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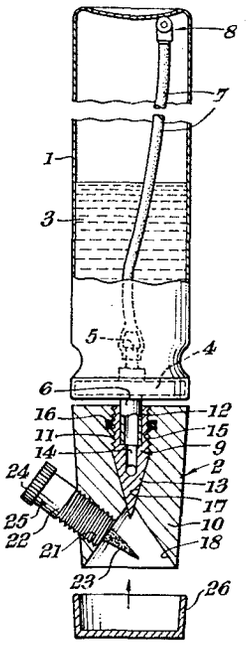
(54) Liquid dispensing and atomizing device.

(57) A liquid dispensing and atomizing device comprises a reservoir (22) for liquid to be dispensed, a capillary feed device, preferably a wick (23) of absorbent material, for feeding liquid from the reservoir (22) and nozzle means (9, 10) for directing a jet of air or other gas under pressure over or against the tip of the wick (23), or other capillary feed device, whereby liquid in the tip is dispensed as an atomized spray in the jet leaving the tip and liquid is simultaneously drawn to the tip from the reservoir (1). The nozzle means (9, 10) is connected to a source (1) of compressed air or other gas through a manually-operable valve (5). With such a device, a variety of effects can be produced in a simple manner, particularly in the graphics art and fine art fields. In a further embodiment a conventional felt or fibre-tip pen, or a conventional technical drawing pen is used as the liquid reservoir.



EP 0 092 359 A2

"LIQUID DISPENSING AND ATOMIZING DEVICE"

This invention relates to liquid dispensing and atomizing devices and is particularly applicable to such devices for use as marking or colouring instruments in the graphics art and fine art fields. The application of the devices of the invention is not, however, limited to these fields, but they can be used with advantage in any application where accurate application of a liquid in finely atomized form is required, such as the pharmaceutical field and in fields where a number of different liquids need to be dispensed in atomized form in succession. For the

sake of clarity, however, the invention will be described with particular reference to its application in the graphics art and fine art fields.

Marking instruments in the form of felt-tip pens have long been used in the graphics art and fine art fields and, particularly for professional use, it is well known to provide a set of such pens, each of which produces a particular shade of a particular colour. Since the number of shades required for each colour is relatively large, the total number of pens in a set is also large; for example, a total of 150 pens may be provided.

While such felt-tip pens have many advantages, they are not able to produce all the markings and colourations which are required. In particular, the markings formed when they are used have sharp outlines and it is practically impossible to produce a coloured marking in which the strength of the colour decreases gradually in a uniform manner, or to provide a marking in which two shades gradually merge into one another. While such effects can with difficulty be produced with the use of a brush and gouache colours, they are usually produced by means of a

so-called "airbrush" in which a stream of compressed air entrains liquid colour from a container attached to the brush and carries it to a spray nozzle whence it is sprayed onto the paper or other surface to be coloured. While such air-brushes, when properly used, are very effective in producing the required effects, they do have certain disadvantages. In the first place, control of the density of the sprayed colour is usually effected by control of the air supply and the operation of such a control whilst moving the nozzle to effect a marking of a required pattern is not easy and requires a skilled operator. Secondly, the airbrush must be very carefully cleaned after the spraying of one shade is completed before a further shade can be sprayed. Finally, the use of an airbrush of course necessitates the provision of a separate supply of compressed air or other compressed gas.

It is an object of the present invention to provide a liquid dispensing and atomizing device which can be used as a marking instrument to obtain similar effects to those obtained when using a conventional airbrush (although it is not limited to such uses), but which is more practical in use to meet present-day requirements in a number of

different fields of use.

According to one aspect of the invention, there is provided a liquid dispensing and atomizing device for dispensing liquid in the form of an atomized spray, comprising a reservoir for liquid to be dispensed, a capillary feed device for feeding said liquid to be dispensed from said reservoir to a tip at one end of the device, and nozzle means for directing a jet of air or other gas under pressure over said tip, whereby liquid is dispensed from said tip in atomized form in the jet leaving the tip.

The capillary feed device may be one having one, or at most a few capillaries therein, such as for example, the nib unit of a conventional technical drawing pen, which commonly takes the form of an elongate, thin-walled metal cylinder having a wire running axially therein to leave an annular space between the inner wall of the cylinder and the wire through which liquid is drawn to the tip of the nib by capillary action. Alternatively, it may be a device having a multitude of capillaries therein, for example, a wick of absorbent material, such as is used in conventional felt-tip, or fibre-tip, pens and markers.

Where such a wick is used, its tip is preferably of pointed or wedge-shaped form, and the jet of air or other gas is preferably arranged to impinge on the side of the tip in a direction making an acute angle with the axis of the tip.

The jet of air or other gas impinging on the tip of the wick or other capillary feed device atomizes the liquid contained in the tip, further liquid being drawn to the tip for atomization at least mainly by capillary action, so that a continuous stream of atomized liquid is produced so long as the supply of liquid lasts and the air or gas stream is maintained.

The nozzle means preferably comprises a nozzle connected to a source of air or other gas under pressure through a manually-operable valve. While the source of compressed air may be an air compressor or a hand-operated air pump, it con-

veniently is in the form of a container for air or other gas under pressure which may be directly connected to a nozzle head in which the nozzle is accommodated. Alternatively, the nozzle head may be connected to a remote source of air or other gas under pressure by a hose, in which case a manually-operable valve to control the gas or air flow to the nozzle will normally be incorporated in the nozzle head and be operated by manual movement of a button or like actuating means located on the outside of the nozzle head.

In such a case, in its simplest form, the wick may be held manually in the path of the jet, but this does not lead to consistent or reproducible results, and the wick is preferably held in position by some form of mounting arrangement. Conveniently, the reservoir for

the liquid to be dispensed is a conventional felt or fibre-tip pen or marker which is removably attached to the nozzle head, e.g. by a resilient gripping means, so that the air or gas jet impinges on the felt or fibre tip.

While the device of the present invention can take many forms, a useful embodiment which is self-contained, comprises an elongate container for compressed air or other gas (which may be provided by the vaporization of a readily vaporizable liquid propellant such as one of those sold under the Trade name "FREON") and a nozzle head mounted at one end of the container co-axially therewith by way of a suitable manually-operable valve, operation of which allows compressed air or other propellant gas to flow from the container to a nozzle in the nozzle head. While any suitable form of valve can be used, one which has been found to be very suitable is a conventional tilt-action valve which is operated to release gas under pressure from the container by tilting a valve stem movable in the top of the container and to which the nozzle head is fixed. However, as already stated, if desired, a completely separate

source of compressed air or propellant gas can be used, connected by suitable tubing to the nozzle head which, in this case, may conveniently be connected to a body portion containing the manually-operable valve controlling the flow of propellant gas to the head.

