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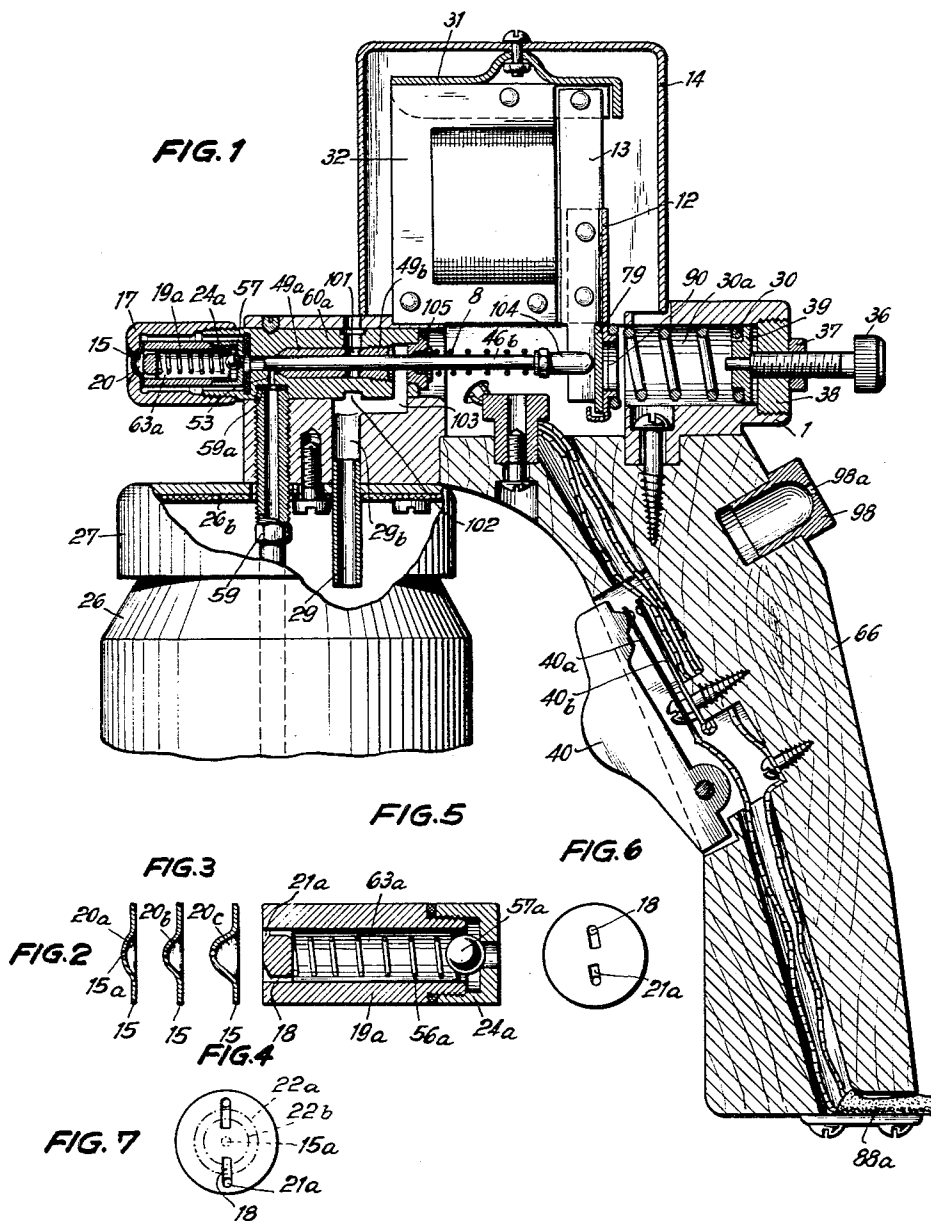
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2,704,690

