

[54] **FEED MILL AND MIXER**

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[51] Int. Cl. **B02c 13/288**

[58] Field of Search 241/34, 35, 48, 56, 63, 241/87.1, 101 B, 101.5, 101.6, 154, 186 R, 189 R, 243

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[57] **ABSTRACT**

An improved hammer mill and mixer combination employing a positive ventilation system which reduces pressure on the outlet side of the hammer mill to increase inflow thereto with improved hammer and knife configuration within the hammer mill together with a separating screen at the outlet side thereof for more efficient shredding of material at the hammer mill. The mixer and mill includes an improved shredder knife configuration and a drive for the input table of the same to prevent overloading of the hammer mill.

23 Claims, 8 Drawing Figures

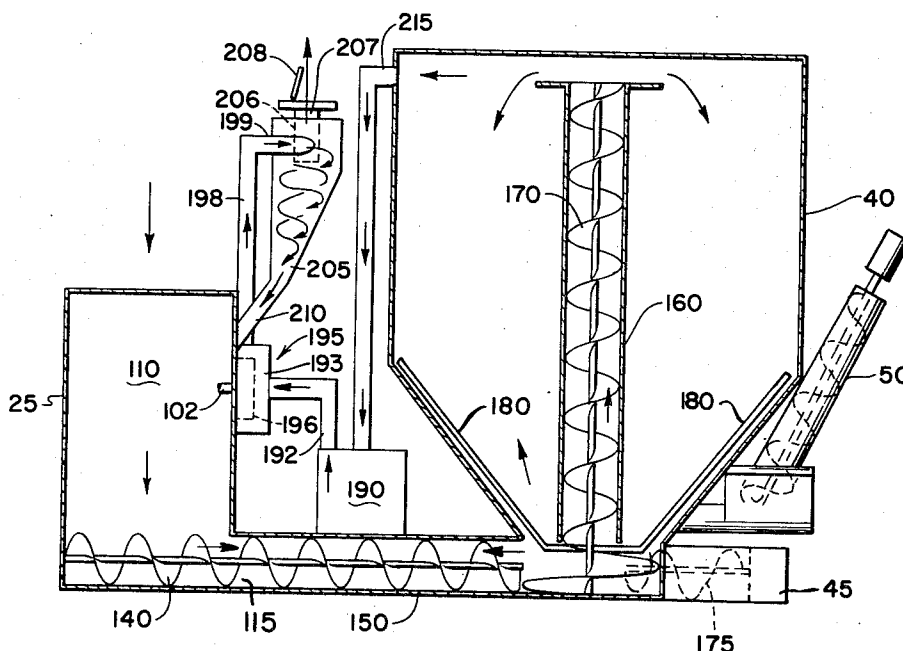


Fig. 1

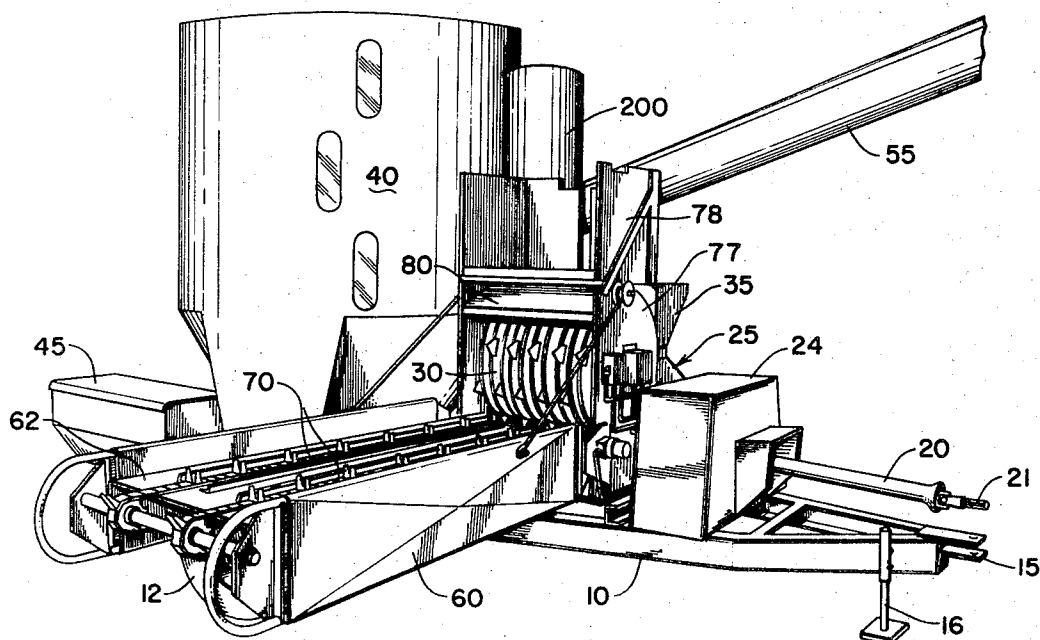


Fig. 2

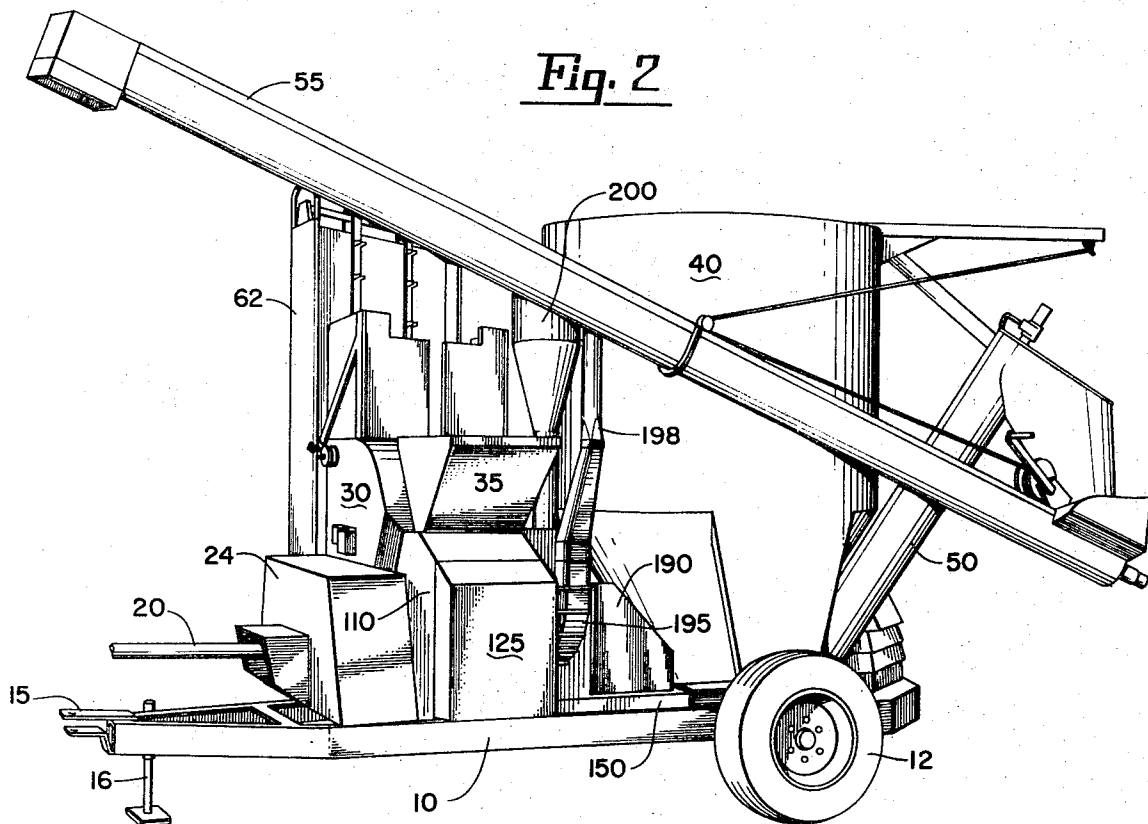


Fig. 3

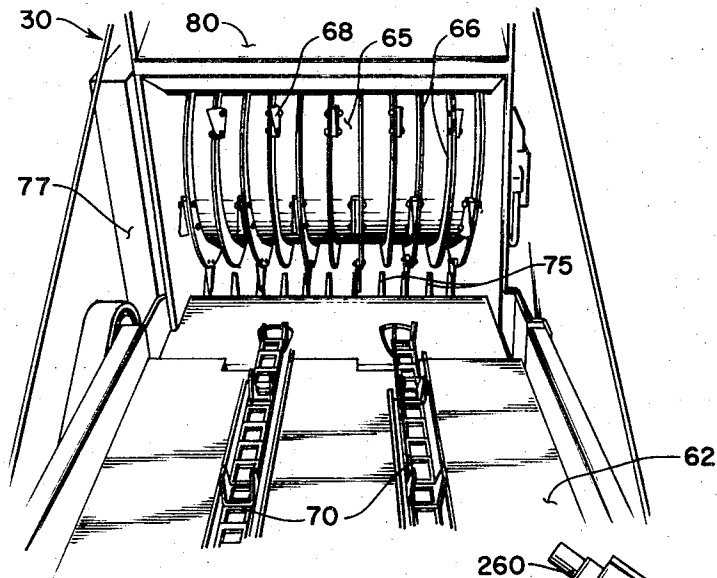


Fig. 4

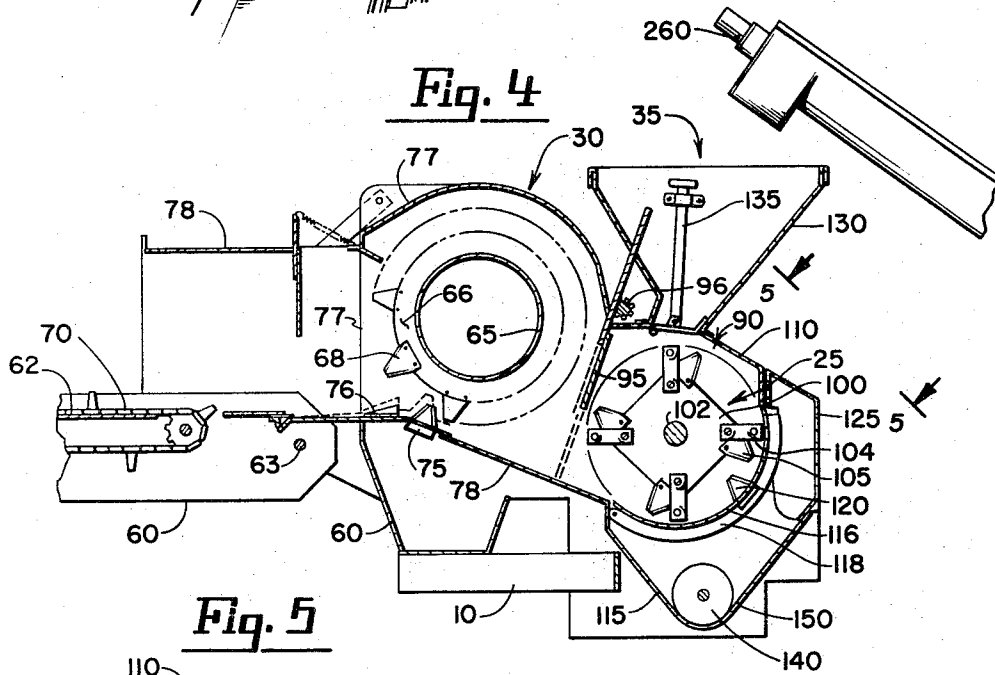


Fig. 5

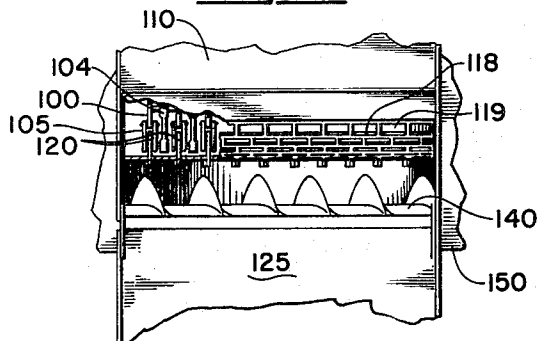


