Feb. 7, 1961 R. L. McILVAINE 2,970,778

METHOD AND APPARATUS FOR MIXING AGGLOMERATIVE MATERIALS

Filed Nov. 25, 1957 4 Sheets-Sheet 1

Fig. 1

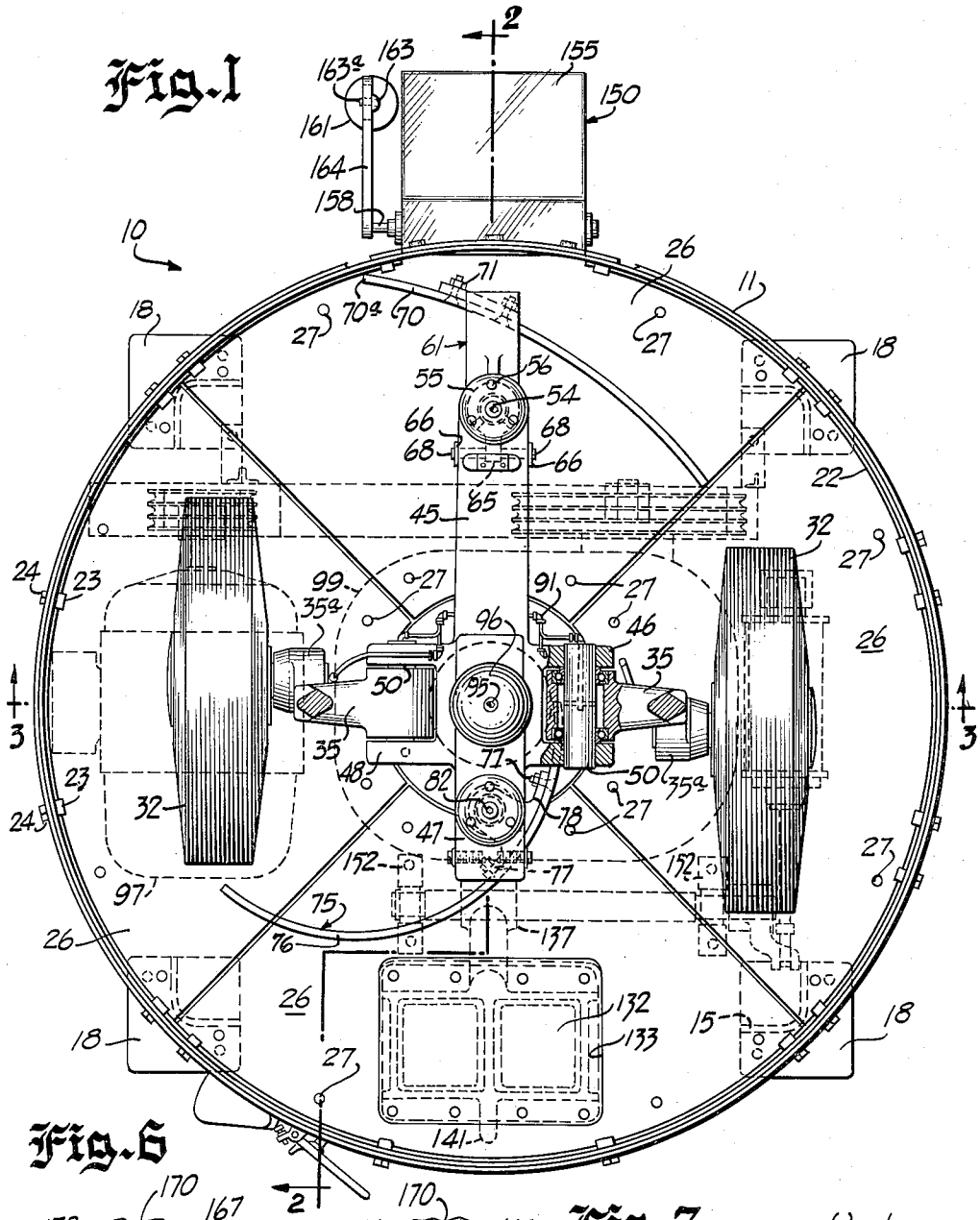



Fig. 6

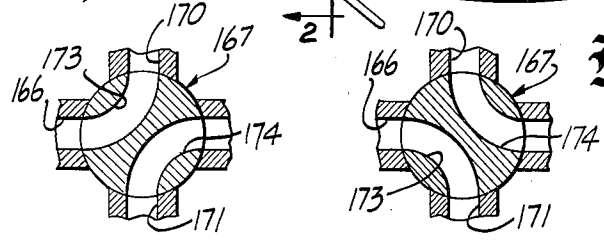



Fig. 7

INVENTOR
ROBERT L. McILVAINE
by Mason, Kolehmainen, Rathburn and Wyss.
ATTORNEYS.

