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SEPTUMLESS INLET FOR CHROMATOGRAPHS

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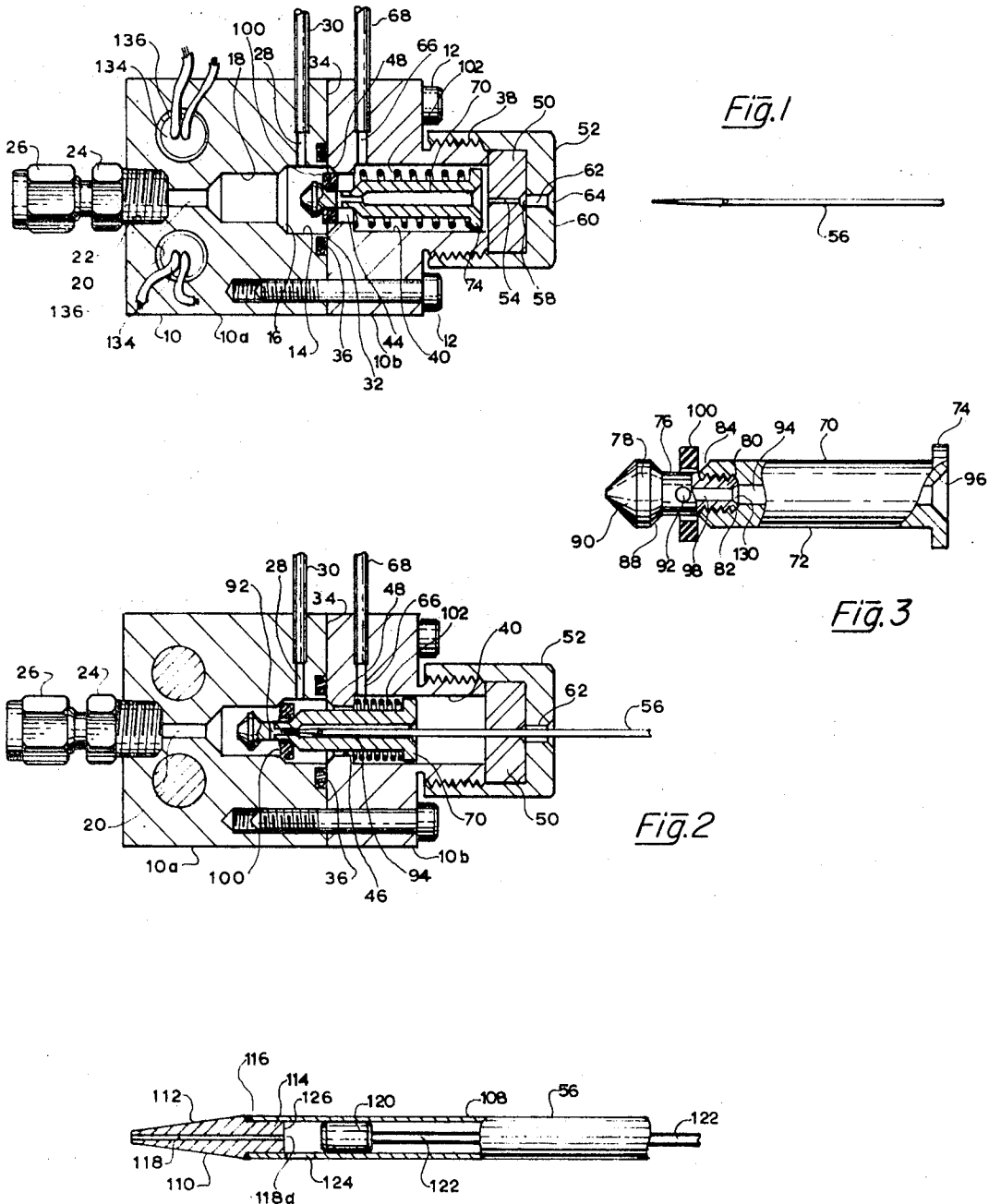


Fig. 4

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SEPTUMLESS INLET FOR CHROMATOGRAPHS

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8 Claims

ABSTRACT OF THE DISCLOSURE

An inlet apparatus for chromatographs, having a shuttle movable between a normal inoperative, retracted position and a second, operative position.

