M. L. Keyes.

APPARATUS FOR MAKING PULP ARTICLES.

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3 SHEETS—SHEET 1.
To all whom it may concern:

Be it known that I, MARTIN L. KEYES, a citizen of the United States, residing at Cambridge, county of Middlesex, State of Massachusetts, have invented an improvement in Apparatus for Making Pulp Articles, of which the following is a specification, in connection with the accompanying drawings, and is a specification, like characters on the drawings representing

This invention relates to a novel device for making articles from pulp; and its objects are to provide novel means for molding the articles and a novel device for transferring the shaped or molded articles from the mold to the mold-faces to gether at a point farther on in the travel of the mold, whereby the pulp which has been delivered to the mold is pressed into an article of the desired shape. The mold-faces are perforated, and I find it most convenient to supply the liquid pulp to the mold by immersing one face of the mold in a body of pulp during the traveling movement of said mold and applying suction to said face while it is so immersed, this operation resulting in causing a layer of pulp to adhere to the face. At a point farther on in the travel of the mold the faces of the mold are brought together, and the layer of pulp which has been deposited on one of them is compressed between them with sufficient pressure to properly shape and form the article.

In the embodiment of my invention hereinafter illustrated and described the complete mold comprises two separable members, each of which is hollow and has a perforated molding-face. In order to make a commercially successful device of this character, I preferably employ a plurality of molds, and in this embodiment of my invention they are given their traveling movement by being supported on or carried by a movable mold-carrier, which by its movement carries the molds successively or one face of each mold into a body of pulp.

In the form of my invention herein illustrated I have made provision for depositing a layer of pulp on one face only of each mold, though my invention would not be departed from if pulp were supplied to both faces of the mold prior to the final shaping of the article by the compression device. Since in this embodiment of my invention the pulp is deposited on one face only of the mold, I will for convenience refer to that face on which it is deposited as the "forming-face" and will refer to the other face of the mold as the "compressing-face." I will also refer to that member of the mold which carries the forming-face as the "former" and the other member of the mold as the "compressing" member.

After the forming-face of the mold has been immersed in the pulp and a layer of pulp deposited thereon by suction and the said layer compressed between the two mold-faces at a point farther on in the travel of the mold, as above described, the two mold-faces are separated from each other. The shaped article is loosened from the faces and is then taken by a transferring device and carried to a suitable conveyor, which in turn conveys the article into an oven or other suitable drier for the purpose of drying it. The loosening of the shaped article from the mold-faces as they are separated is accomplished in this embodiment of my invention by a draft of air, which is forced through the perforated faces. The transferring device is in the form of a suction nozzle, which is at the proper time brought into register with the mold and which operates to take the shaped article by suction from the mold after it has been loosened from the faces thereof and transfer said article to the conveyor. This form of transferring device is preferable, because it can be made to operate upon the wet article without affecting the shape given to it by the mold.

The invention may be embodied in apparatus constructed in various ways, and in the drawings accompanying this application I have shown one structure including the features of the invention.

Referring to the drawings, Figure 1 is a
vertical central section of my improved apparatus. Fig. 2 is a side elevation of the mold-carrier, the vat and the supporting-hub for the mold-carrier being shown in section. Fig. 3 is a top plan view of the device. Figs. 4 and 5 are views of the valve mechanism for the receiver. Fig. 5 being a section on the line 5-5, Fig. 4. Figs. 6 and 7 are details of the two-part mold. Fig. 8 is a detail showing the device for compressing and molding the layer of pulp between the molds. Fig. 9 is a detail of the suction-nozzle of the transferring device. Figs. 10 and 11 are details hereinafter referred to.

In the embodiment of my invention illustrated in the drawings I have shown the mold as having faces of such a shape as to form plates from the pulp; but I wish to have it understood that my invention is not limited to the forming of any particular shape of article, as the particular shape depends entirely upon the shape which is given to the molding-faces. For making plates or other shaped or hollow articles the molding-faces of each mold will be neat faces, this being the form of faces illustrated in the drawings. If, however, it is desired to make articles having straight faces, such as plain disks or articles having both sides thereof convexed or one concavo-convex in cross-section, it would only be necessary to employ a mold having faces of the appropriate shape to form the desired article.

In Fig. 7, which shows one form of the mold in cross-section, the members of the mold are designated by 1 and 5, respectively, said members being hollow and having the perforated molding-faces 6 and 7. The liquid pulp from which the articles are made and in which the mold-faces are immerged in a vessel is contained in a tank or vat 3. In forming the article the pulp is carried into the vat by a mechanism herein-after described, and when the face 7 is immersed in the pulp section is applied thereto for the purpose of causing a layer of pulp to be deposited thereon. As the mold continues its traveling movement the faces are brought together and the pulp layer compressed by a compression device, as will be presently described. In order to prevent the pulp layer from being forced out from between the faces during the compression operation, I have shown the mold member 5 as having the annular lip 7, which is adapted to partially embrace the mold member 4, and the latter mold member is provided with an annular packing-ring, which makes a tight joint with the lip 7.

One convenient way of securing the packing-ring in place is to confine it between the tapered portion 9 of the face 6 and retaining-ring 15. This, however, is only one way in which the requisite tight joint between the faces may be secured, and my invention is not limited to this particular construction.

I have herein shown my invention embodied in a machine which comprises a plurality of molds which are mounted upon a revolving mold-carrier, whereby as the mold-carrier revolves one face of each mold is periodically immersed in the pulp. This mold-carrier is mounted to rotate about a pivotal shaft 8, which is suitably supported above the tank 3.

The form of mold-carrier illustrated comprises a hub 9, rotatable about said shaft and having a series of substantially radial hollow arms 11, to the end of each of which are connected the two members of a mold. It is necessary that the two members of any mold have a movement toward and from each other, which may be accomplished either by making both of them movable or by giving one of them a fixed position with reference to the mold-carrier and supporting the other member to move toward and from the fixed member. It is the latter construction which I have illustrated in this embodiment of my invention. Each mold member 4 is rigid with its supporting-arms 11, and the corresponding mold member 5 is pivoted to said arm.

