

Aug. 4, 1942.

C. BRYNOLDT

2,292,196

FORCE FEED APPARATUS

Filed Nov. 14, 1940

2 Sheets-Sheet 1

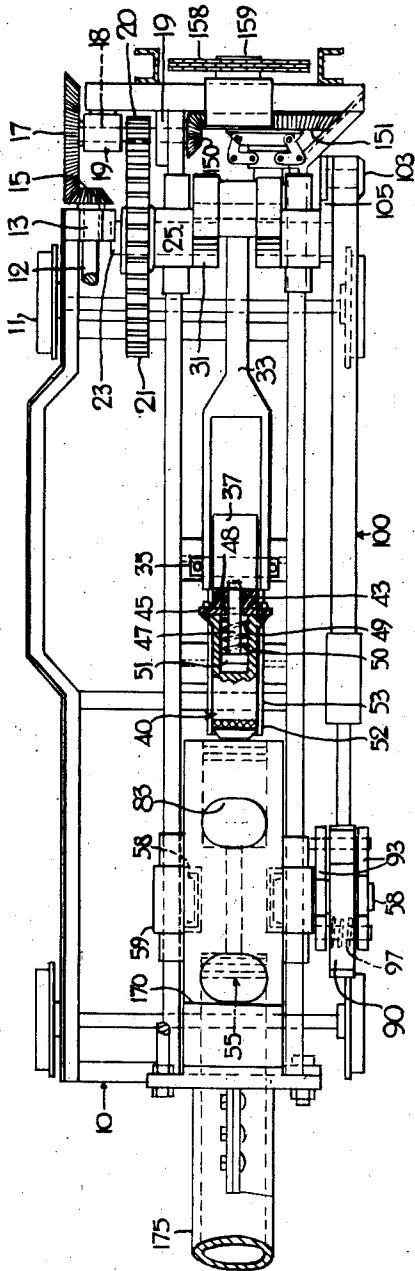


Fig. 1.

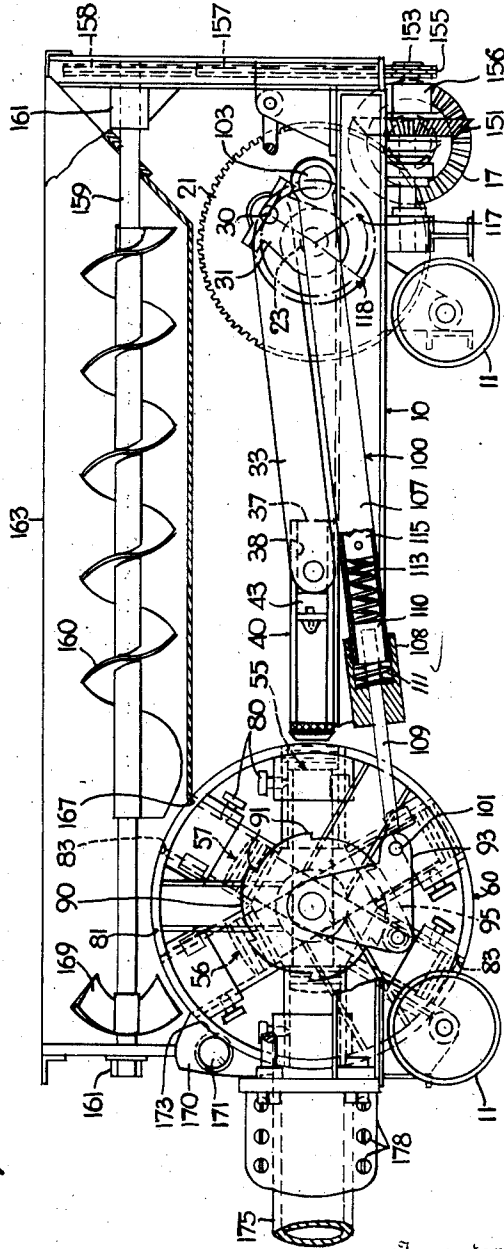


Fig. 2.

