

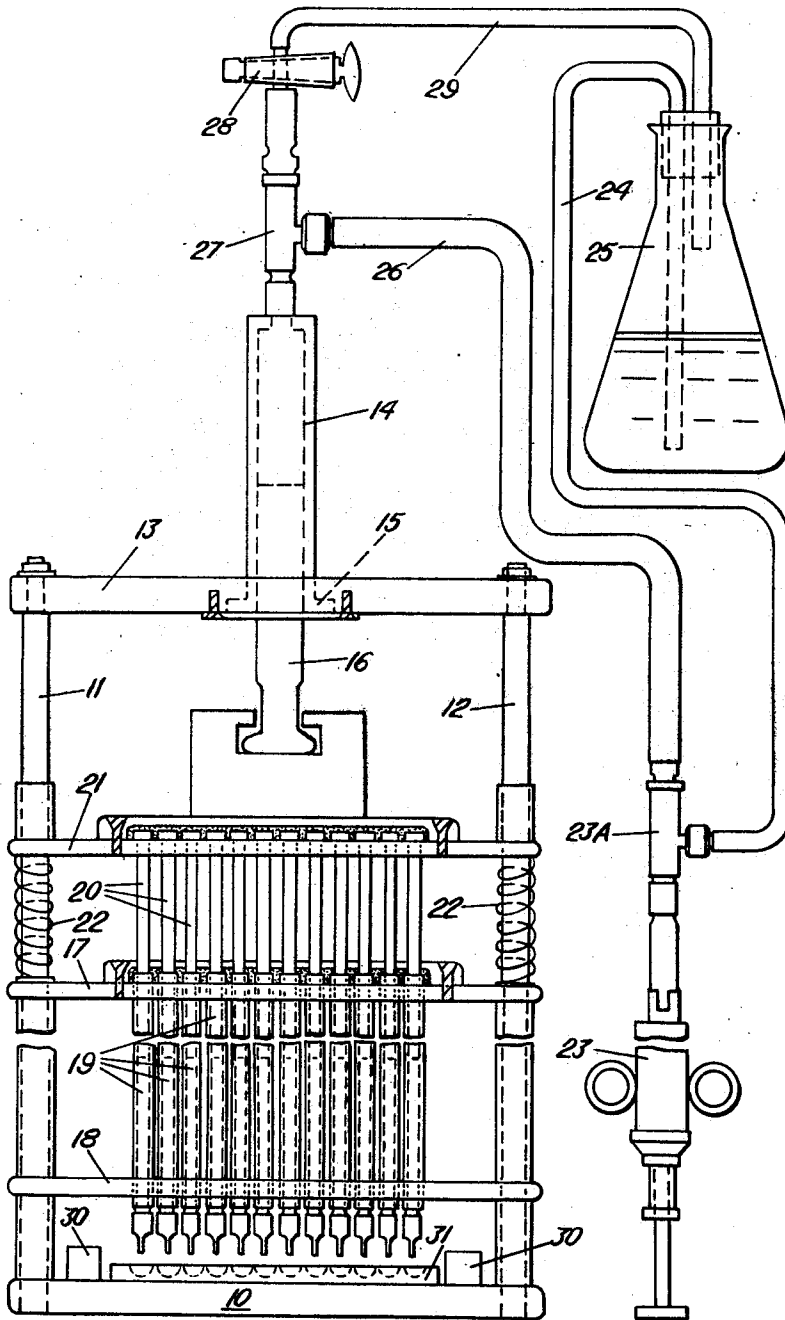
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MULTIPLE DROPPERS

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MULTIPLE DROPPERS

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5 Claims

ABSTRACT OF THE DISCLOSURE

A multiple dropper for supplying equal measured drops of liquid simultaneously, comprises spaced dropper syringes, means actuating the plungers of all syringes in concert, a hydraulic ram for moving said actuating means and a cyclically operable fluid supply means for said ram, successive full cycles of operation of said supply means moving said actuating means successively in the same direction by predetermined equal amounts.

This invention relates to microtitre arrangements, used for serological tests and other purposes. In particular, the invention relates to a multiple dropper for delivering a number of accurately measured drops simultaneously.

Microtitre plates, consisting of regularly arranged rows of cavities in a plastic plate, are used, diluent or reagent being added to each cavity for comparative tests.

This addition has normally been made from a manually-operated calibrated pipette having a tip designed to give a measured drop of, for example, 0.025 ml. The large number of cavities per plate make this very laborious.

An object of the invention is to enable a measured drop of diluent, reagent or other liquid to be simultaneously supplied at each of a series of positions, as, for example, to each of a row of cavities on a Takatsky microtitre plate, thus providing a great saving of time with no sacrifice of accuracy.

A further object is to provide apparatus for this purpose which is simple, cheap to make, and reliable.

Accordingly, the invention comprises a multiple dropper having a series of spaced dropper syringes, actuating means for moving the plungers of said syringes in concert a hydraulic ram for moving the actuating means, and a cyclically operable hydraulic fluid supply means for said ram.

The supply means introduce a predetermined amount of fluid into said ram on each full cycle of operation. The supply means is conveniently and adjustable-delivery automatic syringe.

Preferably a hydraulic fluid reservoir is provided from which said supply means draws fluid and into which the fluid from said ram empties on resetting of the apparatus.

In order that the invention may be better understood, an exemplary embodiment for use with a microtitre plate will be described, with reference to the accompanying drawing, which shows a front elevation.

