

Jan. 24, 1956

M. W. FORTH
HAMMERMILL

2,732,138

Filed March 27, 1952

3 Sheets-Sheet 1

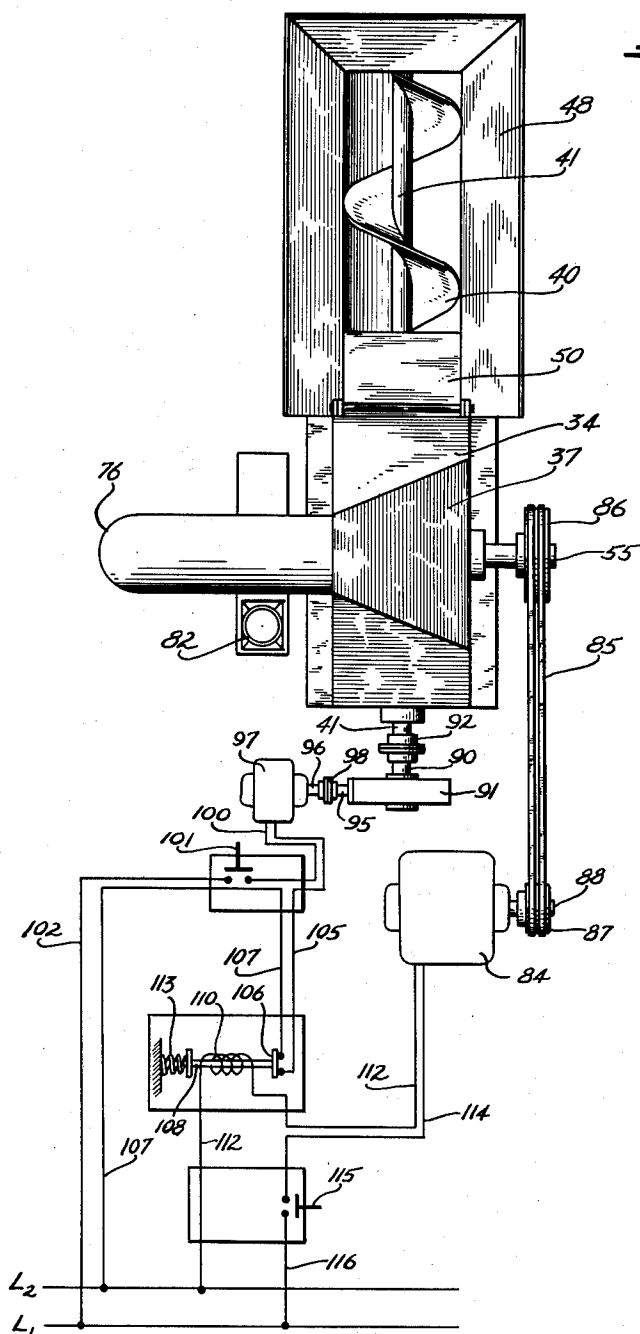


Fig. 1

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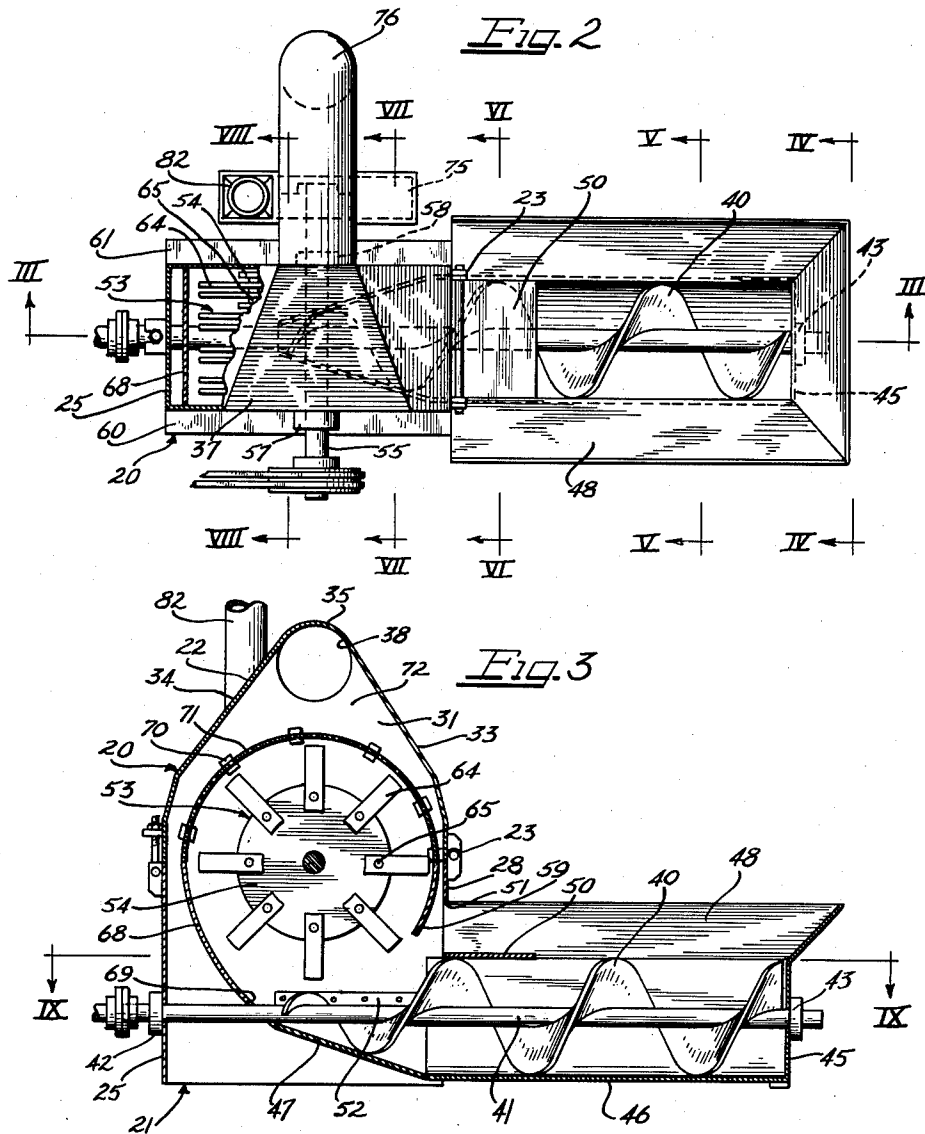
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3 Sheets-Sheet 2



