Dec. 19, 1961 M. E. TOBY 3,013,650

PUMP APPARATUS

Filed March 5, 1958 3 Sheets-Sheet 1

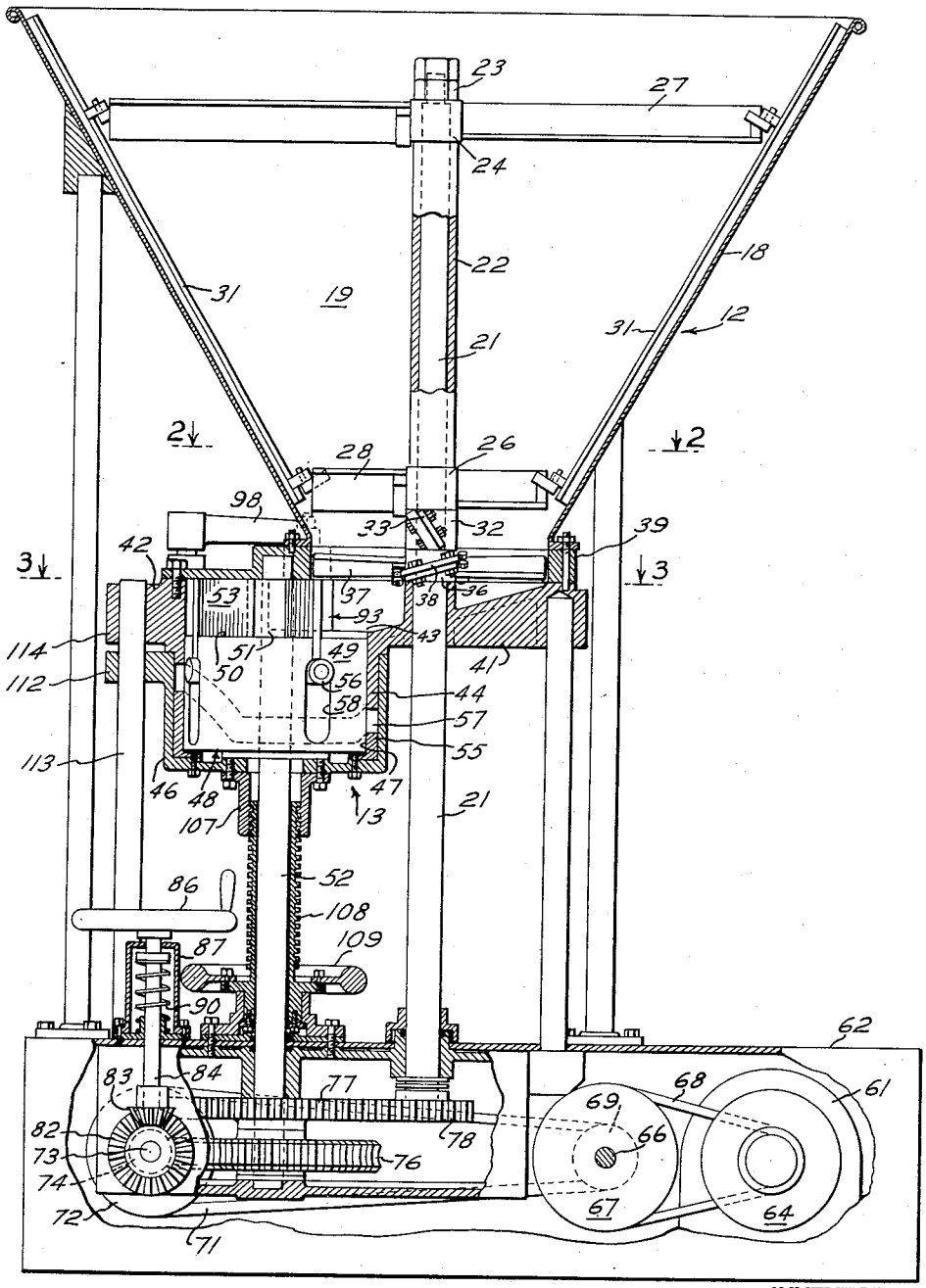

Fig. 1.