Fig. 6

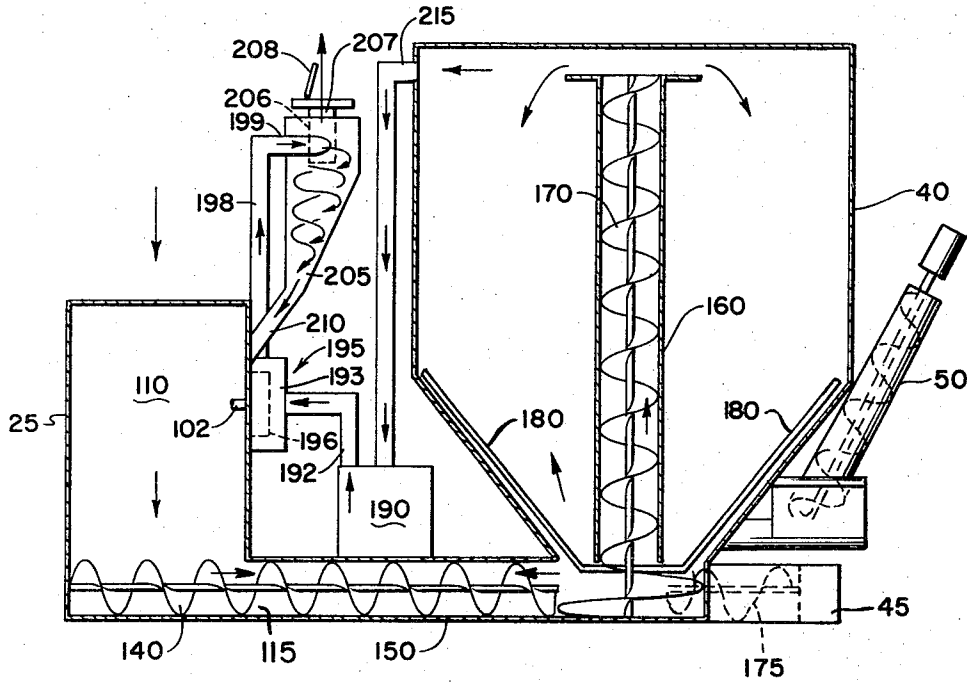


Fig. 7

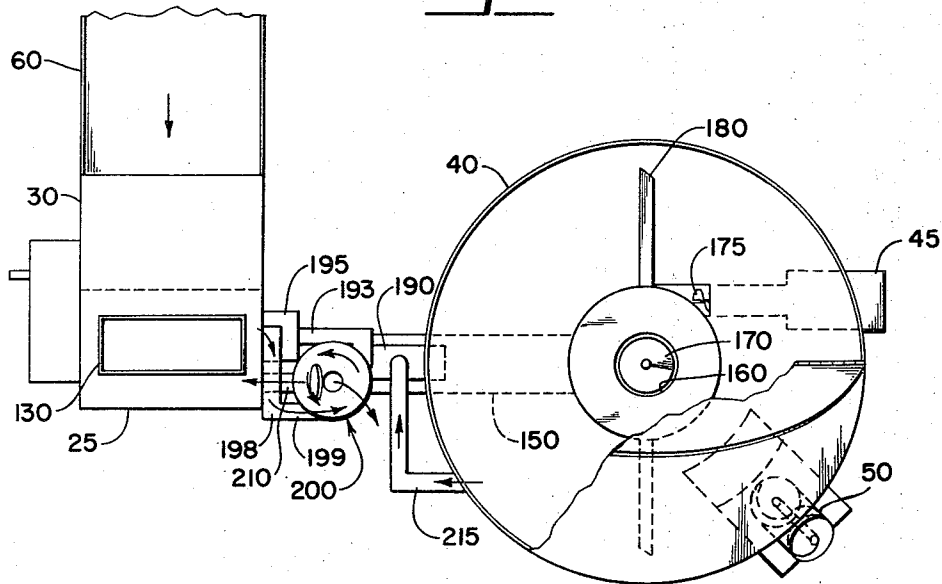
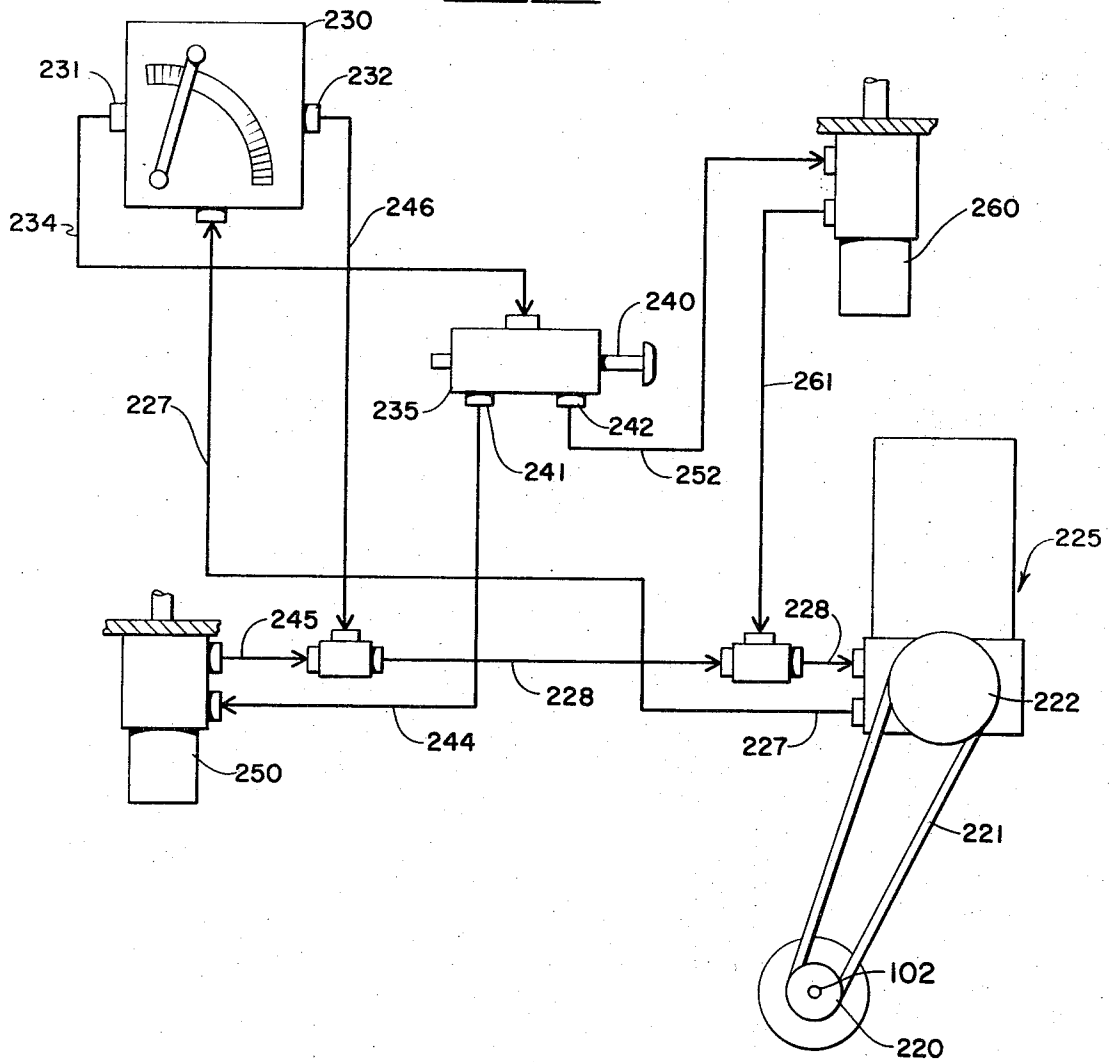


Fig. 8



FEED MILL AND MIXER

This invention relates generally to improvements to feed mills and mixers of the type commonly used in the preparation of animal feed and the like and more particularly to improvements in the construction and an operation of the parts of the same including a shredder attachment, the hammer mill and the conveying means for conveying material through the hammer mill and to a mixing chamber.