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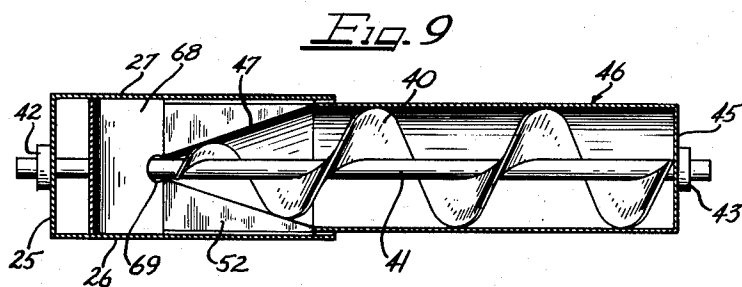
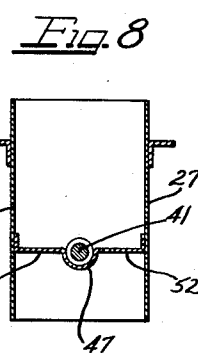
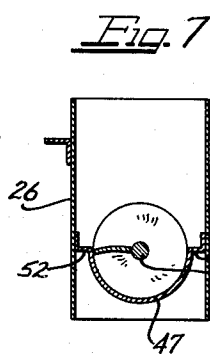
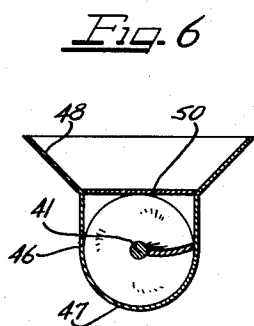
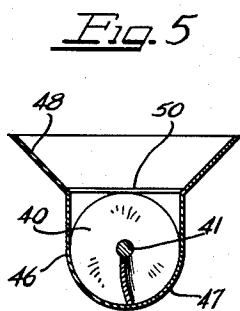
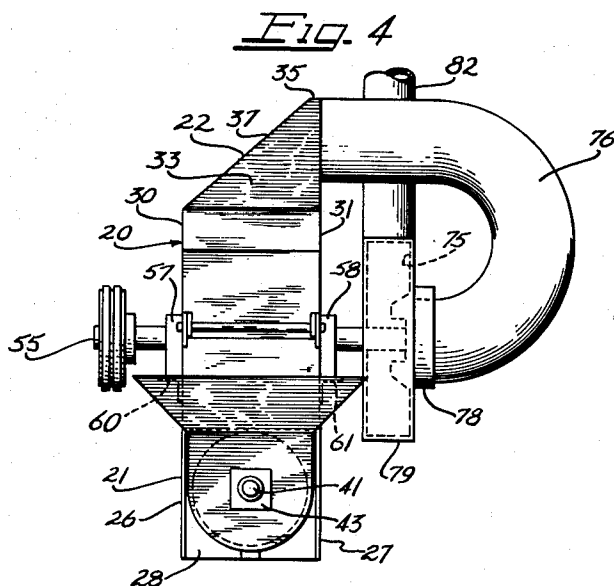
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Filed March 27, 1952