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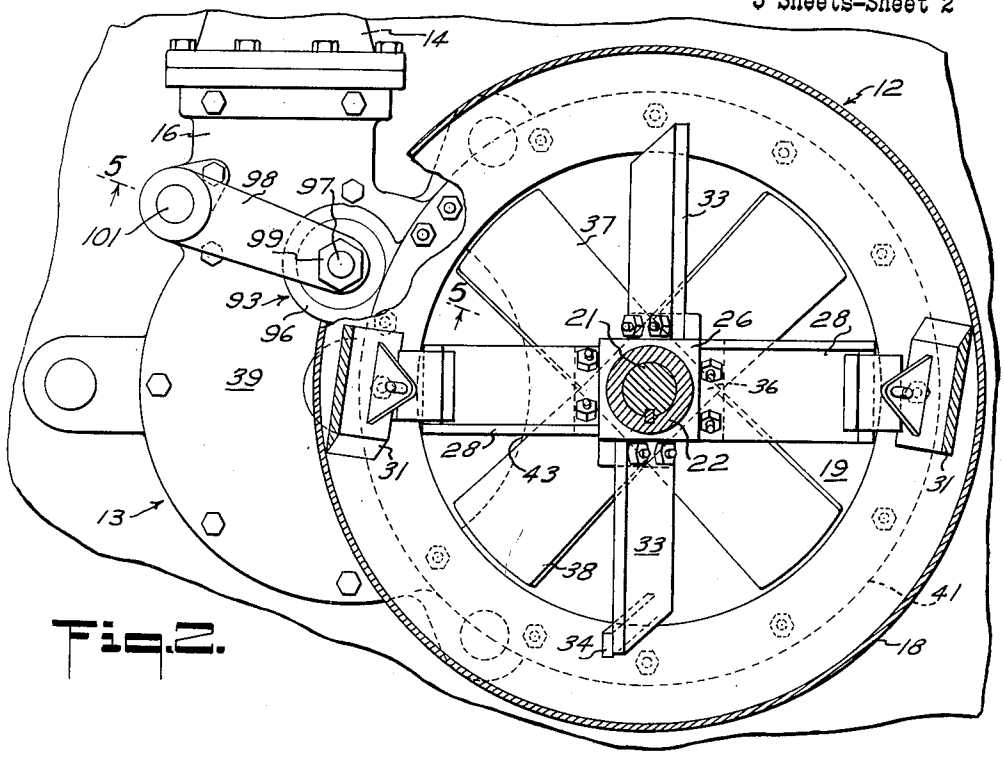

Fig. 2.

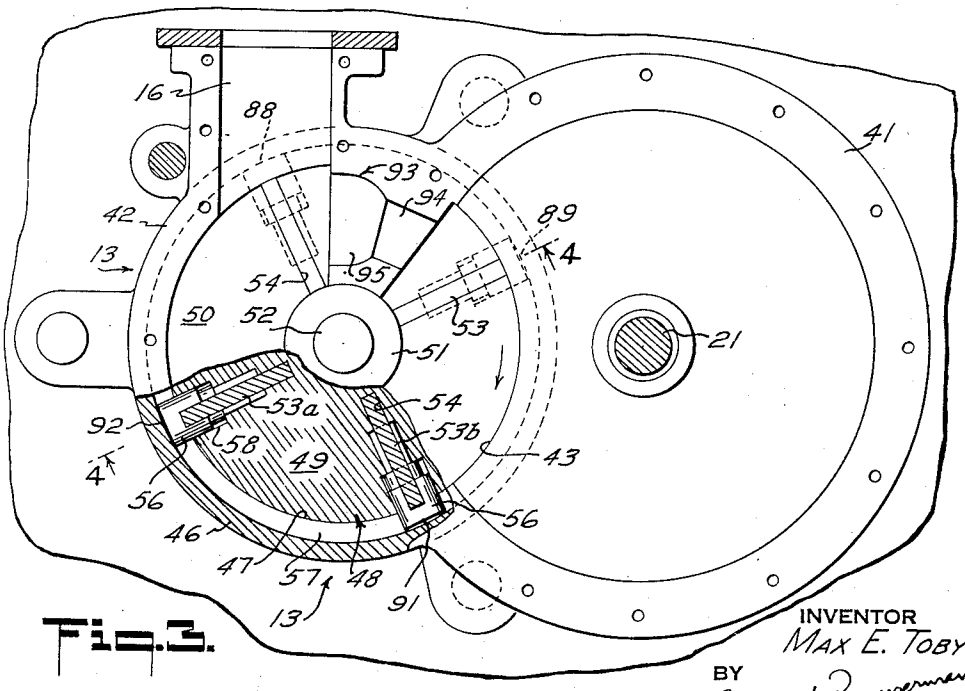

Fig. 3.

