

[54] LIQUID CHROMATOGRAPHY

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[51] Int. Cl. G01n 1/00

[58] Field of Search..... 73/422 G, 423 A, 61, 1 C;
210/31 C, 198 C

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[57]

ABSTRACT

A liquid sample for a liquid chromatography testing is prepared by being injected in a tube containing development liquid to form an elongated slug of liquid sample having development liquid at its opposite ends. Thereafter, the development liquid with the intermediate sample slug is transferred to a chromatographic column for testing, so that only a very small quantity of sample is employed correlated to only the exact needs of the chromatographic column. The sample slug is injected by a hypodermic needle passing through an elastomeric plug, so that the hole made by the hypodermic needle is thereafter elastically sealed as the needle is withdrawn. A transfer valve will selectively connect a reservoir and suction device to the sample holding tube, and the pump and chromatographic column with the sample holding tube to in the first instance prepare the sample holding tube for injection of the sample and in the second instance to transfer the development fluid and injected sample to the chromatographic column. A plurality of such sample holding tubes may be connected by valve means for selective feeding to the chromatographic column.

7 Claims, 7 Drawing Figures

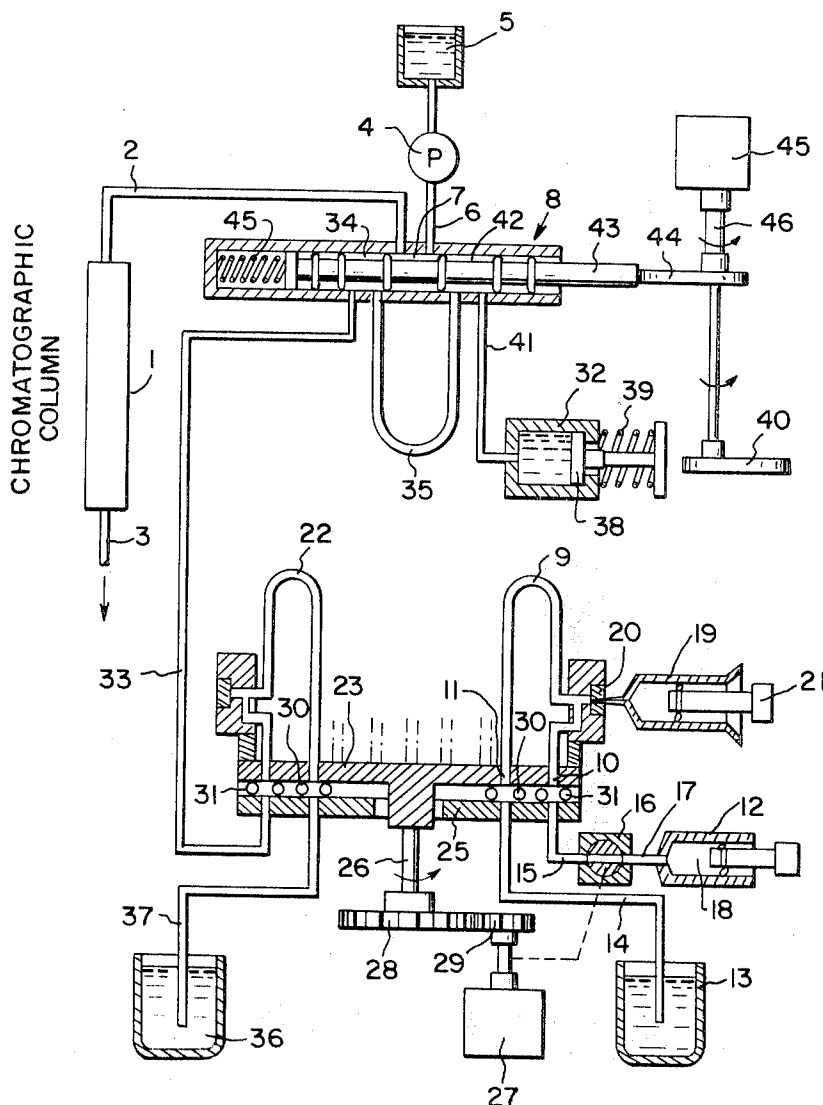


FIG. 1