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2 Sheets-Sheet 2

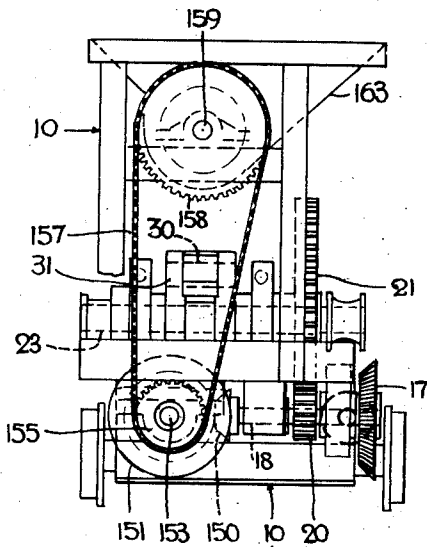


Fig. 3.

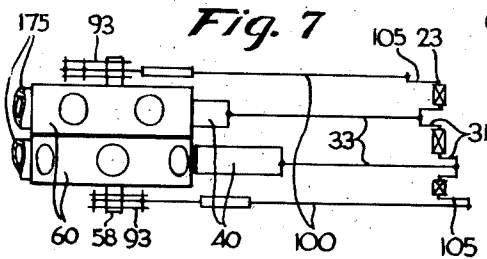


Fig. 7.

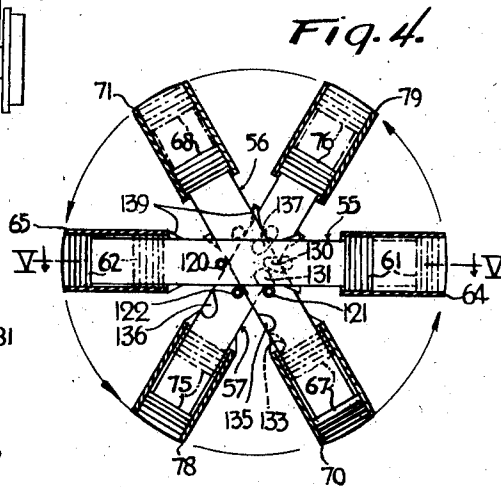


Fig. 4.

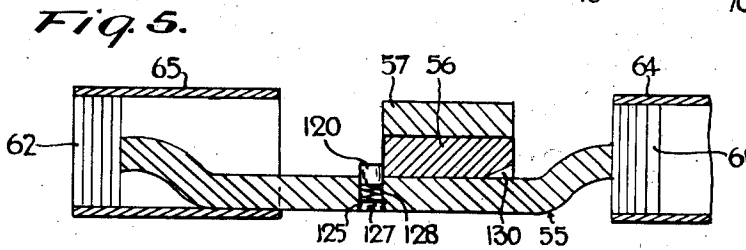


Fig. 5.

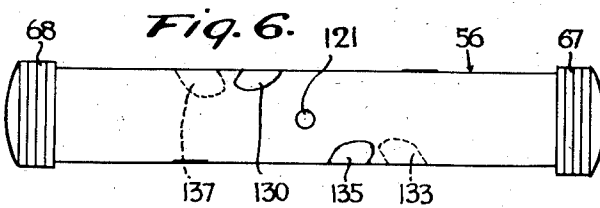


Fig. 6.

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UNITED STATES PATENT OFFICE

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FORCE FEED APPARATUS

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11 Claims. (Cl. 221-103)

This invention relates to apparatus of the force feed type, and it has particular relation to apparatus for feeding under pressure various materials, such as concrete, plastic or viscous material, fluid, and the like.

One object of the invention is to provide an improved apparatus to minimize motion and increase the capacity of force feed mechanism.

Another object of the invention is to provide an improved force feed apparatus of the piston and chamber type in which suction stroke action affecting the materials to be fed is not present.

Another object of the invention is to provide an improved force feed apparatus in which inlet and outlet flow of material is controlled without the use of valves.

Another object of the invention is to provide an improved force feed apparatus of the piston and chamber type wherein the piston is always operated in the same direction in successive cycles of operation.