Feed mills of this type which include various infeed stations together with a hammer mill for shredding materials, introducing materials including shredded material to the hammer mill and conveying the same to a mixing tank wherein it can be combined with other feeds and suitably mixed before removal of the same through an auger type transport to a place of usage are generally old and in use. In the mixer mill and shredder combination it is known to combine with the shredder and the hammer mill, a blower and centrifugal type separator for either transporting material from the hammer mill to the mixing tank wherein it is lifted by an auger and mixed with additional materials through a mixing arm and dispensed through an unloader. It is also known to utilize a direct conveying system from a hammer mill to the mixing tank with a parallel passage taking airborne material from the interior of the hammer mill through a blower and cyclone separator and depositing such materials either directly to the mixing tank or to the conveying apparatus so that the solids removed from the hammer mill are included in the material mixed in the tank. In both instances, the efficiency of the hammer mill is dependent upon the capability of mill to receive materials in the hammer section for shredding and the ability to remove shredded and chopped material at a rate proportional to the input so that it could be efficiently conveyed to the mixing chamber or mixing tank for mixing therein with other feeds or materials introduced to the tank. Plugging in the hammer mill and relatively slow transfer of material through the hammer mill to the conveying system have limited the capacity of existing systems and increased the work in operating and maintenance of the same.

The present invention is directed to an improved feed mill and mixer combination which improves the efficiency of the feed mill and mixer by providing for an increased capacity of feed materials introduced thereto and mixed therein due to an improved ventilation system included in the hammer mill and conveying structure. The improved system creates greater transfer of material, a smaller creation of dust to be discharged from the mill through its operation, an effective collection of material from the hammer mill to insure against loss of valuable feed therefrom, and an improved operation in the hammer mill to efficiently shred various types of feed materials and chop but not pulverize the same for more efficient feeding purposes. In the improved feed mill and mixer combination, the hammer mill was provided with an improved knife arrangement along with the pivoted hammers to effectively chop material therein and the inlet shredder thereto is provided with an improved knife arrangement to effectively shred and feed material to the hammer mill for the greatest efficiency without plugging. An auger is positioned in the outlet of the hammer mill as the conveying system and an improved ventilation system is provided which creates a low pressure area in the outlet side of the hammer mill causing an introduction of

greater amount of air in the inlet side of the hammer mill and hence a greater introduction of material thereto. The ventilation system includes a blower driven in conjunction with the hammer mill and forcing material laden air through a cyclone separator with a discharge of the separated material back to the interior of the hammer mill at a low pressure point therein to provide for a uniform airflow system which will increase the airflow through the inlet to the hammer mill and effectively aid the transfer of the material therefrom to the mixing tank. A suitable screen structure with knives thereon cooperate with the knives on the hammer mill to effectively shred and not pulverize the material to improve the efficiency of the hammer mill structure. A suitable vent connected to the mixing tank and through to the ventilating system equalizes pressure in the closed mixing tank to which material from the hammer mill is conveyed by auger with the hammer mill and the mixing tank having alternate or auxiliary auger driven inlet passages for the introduction of auxiliary materials or additional materials either to the hammer mill or to the mixing tank for effective mixing or a change over in the type of material being chopped and mixed. The hammer mill may be selectively fed from a separate auxiliary feed or a shredder with the separating gate to isolate one or the other together with a separate drive which is tied to the operation of the hammer mill so that overloading of the hammer mill will effectively slow down the infeed to prevent plugging of the hammer mill. This is accomplished by providing a separate hydraulic drive through a centrifugal clutch corresponding to the operation of the hammer mill to provide for operation of hydraulic motors operating either an auxiliary auger feed or the shredder to insure proportional inflow to the hammer mill in accord with the rotational operation of the same.

It is therefore, the principle object of this invention to provide an improved feed mill and mixer combination.

Another object of this invention is to provide in an improved feed mill and mixer combination, provisions for a larger capacity of processing of material in the feed mill through the use of improved hammer mill construction and ventilation system for controlling the inlet to the same.

Another object of this invention is to provide an improved hammer mill configuration including chopping knives thereon in addition to the hammers, the chopping knives cooperating with fixed knives on the outlet of the hammer mill in the event that solid materials are not to be sufficiently shredded by the hammers.

A further object of this invention is to provide in an improved feed mill and mixer combination a ventilation system which employs a partial vacuum at the outlet of the hammer mill to increase airflow and hence material flow into the hammer mill with the vacuum having means for ventilating the air drawn therefrom with provisions for separating any entrained material in the air and returning the same to the hammer mill.

A still further object of this invention is to provide in an improved feed mill and mixing combination, an improved hammer mill construction employing a knife and screen structure in the outlet of the hammer for better shredding of material without pulverizing the same.

A still further object of this invention is to provide an improved combination of a blower and centrifugal sep-

arator which increases the airflow efficiency through the hammer mill and to the conveying system without loss of material being processed and fed to the mixing chamber minimizing dust outlet therefrom.

Another object of this invention is to provide an improved shredder attachment for a feed mill mixer combination in which the shredder and/or auxiliary feed is driven in conjunction with and in proportion to the speed of the hammer mill to insure uniform flow of material therethrough.

A still further object of this invention is to provide in an improved feed mill and mixer combination, a hydraulic drive controlled from a centrifugal clutch operating from the hammer mill drive and controlling a hydraulic system to provide for proportional control to a shredder or auxiliary infeed drive to the hammer mill to insure uniform flow of material thereto with operation of the hammer mill.

These and other objects of this invention will become apparent from reading the attached description together with the drawings wherein:

FIG. 1 is a perspective view of a portable feed mill and mixer showing one input side of the same, namely a shredder attachment;

FIG. 2 is a perspective view of a portable feed mill and mixer of FIG. 1 from the opposite side of the same and including the material discharged auger from removing materials therefrom;

FIG. 3 is a perspective view taken of the shredder as shown in FIG. 1;

FIG. 4 is a sectional elevational view of the shredder attachment of the feed mill and mixer showing the cutting knife arrangement and shield doors from the same;

FIG. 5 is an elevation view of the rotating element of the hammer mill with the hammer and knives therein, and the screen positioned across the outlet end of the hammer mill showing the location of the knives thereon;

FIG. 6 is a schematic circuit showing an airflow diagram of a ventilation system for the improved feed mill and mixer;

FIG. 7 is a schematic plan view of the mixer with the enclosing cover removed, and;

FIG. 8 is a schematic mechanical hydraulic control circuit for the drive motor of the shredder in a drive circuit for an auxiliary infeed to the hammer and mill;

An improved mill and mixer structure is shown in FIGS. 1 and 2 as a portable mill adapted to be connected to a draft vehicle, such as a tractor, for transport of the same between places of usage and being adapted to receive a source of power, such as a power take off, from the tractor for powering the same. Thus in FIGS. 1 and 2, the portable mill and mixer is shown mounted on a chassis type frame structure 10, the frame structure having support wheels mounted on axles and attached to the frame, as indicated at 12, near the rear end of the same and a coupling hitch 15 on the front end of the same. A suitable adjustable support member 16 is attached near the front end of the frame to support the mill in a generally horizontal position whenever it is disconnected from the tractor. Also journaled onto the frame with a suitable universal coupling is the drive shaft 20 and coupling 21 which is adapted to be connected to the power take off of the tractor to impart drive momentum to the various components of the mixer and mill as will be hereinafter identified. In FIGS.

