Nov. 19, 1968 R. CHANAL 3,411,453

SWASH PLATE HYDRAULIC PUMPS HAVING AXIALLY DISPOSED PISTONS

Filed March 25, 1966 3 Sheets-Sheet 1

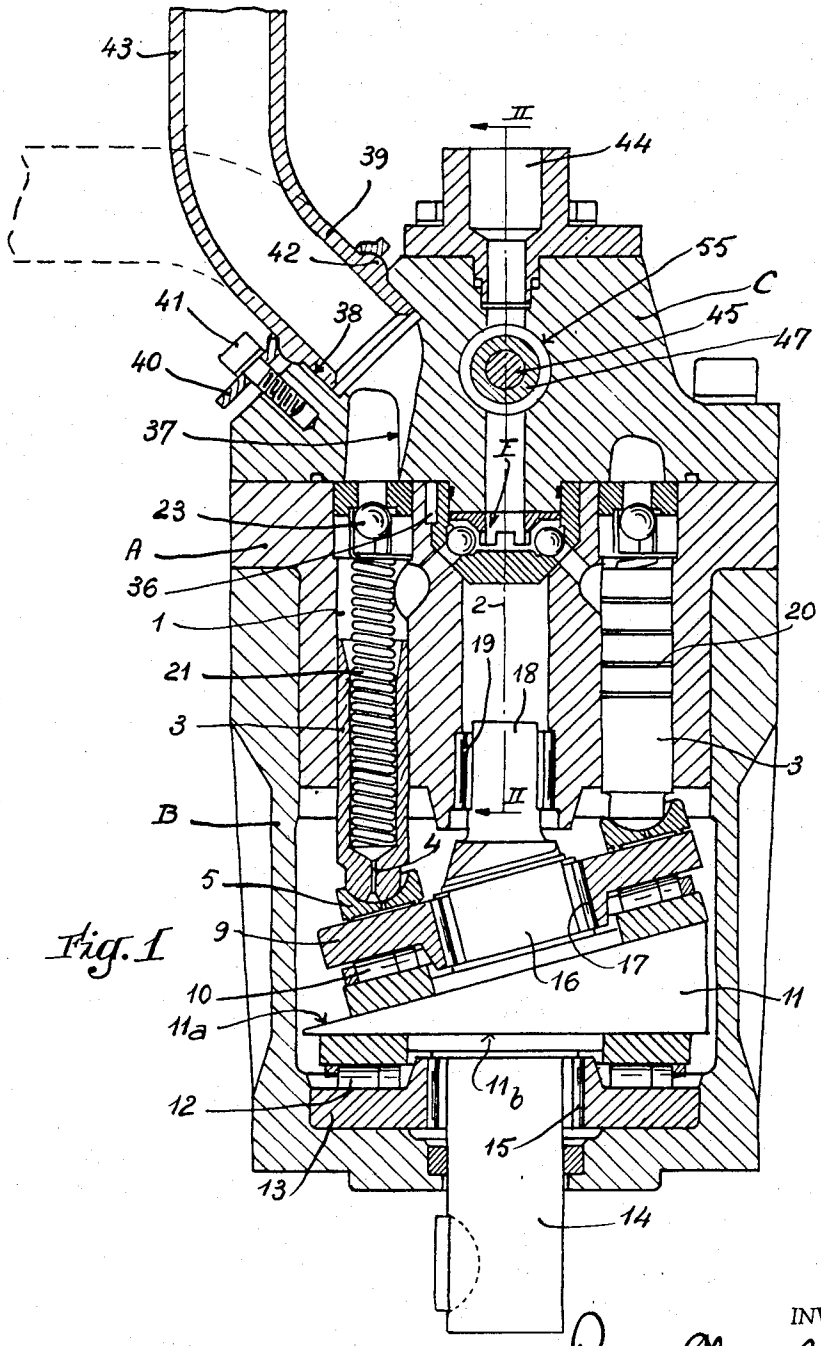

Fig. 1

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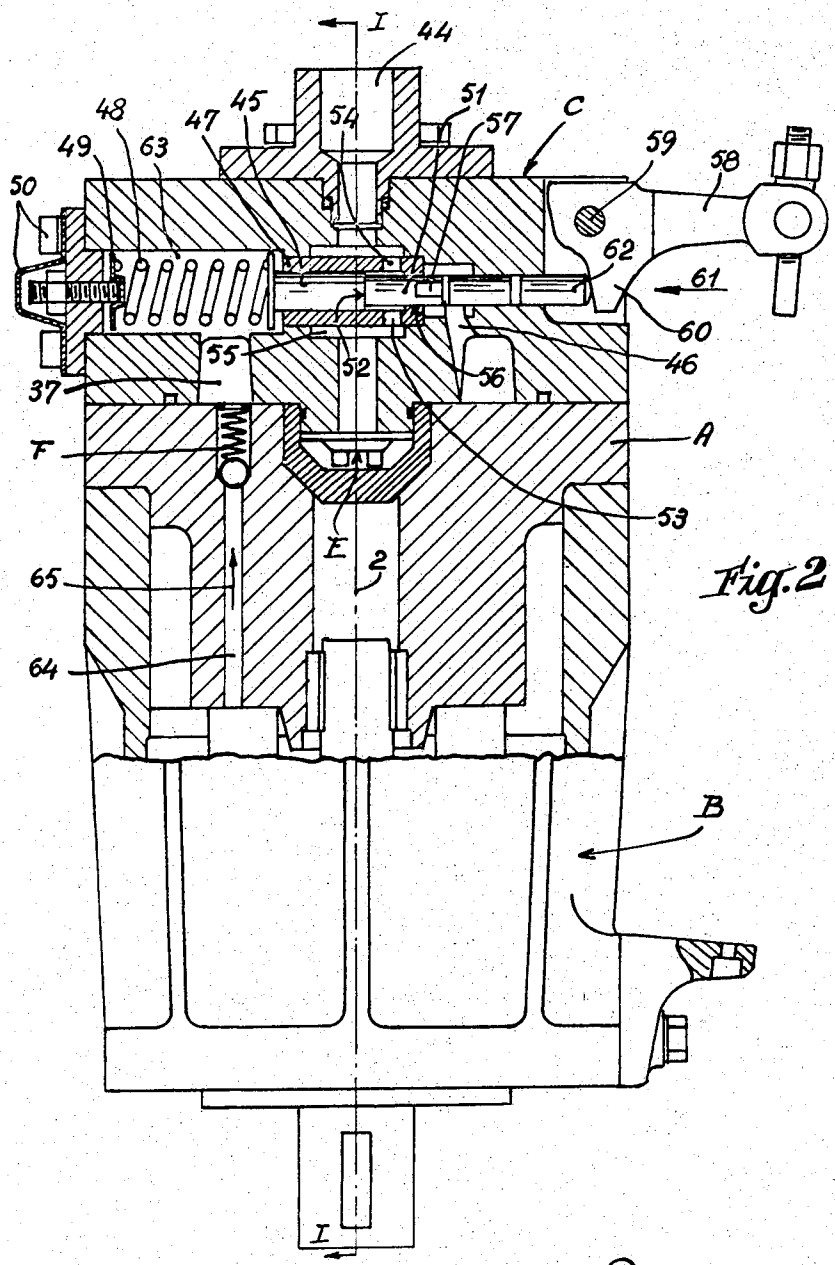

