March 17, 1970 R. A. ARMS 3,501,176

CONNECTOR ASSEMBLY

Filed April 11, 1968

Fig. 2.

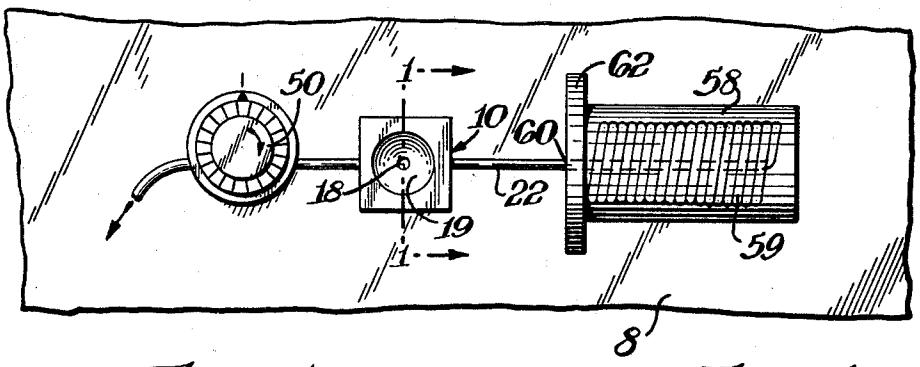



Fig. 4.

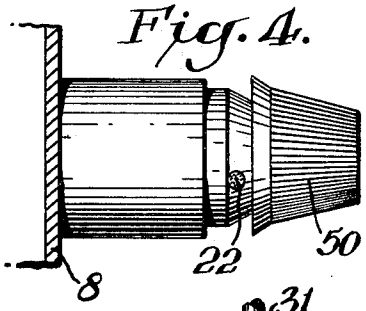



Fig. 3.

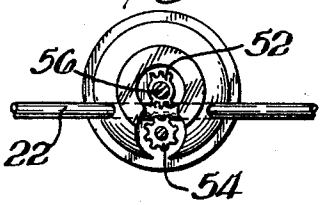



Fig. 1.

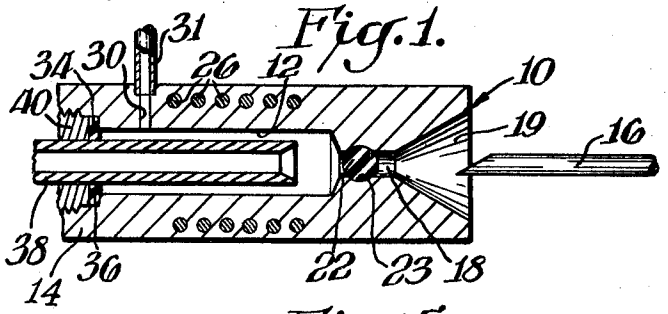



Fig. 5.

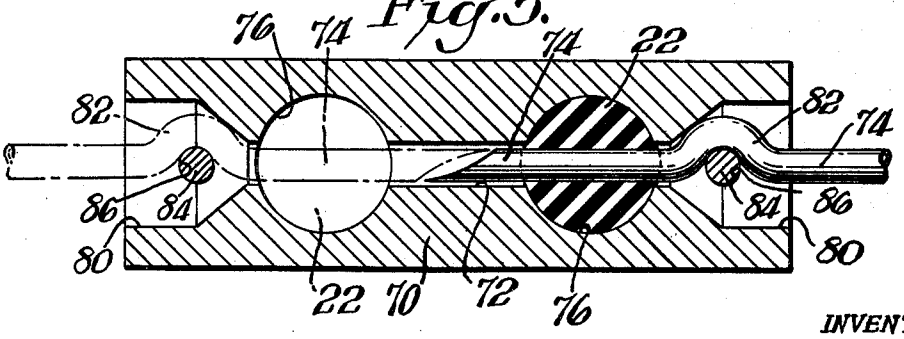
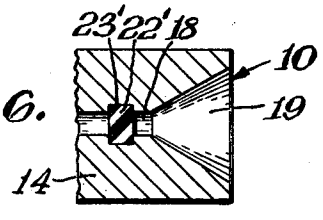



Fig. 6.




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# CONNECTOR ASSEMBLY

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U.S. Cl. 285—305 5 Claims

## ABSTRACT OF THE DISCLOSURE

A connector assembly uses a continuous septum to effect a fluid seal. In one application, the conventional disc shaped septum in the injection port of a gas chromatograph is replaced by an elongated strip of septum material which is disposed transversely across the inlet of the injection port. A hypodermic needle or syringe may then be inserted through the elongated septum material and liquid or gas samples introduced therethrough. After each or several insertions of the needle, the elongated septum may be repositioned along its axis so as to present a new untouched portion of septum material to the needle. In another application, continuous strip-like septums are positioned at either end of a cavity to permit the interconnection of capillary sized tubes.

