March 7, 1939. H. V. MITCHELL 2,149,879

PULP MOLDING

Filed Feb. 27, 1937

Fig. 1

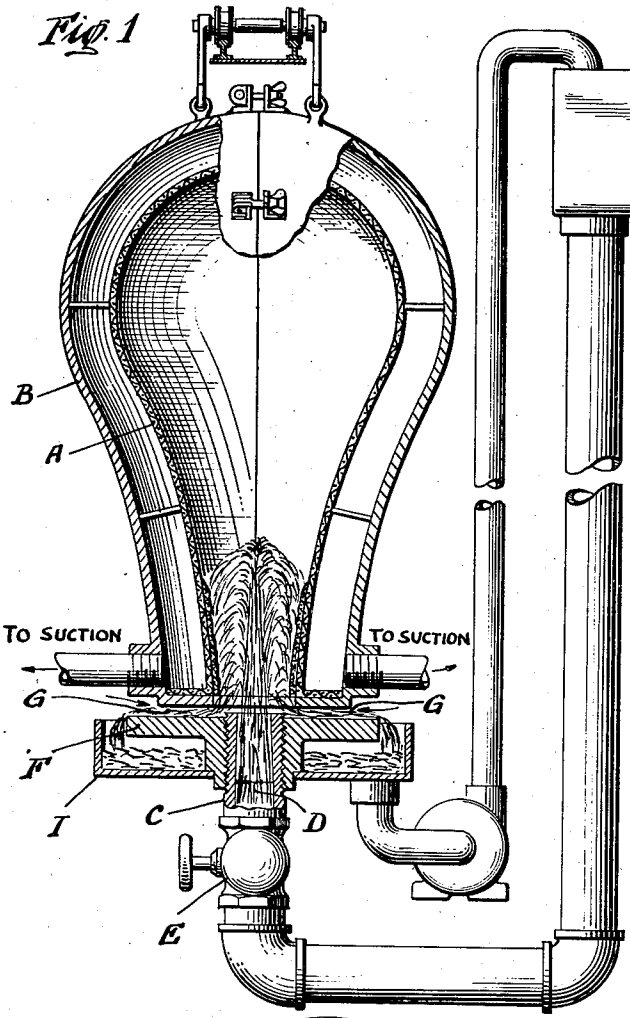


Fig. 2

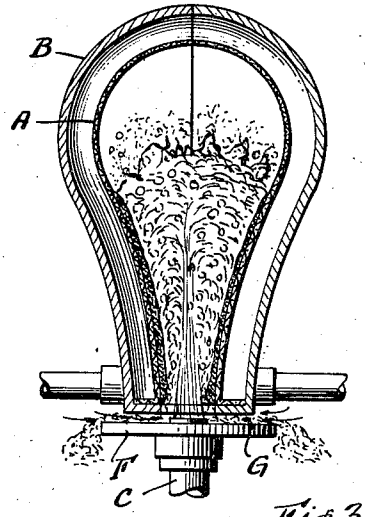


Fig. 3

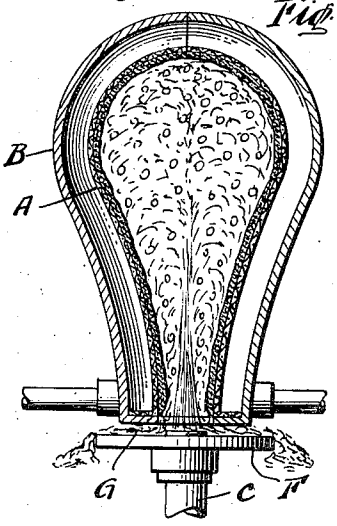
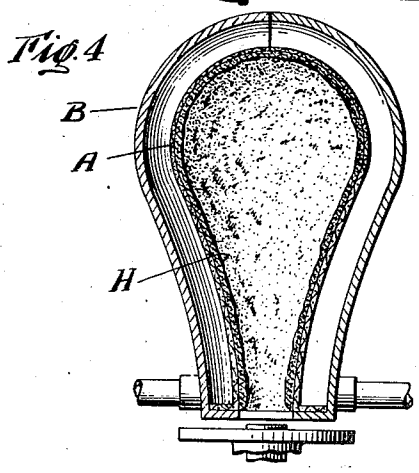


Fig. 4



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PULP MOLDING

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5 Claims. (Cl. 92—54)

This invention relates to an improved method of molding articles from pulp in liquid suspension to form receptacles, containers and other articles therefrom. The invention relates more particularly to a process of molding relatively large shapes under low pressure while maintaining the pulp stock in a constant state of agitation.

The invention consists broadly in molding articles from pulp either of wood, paper, fiber or any other material by depositing the same against a foraminous mold while admitting the stock gradually into the interior of the mold and maintaining it in a constant state of agitation without exerting any considerable pressure on the interior of the mold.

