Dec. 3, 1935. E. HUFF ET AL 2,023,200

ART OF MOLDING PULP CONTAINERS

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Fig. 1.

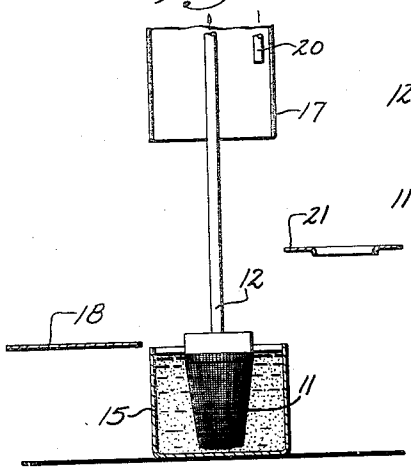


Fig. 2.

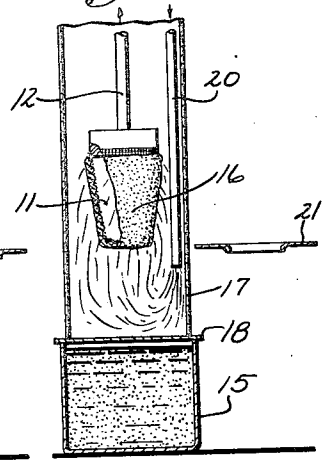


Fig. 3.

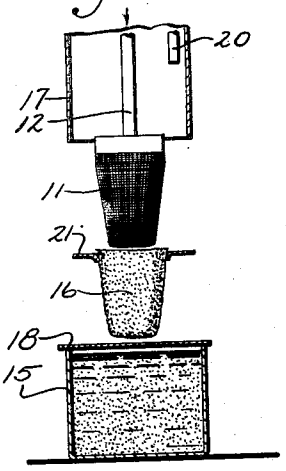


Fig. 4.

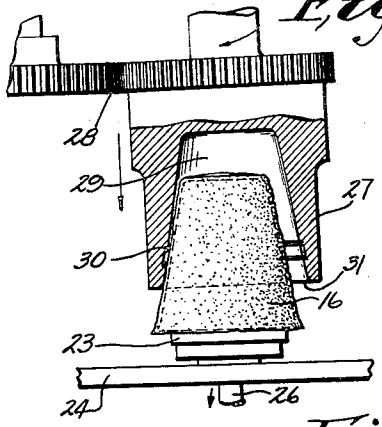


Fig. 5.

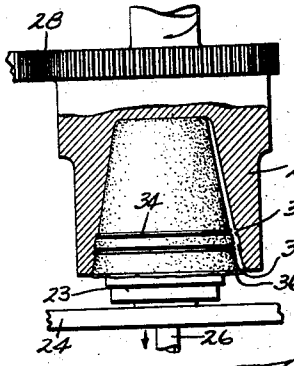


Fig. 7.

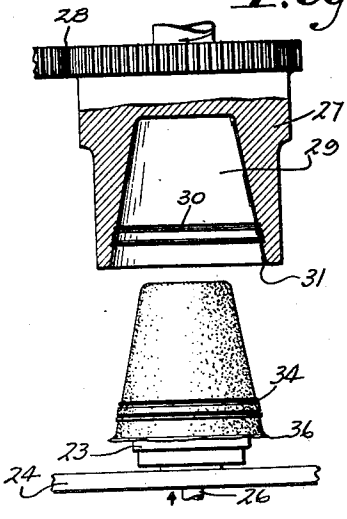
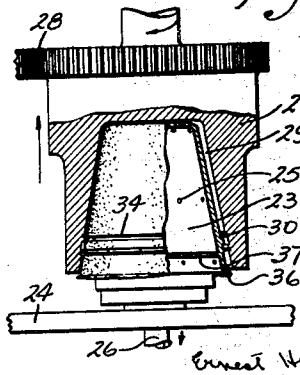


Fig. 6.