Fig. 2

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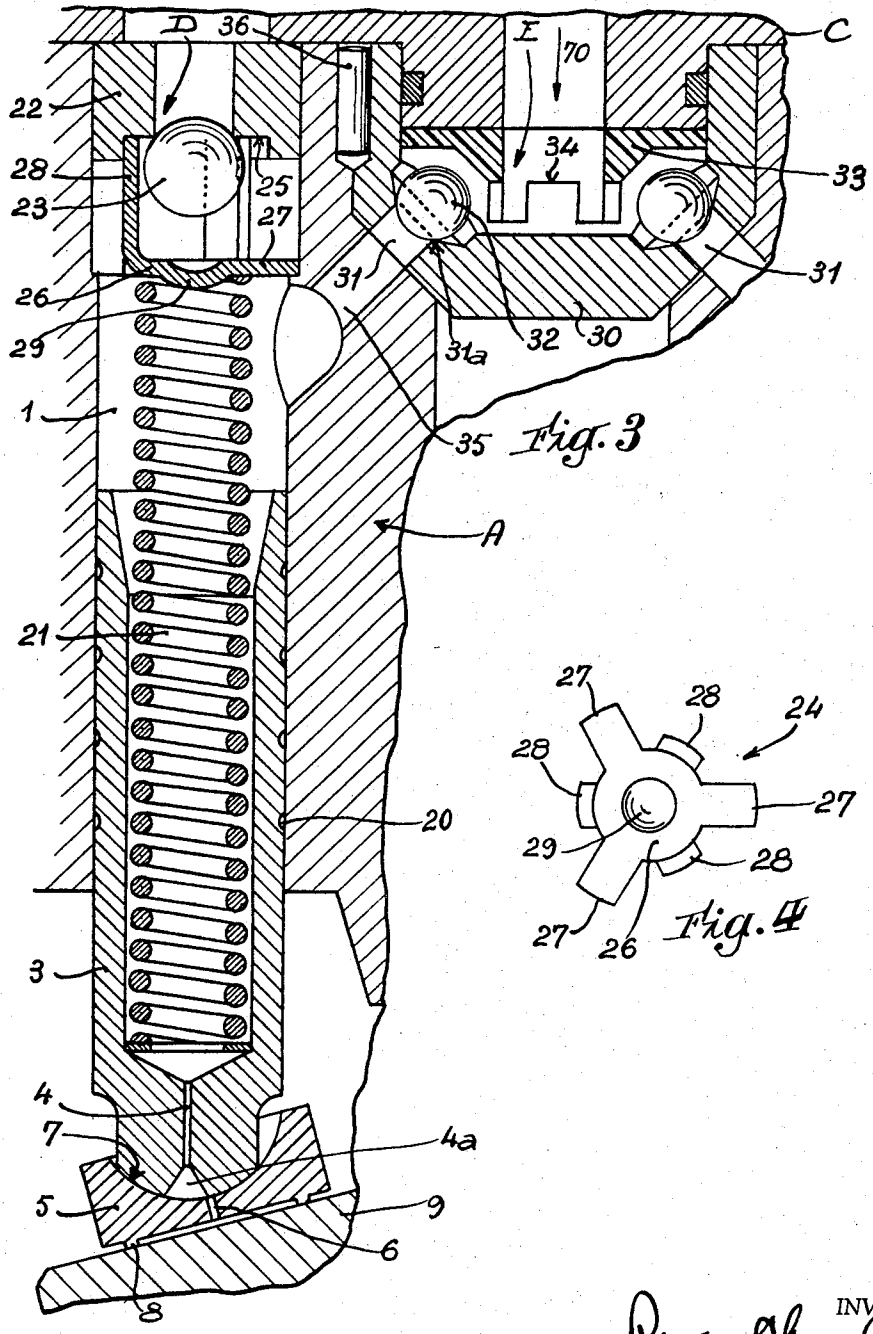

Fig. 3

Fig. 4

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SWASH PLATE HYDRAULIC PUMPS HAVING AXIALLY DISPOSED PISTONS

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5 Claims. (Cl. 103—173)

ABSTRACT OF THE DISCLOSURE

A hydraulic pump comprising a body having a plurality of cylinders and pistons; individual nonreturn inlet valves for each said cylinder, each inlet valve comprising a ball and a guide therefor; a single outlet valve base serving all said cylinders; means for actuating said pistons; each cylinder discharging through inclined bores respectively into a single outlet channel in the body through said single outlet valve base, and the inner edge of each bore serving as a seat for a ball valve; said single outlet valve base being removably seated in a recess therefor in the body by hydraulic reaction; and means in said outlet valve base for limiting the lift of the related ball valves.

The present invention concerns improvements relating to swash plate hydraulic pumps having axially disposed pistons, as used for operating jacks or servomechanisms.

Pumps of the type as known today are generally very noisy during functioning; in addition their length of useful life is greatly reduced when they are submitted to very severe conditions as for example, on contractors' plant.

The invention has for its principal object to avoid these inconveniences by producing a particularly robust hydraulic pump, insensitive to all impurities and silent in operation.

