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(54) **Check valve**

(57) A check valve for use in association with a spray nozzle assembly comprises a diaphragm (70) stretched across a convex thrust-plate (72) having a rearward central spigot (74) having an enlarged collar (76) and being bifurcated at its remote end to provide two barb-like heads (78 and 80). A spring (100) is located in an annular slot (98) in a cylindrical housing (88) resiliently urges the thrust-plate (72) away from the housing (88).

The assembly is fitted into a main housing so that the underside of the diaphragm (70) is urged against an annular seat to isolate an annular inlet chamber from a central cylindrical outlet chamber.

The valve is colour-coded and is a bayonet fitting in the main housing.

A spray nozzle is likewise colour-coded and is a bayonet fitting to the main housing.

The main housing is attached to a first bracket member which is secured to a second bracket member for surrounding a pipe containing the liquid under pressure which is supplied to the annular inlet chamber.

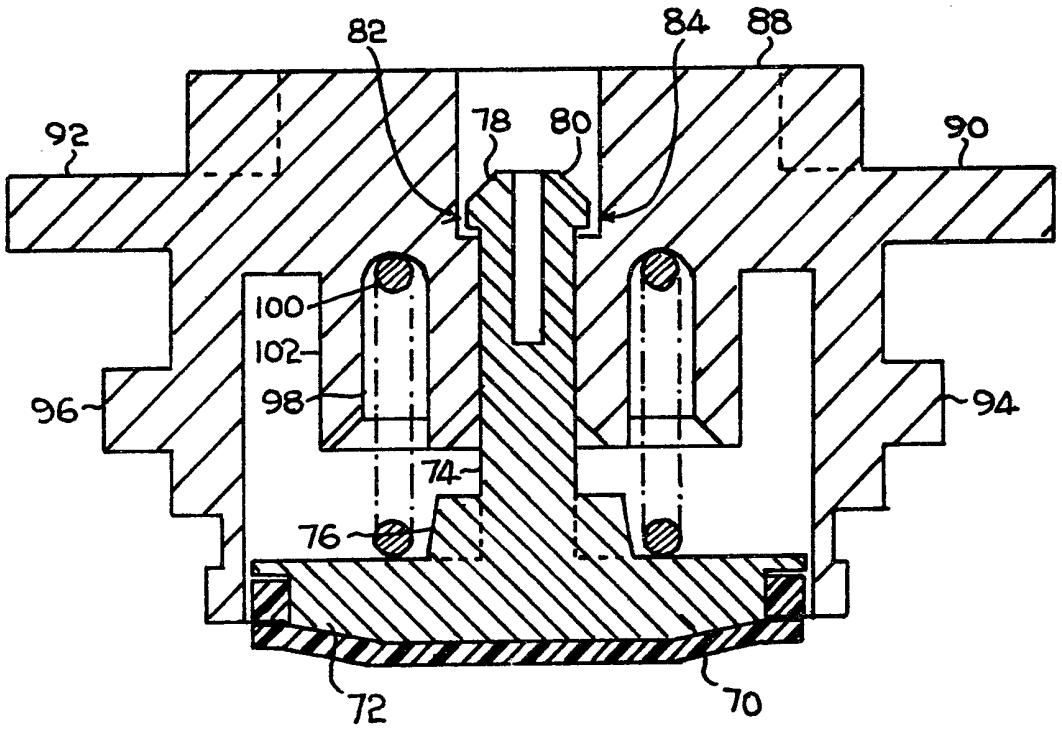

Fig. 6

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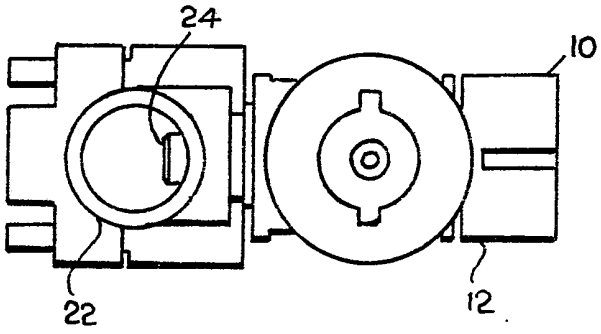

