

[54] FLUID DISPENSING GUN

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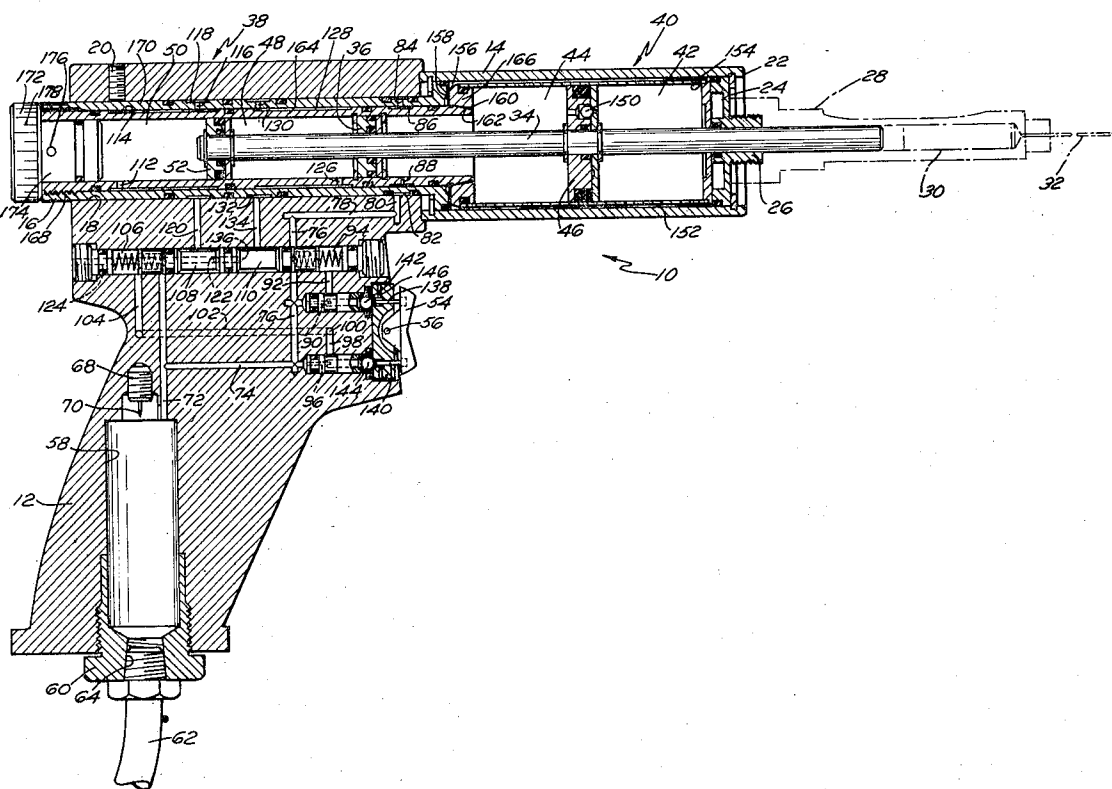
