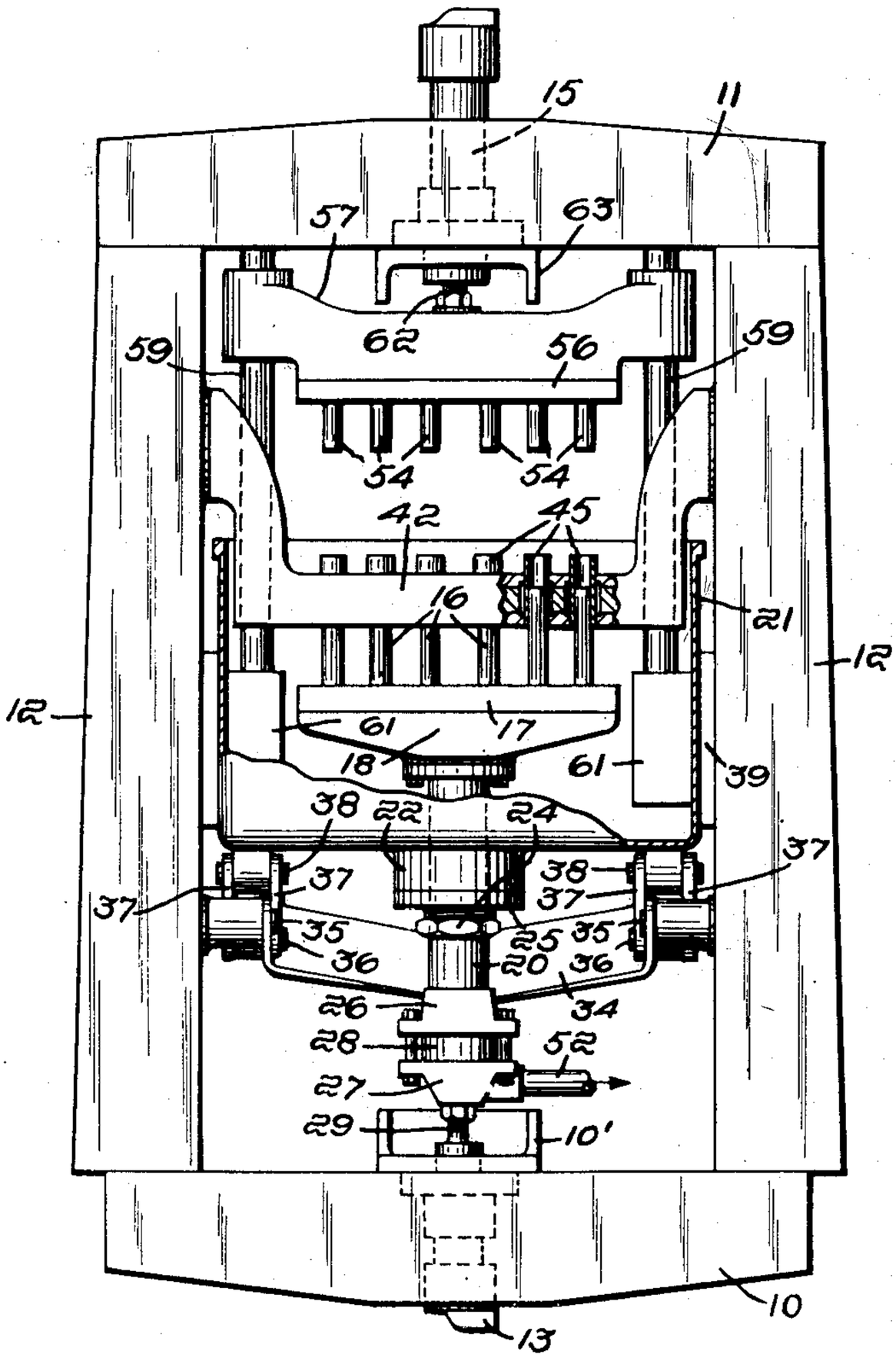
Feb. 17, 1953 W. H. RANDALL 2,628,540

PULP MOLDING MACHINE AND PROCESS

Filed Feb. 26, 1946 3 Sheets-Sheet 1

Fig. 1.



