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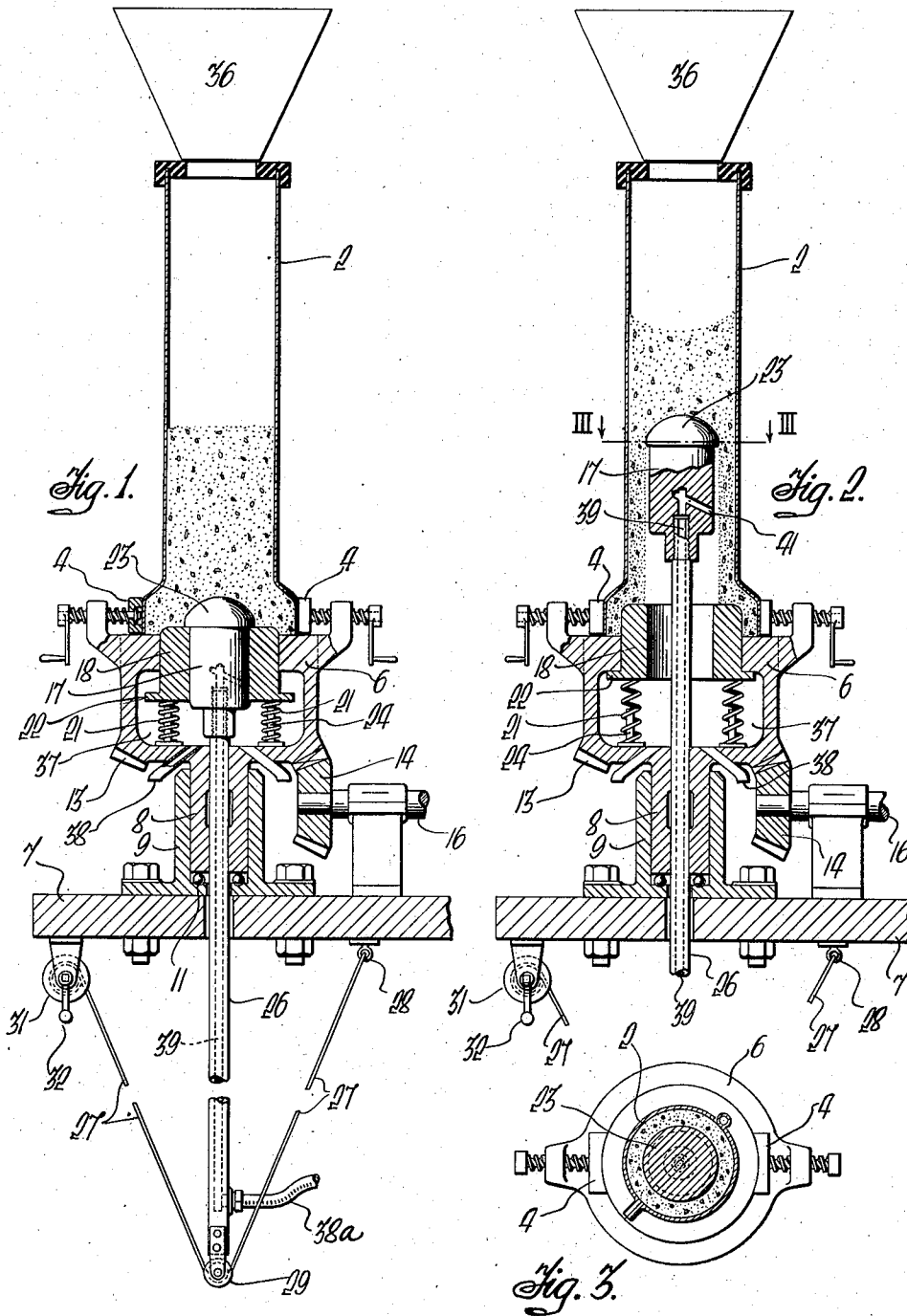
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METHOD OF AND APPARATUS FOR FORMING OR LINING PIPES