When the needle of a syringe or syringe apparatus is inserted into the inlet apparatus, the syringe apparatus seals with the bore of the shuttle and as the syringe is pushed further into the apparatus, the shuttle is moved to the second position so that when a side port in the syringe is opened, carrier gas enters the side opening and washed the sample from the syringe, through the shuttle bore and into the column of the chromatograph.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates generally to inlets for chromatographs and relates more particularly to chromatograph inlets that are septumless.

Description of the prior art

There are various chromatograph inlets in the prior art but they require septums through which needles are inserted. Such septums can be used only a limited number of times as holes are punched therein at substantially one place and after a few punctures the septum does not seal properly on the needle of the syringe. Consequently, it is necessary to frequently replace the septums with new ones. This results in loss of time in replacing the septums and also involves the cost of the septums themselves.

SUMMARY OF THE INVENTION

The present inlet apparatus has a shuttle movable between a normal retracted, inoperative position and a second, operative position. When the shuttle is in its retracted position, carrier gas from a first carrier gas passage flows into the inlet apparatus and out of the inlet and into the column of the chromatograph to which the inlet apparatus is connected. There is a second carrier gas passage which supplies a flushing gas which flows out through a hole in the entrance seal of the inlet.

There is a syringe apparatus for the present inlet, said syringe apparatus which includes a needle with a side port and a plunger movable within the needle for closing said port when the plunger is in one position, said plunger being movable to another position whereat the port is uncovered by the plunger so that said port is open.

When the needle of the syringe apparatus is inserted into the hole in the entrance seal said hole is sealed off, the needle entering an inwardly tapered entrance portion in the bore of the shuttle and contacting the wall of said entrance portion, it being understood that the plunger is in the port closed position. Further inward movement of the syringe causes the shuttle to move to the second position whereat both gas inlets are shut off. Now, when the plunger is retracted to open the side port of the needle carrier gas enters said port and then through the tip portion of the needle in which a sample is disposed. The sample is washed out through the shuttle bore and into the column of the chromatograph to which the inlet is connected.

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OBJECTS OF THE INVENTION

It is an object of the invention to provide an inlet apparatus for chromatographs that does not require a septum.

It is still another object of the invention to provide a septumless inlet that is simple in construction and operation, and that has a minimum of moving parts.

BRIEF DESCRIPTION OF THE DRAWING

Referring to the drawings, which are for illustrative purposes only:

FIG. 1 is a longitudinal section through the apparatus showing the mechanism in the inoperative position;

FIG. 2 is a similar view showing the mechanism in the operative position;

FIG. 3 is an enlarged side elevational view of the shuttle with a portion broken away; and

FIG. 4 is an enlarged fragmentary elevational view of a needle with portions broken away to show the interior construction.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. 1 and 2, there is shown a chromatograph inlet embodying the present invention, the device having a body, indicated generally at 10. While the device is shown disposed horizontally, the body comprises two parts termed herein the lower body part 10a and the upper body part 10b, the two body parts being secured together by suitable screws or bolts 12.

Within the lower body part 10a there is a cylindrical chamber 14 having a valve seat 16 at its outer end. An axial reduced diameter inwardly tapered bore 18 extends from the outer end of the chamber 14, the diameter of said bore being the same diameter as the smaller diameter of said valve seat 16. At the outer end of said bore 18 there is an outwardly extending fluid passage 20 connecting the bore 18 with an enlarged tapped bore 22 for reception of a fitting 24 to which a column connector 26 is attached.

There is a carrier gas inlet passage 28 in the lower body part 10a connected to a source of suitable carrier gas by a conduit 30, said passage 28 being connected with the chamber 14. There is also an annular groove 32 in the inner face 34 of the lower body part 10a of greater diameter than the diameter of the chamber 14, there being an interface seal 36 in said groove to provide a seal between the forming parts of the body, said seal being of any suitable character but being shown as an O-ring.

The upper body part 10b includes an outward or upward, externally threaded extension 38 and there is a shuttle bore 40 extending through said upper body part in axial relationship to the chamber 18, there being a reduced diameter part 44 at the rear end of said shuttle bore 40 defined by an annular, internal flange 46. Flange 46 has a rearwardly flaring valve seat 48 so that there are opposed valve seats at the ends of said chamber 18.