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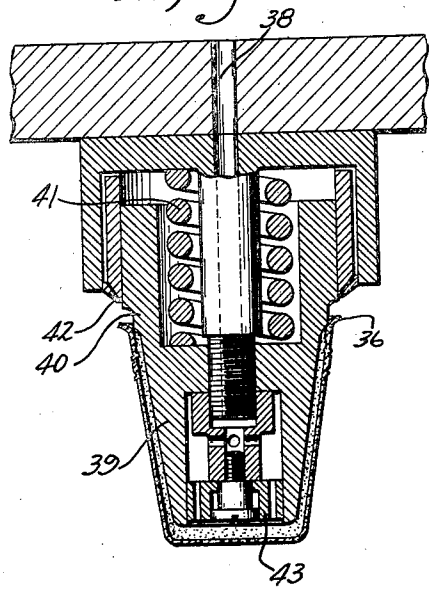
Attorneys

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Fig. 8.



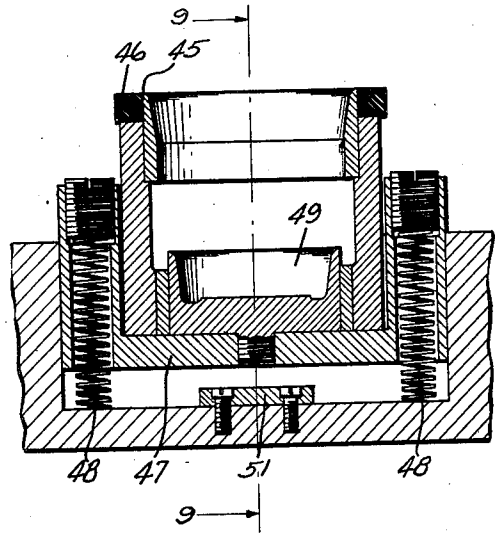


Fig. 10.

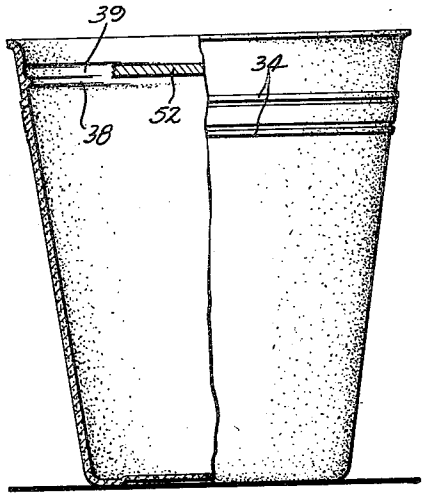
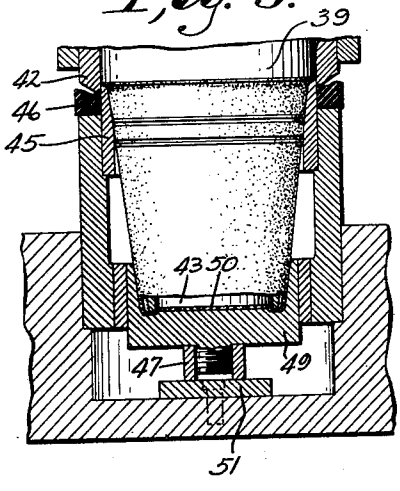


Fig. 9.



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2,023,200

ART OF MOLDING PULP CONTAINERS

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Application January 9, 1933, Serial No. 650,743

10 Claims. (Cl. 92—54)

This invention relates to improvements in the art of molding pulp containers.

As in companion application No. 491,433 filed October 27, 1930, it is the primary object of the present invention to provide a substantially rigid container having a smooth wall both inside and outside, of unusual mechanical strength, unusual resistance to disintegration by hot liquids, unusually low thermal conductivity, and unusually attractive as to the novel appearance in which the wall is finished externally.

