Nov. 20, 1962 R. C. COOPRIDER 3,064,310

METHOD AND APPARATUS FOR MAKING PLASTIC ARTICLES

Filed April 20, 1960 2 Sheets-Sheet 1

FIG. 1.

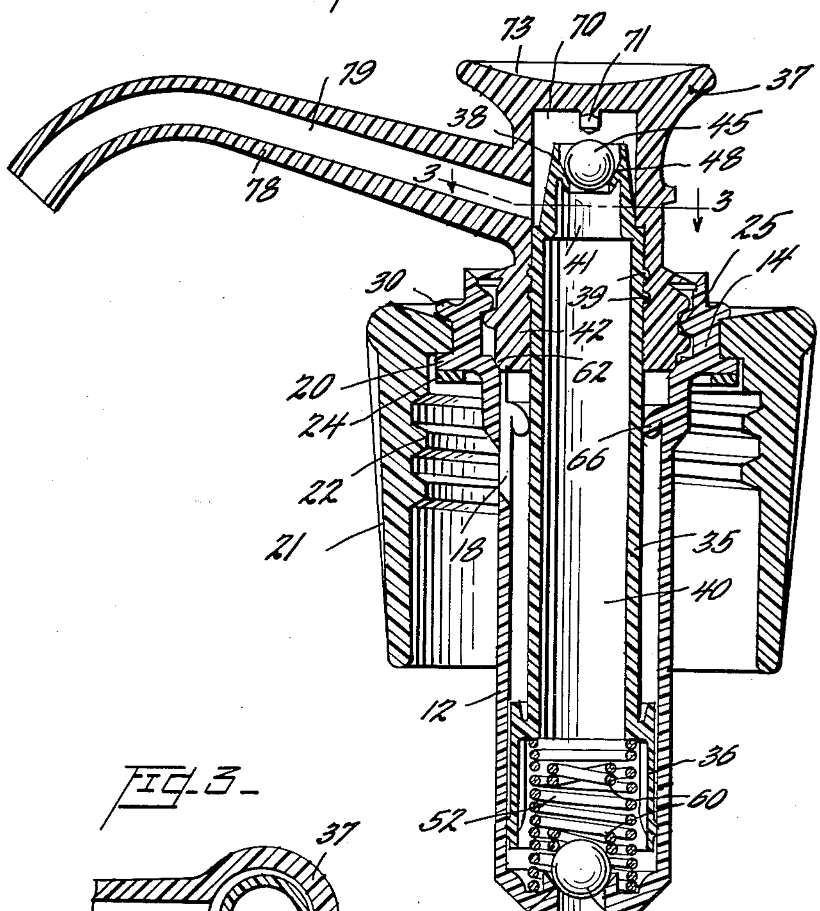
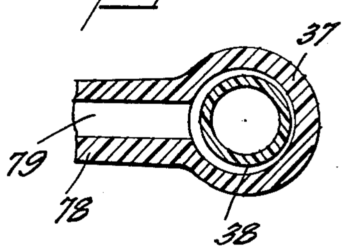


FIG. 3.



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2 Sheets-Sheet 2

FIG. 2.

