Aug. 9, 1960 H. A. WOLTER 2,948,337

PULP MOLDING APPARATUS

Filed May 10, 1957 3 Sheets-Sheet 1

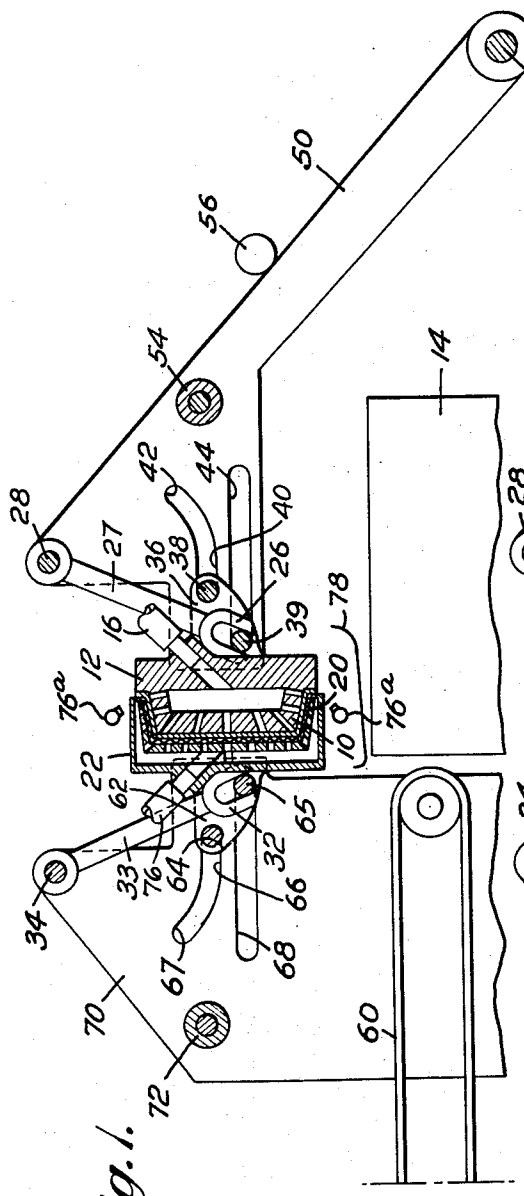


Fig. 1.

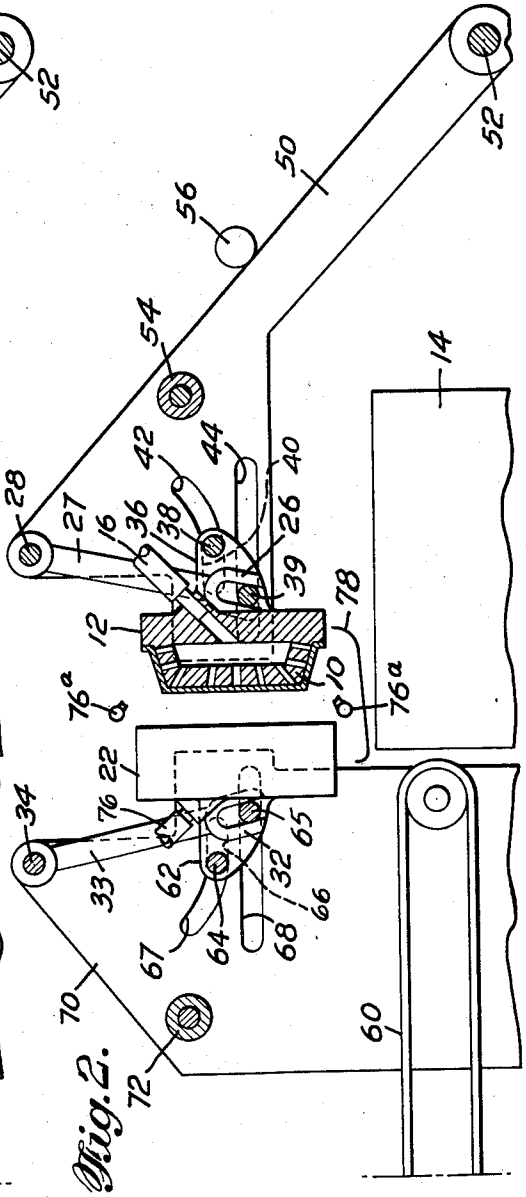


Fig. 2.

