

May 3, 1966

A. R. PURSELL ET AL

3,248,950

STOP MECHANISM FOR PIPETTE FILLING DEVICE

Filed May 25, 1964

2 Sheets-Sheet 1

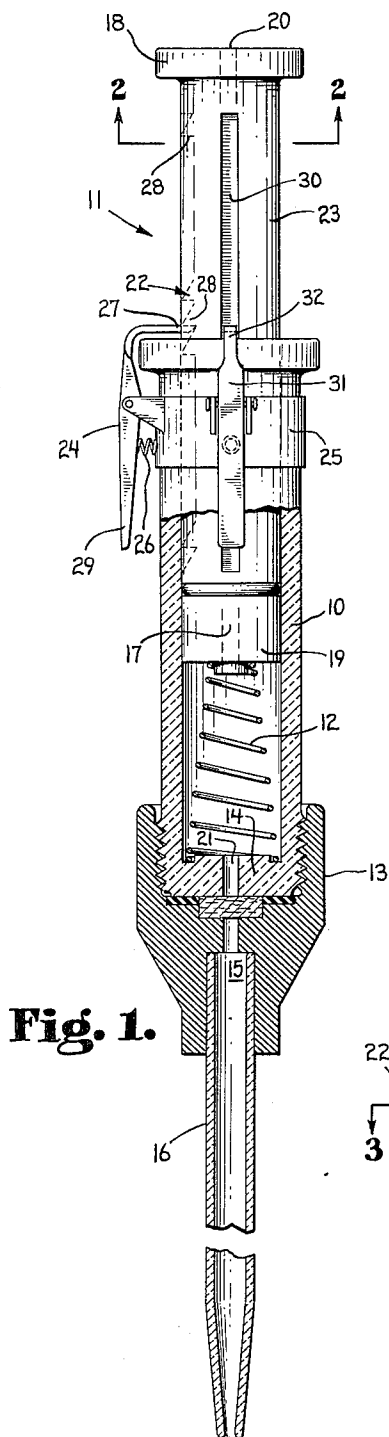


Fig. 1.

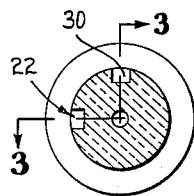


Fig. 2.

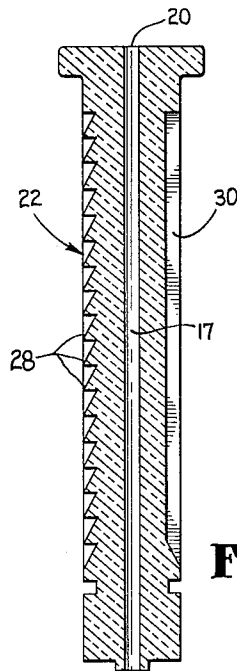


Fig. 3.

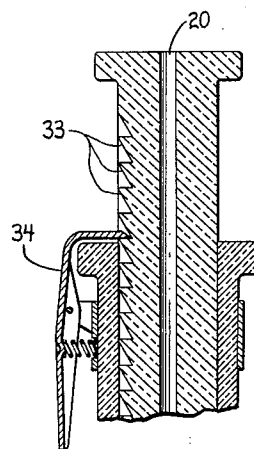


Fig. 4.

INVENTORS.
ALFRED R. PURSELL and
EDWARD E. SCHILLING
BY
Edward E. Schilling
Agent

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A. R. PURSELL ET AL

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2 Sheets-Sheet 2

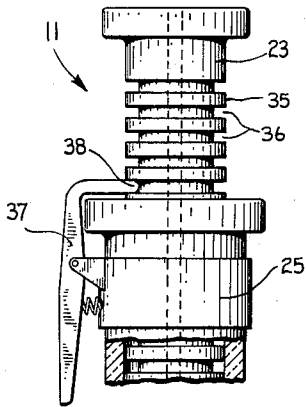


Fig. 5.