The apparatus includes a flat base-plate 10 having spaced vertical rods 11, 12 extending from it. A top cross-piece 13 between the rods supports a "Luer-lok" 20 ml. glass syringe barrel 14, the flange 15 of the syringe 14 being fixed to the cross-piece and the plunger 16 extending downwards. Middle and lower cross-pieces 17, 18 hold the barrels 19 of twelve 1 ml. syringes, arranged side by side with their tips 81 mm. apart (the spacing between cavities of a microtitre plate). Each tip is calibrated to give a preselected drop size (e.g. 0.025 ml.). The plungers 20 of the 1 ml. syringes extend upwards and

are fixed to a movable cross-piece 21 sliding on the rods 11, 12. The plunger 16 of the 20 ml. syringe is fixed to the upper side of the movable cross-piece 21. The movable cross-piece is supported on a light helical spring 22 round each rod to prevent its weight pressing the 1 ml. syringe plungers down.

The actuating means (cross-piece 21) for moving plungers 20 in concert is therefore moved by the 20 ml. syringe 14, 16 held at the top of the framework and acting as a hydraulic ram. The head of the plunger 16 rests on the sliding cross-piece 21. Forcing water into the 20 ml. syringe will force the plunger 16 and hence the sliding cross-piece 21 down, expelling fluid from the dropper syringes 19, 20. The 20 ml. and 1 ml. syringes have the same length of action so that the 1 ml. syringes 19, 20 can be completely filled and emptied with the full stroke of the 20 ml. syringe 14, 16. Hydraulic fluid supply for the 20 ml. syringe 14, 16 is by an automatic syringe 23 fitted with the normal three-way valve 23A. The inlet tube 24 is immersed in a reservoir of water 25. Depressing the plunger of syringe 23 forces water up a pressure line 26 connected to the syringe outlet and into the 20 ml. syringe 14, 16 by means of another three-way valve 27, forcing the plunger 16 down a small distance.

The outlet of the three-way valve 27 is fitted with a stopcock 28 and connected by return line 29 to the reservoir 25. Lifting the sliding cross-piece with the stopcock open returns the water in the barrel 14 to the reservoir 25 and lifts the plungers of the syringes 19, 20.

On the base plate 10 are fitted guides 30 to guide the microtitre plate 31. The base-plate 10 can preferably be lowered so that the diluent container can be placed under the dropper tips to fill the dropper syringes, although this is not shown. In its upper position the base plate 10 holds the microtitre plate 31 just a short distance (3/8") below the dropper tips. The microtitre plates are moved into position under the dropper with one hand and the automatic syringe is operated with the other.

The perspex diluent containers (not shown) are made to allow the dropper tips to reach the bottom, ensuring no wastage of diluent when the dropper syringes 19, 20 are filled. The reagent cells are perspex blocks containing at least one row of twelve 2 ml. cavities spaced so that one dropper tip fits into each cavity. This allows each syringe 19, 20 to be filled with a different reagent.

The apparatus is operated as follows:

The syringes 19, 20 are filled by immersing their tips in the diluent or reagent containers and pushing the sliding cross-piece 21 upwards from its lowermost position with the stopcock 27 open.

With the stopcock 27 still open, repeated operation of the automatic syringe 23 will remove any air bubbles from the hydraulic system.

Stopcock 27 is then closed and the system is adjusted to give one drop at each syringe 19, 20 for each full depression of the plunger of the automatic syringe 23 by adjusting the automatic syringe delivery amount over some ten drops and locking it at the proper setting. Since the strokes of syringes 14, 16 and 19, 20 are equal and their volume ratio is 20:1, the volume supplied by syringe 23 will be nearly twenty times the amount delivered from syringe 19, 20.

The microtitre plate 31 is then positioned by the guide 30 on the base plate 10 and drops placed in the cavities of each row by one full depression of the syringe 23, as each row is positioned under the tips of syringes 19, 20.

It will be seen that the whole contents of each syringe 19, 20 is delivered in successive desired amounts. Each full operation of syringe 23 moves crossbar 21 downwards only, so that many deliveries are obtained between refillings of syringes 19, 20.

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With the very small amounts delivered (e.g. 0.025 ml.) such operation is essential. Any operation attempting to charge a syringe 19, 20 between delivery of successive drops is unworkable.

In the example illustrated, full use is made of standard components normally available in the laboratory so that the equipment is simple and cheap to construct.

It will however, be understood that various changes and modifications may be made in the arrangement described.

I claim:

1. A multiple dropper including a series of spaced dropper syringes; actuating means for moving the plungers of said syringes in concert; a hydraulic ram for moving said actuating means; a hydraulic fluid supply means for said ram, characterized in that said supply means is operable cyclically and, on successive full cycles of operation thereof, produces successive predetermined equal movements of said actuating means in a direction to express drops from said dropper syringes.

2. A multiple dropper as claimed in claim 1, in which the dropper syringe barrels are fixed in a cross-bar of a vertical frame, and said actuating means includes a second cross-bar slidable on said frame to which said plungers are attached, and said ram comprises an inverted syringe with its barrel fixed on a third cross-bar, the stroke of said inverted syringe and each said dropper syringes being equal, but the capacity of said inverted syringe being greater than that of a dropper syringe.

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3. A multiple dropper as claimed in claim 2, in which said supply means includes an adjustable delivery automatic syringe connected by a three-way valve to a hydraulic fluid reservoir and to said ram.

4. A multiple dropper as claimed in claim 3, in which the barrel of said inverted syringe is connected via a three-way valve to said automatic syringe and to a return line leading to said reservoir, said return line having a stopcock therein.

5. A multiple dropper as claimed in claim 1, including a vertically-adjustable horizontal base-plate beneath the delivery points of said dropper syringes, said base-plate being provided with guides for guiding a plate of liquid-containing cells beneath the dropper syringes.

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