3 Sheets-Sheet 3



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HAMMERMILL

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Application March 27, 1952, Serial No. 278,939

3 Claims. (Cl. 241—186)

This invention relates to improvements in feed grinders of the hammermill type for processing hay, fodder, grain, or the like. More particularly it has to do with improvements in a mechanism for feeding the material to the chamber in which the hammers rotate.

In the prior conventional types of feed grinders of the hammermill type, the material to be ground is usually fed to the mill on an inclined apron near the horizontal center of the mill chamber. With such an arrangement the material had to be elevated from the material crib to the apron to be fed by gravity along the apron to the grinding section of the mill. Such a procedure entails considerable manual labor, time and attention, and furthermore is not conducive to automatic operation of the mill.

In the present improved feed grinder, the material is positively fed to the mill by means of an auger or feed screw, and, in addition is fed at a point substantially near the bottom of the mill, so that the material feed trough may be positioned near the bottom of the corn crib or the like, such that the material is permitted to flow from the crib directly into the feed trough and thence conveyed to the mill, resulting in saving of considerable manual labor and time. In addition, the present improved mill may be completely automatic in operation, such that it does not require material feeding attention. For the latter purpose, the present improved mill has provisions incorporated therein to prevent clogging of the material fed to the grinder chamber, through the provision of means for automatically stopping operation of the feed auger or screw when the mill becomes clogged while permitting the grinder to continue to operate until it has cleared the clogged condition.

In hammermills, most efficient operation is obtained when the hammers are rotated at a speed which results in the grain being contacted by the hammers and driven against the breaker plate of the mill with the most effective breaking force. Any choking or jamming of grain in the grinding chamber, which results in a decrease in the peripheral speed of the hammers, causes a decrease in efficiency of operation. It is desirable therefore that the material be positively fed into the path of travel of the hammers at a substantially constant rate in a uniform, even flow. It is also advantageous to provide means for positively and quickly stopping the feed mechanism if the hammers are slowed down for any reason.

It is therefore an important object of the present invention to provide an improved mechanism for positively moving material into the path of travel of the hammers of a hammermill in an uncongested, uniform flow.

Another object of this invention is the provision of a novel feeding mechanism that feeds the material upwardly to the hammers from a zone below the grinding chamber, thus permitting a very low, advantageous position for the hopper into which the material is deposited prior to being fed into the grinder.

According to the general features of the present invention, a set of power driven hammers are mounted in a

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housing for rotation on a horizontally disposed drive shaft. The shaft is positioned above the ground, or other supporting surface, a sufficient distance to define a material feeding chamber below the hammers. A screw conveyor receives material from a relatively low hopper outside of the housing and forces it forwardly into a segmental conical chute that extends into the feeding chamber below the hammers. The chute is of segmental conical configuration to conform to the forward end of the conveyor screw which has an external circle of revolution that diminishes toward the discharge end of the screw. Thus, material is directed upwardly and toward the axis of the screw as it is fed to the hammers in such a manner that any uneven accumulations of material are broken up by the squeezing action of the screw and the conical chute.

In a mill of the presently improved character, it is advantageous to include an arrangement wherein the rotating hammers and the conveyor screw are each driven by a separate motor. Since the value of the current in the circuit of the motor driving the hammers will rise when a choking condition causes an overload on the motor, a relay is arranged in series with the circuit of this motor. The relay is interconnected with the conveyor motor circuit and contains an element so calibrated that, when the current in the hammer motor circuit exceeds a certain value, the relay will operate to open the circuit of the conveyor motor, stopping the feeding of material to the hammers.

