Jan. 13, 1931. M. P. CHAPLIN 1,788,944

PULP MOLDING MACHINE

Filed Oct. 11, 1926 5 Sheets-Sheet 1

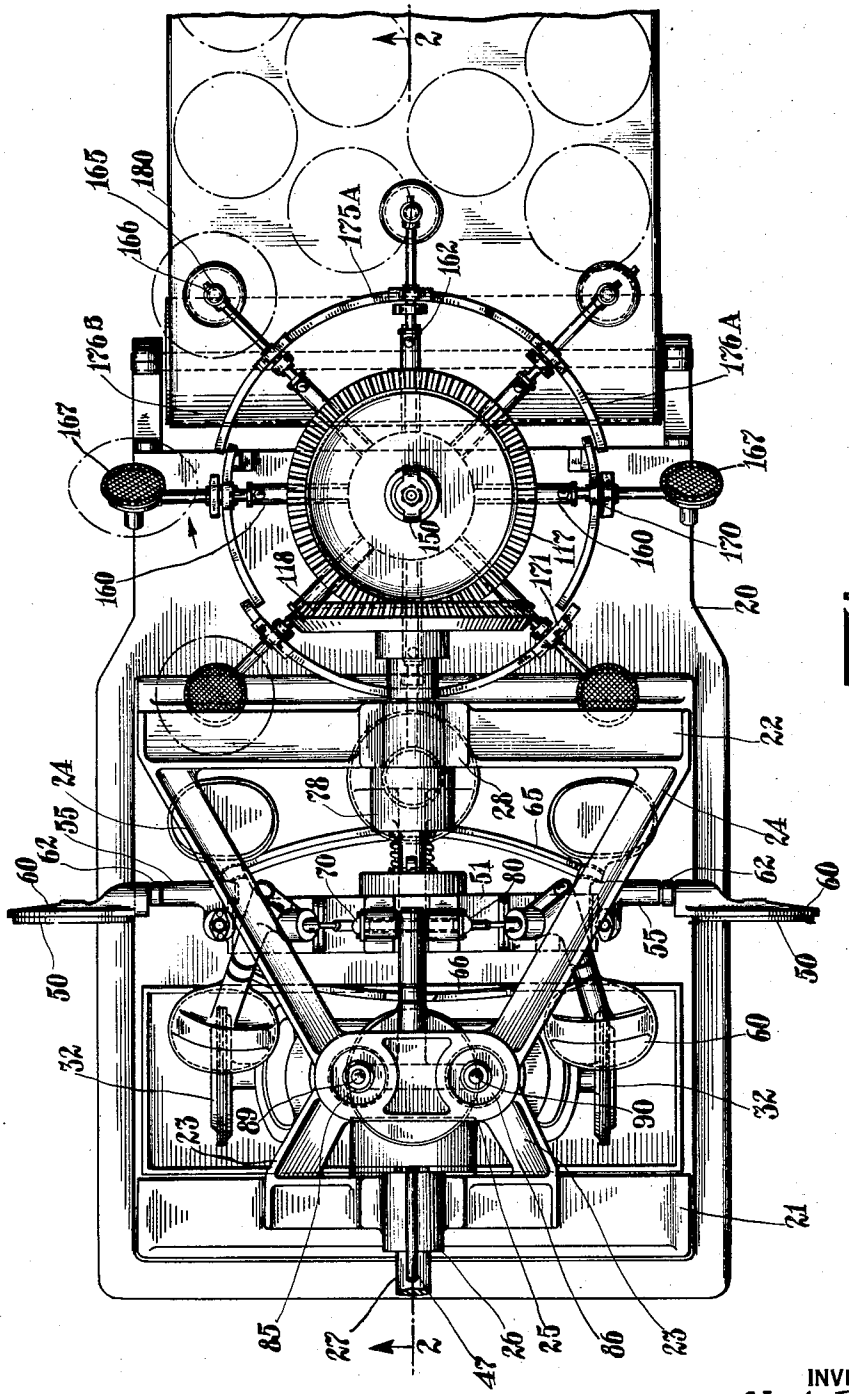


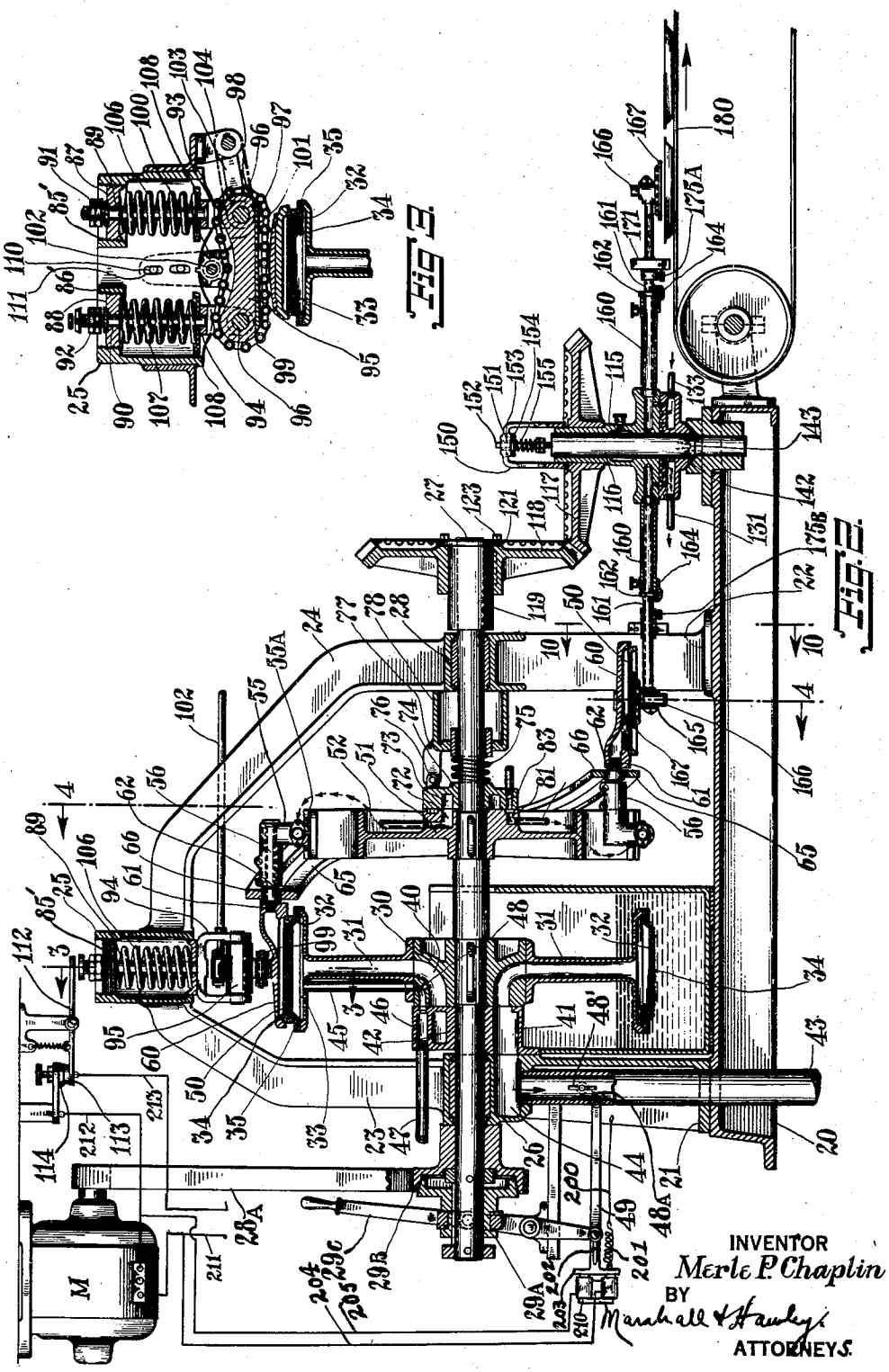
FIG. 1.

