

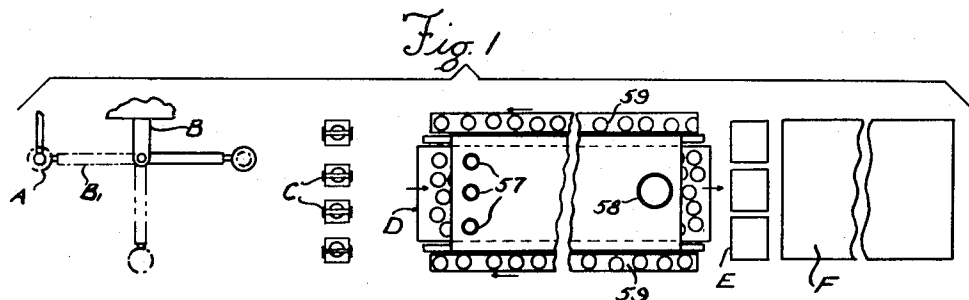
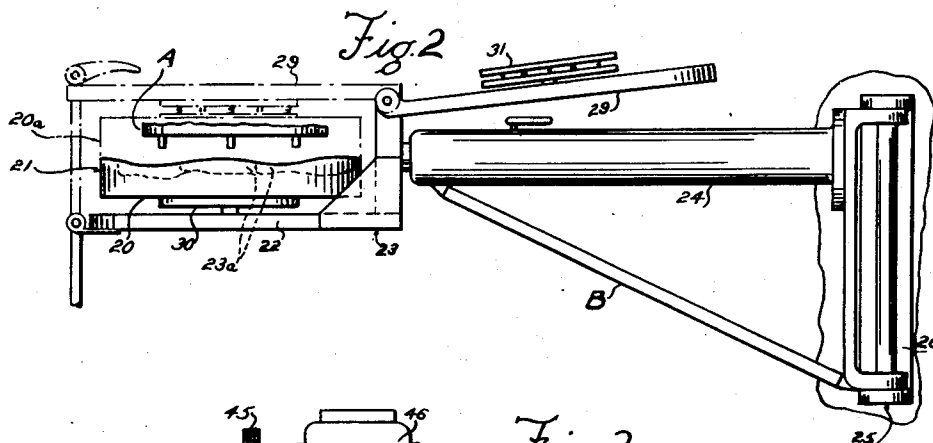
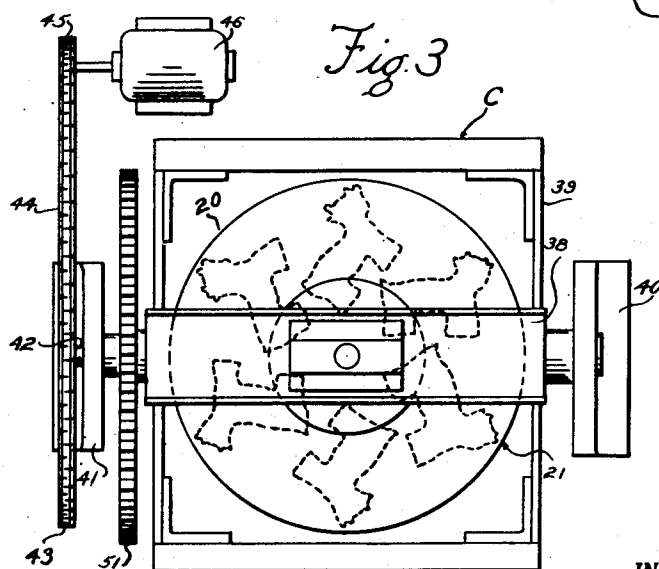
May 10, 1949.