In the art of building pumps, such as those suitable for forcing or conveying concrete through conduits, disadvantages have been encountered because of the resistance, wearing effect, and nature of the materials conveyed. In certain well known types of concrete pumps, reciprocating pistons have been operated at relatively high speeds in order to secure required capacity for handling the materials passing therethrough. In these pumps the material is passed through valves or otherwise into a pressure chamber by suction, or by other known means, during the back stroke of such piston, and is expelled by the piston under pressure during the forward or pressure stroke thereof. Valves which have heretofore been used to control the inlet and outlet passages to the pressure chamber were subject to excessive wear, and it was difficult to maintain them in proper operating condition.

According to the invention herein described, material to be conveyed is delivered over the side or into the rear portion of a suitable hopper, which can be of such height as to be capable of receiving material directly from vehicles, such as trucks. A conveyor in the hopper feeds the material to a revolving unit of ejector or pressure chambers which successively register with a portion of the hopper and are provided with pistons adapted to discharge the material therefrom after the filled chambers have been rotated to a position out of registering relation with the hopper. These pressure chambers and pistons are double ended, and an actuating mechanism forces each piston forwardly to discharge its load once at in-

tervals of 180 degrees of rotation of the unit of cylinders or chambers. As many double ended units can be employed as desired and intermittent rotating mechanism synchronized therewith is provided for successively registering the chambers with the hopper and discharging the material therefrom.

In discharging the material from the chambers, each piston unit moves forwardly in its turn and is held automatically in its forward position until the chamber has been rotated to its next position away from the position of discharging. Likewise the piston is automatically released before it is again actuated forward at the completion of the succeeding 180 degrees of rotation.

If desired, two or more cylinder blocks can be employed in side by side relation and supplied with material from a common hopper. These blocks can be rotated alternately at proper intervals to register with separate discharge conduits and with separate piston actuating elements operated by suitable driving means. In such an arrangement, the output of the apparatus can be increased, or one cylinder block can be operated while the other remains inactive. The diametrically opposed chambers of each unit can be arranged in sets of four, six, or any other number deemed practicable.

In the drawings:

Fig. 1 is a fragmentary plan of an apparatus in which the invention has been incorporated, and from which upper structural portions are omitted for the sake of clearness; Fig. 2 is a fragmentary side elevation of the structure shown in Fig. 1; Fig. 3 is an end elevation of the apparatus shown in Fig. 2; Fig. 4 is a diagrammatic vertical section of pressure or ejector chambers with pistons disposed therein; Fig. 5 is a fragmentary cross section, on a larger scale, taken substantially along the line V-V of Fig. 4; Fig. 6 is a plan of one of the double ended plungers employed in the structure shown in the other figures; and Fig. 7 is a diagrammatic plan of another arrangement of cylinder blocks and actuating mechanism.

In practicing the invention, a machine frame 10 is provided with flanged wheels 11 which can be operated upon suitable tracks or rails (not shown), or the entire frame can be incorporated as a part of a convenient type of transportation vehicle, or it can be a stationary unit.

A motor driven shaft 12 is rotatably carried in bearings 13 that are formed in the frame 10 and a bevel gear 15 at the outer end of the shaft meshes with a larger bevel gear 17 rigidly secured on one end of another shaft 18 which has bearing

supports 19 rotatably carrying it in the frame. A smaller gear 20 rigidly carried by the shaft 18 meshes with a larger reduction gear 21 which is rigidly carried upon a transverse crank shaft 23. Bearing supports 25 in the frame rotatably support the crank shaft and an intermediate crank pin 30 forming a rigid portion of twin crank arms 31 on the shaft provides a pivotal connection for one end of a pitman 33. The other end of the pitman has a pivotal connection 35 securing it to a crosshead 37 that is slidably mounted in a guide 38 (Fig. 2) formed in the rear portion of a reciprocable ram or plunger actuator 40.