The invention further consists in forming the exterior surface of the article being molded by admitting the stock solution gradually into the interior of the mold cavity and causing the wall to be formed as the height of the liquid within the cavity increases until the wall is completely formed.

The invention further consists in forming molded pulp articles within a closed mold by simultaneously subjecting the exterior of the mold to suction to promote the escape of liquid and speed up the deposition of pulp on the mold.

The invention further consists in the new and novel features and steps employed in carrying out my improved process and the relationship of such steps to each other and to the process as a whole.

In practicing my improved process a foraminous mold is provided of the exact configuration of the finished article desired. This mold is mounted so that suction can be maintained on the exterior of the mold during the molding operation. The pulp stock is admitted at the bottom of the mold and a constant flow of pulp stock into the mold cavity is maintained while molding is taking place. The rate of the inlet and overflow of the pulp stock may be regulated so that a body or bath of pulp stock is gradually built up within the mold. As the height of the bath within the mold gradually increases, pulp is deposited on the interior surface of the screen. The depth of the bath is gradually increased until it fills or approximately fills the interior of the mold cavity. As the inlet of the pulp stock is located at or near the bottom of the mold, the admission of fresh stock and air aids in agitating the body of pulp stock within the mold.

During the molding operation suction is maintained on the exterior of the mold wall which facilitates the escape of the liquid carrier therethrough and the deposition of the pulp against the interior of the wall. At the same time air is drawn through the body of pulp in the mold cavity to further facilitate the agitation or ebullition of the pulp bath. The addition of air as a diluent to the pulp stock also allows of molding large articles without the necessity of filling the mold entirely with liquid stock.

The accompanying drawing indicates one form of apparatus for practicing my invention in which—

Fig. 1 is a diagrammatical view partly in cross-section of a molding apparatus showing the pulp being admitted to the mold at the commencement of the operation;

Fig. 2 shows the mold at an intermediate stage of the operation;

Fig. 3 shows the final stage of the molding; and

Fig. 4 shows the article after molding while still in the mold.

Referring particularly to the drawing, the apparatus shown is particularly adapted for molding articles of the shape of electric light bulbs having a height of approximately 30'' and a diameter of approximately 18'', although articles of any desired shape or configuration and of much larger or smaller dimensions may be successfully molded by the process.

The mold A is formed of perforated sheet metal or stiff wire screen of any suitable material, for example, bronze screen, which resists the corrosive action of the pulp stock. The mold is mounted within a closed casing B connected with a suction or vacuum apparatus (not shown). Pulp is admitted to the mold cavity through the nozzle or inlet C connected with a pulp supply D which may feed by gravity to the nozzle and the quantity supplied is controlled by any suitable means, as the valve E. The mold rests, during molding, above a plate or base F. The opening or openings G between the plate and the bottom of the mold casing permits of drawing air into the mold to dilute the pulp stock. The excess pulp stock may also drain out of the mold through these openings. The rate of flow through the outlet G may be controlled also by a valve E. These outlets drain into a suitable catch basin I located beneath the base plate and are open to the atmosphere so that air can enter through the overflow opening G when a vacuum is maintained in the casing B.

The operation of my process employing means like or similar in principle to the apparatus just described consists in admitting pulp stock through the inlet pipe at a rate of flow compared

to the flow from the outlet which will cause a body or bath of the stock comprising the pulp in suspension in a suitable liquid gradually to form in the interior of the mold wall. As the level of the stock bath rises a layer of pulp is deposited against the interior surface of the mold. Simultaneously, suction is maintained on the exterior of the mold which facilitates the formation of the pulp wall. The suction also draws through the liquid bath a certain amount of air which rises in bubbles through the pulp bath maintaining it in agitation, thereby keeping the pulp material in foaming suspension and preventing an undue amount of pulp from being deposited at or near the base of the mold and at the same time causing a more even distribution of the pulp stock on the molded surface. As soon as the bath which is in the form of a foam has reached the top of the mold through progressive stages as illustrated diagrammatically in Figs. 1, 2 and 3 it may be maintained in this condition for a brief interval of time until the pulp wall is formed on the upper interior surface of the mold. The pulp supply and the suction are then cut off and the pulp stock allowed to drain off through the openings G at the base of the mold. As the pulp wall is more or less saturated with the liquid this draining of the stock tends to wash off any excess stock or protuberances which may have been deposited on or which adhere to the bottom of the pulp wall.

After all the pulp stock has been drained off from the interior of the mold it is possible to continue the suction to pull a quantity of atmospheric air through the pulp wall thereby to compact the wall of the molded article H and to remove excess moisture therefrom. If desired, the interior of the molded article may be connected with a source of previously dried or heated air (not shown) which can be pulled through the pulp wall to speed up the drying operation. The formed article may then be removed and completely dried or given such subsequent treatment and finishing as may be desirable.

