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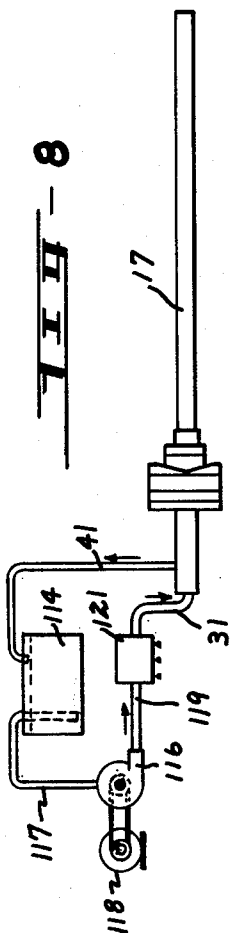
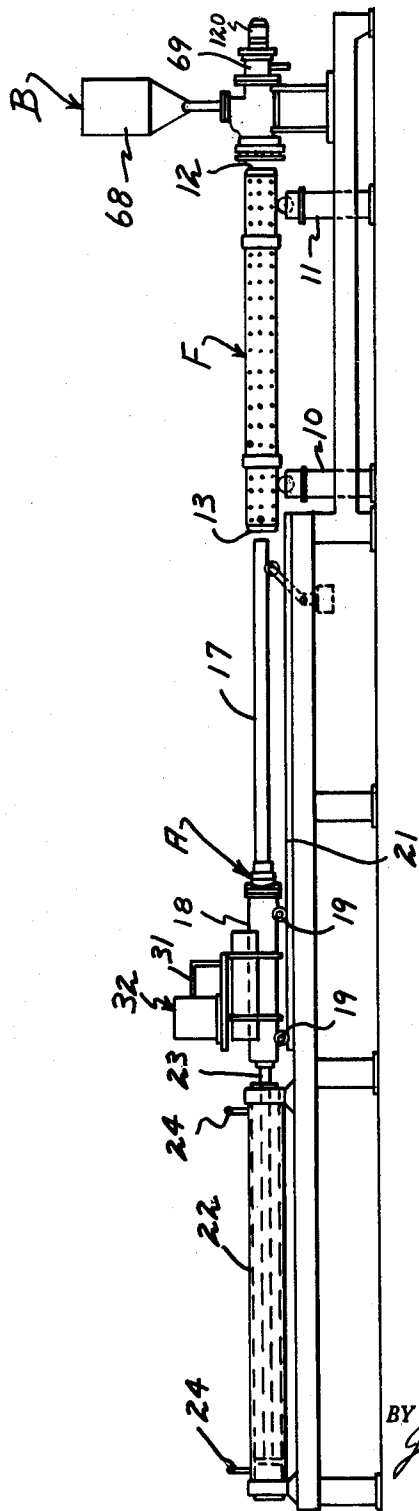
L. J. LE BLANC

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PROCESS AND APPARATUS FOR LINING PIPE MOLDS

Filed Oct. 6, 1961

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INVENTOR.
Leo J. LeBlanc
BY
James Carter & Thompson
Attorneys