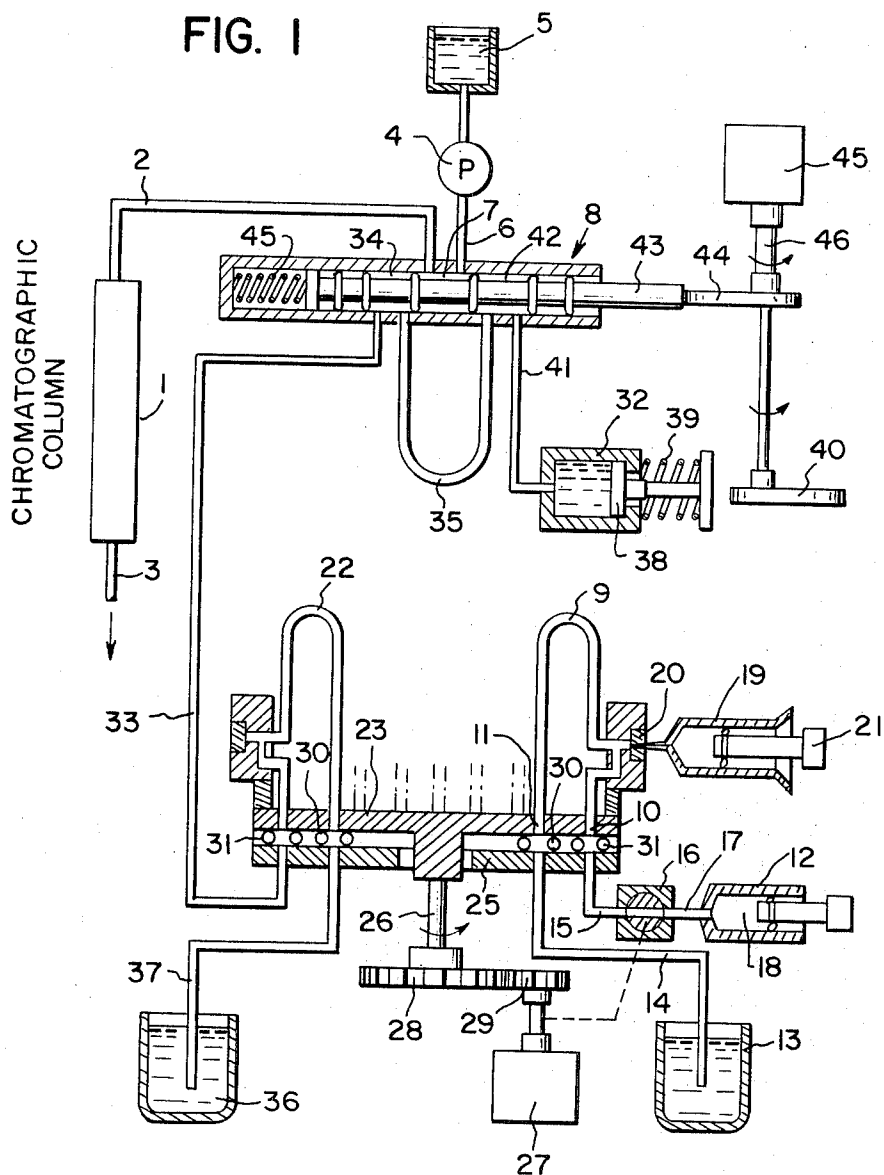


FIG. 2

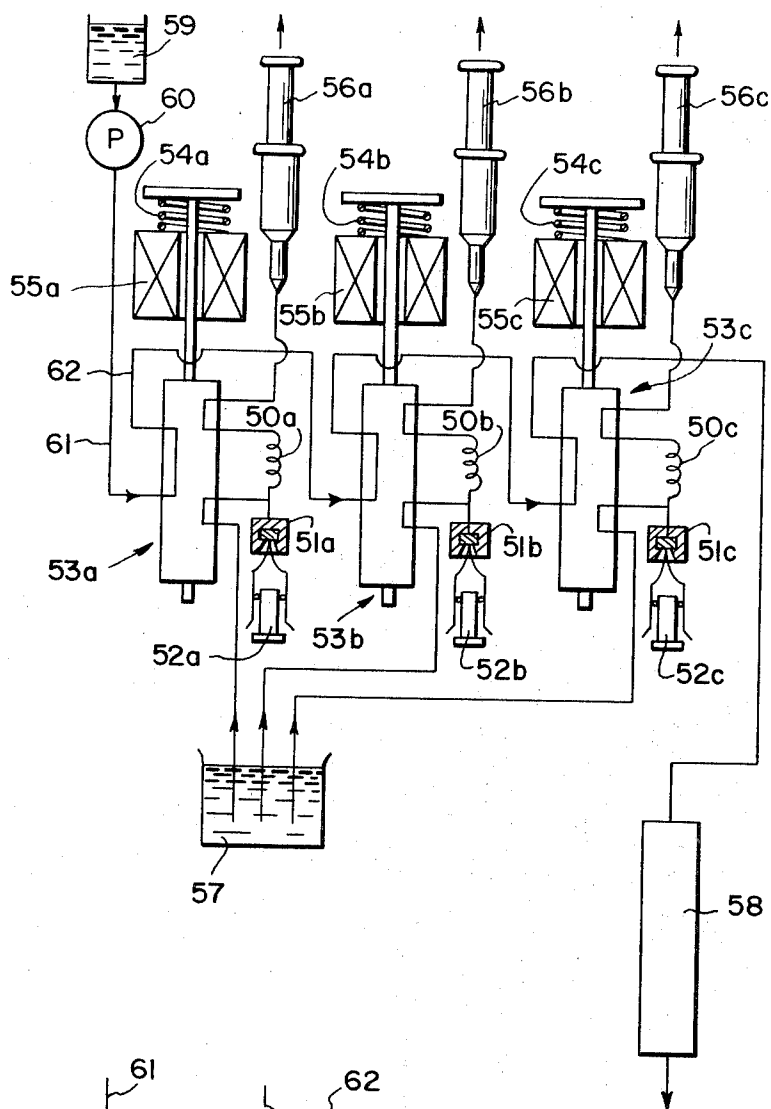


FIG. 3

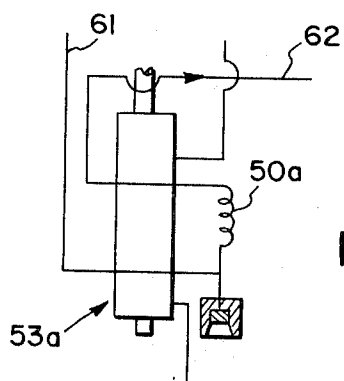


FIG. 4

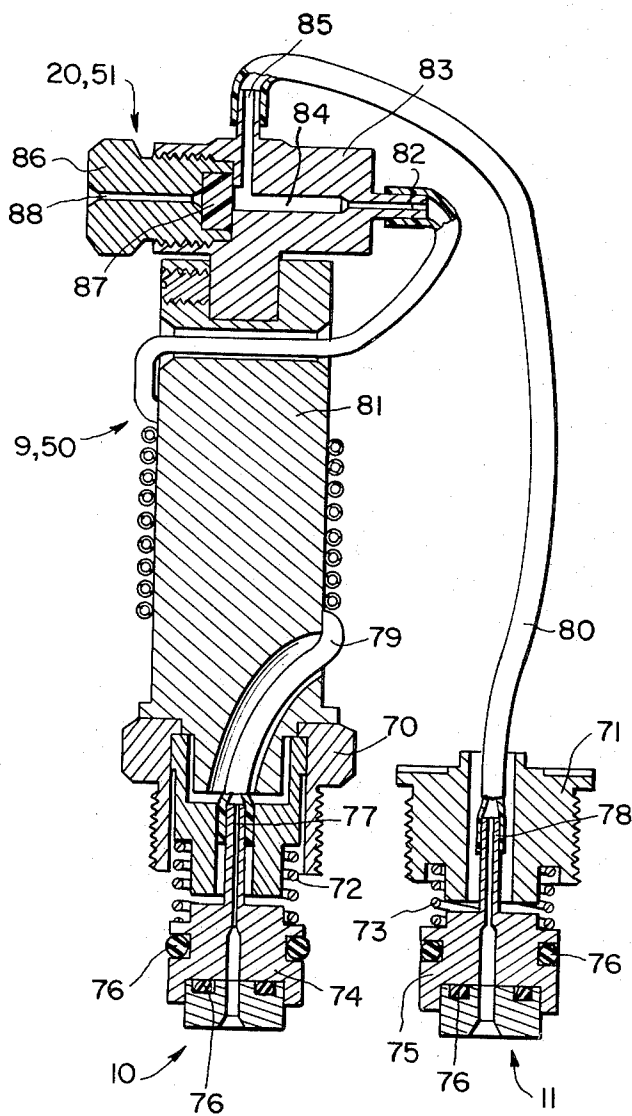


FIG. 5

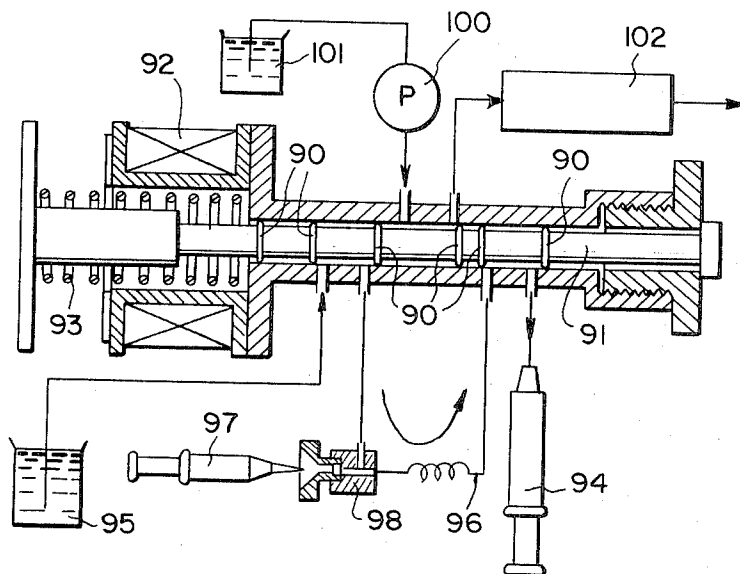


FIG. 6

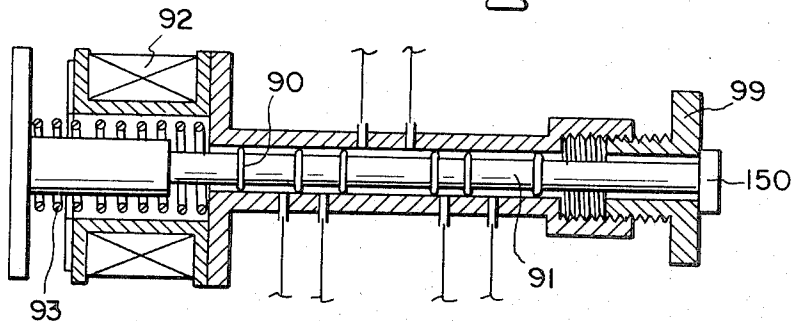
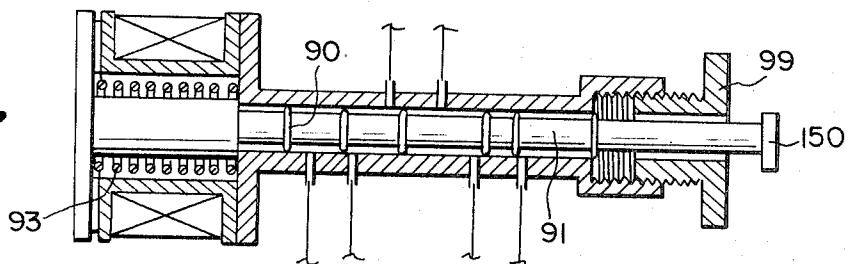


FIG. 7



LIQUID CHROMATOGRAPHY

BACKGROUND OF THE INVENTION

It is conventional in liquid chromatography to provide a plurality of sample measuring tubes, with the sample being sucked into the tubes for subsequent carrying by development fluid to a chromatographic column for analysis. A plurality, for example 12 or 24, of tubes have been used in the past for feeding selected samples to a single chromatographic column.