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PULP MOLDING MACHINE AND PROCESS

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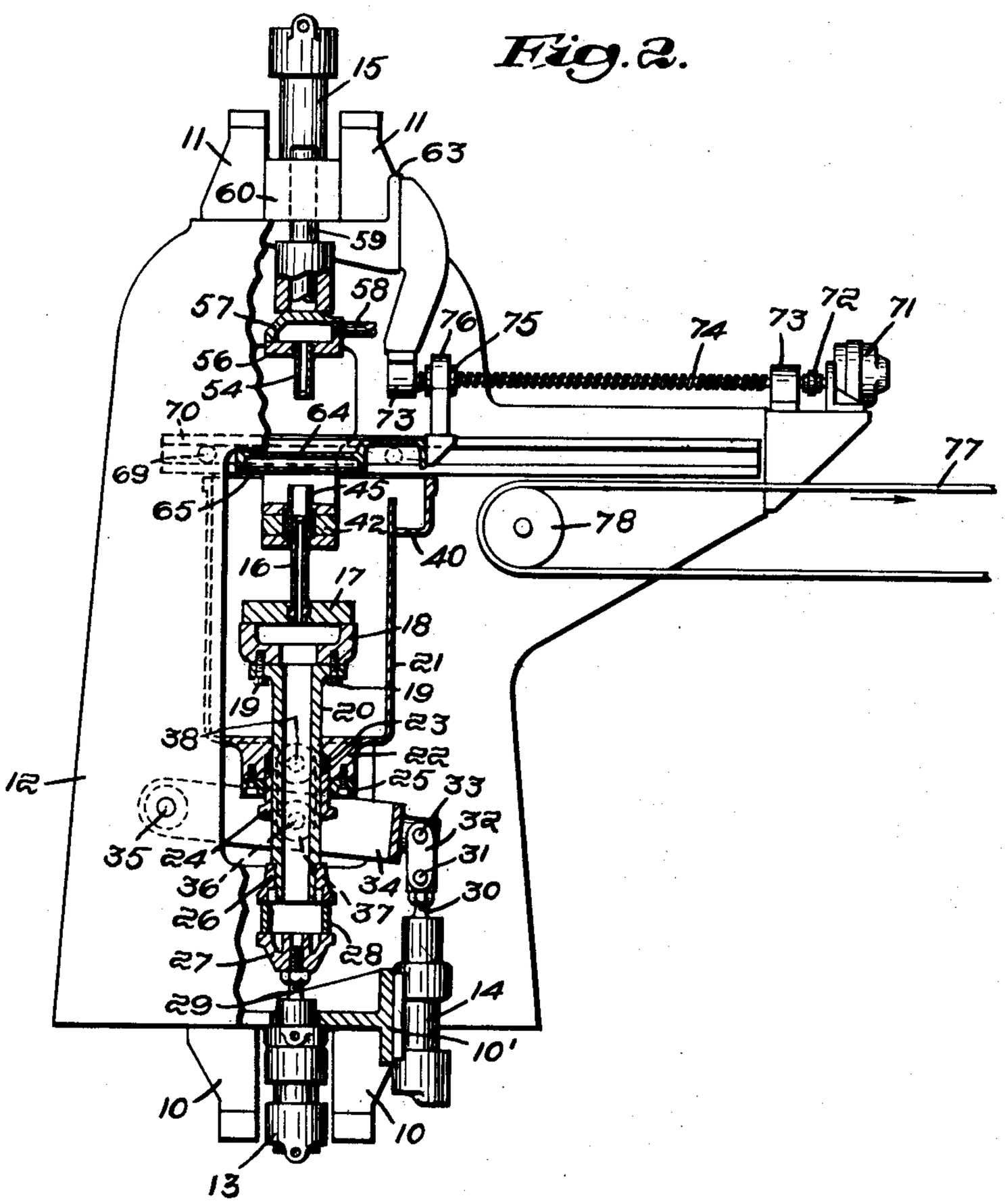
Fig. 2.



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PULP MOLDING MACHINE AND PROCESS

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Fig. 3.