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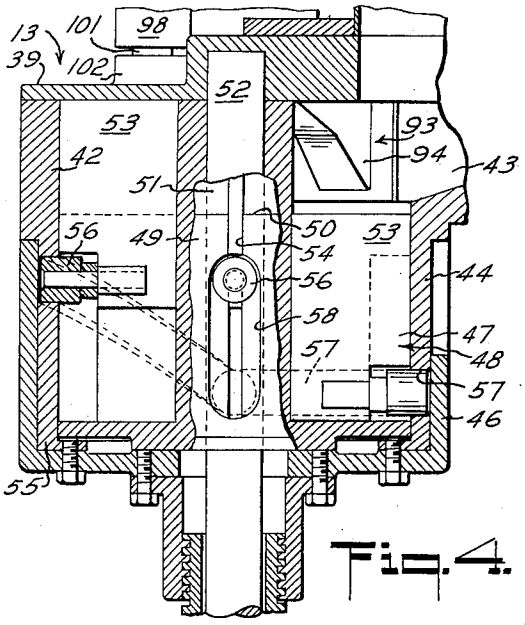
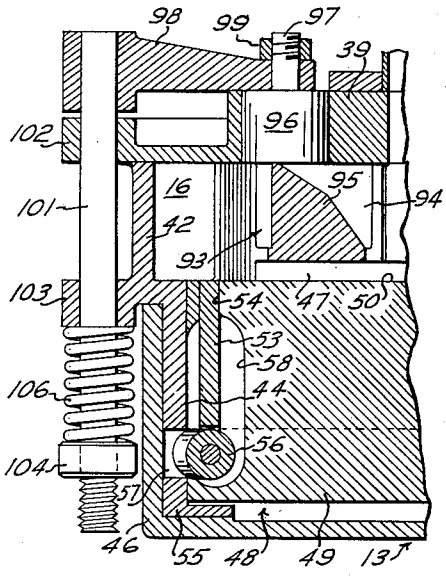


Fig. 4.

Fig. 5.