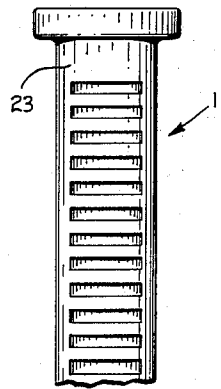


Fig. 6.

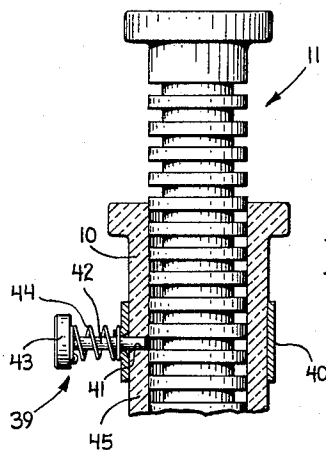


Fig.7.

INVENTORS.

ALFRED R. PURSELL and

EDWARD E. SCHILLING

BY

Edward E. Schilling
Agent

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3,248,950 STOP MECHANISM FOR PIPETTE FILLING DEVICE

Alfred R. Pursell and Edward E. Schilling, Indianapolis, Ind., assignors to The Dow Chemical Company, Midland, Mich., a corporation of Delaware

Filed May 25, 1964, Ser. No. 369,720

10 Claims. (Cl. 73—425.6)

The invention relates to a syringe-like device for filling and emptying laboratory pipettes and more particularly relates to a controllable stop mechanism for regulating the reciprocal motion of the plunger with respect to the barrel of such a device.

It has long been considered desirable to develop and employ suitable pipette filling and emptying devices to be used with laboratory pipettes in order to obviate the necessity or even desirability of mouth pipetting. Mouth pipetting in which the operator places the upper end of the pipette in his mouth and places the tip of the pipette in a liquid to be sampled and fills the pipette as one draws up liquid into a soda straw exposes the operator to danger if the liquid contains strong chemicals or pathological biological materials. As a consequence, there has been developed a syringe-like device for filling and emptying pipettes which employs a syringe having a barrel and a plunger and a connector for attaching the pipette to the syringe. The plunger is provided with a longitudinal channel therethrough and with spring means for urging the plunger out of the barrel. The pipette is filled by depressing the plunger, placing the tip of the pipette in the liquid, closing the channel through the plunger by placing a finger on the channel opening while permitting the plunger to move out of the barrel under the urging of the spring means. The pipette is then removed from the liquid and liquid is dispensed from the pipette without disconnecting it from the device. Fingertip control of dispensing of the liquid, much like the control of a pipette used without a device, is had by placing the fingertip over the channel opening in the top of the plunger. Such syringe-like device is the subject matter of copending patent application Serial No. 369,865, filed even date herewith.

One of the problems which arises in using such a syringe-like pump is the possibility that the spring means may force the plunger completely out of the barrel, especially if the finger of the operator should slip off the top of the plunger. Another problem arising in the use of such a device is the awkwardness in stopping the reciprocal motion of the plunger when the pipette has been filled slightly above the preselected graduation mark and it is desired to carefully adjust the liquid level to the mark before delivering the measured volume of liquid. The difficulty arises especially in trying to maintain careful control of the liquid level while pressing on the plunger sufficiently to maintain the plunger in a stationary position in the situation in which the spring means is in the partly compressed state.

An alternative to this mode of operation requires the operator to develop the technique of placing the finger sealingly over the channel opening in the plunger while filling the pipette to the desired level slightly above the preselected graduation mark, lifting the finger from sealing relation with the channel opening while permitting the plunger to move out of the barrel until the spring means is no longer compressed, and thereafter promptly closing the channel opening again by finger pressure, the adjustment in plunger position being made without allowing the liquid to recede below the preselected graduation mark on the one hand, and on the other hand, not permitting the pipette to overflow into the syringe.

It is a principal object of the present invention to pro-

vide a stop mechanism which controllably stops the reciprocal motion of the plunger with respect to the barrel, leaving the plunger in a stable condition whereby fingertip control of the liquid in the pipette is easily and conveniently maintained by the operator.