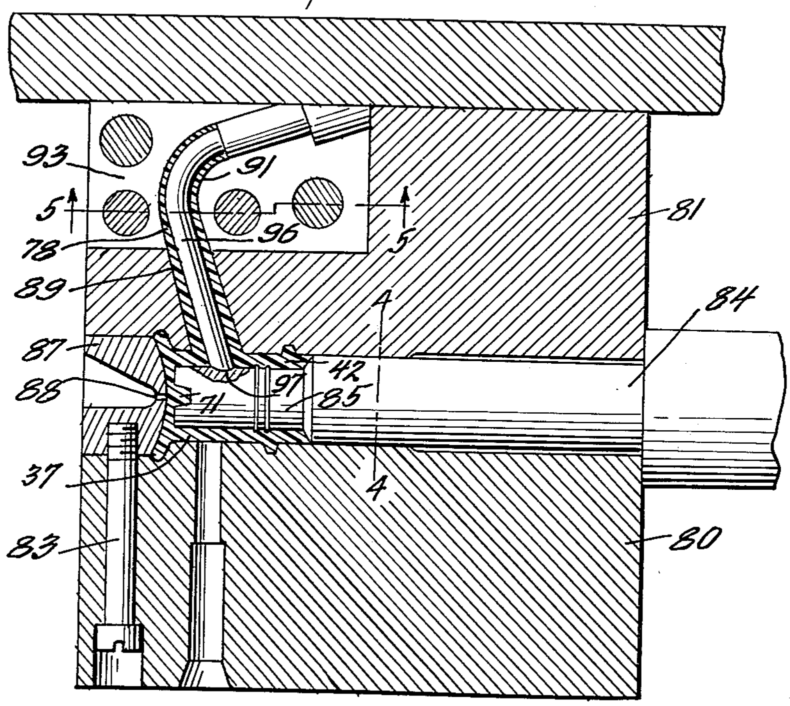


FIG. 4.

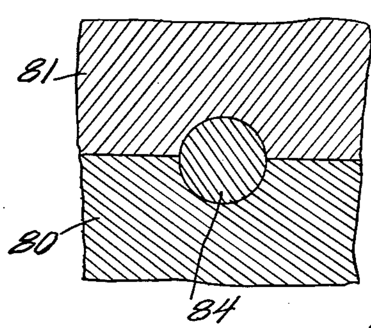
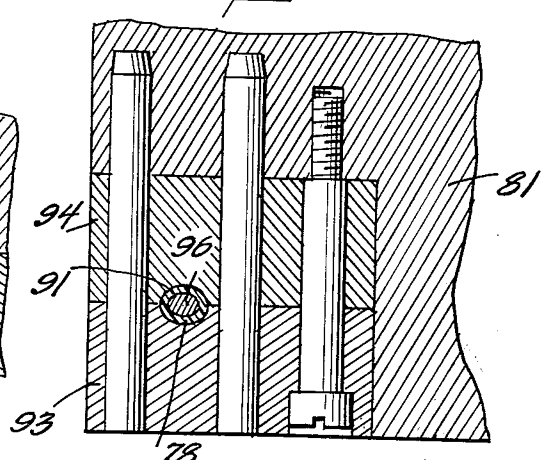


FIG. 5.



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United States Patent Office

3,064,310
Patented Nov. 20, 1962

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3,064,310

METHOD AND APPARATUS FOR MAKING PLASTIC ARTICLES

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Filed Apr. 20, 1960, Ser. No. 23,469
5 Claims. (Cl. 18—42)

This invention relates to an improved method of casting plastic articles by the injection molding process, and is more particularly concerned with the molding of a one-piece head and spout for fluid dispensers.

It has long been the practice to employ, for the dispensing of liquids from small containers, hand actuated pumps formed of moldable plastic material comprising, in assembled relation, a stationary unit for direct association with the container, and a reciprocable piston unit which is manipulated to effect discharge of the container contents. The reciprocable unit normally comprises a plunger having at its lower end a piston, slidably received in a barrel or cylinder forming part of the stationary unit and, at the upper end of the plunger, a head having an integrally formed laterally directed discharge spout, the head being depressible by the finger while the container is held in the hand for the purpose of reciprocating the plunger and piston to discharge liquid upwardly through the interior of the head and out of the spout.

At its outer end the spout is frequently bent or curved downwardly to direct the discharging liquid where desired, for instance as shown in the patent to Stewart and Cooprider 2,846,124, granted August 5, 1958. In that patent the spout is formed separately from the head, and casting the spout in its final configuration offers no problem, since the spout core can be made in two separable sections, withdrawn from the opposite ends of the spout. Where, as in my prior application, Serial No. 777,264, filed December 1, 1958, the spout is formed integrally with the head, it has heretofore been the practice to cast a straight spout, and thereafter to bend the outer end of the spout downwardly while maintaining the spout at an elevated temperature. While this latter procedure has involved no problems in casting, since the spout is readily withdrawn by lengthwise displacement from the die or mold and core by which it is formed, the added step required to provide the bent configuration of the outer end of the spout has involved additional time and expense.

It is an object of the invention to avoid this additional step in the production of an integral head and spout by casting the spout initially in the bent or curved configuration, and thereafter withdrawing the die and core by which it is formed while the spout is still sufficiently hot to permit the same to straighten out as it moves through the straight portion of the die. Contrary to what would be expected, the spout resumes, at least in part, its bent or curved configuration as soon as withdrawal from the die is complete, and the additional step of deforming the spout after withdrawal of the article from the die may thereby be eliminated.

