

Sept. 30, 1941.

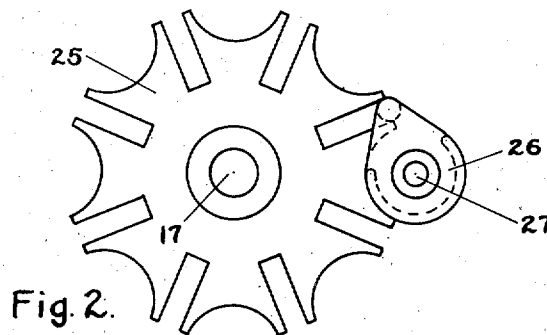
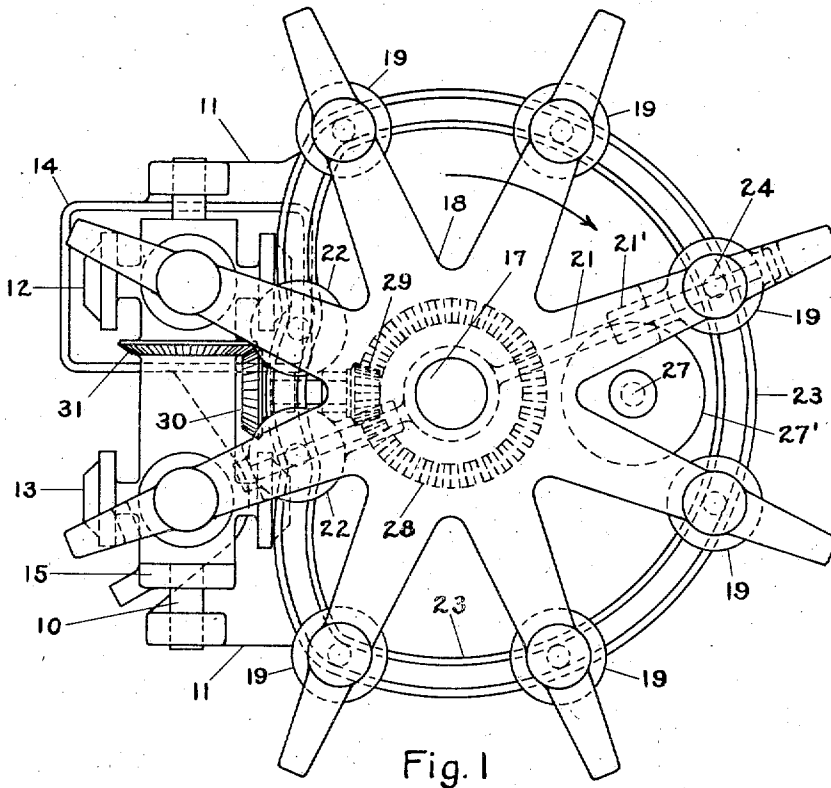
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2,257,573