By the use of my improved process it is possible to mold articles of a size never before produced, so far as I am aware, from molded pulp. It is impractical in molding articles of very large size on a commercial scale to fill the mold completely with liquid stock. I overcome this by introducing the pulp stock diluted with air to form a foam and thus avoid completely filling the mold entirely with liquid. This results in a saving of time in molding as at no time is the mold filled with liquid carrier which in any event must be removed.

A wide variety of pulp stock may be employed in the molding operation. Since no substantial pressures are employed, the mold may be formed of screen or perforated sheet material without heavy or expensive supporting or reinforcement members. No expensive mechanism is required to carry out my process but, on the other hand, comparatively inexpensive apparatus may be used.

While certain novel features of the invention have been disclosed and are pointed out in the annexed claims, it will be understood that various omissions, substitutions, and changes may be made by those skilled in the art without departing from the spirit of the invention.

I claim as my invention:

1. The method of forming hollow pulp articles which comprises introducing a restricted stream of liquid suspension of pulp fibres under controlled head upwardly through a restricted opening at the lower end of a hollow foraminous mold while simultaneously drawing air into said opening directly from the atmosphere by maintaining a sub-atmospheric pressure on the exterior of said mold whereby to dilute said liquid and form a foaming pulp suspension, causing said foaming pulp suspension gradually to rise in the interior of said mold while maintaining said sub-atmospheric pressure whereby to deposit a blanket of pulp fibres on the interior surface of said mold progressively from bottom to top as the foam front rises, discontinuing the flow of liquid suspension after said foam front has reached the top of said mold, and continuing the flow of air for a sufficient time to remove excess liquid from said blanket to render the article so formed sufficiently rigid for removal intact from said mold.

2. A method of forming articles from fibrous pulp which comprises projecting a column of liquid pulp stock of restricted cross-section into a hollow foraminous mold under a controlled head sufficient to cause said column to flow upwardly into the interior of said mold but insufficient to cause said column to reach the top of said mold, simultaneously maintaining a suction on the exterior of said mold whereby to cause air to flow into the interior of said mold around said column and to form a foam with the pulp stock thus introduced into said mold, causing the foam thus formed to rise in the interior of said mold whereby to cause a gradual deposition of fibrous pulp on the interior surface of said mold as the foam front rises, then discontinuing said projected column while continuing said suction for a time sufficient to remove excess liquid from the deposited fibres and render the article thus formed sufficiently rigid to be removed intact from said mold.

3. The process of forming articles from fibrous pulp which comprises introducing pulp stock in a column of controlled height upwardly through a restricted opening into the interior of a hollow foraminous mold, introducing a substantial quantity of air around said column at its locus of entry into said mold whereby to mix said air with pulp stock introduced into said mold and to form a diluted pulp stock bath, causing the diluted bath gradually to rise in the interior of the mold at a rate to cause deposition of pulp fibres against the interior surface of the wall of the mold while maintaining a suction on the exterior of said mold, causing said diluted stock to rise to the top of said mold, allowing said column to flow until part of the pulp stock drains from said mold through said restricted opening, then shutting off said column while maintaining said suction sufficient time to remove excess water from the deposited fibres.

4. The process of forming articles from fibrous pulp which comprises projecting upwardly a controlled stream of pulp stock at low pressure through a restricted opening exposed to the atmosphere at or near the bottom of a hollow foraminous mold, intermixing a gaseous diluent with said stream at the locus of said opening whereby to dilute said stock and maintain said pulp in suspension, causing the diluted stock gradually to rise in the interior of the mold while maintaining a suction on the exterior of said mold to cause a gradual deposition of pulp fibres against the interior of the walls of said mold progressively from bottom to top as the diluted pulp stock rises within the mold, causing the pulp stock to drain from the mold at a rate less than the inlet rate of flow for a sufficient time to effect a smoothing of the interior surface of the deposited pulp, caus-

ing the gaseous diluent to flow into the mold after the cessation of the flow of pulp stock into the mold, and maintaining the suction on the exterior of the mold for a sufficient time to remove excess liquid from the deposited fibres whereby the article so formed may be removed intact from said mold.

5. The process of forming articles from fibrous pulp which comprises introducing a controlled stream of pulp stock at low pressure through a restricted opening at or near the bottom of a hollow foraminous mold, intermixing atmospheric air with said stream at its locus of entry into said mold whereby to dilute said stock, causing the diluted stock gradually to rise in the interior of the mold at a controlled rate of flow to cause gradual deposition of pulp fibres against the interior surface of the mold progressively from bottom to top as the diluted bath rises within the mold, causing the pulp stock to drain from the mold at a rate less than the inlet rate of flow whereby to wash away protuberances of pulp from the interior surface of the pulp wall, then discontinuing the flow of pulp stock into the mold and causing air to continue to flow through said opening while maintaining a suction on the exterior of said mold for a time sufficient to remove excess water from the pulp wall and permit the article so formed to be removed intact from said mold.

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