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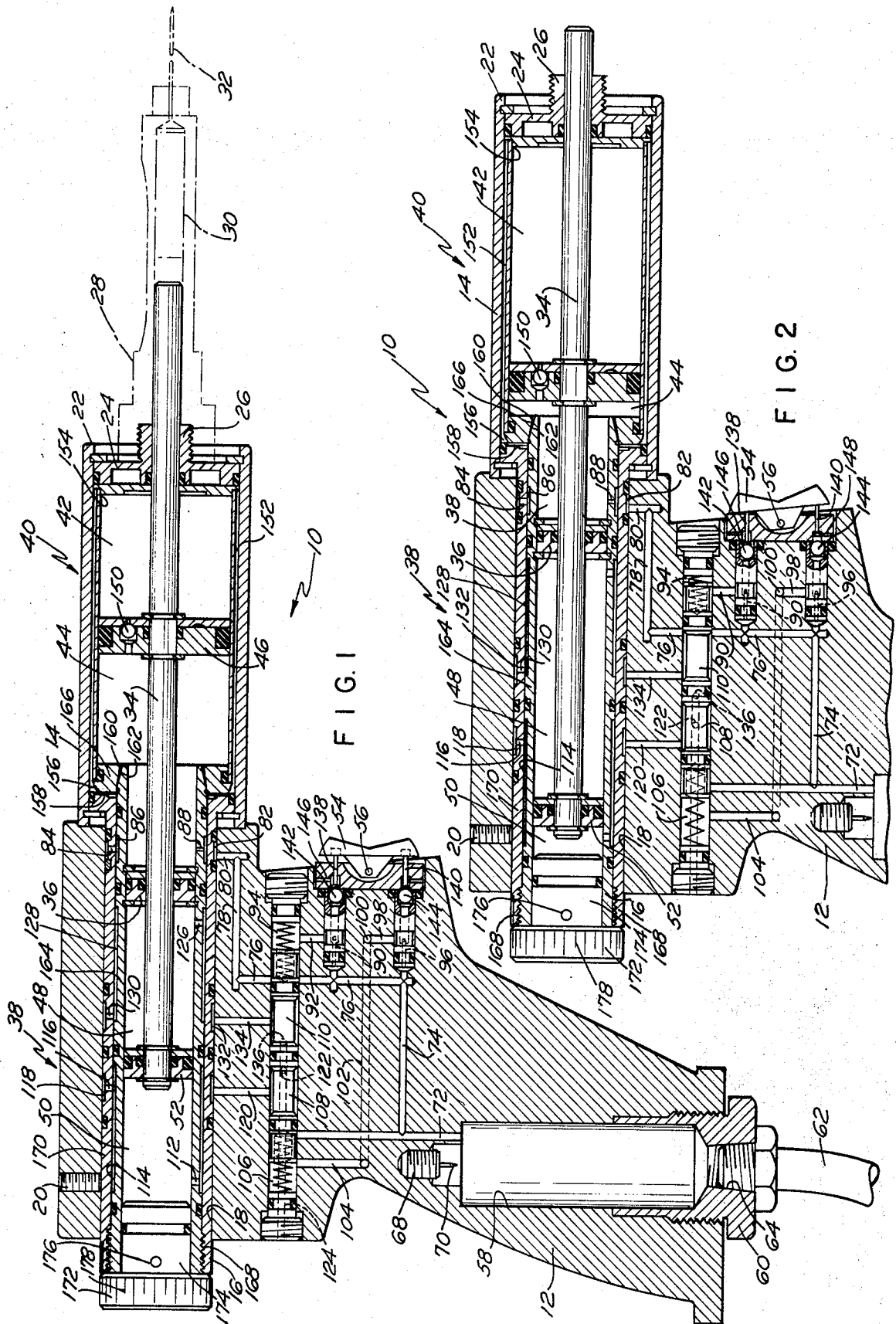
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