Sept. 29, 1964

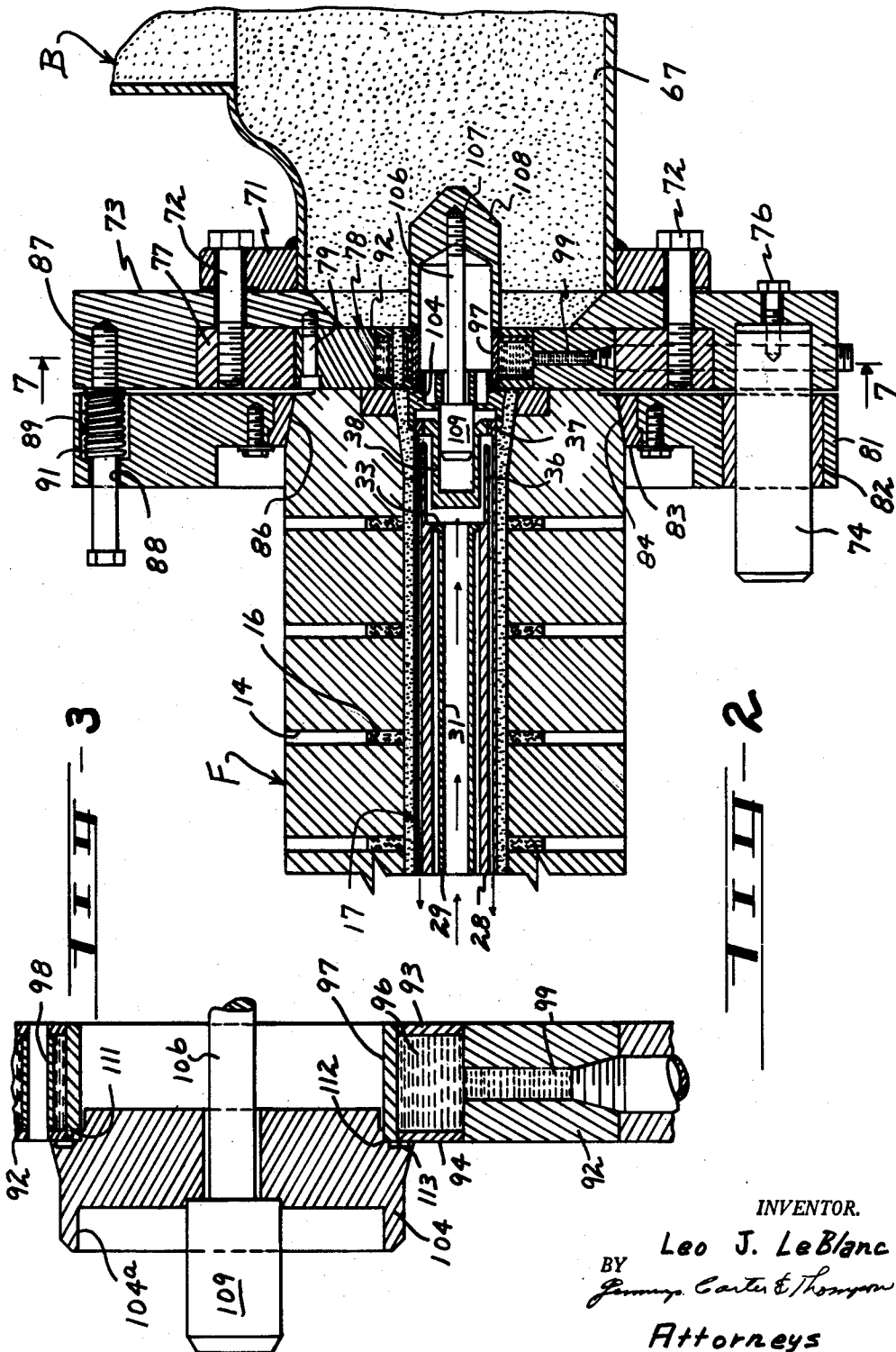
L. J. LE BLANC

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PROCESS AND APPARATUS FOR LINING PIPE MOLDS

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L. J. LE BLANC

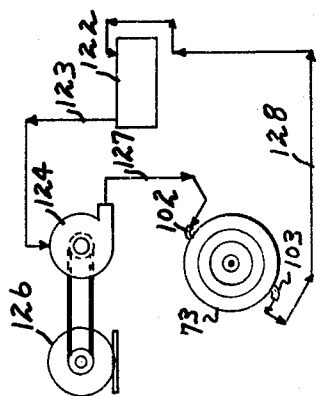
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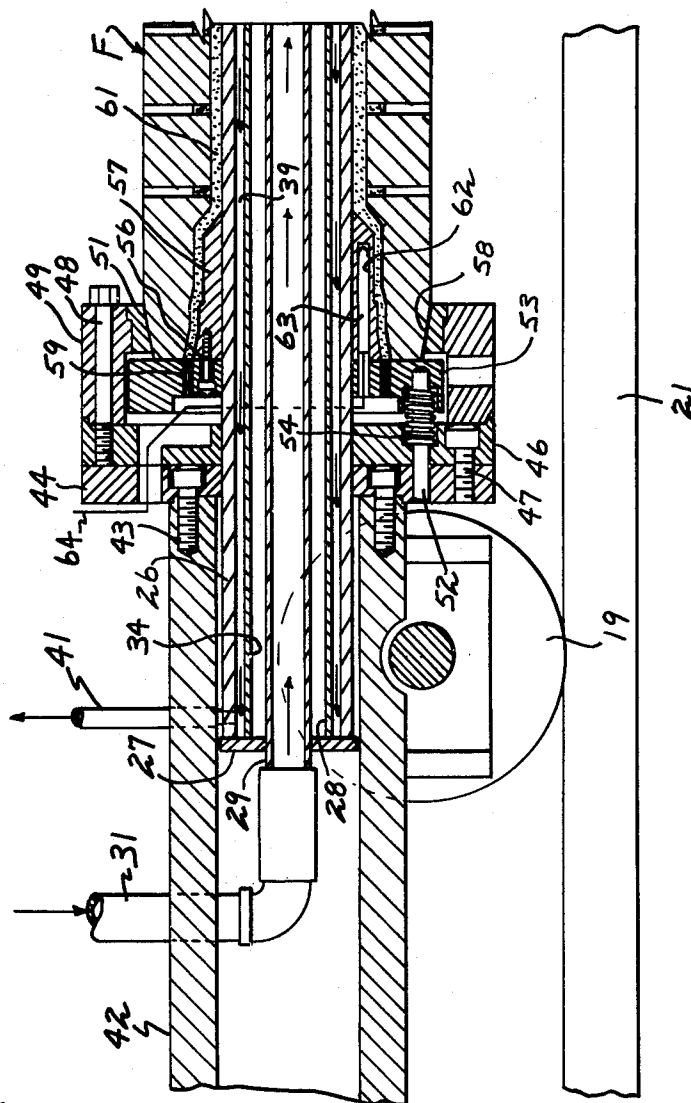
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INVENTOR.