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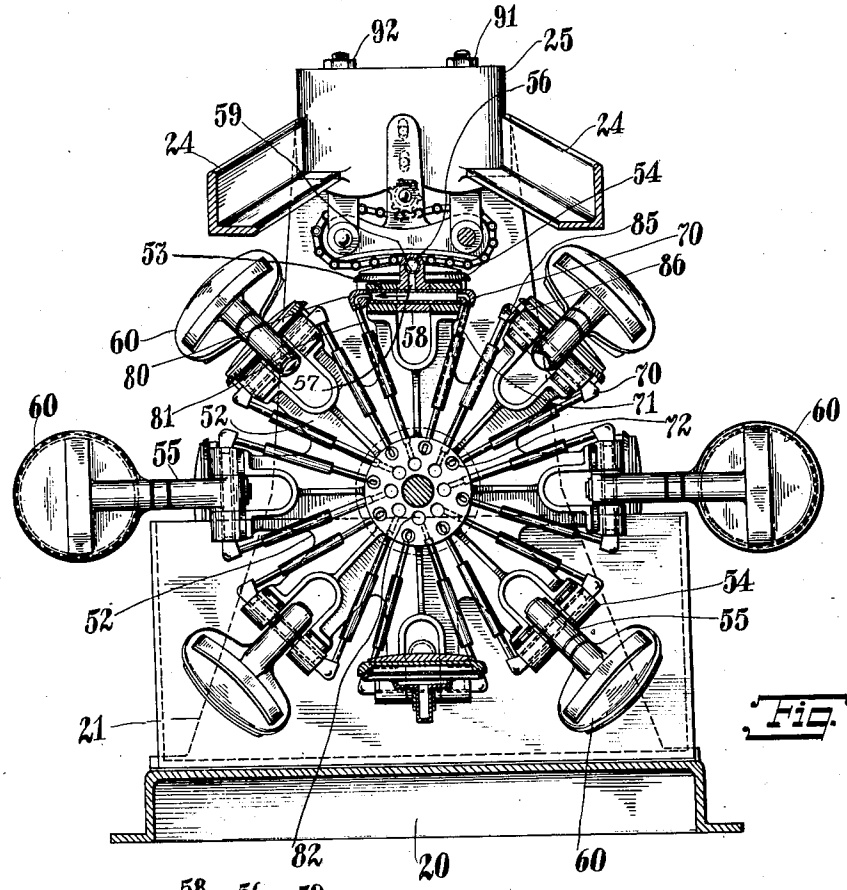


Fig. 4.

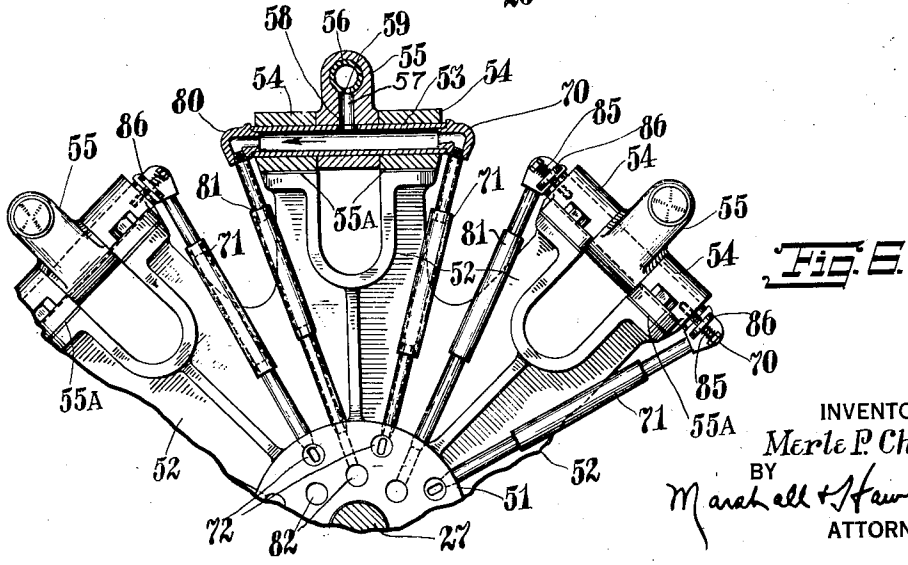


Fig. 6.

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PULP MOLDING MACHINE

Filed Oct. 11, 1926 5 Sheets-Sheet 4

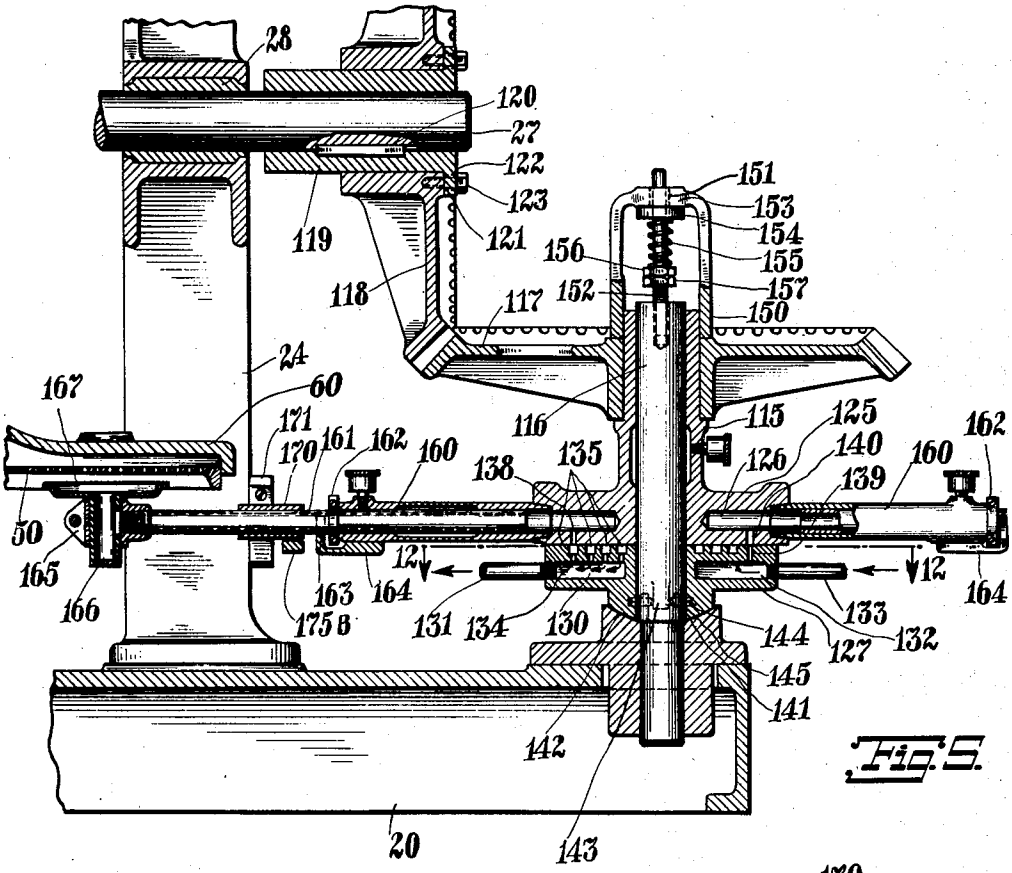


Fig. 5.

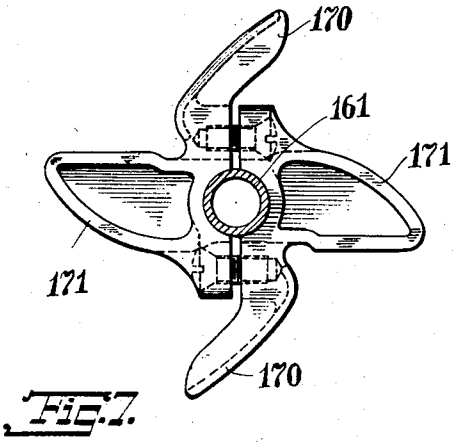


Fig. 7.