Filed July 1, 1927

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

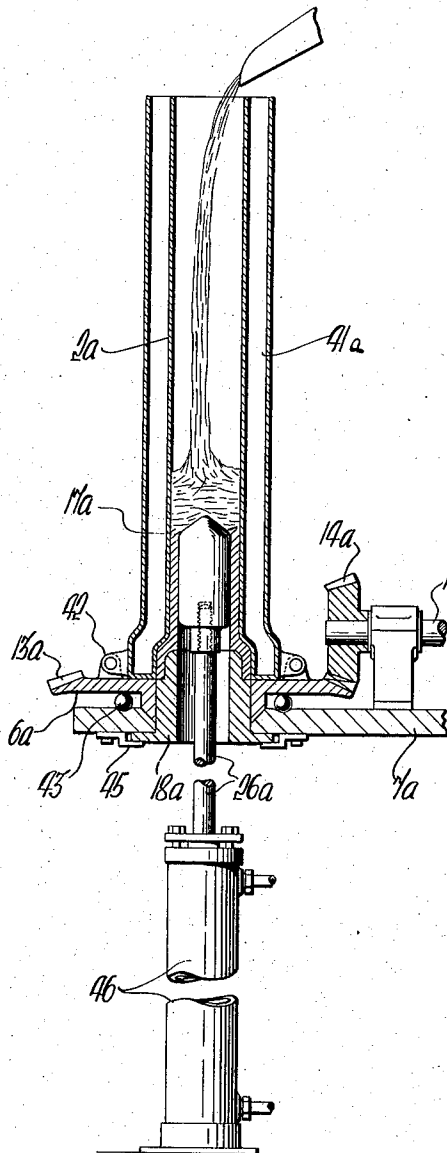


Fig. 4.

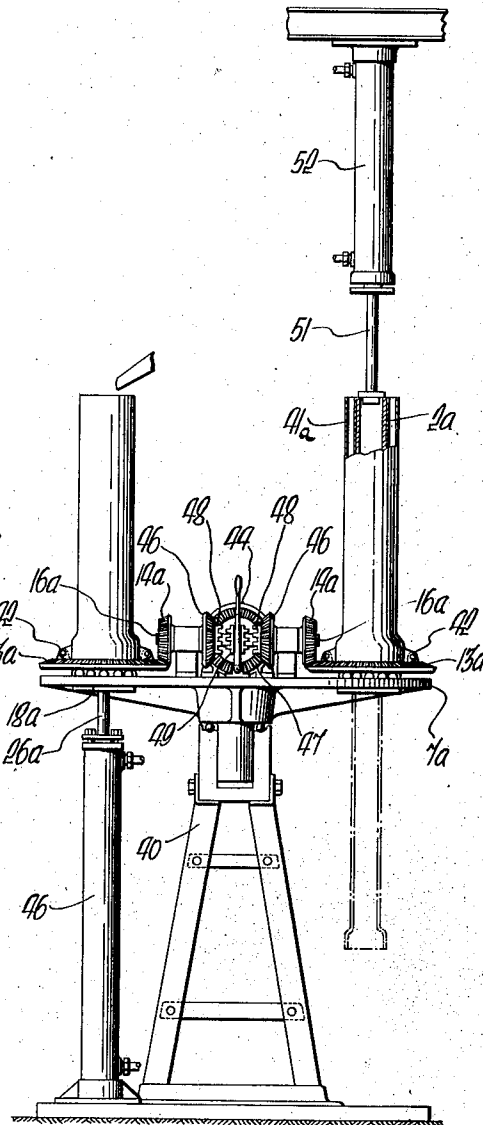


Fig. 5.