SPRAY GUN

Filed Jan. 6, 1953

3 Sheets-Sheet 1



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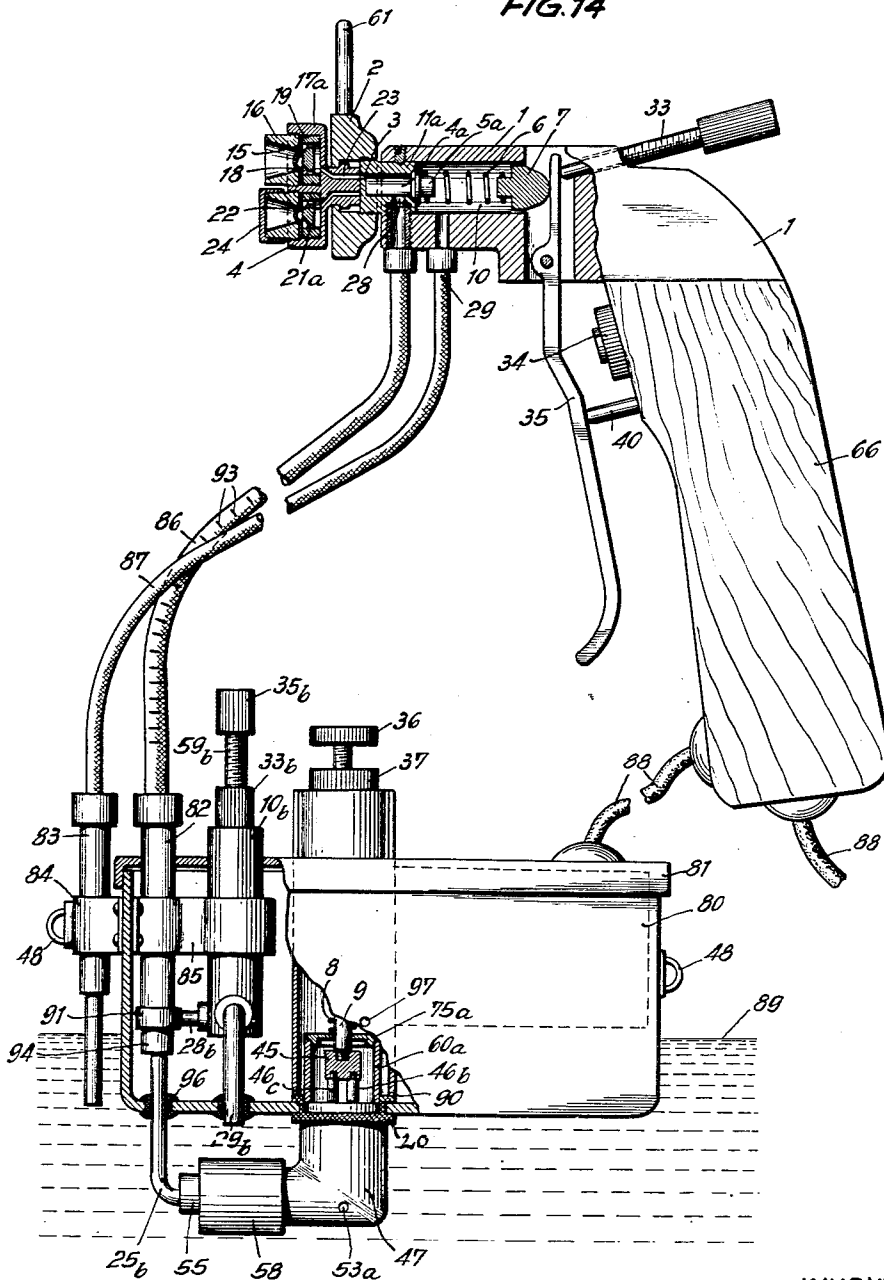
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FIG. 14



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## SPRAY GUN

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15 Claims. (Cl. 299—97)

The present invention relates to improvements in devices for delivering, atomizing or spraying liquids, by means of atomizer nozzles and by vibrating a piston pump driven by an electric alternating current magnet.

Known devices of this type were not suitable for continuous operation since with previously known means of supporting and fastening the magnet armature, wear of the armature and its mounting was unavoidable and a part of the energy was lost by the friction produced by the unsuitable mounting. Moreover, with known devices, the nozzle arrangement was defective and only suitable for nearly water-thin liquids. In devices where vacuum was used for drawing up the liquid, the back-pressure valve and the vacuum formation were capable of improvement on the one hand, and on the other hand the devices with suction feed were only usable for quite pure liquids, since the presence of the slightest impurity on the ball seat caused the vacuum to be lost and the suction effect to be destroyed. Finally prior devices of the character described were not suitable for quantity production.

The present invention avoids the objections to previous devices for atomizing and spraying liquids by mounting the coil spring which controls the oscillation of the armature close to the armature in such manner that between the end of the cylindrical bore, in which the spring is mounted, and the armature, only just sufficient space is left so that the armature has the necessary freedom for oscillation. Moreover, between the nozzle and the liquid pressure chamber a block is provided which lies under the part-spherical hollow space of the nozzle disc, which may be of conventional structure; and this block is provided with two longitudinal bores and with ducts running out radially or nearly radially from these bores towards the center, and of progressively reduced depth. These ducts are partially covered by the nozzle disc. Furthermore, the back-pressure valve is arranged in a removable chamber of which the cover cap serves as a valve seat.

In devices with suction feed there is arranged in front of the exit point of the piston from the pump cylinder, a liquid collector which surrounds the exit point of the piston and also is sealed against entry of air. In order to eliminate sensitivity against disturbance of the back-pressure valve for the suction formation, the inlet opening for the liquid in the pump cylinder is provided, in one form of the invention, below the level of the liquid to be atomized. In this embodiment of the invention, in order to obtain a satisfactory fastening, the securing nipple of the riser tube and the guide tube for the pump piston are arranged parallel one to the other in a common body, in which also the back-pressure valve is provided. Finally in another constructional embodiment the whole driving device is located in a floating container which is supported by the surface of the liquid to be sprayed and is connected with a spray gun by means of one or more pipeways.

Several embodiments of the present invention are shown by way of example, in the accompanying drawings wherein:

Fig. 1 is a fragmentary section through a spray gun made according to one embodiment of the invention and employing suction feed of the liquid;

Figs. 2, 3 and 4 are axial sections showing, respectively, three different forms of nozzle discs that may be used on the spray gun;

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Fig. 5 is an axial section of the removable pressure chamber against which the nozzle discs seat;

Fig. 6 is a front view of this chamber;

Fig. 7 is an end view of the nozzle support plate indicating two different flow-control conditions;

Fig. 8 is a section, similar to Fig. 1, showing a further embodiment of the invention in which there is pressure instead of suction feed of the liquid;

Figs. 9, 10 and 11 are axial sections showing, respectively, three different forms of nozzle discs that may be used with the gun of Fig. 8;

Fig. 12 is an axial section through the support plate for the nozzle discs;

Fig. 13 is a front view of this support plate; and

Fig. 14 is a part elevation, part axial section of a spray gun built according to a further modification of the invention and having a pressure pump adapted to float on the liquid supply.