The nozzle head is preferably so arranged that the cross-sectional area of the nozzle through which the stream of gaseous propellant leaves the nozzle head can be varied, for example, by rotation of an outer head member on an inner needle-shaped member through which the propellant passes, so as to produce an annular nozzle of varying area, or by varying the width of an annular space formed by axial movement of a conical valve member in an aperture in a wall extending transversely across a passage through which the air or gas passes to the nozzle. In this way, the volume flow of gas leaving the nozzle can be adjusted within fine limits and further rotation of the head member on the needle, or the valve member in the aperture, can be used to close the nozzle completely when the dispenser is not in use. However, in some cases, the facility for varying the cross-sectional area of the nozzle is not required; the

volume flow of propellant passing through the nozzle can then be preset at a particular value. In such cases, a fixed (non-rotatable) nozzle can be used, or the valve means for varying the air or gas flow through an aperture can be dispensed with.

The reservoir for the liquid to be atomized may be in the form of a capsule mounted in the nozzle head itself, in such a way that the tip of the wick extending from the reservoir is in the path of the air or gas stream leaving the nozzle and so that the axis of the wick tip makes an angle (preferably an acute angle) with the direction of the air or gas stream leaving the nozzle. When, as is preferred, the wick is provided with a tapered tip, it is advantageous for the capsule to be so mounted in the nozzle that the wick can be advanced and retracted with respect to the air or gas stream, for example, by rotation of the capsule in the nozzle head. This enables the amount of atomized liquid taken up in the air or gas stream to be adjusted. However, again this facility may not always be necessary, in which case the capsule can be mounted in a fixed position in the nozzle head. Preferably, however, the capsule is removably mounted in the head member,

so that after one shade has been sprayed, the capsule containing the liquid of that shade can be removed and replaced by another containing liquid of a different shade. The capsule or like reservoir itself may contain the liquid to be sprayed in the form of a free liquid with the end of the wick dipping into it, or, alternatively, the reservoir itself may be filled with absorbent material forming part of or in contact with the wick, so that the liquid is wholly absorbed in the material. Alternatively a fixed non-replaceable and non-refillable reservoir may be used, the device being thrown away when the liquid in the reservoir is exhausted, or a rechargeable non-removable reservoir may be provided.

As yet a further alternative, the reservoir may be constituted by a chamber formed in the nozzle head which is filled with an absorbent material containing the liquid (e.g. a roll of felt) and into which the inner end of the wick penetrates. Finally, as previously stated, the liquid reservoir and wick can be constituted by a conventional fibre or felt-tip pen or marker.

A self-contained form of device according to the invention may comprise a long thin canister containing the propellant, with the nozzle head at

one end thereof, so that in size and shape the whole device resembles a pen and is suitable for manual handling. While the canister may be arranged to be replaceable or rechargeable if desired, the device is preferably of the "throw-away" type which is thrown away after the initial contents of the propellant container are exhausted (or, as mentioned above, if a fixed non-refillable reservoir is used, when the contents of this reservoir are exhausted). When such "throw-away" devices are used, it is contemplated that a set of the devices will be provided, each having a reservoir containing a liquid colour of each shade required, similar to the known sets of felt-tip or fibre-tip pens. Alternatively, a removable reservoir may be used, in which case it may only be necessary to provide, as a kit, one or more devices consisting of the filled propellant container and the nozzle head and a set of reservoirs each containing a liquid colour of a different shade. In this case, it may be advantageous if, for example, three reservoirs are provided for each shade having felt-tips of different widths, a broad one, a medium one and a narrow one. This again increases the range of effects which can be produced by the use of the

device.

It is, of course, possible to provide a non-disposable nozzle head for use with a propellant container and a liquid reservoir, both of which are disposable. In such a case, it will be convenient to incorporate the valve controlling the flow of air or other gas from the container to the nozzle in the nozzle head itself.

The liquid to be sprayed must be a relatively mobile one, i.e. it must be such that it can be absorbed and transported by a wick. For colouring purposes, any ink or dye, either water- or spirit-based, can conveniently be used. However, it is also possible to use varnishes, provided they are sufficiently thin, or turpentine-thinned paints. Other liquids which need to be sprayed in controlled form can also be used, for example liquid local anaesthetics or medications for use in dentistry and medical treatment, and even perfumes.

As will already be clear from the above description, the dispensing and atomizing device of the present invention is very flexible in its range of applications, is simple to use and can be produced cheaply, using relatively inexpensive plastics materials for most of the parts thereof. The device lends itself to the production of

colour kits of ink or other colour media, using interchangeable reservoirs, and thus allows speedy interchange of colours for the graphic artist. Control of the device is simple and it can be used with ease by a beginner, whilst the wide range of variations in the form of the atomized liquid produced makes it suitable for professional use.

Various embodiments of the invention will now be described in more detail with reference to the drawings, in which :-

Figure 1 is a schematic side sectional view of a first form of device according to the invention with a nozzle head in the closed position;

Figure 2 is an end view of the device of Figure 1 taken in the direction of the arrow; and

Figure 3 is a scrap view of the nozzle portion of the nozzle head of the device of Figure 1, taken at right angles to Figure 1 and showing the nozzle in the open position.

Figure 4 is a schematic side view, partly

in section, of the nozzle head and part of the propellant container of a further embodiment of the invention;

Figure 5 is a side view, partly in section, of yet another embodiment of the invention;

Figure 6 is a section taken along the line VI VI of Figure 5;

Figure 7 is a plan view of the embodiment of Figure 5; and

Figure 8 is an end view of the embodiment of Figure 5.

Figure 9 is a highly-schematic side-sectional view of another embodiment of the invention, particularly applicable to the dispensing of medications in the form of a fine spray.

Referring to Figure 1, the dispenser illustrated which has a general shape similar to that of a felt-tip marker, comprises a longitudinally-extending container 1 and a nozzle head 2. The container 1 contains a propellant under pressure, which may be compressed air, but is preferably,

as shown, a readily vaporized liquid propellant 3, such as one of the organic fluorine compounds sold for this purpose under the Trade Mark "FREON". The open end of the container 1 is closed by a valve body 4 which is secured to the container in sealed manner, e.g. by crimping, and contains a tilt-action valve 5 of known construction, details of which have not been shown in the drawing. It is operated by tilting a valve stem 6 as will hereinafter be described.

Since the dispenser is normally used with the nozzle head downwardly as illustrated, where a liquid propellant 3 is used, the inlet to the valve 5 must be provided with a dip-tube 7 extending to the closed end of the container 1 and thus in the gas space when the container is inverted, so that propellant in the gaseous form rather than liquid propellant passes into the valve 5. Since when not in use, the dispenser will normally be stored with the nozzle head upwards, it is desirable for the open end of the dip-tube to be provided with valve means 8, such as a ball valve, which closes when the container is in the upright position to prevent seepage of liquid propellant up the tube to the valve during storage of the dispenser but opens when the

container is inverted. When a compressed gas is used as propellant, a dip-tube will not, of course, be required.