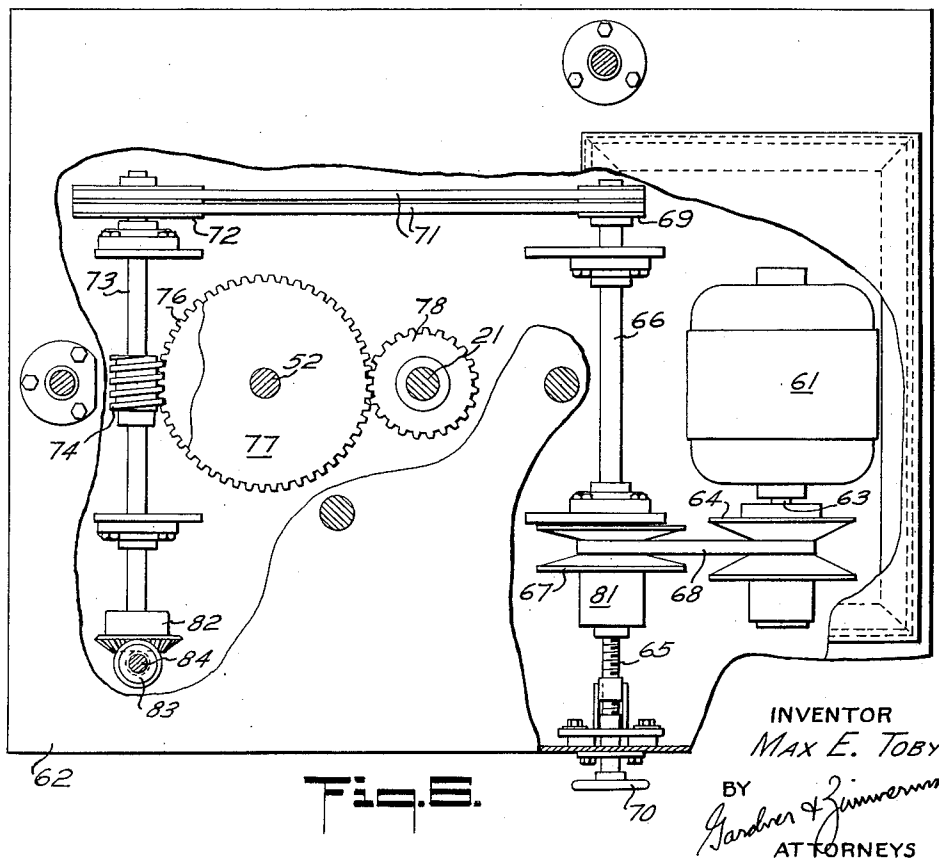


Fig. 6.

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3,013,650
Patented Dec. 19, 1961

3,013,650
PUMP APPARATUS

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Filed Mar. 5, 1958, Ser. No. 719,354
4 Claims. (Cl. 198—209)

The invention generally relates to pumps, and is more particularly directed towards apparatus capable of pumping relatively heavy and solid material such as ground meat, sawdust and the like.

In many instances, it is desirable to pump solid particles under pressure through a conduit. Heretofore, a number of different types of pumps have been developed, including pumps having a plurality of vanes movable radially inwardly and outwardly of the pump shaft to effect a movement of the material through the pump. However, these pumps have not proven to be adequate for a number of reasons, including their inability to feed the material into the pump, their difficulty of proper servicing or cleaning, etc.

It is accordingly an object of the present invention to provide apparatus for pumping ground meat or similar solid products in which a movable vane pump is utilized, with the vanes thereof being movable upon pump rotation in a direction parallel to the axis of such rotation.

Another object of the invention is to provide apparatus of the character described in which means are provided for feeding material towards the pump and in which the pump vanes engage such material exteriorly of the pump housing and cause the material to enter the pump.

A further object of this invention is to provide apparatus of the type referred to in which the parts may be readily disassembled for cleaning or other operations.

Yet an other object of the invention is to provide a pumping system for relatively solid material incorporating a novel by-pass system whereby the discharge pressure may be selectively and accurately controlled.

Another object of the invention is to provide a pump of the type described in which the respective vanes commence moving downwardly into operative position at the time its preceding vane has moved to its lowermost position, thereby providing for constant flow without pulsation.

The invention possesses other objects and features of advantage, some of which, with the foregoing will be set forth in the following description of the preferred form of the invention which is illustrated in the drawings accompanying and forming part of the specification. It is to be understood, however, that variations in the showing made by the said drawings and description may be adopted within the scope of the invention as set forth in the claims.

Referring to said drawings:

FIGURE 1 is a vertical cross-sectional view of the apparatus of the present invention, shown on a reduced scale.

FIGURE 2 is a horizontal cross-sectional view taken substantially in the plane indicated by line 2—2 of FIGURE 1.

FIGURE 3 is a horizontal cross-sectional view taken substantially in the plane indicated by line 3—3 of FIGURE 1.

FIGURE 4 is a vertical cross-sectional view through the pump housing, the plane of the view being indicated by line 4—4 of FIGURE 3.

FIGURE 5 is a vertical-cross-sectional view through another portion of the pump housing taken substantially in the plane indicated by line 5—5 of FIGURE 2.

FIGURE 6 is a top plan view of the drive mechanism for the pump apparatus.

In broad terms, the apparatus of the present invention is adapted to receive a quantity of a substantially solid

or viscous product such as ground meat, feed the same into a pump, and have the pump discharge the product in a smooth non-pulsating flow at a predetermined and preselected pressure. For carrying out the foregoing, and with reference to the drawings, there is provided a hopper, indicated by the numeral 12, and arranged to receive a quantity of material through the open top thereof. A pump 13 embodying the features of my invention is positioned adjacent the bottom of the hopper for receiving material therefrom and discharging the same under pressure into a discharge conduit 14 connected to the pump outlet 16.

