

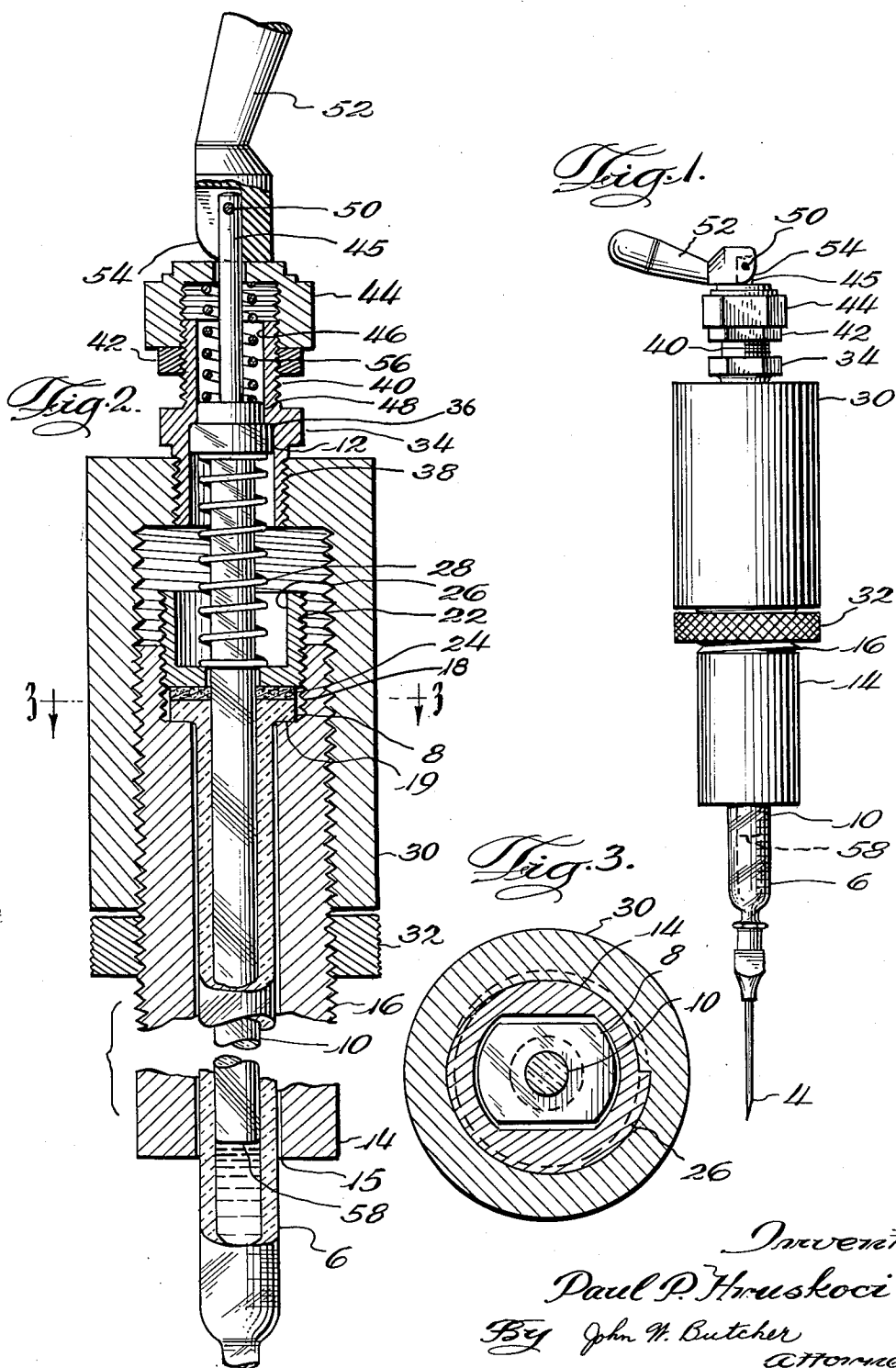
Jan. 29, 1963

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3,075,674

FLUID DISPENSING APPARATUS

Filed July 16, 1959



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1

3,075,674

FLUID DISPENSING APPARATUS

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Filed July 16, 1959, Ser. No. 827,634
1 Claim. (Cl. 222-309)

This invention relates to sample introduction into analytical equipment and more particularly to an apparatus to measure a predetermined quantity of fluid and to dispense this fluid into the analytical equipment.

As a means of illustration, and not by way of limitation, the invention will be described as apparatus for repeatedly injecting uniform samples of fluid into gas liquid chromatographic equipment. It will be understood the apparatus is capable of injecting fluid samples into other types of analytical equipment.

Reproducible analytical results from chromatographic equipment depends on numerous factors such as the nature and amount of the stationary phase, the uniformity of packing, the length and diameter of the column, the temperature, the properties of the components of the mixture to be separated and the size of the sample.