A resilient compression element 43 disposed between the crosshead and an end wall 45 of the ram is held in place by means of a rod 47 that has one end screwthreaded into the crosshead and extends rigidly therefrom through an opening 48 in the wall and partially into a chamber 49 formed longitudinally in the actuator. A compression spring 50 is confined in the chamber between the end wall 45 and a head 51 on the end of the rod 47. The actuator 40, together with the crosshead 37, is slidable longitudinally and horizontally upon stationary guides 52 formed in the frame structure of the apparatus.

The actuator 40 is registerable with any of a plurality of plunger or piston units 55, 56 and 57 mounted radially or diametrically in a cylinder block 60 that has oppositely extending shaft sections 58 that rotatably support the block in suitable bearings 59 in the frame 10. The piston unit 55 has piston heads 61 and 62 at its opposite ends that are slidable in ejector chambers or cylinder sections 64 and 65, respectively, of the cylinder block. The second piston unit 56 likewise has piston heads 67 and 68 at its opposite ends that are slidably mounted in ejector chambers or cylinder sections 70 and 71, respectively. The third piston unit 57 has piston heads 75 and 76 at its opposite ends that are slidably mounted in ejector chambers or cylinder sections 73 and 79, respectively, of the cylinder block. The ejector chambers are rigidly mounted in the cylinder block by means of fasteners 80, such as set screws, or the like. Intermediate portions or shanks of the plunger units 55 and 57 are offset in opposite directions between the heads thereof, and the intermediate portion or shank of the plunger unit 56 is substantially straight and is slidable between these offset portions. Each plunger extends substantially diametrically of the rotary block and its opposite heads are slidable in the diametrically opposite and axially aligned pressure or ejector chambers in which they are slidably mounted. Thus a double headed plunger and two diametrically opposite and axially aligned ejector chambers, which may be termed double headed or double ended ejector structure, constitute a unit operable by actuation of the plunger actuator 40. An annular member 81 having radial openings 82 registerable with and forming a part of the ejector chambers constitutes an outer rigid structural element of the cylinder block.

In response to the forward stroke of the actuator 40, the latter forces the plunger unit 55 from its broken line position (Fig. 4) to its full line position. The ejector chamber 64 is thus opened and the opposite ejector chamber 65 of the unit is concurrently closed by movement of the piston head 61 to its extreme outer position.

The outer end of the stud shaft 58 of the cylinder block 60 is provided with a ratchet wheel 90 rigid therewith, and six ratchet teeth 91 are

formed on the ratchet wheel to correspond to each of the six cylinder sections 64—65, 70—71 and 78—79. A pawl support 93 is suspended in pivotal relation on an end portion of the stud shaft 58 and is provided with a pawl 95 engageable with the teeth 91 and also is constantly urged against the toothed portion of the ratchet wheel by means of a spring 97.

A ratchet actuating connecting rod 100 has a pivotal connection 101 at one end thereof securing it to the pawl support 93 and has a similar pivotal connection 103 securing its other end to a second crank arm 105 of the crank shaft 23. The latter crank arm extends rigidly from the crank shaft 23 in a position offset axially and angularly from the double crank arm 31. The connecting rod 100 is sectional and one section 107, which is hollow, has a larger cylindrical portion 108 threaded upon the inner end thereof for slidably receiving the other section 109 which has a head 110 thereof slidably mounted in the hollow section. A compression spring 111 is disposed in the cylinder 108 between one side of the head 110 and the bottom of the cylinder, and a second compression spring 113 is disposed between the other side of the head 110 and a block 115 secured in the hollow section 107. The connecting rod 100 is thus cushioned in both forward rearward strokes.

In operating the plunger 40 by counter-clockwise rotation of the crank shaft 31 (Fig. 2), it will be noted that during forward movement thereof the pawl 95 moves in a clockwise direction. When the axis of the crank pin 30 reaches the position indicated at 117, in its counter-clockwise travel, the plunger actuator 40 again will have reached the position indicated in the full lines; that is, it will have been retracted to a position outside the cylinder block 60. During this operation the pawl support 93 is moved in a clockwise direction until the pawl 95 snaps behind one of the ratchet teeth 91, and when the axis of the rod connection 103 reaches the position indicated at 118 (Fig. 2), the pawl begins to rotate the cylinder block 60 in a counter-clockwise direction and continues such action until the cylinder block has traversed 60 degrees, or one-sixth of one revolution. In the successive cycles of operation, as described, the plunger units in the ejector chambers are successively brought into registering relation with the plunger actuator and are operated thereby. The plunger units are thus successively moved forwardly always in the same direction, although the position of each plunger unit in the block 60 is reversed after 180 degrees of rotation of such cylinder block.