Further objects and features of the invention will be apparent from the following description taken in connection with the accompanying drawings, in which

FIGURE 1 is a vertical sectional view of a dispenser of the type hereinbefore described, having an integrally formed head and spout to which the method of the present invention is applicable;

FIGURE 2 is a sectional view of a die or mold suitable for the casting or injection molding of an integral head and spout of the type shown in FIGURE 1 by the method of the present invention;

FIGURE 3 is a section on the line 3—3 of FIGURE 1;

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FIGURE 4 is a section on the line 4—4 of FIGURE 2, and

FIGURE 5 is a section on the line 5—5 of FIGURE 2.

To promote an understanding of the invention, reference will now be made to the preferred embodiment thereof illustrated in the accompanying drawings and specific language will be used to describe the same. It will nevertheless be appreciated that no limitation of the scope of the invention is thereby intended, such further modifications and alterations being contemplated as would normally occur to one skilled in the art to which the invention relates.

Referring first to FIGURE 1, the dispenser there illustrated includes a stationary unit which may be molded in one piece to provide a barrel or cylinder **12** from which a suction tube **13** depends and, at the upper end of the barrel **12**, a collar portion **14**, noting that throughout the following description the dispenser will be assumed to occupy the upright position in which it is normally used.

The upper end of the barrel **12** is preferably slotted at circumferentially spaced points, as indicated at **18**, for the purpose of preventing the formation of an airlock in the barrel **12** above the piston, to permit ingress to the container of air in order to replace discharged liquid, and to allow drainage into the container of liquid which may pass the piston and which would otherwise be trapped in the upper portion of barrel **12**.

A radial annular flange **20**, formed on the collar portion **14**, provides a seat for container cap **21**. Cap **21** is apertured to receive collar portion **14** and is internally threaded as shown at **22** for cooperative engagement with external threads formed on the neck of the container; a gasket **24** may be positioned beneath flange **20**.

The collar portion **14** is further provided at its upper end with an interiorly threaded sleeve portion **25**, and an annular lip **30** which is formed by deformation of sleeve portion **25** after assembly of the container cap **21** thereon, in order to lock the cap on the collar portion **14**.

The stationary and reciprocable units of the dispenser may be formed of any moldable plastic materials, preferably materials commonly designated thermoplastics, for instance, polyethylene and polypropylene. Excellent results are achieved by the use of a polyethylene sold under the trade mark "Super Dylan" by Koppers Company, Inc., of Pittsburgh, Pennsylvania. Vinyl chloride acetate is also highly effective, and in general, any plastic material subject to hot or cold flow, capable of being molded, and readily deformed after molding in response to heat and/or pressure may be employed.

The reciprocable unit of the dispenser comprises a plunger **35** and a dependent hollow piston **36**, the piston being enlarged in diameter at its lower end to fit snugly the interior wall of barrel **12**; the plunger and piston may be integrally formed by injection molding.

The interior of plunger **35** defines a fluid passage **40**, communicating at its upper end with a passage **41** which is provided with a valve seat **48** receiving a ball valve **45**. Movement of fluid upwardly in the passages **40**, **41** is thus normally unimpeded, the valve **45** serving merely as a check valve to prevent downward movement of fluid. At its upper end, the plunger **35** is preferably tapered upwardly to provide a conical portion **38**. A discharge head **37**, preferably cast separately, from thermoplastic resins of the type hereinbefore described, is recessed internally for reception with a snug fit on the upper end of the cylindrical portion of the plunger **35**. A spout **78**, bent or curved as shown, projects laterally from the head; discharge passage **79** extending through the spout communicates with head chamber **70**. Assembly of the head **37** on the plunger **35** is effected by applying endwise pressure to force the head downwardly on the plunger until it assumes the position shown, in which annular beads **39** on the plunger seat in coacting annular grooves in the interior of the head, the head yielding sufficiently to pass it over the beads. The head and plunger, thus assembled, are fitted together sufficiently tightly to prevent egress of fluid therebetween.

The tapered portion **38** of the plunger **35** terminates short of the upper end of the head **37**, providing a chamber **70**, into which passage **41** opens. A stud **71**, projecting downwardly from the finger rest portion **73** of the head into chamber **70** serves as a retainer for the ball valve **45**.

