July 12, 1960 E. M. KATZIN 2,944,548

VENTING STRUCTURE

Filed March 18, 1957

Fig. 1

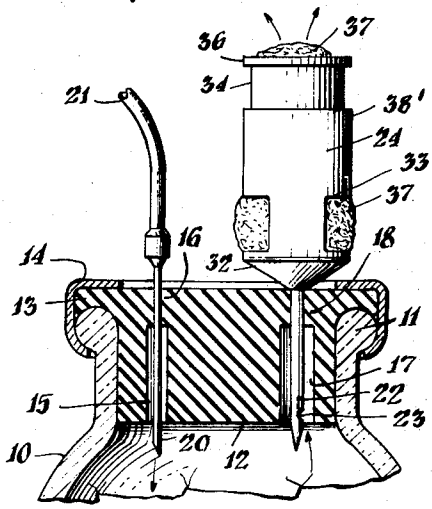


Fig. 2

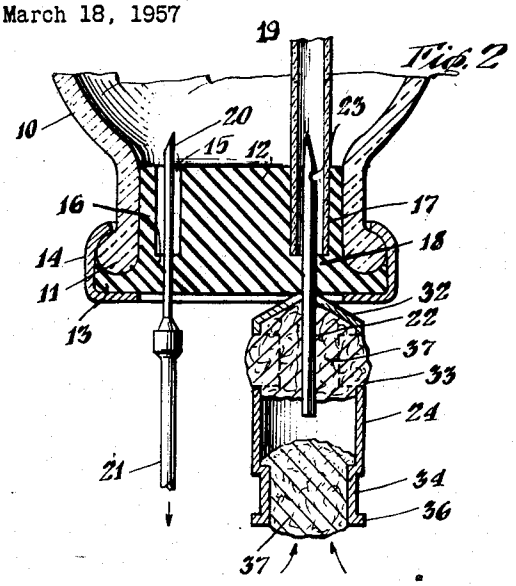


Fig. 3

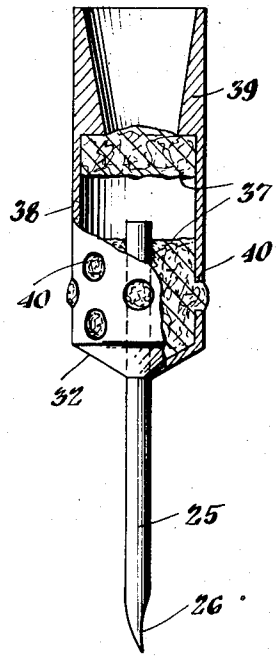


Fig. 4

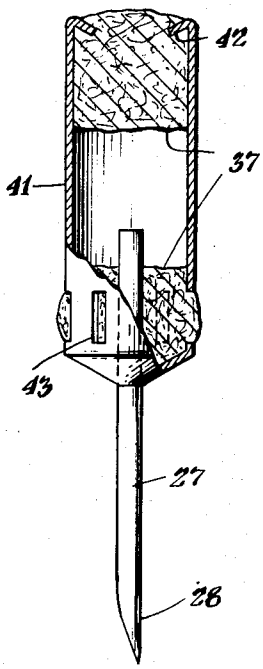


Fig. 5

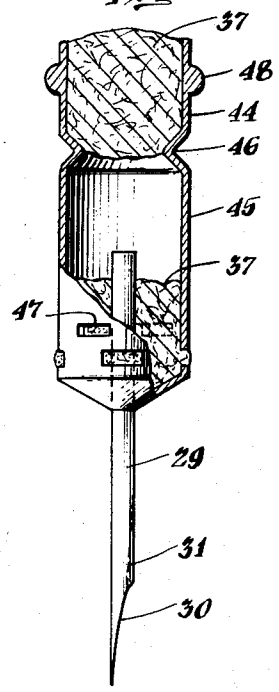
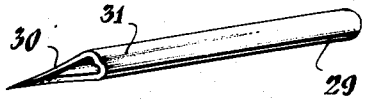


Fig. 6



INVENTOR
Eugene M. Katzin
BY
Kane, Dalsimer and Kane
ATTORNEYS

United States Patent Office 2,944,548 Patented July 12, 1960

2,944,548

VENTING STRUCTURE

Eugene M. Katzin, 50 Baldwin Ave., Newark, N.J.

Filed Mar. 18, 1957, Ser. No. 646,806

3 Claims. (Cl. 128—214)

This invention relates to a venting structure having new and improved functional characteristics, and primarily intended for use in connection with the flow of air or other gases when collecting or dispensing liquids of, for example, the blood and plasma types.