The nozzle head 2 is mounted on the container 1 by means of the valve stem 6. The nozzle head 2 consists of two portions, an inner needle member 9 and an outer nozzle control member 10 rotatably mounted thereon. The needle member 9 consists of an externally-threaded cylindrical portion 11 having at one end thereof a bore 12 which is a pressure fit over the valve stem 6 and fixes the nozzle head to the container 1, and a conical extension 13 at the other end of the cylindrical portion 11. The bore 12 in the cylindrical portion 11 is stepped at its inner end and then continues to form a right-angled bore 14 in the conical portion, terminating in an aperture in the side wall of the conical member as shown more clearly in the scrap view of Figure 3. The control member 10 has a bore extending through it. This has a first internally-threaded cylindrical portion 12 which mates for rotation with the externally-threaded portion 11 of the needle member 9 and has a recess in its wall to accommodate a sealing ring 16, a converging portion 17, the angle of slope of which corresponds

to that of the conical portion 13 of the needle member 9 and a terminal diverging portion 18. Rotation of the control member 10 on the needle member 9 allows a conical gap of predetermined width to be established between the conical portion 13 of the needle member and the divergent portion 17 of the bore to provide an annular nozzle 19 (Figure 3) of predetermined cross-sectional area for the passage of propellant. When the dispenser is not required for use, further rotation of the control member 10 on the needle member 9 can close this gap and thus the nozzle, completely, as shown in Figure 1, to prevent the escape of propellant. In the wall of the control member 10 an internally-threaded bore 21 is provided opening into the divergent portion 18 of the bore in the control member 10. The axis of the bore 21 is at an acute angle to the central axis of the bore in the control member 10. In the bore 21, there is rotatably mounted an externally-threaded capsule 22 forming a reservoir for the liquid to be sprayed. From the inner end of the capsule projects the pointed tip 23 of a wick which extends into the liquid in the capsule and may, if desired completely fill the capsule, itself accommodating

the whole quantity of liquid. The tip 23 extends into the divergent portion 18 of the bore in the control portion 10 in the path of a stream of propellant leaving the nozzle 19, and the tip 23 can be advanced or retracted with respect to the propellant stream by rotation of the capsule 22 in the bore 21 by means of a knurled wall portion 24 provided at the outer end of the capsule. The wall of the capsule 22 is provided with a small opening 25 adjacent its outer end and thus lying outside the bore 21, through which air can enter the interior of the capsule as liquid is withdrawn therefrom so as to avoid the formation of a vacuum within the capsule. Alternatively, in place of the opening 25, a slotted wick could be used for this purpose.

Finally, a cap 26 is provided which fits over the outer end of the control portion 10 when the device is not in use.

When the device in its storage position with the nozzle head uppermost, is required for use, the cap 26 is removed, the nozzle orifice 19 is set to its required width by rotation of the control member 10 on the needle member 9 and the position of the tip 23 with respect to the propellant stream is adjusted as required by rotation of the capsule 22 in the bore 21. When these initial adjustments

have been made, the device is inverted so that the nozzle head is lowermost and is held in the same manner as a conventional pen. On manual tilting of the nozzle head 2 and thus of the valve stem 6, the tilt valve 5 is operated to allow gaseous propellant to pass through the dip-tube 7, the valve 5, the valve stem 6 and the bore 14 in the conical portion 13 of the needle member 9 into the conical space between the conical portion 13 and the control member 10 and thence through the nozzle 19 to form a jet which impinges against the tip 23 of the wick of the capsule 22. The liquid to be sprayed is drawn into the wick tip by capillary action, possibly assisted both by gravity and by the Bernouilli effect exerted by the high pressure stream of propellant passing over the tip, and the liquid is atomized from the tip in a zone indicated at 27 just beyond the tip 23; the atomized liquid will be directed by the propellant stream onto the receiving surface.

It will be seen that, since the width of the nozzle 19 and thus the rate of volume flow of the propellant and also the position of the tip of the wick with respect to the propellant stream are independently adjustable, the only manual adjustment required by the hand holding the pen during movement of the pen to produce a desired pattern is

the tilting of the nozzle head to turn on and off the supply of propellant gas, it will be appreciated that the device is very simple to use and can readily be used with success by beginners. It will also be appreciated that, owing to the number of parameters which can be varied (the duration and rate of propellant flow and the width of the nozzle tip on which the propellant stream impinges), a wide variety of effects can be produced when the device is used as a marking and colouring instrument in the graphic and fine art fields, including very fine effects indeed if the propellant stream is allowed to impinge on only the extreme end of the tip of the wick. Moreover, a substitution of one liquid to be sprayed for another, e.g. a liquid colour of one shade for one of another shade, can be rapidly and easily achieved merely by unscrewing one capsule 22 from the bore 21 and replacing it with another containing the fresh liquid. Substantially no cleaning of the device between its use for two different liquids is necessary, since the liquid (at least in theory) does not come into contact with any part of the device other than the reservoir and wick. Replacement of an exhausted capsule 23 is equally simple. The adjustment of

the flow of the propellant through the orifice 19 and of the tip 23 with respect to the propellant stream are very simply carried out merely by rotation of the control member 10 and the capsule 22 respectively and, if desired, suitable scales and pointers can be provided to indicate the degree of opening of the orifice and the position of the wick tip respectively. Finally, even with relatively thick liquids, there is no danger of clogging of the device, provided that the liquid can be conveyed by the wick.

If desired, locking means can be provided to prevent unintentional tilting of the nozzle head should the device be temporarily left with the nozzle in the open position.

It will be apparent from what has earlier been said, that the construction of the dispenser and atomizer can be varied in many different ways. For example, it is not necessary to use a container for the propellant which forms part of the pen. If desired, a separate supply of propellant can be used, this being connected through a suitable tubing arrangement to the nozzle head which in this case will be attached to an elongate body for holding purposes containing a manually-operated valve to control

the propellant supply. The propellant supply could in this case be, for example, an air compressor, a cylinder of compressed air or other gas, or a canister of a liquid propellant such as a "FREON".

Again, in the embodiment illustrated, the container 1, the valve 5 and the valve stem 6, could be replaced as a unit when the supply of propellant in the container 1 is exhausted, merely by pulling the head portion off the valve stem 6. Usually, however, since the whole device can be made of relatively inexpensive materials, it can be discarded when the propellant is exhausted. A rechargeable container can alternatively be used, if desired.

As the valve 5, it is not necessary to use a tilt valve although this is convenient. Any other form of valve which can readily be digitally operated, e.g. by depressing or sliding a button on the device, can be used.