Received within piston **36** and seated in the lower end of barrel **12** is a coil compression spring **52**, acting to urge the reciprocable unit upwardly. Ball valve **55**, seating by gravity in the lower end of barrel **12**, acts as a check valve to prevent drainage of liquid downwardly from the barrel **12**. Preferably the seat **56** for ball valve **55** forms an angle of at least 45° with the axis of the dispenser to minimize the possibility of wedging of the valve in its seat.

Spring **52** is formed with convolutions **60** of reduced diameter, preferably adjacent each end, as shown, to provide reversibility. In the position which the parts occupy in FIGURE 1, the reciprocable unit being fully depressed, the ball valve **55** is engaged by the adjacent small convolution **60** of spring **52** to hold the valve tightly against its seat, thus preventing flow of liquid into the barrel and outwardly through passages **40** and **41** when the dispenser is inverted.

At its lower end the head is formed to provide a depending skirt portion **42**, formed with external threads which coact with the internal threads on the collar portion **14** of the barrel **12**. When the head is thus screwed down within the collar, as shown in FIGURE 1, coacting inclined surfaces **62** on the head and barrel are pressed together to form a seal preventing discharge of liquid from the container through the slots **18** and externally of the plunger **35**. Since movement of liquid upwardly into the lower end of the barrel **12** and the plunger **35** is prevented in the fully depressed position of the plunger by direct engagement of the convolutions **60** of the spring **52** with the ball valve **55**, leakage of liquid is prevented during handling and shipping, this being of particular importance when toxic liquids, such as insecticides, are used.

It will be appreciated that in order to render the dispenser operative, it is only necessary to unscrew the head from the collar, whereupon the plunger **35** is raised by spring **52**. Liquid may then be forced upwardly within the plunger **35** by finger pressure on the upper surface of the head to reciprocate the plunger in barrel **12**, whereby the head and plunger are reciprocated in the usual manner.

The reciprocable unit is retained in position in the stationary unit by an inwardly directed annular part **66** which extends into close proximity with the plunger **35** and serves as a bearing surface for guiding the plunger during reciprocation thereof, while limiting outward movement of the plunger in response to the action of spring **52**. The annular part **66** is formed after assembly of the two units, by assembling around plunger **35** a cylindrical tool, the tool being pressed downwardly against a shoulder formed at the junction of the barrel proper with the collar portion **14** of the barrel so as to cause the material to flow inwardly.

It will be understood that the dispenser described herein forms no part of the instant invention, but is typical of articles which may be formed more readily and with less time and expense when the present invention is employed in its manufacture. The details of the dispenser, and more particularly of the head and the spout, may vary widely from that illustrated herein.

Turning now to the remaining figures of the drawing, illustrating injection molding apparatus in which the head and spout unit of FIGURE 1 may be cast, it will be seen that the mold or die comprises the sections designated **80** and **81**, which are separable on a plane normal to FIGURE 2 and containing the axis of head core **84**. FIGURE 2 shows the mold sections in assembled relation and after injection of the flowable plastic material. It will be noted that the free end **85** of core **84** projects into the cavity in which the head **37** is formed, and is so shaped as to form internally of the head the chamber **70**, the stud **71** projecting into the chamber, and the annular grooves for reception of the beads **39** formed exteriorly of the plunger **35**. The mold cavity in which the head **37** is cast is shaped to form the head illustrated in FIGURE 1, including the collar portion **42** with its external threads and its tapered sealing surface **62**, and is closed by a sprue bushing **87** having a gate **88** therein through which the flowable plastic material may be forced into the mold. Bushing **87** is retained in position by bolt **83** to provide easy removal for cleaning.

Mold section **81** is provided with an elongated spout cavity, circular in transverse section, and having a straight portion **89** communicating with the cavity in which the head **37** is cast, and a bent or curved portion **91**. Portion **91** of the spout cavity is defined by a separately formed mold part, made in two sections **93, 94** which are bolted together, meeting on a plane containing the center line of the spout cavity portion **91**. Cavity portions **89** and **91** communicate at their adjoining ends and may be tapered gradually from the head portion to the outer end of spout cavity **91** as shown. A spout core **96** closes the outer end of cavity portion **91**, extends through spout cavity **89, 91** and seats at **97** in a recess in the outer end of head core **84**, so as to provide with cavity **89, 91** the annular channel in which spout **78** is cast, the core **96** being circular in transverse section.

