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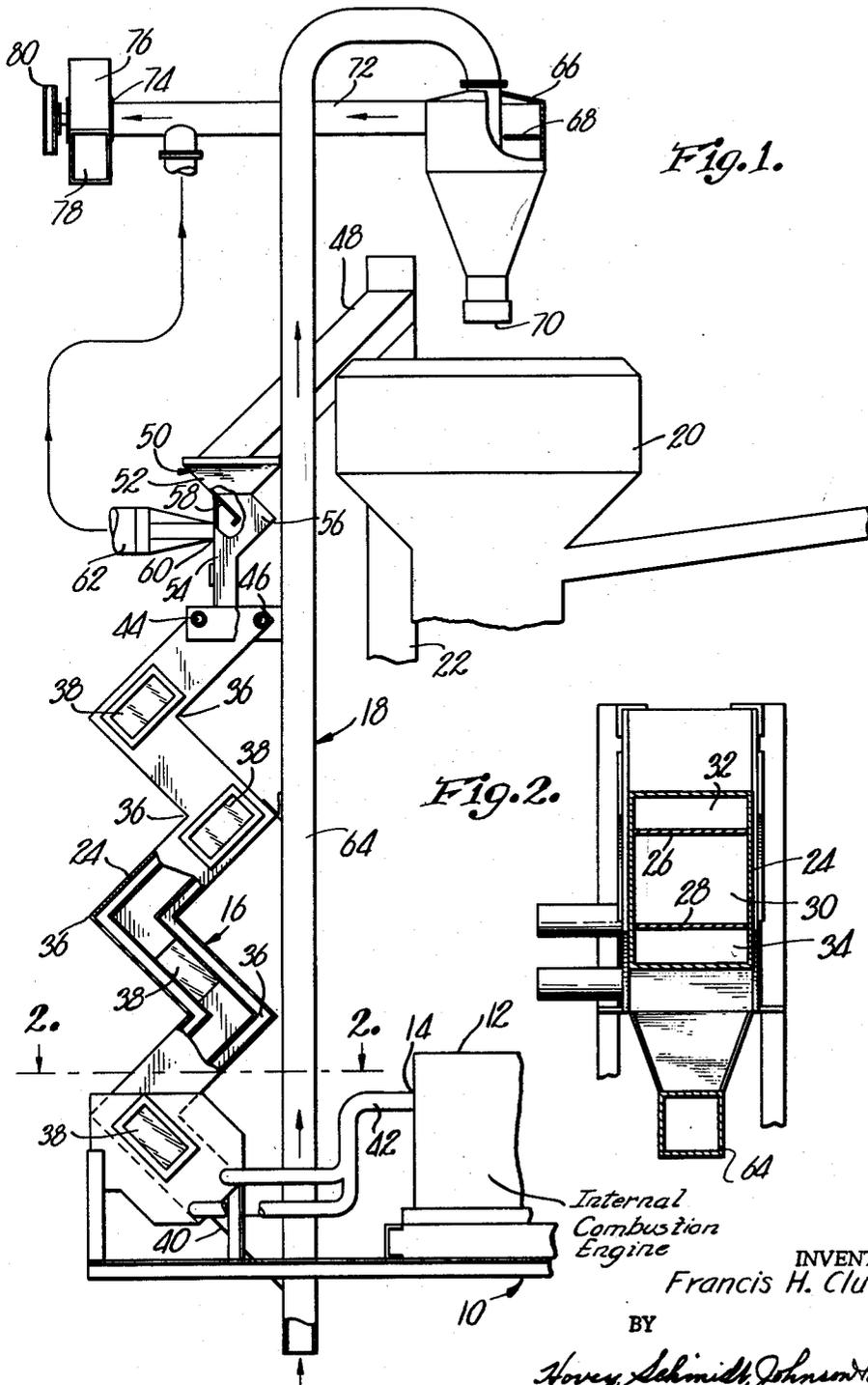


Fig. 1.

Fig. 2.

Internal
Combustion
Engine

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GRAIN DRYING AND CONVEYING APPARATUS FOR COMBINES AND THE LIKE

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9 Claims. (Cl. 34—57)

The present invention relates to grain drying and conveying apparatus for use on combines or the like, and more particularly, the present invention relates to such apparatus provided with pneumatic conveying structure.

It is an object of the present invention to provide grain drying apparatus for use with a combine or the like wherein pneumatic means are provided for conveying grain during at least a part of the drying cycle so that the grain movement may be accomplished in a simplified, inexpensive manner.

