

March 18, 1941.

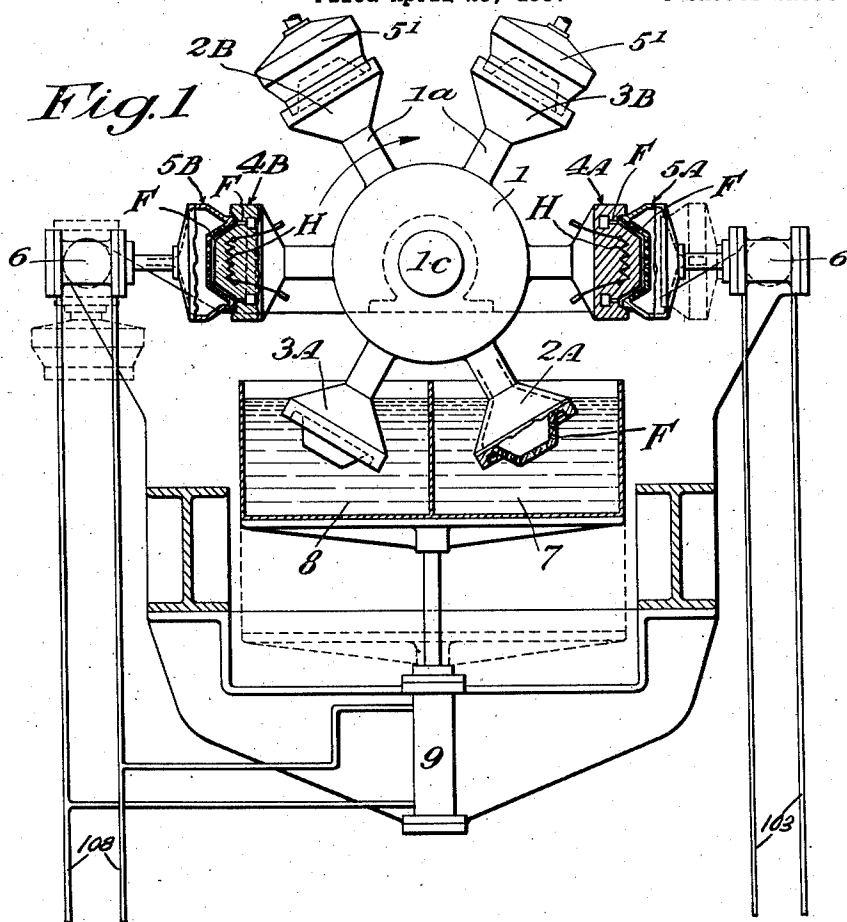
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2,234,979

APPARATUS FOR PRODUCING MOLDED PULP ARTICLES

Filed April 29, 1937

6 Sheets-Sheet 1



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Fig. 3

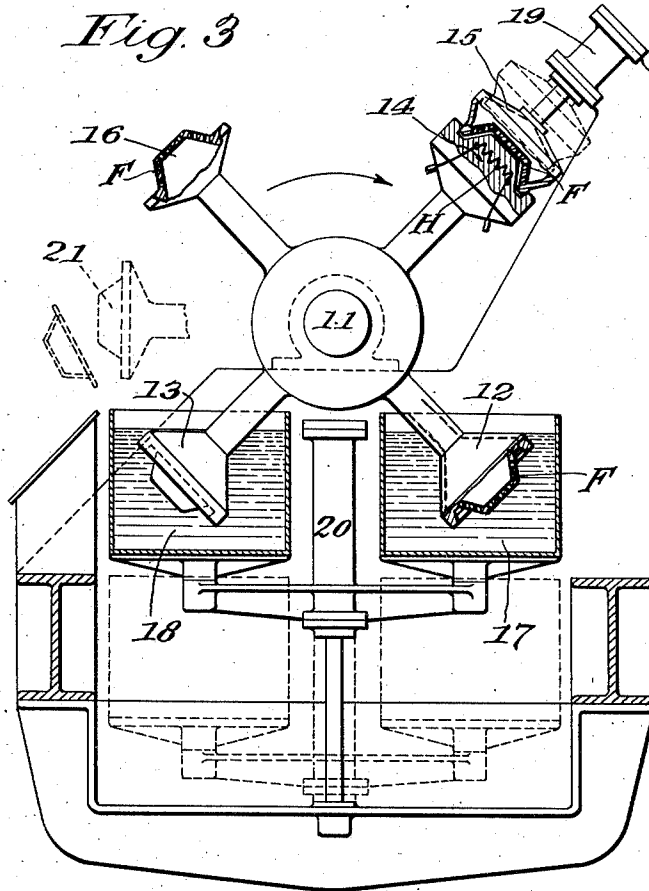
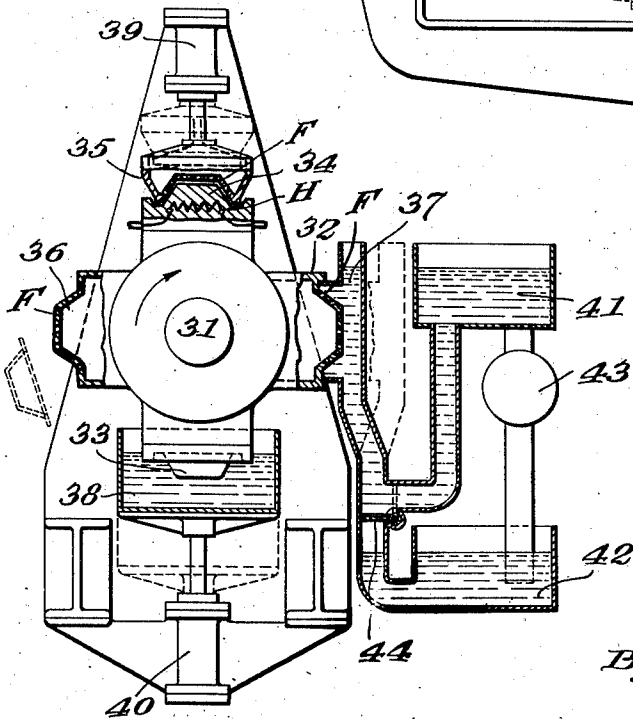


Fig. 4



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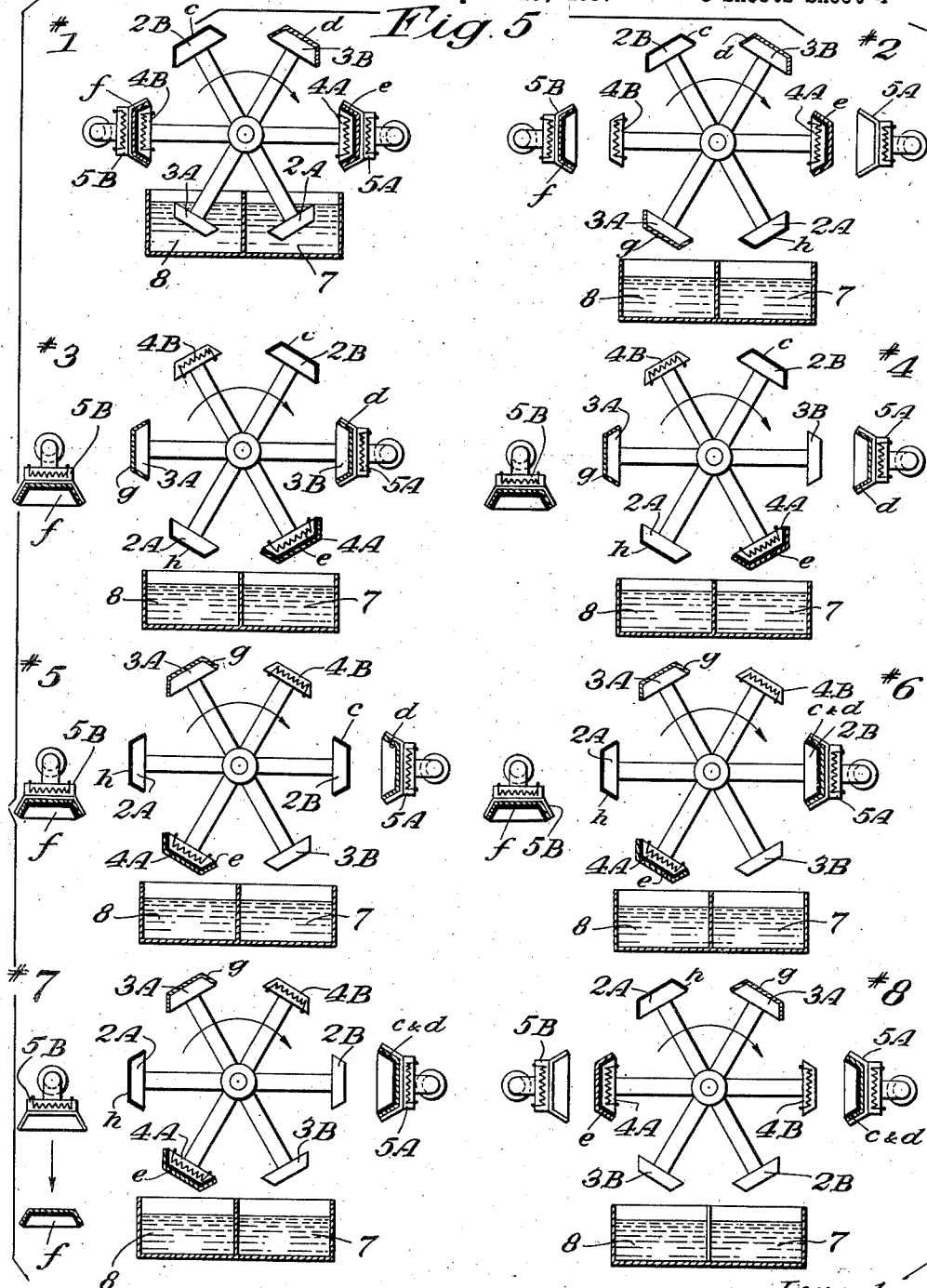
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Fig. 5