It is an object of the invention to furnish a structure of this nature which may readily be associated with the closure or seal of a flask or similar receptacle and to thereby provide an assembly which will assure proper venting of air through the closure regardless of whether the receptacle is in an upright or an inverted position; properly filtered air or other gases being solely embraced in that flow so that no contamination of the receptacle contents will occur.

Among further objects of the invention are those of furnishing an assembly which may be economically produced, which will effectively filter the air, or other gas, and render such gas free of bacterial contamination and will be capable of ready application to and removal from a closure, and which will act in such manner as to prevent accidental injury or death by air embolism. Also, after a single use, it may be discarded.

With these and other objects in mind, reference is had to the attached sheet of drawings illustrating practical embodiments of the invention and in which:

Fig. 1 is a sectional side view of the upper end of a receptacle with a closure applied thereto and the venting structure mounted thereby;

Fig. 2 is a view similar to Fig. 1 but showing the venting structure in section and the receptacle in inverted position;

Figs. 3, 4 and 5 are sectional side views in enlarged scale showing alternative forms of venting structure; and

Fig. 6 is a perspective view of a cannula suitable for inclusion in the assembly.

Referring primarily to Figs. 1 and 2, the body of the receptacle or flask has been indicated at **10**. This member terminates in an open neck portion, the outer edge of which is ordinarily defined by a bead **11**. A stopper including a plug **12** and head **13** seals the mouth of the receptacle by having its plug extending into the bore of the neck with its head overlying and engaging the surface of the pouring lip defined by bead **11**. The stopper is retained against accidental displacement by, for example, a ring **14** conveniently formed of metal. That ring overlaps the outer surface of head portion **13** and may have its skirt edges spun inwardly as shown to underlie bead **11**. Under these circumstances, removal of the closure from the flask is precluded unless the ring be destroyed and stripped from its mounted position.

The stopper will be formed with a suitable number of bores. Thus, bores **15** and **17** extend inwardly from the plug end of the same. They are provided with pierceable diagram portions **16** and **18**. Customarily, the bore **15** may have a smaller diameter than bore **17**. In line with the axes of these bores, the surface of head **13** may be

provided with marks indicating the zones of the diaphragm or diaphragms. A tube or "stalk" **19** (Fig. 2) made of glass or other suitable material may extend into bore **17** and within the receptacle **10** to a point closely spaced from the base thereof. It will be understood that the foregoing presents one preferred grouping of parts to furnish the seal assembly of a receptacle or flask. However, the structure may be modified in numerous respects in accordance with the specifications laid down by the manufacturer of the equipment.

Assuming, however, that an assembly of this general type is present and with which the novel venting structure of this invention is to be combined, it is customary to pierce diaphragm portion **16** by a cannula **20**. This is achieved by simply forcing the pointed end of the latter through the diaphragm. As shown, the piercing action may be continued until the point of the cannula extends beyond the inner face of the closure. The cannula is connected in any suitable manner with a tube **21**. Similarly, a cannula **22** may be introduced through diaphragm **18** and thus extend into the bore of the tube **19**, if the latter is employed. Both cannula **20** and **22** are preferably formed of metal. The lumen of the latter cannula may emerge as indicated at **23** from the side face of its shank. Attached to that end of cannula **22** which is opposite its point is a casing **24**.

Cannula **20** serves to introduce or remove fluids from the interior of receptacle **10**. Those fluids will ordinarily be blood or serium or plasma or intravenous nutriments or medications such as glucose, saline, distilled water (these in various combinations or concentrations), as well as intravenous fluids containing amino acids, vitamins, hormones, chemicals, pharmaceuticals, large molecule plastic suspensions, plasma extenders for fluid volume replacement, blood fractions (albumin, globulin, fibrinogen etc.). The point zone of cannula **20** may be of standard type as illustrated in Figs. 1 or 2, or may embrace any desired construction. It will be appreciated that when either of the cannulae are withdrawn, the perforations through diaphragm portions **16** or **18** may—as is usually required— automatically close so as to again establish an effective seal for the receptacle. Cannula **22** being usually of relatively large diameter, and serving by means of its lumen to provide a vent, it is definitely preferred to employ a needle of the "anticoring" type. Therefore, this unit has been shown as involving a piercing point with a side opening **23**.

This type of needle spreads the stopper diaphragm material (rubber, plastic, etc.) and does not tear or core the stoper. Also, as noted above, the diaphragm reseals upon withdrawal of the needle therefrom. Additionally, obstruction of the lumen of the cannula by stopper material is prevented. Various forms of end zone may be embodied in the cannula associated with the venting structure. For example, as in Fig. 3, the cannula **25** may be provided with an offset outer end portion **26**. As in Fig. 4, the cannula **27** may have its outer end terminate in an imperforate end wall defining the piercing point and with the end of the lumen lying within the plane of the opposite side wall of the cannula as indicated at **28**. The needle shown in Figs. 5 and 6 may embrace a body **29** with an end zone **30** into which a channel shaped depression **31** extends. By such a construction, spreading surfaces are furnished which, as the needle penetrates the stopper, prevent the material of the stopper from coring.