The spray gun shown in Fig. 1 has a wood grip 66 to which is fitted the housing or body 1 for the magnet 32. A vibrating armature 13 is hingedly mounted at one end in front of the magnet coil; and a U-shaped bent clip 12 is firmly riveted to this armature 13. This clip has a collar 90 formed on its lower end to which one end of a coil spring 30 is clamped. A steel plate 79 is inserted in the U-shaped space of the clip 12 at the opposite side of the clip from collar 90. This plate is clamped in position by tongues bent over from the clip 12. A U-shaped clip 31, similar to clip 12 and fitted to the upper part of the magnet, prevents lateral displacement of the armature.

The spring 30 is housed in a cylindrical bore 30a of the housing 1, which extends to a point immediately adjacent the collar portion 90 of the clip 12. There is just sufficient room between the mouth of the cylindrical bore and the clip 12 to allow the armature sufficient freedom. Since the spring 30 is held in the bore 30a and engages firmly around the collar 90, the armature 13 is retained against displacement upwardly, downwardly and laterally.

The device of Fig. 1 is provided with suction feed of the liquid. In this device there is a piston 46b slidably arranged within a cylinder body 60a and a pump cylinder 49a. The pump cylinder 49a itself is mounted within the cylinder body 60a.

The piston 46b carries an elongated nut 104 having a rounded end. Nut 104 presses against the steel plate 79 through action of a spring 8 which engages at one end with the nut or a groove turned in the piston and at its opposite end with a sealing member 105 that is secured in right hand end of cylinder body 60a. Since the counterspring 30 presses on the other side of the plate 79, the force exerted by the spring 30 in relation to the counterpressure can be adjusted by the rotation of the regulating screw 36 and fixed by the ring nut 37. For this purpose the screw 36 is screwed into an internal thread of the ring nut 37 and presses by its tip against the spring plate 39. By rotating the knurled head of the screw 36 the spring 30 can be compressed and slackened.

The cylinder body 60a is provided with a rearwardly directed bore provided with an internal thread 49b and at its forward end, is of conical form. The pump cylinder 49a has a correspondingly coned tip at its forward end and at its opposite end a corresponding external thread, by which the cylinder 49a is screwed into the cylinder body 60a in such manner that the conical tip is seated in the conical recess of the bore of the guide and thus an air-tight connection is obtained between the cylinder bore in the guide member 60a and the cylinder bore in the pump cylinder 49a. Several cylinder bores may be provided in the pump cylinder as shown in Fig. 14 if desired, each having a separate piston.

The pump cylinder 49a has a relief passage formed by a cross bore 101 which is in alignment with a cross bore in the cylinder body 60a; and the latter bore opens into a groove 102 turned in the outer surface of the body 60a. A slot 103 is arranged in the rear of the cylinder 49a in the guide body 60a, said slot running transversely of the guide body 60a, so that a completely free outlet opening

is provided. A circular disc 105 is inserted in the body 60a in the rear outlet from its bore which has a corresponding recess for a conically formed seal. A circular apertured disc is arranged in the rear of the seal, against which the spring 8 presses. The cylinder body 60a is inserted in a cylindrical bore in the housing 1 and is secured against displacement by a set screw. A duct 29b is provided below the slot 103 and the groove 102, which communicates with the return flow pipe 29. The intake pipe 59 is screwed from below into the housing 1 and presses against an apertured sealing washer 59a inserted in the cylinder body 60a. The sealing washer 59a lies in a recess which is continued by the passage 53. A bore is cut in the front end of the cylinder body 60a. The insert piece or pressure chamber 19a together with the cap member 24a are inserted into this bore, and are pressed against an inserted sealing ring mounted therein by the cap nut 17 which threads onto body member 60a and which serves to hold nozzle disc 15 in place against the front end of pressure chamber 19a.

The container cover 27 with the container 26 for the spray liquid 26 is screwed to the spray gun body 1.

The inverted cup-shaped cover 14 fits over the magnet 32, and engages a recess cast in the gun body 1. It is retained in position by a central screw. The insert piece 19a is cylindrical in form and is provided with a cylindrical bore 63a (Fig. 5) and with an external thread. The cap 24a can be screwed in the manner of a cover on the rear of insert piece 19a. This cap includes a central bore of which the inwardly directed edge serves as a valve seat for the ball 57a. In the bore 63a is inserted the valve spring 56a, which presses the ball 57a towards the valve seat.

Two opposite bores 18 (Fig. 5) are provided at the front end of the insert piece 19a, which open into radial or nearly radial recesses 21a in the end face of this insert piece 19a. These recesses 21a are of progressively reduced depth towards the center of the insert piece.

The housing or body 1 is fitted to the wood handle 66 and is secured thereto by pins and screws. On the back of the wood grip 66 there is fitted a cap 98. The purpose of the cap 98 is to cover the cylindrical hollow space in the wood handle 66 which serves for storing spare nozzles; furthermore, the cap 98 serves for testing the viscosity of the liquids to be used. For this purpose the small aperture 98a is provided, through which liquid filled into the hollow part of the cap is allowed to pass out in drops. By measuring the time between two or more successive drops it is possible to estimate the viscosity.