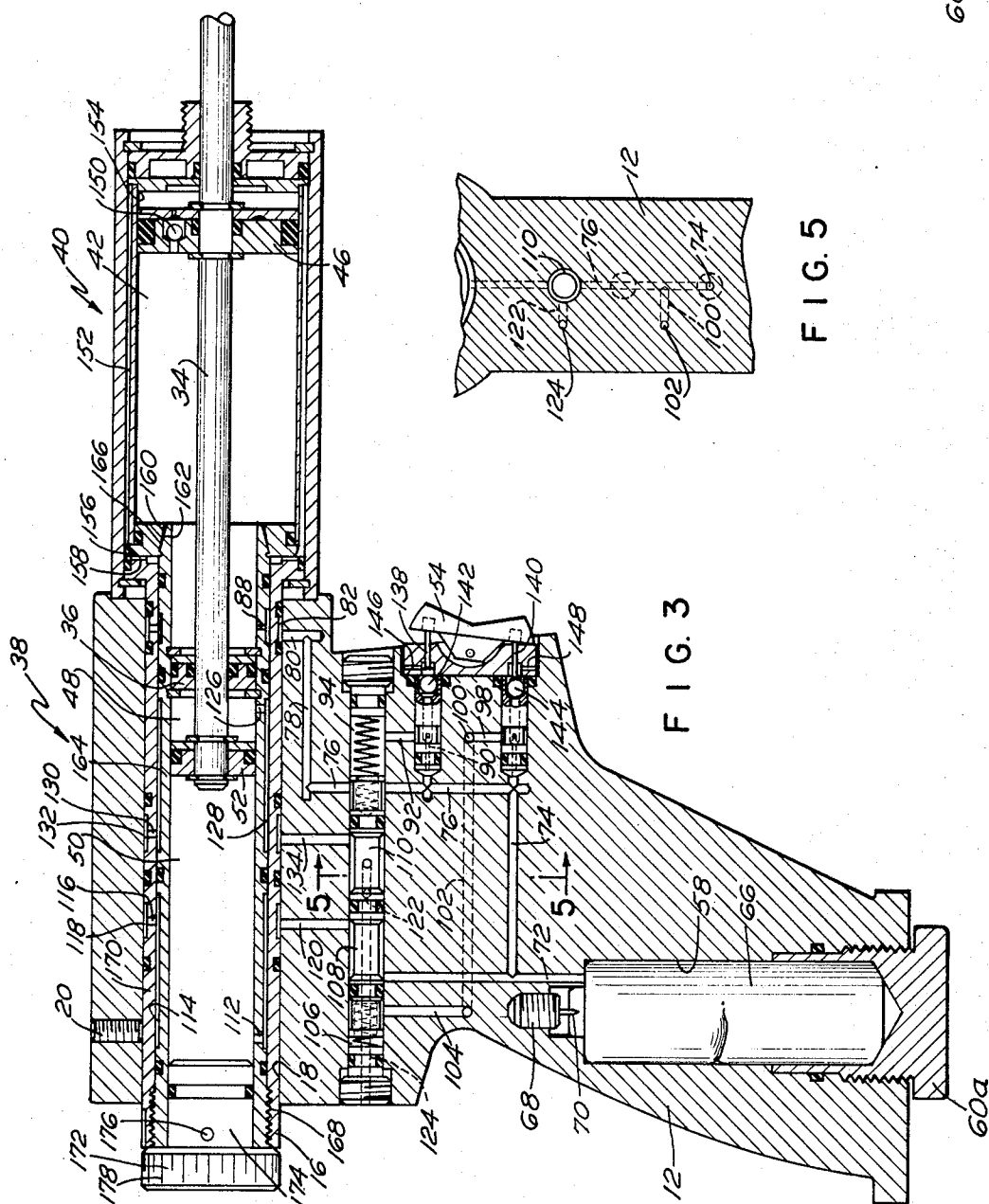
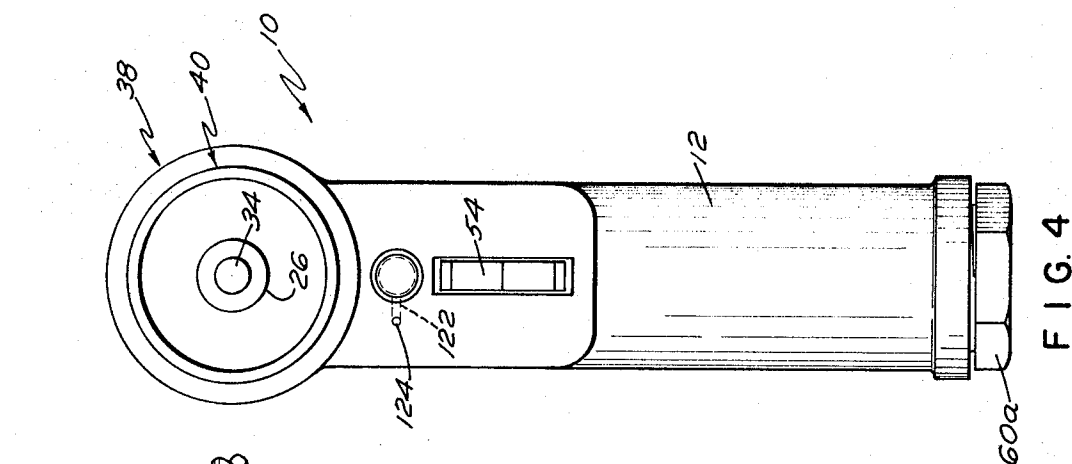
[57] ABSTRACT