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PULP MOLDING APPARATUS

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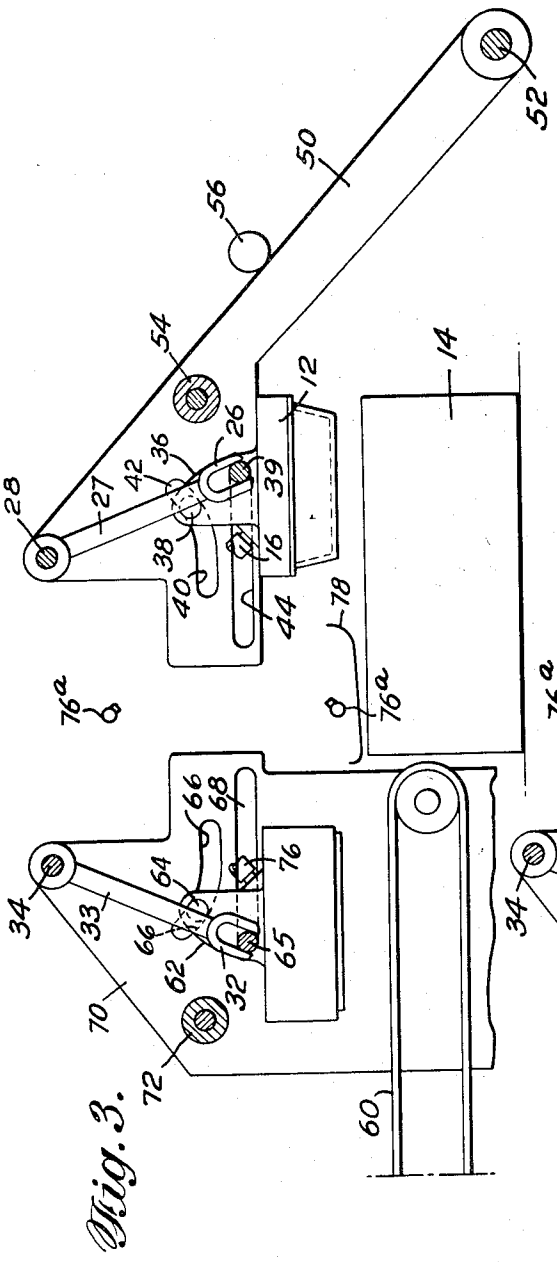


Fig. 3.

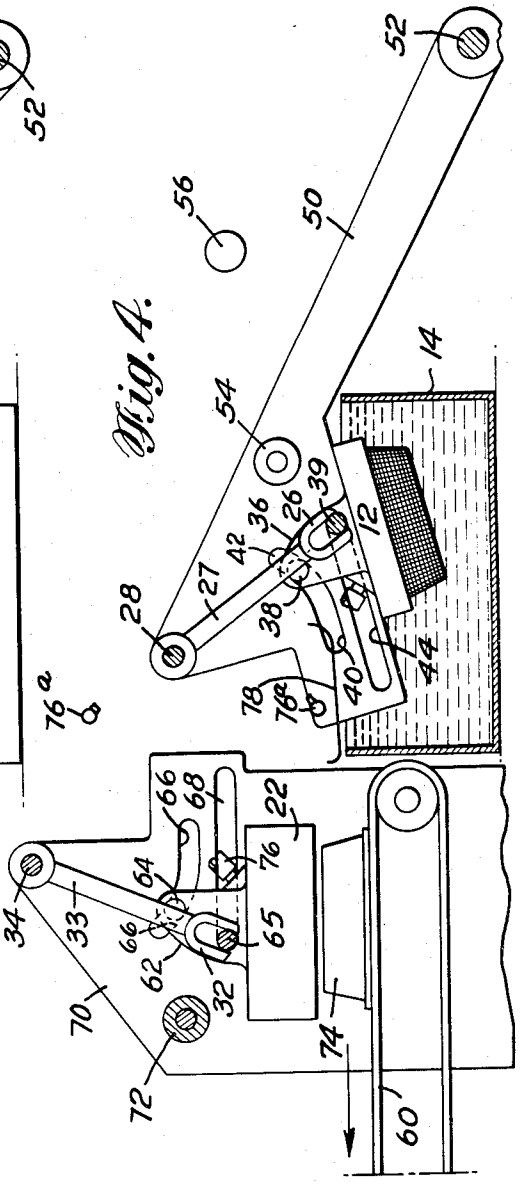


Fig. 4.