MACHINE FOR MANUFACTURING MOLDED PULP ARTICLES

Filed Jan. 3, 1938

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

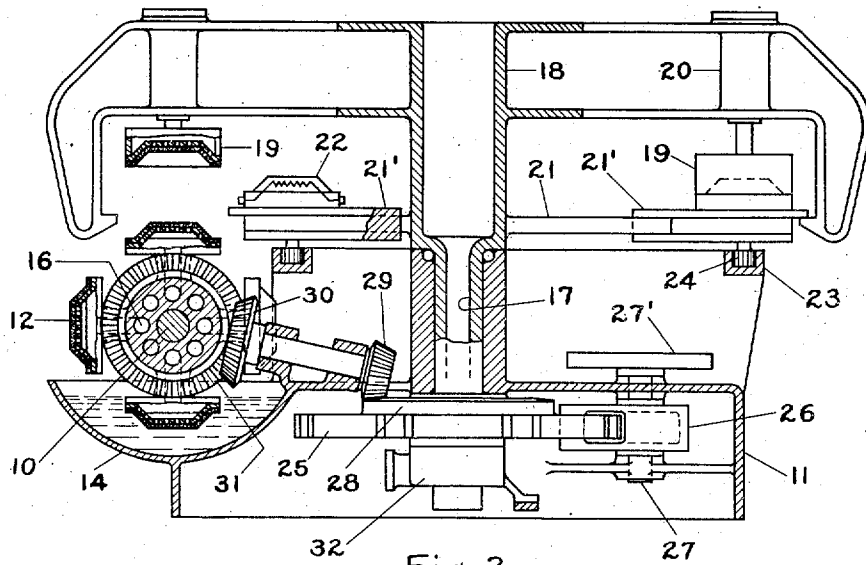


Fig. 3.

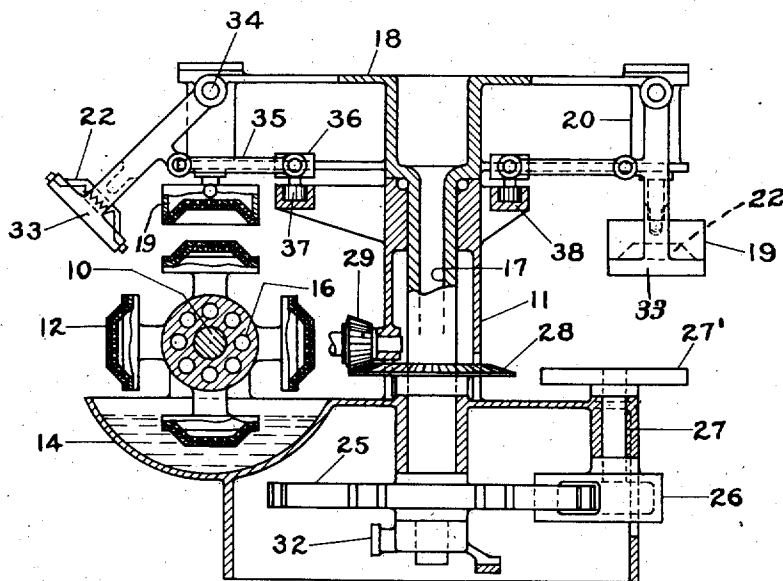


Fig. 4.

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UNITED STATES PATENT OFFICE

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MACHINE FOR MANUFACTURING MOLDED
PULP ARTICLES

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by mesne assignments, to The Canal National
Bank of Portland, Portland, Maine, trustee

Application January 3, 1938, Serial No. 183,047

8 Claims. (Cl. 92—56)

This invention relates to apparatus for automatically molding, drying and finishing individual molded pulp articles for commercial use. It specifically relates to a machine of this type which is simple and compact in design, relatively inexpensive to build and requiring the minimum of floor space. It possesses the advantages of combining in a single machine the molding and drying of individual pulp articles in a manner which will give the maximum production with the minimum of molds or dies and will produce articles which are accurate in shape and of superior finish.

In the preferred embodiment of my machine I provide a vertically mounted step by step drying unit carrying a series of equi-distantly spaced vertically reciprocable holding dies revolving in a fixed orbit and a complementary series of drying dies corresponding in number and angular spacing to the holding dies. Each drying die is so mounted that during that period of the drying unit cycle in which an article is being transferred to or from its complementary holding die of said unit, the drying die is orbitally displaced relative to said holding die to permit the coaction of the holding die with dies of other units.

I also provide a horizontally mounted step by step rotating forming unit carrying a plurality of foraminous forming dies adapted to be successively immersed in an aqueous pulp mixture for the suction formation of molded pulp articles thereon. This unit is located in such relation to the orbit of the holding dies of the drying unit that during each complete revolution of the forming die unit each forming die is successively stepped into coactive alignment with a holding die for transfer of the wet article to the drying unit.

