July 5, 1938. W. H. PRESTON 2,122,658

HAMMER MILL

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Fig. 1

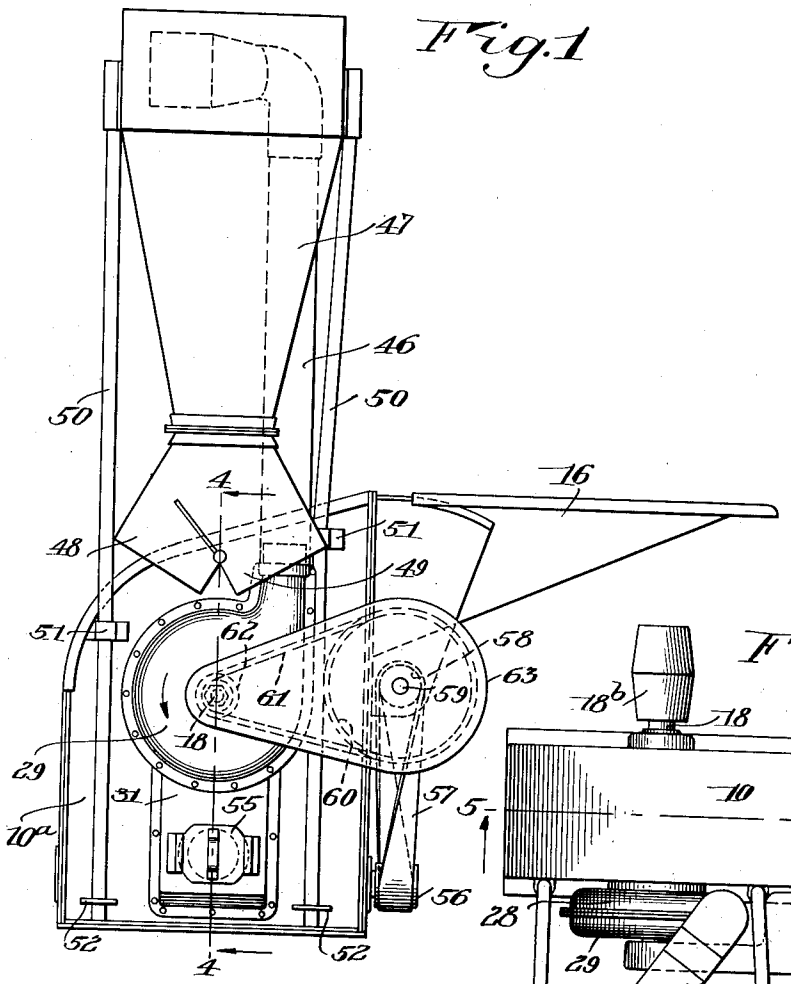


Fig. 2

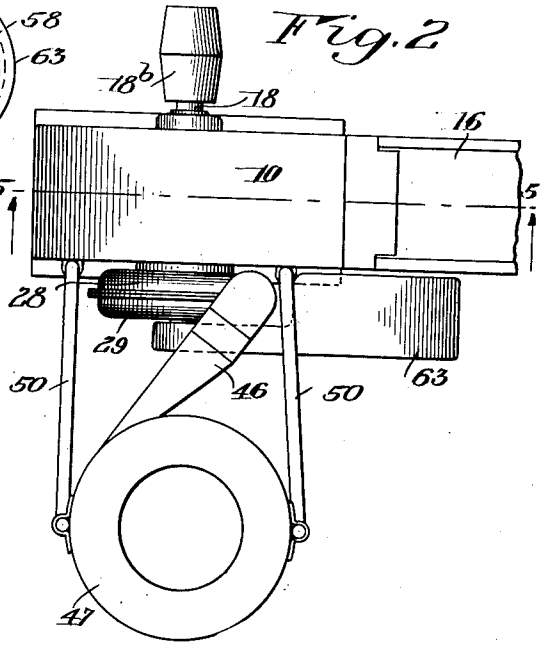
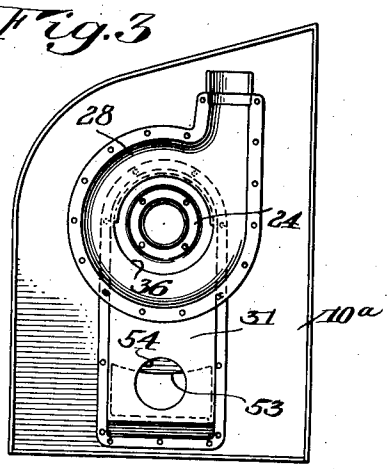


