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PUMP WITH CONCENTRIC VALVE MEANS

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FIG. 1

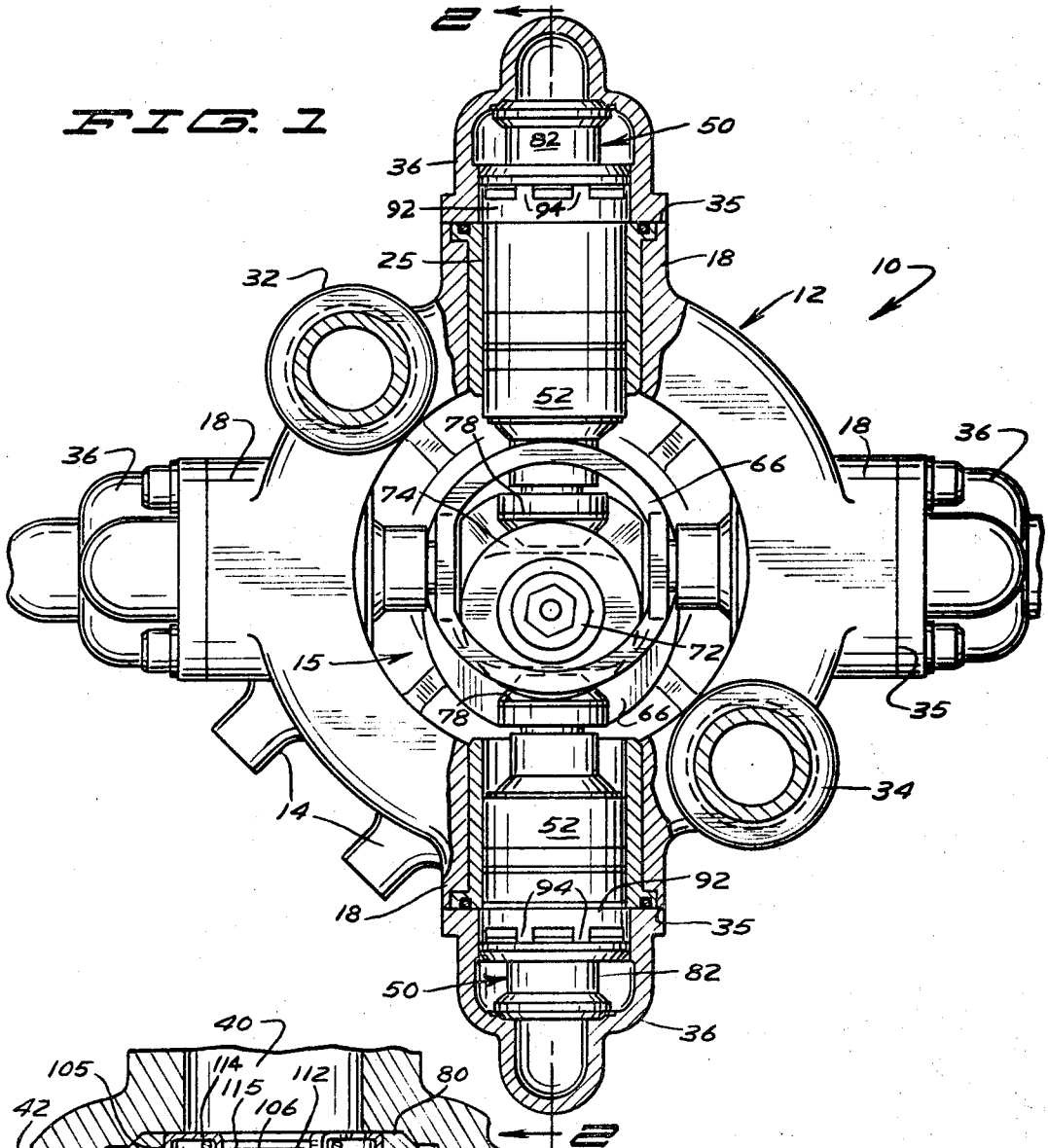
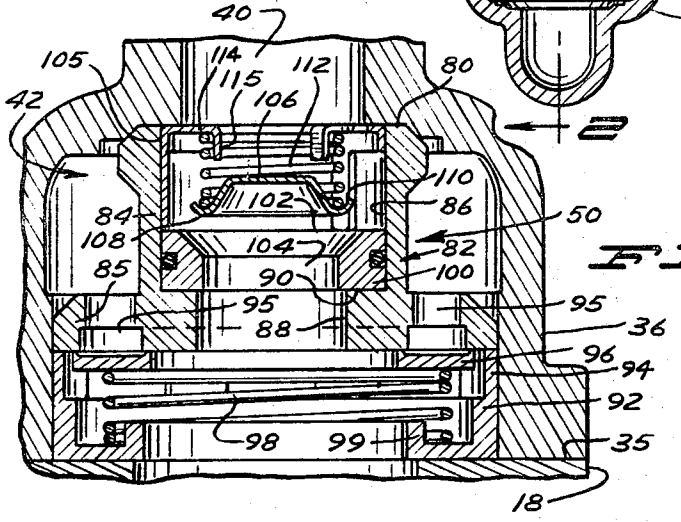