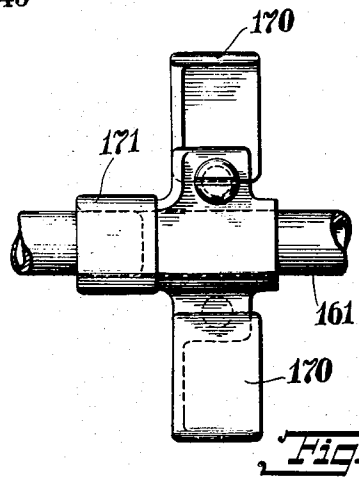


Fig. 8.

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PULP MOLDING MACHINE

Filed Oct. 11, 1926 5 Sheets-Sheet 5

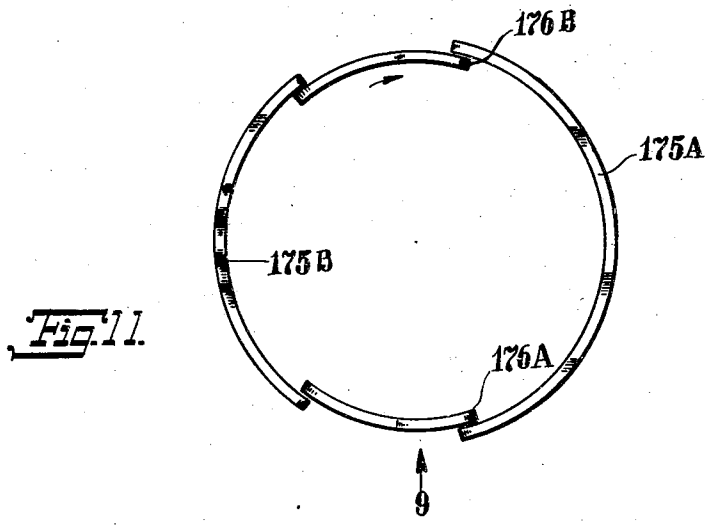


Fig. 11.

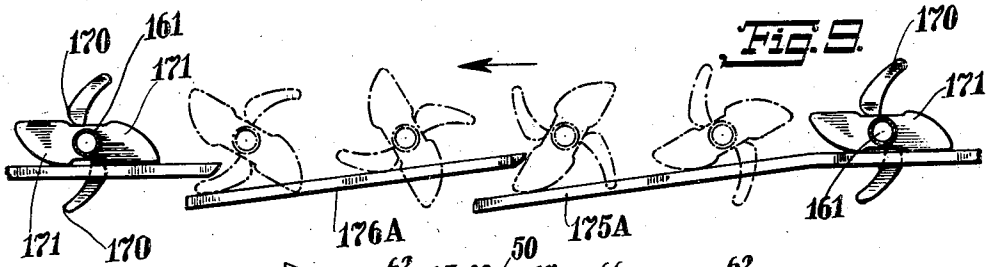


Fig. 9.

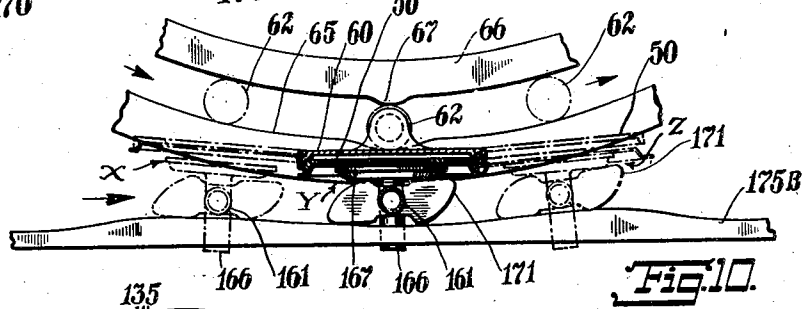


Fig. 10.

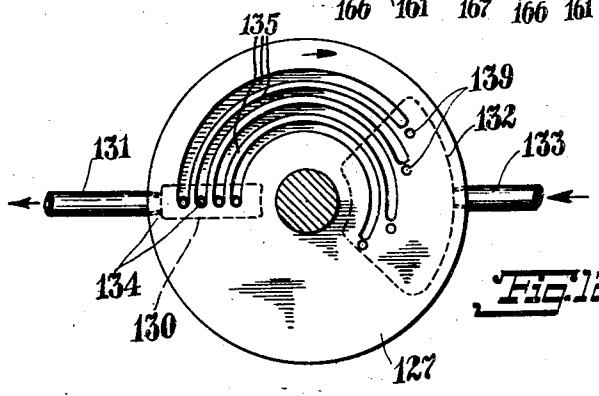


Fig. 12.

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UNITED STATES PATENT OFFICE

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PULP-MOLDING MACHINE

Application filed October 11, 1926. Serial No. 140,715.

This invention relates to pulp molding machines.

More particularly stated, the invention relates to a machine for forming and continuously producing articles formed of pulp or other plastic material, such, for instance, as plates or other dishes, cups, mats, boxes, or other desired articles.

One of the objects of the invention is to provide a machine of the character specified that will be simple, compact and rigid in construction and will effectively perform the desired functions.

Another object of the invention is to provide a pulp forming machine so constructed and arranged that a large proportion of the liquid or moisture will be removed from the pulp before the forming die and the article formed thereon reaches the compression mechanism.

Another object of the invention is to provide a machine of the character described so constructed and arranged that none of the pivoted, rotatable or movable parts thereof requiring lubrication will come in contact with the wet pulp solution.

Another object of the invention is to provide a pulp forming machine of the character specified so constructed that the forming dies will be firmly supported during the application of the compression dies thereto and will effectively withstand the pressure.

Another object of the invention is to provide a machine of the character specified so designed that the transfer of the molded articles from the compression die will be facilitated.

Further objects of the invention will appear from the following specification taken in connection with the drawings, which form a part of this application, and in which

Fig. 1 is a top plan view of a machine constructed in accordance with the invention;

Fig. 2 is a sectional elevation taken substantially on line 2—2 of Fig. 1;

Fig. 3 is a sectional elevation taken substantially on line 3—3 of Fig. 2;

Fig. 4 is a sectional elevation taken substantially on line 4—4 of Fig. 2;

Fig. 5 is an enlarged sectional elevation illustrating the details of the transfer mechanism for transferring the molded articles from the compression dies to the conveyor belt;

Fig. 6 is an enlarged sectional elevation showing the details of the connections to the compression dies;

Figs. 7 and 8 are elevational views taken at right angles to each other showing on an enlarged scale the cam control means for the transfer mechanism;

Fig. 9 is an elevational view showing the guide rails for the cam control means for the transfer mechanism;

Fig. 10 is a detail elevation showing a portion of one of the guide rails;

Fig. 11 is a plan view of the cam tracks or guide rails;

Fig. 12 is a top plan view of the air and suction control casing for the transfer mechanism.

The invention briefly described comprises three different sets of mechanism, namely, forming dies adapted to revolve in a vat containing a solution of pulp material and to receive and form the article on the die, compression dies adapted to register at a predetermined point in the revolution of the forming dies with the forming dies and to compress the article therebetween, and transfer mechanisms adapted to receive the compressed and formed article from the compression dies to transfer the article to a carrier or conveyor.

The forming dies are so constructed that a large proportion of the moisture from the molded article on the forming die will be extracted prior to the operation of the compression dies and the forming dies and compression dies are so relatively arranged that the forming dies will be firmly and rigidly supported during the operation of the compression dies.

The transfer mechanism and compression dies are so arranged that gravity will assist in transferring the molded articles from the compression dies to the transfer mechanism. Furthermore, the transfer mechanism is rotated through 180° from receiving to discharging position so that gravity will again

assist in discharging the devices from the transfer mechanism to the carrier or conveyor.

Various novel features are incorporated in the forming mechanism, compression mechanism and transfer mechanism and these will be brought out in more detail in the following description.

Pulp forming dies and mounting therefor

In the particular embodiment of the invention illustrated, the mechanism is mounted on a base 20, having cross frame members 21 and 22. A frame work consisting of two pairs of uprights, namely 23 and 24, is mounted on the cross frame members, the uprights being connected at their upper ends by a frame 25.