Apparatus for slowly and uniformly injecting fluids, such as liquid anesthesia, into a human or animal body, comprising a gun-shaped body having handle and barrel portions, a piston extending axially through the barrel portion, fluid pressure means for selectively extending or retracting the piston, and adjustable damping means associated with the piston to permit controlled movement thereof; whereby when a syringe having a compressible cartridge is operatively connection to the apparatus, extension of the piston causes compression of the cartridge to effect the desired controlled dispensing from the syringe.

4 Claims, 5 Drawing Figures







FLUID DISPENSING GUN

BACKGROUND AND SUMMARY OF THE INVENTION

During certain surgical and dental procedures, and particularly the latter, it is common practice to administer an anesthetic, such as novocaine, in order to temporarily deaden sensitive nerves so that the patient will not be compelled to ensure undue pain. However, the administration of the anesthetic, in and of itself, is extremely unpleasant and somewhat painful to the patient, and it has been found that the primary cause of the pain and discomfort attendant to the administration of a liquid anesthetic, such as novocaine, is the fact that conventional injection apparatus administers the anesthetic too quickly and without sufficient uniformity. It has been found that if the anesthetic is administered slowly and uniformly, almost on a drop-by-drop basis, no pain or discomfort results. The same situation exists where during surgical or dental procedures liquid adhesives or polymers are being injected, such as during polymer implants, or where a sealant is being injected into a root canal.

Regardless of the specific nature of the injection, the fact of the matter is that there are numerous types of injections wherein for various reasons it is highly desirable to be able to make the injection on an extremely slow and uniform basis. Where such requirements exist, hand syringes, which depend upon the manual dexterity of the person administering same, have proven unsatisfactory; and while there have been previous attempts to provide apparatus for achieving the objectives of the present invention, for one reason or another such prior apparatus has not proven to be completely satisfactory. For example, applicant's U.S. Pat. No. 3,605,745 dated Sept. 20, 1971, is concerned with this same problem, but the apparatus of this prior patent does not lend itself to a relatively small, compact, hand operated device, as does the present invention. Also, it has been found that effective and ready adjustability of the damping means that control movement of the piston that effects the dispensing operation is necessary and desirable in order to impart sufficient versatility to the apparatus.

It is therefore an object of the present invention to provide apparatus designed to receive a syringe having a compressible cartridge or ampule, the apparatus having means for slowly and uniformly compressing the cartridge to effect a slow and uniform dispensing of fluid therefrom.

Another object is the provision of apparatus of the character described that is relatively small, compact, and portable for easy hand operation, the apparatus preferably being in the form of a gun having handle and barrel portions.

Another object is the provision of apparatus of the character described having means for quickly and effectively permitting adjustment of the dispensing means, whereby the rate of dispensing of the fluid from the cartridge may be readily selected and adjusted.

Another object of the present invention is the provision of apparatus of the character described wherein control of the dispensing means is effected by pressurized fluid which may either be self-contained within the apparatus or fed to the apparatus from an external source.

A further object is the provision of apparatus of the character described which is effective and durable in operation.

Other objects, features and advantages of the invention will become apparent as the description thereof proceeds when considered in connection with the accompanying illustrative drawings.

DESCRIPTION OF THE DRAWINGS

In the drawings which illustrate the best mode presently contemplated for carrying out the present invention:

FIG. 1 is a side elevational view, in section, showing the present invention in its static position;

FIG. 2 is a fragmentary elevational view, in section, showing the apparatus in its retracted position;

FIG. 3 is an elevational view, in section, showing the apparatus in its extended or operative position;

FIG. 4 is an end view looking from the right with respect to FIG. 3; and

FIG. 5 is a fragmentary sectional view, taken on line 5—5 of FIG. 3.

DESCRIPTION OF THE INVENTION

Referring to the drawings, there is shown generally at 10 fluid dispensing apparatus in the form of a hand-operated gun comprising a handle portion 12 and a barrel portion 14 removably connected thereto. More specifically, the barrel portion 14 comprises a reduced portion 16 which fits snugly within bore 18 in the handle portion 12 and then is rigidly maintained in position therein by means of set screw 20. At its forward end 22, barrel portion 14 is provided with an end wall 24 from which extends a threaded attachment 26 adapted to threadedly receive a syringe 28 having a compressible ampule or cartridge 30 operatively connected to a needle 32, all in a well-known fashion. It will be understood that compression of ampule 30 by means of a movable piston 34 carried in barrel portion 14 causes fluid from the ampule 30 to be dispensed under pressure through needle 32. The basic object of the present invention is the provision of means for controlling movement of piston 34 so as to effect extremely slow and uniform dispensing of the fluid from the ampule 30.

It will be understood that once the syringe 28 has been used, it may easily be removed from the apparatus 10 by unscrewing it from the attachment 26, whereupon a new syringe may readily be substituted for subsequent use of the apparatus. Also the entire barrel portion 14 may be easily removed from handle portion 12 simply by loosening set screw 20, whereupon a different barrel portion may readily be inserted, either for reasons of disrepair it becomes necessary to replace the barrel portion 14, or if it is desired to substitute a different length operating stroke of the piston is desired for any reason, thus requiring a different length barrel.