D. G. REMPEL
HOLLOW ARTICLE AND METHOD AND APPARATUS
FOR PRODUCING THE SAME

2,469,892

Filed Sept. 10, 1947

4 Sheets-Sheet 1



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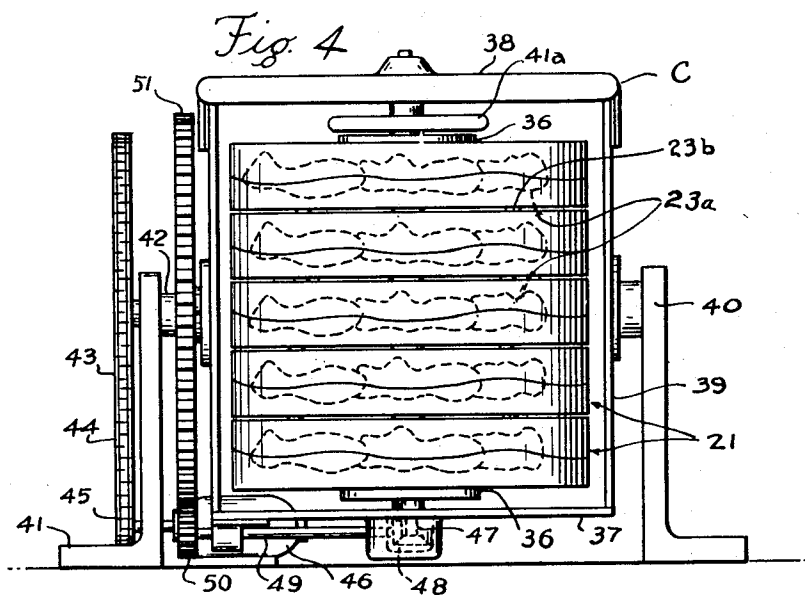
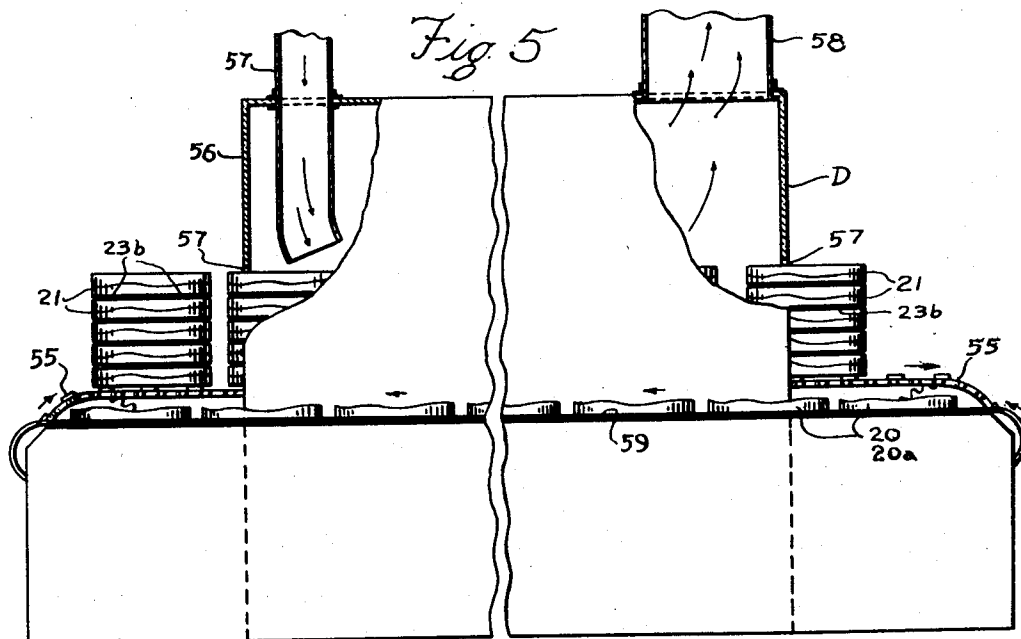
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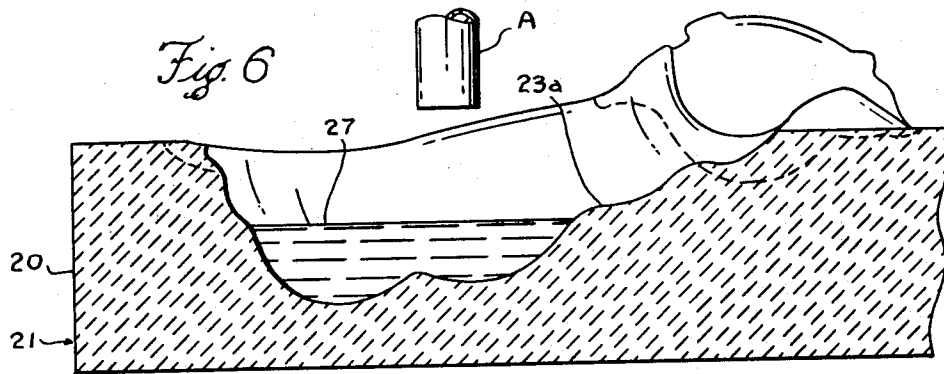
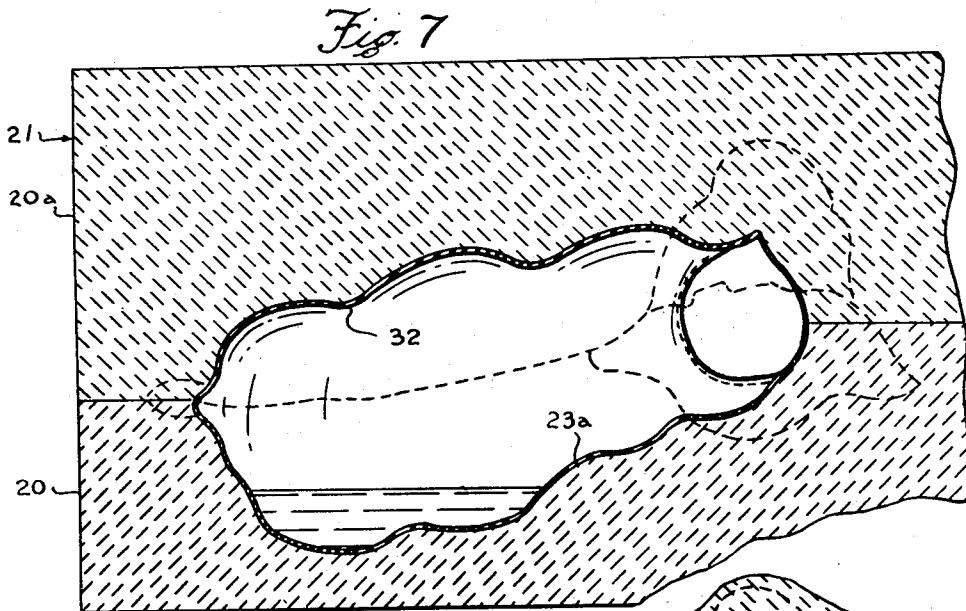
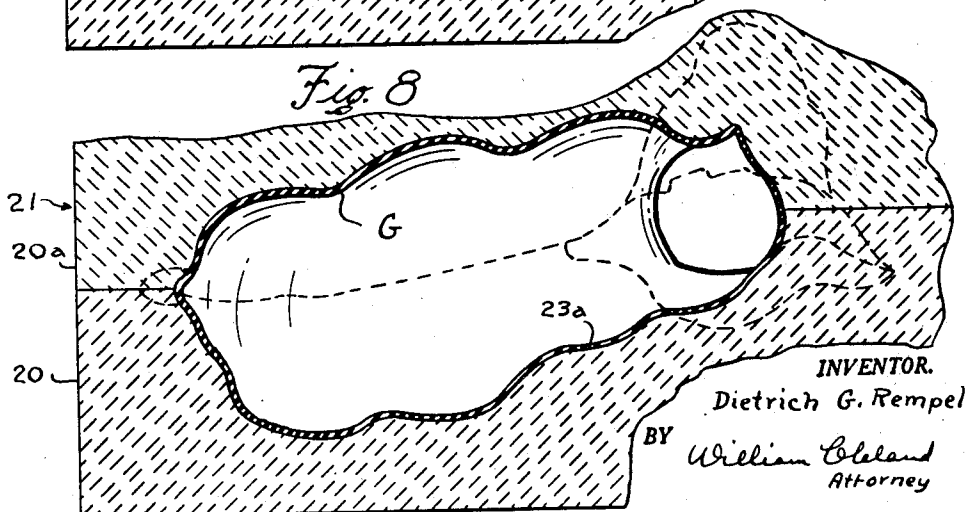
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4 Sheets-Sheet 4