It will be appreciated that the purpose in forming cavity portion **91** in separable die sections **93, 94** is to permit the introduction of core **95, 96** which, because of its substantial inflexibility, could not otherwise be introduced in the position in which it is shown. Once the core **95, 96** and the die sections **93, 94** are assembled, these parts need not be separated during normal operation.

In preparation for the casting operation, the separable die section **80**, together with core **84**, is moved into abutting relation with die section **81** (upwardly in FIGURE 2) and clamped in position to close the head cavity. The plastic material is then forced under pressure through gate **88** in sprue bushing **87** until the head and spout cavities are filled. After filling, the pressure is increased during a pressure boost period. After a further dwell period, during which the plastic material cools somewhat, mold section **80** and head core **84** are withdrawn from mold section **81** by displacing the same downwardly (FIGURE 2). The formed head **37** is carried downwardly with head core **84** to withdraw the spout **78** endwise from the cavity **89**. It will be appreciated that as the spout is thus withdrawn, the bent or curved portion thereof, formed in cavity **91**, will be straightened out during its passage through cavity portion **89**. However, immediately upon the completion of withdrawal of the spout, the latter resumes the bent or curved configuration shown in FIGURE 2, at least in large part, so that the finished spout has the appearance shown in FIGURE 1.

Mechanism for effecting displacement of the several parts of the mold as described may be conventional and forms no part of the instant invention. Similarly, the details of the mold may vary considerably from that illustrated in the practice of the invention herein claimed.

The temperature of the plastic material during the casting operation will, of course, depend primarily on the nature of the plastic employed. As injected, the plastic must be flowable at the pressure employed; conventional injection temperatures, suitable for the plastic material used, may be maintained. The minimum temperature will be that necessary to insure complete filling of the mold cavities; the maximum temperature will be established by economical considerations, inasmuch as too high a temperature may cause flash and will require too long a dwell period to enable the plastic to set up, thus reducing output. As is well known, conventional injection temperatures for most thermoplastic resins range from 300° F. to 600° F. Typical conditions for two thermoplastic resins commercially available are given below:

Plastic Material	Injection temperature, ° F.	Pressure (p.s.i.)	Filling time, seconds	Pressure boost, seconds	Dwell period, seconds
Pro-Fax No. P02005, clear (Hercules Powder Company, Wilmington, Del.), a polypropylene resin	475	15,000	5	4½	8
Marlex No. 5000-40 (Phillips Chemical Company, Bartlesville, Okla.), a polyethylene high-density resin	450	15,000	5	4½	6

The timing above indicated pertains to known procedure in which this initial filling of the mold is effected at comparatively low pressure. Pressure is then built up to a point within an acceptable known range, usually about 10,000 to 20,000 p.s.i., whereupon the plastic material is allowed to set prior to opening of the mold. Obviously the temperature of the material which forms the spout cannot be accurately determined, but the dwell period is adjusted so that withdrawal of the spout can be effected readily, and will be followed by resumption of the bend or curve to conform substantially to the desired configuration.

As is hereinbefore indicated, the core 84 may be displaced laterally with the mold section 80 to withdraw the spout from the mold section 81, this being the preferred practice. Because of the flexibility of the spout, it has been found unnecessary to effect this displacement in the direction of the straight portion of the spout, and the displacement may be normal to the axis of the core 84 with the resultant simplification of operating mechanism. Following the release of the spout from the mold section 81, core 84 is displaced endwise with respect to mold section 80 (to the right in FIGURE 2) to release the head. A knockout pin (not shown), normally closing drill hole 95, may then be displaced against the cast head 37 to release the latter from mold section 80, if this be necessary.

