April 11, 1944. W. H. RANDALL 2,346,608

MACHINE FOR MANUFACTURING MOLDED PULP ARTICLES

Filed July 15, 1941 2 Sheets-Sheet 1

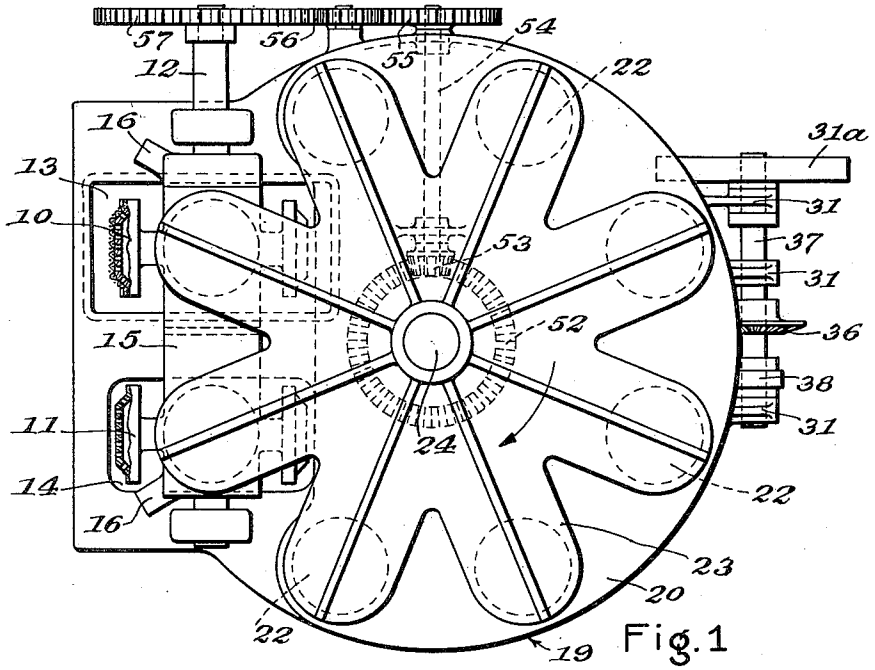


Fig.1

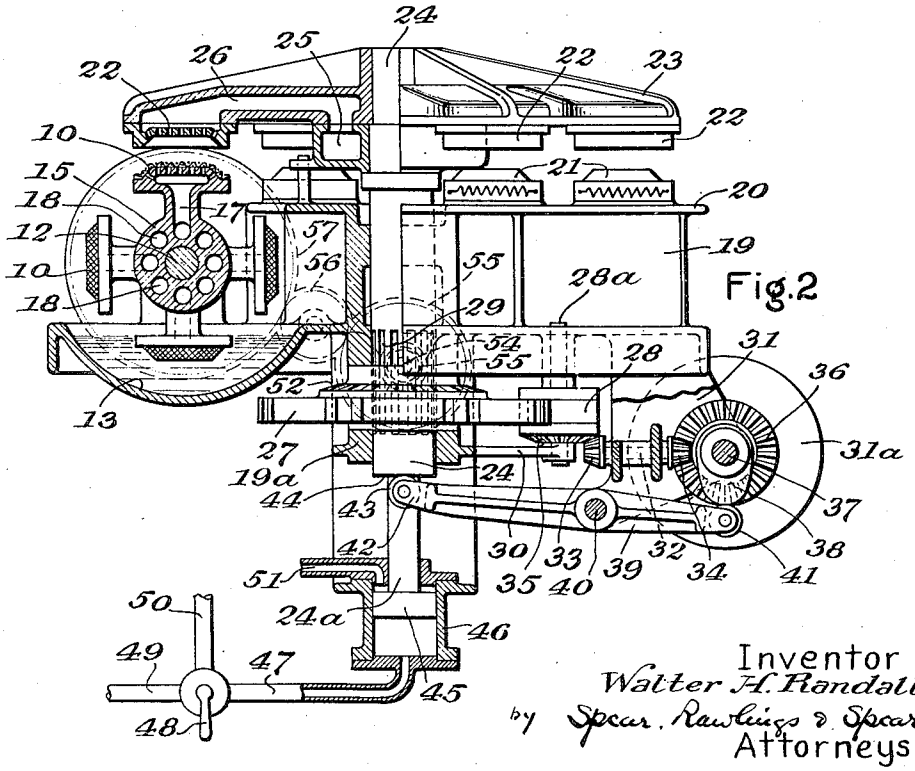


Fig.2

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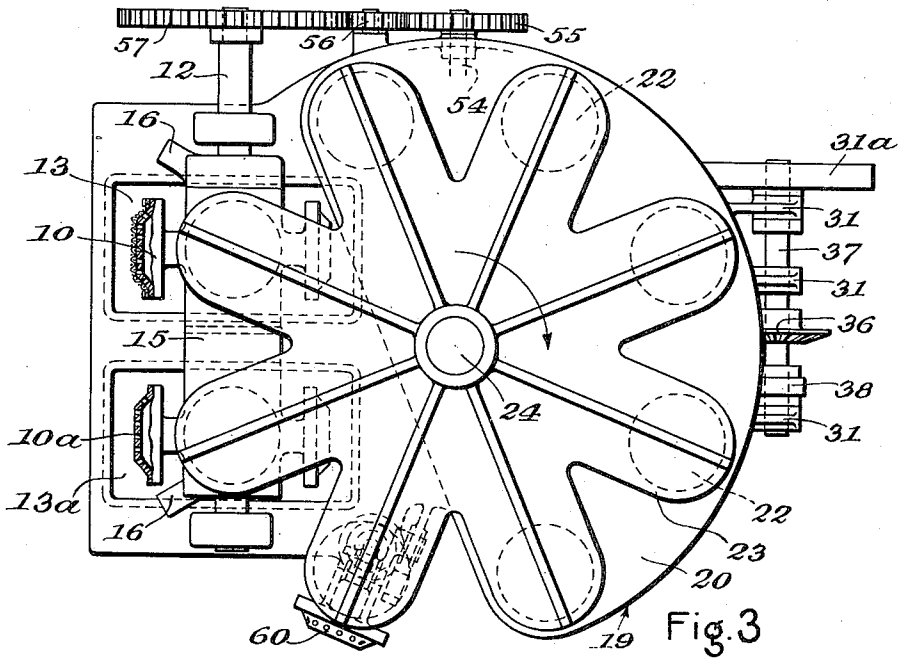


Fig.3

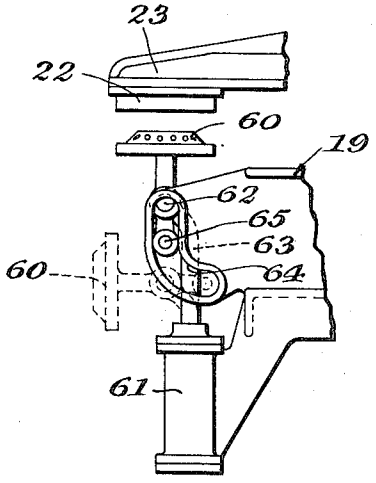


Fig.4

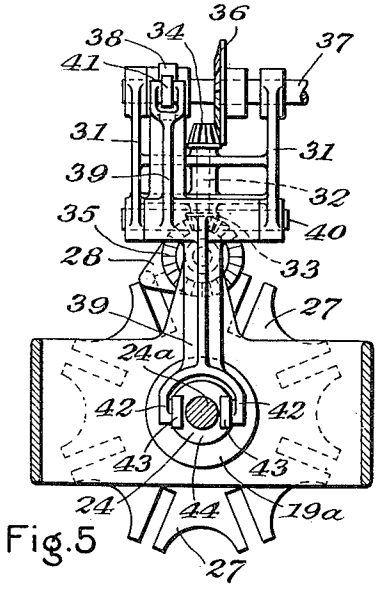


Fig.5

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UNITED STATES PATENT OFFICE

2,346,608

MACHINE FOR MANUFACTURING MOLDED PULP ARTICLES

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Application July 15, 1941, Serial No. 402,476

10 Claims. (Cl. 92—56)

This invention relates to fibrous pulp molding machines of the general type disclosed in my prior application Serial No. 183,047, filed January 3, 1938, now Patent No. 2,257,573, dated September 30, 1941, and is characterized in that all of the drying dies of the drying unit are fixed in their relative positions on a stationary frame and all of the article-holding dies are mounted in fixed positions on a single reciprocating and intermittently rotating turret.