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PULP MOLDING APPARATUS

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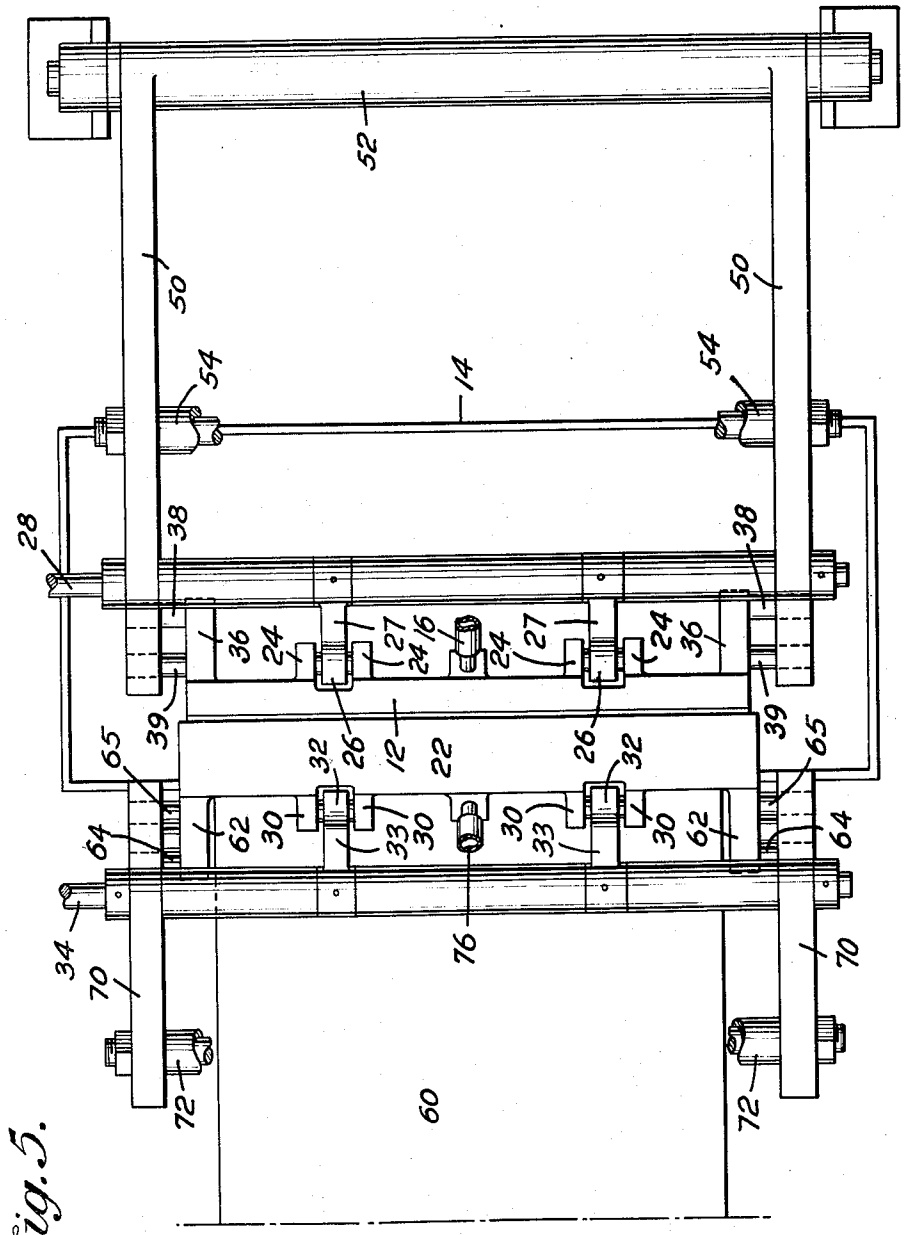


Fig. 5.

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PULP MOLDING APPARATUS

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13 Claims. (Cl. 162—392)

This invention relates to pulp molding apparatus, and more particularly to an improvement in apparatus for successively molding pulp articles.