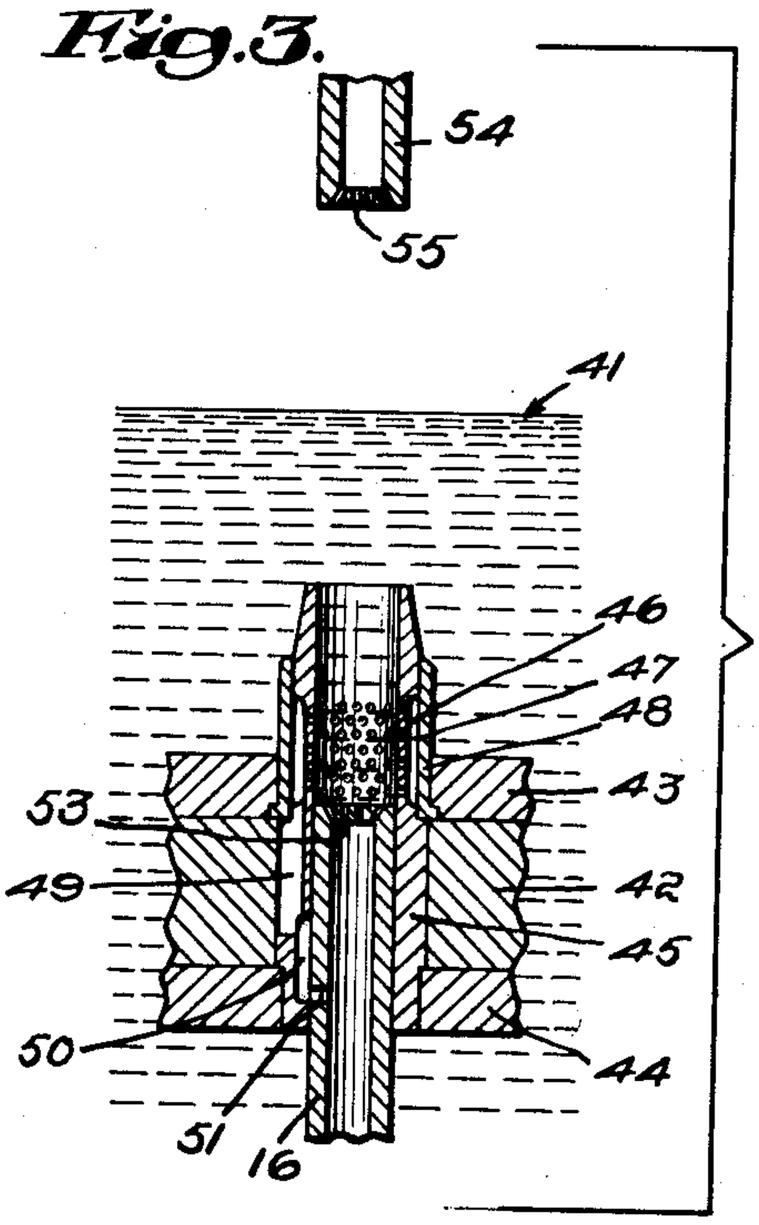

Fig. 4.