When a pump is used for pumping liquid products, little difficulty is encountered in providing a proper feed supply to the pump, but it will be readily appreciated that pumping solid material presents additional problems, since a gravity feed system alone will not insure adequate material reaching the pump rotor for engagement and movement thereby. Accordingly, before setting forth the construction of the pump itself, certain details of the novel feed mechanism will first be discussed.

As best seen in FIGURES 1 and 2 of the drawings, the hopper 12 is of generally conical configuration with the wall 18 thereof diverging upwardly and outwardly and defining a chamber 19 having an open top for reception of the material and an open bottom for discharge of the same. A shaft 21 extends axially of the chamber to substantially the top thereof and is adapted to be rotated in a manner later to be described. A sleeve 22 is keyed to the upper portion of shaft 21, with a retaining nut 23 at the upper end of the shaft releasably preventing axial displacement of the sleeve. Sleeve 22 is provided with an upper and lower block 24 and 26 respectively and secured to each block is a pair of diametrically opposed blades, the upper blades 27 being inclined at angles of about 30 degrees and 45 degrees respectively from a vertical plane containing the shaft axis, with the planes of the respective blades of the pair defining an included angle of about 75 degrees. The lower blades 28 are similarly disposed, and it will be noted that all of the blades 27 and 28 extend substantially to chamber wall 18. The reason for the difference in blade pitch is to permit the one blade to knead the mass and get rid of air pockets, and the other blade to give the mass a downward component to force the same towards the pump inlet.

Secured to the distal ends of the blades is a pair of diametrically opposed scraper elements 31 extending substantially from the top to the bottom of the hopper and inclined in a plane parallel with the conical hopper wall 19, but with planes of the two scraper elements being offset approximately 15 degrees.

Directly beneath the block 26 there is freely mounted on the shaft 21 a block 32 to which is secured a pair of diametrically opposed baffles 33, each baffle being inclined at an angle of approximately 30 degrees from the vertical axis of the shaft 21, but with the planes of the two blades being offset about 60 degrees. The baffles extend substantially to the chamber wall, and as will be seen in FIGURE 2, the distal end of the baffle 33 engages a block 34 secured to the wall 18 whereby the baffle will remain stationary during rotation of the shaft and its attached blades and scraper elements, thereby shearing the product and avoiding danger of continuous recirculation of the product by the rotatable blades.

Abutting the lower portion of block 32 and keyed to the shaft 21 is a block 36 to which are secured two pairs of diametrically opposed blades 37 and 38 which rotate simultaneously with the blades 27 and 28. The two pair of blades 37 and 38 are inclined at an angle of about 15 degrees from a plane normal to the vertical axis of shaft 21, but with the planes of the opposed blades of each pair

offset approximately 30 degrees. It will be noted that the blades 37 and 38 occupy a circular aperture in a pump cover plate 39 for a purpose later to be explained, with such blades extending substantially to the inner wall of such aperture.

The hopper 12 is mounted for releasable attachment on the pump cover plate 39 by means of bolts extending therethrough and anchored at the outer periphery of a generally semicircular extension 41 of an upper pump housing 42. The extension 41 is located at the top of and extends from the right side of the upper pump housing 42 as seen in FIGURES 1 and 3, and is provided with a centrally located bore to accommodate the shaft 21. The upper surface of the extension 41 slopes radially inwardly and downwardly from a point on its periphery diametrically opposite the pump, and commences from a horizontal plane common with the top of the pump at an angle of approximately 15 degrees towards a generally semicircular inlet opening 43 which provides direct access to the pump 13 from the hopper.

The upper pump housing 42 is provided with a downwardly depending cylindrical portion 44, open at the top and bottom, the lower half thereof telescopically fitting into a cylindrical lower pump housing 46, the lower end of which is closed. In this manner, the upper and lower pump housings 42 and 46 define a pump chamber 47.