Fig. 9

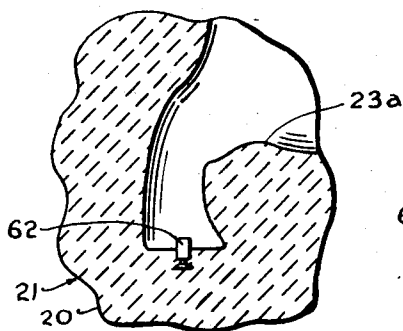


Fig. 10

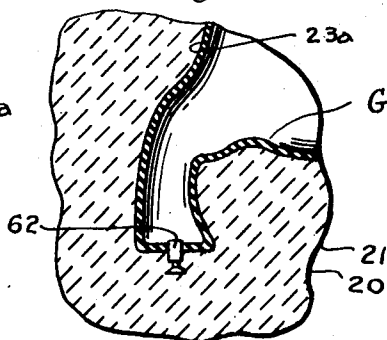
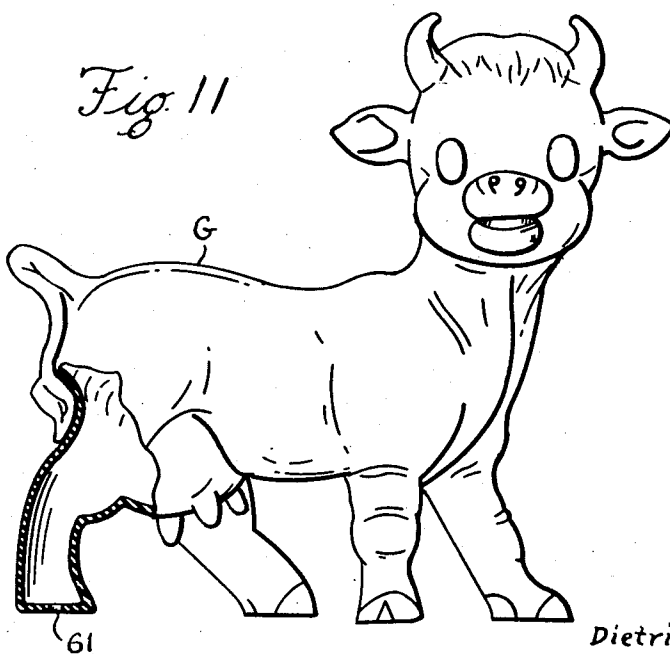


Fig. 11



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UNITED STATES PATENT OFFICE

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HOLLOW ARTICLE AND METHOD AND APPARATUS FOR PRODUCING THE SAME

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Application September 10, 1947, Serial No. 773,209

16 Claims. (Cl. 18—26)

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This invention relates to a method and apparatus for producing hollow articles, and particularly for producing hollow articles by deposition of liquid rubber or other aqueous dispersion material.

In the past various attempts have been made to form hollow rubber articles, for example, by so-called rotary casting methods, but these attempts have not been completely successful and for that reason rotary casting methods have not been generally accepted for large scale production. The accepted practice followed for manufacturing such hollow articles at present utilizes what is known as the "blown" vulcanizing methods, wherein preformed hollow biscuits of sheet rubber stock are formed in sectional cavity molds, under the influence of heat and internal pressure. These "blown" methods, however, require extensive factory floor space to accommodate a vast amount of necessary equipment.

The invention herein utilizes a process by which a predetermined quantity of latex or similar aqueous dispersion material is placed in a plaster of Paris mold, which mold is given a compound rotary motion to form an article by deposition of the latex on the mold cavity surface, and thereby to form a complete hollow article of substantially any desired shape and predetermined wall thickness, without excess deposition material. In the development of the invention, however, it has been found that if certain conditions prevail pertaining to moisture content of the mold either the product or the process, or both, may not be entirely satisfactory. As an example, under certain conditions in production, as between the time articles are removed from the mold after one cycle of operation and refilling of the mold with latex for the next succeeding cycle of operation, drying action may take place at both the inner and outer surfaces of the mold, and result in a layer of moisture intermediate said inner and outer surfaces. Thus, when the mold is refilled with latex as described, air will be trapped between said intermediate moisture layer and a moisture layer at the inner surface of the mold, from the newly supplied latex. A substantial proportion of this trapped air cannot escape outwardly of the mold because of the intermediate moisture layer and is forced into the mold cavity and the product being formed therein, resulting in air bubbles, blisters, and holes in the product. If, on the other hand, the plaster mold is maintained somewhat saturated to the full wall thicknesses thereof, with capillary movement of the water outwardly main-

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tained in normal course, a satisfactory product may result, but the article-drying process necessary to permit opening of the mold and removal of the formed article is extremely slow (48 hours for example). If the mold is in bone dry condition, when the initial deposition is started, the capillary movement of the water from the latex will also be maintained outwardly, in normal course, and a satisfactory product may result; when such a bone dry mold is used the finished product may be removed within from six to eight hours. It therefore, becomes self-evident that for successful use of such rotary casting methods, it is necessary to provide controlled variance of moisture and dryness in different portions of the mold.

One object of the present invention is to provide a process for manufacturing hollow articles utilizing the above described principle of deposition of rubber latex or like aqueous dispersion material, including improved steps and apparatus for controlling capillary movement of water through the porous mold so that it is constantly outward, whereby is produced goods of high quality, free of pockmarks, depressions or holes.

Another object of the invention is to provide an improved method and apparatus capable of producing commercially acceptable hollow rubber or like articles of the character described, in a manner which obviates the necessity for the use of certain equipment normally required, such as rubber mills, rubber reworking machines, article preforming equipment, heavy vulcanizing molds and presses, vulcanizing heat and pressure supplying equipment, as well as other equipment and supplies usually incidental to the employment of the blown rubber methods.