Aside from preventing obstruction of the lumen, it is important with liquids or gases in the receptacle, that an intact stopper diaphragm prevent contamination or loss during storage by precluding contact between the

inside and outside of the container. In the case of the filling of a receptacle with blood by phlebotomy, any obstruction of air flow can cause positive pressure to build up within the receptacle. Therefore, when the tourniquet on the donor's arm is purposely or inadvertently loosened, the entrapped air may reverse the blood flow and be forced up through the "filling" cannula, through the tubing connecting the donor's vein with the flask, and then into the donor's veins and cause serious or even fatal "air embolism."

In Figs. 1 and 2, it will be seen that the body of the unit includes part 24 which is generally cylindrical and terminates in an inner wall 32 firmly secured to the outer face of the cannula 22. The side wall of casing 24 is formed with openings 33. Its outer end conveniently terminates in a tubular casing portion 34 adjacent the inner end of the cannula 22 and an outwardly extending flange 36 at its free edge. This flange may define a fitting of the Luer type which will permit connection of body 24 with a syringe tip or other fluid-conducting unit. Masses of filtering material have been indicated at 37, one within the inner end of casing 24 and the other within portion 34. This material may embrace absorbent or "non-absorbent" cotton which will act as an efficient and adequate trap to filter out any bacteria suspended in air passing through the venting structure. The amount of filtration varies with the volume of air or gas to be passed, the rate of passage, etc. Various materials other than cotton may be employed such as, for example, glass wool, fibre-glass or rock wool, mineral wool, such as steel and asbestos wool. Also, there may be used paper or other cellulose fiber or plastic material so fabricated as to allow bores of adequately fine size such as porous plastic film, plastic or other "sponge" or foam forms. The material must of course lend itself to ready sterilization.

Referring to Fig. 3, it will be seen that the numeral 38 identifies a tubular body, the outer bore zone of which may be defined by an inwardly tapered passage 39 capable of receiving and having its surface grip a tapered nozzle such as that of a syringe. It is furnished with openings 40 adjacent its cannula end. The masses or plugs of filtering material 37 are disposed one adjacent that end and the other adjacent the inner zone of the tapered portion 39. As a consequence of the flange which defines that zone, a shoulder or retaining portion is furnished which prevents accidental dislodgement of the uppermost plug 37 in an outward direction.

In Fig. 4 a tubular body has been indicated at 41 and which has its outer edge zone 42 extending inwardly into the bore to thus furnish a retaining part preventing dislodgement of the outer plug or mass 37. Body 41 is furnished with an annular series of ports 43 adjacent its inner end. In line with these, the second plug of material 37 may be disposed. In Fig. 5, body portions 44 and 45 are furnished and between which an indented part or groove 46 exists. Against the inner surface of the latter, the outermost plug 37 may bear. The inner plug is disposed adjacent the inner end wall of the structure and in a zone where the latter is furnished with openings 47. Conveniently, body portion 44 may have extending from its outer face a bead or flange 48. This will furnish a retaining structure for any tube which may be ensleeved over the body 44—45 for purposes hereinafter brought out.

As is well understood in the practice of medicine and in laboratory work, receptacles of the type which require venting may be used in an upright or in an inverted position. The former has been shown in Fig. 1 while the latter has been illustrated in Fig. 2. When employed in connection with a flask having an inverted position, air must be admitted to the interior of the latter to replace liquids such as blood, glucose, saline, amino acids, molar lactate solution, etc., etc. in administration. Where, for example, gravity collection of blood is being practiced and the flask is in an upright position as in Fig. 1, the venting structure must allow the escape of gas such as air from the flask. Where the assembly is applied to a container under high vacuum, it must admit air without danger of the filtering material "packing down" and thus becoming inoperative. In the case of blood collection by gravity, should any blood or preservative solution be forced up through the cannula by the escaping displaced air, such liquid would in the usual way wet the cotton or other filtering material and make it substantially impenetrable to air. This would also occur in the case of collection of blood which may be mixed with liquids such as acid-citrate-dextrose solution, or citrate, or chelating or other anti-coagulant and preservative solutions, or mixtures of such solutions with blood. In the case of an inverted container with the latter connected for intravenous, subcutaneous or other uses, liquid will frequently flow down and moisten the bacterial filtering material. This, in effect, will also make the usual air vent inoperative.