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METHOD OF AND APPARATUS FOR FORMING OR LINING PIPES

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This invention relates to the centrifugal molding of cementitious, bituminous, metallic or like materials, whilst in a plastic or semi-plastic condition, for the purpose of forming pipes or like bodies and/or lining preformed pipes with internal protective coatings. More particularly the invention is concerned with the centrifugal casting of pipes and pipe linings in rotary molds which are supported in a vertical attitude, and wherein a vertically movable core is utilized within the mold.

At present in the centrifugal casting of pipes and pipe linings from fluid materials where such methods are followed, difficulty is frequently experienced in properly distributing the plastic material within the vertically disposed mold, with the result that in many cases the pipe wall or lining is not uniform in thickness or density.

The primary object of the present invention is to overcome these difficulties and generally to facilitate and expedite the centrifugal casting of pipes or pipe linings which are of uniform thickness and density throughout.

In accordance with the method of the present invention a charge of plastic material is introduced into a vertically arranged rotary mold so that the material covers a distributing core which is normally disposed within and closes or partially closes the lower end of the mold. The mold is rotated at relatively high speed about its longitudinal or vertical axis and, simultaneously therewith, the said distributing core is moved upwardly and concentrically within the rotating mold so that the core progressively forces a central passageway through the pipe forming or lining material and spreads it upwardly and outwardly within the mold, the resultant annulus being consolidated against the inner surface of the rotating mold by centrifugal action.

It is considered that by practising the present method the production and lining of pipes may be expedited to a very great extent. Furthermore, it is considered that particularly beneficial results will arise in applying the present invention to the man-

ufacture or lining of relatively small diameter pipes, owing to the efficient manner in which the pipe forming or lining material is distributed within the mold or pipe.

A further object of the invention is to provide improved apparatus for carrying the foregoing method into effect.

Referring to the drawings which form part of this specification:—

Figure 1 is a vertical section through a mold and associated parts illustrating the manner of forming pipes or pipe linings in accordance with the present invention.

Figure 2 is a sectional view similar to Figure 1 but illustrating a more advanced stage in the formation of a pipe.

Figure 3 is a sectional plan view taken on the line III III of Figure 2.

Figure 4 is a vertical section illustrating an embodiment of the invention particularly suitable for the centrifugal casting of metal pipes.

Figure 5 is a diagrammatic elevation on a reduced scale, of a complete apparatus for centrifugally casting metal pipes, and embodying the arrangement of parts seen in Figure 4.

Assuming that it is required to produce concrete pipe, a suitable mold 2, (see Figures 1, 2 and 3) is employed and is adapted to be rotated whilst supported in a vertical attitude. The mold may be detachably held at its lower end by means of screw operated clamping jaws 4 to a ring member 6 rotatably mounted upon a table or bed plate 7, suitable means being provided to rotate said ring member and the mold at the required relatively high speed. This ring member 6 may be provided with a depending extension or hub 8 rotatably accommodated within a bearing member of bracket 9 which may be suitably secured to the said table 7. Anti-friction balls 11 or like devices may be associated with the ring member 6 and the table. The ring member may have a toothed face 13 adapted to mesh with a driving pinion 14 mounted on a shaft 16 supported by bearings on the aforesaid table or bedplate. This shaft may be operated by an electric motor (not shown) prefer-

ably of the variable speed type and also mounted on the table 7.

It is to be understood however, that instead of supporting and driving the mold at its lower end, it may, if desired, be suspended from its upper end.

In instances where it is desired to produce a pipe with a faucet end, the flared or faucet shaped end of the mold is arranged lowermost as shown in the drawings.

A material distributing core 17 is disposed in concentric or axial alignment with the vertically arranged mold and normally occupies a position within the lower end thereof as seen in Figure 1. A hollow plug 18 may also project through the central passage of the ring member 6 into the lower end of the mold in order to provide, in conjunction with the lower flared end of the latter, a faucet molding space of the required formation. The distributing core is preferably a sliding fit in the bore of the hollow plug, which may if desired, rotate with the mold and ring member. The core however does not rotate.