In the manufacture of molded pulp articles by the usual process of suction molding the articles from a water slurry of pulp fibers, it has been customary to employ a rotary carrier having a plurality of foraminous forming dies mounted on its periphery, which dies are subjected to suction internally as they are advanced successively through a vat containing the slurry during rotation of the carrier. This action causes layers of wet pulp fibers to be extracted from the slurry and deposited on the molds, thereby forming initially molded articles, known as preforms. In order to extract some of the excess moisture from the wet pulp preforms, the suction applied to the molds is continued as the molds emerge from the slurry and advance successively upward thereabove during the continued rotation of the mold carrier. At a predetermined point above the slurry, a transfer device, which is usually of the rotary type also, successively removes the preforms from the molds and transfers them to a dryer.

Such rotary multiple die type molding apparatus is particularly suitable for high speed production of large quantities of relatively non-complex, small, low unit cost molded pulp items, such as pie plates and egg cartons. However, the high cost of this equipment represents such a large investment to be amortized, that only such large quantity production items can be manufactured economically. In order to provide for situations in which only small quantities of certain molded pulp products are to be manufactured, and to fill special orders for items requiring special, larger, or more complex dies, a need has existed for less complex and less expensive apparatus combining simplicity with efficiency. Preferably, this apparatus should have only a single cooperating pair of dies, since the high cost of the individual dies is one of the principal reasons for the large investment involved in the rotary multiple die type molding apparatus. Although simplified apparatus of the general type employing only a single pair of dies has been known in the past, none of such apparatus has been entirely satisfactory.

An object of this invention is to provide new and improved pulp molding apparatus.

Another object of the invention is to provide a more efficient, simplified, and inexpensive pulp molding apparatus of the type embodying only a single pair of cooperating dies.

Still another object of the invention is to provide a new and improved mechanical movement for a single pair of cooperating dies in a pulp molding apparatus.

Other objects and the nature and advantages of the instant invention will be apparent from the following description taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a longitudinal vertical section of pulp molding apparatus embodying the invention, shown in its operating position at one stage of a molding operation;

Fig. 2 is a corresponding view of the apparatus illustrated in Fig. 1, but shown at a subsequent stage of the molding operation;

Fig. 3 is another view corresponding to that of Fig. 1, but showing the apparatus at an intermediate state of the molding operation subsequent to that viewed in Fig. 2;

Fig. 4 is still another view corresponding to Fig. 1, but showing the apparatus in a subsequent position at the completion of that stage of the molding operation shown in Fig. 3; and

Fig. 5 is a plan elevation view of the apparatus at the stage of the operation shown in Fig. 1.

Apparatus embodying the invention features a simplified structural organization operating with an improved type of simple mechanical movement. A foraminous molding die **10** secured to a movable head **12** is periodically dipped into an open-topped vat **14** containing pulp slurry. A flexible hose **16** connects the die head **12** with a source of suction (not shown), and suitable automatic controls for the application of the suction are provided. The suction is applied internally to the die **10** during its immersion in the pulp slurry contained in the vat **14** to cause pulp fibers to be extracted from the slurry and deposited in a layer on the outer forming face of the die **10**, thereby forming an initially molded article known as a preform. The molding die **10** cooperates with a compression die **20** to compress the pulp preform therebetween, thereby completing the molding of the pulp article and at the same time extracting some of the excess moisture therefrom.

The compression die **20** is properly shaped to receive and mate with the molding die **10** when these dies are brought into compressing relationship. The die **20** is supported on a movable head **22** which is mounted for horizontal reciprocation to bring these dies into mating relationship, and the head **12** likewise undergoes horizontal reciprocation to carry the die **10** into such relationship. An important feature of the present invention is the fact that the dies **10** and **20** undergo straight line horizontal reciprocation and are held disposed in parallel vertical planes facing each other while they are moved toward and away from each other in effecting the compression action.