Fig. 3



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Fig. 4

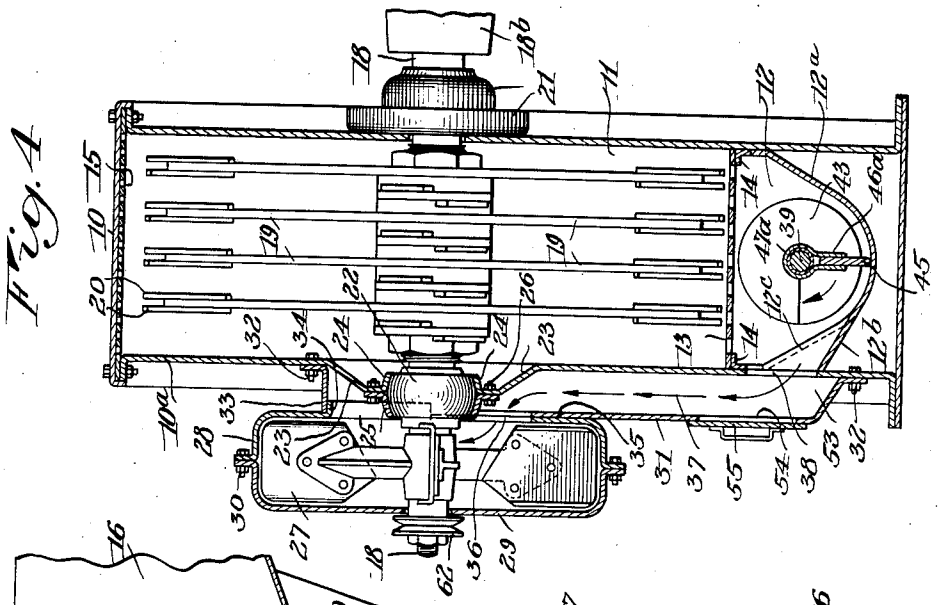
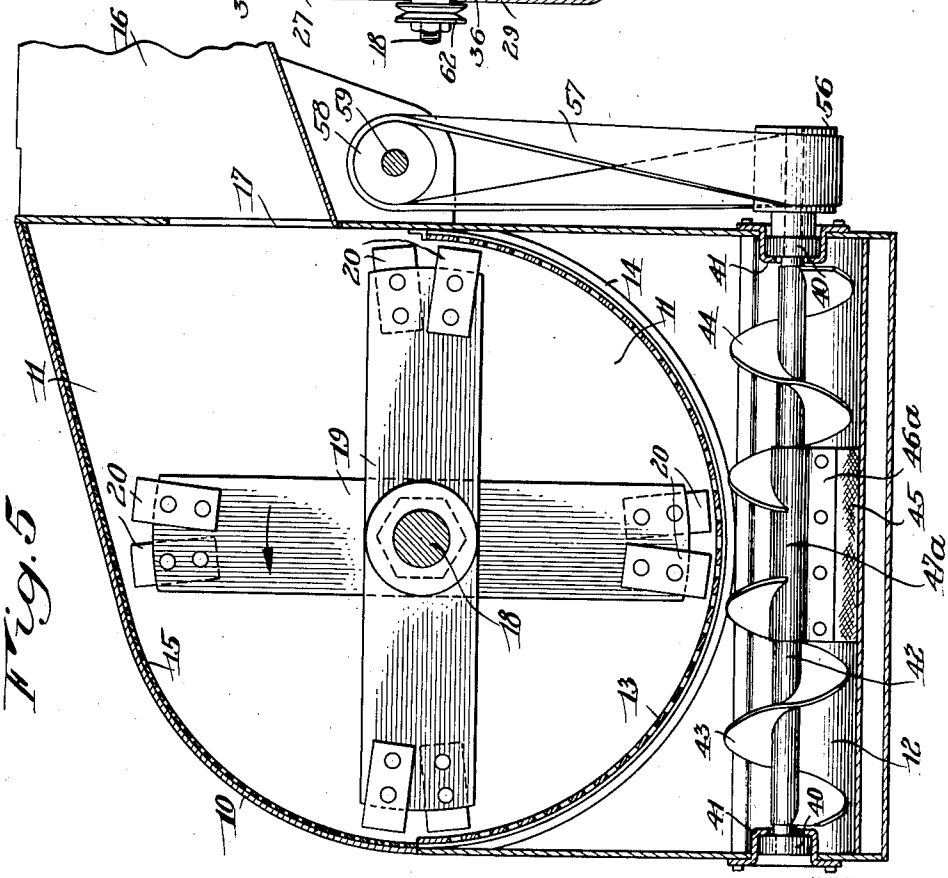