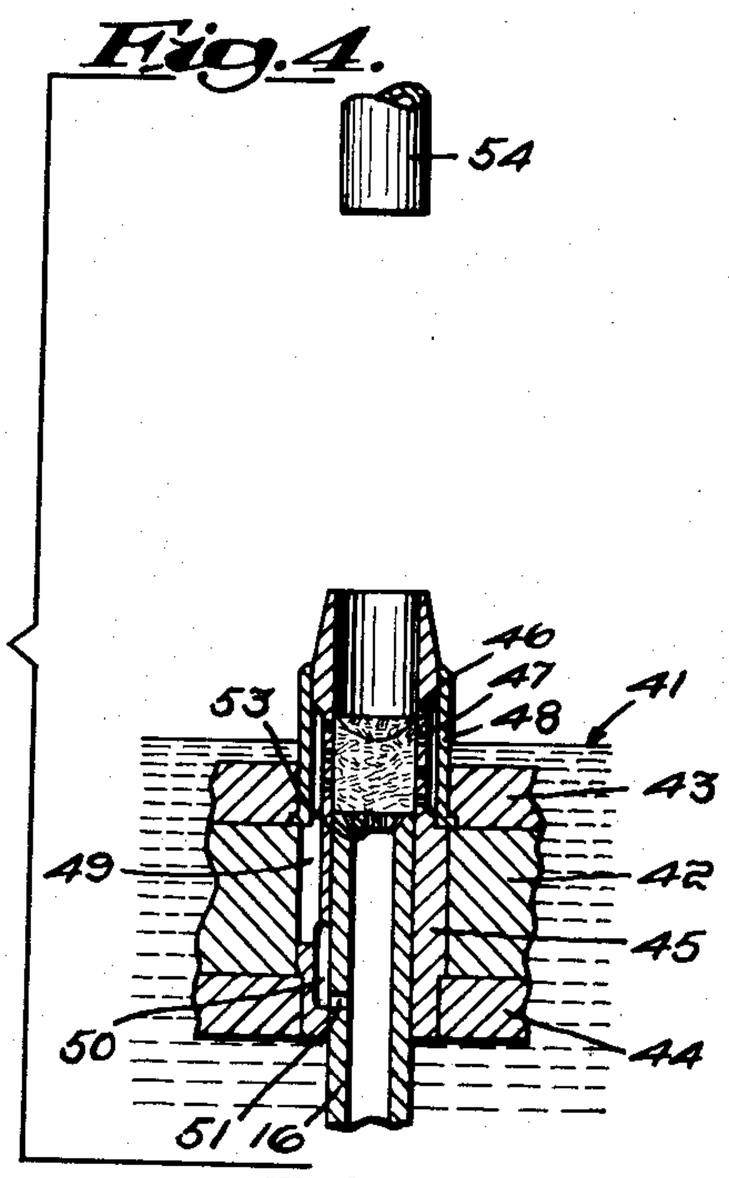

Fig. 6.

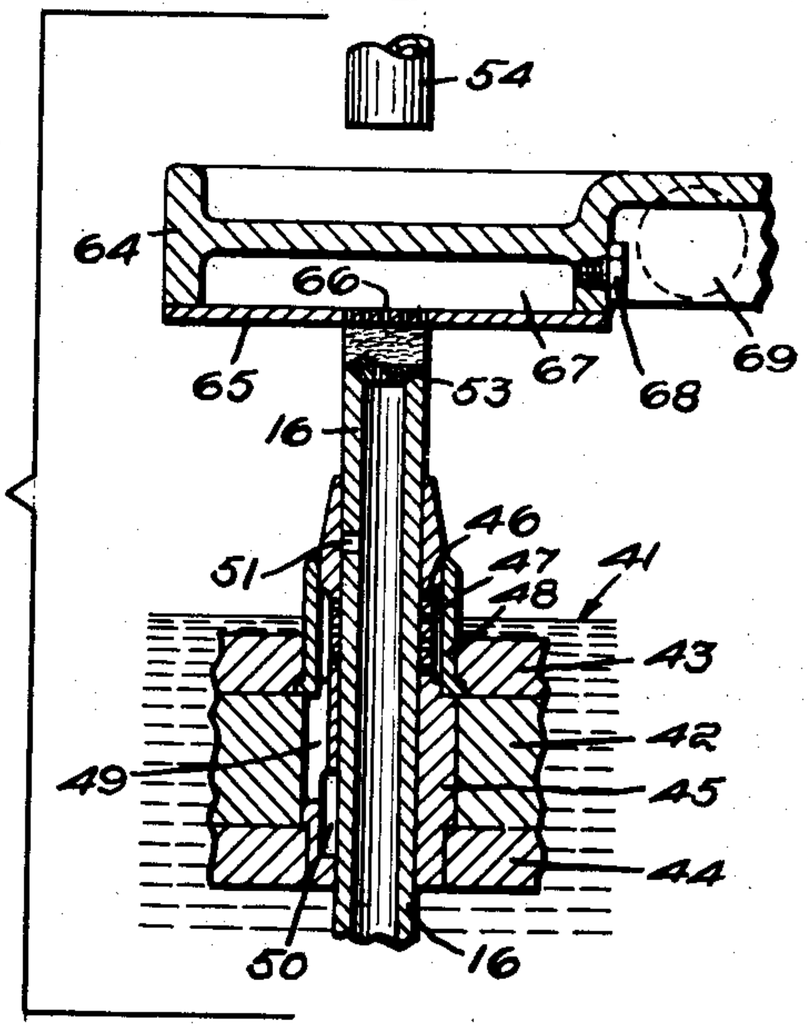

Fig. 5.