Horizontal reciprocation of the dies **10** and **20** may be accomplished in any suitable manner. In the illustrated embodiment of the invention, the die head **12** is provided with a pair of lugs **24** (Fig. 5) which are engaged by a pair of clevises **26** formed on one end of a pair of oscillatable levers **27**. At the other end of the levers **27** a horizontal shaft **28** secured thereto provides a pivot for the oscillatory motion. Any suitable mechanical means may be employed to impart oscillatory motion to the shaft **28** to reciprocate the die head **12** therewith. In a similar manner, on the die head **22** a pair of lugs **30** are engaged by a pair of clevises **32** formed on one end of a pair of oscillatable levers **33**, which are secured at their other end to an oscillating horizontal shaft **34**.

Opposite ends of the die head **12** are provided with a pair of projecting arms **36**, each of which carries pairs of cam rollers **38** and **39**. The rollers **38** ride in a pair of cam track slots **40** which are perfectly straight and horizontal for a substantial portion of their length, but they have an upwardly curved section **42** at their right hand end, as viewed in Figs. 1 to 4, inclusive, and the rollers **39** ride in a pair of cam track slots **44** which are perfectly straight and horizontal throughout their entire length. It is evident that as the rollers **38** and **39** travel from left to right along the slots **40** and **44**, respectively, during horizontal reciprocation of the die head **12**, the die head **12** first moves in a straight horizontal line away

from the compression die 20 from the position shown in Fig. 1 to the position shown in Fig. 2, and then the die head 12 turns downwardly through an angle of 90° to the position shown in Fig. 3. The turning motion of the die head 12 is caused by the divergence of the slots 40 and 44 at the right hand end thereof, where the upwardly curved section 42 of the slot 40 is located.

In the next stage of the molding operation the die 10 is lowered and immersed into the pulp slurry contained in the vat 14, and any suitable mechanism may be provided for this purpose. In some instances it may be advantageous to immerse the molding die with a perfectly straight line vertical reciprocatory movement, while holding the die facing its immersed position in order to attain a perfectly uniform thickness of deposition on the forming face of the die. However, in most instances some slight deviation from a perfectly vertical path is acceptable, as is the case in the operation of the illustrated embodiment of the invention.

The molding die 10 is reciprocated into and out of the vat 14 by means of a pair of rocker arms 50 having one end thereof secured to an oscillatable horizontal shaft 52. The other end of the arms 50 is designed to provide support structure for the horizontal shaft 28 on the upper portion thereof, and in the lower portion of this end of the arms 50 the cam track slots 40 and 44 are formed. The pair of arms 50 may be joined by a connecting rod 54 to provide structural rigidity, and a stop 56 may be provided to limit the upward movement of these arms. Oscillatory movement of the rocker arms 50 immerses the molding die 10 by moving it alternately between the position shown in Fig. 3 and the position shown in Fig. 4.

The horizontal reciprocation of the compression die 20 also alternates with a 90° turning motion, but in this case no vertical reciprocatory motion is necessary, since the molded pulp articles successively produced are merely dropped onto an endless conveyor belt 60. At opposite ends of the die head 22 a pair of projecting arms 62 each carry pairs of cam rollers 64 and 65. The rollers 64 ride in a pair of cam track slots 66 which are perfectly straight and horizontal for a substantial portion of their length but have an upwardly curved section 67 at their left hand end, as viewed in Figs. 1 to 4, inclusive, and the rollers 65 ride in a pair of cam track slots 68 which are perfectly straight and horizontal throughout their entire length. As the rollers 64 and 65 travel from right to left along the slots 66 and 68, respectively, during horizontal reciprocation of the die head 22, this die head first moves in a straight horizontal line away from the molding die 10 from the position shown in Fig. 1 to the position shown in Fig. 2, and then the die head 22 turns downwardly through an angle of 90° to the position shown in Fig. 3. The cam track slots 66 and 68 are formed in a pair of parallel vertical supporting plates 70 which are joined by a horizontal connecting rod 72, and which provide support for the shaft 34.

In Fig. 4 a molded pulp article 74 is shown resting on the conveyor belt 60 directly beneath the compression die 20 from which the article has just been dropped. Suction applied to the head 22 through a flexible hose 76 holds the pulp article 74 in the die 20 until release of the suction allows the article 74 to drop onto the conveyor belt 60. The successive articles produced, such as the article 74, are carried by the belt 60 to a suitable final drying and finishing apparatus (not shown).