Fig. 1

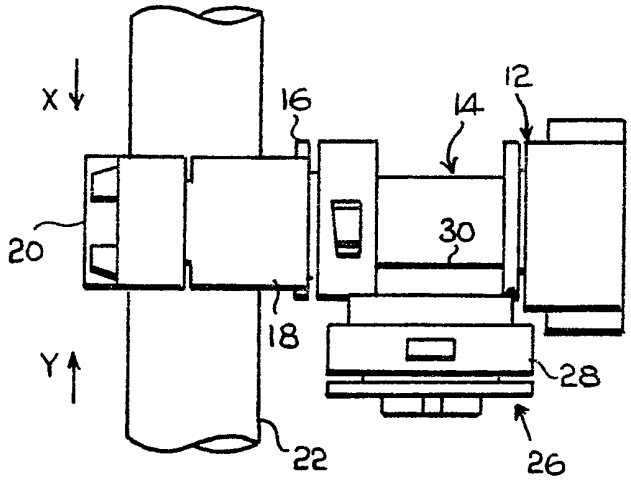

Fig. 2

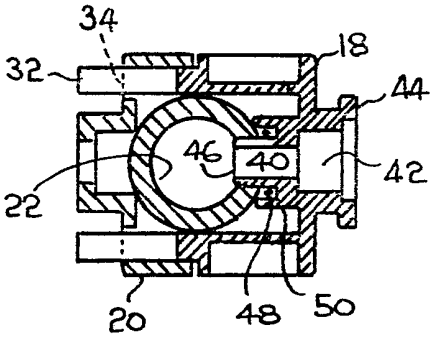

Fig. 3

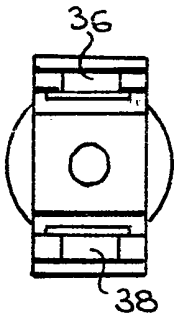

Fig. 3A

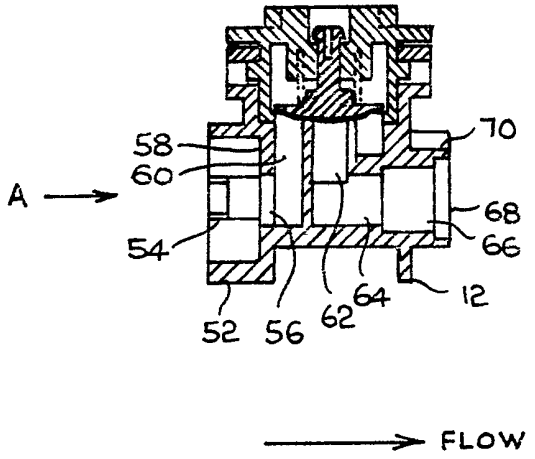

Fig. 4

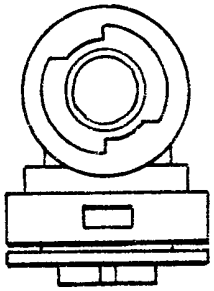

Fig. 5

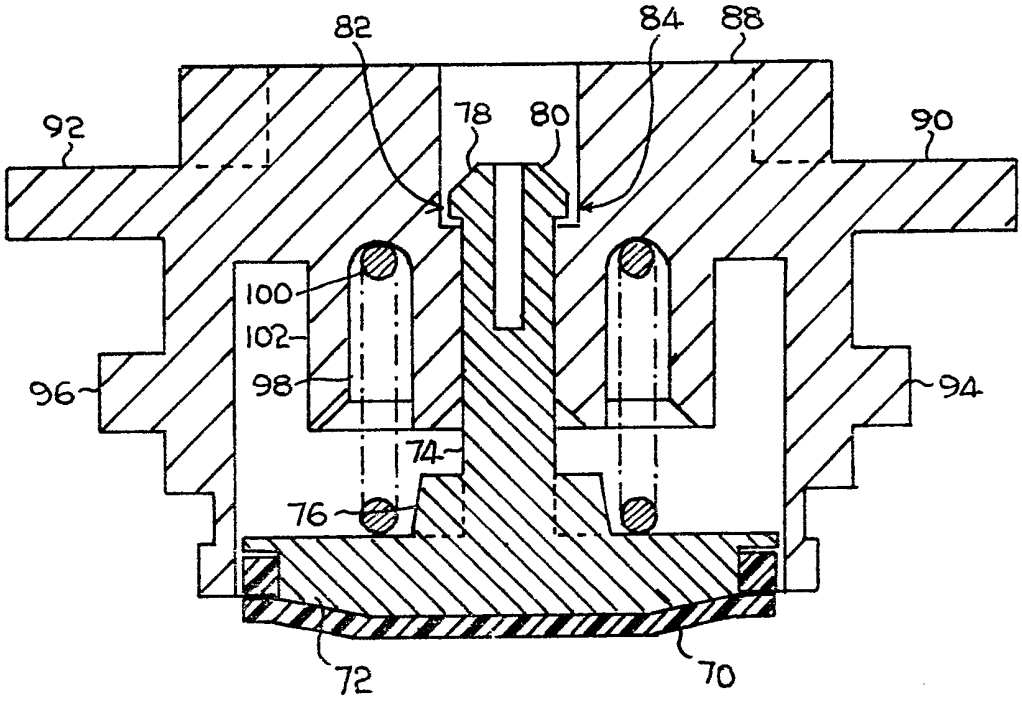

Fig. 6

SPECIFICATION

Improvements in and relating to spray nozzles

This invention concerns spray nozzles particularly for use in agriculture and horticulture.

It is known to provide a horizontal spray bar on an agricultural vehicle and to supply liquid fertilizer or weed inhibitor to the spray bar under pressure for spreading the liquid medium over the ground as the vehicle progresses.

With many present day chemicals it is necessary to control accurately the quantity of liquid applied to the ground per unit area and to this end it is necessary to use finely calibrated nozzles and to maintain a constant head of pressure so that a well defined rate of flow can be obtained.

The pressure along the spray bar would decrease if the nozzles were fed directly from the interior of the spray bar and to this end an individual constant pressure flow control valve is known to be provided in the fluid coupling between the spray bar and each nozzle served by the bar. The provision of such constant pressure flow control valves ensures that a uniform pressure is applied to the nozzles and constant rates of flow can thus be obtained.

It is sometimes necessary to change the operating pressure and to this end one aspect of the present invention is concerned with the design and construction of the constant pressure flow control valve commonly associated with spray bar nozzles.

The rate of flow is largely controlled by the size of the nozzle orifice and since different chemicals require different rates of application it is common practice to provide a plurality of differently sized orifice nozzles for a spray bar and to allow for the differently sized nozzles to be replaced at will.

Another aspect of the present invention is concerned with the design and construction of the means by which the nozzles are fitted to the spray bar.

The spray nozzles may be arranged to provide a fan spray and when the nozzles are so arranged, it is important that the nozzles are aligned correctly along the spray bar or other mounting means.

Another aspect of the invention concerns the self alignment of fan spray nozzles and the prevention of impingement of one spray pattern on an adjoining spray pattern.

Where differently sized nozzles are adapted to be fitted to a single spray bar so as to provide for different rates of application, it is important to ensure that wrongly sized nozzles are not fitted by accident and another aspect of the invention provides for easy identification of differently sized nozzles to avoid the risk of incorrectly sized nozzles being fitted.