As already mentioned, in some cases a fixed nozzle opening of predetermined area may be provided, in which case the control member 10 will be fixed with respect to the needle member 9. Similarly the capsule 25 can be permanently fixed in the head.

The form of dispensing device illustrated is particularly suitable in a kit comprising a dispensing device and a plurality of interchangeable capsules 22, each containing a different liquid, e.g. a water- or spirit-based dye or colour, and if desired each shade being used in two or more capsules differing in the width of the wick tip. Such a kit will enable a professional artist to achieve a very wide variety of possible effects, from broad colouring to very fine work which may even involve the deposition of a single spot of colour.

Similar kits could be provided in which the individual capsules contain different medicinal preparations, or perfumes.

In yet another possible arrangement, the reservoir may be incorporated in the nozzle head in such a manner that the reservoir itself forms a chamber in the needle member 9, the tapered end of the wick extending from the end of the conical portion 13 and being contoured to act as the central needle portion of the nozzle arrangement. In this case, the propellant stream may emerge as a convergent stream from an annular nozzle surrounding the wick tip, or from a plurality of separate orifices surrounding the wick tip (which may even consist of two small

orifices arranged diametrically opposite to one another) to produce two or more streams of propellant, each impinging against the tip of the wick, and thus creating a "double spray" or "multiple spray" effect for wider spray patterns.

Figure 4 illustrates a further embodiment of the invention in the form of a self-contained dispenser in which the liquid to be dispensed is contained within a chamber formed in the nozzle head instead of in a separate capsule.

As in the embodiment described with respect to Figures 1 to 3, the embodiment of Figure 4 also comprises a longitudinally-extending container 30 for a propellant under pressure and a nozzle head 31. The construction of the container 30 is similar to that of the container 1 of Figures 1 to 3, the end of the container 30 being closed by a valve body 32 containing a tilt-action valve of known construction and having a projecting valve stem 33. The nozzle head 31 comprises an inner member 34 provided with a stepped axial bore 35 leading to a nozzle outlet 36. The valve stem 33 is a press-fit into the end of the bore 35, the end of the stem abutting against a shoulder in the bore 35.

The central member 34 has a flange 38 at its

end into which the valve stem is pressed and which is itself a press-fit in the open end of an outer nozzle member 39 which, at its opposite end, is provided with a wall 40 having a frusto-conical aperture 41 therein through which a conical end portion 42 of the inner member 34 projects, so that the nozzle outlet 36 is located within a recess 43 in the end of the outer member 39 remote from the container 30. The wall of the conical end portion 42 is in sealing contact with the wall of the aperture 41. Between the outer wall of the inner member 34, the inner wall of the outer member 39 and the opposite faces of the wall 40 and the flange 38, an annular chamber 44 is formed which is filled with wadding, or other absorbent material such as a roll of felt, saturated with the liquid to be dispensed.

The wall 40 is provided with a further aperture 45 in which is fixed a wick holder 46 through which passes a wick 48 of absorbent material, such as felt or fibre. The inner end of the wick is in contact with the wadding in the chamber 44 whilst its outer end 49 is pointed and terminates within the recess 43. In order to ensure a free flow of liquid through the wick, the latter is provided with at least an axial groove

on its surface through which air can flow from the recess 43 into the chamber 44 to replace liquid withdrawn therefrom. The wick 48 is so adjusted that its longitudinal axis makes an acute angle with the direction of a jet of compressed air or other gas leaving the nozzle outlet 36 and so that such a jet will strike the side of the wick adjacent to the point thereof. The actual point of contact can be adjusted by movement of the wick in the holder 47. The nozzle outlet 36 can be preset to give a jet of any desired size.

In order to protect the wick when the device is not in use, a cover 50 is provided which fits over the nozzle head 31. In order to avoid unrequired operation of the tilt-action valve, the cover preferably extends over the end of the container 30, so that tilting of the nozzle head with respect to the container cannot take place.

In operation, the cover is removed and the tilt-action valve 32 is then operated by manual tilting of the head with respect to the container. This releases compressed air or other gas from the container 30 which passes through the bore 35 and issues as a high velocity jet from the nozzle outlet 36, which strikes the pointed end 49 of the wick and produces an atomized spray of the

liquid which passes out through the open end of the recess 43. At the same time further liquid is sucked up the wick from the wadding in the chamber 44, so that the atomized spray will continue as long as the valve is operated and the supply of liquid lasts.

It will be apparent that the container 30 can be replaced, if desired, when it is exhausted, merely by pulling the valve stem 33 from the end of the bore 35 and inserting the valve stem of a new container. Similarly the supply of liquid in the chamber 44 can be replenished by removing the central member 34 from the outer member 39 and replacing the exhausted wadding with fresh.

This form of dispensing and atomizing device is also suitable for use in a kit consisting of a plurality of such devices each containing a different colour or shade. As with the embodiment of Figures 1 to 3, the device can either be thrown away, when the container 32 is exhausted, or, if desired, the old container can be removed and a new one fitted. Again when the liquid in the chamber 44 is exhausted, it can be replaced by removing the central nozzle portion 34, removing the exhausted wadding or felt roll, and replacing it with fresh material. If desired, this could

be saturated with liquid of a different colour, but this would, of course, entail cleaning of the chamber 44 on changing, unless the wadding or felt is contained in a protective wrapping, such as a plastics film, having an aperture for the insertion of the wick.

Figures 4 to 8 illustrate a liquid dispensing and atomizing device according to the invention, in which a conventional felt or fibre-tip pen is used as the liquid reservoir.

Referring in particular to Figure 4, the device comprises a body portion 51 having a bore 52 therein. One end of the body portion 51 is slanted and into the bore at this end, there is press-fitted the end 53 of a nozzle head portion 54 which is provided with a shoulder 55 against which the end of the head portion abuts.

Into the other end of the bore 52, there is press-fitted a hose connector 56 having an axial bore therein and provided at its outer end with a flange 58 which abuts against the end face of the body portion 51. The outer end of the hose connector 56 is provided with a nipple 59 which receives the end of a hose 60, which is held in place on the nipple by means of a spiral hose clip 61. The other end of the hose 60 is

connected to a source of compressed air (not shown) through a valve (also not shown) which can be operated to adjust the maximum flow rate of air through the device.

In a part of the bore 52, there is housed a valve mechanism comprising a valve bush 62 in sealing contact with the wall of the bore, the bush itself having a bore 63 through which loosely passes a valve stem 64, so as to leave an annular gap between the inner wall of the bore 63 and the stem 64 through which compressed air can flow. The end of the valve stem adjacent to the hose connector 56 is provided with a valve member 65 which is held in sealing contact with an O-ring 66, serving as a valve seat, by a compression spring 68 located in the bore 52 between the valve member 65 and the inner end of the hose connector 56.

