The lower end of the air duct 23 communicates with a hood 27 which in turn communicates with duct means 28 for delivering air from the duct 23 to the pick-up compartment 17, from what is shown in Figure 6 as the right side.

Leading from the lower part of the pick-up compartment 17, and from the left side thereof as viewed in Figure 6, is a duct 29.

Mounted on a platform 30 supported by posts 31, above the boiler room floor F, is a blower B. The duct 29 communicates with the inlet of the blower. A duct 32 communicates with the outlet of the blower and leads to the furnaces or furnace to be supplied with sawdust as a fuel.

Referring to Figure 2 boilers X and Y are disposed in side by side relation to be fired by sawdust as a fuel.

The outlet duct 32 communicates with a junction box 34 from which a branch duct 35 leads to the furnace 36 of the boiler X. Another branch duct 37 leads to the furnace of the boiler Y. The junction box 34 has means within it for proportioning the amount of fuel delivered to the furnaces of boilers X and Y, should there be need for differential supply to the furnaces.

Each of the branch ducts 35 and 37 discharges into its furnace through a divergent nozzle 38. As may be noted in Figure 1 the nozzle 38 is directed in downwardly inclined position and is arranged to discharge into the furnace 36 through the front wall 39 of the furnace, above the grates 40 of the furnace.

While the conveyor shaft 19 may be driven in any suitable manner, I prefer to drive it in a manner now described.

Referring to Figure 7, a conveyor driving motor 42 is connected to a Reeves drive 43 (shown diagrammatically), a mechanism well understood in the art. The Reeves drive 43 is connected to a speed reducer 44 (shown diagrammatically) which in turn is connected to the shaft 19 of the conveyor 18. As is well understood, the Reeves drive is a speed changing mechanism.

In the connection between the shaft 19 and the speed reducer 44 is a shear pin which breaks when some foreign object enters the conveyor and tends to retard the movement of the conveyor.

As shown, the shift rod 45 of the drive 43 is pivoted at 46 to a swinging lever 47. The lever 47 is pivoted by one end at 48 to a lug 49 integral with the casing of the Reeves drive.

For swinging the lever 47 to actuate the Reeves drive

in a manner to change speeds, a reversing motor 50 is employed.

As shown diagrammatically in Figure 7, the reversing motor 50 has a crank 51 connected at one end to the motor shaft 52 and at the other end to one end of a link 53. The other end of the link 53 is pivoted at 54 to the lever 47.

The reversing motor 50 is electrically controlled by means responsive to the steam pressure conditions in the boiler.

Figure 7 shows a circuit including a lead-in wire 55 in which is a resistance winding 56 from which a connection is made to the motor 50 by a conductor 57. A swinging contact finger 59 is pivoted at 60, from which pivot electrical connection is made to the motor 50 by a conductor 61. The other lead wire is designated as 58.

For swinging the contact finger 59 steam pressure responsive means are provided. The means herein shown include a pipe 62 communicating with the steam space of the boiler, which pipe enters a Sylphon bellows 63, one end of which 65 is fixed, the other end of which carrying a nose 64, is movable. The nose 64 is suitably connected to the contact finger 59 to move it as the bellows expands and contracts in accordance with steam pressure conditions in the boiler.

By means of the arrangement just described the Reeves drive 43 is actuated by the reversing motor 50 in accordance with the rise and fall of steam pressure conditions in the boiler.

Inasmuch as the Reeves drive is operatively connected to the conveyor 18 for rotating it to feed sawdust from the bin 15 to the pickup compartment 17, the rate of feed of the sawdust by the conveyor is thus made responsive to steam pressure conditions in the boiler. As the steam pressure falls the speed of the conveyor is increased, and as the pressure rises the speed of the conveyor is reduced. Other means responsive to pressure conditions in the boiler are utilized for starting and stopping the conveyor drive motor 42.

Inasmuch as it is necessary to operate the blower B to create sufficient suction in the duct 29 to withdraw sawdust from the pick-up compartment 17 and deliver it to the blower, more pressure is created in the blower than is necessary to discharge the sawdust into a furnace.

In order to reduce the positive pressure and velocity between the blower and the furnace to a value which is sufficient to carry the sawdust into the furnace and discharge it thereinto under proper conditions and pressure, means are provided for venting the duct 32 between the blower and the furnace.