FIG. 3



INVENTORS
ERNEST E. COOK
RAMON PAREJA
BY Meyers & Peterson
ATTORNEYS

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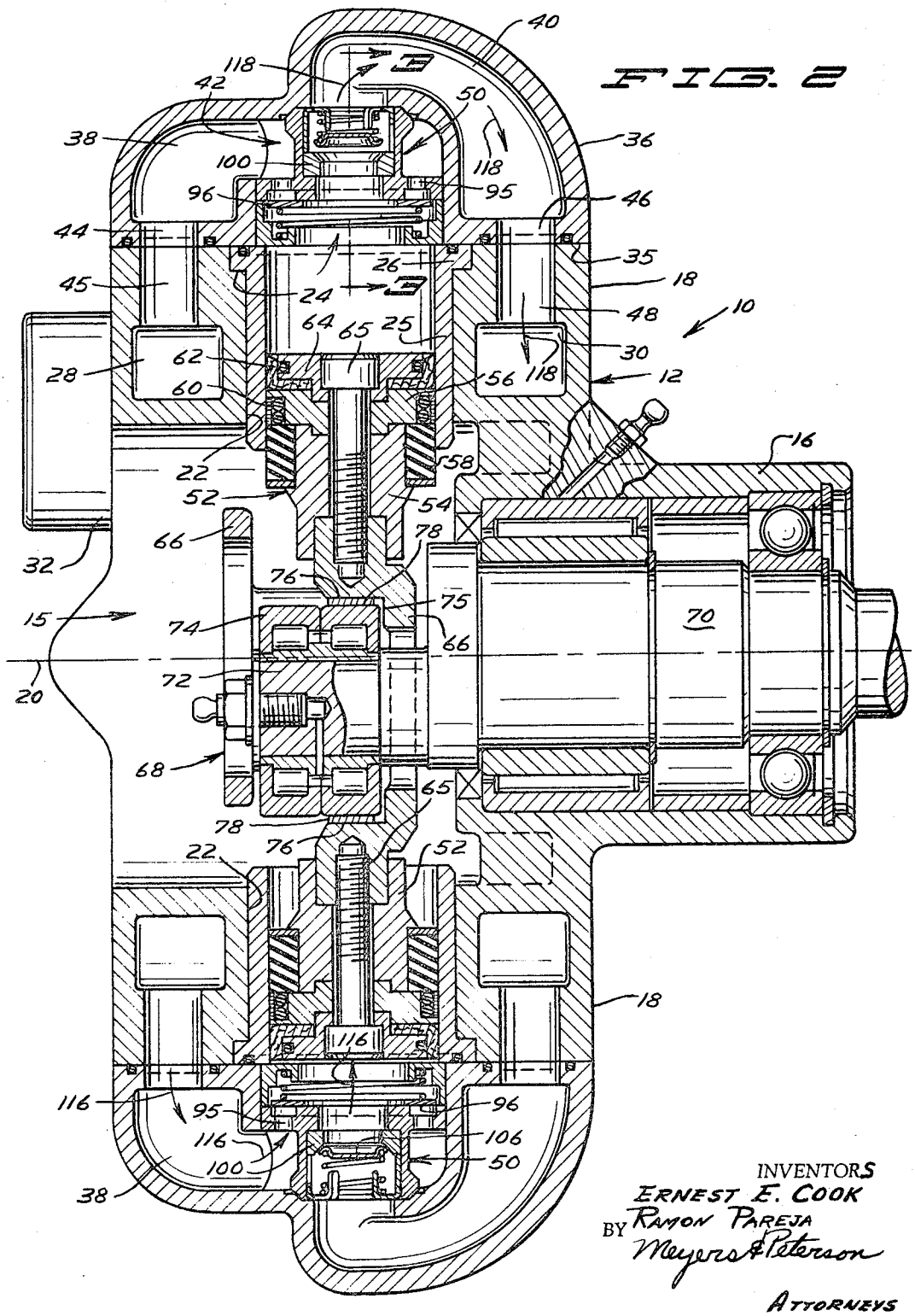
FIG. 2