I also provide a transfer die unit which may carry one or more transfer dies mounted adjacent to and preferably, although not necessarily, on the same shaft as the forming die unit. The transfer die unit is so arranged that its die or dies are brought into successive coactive alignment with the holding dies of the drying unit at the proper time for the successive transfer of the dried and finished articles from the holding dies to the transfer die or dies. Thereafter the articles are ejected from the machine, as by means of a blast of air through the transfer die or dies.

The transfer of an article from one unit to another is accomplished during the period of the stepping cycle in which the units are paused in

their rotation with the proper dies in coactive alignment with each other.

All rotating units of the machine may be driven step by step from a common drive, such as a Geneva, which through proper motion transmitting connections drives said units in required synchronism with each other.

The actuation of the various dies as required may be done either mechanically or by air or hydraulically operated mechanisms, or both.

Suitable air and vacuum connections are provided to the various dies as required, and the timing of the air and vacuum to these dies may be properly synchronized, as by means of cam operated valves.

Heat may be applied to the drying unit for distribution to the various dies thereon as required by means of proper connections to the shaft carrying the drying unit.

An article is first suction formed on a forming die of the forming unit by immersing such die in the liquid pulp mixture. Continued step by step rotation of the forming unit carries the forming die with its wet article thereon into coactive alignment with a holding die of the drying unit. While these two dies are coactively aligned and both units are paused in their rotation, the holding die is coated with and retracted from the forming die to transfer the wet article to itself.

Continued stepping of the drying unit brings a mating drying die, which had previously been orbitally displaced relative to said holding die, into coactive alignment with said holding die and the holding die with its wet article is then coated with said drying die. These two dies remain in continuous pressure contact during the drying of the article or until the continued step by step rotation of the drying unit brings said dies to a position where it is necessary to retract the holding die with the dried and finished article thereon from the drying die to permit said holding die, in the continued step by step rotation of the drying unit, thereafter to coast first with a transfer die to transfer the dried article thereto and subsequently to coast with a forming die to receive a new article.

After the holding die has retracted from the drying die, carrying with it the dried and finished article, the drying die is orbitally displaced relative to the holding die to permit successive coaction of the holding die with a transfer die and a forming die in the continued stepping of the drying unit.

The drying die remains so displaced with relation to the holding die until after a new article has been transferred from the forming die to the holding die and the drying unit rotated step by step to a position where the holding die may once again coast with the drying die for the drying and finishing of such new article.

After the dried and finished article is transferred to a transfer die, it is carried by such die to a position where it may be conveniently ejected from the machine, as by means of a blast of air through the transfer die.

In the accompanying drawings I have illustrated a preferred embodiment of my invention, together with several modifications suggestive of the many variations which are within the scope of my invention. In the drawings:

Fig. 1 is a plan view of the preferred form of my machine.

Fig. 2 is a detail view of a type of mechanism which may be used for imparting a step by step motion to the rotating units of my machine.

Fig. 3 is a vertical section of the machine of Fig. 1.

Fig. 4 is a view similar to Fig. 3 showing a modification in which the drying dies are pivoted and are swung outside the orbit of the holding dies to clear the forming and transfer units.

Fig. 5 is a plan view of a machine similar to Fig. 1, except that there are two forming die units for the formation of a multilayer article and an independent transfer die unit for receiving the composite dried articles from the holding dies and ejecting them from the machine, and

Fig. 6 is a fragmentary elevation showing the transfer unit of the machine of Fig. 5.

Considering the machine of Figs. 1-3 inclusive, I have indicated at 10 a horizontal intermittently rotated shaft journaled in suitable bearings and supported on the machine frame 11. Mounted on shaft 10 is a plurality of equidistantly spaced foraminous forming dies 12 and a plurality of equidistantly spaced foraminous transfer dies 13.

Pulp stock tank 14 mounted on frame 11 is provided for holding the aqueous stock mixture used for the suction formation of the articles on the forming dies 12 as they are successively immersed in the pulp stock.

Air and vacuum as required may be supplied to the forming and transfer dies through port box 15. Drainage between the port box 15 and the forming and transfer dies may be by means of passages 16 in the hubs of said forming and transfer unit (see Fig. 3).