As herein illustrated each arm 11 is provided with a coupling member 13, to which the stem 14 of the corresponding mold member 5 is fixed. In each pivoted mold member 4 is pivotally connected to the coupling 13, as seen in Figs. 1 and 8, and said coupling is illustrated as being provided with a seat portion 15, against which the end of the stem 14 is adapted to rest when the shaped article is being forced from the molding-faces by a burst of air, as will be presently described.

10 designates a circular ring to which each of the mold members 5 are rigidly secured and which forms part of the mold-carrier. Said ring has gear-teeth on its periphery and forms, in effect, a circular rack, which meshes with the driving-gear 18 upon the driving shaft 6. By means of this construction the rotation of the gear 18 is transmitted to the mold-carrier, as will be obvious.

I have herein illustrated the teeth of the rack as being cut upon a separate ring 20, which is detachably secured to the main ring 19 in any suitable way, as by screws 21. With this arrangement of parts the rotation of the mold-carrier will carry the molds into and out of the vat, as will be readily seen from Fig. 2.

The pivotal shaft 8 is hollow and non-rotary and is divided by a partition 25 into two chambers, one of which, 26, is connected by any suitable means with an exhaust apparatus, (not shown,) and the other of which, 27, is connected by means of any suitable pipe to a compressed-air apparatus. (Not shown.)

The hub 9 of the mold-carrier is provided with a series of ports 28, which communicate with the hollow arms 11, and the exhaust chamber 26 of the pivotal shaft 8 has a slot or port 24, which is preferably so positioned that during the rotation of the mold-carrier the port 25 of any arm is brought into regis-
ter with the port 24 just after one face of the mold attached to said arm has been immersed in the pulp in the tank 3, such position being illustrated at a in Fig. 2. As soon as the port 23 of said arm registers with the port 24, the suction apparatus operates to exhaust the air in the hollow mold member 5, forming a vacuum therein the effect of which is to draw or force a layer of material against the face 7 of said mold member. In order to prevent the pulp from being drawn through the apertures in the face 7, I have covered said face with a suitable reticulated material 30, such as fine wire-gauze. During this operation of causing a layer of the pulp to adhere to the molding-face 7 the relative positions of the mold numbers will be seen in Fig. 1, the movable mold member being held separated from the fixed mold member by any suitable means, such as a spring 31, secured to the stem 13 of the fixed mold member and bearing against the stem 14 of the movable mold member.

The port 24 from the vacuum-chamber is elongated, as shown, so that each mold member 5 is in communication with the vacuum-chamber until the arm supporting said mold member is in an approximately horizontal position, in which position the mold passes through a compression device, which operates to force the two mold members together and press the interposed layer of pulp between the molding-faces, thus squeezing or forcing any superfluous moisture out of the pulp, compacting the pulp, and molding it to the desired shape.

In order to maintain a tight joint between the hub 9 and the pivotal shaft 8, I have illustrated the shaft as slightly tapering and the bore in the hub as tapering to fit. 10 designates suitable check-nuts screwed onto the shaft 8 and which serve to keep the hub in proper position. Any wear which occurs between the hub and shaft may be taken up by adjusting the hub longitudinally on the shaft.

In the operation above described suction is applied to the face 7 only of each mold, and since the pulp layer is deposited in the first instance on this face I have referred to it as the "forming" face. The face 6 of each mold I have referred to as the "compressing" face, since it operates to compress the layer of pulp between it and the forming-face. My invention, however, would not be departed from if the device were so constructed that suction could be applied to both faces during the time the mold was immersed in the pulp and pulp thus deposited on both faces.

The compression device may have any suitable position, though I have herein shown it as being supported on the upper edge of the tank. (See Fig. 3.) The form of compression device herein illustrated comprises a roll 33, (see Fig. 5,) which is supported in a suitable rigid bearing 34 and bears against the outside face 35 of the ring 19, thus forming an abutment for the ring, and a pivotally-mounted member 36, which is adapted to engage the member 4 of each mold and force the same against the member 5. I have illustrated each member 4 as having the swell 37, which as the mold-carrier rotates engages the face of the pivoted member 36 and carries said member from the dotted-line position, Fig. 8, to the full-line position, this operation obviously pressing the mold-faces together with an increasing pressure until the crown of the swell 37 passes the dead-center line. When the mold has passed through the compression device, the pivoted member 36 drops back into its dotted-line position and against the stop 38, in which position it is already to operate on the next succeeding mold.

The operating-face of the member 36 is concentric to its axis, and said member forms, in effect, a portion of a large roll. Such a roll might be substituted for the member 36 without departing from the invention. The member 36 is preferably yieldingly mounted, so that it can give slightly if any hard substance gets between the molding-faces, and for this purpose I have herein shown it as being pivoted between the branches of the H-shaped holder 40, which in turn is connected to the rigid support 41 by means of bolts 42, the said bolts 42 passing through slots in the arms of the holder 40, (see Fig. 5,) and between the end of the support 41 and the web of the holder is a block of yielding material 43, such as rubber. A spring may be used instead of the rubber 43, if desired, however.

Since a large amount of pressure is developed as the mold passes between the roll 33 and the pivoted cam 41, I preferably connect the supports 24 and 41 for the roll and pivoted cam respectively, by a yoke 45, which prevents them from spreading apart.

Preferably I will provide a guiding-cam 39 for the purpose of engaging the movable or compressor mold member and closing the same upon the fixed mold member prior to the entering of the molds into the compression device, said guiding-cam 32 being supported in any suitable way as by attaching the same to the side of the tank. The arrow in Fig. 2 indicates the direction of movement of the mold-carrier.

It will be observed that the mold members move in a circular path and that each mold member 4 has a movement toward and from the corresponding member 5 such relative movement of the two members of each mold occurring during a portion only of the travel of the mold.

During the time the mold member 4 has no movement relative to the member 5 the faces of the two members travel in substantially parallel paths.