In one complete cycle of the molding operation, the molding die 10 and the compression die 20 simultaneously move through the successive stages illustrated sequentially in Figs. 1 to 4, inclusive, and thence back again to the stage shown in Fig. 1. Once during each cycle the molding die 10 is immersed in the pulp slurry contained in the vat 14, and the die 10 is then elevated above the slurry by movement of the rocker arms 50 until they strike the stop 56. Next, the die heads 12 and 22 are turned through the 90° angle, thereby being brought into alignment facing each other, and they are then advanced toward each other in a straight line horizontal movement until they mate in compressing relationship, as shown in Fig. 1. The molded pulp article is then transferred from the die 10 to the die 20 by suitable manipulation of the suction applied internally to these dies, and a blast of compressed air may be applied internally to the die 10 to assist the transfer operation. The dies 10 and 20 are then advanced in successive stages back from the positions in which they are viewed in Fig. 1 to the positions shown in Fig. 4, resulting in release of the molded pulp article 74 from the die 20 to drop it onto the conveyor belt 60.

At the completion of each molding operation the molding die 10 may be washed with fresh water sprayed from a plurality of nozzles 76a. A baffle 78 may be mounted below the nozzles 76a to prevent the fresh water spray from diluting the pulp slurry contained in the vat 14. The baffle 78 may be made retractable to enable it to move out of the path of the molding die 10 at the proper moment during each horizontal reciprocation of this die.

Although the invention has been illustrated and described with particular reference to only a single pair of cooperating dies, it is to be understood that each of these dies may be of the multiple type. That is, a plurality of individual dies may be mounted side by side for movement as a group on a single die platen.

It will be obvious to those skilled in the art that various changes may be made without departing from the spirit of the invention and therefore the invention is not limited to what is shown in the drawings and described in the specification, but only as indicated in the appended claims.

What is claimed is:

1. Pulp molding apparatus, comprising a molding die having a foraminous forming face designed to form pulp articles by deposition of pulp fibers from a slurry thereof, means for vertically reciprocating the molding die between a molding position immersed in pulp slurry and an elevated position above the slurry, said molding die forming face being disposed generally horizontally and facing its immersed position during its reciprocation into and out of the slurry, a compression die movably mounted adjacent to said elevated position for cooperation with the molding die, means for turning the molding die and the compression die to bring them into alignment facing each other above the slurry, and means for horizontally reciprocating both of these dies to bring them into mating relationship, thereby compressing a molded pulp article therebetween.

2. The apparatus defined by claim 1 in which the molding die and the compression die are turned simultaneously through an angle of 90°, and these dies are horizontally reciprocated while disposed in vertical planes facing each other.

3. Pulp molding apparatus, comprising a single molding die having a foraminous forming face designed to form pulp articles by deposition of pulp fibers from a slurry thereof, means for vertically reciprocating the molding die between a molding position immersed in pulp slurry and an elevated position above the slurry, a single compression die mounted pivotally adjacent to said elevated position for cooperation with the molding die, means for turning the molding die and the compression die to bring them into alignment facing each other above the slurry, means for horizontally reciprocating both of these dies to bring them into mating relationship, thereby compressing a molded pulp article therebetween, a conveyor mounted below the compression die for successively removing the molded pulp articles produced, and means for turning the molding die and the compression die after they have moved apart a predetermined distance to face them downwardly generally toward the slurry and the conveyor, respectively.

4. The apparatus defined by claim 3 in which the molding die is turned through an angle of about 90° above the slurry while the compression die is simultaneously being turned through an angle of about 90° above the conveyor.

5. The apparatus defined by claim 3 in which the molding die and the compression die are turned simultaneously through an angle of about 90° above the slurry and the conveyor, respectively, and these dies are simultaneously horizontally reciprocated while disposed in parallel vertical planes facing each other.

6. Pulp molding apparatus comprising a single molding die having a foraminous forming face designed to form pulp articles by deposition of pulp fibers from a slurry thereof, a movable die head supporting the molding die, means for vertically reciprocating the die head and the die carried thereon between a molding position immersed in pulp slurry and an elevated position above the slurry, a single compression die mounted adjacent to said elevated position for cooperation with the molding die, a second movable die head for supporting the compression die, means for simultaneously horizontally reciprocating the two die heads to bring the dies into and out of compressing relationship with each other, the dies being held facing each other during such reciprocation, cam means for turning the die heads downwardly through about a 90° angle after they have moved apart a predetermined distance, and conveyor means mounted below the compression die for successively carrying away the molded pulp articles produced.