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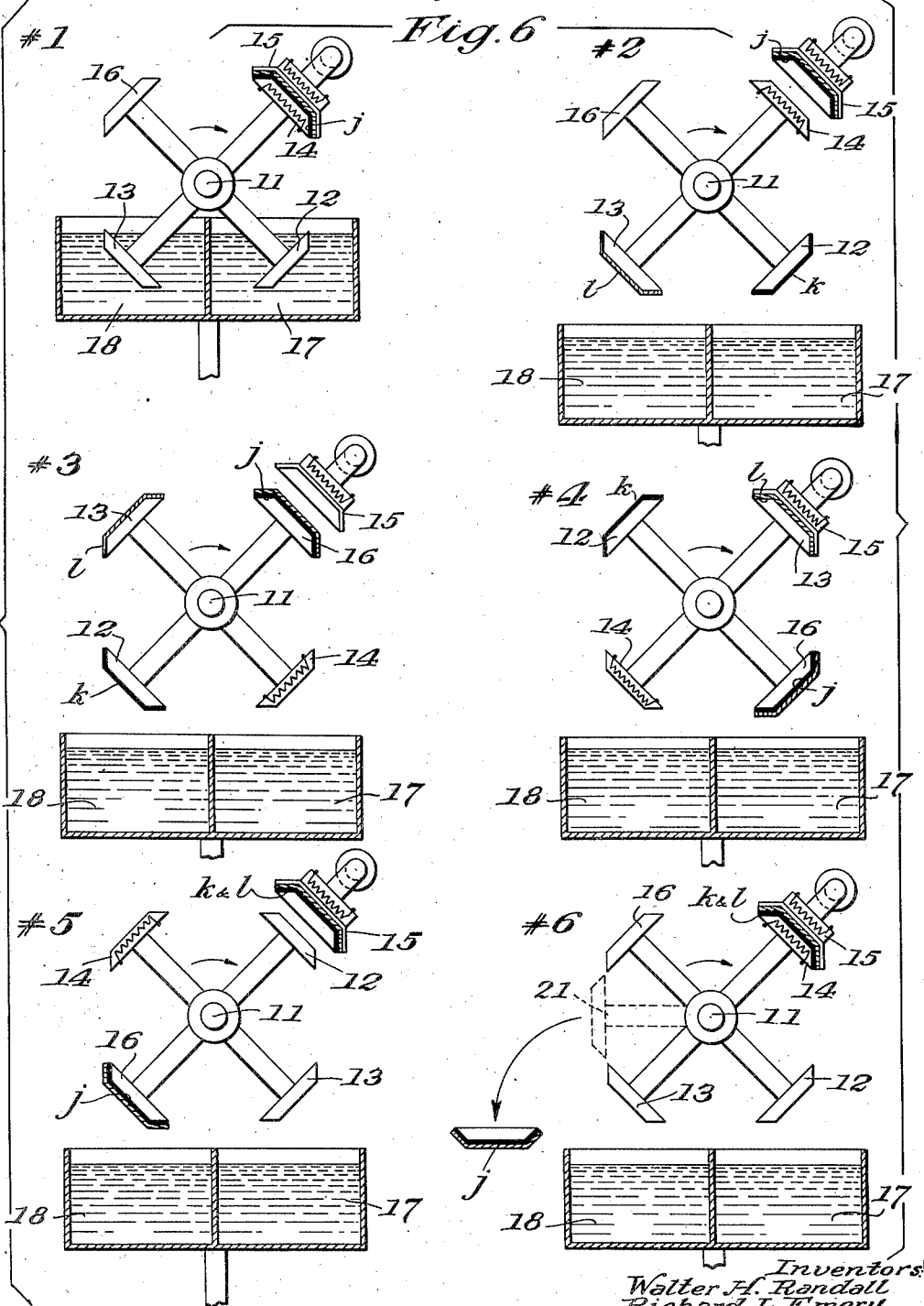
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Fig. 6



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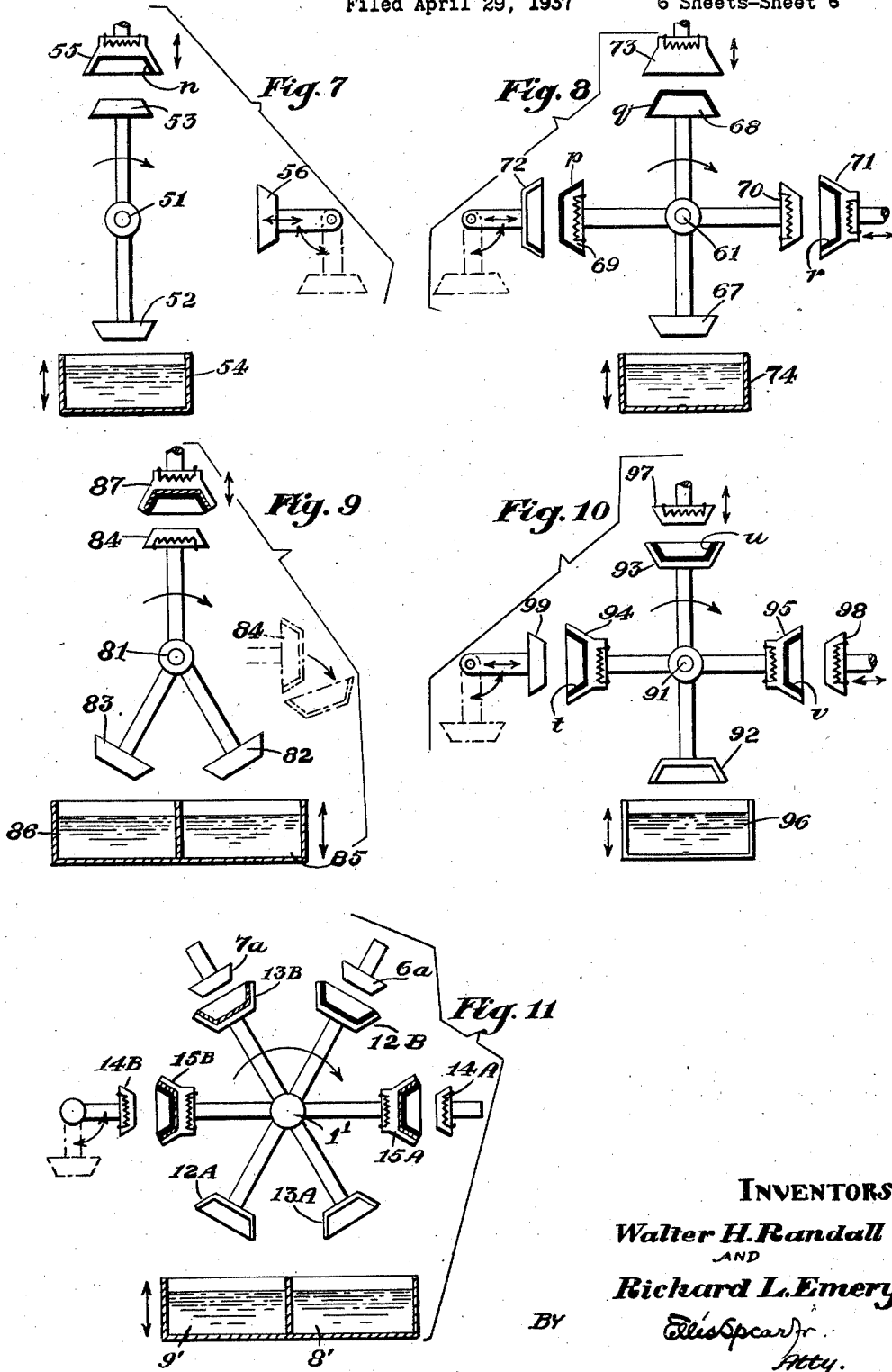
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APPARATUS FOR PRODUCING MOLDED PULP ARTICLES

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6 Sheets-Sheet 6



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APPARATUS FOR PRODUCING MOLDED
PULP ARTICLES

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18 Claims. (Cl. 92—56)

This invention relates to improvements in machines and methods for the production of both single and multi-layer molded pulp articles.

Its general object is to provide a commercially satisfactory machine and method for forming, drying, and finishing such articles.

In the simplest embodiment (Fig. 7) of our invention for producing a single layer molded pulp article, we mount a single forming die and a single drying die on an intermittently rotating shaft and mount outside of the orbit of these revolving dies a single reciprocating drying die which is adapted to coact with the dies on the rotating die unit. Below the intermittently rotating die unit is mounted a pulp tank which is adapted to be raised and lowered for the immersion of the forming die at the proper time for the suction formation of an article thereon.

