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J. W. BROWN ET AL

2,771,217

MEASURING AND DISPENSING DEVICE

Filed July 20, 1953

Fig. 1.

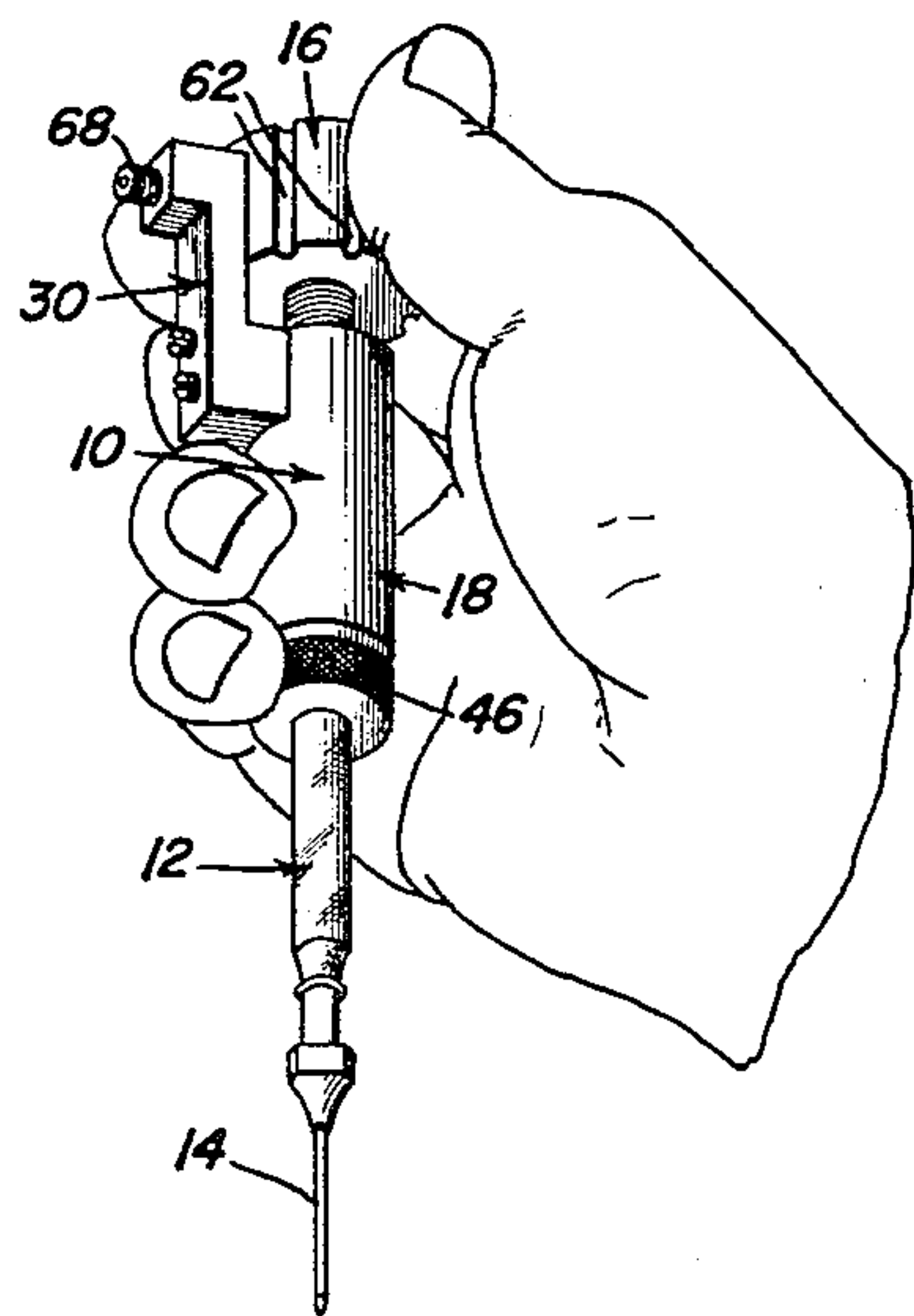


Fig. 2.