INVENTORS
ERNEST E. COOK
BY RAMON PAREJA
Meyers & Peterson
ATTORNEYS

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PUMP WITH CONCENTRIC VALVE MEANS

Ernest E. Cook, Anoka, and Ramon Pareja, Edina, Minn., assignors to Hypro, Inc., Minneapolis, Minn., a corporation of Ohio

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Int. Cl. F04b 21/02, 1/04

ABSTRACT OF THE DISCLOSURE

A compact pump structure having a plurality of radially disposed pumping cylinders, and having concentrically arranged suction and pressure manifolds, the structure utilizing a valving arrangement with a common valve body having an inner core accommodating the pressure valve assembly, and an outer annular portion accommodating the inlet valve assembly. The structure employs a valve housing assembly which is attached radially outwardly of the main housing, and provides for significant ease of assembly and disassembly of the entire unit. The broader area available in the suction valve assembly enhances the flow properties of the structure, and also provides for a compact arrangement of the pressure valve assembly. The unitary body provides ease of cleaning for the valving, should it become clogged or fouled by virtue of use with suspended solids for the like.

This invention relates to fluid pumps and more particularly to a fluid pump of the positive displacement type having improved valving for controlling the pump action thereof.

In the preferred embodiment of the invention to be described in detail below, the pump takes the form of a radial piston pump in which there are a plurality of radially disposed pump cylinders and a central eccentric drive member for reciprocating the pistons in the various cylinders. Pumps of this kind are generally well known and have principal utility in pumping systems such as agricultural spraying systems, residential water supplies and the like. It is often desirable to maintain the external dimensions of pumps of this type as small as possible so that a pump capable of moving fluid at a relatively high rate of flow can be accommodated in a limited space. It is therefore an object of this invention to provide a valving mechanism for a pump of this kind which will be capable of handling fluid at high flow rates while still occupying a very limited amount of space.

It is another object of this invention to provide a valving mechanism having the characteristics outlined above, in which the parts thereof are relatively simple in construction, both inlet and outlet valves being provided in a single structure, easy to manufacture and easy to assemble and disassemble, thus providing for ready maintenance of the pump.

Other objects, advantages and new features of the invention will become apparent from a consideration of the following detailed description, when read in conjunction with the accompanying drawings wherein:

FIGURE 1 is a front elevational view, partly in section, of a pump constructed in accordance with the present invention;

FIGURE 2 is a side sectional view through the pump, taken on the line 2—2 of FIGURE 1; and

FIGURE 3 is an enlarged detailed view through one of the valving units of the invention, taken essentially on the line 3—3 of FIGURE 2 and showing the valve parts in the position which they assume during a pressure stroke of the pump piston.