The present application is concerned with novel methods by which a receptacle or container of the desired type may be economically, rapidly, and effectively produced complete, the casting, drying, forming and trimming operations being correlated to produce the desired result.

It is a further purpose of the invention to provide a process by which material roughly deposited on the usual foraminous form may be manipulated to provide an excess at predetermined points and used to build up embossing without underlay whereby ribs and the like may be provided either in the inner or outer surface of the receptacle without any corresponding interior channel. To mold a wall of varying cross section in an article otherwise having the smooth surfaced impervious characteristics above noted, is an objective not hitherto achieved.

In the drawings:

Figures 1 to 3 illustrate diagrammatically in vertical section the successive positions of apparatus used in molding the blank from which a receptacle is manufactured in accordance with the present invention.

Figures 4 to 7 represent diagrammatically in vertical axial section the successive positions of apparatus used in the forming of the receptacle from the blank.

Figure 8 is a fragmentary detail in vertical section of a compound sizing and trimming die used in the completion of the receptacle.

Figure 9 is a fragmentary detail view showing the parts of the die in a plane at right angles to that at which Figure 8 is taken, and in different relative positions with reference to each other.

Figure 10 is an enlarged view partially in side elevation and partially in vertical axial section, of a completed receptacle made in accordance with the invention.

Like parts are identified by the same reference characters throughout the several views.

As exemplifying the articles that may be made in accordance with this invention, I have illustrated a container or cup preferably molded from pulp on a foraminous body such as that shown at 11. In practice the external surface of such a body is usually made up of a fine mesh screen, suitably supported from within. For the purposes of the present invention the said body preferably has its bottom in convex form to provide extra material which may be shaped as shown in Fig. 10.

The pulp blank from which the article is to be formed is cast by connecting the foraminous body 11 to a pipe 12 temporarily connected to a source of low pressure. The assembly is then lowered into a vat 15 containing a liquid in which paper or wood pulp or other fibrous pulp material is carried.

In ordinary practice the pulp will contain a so-called size, which is an insoluble solid. Such a size will give stiff and rigid body to the pulp article if the article is not greatly disturbed after it dries. If, however, the article is manipulated to any considerable degree after it becomes dry and the size has set, the wall of the article will be comparatively flabby and less impervious than would otherwise be the case. It is because of this consideration that it is necessary to shape the pulp while wet to a form in which the cup may be completed with a minimum of manipulation when dry.

The vacuum to which pipe 12 is subject will withdraw the liquid from tank 15, thereby depositing the pulp content on the surface of the reticulated mold 11 in a manner well known to the art. The exterior surface of the deposited blank 16, as shown in Figs. 2, 3 and 4, will be highly uneven. When deposited to a substantial thickness, it may be described as lumpy in the sense of such irregularities as occur in a rough plaster or stucco. The interior surface of the blank will take the form of the mold 11 and will show the reticulated pattern of the screen cloth comprising the exposed surface of the mold.

When the blank has been built up to the desired thickness of deposit on the mold, the mold is raised from vat 15 as shown in Fig. 2 and the blank and mold are surrounded by a hood 17 which is lowered to contact with a plate 18 which covers the top of the vat 15. Into the closed chamber thus formed about the newly deposited pulp, a drying fluid at high temperature is released from pipe 20 as shown in Fig. 2. This fluid may comprise steam or, under some conditions, hot air may be used. In either case, the effect of the high temperature and the relatively dry fluid upon the wet pulp is such as to result in a fairly

rapid but nevertheless incomplete drying of the pulp. During this operation the plate 18 protects the vat 15 from dilution or contamination.

The drying operation is continued only to such a point that the remaining removable water is about equal to the ultimate weight of the article. Upon conclusion of the drying operation the hood 17 is withdrawn and a tray 21 is thrust beneath the mold to receive the blank 16. Fluid under pressure, such as air, is now supplied through pipe 12 and the container blank is blown, while still very wet, from the mold into the aperture of tray 21.