Fig. 5



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Fig. 6

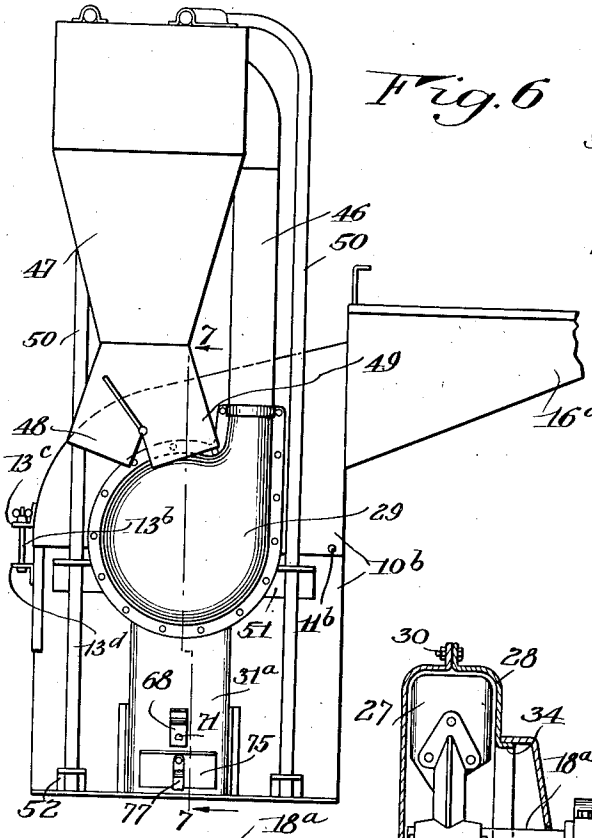


Fig. 12

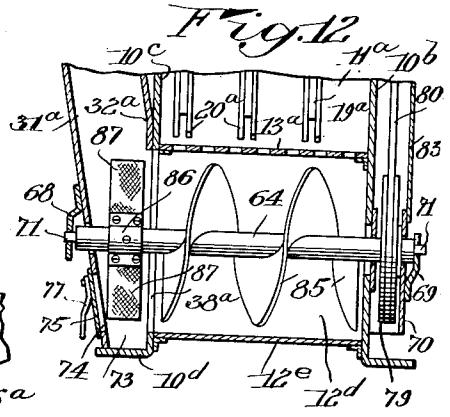


Fig. 7

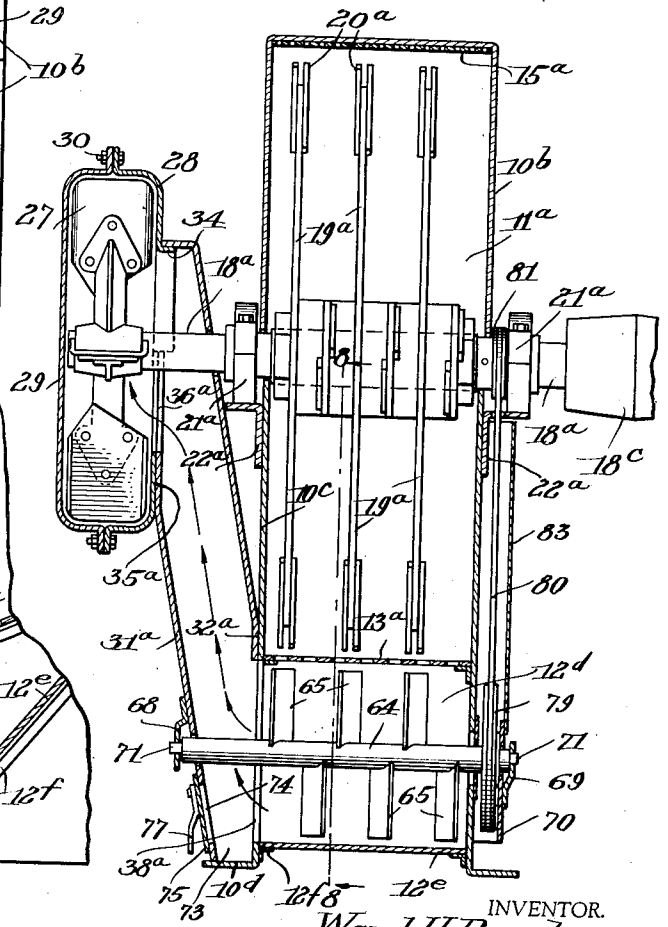
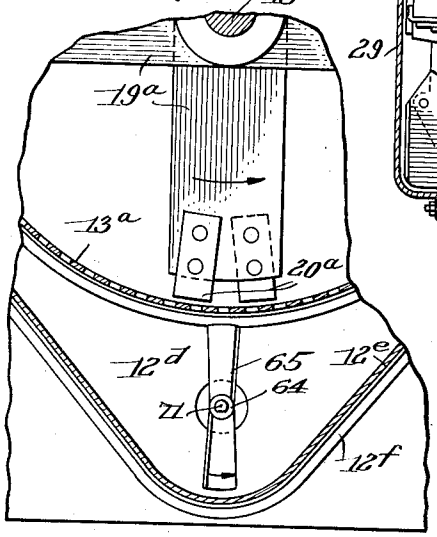