The device which has been described therefore comprises in its construction a traveling mold formed of a plurality of faces adapted to travel (when not moving relatively to each other) in substantially parallel paths and...
form an article from pulp between them combined with means to supply pulp to said mold and means to compress the mold-faces together at a point farther on in the travel of the mold, and this is all accomplished without stopping the movement of the mold.

After the pulp has been compressed between the molding-faces, as above described, the faces are separated and the article loosened therefrom by a blast of air. In the form of the invention herein shown I have provided mechanism for first forcing compressed air into the member 5, which results in forcing the two mold members apart and forcing the article off from the forming-face 7 and subsequently forcing compressed air into the member 4 for the purpose of loosening the article from the compressing-face 6.

The chamber 27 in the pivotal shaft 8, which, it will be remembered, is connected with the source of compressed air, has therein a port 50, so situated as to register with each port 23 in the hub when the corresponding arm is in an approximately vertical position or that represented by the arm b in Fig. 2. When the port 50 thus registers with any port 23 and the compressed air is admitted to the corresponding mold member 5, it acts through the apertures in the face 7 upon the shaped article with sufficient force to force the movable mold member 4 away from the fixed mold member 5, and the movable member falls by force of gravity into the horizontal position illustrated in Fig. 1, the shaped article, it will be understood, adhering to the face of the movable mold member. As the movable mold member 4 reaches the horizontal position in Fig. 1, a current of compressed air is directed into said member and operates to re-form the shaped article from the molding-face 6.

Referring to Fig. 6, it will be seen that the connection 13 has the port 51, which is normally closed by the pivoted flap-valve 52, the said valve having an arm 53 extending therefrom, which is operated by a suitable spring 54 to maintain the valve in the full-line position in Fig. 6, so as to close the port 51, the said spring being stiff enough to hold the valve closed even when a vacuum is established in the arm 11. The stem 14 of the movable member 4 has the tappet 56 connected thereto, which, when the mold member reaches the horizontal position strikes the arm 55, also extended from the pivot of the valve, and operates to shift the valve onto the seat 57, thereby to close communication between the hollow arm 11 and the stem 12 of the fixed mold member and open communication between the said hollow arm and the stem 14 of the movable mold member, the end of the stem 14 when in the horizontal position, it being understood, resting against and making a tight joint with the seat 15 in the connection 13. With the parts in this position the compressed air is admitted to the movable mold member and forces the shaped article therefrom.

If desired, I may provide some suitable device for positively throwing the pivoted mold member into the horizontal position instead of relying on the force of gravity. One example of such a device would comprise an arm 19 on the movable mold member or its stem, which is adapted to engage a cam 53, and thereby force the pivoted mold member into its horizontal position. As the shaped article is thus forced from the mold members by the compressed air, it is taken by a suitable transferring device, which operates to carry the same and deposit it upon a conveyor leading to a suitable drying-chamber.

The transferring I have herein illustrated is a pneumatic device and comprises a pick-off or suction-nozzle and means to bring said nozzle into register with the face 6 of the mold at about the time the article is loosened from the face, whereby the article is transferred from the molding-face to the suction-nozzle by the combined action of the blast of air through the said face and the suction in the nozzle. After being thus transferred the article is carried by the suction-nozzle to a suitable conditioning chamber.

In the best form of my invention now known to me I provide a series of pick-offs or suction-nozzles, these being in this embodiment of my invention one suction-nozzle for each mold. Said suction-nozzles are designated by 78 and are carried by arms 60, extending from a suitable hub 51, which rotates about a hollow standard or support 105 in Fig. 1 the standard or support is illustrated as being mounted upon a suitable bracket 63, secured to the side of the vat, though it will be understood that any other suitable way of mounting the support 62 may be employed. Sleeved over the support 62 is the sleeve 64, carrying at its lower portion the rack 65, which meshes with a suitable gear on one end of the shaft 66, said shaft having at the other end a bevel-gear meshing with the gear 68 on the main drive-shaft 69, to which shaft the gear 18, before referred to, is connected. The upper end of the sleeve 64 is adjustably connected to the hub 61, preferably by making the hub and the sleeve with flanges 70, which are bolted together, one of said flanges having suitable slots therein to receive the bolts in order to provide for relative angular adjustment. The upper end of the support 62 is tapered, as illustrated, and the hub 61 has a corresponding taper to thus make a tight or valve joint between the members, and the support 62 has at its upper end two chambers, one of the chambers 71 communicating by a suitable pipe 73 with the exhaust apparatus and the other chamber 72 communicating by pipe 75 with the compressed-air apparatus. The hub 61 is provided with a series of ports 76, communicating with the various hollow arms 60, respec-
The suction-nozzle 73 is illustrated in Fig. 9 and is shown of bell-shaped form, it being made of any suitable flexible material, such as rubber. The lower end thereof may be stretched over a stiffening or spreading ring 100, having an annular groove on its exterior, a hoop or band 101 surrounding said ring and binding the rubber to the ring 100. Preferably the rubber will project below the ring 100 slightly to form lips 102, which engage the pulp article, thus preventing the same from contacting with the ring 100, and the open end of the nozzle will be covered by a suitable guard, preferably of wire-gauze or similar rotatable material, to prevent the soft pulp article from being drawn up into the nozzle.

To prevent the suction-nozzle 73 of the transferring arms 60 from clashing with the movable member 4 as the latter is forced by the compressed air from its vertical to its horizontal position, I provide each arm 50 with the self-packaging hinged joint 81 and use a suitable cam 50, which is supported in any suitable way, the said cam engaging the pivoted end of the arm 60 just before the said arm comes into its operative position and raising the same into the position shown at 2 in Figs. 1 and 3. The cam 50 is so shaped that just as the movable member 4 is blown or forced into the horizontal position the arm 60 drops off from the cam 50, and the spring 110 forces the suction-nozzle into a horizontal position directly over the faces of the mold member 4, as seen in Fig. 1. At this instant the compressed air is directed into the mold member 4 and the ports 75 and 76 are brought into alignment, so that the air is exhausted from the arm 60, this combined operation resulting in forcing the shaped article from the mold member 4 onto the suction-nozzle 73, where it is held by reason of the vacuum in the arm until the transferrer has been rotated sufficiently to bring the said suction-nozzle 73 over the carrier-belt 90. As this point is reached the port 76 registers with a port 91, leading to the compressed-air chamber 72, when the shaped article will be blown from the suction-nozzle 73 onto the conveyer 90.