Following the treatment with hot drying fluid, the pulp comprising the blank 16 will be in such condition that it may immediately be subjected to a forming operation. About fifty per cent of its weight will comprise free water, as distinguished from such water as will ultimately be retained in its composition. The presence of this amount of water is very desirable to the successful use of any forming operation and particularly to those described in the above identified copending application and to that shown in Figs. 4 to 7 of the drawings of this application.

If much more than 55 per cent of water by weight is present in the pulp, the pulp will be too soft to be molded properly. If much less than 45 per cent of removable water is present in the pulp the fibers will, to a very considerable extent, be broken during the finishing operation and they will fail to become properly felted or interlocked. While water is referred to, in accordance with standard practice, it will be understood that the invention is not limited to the use of water as a vehicle for the pulp.

The wet pulp blank 16 is conveyed by means of tray 21 to a mandrel 23 rotatably mounted on support 24 and having peripheral openings 25 (Fig. 6) connected by a pipe 26 with a source of low pressure. The withdrawal of air through pipe 26 is indicated by the arrow in each of Figs. 4 to 6 inclusive.

The vacuum produced on the peripheral surface of mandrel 23 by means of the vacuum line 26 and the apertures 25 does not serve to withdraw water from the pulp blank 16, but merely serves to hold the blank to the mandrel. It is found that in the absence of some such expedient the blank will not only shift on an internal mandrel during the forming operation, but will be rolled out or distorted in such a way as to increase its diameter. This is very objectionable as the manufacture of a container to specific dimensions is one of the commercial requirements in this art.

With the blank held by vacuum to the rotatable mandrel 23 as shown in Fig. 4, a cup-shaped forming die 27 provided with gearing 28 for its mechanical rotation is lowered on to the cup in an offset and inclined position with reference to the axis of mandrel 23. The forming die 27 has an interior surface 29 which exceeds slightly the diameter of the finished cup and is preferably perfectly smooth except for channels 30 which may be made in the die to produce ribs in the cup when desired. At the lower marginal portion of the forming die 27 its interior surface 29 is flared outwardly as shown at 31 to provide a lip for the receptacle or cup and also to guide the forming die in its movement downwardly over the wet pulp.

As above noted, the Fig. 4 position of the forming die is such that its axis is laterally offset to the right from the axis of mandrel 23, and is also inclined to the right with reference to the mandrel. By virtue of this arrangement the beveled or flared marginal portion 31 for the forming die first contacts the pulp about two thirds of the way down the blank and the reaction of the pulp itself serves to overcome the pressure which inclines the forming die to the right. Thus, as the die moves downwardly over the blank, it is progressively straightened until it is fully engaged with one side of the blank from top to bottom thereof as shown in Fig. 5.

The forming die 27 is rotated as it moves downwardly. The net result of its rotation and its off center and inclined engagement with the blank is to subject the blank to a slight drawing operation in addition to the compression which is ultimately effected by the relatively small clearance between the forming die and the mandrel. It is found that any excess of material is gradually worked downwardly toward the margin of the blank by this operation and there is no such pulling or tearing action as tends to destroy the blank if the above described steps are omitted. Furthermore, the excess of material displaced by the progressive movement of the forming die relative to the mandrel serves to fill the grooves 30 in the forming die, thereby creating complementary ribs 34 on the outside of the hardened receptacle. There is also a certain amount of surplus material forced to the bead portion 36 of the receptacle.

The requisites of a suitable receptacle are achieved with much greater perfection by the downward movement of the die in its inclined and offset position than is possible if the die is moved downwardly in an axial offset direction or is moved downwardly in a concentric position and is later offset.

The clearance between the forming die and the mandrel is very much less than the original thickness of the pulp blank as shown in Fig. 2. The resulting pressure is applied somewhat as if by a rolling operation due to the movement of the forming die and mandrel about different and mutually offset axes. There is, moreover, a certain slight amount of friction due to the fact that both the mandrel and the forming die are in contact with the wall of the cup throughout its height and the wall is tapered as shown.