The frame member 21 has mounted thereon a bearing 26 for supporting one end of a shaft 27. A similar bearing 28 is carried by the frame member 22 and supports the other end of the shaft 27. The shaft 27 may be driven from any suitable source of power as by a motor M, belt drive 28A and clutch member 29A fixed to the shaft and clutch member 29B loose on the shaft. A clutch shaft lever 29C controls the clutch.

A hub 30 is mounted on the shaft 27 to rotate therewith and has connected thereto radially extending, hollow arms 31 to the outer ends of which are secured forming dies 32. Each of the hollow arms terminates in a chamber 33 over which there is secured the perforated forming die 32. A mesh screen 34 formed of wire is preferably secured over the die 32 by means of a ring 35.

The forming dies are so shaped or of such contour as to produce an article of the desired shape and while the die is immersed in the solution, means is provided for exhausting the air in the hollow arms 31 and chambers 33, thus causing the liquid material in the vat to pass through the screens and perforations in the die, the solid matter being deposited on the screen in the form of a thin layer shaped in conformity with the shape of the die. The period of time during which the die remains submerged in the solution and the amount of suction applied to the arms 31 will determine the thickness of the article formed on the die.

Suction is applied to the arms 31 in the following manner. The hub 30 has formed therein a plurality of arcuate conduits 40 adapted to communicate with the inner ends of the arm 31 and with a suction chamber 41 formed in a stationary control casing 42 mounted on the shaft 27 and abutting against one side of the hub 30. The chamber 41 is exhausted in any suitable manner through a conduit 43 which communicates with the chamber 41 through a passage 44 formed in an enlarged portion of the journal 26 for the shaft 27.

It will be evident that the arms 31 after they rise in their rotation above the horizontal will be drained by gravity as well as by suction.

A valve 48′ is provided in the suction conduit 43 for shutting off the suction from the forming dies, when desired. Furthermore, in order to prevent the continuance of suction after the machine is shut down and the shaft 27 stops rotating, means is provided for automatically closing the valve 48′ when the machine stops. This means consists of a link connection 49 between the lower end of the clutch control lever 29C and an arm 48A connected to the valve pintle.

It will be evident that when the clutch lever 29C is shifted to open the clutch 29B, the valve 48′ will be closed, thus shutting off the suction from the forming dies.

In order to automatically shift the clutch lever when the motor M is stopped, the following mechanism is provided. The link 49 is extended beyond the pivotal connection of the link to lever 29C and is slotted at 202. The link extension is connected by a spring 201 and rod or wire 200 to the frame 21.

The extension of the link has secured thereto an armature 203 of an electro-magnet or solenoid 210. The electro-magnet is connected in the motor circuit in parallel, one conductor 204 leading to the magnet winding being connected to motor main 211 and the other magnet lead wire 205 being connected to wire 212 leading from the switch contact 114 to the motor.

Thus when the motor circuit is opened, either by opening the main leads or the circuit through the control switch contacts 113, 114, the electro-magnet coil will be de-energized releasing the armature 203 and permitting the spring 201 to shift link 49 and close the valve 48′ thus cutting off the suction from the forming dies.

It will be understood that the electro-magnet when energized has sufficient pulling force to overcome the action of spring 201 but the spring will shift the link 49 when the magnet is de-energized.

In order to discharge the molded articles from the forming dies 32 onto the compression dies, compressed air is introduced into the chambers 33 at a suitable period in the cycle of operation of the machine. This air enters the chambers 33 through conduits 45 which communicate with a compressed air chamber 46 formed in the control casing 42. A conduit 47 conducts the compressed air from any suitable source to the chamber 46.

From the foregoing description, it will be seen that as the forming dies pass through the vat, they will receive a thin layer of pulp or plastic material which will adhere to the dies by reason of the suction created in back of the dies. This pulp will be carried around the dies, the moisture being drained therefrom partially by gravity and

partially by the suction. When the forming dies register with the compression dies in the manner hereinafter set forth, compressed air is introduced behind the forming dies, thus assisting in drying the article on the forming dies and in discharging the article from the forming dies to the compression dies. In order to prevent any liquid from collecting in the conduit 45, a small opening 48 is formed in the wall between the suction passage 40 and the conduit 45.

Compression mechanism

The compression mechanism comprises a plurality of compression dies 50 conforming in shape to the shape of the forming dies; that is, the inner surface of the compression die conforms in shape to the outer surface of the forming die so that the article molded on the forming die can be compressed between the two dies without changing its contour. The compression dies are carried by a wheel comprising a hub 51 affixed to the shaft 27 and having radially extending therefrom a plurality of arms 52. To the outer end of each of the arms 52 there is swiveled a hollow shaft 53, this shaft being mounted in bearings 54. One or more shims 55A is interposed, if necessary, between the arms 52 and the bearings 54 for the purpose of properly positioning the compression dies relative to the forming dies. An L-shaped bracket or casing 55 is secured to the central portion of the hollow shaft 53 and a conduit 56 is adjustably swiveled and clamped in the bracket or casing 55. This conduit communicates with the interior of the hollow shaft 53 through a connecting conduit 57, an opening 58 in the hollow shaft 53 and an opening 59 in the conduit 56.

The compression die 50 is mounted in a compression head 60 secured as shown at 61 to the outer end of the conduit 56. An antifriction roller 62 is mounted on each of the conduits 56 intermediate the casing or bracket 55 and the compression head 60. A pair of guide rails 65 and 66 are mounted above and below the rollers 62 and are so shaped as to swing the compression dies, compression head and coacting parts from the position shown at the top in Fig. 2 to the position shown at the bottom in Fig. 2.

The rails are provided with a depression 67 at the bottom thereof for guiding the compression dies into proper coacting relation with respect to the transfer heads and quickly removing them from the transfer heads.

A slight pressure is created behind the compression dies 50 during the compression operation, the compressed air preferably being heated or dry, thus assisting in drying the article and also preventing the adhering of the article to the die by interposing a partial film of air between the compression die and the article formed. This compressed air is introduced into one end of the hollow shaft 53 through a coupling 70 which receives the air from the conduit 71 which in turn communicates with a compression chamber 72 in the hub 51. The compression chamber 72 in turn communicates with a compression chamber 73 in a control casing 74 mounted on the shaft 27 and preferably spring-pressed by a spring 75 against the hub 51. The control casing 74 is prevented from turning on the shaft by a pivotal connection 76 to a lug 77 formed on a fixed bearing member 78.

The opposite end of the shaft 53 communicates with a coupling 80 which in turn is connected by a conduit 81 to an exhaust chamber 82 in the hub 51. This chamber registers with an exhaust chamber 83 in the control casing 74.

The couplings 70 and 80 have a swivel connection with the shaft 53 and are held in contact with the ends of the shaft by means of springs 85 which engage flanges 86 extending laterally from the couplings. Thus, the rotation of the brackets or casings 55 will not interrupt the communication between the couplings 70 and 80 and the interior of the hollow shaft 53.

The chambers 72 and 73 and the chambers 81 and 83 are adapted to communicate at such periods in the cycle of operation of the compression dies that pressure will be exerted in back of the compression dies during the compression operation, but suction will be created in back of the compression dies after the compression operation is completed and during the movement of the compression dies from the position shown at the top in Fig. 2 to the position shown at the bottom in Fig. 2. When the compression dies reach a position above the transfer device, the suction behind the die is released and a slight pressure assists gravity in the transfer.

The compressing force is exerted on the compression dies in the following manner, attention being particularly directed to Figs. 2 and 3. The compression mechanism is mounted in the frame 25. This frame is provided with a pair of threaded bosses 85′ and 86′ which receive externally threaded nuts 87 and 88. The nuts are provided with central openings therein through which extend threaded rods or studs 89 and 90. Nuts 91 and 92 are mounted on the outer ends of these studs and the inner ends have secured thereto U-shaped yokes 93 and 94. A block 95 is mounted on studs 96 secured to the depending legs of yokes 93 and 94 and is provided with a hard bearing surface 97 adapted to be engaged by rollers 98 mounted on chains 99. The chains extend around the block 95 and are engaged and driven by a sprocket wheel 100 mounted in an adjustable bracket 101 secured to the block 95. Bracket

101 is guided by a pin and slot connection 110, 111 to frame 25. The sprocket shaft 102 extends laterally and may be driven from any suitable source of power as, for instance, from the shaft 27. The connections to the shaft or other source of power will be so made that the rollers and chain will pass around the block 95 at approximately the same rate of speed as the rate of travel of the forming and compression dies.