A disadvantage with the above-described conventional system is that a considerable amount of sample is wasted. If the volume of the measuring tube is 0.5cc, about 3cc of sample quantity is necessary although that quantity varies with the structure and arrangement. It follows that a sample about five times as great of the sample considered really necessary is wasted in such conventional devices. Such wastage is undesirable in that sample material is generally quite precious, particularly in the case where the sample material comes from a living organism. Wastage has been a fatal defect of the above-mentioned devices, particularly for certain applications.

Further, these conventional processes require the preliminary accurate determination of the volume of the measuring tubes for improving the accuracy of the analytical result. For measuring tubes, a Teflon tube of 0.5 to 1 mm in diameter is generally employed. Thus it is seen that if the sample quantity is to be 0.5cc, the necessary length of the tube is 640mm where the inside diameter of the tube is 1mm. Restricting the error of the internal volume of the tube to within 1 percent is a difficult task, which calls for the employment of special techniques beyond those employed in mass production.

SUMMARY OF THE INVENTION

It is an object of the present invention to overcome the difficulties and disadvantages of the prior art by providing a system wherein a small sample, correlated to the exact requirements of a chromatographic column, may be injected into a carrier fluid or development liquid so that it may subsequently be transferred to the chromatographic column without wastage. This system of liquid chromatography will have improved accuracy of analysis of a small quantity of sample and a simplified procedure, because the sample will always be introduced as a small and accurately defined quantity.

Preferably, a development liquid is held in an elongated passageway so that a liquid sample may be injected, preferably by a hypodermic needle passing through an elastomeric plug, into the elongated passageway at a precise location to displace development liquid away from the precise location in only one direction, so that the position of the sample slug is accurately determined within the elongated passage. Thereafter, transfer means, including a transfer valve, are employed to transfer the development liquid and intermediate sample slug from the elongated passageway to the chromatographic column. The accurate location of the sample slug within the development liquid will enable processes to in turn accurately locate the sample slug within the chromatographic column by passing a predetermined quantity of fluid through the chromatographic column during the transferring.

A plurality of such elongated passageways having the sample injecting means may be provided, with a separate sample to be selectively injected in each. With one embodiment, a holding elongated passageway may be provided with the transfer means, and filled with development liquid and sample liquid slug from a selected one of the elongated passageways having the sample injecting means. According to a further embodiment, a plurality of transfer valves may be used with the transfer means so that only a selected one of the elongated passages having the sample injecting means may be connected at one time directly with the chromatographic column for transferring the development liquid and sample slug contained therein to the chromatographic column.

BRIEF DESCRIPTION OF THE DRAWING

Further objects, features and advantages of the present invention will become more clear from the following detailed description of the drawing, wherein:

FIG. 1 shows one embodiment of the present invention in somewhat schematic form;

FIG. 2 shows a second embodiment of the present invention in schematic form;

FIG. 3 shows in schematic form the transfer position of each of the valves of the embodiment of FIG. 2;

FIG. 4 is a cross sectional view of a development liquid elongated passageway having sample injecting means that may be used with the embodiment of FIG. 1 or the embodiment of FIG. 2;

FIG. 5 shows a third embodiment of the present invention in one position of its transfer valve;

FIG. 6 shows the transfer valve of FIG. 5 in a second position; and

FIG. 7 shows the transfer valve of FIG. 5 in a third position.

DETAILED DESCRIPTION OF THE DRAWING

The present invention is concerned with liquid chromatography capable of efficiently and simply introducing a minimum volume of sample into a chromatographic column without wasting sample by either introducing more sample than is needed into the column or by requiring excess sample for processing to introduce a small quantity in a circuit leading to a column.

In the first embodiment according to the present invention as shown in FIG. 1, a chromatographic column 1 is schematically shown, because it may be of any of the conventional types that are well known in the art and its specific details form no part of the present invention. The liquid enters the chromatographic column 1 by means of a liquid line 2 for analysis within the column in a conventional manner, and thereafter exits through fluid line 3. The pump 4 is supplied with liquid from the development liquid reservoir 5 and is operated to pump development liquid through line 6, passage 7 of valve 8, and line 2 to the chromatographic column 1 for cleansing the same and removing traces of the previous sample, if desired.