The article formed on the forming die remains thereon while the rotating die unit steps ahead and until the forming die is brought into registration with the reciprocating drying die. Thereupon, the reciprocating drying die closes on and retracts from the forming die to transfer the formed article to itself.

The article remains on the reciprocating drying die until the continued stepping of the rotating die unit brings the revoluble drying die into a position for registration with the reciprocating drying die, whereupon the reciprocating drying die with its wet article closes on the revoluble drying die to completely dry and finish the article between these two dies and then retracts, after which the dried article is ejected from the machine in any convenient manner.

During the period in which the article is being dried the forming die is immersed in pulp stock for the suction formation of another article thereon.

In the simplest embodiment (Fig. 9) of our invention for producing a multi-layer molded pulp article, we mount a pair of forming dies and a drying die on the intermittently rotating shaft and mount outside the orbit of these revolving dies a single reciprocating drying die which is adapted to coact with the dies on the rotating die unit.

Below the intermittently rotating die unit is mounted a double compartment tank which is adapted to be raised and lowered for the simultaneous immersion of the forming dies in the respective compartments of said tank at the proper time for the suction formation of article layers thereon.

The articles formed on the forming dies remain

thereon while the rotating die unit steps ahead and until the forming dies are successively brought into registration with the reciprocating drying die. Thereupon the reciprocating drying die closes on and retracts from each forming die to successively transfer the pulp layers to itself.

The composite article remains on the reciprocating drying die until the continued stepping of the rotating die unit brings the revoluble drying die into a position for registration with the reciprocating drying die, whereupon the reciprocating drying die with its composite wet article thereon closes on the revoluble drying die to completely dry and finish the article between these two dies and then retracts, after which the dried article is ejected from the machine in any convenient manner.

During the period in which the composite article is being dried the forming dies are immersed in the compartments of the pulp tank for the suction formation of other article layers thereon.

Thus the individual article layers are formed on independent forming dies, consolidated together under pressure, and the composite article dried, bonded and finished under heat, vacuum and mechanical pressure in the form of the desired commercial article.

In our preferred embodiment (Fig. 8) for producing a single layer article, we mount a pair of oppositely disposed forming dies and a pair of oppositely disposed drying dies on an intermittently rotating shaft, and we mount outside the orbit of these revolving dies a pair of oppositely disposed reciprocating drying dies, one of which may be an ejecting die.

Beneath the rotating unit we mount a pulp tank adapted to be raised for successively immersing the forming dies for the suction formation of individual articles thereon when the tank is raised, as required, towards the die unit.

The suction-formed articles remain on the forming dies during stepping of the rotating die unit and until each forming die reaches a position for registration with the reciprocating drying die, whereupon said reciprocating drying die closes on and retracts from each forming die to transfer the article to itself.

Thereafter, in the continued stepping of the rotating die unit, the article on said reciprocating drying die is contacted with a revoluble drying die to completely dry and finish the article between these two dies.

After drying the article is transferred, in the continued stepping of the machine, from said reciprocating drying die by means of said revolu-

ble drying die to the ejecting die which removes the dried article from the revoluble drying die and ejects it from the machine.

In our preferred embodiment (Fig. 1) for producing a multi-layer article, we mount two oppositely disposed pairs of forming dies and one oppositely disposed pair of drying dies on the intermittently rotating die unit, and we mount a pair of oppositely disposed reciprocating drying dies outside the orbit of these revolving dies.

Beneath the rotating die unit, we mount a double compartment pulp tank within the respective compartments of which two circumferentially adjacent forming dies are adapted to be simultaneously immersed for the suction formation of individual article layers thereon when the tank is raised, as required, towards the die unit.

Such article layers remain on said forming dies during stepping of the rotating die unit and until each forming die reaches a position for registration with one of the reciprocating drying dies, whereupon said reciprocating drying die closes on and retracts from each forming die to successively transfer the article layers to itself as a composite article.

Thereafter, in the continued stepping of the rotating die unit, the composite article on said reciprocating drying die is contacted with one of the revoluble drying dies of the rotating die unit and consolidated under pressure, and bonded, partly-dried and finished under heat, vacuum and mechanical pressure between these two dies.

After drying to a predetermined degree, the composite article is transferred, in the continued stepping of the machine, from said first reciprocating drying die, by means of said revoluble drying die, to the second reciprocating drying die where the drying and finishing of the composite article is completed between these two dies, after which the second reciprocating drying die removes the finished article from the revoluble drying die and ejects it from the machine.

In the accompanying drawings we have shown the simplest and the preferred embodiments of our invention, together with several variations thereof which are suggestive of the many possible modifications in design for achieving our object.

Fig. 1 is an end elevation, partly in section, through so much of our preferred machine for producing a multi-layer article, as is necessary for an understanding of the forming, consolidating, and drying operations.

Fig. 2 is a detail showing one method of intermittently rotating the stepping unit and locking the same in each paused position for proper registration and coaction of the dies, and also showing conventional means for controlling the various reciprocating elements of the machine in their properly timed relationship.

Fig. 3 is a view similar to Fig. 1 showing a modified form of multi-layer machine.

Fig. 4 is a view similar to Fig. 1 but showing a further modified form of multi-layer machine.

Fig. 5 is a diagram illustrating the successive steps in the cycle of operation of the machine shown in Fig. 1.

Fig. 6 is a diagram illustrating the successive steps in the cycle of operation of the machine shown in Fig. 3.

Figs. 7 to 11 are views similar to Fig. 1 but showing still further modifications.

Fig. 7 shows the simplest embodiment of our invention for producing a single layer article.

Fig. 8 shows a machine similar to Fig. 7 but producing two single layer articles at each complete revolution of the rotating die unit.

Fig. 9 shows the simplest embodiment of our invention for producing a multi-layer article.

Fig. 10 shows a machine similar to Fig. 8 but in which the revolving dies are female and the reciprocating dies are male, and

Fig. 11 shows a machine generally similar to Fig. 1, but in which the revolving dies are female and the reciprocating dies are male.

In Fig. 1, we have shown our preferred machine for making multi-layer articles. Such machine comprises a single step-by-step rotating die unit 1 mounted on drive shaft 1c and provided with radial arms 1a on which is mounted a plurality of equi-distantly spaced dies 2A, 2B, 3A, 3B, and 4A and 4B.

The dies 2A and 2B are forming dies for the suction formation of individual article layers from one grade of pulp stock, and are arranged diametrically opposite one another. The dies 3A and 3B are forming dies and are foraminous as indicated at F for the suction formation of individual article layers from another grade of pulp stock, and are likewise arranged diametrically opposite one another. The dies 4A and 4B are revoluble drying dies for drying and finishing the composite articles, and are also arranged diametrically opposite one another between the dies 2A and 3B and 3A and 2B respectively. The dies 4A and 4B are heated in any suitable manner, as indicated at H.

A pulp tank having double compartments 7 and 8 containing different grades of pulp stock is adapted to be raised and lowered relative to the die unit 1. When said tank is raised, the forming dies 2A and 2B and 3A and 3B are immersed in proper sequence in the proper pulp compartments of the tank.

Reciprocating drying dies 5A and 5B are mounted at opposite sides of the revolving unit 1 outside the orbit of the rotating dies on said unit, but in line with the paused positions thereof for coaction with said revolving dies as may be required.

The die 5B in addition to coacting with the required dies on rotating die unit 1 is an ejecting die for ejecting the dried and finished article from the machine.

The machine illustrated in Fig. 1 forms one complete two-layer article every half revolution of the intermittently rotating unit. The forming dies 2A and 2B each mold one layer of the composite article, as for example, a lining layer. The forming dies 3A and 3B mold another layer of the composite article, as for example, a body or backing layer. The revoluble drying dies 4A and 4B coact with the reciprocating dies 5A and 5B to bond, dry and finish the composite articles under heat, vacuum and mechanical pressure, and are foraminous as indicated at F and are each provided with connections for applying vacuum for holding the composite articles thereon during their transfer from die 5A to die 5B.

The machine is equipped with appropriate ports and valves properly timed whereby suction or air pressures may be applied to and discontinued from all dies in proper sequence to their operation.

Any suitable means may be provided for rotating the die unit 1 step by step. For purposes

of illustration we have shown in Fig. 2 a stepping wheel 1b of modified Geneva type fast on the drive shaft 1c. The periphery of the stepping wheel is provided with a series of radial slots 1d corresponding in number and spacing to the number and spacing of the dies on intermittently rotating die unit 1.

Successively coacting with the slots 1d is a roller 1e carried by a driving arm 1f fast on a drive shaft 1g which is continuously rotated from any suitable power source and acts to rotate the stepping wheel and with it the rotating die unit in the direction of the arrow the distance of one die space at each step in the cycle of the machine.

In order to lock the stepping wheel for proper registration and coaction of the rotating dies on unit 1 with the reciprocating dies 5A and 5B as required, we provide an automatic latch 1h adapted to be successively entered into and withdrawn from a series of locking notches 1k located in the periphery of the stepping wheel intermediate of the slots 1d. The locking latch is operated in timed relation to the operation of the driving arm 1f in any suitable manner, as by a suitably timed cam mechanism or as by the hydraulic or air operated cylinder 1m of Fig. 2.