One important advantage of this construction is that it greatly simplifies the machine design by reducing to the minimum the mechanism necessary for imparting the required mechanical motions. Instead of requiring that the drying dies be individually reciprocated into positions of registration with the holding dies, as in my aforesaid prior application, my present machine is so designed that when the turret is paused in its intermittent rotation with the holding dies in coactive alinement with the drying dies, the turret may be reciprocated bodily in a direction to close each holding die upon the drying die with which it is registered. After a predetermined time, but while the turret is still paused in its rotation, it is reciprocated bodily in the reverse direction to open said sets of dies. The turret is then stepped ahead one step, equal to the angular spacing of the drying dies, stopped, and again reciprocated towards and retracted from the drying dies, and this cycle is continued until each holding die has made contact with each drying die and the article has been fully dried, whereupon the dried articles are removed from the holding dies and ejected from the machine.

Another advantage of my present machine is by mounting the drying dies in fixed positions on a stationary frame, and by mounting the holding dies in fixed positions on the reciprocating and intermittently rotating turret, both sets of dies may be readily maintained in accurate alinement with each other, and the matter of supplying heat, air and vacuum to said dies is greatly simplified.

Other advantages will appear as the description proceeds. In the accompanying drawings:

Fig. 1 is a top plan view of a machine for producing single layer molded fibrous pulp articles.

Fig. 2 is an elevation, partly in section, thereof.

Fig. 3 is a top plan view showing a modified form of machine for producing multilayer articles, and

Figs. 4 and 5 are fragmentary views showing constructional details.

The molded fibrous pulp articles to be dried and finished by my machine are suction or pressure formed by any suitable forming mechanism, and placed upon the holding dies of the drying unit in any desired manner. After the articles have been dried and finished, they are removed from said holding dies by any suitable transfer mechanism and ejected from the machine.

Where the forming and transfer mechanism is of the general type disclosed in my aforesaid application, it comprises a set of equi-distantly spaced foraminous forming dies 10 and a set of equi-distantly spaced foraminous transfer dies 11 mounted on a common intermittently rotatable shaft 12.

Beneath the forming dies 10 is a pulp tank 13 in which said dies are adapted to be successively immersed for the suction formation of molded pulp articles thereon. Beneath the transfer dies 11, the machine frame is opened as at 14 to permit the dried articles when discharged from the transfer dies to drop into any suitable collection receptacle.

The shaft 12 has a hub 15 to receive vacuum and air connections through port boxes 16. Ports in each port box connect in timed relation with radial passages 17 and longitudinal passages 18 in the hub providing vacuum and air connection to the forming dies 10 and transfer dies 11. Passages 18 extend from each port box 16 along the hub only sufficiently far to make connections with passages 17, thus giving independent air and vacuum control to both the forming dies and the transfer dies.

The drying and finishing unit of my machine comprises a stationary frame 19 which carries all members of the machine, and on which is fixed a platen 20 carrying a fixed series of radially and angularly spaced imperforate heated drying dies 21.

In practice the platen 20 is cut away to allow room for locating the forming and transfer units in position for direct coaction with a series of foraminous holding dies 22 mounted in fixed positions upon an intermittently rotating and vertically reciprocating turret or platen 23. The holding dies 22 are opposite to the drying dies 21 and correspond in angular and radial spacing thereto. However, and as appears in Fig. 1, there are two less drying dies than holding dies so that during its orbit each holding die may coact at the proper time with a forming die to

receive a wet-formed article and later with a transfer die to discharge a dried article.

The turret 23 is carried by an intermittently revoluble shaft 24 which is vertically journaled in frame 19 and the support 19a carried by said frame, and said shaft is given both step-by-step rotation and vertical reciprocation by a driving mechanism hereinafter described.

Vacuum and air connections to the holding dies 22 are provided by port box 25 (see Fig. 2) with communicating channels 26 between the port box and each individual holding die. This port box 25 raises and lowers with the turret 23 but is prevented from rotating therewith in any suitable manner.

Step-by-step rotation is imparted to shaft 24 in any suitable manner, as by a drive of the Geneva type comprising a Geneva wheel 27 and Geneva 28. A spline connection 29 is provided between shaft 24 and Geneva wheel 27, thus allowing the shaft to reciprocate vertically relative thereto when the turret 23 is being raised or lowered while still maintaining a driving connection rotatively between the Geneva 28 and the Geneva wheel. The Geneva 28 is rotatably mounted on a shaft 28a journaled at its ends in frame 19 and in a bracket 30 extending from support 19a, and is driven by any conventional means.