The wood grip 66 is bored through longitudinally and provided with recesses in which are accommodated the cable 88a and the switch lever 40. The arrangement and the outer curvature of the switch lever 40 is so chosen that when the fingers on the operator's hand engage the grip, the weight of the gun automatically forces upwardly the lever 40. Thereby the coil of the magnet is energized with alternating current through the contact springs 40a and 40b within the hand grip and thus the mechanism is brought into operation. When the current flows in one direction the piston 46b moves against the pressure of the return spring 8 so far that its front end projects, as shown, beyond the inlet passage 53, and this passage is thereby closed. As a result of the change in direction of the electric current the armature 13 is immediately after moved reversely, and the rounded end of the piston is pressed by means of the spring 8 against the steel plate 79. Thereby the suction passage 53 is opened and on the contrary the ball valve 57 is closed.

In the device according to Fig. 1 there is thereby produced in the space in front of the head of the piston a reduction in pressure. The liquid flowing into the space in front of the piston then fills the space in the rear of the ball 57 and on the ensuing forward movement of the piston, the ball valve 57 is forced open and the liquid is forced into pressure chamber 19a. Since the current changes direction rapidly the operations of sucking liquid up and forcing it into chamber 19a are repeated in rapid sequence. The greater part of the incoming liquid is forced forwardly on the pressure stroke of each cycle, and reaches the pressure space 63a in front of the ball 57 or 57a. In this pressure space there is produced a comparatively high pressure by the rapid repetition of the described operations. The liquid under pressure flows through the passages 18 and the recesses 21a into the

part-spherical or hemi-spherical hollow space 20 of the cap disc 15. According to the dimensions of these part-spherical hollow spaces 20a, 20b, 20c (Figs. 2, 3 and 4) the recesses 21a, contracting towards the center, permit more or less liquid to flow into the part-spherical space, 20a, 20b, 20c as indicated by the dotted circles 22a—22b in Fig. 7. By altering the dimensions and the height of the part-spherical space 20a, 20b, 20c, the atomising action can be suited to the viscosity of the liquid and thereby the form of the atomised spray, formed by the outflow of the liquid through the nozzle orifice 15a, is influenced. In each case the flanges of discs 15 cover the passages 18 apart from the outlet spaces formed by the recesses 21a.

The lubrication of the pump cylinder is effected by the liquid in the container.

It cannot be avoided in the device with suction feed that a part of the liquid passes out by the pressure produced in front of the piston, to the rear opening of the pump cylinder. This leakage liquid can flow back into the container since the cylinder body 60a is provided directly behind the opening of the cylinder 49a with the transverse bore or passage 103 which is so large that the piston 46b is completely free, not only below but also above. The liquid flows through the duct 29b and the tube 29 back into the container 26. The liquid, which may be still present on the piston rod, is scraped off by the sealing ring inserted in the ring disc 105 and compressed into this disc by the spring 8.

In devices for pressure feed of the liquid, the magnet armature 13 is arranged horizontally (Figs. 8 and 14). In the embodiment of Fig. 8 the piston 46 is inserted through the apertured disc 100 into the guide tube 60 and at its bottom it projects into the cylindrical sleeve 49. This sleeve 49 is inserted in a corresponding bore in the pump body block 47 and is pressed by the cap-shaped end of the guide tube 60 against a seal 54a located at the base of the cylinder-bore 91 and fastened by an external thread on the end of the guide tube 60. This cylinder bore 91 is continued beyond the seal 54a by a small blind bore 54, parallel to which is a second cylindrical recess in the pump body block 47 in which can be inserted the nipple 55 of the riser pipe 25. The nipple screw 53 presses the nipple 55 in like manner against a seal 50 located at the base of the cylindrical bore and thus provides an air-tight seal between the pipe 25 and the bore 99 arranged beneath the sealing washer 50. A third cylindrical bore 63 is arranged cross-wise in the pump body below this bore 99. Bore 63 merges into a smaller bore 54b and communicates laterally with the bores 54 and 99. The ball valve 57 is adapted to seal the smaller bore 54b and is constantly urged to closed position by a valve spring 56. The bore 54b provides communication with the pump cylinder 49. An inlet opening 53a is cut transversely in the pump cylinder which opens into the somewhat larger inlet passage 53 in the pump body 47. The bore 63 is closed in the embodiment according to Fig. 8 by a cap screw 63b while in Fig. 14 the tube nipple 55 is screwed into the end of the bore by the nipple screw 58.

In the cast body 1 there is provided coaxially with the bore 30a for the spring 30, a longitudinal bore 60a for receiving the guide tube 60, hence the latter can be easily inserted together with the piston 46 in the longitudinal bore 60a. If the nipple 58 of the riser pipe 25 previously screwed into the cast body 1 is screwed into the pump body 47 there is produced a rigid connection not only of the riser pipe 25 with the pump body 47 but simultaneously also of the guide tube 60 with the cast body 1. The riser pipe 25 is, in the same manner as the guide tube 60, inserted from below in a longitudinal bore of the body 1 and secured by a thread against the nozzle tube 11 arranged transversely thereof. Thereby the conically formed tip of the riser pipe 25 seats in a corresponding conical recess of the nozzle tube 11 and thereby secures the nozzle tube 11 against rotation and withdrawal from the cast body 1. Thereby also an air-tight connection is provided between the riser pipe 25 and the transverse bore 28 of the nozzle tube 11.