The conveyer will carry the shaped articles into any suitable drying-chamber, where they will become dry and hard and ready for use. In my preferred form of apparatus the conveyer-belt 90 will be sufficiently wide so as to receive one or more plates or other articles side by side, this construction being preferable, since it requires a less length of belt. Where the plates are thus deposited side by side in rows on the belt, it is necessary to regulate the times of registry of the ports 76 of the arms 61 so that the ports of succeeding arms will be brought to register with the port 91 at different positions of the arm 60. For this purpose when the plates or other articles are to be deposited on the belt in two rows I provide every other arm 60 at its inner end, where it enters the hub 61, with the offset portion 92, the hub having two series of ports 76, one series registering with the straight arms 60 and the other series registering with the inner ends of the offset arms. The vacuum-chamber 71 is also provided with either an elongated port 75 being adapted to register with either series of ports 76 in the hub, or, as shown in the drawings, said vacuum-chamber will have two ports 77, situated one vertically over the other, the upper port 77 being adapted to register with each port 75 of the upper series as the succeeding straight arms come into position shown at m, Fig. 1, and the lower port 77 being adapted to register with each port 75 of the lower series as the succeeding offset arms come into the position m. I have also provided the compressed-air chamber with two ports 91, having a different radial position, (see Fig. 5), the upper port 91 being so situated as to register with the ports 76 of the straight arms as the suction-nozzles on said arms are over one side of the belt and the lower port being adapted to register with the ports 76 of the offset arms when the suction-nozzles on said arms are over the other side of the belt. The plates or other articles will therefore be deposited on the belt in two rows, as shown in Fig. 3. It will be understood, however, that if it is desired to deposit the plates or other articles in three or more rows on the belt a series of ports 91 will be employed, the ports being properly situated to admit compressed air to the arms when the suction-nozzles attached to the same are in the proper positions over the belt. The particular arrangement of ports above described is not essential to my invention, however, because many other arrangements which would accomplish the same result might be adopted. In order to support the arms 60 and tie the same rigidly together, I preferably connect each of them in some suitable way to the ring 95, which may be suitably supported upon the arms 96, extending from a collar 97, which is adjustably mounted upon the sleeve 64. In order to maintain a valve fit between the hub 61 and the tapered portion of the support 92, I make the sleeve 64 capable of vertical adjustment upon the support 62, the said sleeve being illustrated as supported upon an adjustable collar 99. As wear occurs between the hub and the support the collar 99 may be lowered and the hub allowed to drop to take up the wear.

From the above it will be seen that the form of my invention herein illustrated comprises a traveling mold having a plurality of faces and the construction is such that during the movement of the mold one of its faces is immersed in a body of pulp and a layer of pulp is deposited thereon, and during the further
or continued movement of the mold such layer of pulp is compressed between the faces of the mold and shaped into the desired article. With these features I have also combined a pneumatic transferring device which is adapted to take the shaped articles from the mold and transfer them to a conveyor. While it has been necessary in order to describe the invention to illustrate one embodiment thereof in the drawings, yet since I believe that I am the first to devise a pulp-molding apparatus comprising a mold having nesting faces between which the article is formed and means whereby one or the faces of the mold is immersed in a body of pulp and suction applied thereto while so immersed for the purpose of causing a layer of pulp to adhere to said face and said faces subsequently closed together to compress said layer of pulp and form it into an article of the desired shape, I desire to claim such a pulp-molding apparatus broadly. My invention may also be embodied in a pulp-molding machine comprising the following instrumentalities, to wit: a mold having a molding-face, means to move said face into and out from a body of pulp, means to deposit a layer of pulp on said face, and a compressing-face which acts simultaneously on all parts of the pulp deposited on the molding-face and between which and the molding-face the article is formed.

It will be obvious that in a machine having the features above enumerated the mold need not necessarily have a traveling movement, and therefore I intend this application to cover such a machine whether the mold is a traveling mold or not. It will also be obvious that when the invention is embodied in an apparatus having a traveling mold the mold may be given its traveling movement in various ways, and as I believe that I am the first to provide a traveling mold provided with a plurality of faces between which the article is formed and which in its traveling movement is supplied with a quantity of pulp and in its further traveling movement is acted upon by a device to compress the pulp between the face thereof, I intend those of the appended claims which refer to a traveling mold to cover this feature broadly irrespective of the particular mechanisms employed for giving the mold its traveling movement. I also believe that I am the first to combine with any form of pulp-molding device a pneumatic transferring device, and I therefore intend to cover this combination broadly. I also desire to state that it is immaterial to my invention whether the two members of each mold move in unison throughout their entire course or during a portion only of their traveling movement, as it is only necessary that they should thus move in unison during the time that the compressing operation takes place.

Having described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In a machine for forming articles from pulp in combination, a traveling mold formed of a plurality of faces adapted to form said article between them, a pulp-vat into which one or said mold-faces dips to receive a layer of pulp, and means to press said mold-faces together at a point farther on in the travel of said mold to form said article.

2. In an apparatus of the class described, a traveling mold comprising members having faces constructed to form between them an individual article, means to deposit a layer of pulp on one or said faces, means to compress said layer between said faces during the bodily movement of the mold, whereby an individual article is shaped from the pulp, and means to subsequently discharge each article from said mold.

3. In an apparatus of the class described, a series of traveling molds each having a plurality of cooperating faces constructed to form therein between an individual article, means to deposit a layer of pulp on one or the faces of each of the molds, means to compress the pulp between the faces of the molds whereby series of individual articles are shaped from the pulp, and means to thereafter discharge the said shaped articles from the molds.