An entrance seal 50 is disposed on the upper or free end of the extension 38, said seal 50 being secured in position by an internally threaded seal cap 52 screwed onto the extension 38. Entrance seal 50 has an axial passage or opening 54 therethrough which is somewhat smaller in diameter than the diameter of the needle of a syringe or syringe apparatus, indicated generally at 56, to be inserted therein as described hereinafter. The outer end of said passage 54 is flared, as at 58, and is of greater diameter at the outer end. The outer or upper side of the entrance seal 50 is engaged by the inner side of the end wall 60 of the seal cap 52 so that the larger diameter of the flared part 58 of the passage through the entrance seal is adjacent said inner side of wall 60. The latter has a cap

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bore 62 therethrough which is of substantially the same diameter as the larger diameter of the flared part 58 and the outer or upper end of said passage 62 is also flared at 64 to facilitate insertion of the needle.

The upper part 10b of the body 10 also has a carrier gas passage, indicated at 66, communicating with the shuttle bore 40 and which has a connection with a source of carrier gas by means of conduit 68.

There is a shuttle, indicated generally at 70, slidably disposed in the shuttle bore, reduced diameter part 44 of the bore, and chamber 18.

Shuttle 70 has a main body portion or stem 72 with a radially extending flange 74 at the upper end, the flange being of somewhat smaller diameter than the diameter of the shuttle bore 40 so that the shuttle will slide freely in said bore 40 but will be operably guided thereby.

At its lower end shuttle 70 has a reduced diameter neck 76 terminating at its downward end in an enlarged head 78 which has a diameter substantially the same as that of the stem 72.

The neck 76 has an upwardly extending externally threaded part 80 which is screwed into a tapped bore 82 provided therefore in the adjacent end of the shuttle. The end of the stem to which the neck and head are secured has a seat 84 for a seal 86, said seat tapering downwardly to the neck 76. At the opposite end of the neck the head has a seat 88 arranged oppositely relative to the seat 84 and the free end of said head is tapered or somewhat pointed as at 90. There is a cross-bore 92 in the neck between the seats 84 and 88 and there is a passage 94 through the shuttle stem from the flanged end whereat said passage flares outwardly as at 96. At the opposite end of passage 94 there is a reduced diameter passage 98 connecting passage 94 with the cross-bore 92.

A doughnut shaped seal 100 is disposed on the neck 76 of the shuttle, said seal is shown as being an O-ring and it may be of any suitable character, "Teflon" being found to be very satisfactory. "Teflon" is the trademark of the Du Pont Company for their fluorocarbon resins. The O-ring may be circular in cross section but it has been found that better results are obtained by having the O-ring generally square in cross section, as best shown in FIG. 3. The corners may be slightly rounded.

The inside diameter of the O-ring is larger than the outside diameter of the neck 76 and the O-ring is easily installed by unscrewing the neck and head from the stem 72 of the shuttle, placing the O-ring on the neck and then screwing the neck back onto the stem.

When the shuttle is disposed within the shuttle bore, there is a spring 102 which reacts between flange 46 and the flange 74 of the shuttle.

Normally, the shuttle is at its spring urged position as shown in FIG. 1. When in this position, the seal or O-ring 100 sealingly engages the valve seats 48 and 88 of the body and shuttle head respectively, the shuttle flange 74 then being spaced from the entrance seal 50. Carrier gas flows from a suitable source, passes into the passage 28, into the chamber 14, bore 18 and passage 20, thence through the fitting 24 and column connector and into the chromatograph column. Carrier gas supplied to the passage 66 flows into the shuttle bore, into the space between the shuttle flange 74, and out the passage 54 through the seal cap and seal cap bore 62 thereby flushing the shuttle bore.

The injector or syringe apparatus 56 used with the present inlet includes a needle which also serves as a barrel 108 that is cylindrical and is of suitable material such as stainless steel, for example. A needle tip, indicated generally at 110, is attached to the forward end of the barrel of any suitable material such as a suitable metal. For example, this tip may be of stainless steel. The tip 110 has a forward end portion 112 which tapers toward the front end and a rear end portion 114 that is cylindrical and is disposed in a forward end portion of the

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barrel being secured therein by any suitable means such as brazing or the like. The portion 114 is of reduced diameter relative to the rear end of the tapered portion 112 thereby providing a shoulder 116 against which the forward end of the barrel abuts. A passage 118 extends longitudinally throughout the length of the tip.

Slidably within the barrel is a plunger head 120 carried at the forward end of a plunger rod 122 which is longitudinally slidable within the barrel. Plunger head 120 may be of any suitable material such as neoprene, "Teflon" or other suitable plastic. The plunger rod is provided with a suitable head, not shown, to facilitate actuation thereof.