Barrel portion 14 is divided by means of sealing wall 36 into an actuating chamber 38 and a damping chamber 40. In turn, damping chamber 40 is divided into compartments 42, 44 by means of sealing wall 46 fixedly secured to piston 34 for movement therewith. Likewise, actuating chamber 38 is divided into compartments 48, 50 by means of sealing wall 52 also secured to piston 34 for movement therewith. It will be understood that piston 34 slidably passes through wall

36 in sealed relation thereto, and at its forward end the piston 34 extends in sealed relation outwardly through attachment 26 into syringe 28 in order to engage ampule 30 for compression of same.

As will be seen most clearly in FIGS. 1, 2 and 3, handle portion 12 of apparatus 10 comprises an actuator in the form of a trigger member 54 pivotally mounted as at 56. In FIG. 1, the trigger 54 is shown in its off position, i.e., neither end of the trigger is depressed. In this position, the apparatus 10 is in a state of equilibrium, or expressed differently, the piston 34 is stationary and is not compressing the ampule 30. In FIG. 2, the upper end of the trigger 54 has been depressed which, through a system hereinafter to be described in detail, causes retraction of the piston 34. Conversely, in FIG. 3, the lower end of trigger 54 has been depressed, which causes forward or extending movement of piston 34 into engagement with ampule 30 to depress same, thus effecting the desired dispensing of fluid through needle 32. It will be understood that while the present invention is particularly adaptable and of value in connection with the injection of anesthesia, such as novocaine or the like, it is not limited to such use, and may be used to inject adhesives, polymers, sealants to root canals, etc. No matter what the use may be, however, the important feature of the present invention is the system now to be described whereby the fluid to be dispensed is dispensed at an extremely slow and uniform rate, practically on a drop-by-drop basis, if desired, in order to minimize discomfort and pain to the patient. More specifically, it has been found that the slow, uniform flow of fluid in advance of the needle functions as a cushion to reduce pain and shock to the patient and at the same time prevents balling up of the anesthesia, which sometimes occurs where the latter is introduced in spurts. Actually, it is within the scope of my invention to slowly and uniformly inject gaseous fluids, where the need for same exists as well as liquids of the type heretofore mentioned. It is also within the scope of my invention to use the apparatus 10 for aspiration purposes by having piston 34 connected to ampule 30 so as to generate a negative pressure on the ampule while the piston is retracted. The invention may be used in this way to withdraw blood from a patient, for example.

As will be seen most clearly in FIG. 1, handle portion 12 is provided with a recess 58 closed at its end by a threaded fitting 60 connected to a conduit 62 through which a pressurized gas, such as CO₂, is introduced into recess 58, it being noted that fitting 60 has an opening 64 extending therethrough through which the gas passes. In FIG. 3, a slightly modified form of the invention is shown wherein instead of introducing the CO₂ from an outside source, a cartridge 66 is positioned in recess 58 and is maintained therein by threaded fitting 60a. A bushing 68 with a pin 70 extending downwardly therefrom is mounted at the upper extremity of recess 58, whereupon when cartridge 66 is inserted into position, the upper end of the cartridge will automatically be penetrated by the pin to permit the desired escape of the pressurized gas from the cartridge. Of course, where the pressurized gas is supplied from an outside source, as in FIG. 1, the bushing 68 and pin 70 perform no function. Whether the pressurized gas is self-contained, as in FIG. 3, or whether it is supplied from an outside source, as in FIG. 1, it has been found to be beneficial to have the gas under reasonably high press-

sure, since this gives a firmer, more rigid movement of the piston 34, rather than a soft, spongy type of motion, which is undesirable. Certainly, the pressurized gas is at a pressure considerably higher than atmospheric, and it has been found in practice that a pressure of around 90 lbs. per square inch is highly effective.