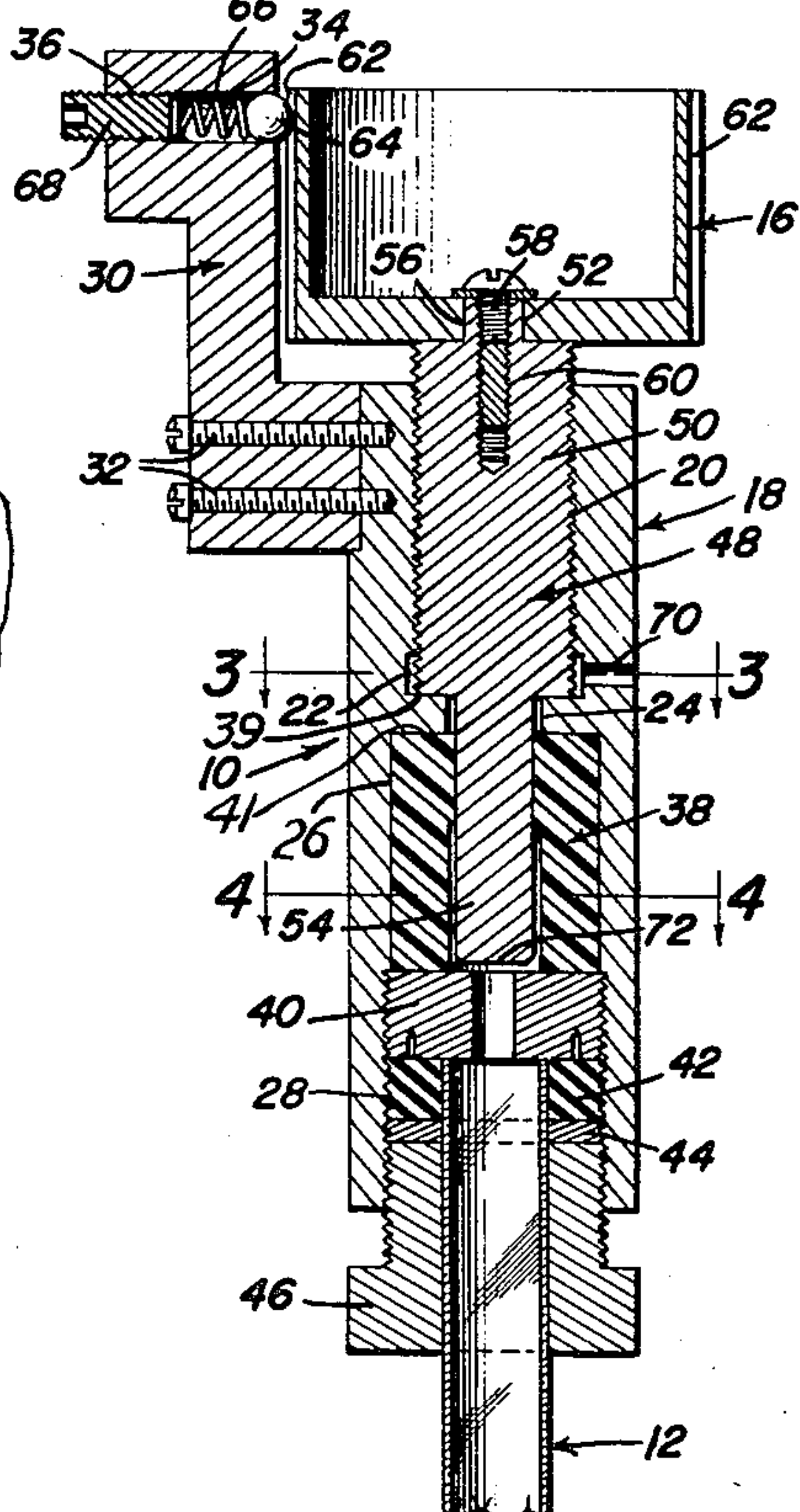


Fig. 5.