Fig. 8



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Fig. 10

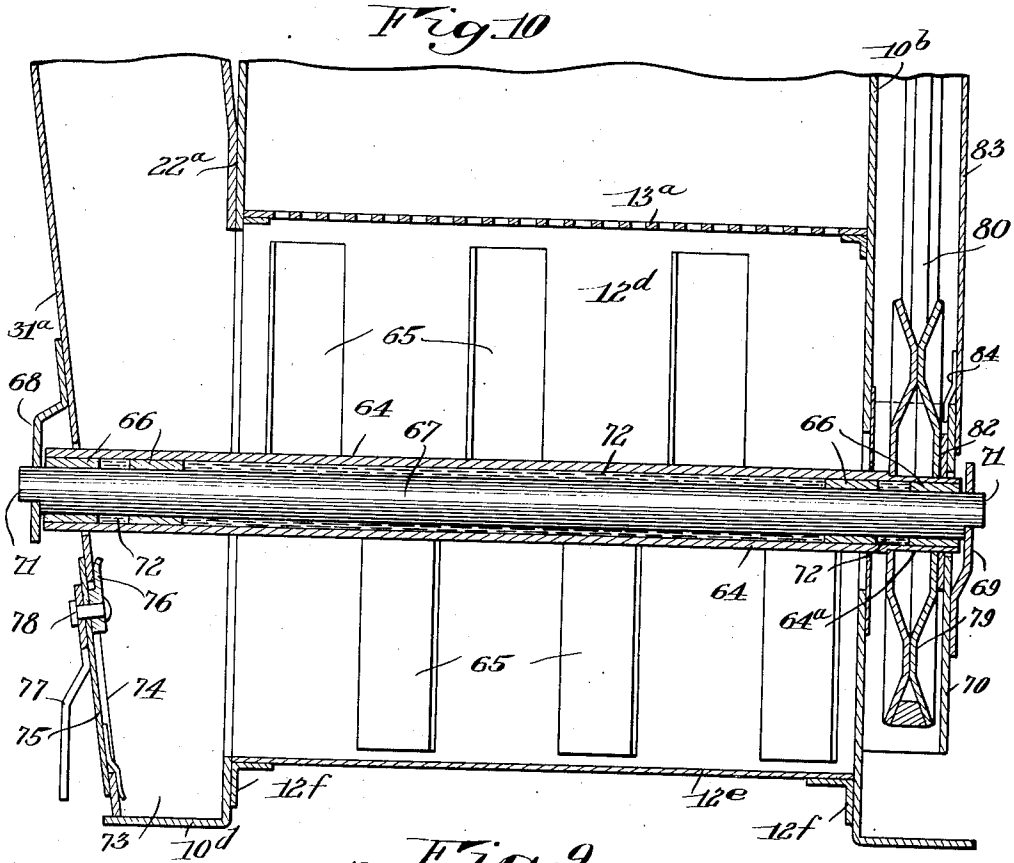


Fig. 9

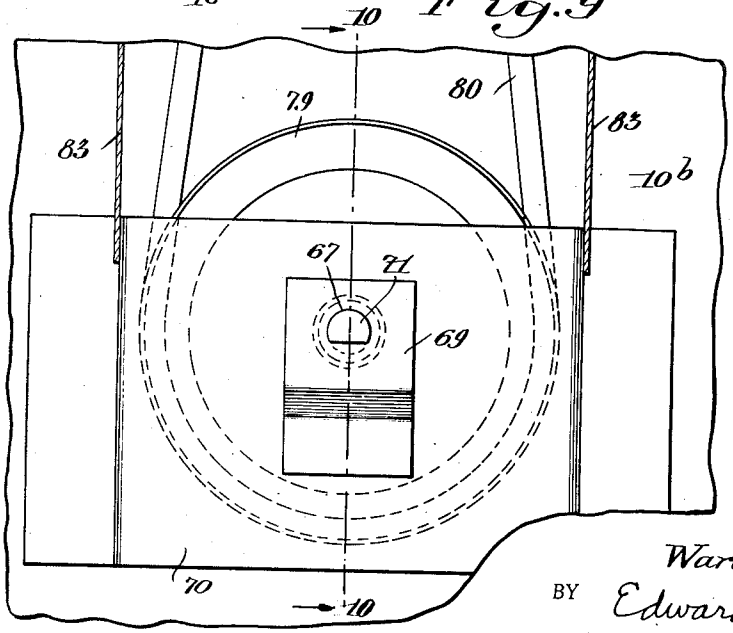
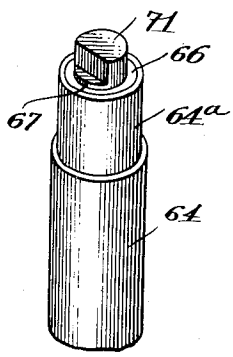


Fig. 11



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Patented July 5, 1938 2,122,658

UNITED STATES PATENT OFFICE

2,122,658

HAMMER MILL

Ward H. Preston, Shortsville, N. Y., assignor to Papec Machine Company, Shortsville, N. Y., a corporation of New York

Application February 17, 1936, Serial No. 64,231

6 Claims. (Cl. 83—11)

The present invention relates to hammer mills and has for its object to provide a compact and simplified machine of this type which can be operated at a relatively low cost.

A further object of the invention is to provide an improved machine for grinding different materials such, for example, as various kinds of cattle feed, the construction of the machine being such as to facilitate rapid and efficient handling of the feed and the grist or ground material, including improved means for conveying the grist from its point of discharge by the grinding means to its destination with a minimum degree of frictional resistance.

A further object of the invention is to provide an improved fan and exhaust pipe arrangement for the ground material in combination with improved means for discharging the material from the receiving chamber to the exhaust pipe in suspension to facilitate delivery of the same to its destination.

A further object of the invention is to provide in a machine of the present type, structural improvements by which to simplify and reduce the cost of constructing and operating the same and which also serve to increase its efficiency and reliability.

To these and other ends the invention resides in certain improvements and combinations of parts, all as will be hereinafter more fully described, the novel features being pointed out in the claims at the end of the specification.

In the drawings:

Fig. 1 is a side elevation of a machine embodying one form of the invention;

Fig. 2 is a plan view of the same with certain parts broken away;

Fig. 3 is a view in elevation of the lower portion of the machine shown in Fig. 1, with the outer section of the fan housing and other parts removed;

Fig. 4 is a transverse sectional elevation taken substantially on line 4—4 of Fig. 1;

Fig. 5 is a sectional elevation taken substantially on line 5—5 of Fig. 2;

Fig. 6 is a side elevation of a machine embodying a modified form of the invention;

Fig. 7 is a transverse section taken substantially on line 7—7 of Fig. 6, with the bag filling means omitted;

Fig. 8 is a fragmentary sectional elevation taken substantially on line 8—8 of Fig. 7;

Fig. 9 is a fragmentary part sectional view of the lower portion of the machine as viewed from the right of Fig. 7;

Fig. 10 is a fragmentary transverse sectional elevation taken substantially on line 10—10 of Fig. 9;

Fig. 11 is a perspective view of one end of the propeller supporting shaft and operating sleeve shown in Fig. 10, and

Fig. 12 is a fragmentary sectional elevation of a modification corresponding generally to the construction shown in Fig. 7, and having a worm type of propeller disposed within the grist receiving chamber and an agitator within the suction conduit extending from said chamber.