1 and 2, the mill and mixer unit incorporates basically a hammer mill indicated generally at 25 which hammer mill is adapted to receive input feeds from a shredder indicated generally at 30 or an auxiliary feed hopper 35 with the output of the mill being directed to a mixing tank 40 wherein the material that has been processed by the hammer mill will be fed and mixed with other materials introduced into the mixing chamber as will be hereinafter identified. In FIGS. 1, 2, 6, and 7, the auxiliary infeed chamber 45 for the mixing chamber is disclosed and the material outlet from the mixing tank is directed through an auger type unloader 50 and distributing pipe 55 to distribute feed mixed in the mill and mixer combination to sites of usage.

The input to the mill will be understood from the perspective and views of the shredder mill and of the auxiliary input as shown in FIGS. 3 and 4. As indicated in FIGS. 2 and 3, the shredder attachment 30 provides one input to the hammer mill 25. The shredder attachment has a base structure or frame 60 which is mounted on the frame structure of the feed mill with an input table 62 pivotally connected thereto, such as is indicated at 63. The shredder attachment includes a drive shaft or rotor 65 which is generally cylindrical in form and has a plurality of circular flange members distributed along the extent of the same. The flange members 66 project from the cylindrical surface of the rotor 65 and cutting knives 68 are attached to the sides of the same. The knives are arranged radially along the circumferential extent of the cylindrical member or rotor 65 and are staggered such as to provide axially aligned rows of knives in which alternate flange members have no knives thereon in that particular row but do so on adjacent rows. This provides a staggered arrangement of shredding knives distributed axially along the cylindrical rotor of the shredder and equidistantly spaced axially along the circumferential extent of the same. The input table 62 is pivotally connected to the frame at 63 and includes a suitable set of drive chains 70 for moving materials such as baled hay to the shredder. A group of stationary knives in a row, indicated generally at 75, are mounted on floor portion 76 of the shredder enclosure 77 which enclosure encloses all surfaces of the rotor. These knives are spaced to be positioned to either side between the knives on the cylindrical member or rotor of the shredder so that the knives thereon will pass to between the stationary knives of the shredder in the shearing operation. A suitable cover member 78 pivoted on the enclosure 77 having pivoted doors which are biased and closed on the baled hay or against the sides of the same minimizes the spacing around the same and prevents dust from being discharged at the input of the shredder. The floor portion 76 of the shredder is downwardly inclined along the base of the same and material as it is cut by the shredding knives is propelled along the surface to the hammer mill 25 at a point and in a direction to be tangential to the rotor 90 thereof. It feeds material to the hammer mill such that it will engage the hammers and the floor of the same tangentially for an efficient feeding action. The hammer mill 25 has an enclosing structure 110 positioned around the same and between the hammer mill section 25 and the shredder 30 has a slidable gate 95 which is positioned between the respective outlet and inlet to separate the same. The gate is opened by means of a gearing 96 positioned outside the enclosure to permit communication between the shredder and hammer

mill and will be closed whenever the hammer mill is receiving material from the auxiliary feed to be later defined.

The hammer mill 25 construction includes a rotating element or rotor 90 which is basically a series of plates 100 mounted and spaced in parallel relationship along a shaft 102 with each plate having a plurality of pivoted hammers 104 pivotally mounted thereon. The hammers being placed in diametrical relationship with respect to alternate hammers on the surface of the plates for rotor balance. Suitable cutting knives 105 are also positioned on the plates between adjacent hammers with complimentary cutting knives being positioned in diametrical relationship with respect to the shafts for balance purposes. The hammer mill has an enclosing structure 110 which includes an outlet hopper section 115, as will be best seen in FIG. 4. The enclosing structure includes an internal support structure 118 which is adapted to mount a screen 116 positioned in spaced arcuate relationship with the center of the rotor shaft 102 and the path of the travel of the hammers. The screen 116 extends across the width of the hammer mill along the extent of the drive axis and has square apertures 119 therein which improves the shearing action on the material and cooperates with the hammers 104 and knives 105 in the rotor of the hammer mill to shread material being fed thereto. The screen also mounts cooperative cutting knives 120 at spaced points along the same to cooperate with the knives 105 on the plates 100 of the hammer mill rotor whenever obstructions in terms of large amounts of material are engaged by the hammers and the hammers pivot clear to expose the knife surfaces. This will effect a further shredding action of the material which will then be acted upon by the hammers as it is carried around the peripheral surface of the rotor and into engagement of the screen 116 again.

The enclosing housing structure 110 also includes a pivoted or movable gate 125 across the face of the housing for the hammer mill which may be removed to expose the screen and allow for interchange of the same. Positioned on the top of the enclosure 110 is a small grain hopper 130. This hopper may include a suitable feed control gate therein, indicated at 135, for the purpose of introducing small grain into the hammer mill chamber to be acted upon by the hammer mill in place of input from the shredder. A fragmentary view of a conveying auger driven by a motor 260 to be later identified is shown in FIG. 4 to indicate the introduction of small grain to the hopper 130, as an alternate to feed of the hammer mill from the shredder. At such times the slide gate 95 separating the shredder and hammer mill will normally be closed. If desired, the gate 95 may be located at the inlet of the shredder to prevent discharge of material at this point. At the base of the mill housing is the outlet section thereof in which the transfer auger 140 is positioned. The transfer auger is driven through suitable chains from the power take off and communicates with a tube 150 from the enclosure and to the base of the mixing mill as will be hereinafter identified. The transfer auger will therefore extend through the enclosure of the hammer mill at the lowest point thereof or the outlet side of the same, through the tube 150 and into communication with the entrance in the mixing chamber as will be hereinafter identified. The actual number of hammers on the hammer mill rotor or the plates making up the same to-

gether with the cutting knives may vary in configuration within the scope of the present invention. The cutting knives 105 are so positioned on the plates 100 as to cooperate with the knives 120 on the screen to provide the additional cutting action whenever impact of material with the hammers causes pivoting of the same. Under normal operation the hammers will be extended radially from the supporting shaft due to centrifugal action or force thereon.

As will be seen in FIG. 5, the screen has a plurality of square apertures 119 therein with the cutting knives 120 mounted on the screen being located in a special section having mounting surfaces for the same. The use of the square apertures in the screen together with the action of the hammers rely for a shredding of stalk type materials, such as hay or the equivalent, to shred as distinguished from pulverize, the material being fed through the hammer mill section for improved quality of feed.

As will be evident in FIG. 2, the mixing tank 40 receives at the base of the same material moved by the conveying tube 150 common to the outlet side of the hammer mill or the inlet side or base of the mixing tank. Within the mixing tank, as will be evident in FIG. 7, is positioned a column or tubular member 160 which houses an elongated auger 170 positioned centrally therein. Material introduced into the mixing tank at the base thereof, may be raised by the auger 170 in the column 160 at the top of the same wherein the column is open and material is allowed to discharge to the outside of the same and to the interior of the mixing tank 40. At the base of the mixing tank 40 is also another auger member, indicated at 175, which is common to an auxiliary feed tank 45 located adjacent the mixing tank at the rear extremity thereof. At this auxiliary hopper and auger, additional concentrate materials are introduced into the mixing tank to be blended with the materials transmitted from the hammer mill and through the tubular member into the column 160. The concentrate material and the input conveyed from the hammer mill are mixed within the tank and a suitable stirring arm 180 driven with the auger provides additional mixing within the general interior of the mixing tank. A suitable take out auger 50 also positioned within a housing attached to and opening into the base of the mixing tank transmits the mixed material up through an up-standing pipe wherein it is discharged through the tubular discharge spout 55 at a second auger which transmits and conveys the material through the discharge spout through a point of usage.