This invention relates to a connector assembly and, more particularly, to a connector assembly having particular advantages when used in the field of gas chromatography.

## BACKGROUND OF THE INVENTION

In the field of gas chromatography a small liquid sample is introduced into and vaporized in the so called injection block of the gas chromatograph. The injection block is located at the inlet end of a separating column and is heated to cause flash vaporization of the sample when injected. The sample usually is injected by means of a syringe or hypodermic needle through a self-sealing material, referred to as a septum, which seals the interior of the injection block from the atmosphere. A carrier gas is swept across the backside of the septum and into the column to transport the vaporized sample through the column for separation and subsequent detection.

The syringe, which often is capable of dispensing the sample in microliter quantities, may be operated either manually or automatically. Regardless of whether the operation is manual or automatic, after the septum has been used one or more times, it can be contaminated with the sample so as to degrade the analytical results. Additionally, with usage, the septum tends to develop leaks, also resulting in degraded analytical results. Whether the problem be leaks or contamination, it must be replaced. Replacement is a time consuming process since the chromatograph usually must be cooled down so that the operator may replace the septum. Such operation requires anywhere from one-half up to as much as three hours after the chromatograph is shut down until it again can be brought up to temperature and operation resumed. This loss of time is appreciable and undesirable to say the least.

When working with fluids, it is often necessary to connect fluid carrying conduits together. For this purpose many diverse tubing connectors have been developed. Many of these are difficult to use, expensive and require a wrench or other tool to effect the coupling. The septum described above is but one type of connector assembly. It couples the syringe to the separating column of a gas chromatograph.

It is, therefore, an object of this invention to obviate



many of the disadvantages of the prior art connector assemblies.

Another object of this invention is to provide an improved continuous septum for usage in the injection block of a gas chromatograph.

## BRIEF DESCRIPTION OF THE INVENTION

The improved connector assembly of this invention includes a tubular member which defines a cavity having an axis and inlet and outlet openings. The tubular member is of sufficient size to receive capillary sized tubes such as the needle of a syringe through either or both of its inlet and outlet openings. A self-sealing elongated member is positioned in the inlet and/or outlet of the tubular member with the member's axis intersecting that of the tubular member. The tube or tubes to be coupled are inserted through the elongated member. To renew the seal provided by the elongated member, it is drawn along its axis relative to the inlet and/or outlet.

In a preferred embodiment of this invention the connector assembly is adapted for use as the injection block of a gas chromatograph. When so adapted, the outlet opening of the tubular member has the inlet of a gas chromatograph column inserted therein. A self-sealing, elongated member has its longitudinal axis disposed in the inlet opening of the tubular member with its axis intersecting the axis of the cavity. In this manner, the elongated member is a substitute for the normal disc-like septum and is adapted to be punctured by a syringe for the introduction of a sample to be vaporized and swept through the separating column. If the elongated member develops a leak due to successive punctures or becomes contaminated, the member is drawn across the inlet to expose a new portion to the syringe.

## BRIEF DESCRIPTION OF THE DRAWINGS

The novel features that are considered characteristic of this invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation as well as additional objects and advantages thereof will best be understood from the following description when read in connection with the accompanying drawings, in which:

FIGURE 1 is a cross-sectional view taken along lines 1—1 of FIG. 2 illustrating an injection block utilizing a continuous septum constructed in accordance with this invention;

FIGURE 2 is a partial front elevation view of the front of a gas chromatograph showing the injection port and the elongated septum constructed in accordance with this invention;

FIGURE 3 is a front view of the driving mechanism having the driving knob removed for pulling the elongated septum illustrated in FIG. 2;

FIGURE 4 is a side view of the mechanism employed to draw the elongated septum through the injection port for its replacement;

FIGURE 5 is a cross-sectional view of a tubing connector assembly, adapted to interconnect two capillary size tubes, constructed in accordance with this invention; and

FIGURE 6 is a partial cross-sectional view of a rectangular elongated septum.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. 1 there is shown a preferred embodiment of the invention. In this embodiment the connector assembly of this invention is substituted for the injection block of a conventional gas chromatograph. Such connector assembly includes a rectangular body member **10** which may be formed of stainless steel, aluminum or other suit-

able material. A bore **18** is formed in the body member **10** to provide a cavity therein. One end **14** of the body member **10** (the lefthand end in the drawing) is counter bored at **12** and the other or inlet end **19** is flared as to facilitate the insertion of a syringe **16** into the cavity for the injection of a sample. Only the needle portion of the syringe **16** is illustrated. Immediately adjacent the inlet **19** to the cavity there is formed a radial bore or orifice **23** whose axis intersects the axis of the cavity to accommodate an elongated septum member **22** of self-sealing septum-like material. Typically, this may be formed of a silicon rubber or any other suitable material capable of accommodating a hypodermic needle or a capillary sized tubing such as employed on syringes.