At its other end, the valve stem 64 projects beyond the bush 62 through an aperture 69 in the upper wall of the body portion, into contact with one arm 70 of an angled operating lever 71, arranged to pivot about a pin 72. The upper side of the other end of the lever 71 carries an actuating button 73 adapted for manual operation of the valve, as will hereinafter be described.

Leakage of compressed air around the extension of the valve stem through the aperture 69 is prevented by a further O-ring 74 surrounding the valve stem and located in a recess 75 in the wall of the body portion surrounding the aperture 69.

The body portion 51 is also provided with attachment means in the form of an annular ring 78 (which could be replaced by a pair of appropriately shaped resilient arms), by means of which a conventional felt or fibre-tip pen or marker 79 (e.g. a commercially available marker, available under the Trade Mark "PANTONE" in a wide variety of colours) can be exchangeably attached to the body portion so that its longitudinal axis is parallel to the axis of the body portion. The pen 79 has an approximately square outer casing 80 which corresponds to the shape of the annular ring 78 and contains the liquid to be dispensed. The pen is provided with a felt or fibre-tip 81 forming the end of a wick through which liquid is fed from the container at the end thereof adjacent to the nozzle portion 54, when the pen is mounted in the arms 78.

The nozzle head 54 has a bore 82 which at one end, communicates with the bore 52 of the body portion and at the other opens into the interior of a bore 83 closed at its upper end and open at its lower end, and the axis of which is angled to

the axis of the bore 82. Into the open end of the bore 83, an internally-threaded bush 84 is press-fitted, into which is screwed an externally-threaded nozzle member 85 having a nozzle outlet 86. Adjacent to its end, the nozzle member is provided with a flange 88 having a knurled or scalloped edge 89 so that it can easily be manually-rotated to vary the distance by which the nozzle member 85 extends from the bush 84.

The nozzle member 83 is so positioned that a jet of compressed air leaving the nozzle outlet 86 will impinge at an acute angle against the tip 81 of the pen 79, when the latter is fitted into the attachment arms 78. Unrequired rotation of the nozzle head 54 in the body portion 51 is prevented by keying means 90 in the form of a slot on the inside of the bore 52 and a co-operating key on the nozzle head 54.

As shown in detail in Figure 6, a fine adjustment of the volume flow of compressed gas to the nozzle is provided by an internally-threaded bush 91 fitted into the side wall of the nozzle head and having a terminal wall portion 92 which extends across and closes the bore 82. This wall portion 92 has an aperture 93 therein by way of which communication is established

between the parts of the bore 82 on either side of the wall portion 92. In the bush 91, an externally-threaded member 94 is screwed. This member is provided with a knurled wheel 95 at its outer end, for manual rotation, and its inner end tapers to form a conical valve member 96 which can partially or completely close the aperture 93 on rotation of the wheel 95, and thus vary the amount of compressed air passing through the aperture. Complete closure of the aperture 93 acts as a safety measure against unintentional operation of the device should the button 73 be accidentally depressed when the device is not in use.

In order to operate the device, a pen 79 containing the required liquid to be dispensed is inserted into the attachment arms 78, so that its tip 81 is adjacent to the nozzle outlet 86. The point on the tip 81 at which the jet of compressed air emerging from the nozzle outlet 86 will strike can be adjusted by moving the pen axially in the arms 78 and the distance of the nozzle outlet from the pen tip can be adjusted by rotation of the flange 89. By controlling these two parameters, different graphic effects can be obtained. The required volume flow of gas is set

by rotation of the wheel 95 (which may be provided with a scale, if desired, to make the setting easier and more reproducible). If the source of compressed air has not already been connected to the device, this is effected by operating the valve (not shown) controlling the volume of air supplied by the source. The device is now ready for use. On manual depression of the valve button 73, the lever 71 pivots so as to move the arm 70 in the direction to move the valve stem 64, and thus the valve member, against the action of the spring 68 so that the member is no longer in contact with the O-ring 66, which serves as a valve seat, and the compressed air can pass through the annular aperture between the inner wall of the valve bush 62 and the valve stem 64 into the part of the bore 52 beyond the valve and thence into the bore 82 in the nozzle head 54, through the aperture 93 and thence into the bore 83 and through the nozzle member 84, to emerge as a jet through the nozzle outlet 86. This jet strikes the tip 81 and dispenses the liquid in the pen 79 in the form of an atomized spray. As soon as pressure on the button 73 is released, the spring 68 acts to urge the valve member 65 against the O-ring 66, so as to close

the valve.

This embodiment of the invention has the obvious advantages that it makes use of conventional felt or fibre-tip pens or markers as the liquid reservoirs and that the pen can easily be changed when a different colour is required. Alternatively, it can be adapted for use with a conventional technical drawing pen. The fact that the point at which the jet strikes the tip, the distance of the nozzle outlet from the tip, and the volume flow of air, can all be independently adjusted makes it possible to achieve a large variety of different effects in a simple manner.

In general, the dispensing and atomizing devices of the present invention can be used for all the purposes for which conventional air-brushes are already known to be useful. Examples of such purposes include, in addition to marking and colouring operations in the graphics art and fine art fields, photo retouching and restoration, printing applications, ceramic decoration, cake decoration, theatrical make-up and other cosmetic applications, perfume dispensing, and dental and medical applications.

Dispensing and atomizing devices in accordance with the present invention are also very suitable for dispensing liquid medicinal preparations in a finely atomized form, and particularly for dispensing liquid medicaments which are to be inhaled, for example, for the relief of asthma symptoms. In such cases, in order to ensure that the droplets of atomized liquid reach the lungs and are not largely deposited on the surfaces of the mouth and throat, droplets having a very fine particle size, preferably of less than 5µm, are required, and sprays having droplets of this order can be obtained in a simple manner with the dispensing devices of the invention.

Figure 9 of the drawings illustrates an embodiment of the invention specifically designed for such uses. The device illustrated is a modified form of a conventional aerosol dispenser of the actuator button type, using an upright canister 100 containing compressed air or other gas, or a vaporizable liquid propellant. The top of the canister is crimped over a valve body containing a metering valve which is operated in conventional manner by depression of a hollow valve stem 101 projecting from and

axially movable in a bush 102 extending from the top of the canister 100, but which is arranged to release only a given quantity of the gaseous propellant when the valve stem is so depressed. Since the canister is used in the upright position, a dip tube, as shown in the embodiment of Figure 1 is not necessary if a vaporizable liquid is used as propellant.

On the top of the canister 100, a head 103 is fitted which has a blind bore 104 which is a press fit over the bush 102 and has a shouldered narrower portion 105 against which the end of the valve stem 101 abuts, so that, in this position, the actuator button formed by the head 103 can still be moved towards the canister 100 to operate the valve.