Leo J. LeBlanc

BY

Jimmie Carter & Thompson
Attorneys

Sept. 29, 1964

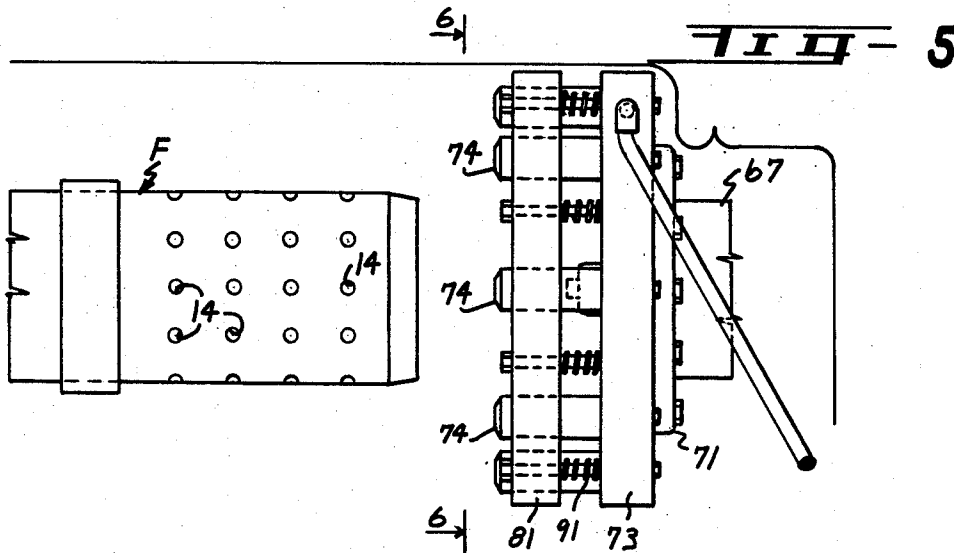
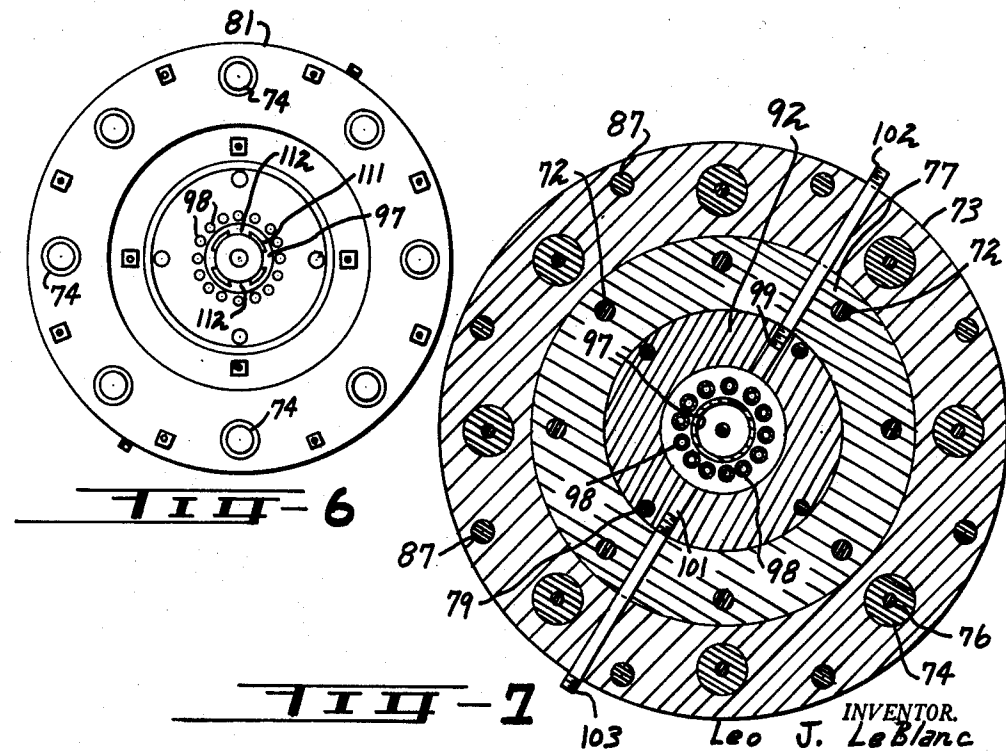
L. J. LE BLANC