Another object of the invention is to provide an effective, efficient and economical procedure for manufacturing hollow articles by deposition of article-forming materials in a cavity mold, wherein the finished articles thereby produced will have substantially uniform predetermined wall thickness as desired and without marks or blemishes on the outer surfaces thereof.

Another object of the invention is to provide a rotary casting method of the character described utilizing predetermined quantities of liquid deposition material for forming each article without excess of the material, and thereby making possible the use of multiple-cavity molds which are also adapted to be in stacks thereof during the rotary casting movements.

Another object of the invention is to provide a method for producing hollow rubber articles

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of the character described by deposition of rubber material in a mold cavity surface, wherein the articles will be substantially completely formed and non-porous upon removal thereof from the mold cavities, without requiring the use of heat and pressure and without requiring the use of swelling or other treatments to close pores in the material.

Another object of the invention is to provide a method and apparatus for producing completely closed hollow rubber articles particularly suitable, for example, to be used as so-called bathtub toys.

Another object of the invention is to provide an improved method and apparatus by which may be produced hollow rubber articles of substantially any shape, irregular or otherwise, and by which the article-forming material is conformed effectively to undercut portions or sharp corners of an article-forming mold.

These and other objects of the invention will be manifest from the following brief description and the accompanying drawings.

This application is a continuation-in-part of co-pending application, Serial Number 683,335, filed July 13, 1946.

Of the accompanying drawings:

Figure 1 is a composite plan view illustrating a suitable arrangement of equipment for carrying out the method of the invention.

Figure 2 is a side elevation of a machine for applying a preliminary compound rotary motion to an article-forming mold, in accordance with the method of the invention.

Figure 3 is a top plan view of a machine for applying a subsequent or secondary compound rotary motion to the mold or molds.

Figure 4 is a front elevation of the machine shown in Figure 3.

Figure 5 is a side elevation, partly broken away and in section illustrating apparatus for conveying and treating the molds received from the machine of Figures 3 and 4.

Figure 6 is a fragmentary cross-section of a lower mold section, illustrating the step in the method prior to application of rotary motion thereto, wherein a predetermined volume of latex is placed in the mold cavity.

Figure 7 is a similar fragmentary cross-section through the closed mold, after a preliminary compound rotation thereof in the apparatus of Figure 2.

Figure 8 is a view similar to Figure 7, partly broken away, illustrating the completely formed articles in the closed mold, after it has been subjected to a secondary compound rotary motion in the machine of Figures 3 and 4.

Figure 9 is a fragmentary cross-section, corresponding to Figure 6, but illustrating a device provided in the mold for forming a whistle aperture in an article deposited therein.

Figure 10 is a view similar to Figure 9, and corresponding to Figure 8, illustrating the article completely formed with the whistle aperture therein.

Figure 11 is an elevational view of a completed hollow rubber article, partly broken away and in section, after removal of the same from the mold of Figure 8.

The improved method may be best described in connection with the operation and use of equipment illustrated in certain figures of the drawings. Referring particularly to Figure 1 thereof, there is illustrated semi-diagrammatically, apparatus for carrying out the method of

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the invention, the same including a latex measuring and supplying device A, a primary mold rotating machine B, one or more secondary mold rotating machines C, mold conveying and treating equipment D, article receiving racks E, and a drying or curing chamber F.

In carrying out the method as for example to produce a hollow rubber character animal G of the type best illustrated in Figure 11, the lower half or section 20 of a two-part cavity mold 21, of plaster of Paris, clay, or like porous material, is mounted on a horizontally positioned plate 22, of a mold support 23 of the mold rotating machine B (see Figure 2), the plate 22 being journaled in a sleeve 24 to rotate on a horizontal axis, and the sleeve 24 being pivotally mounted at 25 to supporting bracket 26 to be swingable to move the mold support 23 toward and from the latex measuring and supplying device A. In the chain-dotted position of the mold-supporting plate 23, indicated at B₁ in Figure 1, a predetermined volume of rubber latex. The term latex herein includes latex, or like aqueous dispersion of rubber or synthetic elastomer, is supplied to each of a plurality of article-forming cavities 23a, 23a in the lower mold half 20, as indicated at 27 in Figure 6.

Immediately upon supplying said predetermined volumes of latex 27 to the lower mold cavities the mold-holding apparatus B is swung away from the filling device A, to a position in which the upper mold section 20a may be readily placed in registry on the lower mold section 20, and then a releasable clamping device 29 is operated with respect to the support 23 to retain the mold sections thereon in tightly closed relation. In this last-named closed position of the mold it is engaged between a disc 30 rotatably mounted on the plate 22 and a coaxial disc 31 yieldingly and rotatably mounted on the shiftable clamping device 29, the common axis of the discs being at right angles to the axis upon which the support 23 rotates in sleeve 24.

Immediately after filling the lower mold cavities with the latex 27 the closed mold 21 may be manually rotated relatively of the support 23 about said axis of the discs, either independently or simultaneously with manual rotation of said support 23 about the axis of the sleeve 24, thereby applying a compound rotary movement to the mold about the two axes. The time elapsing between supplying the latex to the mold and completion of the above described preliminary rotation of the closed mold may be a matter of only a few minutes, one and one-half minutes having been found satisfactory in the use of synthetic rubber latex. Although this preliminary compound rotary movement preferably is carried out as quickly as possible after the latex pouring step the rotary motion itself is maintained slow enough that bubbles will not form on the mold cavity surface, and to obviate such whipping action which would cause foaming of the latex. The rotary movement described is effective to spread a thin preliminary deposit or skin-coating of the article-forming material 27 about the surfaces of the mold cavities to build up fully shaped articles of partial wall thickness (see Figure 7), at the earliest possible time after the latex is supplied to the mold. The quick preliminary coating step prevents the creation of defects in the nature of fissures in the outer surfaces of the deposited articles, caused by surface tension and/or premature setting or drying of the fluid material around the peripheries of the mold cavities at

the surfaces of the fluid bodies of latex therein (see Figure 6). The formation of such defects in the manner described is extremely objectionable, as in most instances they render the articles commercially unacceptable.