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FIG. 2

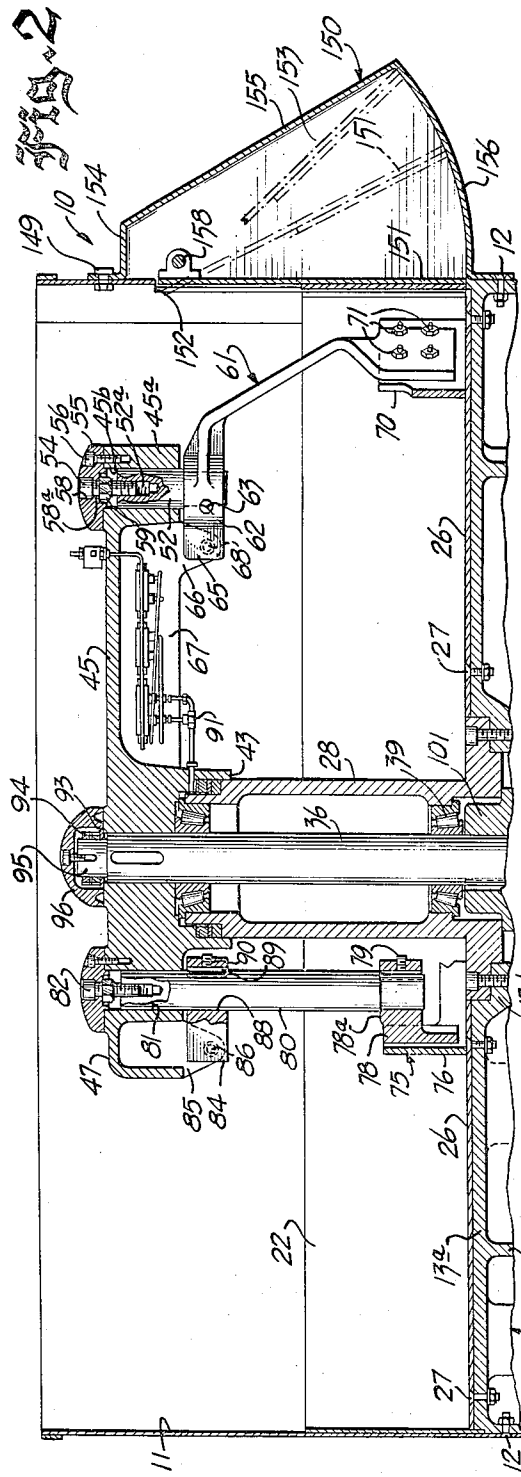


FIG. 5

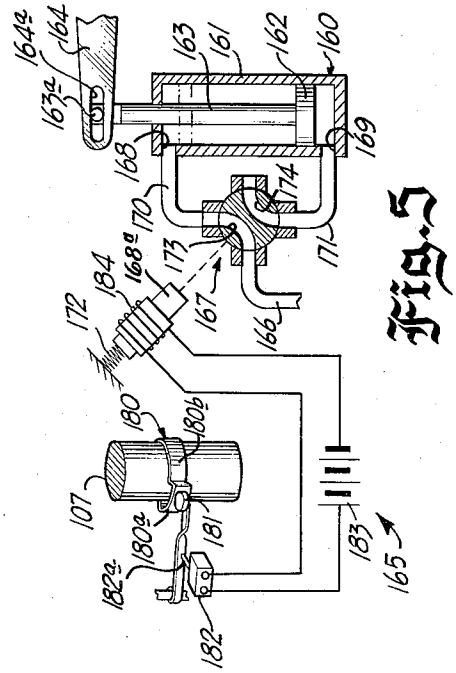
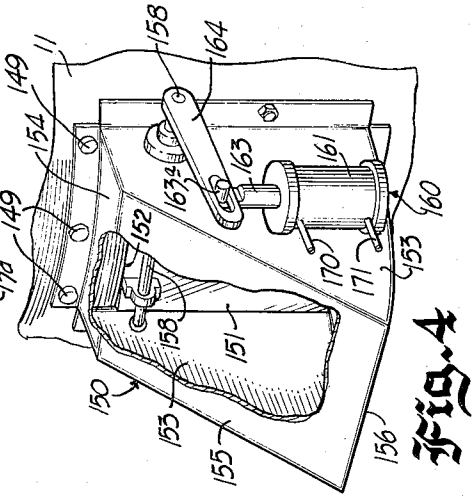


FIG. 4



INVENTOR
ROBERT L. McILVAINE
by Mason, Kolehmainen, Rathburn and Wyss.
ATTORNEYS.

Feb. 7, 1961 R. L. McILVAINE 2,970,778

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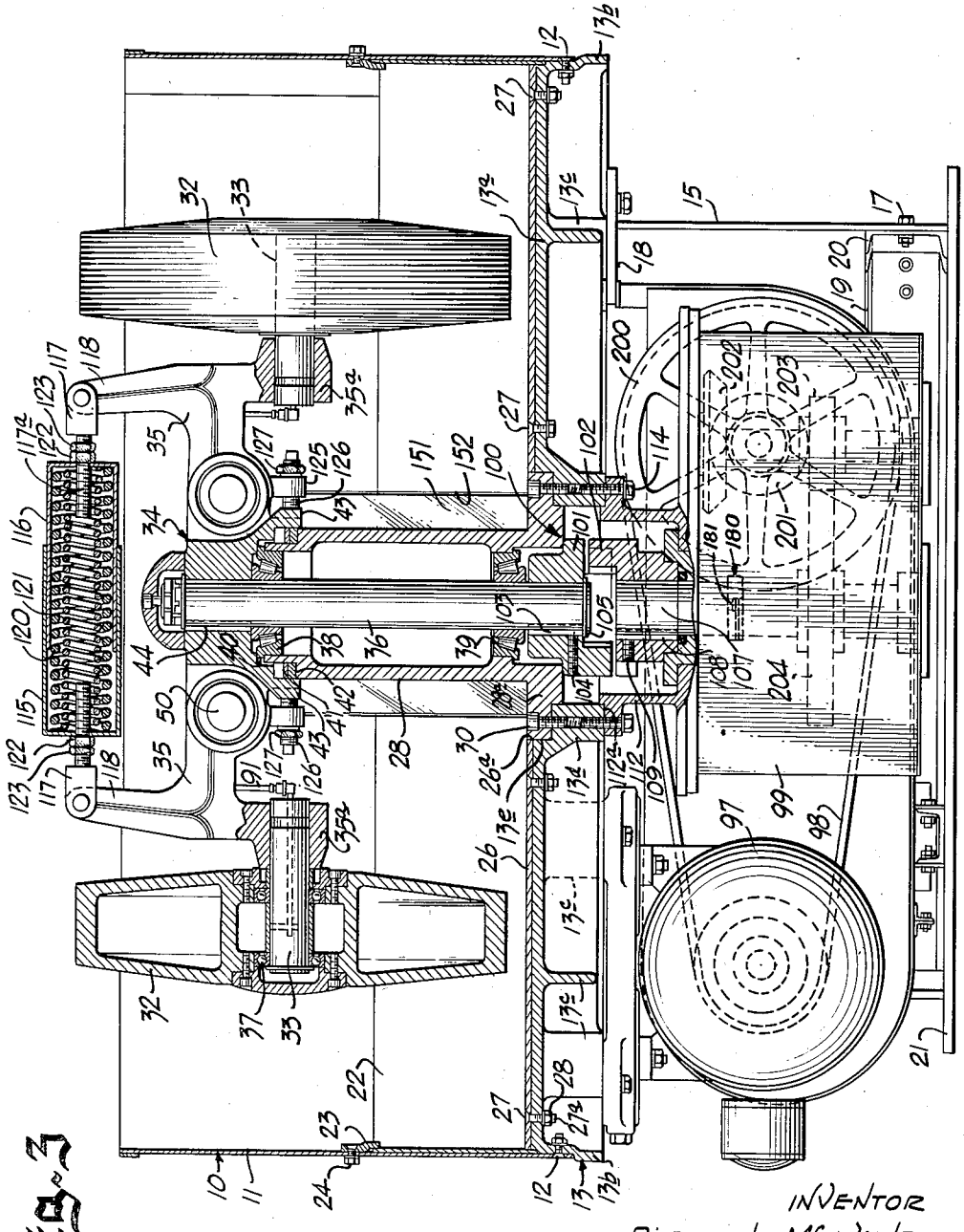


Fig. 3

INVENTOR
ROBERT L. McILVAINE

by
Mason, Kohlmainen, Rath, Brown and Wyss.
ATTORNEYS.

