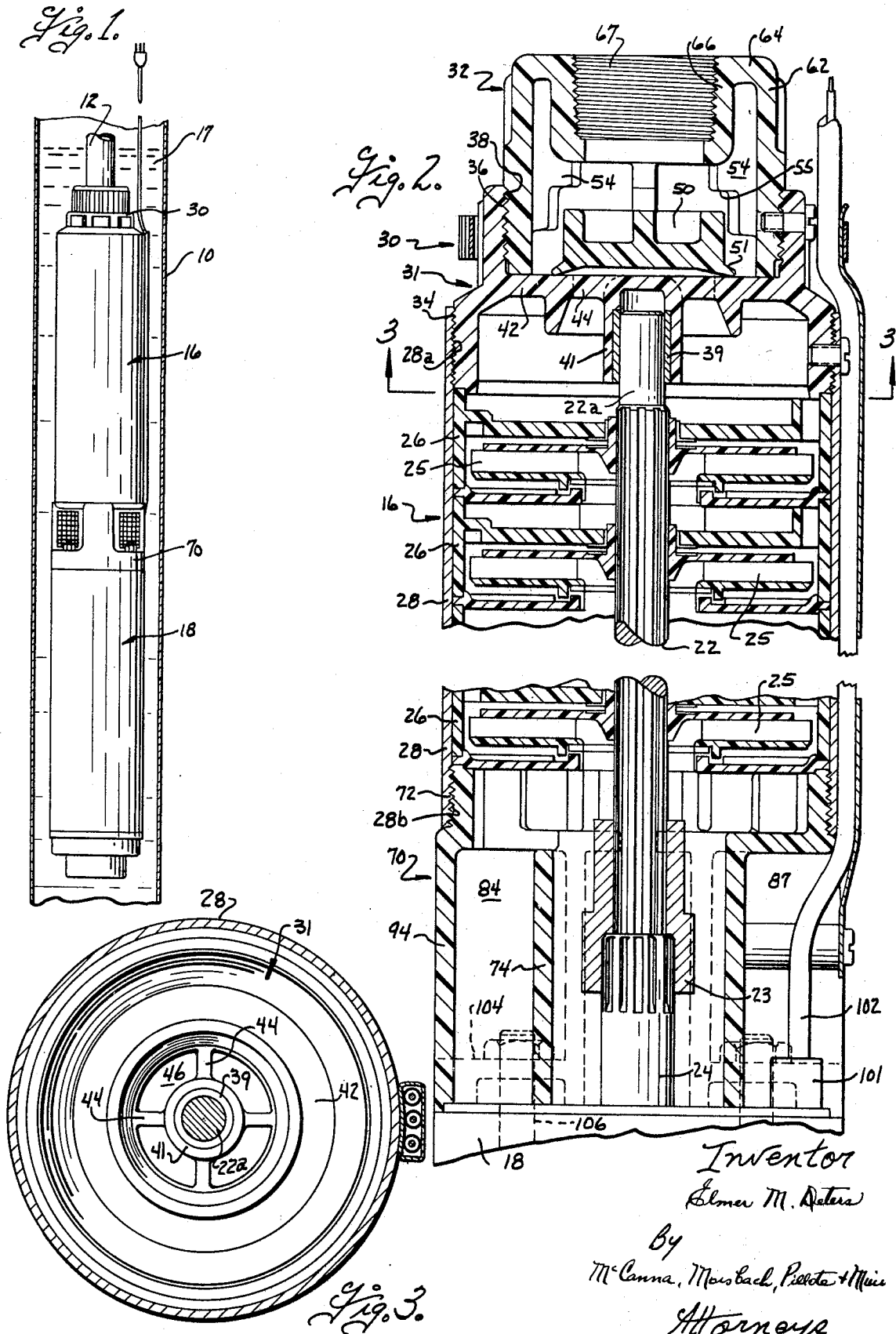


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E. M. DETERS

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SUBMERSIBLE PUMP

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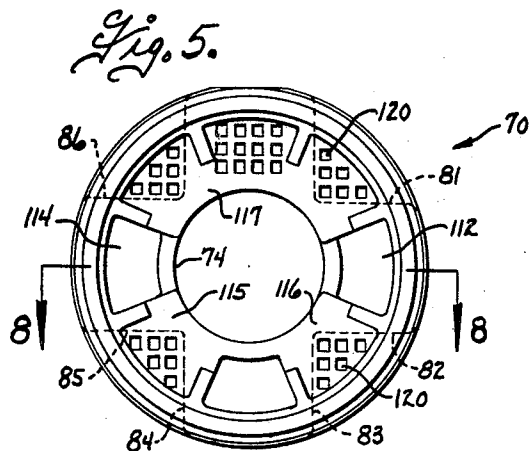
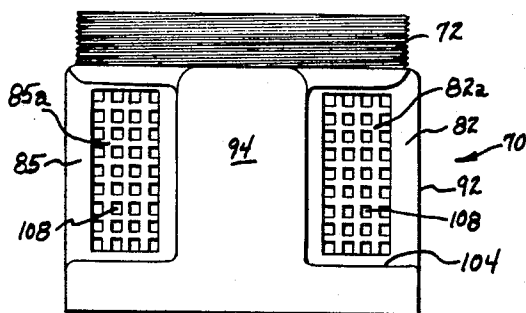


Fig. 4.

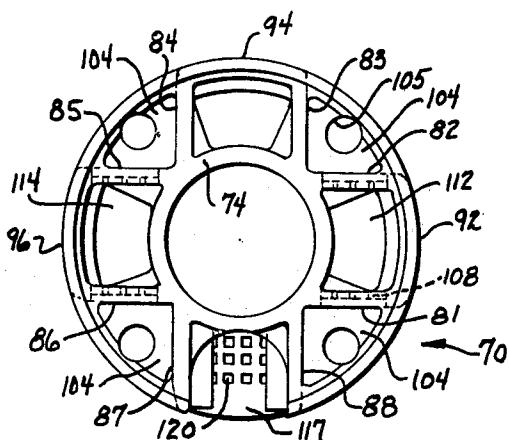


Fig. 6.

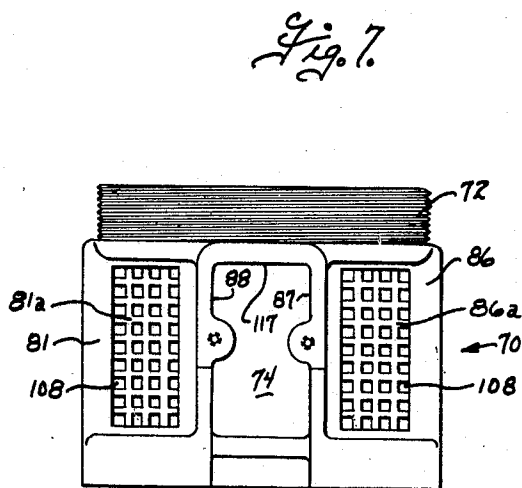
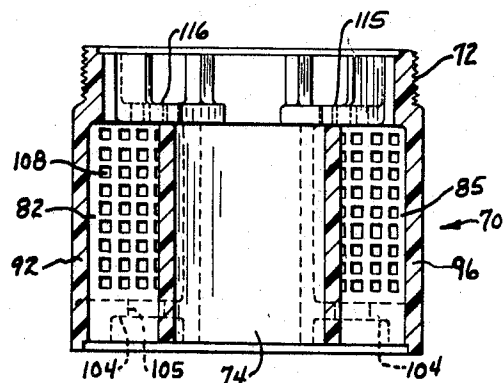


Fig. 8.

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3,521,970

SUBMERSIBLE PUMP

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12 Claims

ABSTRACT OF THE DISCLOSURE

A cylindrical casing, which houses the impellers, is threaded at its upper and lower ends. A plastic suction manifold is attached at the lower end and a motor is bolted thereto. The plastic suction manifold is of cellular construction and has strainers molded integral therewith. A two-piece plastic discharge head is attached at the upper end and has a check valve therein. A re-entrant portion of the discharge head provides a connection to a delivery pipe.

BACKGROUND

The invention pertains generally to pumps and, more specifically, to submersible pumps for use with submersible motors in a casing containing fluid and for pumping the fluid through a delivery pipe.

In the past, submersible pumps have been constructed with metal upper and lower heads. These heads are connected to the delivery pipe and to the motor; therefore, strength is a necessity. This strength must also be sufficient to withstand impact forces subjected in handling and assembly. A separate strainer is usually mounted on the lower head or suction manifold to keep large foreign particles out of the pump.

SUMMARY

The present invention relates to a new and useful pump which is more economical than prior apparatus. The invention is realized by the provision of a head having a unique shape which gives adequate strength, and yet permits the utilization of more economical material.

It is a general object of the present invention to provide a submersible pump which is more economic in construction than prior apparatus, yet resistant to corrosion.

Another object is to provide a submersible pump having heads made of plastic, yet having adequate strength without use of thick sections.

Still another object is to provide a submersible pump having a plastic suction manifold in which the strainer is integral therewith.