It is another object of the present invention to provide grain drying and conveying apparatus for use on a combine or the like, wherein the conveying means includes a suction-type, pneumatic conveyor, and a suction dust and chaff removing means coupled to a common source of vacuum.

Various other objects and advantages will become apparent as the description of the invention proceeds, and various modifications and changes may be made to the structure which will be described without departing from the spirit of the invention. Such additional advantages and modifications are intended to be covered by the scope of the appended claims.

In the drawing:

FIGURE 1 is a partially schematic, side elevational view of grain drying and conveying apparatus embodying the present invention, with portions broken away and shown in cross section for clarity; and

FIG. 2 is a transverse, cross-sectional view taken along line 2—2 of FIG. 1 looking in the direction of the arrows.

In the drawing, there is schematically illustrated a combined frame indicated generally by the numeral 10. Frame 10 supports an internal combustion engine 12, having an exhaust port 14. Frame 10 further supports an upright, tubular member 16 having a generally tortuous configuration in vertical cross section. Frame 10 additionally supports a pneumatic conveyor indicated generally by the numeral 18, and disposed in a vertical plane. Also adapted for support on frame 10 (although not shown in the drawing), are a grain-receiving hopper or container 20 and a threshed grain conduit 22 for conveying threshed grain to hopper or container 20.

A closer inspection of FIGS. 1 and 2 will show that the tubular member 16 comprises an outer rectangular frame 24 provided with partitions 26 and 28 extending between the long side walls of frame 24 in spaced, parallel relationship to each other, and to the short side walls of frame 24. The frame 24 and partitions 26 and 28 thereby define a central grain-carrying passage 30, flanked by passages 32 and 34 for carrying hot products of combustion. As will be seen by referring to FIG. 1 of the drawing, member 16 has a generally zigzag configuration in vertical cross section created by the formation of the member 16 of a series of right-angled bends 36.

A plurality of windows 38 are provided in the long side walls of frame 24, rendering the passage 30 visible from the outside of frame 24. The uppermost and lowermost ends of member 16 are open and there is provided, at the lowermost open end of member 16, a slide 40 for coupling the lower extremity of member 16 to conveyor 18. An exhaust manifold 42 is provided for coupling exhaust port 14 of engine 12 with the passages

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32 and 34 of member 16 at the lowermost extremity of passages 32 and 34. Passages 32 and 34 terminate at the upper extremity of member 16 in a pair of secondary exhaust ports 44 and 46 which are open to atmosphere.

The upper portion of conduit 22 is provided with a trough 48 extending in a downwardly inclined direction to a funnel assembly 50. Funnel assembly 50 includes a funnel 52 and a spout 54 extending downwardly therefrom into the open upper extremity of tubular member 16. Spout 54 is provided with an angular portion 56 having a generally L-shaped, internal baffle 58 inclined downwardly in a direction opposite to the inclination of trough 48. Spout 54 has a port 60 into which one end of a vacuum conduit 62 is coupled.

Conveyor 18 includes an elongated, upright, hollow element 64, being open to atmosphere at its lower end and extending upwardly in a generally inverted, J-shaped configuration to terminate at the opposite end in coupled connection with a cyclonic separator 66. Cyclonic separator 66 is provided with an internal baffle 68 and a discharge opening 70. The cyclonic separator 66 is further provided with a discharge pipe 72 extending tangentially from the upper portion thereof and terminating in coupled connection with an intake port 74 of a compressor 76. Compressor 76 is further provided with a discharge port 78. Compressor 76 may be supported in any suitable manner not shown, from the combine frame 10, or from other structure of the combine, and the same may be driven through a belt and pulley arrangement such as indicated generally at the numeral 80 from any suitable source of power.

While the structure embodying the concepts of this invention could equally well be used in a fixed location as in association with a grain elevator or grain storage bin, the operation of the same will be described in its preferred embodiment where it is used in combination with the structure of a combine.

In operation, threshed grain from the combine is conveyed upwardly through conduit 22 toward the top portion thereof where it is diverted through trough 48 into the funnel 52 of funnel assembly 50. It is obvious, of course, that the trough 48, being inclined, the grain will gravitate downwardly into the funnel 52. The grain will continue to gravitate downwardly over the baffle 58 in spout 54 and thence through the remaining portion of spout 54 into the open upper extremity of passage 30.