When once the preliminary skin-coatings 32 have been deposited about the interior of the mold cavities as best illustrated in Figure 7, the secondary rotary article-forming step may be accomplished in a more leisurely manner in one of the mold rotating machines C (see Figures 1, 3 and 4). Accordingly, while the preliminary mold rotating action is taking place the mold rotating device B may be shifted to the full-line position thereof shown in Figure 1, to be relatively closely adjacent the secondary mold rotating machines C. At this point the closed mold 21 is removed from the mold-holding device 23, and while the sections of the mold are retained in close registering position for placement in the rotating machine C for a secondary relatively slow compound rotary casting operation, a plurality of such molds 21 may be placed in a machine C in a stack, as made possible by said preliminary compound rotation step.

In the present instance the machine C is illustrated as containing five such molds, the same being stacked between spaced end plates 35 and 36, coaxially rotatably mounted on spaced cross-pieces 37 and 38 of a rectangular frame 39, which is in turn supported on spaced brackets 40 and 41 to rotate about a horizontal axis at right angles to the axis of rotation of the plates 35 and 36. The cross-piece 38 may be releasably shiftable outwardly of the frame, by suitable means as shown or otherwise, to permit such stacking or removal of molds from the frame. A suitable device 41a is provided in association with plate 36 to apply clamping action thereto for holding the molds tightly together. Adjacent molds of the stacks thereof may have small spacers 23b, 23b therebetween to permit substantially free circulation of air around each mold, as will be described later, and to facilitate handling of the separate molds. For rotating the mold supporting frame 39 about its horizontal axis, a relatively fixed shaft extension 42 therefrom has a gear 43 keyed thereto to be driven, through a chain 44 and sprocket 45, by suitable motor 46. To the end that the molds 21, together with the discs 35 and 36, may be rotated about an axis angularly of said horizontal axis, a shaft extension 47 from disc 35 has a bevel gear connection 48 with a shaft 49 carried by the frame 39, and a spur gear 50 on a free end of the shaft 49 engages a fixed relatively larger gear 51 secured to the fixed support 41. This arrangement is such that as the motor 46 drives gear 43 to rotate the frame 39 about the horizontal axis, this rotational movement of the frame carries spur gear 50 around fixed gear 51, said gear 50 thereby being driven to rotate shaft 49, and through bevel gears 48 applying rotary motion to the molds about an axis at right angles to the axis of rotation of the frame 39. The compound rotary motion thus attained in machine C is relatively slow, as for example approximately one revolution per minute about each of the two axes, preferably with a slight differential in the speeds about the respective axes to assure complete uniform latex coverage of all cavity surface areas. Highly satisfactory results have been attained by rotating the mold one revolution per minute about one axis and one and one quarter revolutions per minute about the other axis, or

otherwise in accordance with particular conditions or requirements. The compound rotary action provided by the machine C is effective to deposit the remainder of the article-forming latex body 27 about the interior of the mold cavities, over the previously deposited skin-coating 32, and thereby forming complete hollow articles G of predetermined uniform wall thickness (see Figures 8, 10 and 11).

The time required to complete this secondary compound rotational step may vary according to conditions, such as differences in the characteristics of the deposition material, desired thickness and size of the completed article, etc., but in actual full scale production of rubber toys of one type (see Figure 11) by the present method it has been found that latex deposition to full thickness may be accomplished in approximately forty-five minutes.

It has been found also that in forming hollow rubber articles in particular, the setting or gelling action of the latex on the mold cavity surface is relatively rapid during the initial compound rotational movements of the mold, and that as the rotational movement is continued the rate of speed of the setting or drying action becomes slower and slower until it levels off to a constant relatively slow setting action. This no doubt accounts for the improved success of the present method attained by providing a preliminary quick compound rotational movement of the molds to deposit a skin-coating, as described. That is, the tendency for the latex to adhere to the mold cavity at the surface of the latex body in the mold would be at a maximum immediately after the latex is poured into the mold.

After the secondary compound rotary action has been completed, machine C is stopped and the stack of molds is removed therefrom and placed on an intermittently operable conveyor 55, incorporated in equipment D shown in Figures 1 and 5. Conveyor 55 is in the nature of a progressively movable storage space, the same being operable to move mold stacks from one end of the conveyor to the other within a substantial period of time during which articles G in the respective molds will, by continued capillary removal of moisture from the deposited rubber through the pores of the molds, dry or set sufficiently to permit opening of the molds and ready removal of the articles therefrom without damage, at the leading end of conveyor 55 (see arrows in Figure 5). This step in the process, termed the pre-drying stage, may take about eight hours (for synthetic rubber). In other words, when each article is fully formed, by deposition or accretion of latex within its mold cavity, and is ready for removal from the mold, substantially all water from the initial predetermined quantity of latex 27 will have passed outwardly of the mold cavity by capillary attraction, through a myriad of pores in the mold material, the water being dissipated at the outer mold surfaces by evaporation. This substantially complete removal of water from the deposited latex (see Figure 8), together with the above referred to adhesion of the formed article to the mold cavity surface, no doubt accounts for the subsequent slight shrinkage which has been found to be substantially the same as the normal shrinkage of molded rubber articles made by "blowing" methods (about two per cent).