The elongated member **22**, which may be termed a septum rope, is perhaps best seen in FIG. 2. There the front face portion **8** of a typical gas chromatograph is partially illustrated. Also seen in the illustration of FIG. 2 is the head-on view of the flared or conical inlet **19** which accommodates the syringe **16**. The elongated member **22** is drawn through the radial orifice **23** in the body member **10** by any suitable means. Typical of one such means is that illustrated in FIG. 2 which includes a knob **50** which may be rotated by hand. The knob **50** drives one of a pair of closely spaced but not engaged knurled or toothed gear wheels **52** and **54** which may be best seen in FIG. 3. The upper gear wheel **52** is turned directly by the knob **50** which drives a shaft **56** on which the gear wheel **52** is mounted. The elongated member **22** is passed between the gear wheels **52–54**. The spacing between the wheels **52–54** is less than the diameter of the elongated member **22** so that when the upper gear wheel **52** is rotated the member **22** is drawn or pulled through the radial orifice **22** from the supply cartridge **58**.

The supply cartridge **58** may be mounted on the front of the chromatograph panel **8** as by a clip (not shown) and may be a hollow cylindrical chamber in which the elongated member **22** is wound in a roll **59** and withdrawn through the inside of the roll through a hole **60** in the front cap **62** of the supply cartridge **58**. Although the manual knob **50** is shown for the means of drawing the elongated member **22** through the radial orifice **23**, it is to be understood that any other mechanical or electromechanical drive mechanism may be employed. For example, an electric motor actuated by a manual switch or automatic control circuitry may be used to drive the gear wheel **52**. Alternatively a solenoid may be operated to rotate a ratchet which incrementally advances the elongated member **22** in accordance with electrical signals. The electrical signals in turn, if desired, may be derived from a computer or other control mechanism which is related to the injections made.

The side walls of the injection block (FIG. 1) are kept relatively thin in order to facilitate maximum transfer between heating coils **26** which are coiled about the body member **10**. The entire assembly including the heating coils **26** and the body member **10** are then preferably cast within a heat conductive metallic block which acts as a suitable heat sink. This reduces variations in temperature within the body member and facilitates the transfer of heat between the heating coil **26** and the body member **10**. An opening **30** is provided in the side wall of the body member **10** at a point along the counterbore **12** to permit the introduction of a suitable carrier. The carrier gas may be supplied through a tube **31** which may be soldered in place.

The counterbore **12** is counter bored to provide a shoulder portion **34** in which a ferrule **36** or other suitable gasket material such as an O-ring may be seated. The ferrule **36** provides a seal about a tubular insert **38** which is positioned coaxially within the counterbore **12**. The tubular insert **38** may be either the end of a separating column of a conventional gas chromatograph or may be the connecting tube of any fluid system. The tubular insert **38** or column, as the case may be, is held in place by the male insert **40** which is adapted to engage the ferrule **36** to provide a fluid or gas type seal for the interior of the cavity **12**. The column or insert **38** thus is in continuous communication to the remainder of the gas chromatograph or fluid system.

In this manner, a carrier gas introduced through the opening **30** flows along the outside of the tubular insert or column **38** into the area adjacent the elongated member **22** and then through the tubular insert or column **38** into the chromatograph system. This permits the backside of the strip septum or elongated member **22** to be completely flushed of all sample material by the carrier gas.

To inject a sample into the injection block for vaporization and entrainment in the carrier gas, one need merely insert the syringe **16** into the center of the flared mouth **19** through the portion of the septum **22** and directly into the vaporization chamber itself. If now the septum through which the syringe is inserted becomes contaminated or damaged through usage or develops a leak during usage, one need merely rotate the knob **50** to advance the septum **22** through the radial orifice **23**. This presents an entirely new, unused portion of septum material for the next operation. Alternatively, the septum may be advanced after each and every injection such that the septum is punched only once in any one spot. This represents a decided advantage over conventional septums used in gas chromatographs. In each instance the instrument using a conventional septum must be cooled before the septum can be handled and properly replaced. This results in a shut down time of up to three hours in some instances. Furthermore, the simplicity of construction of this new strip-like septum greatly reduces the cost of constructing injection blocks.

To prevent leakage within the injection block cavity, the radial orifice **23** is formed to have a diameter less than that of the strip septum **22**. In alternative embodiments the elongated member or the strip septum **22** need not be cylindrical in cross section but rather may be rectangular as seen in FIG. 6, oval, or for that matter, any other cross-sectional shape. In the event that a rectangular septum **22'** is employed, it may be constructed to present a relatively small thickness to the incoming springe **16** such that it resembles in cross section a conventional septum. The radial opening **23'** is rectangular.