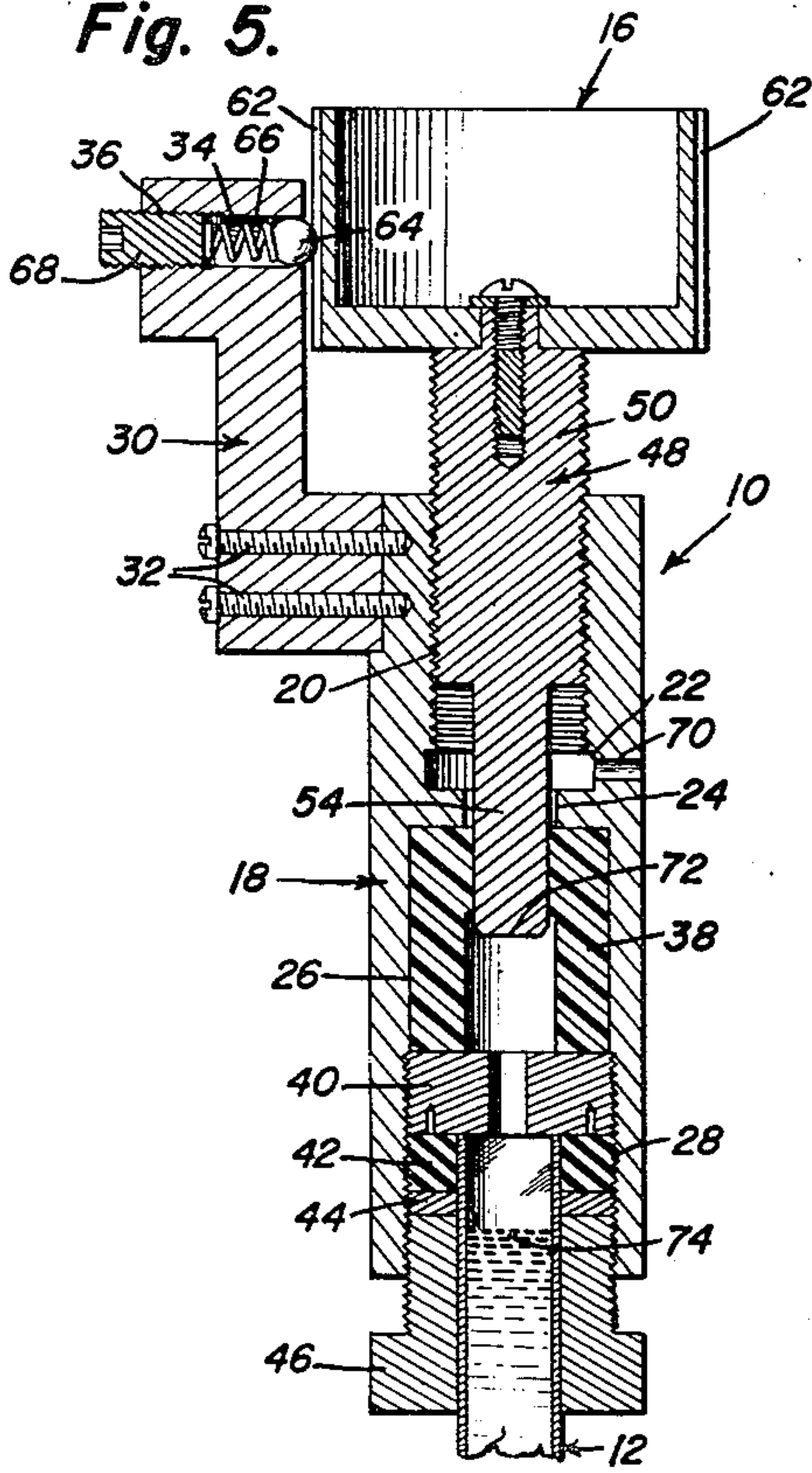


Fig. 3.