Since the vacuum conduit 62 is coupled at its other end with pipe 72, which ultimately is connected with the intake port 74 of compressor 76, a suction is formed in conduit 62 and port 60 which will draw off the dust and chaff present in the grain falling through spout 54. However, the presence of the baffle 58 and its position as indicated in the drawing, is such that the grain itself will not be drawn off through conduit 62, but will gravitate through the tortuous configuration of passage 30. At the same time that the grain is gravitating downwardly through the passage 30, hot products of combustion are being drawn off from port 14 of engine 12, and piped through manifold 42 into the passages 32 and 34. The hot products of combustion, which in most cases will be the exhaust gases of an internal combustion engine, will travel upwardly partially due to the force of the exhaust gases, and partially due to the normal convection currents, to eventually be discharged to atmosphere through ports 44 and 46.

It should be recognized that, when an embodiment of the present invention is used in a fixed location, any source of thermal energy may be substituted for the hot products of combustion and could be in the form of a high resistance electric heater or the like. Since the passages 32 and 34 are separated from passage 30 only by the partitions 26 and 28, it is manifest that the hot prod-

ucts of combustion traveling upwardly through the passages 32 and 34, will be in heat-exchange relationship with the grain traveling downwardly through the passage 30, thereby accomplishing the drying of the grain. When the grain reaches the open lower extremity of member 16, it will be discharged over slide 40 into element 64. Element 64 is connected with the intake port 74 of compressor 76 indirectly through the cyclonic separator 66 and pipe 72.

Compressor 76 induces currents of air through element 64 in an upward direction, due to the fact that the connection is with the intake side of compressor 76, and for this reason, the lowermost extremity of element 64 is open to atmosphere to permit air to be drawn in therethrough. The currents of air, induced in element 64 in an upward direction, are of sufficient pressure to convey the grain received from the lower extremity of member 16, upwardly through element 64 as the grain becomes entrained in the currents of air and eventually into the cyclonic separator 66.

Baffle 68 in cyclonic separator 66, insures that the grain conveyed to the separator will swirl downwardly through separator 66 for eventual discharge through opening 70 into hopper or container 20. At the same time, the baffle 68 also provides for insuring that the air and any remaining dust and chaff, will travel tangentially away from separator 66 through pipe 72, and the same will ultimately be discharged along with the dust and chaff brought into compressor 76, through conduit 62, from the discharge port 78 of compressor 76 into the atmosphere. Of course, a suitable means for catching the dust and chaff could be provided if such were desirable, but as the same forms no part of the present invention, it is not shown in the drawing.

Having thus described the invention what is claimed as new and desired to be secured by Letters Patent is:

1. For use on a combine provided with a frame, a source of hot products of combustion, a grain receiving hopper adjacent the upper part of the combine and a threshed grain conduit for conveying grain to said upper part of the combine, the combination of an upright, imperforate, tubular member adapted to be mounted on the frame and having an open upper end positioned to receive grain from said conduit whereby the grain gravitates through said member; imperforate wall means spaced from and extending along the outer surface of said member for defining with the latter an enclosed fluid passage extending continuously between the ends of said member and adapted to be coupled to said source of hot products of combustion for bringing said products into heat exchange relationship with the grain along a path exteriorly of said member as the grain gravitates through said member; conveyor means adapted to be mounted on said frame and disposed to receive the grain from the lower extremity of said member and extending upwardly therefrom for discharge of grain into said hopper; and suction means connected to said conveyor for forcing currents of air therethrough in a direction and under sufficient pressure to convey the grain from said lower extremity of the member, upwardly through the conveyor as the grain is entrained in said currents of air and whereby the grain is ultimately discharged from said conveyor into the hopper.

2. The structure as set forth in claim 1, wherein said upright tubular member and said wall means are of a tortuous configuration.

3. The structure as set forth in claim 1, wherein said conveyor means includes a cyclonic separator having a discharge opening over said hopper, and an elongated, upright, hollow element open to atmosphere at the lower end thereof and terminating at the other end in said cyclonic separator.

4. The structure as set forth in claim 1, wherein said means for forcing currents of air through said conveyor includes a compressor having an intake port and an ex-

haust port, said intake port being coupled to said conveyor and said exhaust port being open to atmosphere.

5. For use on a combine provided with a frame, a source of hot products of combustion, a grain receiving hopper adjacent the upper part of the combine and a threshed grain conduit for conveying grain to said upper part of the combine, the combination of an upright tubular member adapted to be mounted on the frame and having an open upper end positioned to receive grain from said conduit whereby the grain gravitates through said member; dust and chaff removal means coupled with said member adjacent said open upper end of said member for removing dust and chaff from the grain gravitating through said member; means adjacent said member and adapted to be coupled to said source of hot products of combustion for bringing said products into heat exchange relationship with the grain as the same gravitates through said member; conveyor means adapted to be mounted on said frame and disposed to receive the grain from the lower extremity of said member and extending upwardly therefrom for discharge of grain into said hopper; and means connected to said conveyor for forcing currents of air therethrough in a direction and under sufficient pressure to convey the grain from said lower extremity of the member, upwardly through the conveyor as the grain is ultimately discharged from said conveyor into the hopper.