In connection with the pre-drying stage of the method it is now necessary to consider the previ-

ously described problem of damaged goods caused by formation of air bubbles, particularly during the latex deposition stage or stages. It has been found in actual practice that such conditions will be obviated if the capillary movement of water from the deposited latex is maintained continuously outward through the mold, from the cavity thereof, at all times while the deposited latex is in the molds. To this end, there may be provided over and around the conveyor 55, a heat-insulated hood or housing 56, having suitable openings 57 at opposite ends thereof to permit passage of the stacks of molds carried by the conveyor. Heated air is blown from a suitable source (not shown), through conduits 57, 57, to the interior of housing 56 and outwardly through a conduit 58, thereby circulating the air around the stacks of porous molds. A suitable temperature for the air for the present purposes is approximately 90° F. A temperature approximating 120° F. or over may cause expansion from within the completely formed hollow articles, which would force the molds open and thereby damage the articles. This moderately heated air, then, in circulating around the molds, including the spaces between adjacent molds as provided by spacers 23b, all during the pre-drying stage, will maintain the molds relatively dryer on the outside than on the inside (from the cavity surfaces), and as long as there is water in the latex deposits such water will be steadily dissipated outwardly by capillary attraction and evaporation and no wet layers or strata will be created to cause formation of recesses and holes in the articles, as previously described. This treatment of the molds, of course, is important for preparing the same for each succeeding article-forming cycle, because the mold will then have no localized water-saturated areas creating air pockets outwardly of the cavity surfaces, and when succeeding latex supplies are placed in the molds the molds will again be desirably wetter inside than out and the capillary movement of the water will be maintained continuously or at least consistingly outwardly as long as there is water in the latex or latex deposits.

After the molds have been on conveyor 55 the requisite length of time, as set forth above, they are removed and opened by suitable means (not shown) and the full-formed articles are removed therefrom, the mold halves being returned to the dispensing machine B, on conveyors 59, 59. The removed articles G may be placed on suitable racks E, which are then placed in a drying or vulcanizing chamber or oven F at sufficiently high temperature to complete the curing cycle.

The internal structure of the porous mold may be considered as cellular and comprising inter-connecting microscopic tubes or passages which carry water by capillary attraction from the cavity surfaces to the outer surfaces of the mold. Any condition of the mold in which the mold cavity surface is maintained wet and water in these tubes or passages extends continuously from the cavity surfaces, that is with no air-trapping pockets between said inner and outer mold surfaces, will result in the water or moisture from the deposition material or deposited article being continuously dissipated outwardly of the mold cavity by capillary attraction and evaporation, without creating air bubbles resulting in defective goods. In order that there will be no interruption in this continuous outward capillary movement of the water, which would create an adverse condition as previously described, it is

important to maintain at a minimum the period between the opening of each mold at the delivery end of conveyor 55, for removal of the articles therefrom, and refilling and closing the mold at dispensing machine A. In continuous operation of the process, utilizing return conveyor 59, when this period was maintained at approximately five minutes satisfactory articles were produced.

Although it is possible and practical to form completely closed hollow rubber toys, or so-called bathtub toys, by the present method, when the described drying or vulcanizing step in chamber F is utilized a relatively small vent aperture 61 is necessary in each article to prevent bursting thereof due to internal expansion caused by the high temperature of the chamber. The completed article is best shown in Figure 11.

Aperture 61 may be provided in each article, immediately after it is removed from its mold, as by use of a rotary or other punching tool (not shown). As illustrated in Figure 9, the aperture-punching step may be eliminated by provision of a pin 62 of metal or other non-porous material in each mold, the same projecting inwardly of the mold cavity surface a distance corresponding to at least the desired thickness of the article. Thus, when the latex is deposited on the mold cavity surface there will be little or no latex deposited on the pin (see Figure 10), and when the completed article is removed from its mold the pin or insert 62 will have formed a substantially perfect aperture through the wall thereof. The aperture 61 is shown formed on the foot of article G of Figure 11, although it may be provided on any part of the article, and this aperture may be utilized for installation of a metal whistle or noise-maker, in known manner.

When relatively high vulcanizing heat is applied in chamber F as described to shorten the curing period, the pressures internally and externally of the articles will be the same, due to the provision of vent apertures 61. Any shrinkage which occurs in the articles after removal thereof from the molds is relatively slight and is substantially uniform, regardless of the shapes of the particular articles being produced. Character animals or other hollow articles produced by the herein described method will have substantially uniform wall thickness throughout.

It will be seen from the above described angular velocities of the molds about angularly disposed axes (approximately one revolution per minute) and the length of time required to complete the deposition process, that successive compound rotations of the molds will progressively apply a substantial number of latex laminations, layer-upon-layer in each mold cavity, conforming accurately to the shape thereof. That is, each article G is built up of a series of laminations produced by layering latex solution onto the mold cavity surface with said compound rotations. Because the unused latex retains all of its water until deposition or accretion thereof takes place, it flows freely during the continued compound rotations of the molds and conforms accurately to the shape of every part of each mold cavity, including undercut portions of reentrants, sharp corners, and even such small parts as the ears, horns, tail, teats, etc. of the cow shown in Figure 8, will be hollow and of substantially uniform wall thickness as compared with the other parts of the article. When all of the latex 27 has been used up and the above described self-curing procedure of the article in the mold has been completed, substantially all of the water will have been removed from

the deposited latex. Upon removal of the article from the mold, therefore, it will be of substantially the same size and configuration as the mold cavity. Any shrinkage which takes place with further vulcanization of the article (at room temperatures or otherwise), will be at a minimum. The completed articles are seamless, as distinguished from articles made from preformed plural part "biscuits" of sheet rubber in the use of "blowing" methods.

Although the improved process has been described particularly in connection with the production of hollow rubber character animals, it may be similarly employed for producing other hollow articles such as rubber balls, athletic ball bladders, etc.

Similarly, the improved process may be successfully employed in the production of articles other than rubber, when the material thereof is adapted to be supplied as an aqueous solution and lends itself to setting through dehydration by capillary attraction in a porous mold.

The herein described method in accomplishing the stated objects of the invention makes possible the production of hollow articles which could not be produced heretofore by other known methods, particularly in multiple cavity molds or stacks of such molds. The resulting products are not only of superior quality but can be produced at greatly reduced cost, as compared with said known prior methods.

Modifications of the invention may be resorted to without departing from the spirit thereof or the scope of the appended claims.