The block 95 in addition to being carried by the yokes 93 and 94 is guided by a link 103 which connects one of the studs 96 to depending lugs 104 carried by the frame 25.

Downward pressure is exerted on the block 95 and through the rollers 98 on the compression die by means of springs 106 and 107 mounted on the studs or rods 89 and 90 and seating at one end against the nuts 87 and 88 and at the other end against washers 108 which in turn abut against the upper surfaces of the U-shaped members 93 and 94. The pressure of the springs can be adjusted by adjusting the nuts 91 and 92 on the studs 89 and 90 and by raising or lowering the nuts 87 and 88 in the bosses 85 and 86.

In mechanism of this character, a reasonable uniformity in thickness of the product or article should be maintained. For this purpose, means is provided for automatically stopping the mechanism when the article is too thick. This means consists of a lever 112 pivoted on a fixed pivot and having an end engageable with the upper end of one of the bolts 89 and 90 when the thickness of the article compressed passes the desired limit. The other end of the lever carries a contact 113, normally spring-pressed into engagement with an adjustable contact 114 in the circuit of the driving motor M. When the lever 112 is tilted, it will open a switch 111 in the circuit of the driving motor and stop the machine.

The compression mechanism operates as follows. On referring to the drawings, it will be seen that for each forming die there is a corresponding compression die, these dies being so arranged that when each forming die reaches the position shown in Fig. 2, there will be a compression die juxtaposed thereon and adapted to coact therewith. The movement of the compression dies during the rotation of the hub and wheel by which they are carried is controlled by the guide rails 65 and 66. When a compression die is in the position shown at the top of Fig. 2, compressed air enters the compression head 60 through the conduit 71, coupling 70, hollow shaft 53, passage 57 and conduit 56. During the rotation of the forming die and corresponding compression die, the molded article between these dies will be compressed by pressure derived from the spring-pressed block 95 and rollers 98. As these dies leave this compression mechanism, they are separated and a vacuum is created behind the compression dies and in the compression chamber since at this point in the cycle of operation, the vacuum chamber 83 in the casing 74 will communicate with the vacuum chamber 82 in the hub 51 and this suction is communicated to the hollow shaft 53 through the conduit 81 and coupling 80. The hollow shaft 53 communicates with the compression chamber 60 in the manner just described.

At this period in the cycle of operation also, compressed air is introduced behind the forming die 32 simultaneously with the suction created behind the compression die. Thus the molded article is transferred from the forming die to the compression die and is held in contact with the compression die during the movement of the compression die from the position shown at the top of Fig. 2 to the position shown at the bottom of Fig. 2 in which latter position, the molded article is discharged from the compression die onto transfer mechanism which will next be described. This transfer is facilitated by the depression 67 in the guide rails.

Mechanism for transferring articles from compression die to conveyor

The transfer mechanism is carried by a hub 115 rotatably mounted on a stationary vertical shaft 116. The hub 115 is driven by a bevel gear connection 117, 118, to the shaft 27. The gear 118 is not directly secured to the shaft but is secured to a sleeve 119 which in turn is keyed to the shaft as shown at 120 by the following connection. Sleeve 119 has formed thereon a laterally extending flange 121 having arcuate slots 122 therein and the gear 118 is secured around the sleeve and to the flange by means of bolts 123 which extend through the slots 122 and engage the gear 118. By loosening the bolts and sliding the gear longitudinally on the sleeve, the gear 118 can be moved out of mesh with the gear 117 and by rotating the gears 117 and 118 relative to each other and securing the gear 118 by means of the bolts 123 in rotated position and in mesh with the gear 117, the timing of the compression dies and transfer mechanism can be regulated.

The hub 115 is provided with an enlarged lower end 125 having radially disposed openings or chambers 126 therein. These openings form chambers which communicate with the transfer mechanism hereinafter described and alternately form suction and compression chambers.

A stationary control casing 127 is mounted around the shaft 116 and disposed below the enlarged portion 125 of the hub 115. This casing has a vacuum chamber 130 which is connected by a conduit 131 to a vacuum pump and also has a compression chamber

132 connected by a conduit 133 to a compression conduit. The vacuum chamber 130 communicates through a plurality of openings 134 with a plurality of arcuate grooves 135 formed in the upper surface of the control casing 127 and as shown in Fig. 12 the grooves 135 are graduated in length. Each of the radial openings or chambers 126 has a port 138 communicating with one of the grooves 135 during a part of the revolution of the hub 115 around the shaft 116.

The control casing 127 also has formed thereon a plurality of ports 139 disposed beyond the ends of the concentric grooves 135 and communicating with the compressed air chamber 132. Each of the radial openings 126 has a port 140 adapted to communicate with one of the ports 139 in the casing 127 and to establish communication between the chamber or opening 126 and the compression chamber. The grooves 135 and the ports 139 and also the ports 138 and 140 are so arranged that the transfer arms hereinafter described will have an exhaust connection or vacuum connection when in the position shown in Fig. 2 and during the major portion of the movement of the arms from receiving to discharging position, but will have compressed air forced therethrough when the arms are in the position shown at the right in Fig. 2 or, in other words, in a position to discharge the molded articles therefrom.

The control casing 127 has a spherical bearing surface 141 at its lower end which seats in a spherical seat 142. The casing is held against rotation by means of a depending lug 143 which is positioned between set screws 144 mounted in fixed lugs 145. The construction described will always maintain the hub and casing in effective cooperating relation with respect to each other.

It is desirable that means be provided for regulating the pressure of the enlarged portion 125 of the hub on the control casing 127. This means consists of a yoke 150 secured to the upper end of the hub 115 and having a central opening 151 therethrough. A spindle 152 is secured in the central opening and has thereon below the upper end 153 of the yoke, a collar 154. The collar is so mounted on the spindle that relative rotation between these members is prevented. The lower end of the spindle is threaded into the upper end of the shaft and a spring 155 surrounds the spindle and is mounted between the collar 154 and lock nuts 156 and 157. It will be evident that the spring 155 will exert an upward pressure against the collar and yoke, thus tending to carry a part of the weight of the hub 115 and the parts carried thereby. If desired, the collar 154, spring 155 and nuts 156, 157 can be mounted on the spindle above the yoke 150 and the spring will exert a downward pressure on the yoke and the hub.

The enlarged portion 125 of the hub has secured thereto a plurality of radially extending sleeves 160, each sleeve communicating at its inner end with one of the radial openings 126. There is mounted in each of the sleeves, a hollow spindle or arm 161, each arm having a clamp or split collar 162 adjustably secured thereto and disposed within a flange 163 of a retaining strip or fork 164.

Each of the hollow spindles or arms 161 has secured to its outer end a clamp bracket 165 in which there is adjustably mounted a transfer head 166 provided with a perforated disk 167 at its upper end. The transfer head is vertically adjustable in clamp 165 to position the transfer head a proper distance from the compression die. Furthermore, by loosening the clamp or collar 162, the hollow spindle 161 can be longitudinally adjusted in the sleeve 160, thus further properly positioning the transfer head to register with the compression die. During the rotation of the transfer arms from the receiving position shown at the left in Fig. 2 to the discharging position shown at the right in Fig. 2, the arms are also rotated axially 180°. This is accomplished by means of two sets of cams mounted on the spindle 161 of each transfer arm. The two sets are offset axially on the spindle and are indicated in Figs. 7 and 8 by reference characters 170 and 171. Two cam tracks are provided for the two sets of cams, one of the tracks being shown in Fig. 11 at 175 and the other being shown at 176.