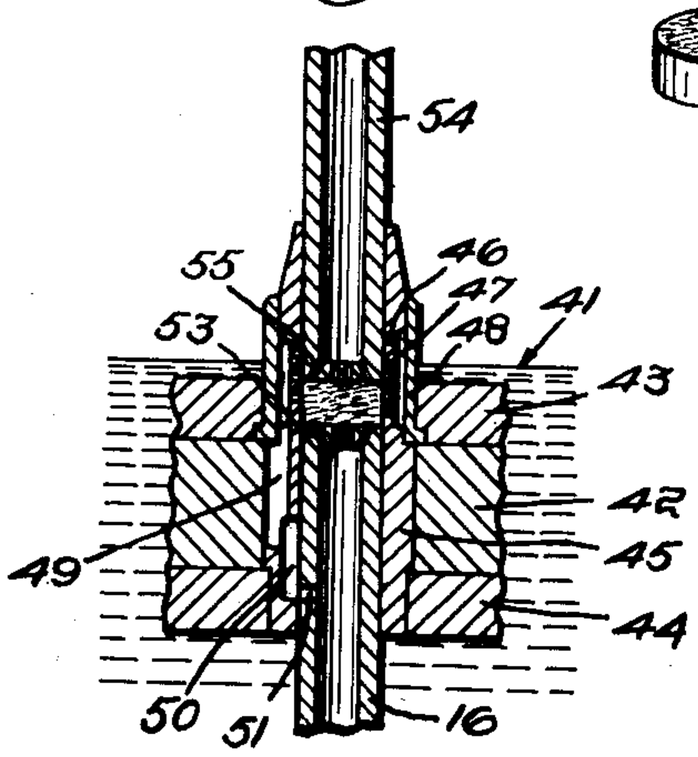

Fig. 7.

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2,628,540

PULP MOLDING MACHINE AND PROCESS

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Application February 26, 1946, Serial No. 650,292

5 Claims. (Cl. 92—56)

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This invention relates to improvements in pulp molding and particularly to a machine for manufacturing molded pulp articles of relatively small size, such as wads or discs, which must be produced in large quantities and at low cost.

For the purpose of this application I shall discuss my invention in connection with the production of molded pulp wads or discs for use in shot shells and other small arms ammunition. It will be understood however, that such discussion is illustrative and not limiting and that the principles of my invention are applicable to the production of other molded pulp articles.

The main object of my invention is to provide a compact and efficient machine for economically producing wads, discs or other molded pulp articles in commercial quantities. Other objects and advantages will appear as this description proceeds.

In the accompanying drawings wherein I have illustrated a preferred embodiment of my invention.

Fig. 1 is a front end elevation partly broken away, of so much of a pulp molding machine in accordance with my invention as is necessary to an understanding thereof.

Fig. 2 is a view at right angles to Fig. 1 and in partial section.

Figs. 3 to 6 inclusive are diagrammatic views illustrating successive stages in the manufacture of a molded pulp wad, and

Fig. 7 is a detail view of a finished wad.

The machine illustrated comprises a lower gang of female forming dies and an upper gang of male pressing dies spaced from and alined with said female dies.

Each female die consists of a stationary imperforate sleeve enclosing and spaced from a stationary cylinder having circumferential drainage perforations. Slidable axially within said cylinder is a tubular member or piston, the upper end of which is closed and perforated. When the article is being formed, the piston is at the bottom of its stroke and constitutes the bottom of the die. After the article has been formed, the piston is moved upwardly through the cylinder to carry the formed article out of the cylinder in position to be removed from the machine.

Each male pressing die consists of a hollow member closed and perforated at its lower end and dimensioned to slide freely into and out of the perforated cylinder of an alined female die.

Stock is supplied to the female dies by a vertically reciprocable stock tank. In the raised position of the tank, the female dies are immersed

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in the aqueous pulp mixture. When the tank is lowered, the supply of stock to said dies is shut off. After the articles have been formed and partially drained in the female dies, the male dies are lowered to compress the formed articles therein and then retracted. The tubular pistons of the female dies are then raised to carry the formed articles out of the stationary cylinders, and the articles are removed from said tubular piston by a horizontally reciprocable transfer unit which is advanced to a position slightly above the formed articles before said tubular pistons reach the upper limit of their stroke. After the articles have been transferred to the transfer unit, said unit is retracted and the tubular pistons are lowered to their original position for the formation of another set of articles in the next cycle of the machine. The formed articles may be discharged from the transfer unit onto a conveyor belt or the like and this belt may carry the articles through a dryer.

Conventional means are provided for supplying vacuum and air to the several dies and to the transfer unit, and for timing to one another the operation of the several different mechanisms which actuate the stock tank, the male dies, the tubular pistons of the female dies, and the transfer unit.

The frame structure of my machine includes spaced pairs of lower and upper supporting beams **10** and **11** and a pair of side frames **12**.

The slidable bottom-forming pistons of the female dies are designated at **16**, the registering male pressing dies at **54**, the stock tank at **21**, and the transfer unit at **64**.

The several elements **16**, **54**, **21** and **64** are adapted to be reciprocated in time to the operation of each other by any suitable actuating means, which may be either mechanical or hydraulic. As here shown, the elements **16**, **54**, and **21** are each actuated by an individual hydraulic ram and the element **64** is actuated by a motor-driven feed screw. The rams are included in hydraulic circuits (not shown) and conventional timing mechanism (also not shown) is provided for advancing and retracting the piston of each ram at the proper time in the operating cycle of the machine.