Positioned for rotation within the chamber 47 is a rotor member 48 generally consisting of a cylindrical block 49 of substantially the same diameter as the inner diameter of the chamber and extending from the lower closed portion of the lower housing 46 upwardly for about three-fourths of the height of the chamber to approximately the level of the lower portion of the opening 43 where its diameter is reduced to provide a transaxial shoulder 50 and an axial concentric sleeve 51 which continues to the top of the chamber adjacent the under surface of the cover plate 39, which, as previously explained, is bolted to the open top end of the upper pump housing 42. The sleeve 51 is mounted for rotation on the upper end of a shaft 52, and in order to effect a movement of product from the inlet opening 43 through the pump and to the outlet 16 the rotor member 48 is provided with a plurality of vertically moving cam actuated vanes 53 in a manner now to be described.

Provided on block 49 and extending from the outer periphery thereof radially inwardly to the outer periphery of the sleeve 51 are a plurality of slots 54 (four being here illustrated) which extend vertically downwardly from the shoulder 50 to within a short distance of the lower face of the block, and as will be noted, said slots are adapted to slidably receive the vanes 53. Rotatably mounted on the lower portion of each vane at its radial extremity is a cam follower or roller 56 which rolls in a cam track 57 defined between the lower open end of the upper pump housing and the upper end of a liner 55 in the lower pump housing, the space therebetween being substantially equal to the diameter of the cam follower 56. The slots 54 are enlarged at the outer periphery of the block as indicated at 58 to accommodate a portion of the cam followers 56. It will be noted in FIGURE 4 that the lower edges of the slot portions 58 terminate on a common plane with the slots 54. However, whereas the slots 54 extend to the shoulder 50 of the block 49, the slot portions 58 terminate a short distance below such shoulder providing a vertical guide for the rollers. It will also be appreciated that irrespective of the vertical position of the vanes, approximately one-third of each vane is always within its slot 54, thereby providing at all times sufficient support to maintain the vane in a vertical position regardless of the force applied thereto, such as by the material being pumped.

Means are provided for rotating the rotor 48 and thereby effect a vertical reciprocating movement of the vanes 53. As here shown, it will be noted that the shafts 21 and 52 are rotated through a gear train which may be either motor driven or hand operated in the following manner. A motor 61 is mounted in a housing 62 below the hopper and pump assembly. A drive shaft 63 extending from the motor is provided with a conical spring loaded variable speed sheave 64 which transmits power from the motor to a driven shaft 66 by means of a similar sheave 67 mounted at one end of the shaft 66 and connected to the sheave 64 by a belt 68. The other end of the shaft 66 has mounted thereon a double sheave 69 provided with belts 71 which extend to a larger double sheave 72 mounted at one end of another shaft 73. Secured to an intermediate portion of the shaft 73 is a worm gear 74 which engages a gear 76 mounted at the lower extremity of shaft 52. Journaled to shaft 52 immediately above the gear 76 is another gear 77 which meshes with a reduced gear 78 secured to shaft 21. To permit speed variations, sheave 67 may be adjusted by means of a threaded shaft 65 and a manually engageable hand wheel 70.

It will be apparent, therefore, that upon actuation of the motor, rotational power is imparted by means of the sheaves 64, 67 and belt 68 to the shaft 66 which in turn transmits power to the shaft 73 through the double sheaves 69, 72, and belts 71. Rotation of the shaft 73 and worm gear 74 rotates shaft 52 through the gear 76 thereby rotating gear 77 which, meshing with gear 78, rotates shaft 21.

There may be instances when it is desirable to rotate the shafts 21 and 52 manually, such as when disassembling the parts, and to effect such manual rotation, the shaft 73 has journaled at one end thereof a bevel gear 82 meshing at right angles with another bevel gear 83 secured to a vertically extending shaft 84, the upper end of which extends through the top of the housing 62 and has secured thereto a hand wheel 86. The hand wheel 86 and its associated gear 83 is normally retained in an elevated condition by a spring 90. To engage gear 83 with gear 82, the hand wheel is pushed downwardly until the bevel gears engage. Consequently, manual rotation of the shaft 84 imparts rotation to the shaft 73 through the bevel gears 82 and 83 to effect rotation of the shafts 52 and 21 in the manner previously described.