A hydraulic pump in accordance with the invention comprises axially disposed pistons located in a fixed barrel body. The main features are that the intake and outlet valves comprise guide members and that the piston operating pressure is balanced by hydraulic pressure. The outlet oil from the driven apparatus is fed into an inlet channel by a nonreturn valve which prevents impurities carried by the oil from returning to the pump mechanism; there is also an excess pressure slide valve to bypass the pump incorporated in the pump body, this forming a compact assembly.

To improve the life of the pump without increasing its selling price, a rotatable intermediate inclined swash plate is provided to actuate the pistons, carried by means of bearings on a base swash plate, this base plate being carried by a bearing located in the base of the sump of the pump. The flexibility of mounting and use of the pump is improved by providing an elbowed inlet pipe orientatable around an axis and forming an acute angle with the axis of the pump.

The invention will now be described further, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is an axial section along the line I—I of FIG. 2 of a hydraulic pump in accordance with the invention;

FIG. 2 is a partial section along the line II—II of FIG. 1;

FIG. 3 is an enlarged detai'ed section showing a piston and the corresponding valves; and

FIG. 4 is a plan view of a seating for the inlet valve.

The hydraulic pump shown in FIGS. 1 to 4 comprises a fixed cylinder A which is fixed at its lower part to a sump B, whilst at its upper end it carries a cylinder head C.

The cylinder A is provided with bores **1** parallel to and distributed around the geometric axis **2** of the pump. In each cylinder **1** slides a hollow piston **3** the base of which is provided with an axial perforation **4** of small diameter the piston terminating in a spherical face which bears on a pressure shoe **5**. The perforation **4** has a chamfered end **4***a*, in the face in contact with the shoe **5**. The shoe has a hole **6** (FIG. 3) the position of which coincides with or is close to the chamfer **4***a* during the functioning of the pump.

Each shoe **5** comprises a spherically concave hollow pattern **7**, which serves as a bearing for the corresponding piston **3**, and a rear flat face with a peripheral rib **8** which bears on an inclined intermediate swash plate **9**. With this arrangement the hole **6** discharges into the centre of the chamber defined between the shoe **5**, the plate **9** and the rib **8**, this chamber being filled with oil under pressure issuing from the holes **4** and **6** so as to cushion the shoe **5** hydraulically.

The intermediate swash plate **9** is carried by means of a roller bearing **10** on the upper face of a base swash plate **11**, the upper face **11***a* of which is inclined, whilst its lower face **11***b* is perpendicular to the axis of the assembly **2** of the pump. This face **11***b* of the plate **11** is carried in turn by a roller bearing **12**, on a plate **13** mounted on the base of the sump B. The plate **11** is secured to a driven shaft **14** which passes through the base of the sump B and the plate **13**, in which it is guided by a needle bearing **15**. The upper face **11***a* of the plate **11** carries a boss **16**, the axis of which is perpendicular to the upper inclined face **11***a*; the boss serves as a support for a needle bearing **17** which passes through a central orifice of the intermediate swash plate **9**. A stub shaft **18** integral with the shaft **14**, the plate **11** and the boss **16**, extends this latter upwardly coaxially with the axis of the assembly **2** of the pump. This shaft **18** is supported by a needle bearing **19** in the fixed cylinder A.

In order to simplify the manufacture and reduce the price as well as the number of spare parts to be stocked, the intermediate swash plate **9** and the base plate **13**, the needle bearings **16** and **17**, and the roller bearings **10** and **12**, are identical.

Each piston **3** is provided with peripheral grooves **20** (FIGS. 1 and 3) which contribute to its fluid tightness, and which gives it a certain flexibility, which is improved by the hollow shape of the piston.

In the inner space of the piston **3** there is mounted a return spring **21** which is compressed between its base and the upper part of the cylinder **1** where the inlet valve D is positioned. This valve D comprises a seating on which a ball **23** rests. A guide **24** is disposed around each ball **23** which prevents any transverse displacement of the ball and serves as a seat for the return spring **21**; the latter holds the guide against a shoulder **25** of the seat **22** (FIGS. 3 and 4).

The guide **24** is made from a single sheet-metal plate bent into an annular box **26** from which radiates six arms designated by references **27** and **28**. Alternate arms are bent upward (for example the arm **28**) so as to make a cage which surrounds the ball **23** and is located on the shoulder **25**. The arms **27** extend perpendicular to the axis of the cylinder **3** and they locate the box **26** with respect to cylinder **1**. An embossed portion **26** projects downward and engages with the upper end of the spring **21**. When the pump operates, the ball **23** of the valve B rises onto its seat **22** whilst transverse movement thereof is prevented by the cage formed by the arms **28**.