A sample slug is prepared within development liquid independently of any analysis being carried on within the chromatographic column or the above-mentioned flushing. For this purpose, there is provided an elongated tubular passage 9 having terminal ends 10 and 11. For cleansing and filling this tubular passage 9 with development liquid, a suction device 12 draws development liquid from a reservoir 13, through line 14,

through tubular passage 9, through line 15, through valve 16, and through line 17 to the expansible chamber 18 of the suction device 12. The suction device 12 may comprise an outer cup-shaped cylinder having its closed end connected to line 17 and a manually operable piston contained therein. When the tubular passage 9 has been filled with development liquid and appropriately flushed with respect to any residues from preceding samples, a sample is prepared in a conventional manner within the expansible chamber of a hypodermic needle 19 in an amount as accurately determined by the conventional volumetric graduations of the hypodermic needle. Thereafter, the operator will thrust the needle portion of the hypodermic needle through an elastomeric sealing plug 20 so that the free exit end of the needle will extend within the tubular passage 9. The point of entry for the needle with respect to the tubular passage 9 is precisely located with respect to the terminal end 10 by accurately formed passageways therebetween. With the needle in this position, the conventional plunger 21 of the hypodermic needle is manually actuated to inject a precise amount of fluid sample within the tubular passage 9 as determined visually by the aforementioned graduations that are conventionally found on hypodermic needles of this type. The inherent resistance of the suction device 12 or actuation of the valve 16 to a closed position, whichever is preferred, will assure that the development liquid within the tubular passage 9 that is displaced by the injected sample will only move away from the point of injection toward the terminal end 11, through the line 14 and into the reservoir 13. It is thus seen that a slug of liquid sample is introduced into the tubular passage 9 to be contained on opposite ends by development liquid to form fluid interfaces at these opposite ends; the fluid interface closest to the terminal end 10 will be precisely located independently of the volume of sample injected due to the aforementioned flow of development liquid only through terminal end 11 during injection.

After the formation of the sample material slug within the development liquid as set forth above, the tubular passage 9 will ultimately be moved to the position of the identical tubular passage 22. To accomplish this, a table 23 is rotatably mounted on a stationary support 25 for indexing rotation about the axis of shaft extension 26, as driven by a motor 27 through the intermediary of meshing spur gears 28, 29 respectively drivingly connected to shaft 26 and the shaft of motor 27. Two or more tubular passages with associated support structure and elastomeric sealing plugs for the hypodermic injection of sample material are provided equally spaced, peripherally and radially with respect to the axis of rotation, supportingly on the rotatable table 23 and identical to each other. As shown by the mechanical schematic interconnection, the valve 16 may be driven by the motor 27 for automatic operation, although it is also contemplated that it may be manually controlled, as may be the rotation of the table 23. A plurality of O-rings 30 are fixedly inserted onto the tubular passages in numbers corresponding to and positions corresponding to the terminal ends of the tubular passages corresponding to the terminal end 11 of the tubular passage 9 so as to be aligned with selected ones for each indexed position of the table 23. Similarly, O-rings 31 are provided for the other terminal ends corresponding to the terminal end 10 of the tubu-

lar passage 9. While O-rings have been specifically shown, it is further contemplated that a single annular elastomeric gasket may be provided with a plurality of through passages as required. In order to assure liquid seal, the O-rings or gasket are made of elastomeric material such as rubber or silicone rubber.

When the table 23 is rotated sufficiently to locate the tubular passage 9 in the position of tubular passage 22, a pump 32 is actuated to draw the development liquid and sample slug carried therein from the tubular passage through line 33, passage 34 of valve 8, and into the holding tubular passage 35. To assure that the tubular passages and lines are always filled with development liquid, a development liquid reservoir 36 is connected to line 37 communicating with the tubular passage in position 22. The position of the sample slug within the holding tubular passage 35 may be accurately located visually with manual control of the pump 32 or automatically. With automatic operation, the volume of the line 33, passage 34 and holding tubular passage 35 are accurately formed to cooperate with the above-mentioned accurate location of the sample slug within the tubular passage 9, so that a predetermined volume change within the expansible chamber of the pump 32 will draw the sample slug from the tubular passage 9, with accompanying development liquid, and accurately locate it within the holding tubular passage 35. For this purpose, the stroke of the piston 38 of the pump 32 is controlled by spring 39, its end positions within the pump cylinder, and a rotatable operating cam 40. It is thus seen that the spring 39 will actuate the pump during the above-mentioned transfer operation and rotation of the cam 40 will return the pump piston to its starting position. During the return of the pump piston, the development liquid contained within the pump expansible chamber may be discharged into a reservoir or the like through a one-way valve, with a one-way valve also being provided on the line 41 that is in communication with the passage 42 of the valve 8 shown connected with one end of the holding tube passage 35.

With a sample slug accurately located within the holding tube passage 35 according to the above description the spool 43 of the valve 8 will be axially shifted by rotation of the engaged cam 44 into which it is biased by spring 45. The cam 44 is rotated by a suitable motor 45 having a motor shaft 46 drivingly connected to the cam 44 and the cam 40. In this manner, the valve spool 43 is shifted so that valve passage 7 will only interconnect line 6 with the right hand end of the holding tubular passage 35 as viewed in FIG. 1 and the valve passage 34 will only interconnect the line 2 with the opposite end of the holding tube passage 35. With this connection, the pump 4 may be actuated to pump development liquid into the right hand end of the holding tube passage 35 to in turn pump the sample slug from the holding tube passage 35 through the valve passage 34, through the line 2, and into the chromatographic column 1. As before, the pump 4 may be volumetrically calibrated to automatically cease pumping when the sample slug is accurately located in its proper position within the chromatographic column 1 by accurately volumetrically sizing the passage 34 and line 2, which cooperates with the previously mentioned accurate positioning of the sample slug within the holding tube passage 35. Thus it is seen that only the exact quantity of sample material needed for chromatographic analysis within the column 1 may be injected

and accordingly only this amount may be withdrawn from its source by the hypodermic needle 19 with very little excess within the hypodermic needle 19 accounting for wetting of the various hypodermic needle surfaces and the small waste volume of the needle.