To enable the plastic material to enter readily into the faucet molding space, the hollow plug 18 may when the distributing core is in its lowermost position be depressed against the action of springs 21, as seen in Figure 1. The springs force the hollow plug upwardly into the molding space during the initial raising movement of the distributing core. The upward movement of the hollow plug 18 is limited by a shoulder 22 on the lower end thereof coming into contact with a co-acting shoulder of the aforesaid ring member 6, the springs holding the plug in the raised position as seen in Figure 2 until the distributing core is lowered after the molding of the pipe. For this purpose the core may have an enlarged head 23 which engages the top of the hollow plug when the core is nearing the end of its downward movement. Short stems 24 may be secured to and upstand from the lower part of the ring member 6 to guide the aforesaid springs associated with the hollow plug.

The material distributing core is preferably screwed to the upper end of a rod 26 which is a sliding fit in a central bore in the aforesaid ring member hub or extension 8. Co-aligned passages may be formed through the aforesaid table 7, and one or more bearings or guide members may be disposed beneath the vertically arranged mold to guide the distributing core in its upward and downward motions.

Any suitable means may be provided to reciprocate the distributing core; for instance, a winch device may be employed as indicated in Figure 1. A cable 27 may be secured at one end to a lug 28 on the under surface of the table 7 and pass around a

sheave 29 at the lower end of the core rod 26. The other end of the cable may be attached to the barrel of a windlass 31 supported beneath the table 7 and having a handle 32, whereby it may be operated as desired. In lieu of such winding mechanism a hydraulic ram may be employed whereby the core may be moved upwardly and downwardly through the centre of the mold at the will of an operator.

In forming a concrete or like pipe according to the invention, an appropriate charge of cementitious material is introduced through the open top of the mold 2, from a hopper 36 or the like, whilst the distributing core 17 is in its lowermost position, as seen in Figure 1, wherein the core and the aforesaid hollow plug 18, prevent the material escaping from the mold. The mold is rotated and the distributing core is simultaneously caused to travel upwardly and concentrically within the mold. During the initial raising of the core, the said hollow plug moves therewith under the influence of its springs 21, until it arrives at the position shown in Figure 2, thereby forming the required faucet moulding space. The upwardly moving core forces a passageway through the body of cementitious material and distributes it from the bottom to the top of the mold in the form of an annulus, which is consolidated or packed against the inner surface of the mold by the centrifugal force arising from the rapid rotation of the mold. The rotation of the mold may be continued until the annulus of cementitious material has set to the required extent. The distributing core takes no part in the actual packing or consolidation of the cementitious material, but serves to distribute the material throughout the length and diameter of the pipe so that it may be consolidated in the required form by centrifugal action.

The surplus moisture which forms a skin or film on the interior of the annular body may be removed therefrom during or after the centrifugal molding action. For instance, by arresting the rotation of the mold it will be evident that the surplus moisture will fall by gravity through the central passageway of the hollow plug 18 into the chamber 37 formed there beneath. By providing outlet openings, or discharge pipes 38 leading from this chamber, the surplus moisture may be led away to a suitable discharge. However, to ensure effective removal of all surplus moisture and other undesirable matter, and to impart smoothness to the inner surface of the pipe I may arrange for a current of air to be directed against the inner surface of the molded pipe whilst the mold is rotating. Accordingly air may be led under pressure, from a fan, pump or the like, for instance, by way of flexible tubing 38^a and a longitudinal passageway 39

formed in the distributing core rod, to an air discharge passage 41 formed in said distributing core, preferably in its lower portion. This discharge passage 41 may be substantially radial and open through the outer surface of the core, and a passage may, if desired, be inclined downwardly and outwardly from the horizontal so that the air issuing therefrom is diffused over a greater area of the inner surface of the pipe wall. Suitable provision may be made for controlling the discharge of the air through said passage 41 of the distributing core, such discharge occurring during the finishing operation, and preferably whilst the core is being moved downwardly from the top of the rotating mold.