The illustrated form of such venting means includes a pipe 67 having a plurality of branch connections, three of which are shown as 68, 69 and 70, to the duct 32 and opening into the dust bin. A pipe 71 leads from the pipe 67 and is connected into the duct means 28 adjacent the pick-up compartment 17 as shown in Figure 6. Thus air under positive pressure, in excess of that necessary to discharge the sawdust into the furnace, is withdrawn from the duct 32 and delivered into the pick-up compartment 17 or, if desired, into the bin. The branch connection 68, 69 and 70 are provided with dampers or valves 72 (Figure 7) which valves are connected by a link 73 to the lever 47 and the link 53 of the Reeves drive. Thus, the dampers or valves 72 are connected to be operated by the reversing motor 50 to thereby regulate the valves 72 in accordance with steam pressure conditions in the boiler.

The operation of the reversing motor 50 is such that the maximum amount of air under positive pressure is available for discharging sawdust into the furnace when the steam pressure falls and to actuate the conveyor 18 at its maximum speed. As the steam pressure rises the reversing motor will function to reduce the speed of the conveyor drive and to operate the valves 72 in a manner

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to reduce the pressure and velocity of the air entering the furnace.

The bottom of the duct 16 between the point 26 and the end plate 20 of the pick-up compartment 17 is provided with an opening 155, shown in Figures 5 and 6 as rectangular. The length of the opening is substantially the diameter of the flight of the conveyor. The width of the opening is such that the area of the opening is equal to one-half, or slightly less, of the cross-sectional area of the passageway 156 in the lower portion of the pick-up compartment 17.

While the present system has been devised, primarily, for utilizing sawdust as a fuel, it has been found satisfactory for utilizing dust made from "Masonite," or like wood products, and could be used in burning feathers as a fuel if a sufficient supply were at hand. Accordingly the word "sawdust" is herein used generically and not by way of limitation.

The operation of the system is as follows:

At the commencement of firing, the boiler pressure is low, hence the reversing motor 50 is energized to actuate the Reeves drive 43 at high speed which, in turn, operates the conveyor 18 at high speed to supply sawdust for fuel. The blower B operates at constant speed. As soon as the blower B begins to run, a suction is created down through the pipe 23 through the pick-up compartment 17 and up through the duct 29 to the inlet of the blower. The suction stream from the duct or pipe 23 enters the passageway 156 and passes upwardly through the duct 29 thus carrying with it sawdust which has accumulated in the bottom of the passageway and in front of the conveyor, thus picking up the sawdust in suspension and carrying it through the blower where the suction stream is changed to a pressure stream and delivered into the furnace. The Reeves drive, being operable by the reversing motor 50, actuates the dampers 72 to vent the duct 32, between the blower and the furnace, to reduce the pressure and velocity of the air stream in this duct to a point where it is sufficient to carry the sawdust into the furnace but not too high as to effect proper combustion in the furnace. The air that is thus vented passes downwardly through the duct 71 and into the passageway 156 at the lower end of the pick-up chamber.

By reason of the fact that the sawdust is packed firmly about the conveyor within the tube 145, it accumulates sawdust ahead of the end 18a of the conveyor on the bottom of the passageway 156. Packing of the sawdust in the tube 145 prevents creation of air channels through the tube. If such air channels were present, then air from within the bin might pass through the tube and through the opening 155 into the passageway 156 and disturb the air-fuel ratio to the furnace.

The fire in the furnace once having been started and with a suitable amount of sawdust in the bin the system continues to supply fuel to the furnace as required.

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As the steam pressure in the boiler increases, the Sylphon bellows 63, will respond to the increase of pressure. As such pressure increases the bellows will be extended to thus move the finger 59 to slow the Reeves drive.

The reversing motor 50 actuates the swinging lever 47 in accordance with its direction of rotation to change the driving ratio of the Reeves drive to change the speed of rotation of the conveyor shaft 19. When the pressure in the boiler builds up to a predetermined value the reversing motor will stop. As the pressure in the boiler drops, because of the discontinuation of fuel supplied to its furnace, the Sylphon bellows 63 will respond to such drop in temperature and will eventually again operate the reversing motor 50 in a direction to cause rotation of the conveyor 18 to resume the supply of fuel to the furnace.

This continues intermittently as long as the furnace is in operation.

I claim as my invention:

In a fuel burning system for sawdust-like material, a fuel duct having an open end arranged to receive fuel and having a closed end opposite said open end, a conveyor screw in said duct having a terminal end spaced from said closed end of said duct for compaction of the sawdust-like material between said closed end of said duct and said terminal end of said conveyor screw, continuously variable drive means for rotating said conveyor screw, an air duct extending transversely of and below said fuel duct adjacent said closed end and beyond said terminal end of said screw, said fuel duct having a transverse opening aligned above said air duct and having a width less than one-half the width of said air duct for passage of the sawdust-like material into said air duct, and a blower having an outlet for communicating with a fuel burner and having an inlet connected to one end of said air duct, the other end of said air duct being in communication with the atmosphere.

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