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PROCESS AND APPARATUS FOR LINING PIPE MOLDS

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4 Sheets-Sheet 4



BY

Gemmings Carter & Thompson
Attorneys

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3,150,424

PROCESS AND APPARATUS FOR LINING PIPE MOLDS

Leo J. Le Blanc, Tyler, Tex., assignor to Woodward Iron Company, a corporation of Delaware
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9 Claims. (Cl. 22—36)

This invention relates to a process and apparatus for producing elongated cast articles, particularly cast iron pipe in lengths on the order of ten feet.

An object of my invention is to provide an improved process and apparatus for casting elongated articles such as cast iron soil pipe in which the pipe is cast against a resin-bonded sand lined mold or flask of substantial length, for instance over ten feet, and to deposit in the flask by blowing the resin-sand from one end thereof, thus to provide an extremely thin, uniform lining, employing a minimum amount of resin.

Another object is to provide a process and apparatus of the character designated in which a thermosetting resin-sand mixture is blown into the mold around a pattern internally and uniformly heated by means of a circulating heating fluid forced continuously through the pattern, thereby to prevent distortion of the pattern due to uneven heating and to provide a portion of the heat required to polymerize the resin.

Another and more general object is to provide a conformed casting surface, that is, conformed in the sense that such surface is an identical replica of the inner surface of the flask and the outer surface of the pattern, and to accomplish this by blowing a thermosetting resin-sand mixture from one end of the flask into the space between the mated flask and internally heated pattern, thereby to provide an accurate, low-cost lining which is exceedingly thin as compared to its length.

More specifically, an object is to employ in the production of linings for pipe molds a mixture of thermosetting resin and sand in which the proportion by weight of the resin may be as low as one percent by weight of resin to sand, thereby providing a mixture which may be blown from one end of a long flask to form a lining therefor, without the danger of choking the blow holes of the sand blowing equipment and without the danger of over-polymerization enroute to the far end of the flask.

A further object is to provide an improved resin bonded sand lined flask for centrifugal casting of elongated bodies such as cast iron soil pipe which mold may be on the order of ten feet in length in which the lining is on the order of one quarter inch thick and contains a polymerized resin bonding the sand and which when blown into the mold represents about one percent by weight of the sand making up the lining.

A still further object is to provide a sand lined flask for casting elongated bodies such as cast iron soil pipe in which the lining, while strong enough to withstand the washing action of molten metal, nevertheless is substantially non-adherent to the flask and the pattern, whereby after casting the entire lining is broken up and discharged from the flask upon ejection of the cast body, eliminating the necessity of having to scrub out the flask prior to relining.

Briefly, my invention is carried out by first providing a flask having in its walls a multiplicity of vent holes. Such flask may be a cast iron or steel cylinder having an inside diameter about one-half inch larger than the outside diameter of the pipe or the like to be cast. Mounted for reciprocation into and out of the flask from one end thereof, preferably the bell end, is a hollow pattern. A heated fluid such as oil is pumped continuously through the pattern as will be described herein to keep the pattern uni-