The improved hammer mill and mixer structure employs a new ventilation system which will be best seen in FIG. 6. This shows schematically the positive mill ventilation system by means of which input to the hammer mill is increased. Thus the hammer mill 25 at its outlet 115 is connected through the transfer tube 150 to the interior of the mixing chamber or tank 40 for the movement of material thereto. The transfer tube 150 has connected thereto adjacent or near the outlet of the hammer mill a vacuum chamber indicated at 190. This vacuum chamber will be seen in FIG. 2 is an enclosing housing communicating with the interior of the transfer tube and has an outlet pipe 192 therefrom leading to the housing 193 of the blower 195, the impellor 196 of which is connected on a shaft common with the shaft 102 of a hammer mill. The inlet of the blower is at the center thereof or at the low pressure section and the

outlet side or outer peripheral of the housing is connected through a pipe or tube 198 to a tangential inlet 199 of a cyclone type separator 200. The separator has a conical lower section 205 with the inner hollow discharge pipe indicated at 206 leading to a vent passage 207 and an adjustable valve or flap 208 at the top of the same. The aggregate or collection section of the cyclone separator is connected by means of a pipe 210 to the enclosure 110 of the hammer mill closely adjacent the shaft 102 portion thereof or the lower pressure point within the enclosure 110 of the hammer mill. Additionally, for equalization of pressure, the mixing chamber has an outlet pipe 215 connected to the top portion thereof and beneath the cover of the same leading through the vacuum chamber 190 for the purpose of ventilating higher pressure within the mixing tank.

The operation of the blower 195 is to create a drop in pressure in the vacuum chamber 190 common to the outlet or transfer tube of the hammer mill increasing the air flow into the same and increasing the amount of material introduced into the same from the shredder attachment as a tangential feed thereto. The operation of the blower will be to increase the air flow through the hammer mill thereby increasing the material flow thereto. With the operation of the blower, finer material will be lifted from the transfer tube 150 and auger feed conveyor 140 therein and directed into the interior housing of the blower 195 wherein it will be discharged under high pressure through the pipe 198 and into the centrifugal or cyclone separator 200. The feed thereto is tangential in a conventional manner as the separator will have no moving parts and the airflow will cause a separation of the air and particles allowing the air to be discharged through the internal pipe 206 while the particulate will be deposited in the particulate chamber 205 and through the pipe 210 and in through the hammer mill. Air will be vented through the pipe 207 as controlled by the cap or valve 208 to minimize discharge of dust. The drop in pressure in the transfer tube 150 due to the operation of the blower, will also modify the pressure within the mixing chamber and the vent passage by means of the pipe 215 of the top of the same back to the vacuum chamber 190 will equalize the pressure within the mixing tank 40 for more uniform handling of the material being mixed therein. With this improved arrangement, a greater amount of feed material will be directed to the interior of the hammer mill 25 increasing the material handling capacity of the same. As an alternate (not shown) to this arrangement of the return of the separated material to the hammer mill, the return could be discharged into the mixing tank directly at the top of the mixing tank or it may be connected to the concentrate housing 45 to be introduced to the mixing tank at this point. In this improved arrangement, the operation of the blower is such as to take the airflow from the outlet side of the hammer mill rather than from the interior of the same as was previously done, so as to increase the flow of material through the hammer mill past the hammers and screening thereof to the outlet side of the hammer mill.

The power supply for the improved feed mill and mixer for the most part is conventional. It receives its power from the power take off of the draught vehicle, a tractor, through the input shaft 21 leading into a gearing and drive chamber, indicated at 24, in FIGS. 1 and 2. Within the same the shaft is coupled through pulleys

and belts to the varying drive shafts driving the shafts for the shredder 30, the hammer mill 25, blower 195, the transfer auger 140 from the hammer mill to the mixer, the augers within the mixer including the lift auger, the auxiliary auger, and the piping arm, and further, to the augers removing material from the mixing chamber or tank. These details are basically conventional with similar mixer mill combinations and their details are omitted here for simplicity.

In FIG. 8, is shown a modification or improvement in terms of the field input to the shredder rotor, in the form of the drive for the feed table thereof and an alternate drive for the auxiliary auger feeding the hammer mill, to prevent overloading of the same. Thus in FIG. 8, it will be noted that the hammer mill rotor shaft 102 has an extension or coupling thereto which is connected to the centrifugal clutch, indicated at 220, which clutch drives through a belt 221 to an input pulley 222 for a self-container reservoir and pump unit 225 providing an hydraulic fluid source for the orbit motor 250 of the feed table for the shredder. The output of the pump from the reservoir is fed through a supply conductor or line 227 with return line 228 leading thereto. The line 227 is directed to a variable control valve 230 which has a pair of outlet ports 231 and 232 at the sides of the same. This valve is adjustable and in effect is a three-way valve dividing inlet flow from the pipe 227 to the outlet ports 231 and 232. The outlet port 231 is connected to a pipe 234 leading to a selector valve 235 or the inlet side thereof. This selector valve is adapted to be manually operated by means of a hand shaft member 240 to divide flow or select flow between two outlet ports 241 and 242. The port 241 leads through a pipe 244 to the orbit motor 250 of the infed table for the shredder. This motor has a return line 245 which is common to a line 246 leading from the port 232 of the variable valve 230 and back to the return line 228 leading to the pump and reservoir. The outlet port 242 of the selector port is coupled through a line 252 to an auger motor, indicated at 260, whose return or outlet line 261 is coupled back to the return line 228 for the hydraulic system. With this arrangement, the speed of the orbit motor driving the chain on the input to the shredder or the bale drive will be controlled in accord with the speed of operation or rotation of the rotor of the hammer mill. Whenever a hammer mill is overloaded due to the introduction of large amounts of material which cannot be effectively chopped or reduced in size and fed through the screening, the loading thereon will tend to cause the rotor shaft 102 thereof to slow down. This shaft, when coupled through the clutch 220, will sense the speed of the rotation since the clutch is a centrifugal clutch shown schematically at 220 and conventional in form. When shaft 102 reduces the speed of rotation of the clutch 220, the clutch 220 will disengage at a predetermined lower speed which stops flow of oil since the pump drive will be stopped in line 227. Thus, the orbit motor or motors driven thereby will similarly be stopped in response to the overloading of the hammer mill to relieve the overloading. The clutch 220 will re-engage when the overload is overcome and speed of shafts 102 increases greater than the predetermined disengage setting. It will be noted that the variable control valve 230 divides the flow from the outlet pipe 227 of the pump so that that portion thereof used for driving the feed table of the shredder may be adjusted to any de-