Journalled in and supported by frame 11 is intermittently rotated vertical shaft 17. This shaft may be hollow and at its upper end carries a spider member 18, the radial arms of which are of equal angular spacement.

Mounted near the free end of each spider arm is a vertically reciprocable foraminous holding die 19. Each holding die is independently reciprocable as by means of individual hydraulic or air operated cylinders 20 mounted on or forming a part of the spider arms.

Also mounted on vertical shaft 17 is a series of radial arms 21 equal in number and angular spacement and in fixed relation to the arms of the spider 18. On each of these arms 21 is slidably mounted a radially reciprocating die carrier 21' on which is mounted a heated drying die 22. Each die carrier 21' is radially reciprocated as required by means of cam roll 24 mounted on carrier 21' and engaged in the race-

way of a fixed cam 23 mounted on the machine frame 11.

Intermittent step by step rotation is imparted to the shaft 17 by any suitable means. For this purpose I have shown a drive of the Geneva type (see Fig. 2). Mounted on the lower end of shaft 17 is Geneva wheel 25 (Fig. 2) driven by Geneva 26 which is mounted on continuously rotating shaft 27. The shaft 27 may be continuously driven by any suitable means such as pulley or gear 27'.

For imparting the required step by step motion to the forming and transfer unit and to insure that it is operated in proper mechanical synchronism with the drying unit, I provide a suitable motion transmitting connection between the forming and transfer unit and the intermittent drive of the vertical shaft 17. This connection may comprise ring gear 28, mounted on vertical shaft 17, pinion 29 and gears 30 and 31. If so desired the forming and transfer unit may be driven by a separate intermittent type of drive and the two drives mechanically or otherwise interlocked so as to insure the required synchronism between the two rotating units.

Air and vacuum connections to the holding dies 19 may be provided as by port box 32 (see Fig. 3) mounted on hollow shaft 17. Distribution of the air or vacuum to the dies 19 may be by means of pipe or flexible hose as required.

The drying dies 22 are heated and if so desired the holding dies 19 may also be heated. If this heat is to be in the form of steam, a swivel steam and condensate connection may be made to the bottom of the shaft 17 with suitable piping connections to each of the dies. If it is desired to use electric heat, a slip ring unit may be mounted at either top or bottom of shaft 17 with suitable connections to each of the dies.

Suitable compressed air or hydraulic connections may also be supplied to shaft 17 with required connections to each individual cylinder 20 for reciprocating the holding dies. The reciprocating of these holding dies in their properly timed relationship may be either from a valve arrangement operated outside of the rotating unit or may be accomplished by a suitably operated and timed valve mechanism which may be mounted on the rotating unit carried by vertical shaft 17. While I have shown the holding dies to be operated by hydraulic or air cylinders, it should be understood that I do not limit myself to this method of operation and that it is feasible to provide a mechanical arrangement which would impart the required timed motion to each of the holding dies.

The operation of this machine is as follows. Each forming die of the forming unit is successively revolved through the aqueous stock mixture in the pulp tank 14 and during the time it is immersed in this pulp mixture an article is suction-formed thereon. Continued rotation of the forming die unit brings each die successively into the upper vertical position shown in Fig. 3. While paused in this position it is in coactive alignment with a holding die 19. The holding die 19 is then coated with the forming die, suction being applied to the holding die and air under pressure applied to the forming die so that when the holding die is retracted the wet article is transferred to it.

Previous to this period of transfer of the wet article from the forming die to the holding die, the mating drying die 22 had been radially retracted within the orbit of the holding die (see

Fig. 1) so as to clear the forming die unit and permit the coaction between the forming die and the holding die.

After the holding die has received the wet article from the forming die, continued rotation of the machine cams the drying die into projected position which brings it into coactive alignment with its mating holding die. As soon as this coactive alignment is accomplished, the holding die with its wet article closes on its mating drying die and stays closed on said die under sustained pressure contact during subsequent rotation of the drying unit and until these dies have revolved to a point adjacent the transfer die unit where the holding die with its now dried article is retracted from the drying die.

