

SELF-CLEANING/UNBLOCKING SPRAY NOZZLE

Spray nozzles are well known devices for producing controlled sprays of liquids for applications such as paint spraying, crop spraying to dispense fertiliser and insecticide, industrial washing and chemical treatment. For most applications it is essential for a spray nozzle to produce an evenly distributed spray of uniform liquid particles in a predetermined spray pattern.

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In most cases the spray pattern consists of fine droplets created by forcing liquid into the nozzle through a large orifice and out of the nozzle through a smaller discharge orifice or plurality of smaller discharge orifices. The finer the droplets required, the smaller the size of the discharge orifice. The discharge orifices in known spray nozzles are usually outlet openings of a static nature and preset dimensions, e.g. holes drilled or moulded into the ends of nozzle members. The outlet openings or holes, being of small size, have a tendency to block frequently with particles of dirt, crystals and other matter present in the liquid or the spraying equipment.

Conventional methods of removing trapped particles to clean the spray nozzle and allow liquid to flow properly are very labour intensive. The spray nozzles need to be removed frequently from the spraying equipment and cleaned out by hand. Often there are large numbers of spray nozzles and they can be in difficult to access locations. The spray nozzles can also be contaminated with toxic or corrosive liquid if that is the nature of the material passing through the nozzle. Whilst this cleaning process is undertaken, production cannot continue which is extremely costly.

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In order to reduce the need for frequent cleaning of the nozzles there is disclosed in GB 0987723 a spray nozzle comprising a hollow member having an outlet opening at its

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front end, and a movable device within the hollow member. The movable device comprises a plurality of separable segmental parts, and the device can be moved by fluid pressure to move the segmental parts towards each other to
5 create a spray discharge orifice at the front end of the nozzle.

The segmental parts can separate when relieved of fluid pressure, so that discharge orifice can be opened-up
10 for releasing particles so as to tend to prevent collection of matter which could block the orifice.

However, this known spray nozzle has the disadvantage that when orientated so that the open end is lowermost, the
15 segmental parts remain together and fail to release such matter.

There is disclosed in EP 0482369A, a nozzle in which the rear ends of the separable parts have radially
20 outwardly projecting flanges which are engaged by a rear end of a helical compression spring, located in an annular space between the movable device and the hollow member, to thrust the device rearwards away from the open front end of the hollow member. To prevent fluid by-passing the device
25 (by flowing through this annular space), the flanged rear ends carry a packing ring which seals against the internal surface of the hollow member. Additionally, the rear end part of the hollow member is fitted internally with a retaining ring to retain the spring, packing ring and
30 separable parts within the hollow member. In order to force such separable parts to separate when fluid pressure is removed from the nozzle, surfaces of said flanges are inclined so that the spring acts thereon in an attempt to urge apart the front ends of the separable parts, to try to
35 cause the orifice to open when the device is moved rearwards to abut the retaining ring.

The nozzle of EP 0482369A gives rise to more problems



than it solves. For example spring acts primarily in the axial (front to rear) direction, and thus the packing ring is necessary to ensure that the fluid pressure generates enough force on the device to overcome the thrust of the spring, but a consequence is that (upon the fluid supply being halted) when the device moves rearwards the volume of said annular space increases, sucking in air and/or fluid back into the space at the same time as the separable parts are being separated, with the resultant probability that clogging matter will be drawn into the annular space. Presence of such matter in the annular space, and especially in the slight gap between the flanges and the hollow member, can cause the nozzle to malfunction.

However, the main problem inherent in said nozzle is that it is complex, expensive to make and designed to be replaced as a pre-assembled unit. It is clearly not designed to be dismantled easily for on-site cleaning and would be even more difficult or nearly impossible to re-assemble without renewing the rings, thus requiring the user to carry on site stocks of spare nozzles for every spray variant, flow rate and etc type of nozzle employed.

The present invention accepts that some blockages or malfunctions are probably inevitable even with nozzles which are designed to be self-cleaning, and seeks to avoid the problems of manufacturing complexity and spare parts costs.

In order to avoid or reduce said problems in respect of a spray nozzle of a kind generally comprising a hollow member having an outlet opening therein at the front of the spray nozzle, a movable device disposed within the nozzle and rearwardly biased to a normal position in which the outlet opening is minimally restricted or is unrestricted by the movable device, wherein the movable device is movable by fluid pressure from the normal position in a forwards direction towards the outlet opening to obstruct



the flow to the outlet opening and to cause relative movement between separable parts of the movable device to create a spray discharge orifice, smaller than the outlet, within or proximal to the outlet opening; the present invention is characterised in that the operationally movable parts of the spray nozzle for forming the discharge orifice and providing said bias are all contained within or incorporated into the movable device.

Thus, the movable device can be removed as a unit to facilitate on-site servicing of the spray nozzle.

In order to further avoid said problems and to reduce the risk of malfunction the present invention further provides a spray nozzle of said kind characterised in that the hollow member has provided therein a sealing abutment surface adjacent the outlet opening, and the separable parts have sealing surfaces on their front ends to engage the abutment surfaces to provide a seal in the operative position of the movable device to prevent fluid by-passing the discharge orifice or orifices.

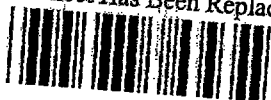
Thus, the remainder of the movable device to the rear of said seal can be a clearance fit in the nozzle, for ease of removal of the device and to minimise friction and risk of matter impeding movement of the movable device.

In preferred embodiments, a nozzle of said kind is characterised according to the present invention in that transverse biasing means is provided in or by the movable device to urge said separable parts to separate and react against an internal surface of the spray nozzle to provide said rearwards to bias indirectly.

Preferably:-

(a) said internal surface is part conical, converges towards the outlet opening and is inclined to the

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axis of the nozzle at an angle within the range of 20° to 40°, preferably 25 to 35°;

- 5 (b) the transverse biasing means comprises a resilient member accommodated inside the movable device between said separable parts;
- 10 (c) said movable device or said resilient member is shaped to impart rotational motion to fluid passing through the movable device.

By arranging the biasing means to act directly in the separating direction on the separable parts of the device, reliable separation is ensured; and by providing the
15 biasing means in the movable device all the above mentioned problems associated with the known helical springs, spring receiving annular spaces, packing rings and retaining rings are avoided.

20 In known spray nozzles the separable parts are individual elements which are discrete from each other, and can be moved to abut in the operative position of the device. In order to further reduce said problems and the cost of the device, said separable parts are preferably
25 parts of a single body which can flex to permit relative movement between said separable parts of the body.

In accordance with the present invention, some preferred embodiments of nozzle of said kind are
30 characterised in that the movable device comprises a body incorporating said separable parts, and in that the flexible body is at least partially resilient, and serves to provide said rearwards bias by urging the separable parts away from each other to react against an internal
35 surface of the spray nozzle.

The integration of the biasing means and the separable parts into a single body makes the spray nozzle



extremely inexpensive, resistant to malfunction and easy to service; and furthermore avoids all the well known problems inherent in metal coil springs, such as corrosion, breakage and malfunction, to which such springs are particularly liable when used in a corrosive or damp environment.

Furthermore, simple exchange of bodies can be employed to give a change of spray characteristics, without having to change the other parts of the spray nozzles. For example, it is known to fit a vaned insert into an ordinary static non-self-clearing spray nozzle, in order to impart rotational momentum to the fluid in the nozzle, but in EP 0482369A the separable parts occupy the space required for such a vaned insert.

In order to solve this additional problem the present invention further provides a spray nozzle of said kind which is characterised in that the movable device is hollow and has disposed therein flow guiding means, such as vane surfaces or vane extensions, to impart rotary motion to fluid passed through the movable device.

The periphery of the discharge orifice may be wholly defined by nozzle surfaces on the movable device so as to be discrete from the periphery of the outlet opening; or the periphery of the discharge orifice may be only partially defined by such discrete nozzle surfaces so as to meet the periphery of the outlet opening so that part or parts of the surface of the hollow member defining the outlet opening serve as a further nozzle surface or surfaces to define part or parts of the discharge orifice.

The nozzle surfaces may be shaped to create a plurality of the discharge orifices. The flow cross sectional area of the discharge orifice or orifices is preferably less than half, e.g. 0.01 to 0.1, of that of the outlet opening.

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In some systems employing several nozzles, the rate of fluid supply may be insufficient to generate the minimum pressure required to move the movable devices whilst all the devices are in the normal positions, even though the working flow rate is being supplied. To avoid problems of actuation of the movable devices, the flexible body preferably serves as a combined piston and flow restrictor in its normal position in the spray nozzle. In a preferred form, the integral parts are connected by a head which serves as the piston, which head is shaped to provide a restricted fluid flow path having a flow cross-sectional area greater than the flow cross-sectional area of the created spray discharge orifice or orifices. The flow path may be defined between the head and the internal surface of the nozzle, but is preferably primarily provided by a port in the head.

In order to shut off the supply of liquid to known nozzles when the supply pressure falls below a predetermined minimum pressure, e.g. in order to reduce "dribbling" from nozzles, it is known to provide pressure sensitive shut off or check valves immediately upstream of each of the nozzles or to incorporate such a valve into a combined valve and nozzle assembly. Again, the aforementioned further problems are involved together with problems of reliability and blockage of the valves.

In order to reduce such problems, the movable device in the normal position preferably serves to block flow through the interior of the spray nozzle. In a preferred embodiment the head cooperates with a static member to close the port in the head whilst leaving part of the pressure supply side face of the head exposed to any pressure supplied to the nozzle.

The static member may be employed to restrict the port, and be arranged, e.g. tapered, so that said restriction reduces progressively with the distance moved

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by the movable device from the normal position.

The static member may serve as a pintle which extends through the port and provides a flow modifying surface or
5 surfaces within the movable device, e.g. to impart rotation to said flow.

The invention further includes and provides a spray nozzle of said kind characterised in that the movable
10 device is hollow and in the normal position cooperates with a static member in the nozzle to serve as a valve closing a flow path into the movable device.

The hollow member is preferably a cap releasably
15 secured to an inlet body, and separable from the body to provide access for removal or insertion of the movable device. The cap may incorporate a spray deflector axially offset from the outlet opening, on which a spray from the discharge nozzle can impinge.

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The invention can be utilised for retro-application to some forms of known spray nozzles, and accordingly the present invention provides a movable device, insertable into a spray nozzle having a removable
25 cap apertured to provide an outlet opening, which device comprises separable nozzle surfaces which can be brought into mutual proximity, against a bias in the movable device, to create a spray discharge orifice.

30 The nozzle surfaces may be configured to form a discharge orifice of any suitable geometric configuration.

The nozzle surfaces may be provided on tips of the separable parts, which tips may be of materials the same as
35 or different from the remainder of the separable parts, e.g. metal or ceramic tips on plastics bodies or separable parts.

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The movable device is preferably a moulding of thermoplastics material. Preferably, the moulding comprises at least two arms joined to a central portion by integral flexible hinges. In preferred embodiments the arms terminate in free end portions shaped to provide surfaces for forming the discharge orifice and further surfaces for sliding engagement with said internal surface of the spray nozzle.