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formly heated throughout to about 500° F. The pattern is moved into the flask and held accurately centered therein and the flask is centered at each end relative to the pattern. Washed and dried silica sand containing about one percent by weight of resin to the sand, and at all events no more than one and one-half percent, is then blown into the mold from the end opposite that through which the pattern has been entered. The blowing equipment itself, except for the features specifically mentioned herein, is well known to the art. However, I have found it necessary carefully to regulate the area of the blow holes through which the sand passes from the blowing equipment to the cross sectional area of the space to be filled with sand. By way of example, for lining a flask to cast 10 foot long pipe, such flask has an inside diameter of 4¾ inches, and with a pattern therein 4¼ inches outside diameter, I employ a total of 20 holes, each ⅝ inch in diameter and spaced equally around the end of the space to be filled. The cross sectional area of the space to be filled in such an example is 3.54 square inches and the total area of the holes for passing the sand is 1.24 square inches, or a ratio of approximately 2.8 to 1. The lining thus formed is approximately ¼ inch thick. I have found that such a flask should have about 210 vent holes, each ½ inch in diameter and substantially equally distributed over the entire area of the mold. The sand used has an American Foundry Standards fineness number of about 50. The resin employed may be a polymerizable, liquid phenolic resin together with the proper proportion of accelerators and release agents such as calcium stearate, mixed with the sand as is customary in foundry practice. The resin-sand mixture is blown and sets in about twelve seconds, some of the heat for such fast setting coming from the residual heat of the flask from which a casting has just been removed and some of it from the heated pattern. The lined flask is then moved to a pouring station at which it is rotated while the molten metal is poured. Upon pushing out the casting the degree of bond afforded by the small amount of resin permits the lining to disintegrate and be pushed out along with the casting. I attribute the non-adhering characteristics of such lining essentially to the fact that the lining is so thin and contains so little resin that the resin is almost completely decomposed very shortly after solidification of the molten metal.

Apparatus suitable for carrying out my improved process and which also illustrates the constructional features of my invention is shown in the accompanying drawings in which:

FIG. 1 is a side elevational view, somewhat diagrammatic, and showing the pattern in position ready for insertion into a flask for blowing the same;

FIG. 2 is a fragmental view, being particularly a detailed vertical sectional view through a portion of the blowing mechanism with the flask in sand receiving position and filled with sand;

FIG. 3 is an enlarged detail, fragmental view through the blow plate and illustrating particularly the blow holes and the water jacket surrounding the same;

FIG. 4 is a fragmental sectional view of the flask and pattern inserted therein, at the bell or hub end of the flask;

FIG. 5 is an enlarged fragmental elevational view of the spigot end of the flask and a portion of the sand blowing mechanism;

FIG. 6 is an end elevational view of the blow head taken along line 6—6 of FIG. 5;

FIG. 7 is a reduced detail sectional view taken generally on line 7—7 of FIG. 2;

FIG. 8 is a diagrammatic view of the fluid system showing the means for heating and distributing the oil; and,

FIG. 9 is a diagrammatic view of the cooling system.

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Referring now to the drawings for a better understanding of my invention and particularly to FIG. 1, my improved apparatus comprises generally two parts. First, as indicated generally by the letter A there is a pattern supporting and reciprocating means, while at B is indicated generally a sand blowing station. It will be understood that the flask F is supported on trackways 10 and 11 so that it may be rolled into and out of sand blowing position as will appear. Furthermore, and while sand may be blown from either end of the flask, when making

bell and spigot pipe I prefer to blow the sand from the spigot end which is indicated at 12, the bell end being indicated at 13. It will further be understood that the flask F is of the vented type, the vents being a plurality of holes 14 drilled through the walls of the mold. Each hole 14 may be provided with a vent 16 which is preferably in the form of a copper tube filled with stainless steel wool.

Referring again particularly to FIG. 1, it will be seen that the pattern 17 is mounted, in a fashion to be described more in detail later, on a carriage 18. The carriage 18 is mounted on rollers 19 which travel on trackways 21. At 22 I show a double-acting fluid pressure cylinder having a piston rod 23 which is connected to the rear of the carriage. Fluid under pressure may be admitted to each end of the cylinder through the connections 24 as indicated by suitable control means and from a source of fluid under pressure, not shown. Upon admission of fluid through the connection 24 the pattern is reciprocated into the flask F.

Referring now particularly to FIGS. 2 and 4, it will be seen that the pattern 17 comprises an outer tube 26. The end of the hollow pattern adjacent the carriage is closed fluid-tight by a plate 27. Next inwardly of the outer plate 27 is a tube 28 which also is welded in fluid-tight manner to the plate 27. Next inwardly of the tube 28 is still another tube 29 which passes through the plate 27 and is connected to a source of hot oil through a pipe 31. Such a source of hot oil is indicated diagrammatically at 32 in FIG. 1 of the drawings and the unit 32 may contain a tank, means to heat the oil, and a pump for circulating the same as will presently appear.

At the forward end of the pattern the inner pipe 31 is fitted with a washer 33 which is welded or otherwise made fluid-tight at the said other end of the pipe 31 and pipe 28. This construction therefore provides an air space 34 between the inner pipe 29 and the intermediate pipe 28.

As shown in FIG. 2 the said opposite end of pipe 28 is extended at 36. Inserted into the outer pipe 26 of the pattern and welded thereto at 37 in fluid-tight manner is a combined closure and pattern centering and guide member indicated at 38.