Obviously, of course, other well known means, either mechanical or hydraulic, may be provided for accomplishing this two-fold function of stepping and locking the rotating die unit.

The reciprocating drying dies 5A and 5B are foraminous as indicated at F and are provided with connections for the application of vacuum to the article for removing the steam vapors given off by the article during drying, and also to permit air pressure to be used for the transfer of the articles from the dies 5A and 5B to coacting dies as may be required.

The dies 5A and 5B may or may not be heated, as desired. They are reciprocated into coacting relation with the several dies of the intermittently rotating die unit at the proper time by any suitable mechanism, as for example, the hydraulic operating cylinders 8 shown in Fig. 1. Obviously, however, such dies may be operated mechanically rather than hydraulically where desired.

The double stock tank 7 and 8 is shown as hydraulically operated by means of the hydraulic cylinder 9, but obviously may be raised and lowered mechanically rather than hydraulically if so desired. The operation of the various hydraulic cylinders 8-9, 9 and 1m may be controlled by means of cam operated valve mechanisms as shown in Fig. 2. Cylinder 1m and the cylinder 8, which controls die 5A, are controlled by valve 100 which is actuated by a timing cam 101, fast on drive shaft 1g, and rocker lever 102. Hydraulic connections 103 are provided between valve 100 and said cylinders. This timing valve 100 will actuate the latch 1h and die 5A once for each step of the rotating unit. Cylinder 9 and cylinder 8, which controls the die 5B, are controlled by valve 104 which is actuated by a timing cam 105, fast on shaft 106, and rocker lever 107. Hydraulic connections 108 are provided between valve 104 and said cylinders. Shaft 106 is driven from shaft 1g by gears 109 and 110. The ratio between said gears is such as to actuate pulp tank 7-8 and die 5B once every third step of the rotating unit. Fluid under pressure is supplied to valves 100 and 104 from any suitable source. Alternatively, if desirable, an individual control valve and operating mechanism may be

provided for each or any one of the several cylinders.

In the diagram of Fig. 5, the successive positions of an article cycle are designated Nos 1-8 inclusive.

For purposes of illustration position #1 may be considered as a starting position. In this position the rotating die unit 1 has paused in its rotation and has been locked in its paused position. The double stock tank has been raised to immerse the forming dies 2A and 3A in the pulp mixtures contained in the respective compartments 7 and 8 of said tank.

The individual pulp layers c and d deposited on the other set of forming dies 2B and 3B at a previous stage of the die cycle are now draining on said dies, vacuum being maintained on said dies 2B and 3B, during their dwell time in this position to facilitate the further removal of moisture from the layers c and d thereon. The reciprocating drying dies 5A and 5B are closed on the complementary revoluble drying dies 4A and 4B, respectively, and these several dies are combinedly drying between them the composite articles e and f which were formed at previous stages in the cycle of the machine.

The parts remain in the #1 position for an interval of time which is determined by the required drying period for the composite articles e and f being dried between the dies 4A and 5A and 4B and 5B respectively. During this drying time, article layers h and g are being formed on forming dies 2A and 3A immersed in pulp tank 7-8.

At the end of the drying period the dies 5A and 5B are retracted from dies 4A and 4B respectively and the tank 7-8 is lowered away from the forming dies 2A and 3A (see position #2). The composite article e shown drying between the dies 4A and 5A in position #1 is at this time partly dried and remains on the revoluble drying die 4A when the die 5A is retracted. The composite article f shown drying between revoluble drying die 4B and die 5B in position #1 is completely dried at this stage of the machine cycle and is transferred to the die 5B which after retraction swings 90° so that the article may be ejected therefrom (see position #7) by means of a blast of compressed air through said die.

The die unit now steps one sixth of a revolution ahead to the #3 position. The forming die 3B with its previously deposited layer of pulp d thereon is now opposite die 5A which has closed thereon and then retracts from die 3B as shown in the #4 position of the diagram, removing the article layer d from the forming die 3B and retaining it on itself.

As soon as die 5A has retracted from die 3B, the die unit 1 steps ahead another step to the #5 position of the diagram. This brings forming die 2B with its previously deposited layer c thereon opposite die 5A on which is retained the article layer d previously removed from forming die 3B at position #4 of this diagram.

The die 5A now closes on the forming die 2B (see position #6) and then retracts (see position #7) from said die, thereby removing the previously deposited layer c from said forming die so that said die 5A now has on it a two-layer article consisting of the first layer d which was removed from forming die 3B at position #4 and the second layer c which was just removed from forming die 2B at position #7.

The machine now steps ahead to the #8 position of the diagram where the die 5B, which has

ejected its article *f*, is shown as having swung back through its 90° arc and aligned itself with the die 4A of the rotating die unit. In this position die 5B is in readiness to coact with die 4A for completing the drying and transfer of the partly dried composite article *e* on die 4A, and the companion die 4B is positioned opposite the die 5A in readiness to coact with the composite article *c-d* on die 5A.

Forming dies 2B and 3B now occupy the positions formerly occupied by forming dies 2A and 3A (see position #1) and are thus in readiness to be immersed in the double compartments of the pulp tank when said tank is again raised.

With the closing of dies 5A and 5B on the revoluble drying dies 4B and 4A, respectively, the die 5A and die 4B will start to dry the composite article *c-d*, and die 5B and die 4A will finish drying the composite article *e* previously partly dried between die 4A and die 5A at position #1.

At or substantially at this time the stock tank is raised and forming dies 2B and 3B are immersed therein ready for the formation of new article layers, the pulp layers *h* and *g* theretofore deposited on the other set of forming dies 2A and 3A being in draining position during the cycle of drying the articles between dies 4A and 5B and 4B and 5A. The cycle of die movement at this moment is stationary for a length of time as may be required for the drying and finishing of the composite articles, at the completion of which drying period the machine repeats its cycle.

It is evident from the foregoing description that die 5A coacts with each and every die on the rotating unit whereas die 5B coacts only with dies 4A and 4B. The die 5B, however, performs the dual function of completing the drying and finishing of the partly dried articles on dies 4A and 4B and also of removing them from the rotating unit and ejecting them from the machine.

It is also evident that a full rotation of die unit 1 forms, dries and ejects two finished articles and that a cycle completing the manufacture of one article is equivalent to a half revolution of the rotating die unit.

Thus, we form a two-layer article, the layers of which are formed on independent forming dies mounted on a common shaft and then transfer these layers in proper sequence to a reciprocating drying die on which they are first consolidated under pressure and afterwards bonded, dried and finished under heat and mechanical pressure between the revoluble drying dies carried on the rotating die unit and the reciprocating drying dies mounted outside the orbit of the revolving dies. The drying of the article under pressure between two complementary drying dies of the required shape prevents any appreciable shrinkage and results in a finished article which is true to the required shape and size.

While the machine herein shown and described has only one unit of dies, it is evident that two or more units of dies may be mounted adjacent to each other on a common drive shaft with their required coacting reciprocating drying dies suitably mounted on the machine frame and with a properly proportioned tank in which to immerse the multiple sets of forming dies.

It is also obvious that by mounting the forming dies for the formation of each grade of material making up the composite article and the revoluble drying dies for the drying of the article on a common rotating unit we greatly simplify the mechanics of the machine and reduce to the minimum the number of parts and size of ma-

chine required for the manufacture of this type of article.

If desired, we may provide one or more reciprocating pressing dies 5¹ opposite the forming dies 2B and 3B in Fig. 1. The dies 5¹ may be used for pressing additional moisture from the respective article layers on the several forming dies during the time the forming dies are paused opposite the dies 5¹, such moisture being expelled through the forming dies themselves. Optionally, the dies 5¹ may be heated for the purpose of pre-heating the article layers to accelerate drying after the two layers have been consolidated on die 5A.

Obviously, also, if desired, the die 5B may be omitted and the drying of the composite article completed on die 5A, which die can be adapted to retract with the article and swing to a position where the dried article may be ejected from it as described for die 5B.

In the modification, Fig. 3, we show a form of our machine in which the intermittently rotating shaft 11 carries four equally spaced dies 12, 13, 14, and 15. This die unit may be intermittently driven in the same manner as the form shown in Fig. 1, except that it is a four step unit instead of a six step unit as in Fig. 1, and may be locked at each pause in its rotation in the same manner as described for Fig. 1.

Mounted on the machine frame and arranged to reciprocate relative to the orbit of the revolving dies is a reciprocating die 15. This is reciprocated in any desired manner as by means of the operating cylinder 19 and successively coacts with each of the revolving dies when these dies are passed or at dwell in their rotation opposite the reciprocating die 15.

A double stock tank having compartments 17 and 18 for different grades of pulp is arranged beneath the rotating die unit and is raised and lowered in any suitable manner as by the operating cylinder 20. The timed operation of cylinders 19 and 20 may be controlled by means of a cam-operated valve mechanism similar to that shown in Fig. 2.

The die 12 is a forming die for the formation of a pulp layer from one grade of stock while immersed in tank compartment 17. The die 13 is a forming die for the formation of another layer of pulp from a second grade of stock while immersed in tank compartment 18. Both dies are foraminous as indicated at F.