Since the nozzles may sometimes have to be fitted in adverse conditions and interchanged whilst the spraying equipment is at least partially filled with chemicals some of which are caustic, or produce unpleasant side effects, the operator may often have to change nozzles whilst still wearing protective clothing and another aspect of the present invention is that the replaceable parts of the nozzles and replaceable parts of the constant pressure flow control valves are replaceable by an operator whilst still wearing protective clothing.

According to one aspect of the present invention in a check valve for supplying liquid under pressure to a spray nozzle, a diaphragm is stretched across inlet and outlet apertures and is urged in the direction so as to close off the inlet aperture from the outlet aperture by spring means so that the liquid pressure has to exceed a given value before the liquid can pass to the nozzle and wherein the diaphragm is in the form of a shallow dish having a circumferential annular wall and is adapted to be fitted over the end of a cylindrical housing containing the said spring means with a radially outer annular region of the diaphragm trapped between an annular shoulder on the cylindrical housing and a cylindrical seating containing the said inlet and outlet apertures.

In one embodiment the seating is generally circular and defines a cylindrical member which constitutes a fluid inlet and the outlet constitutes a concentric cylindrical tube of reduced diameter, the end of the open end of the cylindrical tubular member being substantially co-planar with the open end of the cylindrical housing constituting the said inlet so that the diaphragm, when stretched thereacross closes off the central outlet from the annular opening defining the said inlet aperture.

According to another feature of the invention, the spring means acts through the intermediary of a convexly shaped thrust plate and the central and slightly protruding region of the thrust plate aligns with the central reduced diameter exit tube and the diaphragm is thrust in a generally downward direction by the said spring means and thrust plate so as to firmly engage the central tubular fluid outlet and the spring means has to be compressed before the outer radial regions of the diaphragm can be brought into contact with the outer wall of the cylindrical housing forming the inlet.

According to another feature of the invention, the thrust member is formed with a central spigot which is bifurcated and formed with at least two barb like projections for engaging a shoulder in a central bore within the cylindrical member containing the spring means to facilitate the assembly of the unit. To this end a compression spring is situated around the central member containing the bore and shoulder which will retain the barbed bifurcated end of the spigot and the spigot is introduced through the spring means and into the aperture and pushed beyond the shoulder so that the barb like projections spring out and engage the said shoulder.

The thrust plate can still be pushed in an inward direction against the spring means but is prevented from moving outwardly by more than the distance governed by the inter-engagement of the barb like projections and the said shoulder.

According to another feature of the invention, the cylindrical member is itself formed with diametri-

cally opposed lugs which are adapted to be easily gripped between finger and thumb even when wearing a protective glove and a bayonet fastening is provided between the cylindrical member and a cylindrical extension of the same member containing the inlet and outlet apertures so that the said cylindrical member containing the spring means and to which the diaphragm is attached can be readily fitted thereto or removed therefrom simply by an appropriate twist through approximately 90° or less.

According to another feature of the invention, the colour of at least a part of the cylindrical member containing the spring means or the cylindrical member into which it is fitted is coloured in a distinctive colour the choice of which is determined by the strength of the spring located therein. In this way it is possible to identify quickly and easily whether all the check valve units fitted to a spreader bar are the same and the correct rating for a particular job in hand.

According to another feature of the invention, the spray nozzle is itself contained within a housing which is adapted with a bayonet connection between it and a mounting surrounding an outlet from a check valve of the type previously described so that the mounting or demounting of the nozzle assembly from the check valve assembly can be achieved by rotating the former through 90° or less.

According to another feature of the invention the nozzle housing includes a pair of diametrically opposed lugs or ears which can be clipped readily between finger and thumb to allow the nozzle assembly to be rotated for mounting or demounting even when the operator is wearing a protective clothing glove.