Feb. 7, 1961 R. L. McILVAINE 2,970,778

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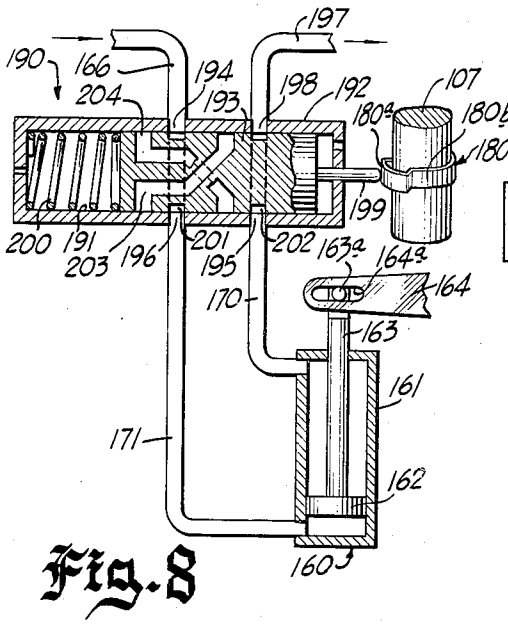



Fig. 8

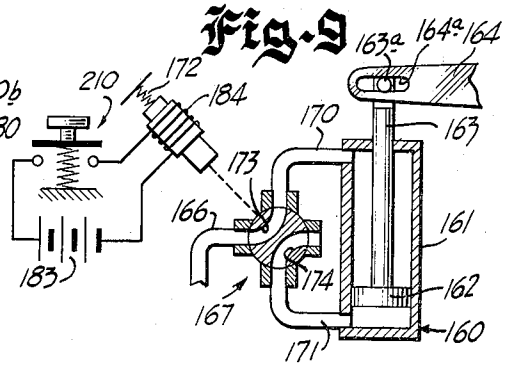



Fig. 9

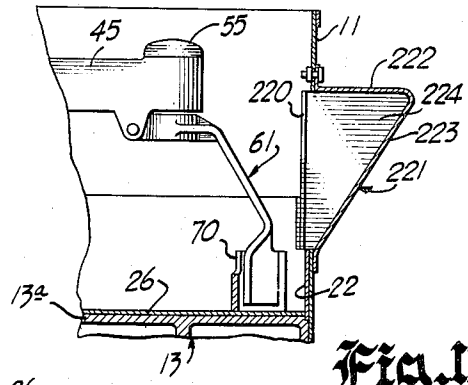
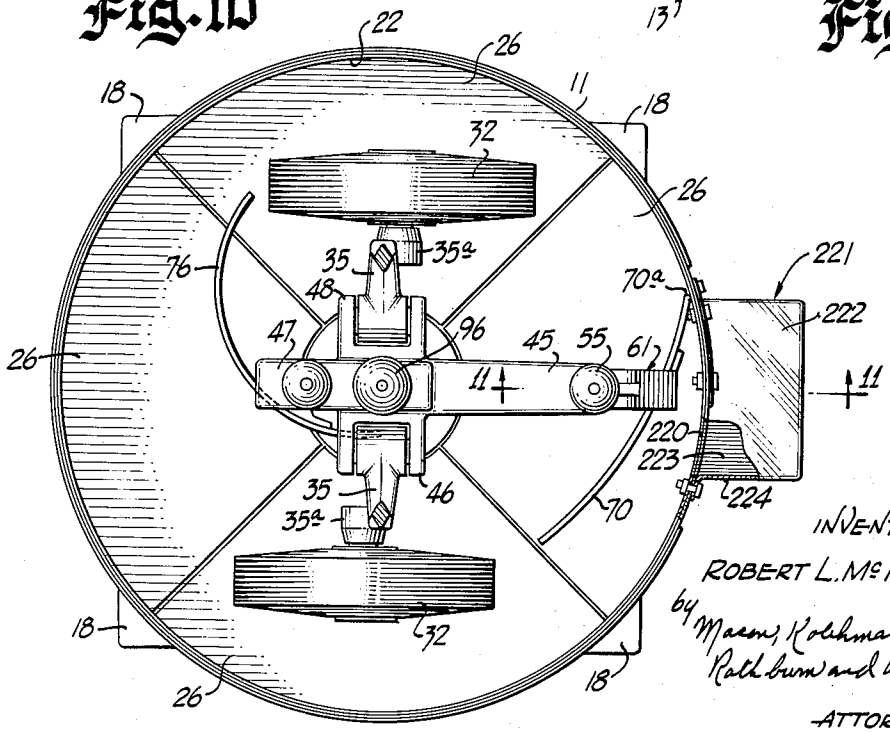



Fig. 11

Fig. 10




INVENTOR
ROBERT L. McILVAINE
by Mason, Kolehmainen, Rathburn and Wyss.
ATTORNEYS.

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# METHOD AND APPARATUS FOR MIXING AGGLOMERATIVE MATERIALS

Robert L. McIlvaine, Winnetka, Ill., assignor to Herbert Simpson Corporation, Chicago, Ill., a corporation of Illinois

Filed Nov. 25, 1957, Ser. No. 698,511

5 Claims. (Cl. 241—97)

The present invention relates to new and improved method and apparatus for mixing granular foundry material and, more particularly, to an improved mulling method and apparatus especially well suited for mixing granular material such as certain plastic materials having agglomerative characteristics. More specifically, the present application pertains to a new and improved mixer of the type disclosed in United States Patent No. 2,727,696 to Walter Horth, assigned to the same assignee as the present invention.