For convenience I have shown the frame 19 as including a support 31 in which is mounted a stub shaft 32 having gears 33 and 34 at its ends meshing, respectively, with a gear 35 carried by the Geneva 28 and with a driving gear 36 on a continuously rotating cam shaft 37 journaled in said support 31 and driven from any suitable power source, as at 31a.

The turret 23 may be raised and lowered by means of a cam 38 on the cam shaft 37 which intermittently actuates a rocker lever 39 pivoted as at 40 to the support 31. The lever 39 carries a cam roll 41 at one end for engagement with cam 38 and its opposite end is forked as at 42 and carries lifting rolls 43 to engage beneath a shoulder 44 on the shaft 24.

One advantage of driving the Geneva and the turret lifting mechanism from a common drive shaft 37 is that I thereby insure proper timed relationship between the required lifting and rotating motions. With the actuating mechanism shown, the turret 23 is raised on each rotation of the shaft 37 and when raised is stepped ahead a distance equal to the angular spacing of adjacent holding dies.

If desired, I may use liquid pressure operated means also in control of the raising and lowering of the turret 23. Such means may include a reduced shaft extension 24a having a piston head 45 operating in a cylinder 46. Liquid under pressure is admitted or exhausted from the cylinder 46 through the conduit 47 which is controlled by the two-way valve 48 so that the cylinder 46 may be connected in the alternative to the delivery conduit 49 or to the conduit 50. A relief conduit is shown at 51 above the piston head. Conduit 49 may be connected with a pressure source, such as an air or weight-loaded accumulator (not shown) in which there is maintained a pressure sufficient to substantially counterbalance the weight of the turret. Conduit 50 may be connected with any source (not shown) giving sufficient hydraulic pressure to raise the turret independently of the lifting action of the cam 38. In the normal operation of the machine, valve 48 is adjusted to connect the hydraulic cylinder 46 with the conduit 49 thereby to provide for counterbalancing the turret. When the machine is to be serviced, or for any other reason necessitating that the turret be raised independently of the lifting cam, valve 48 is adjusted to connect cylinder 46 with conduit 50.

One advantage of using liquid pressure operated means is that during the normal operation of the machine a lifting pressure may be maintained in the cylinder 46 to give what might be termed a hydraulic counterbalance for the weight of the rotating turret 23. By this is meant that the pressure of the liquid under the piston in the cylinder 46 is maintained to a figure which very nearly balances the weight of the turret 23 and the shaft 24. This means that the mechanical lifting mechanism consisting of the cam 38 and the lever 39 has to lift only the amount of weight which may be required to give the desired die pressure between the holding dies and their mating drying dies when they are coacting and such die pressure may be readily adjusted to give the desired finish to the article. Thus the mechanical lifting mechanism need not be built so ruggedly, thus reducing the expense of machine construction, as well as the weight of the machine.

A further advantage of using the liquid pressure operated means is that it provides a means to permit the holding dies to be raised at any period of the machine cycle so as to afford access to the dies for maintenance purposes. In order to make the several dies even more accessible for purposes of servicing, such as changing wires, etc., the lifting stroke of the piston may be made greater than the cam controlled operating lift.

Since the drying dies 21 are fixed on the platen 20, the application of heat thereto is simple. If desired, heat may also be applied to the holding dies 22. This may be accomplished by making the shaft 24 hollow, and employing a conventional slip ring unit supplying electricity to the heating elements associated with the holding dies. The slip ring unit may be mounted on either the upper end of the shaft 24, or the shaft may be extended through the hydraulic cylinder 46, and the slip ring unit mounted on its extending end.

If steam is to be the heating medium, a swivel steam joint may be connected to either end of the shaft 24 with suitable connections through the hollow shaft to the holding dies.

The drive for the shaft 12 carrying the forming and transfer units may be by means of a separate drive of the Geneva type operating in time with the drive for the drying unit, or, as shown, said shaft 12 may take its drive from the Geneva wheel 27 in which event said wheel is provided with a gear 52 in mesh with a pinion 53 on a cross shaft 54. Fast on the shaft 54 is a gear 55 which through a reversing pinion 56 drives a gear 57 on shaft 12 to rotate said shaft 12 step-by-step in timed relation to the step-by-step rotation of the turret 23.