4. In an apparatus of the class described, a series of traveling molds each having two mold-faces constructed to form therein between an article, devices acting in succession first to deposit a layer of pulp on one face of each mold, then to compress said layer between the faces of the mold during the movement of the latter, and finally to discharge each article from its mold, these various operations being performed on each of the molds in succession during the traveling movement of the mold.

5. In an apparatus of the class described, a traveling mold having two mold-faces constructed to form between a pulp article, suction devices to deposit a layer of pulp on one or said faces, means to compress said layer between said faces to form the same into a pulp article, and means to discharge said article from the mold, these various operations being performed in succession.

6. In an apparatus for making pulp articles, a pulp-containing vat, a traveling mold member having a mold-face, means to periodically immerse the said face in a body of pulp, suction devices operating to cause a layer of pulp to adhere to said face, a second mold member also having a mold-face, said last-named member traveling in unison with the first-named mold member during a portion of the movement of the latter, and means for compressing the layer of pulp between the mold-faces while the mold members are traveling in unison whereby a pulp article is formed.

7. In an apparatus for forming articles from pulp, a pulp-containing vat, a traveling mold member having a mold-face, means to peri-
odically immerse the said face in a body of pulp, suction devices operating to cause a layer of pulp to adhere to said face, a second mold member traveling in unison with the first named mold member during a portion of its movement, said second mold member having a mold-face, means to close said mold-face together whereby a pulp particle is formed between said faces, and means to discharge the article from between the said faces.

5 In an apparatus for forming articles from pulp, a pulp-containing vat, a series of bodily-movable mold members each having a mold-face, means to periodically immerse each of said faces in a body of pulp, means to exhaust the air from said members while the faces thereof are in the pulp whereby a layer of pulp is deposited on each face, a series of compressing mold members each having a mold-face, means for causing each of said compressing mold members to travel in unison with the corresponding mold member of the first-named series during a portion of the movement of the latter, means to compress each layer of pulp between the faces of the two mold members while they are moving in unison, and means to discharge the article from between said faces.

10 In an apparatus of the class described, a traveling mold having nesting faces, suction devices to deposit a layer of pulp on one of said faces, means to compress said layer between said faces, whereby an individual article is shaped from the pulp, and means to discharge said article from between said faces, these various operations being performed during the traveling movement of the mold.

15 In an apparatus of the class described, a pulp-containing vat, a traveling mold having a plurality of faces adapted for forming an article between them, means to pass one face of said mold into the pulp in the vat, suction devices operating to deposit a layer of pulp on said face while it is immersed in the pulp, and means to compress the layer of pulp and shape the article between the said faces.

20 In an apparatus for making pulp articles, a pulp-containing receptacle, a traveling mold comprising two members each having a perforated face, means to periodically pass one of said faces through the pulp, means to deposit a layer of pulp on said face, means to compress said layer of pulp and shape the article between said faces as the mold is withdrawn from the receptacle, and means to admit compressed air to said mold members after the article has been formed, whereby the shaped article is forced from the mold.

25 In an apparatus for making pulp articles, a pulp-containing receptacle, a two-part traveling mold comprising two mold members having perforated faces, means to periodically immerse one member of said mold in said receptacle, means to exhaust the air from said mold member while it is thus immersed, whereby a layer of pulp is drawn onto the face thereof, means to compress said pulp between the faces of the two mold members, and shape the article, and means to admit compressed air to said mold member subsequent to the compression of the pulp, said compressed air operating to force the shaped article from the mold.

30 In an apparatus of the class described, a pulp-receptacle, a revolving mold-carrier, a series of molds carried thereby, each mold comprising two hollow members having perforated cooperating faces, said mold-carrier in its revolution periodically immersing one member of each mold in the pulp, means to exhaust the air from said mold member when it is thus immersed in the pulp, whereby a layer of pulp is deposited on the face thereof, and means for subsequently compressing the pulp and shaping it into an article of the desired form.

35 In an apparatus of the class described, a revolving mold-carrier having a series of molds thereon, each mold having two perforated cooperating faces, means to deposit a layer of pulp on one face of each mold during the revolution of the mold-carrier, and means for subsequently compressing the pulp and shaping the pulp article between the faces of the mold.

40 In an apparatus for making pulp articles, a pulp-receptacle, a two-part traveling mold comprising two mold members having a perforated face, a series of mold members fixed thereto, each member being hollow and having a perforated molding-face, said mold-carrier in its revolution periodically immersing each of said fixed mold members in the pulp, means to exhaust the air from each of said mold members whereby a layer of pulp is deposited on the face thereof, a series of movable mold members, means for compressing the pulp on the face of each fixed mold member between the same and one of the movable mold members, and means to admit compressed air to the members of each mold subsequent to the compressing of the pulp whereby the shaped article is discharged from the mold.

45 In an apparatus for making pulp articles, a pulp-receptacle, a two-part traveling mold comprising two hollow mold members having perforated faces, means to periodically immerse one of the mold members in said receptacle, means to cause a layer of pulp to adhere to the face thereof, means to press said layer of pulp and shape the pulp article between the mold members, and means to admit compressed air to the two members of the mold in succession to force the shaped article from between them.

50 In an apparatus for making pulp articles, a pulp-receptacle, a two-part traveling mold comprising two mold members having perforated faces, means to periodically immerse one member of said mold in said receptacle, means to exhaust the air from said mold member while it is thus immersed, whereby a layer of pulp is deposited on the face thereof, means to compress said pulp between the faces of said members, and means to...
matically admit compressed air to the members of the mold in succession subsequent to the compressing of the pulp, whereby the shaped article is forced from the mold.

18. In an apparatus of the class described, a pulp-containing vat, a mold-carrier supporting a plurality of molds, each mold comprising a fixed and a movable mold member, the members of each mold having faces constructed to form an article between them, means to immerse one member of each mold in the pulp, means to exhaust the air from said members while they are thus immersed whereby a layer of pulp is deposited on the faces thereof, means to close the members of each mold together whereby the layers of pulp are compressed and shaped into the desired article, and means to automatically admit compressed air to the members of each mold in succession subsequent to the compressing operation, whereby the shaped article is forced from the mold.