Because of the fact that the axis of the external die 27 falls within the mandrel or internal die 23 (the axes of the two dies being only slightly offset) the effect upon the pulp blank is wholly different from that which would be produced if one of the rolling surfaces deviated sharply from the other. The pulp is, of course, yieldable and consequently the pressure is applied throughout a relatively broad zone. In this pressure zone, the external and internal surfaces of the blank are forced to conform to arcuate die surfaces which are convex in the same direction and deviate but slightly from each other. Thus there is no sharp flexing of the fibers, such as would tend to break the fibers and impair the strength of the cup if the compression surfaces were more widely deviant.

Not only is the forming die preferably grooved, but the mandrel is also preferably shouldered at 37 (Fig. 6). The conformation is such that when the cup is molded thereon it will have a complementary internal rib at 38 and an annular recess at 39, as clearly appears in Fig. 10. It is particularly to be noted both with reference to the external ribs 34 and the internal rib 38, that the opposed surface of the cup is substantially

smooth, no underlay being required to produce this effect by the present process.

The conformation of the mandrel above described is such that the rib portion 38 of the cup is interlocked with the mandrel when the forming operation is completed, as shown in Fig. 6. At this point the forming die 27 is first moved to a position concentric with the mandrel to free ribs 34 from channel 30. It is then lifted from the cup as shown in Fig. 7 and fluid under pressure is now supplied to pipe 26 as indicated by the arrow in Fig. 7. As a result, it will be found that the cup can be blown from the mandrel without destroying it. If the cup is molded with a proper degree of water-free content within the limits above described, its fibers will be so interlocked and felted and so substantially unbroken during the forming operation, that they will have sufficient elasticity to cause the cup to resume its form after being blown from the mandrel as above described.

The drying of the cup is now completed, in a kiln or otherwise.

The fully dried cup is now subjected to a sizing and trimming operation in some such die as that shown in Figs. 8 and 9.

Air withdrawn through duct 38 holds the cup to a sizing die 39 having a relatively large marginal portion 40 conforming to the exact desired dimensions and shape of the rim of the cup. The sizing die 39 is yieldable against the pressure of spring 41 with reference to the outer shear die 42. Rigidly connected with the shear die, to be held stationary when the sizing die 39 yields, is the bottom stamp 43.

The assembly thus far described is vertically movable with reference to the inner shear die 45. Surrounding this shear die is a rubber annulus 46 which receives and supports that portion of the blank which is trimmed off in the shearing operation which forms the margin of the cup rim. Extending transversely beneath the stationary shear 45 is a bridge member 47 resiliently supported by compression springs 48 to carry the bottom forming die 49.

In the extreme position of the parts following the shearing operation, as shown in Fig. 9, the cup is forced on to the sizing die 39, the outer shear 42 has moved past the inner shear 45 severing the surplus material 36 at the edge of the blank and compressing the elastic ring 46, the bottom stamp 43 has forced the bottom of the cup against the bottom forming die 49 which has pressed upwardly the central portion of the cup as shown at 50, the bottom forming die 49 being supported in its retracted position by contact with the base plate 51.

Since there is substantial friction between the cup and the shear die 45 which engages the side of the cup, the bottom die 49 serves as an ejector to force the cup out of the inner shear die and allow it to pass upwardly upon the sizing die 39. At the completion of the operation the cup is blown from the sizing die by supplying air under pressure to duct 38 in lieu of the vacuum with which such duct was originally in communication.

In the completed article shown in Fig. 10 the walls will be found to be exceptionally hard and smooth, bearing no evidence of rubbing or the breaking of fibers and showing no pressure ridges. The desired appearance of ornamental shading or texture will be produced where the lumps of pulp have been flattened by the pressure exerted during the operation shown in Fig. 5 of the drawings. The wall will have substantially uniformly high density, high thermal insulating value, high tensile strength, high resistance to distortion, high resistance to the destructive action of hot liquids, and a substantially uniform thickness except where the thickness has been varied by the ornamental ribs 34 or by the shoulder produced internally by rib 36.