In the machine shown in Fig. 1, there are eight equi-distantly spaced holding dies 22 mounted in fixed positions on the revoluble and reciprocable turret 23, and six correspondingly spaced drying dies 21 mounted in fixed positions on the stationary platen 20. Each holding die 22 coacts with a forming die 10, a transfer die 11, and with each one of the drying dies 21 during one complete revolution of the turret.

There are four equi-distantly spaced forming dies 10 on the shaft 12. When said shaft is paused in its rotation, one forming die is immersed in the pulp mixture for the suction formation of an article thereon, another die is holding a previously formed article in position to drain, another die is positioned to transfer its previously formed article to the holding die 22 on the turret 23 which is paused in alinement therewith, and the last die, from which the article has previously been removed, is free for inspection and spraying.

The operation of the machine shown in Fig. 1 is as follows: Assuming that the machine has come to rest after completing a step, consisting of one-quarter revolution of the forming and transfer units and one-eighth revolution of the holding die turret, and the turret has been lowered, six of the holding dies, each carrying an article previously removed from the forming dies, are simultaneously closed upon six drying dies, the seventh holding die is closed upon an alined forming die for the removal of the wet article therefrom, and the eighth holding die is closed upon an aligned transfer die to remove the dried article from said holding die and place it on said transfer die.

After such interval of time as may be required for the progressively drying of the articles between the holding and drying dies, the holding die turret is once again raised. The holding die which has coacted with the forming die now retains the wet article therefrom. The holding die which has been in coaction with the transfer die leaves the dried article on the transfer die. The other holding dies which have been in coaction with the drying dies retain their articles. As soon as the turret has been raised to the required amount, the entire machine steps ahead one step. In the embodiment shown this is a 90° step for the forming and transfer die units and a 45° step for the turret. After the machine has completed said step, the turret is again lowered to bring the holding dies into coaction with the forming, drying and transfer dies, and the cycle is repeated.

Thus, in the machine shown, once an article has been removed from a forming die, it receives six step-by-step drying treatments before it is transferred to the transfer die. During this entire drying operation, the article remains on the holding die which removed it from the forming die.

Obviously the number of coactions between the holding and drying dies may be varied as circumstances require. Likewise, the intensity of the heat application at the various drying stations may be varied as desired.

If it is desired to make a multi-layer or lined article, the machine of Fig. 3 may be used, in which event both units on the shaft 12 are constructed as forming units, that is to say, the transfer unit 11 of Fig. 1 is replaced by a second forming unit 10*a*, the dies of which are adapted to be immersed in a backing stock contained in a tank 13*a*.

The operation of such machine is generally similar to the machine of Fig. 1, except that in its first step, a holding die first contacts a forming die of the unit 10*a* to take up a layer of backing stock. In its next step, said holding die contacts a forming die of the forming unit 10 to superimpose a layer of lining stock on the backing stock layer already on said holding die. Subsequent steps pass the multilayer article successively through the drying stations.

In order to discharge the dried multilayer article I replace one of the drying stations by a transfer station 60 which may be operated in time with the rest of the machine in any suitable manner, as by means of an air or hydraulic cylinder 61 (see Fig. 4). The stem of the transfer die 60 is pivotally connected at 62 to the piston rod 63, and the frame 19 of the machine is provided with a cam track 64 within which is guided a cam roller 65 carried by the die stem. The shape of the cam track is such that when the transfer die 60 is raised by the piston rod 63, said die will be brought into alinement with a holding die 22 so as to receive a dried article therefrom when the turret 23 is lowered to close die 22 on die 60. After the turret has been raised to open said dies 22 and 60, the die 60 is then lowered and swung through an arc of 90° into article discharging position as appears in dotted lines Fig. 4. Where the shape of the article is such as to permit direct discharge thereof from the holding dies by gravity or by gravity assisted by a blast of air, the transfer die 60 and its operating mechanism may be omitted.

Various other modifications in design and arrangement 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 a fixed series of angularly spaced drying dies and a reciprocable and intermittently revoluble series of oppositely disposed foraminous holding dies, said holding dies overlying said drying dies and corresponding in angular spacing to said drying dies and being of complemental size and shape thereto, means for heating said drying dies, means for placing wet-formed articles on said holding dies, means for intermittently revolving said holding die series as a unit to positions wherein the holding dies are coactively alined with the drying dies, means operative when said holding die series is paused in its revolution for reciprocating the holding die series as a unit downwardly into pressure contact with the drying die series to press and dry the articles therebetween and for thereafter lifting the holding die series as a unit from said dryng die series to provide clearance between the drying dies and the holding dies so that the holding dies may subsequently be stepped as a unit relative to the drying dies, and means for ejecting the dried articles from the holding dies.