On the opposite side the transverse bore 28 is closed by the ball 5 which is under the pressure of the spring 6 which can be tensioned or slackened by the screw 35a having a head 36a. The adjusting ring 37a serves for retaining the spring tension after adjustment. A bore 29a is provided transversely of the cylindrical bore 10 serving for inserting the tension spring 6 and is closed

to the outside by a screw. This bore 29a opens into the longitudinal bore 29b which is in communication with the return flow pipe 29.

A cover 27 is screwed on to the cast body 1 which cover engages with a bayonet lock joint in a corresponding projection of the container 26; and this container is thereby pressed against the seal 26b. The nozzle tube 11, which can be as long as desired, has an external thread at its outer end over which the cover cap 17 is screwed. The nozzle disc 15 and the liquid distributor 19 with the pressure chamber 4 are disposed in the cover cap 17; and these parts are pressed against the sealing ring in front of the pressure tube 11 by tightening the cap 17. Two opposite bores 18 (Fig. 12) are provided, as already described, on the end face of the pressure distributor 19 which open, in like manner to the insert piece 19a (Fig. 1) radial or nearly radial recesses 21a, which are of reduced depth towards the center. On the other side of the bores 18 is provided a cylindrical hollow space 4 which serves as the pressure chamber for distributing the liquid pressure.

In the devices with pressure feed of the liquid (Figs. 8 and 14) the pipe 60 is emptied through the bore 48 after lowering of the liquid level below this bore. If the desired pressure is exceeded the pressure can be reduced by slackening the spring 6 since then a part of the liquid reaches the longitudinal bore 29b, past the ball valve 5 and flows back through the tube 29 into the container.

The device according to Fig. 14 consists of a pistol grip 66 with the same general structure as in Fig. 8, but, however, without the magnet, driving device and paint container. The pistol grip of Fig. 14 is connected with the floating structure 80 by means of the tubing 86/87 and the electric cable 88.

In order to provide for a rapid exchange of various nozzles, several nozzles are eccentrically arranged on the spray gun in the arrangement according to Fig. 14. The nozzle head 17a comprises two or more bores eccentric of its axis of rotation in which are inserted the nozzle discs 15 with the insert plates 19; and they are pressed against the ends of the bores by means of screw sleeves 16. The eccentrically arranged bores in the nozzle head for receiving the various nozzle discs 15 and the nozzle support plates 19 are connected by inclined passages with eccentrically arranged longitudinal bores 23 which can be brought into register, after rotary adjustment, with the eccentrically arranged bore 3 in the member 11a housing the excess pressure valve 5a. The grip member 61 serves for easy slackening of the cap nut 2 when it is desired to rotate the nozzle head 17a.

In order that when using quick-drying lacquers, the lacquer in the nozzle shall not dry off and the nozzle become blocked when the gun is not in use, a cap 24 is provided which can be fitted over the screwed holder 16 of the nozzle which is not in use.

In the embodiment of Fig. 14 a mushroom valve 5a is fitted against the outlet from the outer pressure chamber 4a for sealing purposes. The mushroom valve 5a is pressed by the spring 6 against a conical seat in housing member 11a. This spring is slackened or tightened by the action of the lever 35, the upper part of which acts on the spring head 7. The mushroom valve 5a has a function like the ball valve 5 of Fig. 8. The screw 33 presses by its point against the hand lever 35. By rotating the knurled head of the screw 33 the movement of the hand lever 35 can be limited in one direction while the knurled head screw 34 serves for limitation in the other direction.

The floating unit 80 (Fig. 14) serves for carrying the pump with all the associated components. The pump body block 47 and the back pressure valve are similar to the construction of Fig. 8 but the body block contains two parallel adjacent longitudinal bores for receiving the two pistons 46b, 46c. These two pistons are secured by means of the head block 45 to the piston rod 9. The spring 8 presses against the plate 75a which rests on the guide tube 60a. The body block 47 with the pump cylinder inside extends through the bottom of the floating unit 80 and is retained by a threaded ring 20 screwed on the pipe 90 and sealed against liquid in such a way that the inlet openings 53a for the pump project below the base into the liquid. The tube nipple 55 in this arrangement is not parallel to the guide tube 60a for the piston rod but is screwed directly into the

bore 63 (Fig. 8) of the back pressure valve 57 inside the housing 47; and the pressure pipe 25b is led upwardly at right angles. The pipe 25b is led through the base of the unit 80 being sealed by means of a rubber grommet 96 and screwed to the tube connector 82. A hollow ring 91 with lateral connection 28b is inserted between the screw 94 and the pipe 82, which connection opens into the outer chamber of an excess pressure valve, not shown, but like valve 5 (Fig. 8), the cylindrical housing 10b of which is arranged parallel to pipe 82 and to the tube-connecting member 83, and is secured by a clamp 85 together with the connector 82 to the side wall of the floating unit 80. The excess pressure valve 5 is constructed in the same way as shown and described in Fig. 8, but the regulation is effected by a screw 59b with a knurled head 35b and is retained by a knurled nut 33b as required.