The plunger units 55, 56 and 57 are provided intermediate their ends with detents 120, 121 and 122, respectively, which are slidably mounted in tapped openings 125 in the shanks of the plunger units. Plugs 127 are threaded into the openings 125 in such position that each plug is flush with the surface of the shank in which it is mounted. A coil spring 128 is connected to each plug and its adjacent detent in such manner that the detents normally stand out beyond the surfaces of the plunger shanks, although they can be depressed until they are flush with such surfaces.

In the position of the pressure or ejector chambers as indicated in Fig. 4, the plunger unit 55 has been moved from right to left from its broken line position to its full line position. Before the start of such movement, the detent 120 is in registering relation with an incline or cam surface

130 formed in the shank of the plunger unit 56. In this movement the detent 120 is depressed by such cam surface until it has passed and has snapped behind the left side of the plunger shank 56 and such side provides a stop against which the detent rests to prevent backward movement of the unit 55. After the cylinder block 60 has been rotated through an angle of 60 degrees from the position shown in Fig. 4, the detent 121 operates in the same manner with respect to a cam surface 131 formed in the shank of the plunger unit 55 and snaps behind the shank edge opposite the cam surface 131. Likewise, the detent 122 operates in the same manner with respect to a cam surface 133 formed on the shank of the plunger unit 56. When the detents snap behind the edges of the shanks opposite the cam surfaces the piston heads on such shanks are prevented from backing up for a predetermined period after the plunger actuator 40 has begun its back stroke.

After the three detents 120, 121 and 122 have been operated in the manner described, the block of pressure or ejector chambers will have moved through 180 degrees of rotation. Then the first plunger unit 55 will again be disposed in registering relation with the plunger actuator 40, although the actuator will strike the piston head 62 instead of the piston head 61. The detents will continue to operate in the manner previously described with reference to additional cam surfaces 135, 136 and 137 formed on the shanks of the plunger units 56, 57 and 58, respectively, and with reference to the edges of the shanks opposite these cam surfaces. That is, after the three plunger units have been operated as specified, the cylinder block containing the units will have been rotated through an angle of 120 degrees and the next step of the operation, including the succeeding 60 degrees of rotation of the cylinder block, will bring the unit 55 again into linear registering relation with the plunger actuator 40, but at a position 180 degrees from the position of the first described actuation of this plunger unit 55. After the plunger units 55, 56 and 57 have been successively rotated 180 degrees, along with the rotation of the cylinder block 60, the relative movement of these plunger units is such as to bring the detents 120, 121 and 122 successively into registration with the cam surfaces 135, 136 and 137, respectively, and thus, successively free them from the temporary locked relation that had prevented the backing up of each plunger unit at least until the succeeding plunger unit had discharged its load from its cylinder. Thus the plunger units are successively operable without interfering with one another and these units are prevented from backing up after forward actuation thereof until a succeeding operation has occurred. Stops 139 are also formed on the edges of the plunger units to prevent the piston heads from accidentally extending too far through the respective ejector chambers.

The end of the shaft 18 opposite the bevel gear 17 is provided with a second and smaller bevel gear 150 which meshes with a larger reduction bevel gear 151 for driving a shaft 153 upon which the latter gear is rigidly mounted. The outer end of the shaft 153 rigidly supports a sprocket 155 and an intermediate portion of the shaft is rotatably carried in bearing supports 156 in the frame 10. A sprocket chain 157 trained about the sprocket 155 is also trained about an upper sprocket 158 that is rigidly secured upon a shaft 75

159 of a horizontally disposed screw conveyor 160. Conventional bearings 161 carry the conveyor 160 in the apparatus frame, and a hopper 163 in which the conveyor operates is also formed in the upper portion of the apparatus frame.