The same reference numerals throughout the several views indicate the same parts.

The present machine is designed to economically and efficiently grind or pulverize various kinds of material and to convey it to suitable receiving means therefor during continued operation of the machine. The machine embodies a new and novel arrangement of elements by which the grist is controlled and conveyed to its destination and also includes various structural improvements for accomplishing the desired results in an efficient and economical manner as described hereinafter.

Referring to the drawings, the mill housing 10 forms a grinding chamber 11 beneath which is a lower chamber 12 into which the grist or pulverized material is discharged, said lower chamber being formed between the side walls of the housing by a channel-shaped member 12a. The lower wall of the chamber 11 comprises a substantially semi-circular separating screen 13 of any suitable mesh through which the ground material discharges to the receiving chamber 12, said screen being suitably supported as, for example, by the curved angle bars 14 secured on the side walls of the housing, Figs. 4 and 5, by any preferred means.

In the upper portion of the housing is disposed a curved retarding screen 15 of any suitable design and which holds the feed in the top of the housing until ground. The feed or other material to be ground or pulverized is placed in a chute 16 and discharged therefrom into the grinding chamber 11 through an opening 17 in the wall of the housing 10.

The grinding means is supported by a main shaft 18 extending transversely through the side walls of the housing and provided with a driving pulley 18b, said shaft having thereon a suitable number of hammers comprising the arms or plates 19, which may or may not include the reversible grinding tips 20 on the opposite ends of the arms. In other words, the hammers may

each be of a one-piece construction. However, where it is found desirable to use the removable tips they may be applied as shown or mounted loosely on or between the blades so as to be held by centrifugal force in a radial or tangential line from the blade-supporting shaft during operation thereof. The hammers when driven at high speed strike and grind or pulverize the material as it is fed to the screen from the chute through the opening 17. The pulverized material is discharged through the screen 13 to the receiving and collection chamber 12 from which it is discharged by means described hereinafter.

The hammer operating shaft 18 is carried by suitable bearings mounted within the casings or enclosures 21 and 22, Fig. 4, suitably secured upon the side walls of the main housing 10 of the machine. For supporting the bearing casing 22 the side wall 10a of the housing is provided with outwardly offset portions 23 which are bent inwardly at 24 to receive the casing 22, which is held in position by a flanged ring 25 detachably connected with the offset wall portions 23 by means of the bolts 26.

A centrifugal blower or suction fan 27 is fixed on the hammer operating shaft 18, the rotary element of the fan being enclosed within a suitable casing or housing comprising the inner and outer sections 28 and 29 which are flanged to receive the bolts 30 by which the outer section is detachably connected with the inner section. The inner section of the fan housing is connected with and supported by a channel-shaped conduit 31 secured upon the wall 10a of the main housing 10 by bolts 32, Fig. 4. The upper end of the channel member has an outwardly bent portion 33 of U-shaped construction within which extends a correspondingly shaped outwardly bent portion 34 on the inner section 28 of the fan housing, said U-shaped portions being preferably connected one with another by spot welding. The lower portion of the fan housing section 28 is also connected with the channel member 31 by spot welding, preferably at or adjacent the point 35, Fig. 4.

The adjacent walls of the channel member 31 and the inner section 28 of the fan housing are cut away to form an opening 36 by which to establish communication between the fan housing and the flue or conduit 37 formed through cooperation of the channel member and the side wall 10a of the housing and into which the grist or ground material is discharged from the chamber 12 through an opening 38 in the wall 10a of the housing by means described hereinafter.

The grist receiving chamber 12 extends beneath the screen 13 and transversely of the axis of the hammer operating shaft 18, the outlet 38 being located preferably at a point between the ends of the chamber. A shaft 39 is extended longitudinally through the grist receiving chamber 12 and has its opposite ends journaled in bearings 40 supported by the recessed or cup-shaped members 41 carried by opposite walls of the housing 10 as shown in Fig. 5. The shaft has fixed thereon a sleeve 42 provided with spiral screw propeller blades 43 and 44 of opposite pitch which serve to positively feed the grist accumulating within the ends of the chamber to a point opposite the outlet 38 through which the grist is fed and discharged upwardly into the flue 37 by the revolving blade 45 on the shaft 39, which not only ejects the grist well into the flue but forces air therein under pressure sufficient to hold it in suspension whereby it may be more readily exhausted from the flue by the operation of the fan. The blade is preferably secured between the laterally extending portions 46a of a collar 47a suitably secured upon the screw carrying sleeve 42, Figs. 4 and 5.