Adjacent the inner end of the rear part 114 of the tip the barrel has a side opening or port 124. When the plunger head 120 is at its forward limit of movement it is in abutment with the rear end 126 of said rear part 114 and closes the inner end 118a of the passage 118. When the plunger head 120 is retracted the inner end 118a of passage 118 is open as well as the port 124.

When the needle is inserted into the inlet, the plunger head is at its forward position closing the inner end 118a of passage 118 and the port 124. The needle is inserted through the cap bore 62, the passage 54 of the entrance seal 50 and into the shuttle bore 94; the tapered tip 110 of the needle engages the shoulder 130 rearwardly of the cross bore 82 of the shuttle as shown in FIG. 2.

Further movement of the syringe apparatus 56 inwardly moves the shuttle forwardly causing the O-ring to slide back on the neck 76 of the shuttle until it engages the seat 84 and is moved into engagement with the seat 16 at the bottom of chamber 14. There is thus sealing engagement between said seats 16 and 84. The opening or passage 54 in the entrance seal is closed by the needle, said entrance seal effecting a seal about the needle. With the shuttle at its downward position described above and the needle in the passage 54 the flow of carrier gas from both inlet passages 28 and 66 is shut off.

The plunger rod is then retracted which effects retraction of the plunger 120 to uncover the inner end 118a of passage 118 and the port 124 of the syringe. Carrier gas then enters said port and flows through the tip bore 118 thereby entraining the sample in the syringe and carrying it through the shuttle bore, fixture 24, column connector and into the column of the chromatograph.

It is desirable to heat the inlet and for this purpose one or more electrical heating elements or cartridges 134 are installed in bores 136 provided therefore in the lower body part 10a. These cartridges are of well known character.

I claim:

1. An inlet for chromatographs, comprising:

(A) a body having a bore therein and a carrier gas inlet passage and a carrier gas outlet;

(B) a shuttle slidably movable in said bore between a normal inoperative position and an operative position, said shuttle having means for controlling the flow of carrier gas, said shuttle having a bore with an inlet at one end and an outlet adjacent the opposite end;

(C) and yielding means urging the shuttle to the inoperative position, the shuttle means being positioned for carrier gas outlet while shutting off flow of carrier gas to the shuttle bore inlet and shutting off communication between the shuttle bore outlet and the carrier gas outlet;

(D) and when said shuttle is moved to its operative position said shuttle means cuts off flow of carrier gas to the carrier gas outlet, diverts carrier gas flow to the inlet of the shuttle bore and opens communication between the shuttle bore outlet and the carrier gas outlet.

2. The invention defined by claim 1, including an entrance seal at the outer end of the bore in the body, said seal having an opening therethrough in alignment with

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the shuttle bore, said opening through the entrance seal being of smaller diameter than the diameter of a needle of a syringe apparatus for effecting a seal with said needle when inserted in said opening.

3. The invention defined by claim 2, wherein said body has a second carrier gas inlet communicating with the bore in said body for flushing said bore and said opening in the entrance seal when said opening is open.

4. The invention defined by claim 1, wherein said means includes a pair of opposed and axially spaced valve seats adjacent the inner end of the bore of the body, and said shuttle has a reduced diameter neck at the inner end with opposed seats at the ends of said reduced diameter neck, and a doughnut shaped seal on said reduced diameter neck of the shuttle, the seats at the ends of said reduced diameter part of the shuttle being spaced apart a greater distance than the thickness of the seal so that said seal will move on said neck from one seat to the other and into sealing engagement with respective opposed valve seats adjacent the inner end of the bore of the body with movements of the shuttle between inoperative and operative positions, the outlet end of the bore in the shuttle comprising a cross bore in the reduced diameter neck of said shuttle intermediate the ends thereof so that said cross bore is cut off from communication with the carrier gas outlet when the shuttle is in the operative position and in communication therewith when said shuttle is in the operative position.

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5. The invention defined by claim 4, wherein said seal is an O-ring generally square in cross section.

6. The invention defined by claim 2 in combination with a syringe type apparatus having a needle sealingly receivable in the opening through the entrance seal and engageable with an inlet portion of the shuttle bore whereby said shuttle may be slidably moved to the operative position by said syringe apparatus.

7. The invention defined by claim 6, wherein said body has a second carrier gas inlet communicating with the bore in said body.

8. The invention defined by claim 6, wherein the needle of the syringe type apparatus has a side opening, and a plunger in said syringe apparatus for controlling said side opening, said needle having a tip shaped for entrance into the inlet end of the bore of the shuttle and for engagement with the wall of the shuttle bore.

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