From the top of the narrower part of the bore 105, a discharge passage 106 extends to an orifice in the side wall of a chamber 108 formed in the head. Into this orifice, a nozzle 109 is inserted, which acts to produce a high-speed jet of propellant gas when the canister valve is opened. The wall of the chamber 108 opposite to the nozzle 109 is provided with an outlet 110 leading to a straight discharge tube 111, integral with the head 103, so that a jet of gas

leaving the nozzle 109 will pass in a straight line across the chamber 108 to the outlet 110 and axially out through the discharge tube 111.

The top of the chamber 108 is open and is surrounded by a peripheral resilient lip 112. Through the lip is pushed a capsule 113, which may be made of glass or a transparent plastics material and contains a liquid medicament 114, which is to be dispensed in atomized form. The capsule is shaped to have a slightly bulging end portion 115 over which the lip 112 snaps when the capsule is pushed into the chamber 108. At its upper end the capsule is closed by a disc-shaped knob 116 by means of which the capsule can manually be moved in the axial direction within the chamber 108. Through an orifice in the wall of the lower end of the chamber 108, a wick 117 passes. The wick is made of an absorbent material, preferably a fibrous material. The upper end of the wick is immersed in the liquid 114 in the capsule 113, whilst the lower end of the wick is pointed. The side of the wick is provided with at least one axial groove for the passage of air into the capsule 113 to replace liquid withdrawn therefrom through the wick.

When the device is not in use, the capsule 113 is pushed into the chamber 108 until the knob 116 abuts against the top surface of the head 103. In this position, the wick is housed in the lower part of the chamber 108 below the outlet 110, where it is protected from contamination by dust or the like, since the sides of the bulging end portion 115 are in sealing contact with the peripheral wall of the chamber 108. In this position also, the capsule substantially blocks direct passage between the nozzle 109 and the outlet 111 so as to prevent or reduce loss of propellant gas should the actuator button be accidentally depressed. For use, however, the capsule is pulled out of the chamber by means of the knob 116 until the bulging end portion 115 abuts against the lip 112. In this position, the pointed tip of the wick is so positioned in the chamber 108 that a jet of compressed air or other gas leaving the nozzle 109 will impinge against the side of the wick 118 adjacent its end, and will atomize the liquid in the wick tip to form a fine spray which leaves the device through the outlet 110 and the discharge tube 111. At the same time, further liquid is drawn into the tip of the wick

by capillary action, possibly assisted by the aerodynamic action of the jet and by gravity. Since the amount of gaseous propellant released at each operation of the actuating button is determined by the setting of the metering valve in the canister, the quantity of liquid dispensed at each operation of the button will similarly be metered.

With the device illustrated in Figure 9, a very fine spray in which the liquid droplets have a particle size of less than 5 µm can be obtained, as is particularly required in many medical applications, particularly where the dispensing of liquid to be inhaled is concerned.

While the device of Figure 9 is particularly suitable for the dispensing of liquid medicaments, it can, of course, equally be used for spraying other liquids, such as perfumes, where a very fine spray is required.

CLAIMS

1. A liquid dispensing and atomizing device for dispensing liquid in the form of an atomized spray, comprising a reservoir for liquid to be dispensed, a capillary feed device for feeding said liquid to be dispensed from said reservoir to a tip at one end of the device, and nozzle means for directing a jet of air or other gas under pressure over said tip, whereby liquid is dispensed from said tip in atomized form in the jet leaving the tip.

2. A device as claimed in Claim 1, wherein said capillary feed device is a wick of absorbent material.

3. A device as claimed in Claim 2, wherein the tip of said wick is of pointed or wedge-shaped form.

4. A device as claimed in any one of Claims 1 to 3, wherein said nozzle means comprises a nozzle adapted to be connected to a source of air or other gas under pressure through a manually-operable valve.

5. A device as claimed in Claim 4, wherein said source is a container for air or other gas under pressure directly connected to a nozzle head containing said nozzle.

6. A device as claimed in Claim 5, wherein said container for air or other gas under pressure is connected co-axially to said nozzle head through a tilt-action valve actuated by tilting said container with respect to said nozzle head.

7. A device as claimed in Claim 5, wherein said nozzle is adapted to be connected to a remote source of gas or air under pressure through a hose, said nozzle head being connected to a body portion accommodating said manual valve.

8. A device as claimed in any one of Claims 4 to 6, wherein means are provided for varying the volume flow of air or other gas under pressure through said nozzle.

9. A device as claimed in Claim 2 or Claim 3, or any one of Claims 4 to 7 as dependent thereon, wherein said liquid is accommodated in absorbent material in said liquid reservoir in contact with said wick.

10. A device as claimed in Claim 9, wherein said absorbent material is constituted by a length of said wick housed in said liquid reservoir.

11. A device as claimed in any one of the preceding Claims, wherein said liquid reservoir is

adapted to be removably mounted in or on said nozzle head.

12. A device as claimed in any one of Claims 1 to 9, wherein said liquid reservoir is constituted by a chamber in said nozzle head.

13. A device as claimed in any one of Claims 1 to 10, wherein said liquid reservoir is constituted by a conventional felt or fibre-tip pen or marker, or by a conventional technical drawing pen having a capillary feed nib.

14. An attachment for use with a conventional felt or fibre-tip pen or marker, or a conventional technical drawing pen, to form a device as claimed in Claim 13 comprising a nozzle head having nozzle means adapted to be connected to a remote source of air or other gas under pressure through manually-operable valve means accommodated in the nozzle head, and means for removably attaching said nozzle head to said pen or marker so that a jet of air or other gas under pressure issuing from said nozzle means will impinge on the tip of a pen or marker attached thereto by said attachment means.

15. A kit comprising a plurality of devices according to any one of Claims 1 to 11 each

containing a different liquid to be dispensed.

16. A kit comprising a plurality of conventional felt or fibre-tip pens or markers, or conventional technical drawing pens having capillary feed nibs, and an attachment as claimed in Claim 14.