In prior art mulling devices employing one or more movable plows and cooperating mullers, it has been found that certain materials cannot be mixed or mulled successfully because a portion of these materials forms a mass in which particles of material do not change their relative position but are instead pushed or carried around the mixer crib. More specifically, in mixing agglomerative materials a large mass tends to build up around the plow and the adjacent muller with the result that the mass is carried around the mixer and very little mixing and processing of the material within the mass is achieved. Therefore, it would be desirable to either inhibit the accumulation of such a large material mass or to break up any accumulated mass as quickly as possible and, accordingly, it is a principal object of the present invention to achieve these results.

It is also an object of the present invention to provide a new and improved mixing method and apparatus wherein any mass of material built up adjacent to a mixing plow in a mulling crib is broken up in order to provide a more effective mixing and processing of the material.

Another object of the present invention is to provide a new and improved mixing method and apparatus wherein the accumulation of a large mass of material immediately ahead of a mixing plow in the mulling apparatus is effectively prevented.

It is a still further object of the present invention to provide a mulling machine wherein a portion of the material tending to build up adjacent to the mixing plow is cut off and removed from the mass and is thereafter returned to the crib at a point spaced from the mass.

It is yet another object of the present invention to provide a new and improved mulling machine in which a crib extension is provided for temporarily accommodating a portion of any mass built up ahead of a mixing plow and for discharging or returning the mass portion back into the crib for further mixing and processing.

It is still another object of the present invention in accordance with the previous object to provide a control circuit for automatically returning the material stored in the crib extension to the mixing crib.

The above and other objects are achieved, in accordance with the present invention, by providing a new and improved mulling apparatus which embodies means for breaking up any mass of material tending to accumulate between a rotatable plow and a muller located within a crib. More particularly, any mass of material forming immediately in front of the plow is moved along the side wall of the crib and past an opening guarded by a pivoted plate or door. The bounding edges of the opening cooperate with the plow to sever and break up the mass so that a portion of the mass can be directed through the opening and into a crib extension or chamber formed



on the side of the crib. After the plow has been rotated past the crib extension, the material stored within the crib extension is discharged back into the crib for further mixing. In one form of the invention the crib extension is at all times open to the main crib, through the crib opening and the material stored within the crib extension is returned to the main crib by gravity. In another form of the invention the crib opening is guarded by a pivoted plate or door for controlling the flow of material from the crib to the crib extension. In the latter form of the invention the pivoted plate is housed within the crib extension and is movable between a closed position in which it covers the crib opening and an open position in which the opening is uncovered. The plate is pivoted by means of a motor operated by a control circuit, this circuit being operable to actuate the pivoted plate into its open position to permit entry of material into the crib extension immediately prior to passage of the plow past the crib opening and further operable to move the plate into registry with the crib opening in order to eject the material from the crib extension after the plow has been moved beyond the crib opening. By this arrangement, a portion of any mass of material developed ahead of the plow is cut off from the mass, is withdrawn from the crib and is returned to the crib to be mixed with the balance of the material in the crib.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following description taken in connection with the accompanying drawings, in which:

Fig. 1 is a top plan view, shown partly in phantom, of a mulling machine embodying the features of the present invention;

Fig. 2 is an enlarged, fragmentary sectional view taken along a line substantially corresponding to line 2—2 of Fig. 1;

Fig. 3 is an enlarged sectional view taken along a line substantially corresponding to line 3—3 of Fig. 1;

Fig. 4 is an enlarged fragmentary perspective view showing primarily the crib extension embodied in the machine of Fig. 1 with a portion of the crib extension being broken away to show certain details of construction;

Fig. 5 is a partially schematic, partially diagrammatic view of a control circuit for operating the entrance door or plate to the crib extension;

Figs. 6 and 7 are sectional views of a valve employed in the control circuit of Fig. 5 and respectively illustrate the different operating positions of the valve;

Fig. 8 diagrammatically illustrates a modification of the control circuit for automatically operating the entrance door to the crib extension;

Fig. 9 shows a manually operated mechanism for operating the crib extension door;

Fig. 10 illustrates another form of the invention wherein the mass diverted into the crib extension is returned to the main crib by gravity; and

Fig. 11 is a fragmentary sectional view illustrating the crib extension and taken along a line substantially corresponding to line 11—11 in Fig. 10.

Referring now to the drawings and more particularly to Figs. 1, 2 and 3, the reference numeral 10 indicates a mulling machine having a generally cylindrical crib 11 secured near its lower end to a bedplate 13 by means of bolts 12. The bedplate 13 has a flat upper supporting surface 13*a* and an annular depending outer peripheral flange 13*b*. The bedplate 13 is reinforced by a plurality of depending ribs 13*c* which may be coextensive with the flange 13*b*. At its center the bedplate 13 has a depending ring-like boss 13*d* having a recessed circular upper annular portion 13*e*.

The machine is supported by welded steel pedestals 15

which have a substantially V-shape in plan, as seen in Fig. 1. At the lower end the pedestals are secured by bolts 17 to spaced channel members 19 and 20, which are in turn welded to a base-plate 21. At the upper ends the pedestals 15 are secured, as by welding, to plates 18 which are secured to the lower ends of the flange 13*b* and the ribs 13*c*.

A liner 22 is disposed around the inner wall of the lower portion of the crib 11 and is held therein by a plurality of clamps 23 which are fastened in the crib wall by means of bolts 24 and which have an inner end portion overlying the upper end of the liner 22.

The bedplate 13 is provided with a hardened steel wearplate 26 which is made in quadrants and is secured on the bedplate by means of a plurality of bolts 27. Nuts 28 are adapted to be threaded on the lower ends of the bolts 27. To facilitate tightening the nuts 28, the bolts 27 have lower ends 27*a* equipped with Allen head sockets. By holding the bolt 27 with an Allen head wrench the nut 28 can be tightened with a conventional open-ended wrench. The wearplate 26 has a central opening 26*a* conforming to and aligned with the opening 13*e* in the bedplate 13. A generally cylindrical hollow turret 28 has a laterally extending base portion 28*a* fitting snugly in the opening 13*e* and 26*a* and this base portion is provided with openings through which bolts 30 secure the turret to the annular boss 13*d* of the bedplate 13.