The cylinder of the hydraulic ram which actuates the slidable bottom-forming members **16** is indicated at **13**, that which actuates the stock tank **21** is indicated at **14**, and that which actuates the male pressing dies **54** is indicated at **15**.

Cylinders **13** and **14** are supported by a bracket **10'** bolted to the lower beams **10**, and cylinder **15**

is supported by a bracket 63 bolted to the upper beams 11.

The bottom-forming pistons 16 of the female dies slide vertically within stationary cylinders 45 which are circumferentially perforated at 46, and said perforated portion of the cylinder 45 is enclosed within imperforate stationary sleeves 48. Sleeves 48 are spaced from cylinders 45 to provide chambers 47 through which the water of formation passing through perforations 46 may drain.

The gang of female forming dies is mounted between the side frames 12 in a platen 42, to which is attached an upper plate 43 and a lower plate 44. The platen and plates are bored and counterbored to receive respectively the cylinders 45 and sleeves 48. Chambers 47 are connected by passages 49 in cylinders 45 with chambers 50 in cylinders 45 and chambers 50 connect with the interior of piston members 16 through holes 51 in said members. Pistons 16 are evacuated or provided with air pressure as may be required, through connection 52, and are perforated at their closed upper ends at 53. The lower ends of said piston members extend through the top plate 17 of a hollow platen 18 and connect with the chamber thereof. Platen 18 is bolted as at 19 to the upper end of a hollow push rod 20 which slides vertically through a stuffing box 22 closing the bottom end of vertically reciprocating stock tank 21. Stuffing box 22 is provided with packing 23, packing gland 24, and gland ring 25. The lower end of the push rod 20 is clamped to the upper end of the piston rod 29 of hydraulic cylinder 13 by an upper clamp collar 26, spacer 28, and lower clamp collar 27. Spacer 28 is removable so that members 16 may be withdrawn from platen 42 when the assembly requires to be changed.

The motion transmitting connections between stock tank 21 and the piston rod 30 of the hydraulic cylinder 14 which actuates said tank, comprise a trunnion block to which rod 30 is pinned at 31, a pair of links 32 fastened to said trunnion block, and a yoke-shaped lever 34 to which the upper ends of said links are pinned at 33. Lever 34 is pivoted at its ends at 35 to the side plates 12 and is connected to the stock tank by duplicate pairs of links 37 which are pinned to said lever at 36 and to the bottom of the stock tank at 38. The stock tank is provided at its upper end with an overflow compartment 40. The level of the stock in said tank is indicated at 41.

The male pressing dies 54 are hollow and are closed and perforated at their lower ends at 55. These dies are dimensioned to slide freely into and out of the cylinders 45 of the female forming dies. The upper ends of dies 54 are mounted in a plate 56 forming the bottom wall of a vertically reciprocable platen 57. Platen 57 is hollow so as to provide a vacuum or pressure chamber with which dies 54 connect and which chamber is evacuated or provided with air pressure as may be required, through connection 58. Platen 57 is guided in its up and down movements on guide rods 59, the upper ends of which are mounted in a block 60 located between the pair of upper beams 11. The lower ends of guide rods 59 slide within bosses 61 fastened to the opposite sides of the stock tank interiorly thereof. Bosses 61 extend through openings in the sides of the tank and exteriorly of the tank are formed as bearing surfaces 39 which bear against the adjacent faces of the side plates 12.

The gang of male pressing dies is reciprocated by the piston rod 62 of hydraulic cylinder 15. Rod 62 is fastened in any suitable manner to platen 57.

Transfer unit 64 includes a transfer plate 65 perforated on its under face as at 66 and defining with member 64 a vacuum and air pressure chamber 67 adapted to be connected as at 68 to either a vacuum pump or an air pump (not shown).

Transfer unit 64 reciprocates in a horizontal plane between the gangs of male and female dies when said dies are separated. Unit 64 is provided with rollers 69 which track in a suitable guide way 70 mounted on stock tank 21 to follow the up and down movements thereof, and is reciprocated by means of motor 71 coupled as at 72 to a feed screw 74. Screw 74 is journaled in bearings 73 and drives a threaded nut 75. Nut 75 is recessed between its ends to receive the forked upper end of a slide 76 and the lower end of which is fastened to platen 64. Since platen 64 is carried by stock tank 21 and slide 76 is fastened to said platen, the slide will move up and down relative to nut 75 with the movements of the tank but is restrained against sidewise movement by said nut. Nut 75 is itself fixed against rotation in any suitable manner. Motor 71 is preferably a hydraulic motor and is controlled by any conventional valve (not shown) so as to start and stop at the proper time with respect to the operation of the other moving parts of the machine.