According to the specific embodiment, there are provided twelve passageways and injection means associated therewith corresponding identically with the tubular passage 9 and sealing plug 20 so that the table 23 is indexed in amount corresponding to the peripheral spacing between these identical members to successively position the members in position 22. Thus the tubular passages will take on development liquid in the position shown for tubular passage 9 and may take on sample material thereafter at this position or in any position in one rotatable direction up to the position 22.

Preferably, the elastomeric sealing plug 20 is a silicone rubber packing. Further, it is preferred to have the various lines and portions of the passages constructed of Teflon tubing. Although various reservoirs have been shown, only one reservoir may be provided in actual practice.

FIG. 2 shows a further embodiment of a liquid chromatography according to the present invention. This embodiment is provided with three sample holding tubular passages 50a, 50b, 50c that are arranged generally parallel to each other and respectively equipped with sample injecting means 51a, 51b, and 51c, each of which may be identical with the injecting means 20 of FIG. 1. The injecting means 51a, 51b, 51c may cooperate with one or more hypodermic needle injectors 52a, 52b, 52c. Preferably, disposable hypodermic needles, which are conventional, may be employed with the present invention to prevent cross contamination.

To control the various flow routes, there are provided a corresponding number of valves 53a, 53b, 53c which may be identical to the slide valve of FIG. 1, except that they are operated preferably by biased springs 54a, 54b, 54c and solenoids 55a, 55b, 55c. In the position of the valve shown in FIG. 2, respective suction devices 56a, 56b, 56c may be operated simultaneously or selectively to draw development liquid from a source or reservoir 57 through the appropriate valve passages as schematically shown to fill the sample holding tubes 50, 50b, 50c.

Thereafter, sample material is taken into one or more of the hypodermic needles 52a, 52b, 52c in a known manner and transferred as mentioned previously with respect to FIG. 1 through the injecting means 51a, 51b, 51c into the holding tubular passages 50a, 50b, 50c with displaced development liquid returning to the reservoir 57. Thus, a slug of sample material will be held in one or more of the holding tubular passages as previously described with the embodiment of FIG. 1. When any one of the valves 53, for example 53a, is changed by actuation of its solenoid to the position schematically shown in FIG. 3, the sample held therein will be placed in liquid circuit with the chromatographic column for transfer to the chromatographic column 58. With the valve 53a in the position as shown schematically in FIG. 3, development liquid from reservoir 59 will be moved by pump 60 through line 61, the appropriate passage in the valve 53a, the holding tubular passage 50a, the appropriate passage in valve 53a, and line 62 that as shown in FIG. 2 with the valves 53b and 53c in their illustrated position of FIG. 2 leads directly to

the chromatographic column 58. In a similar manner, if the valve 53b is changed from its position as shown in FIG. 2 to a position as shown in FIG. 3 with the other valves remaining in their FIG. 2 position, only the holding tubular passage 50b will be directly in liquid circuit between the pump 60 and chromatographic column 58. Similarly, the above process is repeated for the remaining holding tubular passages 50 regardless of their number. Operation of the pump 60 and solenoids 55 may be controlled either manually or automatically.

A further advantage of the present invention is that in both of the embodiments of FIGS. 1 and 2, a valve is interposed between the high pressure transfer pump 4, 60 and the injecting means 20, 51 so that sample injecting may be carried out at any desired pressure, for example advantageously at atmospheric pressure which greatly facilitates the sealing function of the elastomeric plug with respect to the hole left by the hypodermic needle, and the sample collecting mechanism will not in any way dictate or compromise the pressure to be used with the chromatographic column. Further, an accurate amount of sample may be injected into the system according to the graduations on the hypodermic needle as facilitated by the above-mentioned reduced pressure preventing leakage and providing normal back flow pressure for the hypodermic needle.

In FIG. 4, there is shown a detailed cross sectional view of a preferred form for the tubular passage 9 and injecting means 20 of FIG. 1, and the tubular passage 50 and injecting means 51 of FIG. 2. The element of FIG. 4 will be specifically described with respect to its employment in the embodiment of FIG. 1. The coupling members 70, 71 are externally threaded for a reception in correspondingly formed holes within the table 23. Springs 72 and 73, upon coupling, will assure a tight sealing engagement between the table portions and the tube carrying blocks 74, 75, with O-rings 76 improving the sealing. The blocks 74, 75 are respectively provided with coupling extensions 77, 78 for telescopically receiving the adjacent terminal ends of tubes 79, 80. These tube ends along with the extensions 77, 78 are freely slidable within the coupling members 70, 71.

The tube 79 is helically coiled about the core 81, which core is integrally connected with the coupling member 70. The opposite end of the tube 79 is telescopically received on a coupling nipple 82 of an injector block 83 that is provided with an internal passage 84 extending between the coupling nipple 82 and a corresponding coupling nipple 85 receiving the other end of the tube 80. A guide sleeve 86 is rigidly connected to the injector block 83 for clamping therebetween a neoprene packing 87 so that the hypodermic needle may pass through a passage 88 and the packing 87 in perfect alignment with one leg of the passage 84. The tubes 79, 80 are preferably constructed of Teflon having an accurate inside diameter of 1mm and a combined length of approximately 650mm. The winding core 81 is preferably cylindrical and about 15mm in outside diameter and about 60mm in height.