A pair of muller wheels 32 are mounted in substantially diametrically opposed position on shafts 33 which extend outwardly from rocker arm 35 pivotally mounted on a crosshead 34. Each muller wheel 32 is rotatably mounted on the shaft 33 on ball bearing assemblies 37. The opposite end of the shaft 33 is secured, as by a press fit, in a lower end portion 35*a* of the rocker arm 35. The end portion 35*a* is inclined as shown in Fig. 1, so that the center of the muller wheel is displaced from the center line of the crosshead.

The crosshead 34 is rotated and supported by means of a drive shaft 36 which is journaled for rotation in the turret 28 by bearing assemblies 38 and 39. The inner face of the bearing assembly 38 is pressed on the shaft 36 while the outer face has a shoulder portion 40 overlying the upper end of the turret 28. For the purpose of preventing the entry of foreign materials into the bearing assembly of the machine, a seal ring assembly 41 is disposed between a recessed shoulder portion 42 of the turret 28 and a depending skirt 43 of the crosshead 34.

The crosshead 34 is secured for rotation with the shaft 36 by means of a key 44 and, as is best shown in Fig. 1, has four arm portions 45, 46, 47 and 48 which are integrally formed and disposed substantially at right angles to each other. The arms 46 and 48 are bifurcated and have openings therethrough journaling rocker arm shafts 50 which carry the rocker arms 35.

The arm 45 extends radially outwardly and carries at its free end portion a sleeve 45*a* (Fig. 2) having a vertical opening 45*b* therethrough arranged to receive a rod 52 in sliding engagement. The rod 52 has a threaded longitudinal opening 52*a* in the upper end into which is threaded an adjusting bolt 54. A cap 55 is secured by means of set screws 56 to the top surface of the sleeve portion 45*a* and has a central opening 58 with a shouder 58*a* on which the head of the bolt 54 rests. A lock nut 59 is threaded on the shank of the bolt 54 and seats against the lower surface of the cap 55. Thus, the bolt 54 may be rotated by means of a socket head to cause the shank of the bolt 54 to be threaded in and out of the rod 52 to cause the rod to be raised or lowered.

A plow arm 61, having an upper substantially cylindrical end portion 62 locked to the lower end of the rod 52 by means of a set screw 63, carries a positioning arm 65 which extends between a pair of ears 66 depending from a rib 67 of the arm 45. An adjusting set screw 68 (Fig. 1) is threaded through each ear 66 and seats at its inner end against the arm 65 in order to lock this arm in an adjusted position. It will be seen that, when the set screws 68 are backed away from the arm 65, the plow arm 61 may be rotated with the rod 52. When the desired setting of the arm 61 is reached, the set screws 68 can be tightened against the arm to lock it in position. Thus, the vertical position of the plow arm 61 may be adjusted by the rotation of the bolts 54 while the radial position may be adjusted by means of the set screws 68.

At the lower end of the pow arm 61 a plow blade 70 is secured thereon by means of bolts 71. As best shown in Fig. 1, the plow blade 70 has its forward end 70*a* disposed close against the side of the liner 22 of the crib. Thus, it is effective to scrape the material from the side of the crib while at the same time scraping it from the wear plate 26. The plow blade 70 is so disposed that it will move material inwardly toward the path of the muller wheel.

A second plow or scraper 75 is mounted on the crosshead arm 47. The plow 75 has a blade 76 secured by bolts 77 to a support arm 78 and the arm 78, in turn, has a sleeve portion 78*a* (Fig. 2) keyed by means of a set screw 79 to a shaft 80. At its upper end the shaft 80 is journaled for sliding and rotating movement in a vertical opening 81 in the arm 47. An adjusting bolt 82 has a lower threaded shank portion which is received in a threaded opening at the upper end of the rod 80 and is effective to adjust the vertical position of the rod and consequently the plow 75 exactly in the manner described above in connection with the adjusting bolt 54 of the plow 61.

The angular position of the plow 75 is regulated by the movement of an arm 84 which extends between a pair of ears 85 of the crosshead arm 47. Set screws 86 threaded through the ears 85 are arranged to hold the arm 84 in a selected position. The shaft 80 extends through an opening 88 in the arm 84 and is slidably held therein by a key 89 and by a set screw 90 which is threaded in the arm 84 against the key 89. This connection, of course, permits the vertical adjustment of the rod 80 while the arm 84 remains in a substantially horizontal position.

The bearings of the muller shaft, those on the rocker arm shaft, and the bearings on the carriage by the turret are lubricated through a forced lubrication system indicated generally by the reference numeral 91.

The crosshead 34 is locked on the shaft 36 by the key 44 and by a washer 93 and a pair of lock nuts 94 which are threaded against the lower end of the clutch seats upper end 95 of the shaft 36. This threaded connection is effective to press the crosshead 34 down on the bearing assemblies 38 and 39. A cap 96 is disposed over the upper end of the shaft 36.

The shaft 36 is driven by an electric motor 97 through a V-belt drive 98 and a gear reduction unit 99 and through a positive acting jaw clutch 100. The gear reduction unit 99 comprises a wheel 200 driven by V-belt 98 and mounted on a common shaft with a bevel gear 201 which meshes with a bevel gear 202. The bevel gear 202 is mounted on a common shaft with a small gear 203 which in turn drives a large gear 204 on the output shaft 107.

One portion 101 of the jaw clutch 100 is keyed for rotation with the shaft 36 by means of a key 103 and a set screw 104 which bears against the key 103. A snap retainer ring 105 is disposed around the lower end of the shaft 36 and seats against the lower end of the clutch element 101 to prevent axial displacement of the member 101 relative to the shaft 36.

The other member 102 of the clutch 100 is secured for rotation on the output shaft 107 of the gear reduction unit by means of a key 108 and a set screw 109 which engages the key 108. The casing of the reduction unit 99 has an upwardly extending annular sleeve portion

112 with a recessed shoulder 112*a* which receives the depending annular boss 13*d* of the bedplate 13. As is best shown in Fig. 3, the reduction unit is positioned relative to the bedplate 13 merely by lifting it upwardly so that the annular ring 13*d* fits into the recessed shoulder of the speed reduction unit housing. The housing is then secured by bolts 114 to the ring 13*d*. It should be observed that the sleeve 112 provides an automatic pilot for centering the speed reduction unit in the machine and assures the alignment of the output shaft 107 with the drive shaft 36.