From what has just been described it will be apparent that oil or other heated fluid may be pumped into the inner pipe through conduit 31 where it makes the passage through the pattern as indicated, returning to the end adjacent the closure 27 through the space 39 between the pipes 26 and 28. A return conduit 41 is provided in communication with the space 39. It will thus be seen that the pattern is heated uniformly throughout its entire length and, as stated, I preferably heat the oil to around 500° F. and maintain it at that temperature. I have found that constructed as shown the pattern is substantially free of all warping and that the liquid heating medium prevents deflection due to localized heating of the pattern.

Referring again to FIG. 4, mounted on a tubular extension 42 of the carriage 18 by means of studs 43 is an end plate 44. A pattern support plate 46 is secured by studs 47 passing through the end plate 44.

Mounted by studs 48, screwed into the plate 46 and spaced from the inner surface of plate 46, is a line up and flask supporting plate 49. A removable, inner ta-

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pered surface wear ring 51 is provided at the center opening of the plate 49.

Secured in the end plate 44 and passing through the pattern support plate 46 are a plurality of pins 52. These pins project slidably into suitable opening provided in a vent plate 53. Surrounding each pin, and interposed between the plates 46 and 53 are compression springs 54. Secured to the vent plate 53 by studs 56 is a hub pattern 57.

From what has just been described it will be seen that the tapered end 58 of the end 13 of the flask F is engaged and centered by the cooperating surfaces on the inner surface of the wear ring 51. Furthermore, when the carriage moves to the right as viewed in FIG. 1 to the position shown in FIG. 4, the vent plate 53 contacts against the face or end of the flask F and hub pattern 57 slides on the central pattern 17 against the force of the springs 54. Therefore, simply by moving the carriage 18 to the right into proper position pattern 17 is inserted, the flask is centered, and the vent plate is held resiliently yet firmly into contact with the end of the flask. It will be noted that the vent plate 53 is provided with a vented plate 59 which registers with the sand space 61 resulting between the outer surface of the print 57 and the inner surface of the flask.

It will further be noted that the print 57 may be provided with a plurality of openings 62 in which may be inserted cartridge type electric resistance heaters 63. The heaters may be provided with energy by means of an electrical connection indicated at 64. Further, the plurality of such heaters may either be in series or parallel, as desired. It will be seen that such heat may if desired be supplied by circulating heated fluid through suitable openings in the print or pattern 57.

Referring now particularly again to FIG. 2 of the drawings, it will be seen that as a part of the sand blowing equipment there is a sand chamber 67. As will be understood, the chamber 67 is always filled with sand from the hopper indicated at 68 and air for blowing the sand is supplied in suitable manner from a source not shown to the part 69 of the blowing equipment shown in FIG. 1.

Secured to the end of the sand chamber 67 as by welding is a flange 71. Secured to the flange 71 by studs 72 is a guide pin support plate 73. Projecting outwardly from the opposite side of the plate 73 from the flange 71 are a plurality of guide pins 74. These pins may be held in place by studs 76.

The studs 72 are threaded into a spacer ring 77. Filling the opening in the spacer ring 77, at its center, is a blow plate indicated generally by the numeral 78 and which may be secured by studs 79 to the guide pin plate 73. The details of the blow plate will be later described.

Slidably mounted on the extending ends of the guide pins 74 is a line-up ring 81. For convenience, bushings 82 may be provided which are replaceable and which slide on the pins 74. At its center the line-up ring 81 may be provided with replaceable wear ring 83 having a tapered surface 84 to fit a complementarily tapered surface 86 on the spigot end 12 of the flask F. Screwed into the ring or plate 73 are a plurality of studs 87 which pass slidably through suitable openings 88 in the line-up ring 81. The face of the line-up ring may be counterbored as indicated at 89. Around each stud 87 is a compression spring 91 which tends to urge the line-up ring outwardly, away from the guide pin ring or plate 73.

Referring again particularly to the details of the blow plate indicated generally at 78 it will be seen first that the plate comprises an annular disc 92 through which the studs 79 pass. As shown particularly in FIG. 3 there are welded to the central opening of the plate 92 a pair of washer-like plates 93 and 94. The plates 93 and 94 are spaced apart to define a water chamber 96, annular in configuration and which is closed at its center by a ring 97 also welded to the inner peripheries of the washers or plates 93 and 94.

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Passing across the water space 96, and secured as by welding into the washer-like members 93 and 94, are a plurality of tubelike blow holes 98. These may be in the form of drilled rods or the like. It will further be noted that these are spaced equally around the sand opening defined at the spigot end of the mold and of course are made water-tight. The plate 92 is drilled with a pair of radial openings 99 and 101 so that cooling water may be circulated into and out of the space 96, around the blow tubes 98. The opening 99 is connected to a supply of water, not shown, through a pipe which is indicated at 102 in the drawings and which pass through suitable holes drilled radially through the plates 73 and 77. In like manner, opening 101 is connected by a similar pipe 103 which passes through a hole in the members 73 and 77.