According to a further aspect of the invention, the mounting of the jet and selection of the angle of aim of the jet relative to the access about which the nozzle is fitted to the check valve outlet is related to the bayonet connections so that when fitted to the check valve outlet and firmly rotated into the locked-on position of the bayonet coupling, the orifice within the nozzle will direct a jet of liquid in a predetermined direction. In this way a plurality of fan spray nozzles can always be mounted consistently so that the adjoining patterns do not interfere and are correctly aligned and where individual sprays are required, the deflection of each is consistent.

According to another feature of the invention, at least part of each spray nozzle or it's surrounding housing is formed in a distinctive colour so as to indicate the size of the nozzle or some other feature of the orifice such as direction of the jet or the extent of any fan spread associated with the nozzle so that a check on the size and other characteristics of the nozzles can readily be made in situ.

According to another feature of the invention the check valve is situated intermediate a bracket for attaching the check valve to a pipe containing liquid under pressure and mounting fourth nozzle at the opposite end. The bracket conveniently includes a generally semi cylindrical recess for fitting around the pipe and includes a reduced diameter tubular nozzle which extends generally centrally into the semi-cylindrical recess and is surrounded by a resiliently deformable seal such as a rubber ring seal for fitting through an aperture in the wall of the pipe containing liquid under pressure. Conveniently another part of the bracket which co-operates with the first part so as to competely surround the pipe is adapted to be secured to the first mentioned part of the bracket and quick release means is provided for securing the two halves of the bracket together so as to clamp the bracket around the pipe. The means may comprise screw threaded members such as bolts or may comprise clips or cams or levers or bayonet type connectors.

According to another feature of the invention all of the parts of the check valve and the nozzle assembly and the bracket are formed from injection moulded plastics material with the exception of the diaphragm which is preferably formed from a rubber, plastics or composite material or a material such as nitrial or viton and the jet defining orifice which may itself be formed from metal.

Where bolts are used for securing the two bracket halves together or other screw threaded members, these may, of course, be formed from metal.

It is to be understood that the spring means urging the diaphragm into it's closed position will normally be a helical spring or spring steel or the like but may alternatively be formed from rubber.

The use of a cap shaped diaphragm i.e. a diaphragm having an upstanding annular wall and an integral circular membrane provides the following advantages:—

1. Positive location and sealing of the diaphragm
2. A speedy replacement of the diaphragm in the field should failure occur,
3. Positive shut-off at closely defined predetermined pressures,
4. The use of lower system pressures,
5. That the diaphragm is only stressed when the unit is operated due to it's shape and,
6. For air operation as well as manual operation since the diaphragm is circumferentially sealed.

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

Fig. 1 is a side elevation of a nozzle holder and check valve assembly mounted on a feeder pipe,

Fig. 2 is a plan view of the assembly shown in Fig. 1,

Fig. 3 is a cross-section view through the two part bracket which secures the check valve and nozzle assembly onto the supply pipe,

Fig. 4 is a cross-section through the check valve assembly which is located intermediate the supply pipe and the nozzle,

Fig. 5 is an end view in the direction of arrow 'A' in Fig. 4 and shows how the check valve assembly can be secured to one of the brackets and

Fig. 6 is an enlarged scale cross-section through the check valve assembly shown in Fig. 4.

Figs. 1 and 2 show a complete nozzle and check valve assembly mounted on a supply pipe.

The assembly comprises a nozzle tip nut 10 containing an orifice (not shown) through which liquid is forced under pressure to form a fine spray. The nut 10, is formed with a bayonet connection (not shown)

for fitting to a complementary bayonet connection formed in the end face 12 of a housing 14. The latter includes at it's opposite end another flange 16 having another bayonet or similar connection by which it is secured to one half 18 of a two part bracket the other part of which 20 is secured thereto in a manner to be hereinafter described.

The two part bracket surrounds a pipe 22 which contains a liquid under pressure such as fertilizer or weed killer or the like. The transfer of the liquid in the pipe to the orifice (not shown) in the nozzle tip nut 10 is by means of tapering tubular probes one of which is shown at 24 protruding into the interior of the pipe 22 in Fig. 1.