A pump in accordance with the invention is generally indicated at 10 in the drawings. Pump 10 has a main

housing 12 which is provided with various conduits and passageways to be described hereinafter and which is adapted to be mounted in position adjacent a source of driving power for the pump such as an electric motor (not shown), as by a pair of mounting posts 14. The main pump housing 12 is basically circular in form as seen in FIGURE 1, and is provided with a central open drive chamber 15, a rearwardly extending bearing support sleeve 16, and a plurality of cylinder bosses 18 which are radially disposed with respect to a central axis 20 of the main pump housing 12.

Formed coaxially within each of the cylinder bosses 18 is a cylinder bore 22 which is countersunk, as indicated at 24, so as to retain a cylinder sleeve 25 having a terminal flange 26 which is received in the counterbore 24. Also formed within the main pump housing 12 are suction and pressure chambers or passages which consist of an annular suction passage 28 and an annular pressure passage 30, both of which are coaxial with the main pump housing axis 20 and which are disposed respectively on opposite sides of the cylinder bores 22. The suction passage 28 is in fluid communication with an inlet port 32, and the pressure chamber 30 is in communication with an outlet port 34, each by means of passages not shown. In addition, each of the suction and pressure chambers are in communication with the various pump cylinders in a manner which will subsequently be described.

Each of the cylinder bosses 18 terminates outwardly in a lapped surface 35. Secured to each of the cylinder bosses 18, in sealing relation to the lapped surface 35 thereon, is a valve housing 36 having an inlet passage 38, an outlet passage 40 and a central valve chamber 42 which is arranged to lie coaxially with respect to the cylinder bore 22. The various inlet passages 38 in the several valve housings 36 are in fluid communication with the annular suction chamber 28 by means of radially directed passages 44 and 45 in the valve housing 36 and the main pump housing 12, respectively. The outlet passage 40 communicates with the annular pressure chamber 30 in similar manner by means of radial passages 46 and 48. Any desired sealing arrangement may be employed between the cylinder bosses 18 and the valve housing 36, a plurality of "O-rings" being used for this purpose in the illustrated embodiment. Valve chambers 42 are generally cylindrical in form and provide support for a plurality of valve units 50, which will be described in detail hereinafter.

Operatively disposed within each of the cylinder sleeves 25 is a piston 52. Each of the pistons 52 is of built-up construction, having a main body portion 54 and a first disc-shaped member 56 the outer peripheries of which are shaped to provide support for a bearing member 58 and a sealing member 60. In addition to the sealing member 60, the piston 52 carries a cup-type seal 62 which is retained by a disc member 64. The various piston parts are secured together, and diametrically opposed pistons 52 are connected together for common movement, by means of a pair of fasteners 65 which are threadedly engaged with a connecting member 66 disposed within the drive chamber 15.

An eccentric drive mechanism 68 is provided for reciprocating the pistons 52 to perform their pumping function. The eccentric drive mechanism 68 consists of a main drive shaft 70 which is supported on suitable bearings within the bearing support sleeve 16 and is adapted to be connected to a driving means such as a motor, not shown. At its forward or left side, as seen in FIGURE 2, the main drive shaft 70 is machined to form an eccentric shaft 72. A roller bearing assembly 74 is mounted in surrounding relation to eccentric shaft 72.

The connecting elements 66 are shaped so as to provide a recessed area 75 having surfaces 76 in close peripheral relation to the outer periphery of the roller bearing as-

sembly 74. Suitable bearing strips 78 are provided on the surfaces 76 to resist the wearing action produced by the transverse movement of the bearing assembly as the pump operates. It will be appreciated that as the main drive shaft 70 is rotated, the eccentric shaft 72 and the roller bearing assembly 74 will act to reciprocate the pistons 52 in diametrically opposed pairs within the cylinder sleeves 25. It should be mentioned that the axes of the pistons which do not appear in FIGURE 2 are offset from the pistons shown and centered on the left side of the bearing assembly 74. This provides more space for the connecting members 66.