10 The invention will be described further, by way of example, with reference to the accompanying diagrammatic drawings, wherein:-

FIGURE 1 shows an axial cross-section through a spray nozzle of the invention incorporating a first form of movable device of the invention in an "operative" position adopted when spraying;

FIGURE 2 shows an axial cross-section through part of the spray nozzle with the movable device in a "normal" position;

FIGURE 3 shows the first form of movable device of the invention in plan in an "as moulded" condition;

FIGURE 4 shows an axial section through a modified static member and part of the movable device for use in the spray nozzle;

FIGURE 5 shows a second form of the movable device in plan in an "as moulded" condition;

FIGURE 6 shows a cross section through a further modified form of the movable device;

FIGURES 7, 8 and 9 show front end views of variations of the nozzle providing different spray patterns;



FIGURE 10 is an axial sectional view through a first part of a further modified form of the nozzle;

FIGURE 11 is a front end view of the device on its own in the operative condition with the cap shown in FIGURE 10 removed; and

FIGURE 12 is a view similar to FIGURE 4 showing a further modified form of static member and device.

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Referring to FIGURES 1 to 3, the spray nozzle primarily comprises a hollow inlet body 10 on which a hollow member in the form of a cap 11 is releasably mounted, and a movable device 12 movable within a cylinder 13 defined primarily by the cap. The spray nozzle may optionally also be provided with static member 14 and/or a filter 15.

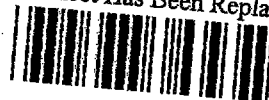
The cap 11 provides an outlet opening 16, and has a conically inclined internal ramp surface 17 leading from the opening 16 to an internal cylindrical surface 18 around the cylinder 13.

The movable device 12 is in the form of a flexible body moulded from plastics material so as to comprise parts which form arms 20 connected together by a head 21. Each arm 20 provides, on its free end portion, a nozzle surface 22, at least one abutment surface 23 (FIGURE 3) and a slider surface 24 (FIGURE 2) in a predetermined mutual configuration. In the embodiment shown in FIGURES 1 to 3, two arms 20 are provided and the surfaces 22 are configured so that when the surfaces 23 abut (FIGURE 1) the surfaces 22 define between them a discharge orifice 26 smaller than and concentric with the outlet opening 16.

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The head 21 is dimensioned to be a sliding fit in the cylinder, and is provided with an axial port 28 providing a restricted flow path for fluid to flow into the movable

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device 12.

Each arm 20 is joined to the head 21 by an integral resilient hinge 27 so that the arms can be swung together against an inherent resilient resistance from the "as moulded" condition shown in FIGURE 3 for insertion of the device into the cylinder 13 so that the slider surfaces 24 are in contact with the ramp surface 17 (FIGURE 2) in the normal position of the device 12.

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The ramp surface 17 is inclined to the central axis of the cylinder 13 at an angle determined so that the reaction to forcible engagement of the slider surfaces with the ramp surface (because of the radially outwardly directed force applied to the arms by said resilient resistance) produces a rearwardly directed bias acting to urge the movable device axially away from the outlet opening 16 and towards the normal position, e.g. about 30°. In the normal position said abutment surfaces 23 are separated so that the surfaces 22 no longer define any discharge orifice 26 and merely lie in a relatively wide flow path 29 to the rear of the outlet opening (FIGURE 2).

In use, in the absence of the static member 14 and filter 15, when fluid is initially supplied to the nozzle, the initial resistance to flow through the nozzle is primarily determined by the area of the restricted flow path i.e. the area of the port 28, the liquid will initially flow through the wide flow path 29 between the arms to the opening 16 until the force imparted to the head 21 (which serves as a piston under these conditions) is sufficient to overcome the bias (and friction of the engagement of the surfaces 24 and 17) and thereby drives the device to move forwards towards the outlet. This forwards movement causes the free end portions of the arms to be forced towards the axis, as the surfaces 24 traverse the ramp surface 17, until the abutment surfaces 23 abut and the discharge orifice 26 is formed when the device



reaches the operative position. In the operative position the ramp surface 17 serves also as a sealing abutment surface and the slider surfaces 24 serve also as sealing surfaces which engage the surface 17 to provide a seal preventing fluid from by-passing the orifice 26; and the resistance to flow through the nozzle is greater than the initial resistance and is determined primarily by the dimensions of the orifice 26.

The wide flow path 29 preferably has a minimum flow cross-sectional area about the same as that of the outlet opening 16.

The initial flow serves as a flushing flow to remove particles of matter which could otherwise restrict or block the orifice 26.

The simple example just described involves a compromise between the necessity of generating a sufficient piston force and the desirability of keeping the port 28 sufficiently large to reduce the probability of the port 28 becoming blocked. This compromise is not significant where the fluid supply is sufficient, but could be detrimental if the rate of said supply is restricted. In the latter case the compromise can be avoided by locating a static flow restrictor 30 in the cylinder so that it restricts the port 28 in the normal position of the device and until the device has moved forwards to take the port clear of the restrictor, and has thereby moved the arms radially towards each other to an extent sufficient to cause the resistance to flow to be substantially determined by the spacing between the surfaces 22 and/or 23. The static restrictor 30 is arranged to permit a flushing flow, and also serves as a plunger or wiper to clear the port as the device returns to the normal position.

The restrictor may be dimensioned to close the port completely in the normal position, and, if the head 21 of

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the device is a sufficiently close fit in the cylinder, the restrictor and head will serve as a non-return valve, to prevent further, i.e. leakage, flow through the nozzle, and, if the filter 15 is included, to keep the filter bathed in the fluid.

However, the head is preferably a clearance or free sliding fit in the cylinder, and, if a non-return valve function is required, the static member 14 is employed. The static member is primarily an apertured disc in which the apertures 31 do not register with the port 28 so that when the head abuts the disc the port is closed whilst part of the surface of the head remains exposed for application of fluid pressure via the apertures 31, as shown in FIGURE 2.

In such a form of the spray nozzle, the disc 14 is positioned to limit the stroke of the device so that in the normal position the surfaces 24 remain in contact with the ramp surface 17 whereby to maintain said rearwards bias and force the piston to abut the disc. Initial forwards movement is thus initiated by the pressure of the fluid supply imparting the required minimum force to the piston, prior to commencement of flow through the flow passages.

The restrictor 30 may optionally be provided or mounted on the disc 14, as shown.

The movable device may be moulded to provide vanes 33 to impart rotation to the flow, e.g. as shown in FIGURES 1 and 5; or an extra arm or arms 34 carrying a vane 35 may be provided on the device e.g. as shown in FIGURE 5. A swirl vane 37 may be provided on the restrictor 30, and the ports 31 may be inclined to promote swirl as indicated in FIGURE 4. The arms may have lateral extensions 45, indicated in broken lines in FIGURE 5, which abut in the operative position to provide within the arms a smooth walled, almost circular in section, swirl chamber 46

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(FIGURE 6).

The shape and number of the discharge orifice or orifices is determined by the form of spray required. For example, the abutment surface 23 on an arm 20 may lie between two nozzle surfaces 22 each of which extends to an edge of the arm, as shown in FIGURE 7, so that in the operative position the edges abut the surface of the outlet opening 16 with the result that a pair of discharge orifices 26 partially concomitant with the opening 16 are formed within the opening by the surfaces 22.

More than two arms 20 may be employed, e.g. three arms 20 as shown in FIGURE 8, at equal or unequal angular intervals around the head.

Where the discharge opening 26 is non-circular, e.g. elongate, as shown in FIGURE 9, or where a spray pattern assymetric to the axis or of non-circular form is required, the axial orientation of the device 12 in the cylinder 13 may be determined by any suitable guide means. For example, the port 28 may be of keyhole form, and a modified form of the static member 14 having a guide finger 38 thereof parallel to the axis to engage in the eccentric portion of the port, as shown in FIGURE 12, may be employed as the guide means. However, it is preferred to provide the cylinder with an axially directed rib 50 to engage in a recess 51 in the head (FIGURES 2 and 3) or to provide a keyway in the cylinder to receive a radially directed projection on the periphery of the head 21. As can be seen in FIGURE 6, the hinges 27 provide chordal flats 53 on the periphery of the head, and to prevent rotation of the insert, the cylinder may have corresponding chordal flats, not shown. Markings 54 may be provided on the cap 11 to indicate the orientation of the device 12 and thus the spray pattern.

The resilient resistance from which the bias is



derived may be supplemented, e.g. by extending the vanes 33 to abut so as to urge the arms 20 apart; by using the vane 35 on the arm 34 to urge the arms 20 apart; by forming buttresses 39 on the arms 20 to engage and react against the head to urge the arms radially outwards (FIGURES 1 and 3); or by any combination thereof.

A stop surface or flange 42 on the cap may usefully be employed to seal against the end portions of the arms to prevent flow bypassing the discharge orifice or orifices; and in such embodiments the slider surfaces 24 may be provided by narrow ribs 43 on the arms 20 to reduce friction in the engagement with the ramp surface (FIGURES 10 and 11).

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The end portions of the arms 20 may, in the operative position, project forwards beyond the outlet opening 16 (FIGURE 10), to be co-terminus with the outlet opening (FIGURE 8), extend into the outlet opening (FIGURE 7) or terminate to the rear of the outlet opening (FIGURE 1).

In all embodiments, movement (and optional flexing) of the movable device serves to dislodge, and/or break up solid or non-fluid deposits, on the device, for removal thereof together with other particles by flushing flow, for automatic self cleaning or unblocking of the nozzle. Repeated interruption of the fluid supply can be employed to facilitate cleaning and/or unblocking of the nozzles.

The invention is not confined to details of the foregoing examples, and many variations and modifications are possible within the scope of the invention.

For example, the cap may provide merely the stop surface or flange 42 or the ramp surface 17, the remaining cylinder surfaces 17 and 18 or surface 18 being provided by the inlet body 10 or by a suitably shaped insert (not shown) inserted into the interior of the nozzle.



In the event of a shaped insert being employed, components such as the static member 14 and/or filter 15, together with the device 10, or any thereof, may be pre-assembled with the insert to form an assembly to facilitate
5 adaptation of a known form of nozzle, or repair or refurbishment of a nozzle in accordance with the invention.

The member 14 and filter 15 need not be located at a junction between the cap and body, even though it is
10 convenient to locate the member 14 by means of a junction seal washer 44 and a locating flange on the filter as shown in FIGURE 1.

The terms and expressions employed herein are by way
15 of example and include within the scope thereof applicable generic terms and synonymous and functional equivalents.

The invention further provides a nozzle, movable device or assembly comprising any novel part, feature or
20 functional arrangement disclosed herein or in the accompanying drawings, or any novel combination of parts, features or functional arrangements so disclosed.

For example the invention further provides and
25 includes a spray nozzle having a hollow member defining an outlet opening and a device movable within the nozzle between a normal position in which the outlet opening is unrestricted or minimally restricted and an operating position defining a discharge orifice within or proximal to
30 the outlet opening and having a flow cross-sectional area less than half that of the outlet opening.