The channel 12a is provided with a depressed portion 12b opposite the outlet 38 of the chamber 12, said depressed portion having side walls 12c between which the grist or ground material accumulating within said chamber is fed by the propellers 43 and 44 for ejection by the revolving blade 45 as stated above. The grist after entering the fan housing is discharged by the fan through the pipe 46 to the hopper 47, the latter having oppositely disposed bag receiving extensions 48 and 49 the outlets of which are controlled by a suitable valve, not shown. The hopper is supported by the vertically disposed rods 50, the upper ends of which are bent outwardly and suitably connected with the hopper. The rods are attached to the housing 10 by suitable upper and lower brackets 51 and 52, respectively, Fig. 1.

The flue 37 through which the grist is conveyed to the fan housing is provided at its lower end with a pocket 53 for the collection of any relatively heavy material or objects that may enter the grist chamber 12 and be discharged into the flue from time to time, the removal of such objects from said pocket being effected when desired through an opening 54 in the wall of the flue which is normally closed by a removable door 55.

It has heretofore been proposed to connect the grist receiving chamber in the bottom of the housing for the grinding means with a fan or blower by a relatively long bent or curved pipe projecting a considerable distance from the housing. This form of construction has been found to be extremely objectionable for the reason that it not only interferes with the movements of those in charge of the machine and is likely to become bent or displaced, but also for the reason that its increased length and curvature greatly increases the frictional resistance offered to the passage of the grist therethrough. These disadvantages have been overcome in the present machine by extending the flue or conduit upwardly between the housing for the grinding means and the fan on the hammer shaft so that a relatively short and substantially straight passage is afforded between the fan housing and the outlet 38 of the grist receiving chamber 12, as shown in Fig. 4, and also in the modification shown in Fig. 7, thus considerably reducing the extent of the frictional resistance offered to the passage of the grist to the fan as well as avoiding the use of a pipe or conduit protruding or projecting outwardly beyond the fan housing.

The propeller shaft 39 is provided with a pulley 56 driven by a belt 57 on a pulley 58 carried by a shaft 59 located outside of the housing 10 and paralleling the hammer shaft 18. The shaft 59 is provided with a pulley 60 driven by a belt 61 operated by a pulley 62 on the hammer shaft 18, Figs. 1 and 5. A guard 63 is provided for the belt and the pulleys 60 and 62, as shown in Figs. 1 and 2.

The modification shown in Figs. 6, 7, and 8 is generally similar to that shown in Figs. 1 to 5, inclusive, except for the construction of the propeller in the grist receiving chamber beneath the grinding chamber, and certain other forms of the construction which have been slightly modified. The housing 10b of the modified form of the in-

vention preferably comprises upper and lower sections which form the grinding chamber 11a and the grist receiving chamber 12d therebeneath. The lower wall of the chamber 11a comprises a substantially semi-circular screen 13a of any suitable mesh through which the grist or ground material discharges to the chamber 12d, the latter having a bottom wall 12e, the opposite ends of which are inclined to the horizontal, as shown in Fig. 8, so as to discharge the grist received thereby to the bottom of the chamber for ejection therefrom by means described hereinafter. Within the upper section of the housing is disposed a curved retarding screen 15a similar to the screen 15 of Figs. 4 and 5, and provided for the same purpose.

The grinding means is supported by a main shaft 18a having an operating pulley 18c thereon, the shaft extending transversely through the housing and having a suitable number of hammers thereon including the arms 19a and the edgewise projecting steel grinding tips 20a which operate to grind and pulverize the material as it is fed to the upper portion of the chamber 11a through a chute 16a, suitably connected with the upper section of the housing. The chute and upper housing section constitute a unit which is pivotally connected with the lower section of the housing at 11b so that said unit may be swung to a position at which the hammers may be rendered accessible for repair and reversal of the tips. However, the hinged upper section of the housing is normally held in closed position by a clamping bolt 13b, the opposite ends of which are connected with the brackets 13c and 13d of the upper and lower housing sections, respectively, as shown in Fig. 6.

The hammer operating shaft 18a is carried by suitable bearings 21a supported by brackets 22a fixed on the walls of the housing 10b, preferably by spot welding.

The suction fan or centrifugal blower is mounted on the shaft 18a, the several parts of the fan corresponding to those shown in Fig. 4, and have therefore been given the same reference characters. The inner section 28 of the fan housing is connected with and supported by a conduit or channel 31a which has at its upper end a part formed to fit the U-shaped portion 34 of the inner section of the fan housing and with which it is suitably connected by spot welding, or otherwise, as preferred.

The lower portion of the conduit 31a is connected with the wall 10c of the hammer housing at 32a, by spot welding or otherwise. The outer wall of the conduit has its lower end resting upon a flange 10d of the housing and may be secured thereto by any suitable means, said outer wall being also suitably connected at 35a with the fan housing section 28.

The adjacent walls of the conduit 31a and the inner section of the fan housing are cut away to afford an opening 36a for the passage of the grist from the conduit to the interior of the fan housing, the lower end of the conduit being also cut away to form an inlet for receiving the grist discharging from the chamber 12d through the outlet 38a of said chamber.

The means for ejecting the grist from the chamber 12d into the conduit 31a is in the form of a propeller which includes a rotatably mounted sleeve 64 paralleling the hammer shaft 18a and having a series of spaced blades 65 for feeding the grist from the chamber 12d through the outlet 38a into the flue or conduit 31a. The blades are inclined relative to the axis of the sleeve and serve to feed the grist from the chamber 12d, but at the same time allowing slippage when the blower is operating slowly either during starting or stopping or in cases where the flow of the material through the flue may for any reason be interrupted.