With the above description of the constructional details of the pump in mind, a disclosure of the operation of the pump will now be made. Solid material such as ground meat or the like is introduced into the open upper end of the hopper, and upon actuation of the motor, shafts 21 and 52 commence rotating, and since the sleeve 22 is keyed to the shaft 21, it likewise rotates, along with the upper and lower blades 27 and 28, and the interconnected scraper elements 31. The angular displacement of the blades 27 and 28 forces the meat downwardly in the hopper chamber 19, while the scraper elements 31 scraping the meat from the hopper wall 18 keep the meat moving toward the center of the chamber and therefore within the area where the blades 27 and 28 effectively force the meat downwardly toward the discharge end of the hopper.

As the meat is moved down below the lower blades 28, the relative movement between blades 28 and the subjacent stationary baffles 33 reduces the danger of the meat turning with the blades, and continued downward pressure on it from the meat above being forced down by blades 26 pushes the meat on down until the blades 37 and 38 engage the mass forcing it on down through the lower end of the hopper and into the opening 43 which provides access to the pump chamber 47.

Looking now especially at FIGURE 3, it should be noted that the vanes 53 of the pump member 48 are maintained in their lowermost position, due to the rollers 56 following the configuration of the cam track, from a point indicated by the numeral 88 to a point 89 positioned within the opening 43 which is substantially one quarter of the outer periphery of the pump. From the point 89, the vanes commence rising and just past the opening 43 the vanes reach their uppermost position as indicated by the numeral 91, disposed approximately 90° from the point 89. Thereafter the vanes continue their upper

level for another 90° to a point 92 where the vanes commence descending to their lowermost point at 88 which is substantially medial of the discharge conduit 16. It will therefore be apparent that as the meat is extruded from the discharge end of the hopper into the opening 43 of the pump, a vane will begin rising at point 89 which occurs substantially at the commencement of the opening 43, and as the pump member 48 rotates in a clockwise direction the rising vane will push the extruded meat before it. When a vane has reached its highest position at 91 it has passed the opening 43 so that the area between points 91 and 92 is substantially packed with meat, being contained within said area by two vanes 53*a* and 53*b* both of which are at the uppermost position. Continued rotation, however, causes the vane 53*a* to descend to its lowermost position at 88. The point 88 occurs at the pump outlet 16 allowing the meat which is still being moved around by the vane 53*b* to enter the pump outlet 16 into the discharge conduit 14.

Between the low points 88 and 89 there is provided a by-pass means 93 to allow excess meat which may build up at the pump outlet 16 to return to the opening 43 where it will again be moved by the vanes to the outlet. The by-pass means 93 includes a passage 94 in the upper pump housing 42 adjacent the pump outlet 16 to the opening 43. This passage 94 is normally maintained in a closed condition by means of a spring loaded cylindrical block 96 which extends through the pump cover plate 39 filling the passage 94 and normally engaging the relatively sharp upper end of a fixed baffle 95. A threaded stub shaft 97 is secured to the top surface of the block 96, and this stub shaft passes through a bore in one end of an arm 98 and is secured thereto by a nut 99. The other end of the arm 98 is secured as by set screws to the upper end of a vertical shaft 101 which is journaled in lugs 102 and 103 provided on the pump cover plate 39 and the upper pump housing 44 respectively. The lower end of the shaft 101 is threaded to receive a retaining nut 104 which selectively controls the compression of a spring 106 positioned between the lower lug 103 and the retaining nut 104. When excessive pressure builds up at the pump output 16 it will force the block 96 to move upwardly against the pressure of the spring 106 and away from baffle 95, thus opening the lower portion of the passage 94 in order to allow the meat to be bled off into the opening 43. In this manner, the setting of the spring pressure may accurately control the discharge pressure of the pump.

An important feature of the invention is the ease with which all elements which contact the meat may be disassembled for cleaning. In this respect it will be observed that the sleeve 22 which carries the blades 26 and 27 and the scraper elements 31 may easily be removed from the shaft 21 simply by removing the nut 23. Thereafter the baffles 33 may be readily removed from the shaft, and subsequently the blades 37 and 38 attached to block 36 may be slipped off the shaft 21. The hopper itself, if desired, may be detached from the pump assembly merely by removing the nuts at the lower end of the hopper.