2. The machine of claim 1, the drying dies being mounted on a stationary frame, and the holding dies being mounted on a turret which is carried by a shaft journaled vertically of said frame.

3. A fibrous pulp molding machine, comprising a stationary frame carrying a fixed series of angularly spaced drying dies, means for heating said drying dies, a shaft vertically journaled in said frame, a turret carried by said shaft and provided with a fixed series of oppositely disposed foraminous holding dies, said holding dies overlying said drying dies and corresponding in angular spacing to said drying dies and being of complemental size and shape thereto, means for placing wet-formed articles on said holding dies, means for intermittently revolving said turret shaft to bring the holding dies into coactive alinement with said drying dies, means operative

to reciprocate said turret downwardly to bring the articles on the holding dies into drying contact with said drying dies and for thereafter lifting the holding dies upwardly away from said drying dies to provide clearance between the drying dies and the holding dies so that the holding dies may subsequently step as a unit relative to the drying dies, said last-named means including a piston head on one end of said turret shaft, a cylinder to receive said piston head, and means to supply pressure liquid to said cylinder to assist in raising the turret shaft, and means for ejecting the dried articles from the holding dies.

4. A fibrous pulp molding machine, comprising a fixed series of drying dies, and a fixed series of holding dies overlying said drying dies and complemental in size and shape to the drying dies, each of said series being so spaced and arranged that any die of one series may coact with any die of the other series, means for heating said drying dies, means to place wet-formed pulp articles on said holding dies, means for intermittently revolving said holding die series as a unit so that a pulp article on one of said holding dies progressively alines with said drying dies, means operative when said intermittently revoluble die series is motionless for reciprocating said holding die series as a unit downwardly into and upwardly out of pressure contact with the drying die series, and means for ejecting the dried articles from the holding die series.

5. A fibrous pulp molding machine, comprising a fixed series of drying dies, and a fixed series of holding dies overlying said drying dies and complemental in size and shape to the drying dies, each of said series being so spaced and arranged that any die of one series may coact with any die of the other series, means for heating said drying dies, means to place wet-formed pulp articles on said holding dies, means for intermittently revolving said holding die series as a unit so that a pulp article on one of said holding dies is progressed from a position in which it is alined with one of said drying dies to a position in which it is alined with another of said drying dies, means operative when said holding die series is motionless for reciprocating said holding die series as a unit downwardly into and upwardly out of pressure contact with said drying die series, pressure operable means in support of said holding die series determining the load on said reciprocating means and the pressure of said holding dies on the pulp layer, and means for ejecting the dried articles from the holding dies.

6. A fibrous pulp molding machine, comprising a stationary frame carrying a fixed series of radially disposed angularly spaced drying dies, a shaft vertically journaled in said frame, a turret carried by said shaft and provided with a fixed series of foraminous holding dies of complemental size and shape to said drying dies and overlying said drying dies and angularly spaced in correspondence thereto, a first means for placing wet-formed articles on said holding dies, a second means for intermittently rotating said shaft to bring the holding dies of said turret into coactive alinement with their complemental drying dies, a third means operative when said turret is paused in its rotation for reciprocating the turret downwardly towards and upwardly from said drying die frame to first close said holding dies upon said drying dies to press and dry the articles therebetween and to thereafter open said dies to permit stepping of the turret, a fourth means for ejecting the dried articles from said holding dies, and a common drive for operating said second named means in timed relation to said third named means.

7. The machine of claim 6, said common drive also operating said first-named means in timed relation to the operation of said second and third named means.

8. The machine of claim 6, said common drive also operating said first-named means and said fourth-named means in timed relation to the operation of said second and third named means.

9. The machine of claim 6, the common drive comprising a continuously rotating shaft, a cam and a gear fast on said shaft, a rocker lever actuated by said cam for reciprocating said turret shaft, a Geneva wheel splined to said turret shaft, a Geneva engaging said Geneva wheel, and motion transmitting connections between said Geneva and said gear for driving said Geneva to intermittently rotate said turret shaft.

10. The machine of claim 6, one end of said turret shaft being provided with a piston head, a cylinder to receive said piston head, and means to supply pressure liquid to said cylinder to assist in raising the turret shaft.

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