The sleeve is provided with spaced bearings 66 at its opposite ends which are rotatably mounted on a shaft 67 supported at one end by a bracket 68 on the conduit 31a and at its opposite end by a similar bracket 69 carried by a channel-shaped support 70 suitably connected with the wall of the housing 10b. The opposite ends of the shaft are cut away to form substantially semi-circular supporting parts 71 which are positioned in correspondingly shaped openings formed in the brackets 68 and 69 whereby the shaft is held against turning.

The space between the shaft and the sleeve 64 is preferably filled with a suitable lubricant, such as oil or grease, indicated at 72 whereby to lubricate the bearings 66 of the sleeve, said bearings serving to seal the ends of the sleeve and to prevent escape of the lubrication therefrom.

The conduit 31a is provided at its lower end with a pocket 73 for receiving any relatively heavy materials or objects which may be discharged to the grist receiving chamber 12d and be fed therefrom by the propeller blades 65 into said conduit. Removal of such objects from the pocket can readily be effected from time to time through an opening 74 in the outer wall of the conduit which is normally closed by a removable door 75 having a latch 76 rotatable to and from locking engagement with the wall of the conduit by a handle 77 rigidly connected with a supporting pivot member 78 for the latch which extends through the door as shown in Fig. 10.

The grist or ground material fed to the conduit 31a from the receiving chamber 12d by rotation of the propeller blades therein is sucked up through the conduit into the fan housing by rotation of the fan within the housing. The grist is discharged by the fan through the pipe 46 to the hopper 47 for alternate discharge to the feed bags through the extensions 48 and 49 of the hopper as described above in connection with Figs. 1 and 2 of the drawings. The discharge pipe 46, hopper 47, and its outlet extensions and the supporting means for the hopper being the same in Fig. 6 as in Fig. 1, have been given the same reference characters.

The driving means for the propeller sleeve 64 comprises a pulley 79 secured to the reduced end 64a of the sleeve and driven by a belt 80 which in turn is driven by a pulley 81 on the hammer shaft 18a, as shown in Fig. 7. The sleeve 64 is provided with a thrust bearing 82 interposed between the pulley 79 and the bracket supporting member 70 as shown in Fig. 10. The belt 80 is protected by a shield or cover plate 83 which forms a continuation of the channel-shaped bracket support 70, the lower edge of the cover plate having one or more inwardly offset parts 84 engaging the rear face of the support 70 to maintain the cover in position thereon.

In the operation of the modification shown in Figs. 1 to 5, inclusive, the feed, such as grain and various kinds of roughage, is discharged to the grinding chamber by the chute 16 and is driven against the retarding screen 15 and ground by the rotating hammers. The grist is discharged through the separating screen 13 into the elongated chamber 12 extending transversely of the

hammer shaft. The oppositely pitched screw propellers **43** and **44** serve as means for feeding the grist or ground material from the ends of said chamber to a point opposite the outlet **38**, through which the material is discharged into the conduit **37** by the rotating blade **45** which acts as a means for propelling the material into said conduit and for producing pressure therein to hold the material in suspension whereby exhaustion of the material from the conduit by the fan is greatly facilitated. The fan operates to discharge the grist through the outlet pipe **46** to the hopper or separator **47** for delivery to suitable receiving means such, for example, as a plurality of feed bags which can be readily attached to the outlet extensions **48** and **49** of the hopper by suitable means, not shown.

In the modification shown in Figs. 6, 7, and 8, the operation is substantially the same as that shown in Figs. 1 to 5, inclusive, except that the grist receiving chamber *12d* parallels the hammer shaft, and the revolving blades **65** within said chamber allow slippage when the blower is operating slowly during starting or stopping. In each modification any relatively heavy materials or objects discharged from the grist receiving chamber will accumulate within the pocket formed at the bottom of the exhaust conduit and can be removed from said pocket through the door thereof from time to time.

In the modification shown in Fig. 12 the various parts of the machine will be the same as those shown in Figs. 6 to 11, inclusive, with the exception of the propeller for discharging the grist or ground material from the receiving chamber *12d* into the conduit *31a*, and the means for agitating and forcing the material upwardly within the conduit. Consequently the parts of Fig. 12, which are the same as those for example of Fig. 7, are designated by the same reference characters.

In Fig. 12 the rotary sleeve **64** and the pulley and belt for driving the same are mounted and supported as in Figs. 7 and 10, but instead of employing the spaced blades **65** to discharge the grist from the chamber *12d*, a worm **85** is employed for this purpose which may be secured on the sleeve by any suitable means. It will be understood that the worm type of propeller shown in Fig. 12 is particularly adapted for use where it is desired to grind wet materials of various kinds such for example as wet fodder, hay, and the like, it being more difficult to effect discharge of the material in this condition than when dry. The worm propeller will, of course, insure a more positive feed of the wet material from the grist receiving chamber into the bottom of the conduit *31a* than the spaced blades shown in Fig. 7. Furthermore, withdrawal of the wet material from the conduit *31a* by suction produced by the operation of the fan cannot be effected as readily as in the case of dry material, in view of which fact an agitator or impeller has been mounted on the rotary sleeve **64** within the conduit *31a* comprising a hub-like portion **86** suitably secured on said sleeve and having oppositely extending blades **87** which serve to force the ground material upwardly within the conduit with a tendency to maintain it in suspension therein to facilitate its withdrawal therefrom by the fan.