This and other objects and advantages of the present invention will be apparent to those skilled in the art upon becoming familiar with the following description and claims and the appended drawings in which like reference numerals refer to like parts, and in which,

FIG. 1 is a foreshortened view in side elevation partly in section showing the controllable stop mechanism of the invention in connection with a syringe-type device, the stop mechanism comprising a pawl mounted on the barrel of the syringe and an associated linear ratchet formed in the shank of the plunger,

FIG. 2 is a sectional view taken through the shank of the plunger along line 2—2,

FIG. 3 is a longitudinal sectional view through the plunger taken along lines 3—3 of FIG. 2, showing the linear ratchet as well as a guide-way formed in the shank of the plunger,

FIG. 4 is a fragmentary sectional view of a plunger and associated barrel showing another embodiment of the invention in which the teeth of the linear ratchet are pointed oppositely to the teeth of the embodiment shown in FIGS. 1 and 3,

FIG. 5 is a fragmentary view partly in section showing another embodiment of the invention in which the ratchet consists of circumferential lands and grooves, rather than pointed ratchet teeth, formed in the surface of the shank of the plunger,

FIG. 6 is a fragmentary view showing a portion of a plunger having formed on the surface of the shank a very wide linear ratchet, and

FIG. 7 is a view of yet another embodiment of the invention in which the pawl is mounted on the barrel and adapted to operate through the wall of the barrel rather than over the flange of the barrel.

Referring more particularly to FIG. 1, the syringe-type device with which the stop mechanism is employed consists of a barrel 10 shown partly in full and partly broken away and in section to better illustrate the relationship thereto of the plunger reciprocally disposed therein and indicated generally by the numeral 11, a spring 12 which is placed in the barrel below the plunger and adapted to resiliently urge the plunger out of the barrel, and a connector 13 which threadably attaches to the dispensing end 14 of the barrel and which is provided with an opening to sealingly receive the upper end 15 of pipette 16. The plunger 11 is provided with a longitudinal channel 17 which extends approximately axially from the finger-engaging end 18 to the lower or opposite end 19 of the plunger. Communication is provided from the ambient atmosphere through the channel opening 20, through the channel 17, through the barrel 10, through the channel 21 in the dispensing end 14 of the barrel to any pipette which is inserted into the connector 13.

The stop mechanism consists of a linear ratchet 22 formed in the shank 23 of the plunger 11 and an associated pawl 24 pivotally mounted on the barrel. The manner of mounting is not critical. A convenient means for mounting is by the use of a band 25 surrounding the barrel 10 as shown. A spring 26 actuates the pawl 24 and resiliently urges the end 27 of the pawl 24 into engagement with the teeth 28 of the ratchet 22.

In using the syringe-like device having embodied therein the present stop mechanism, the operator operates the pawl by placing a finger over the lever end 29 of the pawl and squeezing the lever end 29 against the barrel, thus disengaging the other end 27 of the pawl 24 from the ratchet

22. The plunger 11 is then freely reciprocable. When the operator wishes to prevent telescoping motion of the plunger 11 into the barrel 10, the pawl 24 is released so as to engage one of the teeth 28 of the ratchet 22. On maintaining sufficient finger pressure on the finger-engaging end 18 of the plunger 11 to overcome the pressure of spring 12, the stop mechanism remains engaged, the plunger is held in position and the operator may place adequate pressure on the plunger 11 to maintain positive fingertip control of the dispensing of liquid from a pipette attached to the device.

To make sure that the pawl 24 is aligned with the linear ratchet 22, it is highly desirable to provide guide means which will prevent rotation of the plunger 11 while the device is being used. A suitable form of guide means, as shown in FIG. 1, consists of a longitudinal groove 30 formed in the surface of the shank 23 of the plunger in combination with a pawl 31 mounted on the band 25 surrounding the barrel 10 and spring actuated in a manner similar to pawl 24. The pawl 31 rides in the groove 30 while the plunger is being reciprocated. The pawls 24 and 31 being spring actuated, the ratchet or groove-engaging ends 27 and 32 may be raised for assembling or disassembling the plunger and barrel. Any other suitable form of guide may be used, if desired, for example, a key and groove combination.