Means are likewise provided for readily separating the upper and lower pump housings 42 and 46 in the following manner. Secured to the closed lower end of the lower pump housing 46 is an internally threaded sleeve 107 which is engaged by external threads on a sleeve member 108 which terminates in a hand wheel 109 which is suitably mounted on the top surface of the housing 62. The shaft 52 extends through the sleeve 108, but sufficient clearance is allowed in the bore so that rotation of the shaft 52 does not cause rotation of the sleeve 108. Rotation of the hand wheel 109 causes the lower pump housing 46 to move downwardly on the sleeve 108 thereby exposing the cylindrical block 49 and permitting ready radial withdrawal of the vanes 53 therefrom. Lowering of the pump housing is guided by providing

apertured ears 112 on the lower housing 46 slidably engaging standards 113 which are also secured to ears 114 of the upper pump housing 42.

Also the pump cover plate 39 may be dismantled, first by removing the nut 104 and spring 106 from the vertical shaft 101, thereby allowing the removal of the cylindrical block 96, after which various bolts securing the pump cover plate 39 to the upper pump housing 42 may be unscrewed, thereby providing ready access to the upper portions of the pump.

What is claimed is:

1. A pump including a housing having a top wall and a bottom wall and provided with circumferentially spaced lateral inlet and outlet openings adjacent said top wall, a cylindrical member telescopically positioned within said housing and having an upper end wall axially spaced from said top wall to define a chamber therebetween in communication with said openings, means for rotating said member, means defining a plurality of radial slots in said member extending axially downwardly from said upper end wall towards a lower end wall of said member, a plurality of generally planar vanes with each of such vanes being positioned for axial sliding movement in the respective slots, means defining a cam surface in said housing, each of said vanes having a cam follower engageable with said cam surface whereby each of said vanes will sequentially be extended into said chamber to overlie at least a portion of said openings and returned to a position below said member end wall during each rotational cycle of the member, a baffle element in said chamber and provided with a by-pass means interconnecting said inlet and outlet openings, a spring loaded plug member operatively associated with said by-pass means and normally engaging said baffle element for restricting the opening of said by-pass means, and means for selectively varying the spring pressure of the member whereby a predetermined pressure in said outlet opening will effect an opening of said spring loaded member and permit material being pumped to return to said inlet opening past said baffle element.

2. Apparatus of the character described including an upper cylindrical housing section having a top wall and circumferentially spaced inlet and outlet openings adjacent said top wall, a lower cylindrical housing section operatively connected to said upper housing section and having a bottom wall, a rotor positioned substantially entirely within said lower housing section and having an upper end wall spaced from said top wall of the upper housing section to define a chamber therebetween in communication with said openings, means for rotating said rotor about the axes of said sections, means defining a plurality of radial slots in said rotor extending axially downwardly from said upper end wall, a plurality of generally planar vanes with each of such vanes being positioned for axial sliding movement in the respective slots, means on said housing sections defining a cam surface adjacent the periphery of said lower housing section, each of said vanes having a cam follower engageable with said cam surface whereby each of said vanes will sequentially be extended into said chamber and returned to a position below said end wall during rotation of said rotor, and means for lowering said lower section without rotation thereof for access to said rotor.

3. Apparatus as set forth in claim 2 in which said cam followers extend radially beyond the peripheral extent of said rotor, and said cam surface has an upper and lower portion between which said followers extend.

4. A pump including a housing having a top wall and a bottom wall and provided with circumferentially spaced inlet and outlet openings adjacent said top wall, a cylindrical rotor member telescopically positioned within said housing and having an upper end wall axially spaced from said top wall to define a chamber therebetween in communication with said openings, means defining a radial extension of said housing and including a surface inclined downwardly towards said inlet opening for supporting

product to be pumped, means for rotating said member, means defining a plurality of radial slots in said member extending axially downwardly from said upper end wall towards a lower end wall of said member, means defining a cam surface in said housing, a vane positioned in each slot, each of said vanes having a cam follower adjacent the lower edge thereof engageable with said cam surface whereby each of said vanes will sequentially be extended into said chamber adjacent said inlet opening and returned to a position below said member end wall during rotation of the member whereby said vanes will as they pass along said cam surface be caused to rise upwardly and move product through said chamber and then descend as they approach said discharge opening, adjacent vanes each being at their raised position intermediate said inlet and outlet openings.

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