Intermediate the nozzle tip duct 10 and the bracket member 18 is located at check valve assembly generally designated by reference numeral 26. The check valve assembly includes a removable cap 28 secured by a bayonet fitting (not shown) to a laterally extending housing 30 extending from the cylindrical housing 14. The check valve will be described in more detail with reference to the later Figs.

The purpose of the check valve is to inhibit the flow of liquid from the pipe 22 to the nozzle orifice except when the pressure in the pipe is greater than a given value.

The communication between the housing 14 and the inside of the pipe is best seen with reference to Fig. 3 which shows the two bracket halves in cross-section around the pipe 22. The bracket part 18 includes four upstanding arms one of which is designated by reference numeral 32 which is best shown in Fig. 2. including an enlarged head having a shoulder, the position of which is shown in dotted outline at 34 in Fig. 3. The bracket portion 20 is secured to the bracket portion 18 by pushing the arms 32 through slots formed on opposite sides of the number 20 until enlarged heads at the remote ends of the arms 32 overlie the edges of the slots so as to prevent the two parts from moving apart. It is a simple matter to squeeze the heads together in the direction of the two arrows 'X' and 'Y' in Fig. 2 so as to disengage the overhanging shoulders such as 34 and allow the part 20 to be slid along the arms away from the part 18 to split the joint.

Fig. 3a, shows the heads of the arms in the two slots denoted by reference numerals 36 and 38.

Communication with the interior of the pipe 22 is achieved through the bore 40 and enlarged diameter bore 42. A bayonet flange 44 surrounds the opening to the bore 42. It is to this bayonet flange that the left-hand end of the housing 14 is attached.

The pipe 22 includes apertures along it's length through the wall thereof through which the tubular probe 46 will fit and 'O' ring seals 48 which surround the probe 46 serve to seal the latter to the pipe 22.

The resilience of the material forming the two halves of the bracket 18 and 20 is selected so as to be sufficient to grip the pipe firmly when the two bracket parts are firmly secured together and in turn the dimensions of the internal integral collar 50 containing the bore 40 thus selected so that when the bracket part 18 is firmly clamped to the bracket part 20, the seal 48 is compressed into sealing engagement with the wall of the pipe 22.

Fig. 4 is a cross-section viewed through the main body of the check valve and mounting part for attaching to the bracket at the left-hand end and the nozzle tip at the right-hand end as shown in Fig. 1.

The left-hand end 52 is adapted to fit over and around the bayonet flange 44 (see Fig. 3) and a central cylindrical tubular connection 54 communicates with the bores 40 and 42 when the two parts are securely joined together.

An aperture 56 in an internal wall 58 communicates with an annular region 60 within the housing, the access which is perpendicular to the general access of the bayonet fitting formed by the parts 44 and 52.

The upper part of the annular region 60 constitutes an inlet aperture for a check valve and a central concentric reduced diameter tube 62 constitutes the outlet aperture from the check valve and this communicates with a series of bores 64 and 66 which terminate in an aperture 68 which constitutes the male portion 70 of a bayonet fitting the female portion of which is contained on the nozzle tip nut 10 to allow the latter to be fitted thereto.

Details of the nozzle tip is not given since it essentially comprises nothing more than a quick release collar containing a concentric central aperture through which liquid under pressure can flow to an outlet orifice in the end face of the collar.

Detail of the check valve assembly is obtained from the enlarged scale drawing of Fig. 6.

This latter illustrates a complete sub-assembly which can be fitted quickly at will to the intermediate housing section 14 in Fig. 2 and constitutes the closure member for the check valve assembly.

The main sealing member is a cap shaped diaphragm 70 which is stretched across and around the outer rim of a slightly convexed thrust plate 72 which on its rearward face contains a central spigot 74 surrounded at its lower end by an enlarged collar 76.