It will be seen on referring to Fig. 11 that the track 175 is divided into two sections 175A and 175B and the track 176 is also divided into two sections 176A and 176B. Furthermore, it will be evident that while one set of tracks is operating on the cams controlled thereby, the other set of tracks is not operating on its cams. The tracks 175A and 175B and the cams 171 which coact therewith operate to hold the transfer head in receiving and discharging positions. The tracks 176A and 176B in conjunction with cams 170 operate to rotate the transfer head from receiving position to discharging position or, in other words axially through 180°.

Since each of the compression dies is traveling in a circular path during the transfer of the molded article to the suction head or transfer head 166 the track 175B is made slightly undulating as shown in Fig. 10. As the cams 171 follow this undulating track, they will bring each transfer head 166 from a diverging position relative to the compression die into a position approximately parallel thereto and will then move the transfer head away from the compression die.

Fig. 10 is more or less diagrammatic and shows at X the transfer head in a position

approaching the compression die, at Y the head and die are substantially parallel and in coactive relation and at Z the head is moving away from the die. At position Y where the transfer takes place the depression 67 in guide rails 65 and 66 assist in bringing the dies into close relation with the transfer heads.

The operation of the tracks 176A and 176B in turning the transfer head through 180° is roughly illustrated in Fig. 9 in which it will be seen that the tracks 176A and 176B come into operation as the cams 171 leave the guiding action of the tracks 175A and 175B. As the tracks 175A and 175B coact with the cams 171, the transfer heads are rotated axially through 180° as shown in Fig. 9.

The transfer mechanism operates as follows. When the transfer heads have been properly adjusted vertically and longitudinally of the axis of the rotating hub 115 to coact with the compression dies, the transfer head will be disposed beneath the compression die in receiving position as shown at the left in Fig. 2. At this period in the cycle of operation of the transfer arm, suction will be communicated to the suction or transfer head from the suction chamber 130 through one of the ports 134, one of the grooves 135 and one of the ports 138 which in turn communicates with one of the radial openings 126. During the transfer operation of the molded article from the compression die to the transfer head, compressed air communicates with the compression die and forces the molded article away from the compression die and the suction in the transfer head will tend to assist in the transfer of the molded article. Gravity also facilitates the transfer. After the transfer head has received the molded article, the transfer arm will rotate about the axis of the hub 115 and during this rotation will also rotate axially so that the head will be inverted to the position shown at the right of Fig. 2 when the head is positioned over a conveyor belt 180. This belt as shown in Fig. 1 is relatively wide so that the molded articles can be deposited across the width thereof, thus rendering the machine capable of high speed operation.

Summary of operation

The operation of the complete machine may be briefly set forth as follows. The rotation of the forming dies in the vat containing the solution of pulp or other plastic material will cause a thin layer of the material to adhere to the forming die due to the suction therein. When the forming dies reach the position shown at the top in Fig. 2, the compression dies coact therewith and as the two sets of dies pass beneath the compression block 95 and rollers 98, the pulp is tightly squeezed or pressed between the two dies. During the rotation of the forming dies, suction has removed a large proportion of the liquid or moisture from the pulp and after compression, the molded article is transferred to the compression die by means of compressed air, the compression die also being connected at this time to a source of suction.

After receiving the molded article from the forming dies, the compression dies are rotated through 180° and are also rotated pivotally to the position shown at the right in Fig. 2 or, in other words, to a position above one of the transfer heads. At this period in the cycle of operation, compressed air is introduced in back of the compression die and transfers the molded article from the compression die to the transfer head, the latter being under suction. Gravity also assists in this transfer.

After receiving the molded article from the compression dies, the transfer heads are rotated through approximately 180° and also axially to a position above the conveyor belt whereupon compressed air in the transfer head discharges the molded articles therefrom to the conveyor belt.

When the machine is stopped for any reason the suction to the forming dies is automatically cut off by the closing of valve 48′.

If during the operation of the machine the thickness of the product or article molded exceeds a maximum limit the machine will be automatically stopped by the tripping of lever 112 which opens the motor circuit.

Although certain specific embodiments of the invention have been particularly shown and described, it will be understood that the invention is capable of modification and that changes in the construction and in the arrangement of the various cooperating parts may be made without departing from the spirit or scope of the invention, as expressed in the following claims.

What I claim is:

1. A pulp molding machine comprising a rotatable forming die, a compression die adapted to coact therewith and separately mounted on an axis coinciding with the axis of the forming die and a spring-controlled pressure device engageable with the compression die to force the compression die toward the forming die.

2. A pulp molding machine comprising a rotatable forming die, a compression die adapted to coact therewith and separately mounted on an axis coinciding with the axis of the forming die and a spring-controlled pressure device engageable with the compression die to force the compression die toward the forming die, said device comprising a block and springs forcing said block toward the compression die.

3. A pulp molding machine comprising a forming die, a compression die adapted to coact therewith and a spring-controlled pressure device engageable with the compression

die to force the compression die toward the forming die, said device comprising a block, springs forcing said block toward the compression die, and rollers mounted on said block and engageable by said compression die.

4. A pulp molding machine comprising a forming die, a compression die adapted to coact therewith and a spring-controlled pressure device engageable with the compression die to force the compression die toward the forming die, said device comprising a block, springs forcing said block toward the compression die, rollers mounted on said block and engageable by said compression die, and means for moving said rollers around the block.

5. A pulp molding machine comprising a forming die, a compression die adapted to coact therewith and a spring-controlled pressure device engageable with the compression die to force the compression die toward the forming die, said device comprising a block and springs forcing said block toward the compression die, a chain extending around the block and rollers carried by said chain and engageable by the compression die.

6. A pulp molding machine comprising a forming die, a compression die adapted to coact therewith and a spring-controlled pressure device engageable with the compression die to force the compression die toward the forming die, said device comprising a block and springs forcing said block toward the compression die, a chain extending around the block and rollers carried by said chain and engageable by the compression die, and means for driving said chain and moving the rollers across the block.

7. A pulp molding machine comprising forming dies, and compression dies mounted independently of and laterally displaced from the forming dies and adapted to coact therewith, said compression dies being mounted for rotation about a plurality of axes at right angles to each other.

8. A pulp molding machine comprising pulp forming dies, compression dies and transfer mechanism, said compression dies being mounted on a carrier disposed between said forming dies and said transfer mechanism, said compression dies being rotatable with said carrier and relative thereto.

9. A pulp molding machine comprising pulp forming dies, compression dies and transfer mechanism, said compression dies being mounted on a carrier disposed between said forming dies and said transfer mechanism, said compression dies being rotatable with said carrier and being pivoted thereon for movement from one side of the plane of the carrier to the other side thereof.

10. In a pulp molding machine, a carrier, forming dies mounted thereon, a rotatable carrier independent of said forming die carrier, and compression dies mounted on said rotatable carrier for rotation therewith and for rotation relative thereto.

11. A pulp molding machine comprising pulp forming dies, compression dies and transfer mechanism, said compression dies being mounted on a carrier disposed between said forming dies and said transfer mechanism, said compression dies being rotatable with said carrier and being pivoted thereon for movement from one side of the plane of the carrier to the other side thereof, and means for guiding said compression dies from a position above said forming dies to a position above said transfer mechanism.

12. A pulp molding machine comprising pulp forming dies, compression dies and transfer mechanism, said compression dies being mounted on a carrier disposed between said forming dies and said transfer mechanism, said compression dies being rotatable with said carrier and being pivoted thereon for movement from one side of the plane of the carrier to the other side thereof, and means for guiding said compression dies from a position above said forming dies to a position above said transfer mechanism, said compression dies facing downwardly in both of said positions.

13. A pulp molding machine comprising pulp forming dies, compression dies and transfer mechanism, said compression dies being mounted on a carrier disposed between said forming dies and said transfer mechanism, said compression dies being rotatable with said carrier and being pivoted thereon for movement from one side of the plane of the carrier to the other side thereof and on the opposite side of the axis of the carrier.

14. A pulp molding machine comprising a tank, a hub, a plurality of forming dies carried by said hub and disposed at right angles to radii thereof, a shaft for rotating said hub, a carrier mounted on said shaft and disposed laterally of said hub, a plurality of compression dies on said carrier, and means for moving said compression dies into coactive relation with said forming dies and in a path outside of said tank.