Continued rotation of the drying unit beyond this point cams said drying die inside the orbit of the holding die (see Fig. 1) for clearance between the drying die and the transfer die unit and brings the holding die in paused coactive alignment with a transfer die. The holding die is then coated with the transfer die and air under pressure is applied through the holding die and suction to the transfer die. The holding die is then retracted leaving the dried and finished article on the transfer die for subsequent ejection from the machine by means of a blast of air through the transfer die. This completes the cycle for the manufacture of one article. The cycle is then repeated and is the same for each successive set of complementary dies.

It is obvious that for each complete revolution of the drying unit there are as many articles successively formed, successively transferred to the holding dies, and successively dried and finished and ejected from the machine as there are complementary pairs of holding and drying dies on the drying unit.

Fig. 4 shows in vertical section a modification of the machine of Figs. 1-3. The difference between this machine and the machine previously described lies entirely in the method of mounting the drying dies and successively moving these dies outside the orbit of the holding dies to clear the forming and transfer die unit and to permit successive coaction of the holding dies with the dies of the forming and transfer unit for purposes of article transfer.

On the machine of Fig. 4 the drying dies 22 are mounted on individual swinging carriers 33 which are pivoted to the several arms of the spider member 18 as at 34.

For imparting the required swinging motion to each carrier 33 and drying die 22 a fixed cam 38 is mounted on the machine frame 11. Connection between this fixed cam 38 and each of the swinging carriers 33 is by means of individual cam rolls 37 engaged in the cam raceway and mounted on the individual slide blocks 36 which are slidably mounted on the arms of the spider 18. Connecting link 35 connects each slidably mounted block 36 to a carrier 33.

The shape of the raceway of fixed cam 38 is such as to impart the required swinging motion to each carrier 33 and its drying die 22 so that during that part of the rotation of the drying unit in which the holding dies 19 are in coactive alignment with either the transfer dies or the forming dies, their mating drying dies and carriers are swung outside the orbit of the holding dies for clearance with the forming and transfer die unit to permit the successive coac-

tion of the holding dies with the forming and transfer dies of this unit.

During that part of the rotating cycle of the drying unit in which each mating pair of holding and drying dies is revolving outside the zone of the forming and transfer die unit, the drying dies are successively swung into coactive alignment with their respective holding dies and the holding dies with their wet articles are successively coated with and remain continuously in pressure contact with their complementary drying dies.

As each mating pair of holding and drying dies is stepped into proximity to the transfer die unit, the holding die retracts, retaining its dried and finished article. Continued stepping of the drying unit swings the complementary drying die outside the orbit of the holding dies for clearance with the transfer unit and brings the holding die into paused coactive alignment with a transfer die for transfer of the dried and finished article to such transfer die for subsequent ejection from the machine.

The machine of Fig. 4 otherwise operates the same as the machine of Figs. 1-3.

The machine of Figs. 5 and 6 is designed for the formation of multilayer articles. It differs from the machines previously described in that in place of the transfer die unit of the previous machines I have provided a second forming die unit 40 for the purpose of manufacturing a multilayer article and have provided a different type of transfer die unit 41 to receive the dried multilayer articles from the holding dies and eject them from the machine.

The transfer die unit 41 is shown as a single die oscillating type, operated by means of air or hydraulic cylinder as at 42. The transfer die 43 is pivoted to the frame as at 44 and connected to operating cylinder 42 by any suitable linkage. It is swung to the vertical position as shown for successively receiving the dried multi-layer articles from the holding dies and successively swung to the horizontal position shown dotted in Fig. 6 for ejecting each article from the die and machine as by means of a blast of air.