The regulating screw 36 for the magnet oscillation spring 30 (Fig. 8) is located near the regulator 35b of the relief valve. Moreover the tube connection member 83, through which the liquid flowing back from the gun through the pipe 87 again reaches the container, is secured externally of the floating unit by the clamp 84. The floating unit is covered by a cover 81 through openings in which project vertically upwardly the magnet regulator 36, the regulator 35b for the relief valve and the pipe connection member 82.

Pressure against the lever 35 moves the rod 40 to bring the electric switch into operation.

The armature 13 (Fig. 8) of the alternating current magnet, which operates in the same way as the magnet 32 in Figs. 1 and 8, commences to vibrate as a result of the alternation of the direction of current flow, and thereby reciprocates the piston rod 9 with the pistons 46b and 46c against the pressure of the spring 8 in the pipe 90. The oscillation can be regulated by rotation of the knurled screw 36, which presses against a spring plate like plate 39 of Fig. 1, so that the magnet spring, like spring 30, is tightened or slackened by screwing up or releasing the screw 36. The knurled screw 36 serves for adjustment to secure the most favourable operation.

By pressing on the lever 35 the spring head 7 is also set into movement whereby the relief valve 5a is more or less stressed or released, or the same result is obtained by rotating the knurled screw 35b. The liquid located in the outer chamber 4a of the relief valve can be more or less returned through the relief valve into the relief duct 29 and thus to the container. By this regulation the result is obtained that the pressure appearing at the spray nozzle can be made smaller or greater by adjustment of the valve spring and thus the jet is regulated in size.

The two or more nozzle discs arranged in the nozzle head can be selectively brought into communication with the eccentrically arranged bore 3 of the pressure chamber 4a, by rotating the nozzle head after slackening the holding nut 2, so that after each adjustment one or other nozzle comes into operation.

The device according to Fig. 14 serves for quantity feed, for example for spraying direct from a vessel or large container. The floating unit 80 is placed on the liquid surface and retained in the horizontal position either freely floating or in some cases with the assistance of cork elements, which can be fastened to the lugs 48, in such manner that the fluid level 89 remains under the pipe 90 in order that excess fluid can return to the container through the pipe 87.

The liquid is forced in the manner previously described through the pipe 86 to the gun. The excess liquid can be returned by regulation of the relief valve, previously mentioned, which is inside housing 10b and which is similar to valve 5 of Fig. 8. The pipe 87, however, permits regulation by hand from the gun during spraying if desired, the pipe 87 being arranged so that the liquid leaving the relief valve 5a on the gun can flow back to the container. Since the floating unit 80 falls with the liquid level the pipeway 86 is provided with markings 93 in order that the operator can always see how much liquid is still in the container.

The atomisation of the pumped liquid is effected in such manner that it is forced through the two recesses 21a and apertures 18 in the support plate 19 which are practically completely covered by the part-spherical hollow space similar to the hollow spaces 20a, 20b, 20c (Figs. 9 to 11) of the nozzle disc 15. As a result of the radial

or nearly radial opposed arrangement of the recesses, a vortex movement is produced in the hollow space of the nozzle disc 15; and the liquid passes outwardly in the form of an atomised liquid jet through the nozzle opening which is similar to nozzle opening 15a (Fig. 9).

The device fitted in the floating unit 80 can also be used as a separate delivery device for liquids. In place of the particular spray gun shown in Fig. 14 in this case, a normal type of compressed air gun or alternatively an atomising nozzle may be connected to the tubing 86.

While the invention has been described in connection with several different embodiments thereof, it will be understood that it is capable of further modification. This application is intended to cover any variations, uses, or adaptations of the invention following, in general, the principles of the invention and including such departures from the present disclosure as come within known or customary practice in the art to which the invention pertains and as may be applied to the essential features hereinbefore set forth and as fall within the scope of the invention or the limits of the appended claims.

Having thus described my invention, what I claim is:

1. A device for spraying liquids comprising a cylinder having an inlet and an outlet, a pump-piston reciprocable in said cylinder to open and close said inlet on the suction and pressure strokes, respectively, of said piston, a pressure chamber connected to said outlet, a back-pressure valve positioned in one end of said chamber to close said connection on the suction strokes of said piston, a cylindrical disc secured to said pressure chamber and having parallel longitudinal passages therethrough and having open passages at its end remote from said back pressure valve that communicate with said longitudinal passages and that extend generally radially inwardly and that are of progressively reduced depth toward the axis of said cylindrical disc, and a cap-disc secured over said end of said cylindrical disc and partially covering said longitudinal passages, said cap disc having a hollow part-spherical recess confronting said end of said cylindrical disc and having a central opening communicating with said generally radial passages through which the spraying liquid may pass.
2. A device for spraying liquids comprising a cylinder having an inlet and an outlet, a pump-piston reciprocable in said cylinder to open and close said inlet on the suction and pressure strokes, respectively, of said piston, a pressure chamber connected to said outlet, a back-pressure valve positioned in one end of said chamber to close said connection on the suction strokes of said piston, a cylindrical disc secured to said pressure chamber and having parallel longitudinal passages therethrough and having open passages at its end remote from said back pressure valve that communicate with said longitudinal passages and that extend generally radially inwardly and that are of progressively reduced depth toward the axis of said cylindrical disc, and a cap-disc secured over said end of said cylindrical disc and partially covering said longitudinal passages, said cap disc having a hollow part-spherical recess confronting said end of said cylindrical disc and having a central opening communicating with said generally radial passages through which the spraying liquid may pass, and an electromagnet adapted to be energized by alternating current for reciprocating said piston.
3. A device for spraying liquids comprising a nozzle, and means for delivering liquids to said nozzle under pressure comprising a cylinder, a pump-piston reciprocable in said cylinder, an electromagnet operable by alternating current, an armature oscillatable by said magnet, a removable plate carried at one side of said armature, a spring holding said piston against said plate, and a second spring fastened to the opposite side of said armature to hold said armature in engagement with said piston, said second spring being a cylindrical coil spring, and a cylindrical housing in which said second spring is mounted, the mouth of said housing being located so close to said armature that only sufficient space is left between the armature and the mouth of said housing for said armature to oscillate.
4. A device for spraying liquids comprising a cylinder having a central bore, an inlet and an outlet, a pump-piston reciprocable in the central bore of said cylinder to open and close said inlet on the suction and pressure strokes, respectively, of said piston, and a nozzle assembly secured to said cylinder coaxial therewith, said nozzle assembly com-