Yet another object is to provide a submersible pump having a plastic discharge head having a unique construction which accommodates the forces applied when the delivery pipe is connected thereto.

These, and other objects and advantages of the present invention, will become apparent as the invention becomes better understood from the following detailed description taken in conjunction with the drawings.

DRAWINGS

FIG. 1 is a fragmentary vertical sectional view of a well casing having a motor and a pump in accordance with the present invention submerged therein;

FIG. 2 is a fragmentary vertical sectional view through the submersible pump;

FIG. 3 is a cross-sectional view taken along line 3—3 of FIG. 2;

FIG. 4 is a front elevational view of the lower head;

FIGS. 5, 6 and 7 are, respectively, top, bottom and back views of the suction manifold; and

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FIG. 8 is a cross-sectional view taken along line 8—8 of FIG. 5.

DESCRIPTION

Reference is now made more particularly to the drawings which illustrate the best presently known mode of carrying out the invention and wherein similar reference characters indicate the same parts throughout the several views.

In FIG. 1, the invention is shown as applied to a well which has a well casing 10 which normally extends from a point adjacent the ground level downwardly to the aquifer or is terminated in a well screen (not shown). A drop pipe or delivery pipe 12 extends downwardly in the casing to a pump 16 submerged in a fluid, such as water 17. A submersible electric motor 18 is connected to the pump 16 to drive the same as hereafter described.

Referring to FIG. 2, pump 16 is illustrated as a multi-stage centrifugal pump having a drive shaft 22 with a smooth upper end 22a for a purpose hereafter described. The drive shaft 22 is driven by the motor 18 through a coupling 23 which is engaged with a motor shaft 24 extending from the upper end of the motor 18. A plurality of impellers 25 are mounted on the drive shaft 22 and have a driving connection therewith. A plurality of impeller casings 26 contain the impellers 25 and are, in turn, housed within a cylindrical sleeve 28 which has internal threads 28a and 28b at its top and bottom, respectively. The impeller casings 26 and the impellers 25 may be of any suitable construction and are herein illustrated as of the type shown and described in U.S. Pat. No. 3,265,001, entitled "Centrifugal Pump," and issued to Elmer M. Deters. Reference is made to said patent for a more complete description of the impellers and impeller casings.

An upper head or discharge head, generally designated 30, is attached at the upper end of the sleeve 28. The discharge head 30 is preferably made of plastic and includes a lower or first member 31 and an upper or second member 32. First member 31 has external threads 34 for connection to the sleeve threads 28a. Internal threads 36 on the first member 31 and external threads 38 on the second member 32 are arranged for interfitting to connect the two members.

Means is provided on the first member 31 for supporting a bearing 39 which radially supports the smooth upper end 22a of the drive shaft 22. For this purpose, a cup-like socket 41 is axially located. A laterally extending wall 42 is provided and has cross members 44 (see FIG. 3) connected to the socket 41 and integral therewith. In this manner, openings 46 are provided adjacent the socket 41 to accommodate the flow of fluid pumped by the impellers 25.

A check valve 50 overlies the openings 46 (see FIG. 2) and is movable between an open position (not shown) to permit flow through the openings 46, and the closed position illustrated to prevent backflow. The openings 46 provide a larger flow area than normal, while the check valve 50 is quite wide to overlie the openings. Check valve 50 is made of a relatively flexible plastic and has an annular lip 51 at its lower edge so that it will conform to any irregularities on the seating face provided by wall 42. Because of the large flow area, check valve 50 has a short stroke and, with generous guide clearance, its chances of sticking open are negated. The guide clearance is provided by a plurality of ribs 54 on the second member 32. These ribs have a downwardly extending face 55 which provides a stop for the check valve 50 in its open position (not shown).

As shown in FIG. 1, the second member 32 is connected to the delivery pipe 12. Pipe taping for standard pipe is a problem in plastic since the tapered thread exerts

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a heavy force when screwed tight. This is further complicated when utilizing relatively thin wall plastic as is herein illustrated. To accomplish this connection, the second member 32 has a generally inverted U-shaped cross section. This U-shaped cross section includes an outer wall 62, a top wall 64, and an inner or re-entrant wall 66. The re-entrant wall is threaded as at 67 and defines an outlet opening for the flow of fluid. In this manner, a double thin wall section is provided with maximum radial strength at the top to absorb the force of the tapered thread of the delivery pipe 12. As illustrated, the ribs 54 also reinforce the inner wall 66.