What is claimed is:

1. A method of making hollow articles, comprising the steps of providing a plurality of sectional molds of porous material, each mold having a plurality of article-forming cavities therein and each cavity being supplied with a predetermined volume of aqueous dispersion material sufficient for forming an article of desired wall thickness, and while maintaining said molds in stacked relation applying compound rotary motion to the stack about a plurality of angularly disposed axes to deposit the predetermined volumes of dispersion material in successive accreted layerings over the surface portions of the respective article-forming cavities in diverse directions of flow of the dispersion material, whereby said deposition and accretion of the dispersion material is accomplished by removing water from the dispersion material by capillary attraction outwardly through the mold pores and evaporation at the outer mold surface portions.

2. A method of making hollow articles comprising the steps of providing a sectional porous mold having an article-forming cavity adapted to contain a liquid in all positions of rotation thereof and being adapted to be opened and closed, placing in said article-forming cavity a predetermined quantity of aqueous dispersion material capable of setting by removal of water therefrom, and thereafter applying to said closed mold a series of compound rotary motions about a plurality of angularly disposed axes to deposit said predetermined quantity of the aqueous dispersion material in successive accreted layerings over the surfaces of the mold cavity in diverse directions of flow of the dispersion material, whereby said deposition and accretion is accomplished by removing water from the dispersion material by capillary attraction outwardly through the mold pores and evaporation at the outer mold surface portions.

3. A method of making hollow articles comprising the steps of providing a sectional porous mold having an article-forming cavity adapted to contain a liquid in all positions of rotation thereof and being adapted to be opened and closed, placing in said article-forming cavity a predetermined quantity of latex aqueous dispersion material capable of setting by removal of water therefrom, and thereafter applying to said closed mold a series of compound rotary motions about a plurality of angularly disposed axes to deposit said predetermined quantity of the aqueous dispersion material in successive accreted layerings over the surfaces of the mold cavity in diverse directions of flow of the dispersion material, whereby said deposition and accretion is accomplished by removing water from the dispersion material by capillary attraction outwardly through the mold pores and evaporation at the outer mold surface portions.

4. A method of making hollow articles comprising the steps of providing a sectional porous mold having an article-forming cavity adapted to contain a liquid in all positions of rotation thereof and being adapted to be opened and closed, placing in said article-forming cavity a predetermined quantity of latex aqueous dispersion material capable of setting by removal of water therefrom, and substantially immediately thereafter applying compound rotary motion to said mold about a plurality of axes to deposit an initial coating of the dispersion material over the entire article-forming surface of the mold before sufficient time has elapsed for the dispersion material to set over less than the entire article-forming surface of said cavity, thereafter applying to said mold additional compound rotary motions about a plurality of axes to deposit the remainder of said aqueous dispersion material in successive accreted layerings over said skin coating in diverse directions of flow of the dispersion material, whereby said deposition and accretion is accomplished by removing water by capillary attraction outwardly through the mold pores and evaporation at the outer mold surface portions.

5. A method of making hollow articles comprising the steps of providing a sectional porous mold having an article-forming cavity adapted to contain a liquid in all positions of rotation thereof and being adapted to be opened and closed, placing in said article-forming cavity a predetermined quantity of latex aqueous dispersion material capable of setting by removal of water therefrom, applying to said closed mold a series of compound rotary motions about a plurality of angularly disposed axes to deposit said predetermined quantity of the aqueous dispersion material in successive accreted layerings over the surfaces of the mold cavity in diverse directions of flow of the dispersion material, whereby said deposition and accretion is accomplished by removing water from the dispersion material by capillary attraction outwardly through the mold pores and evaporation at the outer mold surface portions, drying the deposited layerings by capillary attraction until substantially all water has been removed therefrom through the mold pores, opening the mold, and removing the article therefrom.

6. A seamless hollow article produced by the method of claim 2.

7. A seamless hollow article produced by the method of claim 3, the outside of the article bearing the impressions of the mold surface portions, the article being of substantially accurately uni-

form wall thickness and free of a mold pouring opening.

8. A method of making hollow articles comprising the steps of providing a sectional porous mold having an article-forming cavity adapted to contain a liquid in all positions of rotation thereof and being adapted to be opened and closed, placing in said article-forming cavity a predetermined quantity of aqueous dispersion material capable of setting by removal of water therefrom, and thereafter applying to said closed mold a series of compound rotary motions about a plurality of angularly disposed axes to deposit said predetermined quantity of the aqueous dispersion material in successive accreted layerings over the surface of the mold cavity in diverse directions of flow of the dispersion material, whereby said deposition and accretion is accomplished by removing water from the dispersion material by capillary attraction outwardly through the mold pores and evaporation at the outer mold surface portions, the steps of the method being carried out while substantial proportions of the outer mold surface portions are constantly exposed to atmosphere of relatively lower humidity than the atmosphere within the mold cavity, whereby the mold cavity surface portions will be maintained constantly wetter than said outer surface portions thereof and whereby the water from the dispersion material will be continuously dissipated outwardly of the mold cavity by said capillary attraction and evaporation.

9. A method of making hollow articles comprising the steps of providing a sectional porous mold having an article-forming cavity adapted to contain a liquid in all positions of rotation thereof and being adapted to be opened and closed, placing in said article-forming cavity a predetermined quantity of latex aqueous dispersion material capable of setting by removal of water therefrom, and thereafter applying to said closed mold a series of compound rotary motions about a plurality of angularly disposed axes to deposit said predetermined quantity of the aqueous dispersion material in successive accreted layerings over the surface of the mold cavity in diverse directions of flow of the dispersion material, whereby said deposition and accretion is accomplished by removing water from the dispersion material by capillary attraction outwardly through the mold pores and evaporation at the outer mold surface portions, the steps of the method being carried out while substantial proportions of the outer mold surface portions are constantly exposed to atmosphere of relatively lower humidity than the atmosphere within the mold cavity, whereby the mold cavity surface portions will be maintained constantly wetter than said outer surface portions thereof and whereby the water from the dispersion material will be continuously dissipated outwardly of the mold cavity by said capillary attraction and evaporation.