6. The structure as set forth in claim 5, wherein said dust and chaff removal means includes a vacuum conduit coupled at one end with said member and at the other end with said means for forcing currents of air through said conveyor; and a baffle mounted in said member and positioned to permit air, dust and chaff to pass into said vacuum conduit while directing grain toward gravitational flow through said member.

7. For use on a combine provided with a frame, a source of hot products of combustion, a grain receiving hopper adjacent the upper part of the combine and a threshed grain conduit for conveying grain to said upper part of the combine, the combination of an upright tubular member adapted to be mounted on the frame and having an open upper end positioned to receive grain from said conduit whereby the grain gravitates through said member; means adjacent said member and adapted to be coupled to said source of hot products of combustion for bringing said products into heat exchange relationship with the grain as the same gravitates through said member; an elongated, upright, hollow element open to atmosphere at the lower end thereof, said element adapted to be mounted on said frame and disposed to receive the grain from the lower extremity of said member, said element terminating at the upper end thereof in a cyclonic separator having a discharge opening over said hopper; a compressor adapted to be mounted on said frame, said compressor having an intake port and an exhaust port; a vacuum conduit coupled at one end with said member adjacent said open upper end of said member; a baffle mounted in said member and positioned to permit air, dust and chaff to pass into said vacuum conduit while directing grain toward gravitational flow through said member; said intake port of said compressor being coupled to said separator and said vacuum conduit whereby currents of air are induced in said vacuum conduit in a direction and under sufficient force to entrain and remove dust and chaff from the grain gravitating through said member and currents of air are induced in said element and separator in a direction and under sufficient pressure to convey the grain from said lower extremity of the member, upwardly through the element as the grain is entrained in said currents of air to said separator wherein said grain is separated from said currents of air and discharged through said opening into said hopper, the air, dust and chaff being discharged through said compressor and exhaust port to atmosphere.

8. In a grain drying and conveying assembly, a source

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of thermal energy; a source of grain to be dried and conveyed; an upright tubular member having an open upper end positioned to receive grain from said source of grain to be dried and conveyed, whereby the grain gravitates through said member; dust and chaff removal means coupled with said member adjacent said open upper end of said member for removing dust and chaff from the grain gravitating through said member; means adjacent said member coupled to said source of thermal energy for bringing said thermal energy into heat exchange relationship with the grain as the same gravitates through said member; a grain collection container positioned above said open upper end of said member; conveyor means disposed to receive the grain from the lower extremity of said member and extending upwardly therefrom for discharge of grain into said container; and means coupled with said conveyor for forcing currents of air there-through in a direction and under sufficient pressure to convey the grain from said lower extremity of the member, upwardly through the conveyor as the grain is entrained in said currents of air and whereby the grain is ultimately discharged from said conveyor into the container.

9. In a grain drying and conveying assembly, a source of thermal energy; a source of grain to be dried and conveyed; an upright tubular member having an open upper end positioned to receive grain from said source of grain to be dried and conveyed, whereby the grain gravitates through said member; means adjacent said member coupled to said source of thermal energy for bringing said thermal energy into heat exchange relationship with the grain as the same gravitates through said member; a grain collection container positioned above said open upper end of said member; an elongated, upright, hollow element open to atmosphere at the lower end thereof, said element coupled with the lower extremity of said member for receiving grain therefrom, said element terminating at the upper end thereof in a cyclonic separator having a discharge opening over said container; a compressor having

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an intake port and an exhaust port; a vacuum conduit coupled at one end with said member adjacent said open upper end of said member; a baffle mounted in said member and positioned to permit air, dust and chaff to pass into said vacuum conduit while directing grain toward gravitational flow through said member; said intake port of said compressor being coupled to said separator and said vacuum conduit whereby currents of air are induced in said vacuum conduit in a direction and under sufficient force to entrain and remove dust and chaff from the grain gravitating through said member and currents of air are induced in said element and separator in a direction and under sufficient pressure to convey the grain from said lower extremity of the member, upwardly through the element as the grain is entrained in said currents of air to said separator wherein said grain is separated from said currents of air and discharged through said opening into said container, the air, dust and chaff being discharged through said compressor and exhaust port to atmosphere.

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