Each cylinder **1** discharges into a single channel E in the centre of the pump through a seating member **10**, on the periphery of which are discharge passages or bores **31**.

The axes of these latter are disposed obliquely and they all converge on the axis 2 of the pump. The inner edge 31*a* of each bore 31 (FIG. 3) serves as a seat for a ball valve 32 the lift of which is limited by a central core 33, made of plastic material with flutings 34 to pass out the pump fluid. A channel 35, disposed obliquely to the interior of the cylinder A, connects the upper part of each cylinder 1 to the corresponding discharge bore 31.

The member 30 is located with respect to the cylinder A by a pin 36.

This member 30 receives a main hydraulic pressure in the direction of the arrow 70 (FIG. 3), and the other hydraulic forces applied to it are insufficient to lift it from its position in the cylinder A.

The cylinder head C (FIGS. 1, 2 and 3) is hollowed to provide an admission chamber 37 which connects with the upper parts of the valves D. The upper part of the chamber 37 is connected to a bore 38 inclined at 45° to the axis 2 of the pump, in which fits an elbowed return pipe 39. This latter is made of plastic material or metal, and it is retained in a water-tight manner in the bore 38 by a clip 40 locked by means of a screw 41, the clip acting on an outer bead 42 of the pipe 39. With this arrangement the angular orientation of the pipe 39 around the axis of the bore 38 can be adjusted so that the free end 43 points in a direction to suit the conditions of mounting and use of the pump. FIG. 1 shows in full and broken lines two possible locations of the free end 43 of the pipe.

The main discharge chamber 44 of the pump is situated on the axis thereof, above a slide valve 45 communicating with a by-pass 46 (FIG. 2), which interconnect the exhaust and delivery sides of the pump. This valve comes into action when, for example, a jack fed by the pump reaches the end of its travel.

The slide valve 45 slides in a sleeve 47, which is housed inside the cylinder head C perpendicular to the axis 2 of the pump. The free end of the slide valve 45 is acted upon by a compression spring 48, which bears on stop 49 disposed on the side of the cylinder head and adjustable from the outside, the stop being provided with a protective cover 50. The other end of the slide valve 45 is extended by a rod 51, of smaller diameter than the valve and connected to it at a shoulder 52 on which the exhaust pressure of the liquid acts in the manner of a differential piston.

This rod 51 is disposed between two lateral holes 53 and 54 in the sleeve 47 the central part of which is located in a cavity 55 provided between the exhaust valve E and the main exhaust chamber 44. The free end of the rod 51 slides in a fluid-tight manner in the hole 56 of the bush 47. In normal operation the pump discharges fluid via the seating E, the cavity 55, the holes 53 and 54, and the annular space around the rod 51, to the chamber 44, substantially without leakage through the hole 56.

The projecting end of the rod 51 is provided with channels 57 which provide an escape path for fluid between the cavity 55 and the by-pass 46 if the rod 51 is sufficiently depressed by compression of spring 48 for these channels 57 to extend to the interior of the sleeve 47. This may be effected by actuating a lever 58, which is pivoted on a fixed axis 59. The lever has an arm 60 which can push back, in the direction of the arrow 61, a sliding shuttle 62 which is guided in a fluid-tight manner in the wall of the cylinder head C. The return spring 48 is housed in a cavity 63 which communicates with the inlet chamber 37.

This latter chamber is connected via a nonreturn ball valve F (FIG. 2) to a channel 64, which interconnects the sump in which the assemblies 9, 11, 14, 16 are housed, with the intake chamber 37. This ball valve permits the free passage of oil from the sump to the inlet chamber 37, as indicated by the arrow 65, while it prevents oil leaking in the reverse direction. With this arrangement, the oil fills the sump under low pressure, lubricates the shoes 5, and returns to the intake chamber 37 via the valve F, when the pressure in the sump exceeds a limit fixed by this valve. Dirt from oil returned to the pump, cannot enter the sump not only because of valve F which prevents all circulation in the reverse direction to the arrow 65, but because of the small diameter of the perforations 4 and 6 which feed a small flow of pressure oil to the shoes 5. The dirt can enter the cylinders 1, but it is subsequently emitted from the chamber 44, without contaminating the parts 10, 12, 17, 19. In operation, the shaft 14 is rotated and the pistons 3 are successively reciprocated with a movement which alternately sucks fluid from the chamber 37 into the cylinders 1, the fluid under pressure emerging from chamber 44.