19. In an apparatus for making pulp articles, a pulp-containing vat, a rotating mold-carrier comprising a series of radially-arranged arms, a mold carried by each arm, each mold comprising two hollow mold members movable relatively to each other and constructed to form an article between them, and a method of mold-carrier periodically immersing one member of each pair in the pulp, means to exhaust the air from the immersed members of each mold while it is thus immersed whereby a layer of pulp is deposited on the face thereof, means to bring the members of each mold together to compress the pulp and shape the article, and means to admit compressed air to the members of each mold in succession whereby said members are forced apart and the shaped article forced therefrom.

20. In apparatus for making pulp articles, a pulp-containing vat, a revolving mold-carrier comprising a rotating hub having a series of hollow radially-arranged arms, a two-part mold supported on each arm, a compressed-air and a vacuum chamber, a port in said hub communicating with each hollow arm, each of said ports during the rotation of the mold-carrier being brought into register with the vacuum-chamber and compressed-air chamber in succession, whereby a vacuum is created in each mold at a predetermined point in its revolution and a layer of pulp is deposited thereon, and compressed air is subsequently admitted to the mold, combined with means to compress the layer of pulp between the mold members previous to the admission of the compressed air therein.

21. In an apparatus for making articles from pulp, a mold having a molding-face, a vat to contain pulp, means to move said molding-face into and out from the pulp, means to deposit the pulp on the molding-face, and compressing means acting simultaneously on all the parts of the pulp deposited on the molding-face to compress said pulp and form the same into an article of the desired shape.

22. In an apparatus for making articles from pulp, a mold having a molding-face, a vat to contain pulp, means to move the molding-face into and out from the pulp, means to create a vacuum in the mold while in the pulp, and coacting compressing means movable with the mold and operating to compress the pulp article on the molding-face after said face is withdrawn from the pulp, said vacuum remaining on the mold during the compressing operation.

23. In an apparatus of the class described, a pulp-containing vat, a mold-carrier comprising a hub, a series of hollow arms extended therefrom, each supporting at its end a hollow mold, having a perforated face, a hollow stationary bearing about which the hub rotates, said bearing having a vacuum and a compressed-air chamber, ports leading from said chamber and adapted to register successively with each hollow arm, whereby the members of the mold are immersed in the pulp a layer of pulp is deposited thereon by a creation of a vacuum in the mold, and after the mold has been withdrawn from the pulp said layer of pulp is forced from the mold.

24. In an apparatus of the class described, a pulp-containing receptacle, a hollow bearing having a vacuum-chamber and a compressed-air chamber, a mold-carrier rotatably mounted thereon, a series of molds carried thereby, each mold comprising two hollow mold members having cooperating perforated faces, the rotation of the mold-carrier periodically immersing the molds in the pulp, means to automatically connect one member of each mold to the vacuum-chamber when the mold is immersed in the pulp whereby a layer of pulp is deposited on the face thereof, means to compress said pulp layer between the mold members, and means to automatically connect the mold members to the compressed-air chamber whereby the pulp article is forced from between them.

25. In an apparatus of the class described, a pulp-containing vat, a mold-carrier supported above the vat and on a horizontal bearing for rotation about a horizontal axis, said horizontal bearing having a vacuum-chamber and a compressed-air chamber, said mold-carrier comprising a series of hollow radial arms, a mold supported on each arm, said molds each including two hollow mold members having perforated cooperating faces, one member of each mold being fixed to its hollow arm and having a normally open connection therewith and the other member being pivoted to said arm, means to automatically establish a connection between each hollow arm and the vacuum-chamber when the mold carried by said arm is immersed in the pulp, whereby a layer of pulp is deposited on the face of the fixed mold member, means to compress said pulp layer between the mold members, and means to automatically establish a
communication between the compressed-air chamber and each hollow arm when the said arm is in a substantially vertical position, the compressed air operating to force the pivoted mold member away from the fixed member, the shaped article being carried by said pivoted mold member, and valve devices operated by the movement of the pivoted mold member adapted to direct the air into said pivoted mold member, whereby the shaped article is forced therefrom.

26. In a machine for forming articles from pulp in combination, a vertically-rotating mold formed of a plurality of faces adapted to travel (when not moving relatively to each other in substantially parallel paths and form said article between them, means to supply suitable pulp to said mold, and means to press said mold-faces together at a point farther on in the travel of said mold, to form said article.

27. In a machine for forming articles from pulp in combination, a rotating mold formed of a plurality of faces adapted to travel (when not moving relatively to each other in substantially parallel paths and form said article between them, means to supply suitable pulp to said mold, and means to press said mold-faces together at a point farther on in the travel of said mold, to form said article.

28. In a machine for forming articles from pulp in combination, a vertically-rotating mold formed of a plurality of faces adapted to travel (when not moving relatively to each other in substantially parallel paths and form said article between them, means to supply suitable pulp to said mold, and means to press said mold-faces together at a point farther on in the travel of said mold, to form said article.

29. In a machine for forming articles from pulp in combination, a rotating mold formed of a plurality of faces adapted to travel (when not moving relatively to each other in substantially parallel paths and form said article between them, means to supply suitable pulp to said mold, and means to press said mold-faces together at a point farther on in the travel of said mold, to form said article.

30. In a machine for forming articles from pulp in combination, a vertically-rotating mold formed of a plurality of faces adapted to travel (when not moving relatively to each other in substantially parallel paths and form said article between them, means to supply suitable pulp to said mold, and means to press said mold-faces together at a point farther on in the travel of said mold, to form said article.

31. In a machine for forming articles from pulp in combination, a rotating mold formed of a plurality of faces adapted to travel (when not moving relatively to each other in substantially parallel paths and form said article between them, means to supply suitable pulp to said mold, and means to press said mold-faces together at a point farther on in the travel of said mold, to form said article.
mold formed of a plurality of mold-faces adapted to form said article between them, means to supply suitable pulp to said mold, a pressure device adapted to press said mold-faces together at a point farther on in the travel of and without stripping said mold, and means to remove said article from said mold.