An alternative embodiment of the invention is illustrated in FIG. 5 which depicts a connector assembly utilizing two strip septums **22** to seal a connector assembly. Essentially, the connector assembly of FIG. 5 includes a block **70**, of suitable relatively rigid material such as stainless steel having a bore **72** through its length. The bore **72** is of sufficient diameter just to accommodate capillary sized tubes **74** of stainless steel or other material. Preferably, the bore diameter should not greatly exceed twice the diameter of the tubes **74** to minimize dead space in the flow path. A pair of radial bores **76**, intersecting the central bore **72** are formed in the block **70**. Elongated member or strip septum **22** is passed through the radial bores **76** in a manner similar to that described hereinbefore. The diameter of the strip septum should exceed that of the bores **76** to maintain a seal. Now if capillary tubes **74** (preferably sharpened) are inserted into the bore **72** from either end such that they are just short of touching within the central cavity portion, a communicating gas link is formed. When the tubes are withdrawn, different or new tubes may again be inserted through the septum. As the septum becomes leaky, damaged, or contaminated in any way, one need merely draw the two strip septums **22** through the radial orifices **76** as described.

To facilitate the insertion of the capillary sized tubes **74**, the central bore **72** in the cavity **70** may be counter bored as at **80** at either end to provide an enlarged portion. Finally, to prevent the capillary sized tube **74** from being pulled out through the strip septum material **22**, a crook **82** is formed in the tubes **74** closely adjacent their

ends. The crooks **82** provide an offset portion in the tubes **74** through which locking pins **84** may be passed. Radial holes **86** are drilled through the counter bored regions **80** at either end of the block **70** so as to intersect the axis of the main bore **72**. These locking pins **84** are inserted through the holes **86** to lock the tubes **74** in place and may be of stainless steel or other suitable metal.

In use, gas flowing from the left, in the drawing, through the tube **74**, shown in phantom passes into the righthand tube **74** through the small space provided by the bore **72**. Desirably, the diameter of the bore **72** should approximate, i.e., slightly exceed, that of the tube outside diameter to reduce dead space. Tubes appreciably greater than capillary size cannot be used for the simple reason that they tend to damage the septum material and cause leaks.

While the radial bores **23** (FIG. 1), **76** (FIG. 5), and **23'** (FIG. 6) have been described as having an axis which intersects the axis of the central bores **18** (FIGS. 1 and 6) and **72** (FIG. 5) it is to be understood that the angle of intersection $\theta$ has the limits $0<\theta\leq 90°$. The ninety degree or perpendicular intersection is preferred but other angles may be used as desired or circumstances of construction dictate.

There has thus been described a relatively simple, low cost connector assembly which may be used for removably connecting capillary sized tubes together and as the inlet end of the injection block of a gas analysis apparatus. Both devices use as the sealing mechanism a strip septum which may be continuously or incrementally drawn across the opening or openings of the cavity to be sealed. In this manner, the inner cavity is free from leaks and contamination and its replacement is easily accomplished.

While the invention has been disclosed herein in connection with certain embodiments and certain structural and procedural details, it is clear that changes, modifications, or equivalents can be used by those skilled in the art.

What is claimed is:

**1.** A sealed connector assembly for interconnecting two tubes comprising:

a member defining a cavity and having first and second bores defining corresponding first and second openings to said cavity, each of said bores being adapted to receive one of said tubes;

a third bore in said member having an axis intersecting the axis of said first bore,



a fourth bore in said member having an axis intersecting the axis of said second bore; and

first and second self-sealing elongated members, each having a longitudinal axis, and respectively disposed axially in said third and fourth bores, thereby to seal said cavity.

**2.** A connector assembly according to claim **1** which also includes:

means for securing said tubes against axial movement including separate pins adapted to be positioned in said first and second bores transversely to and on the axes of said bores and on the non-adjacent sides of said third and fourth bores,

said two tubes each having an offset portion adapted to engage the coresponding one of said pins.

**3.** A connector assembly according to claim **1** which includes means for incrementally moving each of said elongated members along their respective longitudinal axes through their respective bores, thereby to replace the seals for said cavity.

**4.** A connector assembly according to claim **3** wherein the respective cross-sectional areas of said elongated members exceed the respective cross-sectional areas of said third and fourth bores.

**5.** A connector assembly according to claim **2** wherein the respective cross-sectional areas of said elongated members exceed the respective cross-sectional areas of said third and fourth bores.


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U.S. Cl. X.R.

73—422; 285—369, 404