The guide means described is preferably disposed on the circumference of the band 25 other than 180° apart from the pawl 24. Desirably, the guide means is spaced about 90° apart from the pawl 24 as shown in sectional view in FIG. 2. Normally, the groove 30 extends substantially the length of the shank 23 of the plunger, but must not extend to the end 19 of the plunger. If an O-ring is used to assure sealing relationship between plunger and barrel, the groove 30 should stop above the O-ring as shown in FIG. 3.

Referring more particularly to FIG. 4, the ratchet, in another embodiment of the invention, may consist of upwardly pointed teeth 33 which are disposed so as to engage a complementary pawl 34 in a manner to prevent movement of the plunger 11 outwardly from the barrel 10. In the operation of such a ratchet-pawl combination, it is essential to employ spring means, such as spring means 12 shown in FIG. 1, which is strong enough to maintain resilient pressure on the bottom 19 of the plunger throughout substantially full scale reciprocal motion of the plunger inside the barrel. After depressing the plunger while the pipette is attached to the device, placing the pipette in the liquid to be sampled and allowing the plunger to raise until the pipette is filled to a desired level, the operator releases the pawl 34 so that it engages ratchet 33. The plunger becomes locked in position as the pawl is urged by its own spring against the ratchet teeth. The operator may then proceed to dispense liquid from the pipette without disconnecting the device. Fingertip control is maintained by placing a finger over the channel opening 20 in the top of the plunger. Easy fingertip control is facilitated since it is not necessary to balance or overcome the resilient pressure of spring means 12 in order to keep the ratchet and pawl in locking engagement.

In another embodiment of the invention, the shank 23 of the plunger is provided with circumferential lands 35 and grooves 36 which serve as a linear ratchet in place of the pointed teeth employed in the above-described embodiments. A pawl 37, having an end 38 shaped to fit into the grooves 36, is pivotally mounted on the barrel by means of a band 25 or by any other suitable manner of attaching to the barrel. Using this form of ratchet and pawl, the locking action is positive in both directions of movement of the plunger 11 and the plunger may be conveniently locked in almost any position relative to the barrel. The strength of the spring means, such as spring means 12 in FIG. 1, is less critical to the total operation, and it is not necessary for the operator to apply

finger pressure to maintain the locking relationship. In fact, the operator may apply finger pressure over the channel opening 20 in the dispensing of liquid with complete freedom from concern about reciprocal motion of the plunger.

If desired, the linear ratchet may be formed in yet a different manner as illustrated in FIG. 6. The ratchets of FIG. 1 and FIG. 4 may be formed in the shank of a plunger as a relatively wide series of teeth. The wide ratchet makes the use of a guide means unnecessary. Moreover, the device has greater flexibility in that the operator may rotate the ratchet out of alignment with the pawl so that the plunger may be freely reciprocated without having to place a finger on the lever end of the pawl.

The wide ratchet may also be made in the form of lands and grooves in the style of the plunger of FIG. 5 but with each land and groove extending along a limited arc on the surface of the shank of the plunger.

In yet another embodiment of the present invention, there is employed a different style of pawl. As illustrated in FIG. 7, a pawl indicated generally by the numeral 39 is mounted on the barrel by means of a band 40 and adapted to operate through an opening 41 in the wall of the barrel. The pawl means consists of a shank 42 having a finger-engaging end 43 attached thereto, and a spring 44 surrounding the shank 42 and attached to the band 40 and the finger-engaging end 43 so as to serve both as a compression spring and a retaining means limiting the reciprocal motion of the plunger in either direction. Disposed in the barrel is a plunger 11 having formed thereon ratchet means adapted to be engaged by the pawl when the pawl is pushed through the wall 45 of the barrel. The more suitable type of ratchet employed with this type of pawl consists of teeth formed as the lands and grooves as shown in FIGS. 6 and 7.