40. In a machine for forming articles from a suitable pulp in combination, a traveling mold formed of a plurality of mold-faces adapted to form said article between them, means to supply suitable pulp to said mold, a pressure device adapted to press said mold-faces together at a point farther on in the travel of said mold, and means to remove said article from said mold by a draft of air.

41. In a machine for forming articles from a suitable pulp in combination, a traveling mold formed of a plurality of mold-faces adapted to form said article between them, one of said faces being perforated, means to supply suitable pulp to said mold, a pressure device adapted to press said mold-faces together at a point farther on in the travel of said mold, and means to remove said article from said mold by a draft of air through said perforated mold-face.

42. In a pulp-machine in combination a traveling mold formed of a plurality of separable mold-faces, a pulp-vat and means to cause said mold to dip into the pulp therein to introduce a suitable pulp into said mold, and a roller device to press said faces together to form said article.

43. In a pulp-machine in combination a traveling mold formed of a plurality of separable mold-faces, a pulp-vat and means to cause said mold to dip into the pulp therein to introduce a suitable pulp into said mold, means to cause said mold to rise from said vat, and a roller device to press said faces together to form said article.

44. In an apparatus of the class described, a two-part mold, means to deposit a layer of pulp between the members of said mold, and a compression device adapted to force the two mold members together and shape the layer of pulp therein, said compression device comprising a roll adapted to bear against one mold member, and a pivoted yielding member adapted to engage the other mold member.

45. In an apparatus of the class described, a series of two-part molds, means to force the members of said mold together, said means comprising a roll adapted to bear against one mold member, and a pivoted member having a concentric face adapted to engage the other mold member, said last-named mold member having a convexed face whereby as the mold passes between the roll and the member, the latter engages said convex face and forces the mold member together.

46. In a pulp-machine in combination a perforated traveling mold-face, a pulp-vat, means to supply a layer of pulp to said face, a suction device to apply suction through said perforated face, a second mold-face, and a compressing device to press said faces together in a direction transverse to the plane of movement of said first face, to form said article.

47. In a pulp-machine in combination a traveling mold formed of a plurality of separable mold-faces, a pulp-vat, means to cause one of said faces to dip into the pulp in said vat and receive a layer of pulp, and a roller device to press said faces together to form said article.

48. In a pulp-machine in combination a pulp-vat, a traveling mold formed of a plurality of separable faces, a rotatable shaft carrying said mold, one of said mold-faces being pivotet on a pivot transverse to said shaft, means to cause one of said faces to dip into the pulp in said vat and receive a layer of pulp, and means to press said faces together to form said article.

49. In an apparatus of the class described, a series of traveling molds, means whereby during the movement of said molds an individual pulp article is formed or shaped by each mold, and a series of pneumatic pick-offs, means to bring each pick-off into register with a mold, whereby the shaped articles are removed from the molds.

50. In an apparatus for forming articles from a suitable pulp in combination, a traveling mold having a plurality of faces between which the article is formed, means to cause one of said faces to dip into a body of pulp to receive a layer thereof, means to compress said pulp layer between the faces whereby a pulp article is formed, and a suction device to remove the shaped article from the mold.

51. In a machine for forming articles from pulp, a mold having a plurality of faces between which the article is formed, means to apply a layer of pulp to one of said faces, means to compress the pulp layer between the faces, and a suction device to remove the shaped article from the mold.

52. In an apparatus of the class described, a series of molds each having two mold-faces, means to deliver pulp to the molds in succession, means to compress said pulp between the two members of each mold, and a traveling transferring mechanism comprising means to remove successively articles from the molds by suction.

53. In an apparatus of the class described, a plurality of traveling molds each constructed to form an individual article from pulp, a corresponding number of traveling pick-offs, means to move said molds and pick-offs in synchronism, the molds during their traveling movement being brought successively into register with the corresponding pick-offs whereby the articles formed by the molds are successively removed therefrom.

54. In an apparatus of the class described, a plurality of separate traveling molds, each constructed to form an individual article from pulp during a portion of its traveling movement, a corresponding number of traveling
pneumatic pick-offs, means to move said molds and pick-offs in synchronism, each mold during its continued traveling movement being brought into register with the corresponding pick-off, and means to admit a jet of compressed air to the mold when it is in register with the pick-off whereby the articles are removed from the molds in succession.

55. In an apparatus of the class described, two traveling mold-faces, means to deposit a quantity of pulp on one of said faces during its traveling movement, and means to subsequently compress said layer of pulp between said faces to form an article of the desired shape, combined with a pneumatic transferring device comprising a suction-nozzle, means to bring the latter into register with one mold-face, means to create a vacuum within said suction-nozzle when in such position, and means subsequently to admit compressed air to said nozzle, whereby the shaped article is forced therefrom.

56. In an apparatus of the class described, means to mold a series of individual articles, a conveyor and pneumatic transferring device to transfer the shaped articles from the mold to the conveyor, said transferring device comprising a suction-nozzle, means to move the latter from the mold to the conveyor, means to create a vacuum in said nozzle when it is over the mold, and means to admit compressed air thereto when it is over the conveyor, whereby the shaped article is lifted from the mold and deposited on the conveyor.

57. In an apparatus for making pulp articles, molding mechanism adapted to form individual articles from pulp, a suction device to remove the shaped article from the molding mechanism, said suction device comprising an arm having a suction-nozzle, means to bring the suction-nozzle over the molding mechanism, means to automatically create a vacuum in said arm, whereby the pulp article is lifted from the molding mechanism by the nozzle, and means to automatically admit air to said nozzle when it is desired to force the article therefrom.

58. In an apparatus for making pulp articles, a series of molding devices each adapted to shape an individual article from pulp, a device to remove the articles from the molds, said device comprising a series of hollow arms having flexible suction-nozzles at their ends, means to bring said suction-nozzles in succession over the exposed article in the molding devices, means to automatically create a vacuum in each arm as its suction-nozzle comes over mold, and means to automatically admit compressed air to said suction-nozzle to force the article therefrom.