All of the cups produced by the foregoing process will be found to be uniform in size at and above rib 38 due to the operation of the sizing die as above noted. This feature makes it conveniently practicable to use this cup as a container into which a disk shaped cover may be inserted with a snap fit into groove 39 as fragmentarily shown at 52 in Fig. 10. As above noted, it is unknown in a receptacle of this type and smooth finish, both inside and out, to have ribbed surfaces without underlay and opposed by perfectly smooth cup surfaces.

As a result of the particular forming operation above described, all marks of the mold and all irregularity of surface attributable to the casting will have been completely eliminated. Additionally, the surplus material required at the bead and at the ribs above described and at the bottom of the cup, will have been supplied in such manner that the completion of the cup will not have involved any weakening of the cup structure such as might occur if the material were subjected unduly to tension in the forming of these parts.

The article produced by the process herein disclosed and claimed comprises the subject matter of a companion application executed of even date herewith and entitled Receptacles of molded pulp.

We claim:

1. The process of manufacturing containers from fibrous pulp which includes the step of simultaneously drawing and rolling a hollow blank.

2. The process of manufacturing receptacles from fibrous pulp which includes the fixation of a hollow pulp blank upon a correspondingly shaped mandrel, and the application to the outer surface of the blank of a drawing and rolling pressure axially and rotatively advancing to act on successive portions of said blank.

3. The process of manufacturing receptacles from fibrous pulp which includes placing a wet pulp blank upon a mandrel and exerting a drawing pressure on rotatively successive peripheral portions of the blank.

4. The process of manufacturing pulp articles which comprises the deposit-molding of a blank from size-containing pulp stock, the displacement of wet pulp from one portion of said blank to another portion thereof, the drying of the blank, and the application of pressure to the portion of the blank to which pulp was displaced, whereby to form the dry blank in a manner which, but for the excess of pulp deposited by such displacement, would destroy the set of the size and the rigidity of the blank.

5. Those steps in the process of manufacturing receptacles from pulp which include the molding of a blank having a wall of approximately a uniform thickness, the displacement of a portion of the material of said wall to build up the thickness thereof, at predetermined points about said wall both internally and externally thereof and the pressure manipulation of the built up portions of the wet blank to produce shoulders both internally and externally thereof.

6. The process of manufacturing receptacles from pulp which includes the deposit-molding of a blank in the general form of the desired receptacle, the pressure forming of the blank while wet to compact the pulp and displace portions of it toward the margin of the receptacle, the drying of the blank, and the subsequent compression of the marginal portions of the blank upon which such excess of material was deposited.

7. The process of manufacturing a receptacle from pulp which includes the compression of marginal portions of a pulp blank, and the die trimming thereof while subject to compression.

8. The process of manufacturing a receptacle of pulp which includes the displacement of wet pulp on a wet blank toward the margin thereof, the drying of the blank, the compression of the marginal portion of the blank, and the trimming therefrom of the surplus material.

9. The process of manufacturing a receptacle from pulp which includes a rolling operation in which a hollow pulp blank is compressed toward its center in axially extending zones successively offset in a peripheral direction, the pressure in each zone being applied to the blank in a manner to require corresponding inner and outer surfaces thereof to conform to slightly deviating arcs whereby the blank is rolled without subjecting its fibers to sharp bending strains.

10. The process of manufacturing receptacles of pulp which includes the successive compression of successive peripheral zones of a wet pulp blank into conformity with arcs deviating but slightly from concentricity, axially extending the successive zones of pressure to include increasing areas of the blank, simultaneously displacing a portion of the material thereof, and shouldering both internally and externally of said blank the portion thereof toward which said material is displaced.

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