It is desirable to inject very small samples of fluid into a chromatographic column such that the sample, after introduction, occupies only a short section of the column. In order to obtain narrow elution peaks, the sample introduction method should be one that will bring the sample into the column in the most concentrated form or, in other words, so as to occupy the shortest possible column section. In addition to the feature of rapid introduction of small samples, the apparatus should be capable of injecting a plurality of uniform samples into the column without reloading the apparatus. These samples should be of uniform size such that one particular scale setting of the recording section of the analytical equipment will accommodate numerous individual sample analysis.

The most widely used method of injecting samples into the chromatographic column is the syringe method. A small needle on the end of a micro-syringe is projected through a self-sealing serum cap closing the end of the column. The point of the needle is normally placed near the top of the column packing. This injection method, until the present time, has been objectionable because it was subject to small systematic errors.

It is therefore an object of this invention to provide apparatus to inject a plurality of samples into analytical equipment. A further object of this invention is to provide apparatus to inject a plurality of samples of uniform size into analytical equipment. A still further object of this invention is to provide apparatus to inject a plurality of small samples of uniform size into analytical equipment. A further object of this invention is to provide apparatus for discharging a small uniform sample in "slug" form.

Briefly described, the invention includes a housing adapted to receive a syringe, cam means to depress the syringe plunger, a resilient member adapted to maintain the syringe plunger against the depressor means, and means adapted to reposition the cam and the plunger, with respect to the housing after a sample has been discharged.

The invention will be more clearly understood from the following detailed description of a specific example thereof read in conjunction with the accompanying drawings which form a part of this specification and in which:

FIGURE 1 is an elevational view of the fluid injection apparatus;

FIGURE 2 is an elevational view, partially in cross section, showing the various parts of the fluid injection apparatus and;

FIGURE 3 is a top view of the fluid injection apparatus taken along lines 3-3 of FIGURE 2.

2

The micro-syringe portion of the fluid injection apparatus includes a needle 4 which is connected to the lower end of the cylinder 6. The cylinder 6 has a cylinder flange 8 located at the upper end thereof. A plunger 10 is adapted to fit within the cylinder 6. A plunger head 12 is located on top portion of the plunger 10. The housing 14 has a bore 15 therethrough and a counterbore 19 therein. The cylinder 6 fits within the bore 15 such that the cylinder flange 8 rests on the shoulder formed at the bottom of the counterbore 19.

A packing nut 22 is adapted to thread into the internal threads 18 of housing 14. Packing 24 may be placed between the cylinder flange 8 and the packing nut 22, such that, as the packing nut is screwed into the internal threads 18, the packing 24 is compressed between the packing nut 22 and the cylinder flange 8. The packing forms a fluid-tight fit between the plunger 10 and the cylinder 6. The packing nut 22 contains a cylindrical recess 26. A plunger spring 28 fits within the recess 26 and about the plunger 10. One end of the plunger spring acts against the bottom portion of the recess 26 while the other end acts against the plunger head 12.

A collar 30 is adapted to fit the external threads 16 of the housing 14. A stop nut 32 is adapted to fit the external threads 16 of the housing 14. The collar 30 includes a head stop nut 34 which is mounted therein. The head stop nut 34 has a plunger head shoulder 36 which limits the travel of the plunger 10 by engaging the plunger head 12. The head stop nut has a first thread 38 which engages a thread within the collar 30 and a second thread 40. The second thread 40 receives a lock nut 42 and cam housing 44. The head stop nut 34 has a small bore therethrough which forms a head depressor cylinder 46.

The cam housing 44 slidably holds a cam rod 45. The cam rod 45 has a pivot pin 50 on one end and a head depressor 48 on the other end. A handle 52 is connected to the pivot pin 50. The handle has a cam surface 54 which is adapted to slide on the cam housing 44 as the handle is moved from a retracted position (FIGURE 2) to an extended position (FIGURE 1). A cam spring 56 is positioned within the cam housing 44. The cam assembly is "snap-acting." The snap-acting feature is achieved by the particular design of the handle 52 in combination with the cam spring 56. The handle 52 is connected to the cam rod 45 by means of the pivot pin 50 such that as the handle is rotated from a laterally extended position (FIGURE 1) to a longitudinally aligned retracted position (FIGURE 2), the cam rod passes top dead center. This provides a means to lock the cam in a longitudinally aligned position. The cam spring 56 exerts a greater force, in a downward direction, on the head depressor 48 than the plunger spring 28 exerts, in an upward direction, on the plunger head 12. Thus, as the handle 52 is rotated from a longitudinally aligned position and as the cam rod passes top dead center, the action of the cam spring 56 snaps the handle to a laterally extended position as shown in FIGURE 1.