Other and further features, objects, and advantages of the present invention will be apparent to one skilled in the art from the following detailed description taken in connection with the accompanying drawings.

On the drawings:

Figure 1 is a top plan view of a hammermill constructed according to the teaching of the present invention and showing in diagrammatic form an electrical system for controlling the operation of the mill.

Figure 2 is a top plan view of the hammermill with parts in section and parts broken away to more clearly disclose the mechanism.

Figure 3 is a vertical sectional view taken on line 3—3 of Figure 2.

Figure 4 is an end elevational view looking in the direction indicated by reference line 4—4 of Figure 2.

Figure 5 is a vertical sectional view taken on line 5—5 of Figure 2.

Figure 6 is a vertical sectional view taken on line 6—6 of Figure 2.

Figure 7 is a vertical view taken on line 7—7 of Figure 2.

Figure 8 is a vertical sectional view taken on line 8—8 of Figure 2.

Figure 9 is a horizontal sectional view taken on line 9—9 of Figure 3.

As shown on the drawings:

In Figures 2, 3, and 4 the reference numeral 20 indicates generally a hammermill housing having an open-top, box-shaped base 21 and a hood 22 pivotally mounted by means of a hinge 23 on the base 21. The base 21 is preferably made of heavy sheet metal and consists of a rear wall 25, sidewalls 26 and 27, and a front wall 28, all suitably secured together as by welding.

As best seen in Figures 3 and 4, the hood 22 has an irregular shape with spaced, upright side walls 30 and 31 connected by sloped front and rear walls, 33 and 34 respectively, that converge to a rounded portion 35 at the top of the hood. The hood top is also defined by a flat panel 37 that slants upwardly and laterally toward a circular discharge opening 38 in the side wall 31. Thus the slanted front, rear, and top walls of the hood 20 serve

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to direct ground material to the discharge opening 38 for a purpose which will be explained hereinafter.

Material to be ground is moved into the base 21 by means of a conveyor screw 40 which has a shaft 41 journaled near one end in a bearing box 42 mounted on the exterior of the base wall 25 and the other end journaled in a bearing box 43 mounted on a wall 45 of a conveyor housing or feed trough 46. The housing 46 is an elongated, open-top box-like structure defining a conveyor or feed trough and having a segmental conical rear ramp or discharge portion 47 conforming to the shape of the rear end of the conveyor screw 40 which, as seen in Figure 3, has an external circle of revolution that diminishes toward the rearward end of the screw. This tapered end of the screw has a uniform clearance relative to the conical discharge chute 47 and coacts therewith to direct material upwardly and toward the axis of the screw and to break up any uneven accumulations of material before the material is fed to the hammers. It is to be noted that the chute or ramp 47 discharges the material substantially at the longitudinal center of a hammer assembly 53 which will be described presently. A hopper 48, with slanted walls, is secured around the open top of the feed housing 46 in any suitable manner. A plate 50 is disposed across the top of the conveyor housing 46. The plate 50 serves as a top wall preventing the material that is being advanced by the conveyor screw from moving upwardly away from the screw.

The front wall 28 of the base 21 has an opening 51, Figure 3, of a size and shape to receive the conveyor housing 46 and the hopper 48.

The segmental conical discharge chute 47 is provided on either side with a horizontal disposed support flange 52, Figures 7 and 8, which extends to the adjacent side walls 26 or 27. At each side wall the flange 52 is bent upwardly and secured, as by welding or riveting, to the side wall.

A rotating hammer assembly 53 is mounted in the mill, half in the base 21 and half in the hood 22. This hammer assembly comprises a plurality of spaced disks 54 which are keyed to a shaft 55. The shaft 55 is journaled for rotation in bearing blocks 57 and 58 mounted on angle brackets 60 and 61 which are welded to the exterior surface of the walls 26 and 27 of the base 21. A plurality of hammers 64 are pivotally mounted on each disk 54 by means of rods 65 which extend through all the disks.