Referring again to FIG. 1, with the trigger 54 in its off position, pressurized gas flows from recess 58 through conduit 72, conduit 74 and then upwardly through conduit 76 to conduit 78 to conduit 80 to annular channel 82, then through passage 84 to annular chamber 86 and then finally through pinhole 88 into damping chamber 44. Since the aperture 88 is in the form of a pinhole, the pressurized gas, which maintains the pressure in damping chamber 44, flows, on demand, at an extremely low rate of flow. It will be understood that no matter what the position of trigger 54, the low rate flow of pressurized gas into damping chamber 44 always exists as long as make-up gas, because of leakage, is required. At the same time, pressurized gas from conduit 76 flows through conduit 90 to conduit 92 and then upwardly into spring chambers 94. Simultaneously, pressurized gas from conduit 74 flows through conduit 96 to conduit 98 and then through lateral conduit 100 (FIG. 5) to conduit 102, then laterally back to conduit 104 into spring chamber 106. The fact that gas under equal pressure is being introduced into chambers 94 and 106 maintains the servo valve mechanisms 108, 110 therebetween in balanced, stationary position. In this position, pressurized gas is prevented from entering into either of the actuating chambers 48, 50, and hence the pressure within these chambers, which is at atmosphere, is balanced, whereupon piston 34 remains stationary. It will be understood that chamber 50 is in communication with atmosphere through port 112, annular chamber 114, passage 116, and annular chamber 118 which in turn communicates with conduit 120 which communicates with lateral passage 122 and then outwardly through vent passage 124 to atmosphere. Likewise, chamber 48 is in communication with atmosphere through port 126, annular chamber 128, passage 130, and annular chamber 132 which in turn communicates with conduit 134 which communicates with lateral passage 136 to vent passage 124.

As will be seen in FIGS. 1, 2 and 3, the trigger member 54 carries a pair of plungers 138, 140 which, when the trigger is depressed, are adapted to engage ball valves 142, 144, respectively, to dislodge the balls from their closed position, in which position they are normally maintained by the pressure in the system. More specifically, when the trigger 54 is in the position illustrated in FIG. 1, neither of the balls are dislodged, and hence venting through exhaust ports 146 and 148 is prevented. However, when the uppermost portion of trigger 54 is depressed, as in FIG. 2, plunger 138 engages ball 142 to unseat same, thus exhausting pressurized gas from spring chamber 94, through exhaust port 146 whereupon the gas pressure in chamber 106 takes over and moves the servo valve parts 108, 110 to the right to the position shown in FIG. 2. With the parts in this position, pressurized gas passing upwardly through conduit 76 is now free to flow around valve part 110 into communication with conduit 134 and then through annular chamber 132, passage 130, annular chamber 128, and finally port 126 into the chamber 48. The introduction of pressurized gas into chamber 48 forces piston 34, along with piston walls 46 and 52 carried

thereby, to move to the left to the positions illustrated in FIG. 2. Wall 46 carries a one-way ball-check-valve 150 which permits gas in chamber 44 to freely pass into chamber 42 as the piston is retracting, thus permitting relatively rapid movement of the piston as it retracts. It will, of course, be understood that the gas in chamber 50 is exhausted to atmosphere through the path previously described, as piston wall 52 moves to its retracted position.

Referring now to FIG. 3, it will be seen that the lower portion of trigger 54 has been depressed, thus causing plunger 140 to unseat ball 144, while at the same time permitting the upper ball 142 to again move to its closed position. With ball 144 unseated, thus opening exhaust port 148, gas from spring chamber 106 now exhausts through conduits 104, 102, 100, 98 and then outwardly through port 148. This causes the pressure in chamber 94 to now take over and move the servo valve parts to the left to the position illustrated in FIG. 3. In this position, the flow of pressurized gas to chamber 48 is shut off while simultaneously the pressurized gas now passes straight upwardly through conduit 72, whereupon it is free to pass around valve part 108 into communication with conduit 120, annular channel 118, port 116, annular channel 114, and then through port 112 into chamber 50, thus forcing piston 34, and walls 46 and 52 carried therewith, to move to the right to the position illustrated in FIG. 3, in which position the piston 34 is extended into pressurized engagement with ampule 30 to compress same and cause dispensing of the fluid therefrom through needle 32. Once again it will be understood that as piston wall 52 moves from left to right, or from its retracted to its extended position, the gas in chamber 48 is exhausted to atmosphere through the path previously described. It is important to note, however, that as damping wall 46 moves from its left-hand position of FIG. 2 to its right-hand position of FIG. 3, the one-way check valve 150 prevents air or gas in the chamber 42 from passing therethrough into the chamber 44. However, as an important part of my invention, novel means are provided for permitting an adjustable and regulated flow of air or gas to pass from chamber 42 to chamber 44 during forward or extending movement of piston 34, in order to effect a controlled damping of said movement.