15. A pulp molding machine comprising a tank, a hub, a plurality of forming dies radially mounted on said hub, a shaft for rotating said hub, a carrier mounted on said shaft and disposed laterally of said hub, a plurality of compression dies on said carrier, and means for moving said compression dies into coactive, substantially parallel relation with said forming dies and in a path disposed outside of said tank.

16. A pulp molding machine comprising a tank, a hub, a plurality of forming dies

radially mounted on said hub, a shaft for rotating said hub, a carrier mounted on said shaft and disposed laterally of said hub, a plurality of compression dies on said carrier, means for moving said compression dies into coactive relation with said forming dies and in a path disposed outside of said tank, a compression device adapted to coact with said forming and compression dies when said dies are disposed in coactive relation.

17. A pulp molding machine comprising a hub, a plurality of forming dies radially mounted on said hub, a shaft for rotating said hub, a carrier mounted on said shaft, a plurality of compression dies on said carrier, means for moving said compression dies into substantially horizontal coactive relation with said forming dies, a compression device adapted to engage said forming and compression dies when said dies are disposed in coactive relation.

18. A pulp molding machine comprising a tank, rotatable pulp forming mechanism, pulp compression dies mounted separately and spaced laterally therefrom and rotatable on an axis coinciding with the axis of rotation of the pulp forming mechanism, said compression dies being movable in a path outside of said tank and adapted to coact with said forming dies and to receive the molded material therefrom, a conveyor and means for transferring the molded articles from the compression dies to the conveyor.

19. A pulp molding machine comprising pulp forming mechanism, pulp compression dies adapted to coact therewith in a horizontal plane and to receive the molded material therefrom, a conveyor and means for transferring the molded articles in a substantially horizontal plane from the compression dies to the conveyor, said transferring means comprising a plurality of transfer arms rotatable in a substantially horizontal plane.

20. A pulp molding machine comprising pulp forming mechanism, pulp compression dies adapted to coact therewith and to receive the molded material therefrom, a conveyor and means for transferring the molded articles from the compression dies to the conveyor, said transferring means comprising a plurality of transfer arms rotatable in a substantially horizontal plane and axially on axes disposed in said plane.

21. A pulp molding machine comprising pulp forming mechanism, pulp compression dies adapted to coact therewith and to receive the molded material therefrom, a conveyor and means for transferring the molded articles from the compression dies to the conveyor, said transferring means comprising a plurality of transfer arms rotatable in a substantially horizontal plane and axially on axes disposed in said plane, said arms being movable axially through substantially 180° during their rotation 180° in said horizontal plane.

22. A pulp molding machine comprising a tank, forming dies movable therethrough, and compression dies adapted to coact therewith, both sets of said dies being separately mounted on the same shaft and spaced laterally from each other, and means for moving said compression dies in a path outside of said tank and into coactive parallel relation to said forming dies.

23. A pulp molding machine comprising forming dies, and compression dies adapted to coact therewith, both sets of said dies being separately mounted on the same shaft, and means for moving said compression dies into coactive parallel relation to said forming dies in substantially horizontal planes.

24. A pulp molding machine comprising forming dies, and compression dies adapted to coact therewith, both sets of said dies being mounted on the same shaft, means for moving said compression dies into coactive parallel relation to said forming dies, and to a position disposed substantially parallel to said coactive position but displaced 180° therefrom.

25. A pulp molding machine comprising pulp forming dies, compression dies and transfer mechanism, said compression dies being mounted on a carrier disposed between said forming dies and said transfer mechanism, said compression dies being movable from a horizontal coactive position relative to said forming dies to a horizontal coactive position relative to said transfer mechanism.

26. In a pulp molding machine, a plurality of dies, a hub, a plurality of arms secured to said hub and rotatable therewith, a transfer head secured to each arm, and means for positioning said heads upright in position to receive molded articles from said dies and means for positioning said heads inverted when the heads are disposed in discharging position.

27. In a pulp molding machine, a plurality of dies, a hub, a plurality of arms secured to said hub and rotatable therewith, a transfer head secured to each arm having a surface adapted to receive a molded article and adapted in one position to receive said article from a die and in another position to discharge said article, and means for positioning each of said heads in receiving position with the receiving surface at the upper end of the head and means for positioning each of said heads in discharging position with the surface disposed at the bottom thereof or inverted.

28. In a pulp molding machine, a hub, transfer arms carried thereby and rotatable therewith, a perforated transfer head on each arm, a control casing disposed in abutting relation to said hub, a suction chamber, a compression chamber in said casing and ports in said casing and in said hub adapted to

establish communication between the transfer arms and said suction chamber and said compression chamber at predetermined points in the rotation of the hub and arms, and means for regulating the pressure between the abutting surfaces of the hub and control casing.

29. In a pulp molding machine, a hub, transfer arms carried thereby and rotatable therewith, a transfer head on each arm, a control casing disposed beneath said hub and a seat for supporting said casing and hub, said seat and casing having surfaces so constructed and arranged that the hub and casing will be always maintained in effective cooperating relation with respect to each other.

30. In a pulp molding machine, a hub, transfer arms carried thereby and rotatable therewith, a transfer head on each arm, a control casing disposed beneath said hub and a seat for supporting said casing and hub, said seat and casing having coacting interengaging spherical surfaces.

31. In a pulp molding machine, a plurality of dies, a hub, a plurality of arms secured to said hub and rotatable therewith, a transfer head secured to each arm, and means for creating suction in said heads when they are disposed in upright position to receive molded articles from said dies and means for creating pressure in said heads when the heads are disposed in inverted or discharging position.

32. In a pulp molding machine, a rotatable hub, a plurality of transfer arms carried thereby, a transfer head carried by each arm, said arms being axially rotatable, two sets of cams carried by each arm and a cam track controlling each set of cams in a manner to cause the axial rotation of said transfer arms as the hub is rotated.

33. In a pulp molding machine, a rotatable hub, a plurality of transfer arms carried thereby, a transfer head carried by each arm, said arms being axially rotatable, two sets of cams carried by each arm, a plurality of dies, a cam track for holding said cams in a position to dispose the heads substantially parallel to the dies in receiving position, a cam track for positioning the heads substantially horizontal in discharging position and tracks intermediate said cam tracks for rotating the arms axially.

34. In a pulp molding machine, a plurality of dies rotatable around a horizontal axis, a plurality of transfer heads rotatable around a vertical axis, means for guiding said transfer heads to a substantially horizontal receiving position adjacent the dies, and control means for guiding said dies to a substantially horizontal, inverted discharging position.

35. In a pulp molding machine, a plurality of dies rotatable around a horizontal axis, a plurality of transfer heads rotatable around a vertical axis, control means for guiding said dies and heads into juxtaposition with relation to each other and means for giving the die a sudden movement toward and away from the head.

36. In a pulp molding machine, a plurality of dies rotatable in a circular path around a horizontal axis, a plurality of transfer heads rotatable in a circular path around a vertical axis and means including cams operatively connected to said heads and an undulating cam track engageable by said cams for bringing said heads to parallel relation with respect to said dies and moving the heads into coactive relation with the dies and subsequently away from the dies.

37. A pulp molding machine comprising a forming die, a compression die adapted to coact therewith and a spring-controlled pressure device engageable with the compression die to force the compression die toward the forming die, said device comprising positively driven means movable with the dies during the compressing operation.

38. A pulp molding machine comprising a forming die, a compression die adapted to coact therewith and a spring-controlled pressure device engageable with the compression die to force the compression die toward the forming die, said device comprising positively driven, continuously operating means engageable with said compression die.

39. A pulp molding machine comprising a forming die, a compression die adapted to coact therewith and a spring-controlled pressure device engageable with the compression die to force the compression die toward the forming die, said device comprising positively driven means movable in the direction of travel of the die and engageable therewith.

40. A pulp molding machine comprising a forming die, a compression die adapted to coact therewith and a spring-controlled pressure device engageable with the compression die to force the compression die toward the forming die, said device comprising means engageable with the die and movable therewith, said means being always movable in its operative position, in one direction.