At 104 I indicate a spigot print. This print is secured to the central opening of the blow plate by means of a rod 106 having a threaded end 107 engaged in a drilled and tapped opening in an elongated nut member 108. On the inner end of the rod I provide a pattern centering guide member 109 which is adapted to fit snugly into the central opening of the guide member 38 which as will be remembered is on the end of the pattern. It will be noted that the spigot print is shouldered so that it rests against the inner surface of the blow plate and that the nut 108 is shouldered so that it rests against the opposite side of the blow plate. Therefore, upon tightening the nut the print 104 is held in place, as is the guide member 109, properly centered, in position to center the pattern when it is pushed into the flask.

It will be readily apparent that in continuous casting operation, the core print becomes hot. In view of the fact that it is in contact with the side or surface of the water cooled portion of the blow plate, I have found it necessary to reduce the transfer of heat between spigot print and the water cooled blow plate. To this end I reduce the contact area by undercutting the major portion of the periphery of the central ring 97 of the blow plate as indicated at 111. I leave pads 112, that is, segments of the periphery of the edge of the plate 97 are not cut. In order further to reduce the contact area I provide an annular undercut groove 113 in the back face or surface of the spigot print 104, as shown in FIG. 3.

In FIG. 8 of the drawings I show a means for heating and distributing the oil. Oil is pumped out of reservoir 114 by pump 116 through line 117, and pump 116 is driven by motor 118. The oil passes through line 119 to a heater 121 which heats the fluid to 500° F. and then the oil passes through line 31 into the pattern 17 which has been described herein. Heated oil returns through line 41 to reservoir 114.

In FIG. 9 of the drawings I show a cooling system for the blow plate 78. Water is pumped from cooler 122 through line 123 by pump 124 which is driven by motor 126. Water enters the blow plate through lines 127 and 102 and returns by lines 103 and 128 to cooler 122.

From the foregoing the method of carrying out my improved process and of constructing and using my improved apparatus may now be explained and understood.

The chamber 67 of the sand blowing equipment B is maintained full of sand containing, as stated, by weight, no more than one and one-half percent (1½%) of a thermosetting phenolic resin of the kind commonly used in foundry practice. A flask F is rolled into place, whereupon the cylinder 22 is actuated and the carriage 18 moves to the right as viewed in FIG. 1. The first action is for the centering ring 51 at the bell end to contact the tapered section 58 at the bell end of the flask. Along with this action the face or end of the flask contacts the face of the vent plate 53 and, due to the provision of the springs 54, the vent plate is held resiliently in contact with the end of the flask. Continued righthward movement of the carriage, after contact of the ring 51 with the bell end of the mold, in like manner forces the tapered surface 86 against the tapered wear ring 83, compressing

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the springs 89, and bringing the end of the flask into proper relation to the blow plate. It will be understood, also, that the centering member 38 carried by the end of the pattern engages snugly around the centering pin 109, thus accurately to center the pattern. Therefore, the combination with the pattern centering means and the two spring loaded centering means for the flask assures that the flask and pattern are in correct, centered relation.

With the parts thus assembled a valve controlling a supply of air under pressure, not shown and indicated diagrammatically at 120 in FIG. 1, is opened momentarily, usually for a period of about two seconds, and sand containing the resin is blown into the space between the outer surface of the pattern and the inner surface of the flask. During all of this time heated oil is being circulated through the pattern. That is, I continuously circulate oil in order to maintain the temperature of the pattern at around 500° F. The air carrying the sand escapes through the vent holes 14 of the mold and the sand is effectively stopped against blowing out the bell end by the action of the vent plate 53. The continuous circulation of water around the tubes forming the blow holes 98 prevents these tubes from becoming hot enough to polymerize the resin of the sand and effectively prevents them from becoming clogged. Likewise, the provision of the undercut at 111 in the plate 97 together with the undercut 113 in the back side of the spigot print 104 greatly reduces the heat transfer between the heated spigot prints and the blow plate.

From the foregoing it will be apparent that I have devised an improved process and apparatus for sand lining flasks for pouring elongated articles. My improved process and apparatus is in commercial production and has proved to be highly satisfactory in every manner. By using a very thin lining, such as a quarter-inch thick for 4 to 6 inch diameter pipe, and by greatly reducing the amount of resin, I not only lower the resin cost and the sand handling cost, but in like manner provide a non-adherent lining. In practice I find that there is no difficulty in withdrawing the pattern with the resin sand mixture herein specified. Further, after the pipe is poured it is pushed out by pushing against the spigot end and the degree of bond of the sand is such that all of the sand comes out of the mold quite cleanly and evenly, eliminating having to scrub out the flask before relining the same.