To facilitate the breaking of the material, a curved breaker plate 68 of heavy steel construction is disposed in the base 21 between the walls 26 and 27 closely adjacent the free ends of the hammers 64. At its lower end the breaker plate 68 is secured, as by welding, to the rear end of the conical chute 47 and is provided with an opening 69 through which the shaft 41 extends. As seen in Figure 3, the tapered rear end of the screw 40 extends into the housing to a point past a vertical plane through the shaft 55. Thus the material at the end of the screw is delivered to the hammers when they are moving in an upwardly curved path. With this arrangement, the hammers do not tend to drive the material back into the conveyor but rather they tend to sweep the material out of the conveyor and drive it against the breaker plate. A baffle plate 70 is mounted between the walls 26 and 27 between the hammers and the front wall 28 to prevent the ejection of material back into the hopper before it is ground. After the material is broken up by the flailing hammers 64 it is discharged through a semi-cylindrical screen 71 into a discharge chamber 72 defined above the hammers by the slanted walls of the hood 22.

The screen 71 may be removably mounted on the hood, in a curved guide passageway defined by pairs of spaced tabs 70 secured to the inside surface of the hood side walls 30 and 31. The screen may be removed by sliding it out of the guide passageway.

After the material is ground, it is drawn from the discharge chamber 72 of the hood by a blower 75 which has

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a central suction eye in communication with a curved conduit 76. The conduit 76 has one end secured in the discharge opening 38 at the top of the hood 22 and the other end removably secured by a clamping band 78 to a cylindrical flange (not shown) extending from the blower housing 79. The blower discharges into a conduit 82 that leads to a suitable storage container. The blower 75 is keyed to an extension of the drive shaft 55 of the hammers so that the blower will operate whenever the hammers are rotated. It will, of course, be understood that substantially the major portion of the air supplied to the blower 75 is obtained through the feed trough 46 of the mill. Therefore, air is drawn through the entire grinding chambers of the mill, picking up the ground feed and drawing it through the screen 71 into the discharge opening 38. Any material that has not been ground to a size permitting the air to draw it through the mesh size of the screen is reground by the mill until it is of a mesh size to pass through the screen by the current of air into the discharge opening in the conduit 76.

The shaft 55 is driven from an electric motor 84, Figure 1, by means of a belt 85 disposed over a pulley 86 keyed to the shaft 55 and a pulley 87 keyed to the motor shaft 88.

The shaft 41 of the conveyor screw 40 is connected to a power takeoff shaft 90 of a speed reducer 91 by a coupling 92 of standard construction. An input shaft 95 of the speed reducer 91 is connected to a shaft 96 of an electric motor 97 by a coupling 98. Thus the conveyor screw 40 is driven by one motor 97 while the hammers and the blower are driven simultaneously by a separate motor 84.

As before indicated, it is desirable to include in the mill assembly a suitable type of automatic control means which stops the conveyor screw 40 when an accumulation of material in the mill causes an overload on motor 84. Referring to Figure 1, it will be seen that the motor 97 of the conveyor screw is supplied with electric power from the power mains L1 and L2. The motor 97 is electrically connected to main L1 through a conductor 100, a manually operated switch 101, and a conductor 102. It is electrically connected to the main L2 through a conductor 105, a normally closed switch 106, and a conductor 107. The switch 106 has a movable member 108 which forms the core of a solenoid. The solenoid coil 110 is formed by loops of a conductor 112 that electrically connects motor 84 to main L2. The motor 84 is connected to the main L1 through conductor 114, a manually operated switch 115, and a conductor 116.

Under certain conditions of operation of the mill an excessive amount of material may be fed to the chamber in which the hammers 64 rotate and cause an overload on the motor 84. Such an overload on the motor 84 which drives the hammers will cause the core 108 to be drawn into the coil 110 against the resistance of a spring 113, thus breaking the electrical circuit to the motor 97 and shutting down the feed screw. The motor 84, which drives the hammers 64, will, of course, continue to be energized and will continue to rotate the hammers until the choked or clogged condition in the mill is cleared, removing the overload on the motor 84, followed by reclosure of switch 106, attained by resumption of operation of the feed motor.

In operation, the hammermill of this invention is positioned alongside a corn crib or other material storage bin. Since the hopper 48 is only spaced above the ground a distance equal to the depth of the conveyor trough 46, it will be readily recognized that the corn can be fed directly into the hopper 48 from the crib. This arrangement eliminates the shoveling of the corn into the hopper which is usually done manually. The electrical control switches 101 and 115 are manually closed to energize the electric motors and actuate the conveyor and the mill.