Located beneath guideway 70 is a conveyor belt 77 which may carry the discharged articles through a dryer (not shown). The head roll for this belt is indicated at 78.

The operation is as follows:

Stock tank 21 is first raised (see Fig. 3) sufficiently to submerge the upper open ends of the female forming dies in the pulp mixture and vacuum is applied to said dies for the suction formation of articles therein. After sufficient stock has been supplied to the forming dies, depending upon the thickness wanted for the final articles, the stock tank is lowered (see Fig. 4) thereby cutting off further supply of stock to the forming dies. Sufficient drainage time is allowed to permit the suction drainage of as much water as practicable from the stock mixture remaining in the forming dies and from the articles being formed in said dies. This water is carried out of the machine through the hollow piston members 16 of said dies.

In the construction shown, suction of equal value is applied to the perforations 46 in the side walls of each die cavity and to the perforations 53 in the bottoms of each die cavity, all from a single source 52 by way of chamber 47, passage 49, chamber 50, hole 51 and hollow pistons 16. Since, as shown, the perforations 46 in the side walls extend to the bottom of the die cavity, and since the suction applied to the side walls and bottom of the die cavity is uniform, the outer portions of the initially formed pulp will be cup-shaped, and continuous and integral in character.

The male pressing dies are lowered into the female dies (see Fig. 5) to compress the formed articles therein and to express additional water therefrom, as well as to reduce the articles to substantially uniform thickness and density. During this compression period I may, if desired, send compressed air through the perforated ends of the male pressing dies to assist the removal of free water from the articles. At the end of the compression period the male pressing dies are retracted from the female dies, leaving the formed and compressed but still wet articles in the female dies.

The articles are removed from the female dies

by raising the slidable bottom forming piston members 16 of the female dies (see Fig. 6) a distance sufficient to carry the articles beyond the upper ends of the cylinders 45 of said dies in position to be removed from the machine by the laterally reciprocating transfer unit 64 which has moved inwardly over the articles on the now raised members 16. In Fig. 6 the piston 16 is shown as raised to a position where the molded article just contacts with the transfer plate 65 without any circumferential bulging of the article. The vacuum on said members 16 is now shut off and vacuum is applied to the transfer plate to cause the articles to be transferred to the perforated under face of said plate, after which members 16 are retracted into the cylinders 45 of the female dies in readiness to form another set of articles. The vacuum on the transfer plate holds the articles thereagainst until the transfer unit reverses its stroke and moves to a position where the articles may be dropped onto belt 77, at which time the vacuum on the transfer plate is discontinued and the articles permitted to drop by gravity onto the belt. At this time, if desired, I may send compressed air through the perforations of the transfer plate to assist the release of the articles from the plate.

In cases where it is not desirable to apply pressure to the articles while they are being transferred from the raised members 16 to the transfer unit, I may accomplish such transfer by so regulating the stroke of members 16 that there will be a slight gap between the transfer plate and the upper faces of the articles when said members are at the limit of their upward stroke.

The importance of avoiding pressure on the article during its transfer is that the article is not only still wet but is generally of relatively small diameter and considerable thickness. Once the article has been moved out of cylinder 45 by member 16, it is of course no longer circumferentially confined by said cylinder and were pressure applied to it at this time, the article would bulge circumferentially as well as tend to change its thickness, which was carefully gauged initially by properly setting the stroke of the male pressing die.

While I have disclosed a preferred embodiment of my invention it will be understood that various modifications in structure and design may be made within the scope of the appended claims.

I claim:

1. In a machine for making molded pulp shot gun shell wads of cylindrical shape, in combination, a vertically disposed hollow cylinder arranged to form the side walls of a die cavity, a piston reciprocable vertically within said cylinder and having a head arranged to form the bottom of the die cavity, said head being perforated, said cylinder being perforated at the pulp-depositing portion thereof adjacent to the piston head forming the bottom of the die cavity, external suction-applying conduits connecting both the outside of the cylinder perforations and the lower side of the piston perforations to a suction pump for simultaneously applying suction to the perforations in said cylinder and said piston during the molding operation to mat the pulp fibres together in continuous cup-shaped form along the bottom and upwardly along the sides of the die cavity, an additional piston arranged to move downwardly into said die cavity to curl over the cup-shaped pulp mass and provide vertical pressure between the bottom-forming piston and the upper piston to press the pulp into cylindrical shape, and operating mechanism connected to control the application of suction and to control the lowering of the piston, said mechanism being synchronized to hold the piston elevated above the die cavity when the suction application is initiated, and to lower the piston after the suction application has caused cup formation of the pulp fibers, said bottom-forming piston being movable vertically out of said die cavity to unload the cylindrical wad.