prising a cylindrical pressure member aligned axially with said cylinder and abutting against the same at one end, said pressure member having a bore aligned axially with the bore of said cylinder, a valve, a cap secured on one end of said member and having an aperture there-through communicating with both bores, spring means for normally holding said valve against said cap to close the bore of said pressure member off from the bore of said cylinder, said pressure member having a plurality of ducts leading axially longitudinally from its bore at opposite sides of its axis toward the end of said pressure member distal from said cylinder and having open ducts formed in said distal end communicating with said longitudinal ducts and extending toward the axis of said bore, the last-named ducts being of progressively reduced depth toward said axis, a nozzle disc seated against said distal end and partly, at least, covering said longitudinal ducts, said nozzle disc having a generally spherical-shaped recess in its face opposed to said last-named ducts and having a central aperture, and means for securing said nozzle assembly to said cylinder.

5. A device for spraying liquids comprising a cylinder having a central bore, an inlet and an outlet, a pump-piston reciprocable in the central bore of said cylinder to open and close said inlet on the suction and pressure strokes, respectively, of said piston, and a nozzle assembly secured to said cylinder coaxial therewith, said nozzle assembly comprising a cylindrical pressure member aligned axially with said cylinder and abutting against the same at one end, said pressure member having a bore aligned axially with the bore of said cylinder, a valve, a cap secured on one end of said member and having an aperture therethrough communicating with both bores, spring means for normally holding said valve against said cap to close the bore of said pressure member off from the bore of said cylinder, said pressure member having a plurality of ducts leading axially longitudinally from its bore at opposite sides of its axis toward the end of said pressure member distal from said cylinder and having open ducts formed in said distal end communicating with said longitudinal ducts and extending toward the axis of said bore, the last-named ducts being of progressively reduced depth toward said axis, a nozzle disc seated against said distal end and partly, at least, covering said longitudinal ducts, said nozzle disc having a generally spherical-shaped recess in its face opposed to said last-named ducts and having a central aperture, and a cap member threading on said cylinder and securing said nozzle disc to said nozzle assembly and said nozzle assembly to said cylinder.

6. A device for spraying liquids comprising a cylinder body having a central bore which at a point remote from one end of the body is formed with a conical seat, a cylinder mounted against said seat and having a conical end to seat in said bore, said cylinder having a central bore aligned axially with the bore of said cylinder body, a pump-piston reciprocable in the two bores, said cylinder body being provided with an inlet communicating with its bore and outside said cylinder, a spring-pressed valve disposed at the opposite side of said inlet from said cylinder and normally closing the outer end of the bore of said cylinder body and adapted to be opened on the pressure stroke of said pump-piston, and said cylinder body and cylinder having communicating ducts transverse to and communicating with the bore of said cylinder to conduct away liquid carried along by said piston on its suction stroke, and a peripheral groove around said cylinder body and communicating with the last-named ducts, an electromagnet operable by alternating current for reciprocating said piston, and a nozzle connected to the bore of said cylinder body at a point more remote from said inlet than said valve.

7. A device for spraying liquids comprising a cylinder body having a central bore which at one end is conical, a cylinder mounted in said bore and having a conical end to seat in said bore, said cylinder having a central bore aligned axially with the bore of said cylinder body, a pump-piston reciprocable in the two bores, said cylinder body being provided with an inlet communicating with its bore and outside said cylinder, and said cylinder body and cylinder having communicating ducts transverse to and communicating with the bore of said cylinder to conduct away liquid carried along by said piston on its suction stroke, an electromagnet for reciprocating said piston, and a nozzle connected to the bore of said cylinder body at

the opposite side of said inlet from said cylinder, said cylinder body having a slot therein adjacent its end distal from said nozzle and completely surrounding said piston to provide free space around said piston, said slot serving as a discharge duct for liquid carried beyond said cylinder by said piston on its suction strokes.

8. A device for spraying liquids comprising a nozzle having an inlet, a chamber into which liquid is delivered from said inlet, a member mounted in said chamber, a plurality of parallel ducts extending through said member and leading from said chamber, open ducts in one end of said member extending radially inwardly from said parallel ducts, a nozzle disc covering said parallel ducts partly at least and having a generally spherical-shaped recess in its rear face over said radial ducts, a pump body, a cylinder secured to said pump body and having an inlet and an outlet, a piston reciprocable in said cylinder, a riser pipe secured at one end to said pump body in communication with said outlet and parallel to said cylinder, a back-pressure valve mounted in said pump body to prevent flow of liquid back from said riser pipe into said cylinder, a duct connecting said riser pipe with said nozzle, and an electromagnet for reciprocating said piston at high speed.