The die 15 is a reciprocating drying die to which are successively transferred the pulp layers from the forming dies 13 and 12. The die 15 is foraminous as indicated at F for applying vacuum to remove the steam vapors during the period in which the article is being dried between it and the revoluble drying die 14 and for applying air pressure to transfer the article to the ejector die 16. If desired, heat may be applied to the die 15 in any suitable manner. The die 14 is heated as indicated at H.

The ejector die 16 is foraminous as indicated at F and functions to remove the article from die 15 after it is dried and carries it to dotted line ejecting position marked 21 where the article is ejected from said ejector die as by means of a blast of air.

In the diagram of Fig. 3 the successive positions of an article cycle are designated from 1-8 inclusive.

For purposes of illustration position #1 may be considered as a starting position. In position #1, the rotating die unit 11 has paused in its

rotation and the double stock tank 17—18 has been raised to immerse the forming dies 12 and 13 in the respective compartments thereof. The revoluble drying die 14 and the reciprocating drying die 15 are drying a previously formed composite article *j* therebetween.

After an interval of time required for the complete drying of the composite article *j* between the dies 14 and 15, and during which period individual pulp layers *l* and *k* have been deposited on forming dies 13 and 12, the die 15 retracts from the die 14 (see position #2) carrying with it the completely dried composite article *j*.

The stock tank is now lowered so that the forming dies 12 and 13 are no longer immersed therein and the rotating unit 11 steps one quarter of a revolution ahead as shown in position #3.

This brings ejector die 16 opposite die 15 at at which time die 15 closes on and retracts from ejector die 16 for the purpose of transferring the composite dried article to ejector die 16, such transfer being accomplished by means of suction applied to ejector die 16 and air pressure applied to die 15.

As soon as die 15 has retracted after transferring the composite dried article *j* to ejector die 16, the rotating die unit 11 steps ahead one quarter revolution (see position #4) bringing forming die 13 opposite die 15 which now closes on and retracts from forming die 13, removing the layer of pulp *l* therefrom.

As soon as die 15 has retracted carrying with it the pulp layer *l* from forming die 13, the machine steps one quarter of a revolution as shown in position #5, bringing forming die 12 opposite die 15.

The die 15, which is already carrying the pulp layer *l* previously removed from forming die 13 at position #4, now closes on and retracts from forming die 12, removing the pulp layer *k* therefrom as shown in position #5.

The die 15 now has a two layer article on it consisting of the layer *l* removed from forming die 13 at position #4 and the layer *k* removed from forming die 12 at position #5.

As soon as the pulp layer *k* is removed from the forming die 12 at position #5, the rotating unit 11 steps one more quarter turn to position #6, bringing revoluble drying die 14 again opposite die 15. The die 15 with its two-layer article thereon now closes on die 14 as shown in position #6 and remains in this position under mechanical pressure until the composite article is dried, after which the cycle above described is repeated.

The composite dried article *j* which was removed from die 15 by ejector die 16 may be ejected from the ejector die by a blast of air at any convenient time, as for example, when the ejector die 16 reaches approximately the dotted line ejecting position marked 21 in position #6.

Stock tank 17—18 remains in the down position until forming dies 12 and 13 have deposited their articles on die 15 and made a complete revolution and returned to position #6 of the diagram.

As soon as the forming dies 12 and 13 have returned to position #6, tank 17—18 is again raised (see position #1), to again immerse the forming dies in the pulp stock and suction is again applied to both dies to cause new pulp layers to be deposited on them. The composite article *k—l* is being dried between dies 14 and 15 during this formation period.

With this machine as with the form shown in Fig. 1 the raising and lowering of the tank 17—18

and the reciprocation of die 15 may be accomplished by mechanical means such as cams, etc. if desired, instead of by the hydraulic cylinders 20 and 19, as shown.

Air and vacuum for the formation and transfer of articles are supplied to the rotating die unit through port boxes and timed by a valve cam shaft as is customary. Vacuum and air with proper timing are also provided on die 15.

A still further modified form of our machine is shown in Fig. 4, this being substantially the same as that of Fig. 3 except for the arrangement for providing pulp stock to one of the two forming dies.

In the modification, Fig. 4, the intermittently rotating die unit 31 carries four equally spaced dies 32, 33, 34 and 36. This unit is rotated in progressive steps, one quarter of a revolution each step by mechanism similar to that described in Fig. 1.

A reciprocating drying die 35 is mounted outside of the orbit of the revolving dies and is reciprocated by means of operating cylinder 38 or its equivalent into timed coaction with each of the dies on the rotating die unit 31.

The stock tank 38 is raised and lowered by means of cylinder 40 or its equivalent. This tank is a single tank and provides stock only for the formation of a pulp layer on forming die 33. The timed operation of cylinders 38 and 40 may be controlled by means of a cam-operated valve mechanism similar to that shown in Fig. 2.

Stock for the formation of a pulp layer on forming die 32 is provided by means of an open faced bucket or stock container 37, the open face of which is held sealed to the ring of the forming die 32 during the formation period as shown in Fig. 4.

Stock supplied to container 37 from tank 41 is controlled by valve 44. During the period of formation and when the container 37 is held in contact with die 32, the valve 44 is in the open position shown in full lines so as to allow the stock from tank 41 to fill the container 37. After the article is formed and before the rotating unit 31 starts to step, valve 44 is moved to the dotted line position of Fig. 4, thereby shutting off any further stock from tank 41 to container 37, and allowing the surplus stock in container 37 and its connecting pipes to drain into drain tank 42.

As soon as this drainage is completed, container 37 is moved to the dotted line position shown in Fig. 4 so as to give clearance for revolving the die 32. If desired, a pump 43 is provided to pump surplus stock from tank 42 to tank 41.

The functions of the various dies are as follows:

The die 32 is a foraminous forming die for the formation of one grade of stock which is carried in tank 41 and formed by the bucket method as above described.

The die 33 is a foraminous forming die for forming a second grade of stock while immersed in tank 38.

The die 34 is a revoluble drying die, and is heated as indicated at H.

The die 35 is a replicating drying die to which is successively transferred the pulp layers from the forming dies 33 and 32. Die 35 is foraminous as indicated at F and is provided with drainage for applying suction to the article and for removing the steam vapors during the period in

which the article is drying between it and the revoluble drying die 34.

The die 36 is foraminous as indicated at F and is an ejector die, which removes the dried composite article from die 35 and ejects it (as shown in dotted lines Fig. 4) from the machine when the die 36 is stationary in the position shown in Fig. 4.

The sequence of operations of this modification is exactly the same as described for the form shown in Fig. 3, the only exception being in the method of providing the stock for the formation of article on the forming die 32.

It is obvious that with the form of Figs. 1 and 3 by increasing the number of pairs of oppositely disposed forming dies, articles of more than two layers may be formed. For example, by providing three pairs of oppositely disposed forming dies and a three compartment tank, a three layer article may be formed, consolidated, dried, bonded, and finished without any other major change beyond the addition of the third pair of oppositely disposed forming dies.

In Fig. 7 we show the simplest form of our machine for forming, drying and finishing a single layer article. In this form, the intermittently rotating die unit 51 carries a single foraminous forming die 52 for the suction formation of a single layer article and a single foraminous drying die 53 which is heated as indicated at H.

Below the intermittently rotating die unit is mounted a pulp tank 54 which is adapted to be raised to immerse the forming die therein at the proper time for suction formation of an article thereon.

A reciprocating drying die 55 is mounted outside the orbit of the revolving dies for coaction with the dies on said unit. The die 55 is foraminous and its function is to remove the wet article from the forming die 52 and to close on and press the article against the revoluble drying die 53 so as to dry the article between these two dies. The die 55 may or may not be heated and is provided with drainage for maintaining vacuum on the article for withdrawal of the steam vapors given off while drying the article thereon and for the application of vacuum and air pressure for transfer of the article to and from this die as may be required.

After the article is dried, it is carried by the die 53 to a position opposite a foraminous ejector die 56 which is also mounted outside the orbit of the revolving dies for coaction with the die 53 to thereby remove the dried article from the die and eject it from the machine.

Assuming that the position shown in Fig. 7 to be a starting position and that the rotating unit 51 has just completed a step, the successive steps of an article cycle are as follows:

The die 55 carrying a wet article *n* previously removed from forming die 52 will coact with die 53 for the purpose of drying and finishing this article between these dies. During this drying interval the pulp tank 54 will be raised immersing forming die 52 for the suction formation of an article thereon after which the pulp tank 54 will be lowered.

As soon as the drying of the article *n* has been completed, die 55 retracts leaving article *n* on die 53 and the rotating unit 51 steps one quarter of a revolution ahead.

This brings die 53 carrying article *n* adjacent to ejector die 56 which coacts with the article on die 53 and then retracts removing the article

from the die. During this period when the article is being transferred from die 53 to ejector die 56, forming die 52 is in a drainage position for the removal of additional moisture by means of air drawn through the article by application of vacuum to the forming die.

As soon as ejector die 56 has retracted the rotating unit 51 steps one quarter revolution. This brings forming die 52 with its previously formed article in line with die 55 which immediately coacts with forming die 52 and then retracts removing the wet article from the forming die. During this interval the ejector die 56 will be swung to the dotted position for ejecting the dried article *n* from this die by means of a blast of air.