59. In an apparatus of the class described, a series of molds adapted to mold an article from pulp, a transferring device to remove the shaped article from the molds, said transferring device comprising a hub supporting a series of hollow arms, a flexible suction-nozzle at the end of each arm, means to bring the suction-nozzles in succession over the shaped articles in the molds, means to automatically create a vacuum in each arm as its suction-nozzle comes over mold, and means to automatically admit compressed air to said suction-nozzle to force the article therefrom.

60. In an apparatus of the class described, a series of molds adapted to mold an article from pulp, a transferring device to remove the shaped article from the molds, said transferring device comprising a hub supporting a series of hollow arms, a compressed-air chamber, a hub rotatably mounted on said support and having a series of hollow arms each provided with a suction-nozzle, a port leading from the vacuum-chamber and adapted to register with each arm as the suction-nozzle connected thereto passes over a mold, whereby the vacuum created in the suction-nozzle lifts the article from the mold, a conveyor-belt, and a port leading from the compressed-air chamber and adapted to register with each arm as the suction-nozzle attached thereto passes over the belt whereby the article is forced onto the belt.

61. In an apparatus of the class described, a series of molds each comprising a fixed mold member and a movable mold member pivoted thereto, said mold members being adapted to mold a pulp article therebetween, means to automatically admit compressed air into the two members of each mold in succession, whereby the mold members are separated, and the shaped article forced from the same, a transferring device to take the article from the mold members, said transferring device having a series of suction-nozzles over the pivoted mold members in succession, and means to automatically create a vacuum in each suction-nozzle as it passes over a pivoted mold member, whereby the article forced from said mold member is sustained by the suction-nozzle.

62. In an apparatus of the class described, a series of molds each comprising a fixed mold

member and a movable mold member pivoted thereto, said mold members being adapted to mold a pulp article therebetween, means to automatically admit compressed air into the two members of each mold in succession, whereby the mold members are separated, and the shaped article forced from the mold member is sustained by the suction-nozzle, a conveyer-belt, and means to destroy the vacuum in each suction-nozzle as it passes over the said belt.

64. In an apparatus of the class described, a series of molds each comprising a fixed mold member and a movable mold member pivoted thereto, said mold members being adapted to mold a pulp article therebetween, means to automatically admit compressed air into the two members of each mold in succession, whereby the mold members are separated, and the shaped article forced from the mold member is sustained by the suction-nozzle, a conveyer-belt, and means to destroy the vacuum in each suction-nozzle as it passes over the said belt.

65. In an apparatus of the class described, a series of molds each comprising a fixed mold member and a movable mold member pivoted thereto, said mold members being adapted to mold a pulp article therebetween, means to automatically admit compressed air into the two members of each mold in succession, whereby the mold members are separated, and the shaped article forced from the mold member is sustained by the suction-nozzle, a conveyer-belt, and means to destroy the vacuum in each suction-nozzle as it passes over the said belt.

66. In an apparatus of the class described, a series of molds each comprising a fixed mold member and a movable mold member pivoted thereto, said mold members being adapted to mold a pulp article therebetween, means to automatically admit compressed air into the two members of each mold in succession, whereby the mold members are separated, and the shaped article forced from the mold member is sustained by the suction-nozzle, a conveyer-belt, and means to destroy the vacuum in each suction-nozzle as it passes over the said belt.

67. In an apparatus for making pulp articles, a pneumatic transferring device comprising a hollow arm, a flexible suction-nozzle attached to the end thereof, means to bring said suction-nozzle over the pulp article to be transferred, and means to simultaneously create a vacuum therein, whereby the article is held to the suction-nozzle by suction, said suction-nozzle having in the open end thereof means to prevent the pulp from being drawn into the same.

68. In an apparatus for making pulp articles, a pneumatic transferring device comprising a hollow arm, a flexible suction-nozzle attached to the end thereof, means to bring the said suction-nozzle over the pulp article to be transferred, and means to simultaneously create a vacuum therein, whereby the article is held to the suction-nozzle by suction, said suction-nozzle having a reticulated guard across the open end thereof, whereby the pulp article is prevented from being drawn into the same.

69. A pneumatic transferring device, comprising a hollow arm, a flexible bell-shaped suction-nozzle at the end thereof, a stiffening-ring at the open end of said suction-nozzle, a reticulated guard supported by said ring, and means to intermittently create a vacuum in said arm.

70. A pneumatic transferring device, comprising a hollow arm having at the end thereof a bell-shaped suction-nozzle of elastic material, a stiffening-ring in the open end thereof, and a reticulated guard supported by said ring, and extending across the open end of the suction-nozzle, the lower end of the flexible material of the suction-nozzle extending below the stiffening-ring to form flexible lips, combined with means to intermittently create a vacuum in said arm.

71. In an apparatus of the class described, a pneumatic transferring device comprising a hollow arm, a flexible bell-shaped suction-nozzle at the end thereof, a stiffening-ring in the open end of the suction-nozzle, a reticulated guard supported by said ring, the end of the hollow arm extending into the suction-nozzle, and means to intermittently create a vacuum in said arm.

72. In an apparatus for making articles from pulp, a mold having nesting faces between which the article is formed, a vat to contain pulp, means to dip one of said faces into the pulp, and to subsequently close said faces together, and means to apply suction to the face which is immersed in the pulp, while it is so immersed, the faces when closed together compressing all parts of the layer of pulp simultaneously.

73. In an apparatus for making articles from pulp, a mold having a molding-face and a compressing-face, a vat to contain pulp,
means to dip said molding-face into the pulp to receive a layer thereof, and subsequently to close said faces together said faces being so shaped that all parts of the pulp layer between them are acted upon simultaneously.

74. In an apparatus for making articles from pulp, a molding-face, a vat to contain pulp, means to move said face into and out from the pulp, means to deposit a layer of pulp on the molding-face, and a compressing-face acting simultaneously on all parts of the pulp deposited on the molding-face to compress said pulp and form the article between said faces.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

MARTIN L. KEYES.

Witnesses:
LOUIS C. SMITH,
GEO. W. GREGORY.