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CLAIMS

1. A spray nozzle comprising a hollow member having an outlet opening therein at the front of the spray nozzle, a
5 movable device disposed within the nozzle and rearwardly biased to a normal position in which the outlet opening is minimally restricted or is unrestricted by the movable device, wherein the movable device is movable by fluid pressure from the normal position in a forwards direction
10 towards the outlet opening to obstruct the flow to the outlet opening and to cause relative movement between separable parts of the movable device to create a spray discharge orifice, smaller than the outlet opening, within or proximal to the outlet opening; and characterised in
15 that the operationally movable parts of the spray nozzle for forming the discharge orifice and providing the bias are all contained within or incorporated into the movable device.
- 20 2. A spray nozzle as claimed in Claim 1 further characterised in that the movable device comprises a flexible body incorporating said separable parts, and in that the flexible body is at least partially resilient, and serves to provide said rearwards bias by urging the
25 separable parts away from each other to react against an internal surface of the spray nozzle.
3. A spray nozzle comprising a hollow member having an outlet opening therein at the front of the spray nozzle, a
30 movable device disposed within the nozzle and rearwardly biased to a normal position in which the outlet opening is minimally restricted or is unrestricted by the movable device, wherein the movable device is movable by fluid pressure from the normal position in a forwards direction
35 towards the outlet opening to obstruct the flow to the outlet opening and to cause relative movement between separable parts of the movable device to create a spray discharge orifice, smaller than the outlet opening, within





or proximal to the outlet opening; and characterised in that transverse biasing means is provided in or by the movable device to urge said separable parts to separate and react against an internal surface of the spray nozzle to
5 provide said rearwards to bias indirectly.

4. A spray nozzle as claimed in Claim 2 or 3 wherein said internal surface is part conical, converges towards the outlet opening and is inclined to the axis of the
10 nozzle at an angle within the range of 20° to 40°, preferably 25 to 35°.

5. A spray nozzle as claimed in Claim 3 wherein the transverse biasing means comprises a resilient member
15 accommodated inside the movable device between said separable parts.

6. A spray nozzle as claimed in Claim 5 wherein said movable device or said resilient member is shaped to impart
20 rotational motion to fluid passing through the movable device.

7. A spray nozzle comprising a hollow member having an outlet opening therein at the front of the spray nozzle, a
25 movable device disposed within the nozzle and rearwardly biased to a normal position in which the outlet opening is minimally restricted or is unrestricted by the movable device, wherein the movable device is movable by fluid pressure from the normal position in a forwards direction
30 towards the outlet opening to obstruct the flow to the outlet opening and to cause relative movement between separable parts of the movable device to create a spray discharge orifice, smaller than the outlet, within or proximal to the outlet opening and characterised in that
35 the movable device is hollow and has disposed therein flow guiding means such as vane surfaces or vane extensions to impart rotary motion to fluid passed through the movable device.

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8. A spray nozzle as claimed in any preceding claim wherein in the normal position the movable device cooperates with a static member in the nozzle to restrict an opening into the movable device.

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9. A spray nozzle as claimed in any preceding claim wherein the periphery of the discharge orifice is wholly defined by nozzle forming surfaces on the separable parts.

10 10. A spray nozzle as claimed in any one of claims 1 to 8 wherein the periphery of the discharge orifice is defined by a combination of nozzle surfaces on the separable parts and a portion of the surface of the outlet opening.

15 11. A spray nozzle as claimed in claim 8 or 9 wherein said surfaces define a plurality of the discharge orifices.

12. A spray nozzle as claimed in claim 2 wherein the flexible body serves as a combined piston and flow
20 restrictor in the normal position in the spray nozzle.

13. A spray nozzle as claimed in any preceding claim wherein the movable device in the normal position cooperates with a static member in the nozzle to serve as a
25 valve closing a flow path into the movable device.

14. A spray nozzle as claimed in any preceding claim wherein the movable device is a moulding of thermoplastics material.

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15. A spray nozzle as claimed in Claim 14 wherein the moulding comprises at least two arms joined to a central portion by integral flexible hinges.

35 16. A spray nozzle as claimed in Claim 15 as appended to Claim 2 wherein the arms terminate in free end portions shaped to provide surfaces for forming the discharge orifice and further surfaces for sliding engagement with

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said internal surface of the spray nozzle.

17. A spray nozzle as claimed in any preceding claim wherein the hollow member is a cap releasably secured to an inlet body, and is separable from the body to provide access for removal or insertion of the movable device.

18. A spray nozzle as claimed in any preceding claim wherein guide means slidably engages the movable device to prevent rotation of the movable device.

19. A spray nozzle as claimed in any preceding claim wherein the hollow member has provided therein a sealing abutment surface adjacent the outlet opening, and the separable parts have front end portions shaped to engage the abutment surface to provide a seal in the operative position of the movable device to prevent fluid by-passing the discharge orifice or orifices.

20. A spray nozzle comprising a hollow member having an outlet opening therein at the front of the spray nozzle, a movable device disposed within the nozzle and rearwardly biased to a normal position in which the outlet opening is minimally restricted or is unrestricted by the movable device, wherein the movable device is movable by fluid pressure from the normal position in a forwards direction towards the outlet opening to obstruct the flow to the outlet opening and to cause relative movement between separable parts of the movable device to create a spray discharge orifice, smaller than the outlet, within or proximal to the outlet opening and characterised by at least one of the following:-

(a) the bias acting on the separable parts for opening-up of the discharge orifice of the spray nozzle are contained within or incorporated into the movable device;

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- (b) transverse biasing means is provided in or by the movable device to urge said separable parts to separate and react against an internal surface of the spray nozzle to provide said rearwards bias indirectly;
- (c) the movable device comprises a body incorporating said separable parts, and in that the flexible body is at least partially resilient, and serves to provide said rearwards bias by urging the separable parts away from each other to react against an internal surface of the spray nozzle;
- (d) the movable device is hollow and has disposed therein vane surfaces or vane extensions to impart rotary motion to fluid passed through the movable device;
- (e) the hollow member has provided therein a sealing abutment surface adjacent the outlet opening, and the separable parts have front end portions shaped to engage the abutment surface to provide a seal in the operative position of the movable device to prevent fluid by-passing the discharge orifice or orifices;
- (f) the movable device is hollow and in the normal position cooperates with a static member in the nozzle to serve as a valve closing a flow path into the movable device.
21. In a spray nozzle, a movable device comprising a moulded plastics body in which a plurality of arms are connected by hinge portions to a head and have end portions shaped to abut for defining at least part of a spray discharge orifice when the body is resiliently compressed so that said end portions are moved towards each other.

22. A spray nozzle as hereinbefore described with reference to any figure or combination of figures shown in

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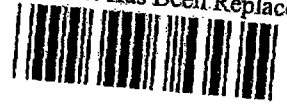
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the accompanying drawings.



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FIG.1.

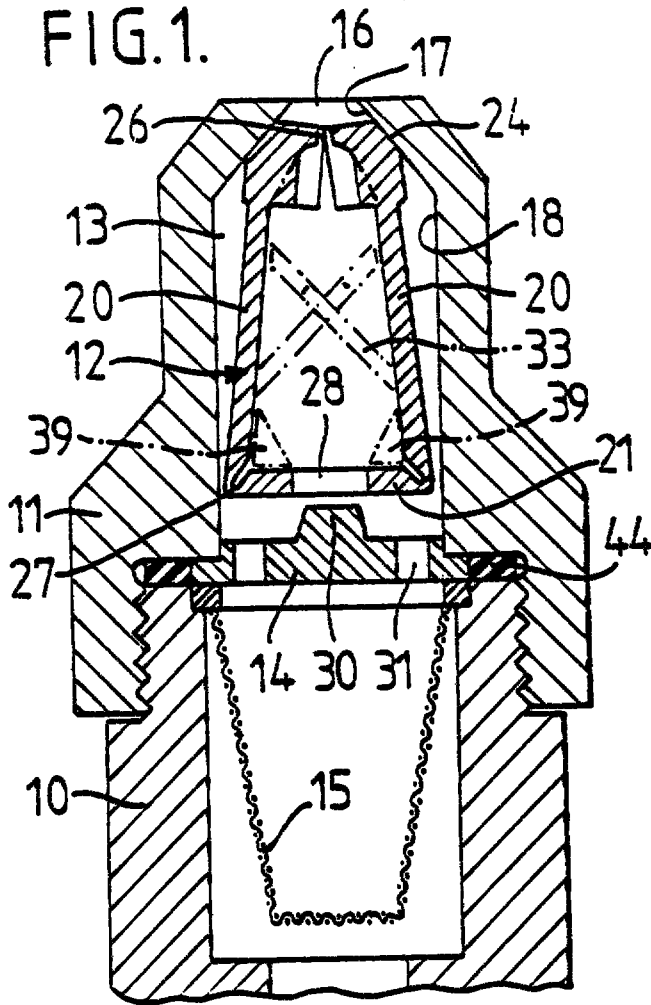


FIG.2.

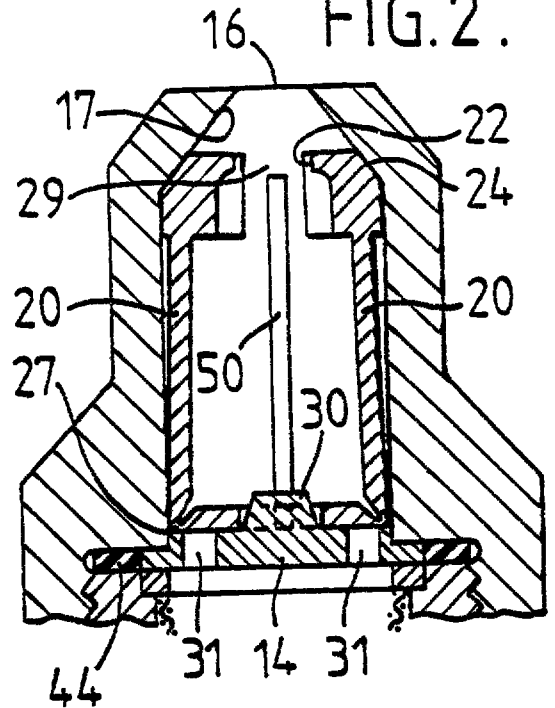


FIG.4.

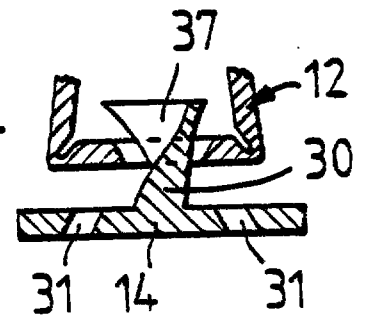


FIG.3.

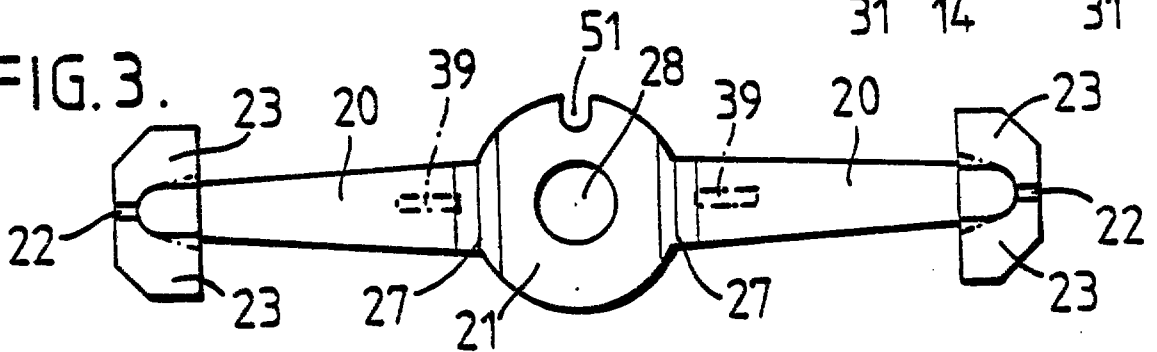


FIG.5.