sired speed and through the clutch arrangement held to operation proportionally with the loading of the hammer mill. The remainder of the flow as evidenced by the outlet port 232 is returned to the return line 228 of the hydraulic system. The selector valve is two positioned valve which can select the operation of the feed table motor 250 or the auger drive or motor 260 for the auxiliary small grain feed auger which is an alternate infeed to the hammer mill through the hopper mounted thereon. The gate 95 or door positioned between the shredder and hammer mill may be closed and the valve 135 for the auxiliary or small hopper will be opened for such infeed. Thus, one or the other of the motors 250 or 260 will be operated under control of the variable valve 230 to be tied to the operation or of the rotation of the hammer mill to prevent overloading of the same and to provide proportional infeed to the same. Whenever the shredder is not to be used the manual valve 235 is adjusted by means of its handle 240 to select operation of the auger motor 260 which will receive its fluid flow through the pipe 227 and select the passage 231 through the selector valve and pipe 252 with the return flow being through the pipe 261 to the pipe 228. Thus the auxiliary auger motor 260 or the bale feed drive motor 250 will be operated in connection with the hammer mill and in proportional speed thereof so that conditions of overloading will be sensed and further overloading will not be maximized apart from the speed of rotation of the hammer mill.

In the improved hammer mill and mixer, we have provided an improved shredder configuration by means of which baled hay may be introduced into the interior of the hammer mill through a tangential feed and through a cutting arrangement which provides for a uniform feed flow and a tangential feed flow to the hammer mill for greater efficiency and operation. The improved hammer mill not only includes hammers mounted on the supporting plates of the rotor but the individual cutting knives cooperating with the cutting knives on the screen having square holes therein for a more efficient cutting or shearing of the material and to insure uniformity in size of the material being cut through the screen to the outlet side thereof. In addition, the positive ventilation control system reduces the pressure on the outlet side of the hammer mill to increase the inflow thereto for improved and increased material handling capabilities. The positive ventilation system provides for a blower connected to the outlet side of the hammer mill or the conveying pipe between the hammer mill and the mixing tank to reduce the pressure in this line and provide for a discharge therefrom through a cyclone type separator to collect particulate included in the airflow stream and separate the same therefrom discharging the air to atmosphere through a controllable spring biased cap or valve system which minimizes dust discharges from the separator and blower and returning the previously entrained particulate to the hammer mill at the low pressure side thereof or introducing the same directly to the mixing tank or to the concentrate hopper feeding the input side of the same. The output of the hammer mill is fed to the base of the mixing chamber through an auger system which is generally conventional and this tank has an auxiliary feed hopper for introducing concentrate thereto in a conventional mixing operation. The details of the tank are largely conventional and the tank is vented at its top to the positive vent line or the low

pressure side of the blower for equalization of pressure within the mixing tank. The discharge extremity of the tank includes a conventional auger system and distribution pipes for withdrawing material from the interior of the mixing tank and discharging the same to the site of usage. In the improved hammer mill and mixer, infeed to the shredder or the auxiliary feed to the hammer mill is controlled by means of an hydraulic drive system operated from a centrifugal clutch off of a hammer mill rotor to tie the infeed of speed to the auger or the shredder mill to a variable control valve and selector valve to the speed of the hammer mill to control feed rate of bales or grain feed and a clutch to prevent further overloading of the same in case loading reduces the speed of the hammer mill.

In considering this invention, it should be remembered that the present disclosure is illustrative only and the scope of the invention should be determined by the appended claims.

We claim:

1. A feed mill and mixer comprising:

a frame structure with a hammer mill mounted on the frame structure including enclosing walls and a drive means for driving the same;
a mixing tank mounted on the frame structure adjacent said hammer mill;
a transfer tube connected through the base of the hammer mill and a base in the mixing tank and including conveying means therein to transfer material from the hammer mill through the mixing tank;

a blower carried by the frame structure and having an inlet connected to the transfer tube near the outlet of the hammer mill, said blower having an outlet therefrom and including an impeller driven by the drive means of the hammer mill for simultaneous and proportional operation with the hammer mill;

a separator means having an air inlet connected to the outlet of the blower means and including a material outlet for transferring the separated material from the blower means and the separator and including an exhaust means for venting air from the separator;

tube means connecting the material outlet of the separator means through the enclosing walls of the hammer mill and a low pressure point therein;

a drive means in the mixer tank for raising materials delivered from the transfer tube to the interior of the mixing tank, said blower being adapted to lower the pressure at the outlet side of the hammer mill to increase the flow of material in the mixing tank with operation of the conveying means; and means for removing mixed material from the tank.

2. The feed mill and mixer of claim 1 in which the separator means is a cyclone type separator.

3. The feed mill of claim 1 in which the conveying means in the transfer tube is an auger type conveyor.

4. The feed mill and mixer of claim 1 and including a shredder positioned at the inlet to the hammer mill and adapted to receive and shred material fed to the hammer mill; said shredder being driven by the drive means of the hammer mill.

5. The feed mill and mixer of claim 1 in which the hammer mill includes plates with pivoted hammer members thereon and the outlet across the same in-

cludes a curved screen with square apertures therein to cooperate with the hammers in shearing materials passed therethrough.

6. The feed mill and mixer of claim 5 in which the plates of the hammer mill includes knife means positioned on directly opposite points of the same and spaced from said pivoted hammers to cooperate with similar knives fixed to the screen when said hammers are deflected.

7. The feed mill and mixer of claim 1 in which the material outlet of the separator is fed back to the hammer mill through the enclosure and adjacent the access of rotation of the hammer mill.

8. The feed mill and mixer of claim 1 in which the mixing tank includes an additional auger type inlet at the base of the same independent of the transfer tube for adding additional material to the base of the mixing tank to be moved by the drive means therein raised with the material from the transfer tube.

9. The feed mill and mixer of claim 1 and including a vent passage means from the top of the mixing tank to the inlet of the blower.

10. The feed mill and mixer of claim 9 in which the separator means is a cyclone type separator whose inlet is connected to the outlet of the blower means and with the air outlet of the cyclone including a pivoted cover which is only opened with operation of the blower and air movement through the cyclone.

11. The feed mill and mixer of claim 4 and including additional passage means through the enclosing walls of the hammer mill for the insertion of materials to the interior of the hammer mill independent of the shredder.

12. The feed mill and mixer of claim 11 and including means to close the communication between the shredder and the hammer mill to seal the passage therebetween.