The damping means referred to above comprise an annular chamber 152 surrounding damping chamber 40, whereupon when damping wall 46 moves from left to right, i.e., from the position of FIG. 2 to that of FIG. 3, the air or gas in chamber 42 is forced into annular chamber 152 since there is no seal between chamber 42 and annular chamber 152 at the end 154 of the former. Thus, as the air or gas in chamber 42 is compressed, it forces its way at the end 154 into annular chamber 152 and then back through said chamber to end 156 at which point there is an annular passageway 158 which in turn communicates with passage 160 which leads into chamber 44. It is important to note that passage 160 is defined by beveled end 162 of tubular member 164, which beveled end cooperates with beveled annular portion 166 which is carried by the inner wall of annular chamber 152. The tubular member 164 is threadedly mounted as at 168 with barrel portion 170, which barrel portion is maintained in fixed position by means of set screw 20. An end cap 172 having an inner tubular portion 174 is secured to tubular member 164 by any suitable means, such as cross pin

176; whereupon turning movement of cap 172 causes tubular portion 164 to threadedly move inwardly or outwardly with respect to fixed portion 170, depending upon the direction of turning movement of the cap 172. By turning end cap 172 so that tubular portion 164 moves inwardly, its beveled end 162 is caused to wedgeingly engage more tightly with beveled portion 166, thus decreasing the size of passage 160 defined by these parts, thus slowing down the flow of air or gas from chamber 42 to chamber 44. Conversely, by turning end cap 172 so as to threadedly move tubular portion 164 in an outward direction, the size of passage 160 is increased, thus proportionately increasing the rate of flow of air or gas from the chamber 42 to the chamber 44. It will thus be seen that by the simple medium of adjusting end cap 172, the rate of flow of air or gas from chamber 42 to chamber 44 may readily be adjusted, thus controlling the damping action on piston 34 and piston wall 46 as the latter parts move in a forward direction. Suitable graduations 178 may be provided on end cap 172 to facilitate proper adjusting of the damping action.

It will be understood that only an extremely light load is required to press or actuate the trigger 54, and in use a load of approximately five ounces has been found to be sufficient to depress the trigger. As previously stated, when the trigger 54 is released, the compressed air or gas in the system automatically causes both ball valves to close, thus automatically maintaining the trigger in the off position illustrated in FIG. 1. Also as previously stated, any pressurized air or gas may be used in the system, although it is important that whatever medium be used, it must be relatively clean and free from dust or other dry particles in order to prevent clogging of any of the pressure lines. The apparatus is also capable of dispensing different vis-cosity fluids from the cartridge 30, simply by suitably regulating the gas pressure in the system.

While there is shown and described herein certain specific structure embodying the invention, it will be manifest to those skilled in the art that various modifications and rearrangements of the parts may be made without departing from the spirit and scope of the underlying inventive concept and that the same is not limited to the particular forms herein shown and described except insofar as indicated by the scope of the appended claims.

What is claimed is:

1. Fluid dispensing apparatus comprising an elongated cylindrical housing, means on one end of said housing for mounting a compressible fluid-containing ampule exteriorly of said housing in axial alignment therewith, a piston in said housing and extending outwardly therefrom through said one end, means for moving said piston into engagement with said ampule to compress same and effect dispensing of fluid therefrom, said moving means comprising separate operating and damping chambers through which said piston movably extends, spaced sealing walls on said piston dividing each of the aforesaid chambers into separate compartments, fluid pressure means in communication with said operating chamber for effecting forward and reverse movement of said piston, a passage located inside of said housing and interconnecting said damping compartments for permitting a controlled flow of fluid from one damping compartment to the other during the

7

forward stroke of the piston, thus controlling the rate of movement of the piston during its forward stroke.

2. In the apparatus of claim 1, calibrated means for adjusting the permissible flow of fluid through said passage, whereby the rate of movement of the piston during its forward stroke is correspondingly adjusted, said adjusting means comprising an axially movable portion, movement of which in one direction restricts said pas-

8

sage and in the opposite direction increases the capacity of same.

3. In the apparatus of claim 1, said damping chamber being of larger diameter than said operating chamber.

4. In the apparatus of claim 1, said passage comprising an annular chamber extending around and along the exterior of said damping chamber.

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