9. A device for spraying liquids comprising a nozzle having an inlet, a chamber into which liquid is delivered from said inlet, a member mounted in said chamber, a plurality of parallel ducts extending through said member and leading from said chamber, open ducts in one end of said member extending radially inwardly from said parallel ducts, a nozzle disc covering said parallel ducts partly at least and having a generally spherical-shaped recess in its rear face over said radial ducts, a pump body, a cylinder secured to said pump body and having an inlet and an outlet, a piston reciprocable in said cylinder, a riser pipe secured at one end to said pump body in communication with said outlet and parallel to said cylinder, a back-pressure valve mounted in said pump body to prevent flow of liquid back from said riser pipe into said cylinder, a duct connecting said riser pipe with said nozzle, and extending at right angles to the bore of said riser pipe, a ball valve closing the end of said riser pipe distal from said pump body, adjustable spring means for holding said ball valve closed, and an electromagnet for reciprocating said piston at high speed.

10. A device for spraying liquids comprising a nozzle having an inlet, a chamber into which liquid is delivered from said inlet, a member mounted in said chamber, a plurality of parallel ducts extending through said member and leading from said chamber, open ducts in one end of said member extending radially inwardly from said parallel ducts, a nozzle disc covering said parallel ducts partly at least and having a generally spherical-shaped recess in its rear face over said radial ducts, a pump body, a cylinder secured to said pump body and having an inlet and an outlet, a piston reciprocable in said cylinder, a riser pipe secured at one end to said pump body in communication with said outlet and parallel to said cylinder, a back-pressure valve mounted in said pump body to prevent flow of liquid back from said riser pipe into said cylinder, a duct connecting said riser pipe with said nozzle, and extending at right angles to the bore of said riser pipe, a ball valve closing the end of said riser pipe distal from said pump body, adjustable spring means for holding said ball valve closed, and an electromagnet for reciprocating said piston at high speed, and an outlet for conducting off liquid flowing through the upper end of said riser pipe when said ball valve is open.

11. A device for spraying liquids comprising a nozzle having an inlet, a chamber into which liquid is delivered from said inlet, a member mounted in said chamber, a plurality of parallel ducts extending through said member and leading from said chamber, open ducts in one end of said member extending radially inwardly from said parallel ducts, a nozzle disc covering said parallel ducts part-

ly at least and having a generally spherical-shaped recess in its rear face over said radial ducts, a pump body, a cylinder secured to said pump body in communication with said outlet and parallel to said cylinder, a back-pressure valve mounted in said pump body to prevent flow of liquid back from said riser pipe into said cylinder, a duct connecting said riser pipe with said nozzle, and extending at right angles to the bore of said riser pipe, a ball valve closing the end of said riser pipe distal from said pump body, adjustable spring means for holding said ball valve closed, and an electromagnet for reciprocating said piston at high speed, a seal in said pump body, and means for securing said riser pipe at its first-named end against said seal and for simultaneously securing said cylinder in said pump body.

12. A device for spraying liquids comprising a cylinder, a piston-pump reciprocable therein, a pressure body, a nozzle connected to said pressure body, a duct for delivering liquid to said pressure body from said cylinder on actuation of said piston-pump, a back-pressure valve mounted in said pressure body, spring means for holding said valve closed but permitting it to open upon excess pressure in said pressure body, an electromagnet operable by alternating current for reciprocating said piston-pump, and a manually movable member for simultaneously controlling the pressure of said spring means and the operation of said electromagnet.

13. A device for spraying liquids comprising a reciprocable piston pump, an electromagnet operable by alternating current for reciprocating said piston-pump, a pressure body, a duct for delivering liquid to said pressure body, a nozzle cap rotatably mounted on said pressure body and having a plurality of feed passages therein, a plurality of nozzles mounted in said nozzle cap eccentrically of its axis of rotation and communicating with said several feed passages, respectively, said pressure body having a duct eccentric of the axis of rotation of said nozzle cap and adapted to be connected selectively with the different feed passages by rotary adjustment of said nozzle cap.

14. A device for spraying liquid comprising a nozzle, a reciprocable piston-pump for supplying liquid to said nozzle, an electromagnet operable by alternating current for reciprocating said pump, an electric switch for controlling flow of current to said electromagnet, said device having a hand grip for holding it, and a control lever for said switch pivotally mounted on said grip, said control lever being curved so that when the operator grasps the hand grip the two lower fingers of the operator's hand press on the curved part of said lever and the weight of the device automatically closes said switch.

15. A device for spraying liquids comprising a nozzle, a cylindrical member mounted in said nozzle and having ducts extending axially of said member and other ducts communicating with said axially-extending ducts and extending from said axially-extending ducts inwardly toward the axis of said member, the last-named ducts opening toward the discharge end of said nozzle and decreasing in depth toward said axis, a nozzle disc mounted in said nozzle in front of said last-named ducts and having a concavity in its side opposed to said last-named ducts and having a discharge aperture therethrough, and means for pumping liquid to said cylindrical member comprising a reciprocable piston-pump, and an electromagnet operable by alternating current for reciprocating said pump.

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