At the bottom of the sleeve 28 is a lower head or suction manifold, generally designated 70. The suction manifold is preferably of cellular construction and molded of plastic. At its upper end there are threads 72 for connecting to the threads 28b at the lower end of the sleeve 28. The cellular construction is defined by the walls of the lower head 70. The preferred embodiment shown, includes a cylindrical inner wall 74 which surrounds a chamber for the shafts 22 and 24 and the coupling 23, as best seen in FIG. 2. Extending outwardly from the inner wall 74, are eight intermediate walls 81-88, as best seen in FIG. 6. As shown, these intermediate walls are arranged in pairs generally parallel to each other and extending outwardly to the circumferential edge of the lower head 70. An arcuate outer wall portion 92 connects the outer ends of intermediate walls 81 and 82. Similarly, outer wall portions 94 and 96 connect intermediate walls 83 and 84, and 85 and 86, respectively. There is no outer wall portion interconnecting intermediate walls 87 and 88 thereby leaving an outwardly open chamber to accommodate an electrical connector 101 and supply line 102 (see FIG. 2) to provide power for the motor 18. The outer walls are preferably imperforate to add strength to the structure. The forces acting on the lower head are frequently greatest during handling and assembly of the pump and motor and placing it into operation. These are bending forces to which the outer walls are most effective in resisting, and so it is preferable that they be solid.

As best seen in FIG. 6, bottom wall portions 104 extend between adjacent intermediate walls and have openings 105 therein. A fastener such as a bolt 106 (see FIG. 2) is passed through the openings 105 for mounting the motor 18 on the lower head 70.

In the preferred construction, openings 108 are provided in the intermediate walls 81, 82, 85 and 86; but not in the other intermediate walls. In this manner, the openings 108 can be readily formed during the molding of the lower head 70. The openings 108 provide a strainer to eliminate large particles from the fluid being pumped. Preferably, the openings are formed in reduced wall portions such as at 81a, 82a, 85a and 86a. In this way the strainer sections are substantially thin so that they can be knocked out, if desired, should a deposit be built up from the fluid being pumped. By locating the strainers inwardly of the outer walls, the strainer area is sure to be spaced from the well casing 10 and thus cannot be restricted thereby. Fluid passing through the openings 108 flows into channels 112 or 114 which are defined by the inner, intermediate and outer walls. These channels are open at the top for flow directly to the impellers 25.

Referring to FIG. 5, it can be seen that top wall portions 115-117 are provided. These top wall portions each have a plurality of openings 120 therethrough to provide additional flow area for the fluid. In this manner, additional strainer sections are provided.

The top wall portions, the bottom wall portions, and the inner, intermediate, and outer wall portions define the cellular construction of the suction manifold. This construction provides relatively thin walls yet a sturdy structure. The strength of the construction allows the suction manifold 70 to serve as a mount for the motor

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18. In addition, the strainer is molded directly into the suction manifold instead of being a separate part.

While a preferred embodiment of the present invention has been described, this has been done by way of illustration and not limitation, and it is to be understood that various modifications in structure will occur to a person skilled in the art.

What is claimed is:

1. A submersible pump for use with a casing containing fluid to be pumped, a delivery pipe in the casing and having an inlet at its lower end, and a submersible motor in the casing and having a motor or shaft extending from the upper end thereof, the submersible pump including: a pump casing having a top and a bottom, a plurality of impellers mounted within the pump casing, a drive shaft having upper and lower ends and extending axially through the impellers, and means providing a driving connection between the drive shaft and the impellers and between the drive shaft and the motor shaft whereby the impellers are driven when the motor is operated, the improvement comprising: a plastic discharge head at the top of the pump casing and having a discharge opening connected to the delivery pipe inlet, check valve means in the discharge head for permitting flow of the fluid into the delivery pipe and preventing return flow, a bearing engaged with the upper end of the drive shaft, and the discharge head having means for supporting the bearing; and a plastic suction manifold at the bottom of the pump casing and having an upper end adapted for generally fluid-tight connection to the bottom of the pump casing, a lower end, imperforate outer wall portions extending between said ends and having laterally-spaced side edges, and intermediate wall means extending between adjacent edges of two adjacent outer wall portions and disposed inwardly of an imaginary circle connecting the lateral side edges of the outer walls, at least a portion of the intermediate wall means having a plurality of openings formed therein to provide a strainer for the fluid.

2. A submersible pump as set forth in claim 1 wherein the imperforate outer wall portions of the suction manifold includes two portions at opposite sides thereof, and wherein the intermediate wall means has sections extending inwardly from the opposite sides of said two portions, said sections being generally parallel to each other.