41. A pulp molding machine comprising a forming die, a compression die adapted to coact therewith and a spring-controlled pressure device engageable with the compression die to force the compression die toward the forming die, said device comprising means engageable with the compression dies and successively acting springs operable on said means to force said means against the compression dies.

42. A pulp molding machine comprising a shaft, a carrier mounted thereon, a plurality of forming dies radially mounted on said carrier and facing away from the axis

of the carrier, and compression dies mounted for rotation with said shaft and adapted to coact with said forming dies.

43. A pulp molding machine comprising a shaft, a carrier mounted thereon, a plurality of forming dies radially mounted on said carrier and facing away from the axis of the carrier, and compression dies mounted on a separate carrier on said shaft and adapted to coact with said forming dies.

44. A pulp molding machine comprising a shaft, a carrier mounted thereon, a plurality of forming dies radially mounted on said carrier and facing away from the axis of the carrier, compression dies mounted for rotation with said shaft and adapted to coact with said forming dies, and means engageable with each of said compression dies when said dies are coacting with a forming die for forcing said compression die toward the forming die and in a radial direction relative to the forming die carrier.

45. A pulp molding machine comprising a shaft, a carrier mounted thereon, a plurality of forming dies radially mounted on said carrier and facing away from the axis of the carrier, compression dies mounted on a separate carrier on said shaft and adapted to coact with said forming dies, and means engageable with each of said compression dies when said dies are coacting with a forming die for forcing said compression die toward the forming die and in a radial direction relative to the forming die carrier.

46. A pulp molding machine comprising a shaft, a carrier mounted thereon, forming dies mounted on and disposed tangent to the periphery of the carrier and compression dies carried by said shaft and movable into juxtaposition on said forming dies.

47. A pulp molding machine comprising a shaft, a carrier mounted thereon, forming dies mounted on and disposed tangent to the periphery of the carrier and compression dies mounted on a separate carrier on said shaft and movable into juxtaposition on said forming dies.

48. A pulp molding machine comprising a shaft, a carrier mounted thereon, forming dies mounted on and disposed tangent to the periphery of the carrier and compression dies mounted on a separate carrier on said shaft and laterally displaced from the forming dies and movable into juxtaposition on said forming dies.

49. In a pulp molding machine, a shaft, arms carried thereby, forming dies mounted on said arms, a suction conduit communicating with each of said dies, an air conduit communicating with each of said dies and a port establishing communication between said conduits for each die.

50. A pulp molding machine comprising compression dies, transfer heads, and means for positioning said transfer heads below said compression dies to receive the molded articles therefrom.

51. A pulp molding machine comprising compression dies, transfer heads, a conveyor, and means for positioning said transfer heads below said compression dies to receive the molded articles therefrom and for positioning the transfer heads above the conveyor to discharge the articles thereon.

52. A pulp molding machine comprising compression dies, transfer heads, means for positioning said dies in downwardly facing delivery position and means for positioning said heads in upwardly facing receiving position below said dies.

53. In a pulp molding machine, a shaft, a hub mounted thereon, arms extending radially from said hub, forming dies on said arms, a carrier, and compression dies mounted thereon and adapted to coact with the forming dies when positioned tangent to said radial arms.

54. In a pulp molding machine, a shaft, a hub mounted thereon, arms extending radially from said hub, forming dies on said arms, a carrier, compression dies mounted thereon and adapted to coact with the forming dies when positioned tangent to said radial arms, and a pressing device disposed in position to exert its pressing force in the direction of the radii of said arms.

55. In a pulp molding machine, a shaft, a carrier thereon, forming dies on said carrier, a second carrier on said shaft, compression dies on said second carrier adapted to coact with said forming dies in a position disposed substantially vertically above the shaft and a vat surrounding the lower portion of the forming die carrier.

56. In a pulp molding machine, a shaft, a carrier thereon, forming dies on said carrier, a second carrier on said shaft, compression dies on said second carrier adapted to coact with said forming dies in a position disposed substantially vertically above the shaft and transfer mechanism for receiving the article from the compression dies in a position below the carrier shaft.

57. In a pulp molding machine, a shaft, a carrier thereon, forming dies on said carrier, a second carrier on said shaft, compression dies on said second carrier adapted to coact with said forming dies in a position disposed substantially vertically above the shaft and transfer mechanism for receiving the article from the compression dies in a position below the carrier shaft and angularly displaced substantially 180° from the compression die receiving position.

58. In a pulp molding machine, a shaft, a plurality of forming dies carried thereby, a plurality of compression dies adapted to coact with said forming dies in a position above the shaft and transfer mechanism adapted

to receive the molded articles from the compression dies in a position below the shaft.

59. In a pulp molding machine, a shaft, a plurality of forming dies carried thereby, a plurality of compression dies adapted to coact with said forming dies in a position above the shaft and transfer mechanism adapted to receive the molded articles from the compression dies in a position below the shaft and angularly displaced substantially 180° from the compression die receiving position.

60. In a pulp molding machine, a substantially horizontal shaft, compression dies carried thereby, a second shaft disposed at right angles to said first shaft, transfer mechanism on said second shaft adapted to receive the molded articles from the compression dies, a gear on said first shaft, a gear connected to said transfer mechanism and meshing with said first gear, and means for vertically adjusting said transfer mechanism and the gear carried thereby.

61. In a pulp molding machine, a substantially horizontal shaft, compression dies carried thereby, a second shaft disposed at right angles to said first shaft, transfer mechanism on said second shaft adapted to receive the molded articles from the compression dies, a gear on said first shaft, a gear connected to said transfer mechanism and meshing with said first gear, said first gear being slidable on the shaft to permit vertical movement of the transfer mechanism.

62. In a pulp molding machine, transfer mechanism comprising a shaft, a hub mounted thereon, a suction and air control casing disposed below and engaging said hub and means for adjustably supporting said hub and transfer mechanism on said shaft.

63. In a pulp molding machine, transfer mechanism comprising a shaft, a hub mounted thereon, a suction and air control casing disposed below and engaging said hub, and means for supporting said casing in a manner whereby said casing will automatically adjust itself to the hub.

64. In a pulp molding machine, forming dies, compression dies, and transfer mechanism, means for so positioning said dies and transfer mechanism that the product will be transferred from the forming dies to the compression dies in an upward direction and will be transferred from the compression dies to the transfer mechanism downwardly.

65. In a pulp molding machine, a rotary carrier, forming dies thereon, compression dies adapted to coact therewith, and means operable in a direction substantially at right angles to the axis of the forming die carrier to press the compression dies toward the forming dies.

66. A pulp molding machine comprising a pulp tank, forming dies movable through said tank, and compression dies disposed outside of said tank and adapted to coact with said forming dies, both sets of dies being separately mounted on and rotatable with the same shaft.

67. A pulp molding machine comprising a tank, pulp forming dies, compression dies and transfer mechanism, said compression dies being mounted on a carrier for movement in a path outside of said tank and disposed between said forming dies and said transfer mechanism, said compression dies being rotatable with said carrier and being pivoted thereon.

68. A pulp molding machine comprising a tank, pulp forming dies, compression dies and transfer mechanism, said compression dies being mounted on a carrier for movement in a path outside of said tank and disposed between said forming dies and said transfer mechanism, said compression dies being rotatable with said carrier and being pivoted on pivots disposed at right angles to the axis of the carrier.

69. A pulp molding machine comprising a tank, pulp forming dies, compression dies and transfer mechanism, said compression dies being mounted on a carrier for movement in a path outside of said tank and disposed between said forming dies and said transfer mechanism, said compression dies being rotatable with said carrier and being rotatable on axes disposed within the plane of the carrier.

70. A pulp molding machine comprising a tank, pulp forming dies, compression dies and transfer mechanism, said compression dies being mounted on a carrier for movement in a path outside of said tank and disposed between said forming dies and said transfer mechanism, and means for guiding said compression dies from a position to receive the molded article from the forming dies to a position for discharging the molded article to the transfer mechanism.

In witness whereof, I have hereunto set my hand this 9th day of October, 1926.

MERLE P. CHAPLIN.