In operation the stop nut 32 is positioned in the lower part of the external threads 16 of housing 14. The collar 30 is rotated to move the collar downward with respect to the housing 14. This positions the plunger end 58 near the lower end of the cylinder 6. The needle 4 is then protruded through a serum cap of a fluid sample container (not shown). The collar 30 is then rotated to move the collar upward with respect to the housing 14. The plunger spring 28 maintains the plunger head 12 against the plunger head shoulder 36 as the collar moves upward with respect to the housing. A fluid sample is thus drawn from the sample container into the cylinder 6. The needle 4 is then removed from the serum cap of the fluid sample container and projected through a self-sealing

serum cap of a chromatographic column. The point of the needle is preferably placed near the top of the column packing. The fluid sample is then injected into the chromatographic column by moving the handle 52 from a vertically aligned position with respect to the micro-syringe (FIGURE 2) to a laterally extended position (FIGURE 1). As the handle is moved to the laterally extended position, the cam spring 56, acting against the head depressor 48, forces the head depressor to move the plunger head 12 away from the plunger head shoulder 36. This forces fluid from the cylinder 6 through the needle 4 into the chromatographic column. A subsequent sample may be injected into the column by moving the handle 52 from a laterally extended position to a longitudinally aligned position (this allows the plunger 10 to move upward with respect to the cylinder 6 and draws a volume of inert fluid from the column into the lower end of the cylinder 6), rotating the stop nut 32 to move it downward with respect to the housing 14, rotating the collar 30 to move it downward with respect to the housing 14 until the inert fluid is discharged from the lower end of the cylinder 6 and the fluid sample is positioned at the lower tip of the needle 4, rotating the stop nut 32 such that it moves upward with respect to the housing 14 until the stop nut 32 engages the lower end of the collar 30, and by then moving the handle 52 from the longitudinally aligned position to the laterally extended position.

There are certain conditions wherein it is desirable to inject a fluid sample into the chromatographic column in such a manner that the sample is not allowed to remain within the needle 4 between injection steps. The reason for this procedure may be due to the nature of the sample, the pressure and temperature of the column, or a combination of these effects. The procedure may be carried out by first filling the cylinder 6 with a fluid sample as taught in the preceding paragraph. The needle 4 is then projected through a self-sealing serum cap of a chromatographic column. The collar 30 is rotated to move the collar upward with respect to the housing 14 until the sample recedes from the needle 4 to a predetermined mark on the lower portion of the cylinder 6. The fluid sample is then injected into the chromatographic column by moving the handle 52 from a vertically aligned position with respect to the micro-syringe to a laterally extended position. A predetermined quantity of fluid is forced from the cylinder 6 through the needle 4 into the chromatographic column. A subsequent sample may be injected into the column by first moving the handle 52 from a laterally extended position to a longitudinally aligned position. This allows the plunger 10 to move upward with respect to the cylinder 6 and draws an inert volume of fluid from the column into the lower end of the cylinder 6. The stop nut 32 is then moved downward with respect to the housing 14. The collar 30 is then rotated to move the collar downward with respect to the housing 14 until the inert fluid-sample interface is positioned adjacent the predetermined mark on a lower portion of the cylinder 6, thus, leaving a determinable quantity of inert fluid in the cylinder 6 between the mark and the tip of the needle 4. The subsequent sample may then be injected by moving the handle 52 from a vertically aligned position to a laterally extended position.

While we have described a specific example of the invention, it should be understood that various modifications and alternative embodiments of the disclosed apparatus will be apparent from the above description to those skilled in the art. For example, instead of using a cam arrangement to depress the plunger 10, other actuating mechanisms may be used in lieu thereof. A bayonet type slot and pin could be used to depress the plunger 10. Alternatively, the resilient members, i.e., the cam spring 56 and the plunger spring 28, may be replaced by other resilient members such as leaf springs or pneumatic actuators. The cylinder 6 may be an integral part of the housing 14, thus, combining the syringe and the housing 14 into a unitary body.

The disclosed apparatus may be used in combination with any fluid dispensing apparatus wherein it is desired to dispense one or more volumes of fluid. For example, the apparatus may be used in combination with hypodermic syringes, burettes, pipettes, and the like.

From the foregoing, it will be seen that the objects of the invention have been accomplished and that the disclosed apparatus is capable of dispensing a plurality of small equal volume fluid samples in slug form. Having described one embodiment of my invention in great detail, it is not thereby intended that I be limited to the specific structure illustrated, for there are many changes that may be made by one skilled in the art that fall within the spirit and scope of my invention. The invention should be limited only by the appended claim.

I claim:

An apparatus for rapidly dispensing fluid samples of predetermined volume from a syringe, said apparatus comprising a bored and externally threaded housing adapted for receiving a syringe, said syringe comprising a cylinder and a plunger slidably mounted within said cylinder and extending outwardly beyond said cylinder, said cylinder being provided with a flange at the outer end thereof, said housing having a threaded counterbore, said flange being positioned within said counterbore, a packing nut threadably engaging said counterbore and forming a fluid-type fit with said plunger, a collar threadably engaging the external threads of said housing and extending outwardly beyond said housing, a snap-acting cam assembly comprising a cam, a rod, and a cam spring, said assembly being mounted on and in longitudinally adjustable spatial relationship with the outer end of said collar whereby actuation of said snap-acting cam assembly depresses said plunger inwardly with respect to said cylinder, and a plunger spring engaging the outer end of said plunger and said packing nut, said plunger spring urging said plunger outwardly with respect to said cylinder, and being weaker than said cam spring.

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