3. A submersible pump as set forth in claim 1 wherein the pump casing is generally cylindrical and has a threaded connection at its lower end, the upper end of the lower head is threaded for connecting to the sleeve, the outer wall portions are arcuate and have an outer surface at said imaginary circle, the intermediate wall means has sections arranged in generally parallel planes, each section having an inner edge joined to an adjacent section and at generally right angles thereto, and the openings being formed in the generally parallel sections at opposite sides of the lower head but not in the sections at generally right angles thereto.

4. A submersible pump as set forth in claim 1 wherein the delivery pipe has an exterior threaded portion at its lower end; and wherein the plastic discharge head has an outer wall surrounding the lower end of the delivery pipe and spaced outwardly therefrom, a re-entrant wall inwardly of the outer wall and spaced therefrom, the walls being connected at their upper ends, the reentrant wall having a threaded interior for connection to the threaded pipe portion and to support the submersible pump and motor thereon.

5. A submersible pump as set forth in claim 1 wherein the pump casing includes a generally cylindrical sleeve having a threaded connection at its upper end, the plastic discharge head includes first and second members, the first member having threads for connection to the sleeve, the first member having an axially located socket for supporting the bearing and crosswise extending wall means for supporting the socket, the wall means having at least one opening therein for passage of the fluid, the

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second member being connected to the delivery pipe and to the first member and having positioning means on the interior surface thereof for positioning the check valve over the opening in the wall means when closed and providing a stop for the check valve when open.

6. A submersible pump for pumping a fluid and for use with a delivery pipe having an inlet at its lower end, and a submersible motor for driving the submersible pump and having a motor shaft extending from the upper end thereof, the submersible pump comprising: a pump casing having a top and a bottom, a plurality of impellers mounted within the pump casing, a drive shaft extending axially through the impellers and having a driving connection thereto, means for connecting the drive shaft and motor shaft so that the impellers are driven when the motor is operated, a discharge head at the top of the pump casing and having a discharge opening connected to the delivery pipe inlet, and a plastic suction manifold of cellular construction at the bottom of the pump casing and including inner wall means defining a chamber for at least a portion of said shafts, outer wall portions disposed outwardly of the inner wall means and having laterally-spaced side edges, intermediate wall means extending from each outer wall side edge to the inner wall means and at least a portion of the intermediate wall means having openings formed therein to provide a strainer for the fluid.

7. A submersible pump as set forth in claim 6 wherein the intermediate wall means includes a section extending inwardly from each outer wall portion side edge and generally parallel to the section at the opposite side edge of the outer wall portion.

8. A submersible pump as set forth in claim 7 wherein there are four pairs of said generally parallel sections, each section being generally coplanar with a section at the opposite side of the lower head, and wherein the openings are formed in one pair of sections and in the pair generally opposite thereto and not in the other two pairs, the sections being of preselected thickness and having an inner surface and an outer surface, the sections having the openings therein having an indented area in the outer surface thereof, and the openings being located in said indented area.

9. A submersible pump as set forth in claim 6 wherein the plastic section manifold includes bottom wall means at the bottom thereof and extending between each two adjacent laterally-spaced side edges of the outer wall portions, the bottom wall means being connected to the intermediate wall means and having at least two openings

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therein for the passage of fasteners to fasten to the upper end of the submersible motor.

10. A pump for pumping a fluid and for use with a threaded delivery pipe having an inlet at its lower end, and a motor for driving the pump, the pump comprising: a pump casing having a top and a bottom, a plurality of impellers mounted within the pump casing, connecting means providing a driving connection between the impellers and the motor so that the impellers are driven when the motor is operated, a suction manifold at the bottom of the pump casing and having intake openings therein for passage of the fluid, a plastic discharge head at the top of the pump casing and having an outer wall surrounding the lower end of the delivery pipe and spaced outwardly therefrom, a re-entrant wall spaced inwardly of the outer wall and connected thereto, and the re-entrant wall having a threaded interior for connection to the threaded delivery pipe.

11. A pump as set forth in claim 10 wherein the connecting means includes a drive shaft extending through the impellers; and wherein the discharge head includes a bearing for radially supporting the drive shaft, and means for supporting the bearing and permitting flow of the fluid therepast.

12. A pump as set forth in claim 11 wherein: the pump casing is generally cylindrical and has a threaded connection at its upper end, the plastic discharge head includes first and second members connected to each other, the first member has threads for connection to the pump casing, and the means for supporting the bearing includes a socket located axially of the first member and laterally extending wall means for supporting the socket, the laterally extending wall means having at least one opening therein for passage of the fluid to the delivery pipe; and including a check valve movable from a closed position overlying the opening in the laterally extending wall means to prevent return flow from the delivery pipe and an open position to permit flow through the opening.

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