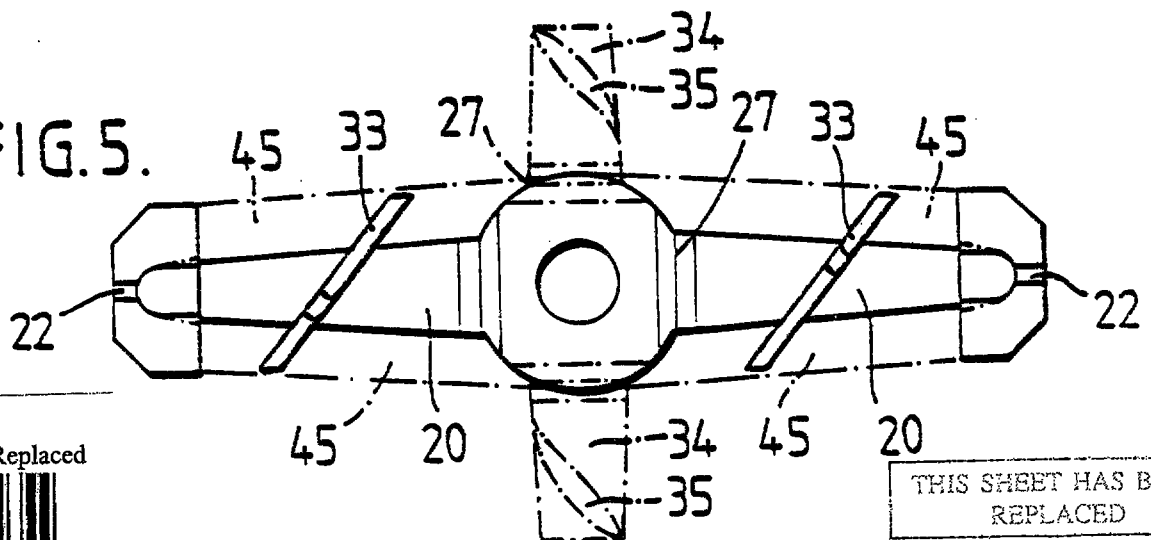


FIG. 6.

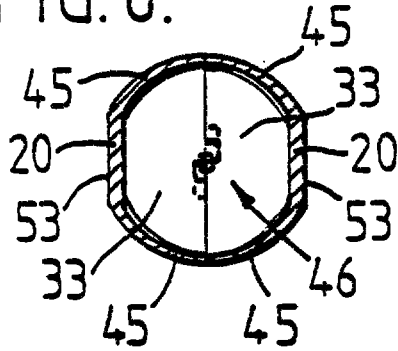


FIG. 7.

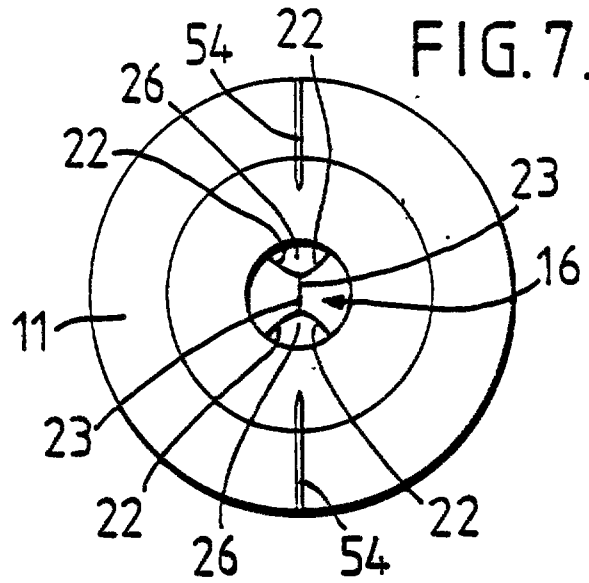


FIG. 8.

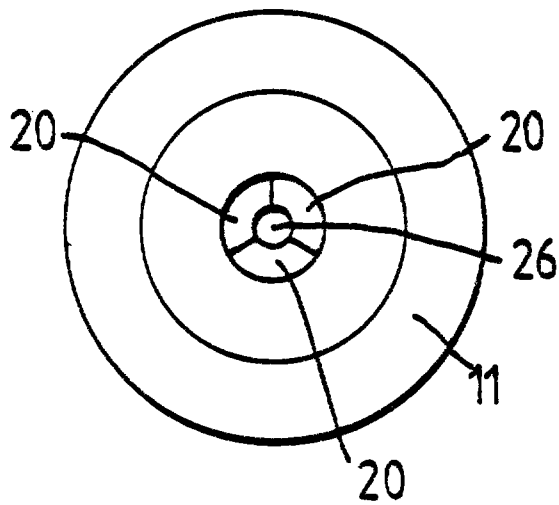


FIG. 9.

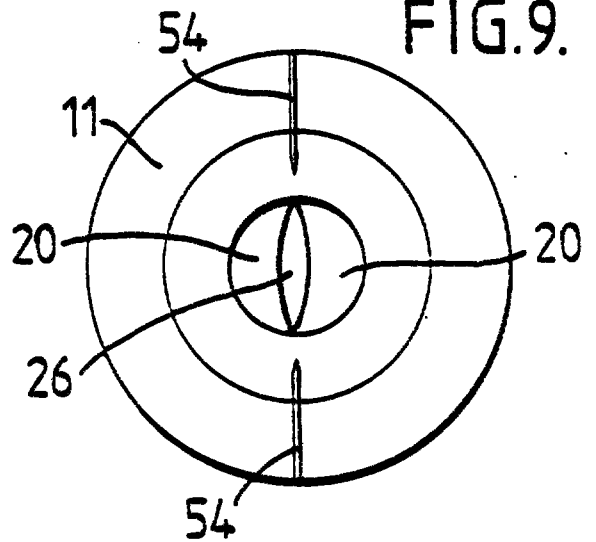


FIG. 10.

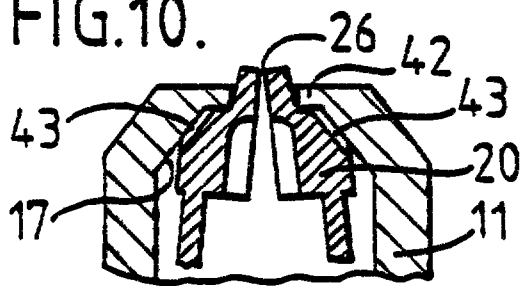


FIG. 11.

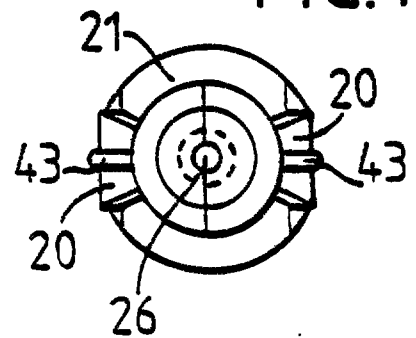
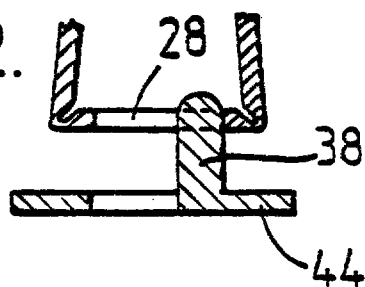


FIG. 12.



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SELF-CLEANING/UNBLOCKING SPRAY NOZZLE

Spray nozzles are well known devices for producing controlled sprays of liquids for applications such as paint spraying, crop spraying to dispense fertiliser and insecticide, industrial washing and chemical treatment. For most applications it is essential for a spray nozzle to produce an evenly distributed spray of uniform liquid particles in a predetermined spray pattern.

In most cases the spray pattern consists of fine droplets created by forcing liquid into the nozzle through a large orifice and out of the nozzle through a smaller discharge orifice or plurality of smaller discharge orifices. The finer the droplets required, the smaller the size of the discharge orifice. The discharge orifices in known spray nozzles are usually outlet openings of a static nature and preset dimensions, e.g. holes drilled or moulded into the ends of nozzle members. The outlet openings or holes, being of small size, have a tendency to block frequently with particles of dirt, crystals and other matter present in the liquid or the spraying equipment.

Conventional methods of removing trapped particles to clean the spray nozzle and allow liquid to flow properly are very labour intensive. The spray nozzles need to be removed frequently from the spraying equipment and cleaned out by hand. Often there are large numbers of spray nozzles and they can be in difficult to access locations. The spray nozzles can also be contaminated with toxic or corrosive liquid if that is the nature of the material passing through the nozzle. Whilst this cleaning process is undertaken, production cannot continue which is extremely costly.

In order to reduce the need for frequent cleaning of the nozzles there is disclosed in GB 0987723 a spray nozzle comprising a hollow member having an outlet opening at its

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front end, and a movable device within the hollow member. The movable device comprises a plurality of separable segmental parts, and the device can be moved by fluid pressure to move the segmental parts towards each other to create a spray discharge orifice at the front end of the nozzle.

The segmental parts can separate when relieved of fluid pressure, so that discharge orifice can be opened-up for releasing particles so as to tend to prevent collection of matter which could block the orifice.

However, this known spray nozzle has the disadvantage that when orientated so that the open end is lowermost, the segmental parts remain together and fail to release such matter.

There is disclosed in EP 0482369A, a nozzle in which the rear ends of the separable parts have radially outwardly projecting flanges which are engaged by a rear end of a helical compression spring, located in an annular space between the movable device and the hollow member, to thrust the device rearwards away from the open front end of the hollow member. To prevent fluid by-passing the device (by flowing through this annular space), the flanged rear ends carry a packing ring which seals against the internal surface of the hollow member. Additionally, the rear end part of the hollow member is fitted internally with a retaining ring to retain the spring, packing ring and separable parts within the hollow member. In order to force such separable parts to separate when fluid pressure is removed from the nozzle, surfaces of said flanges are inclined so that the spring acts thereon in an attempt to urge apart the front ends of the separable parts, to try to cause the orifice to open when the device is moved rearwards to abut the retaining ring.

The nozzle of EP 0482369A gives rise to more problems

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than it solves. For example³ spring acts primarily in the axial (front to rear) direction, and thus the ~~packing ring~~ is necessary to ensure that the fluid pressure generates enough force on the device to overcome the thrust of the spring, but a consequence is that (upon the fluid supply being halted) when the device moves rearwards the volume of said annular space increases, sucking in air and/or fluid back into the space at the same time as the separable parts are being separated, with the resultant probability that clogging matter will be drawn into the annular space. Presence of such matter in the annular space, and especially in the slight gap between the flanges and the hollow member, can cause the nozzle to malfunction.

However, the main problem inherent in said nozzle is that it is complex, expensive to make and designed to be replaced as a pre-assembled unit. It is clearly not designed to be dismantled easily for on-site cleaning and would be even more difficult or nearly impossible to re-assemble without renewing the rings, thus requiring the user to carry on site stocks of spare nozzles for every spray variant, flow rate and etc type of nozzle employed.

The present invention accepts that some blockages or malfunctions are probably inevitable even with nozzles which are designed to be self-cleaning, and seeks to avoid the problems of manufacturing complexity and spare parts costs.

In order to avoid or reduce said problems in respect of a spray nozzle of a kind generally comprising a hollow member having an outlet opening therein at the front of the spray nozzle, a movable device disposed within the nozzle and rearwardly biased to a normal position in which the outlet opening is minimally restricted or is unrestricted by the movable device, wherein the movable device is movable by fluid pressure from the normal position in a forwards direction towards the outlet opening to obstruct

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the flow to the outlet opening and to cause relative movement between separable parts of the movable device to create a spray discharge orifice, smaller than the outlet, within or proximal to the outlet opening; the present invention is characterised in that the operationally movable parts of the spray nozzle for forming the discharge orifice and providing said bias are all contained within or incorporated into the movable device.