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Fig.1

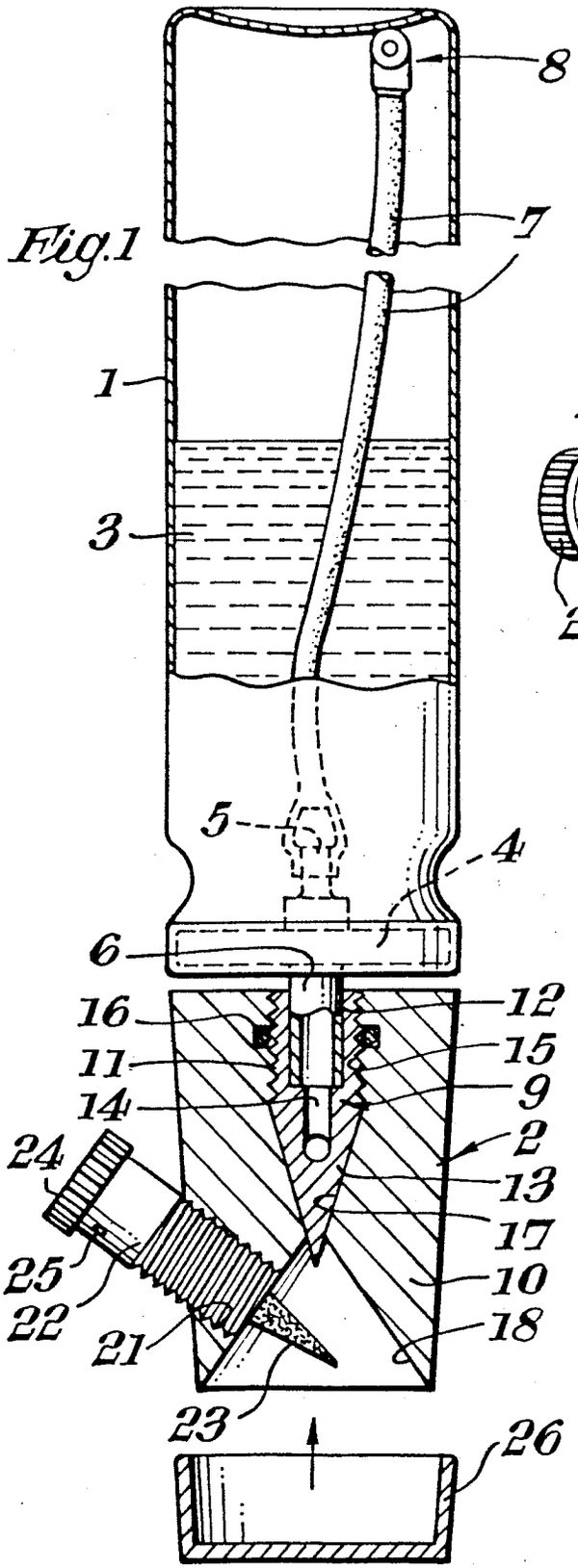


Fig. 2

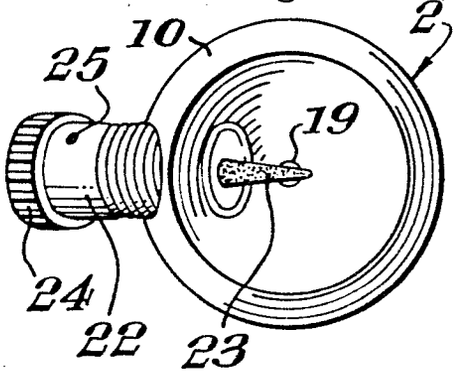
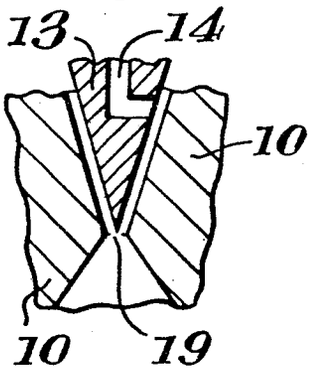