7. The apparatus defined by claim 6 in which the molding die and the compression die are turned simultaneously through an angle of about 90° above the slurry and the conveyor, respectively, and these dies are simultaneously horizontally reciprocated while disposed in parallel vertical planes facing each other.

8. Pulp molding apparatus comprising a single molding die having a foraminous forming face designed to form pump articles by deposition of pulp fibers from a slurry thereof, a movable die head supporting the molding die, a pair of oscillatable rocker arms for supporting the die head, said arms being adapted to vertically reciprocate the die head and the die carried thereon between a molding position immersed in pulp slurry and an elevated position above the slurry, a single compression die mounted adjacent to said elevated position for cooperation with the molding die, a second movable die head for supporting the compression die, means for simultaneously horizontally reciprocating the two die heads to bring the die into and out of compressing relationship with each other, the dies being held facing each other during such reciprocation, a plurality of cams mounted on the die heads and movable along cam tracks during reciprocation of said heads, said cam tracks having perfectly straight horizontal portions for guiding the heads in straight line horizontal reciprocation while being held facing each other until they are spaced apart a predetermined distance and said tracks having curved portions for turning the heads downwardly through about a 90° angle after they have moved apart said distance, and conveyor means mounted below the compression die for successively carrying away the molded articles produced.

9. The apparatus defined by claim 8 in which the molding die and the compression die are turned simultaneously through an angle of 90° above the slurry and the conveyor, respectively, and these dies are simultaneously horizontally reciprocated while disposed in parallel vertical planes facing each other.

10. The apparatus defined by claim 8 in which the cam tracks for guiding the die heads are formed on the oscillatable rocker arms, and a plurality of oscillatable levers for horizontally reciprocating the heads are also mounted on the rocker arms.

11. The apparatus defined by claim 8 in which a plurality of spray nozzles are mounted adjacent to and directed toward the molding die in its elevated position for washing this die at the completion of a cycle of the molding operation, and a baffle is mounted beneath the nozzles to prevent dilution of the pulp slurry.

12. Pulp molding apparatus comprising a single movable die head supporting a foraminous molding die on which pulp articles are formed by deposition of fibers from a slurry thereof, means for supporting the die head and adapted to vertically reciprocate said head between a molding position wherein the head is lowered to immerse the die in pulp slurry and a compressing position wherein the head is elevated above the slurry, a second single movable die head supporting a compression die adjacent to said compressing position for cooperation with the molding die, both of said movable die heads being mounted pivotally and adapted to turn through an angle of about 90° to bring them into alignment facing each other when the molding die has been elevated to its compressing position, means for simultaneously horizontally reciprocating the two die heads to bring the dies thereon into and out of compressing relationship with each other, cam means for maintaining said dies disposed in parallel vertical planes facing each other during such reciprocation and for turning the heads through said angle of about 90° after they have moved apart a predetermined distance during such reciprocation, and conveyor means mounted below the compression die for carrying away the molded articles produced.

13. Pulp molding apparatus comprising a single movable die head supporting a foraminous molding die on which pulp articles are formed by deposition of fibers from a slurry thereof, a pair of oscillatable rocker arms supporting the die head and adapted during oscillation to vertically reciprocate said head between a molding position wherein the head is lowered to immerse the die in pulp slurry and a compressing position wherein the head is elevated above the slurry, a second single movable die head supporting a compression die adjacent to said compressing position for cooperation with the molding die, a pair of support members on which said second die head is movably mounted, both of said movable die heads being mounted pivotally and adapted to turn upwardly through an angle of about 90° to bring them into alignment facing each other when the molding die has been elevated to its compressing position, means for simultaneously horizontally reciprocating the two die heads to bring the dies thereon into and out of compressing relationship with each other, a plurality of cams carried by the die heads and movable along cam track slots formed in the supporting members and in the rocker arms on which the heads are mounted, said cams and slots cooperating to maintain the die heads disposed in parallel vertical planes facing each other during reciprocation thereof and to turn the heads downwardly through said angle of about 90° after they have moved apart a predetermined distance during such reciprocation, and conveyor means mounted below the compression die for carrying away the molded articles produced.

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