As illustrated, spout 78 extends downwardly from its point of intersection with head 37. It may project in a direction normal to the head, if desired. Similarly, the curve or bend in the spout may be altered substantially in magnitude and direction from that shown. For instance, the spout may be curved throughout its length, over a substantial portion of its length, or at one point only in its length.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In a method of casting an integral plastic article having a hollow body portion and an elongated curved hollow spout portion protruding from said hollow body portion in a mold having cores which intersect to establish communication between the interior of said body portion and said spout portion, the cavity and core for the spout portion being substantially straight adajacent the intersection of said body and spout portions and being curved at a point remote from such intersection, said mold comprising a pair of mold blocks meeting in a plane transverse to the direction of the axis of said spout portion at its juncture with said body portion, comprising the steps of engaging said mold blocks to close said mold, injecting a thermoplastic resin in said mold under pressure and at a temperature at which said resin is sufficiently fluid to fill the mold cavity, allowing said resin to harden sufficiently to retain the shape of the cavity, separating said mold blocks, and maintaining the cavity for the spout portion closed with the core for the spout portion therein while withdrawing said spout portion endwise while at a temperature such that the spout exhibits sufficient elasticity to straighten during withdrawal and to resume a curved configuration after withdrawal.

2. In a method of casting by injection molding an integral plastic head for use in a fluid pump of the reciprocating type, having a hollow body portion and an elongated curved hollow spout portion protruding from and communicating with the interior of said hollow body portion, in a mold having cores which intersect to establish communication between the interior of said body portion and said spout portion and comprising a pair of mold blocks meeting in a plane transverse to the direction of the axis of said spout portion at its juncture with said body portion, the spout cavity and core having a nonlinear configuration over a portion of their length, comprising the steps of engaging said mold blocks to close said mold, with the cores positioned therein, injecting a thermoplastic resin in said mold under pressure and at a temperature at which said resin is sufficiently fluid to fill the mold cavity, allowing said resin to harden sufficiently to retain the shape of the cavity, separating said mold blocks and maintaining the cavity for the spout portion closed with the core for the spout portion therein while withdrawing said spout portion endwise while at a temperature such that the spout portion exhibits sufficient elasticity to alter its initial configuration during withdrawal and to resume an approximation of its initial configuration after withdrawal.

3. In a method of casting a unitary plastic article having a hollow body portion and an elongated curved hollow spout portion protruding from and communicating with the interior of said hollow body portion in a mold having cores which intersect to establish communication between the interior of said body portion and said spout portion, the core for said spout portion being curved, said mold comprising a pair of mold blocks meeting in a plane transverse to the direction of the axis of said spout portion at its juncture with said body portion, comprising the steps of engaging said mold blocks to close said mold, injecting a thermoplastic resin in said mold under pressure and at a temperature at which said resin is sufficiently fluid to fill the mold cavity, allowing said resin to harden sufficiently to retain the shape of the cavity, separating said mold blocks, and maintaining the cavity for the spout portion closed with the core for the spout portion therein while withdrawing said spout portion endwise while at a temperature such that the spout exhibits sufficient elasticity to straighten during withdrawal and to resume a curved configuration after withdrawal.

4. A method of withdrawing from an injection molding die an integral article of thermoplastic resin having a hollow body and an elongated hollow spout protruding laterally from said body and communicating with the interior of said body, said die being formed to provide a body cavity and a spout cavity having therein cores which intersect to establish communication between the interior of said body and spout, said spout having as cast a straight portion adjacent said body and a curved portion remote from said body, which comprises the step of maintaining the cavity for the spout closed with the core for the spout therein while withdrawing said spout endwise from said die while at a temperature such that the spout exhibits sufficient elasticity to straighten during withdrawal and to resume substantially its initial configuration after withdrawal.

5. In an injection molding machine for casting an integral plastic head and spout for a fluid dispenser from thermoplastic resin, said head and spout being

hollow and affording a continuous fluid passage, said spout having a straight portion adjacent said head and a curved portion remote from said head, a pair of mold blocks shaped to provide a head cavity in which the head is formed, a first one of said blocks being shaped to provide an elongated straight cavity in which the straight portion of the spout is formed, said blocks meeting in a plane transverse to the axis of said last named cavity, means secured to said first one of said blocks to provide an elongated curved cavity in which the curved portion of said spout is formed, an integral spout core mounted in said means and extending through said curved and straight cavities, and a core extending into said head cavity and engaging said spout core.

References Cited in the file of this patent

UNITED STATES PATENTS

1,916,692	Scribner	July 4, 1933
2,396,406	Anderson	Mar. 12, 1946
2,477,368	Gits	July 26, 1949
2,860,376	Graves et al.	Nov. 18, 1958