The muller wheels 32 which roll over the material disposed on the wearplate 26 in the crib, may be preloaded by means of telescoping cylinders 115 and 116 which are pivotally mounted by connectors 117 to upwardly extending arms 118 of the rocker arms 35. The connectors 117 are provided with threaded shanks 117*a* which extend through openings in the ends of the cylinders 115 and 116.

Coil springs 120 and 121 are disposed inside the cylinders 115 and 116 and have their ends abutting the inner end walls of the cylinders. The pressure exerted by the springs on the arms 118 is regulated by lock nuts 122 and 123 which are threaded on the shank 117*a* of each connector. The closer the cylinders 115 and 116 are telescoped inside each other to compress the spring, the greater will be the loading on the arms and consequently on the muller wheel 32.

The rocker arms 35 also carry downwardly extending ear members 125 each of which has a threaded opening receiving an adjusting screw 126 which bears against the skirt 43 of the crosshead. A lock nut 127 is effective to hold each of the adjusting screws 126 in a selected position. It will be seen that this adjusting screw, by its contact against the skirt 43, will control the downward pivoting movement of the rocker arm so that the clearance between the wearplate 26 and each muller wheel 32 can be regulated.

Sand is discharged from the mulling machine 10 through a discharge door 132 (Fig. 1) which is of a generally rectangular configuration and fits snugly into a rectangular opening 133 in one quadrant of the wearplate 26. The door 132 may be constructed and operated in the manner set forth in the above identified Horth patent and, hence, need not be described in detail. Conventional means such as a power cylinder (not shown) may be provided for operating the door and may be actuated by any suitable fluid and connected for energization through control means remote from the cylinder itself by any of the well known remote control mechanisms.

All of the apparatus referred to above is shown and described in the Horth Patent No. 2,727,696 to which reference may be had for a better understanding of the operation of the working parts of the mixer.

In mixing certain materials such as stiff mud for ceramic ware, shell sand, oil loaded core sands and the like, it has been found that the mixing action is impeded by the formation or agglomeration of a large mass of these materials adjacent the plow 70. Such a mass tends to be pushed or slid along the bottom or sides of the mixer crib without being mixed.

For the purpose of breaking up any such mass of material, there is provided, in accordance with the present invention and as shown in Figs. 1, 2 and 4, a crib extension or chamber 150 which is adapted to be opened to the interior of the crib 11 by means of a movable door or plate 151. More specifically, a generally rectangular opening or material outlet 152 is defined in the wall of the crib 11 at a location near the wearplate 26 and the crib extension 150 is secured to the crib 11 around the opening 152. The crib extension 150 includes a pair of spaced vertical walls 153 which are interconnected by a horizontal roof 154 and an inclined roof 155 and by a floor 156, the members 153, 154, 155 and 156 being welded together to provide a housing which is inaccessible from the outside of the crib. In order to facilitate fastening the crib extension 150 to the crib 11, the edges of the roof 154 and the floor 156 are respectively provided with upwardly and downwardly extending lips which are of generally arcuate shape to conform to the cylindrical surface of the crib. Each of these lips is provided with spaced apertures so that the lower or bottom lip may be secured to the peripheral flange 136 of the bedplate by means of the bolts 12 referred to above while the upper lip is secured to the crib wall by means of bolts 149 best shown in Fig. 4.

Inasmuch as the forward end 70*a* of the plow blade 70 passes by the opening 152, it will be appreciated that any material mass accumulated in front of this plow blade is exposed to the mouth of the crib extension 150. Such a mass of material is urged radially and outwardly around the end 70*a* of the plow 70 because of the centrifugal force imparted to the material by the rotating plow.

For the purpose of permitting the entry of a portion of any mass of material built up in front of the plow 70 into the crib extension 150 and for returning this material to the crib 11, the plate or door 151 is automatically opened just prior to the time when the plow 70 reaches the leading edge of the opening 152 and is automatically closed to push any material stored in the crib extension back into the crib as soon as the plow has been rotated beyond the trailing edge of the opening 152. Specifically, the plate 151 is fixedly secured at its upper edge to a rod 158 the ends of which are journalled within bearings carried on the side walls 153 at points near the top of the opening 152. The plate 151 is movable from a closed position represented by the solid lines in Fig. 2 wherein it is in substantial registry with the opening 152 to an open position represented by the broken lines in Fig. 2 wherein it extends into the crib extension and uncovers the opening 152. The plate 151 is arcuate in plan so that in its closed position it effectively forms a portion of the cylindrical wall of the crib and it is dimensioned to cover the opening 152. The height of the plate 151 is such that during its pivotal movement between closed and open positions, the bottom edge of the plate is slightly spaced from the arcuately shaped floor 156 and the side edges are spaced a small distance from the walls 153. It will be understood that when the plate 151 is moved to its open position within the crib extension 150 a portion of the mass of material in advance of the plow 70 flows into the crib extension. The material stored in the extension 150 is returned to the crib 11 when the plate is moved to its closed position since the plate functions to scrape off any material tending to adhere to the walls 153 or to the floor 156 of the crib extension.

In order to pivot the plate 151 between the described position, a fluid operated motor 160 is connected to the plate 151 and is automatically operated by means of a control circuit 165, illustrated in Fig. 5. Specifically, the motor 160, which may be either of the pneumatic or hydraulic type but which will hereinafter be described as a pneumatic motor, includes a cylinder 161 for housing a piston 162 driving a piston rod 163. The upper end of the piston rod 163 is provided with a stud 163*a* accommodated within an elongated slot 164*a* in a connecting arm 164, one end of which is fixedly secured to the rod 158. The effective length of the slotted arm 164 between the center of the rod 158 and the center of the stud 163*a* is thus free to change as the piston rod 163 is extended or retracted along a linear path, thereby to facilitate translation of the linear movement of the piston rod into rotary or pivotal movement of the arm 164.