The upper end of a spigot is bifurcated and two barb like heads are formed at the upper end thereof, the two heads in cross-section being denoted by reference numerals 78 and 80. The heads overlie shoulders 82 and 84 formed in the upper end of the bore through which the spigot is pushed and prevents the spigot from being pulled rearwardly therethrough.

The bore containing the heads which itself is denoted by reference numeral 86 is contained centrally within a cylindrical housing 88 which latter includes radially oppositely directed lugs or ears 90 and 92 and also includes a bayonet flange 94 and 96 by which the sub-assembly can be quick release fitted to the right-hand end of the intermediate housing 14 of Figs. 1 and 2.

The thrust plate 72 is urged in a generally downward direction as shown in Fig. 6 under the action of a helical compression spring 98. This latter is located in an annular slot 100 formed in a central cylindrical region 102 within the overall member 88 and a degree of axial alignment is provided for by arranging that the internal diameter of the spring 78 is just fractionally greater than the external diameter of the collar 76.

The shape of the underside of the thrust plate 72 is

chosen so that the central and slightly more protruding region pushes the diaphragm 70 into contact with so as to close off the central exit 62.

Movement of the thrust plate 72 in an upward direction as shown in Fig. 6, lifts the diaphragm 70 off the tubular member 62 and allows liquid to flow from the outer annular space 60 into the inner tubular member 62 and from thence to the outlet nozzle orifice.

Although one size of the bracket 20 is shown in the drawings, two or more brackets may be provided and the curved recesses formed therein and in the co-operating end 18 to accommodate different diameter pipes such as 22.

The modular design enables fitment of a standard nozzle holder, subsequent attachment of a diaphragm operated anti-drip device in the form of a second module by removing the existing cap tip, fitting the D.C.V. device in its place and replacing the cap tip on the appropriate end of the D.C.V. device.

CLAIMS

1. A check valve for supplying liquid under pressure to a spray nozzle comprising a diaphragm stretched across inlet and outlet apertures and urged in the direction so as to close off the inlet aperture from the outlet aperture by spring means so that the liquid pressure has to exceed a given value before the liquid can pass to the nozzle characterised in that the diaphragm is in the form of a shallow dish having a circumferential annular wall and is adapted to be fitted over the end of a cylindrical housing containing the said spring means with a radial outer annular region of the diaphragm trapped between an annular shoulder on the cylindrical housing and a cylindrical seating containing the said inlet and outlet apertures.

2. A check valve as claimed in claim 1 in which the seating is generally circular and defines a cylindrical member which constitutes a fluid inlet, and the outlet constitutes a concentric cylindrical tube of reduced diameter, the end of the open end of the cylindrical tubular member being substantially coplanar with the open end of the cylindrical housing constituting the said inlet so that the diaphragm, when stretched thereacross, closes off the central outlet from the annular opening defining the said inlet aperture.

3. A check valve as claimed in claim 1 or 2 in which the spring means acts through the intermediary of a convexly shaped thrust-plate and a central and slightly protruding region of the thrust-plate aligns with the central reduced diameter exit tube and the diaphragm is thrust in a generally downward direction by the said spring means and thrust-plate so as to firmly engage the central tubular fluid outlet.

4. A check valve as claimed in claim 3 in which the spring means has to be compressed before the outer radial regions of the diaphragm can be brought into contact with the outer wall of the cylindrical housing forming the inlet.

5. A check valve as claimed in claim 3 or 4 in which the thrust member is formed with a central spigot which is bifurcated and formed with at least two barb-like projections for engaging a shoulder in a central bore within the cylindrical member containing the spring means, to facilitate the assembly of the unit.

6. A check valve as claimed in claim 5 in which a compression spring is situated around the central member containing the bore and a shoulder which will retain the barb bifurcated end of the spigot and the spigot is introduced through the spring means and into the aperture and pushed beyond the shoulder so that the barb-like projections spring out and engage the said shoulder.