However, by having two areas of filtering material, one of which cannot be contaminated or moistened by the flask contents when upright, while the other cannot be moistened with the container or flask in an inverted position, it is apparent that under all circumstances an effective venting structure and bacterial filter is achieved. As in Fig. 2, liquid may pass through the lumen of cannula 22 and into contact with the lower plug 37. However, the inner end of the cannula being disposed between the two filtering bodies, it is apparent that air will be free to flow through ports 33 and the upper body of filtering material into the lumen of the needle and discharge into the flask through opening 23. As in Fig. 1, any liquid flowing through this port into the lumen of the cannula 22 and out its upper end will deposit on the filtering body 37 adjacent end wall 32 and will not destroy the effectiveness of the structure. This will be because the plug of material 37 within portion 34 will not receive the liquid thus discharged and will therefore remain operative.

The same is true of the structures embraced in the forms illustrated in Figs. 3, 4 and 5 in which, in each instance, the inner end of the needle is disposed intermediate the bodies of filtering material. In common with the structure shown in Fig. 1, bodies 38, 41 and 44—45 may be provided with an exterior indication such as 38'. This may be in the form of indicia, color-marking, a flattened surface, etc. In any event it relates the face of the outer end of the needle lumen to the external surface of the assembly. Accordingly, an operator may at all times know the direction in which the cannula opening is lying so that this opening may be turned away from the inflowing blood or other fluid. This will avoid any probability of any sputtering, bubbling, or splashing liquid from entering the lumen of the structure when the receptacle is in upright position, by turning the openings in the cannulae of the venting and the filling needle 180 deg. away from one another. This will also prevent "short circuiting" in instances in which the inflow of material is very rapid and the air or gas content of the receptacle is very quickly displaced. Under such conditions some degree of positive pressure may be built up within the receptacle. Also, in the case of plastic or flexible containers, air or gas currents can be set up in rapid filling. In such cases incoming gas or liquid, can by these currents, be deflected or shunted from the filling cannula opening to the venting structure opening with greater or lesser loss of material being introduced. This, as indicated above can largely be avoided by turning the openings of the cannulae away from one another.

Indentations, extensions, such as lateral bars, rings, or other devices may be added to the outside of the venting structure to give "purchase" or grip and to act as shields to prevent the fingers from touching the stopper surface and to give greater bearing or gripping surface

to force the cannula through the diaphragm and to later remove it.

As will be observed, the body of the unit is adequately long to provide a sufficient grip for the fingers when the cannula is being forced through the diaphragm portion **18**. In this manner, the fingers will remain spaced from the sterile surface of the stopper as well as the outer wall of the cannula. It is apparent that in order to exert negative or positive pressure to the interior of the container through a venting structure such as the present, a section of tubing of any proper material connected to the source of pressure or vacuum may be employed. This tubing will simply be slipped over the exterior of bodies **24**, **38**, **41** or **44—45** a sufficient distance to close the side wall openings of the same. Where so disposed, flange **36** or bead **48** may assist in retaining the tubing from accidentally slipping over the bodies. Obiously, if it were desired not to ensleeve the tubing completely over the bodies, then the openings of the latter might be closed in any desired manner.

Thus among others, the several objects of the invention as specifically aforenoted are achieved. Obviously numerous changes in construction and rearrangements of the parts might be resorted to without departing from the spirit of the invention as defined by the claims.

I claim:

1. A venting structure including in combination a single cannula having a pointed closure-piercing end, a hollow body secured to said cannula and surrounding its opposite end, a side wall forming a part of said body and having an opening, another opening of said body being defined by a tubular end thereof, filtering material within such body adjacent said openings and said opposite needle end being disposed at a position intermediate such openings.

2. A venting structure including in combination a single cannula having a pointed closure-piercing end, a tubular body, a wall at one end of said body and secured to said cannula whereby the opposite end of the latter is surrounded by said body, the side wall of said body being formed with openings adjacent said end wall, a mass of filtering material disposed within such body adjacent said openings, a second mass of filtering material within said body at a point opposite said end wall, said body being unobstructed at such end and said opposite needle end extending into a space existing between said masses of filtering material.

3. A venting structure including a tubular body formed with openings in its side wall, a pointed cannula attached to one end of said body, a mass of filtering material within said body and adjacent said cannula, a second mass of filtering material disposed adjacent the open end of said body and the masses of filtering material being separated with the inner end of said cannula extending into the space defining that separation.

References Cited in the file of this patent

UNITED STATES PATENTS

2,100,610	Paisley et al.	Nov. 30, 1937
2,416,391	Hinson	Feb. 25, 1947
2,473,153	Lager	June 14, 1949
2,568,108	Barton	Sept. 18, 1951
2,581,331	Ryan et al.	Jan. 1, 1952
2,775,240	Morrisey et al.	Dec. 25, 1956

FOREIGN PATENTS

190,388	Great Britain	Dec. 21, 1922
1,071,557	France	Mar. 3, 1954