When the piston 162 is in its lower position, shown in solid lines in Fig. 5, the arm 164 is in its lowermost position and the plate 151 is closed and, conversely, when the piston is in its upper position, shown in broken lines in Fig. 5, the arm 164 is in its upper position and the

plate is open. In order to move the piston, fluid, such as compressed air available from a supply line 166, is selectively admitted either to the upper or lower ends of the cylinder 161 by a valve 167. Specifically, ports 168 and 169 are provided in the upper and lower ends, respectively, of the cylinder 161 and these ports respectively communicate with fluid inlet conduits 170 and 171. The conduits 170 and 171 thus connect the upper and lower ends of the cylinder 161 with the valve 167 which may be operated to direct compressed air from the supply line 166 to either side of the piston 162. The valve 167 may be biased by a spring 172 or the like into the position illustrated in Fig. 5 wherein the conduit 170 is in communication with the supply line 166 through a curved passageway 173 defined in the valve body while, at the same time, the conduit 171 is vented to atmosphere through a curved passageway 174 defined in the valve body. In this position of the valve, air under pressure is applied to the upper side of the piston 162 in order to move the piston from its upper position to its lower position. The valve 167 is connected to a rotary solenoid 168*a* which, incident to energization, rotates the valve 90° against the action of spring 172 in a counterclockwise direction as viewed in Fig. 5, so that it moves from the position illustrated in Fig. 6 to the position shown in Fig. 7. When the valve is in the latter position the supply line 166 is in communication with the conduit 171 through the passageway 173 and the conduit 170 is vented to atmosphere through the passageway 167. Thus, air under pressure is applied through the conduit 171 to the underside of the piston 162, thereby causing the latter piston to move upwardly within the cylinder 161.

In order to synchronize the movement of the plate 151 with the movement of the plow 70, the solenoid 168*a* is energized through an electrical circuit including a cam operated switch 182 which is adapted to be closed by a cam follower 181 riding upon a cam 180 secured to the vertical shaft 107. Specifically, the cam 180 is configured to include a depressed ring-like portion 180*b* and a raised cam portion 180*a* which engages the cam follower 181 to pivot the latter into operative engagement with an operating button 182*a* of a microswitch 182 for a predetermined interval of each revolution of the shaft 107. The engagement of the button 182*a* by the cam follower 181, of course, closes the contacts of the microswitch 182 and completes an energizing circuit from an electrical power source 183 to the winding 184 of the solenoid 168*a*, thereby to move the valve against the action of biasing spring 172 from the position illustrated in Fig. 6 to the position illustrated in Fig. 7. The cam portion 180*a* is so oriented on the shaft 107 that the microswitch contacts are closed to operate the solenoid 168*a* and thus rotate the valve 167 in order to raise the piston 162 and open the door 151 just prior to movement of the plow 70 past the leading edge of the opening 152. The length of the cam portion 180*a* is such as to permit the plow means 70 to pass beyond the opening 152 before the circuit to the winding 184 is broken to lower the piston 162 and return the door 151 to closed position. When the door 151 is closed the material stored in the crib extension 150 is ejected to a position in back of the plow 70 so that it will be crushed or mixed by the muller wheel 32 which follows this plow. In this manner, the mass returned from the crib extension will be broken up and mixed with the granular material remaining in the crib.

In operation, the plow 70 is rotated within the crib 11 by the shafts 36 and 107 with the result that any mass of material built up adjacent to plow 70 is moved along the cylindrical wall of the crib 11. Assuming that the plate 151 is in registry with the opening 152 and that the valve 167 is in the position indicated in Fig. 6, when the plow 70 is located a few degrees in advance of the leading edge of opening 152, the cam portion 180*a* causes the follower 181 to close the microswitch 182 in order to complete the circuit to winding 184. The valve 167 is thus moved into the position indicated in Fig. 7 in order to raise piston 162 and pivot connecting arm 164 in a clockwise direction as viewed in Fig. 4. The rod 53 is thus turned to cause the door 151 to be moved to its open position wherein it extends into the crib extension 150 as indicated by the boken lines in Fig. 2. When the mass of material rotating with the blade 70 is moved past the opening 152, a portion of this mass is urged by centrifugal force into the crib extension 150 and, more particularly, into the space defined by the plate 151, the walls 153 and the floor 156.

As the plow 70 is moved past the opening 152, the cam follower 181 rides along the cam portion 180*a* so that the door 151 remains in open position until the plow passes beyond the trailing edge of the opening 152. Any large mass of material trapped between the forward edge 70*a* of the plow and the trailing side wall 153 of the crib extension will be sheared and broken up as the edge of the plow passes the trailing edge of the opening 152. It will be appreciated that the flow of a portion of the mass into the crib extension effectively reduces the size of the mass adjacent to the plow 70 with the result that the latter mass is broken up so that it is either reduced to a size which can be acted upon by the plow and mullers 32 or can be further reduced by the crib extension during the next succeeding revolution of the plow 70.

After the plow moves beyond the opening 152 she follower is moved into engagement with the depressed cam portion 180*b* thereby causing the microswitch 182 to open. When the microswitch 182 is opened, the circuit to winding 184 is broken and the solenoid 168*a* is deenergized and returned by the spring 172 to the position illustrated in Fig. 6. The piston 162 is thus urged downwardly to pivot the arm 164 in a counterclockwise direction as viewed in Fig. 4, thereby moving the plate 151 to its closed position and pushing the portion of the mass housed within the crib extension 150 back into the crib 11 for further mixing by the mullers 32. Thus, once every revolution of the plow, the mass located in front of the plow 70 is broken down by shearing off and removal of a portion of the mass and that portion is thereafter commingled with the balance of the material in the crib by the mullers 32.

In the event that material having relatively slight agglomerating tendencies is being mixed, it may not be necessary to operate the motor 161 during every revolution of the plow. Therefore, even though no serious disadvantages are introduced by such frequent operation of the motor, it may be desirable in mixing such materials, to adjust the circuit 165 to operate once every other revolution or once every third revolution.

It will also be understood that the electrically operated valve 167 can be replaced by a valve operated directly from the shaft 107. Such a valve, as is shown in Fig. 8, might take the form of a slide valve having a valve plug movable by the cam 180 and operable in its different positions to direct fluid to the motor 160 in exactly the same manner as the valve 167. The slide valve, which is generally indicated by reference numeral 190, includes a valve bore 191 defined within a valve body 192. A piston 193 is slidably mounted within the valve bore 191 for the purpose of controlling the flow of fluid from the inlet line 166 to the fluid operated motor 160. Specifically, inlet line 166 opens to the valve bore 191 in an inlet port 194 while fluid conduits 170 and 171 communicate with the valve bore through ports 195 and 196, respectively. An outlet line 197 opening to the bore 191 through port 198 is connected to the sump in order to return fluid passing from the outlet side of the motor 160.