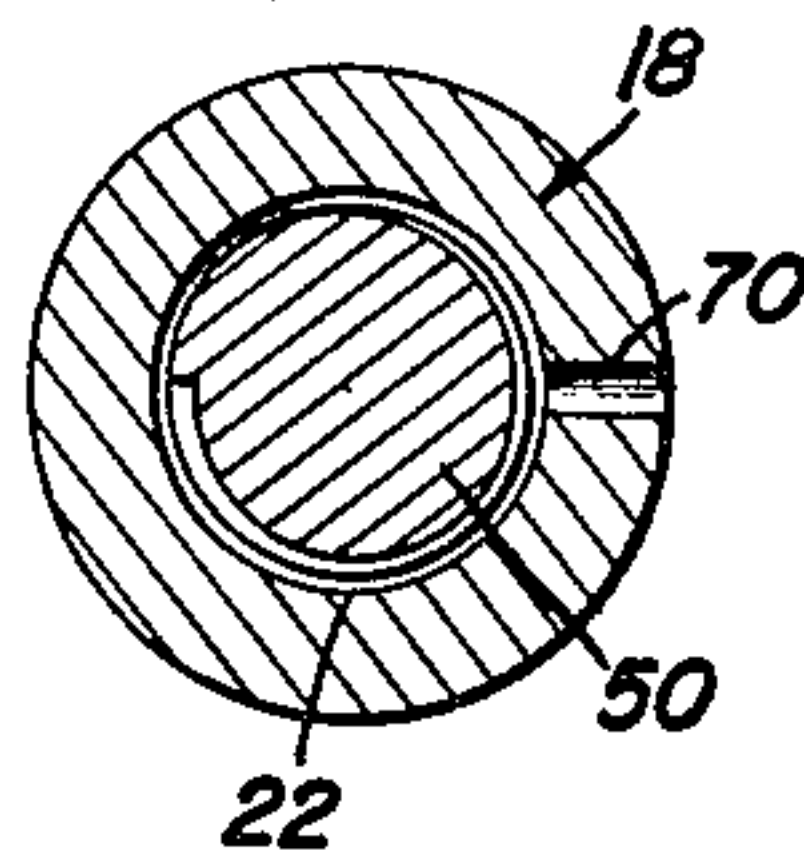
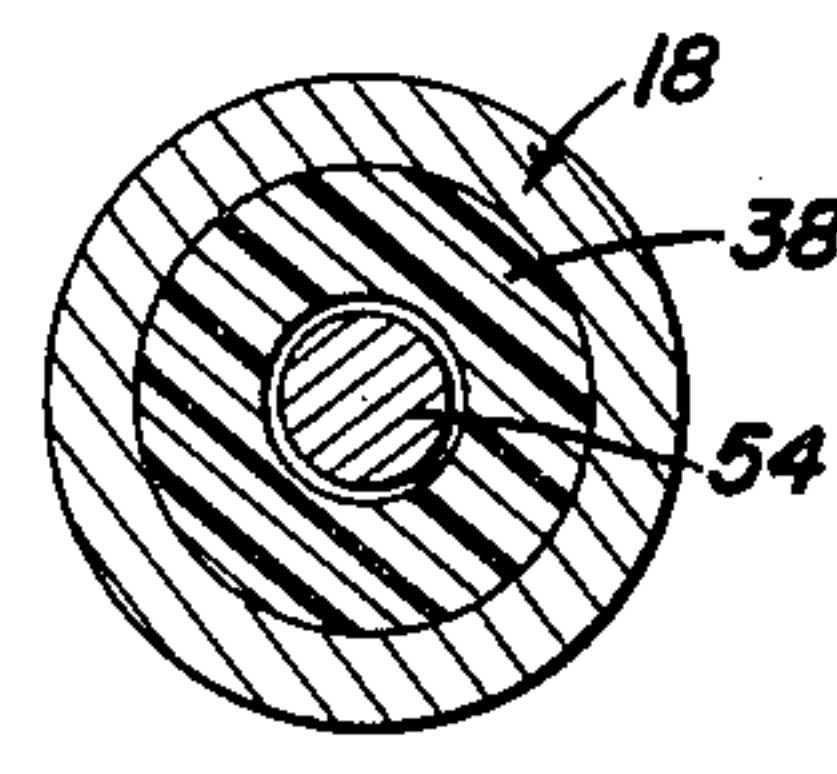


Fig. 4.