The cycle of operation of the machine of Figs. 5 and 6 differs from the machines previously described only in that each holding die first coacts with a forming die of the forming die unit 40 and removes the article layer from it and then steps into coactive alignment with a forming die of the second forming die unit 42 so that the article layer from the second forming die is superimposed on the article layer removed from the first forming die. Except for the addition of the second forming die unit and the difference in the type of transfer die unit, the operation of the machine is the same as described for the machines of Figs. 1-4.

In the machines of Figs. 1-4 inclusive, I have shown the forming and transfer dies as mounted on a common shaft. It is obvious, however, that the forming die unit and the transfer die unit may be mounted on separate shafts having different axes of rotation.

Also, if desired, a swinging transfer die unit such as shown in Figs. 5 and 6 may be substituted for the intermittently rotating type of transfer die unit shown in Figs. 1-4.

Similarly if desired the machines of Figs. 5 and 6 may be provided with more than two forming units for the formation of articles of three or more layers.

In all of the machines shown the number of

dies on the forming and drying units may be varied as desired to give the required machine production and physical characteristics wanted in the finished product.

Obviously, there is considerable possible variation in the arrangement and operation of the various dies of the various units to permit the transfer of the articles to and from one unit to the other. For instance, the holding dies may be non-reciprocable and the dies of the forming and transfer units may be reciprocable as well as intermittently revoluble for the transfer of articles to and from these units and the drying dies may be vertically reciprocable as well as orbitally displaceable or the holding dies may be orbitally displaceable for transfer of the articles from the forming dies and to the transfer dies.

These and all such modifications in machine and method may obviously be resorted to within the spirit and scope of my invention as defined by the appended claims.

What I therefore claim and desire to secure by Letters Patent is:

1. A fibrous pulp molding machine, comprising an intermittently rotatable shaft, a spaced series of holding dies adapted to receive wet-formed molded pulp articles and a series of coacting complementary drying dies, both of said series of dies being mounted on and revolving with said shaft, said drying dies corresponding in number and angular spacing to said holding dies, means for rotating said shaft step by step, means for placing wet formed articles on said holding dies, means for coacting each holding die, with a wet article thereon, with its complementary drying die during a substantial portion of the rotating cycle of said shaft to dry the article between said pair of dies under heat and mechanical pressure, means for discharging the dried articles from said holding dies at the completion of the drying cycle, and means for displacing each drying die from the path of coactive movement of its complementary holding die during those portions of the rotating cycle of said shaft at which a wet formed article is being placed on each holding die and at which each holding die is discharging a dried article.

2. A fibrous pulp molding machine comprising a rotary step by step forming and transfer die shaft carrying a series of foraminous forming dies for the suction formation of wet molded pulp articles, an intermittently rotating drying shaft having its axis of rotation disposed substantially at right angles to the axis of rotation of said first named shaft and carrying a series of spaced holding dies and a complementary series of drying dies corresponding in number and angular spacing to the holding dies, a series of foraminous transfer dies carried by said forming and transfer die shaft for receiving and ejecting dried articles from the machine, means for rotating said shafts step by step in synchronism to bring the forming dies and the transfer dies into coactive alignment with the holding dies for the successive transfer of wet articles from said forming dies to said holding dies and dried articles from said holding dies to said transfer dies, means for successively imparting coactive movements to each holding die first to coact said holding die with a forming die while said dies are paused in their revolution for transferring a wet article to the holding die and then to coact said holding die with its complementary drying die for drying the article under continuous heat, pressure and vacuum between said holding die and said drying die for a substantial portion of the rotating cycle of

said drying shaft and subsequently to coact said holding die with a transfer die while said dies are paused in their revolution for transferring the dried article from the holding die to the transfer die, and means for displacing each drying die from the path of coactive movement of its complementary holding die during the periods in which the holding die is removing a wet article from a forming die and is transferring a dried article to a transfer die.