The material in the hopper 48 is fed into the housing below the hammers and then up the segmental conical chute 47 into the path of travel of the hammers. The

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hammers contact the material as they move in a circular path about the shaft 55 and drive it against the breaker plate 68. This material is cut up and broken and discharged through the screen 71 into the chamber 72 in the upper part of the housing. The slanted upper walls of the housing direct the ground material toward the discharge opening 38 where it becomes entrained in the air being drawn through the conduit 76 by the blower 75 and later discharged into conduit 82.

From the foregoing description it will be seen that there is provided by the present invention a novel hammermill construction wherein material to be ground can be fed directly into a hopper disposed close to the ground and wherein the material is moved in a continuous, uncongested flow upwardly into the path of movement of the rotating hammers.

It will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention.

I claim:

1. In a hammermill, a casing, a rotary hammer assembly in the casing with its axis of rotation horizontal, said hammer assembly providing pivoted, material comminuting hammers the free ends of which in hammer assembly rotation, move through a generally circular path, a material feed trough extending horizontally at the lower end of said casing, said trough including a conically constricted delivery end portion extending within the casing beneath said hammer assembly, said delivery end portion opening upwardly along and relatively closely adjacent the lowermost portion of said generally circular path of movement of the free ends of said hammers, a positive displacement screw conveyor extending longitudinally in said trough and providing a terminal end portion located in and conforming to the conical constriction of said delivery end portion of the trough, the upper end portion of said casing providing a chamber above the hammer assembly, a comminuting material discharge conduit opening to said chamber and a blower included in said conduit and operative to establish air flow entering the casing through said trough and passing upwardly about the hammer assembly and in said chamber to and through said discharge conduit, the air flow in passage about the hammer assembly and in said chamber, entraining therein hammer-comminuted material.

2. A hammermill of the character described, comprising a casing structure providing a hammer chamber and a comminuted material-receiving chamber thereabove, the casing having a discharge opening for said material-receiving chamber located near the upper end of the chamber, a rotary hammer assembly in the hammer chamber, a perforated wall between said chambers, a trough extending horizontally at one side of said casing structure near the bottom thereof and having a material-receiving opening in the top of the trough, said trough providing a conically constricted delivery end portion extending in the casing in the bottom thereof and centrally below said rotary hammer assembly, said trough end portion opening upwardly beneath the hammer assembly, a rotary screw conveyor extending longitudinally in said trough and having a tapering terminal end portion located in and conforming to the conical constriction of said delivery end portion of the trough, a material-breaker plate between said constricted delivery end portion of the trough and one end of said perforated wall,

and a blower having its suction input connected to said casing discharge opening, the blower drawing air through said trough and its said delivery end portion, to and upwardly through said hammer chamber and through said perforated wall into said comminuted material-receiving chamber, thence through said casing discharge opening to the blower suction input for discharge through the blower, the air flow thus established by the blower, entraining hammer-comminuted material for conveyance thereof from the hammer chamber through said perforated wall, said comminuted material-receiving chamber and said casing discharge opening, to the blower for discharge therefrom.

3. A hammermill of the character described, comprising a casing structure providing a hammer chamber, a rotary hammer assembly in said chamber with its axis of rotation horizontal, said casing providing a second chamber extending over the hammer chamber for receiving hammer-comminuted material, said casing providing a discharge opening at the upper end of said second chamber for the discharge of comminuted material from the second chamber, a perforated wall between said chambers, a trough extending horizontally from one side of said casing near the bottom thereof and having a material-receiving opening in the top of the trough, said trough providing a conically constricted material delivery end portion extending in the casing in the bottom thereof and centrally below said rotary hammer assembly toward the opposite side of the casing, said constricted end portion terminating beyond a plane vertically of said casing and containing the axis of said rotary hammer assembly, and opening upwardly over its length beneath the rotary hammer assembly, a rotary screw conveyor extending longitudinally in said trough and having a tapering terminal end portion located in and conforming to the conical constriction of said delivery end portion of the trough, a material-breaker plate between the terminal of said constricted end portion of the trough and one end of said perforated wall, and a blower having its suction input connected to said casing discharge opening, the blower drawing air through said trough and its said delivery end portion, to and upwardly through said hammer chamber and through said perforated wall into said second chamber, thence through said casing discharge opening to the blower suction input for discharge through the blower, the air flow thus established by the blower, entraining hammer-comminuted material for conveyance thereof from the hammer chamber through said perforated wall, said second chamber and said casing discharge opening, to the blower for discharge therefrom.

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