Rotating unit 51 now makes a half revolution which may be a continuous step or two 90° steps. This brings die 53 once again in line with die 55 die 55 carrying the wet article previously removed from forming die 52 coacts with die 53 and these two dies remain in coaction for an interval of time required to dry the article between them. The pulp stock tank 54 is again raised immersing forming die 52 for the suction formation of an article thereon.

This completes one article cycle which requires a 360° revolution of the rotating die unit 51, the machine having suction-formed, dried, finished and ejected one single layer article.

In the preferred form of our machine for forming, drying and finishing a single layer article (see Fig. 8) the intermittently rotating die unit 61 is provided with a pair of oppositely disposed foraminous forming dies 67 and 68 and a pair of oppositely disposed foraminous drying dies 69 and 70.

In this machine we provide outside the orbit of the revolving dies a reciprocating foraminous drying die 71 which may or may not be heated but which is provided with drainage means so that vacuum may be applied to the article for withdrawal of steam vapors given off by the drying article and for the application of air and vacuum for the transfer of the article to and from said die.

We also preferably mount a foraminous ejector die 72 on the opposite side of the rotating die unit from the die 71 for removing the dried articles from the revoluble drying dies 69 and 70 and ejecting them from the machine.

Optionally we may mount opposite the die 68 in Fig. 8 a reciprocating pressing and preheating die 73. The function of this die is, through pressure on the articles on the forming dies, to remove additional moisture and to preheat and partly dry the articles so as to accelerate the drying of the articles between dies 69 and 70 and vacuum die 71.

In the machine of Fig. 8 the article cycle is 180° and the machine makes two single layer articles for each complete revolution of the rotating unit.

Assuming the position shown in Fig. 8 to be a starting position and the rotating die unit 61 as having just completed a 90° step, the successive steps of an article cycle are as follows:

The die 71 carrying wet article *r* previously removed from forming die 67 coacts with die 70 and remains in such coaction for a period of time required to dry the article *r* between these two dies. During this drying period pulp tank 74 is raised immersing forming die 67 for the suction formation of an article thereon and is then lowered. Ejector die 72 coacts with die

69 and then retracts, removing from the die 69 the dried article *p* which had previously been dried between die 69 and die 71. Pressing die 73 coacts with forming die 68 for the purpose of squeezing additional moisture from article *q* through the forming die 68. It then retracts leaving article *q* on forming die 68.

As soon as the article *r* being dried between die 70 and vacuum die 71 is dried to the required degree, die 71 retracts leaving article *r* on die 70 and the rotating die unit 61 rotates one quarter of a revolution. This brings forming die 68 with article *q* thereon adjacent to die 71. The die 71 then coacts with forming die 68 and retracts removing article *q* from forming die 68. During this interval ejector die 72 will swing to dotted position and eject the dried article *p* from the machine by means of a blast of air or otherwise.

As soon as the die 71 has retracted removing article *q* from forming die 68, rotating die unit 61 again steps one quarter revolution bringing die 69 adjacent to die 71. The die 71 with wet article *q* removed from forming die 68 then coacts with die 69 and these dies stay in coaction for an interval of time required to dry the article to a required degree. During this drying interval pulp stock tank 74 is again raised immersing forming die 68 for the suction formation of an article thereon. Ejector die 72 returns to a position for coaction with die 70 and removes dried article *r* from this die for ejection from the machine. Pressing die 73 coacts with forming die 67 carrying a previously formed article for the purpose of squeezing additional moisture from this article through the forming die.

This completes one article cycle of the machine which is a 180° revolution of the rotating unit 61, the machine having suction-formed, dried, finished and ejected one single layer article.

In Fig. 9 we show a still further modification which is the simplest embodiment of our invention for producing multi-layer articles. This is based generally on the form of Fig. 3, but omits the ejector die 16 of said figure.

In this form of our invention the intermittently rotating die unit is indicated at 81. The forming dies 82 and 83 and the heated, drying die 84 are appropriately mounted on the die unit 81. The double compartment pulp stock tank 85-86 is mounted below said unit for raising and lowering movements relative to the forming dies as required, and the reciprocating foraminous drying die 87 is mounted outside of the orbit of the rotating dies for coaction therewith. The die 87 may be heated by any suitable means if so desired.

The machine of Fig. 9 makes one two-layer article for each complete revolution of the die unit. The cycle is generally similar to the machine of Fig. 3, except that the revoluble drying die 84 ejects the dried and finished article at an intermediate stage in the stepping of the die unit.

When the pulp tank is raised the foraminous forming dies 82 and 83 are simultaneously immersed in the respective compartments of the tank for the suction formation of pulp layers thereon. When the tank is lowered and the rotating die unit steps ahead, the forming dies are successively brought into positions for registration with the reciprocating drying die 87 which successively closes on and retracts from said dies, removing the individual layers therefrom

and retaining them upon itself as a composite article.

After die 87 has removed the individual layers from the forming dies 83 and 82, the continued stepping of the die unit brings the revoluble drying die 84 into line with the die 87, which thereupon closes on the die 84, to compress, dry, bond, and finish the composite article between these two dies. When the die 87 retracts, the dried and finished article is left on the die 84 and in the continued stepping of the machine is ejected therefrom as shown in dotted lines. When the article is thus ejected from the machine die 84 is foraminous.

The modifications of Figs. 10 and 11 are based on the machines of Figs. 8 and 1 but the die arrangement is reversed. In Figs. 10 and 11, all revoluble dies are female and all reciprocating dies are male, whereas in Figs. 8 and 1 all revoluble dies are male and all reciprocating dies are female.

The machines of Figs. 10 and 11 each form one article at each half revolution of the rotating die unit or two articles for each complete revolution of such unit. The article formed by the machine of Fig. 10 is a single layer article, whereas that formed by the machine of Fig. 11 is a two-layer article.

Referring to Fig. 10, the intermittently rotating shaft is indicated at 91. The forming dies 92, 93 and the revoluble drying dies 94, 95 are mounted on this shaft above the pulp stock tank 96. The reciprocating and transfer die 97, the reciprocating drying die 98, and the reciprocating and swinging ejector die 99 are all mounted outside of the orbit of these revolving dies. Dies 92, 93, 94, 95, 97 and 99 are preferably foraminous, and dies 96 and 98 are preferably heated. Die 98 does not need to be foraminous unless used as an ejector die.

The article cycle is as follows:

Referring to Fig. 10 the rotating die unit 91 has just completed a 90° step and is in a stationary or paused position. The die 94 carries a previously dried article *t* which during this paused position is removed from this die by ejector die 99. Forming die 93 carries a previously formed article *u* which in this machine position is pressed and removed from forming die 93 by pressing and transfer die 97.

The revoluble drying die 95 carries a wet article *v* which has previously been transferred to it by pressing and transfer die 97. The reciprocating drying die 98 coacts with die 95 for a sufficient length of time to dry the article *v* between these dies. During the period of time in which article *v* is being dried, pulp stock tank 96 is raised immersing forming die 92 for the suction formation of an article thereon and then lowered to clear the orbit of the revolving dies. As soon as the article *v* has been dried to the required degree, die 98 retracts leaving article *v* on die 95 and the machine makes one step ahead.

This will bring forming die 92 with its newly formed article thereon in a drainage position for the removal of additional moisture by means of air drawn through the article by application of vacuum to the forming die. The revoluble drying die 94 will be in a position for registration with pressing and transfer die 97 which will close on and retract from die 94 transferring the wet article *u* to die 94. During this period ejector die 99 will pivot to the dotted line position shown and the dried article *t* will be ejected from the ejector die by means of a blast of air. The die

98 remains retracted and pulp tank 96 remains lowered.

Rotating die unit 91 now makes one step ahead. The revoluble drying die 94 with its wet article *u* previously transferred to it by pressing and transfer die 97 will have moved to a position in line with die 98. The die 98 will coat with die 94 for the drying of article *u* between these two dies. Ejector die 99 will remove dried article *v* from die 95 and pressing die 97 will coat with forming die 92 and pulp tank 96 will be raised immersing forming die 93 for the suction formation of an article thereon.

This completes one article cycle of the machine which is a 180° revolution of the rotating unit and which has suction-formed, dried, finished and ejected one article from the machine.

With this machine or that of Fig. 8 it is possible, if desired, to omit the ejecting die 72 or 99 and to remove the article from the machine at the die 71 of Fig. 8, or the die 98 of Fig. 10, in which event the dies 71 or 98 would be mounted for both pivotal and reciprocating movements.

In the machine of Fig. 11, the intermittently rotating shaft is designated at 1' and the pulp stock tank disposed therebeneath is provided with double compartments 9¹ and 9². Two oppositely disposed pairs of foraminous forming dies 12A, 12B, and 13A, 13B, respectively, are mounted on said shaft, as are two oppositely disposed pairs of revoluble drying dies 15A and 15B. The dies 15A and 15B may be heated if desired, and are foraminous and provided with connections for applying vacuum to hold the article layers thereon and to remove the steam vapors given off by the drying articles.

Reciprocably mounted outside of the orbit of these revolving dies is a pair of circumferentially adjacent dies 6a and 7a and a pair of heated drying dies 14A and 14B, the die 14B also being foraminous and pivoted so as to function as an ejecting die.