With reference now to FIGURE 3, the details of the valve units 50 will be described. As will appear, the relatively simple construction of the valve units 50 provides the above-mentioned advantages of supplying both the inlet and the outlet valves in a single simple structure which is easy to assemble and to maintain. Also, as stated above, the valve chamber 42 is generally cylindrical and coaxial with the cylinder with which the valve unit cooperates.

As seen in FIGURE 3, the valve unit 50 is retained by clamping action between the lapped surface 35 on the cylinder boss 18 and a retaining surface or recess 80 formed at the junction of the outlet passage 40 and the valve chamber 42.

The elements of the valve unit 50 are first a main valve body 82 which is machined externally to provide a cylindrical portion 84 and a radial flange 85. Internally, the main valve body 82 is provided with a stepped bore consisting of the larger bore 86 and the smaller bore 88, separated by a shoulder 90.

The main valve body 82 is held in place within the valve chamber 42 by means of a cup-shaped spacer element 92 which has a plurality of upstanding lugs 94 thereon which bear against the flange 85 near its periphery when the parts are assembled within the valve chamber 42 and confined between the surfaces 35 and 80. The inlet and outlet valves may be said to be coaxially arranged in the valve unit 50, this arrangement contributing to the overall compactness of the present pump.

The inlet valve of the valve unit 50 is defined by a plurality of openings through the flange 85, as indicated by the reference numeral 95. The lower ends of the openings 95 are selectively closed by an annular valve plate 96 which is biased into closing relation by a spring 98, anchored by a suitable boss 99 on the cup-shaped element 92. The strength of spring 98 is selected such that the suction force produced on the suction stroke of the piston 52 will overcome the spring force and allow the valve plate 96 to move away from its closing relation to the openings 95, thus allowing fluid to enter the cylinder on the suction stroke.

The outlet valve structure is contained within the cylindrical portion 84 of the main valve body 82 and consists of a valve seat member 100 having a valve seat 102 and an opening 104 formed therein, opening 104 being in communication with the bore 88. The valve seat element 100 is retained in the bore 86 against the shoulder 90 by means of a plurality of downwardly extending finger portions of a retaining sleeve 105, sleeve 105 reacting against the surface 80.

The movable plug element of the outlet valve assembly is a hat-shaped element 106, the shape of the element 106 providing a valve closing surface 108 on the lower side thereof and an anchoring groove or recess 110 on the top side for the accommodation of the lower end of a biasing spring 112. The opposite end of the spring 112 is retained by a plurality of fingers 114 formed on the retaining sleeve 105, the fingers 114 having downwardly turned lugs 115 thereon for maintaining the coaxial position of the spring 112.

The operation of the pump according to the present invention should be readily understandable from the above description of its structure. The following summary, however, may be of some assistance to a full understanding of the invention. With reference to FIGURE 2 and the position of the pump elements shown therein, an intake stroke of the pump is just about to begin in the cylinder at the lower side of the figure. As seen there, the piston 52 is just starting to move upwardly with respect to the figure. Upon such upward movement of the piston 52, the force of the spring 98 will be overcome and the valve plate 96 will move away from the openings 95 to allow fluid to pass from the inlet chamber 38, through the openings 95 and into the cylinder, as illustrated by the arrows designated by the reference numeral 116. After 180° of travel of the drive shaft 70, the lower piston 52 will reach the opposite end of its travel and the suction stroke will be at an end, at which time the spring 98 will act to close the valve plate 96 down against the openings 95.

At the same time that the lower cylinder in FIGURE 2 undergoes a suction stroke, the diametrically opposite piston and cylinder goes through a pressure stroke. Thus, as seen at the top of FIGURE 2, the piston 52 is just beginning its pressure stroke. As the piston rises in the cylinder sleeve 25, the pressure created thereby will lift the valve element 106 off valve seat 102 against the reaction of the spring 112 to allow fluid to pass out of the cylinder into the outlet passage 40 and subsequently to the outlet passage 30 as indicated by the arrows labeled 118. The cycle then repeats itself over each half revolution of the main drive shaft 70.