Thus, the movable device can be removed as a unit to facilitate on-site servicing of the spray nozzle.

In order to further avoid said problems and to reduce the risk of malfunction the present invention further provides a spray nozzle of said kind characterised in that the hollow member has provided therein a sealing abutment surface adjacent the outlet opening, and the separable parts have sealing surfaces on their front ends to engage the abutment surfaces to provide a seal in the operative position of the movable device to prevent fluid by-passing the discharge orifice or orifices.

Thus, the remainder of the movable device to the rear of said seal can be a clearance fit in the nozzle, for ease of removal of the device and to minimise friction and risk of matter impeding movement of the movable device.

In preferred embodiments, a nozzle of said kind is characterised according to the present invention in that transverse biasing means is provided in or by the movable device to urge said separable parts to separate and react against an internal surface of the spray nozzle to provide said rearwards to bias indirectly.

Preferably:-

- (a) said internal surface is part conical, converges towards the outlet opening and is inclined to the

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axis of the nozzle at an angle within the range of 20° to 40°, preferably 25 to 35°;

- (b) the transverse biasing means comprises a resilient member accommodated inside the movable device between said separable parts;
- (c) said movable device or said resilient member is shaped to impart rotational motion to fluid passing through the movable device.

By arranging the biasing means to act directly in the separating direction on the separable parts of the device, reliable separation is ensured; and by providing the biasing means in the movable device all the above mentioned problems associated with the known helical springs, spring receiving annular spaces, packing rings and retaining rings are avoided.

In known spray nozzles the separable parts are individual elements which are discrete from each other, and can be moved to abut in the operative position of the device. In order to further reduce said problems and the cost of the device, said separable parts are preferably parts of a single body which can flex to permit relative movement between said separable parts of the body.

In accordance with the present invention, some preferred embodiments of nozzle of said kind are characterised in that the movable device comprises a body incorporating said separable parts, and in that the flexible body is at least partially resilient, and serves to provide said rearwards bias by urging the separable parts away from each other to react against an internal surface of the spray nozzle.

The integration of the biasing means and the separable parts into a single body makes the spray nozzle

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extremely inexpensive, resistant to malfunction and easy to service; and furthermore avoids all the well known problems inherent in metal coil springs, such as corrosion, breakage and malfunction, to which such springs are particularly liable when used in a corrosive or damp environment.

Furthermore, simple exchange of bodies can be employed to give a change of spray characteristics, without having to change the other parts of the spray nozzles. For example, it is known to fit a vaned insert into an ordinary static non-self-clearing spray nozzle, in order to impart rotational momentum to the fluid in the nozzle, but in EP 0482369A the separable parts occupy the space required for such a vaned insert.

In order to solve this additional problem the present invention further provides a spray nozzle of said kind which is characterised in that the movable device is hollow and has disposed therein flow guiding means, such as vane surfaces or vane extensions, to impart rotary motion to fluid passed through the movable device.

The periphery of the discharge orifice may be wholly defined by nozzle surfaces on the movable device so as to be discrete from the periphery of the outlet opening; or the periphery of the discharge orifice may be only partially defined by such discrete nozzle surfaces so as to meet the periphery of the outlet opening so that part or parts of the surface of the hollow member defining the outlet opening serve as a further nozzle surface or surfaces to define part or parts of the discharge orifice.

The nozzle surfaces may be shaped to create a plurality of the discharge orifices. The flow cross sectional area of the discharge orifice or orifices is preferably less than half, e.g. 0.01 to 0.1, of that of the outlet opening.

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In some systems employing several nozzles, the rate of fluid supply may be insufficient to generate the minimum pressure required to move the movable devices whilst all the devices are in the normal positions, even though the working flow rate is being supplied. To avoid problems of actuation of the movable devices, the flexible body preferably serves as a combined piston and flow restrictor in its normal position in the spray nozzle. In a preferred form, the integral parts are connected by a head which serves as the piston, which head is shaped to provide a restricted fluid flow path having a flow cross-sectional area greater than the flow cross-sectional area of the created spray discharge orifice or orifices. The flow path may be defined between the head and the internal surface of the nozzle, but is preferably primarily provided by a port in the head.

In order to shut off the supply of liquid to known nozzles when the supply pressure falls below a predetermined minimum pressure, e.g. in order to reduce "dribbling" from nozzles, it is known to provide pressure sensitive shut off or check valves immediately upstream of each of the nozzles or to incorporate such a valve into a combined valve and nozzle assembly. Again, the aforementioned further problems are involved together with problems of reliability and blockage of the valves.

In order to reduce such problems, the movable device in the normal position preferably serves to block flow through the interior of the spray nozzle. In a preferred embodiment the head cooperates with a static member to close the port in the head whilst leaving part of the pressure supply side face of the head exposed to any pressure supplied to the nozzle.

The static member may be employed to restrict the port, and be arranged, e.g. tapered, so that said restriction reduces progressively with the distance moved

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The static member may serve as a pintle which extends through the port and provides a flow modifying surface or surfaces within the movable device, e.g. to impart rotation to said flow.

The invention further includes and provides a spray nozzle of said kind characterised in that the movable device is hollow and in the normal position cooperates with a static member in the nozzle to serve as a valve closing a flow path into the movable device.

The hollow member is preferably a cap releasably secured to an inlet body, and separable from the body to provide access for removal or insertion of the movable device. The cap may incorporate a spray deflector axially offset from the outlet opening, on which a spray from the discharge nozzle can impinge.

The invention can be utilised for retro-application to some forms of known spray nozzles, and accordingly the present invention provides a movable device, insertable into a spray nozzle having a removable cap apertured to provide an outlet opening, which device comprises separable nozzle surfaces which can be brought into mutual proximity, against a bias in the movable device, to create a spray discharge orifice.

The nozzle surfaces may be configured to form a discharge orifice of any suitable geometric configuration.

The nozzle surfaces may be provided on tips of the separable parts, which tips may be of materials the same as or different from the remainder of the separable parts, e.g. metal or ceramic tips on plastics bodies or separable parts.

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The movable device is preferably a moulding of thermoplastics material. Preferably, the moulding comprises at least two arms joined to a central portion by integral flexible hinges. In preferred embodiments the arms terminate in free end portions shaped to provide surfaces for forming the discharge orifice and further surfaces for sliding engagement with said internal surface of the spray nozzle.

The invention will be described further, by way of example, with reference to the accompanying diagrammatic drawings, wherein:-

FIGURE 1 shows an axial cross-section through a spray nozzle of the invention incorporating a first form of movable device of the invention in an "operative" position adopted when spraying;

FIGURE 2 shows an axial cross-section through part of the spray nozzle with the movable device in a "normal" position;

FIGURE 3 shows the first form of movable device of the invention in plan in an "as moulded" condition;

FIGURE 4 shows an axial section through a modified static member and part of the movable device for use in the spray nozzle;

FIGURE 5 shows a second form of the movable device in plan in an "as moulded" condition;

FIGURE 6 shows a cross section through a further modified form of the movable device;

FIGURES 7, 8 and 9 show front end views of variations of the nozzle providing different spray patterns;

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FIGURE 10 is an axial sectional view through a first part of a further modified form of the nozzle;

FIGURE 11 is a front end view of the device on its own in the operative condition with the cap shown in FIGURE 10 removed; and

FIGURE 12 is a view similar to FIGURE 4 showing a further modified form of static member and device.

Referring to FIGURES 1 to 3, the spray nozzle primarily comprises a hollow inlet body 10 on which a hollow member in the form of a cap 11 is releasably mounted, and a movable device 12 movable within a cylinder 13 defined primarily by the cap. The spray nozzle may optionally also be provided with static member 14 and/or a filter 15.

The cap 11 provides an outlet opening 16, and has a conically inclined internal ramp surface 17 leading from the opening 16 to an internal cylindrical surface 18 around the cylinder 13.

The movable device 12 is in the form of a flexible body moulded from plastics material so as to comprise parts which form arms 20 connected together by a head 21. Each arm 20 provides, on its free end portion, a nozzle surface 22, at least one abutment surface 23 (FIGURE 3) and a slider surface 24 (FIGURE 2) in a predetermined mutual configuration. In the embodiment shown in FIGURES 1 to 3, two arms 20 are provided and the surfaces 22 are configured so that when the surfaces 23 abut (FIGURE 1) the surfaces 22 define between them a discharge orifice 26 smaller than and concentric with the outlet opening 16.

The head 21 is dimensioned to be a sliding fit in the cylinder, and is provided with an axial port 28 providing a restricted flow path for fluid to flow into the movable

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device 12.

Each arm 20 is joined to the head 21 by an integral resilient hinge 27 so that the arms can be swung together against an inherent resilient resistance from the "as moulded" condition shown in FIGURE 3 for insertion of the device into the cylinder 13 so that the slider surfaces 24 are in contact with the ramp surface 17 (FIGURE 2) in the normal position of the device 12.

The ramp surface 17 is inclined to the central axis of the cylinder 13 at an angle determined so that the reaction to forcible engagement of the slider surfaces with the ramp surface (because of the radially outwardly directed force applied to the arms by said resilient resistance) produces a rearwardly directed bias acting to urge the movable device axially away from the outlet opening 16 and towards the normal position, e.g. about 30°. In the normal position said abutment surfaces 23 are separated so that the surfaces 22 no longer define any discharge orifice 26 and merely lie in a relatively wide flow path 29 to the rear of the outlet opening (FIGURE 2).

In use, in the absence of the static member 14 and filter 15, when fluid is initially supplied to the nozzle, the initial resistance to flow through the nozzle is primarily determined by the area of the restricted flow path i.e. the area of the port 28, the liquid will initially flow through the wide flow path 29 between the arms to the opening 16 until the force imparted to the head 21 (which serves as a piston under these conditions) is sufficient to overcome the bias (and friction of the engagement of the surfaces 24 and 17) and thereby drives the device to move forwards towards the outlet. This forwards movement causes the free end portions of the arms to be forced towards the axis, as the surfaces 24 traverse the ramp surface 17, until the abutment surfaces 23 abut and the discharge orifice 26 is formed when the device

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reaches the operative position. In the operative position the ramp surface 17 serves also as a sealing abutment surface and the slider surfaces 24 serve also as sealing surfaces which engage the surface 17 to provide a seal preventing fluid from by-passing the orifice 26; and the resistance to flow through the nozzle is greater than the initial resistance and is determined primarily by the dimensions of the orifice 26.

The wide flow path 29 preferably has a minimum flow cross-sectional area about the same as that of the outlet opening 16.

The initial flow serves as a flushing flow to remove particles of matter which could otherwise restrict or block the orifice 26.

The simple example just described involves a compromise between the necessity of generating a sufficient piston force and the desirability of keeping the port 28 sufficiently large to reduce the probability of the port 28 becoming blocked. This compromise is not significant where the fluid supply is sufficient, but could be detrimental if the rate of said supply is restricted. In the latter case the compromise can be avoided by locating a static flow restrictor 30 in the cylinder so that it restricts the port 28 in the normal position of the device and until the device has moved forwards to take the port clear of the restrictor, and has thereby moved the arms radially towards each other to an extent sufficient to cause the resistance to flow to be substantially determined by the spacing between the surfaces 22 and/or 23. The static restrictor 30 is arranged to permit a flushing flow, and also serves as a plunger or wiper to clear the port as the device returns to the normal position.