While the device of FIGS. 5, 6 and 7 may be considered as a separate embodiment, the slide valve disclosed therein and its operation may be incorporated in each of the embodiments of FIGS. 1 and 2.

As shown in FIG. 5, the slide valves include a plurality of O-rings 90 fixedly carried by a reciprocating rod 91 carried within the valve body to form a plurality of

valve passages therebetween. The rod 91 is reciprocated to the right by a solenoid 92 and to the left by means of return spring 93.

With the valve in the position as shown in FIG. 5 and prior to injection of a sample, the suction device 94 is operated to draw development liquid from a reservoir 95 through the appropriate passages of the valve to fill the holding tubular passage 96, which is shown in more detail in FIG. 4. Subsequently, a precise quantity of sample material is drawn into the hypodermic needle 97 as determined by its graduations as mentioned before to later be injected through the injection means 98 into the holding tubular passage 96 while displacing development liquid back into the reservoir 95. While the sample material is held as a sample slug with development liquid on opposite sides within the holding tubular passage 96, there may be considerable diffusion of the sample throughout the development liquid over long periods of time under certain circumstances, so that sample material may get into unwanted areas and diffuse to an undesirable extent outside of the holding tubular passage 96 for undesirable dilution of the mixture within the holding tubular passage 96. To prevent this, the valve is moved to the position of FIG. 6 by turning the threaded member 99 in one direction to unscrew it to the right as shown and correspondingly move the rod 91 to the right due to the abutting engagement between the increased diameter portion 150 of the rod 91 and the adjacent surface of the member 99. In this manner, the valve passages are reoriented so that the terminal ends of the holding tubular passage 96 are closed while the flow route between the pump 100 with its reservoir 101 and the chromatographic column 102 is maintained open, as is particularly necessary with the embodiment of FIG. 2.

When it is desired to transfer the sample held within the holding tubular passage 96 to the chromatographic column 102, the solenoid 92 is energized to move the rod 91 against the bias of spring 93 to its extreme right position as shown in FIG. 7. In this position, it is seen that fluid from reservoir 101 will pass through pump 100 and the indicated passage in the valve of FIG. 7 to force the sample and development fluid from the holding tubular passage 96 through the indicated passage within the valve to the chromatographic column 102. Thus, a plurality of devices as shown in FIG. 5 may be connected either in parallel or series to hold a corresponding plurality of samples in readiness to be easily and quickly transferred to the chromatographic column in succession by operating the corresponding plurality of valves. In the manner described above, the position of the valve of FIG. 6 will allow holding of samples for many hours without contamination of other areas or undue dilution so that the operation of the liquid chromatography apparatus may be continuous without interruptions for cleaning or removal of diffused samples.

Thus according to the present invention, as more fully described above, there is provided a tube for holding development liquid and a sample liquid in a flow route separated from the high pressure flow route of a chromatographic column by the interposition of a valve. The sample is injected in a precise amount by an injector using only his precise amount, with small variations, so that the thus injected slug of sample will be held with development liquid on each side for subsequent transfer by operation of the valve to the chro-

matographic column. With the present invention, it is possible to use a quantity of sample material approximately one-hundredth as small as the quantity of sample material used with the above-mentioned prior art type of devices with equally satisfactory results as to the sample material as reaches the chromatographic column for analysis. The analytical accuracy of the present invention is quite superior with respect to the prior art in that the injection is accomplished with respect to a controlled volume by reading the graduations carried by the hypodermic injector to thus improve operational efficiency of sample measuring over the conventionally required special techniques. Further, the operator of the present device may function more easily and with less experience than an operator of a corresponding prior art device that is considerably more complex. Further, the chromatography apparatus may operate continuously over a long period of time since the sample can be maintained indefinitely without diffusion beyond the holding passage as determined by both liquid seals and valve seals.

Further variations, embodiments and modifications are contemplated according to the broader aspects of the present invention while the specifically described details are quite important in their own right, according to the spirit and scope of the present invention as defined by the following claims.

What is claimed is:

1. A liquid chromatography apparatus, comprising: a chromatographic liquid passage means to conduct liquid to a chromatographic column for processing under high pressure a liquid sample undergoing chromatography testing; sample passage means for holding a development liquid in an elongated path; means for supplying development liquid in said path; elastomeric seal means intermediate the length of said path for receiving a hypodermic needle passing therethrough to the interior of said sample passage means for injecting a liquid sample to be analyzed within said sample passage means to provide development fluid on each side of an intermediate small quantity of liquid sample within said path; said elastomeric means further sealing upon withdrawal of the hypodermic needle; valve means having an open position providing fluid communication between said sample passage means and said chromatographic fluid passage, and a closed position fluid isolating said sample passage means and said chromatographic fluid passage; means including said valve means and pump means for transferring the development liquid and intermediate injected sample liquid from said path at a low pressure through the open valve means to said chromatographic fluid passage at a higher pressure for conducting the fluids to the chromatographic column; said transferring means including pump means for circulating development fluid through said open valve means and said sample passage means to said chromatographic fluid passage; and said valve means having a third selectable position fluid connecting said pump means to said chromatographic fluid passage, and fluid isolating said sample passage means from said pump means and chromatographic fluid passage.