10. A method of making hollow articles comprising the steps of providing a sectional porous mold having an article-forming cavity adapted to contain a liquid in all positions of rotation thereof and being adapted to be opened and closed, placing in said article-forming cavity a predetermined quantity of aqueous dispersion material capable of setting by removal of water therefrom, thereafter applying to said closed mold a series of compound rotary motions about a plurality of angularly disposed axes to deposit said predetermined quantity of the aqueous dispersion

material in successive accreted layerings over the surface of the mold cavity in diverse directions of flow of the dispersion material, whereby said deposition and accretion is accomplished by removing water from the dispersion material by capillary attraction outwardly through the mold pores and evaporation at the outer mold surface portions, retaining the resulting fully-formed article in the mold until it has become sufficiently set by continued capillary attraction and evaporation to permit removal of the article without damage thereto, removing the article from the mold, and exposing the article to open drying temperature.

11. A method of making hollow articles comprising the steps of providing a sectional porous mold having an article-forming cavity adapted to contain a liquid in all positions of rotation thereof and being adapted to be opened and closed, placing in said article-forming cavity a predetermined quantity of latex aqueous dispersion material capable of setting by removal of water therefrom, thereafter applying to said closed mold a series of compound rotary motions about a plurality of angularly disposed axes to deposit said predetermined quantity of the latex aqueous dispersion material in successive accreted layerings over the surface of the mold cavity in diverse directions of flow of the dispersion material, whereby said deposition and accretion is accomplished by removing water from the dispersion material by capillary attraction outwardly through the mold pores and evaporation at the outer mold surface portions, retaining the resulting fully-formed article in the mold until it has become sufficiently set by continued capillary attraction and evaporation to permit removal of the article without damage thereto, removing the article from the mold, and exposing the article to heat of vulcanization, an aperture being provided through the wall of the article prior to the vulcanizing step.

12. A hollow article produced by the method of claim 11.

13. A method of making hollow articles comprising the steps of providing a sectional porous mold having an article-forming cavity adapted to contain a liquid in all positions of rotation thereof and being adapted to be opened and closed, said mold being provided with a protuberance of substantially non-porous material extended into the mold cavity from the surface thereof, placing in said article-forming cavity a predetermined quantity of aqueous dispersion material capable of setting by removal of water therefrom, and thereafter applying to said closed mold a series of compound rotary motions about a plurality of angularly disposed axes to deposit said predetermined quantity of the aqueous dispersion material in successive accreted layerings over the surface of the mold cavity in diverse directions of flow of the dispersion material, but excluding the portion of the mold cavity occupied by said non-porous protuberance, whereby said deposition and accretion is accomplished by removing water from the dispersion material by capillary attraction outwardly through the mold pores and evaporation at the outer mold surface portions, said non-porous protuberance, by preventing accretion of the dispersion material in said excluded portion of the mold cavity surface thereby forming an opening in the wall of the article.

14. A method of making hollow articles comprising the steps of providing a sectional porous

mold having an article-forming cavity adapted to contain a liquid in all positions of rotation thereof and being adapted to be opened and closed, placing in said article-forming cavity a predetermined quantity of latex aqueous dispersion material capable of setting by removal of the water therefrom, and thereafter applying to said closed mold a series of compound rotary motions about a plurality of angularly disposed axes to deposit said predetermined quantity of the latex aqueous dispersion material in successive accreted layerings over the surfaces of the mold cavity in diverse directions of flow of the dispersion material, whereby said deposition and accretion is accomplished by removing water from the dispersion material by capillary attraction outwardly through the mold pores and evaporation at the outer mold surface portions, retaining the resulting fully-formed article in the mold until it has become sufficiently set by continued capillary attraction and evaporation to permit removal of the article without damage thereto, the foregoing steps of the method being carried out while a major proportion of the outer surfaces of the mold is exposed to the evaporative action and under controlled conditions whereby the mold will be maintained constantly wetter at the cavity surface portions thereof than at said exteriorly exposed surface portions of the mold and whereby the water from the dispersion material will be continuously dissipated outwardly of the mold cavity by said capillary attraction and evaporation, removing the article from the mold, and exposing the article to open heat of vulcanization, an aperture being provided through the wall of the article prior to the vulcanizing step.

15. Apparatus for producing hollow articles by deposition of aqueous dispersion material, comprising a plurality of sectional cavity molds of porous material each having at least one article-forming cavity therein adapted to contain predetermined quantities of the dispersion material in all positions of rotation of the molds, a mold support having guide means for removably retaining said molds in stacked relation, releasable clamping means on said support for clamping the molds in said stacked relation in said support, spacer means between adjacent molds of the stack, said support and spacer means being proportioned to provide for exposure of the pores of the molds over substantial proportions of the outer surface areas of the molds including the spaced adjacent surfaces of the same, means for

mounting said mold support to be rotatable about a plurality of angularly disposed axes to apply compound rotary motion to said mold stack, and means operable to apply said compound rotary motion to said mold support to deposit predetermined quantities of dispersion material in successive accreted layerings over the surfaces of the respective article-forming cavities, by capillary removal of water from the dispersion material outwardly through the mold pores and evaporation at said exposed outer mold surface areas.

16. A method of making hollow articles comprising the steps of providing a sectional porous mold having an article-forming cavity adapted to contain a liquid in all positions of rotation and having a non-porous portion to be presented inwardly of the mold cavity surface, placing in said article-forming cavity a predetermined quantity of aqueous dispersion material capable of setting by removal of the water therefrom, and thereafter applying to the mold a series of compound rotary motions about a plurality of angularly disposed axes to deposit said predetermined quantity of the solution in successive accreted layerings over the surfaces of the mold cavity in diverse directions of flow of the dispersion material, whereby said deposition and accretion is accomplished by removing water from the dispersion material by capillary attraction outwardly through the mold pores and evaporation at the outer mold surface portions, said deposition of dispersion material by being substantially ineffective as to said non-porous portion thereby providing a corresponding void in the wall of the article.

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