The restrictor may be dimensioned to close the port completely in the normal position, and, if the head 21 of

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the device is a sufficiently close fit in the cylinder, the restrictor and head will serve as a non-return valve, to prevent further, i.e. leakage, flow through the nozzle, and, if the filter 15 is included, to keep the filter bathed in the fluid.

However, the head is preferably a clearance or free sliding fit in the cylinder, and, if a non-return valve function is required, the static member 14 is employed. The static member is primarily an apertured disc in which the apertures 31 do not register with the port 28 so that when the head abuts the disc the port is closed whilst part of the surface of the head remains exposed for application of fluid pressure via the apertures 31, as shown in FIGURE 2.

In such a form of the spray nozzle, the disc 14 is positioned to limit the stroke of the device so that in the normal position the surfaces 24 remain in contact with the ramp surface 17 whereby to maintain said rearwards bias and force the piston to abut the disc. Initial forwards movement is thus initiated by the pressure of the fluid supply imparting the required minimum force to the piston, prior to commencement of flow through the flow passages.

The restrictor 30 may optionally be provided or mounted on the disc 14, as shown.

The movable device may be moulded to provide vanes 33 to impart rotation to the flow, e.g. as shown in FIGURES 1 and 5; or an extra arm or arms 34 carrying a vane 35 may be provided on the device e.g. as shown in FIGURE 5. A swirl vane 37 may be provided on the restrictor 30, and the ports 31 may be inclined to promote swirl as indicated in FIGURE 4. The arms may have lateral extensions 45, indicated in broken lines in FIGURE 5, which abut in the operative position to provide within the arms a smooth walled, almost circular in section, swirl chamber 46

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(FIGURE 6).

The shape and number of the discharge orifice or orifices is determined by the form of spray required. For example, the abutment surface 23 on an arm 20 may lie between two nozzle surfaces 22 each of which extends to an edge of the arm, as shown in FIGURE 7, so that in the operative position the edges abut the surface of the outlet opening 16 with the result that a pair of discharge orifices 26 partially concomitant with the opening 16 are formed within the opening by the surfaces 22.

More than two arms 20 may be employed, e.g. three arms 20 as shown in FIGURE 8, at equal or unequal angular intervals around the head.

Where the discharge opening 26 is non-circular, e.g. elongate, as shown in FIGURE 9, or where a spray pattern assymmetric to the axis or of non-circular form is required, the axial orientation of the device 12 in the cylinder 13 may be determined by any suitable guide means. For example, the port 28 may be of keyhole form, and a modified form of the static member 14 having a guide finger 38 thereof parallel to the axis to engage in the eccentric portion of the port, as shown in FIGURE 12, may be employed as the guide means. However, it is preferred to provide the cylinder with an axially directed rib 50 to engage in a recess 51 in the head (FIGURES 2 and 3) or to provide a keyway in the cylinder to receive a radially directed projection on the periphery of the head 21. As can be seen in FIGURE 6, the hinges 27 provide chordal flats 53 on the periphery of the head, and to prevent rotation of the insert, the cylinder may have corresponding chordal flats, not shown. Markings 54 may be provided on the cap 11 to indicate the orientation of the device 12 and thus the spray pattern.

The resilient resistance from which the bias is

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derived may be supplemented, e.g. by extending the vanes 33 to abut so as to urge the arms 20 apart; by using the vane 35 on the arm 34 to urge the arms 20 apart; by forming buttresses 39 on the arms 20 to engage and react against the head to urge the arms radially outwards (FIGURES 1 and 3); or by any combination thereof.

A stop surface or flange 42 on the cap may usefully be employed to seal against the end portions of the arms to prevent flow bypassing the discharge orifice or orifices; and in such embodiments the slider surfaces 24 may be provided by narrow ribs 43 on the arms 20 to reduce friction in the engagement with the ramp surface (FIGURES 10 and 11).

The end portions of the arms 20 may, in the operative position, project forwards beyond the outlet opening 16 (FIGURE 10), to be co-terminus with the outlet opening (FIGURE 8), extend into the outlet opening (FIGURE 7) or terminate to the rear of the outlet opening (FIGURE 1).

In all embodiments, movement (and optional flexing) of the movable device serves to dislodge, and/or break up solid or non-fluid deposits, on the device, for removal thereof together with other particles by flushing flow, for automatic self cleaning or unblocking of the nozzle. Repeated interruption of the fluid supply can be employed to facilitate cleaning and/or unblocking of the nozzles.

The invention is not confined to details of the foregoing examples, and many variations and modifications are possible within the scope of the invention.

For example, the cap may provide merely the stop surface or flange 42 or the ramp surface 17, the remaining cylinder surfaces 17 and 18 or surface 18 being provided by the inlet body 10 or by a suitably shaped insert (not shown) inserted into the interior of the nozzle.

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In the event of a shaped insert being employed, components such as the static member 14 and/or filter 15, together with the device 10, or any thereof, may be pre-assembled with the insert to form an assembly to facilitate adaptation of a known form of nozzle, or repair or refurbishment of a nozzle in accordance with the invention.

The member 14 and filter 15 need not be located at a junction between the cap and body, even though it is convenient to locate the member 14 by means of a junction seal washer 44 and a locating flange on the filter as shown in FIGURE 1.

The terms and expressions employed herein are by way of example and include within the scope thereof applicable generic terms and synonymous and functional equivalents.

The invention further provides a nozzle, movable device or assembly comprising any novel part, feature or functional arrangement disclosed herein or in the accompanying drawings, or any novel combination of parts, features or functional arrangements so disclosed.

For example the invention further provides and includes a spray nozzle having a hollow member defining an outlet opening and a device movable within the nozzle between a normal position in which the outlet opening is unrestricted or minimally restricted and an operating position defining a discharge orifice within or proximal to the outlet opening and having a flow cross-sectional area less than half that of the outlet opening.



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CLAIMS

1. A spray nozzle comprising a hollow member having an outlet opening therein at the front of the spray nozzle, a movable device disposed within the nozzle and rearwardly biased to a normal position in which the outlet opening is minimally restricted or is unrestricted by the movable device, wherein the movable device is movable by fluid pressure from the normal position in a forwards direction towards the outlet opening to obstruct the flow to the outlet opening and to cause relative movement between separable parts of the movable device to create a spray discharge orifice, smaller than the outlet opening, within or proximal to the outlet opening; and characterised in that the operationally movable parts of the spray nozzle for forming the discharge orifice and providing the bias are all contained within or incorporated into the movable device.
2. A spray nozzle as claimed in Claim 1 further characterised in that the movable device comprises a flexible body incorporating said separable parts, and in that the flexible body is at least partially resilient, and serves to provide said rearwards bias by urging the separable parts away from each other to react against an internal surface of the spray nozzle.
3. A spray nozzle comprising a hollow member having an outlet opening therein at the front of the spray nozzle, a movable device disposed within the nozzle and rearwardly biased to a normal position in which the outlet opening is minimally restricted or is unrestricted by the movable device, wherein the movable device is movable by fluid pressure from the normal position in a forwards direction towards the outlet opening to obstruct the flow to the outlet opening and to cause relative movement between separable parts of the movable device to create a spray discharge orifice, smaller than the outlet opening, within



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or proximal to the outlet opening; and characterised in that transverse biasing means is provided in or by the movable device to urge said separable parts to separate and react against an internal surface of the spray nozzle to provide said rearwards to bias indirectly.

4. A spray nozzle as claimed in Claim 2 or 3 wherein said internal surface is part conical, converges towards the outlet opening and is inclined to the axis of the nozzle at an angle within the range of 20° to 40°, preferably 25 to 35°.

5. A spray nozzle as claimed in Claim 3 wherein the transverse biasing means comprises a resilient member accommodated inside the movable device between said separable parts.

6. A spray nozzle as claimed in Claim 5 wherein said movable device or said resilient member is shaped to impart rotational motion to fluid passing through the movable device.

7. A spray nozzle comprising a hollow member having an outlet opening therein at the front of the spray nozzle, a movable device disposed within the nozzle and rearwardly biased to a normal position in which the outlet opening is minimally restricted or is unrestricted by the movable device, wherein the movable device is movable by fluid pressure from the normal position in a forwards direction towards the outlet opening to obstruct the flow to the outlet opening and to cause relative movement between separable parts of the movable device to create a spray discharge orifice, smaller than the outlet, within or proximal to the outlet opening and characterised in that the movable device is hollow and has disposed therein flow guiding means such as vane surfaces or vane extensions to impart rotary motion to fluid passed through the movable device.

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8. A spray nozzle as claimed in any preceding claim wherein in the normal position the movable device cooperates with a static member in the nozzle to restrict an opening into the movable device.
9. A spray nozzle as claimed in any preceding claim wherein the periphery of the discharge orifice is wholly defined by nozzle forming surfaces on the separable parts.
10. A spray nozzle as claimed in any one of claims 1 to 8 wherein the periphery of the discharge orifice is defined by a combination of nozzle surfaces on the separable parts and a portion of the surface of the outlet opening.
11. A spray nozzle as claimed in claim 8 or 9 wherein said surfaces define a plurality of the discharge orifices.
12. A spray nozzle as claimed in claim 2 wherein the flexible body serves as a combined piston and flow restrictor in the normal position in the spray nozzle.
13. A spray nozzle as claimed in any preceding claim wherein the movable device in the normal position cooperates with a static member in the nozzle to serve as a valve closing a flow path into the movable device.
14. A spray nozzle as claimed in any preceding claim wherein the movable device is a moulding of thermoplastics material.
15. A spray nozzle as claimed in Claim 14 wherein the moulding comprises at least two arms joined to a central portion by integral flexible hinges.
16. A spray nozzle as claimed in Claim 15 as appended to Claim 2 wherein the arms terminate in free end portions shaped to provide surfaces for forming the discharge orifice and further surfaces for sliding engagement with





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said internal surface of the spray nozzle.

17. A spray nozzle as claimed in any preceding claim wherein the hollow member is a cap releasably secured to an inlet body, and is separable from the body to provide access for removal or insertion of the movable device.

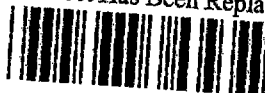
18. A spray nozzle as claimed in any preceding claim wherein guide means slidably engages the movable device to prevent rotation of the movable device.

19. A spray nozzle as claimed in any preceding claim wherein the hollow member has provided therein a sealing abutment surface adjacent the outlet opening, and the separable parts have front end portions shaped to engage the abutment surface to provide a seal in the operative position of the movable device to prevent fluid by-passing the discharge orifice or orifices.

20. A spray nozzle comprising a hollow member having an outlet opening therein at the front of the spray nozzle, a movable device disposed within the nozzle and rearwardly biased to a normal position in which the outlet opening is minimally restricted or is unrestricted by the movable device, wherein the movable device is movable by fluid pressure from the normal position in a forwards direction towards the outlet opening to obstruct the flow to the outlet opening and to cause relative movement between separable parts of the movable device to create a spray discharge orifice, smaller than the outlet, within or proximal to the outlet opening and characterised by at least one of the following:-

- (a) the bias acting on the separable parts for opening-up of the discharge orifice of the spray nozzle are contained within or incorporated into the movable device;

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- (b) transverse biasing means is provided in or by the movable device to urge said separable parts to separate and react against an internal surface of the spray nozzle to provide said rearwards bias indirectly;
- (c) the movable device comprises a body incorporating said separable parts, and in that the flexible body is at least partially resilient, and serves to provide said rearwards bias by urging the separable parts away from each other to react against an internal surface of the spray nozzle;
- (d) the movable device is hollow and has disposed therein vane surfaces or vane extensions to impart rotary motion to fluid passed through the movable device;
- (e) the hollow member has provided therein a sealing abutment surface adjacent the outlet opening, and the separable parts have front end portions shaped to engage the abutment surface to provide a seal in the operative position of the movable device to prevent fluid by-passing the discharge orifice or orifices;
- (f) the movable device is hollow and in the normal position cooperates with a static member in the nozzle to serve as a valve closing a flow path into the movable device.