The piston 193 is adapted to be reciprocated with the valve bore 191 by means of the cam 180 which has been described above and, to this end, the right hand end of the piston as viewed in Fig. 8 is provided with an axial stem or rod 199 having its free end riding upon the cam 180. The piston is urged towards the right by a biasing

spring 200 which functions to bias the stem 199 into engagement with the surface of cam 180. When the raised cam portion 180*a* engages the stem 199, the piston 193 is moved to the left so that it occupies the position shown in Fig. 8. At this time the inlet port 194 is connected to port 196 as, for example, through an annular groove 201 in the periphery of the piston. Fluid under pressure is thus delivered through conduit 171 to the underside of piston 162 which is, therefore, raised within the cylinder 161 to pivot the arm 164 in a clockwise direction as viewed in Fig. 8 and, hence, to move the door 151 to open position. The upper side of piston 162 is connected to sump through conduit 170, ports 195 and 198, annular groove 202 in the piston and exhaust line 197. Again, the cam 180 is positioned to open the door 151 just prior to movement of the plow 70 past the leading edge of opening 152.

The door remains open until the plow moves past the opening at which time the stem 199 moves into engagement with the depressed portion 180*b* of the cam 180. The piston 193 is then moved to the right under the influence of spring 200 at which time the lower side of piston 162 is connected to sump through conduit 171, port 196, passageway 203 in the valve piston, port 198 and exhaust line 197. The upper side of the piston 162 receives fluid under pressure from line 166 through port 194, through passageway 204 in the piston, through port 196 and through conduit 170. The piston 162 then moves downwardly within the cylinder 161 to pivot arm 164 in a counterclockwise direction, thereby closing the door 151 and returning the material in the crib extension to the main crib in the manner described above.

In certain installations it may be desirable to dispense with the automatic operation of the door 151 and to permit its manual operation instead. In such instances a manually operable valve can be employed to control the fluid flow to the motor 160 or, as is shown in Fig. 9, a manually operable switch 210 may be used in place of the automatically operated switch 182 shown in Fig. 5. The switch 210 may, of course, be employed to operate the valve 167 in the manner described previously.

In accordance with another embodiment of the present invention shown in Figs. 10 and 11, the pivoted plate 151, the pneumatic piston motor 160 and the control circuit 165 may be completely eliminated. In this embodiment of the invention the construction of the crib extension 150 is substantially modified and the location of the opening 152 is changed. Specifically, the opening in the crib wall, which opening in Fig. 11 is designnated by reference numeral 220, is located well above the wear-plate 26 and a crib extension 221 is secured to the crib wall to cover the opening 220.

The crib extension 221 includes a pair of spaced apart side walls 224 and a single horizontal roof 222 but, in contrast to the floor of the crib extension 150 described above, the floor 223 of the crib extension 221 may be planar and is inclined somewhat with respect to the vertical. By this construction, the mass built up in front of the plow 70 is forced upwardly and outwardly into the crib extension 221 and is stored within the crib extension by the force applied to the mass through the plow and through centrifugal force. Again, the forward end 70*a* of the plow 70 cooperates with the trailing edge of the opening 220 to shear the mass carried by the plow so that the sheared off mass portion is forced into the crib extension. Immediately after the mass of material carried by the plow 70 has passed beyond the opening 220, that portion of the mass contained within the crib extension flows along the floor 223 and is returned to the crib by gravity.

While several embodiments of the present invention have been shown and described, it will be understood that various modifications may be made which are within the true spirit and scope of the invention as defined in the appended claims.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. In a mixer having a rotatable muller and a rotatable plow co-operable to mull material within a crib having an apertured wall, means for breaking up a mass of material built up in front of the plow comprising a crib extension covering the aperture in said wall, a pivoted closure adapted to be moved into a first position in registry with said aperture and into a second position extending into said crib extension, and means operable in synchronism with the rotation of said plow for moving said pivoted closure into its second position at a predetermined period prior to passage of said plow past said aperture, thereby to permit a portion of said mass to enter said crib extension, and for moving said pivoted closure into its first position after passage of said plow beyond said aperture, thereby to force said portion of said mass back into said crib for commingling with the material in the crib.

2. A mixer comprising a crib for accommodating material to be mulled and having a floor and a wall, means defining an opening in said wall, a plow movably mounted relative to said crib and having an end portion movable adjacent said wall, a crib extension in communication with said opening, a closure movable relative to and within said extension means, said closure being movable to a first position to close said opening and to a second position in which the closure is displaced from the opening, and means operable in sychronism with the rotation of said plow to move said closure from said first position to said second position prior to the passage of said plow past said opening to permit entry into said crib extension of a portion of any mass of material carried by the plow, the last named means also being operable to move said closure from said second position to said first position to permit the discharge of the portion of material in the crib extension back into said crib for commingling with the remaining material in said crib.

3. The mixer of claim 1 wherein said crib extension includes a pair of side walls and a bottom and said closure includes a pivoted plate having opposed side edges movable adjacent said side walls together with a bottom edge movable adjacent said bottom in order to scrape off any material tending to adhere to said side walls or to said bottom.

4. The mixer of claim 1 wherein the means for moving the closure includes a fluid operated motor and means operable in synchronism with the rotation of the plow for controlling admission of fluid to said motor.

5. In a mixer having a muller and a plow co-operable to mull material within a crib; means for breaking up a mass of material built up in front of the plow and comprising means defining an opening in said crib, a crib extension having a mouth in communication with said crib opening, closure means movable into a first position in which the mouth of the crib extension is closed and into a second position within said crib extension, and means for moving said closure means into its second position to permit entry of a portion of the material of said mass into said crib extension and for moving said closure means from its second position to its first position after said plow passes said opening to eject said portion as a mass from the crib extension back into the crib, wherein the means for moving the closure means comprises a fluid operated motor operatively connected to the closure means together with means for controlling the flow of fluid to said motor to effect the movement of the closure means between said positions.

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