Although not illustrated, it will be understood that reinforcement may be suitably positioned within the mold prior to the introduction of the cementitious material, so that reinforced pipe may be produced.

The lining of preformed metal or other pipes with protective coatings, for instance, of cementitious or like materials, is carried out in a similar manner and by similar apparatus with the exception that the mold 2 in such instances is substituted by the pipe to be lined.

To facilitate and expedite production the unit comprising a mold 2, ring member 6, a hollow plug 18, distributing core 17, distributing core operating means and associated parts, as seen in Figures 1 and 2, may be disposed at various circumferential intervals around the aforesaid table 7, which may be rotatably supported at its centre so that it may be partially rotated at intervals to bring each mold successively into different positions or stations, at each of which a certain operation or operations may be performed. These stations may, for instance, include a mold loading or filling station where pipe forming or lining material is fed into the mold; a molding or spinning station whereat the mold or pipe to be lined is rotated whilst the distributing core is moved upwardly therein; a finishing station whereat any finishing necessary to the pipe or lining may be carried out, and finally, a mold unloading station whereat the mold with the finished article therein may be unloaded and a fresh mold applied to the rotary table.

Referring now to the centrifugal casting of iron or other metallic pipes non divided molds 2^a, (Figs. 4 and 5) of one piece construction may be employed, each mold being provided with an external jacket 41^a to contain a cooling medium, such as water, and provision may be made, if so desired, for a thermo-siphonic circulation of the cooling medium therethrough. Suitable clamps 42 are provided to retain each mold 2^a in a vertical attitude upon a ring member 6^a.

This ring member may be rotatably mounted upon the upper surface of a rotary table 7^a supported by a suitable framework 40 as in Figure 5. Anti-friction means such as balls 43 or the like, may be interposed between the driving ring and the table. Any suitable means may be provided to rotate the driving ring and the mold at the required speed, such means may for instance, consist of an electric motor, indicated by the reference 44 in Figure 5, having its shaft connected by toothed gearing to a toothed face 13^a of said ring member 6^a.

Coinciding vertical apertures or passages may be formed through the ring member 6^a and the rotary table 7^a to accommodate a hollow plug 18^a which, in this instance may be detachably held to the under side of the table by turn buttons, or similar fasteners 45, so that the upper part of the hollow plug projects into the lower portion of the mold and in conjunction with the lower flared end thereof, provides the necessary molding space of faucet shape. The material distributing core 17^a may in this instance, be made of heat refractory material, or, if desired it may be made of metal and of hollow construction to contain a cooling medium such as water, which may be led from a cold supply into the interior thereof by means of a longitudinal passageway within the core rod 26^a to the lower end of which a supply hose may be connected.

The distributing core 17^a may be detachably connected to the upper end of a rod 26^a which is a sliding fit within the bore of the hollow plug, and one or more bearings or guide members may be provided beneath the table to guide the core rod in its vertical movements. Hydraulic mechanism may be employed to reciprocate the distributing core. The core rod 26^a may be connected at its lower end to a ram operating within a cylinder 46. The cylinder may be connected by piping with a reservoir or supply of some suitable fluid or liquid, and with a pump, whereby the fluid may be forced into the cylinder 46 on either side of the ram to effect raising and lowering of the rod 26^a. The piping may be provided with suitable valve means to control the flow of the pressure liquid to either side of the ram.

Two of the mold supporting and driving units seen in Figure 4 may be disposed at diametrically opposite positions on the rotary table 7^a as seen in Figure 5. The toothed faces 13^a of each ring member 6^a may mesh with toothed pinions 14^a mounted on co-aligned shafts 16^a, a clutch device being provided between the inner ends of these shafts and the shaft of the electric motor 44 whereby either shaft may be connected with the motor to thereby drive the respective mold. This clutch may comprise bevel pinions 46 loose on the shafts 16^a and

meshing with a bevel wheel 47 fixed on the motor shaft, each bevel pinion having a clutch face 48 adapted to be engaged by a dog clutch 49 which is axially movable on one of the shafts 16^a.