The die 6a is a wet transfer die for successively removing the article layers from the forming dies and then transferring the composite article to one of the dies 15A or 15B. Die 6a is foraminous and provided with the necessary air and vacuum connections for the transfer of the articles and article layers.

The die 7a is a pressing die for the purpose of squeezing additional moisture from the wet article layers through the forming dies. Die 7a may be heated if desired for preheating the article layers to accelerate drying of the composite article.

The article cycle is as follows:

With the pulp stock tank raised, the forming dies 12A and 13A are immersed in the respective tank compartments for the suction formation of article layers thereon. Transfer die 6a coats with a previously formed wet article layer on forming die 12B. Pressing die 7a coats with a previously formed article layer on forming die 13B. The reciprocating drying dies 14A and 14B have coated with composite articles on revoluble drying dies 15A and 15B, respectively.

The machine remains in this position until the composite articles between die 15A and die 14A and die 15B and die 14B respectively are dried to the required degree, whereupon the pulp stock tank is lowered away from forming dies 12A and 13A leaving a suction-formed pulp layer of the required thickness on each forming die.

Wet transfer die 6a retracts from forming die 12B removing the article layer from this die.

Pressing die 7a retracts from the article layer on forming die 13B. The die 14A retracts from the now partly dried composite article on die 15A. The die 14B retracts from die 15B removing a completely dried article therefrom.

The rotating die unit now steps ahead one-sixth of a revolution and pauses. Transfer die 6a carrying the wet article layer which it had previously removed from forming die 12B coats with the article layer on forming die 13B thus combining the two layers into a composite article. The die 14B swings 90° and is ready to eject the dried composite article which it is carrying.

Thereafter transfer die 6a retracts carrying with it the composite article made up of article layers successively removed from forming dies 12B and 13B and die 14B ejects the composite dried article from the machine.

The rotating die unit now makes another step and pauses. While so paused the only action which takes place with reference to the reciprocating dies is the transfer of the wet multi-layer article from transfer die 6a to die 15B.

The die rotating unit 1 now makes another step and pauses. While so paused the die 15B with its wet composite article transferred to it from transfer die 6a is in a position for coating with die 14A. The die 15A with its partly dried multi-layer article is in a position to coat with die 14B for the completion of the drying of the article thereon. Forming die 12A with its article layer thereon has revolved to a position opposite to transfer die 6a. Forming die 13B with its article layer thereon has revolved to a position opposite to pressing die 7a and all reciprocating dies now close on the articles carried by the dies adjacent to them. This completes an article cycle of the machine, it being noted that die 6a is the only die of the series of four reciprocating dies 6a, 7a, 14A and 14B which coats with all of the dies of the rotating die unit. When so desired transfer die 6a may be omitted and the pulp layers may be successively removed from the forming dies by die 14A in which event die 14A is made foraminous. The die 14A with its composite article is thereafter coated with die 15B for a period of time required to dry the article as desired. Where die 14A is also used as a transfer die for removing the article layers from the forming dies, said die is provided with connections for applying vacuum for holding the successive pulp layers thereon. Also, when so desired, die 14B may be omitted and the composite article completely dried, bonded, and finished at die 14A in which event die 14A is also pivoted to function as an ejecting die.

In all forms, where the heated dies are used for transferring articles from one station to another, they are provided with drainage connections in their surface for the purpose of holding the article on these dies by means of suction and for the transfer of these articles by means of air pressure.

In all forms, it is evident that the formed article is held under mechanical pressure between a pair of complementary drying dies, one of which is revoluble and the other of which is reciprocable, and that the article is dried by the application of heat thereto from one or both of said dies.

Accordingly the term "drying die" as used herein is used to designate both the revoluble die (or dies) mounted on the intermittently rotating unit and the reciprocable die (or dies) mounted outside the orbit of the dies on said unit for timed coaction therewith.

It is obviously a matter of choice whether the revoluble drying die or the reciprocating drying die, or both of them, be directly heated, since said dies are complementary and when coated with each other combinedly function to dry and finish the wet formed article.

It is likewise a matter of choice whether the revoluble drying die or the reciprocating drying die, or both of them, be foraminous for the purpose of exhausting the water and water vapors given off by the drying article or for transferring the article from one die to another.

Various other modifications in machine and method may obviously be resorted to within the spirit and scope of our invention as defined by the appended claims.

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

1. A fibrous pulp molding machine, comprising an intermittently revolving shaft carrying two pairs of oppositely disposed foraminous forming dies and one pair of oppositely disposed drying dies, a first and a second oppositely disposed reciprocating drying die mounted outside the orbit of the revolving dies for timed coaction therewith, means for depositing a layer of wet pulp on each of a pair of forming dies, means for revolving said shaft step by step to bring the dies thereon successively into coactive alinement with the reciprocating dies, means operative when said shaft is paused in its rotation for successively coacting said first reciprocating die with each of a pair of forming dies to remove the wet pulp layers from said forming dies in superimposed order and thereafter for coacting said first reciprocating die carrying the superimposed article layers thereon with one of said revoluble drying dies to partly dry, bond and finish the composite article therebetween under mechanical pressure and heat applied by at least one of said dies, means for retaining the partly-dried composite article on said revoluble drying die during that portion of the revolving travel of said revoluble drying die from said first reciprocating die to said second reciprocating die, and means operative when said shaft is paused in its rotation for coacting said second reciprocating die with the partly-dried composite article on said revoluble drying die, to complete the drying, bonding and finishing of said composite article therebetween under mechanical pressure and heat applied by at least one of said dies and to remove the finished article and eject it from the machine.

2. The combination of claim 1, and a pressing and preheating die reciprocally mounted outside the orbit of the revolving dies for successive coaction with the article layers on the forming dies when said shaft is paused in its rotation.

3. The combination of claim 1, the means for revolving the die shaft step-by-step comprising a stepping wheel having a plurality of spaced slots corresponding in number and spacing to the number and spacing of the revolving dies, a drive shaft, an arm mounted on said shaft and carrying a roll adapted for successive entrance and withdrawal from said slots to step the wheel one step for each revolution of the drive shaft, and means for locking the revolving die shaft in paused position comprising notches in the stepping wheel and a latch for engagement with said notches adapted to be withdrawn when the stepping wheel is in motion and to be engaged when said wheel is at rest.

4. A fibrous pulp molding machine comprising an intermittently revolving shaft on which are

mounted a foraminous forming die and a drying die, means for depositing a wet pulp article on said forming die, a reciprocating drying die and a reciprocating and pivoting ejecting die mounted outside the orbit of said revolving dies at points spaced from each other, means for revolving said shaft step by step to bring the dies thereon successively into coactive alinement with the reciprocating drying die and with the ejecting die, means operative when said shaft is paused in its rotation for coacting the reciprocating drying die first with the forming die to remove the wet article from the forming die and thereafter for coacting said reciprocating drying die carrying the wet article thereon with the revoluble drying die to dry the article between said reciprocating drying die and said revoluble drying die under mechanical pressure and heat applied by at least one of said dies and leave the dried article on the revoluble drying die, means for retaining the dried article on the revoluble drying die during that portion of the revolving travel of said revoluble drying die from the reciprocating drying die to the ejecting die, and means operative when said shaft is paused in its rotation for coacting the ejecting die with said revoluble drying die to remove the dried article from said revoluble drying die and eject it from the machine.

5. A fibrous pulp molding machine, comprising an intermittently revolving shaft on which are mounted a plurality of foraminous forming dies and a plurality of drying dies, means for depositing a wet pulp article on each forming die, a plurality of reciprocating dies mounted outside the orbit of said revolving dies at points spaced from each other, at least one of said reciprocating dies being a drying die, means for revolving said shaft step by step to bring the dies thereon successively into coactive alinement with the reciprocating dies, means operative when said shaft is paused in its rotation for coacting a reciprocating die with the forming dies to remove the wet articles from the forming dies and transfer them to the revoluble drying dies, means operative when said shaft is paused in its rotation for drying the articles between a reciprocating drying die and the revoluble drying dies under mechanical pressure and heat applied by at least one of said dies, means for retaining the dried articles on said revoluble drying dies during a portion of the revolving travel of said dies, and means operative when said shaft is paused in its rotation for coacting a reciprocating die with the dried articles on said revoluble drying dies to remove the dried articles therefrom and eject them from the machine.

6. A fibrous pulp molding machine, comprising an intermittently revolving shaft carrying two pairs of oppositely disposed foraminous forming dies and one pair of oppositely disposed drying dies, means for depositing a layer of wet pulp on each of a pair of forming dies, a reciprocating transfer die and a pair of oppositely disposed reciprocating drying dies mounted outside the orbit of the revolving dies, means for revolving said shaft step by step to bring the dies thereon successively into coactive alinement with the reciprocating transfer die and with the pair of reciprocating drying dies, means operative when said shaft is paused in its rotation for successively coacting said transfer die with each of a pair of forming dies to remove the wet article layers from said forming dies superimposing one layer upon the other and to thereafter transfer the

superimposed layers to a revoluble drying die, means operative when said shaft is paused in its rotation for coacting a reciprocating drying die with said revoluble drying die carrying the superimposed layers thereon for partially drying, bonding and finishing the composite article therebetween under mechanical pressure and heat applied by at least one of said dies, means for retaining the partially dried composite article on said revoluble drying die during a portion of its revolving travel, and means operative when said shaft is paused in its rotation for coacting the other reciprocating drying die with the partially dried composite article on said revoluble drying die to complete the drying, bonding and finishing of said article therebetween under mechanical pressure and heat applied by at least one of said dies and to remove the finished article and eject it from the machine.