If the opening 41 in the wall 45 of the barrel is made large so that the shank 42 of the pawl means 39 makes a sloppy fit therein, and if the ratchet consists of lands and grooves, then the pawl means 37 tends to become locked in place under the shearing action of resilient pressure from the spring means 12 urging the plunger 11 out of the barrel. This embodiment of the invention has the advantage for some operators that the pawl means is somewhat more convenient to use than the pivotally mounted pawls operating over the flange of the barrel.

The parts of the pipetting device of the invention may be made of any suitable material of construction such as glass, polymeric material and/or corrosion resistant metal. The plungers provided with pointed ratchet teeth are more conveniently molded from glass or polymeric material. The plungers provided with lands and grooves may be molded from glass or polymeric material but are also adapted to be made from metal as by turning on a lathe. Other parts such as the pawl and spring and the band for mounting the pawl are best made from metal.

The apparatus of the invention having been thus described, modifications thereof will at once be apparent to those skilled in the art, and the scope of the invention is to be considered limited only by the claims annexed hereto.

We claim:

1. An improved pipetting device comprising:
 - a syringe having an associated plunger and barrel, said plunger having a finger-engaging top end and said barrel having a dispensing end;
 - a pipette connector operatively attached to the dispensing end of the barrel;
 - spring means disposed in the barrel and adapted to resiliently urge the plunger out of the barrel;
 - a channel formed longitudinally through the length of the plunger from the finger-engaging top end to the end opposite, thereby to permit fingertip control of the emptying of a pipette attached to the device;

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and a stop mechanism for controlling reciprocal motion of the plunger with respect to the barrel, said stop mechanism comprising a linear ratchet forming an integral part of the plunger, and a spring actuated pawl mounted on the barrel and adapted to controllably engage said linear ratchet.

2. The apparatus as in claim 1 wherein said linear ratchet comprises downwardly inclined teeth pointed generally toward the end of the plunger opposite the finger-engaging end, and the pawl end is pointed upwardly and adapted to controllably engage said linear ratchet and stop telescoping motion of the plunger into the barrel.

3. The apparatus as in claim 1 wherein said linear ratchet comprises upwardly inclined teeth pointed generally toward the finger-engaging end of the plunger, and the pawl end is pointed downwardly and adapted to controllably engage said linear ratchet and stop sliding motion of the plunger out of the barrel.

4. The apparatus as in claim 1 in which the ratchet teeth extend substantially normal from the plunger with substantially parallel upper and lower sides, and the pawl which is formed complementary thereto is adapted to engage said ratchet and to stop reciprocal motion of the plunger.

5. The apparatus as in claim 1 in which a longitudinal groove guide-way is formed in the surface of the plunger parallel to the linear ratchet.

6. The apparatus as in claim 1 in which the teeth of the linear ratchet are substantially wider than the pawl.

7. The apparatus as in claim 1 in which the ratchet teeth encircle the plunger.

8. The apparatus as in claim 1 in which the pawl is pivotally mounted on the barrel and is adapted to extend past the flange of the barrel and to engage the plunger.

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9. The apparatus as in claim 1 in which the pawl is mounted in the barrel and is adapted to operate through the wall of the barrel and to engage the plunger therein when the pawl is pressed by the finger of the operator.

10. In a pipette filling and emptying device comprising a syringe having an associated plunger and barrel, said plunger having a finger-engaging top end and said barrel having a dispensing end; a pipette connector operatively attached to the dispensing end of the barrel; spring means disposed in the barrel and attached to resiliently urge the plunger out of the barrel; a channel formed longitudinally through the length of the plunger from the finger-engaging top end to the end opposite, thereby to permit fingertip control of the emptying of a pipette attached to the device; the improvement which comprises: a stop mechanism for controlling reciprocal motion of the plunger with respect to the barrel, said stop mechanism comprising a linear ratchet forming an integral part of the plunger and extending longitudinally thereon, and a spring actuated pawl mounted on the barrel and adapted to controllably engage said linear ratchet thereby to controllably lock the plunger in a preselected position with respect to the barrel.

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LOUIS R. PRINCE, *Primary Examiner.*