21. In a spray nozzle, a movable device comprising a moulded plastics body in which a plurality of arms are connected by hinge portions to a head and have end portions shaped to abut for defining at least part of a spray discharge orifice when the body is resiliently compressed so that said end portions are moved towards each other.

22. A spray nozzle as hereinbefore described with reference to any figure or combination of figures shown in



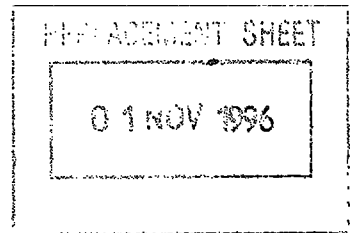
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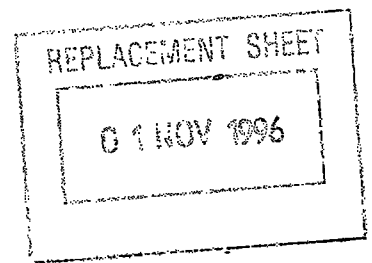
the accompanying drawings.



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SELF CLEANING/UNBLOCKING SPRAY NOZZLE

ABSTRACT

A self-unblocking spray nozzle 10, 11 in which an easily removable insert 12 is automatically moved by fluid pressure to form a spray orifice 26, and expands resiliently when the fluid pressure falls. The insert 12 may include swirl vanes 33 to rotate the fluid, and may operate with a static member 14 to form an automatic anti-drip valve.

The orifice 26 is smaller than aperture 16 and is defined by the ends of arms 20 which are hinged at 27 to a central body 21; the hinges are resilient and tend to open out the arms so that the cam surfaces 24 push the insert 12 away from aperture 16. This opening of the orifice 26 assists in removing any dirt lodged there and the initial discharge when the fluid is turned on flushes it.

The device may be adapted to plural orifices and orifices producing shaped sprays.

FIGURE 1.

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FIG.1.

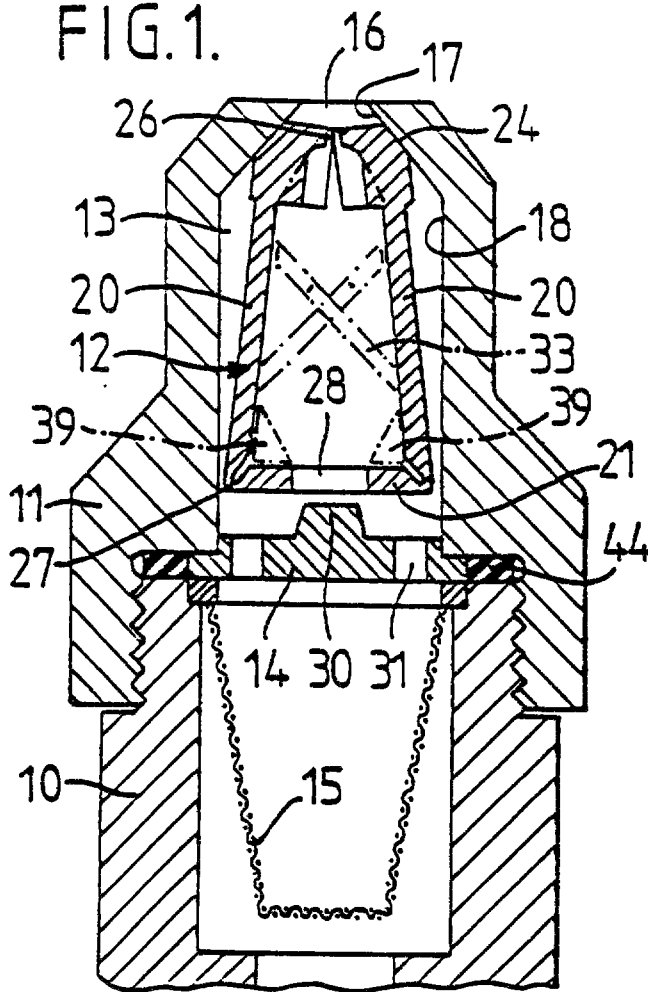
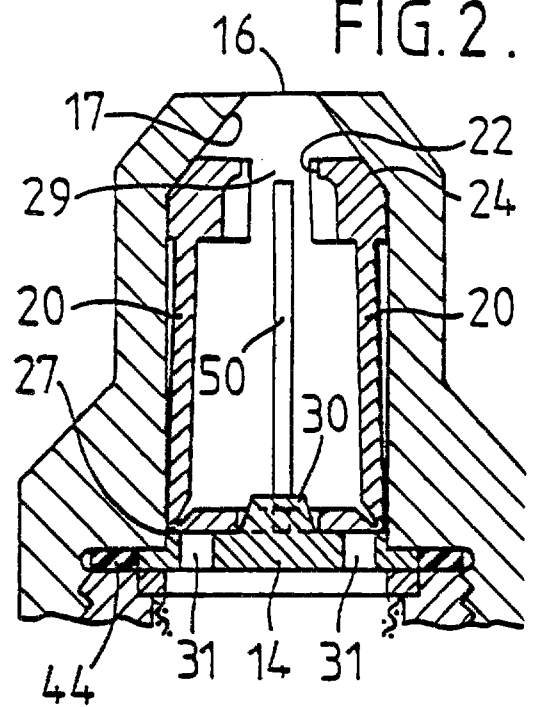
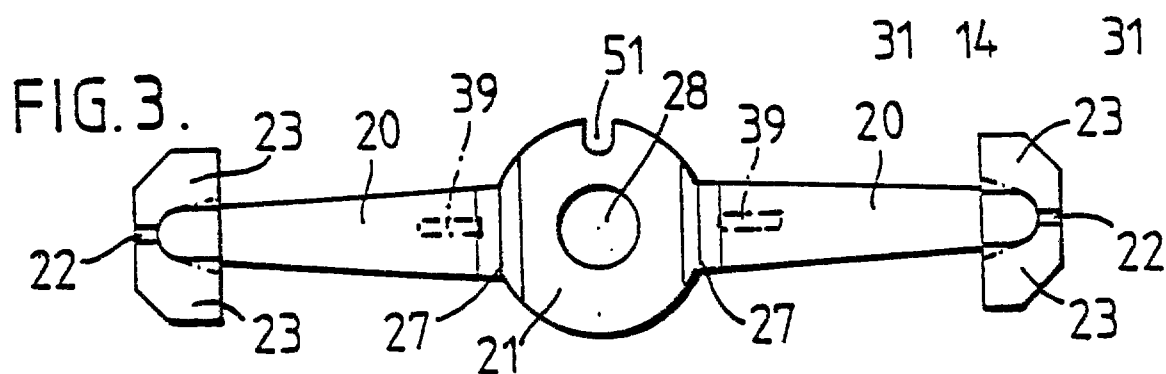
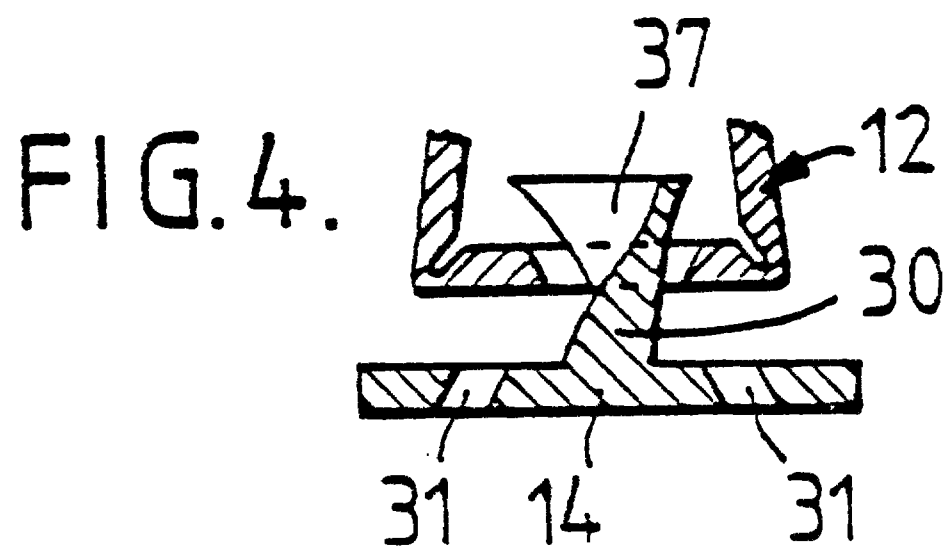


FIG.2.

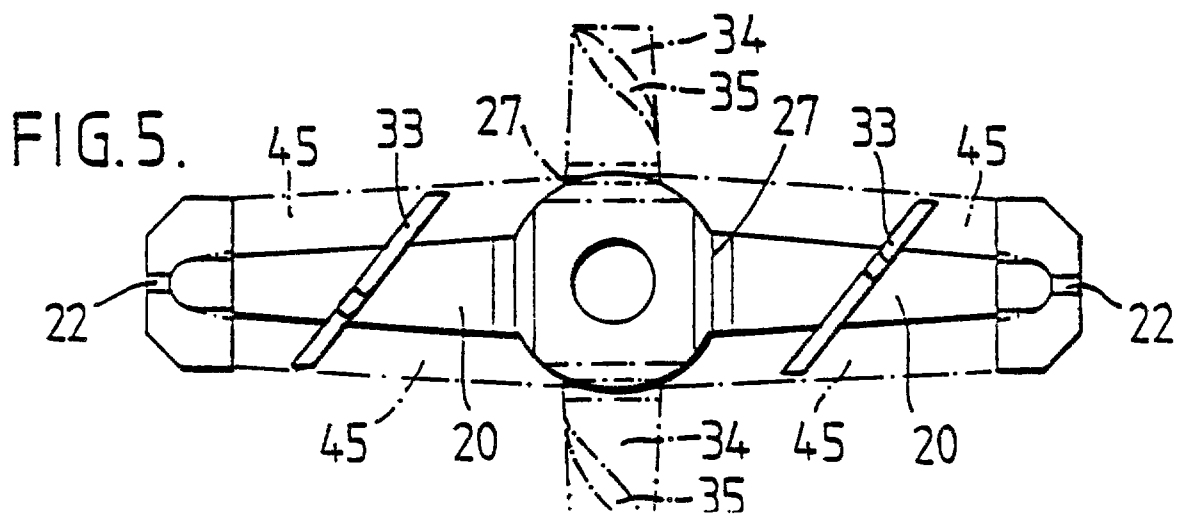






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FIG. 6.

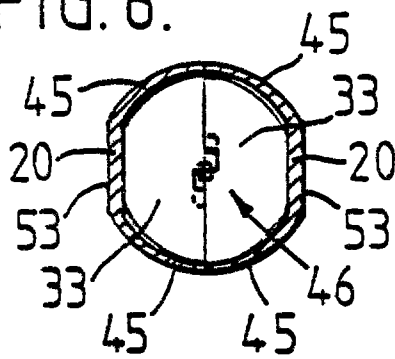


FIG. 8.