It will be especially noted that in my improved apparatus the parts are so constituted that there is no likelihood of sand collecting between portions of the same which have to match or contact when the flask is at the blowing station. For instance, the spigot print 104, being provided with the interiorly undercut portion 104^a slidably receives the outer end of the pattern and effectively prevents sand from accumulating on the end of the pattern or in the recess 104^a. Likewise, this arrangement effectively prevents the accumulation of sand in the opening in member 38 which slidably fits over the pin 109.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What I claim is:

1. The process of lining elongated hollow vented pipe flasks and the like which comprises inserting through one end of the flask and holding centered therein a hollow pattern, uniforming heating the entire surface of the pattern to about 500° F. by circulating therethrough a liquid heating medium, blowing from the other end of said flask into the space between the flask and pattern a quantity of sand coated with about 1% by weight of a thermosetting resin and in an amount sufficient to fill said space, holding the pattern in place until the resin sets, and withdrawing the pattern.

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2. The process of lining elongated hollow vented pipe flasks and the like which comprises inserting through one end of the flask and holding centered therein a hollow pattern, uniformly heating the entire surface of the pattern to about 500° F. by circulating therethrough a liquid heating medium, the difference in outside diameter of the pattern relative to the inside diameter of the flask being about 1/2 inch, blowing from the other end of the flask into the space between the flask and pattern a quantity of sand coated with about 1% by weight of a thermosetting resin and in an amount sufficient to fill said space, holding the pattern in place until the resin sets, and withdrawing the pattern, thereby to provide a lining capable of being cast upon and which is substantially non-adherent either to the flask or to said pattern.

3. In apparatus for blow lining flasks with sand coated with a thermosetting resin, a blow plate member adapted to fit against one end of the flask and having a plurality of tubes passing therethrough and defining holes through which the resin coated sand is blown, means to cool the outer surfaces of the tubes defining said holes, a heated pattern member having a part disposed to be contacted by the sand of the finished lining and having a part in contact with the blow plate, and means to reduce the amount of heat transmission between the heated pattern and the blow plate comprising a contact section of reduced surface area on one of said members in contact with the other thereof.

4. In apparatus for blow lining flasks with sand coated with thermosetting resin, a blow plate having a plurality of tubes passing therethrough defining holes laid out in a circular pattern through which the resin coated sand is blown, means to circulate a cooling medium in direct contact with the outer surfaces of said tubes, a heated pattern lying inwardly of the flask relative to the blow plate and disposed in contact with the inner surface of the blow plate lying radially inwardly of the tubes, and means to reduce the area of contact between the heated pattern and blow plate, thereby to reduce the rate of heat transfer between the pattern and blow plate.

5. In apparatus for blow lining vented flasks and the like with sand, a pattern, means supporting the pattern in cantilever fashion for entry into the flask and effective to hold the end of the pattern adjacent said means in centered relation with the adjacent end of the flask, sand

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blowing means adjacent the opposite end of the flask, flask centering means located at each end of the flask each of which embodies a centering ring resiliently biased toward the respective ends of the flask, and means located adjacent the end of the flask nearest the sand blowing means effective to hold the end of the pattern adjacent thereto centered in said end of the flask.

6. Apparatus as defined in claim 5 in which the resiliently mounted flask centering means each comprises a flask centering ring having a tapered inner surface, and in which the flask is provided at each end with complementarily outer tapered surfaces disposed to cooperate with the tapered inner surfaces of said rings.

7. In apparatus for blow lining flasks and the like with sand coated with a thermosetting resin, a hollow pattern, means to circulate a hot fluid through the pattern thereby to maintain the outer surface thereof at a substantially constant uniform temperature, sand blowing equipment including a blow chamber and a blow plate having tube-like sand passages therethrough, means to circulate a cooling fluid around and directly in contact with the outer surfaces of the tube-like sand passages thereby to maintain the inner surfaces thereof below the setting temperature of the resin, and means to hold the pattern centered within the flask while filling the same.

8. Apparatus as defined in claim 7 in which the pattern carries a print having a portion disposed in contact with the blow plate when filling the flask, means to heat the print, and means to reduce the transfer of heat between the print and blow plate.

9. Apparatus as defined in claim 8 in which the means to reduce said transfer of heat comprises a reduced area contact section between the heated print and the blow plate.

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