13. A feed mill and mixer comprising: a frame structure with a rotary hammer mill mounted on the frame structure including enclosing walls and a drive means for driving the same; a mixing tank mounted on the frame structure adjacent the said hammer mill; a transfer tube connected through the base of the hammer mill and a base of the mixing tank and including conveying means therein to transfer material from the hammer mill to the mixing tank; ventilation means connected to said transfer tube at the base of the hammer mill and including means for increasing air flow through the hammer mill; said ventilation means providing an exhaust to the hammer mill at the low pressure area thereof adjacent to axis of rotation of the same; drive means for the mixing tank for raising materials delivered from the transfer tube to the interior of the mixing tank; shredder means positioned at the inlet to said hammer mill adapted to receive and shred material fed to said hammer mill, said shredder means being positioned so that the outlet therefrom is fed tangentially to the inlet of the hammer mill; and means for removing mixed material from the tank.

14. The feed mill and mixer of claim 13 in which the shredder means includes a plurality of rows of knives mounted on a rotating element forming a part of said shredder means and cooperating with a single row of stationing knives positioned on the frame structure said knives being distributed circumferentially about the rotating element of the shredder means to form a plurality of rows in spaced relationship circumferentially

about the rotating element with the positioning of knives on the adjacent rows being offset axially to provide a staggered relationship and with the stationary knives being mounted in pairs to cooperate with and be positioned on each side of a knife mounted on the rotating element as the shredder means is rotated.

15. The feed mill and mixer of claim 13 in which the hammer mill includes a rotating element mounted on a shaft with a plurality of spaced-apart plates positioned axially along the extent of the shaft and with each plate having a plurality of hammers positioned radially from the shaft on the plate in diametrically opposed relationship from a corresponding hammer and with the hammers pivoted to move circumferentially between an extended position to a retracted position upon engaging solid material as the shaft is rotated, at least a pair of cutting knife blades positioned diametrically with respect to said shaft on each of said plates and between adjacent hammers with the hammers being capable of being pivoted on the plates clear of the knives to permit exposure of the knives and cutting therefrom with deflection of the hammer means.

16. A feed mill and mixer comprising: a frame structure with a rotary hammer mill mounted on the frame structure including enclosing walls and a drive means for driving the same; a mixing tank mounted on the frame structure adjacent the same hammer mill; a transfer tube connected through the base of the hammer mill and a base in the mixing tank and including conveying means therein to transfer material from the hammer mill to the mixing tank; ventilation means connected to said transfer tube at the base of the hammer mill and including means for increasing air flow through the hammer mill; said ventilation means providing an exhaust to the hammer mill at the low pressure area thereof adjacent the axis of rotation of the same; drive means for the mixing tank for raising materials delivered from the transfer tube to the interior of the mixing tank; shredder means positioned at the inlet to said hammer mill adapted to receive and shred material fed to said hammer mill, said shredder means being positioned so that the outlet therefrom is fed tangentially to the inlet of the hammer mill; said hammer mill including a rotating element mounted on a shaft with a plurality of spaced-apart plates positioned axially along the extent of the shaft and with each plate having a plurality of hammers positioned radially from the shaft of the plate in diametrically opposed relationship from a corresponding hammer and with the hammers pivoted to move circumferentially between an extended position to a retracted position upon engaging solid material as the shaft is rotated, at least a pair of cutting knife blades positioned diametrically with respect to said shaft on each of said plates and between adjacent hammers with the hammers being capable of being pivoted with the plates clear of the knives to permit exposure of the knives and cutting therefrom with deflection of the hammer means, means for removing mixed material with the tank, and a curved screen member positioned across the outlet of the hammer mill and having a plurality of square apertures distributed along the same and at least one row of knives cooperating with the knives positioned on the rotating element of the hammer mill to provide a shearing action therebetween as material is passed around the rotating element and through the square apertures in the screen to the outlet of the hammer mill.

17. A feed mill and mixer comprising: a frame structure with a hammer mill mounted on the frame structure including enclosing walls and a drive means for driving the same; a mixing tank mounted on the frame structure adjacent said hammer mill; a transfer tube connected through the base in the hammer mill and a base of the mixing tank and including conveying means therein to transfer material from the hammer mill through the mixing tank; a blower carried by the frame structure and having an inlet connected to the transfer tube near the outlet of the hammer mill, said blower having an outlet therefrom and including an impellor driven by the drive means of the hammer mill for simultaneous and proportional operation with the hammer mill; a separator means having an air inlet connected to the outlet of the blower means and including a material outlet for transferring the separated material from the blower means and separator and including an exhaust means for venting air from the separator; tube means connecting the material outlet of the separator means through the enclosing walls of the hammer mill and a low pressure point therein; a drive means in the mixer tank for raising materials delivered from the transfer tube to the interior of the mixing tank, said blower being adapted to lower the pressure at the outlet side of the hammer mill to increase the flow of material in the mixing tank with operation of the conveying means; a shredder positioned at the inlet of said hammer mill and adapted to receive and shred material fed to the hammer mill; said shredder being driven by the drive means of the hammer mill; additional passage means through the enclosing walls of the hammer mill for the insertion of materials to the interior of the hammer mill independent of the shredder; means for closing communication between the shredder and the hammer mill to seal the passage therebetween; and means for removing the mixed material from the tank; said drive means for the shredder being coupled to the drive means for the hammer mill and includes a centrifugal clutch coupling and belt drive with a pump driven from the belt drive, said drive means including a self-contained hydraulic system with a reservoir and said pump with control valve means leading to an orbit motor driving the rotating element of the shredder.

18. The feed mill and mixer of claim 17 in which the

control valve means includes a variable flow control valve to vary the flow of hydraulic fluid through the reservoir to the pump to the orbit motor of the shredder to vary speeds thereof in proportion to the speed of the drive means of the hammer mill.

19. The feed mill and mixer of claim 18 and including a slidable gate means positioned in the frame means common to the enclosures of the shredder and the hammer mill and adapted to open and close the tangential feed from the shredder to the inlet of the hammer mill, and additional passage means including an auger and an hydraulic orbit motor driving the same for providing an alternate passage to the interior of a hammer mill, said orbit motor being driven by said control valve means and coupled to the hydraulic system of the shredder motor.

20. The feed mill and mixer of claim 19 and including selector valve means included in the hydraulic system with the control valve means and adapted to selectively connect the hydraulic pump to the shredder motor and to orbit motor of the auxiliary feed means.

21. The feed mill and mixer of claim 20 in which the drive means for the hammer mill includes a rotating shaft adapted to be connected to a power take off drive from a towing vehicle.

22. The feed mill and mixer of claim 21, in which ventilation system includes a blower carried by the frame structure and having an inlet connected to the transfer tube near the outlet of the hammer mill with the blower having an impellor driven by the drive means to the hammer mill for operation therewith and including separator means having inlet connected to the blower to receive outlet air therefrom and separate material from the blower exhausting ventilated air from the blower to receive outlet air therefrom and separate material from the blower exhausting ventilated air from the blower and separating material therefrom returning the same through a coupling with the hammer mill to an area of low pressure therein.

23. The feed mill and mixer of claim 22, and including drive means for said mixing tank, conveying means, hammer mill and the means for removing material from the tank, all being mechanically connected to the drive shaft and operated from the power take off.

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