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2,771,217

MEASURING AND DISPENSING DEVICE

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8 Claims. (Cl. 222—43)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment to us of any royalty thereon.

The invention relates generally to pipettes, and specifically to those which are used in laboratory biological studies wherein minute volumes of radioactive or toxic liquids are involved.

Laboratory infections are common among biologists working with pathogenic microorganisms. Often such infections are traceable to violations of safe laboratory technique, however, frequently such infections are caused by accidents that occur while aspirating infectious liquids through a pipette. Various solutions to this problem have been attempted, among which are included the well known rubber bulb-type pipette, pipettes including an extension of rubber tubing for contact with the mouth, and those which include a cotton filter in the tubing. Other modified pipettes have also been tried, but none of the proposals have been fully accepted either because of failure to insure safety or inability to accurately dispense minute quantities of liquid.

It is an object of this invention to provide a pipette which can accurately and safely handle minute volumes (0.002 to 0.01 ml.) of liquids containing radioactive elements or toxic agents.

It is another object of the invention to provide a portable, safety pipette which may be operated by only one hand.

It is still another object of the invention to provide a portable, safety pipette which is capable of delivering successive volumes of liquid of small magnitude from a single filling.

It is a further object of the invention to provide a portable safety pipette which is capable of delivering small amounts of liquid, and wherein visual measuring is eliminated.

It is a still further object of the invention to provide a pipette wherein the liquid being handled is not brought into contact with the pipette in normal use, and wherein the delivery tips may be easily replaced.

The above and other objects of the invention will become apparent from the following description taken in conjunction with the attached drawings, wherein:

Fig. 1 is a perspective view of the improved pipette being held in the hand of an operator.

Fig. 2 is a sectional view taken in a vertical plane passing through the pipette.

Fig. 3 is a sectional view taken on lines 3—3 of Fig. 2.

Fig. 4 is a sectional view taken on line 4—4 of Fig. 2.

Fig. 5 is a view similar to Fig. 2 showing some of the parts in a different position.

Referring to Fig. 1, the pipette 10 is shown positioned in the right hand of an operator during use. The pipette has a detachable delivery tip 12 connected thereto, which may include a conventional hypodermic needle 14. The thumb and index finger of the operator grip the grooved

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control knob 16, while the remaining fingers encircle the body portion of pipette 10.

The structure of pipette 10 can be more clearly seen in Figs. 2 to 5. Fig. 2 shows the parts in position prior to loading the pipette with liquid. Fig. 5 shows the parts in position after the pipette has been loaded with liquid, and prior to expelling the liquid in measured quantities.

In Fig. 2 it will be observed that the body portion of the pipette comprises cylinder 18, which has an irregular passageway formed therethrough by a series of connecting bores. Reading from top to bottom in Fig. 2, the series of bores comprises threaded bore 20, enlarged bore 22, reduced bore 24, enlarged bore 26 and threaded bore 28. Z-shaped block 30 is secured to the top of cylinder 18 at one side thereof by conventional securing means 32. A horizontal bore 34, a portion of which is threaded at 36, is formed in the upper leg of block 30.