In carrying the invention into effect a charge of molten pipe forming material is introduced into the mold 2^a by way of its open top, whilst the distributing core 17^a is in a lowered position. The mold is rotated at the required relatively high speed and the distributing core is simultaneously moved upwards within the mold, thus progressively forcing a central passageway through the body of molten material and uniformly distributing it within the mold from the bottom to the top thereof. The resultant annulus is consolidated against the inner wall of the mold by centrifugal action. The material distributing core 17^a is preferably detached from its rod when it has arrived at its highest position. After the molded pipe has cooled it is removed from the mold.

As the molded material will tend to contract owing to congelation, the finished pipe may be readily extracted or ejected lengthwise through one of the open ends of the mold. For this purpose the rotary table 7^a may be partially turned about its axis, the distributing core rod 26^a being suitably lowered beneath the under surface of the table so that it will not impede such rotary movement, thus bringing the mold with the finished pipe therein into an unloading station where a suitable extractor or ejector device is located. The extractor or ejector may consist of a ram or plunger 51, operating by medium of a fluid under pressure in a hydraulic cylinder 52, which may be mounted in vertical alignment either above or below the mold at the unloading station as seen in Figure 5. The hollow plug 18^a may remain in position whilst the respective mold is being moved to an unloading position whereat the plug is removed. The plunger 52 may then be depressed against the upper end of the molded pipe to thereby force the same longitudinally out of the lower open end of the mold and through the passage in the table as indicated by broken lines in Figure 5.

When forming or lining spigot ended pipes the aforesaid hollow plugs 18, 18^a are unnecessary and the distributing cores 17, 17^a may be sliding fits within the bores of the ring members 6, 6^a.

Having now described my invention what I claim as new and desire to secure by Letters Patent is:—

1. A method for the centrifugal manufacture of pipes or pipe linings from plastic materials which consists in introducing a charge of the material into the open top of a rotary vertical mold so that the material

covers a vertically movable distributing core which is normally disposed within and partially closes the lower end of the mold, rotating said mold at relatively high speed about its vertical axis, simultaneously moving said distributing core upwardly within the rotating mold to thereby progressively form a passageway through the material and to distribute it upwardly and outwardly within the mold, subsequently lowering said distributing core within the mold, and at the same time causing a current of air to be directed against the internal surface of the molded annular body to thereby effect removal of surplus moisture and to impart a smooth finish to the interior of the pipe wall or lining.

2. A method for the centrifugal manufacture of pipes or pipe linings from plastic materials, which consists in introducing a charge of the material into the open top of a rotary mold, so that the material covers a vertically movable distributing core which is normally disposed at the lower end of the mold, rotating said mold at relatively high speed about its vertical axis, simultaneously moving said distributing core upwardly within the rotating mold to thereby progressively form a passageway through the material and to distribute it upwardly and outwardly within the mold, arresting the rotation of the mold when the distributing core arrives at or adjacent the top of the mold so that surplus moisture on the inner surface of the molded body may flow out of the lower end of the mold, subsequently resuming the rotation of the mold, and at the same time causing a current of air to be directed against the internal surface of the molded body, for the purpose specified.

3. Apparatus for the centrifugal manufacture of pipes or pipe linings from plastic materials, comprising in combination, an open ended mold, a ring member, means for detachably holding said mold at its bottom to said ring member in concentric relationship, therewith, means for imparting rotary motion to said ring member, a hollow plug within said ring member, springs supporting the plug and adapted to project it into the lower end of the mold, a vertically reciprocal non-rotary distributing core of circular cross section concentrically aligned with said mold and normally accommodated within said hollow plug to thereby prevent egress of the plastic material from the bottom of the mold, and means for raising said core through the body of material within the rotating mold to distribute material into the zone of maximum centrifugal force within the mold without exerting compressive force on the distributed material.