7. The combination of claim 6, and a pressing die reciprocally mounted outside the orbit of the revolving dies in advance of said transfer die for successive coaction with the article layers on the forming dies when said shaft is paused in its rotation.

8. A fibrous pulp molding machine, comprising an intermittently revolving shaft carrying two pairs of oppositely disposed foraminous forming dies and one pair of oppositely disposed drying dies, a reciprocating drying die mounted outside the orbit of the revolving dies, means for depositing a layer of wet pulp on each of a pair of forming dies, means for revolving said shaft step by step to bring the dies thereon successively into coactive alinement with the reciprocating die, means operative when said shaft is paused in its rotation for successively coacting said reciprocating die with each of a pair of forming dies to remove the wet pulp layers from said forming dies in superimposed order and thereafter to coact said reciprocating die carrying the superimposed article layers thereon with one of said revoluble drying dies to dry, bond and finish the composite article therebetween under mechanical pressure and heat applied by at least one of said dies, and means to eject the finished article from the machine.

9. A fibrous pulp molding machine, comprising an intermittently revolving shaft carrying two pairs of oppositely disposed foraminous forming dies and one pair of oppositely disposed drying dies, means for depositing a wet pulp layer on each of a pair of forming dies, a reciprocating transfer die and a reciprocating drying die mounted at spaced points outside the orbit of the revolving dies, means for revolving said shaft step by step to bring the dies thereon successively into coactive alinement with the reciprocating transfer die, means operative when said shaft is paused in its rotation for successively coacting said transfer die with each of a pair of forming dies to remove the wet article layers from said forming dies in successive order and to thereafter transfer the superimposed layers to a revoluble drying die, means operative when said shaft is paused in its rotation for coacting said reciprocating drying die with said revoluble drying die carrying the superimposed layers thereon to dry, bond and finish the composite article therebetween under mechanical pressure and heat applied by at least one of said dies, and means to eject the finished article from the machine.

10. A fibrous pulp molding machine, comprising an intermittently revolving shaft on which are mounted a foraminous forming die and a

drying die, means for depositing a wet pulp article on said forming die, a reciprocating drying die mounted outside the orbit of the revolving dies for timed coaction therewith, means for revolving said shaft step by step to bring the dies thereon successively into coactive alinement with said reciprocating die, and means operative when said shaft is paused in its rotation for coacting said reciprocating die first with said forming die to remove the wet formed article from the forming die and thereafter with said revoluble drying die to dry the wet article between said revoluble drying die and said reciprocating die under mechanical pressure and heat applied by at least one of said dies.

11. A fibrous pulp molding machine, comprising an intermittently revolving shaft on which are mounted a pair of foraminous forming dies, a drying die and an ejecting die, means for depositing wet pulp layers on said forming dies, a reciprocating drying die mounted outside the orbit of said revolving dies, means for revolving said shaft step by step to bring the dies thereon successively into coactive alinement with said reciprocating die, means operative when said shaft is paused in its rotation for successively coacting said reciprocating die first with said forming dies to remove the wet pulp layers therefrom and leave them superimposed on said reciprocating die, secondly with said revoluble drying die to dry, bond and finish the composite article between said dies under mechanical pressure and heat applied by at least one of said dies, and thirdly with said ejecting die for transferring the dried article to said ejecting die, and means for ejecting the finished article from said ejecting die.

12. The combination of claim 11, the means for depositing pulp layers on the forming dies comprising respectively a pulp tank adapted to be raised and lowered relative to the dies on said shaft for the immersion of one forming die and the suction formation of a pulp layer thereon when the tank is raised, and an open face pulp container mounted outside the orbit of the revolving dies and adapted to be moved into sealed contact with the other forming die, and means for filling said container with pulp stock for the suction formation of a pulp layer on said second forming die and for draining the container of surplus stock after the layer is formed and before the container is moved away from said second forming die to a position to clear the orbit of said die.

13. A fibrous pulp molding machine, comprising an intermittently revolving shaft, means for revolving said shaft step by step, two pairs of foraminous forming dies and one pair of drying dies mounted on said shaft, a double compartment pulp stock tank containing aqueous fibrous pulp mixtures disposed outside the orbit of said revolving dies, means for moving said tank towards said revolving dies for immersing two circumferentially adjacent forming dies therein for the suction formation of independent article layers on said forming dies and for thereafter lowering said tank to enable said revoluble drying dies to rotate through their orbit without immersion in the pulp mixtures, a pair of reciprocating drying dies mounted outside the orbit of the revolving dies, means for successively coacting one of said reciprocating dies with all of said revolving dies as each revolving die is paused opposite said reciprocating die to first remove wet pulp layers from the forming dies in superimposed or-

der and thereafter to partly dry, bond and finish said layers as a composite article between said reciprocating die and one of said revoluble drying dies under mechanical pressure and heat applied by at least one of said dies and leave the partly dried composite article on said revoluble drying die, and means for successively coacting the other reciprocating die with the revoluble drying dies only as each revoluble drying die with its partly dried composite article thereon is paused in its rotation opposite said last named reciprocating die to complete the drying, bonding and finishing of the composite article on said revoluble drying die under mechanical pressure and heat applied by at least one of said dies and remove the finished article therefrom.

14. A fibrous pulp molding machine comprising a pulp tank containing an aqueous fibrous pulp mixture, an intermittently revolving shaft on which are mounted a foraminous forming die and a drying die, means for revolving said shaft step by step, means for periodically raising and lowering the pulp tank to immerse said forming die in the pulp mixture for the suction formation of a wet article layer thereon and to enable the revoluble drying die to rotate through its orbit without immersion in the pulp mixture, a reciprocating drying die mounted outside the orbit of the revolving dies for timed coaction therewith, means operative when said shaft is paused in its rotation for first coacting said reciprocating drying die with said forming die to remove the wet article from the forming die and for thereafter coacting said reciprocating drying die with the revoluble drying die to dry the wet article therebetween under mechanical pressure and heat applied by at least one of said dies, and means for ejecting the dried and finished article from the machine.

15. A fibrous pulp molding machine comprising an intermittently revolving shaft, a forming die and a drying die mounted in angularly spaced relationship on said shaft, means for heating said drying die, means for revolving said shaft step by step, a pulp tank carrying an aqueous fibrous pulp mixture in which the forming die is immersed during a part of its cycle for the suction formation of an article thereon, means for periodically lowering the pulp tank to permit the revoluble drying die to revolve through its orbit without immersion in the pulp mixture, means for removing the wet formed article from the forming die, and means for drying the removed wet article under heat and mechanical pressure on the revoluble drying die and ejecting the dried and finished article from the machine.

16. A fibrous pulp molding machine, comprising an intermittently revolving shaft carrying a foraminous forming die and a drying die, means for depositing a wet pulp layer on said

forming die, a reciprocating drying die mounted outside the orbit of said revolving dies and complementary in shape to and adapted for timed coaction with said revolving dies, means timed to the intermittent rotation of said shaft for coacting said reciprocating drying die first with said forming die to remove therefrom a wet article and thereafter with said revoluble drying die to dry and finish the article between said reciprocating drying die and said revoluble drying die under mechanical pressure and heat applied by at least one of said dies, and means for ejecting the finished article from the machine.

17. A fibrous pulp molding machine, comprising an intermittently revolving shaft carrying a pair of foraminous forming dies and at least one drying die, means for depositing wet pulp layers on said forming dies, a reciprocating drying die mounted outside the orbit of said revolving dies and complementary in shape to and adapted for timed coaction with said revolving dies, means for rotating said shaft step by step to bring the dies thereon into coactive alinement with said reciprocating die, means operative when said shaft is paused in its rotation to coact said reciprocating die first with the forming dies to successively remove the wet articles therefrom and thereafter with a revoluble drying die to dry and finish the composite article between said reciprocating die and said last-named revoluble drying die under mechanical pressure and heat applied by at least one of said dies, and means for ejecting the finished article from the machine.

18. A fibrous pulp molding machine, comprising an intermittently revolving shaft, an article-forming mechanism and an article-drying and finishing mechanism associated therewith, said article forming mechanism comprising a foraminous forming die mounted on said shaft to revolve therewith and means for depositing a wet pulp article on said forming die, and said article-drying and finishing mechanism comprising a drying die mounted on said shaft to revolve therewith and a reciprocating drying die mounted outside the orbit of the revolving dies and complementary in shape thereto and adapted for timed coaction therewith, means for revolving said shaft step by step, means operative when said shaft is paused in its rotation for first coacting said reciprocating die with the forming die to remove the wet pulp layer therefrom and for thereafter coacting said reciprocating die with said revoluble drying die to dry and finish the wet article between said reciprocating die and said revoluble drying die under mechanical pressure and heat applied by at least one of said dies, and means for ejecting the dried and finished article from the machine.

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