2. The device of claim 1, wherein said pump means circulates development fluid through said sample passage means separate from said chromatographic fluid passage only in the closed position of said valve, and is

isolated from said sample passage means in said third position of said valve means.

3. A liquid chromatography apparatus, comprising: a chromatographic liquid passage means to conduct liquid to a chromatographic column for processing under high pressure a liquid sample undergoing chromatography testing; sample passage means for holding a development liquid in an elongated path; means for supplying development liquid in said path; elastomeric seal means intermediate the length of said path for receiving a hypodermic needle passing therethrough to the interior of said sample passage means for injecting a liquid sample to be analyzed within said sample passage means to provide development fluid on each side of an intermediate small quantity of liquid sample within said path; said elastomeric means further sealing upon withdrawal of the hypodermic needle; valve means having an open position providing fluid communication between said sample passage means and said chromatographic fluid passage, and a closed position fluid isolating said sample passage means and said chromatographic fluid passage; means including said valve means and pump means for transferring the development liquid and intermediate injected sample liquid from said path at a low pressure through the open valve means to said chromatographic fluid passage at a higher pressure for conducting the fluids to the chromatographic column; a holding passage separate from said sample passage means and said chromatographic fluid passage; said transferring means selectively transferring the development fluid and liquid sample therein from said sample passage means to said holding passage; said valve means selectively fluid isolating said holding passage from said sample passage means and said chromatographic fluid passage for storage; and said valve means being operable to provide fluid communication between said holding passage and said chromatographic fluid passage for transferring the development fluid and liquid sample in said holding passage to the chromatographic column through said chromatographic fluid passage.

4. A liquid chromatography apparatus, comprising: a chromatographic liquid passage means to conduct liquid to a chromatographic column for processing under high pressure a liquid sample undergoing chromatography testing; sample passage means for holding a development liquid in an elongated path; means for supplying development liquid in said path; elastomeric seal means intermediate the length of said path for receiving a hypodermic needle passing therethrough to the interior of said sample passage means for injecting a liquid sample to be analyzed within said sample passage means to provide development fluid on each side of an intermediate small quantity of liquid sample within said path; said elastomeric means further sealing upon withdrawal of the hypodermic needle; valve means having an open position providing fluid communication between said sample passage means and said chromatographic fluid passage, and a closed position fluid isolating said sample passage means and said chromatographic fluid passage; means including said valve means and pump means for transferring the development liquid and intermediate injected sample liquid from said path at a low pressure through the open valve means to said chromatographic fluid passage at a higher pressure for conducting the fluids to the chromatographic column; a plurality of substantially identical

separate sample passage means and corresponding injecting means; means, including said valve means for separately connecting each of said sample fluid passage means with said chromatographic fluid passage.

5. The device of claim 4, wherein said plurality of sample passage means and their associated elastomeric sealing means are carried by an indexable rotatable table having a plurality of indexed positions corresponding in number to the number of sample passage means carried thereby; each of said sample passage means having first and second terminal fluid connecting ends, with all of said first terminal ends being symmetrically arranged with respect to the axis of rotation to correspond to the indexed positions, and all of said second terminal ends being symmetrically arranged with respect to the axis of rotation to correspond to the indexed positions; a source of development fluid and pump means stationarily mounted with respect to said indexable table at a position to be successively fluid connected with respective ones of said first and second terminal ends for each of said sample passage means for respectively each of said indexed positions to fill said sample passage means with development fluid successively; and said transferring means including development fluid source means and pump means stationarily mounted with respect to said indexable table to be successively connected with one of said sample passage means for each indexed position of said table to pump development fluid and liquid sample held therein from said selected sample passage means to said chromatographic fluid passage.

6. The device of claim 5, including a valve fluid interposed between said first mentioned pump means and one end of the associated selected sample passage means to be closed during injecting to displace fluid from the other end of said the sample passage means during injecting.

7. A liquid chromatography apparatus, comprising: a chromatographic liquid passage means to conduct liquid to a chromatographic column for processing under high pressure a liquid sample undergoing chromatography testing; sample passage means for holding a development liquid in an elongated path; means for supplying development liquid in said path; elastomeric seal means intermediate the length of said path for receiving a hypodermic needle passing therethrough to the interior of said sample passage means for injecting a liquid sample to be analyzed within said sample passage means to provide development fluid on each side of an intermediate small quantity of liquid sample within said path; said elastomeric means further sealing upon withdrawal of the hypodermic needle; valve means having an open position providing fluid communication between said sample passage means and said chromatographic fluid passage, and a closed position fluid isolating said sample passage means and said chromatographic fluid passage; means including said valve means and pump means for transferring the development liquid and intermediate injected sample liquid from said path at a low pressure through the open valve means to said chromatographic fluid passage at a higher pressure for conducting the fluids to the chromatographic column; a plurality of said sample passage means; a corresponding plurality of injecting means respectively for each of said sample passage means; a corresponding plurality of said valve means directly connected with respective ones of said sample passage

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means; pump means; said transferring means fluid connecting said pump means with said chromatographic fluid passage in a circuit through all said valve means with said valve means closed separate from said sample

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passage means; and each of said valve means independently placing only its associated sample passage means in said circuit in the open position.
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