3. A machine for manufacturing multilayer molded fibrous pulp articles, comprising a rotary step by step forming shaft carrying at least two adjacent series of foraminous forming dies for the suction formation of wet molded pulp article layers, an intermittently rotating drying shaft carrying a plurality of spaced holding dies and a plurality of drying dies corresponding in number and angular spacing to the holding dies, means for rotating said shafts step by step in synchronism to bring the forming dies into coactive alignment with the holding dies for the successive transfer of article layers to the holding dies, means for successively imparting coactive movements to each holding die first to coact said holding die with a forming die of each of said series of forming dies while said dies are paused in their revolution for successively transferring wet article layers in superimposed order to the holding die and then to coact said holding die with its complementary drying die for drying the composite article under continuous heat, pressure and vacuum for a substantial portion of the rotating cycle of said drying shaft between said holding die and said drying die and subsequently for discharging the dried composite article from said holding die, and means for displacing each drying die from the path of coactive movement of its complementary holding die during the periods in which the holding die is successively removing wet article layers from the forming dies and a composite dried article is being discharged from the machine.

4. A fibrous pulp molding machine comprising a rotary step by step forming shaft, a foraminous forming die for the suction formation of a wet molded pulp article mounted on and revoluble with said shaft, a rotary step by step drying shaft mounted adjacent to but independently of said forming shaft, a foraminous holding die and a coacting drying die both of which are mounted on and revoluble with said drying shaft, said holding die being reciprocally mounted relative to said drying die and said drying die being of complementary size and shape to said holding die and being displaceable relative to the path of reciprocation of said holding die, means for rotating both of said shafts step by step in synchronism with each other to bring the forming die and the holding die into positions of coactive alignment with each other, means operative while both of said shafts are paused in their rotation for successively imparting reciprocating movements to said holding die first to cause said holding die to coact with said forming die to thereby transfer a wet article to the holding die and thereafter to cause said holding die, with the wet article thereon, to coact with said drying die to thereby dry the article between said pair of dies under heat and mechanical pressure, means for subsequently discharging the dried article from the holding die, and means for displacing the drying die from the path of reciprocating movement of the holding die during the periods

in which the holding die is removing a wet article from the forming die and is discharging a dried article.

5. The machine of claim 4, in which the means for subsequently discharging the dried article from the holding die comprises a transfer die pivotally mounted relative to the holding die to receive the dried article from the holding die, and means for swinging said transfer die to a position for ejecting the dried article from the machine.

6. A fibrous pulp molding machine comprising a rotary step by step forming shaft, a foraminous forming die for the suction formation of a wet molded pulp article mounted on and revoluble with said shaft, a rotary step by step drying shaft mounted adjacent to but independently of said forming shaft, a foraminous holding die and a coacting drying die both of which are mounted on and revoluble with said drying shaft, said holding die being reciprocally mounted relative to said drying die and said drying die being of complementary size and shape to said holding die and being displaceable relative to the path of reciprocation of said holding die, a transfer die mounted on and revolving with said forming shaft for receiving a dried article from the holding die and ejecting it from the machine, means for rotating both of said shafts step by step in synchronism with each other to bring the forming die and the holding die into posi-

tions of coactive alignment with each other, means operative while both of said shafts are paused in their rotation for successively imparting reciprocating movements to said holding die first to cause said holding die to coact with said forming die to thereby transfer a wet article to the holding die, thereafter to cause said holding die, with the wet article thereon, to coact with said drying die to thereby dry the article between said pair of dies under heat and mechanical pressure, and finally to cause said holding die to coact with the transfer die to transfer the dried article from the holding die to the transfer die for ejection from the machine, and means for displacing the drying die from the path of reciprocating movement of the holding die during the periods in which the holding die is removing a wet article from the forming die and is transferring a dried article to the transfer die.

7. The machine of claim 6, the means for displacing the drying die comprising a die carrier slidably mounted on the drying shaft, a cam roll carried by said die carrier, and a fixed cam with which said cam roll coacts.

8. The machine of claim 6, the means for displacing the drying die comprising a die carrier pivoted to the drying shaft, a sliding member connected to said carrier and provided with a cam roll, and a fixed cam with which said cam roll coacts.

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