7. A check valve as claimed in claim 2 in which the cylindrical member is itself formed with diametrically opposed lugs which are adapted to be easily gripped between finger and thumb even when wearing a protective glove and a bayonet fastening is provided between the cylindrical member and a cylindrical extension of the same member containing the inlet and outlet apertures, so that the said cylindrical member containing the spring means and to which the diaphragm is attached, can be readily fitted thereto or removed therefrom, simply by an appropriate twist through approximately 90° or less.

8. A check valve as claimed in any of claims 2 to 7 in which the colour of at least a part of the cylindrical member contains a spring means or the cylindrical member into which it is fitted, is coloured in a distinctive colour, the choice of which is determined by the strength of the spring located therein.

9. A check valve as claimed in any of the preceding claims when fitted with a spray nozzle.

10. A check valve as claimed in claim 9 in which the spray nozzle is contained within a housing which is adapted with a bayonet connection between it and a mounting surrounding the outlet from the said check valve, so that the mounting or de-mounting of the nozzle assembly from the check valve can be achieved by rotating the former through 90° or less.

11. A check valve as claimed in claim 10 in which the nozzle housing includes a pair of diametrically opposed lugs or ears for gripping between the finger and thumb.

12. A check valve as claimed in either of claims 10 or 11 in which the bayonet connection determines the direction in which the jet of liquid will leave the nozzle when the housing containing the nozzle has been firmly rotated into the locked-on position of the bayonet connection between the nozzle housing and the check valve.

13. A check valve as claimed in any of claims 9 to 12 in which at least part of each spray nozzle or its surrounding housing is formed in a distinctive colour so as to indicate either the size of the nozzle or the outlet angle of the orifice or the extent of any fan spread of the orifice so that a check on the size or other characteristics of a nozzle can readily be made.

14. A check valve as claimed in any of claims 9 to 13 in which the valve is situated intermediate a bracket for attaching the check valve to a pipe containing liquid under pressure and a mounting for the nozzle at the opposite end.

15. A check valve as claimed in claim 14 in which the bracket conveniently includes a generally semi-cylindrical recess for fitting around the pipe and includes a reduced diameter tubular nozzle which extends generally centrally in semi-cylindrical recess

and is surrounded by a resiliently deformable seal for fitting through an aperture in the wall of the pipe containing the liquid under pressure.

16. A check valve as claimed in claim 15 in which another part of the bracket which co-operates with the first part serves to surround the pipe is adapted to be secured to the first-mentioned part of the bracket and a quick-release means is provided for securing the two halves of the bracket together so as to clump the bracket around the pipe.

17. A check valve as claimed in claim 16 in which the quick-release means comprises screw-threaded members such as bolts or comprises clips or cams or levers or bayonet-type connectors.

18. A check valve as claimed in any of claims 1 to 8 in which all the parts of the valve are formed from injection moulded plastics material with the exception of the diaphragm.

19. A check valve as claimed in any of claims 9 to 17 inclusive in which all of the parts of the nozzle assembly are formed from injection moulded plastics material.

20. A check valve as claimed in any of claims 14 to 17 inclusive in which the bracket parts are formed from injection moulded plastics material.

21. A check valve as claimed in any of the preceding claims in which the diaphragm is formed from a rubber, plastics or composite material.

22. A check valve as claimed in any of the preceding claims in which the checked orifice is formed from metal.

23. A check valve as claimed in any of the preceding claims in which the spring means urging the diaphragm into its closed position is a helical spring.

24. A check valve as claimed in any of the preceding claims 1 to 22 inclusive in which the spring means urging the diaphragm into its closed position is formed from rubber.

25. A check valve constructed arranged and adapted to operate substantially as herein described with reference to and as illustrated in the accompanying drawings.

26. A check valve when fitted in a spray nozzle assembly for attachment to a spraying bar constructed arranged and adapted to operate substantially as herein described with reference to the accompanying drawings.

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