It will now be appreciated that a pump has been described which adequately fulfills the objects of the invention set forth hereinabove. Particularly, a pump having a compact construction has been described in which a valve assembly or unit of relatively simple construction provides for effective and efficient pumping operation while occupying a minimum amount of space.

We claim:

1. In a pump comprising a main housing having means defining pumping cylinders, a suction chamber and a pressure chamber with a suction passage and a pressure passage in respective communication with said cylinders, and a piston operatively disposed in each of said cylinders; valve means for providing alternative fluid communication between each of said cylinders and said suction and pressure passages, said suction and pressure chambers being disposed coaxially and generally radially coextensively, one with another, and on opposite sides of said cylinders, said valve means comprising a valve housing disposed adjacent one end of said cylinder, said valve housing having a valve chamber disposed coaxially with respect to said cylinder and passage means adapted to provide fluid communication between said valve chamber and said suction and pressure passages, a valve unit having a body member disposed within said valve chamber, said body member having a cylindrical portion having an external annular flange, an intake valve comprising fluid passage means through said annular flange and an annular valve plate spring biased into closing relation to said fluid passage means and adapted to open to permit fluid to flow into said cylinder upon a suction stroke of said piston, and an outlet valve comprising means defining a valve seat having an opening disposed in said cylindrical portion of said valve body member and a valve plug element spring biased into closing relation to said opening and adapted to open to permit fluid to flow out of said cylinder upon a pressure stroke of said piston, said main housing and said valve housing each having means defining a retaining surface for said valve unit, said valve unit further comprising spacer means disposed within said valve chamber for holding said body member in engagement with the retaining surface of said valve housing when said valve housing is connected to said main housing, said spacer means being generally cup-shaped and having a plurality of lugs bearing against said annular flange on said body member near the periphery thereof.

2. Pump valve means as defined in claim 1, said spacer means also having means for anchoring one end of a coil

spring for biasing said annular valve plate, and wherein said valve plate has a planar surface for closure contact, said plate having an annular recess zone disposed between inner and outer annular lugs.

3. In a pump comprising a main housing having means defining pumping cylinders, a suction chamber and a pressure chamber with a suction passage and a pressure passage in respective communication with said cylinders, and a piston operatively disposed in each of said cylinders; valve means for providing alternative fluid communication between each of said cylinders and said suction and pressure passages, said suction and pressure chambers being disposed coaxially and generally radially coextensively, one with another, and on opposite sides of said cylinders, said valve means comprising a valve housing disposed adjacent one end of said cylinder, said valve housing having a valve chamber disposed coaxially with respect to said cylinder and passage means adapted to provide fluid communiction between said valve chamber and said suction and pressure passages, a valve unit having a body member disposed within said valve chamber, said body member having a cylindrical portion having an external annular flange, an intake valve comprising fluid passage means through said annular flange and an annular valve plate spring biased into closing relation to said fluid passage means and adapted to open to permit fluid to flow into said cylinder upon a suction stroke of said piston, and an outlet valve comprising means defining a valve seat having an opening disposed in said cylindrical portion of said valve body member and a valve plug element spring biased into closing relation to said opening and adapted to open to permit fluid to flow out of said cylinder upon a pressure stroke of said piston, said body member having a stepped bore having a radial shoulder, said valve seat defining means comprising a separate annular element disposed within said bore in engagement with said shoulder, said main housing and said valve housing each having means defining a retaining surface for said valve means, said valve means further comprising a retaining sleeve disposed in said stepped bore and reacting between said valve seat element and said retaining surface on said valve housing to hold said valve seat element against said shoulder without additional fastening means, said retaining sleeve having means for anchoring one end of a coil spring for biasing said valve plug element.

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WILLIAM L. FREEH, *Primary Examiner.*

U.S. Cl. X.R.

103—174; 230—231