4. Apparatus for the centrifugal manufacture of pipes or pipe linings from plastic

materials comprising in combination, an open ended mold, means for supporting the mold in a vertical attitude, means for closing the lower end of the mold to prevent egress of the plastic pipe forming or lining material, a vertically movable distributing core concentrically aligned within the mold, said core being normally disposed within the lower portion of the mold and forming an element of said end closing means, means for rotating the mold at relatively high speed, means for raising said core through a body of the plastic material within the rotating mold, an air discharge pipe projecting into the mold, and means for directing air under pressure through said discharge pipe against the inner surface of the pipe or lining for the purpose specified.

5. Apparatus for the centrifugal manufacture of pipes or pipe linings from plastic materials, comprising in combination, an open ended mold, means for supporting said mold in a vertical attitude, means for closing the lower end of the mold to prevent egress of the plastic material, a vertically movable non-rotary distributing core of circular cross section concentrically aligned with said mold, said core being normally disposed at the bottom of the mold and forming an element of said end closing means, means for rotating the mold at relatively high speed about its vertical axis, means for raising said core concentrically through the rotating mold, and means for directing a current of air under pressure outwardly from said core against the internal surface of the molded pipe wall or lining, for the purpose specified.

6. Apparatus for the centrifugal manufacture of pipes or pipe linings from plastic materials, comprising in combination an open ended mold, means for supporting said mold in a vertical attitude, means for rotating said mold about its vertical axis, a hollow rod, a vertically reciprocal distributing core of circular cross section mounted on the upper end of said hollow rod and having a radial passageway which communicates at one end with the interior of said rod, said core being concentrically aligned within said mold and normally disposed at the bottom thereof to prevent egress of the plastic pipe forming or lining material, means connected to the lower end of said hollow rod, for raising and lowering said core, and means for delivering air under pressure into the said hollow rod, for the purpose specified.

7. Apparatus for the centrifugal manufacture of pipe or pipe linings from plastic materials, comprising in combination, an open ended mold, a ring member, means for detachably holding said mold at its bottom to said ring member in concentric relationship therewith, means for imparting

rotary motion to said ring member, a vertically movable distributing core of circular cross section concentrically aligned with said mold and normally disposed at the bottom thereof, said core and ring member preventing egress of the plastic material from the bottom of the mold, means for raising said core within the rotating mold, an air discharge pipe, and means for forcing air through said discharge pipe against the inner surface of the pipe or lining, for the purpose specified.

8. Apparatus for the centrifugal manufacture of pipes or pipe linings from plastic materials comprising in combination, an open ended mold, a mold supporting member, at the bottom of the mold, said supporting member having an opening which is concentric with the mold, means for rotating said mold at relatively high speed about its vertical axis, a hollow faucet forming plug capable of sliding vertically within the opening of said mold supporting member, a material distributing core, capable of sliding vertically within said hollow plug, said core being normally disposed adjacent the bottom of the mold to prevent egress of the plastic material and to depress said hollow plug so that the upper face of the latter is approximately flush with the bottom of the mold, means for raising and lowering said core within the mold, and means to yieldingly oppose depression of said plug and to automatically force same upwardly into the mold during initial raising movement of said core, for the purpose specified.

9. Apparatus for the centrifugal manufacture of pipes or pipe linings from plastic materials, comprising in combination, an open ended mold, means for supporting said mold in a vertical attitude, means for rotating said mold at high speed about its vertical axis, a vertically movable rod, a non-rotary material distributing core connected to the top of said rod in concentric alignment with said mold and normally disposed adjacent the bottom thereof to prevent egress of the plastic material, means operatively connected to the lower end of said rod to raise same and said core to cause the core to distribute the material without exerting compressive force thereon, and means for guiding said rod during its vertical movement for the purpose specified.

In testimony whereof, I affix my signature.

WALTER REGINALD HUME.