In the operation of the apparatus, materials are fed into the hopper 163 in a suitable manner and the screw conveyor 160 supplies the materials to a pair of the ejector chambers which are open and register through an opening 167 formed therein with one end portion of the hopper. The upper portion of the cylinder block 60 fits slidably but in tight relation with the portion of the hopper forming the opening to prevent leakage of the materials. It will be noted that the ejector chamber nearer or facing the screw conveyor 160 is inclined upwardly toward the latter to facilitate the filling of the chamber. A paddle 169 formed on the end portion of the conveyor shaft 159 registers with the adjacent chamber while the first chamber is being filled, and such paddle operates to strike off the material adjacent the mouth of the ejector chamber with which the paddle registers. It will be understood that the ejector chambers 64, 70, 78, 65, 71 and 79 successively register with the screw conveyor and paddle in connection with the successive cycles of operation of the plunger actuator 40.

A strike off block 170 secured to the machine frame 10, as indicated at 171, has an edge portion thereof extending into the hopper and a curved surface 173 conforming to the curvature of the cylinder block and frictionally contacting the latter. This block 170 strikes off the excess material flush with the mouths of the filled ejector chambers and the curved face of the block extends from a position adjacent the mouths of the chambers as they register with the paddle 169 to a conveyor conduit 175 which is registerable with each ejector chamber at a position diametrically opposite the forward end of the plunger actuator 40.

The apparatus frame 10 is provided with suitable fixtures 178 for connecting the conveyor conduit in such manner that it registers in substantially fluidtight relation with the ejector chambers 65, 71, 79, 64, 70 and 78 as they are successively moved into registering relation therewith. The conveyor conduit 175 can be flexible, or any other construction desired. Since the strike off block 170 contacts the cylinder block along the area reaching from the hopper to the conveyor conduit 175, the material is confined in substantially fluidtight relation by this curved face of the block during the movement of each ejector chamber from its position of registering with the hopper to its position of registering with the conveyor conduit 175. At the latter position the plunger actuator 40 forces the piston heads to discharge the materials into the conduit. Although the pressure of the actuator 40 on the plunger units is exerted by forward movement of this actuator, the plunger units are relieved from all such pressure during the back stroke of the actuator. These plunger units are not affected by back pressure of the material which has been forced into the conduit 175 because of the operation of the detents 120, 121 and 122 which maintain the piston heads in forward positions until after the chambers have moved out of registering relation with the conveyor conduit.

Although there are three double headed plung-

ers 55, 56 and 57 shown in the drawings, these are only a convenient number and it is to be understood that the machine is operable with only one unit, or with more than the number shown. Likewise, if a greater volume of feeding is desired, or a plurality of conveyor conduits are desired, an arrangement including more than one rotatable cylinder block 60 can be employed, such as that shown in Fig. 7 in which two independently rotatable cylinder blocks 60 are operated by a common driven crank shaft 23 having cranks 31 and 105 so spaced as to cause the piston actuating rams 40 to be actuated alternately. Since the elements of Fig. 7 correspond substantially to those of the other figures already described, corresponding reference characters are employed and the previously set forth description applies thereto.

Although illustrative structure embodying the invention has been shown and described in detail, it will be apparent to those skilled in the art that the invention is not so limited, but that various changes can be made therein without departing from the spirit of the invention or from the scope of the appended claims.

I claim:

1. In an apparatus for feeding various types of material, a plurality of ejector chambers rotatable about a common axis, means for supplying the material to the chambers in one position incidental to the rotation thereof, a piston head in each chamber, means for operating each piston head in its chamber and discharging the material therefrom in another position incidental to the rotation thereof, and means operatively associated with said piston heads and responsive to relative movement thereof for temporarily locking the latter against backward movement immediately following the discharging operations.
2. In an apparatus for feeding various types of material, a plurality of ejector chambers having plungers therein and being rotatable about a common axis, supplying means for loading material into the chambers, actuating means engageable with each plunger to discharge material from each chamber, synchronizing mechanism associated with the actuating means for arresting rotation of the chambers while the actuating mechanism is actuating the plunger in any one of the chambers.
3. In a force feed apparatus, a double ended chambered member having a two-way plunger mounted therein and alternately movable to provide alternate open and closed chambered portions at opposite extremities thereof, means for intermittently reversing the position of the chambered member, supply means communicable with either end of the chambered member when the latter is open to supply material thereto, and means for actuating the plunger after the material has been supplied and thereby discharging the material from the chambered member.
4. In a force feed apparatus, a double ended chambered member having a two-way plunger mounted therein and alternately movable to provide open and closed chambered portions at opposite extremities of the member, means for successively reversing the position of the chambered member, supply means successively communicating with opposite end portions of the chambered member while such end portions are open to the supply means, and actuating means successively operable against the plunger ends to discharge material from one chambered portion and con-

currently opening the opposite chambered portion.

5. In a force feed apparatus, a member having chambered portions therein facing in substantially opposite directions, a plunger unit having opposite head portions movable in the chambered member for alternately opening and closing the chambered portions in opposite extremities thereof, actuating mechanism engageable with said plunger to operate the latter in the chambered member, means for alternately bringing the opposite chambered portions of said member into registering relation with said actuating mechanism, and means for feeding material to said chambered portions intermediate the positions of operations of said plunger.

6. In a force feed apparatus having mechanism for supplying material to be forced, a member having chambered portions facing in substantially opposite directions and adapted to receive material therein from the supply mechanism, a plunger unit extending from one chambered portion to the other and movable therein alternately to produce force feed strokes in said chambered portions, actuating mechanism engageable with said plunger unit to force the material from the chambered portions, and means for repeatedly bringing the extremities of the chambered member into registering relation with said actuating mechanism.

7. In a machine for feeding material capable of flowing, mechanism for supplying the material, a plurality of material receiving chambers substantially radially arranged about an axis of rotation and adapted to receive charges of material from the supplying mechanism, means movable intermittently in a direction to force the material from the chambers, and actuating mechanism operable upon said means only in a direction to force the material from the chamber, and devices operable to rotate the chambers intermittently according to the intermittent movement of said means.

8. In a force of feed mechanism, a pair of rotatable blocks, bearing means supporting the blocks in relatively rotatable relation, each block having chambered portions facing in opposite directions and adapted to receive material therein from a source of supply, a plunger unit extending from one chambered portion to the other in each block and movable therein, an actuating member for each block engageable with the plunger unit therein, and means operably associated with the blocks and actuating members for alternately bringing one actuating member into operable engagement with the plunger unit of one block while maintaining the other actuating unit out of operable relation with the plunger unit of the other block.

9. In a force feed apparatus, a plurality of ejector chambers rotatable about a common axis, means for supporting said chambers in their rotatable relation, means for supplying material to each chamber at a predetermined position in its path of rotation, a plunger operable in each chamber to discharge material therefrom in another position in its path of rotation, actuating means for operating each plunger in its chamber, and locking mechanism operatively associated with said actuating means and plunger for temporarily locking the plunger against backward movement following the discharging movement thereof and releasing the plunger from locked position before it reaches its succeeding discharging position.

10. In a force feed apparatus, a chambered device opening in substantially opposite directions for receiving material to be forced, a plunger unit in said chambered device extending from the chambered portion that opens in one direction to the chambered portion that opens in the opposite direction and said unit being repeatedly movable in said device to alternately open, and discharge material from, the opposite chambered portions, and actuating means movable repeatedly in a given direction and operatively associated with the plunger unit to actuate the latter in alternately forcing the material from one chambered portion and from the other chambered portion.

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11. In a force feed apparatus, a plurality of rotatable blocks, each block having chambered portions facing in substantially opposite directions and adapted to receive material therein from a source of supply, a plunger unit extending from one chambered portion to the other of each block and movable therein, actuating mechanism operatively associated with the plunger units for alternately forcing the plunger units slidably in the chambered portions in material-discharging relation, and means for alternately bringing the chambered portions of the rotatable blocks into operative relation with the actuating mechanism.

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