The pump in accordance with the invention presents the following advantages:

(a) the use of a single exhaust valve for each cylinder, the seating of which is insured by the exhaust pressure;

(b) the volumetric yield of the pump is maintained high by the accurate guiding of the balls 23 of the inlet valves;

(c) the safety valve and overflow bypass are incorporated in the pump, thus avoiding the use of external high pressure connections used in known pump systems;

(d) the operation of the pump is very silent as a result of the use of plastic material in certain parts of the exhaust valves;

(e) the nonreturn valve F protects the mechanism of the pump against dirt brought by oil, especially in the case of the use of the pump in situations exposed to such dirt.

It should be understood that the preceding description is only given by way of example and does not in any way limit the scope of the invention other than as defined in the following claims.

I claim:

1. A hydraulic pump of the swash plate type comprising a body having a plurality of cylinders and pistons; individual nonreturn inlet valves for each said cylinder; each inlet valve comprising a ball and a guide therefor; a single outlet valve base serving all said cylinders; a swash plate for actuating said pistons; a driven shaft entering said body for rotating said swash plate; each cylinder discharging through inclined bores respectively into a single outlet channel in the body through said single outlet valve base, and the inner edge of each bore serving as a seat for a ball valve; said single outlet valve base being removably seated in a recess therefor in the body by hydraulic reaction; and a resilient core in said outlet valve base for limiting the lift of the related ball valves.

2. In a pump as set forth in claim 1, said outlet valve base being cup-shaped and its upper end communicating with the single outlet channel with its lower end of truncated conical form and provided with holes registering with said inclined bores, the inner ends of said holes forming said seats for said related ball valves, and said core being housed within the base above said ball valves and having a fluted central bore registering with the single outlet channel.

3. A pump as set forth in claim 1, said inlet valves each comprising a ball adapted to engage a valve seat in the upper inlet end of its related cylinder; and each guide comprising a single plate bent to form an annular box from which a plurality of arms radiate; alternate arms extending upwardly to form a cage surrounding the ball and engaging the valve seat, and the remaining arms extending laterally to engage the walls of a recess therefor in the body registering with the inlet.

4. A hydraulic pump comprising a body having a plurality of cylinders and pistons; individual nonreturn inlet valves for each said cylinder, each inlet valve comprising a ball and a guide therefor; a single outlet valve base serving all said cylinders; means for actuating said

pistons; each cylinder discharging through inclined bores respectively into a single outlet channel in the body through said single outlet valve base, and the inner edge of each bore serving as a seat for a ball valve; said single outlet valve base being removably seated in a recess therefor in the body by hydraulic reaction; means in said outlet valve base for limiting the lift of the related ball valves; said outlet valve base being cup-shaped and its upper end communicating with the single outlet channel; and its lower end contracted and provided with holes registering with said inclined bores, the inner ends of said holes forming said seats for said related ball valves, and said limiting means being resilient and housed within the base above said ball valves and having a central bore registering with the single outlet channel.

5. A hydraulic pump comprising a body having a plurality of cylinders and pistons; individual nonreturn inlet valves for each said cylinder, each inlet valve comprising a ball and a guide therefor; a single outlet valve base serving all said cylinders; means for actuating said pistons; each cylinder discharging through inclined bores respectively into a single outlet channel in the body through said single outlet valve base, and the inner edge of each bore serving as a seat for a ball valve; said single outlet valve base being removably seated in a recess therefor in the body by hydraulic reaction; means in said outlet valve base for limiting the lift of the related

ball valves; said inlet valves each comprising a ball adapted to engage a valve seat in the upper inlet end of its related cylinder; and each guide comprising a single plate bent to form an annular box from which a plurality of arms radiate; alternate arms extending upwardly to form a cage surrounding the ball and engaging the valve seat, and the remaining arms extending laterally to engage the walls of a recess therefor in the body registering with the inlet.

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