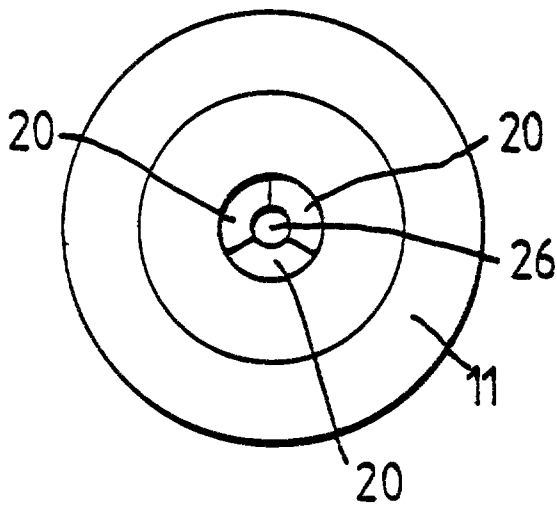


FIG. 10.

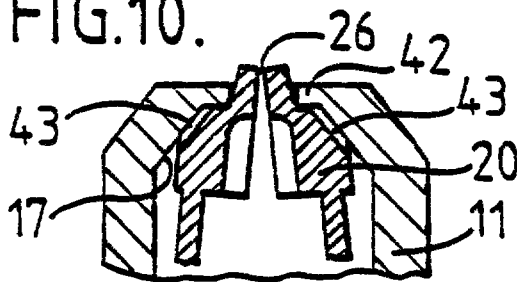
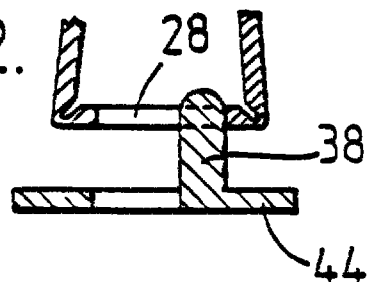


FIG. 12.



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FIG. 7.

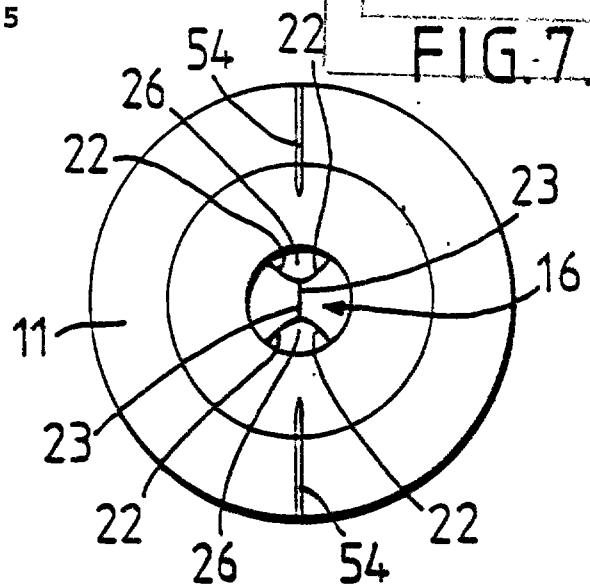


FIG. 9.

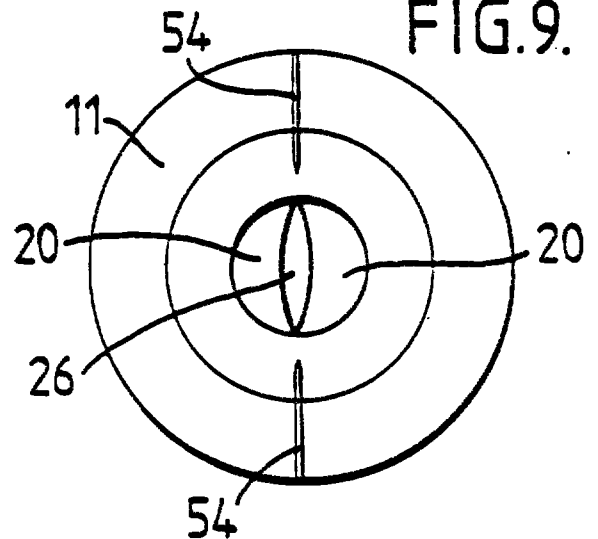
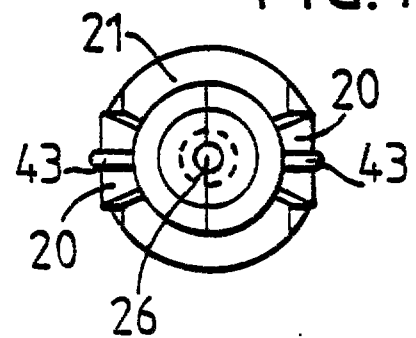
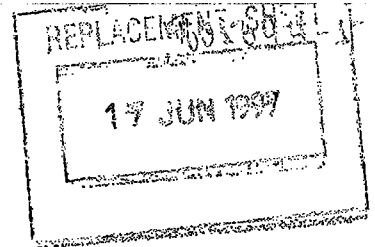


FIG. 11.



CLAIMS

1. A spray nozzle comprising a hollow member having an outlet opening therein at the front of the spray nozzle, a movable device movable within the hollow member and rearwardly biased to a normal position in which the outlet opening is minimally restricted or is unrestricted by the movable device, wherein the movable device is movable by fluid pressure from the normal position in a forwards direction towards the outlet opening to obstruct the flow to the outlet opening and to cause relative movement between separable parts of the movable device to create a spray discharge orifice, smaller than the outlet opening, within or proximal to the outlet opening; and characterised in that transverse biasing means is provided in or by the movable device to subject the separable parts to radially outwardly directed force whereby to urge said separable parts to separate and react against an internal surface of the spray nozzle to provide said rearwards bias indirectly.
2. A spray nozzle as claimed in Claim 1 wherein the movable device comprises a flexible body incorporating said separable parts.
3. A spray nozzle as claimed in Claim 2 wherein said flexible body is at least partially resilient, and serves to provide said rearwards bias by urging the separable parts away from each other.
4. A spray nozzle as claimed in Claim 1, 2 or 3 wherein said internal surface is part conical, converges towards the outlet opening and is inclined to the axis of the nozzle at an angle within the range of 20° to 40°.
5. A spray nozzle as claimed in Claim 1, 2 or 3 wherein said internal surface is part conical, converges towards the outlet opening and is inclined to the axis of the



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nozzle at an angle within the range of 25° to 35°.

6. A spray nozzle as claimed in Claim 1, 2, 3, 4 or 5 wherein the transverse biasing means comprises a resilient member accommodated inside the movable device between said separable parts.

7. A spray nozzle as claimed in Claim 6 wherein said movable device or said resilient member is shaped to impart rotational motion to fluid passing through the movable device.

8. A spray nozzle as claimed in any one of Claims 1 to 7 wherein the movable device has disposed therein flow guiding means to impart rotary motion to fluid passed through the movable device.

9. A spray nozzle as claimed in any preceding claim wherein in the normal position the movable device cooperates with a static member in the nozzle to restrict an opening into the movable device.

10. A spray nozzle as claimed in any one of Claims 1 to 8 wherein the movable device in the normal position cooperates with the static member in the nozzle to serve as a valve closing a flow path to the movable device.

11. A spray nozzle as claimed in any preceding claim wherein the periphery of the discharge orifice is wholly defined by nozzle forming surfaces on the separable parts.

12. A spray nozzle as claimed in any one of claims 1 to 10 wherein the periphery of the discharge orifice is defined by a combination of nozzle surfaces on the separable parts and a portion of the surface of the outlet opening.

13. A spray nozzle as claimed in claim 10 or 11 wherein



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said surfaces define a plurality of the discharge orifices.

14. A spray nozzle as claimed in claim 2 wherein the flexible body serves as a combined piston and flow restrictor in the normal position in the spray nozzle.

15. A spray nozzle as claimed in any preceding claim wherein the movable device is a moulding of thermoplastics material.

16. A spray nozzle as claimed in Claim 15 wherein the moulding comprises at least two arms joined to a central portion by integral flexible hinges.

17. A spray nozzle as claimed in Claim 16 wherein the arms terminate in free end portions shaped to provide surfaces for forming the discharge orifice and further surfaces for sliding engagement with said internal surface of the spray nozzle.

18. A spray nozzle as claimed in any preceding claim wherein the hollow member is a cap releasably secured to an inlet body, and is separable from the body to provide access for removal or insertion of the movable device.

19. A spray nozzle as claimed in any one of Claims 1 to 17 wherein said internal surface is provided by the inlet body in which the movable device is slidably movable.

20. A spray nozzle as claimed in any preceding claim wherein guide means slidably engages the movable device to prevent rotation of the movable device.

21. A spray nozzle as claimed in any preceding claim wherein a stop flange or said internal surface provides a sealing abutment surface adjacent the outlet opening, and the separable parts have front end portions which are



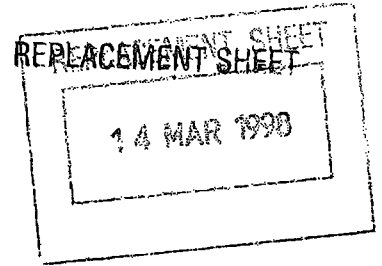
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shaped to engage the abutment surface to provide a seal in the operative position of the movable device ~~to prevent~~ fluid by-passing the discharge orifice or orifices.

22. In a spray nozzle, a movable device comprising a moulded plastics body in which a plurality of arms are connected by hinge portions to a head and have end portions shaped to abut so that surfaces thereof define at least part of a spray discharge orifice when the body is resiliently compressed so that said end portions are moved towards each other.

23. A spray nozzle comprising a hollow member having an outlet opening therein at the front of the spray nozzle, a movable device disposed within the nozzle and rearwardly biased to a normal position in which the outlet opening is minimally restricted or is unrestricted by the movable device, wherein the movable device is movable by fluid pressure from the normal position in a forwards direction towards the outlet opening to obstruct the flow to the outlet opening and to cause relative movement between separable parts of the movable device to create a spray discharge orifice, smaller than the outlet opening, within or proximal to the outlet opening; and characterised in that the operationally movable parts of the spray nozzle for forming the discharge orifice and providing the bias are all contained within or incorporated into the movable device.

24. A spray nozzle or a movable device for insertion into a spray nozzle substantially as hereinbefore described with reference to any FIGURE or combination of FIGURES shown in the accompanying drawings.



SELF CLEANING/UNBLOCKING SPRAY NOZZLE

ABSTRACT

A self-unblocking spray nozzle 10, 11 in which an easily removable insert 12 is automatically moved by fluid pressure to form a spray orifice 26, and expands resiliently when the fluid pressure falls. The insert 12 may include swirl vanes 33 to rotate the fluid, and may operate with a static member 14 to form an automatic anti-drip valve.

The orifice 26 is smaller than aperture 16 and is defined by the ends of arms 20 which are hinged at 27 to a central body 21; the hinges are resilient and tend to open out the arms so that the cam surfaces 24 push the insert 12 away from aperture 16. This opening of the orifice 26 assists in removing any dirt lodged there and the initial discharge when the fluid is turned on flushes it.

The device may be adapted to plural orifices and orifices producing shaped sprays.

FIGURE 1.