Referring to the lower portion of cylinder 18, it will be observed that a bushing 38 is positioned within bore 26, and that an apertured plug 40 is threaded into the threaded bore 28, which locks said bushing in position. Bushing 38 may be made of metal or a plastic, teflon being well suited. At reduced portion 24 the bores define an inwardly extending annular shoulder having flat upper and lower faces 39 and 41, respectively. The bushing 38 is held against face 41 by plug 40. Below plug 40 are positioned in turn: soft rubber ring 42, metal washer 44 and knurled closure plug 46. Delivery tip 12 is shown mounted in the lower portion of cylinder 18. The delivery tip 12, which may be of the conventional glass variety, is detachably secured in the cylinder 18 by the radially-inwardly directed force of the soft rubber ring 42, which is created when said ring is compressed by the closure plug 46. To secure or remove the delivery tip 12 in the cylinder 18, it is only necessary to screw or unscrew closure plug 46, thereby creating or releasing pressure on the upper portion of the delivery tube.

Ejection piston 48 is mounted in the upper portion of the cylinder 18, and comprises a central threaded portion 50, a non-circular stub portion 52 and a piston portion 54. Control knob 16, having an opening 56 of the same shape as stub 52, fits onto stub 52 and is secured to the ejection piston 48 in a driving fit by conventional securing means 58, which are received in threaded opening 60 in the ejection piston. Control knob 16 has a plurality of parallel axial grooves 62 formed in its outer surface (see Fig. 1). Grooves 62 are adapted to cooperate with ball 64, which is resiliently pressed out of bore 34 in the block 30 into one of said grooves by compression spring 66. Pressure on the ball 64 can be varied by adjusting threaded plug 68, which is fitted in the threaded portion 36 of the bore 34. With this arrangement, the control knob 16 and ejection piston 48 can be rotated through a predetermined portion of a turn by rotating the knob 16 so that the ball 62 is forced out of the groove it is seated in, rolls over the knob and enters the next groove. This operation will be more fully explained subsequently.

The threaded portion 50 of the ejection piston 48 is adjustably received in the threaded bore 20 of the cylinder 18, and the piston portion 54 is slidably mounted in the bushing 38 in fluid tight relation therewith, so that the bushing acts as a sealing means. Radial vent hole 70 is formed in one side of cylinder 18, and places the interior of cylinder 18, in the vicinity of bore 22, into communication with the atmosphere.

The above described structure functions in the following manner: rotation of the control knob 16 causes the ejection piston 48 to advance or retract in the cylinder 18 and displace a volume of air. The volume of air displaced is dependant upon the area of the lower face 72

of the piston portion 54 of the ejection piston, and the linear distance said face is moved. The area of the face 72 is determined when the dimensions are fixed. The linear movement depends upon the pitch of the threads in threaded portion 50, and the angular displacement of the control knob. The pitch of the threaded portion 50 is determined at the outset, therefore the only variable is the angular displacement of the control knob 16.

The spring pressed ball and axial groove arrangement discussed above makes it possible for the control knob 16 to be moved through any convenient, predetermined angle, simply and automatically. This is accomplished by forming any convenient number of axial grooves in the outer surface of control knob 16. For example, if eight equally spaced grooves are formed in the outer surface of control knob 16, rotation of the knob the distance between two grooves causes the knob to rotate through one eighth of a turn. Since the linear movement of the piston face 72 equals the pitch of the threads multiplied by the number of times the ejection piston is turned, the volume of air displaced equals this product multiplied by the area of piston face 72. Knowing the area of the face 72 of piston portion 54, and the pitch of the threads on threaded portion 50, and the number of grooves in the control knob 14, it will be apparent that the volume of air displaced may be calculated at will by fixing the critical dimensions.

The above mentioned displacement of air caused by moving ejection piston 48 results in a like displacement of solution either into or out of the delivery tip 12 depending up the direction of movement of the piston. To illustrate this, with the parts positioned as shown in Fig. 2, the lower portion of delivery tip 12 is immersed in the solution and the control knob 16 moved in a direction to retract ejection piston 48 out of cylinder 18 (move the piston upwardly relative to the cylinder 18). This causes a predetermined amount of air to be displaced which creates a suction and causes an equal volume of liquid to be drawn into the delivery tip. Continued movement of the ejection piston in this direction results in the ejection piston 48 ultimately assuming the retracted position shown in Fig. 5. In this position the pipette is loaded, however, it should be realized that, unless otherwise intentionally desired, none of the liquid contacts any portion of the pipette structure, the uppermost level to which it reaches being indicated by reference numeral 74 in Fig. 5.