It will be understood that the operation of the impeller within the conduit will not interfere with the accumulation of the relatively heavy material or objects within the pocket **73** at the bottom of the conduit. It will be further understood that in the modification shown in Fig. 12 that the unit comprising the pulley **79**, sleeve **64**, shaft **67**, and associated parts, will be constructed, mounted, and operated in the same manner as the corresponding parts of Fig. 10, and that such units, with the worm propeller **85** and agitator **86**, **87** thereon can be kept on hand and substituted for the grist propelling type of unit shown in Figs. 7 and 10 when desired.

It will be understood that the machine of the present invention is adapted for grinding various other materials not specifically mentioned herein, in a highly satisfactory and economical manner.

One of the several advantages of the present invention is the vertical and direct conduit connection between the grist receiving chamber and the fan housing, which permits the ground material to be lifted by the fan with much greater ease than has previously been possible with the circuitous pipe construction heretofore used for the same purpose in machines of this type. In other words, the cost of operation is considerably reduced by greatly reducing the power required to operate the fan.

I claim:

1. In a grinding machine, a housing forming a grinding chamber, grinding means within said chamber, an operating shaft for the grinding means extending from the housing at one side thereof, a receiving chamber for the ground material communicating with the grinding chamber and having an outlet intermediate its ends, a fan on said shaft, a substantially vertical conduit extending between a wall of the housing and the fan and connecting said outlet with the fan housing, means rotatable within said receiving chamber about an axis transverse to the axis of said shaft and operable to advance the ground material from the ends of the chamber to and through said outlet into said conduit, said fan operating to exhaust the ground material from said conduit, said conduit being extended below the outlet of said receiving chamber and forming a pocket for the reception of the relatively heavy particles discharging from the chamber into the conduit, said conduit being provided with an opening in its lower end adjacent said pocket and having a closure therefor, and driving means for said last mentioned means.

2. In a grinding machine, a housing having a grinding chamber, grinding means within said chamber, an operating shaft for the grinding means extending from the housing at one side thereof, a centrifugal blower on said shaft, an elongated receiving chamber for the ground material disposed beneath said grinding chamber, said receiving chamber having an outlet intermediate its ends, a conduit extending upwardly adjacent a wall of the housing and forming a connecting passage between the fan and said outlet, a rotary element within said receiving chamber extending transversely of said operating shaft and including means for advancing the ground material from the ends of said receiving chamber toward said outlet, means associated with said rotary element for discharging the ground material through said outlet into said conduit, and driving means for a rotary element.

3. In a grinding machine, a housing having a grinding chamber, grinding means within said chamber including a rotary element, an operating shaft for the rotary element extending from the housing at one side thereof, a fan on said

shaft including a casing spaced from the housing, a receiving chamber for the ground material disposed beneath said grinding chamber and having an outlet disposed substantially midway between its ends, a conduit extending upwardly from the receiving chamber between the casing and the housing and discharging to said casing through the inner wall thereof, and means within the receiving chamber for discharging the ground material therefrom into said conduit, said means including parts for moving the material from the opposite ends of said chamber toward said outlet.

4. In a grinding machine, a housing having a grinding chamber, grinding means rotatable within said chamber and provided with driving means, a receiving chamber for the ground material disposed below and communicating with the grinding chamber and having an outlet intermediate its ends, means rotatable within said chamber about an axis substantially at right angles to the axis of rotation of said driving means and operable to move the ground material from the ends of said chamber to and through said outlet, a fan connected with said driving means for operation thereby and including a casing spaced from the housing, means extending between the housing and said casing and forming supporting means for the latter, and a substantially straight discharge conduit for the ground material extending from said outlet upwardly between the housing and the fan casing and forming additional supporting means for the latter.

5. In a grinding machine, a housing having a grinding chamber, grinding means within said chamber provided with driving means, a receiving chamber for the ground material disposed below and communicating with the grinding chamber and having an outlet intermediate its ends, a rotary element within said receiving chamber having spaced helical members thereon for advancing the ground material from the ends of said receiving chamber toward said outlet, said rotary element also having a radial blade substantially parallel to the axis of said rotary element and extending between said helical members and opposite said outlet for discharging the ground material therethrough, a fan at one side of said housing including a casing, said fan being connected with said driving means for operation thereby, and a conduit extending between said casing and said outlet and forming a substantially straight discharge passage between the outlet and said casing.

6. In a grinding machine, a housing having a grinding chamber, grinding means within said chamber provided with a driving element, a receiving chamber for the ground material disposed below and communicating with said grinding chamber and having an outlet intermediate its ends, a fan spaced from said housing and connected with said driving element for operation thereby, a substantially straight discharge conduit extending from a point below said outlet upwardly between the housing and the fan and forming a support for the latter, an impeller within the receiving chamber for moving the ground material from the ends thereof to and through the outlet into said conduit, means within said conduit adjacent the lower end thereof for elevating the ground material within the conduit, said means being connected with the impeller for operation thereby, the lower end of said conduit forming a pocket for the reception of relatively heavy particles discharging from said chamber into the conduit, said conduit having an outlet adjacent said pocket, and a removable closure for said outlet.

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