2. In a machine for making molded pulp shot gun shell wads of cylindrical shape, in combination, a die platen, a hollow vertical cylinder mounted in said platen and fixed against vertical movement relative thereto and arranged to form the vertical sides of a cylindrical die cavity, a hollow piston vertically reciprocable within said cylinder and having a horizontal perforated head arranged to form the bottom of the die cavity, said cylinder being perforated around its periphery in the molding portion thereof adjacent to the perforated head of said piston when in molding position, a sleeve secured to said platen and surrounding the perforated portion of said cylinder in spaced relation thereto to provide a chamber, said piston connecting the perforated bottom of the die cavity with a suction-applying mechanism, and conduit elements connecting said chamber with a suction-applying mechanism to cause fibrous pulp to be simultaneously deposited in continuous matted form across the bottom of the mold cavity and up the vertical sides thereof, a second vertically disposed piston having a perforated lower end and movable downwardly into said cylinder to a predetermined pressing distance from the bottom-forming surface to shape the molded pulp into cylindrical form and to compress it between said upper and lower pistons, the bottom-forming piston being movable vertically out of the cylinder to remove the cylindrical wad from the die, and transfer structure connected for positioning over the removed wad-carrying bottom-forming piston, said transfer structure including suction elements connected to lift the wad from the bottom-forming piston for transfer to an unloading device, said transfer structure being connected for approaching the bottom-forming surface no closer than a distance greater than said predetermined pressing distance, to keep from squeezing the wad out of shape during its transfer.

3. The method of forming a molded pulp cylindrical shot gun shell wad which comprises providing a die having an open-top cylindrical die cavity with vertical side walls and a vertically movable horizontal bottom arranged for the simultaneous application of suction throughout said bottom and adjacent side walls, supplying pulp stock to said die cavity, applying suction uniformly to the bottom and adjacent sides of the die cavity whereby to mat fibres continuously across the bottom of the die cavity and up the adjacent sides thereof, applying downward pressure on the deposited pulp in said die cavity whereby to curl inwardly the upper edges of the pulp and form a solid substantially cylindrical product, and expelling the molded pulp wad upwardly out of the die cavity.

4. The method of forming a molded pulp cylindrical shot gun shell wad in which the exterior fibres are matted continuously across the bottom and up the sides and inwardly of the top, which comprises providing a die having an open-top

cylindrical die cavity with vertical side walls and a vertically movable horizontal bottom arranged for the simultaneous application of suction throughout said bottom and adjacent side walls, supplying pulp stock to said die cavity and applying suction simultaneously and uniformly to the bottom of said die cavity and to the vertical sides adjacent thereto whereby the fibres are matted continuously across the bottom of said die cavity and up the sides thereof, continuing to supply pulp stock to said die cavity to deposit a pulp mass having an upper surface of substantial concavity, applying uniform downward pressure over the area of the mold cavity in a horizontal front whereby the peripheral upper edges of the deposited pulp are curled inwardly and the deposited pulp is compressed into solid substantially cylindrical shape, and expelling the molded pulp wad upwardly out of the die cavity.

5. In a machine for making molded pulp wads of cylindrical shape, in combination, a plurality of hollow cylinders having perforated walls arranged to be vertically positioned to form the side walls of die cavities, a plurality of pistons each reciprocable within a different cylinder and having a perforated head arranged to form the bottoms of the die cavities, external suction-applying conduits connecting both the outside of the cylinder perforations and the lower side of the piston perforations to a suction-applying mechanism for simultaneously applying suction to the respective sets of perforations in a cylinder and its piston during a pulp molding operation to mat the pulp fibers together in continuous cup-shaped formation along the bottom and upwardly along the sides of the die cavities, an additional piston mechanism arranged to move downwardly into said die cavities to curl over the cup-shaped pulp mass and provide vertical pressure between the bottom-forming piston and the upper piston to press the pulp into cylindrical shape, and operating mechanism connected to control the application of suction and to control the lowering of the piston mechanism, said operating mechanism being synchronized to hold the piston mechanism elevated above the die cavity when the suction application in that cavity is initiated, and to lower the piston mechanism after the suction has caused cup formation of the pulp fibers, said bottom-forming pistons being movable out of said die cavities to unload the cylindrical wads.

WALTER H. RANDALL.

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