Movement of the control knob 16 in the opposite direction causes the ejection piston 48 to move downwardly relative to the cylinder 18 (as shown in Fig. 5), thereby displacing a predetermined volume of air and consequently expelling an equal volume of liquid out of the delivery tip. It should be noted that while the ejection piston 48 is advancing downwardly, air in the vicinity of bore 22 is vented out of radial bore 70 to preclude the possibility of building up air pressure in that area.

From the above description of the structure and operation of our improved pipette, it will be observed that we have provided a portable pipette which may be conveniently and efficiently operated by one hand; wherein the necessity for the operator to touch the device with his lips is eliminated, along with visual measurement of the liquid being dispensed; wherein none of the liquid contacts any portion of the pipette structure, and which therefore is extremely safe to use. With our improved pipette, successive volumes of minute quantities of liquid can be dispensed from a single filling; the range of volume accurately dispensed being 0.002 to 0.01 ml. Our pipette permits a wide range of choice of volume to be dispensed, for it is simply a matter of changing the number of grooves in the control knob 16 (by substituting a different control knob), or varying the pitch of the threads on threaded portion 50 or the area of the face 72 of the piston portion 54. From the above it will be observed that our im-

proved pipette fulfills each and every object of this invention.

Having described one embodiment of our invention in great detail, it is not thereby intended that we be limited to the specific structure illustrated, for there are many changes that may be made by one skilled in the art which fall within the spirit of our invention and the scope of the appended claims.

We claim:

1. A measuring and dispensing device comprising a cylinder having an axial passageway extending throughout its length, means for removably securing a delivery tip in a first end of said passageway, an ejection piston in threaded engagement with the second end of said passageway, said ejection piston having a smoothly cylindrical piston portion within said passageway, a sealing means in said passageway engaging said piston portion in fluid tight relationship, a vent communicating with said passageway beyond said sealing means toward said second end, a control knob secured to said ejection piston, detent means carried by said knob and said cylinder and so constructed and arranged as to detain said knob at a plurality of evenly divided points during rotation thereof.
2. A device as defined in claim 1 wherein said detent means comprises a plurality of axially extending slots evenly distributed about the peripheral surface of said knob and a spring pressed detent carried by said cylinder.
3. A device as defined in claim 1 wherein said sealing means comprises a removable bushing having a cylindrical surface in fluid-tight engagement with said piston portion.
4. A device as defined in claim 3 wherein said bushing is of plastic and said piston portion is metal.
5. A measuring and dispensing device comprising a cylinder having an axial passageway, means for removably securing a delivery tip in the lower end of said passageway, an ejecting piston mounted in said passageway, an internally threaded portion in the upper end of said passageway, an external threaded portion on said ejecting piston cooperating with said internally threaded portion, an inwardly extending annular shoulder in said passageway below said threaded portions, a vent leading from said passageway above said shoulder, a removable bushing in said passageway below and abutting said shoulder, a collar threaded in said passageway below and abutting said bushing, a smoothly cylindrical piston portion on said ejecting piston extending past said shoulder and into said bushing, said bushing having a bore the upper portion of which is in fluid-tight engagement with said piston; said means for removably securing a delivery tip in said lower end comprising an elastic compressible ring abutting the lower side of said collar, and a plug for compressing said elastic ring against said collar, said plug having a central aperture to receive the delivery tip; a control knob on the upper end of said piston, and cooperating detent means on said knob and cylinder constructed and arranged to detain said knob at a plurality of evenly divided points during rotation thereof.
6. A device as defined in claim 5 wherein said bushing is formed of plastic and said piston portion is metal.
7. A device as defined in claim 5 wherein said bushing is formed of teflon and said piston portion of metal.
8. A device as claimed in claim 5 wherein said detent means comprises a plurality of axially extending slots evenly distributed about the peripheral surface of said knob and a spring-pressed detent carried by said cylinder.

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