Fig. 3



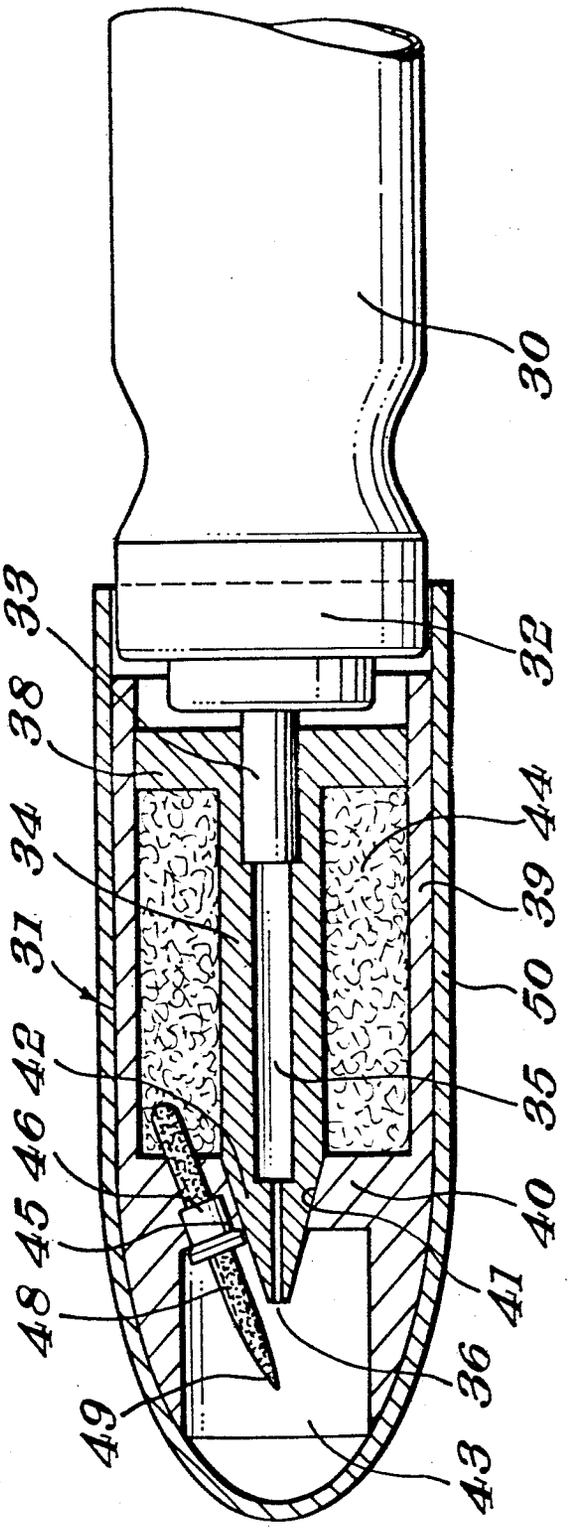


Fig. 4

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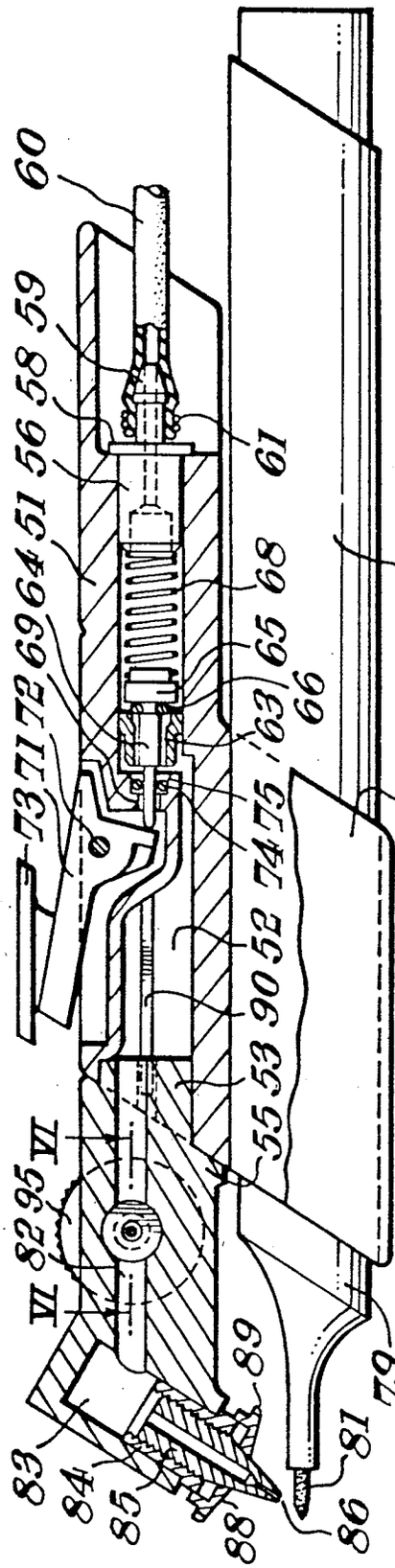

Fig. 5

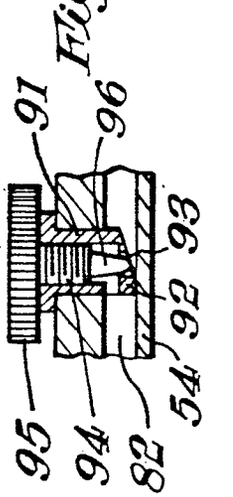

Fig. 6

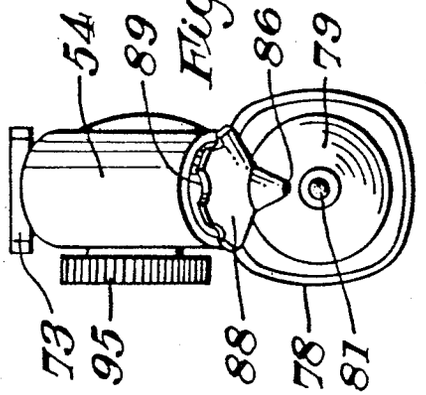

Fig. 8

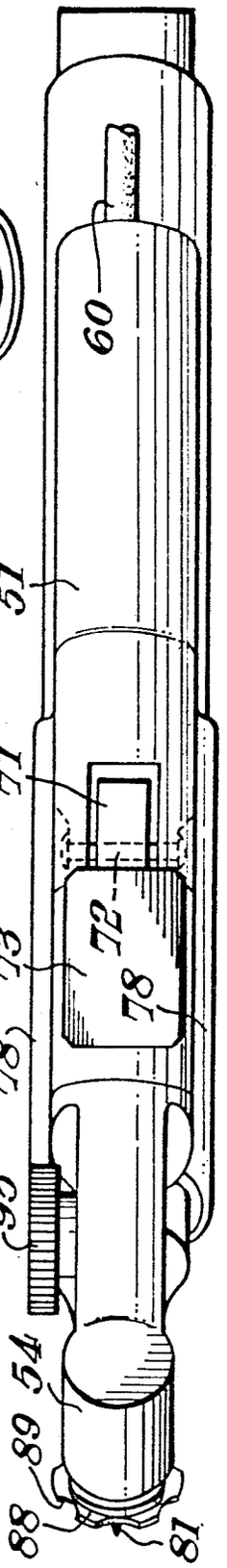

Fig. 7

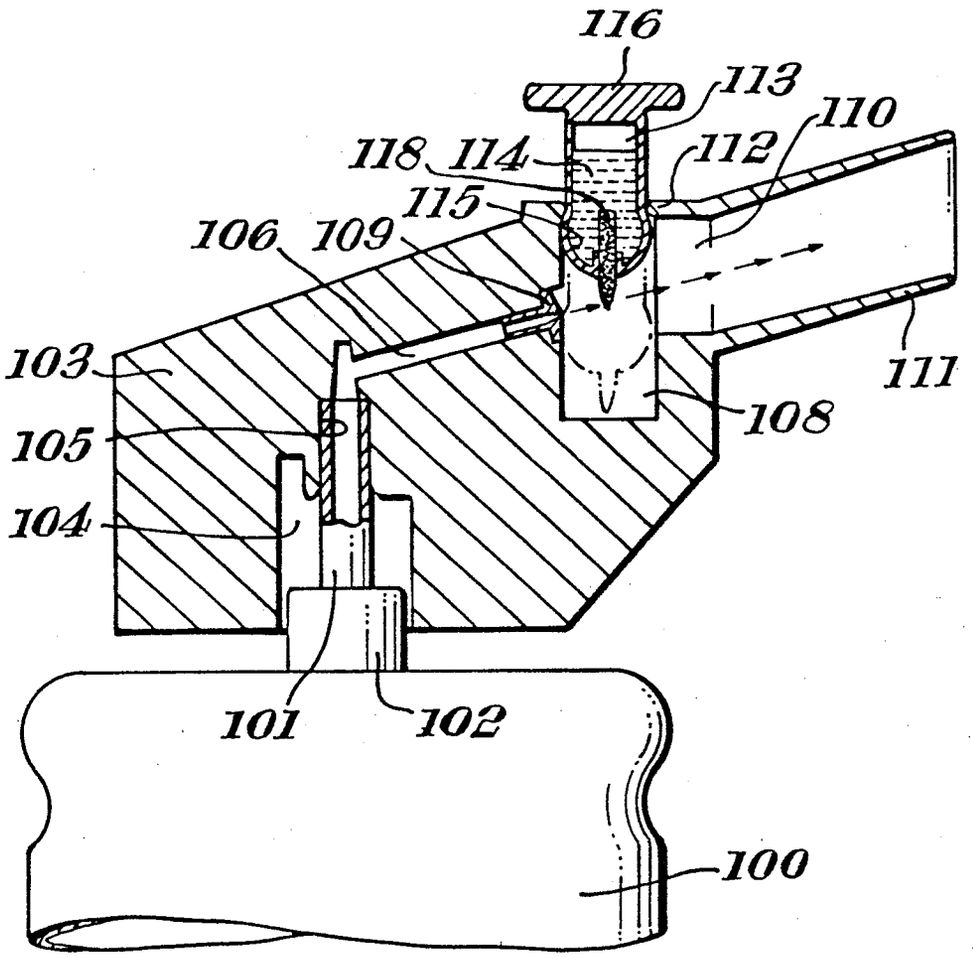
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Fig. 9