Jan. 16, 1951 C. C. ABBOTT 2,538,662

EXPENDABLE VALVE UNIT FOR SURGICAL APPLIANCES

Filed Jan. 24, 1950

Fig. 2.

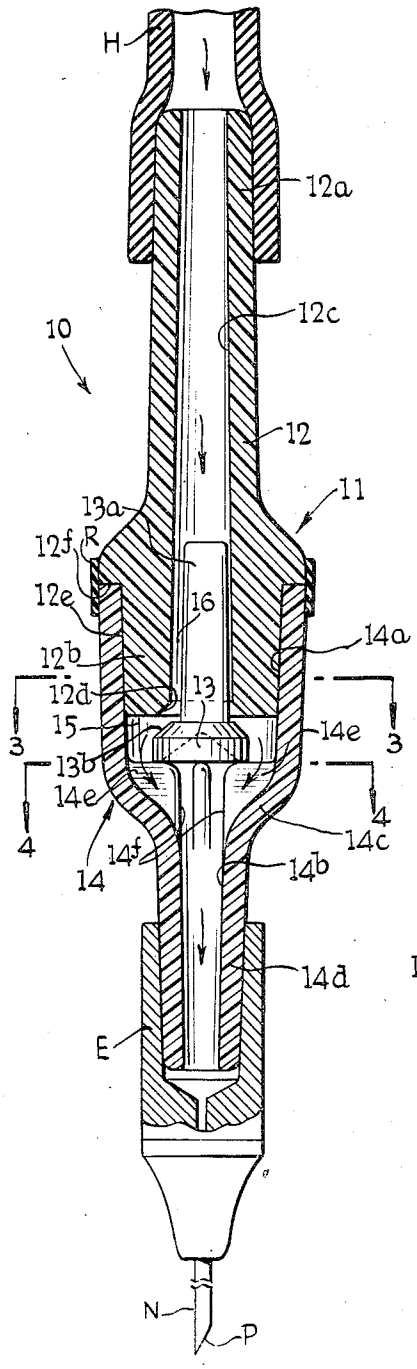


Fig. 3.

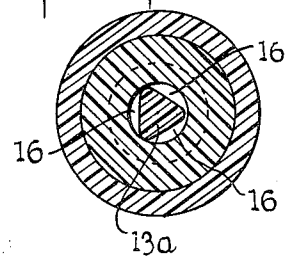


Fig. 4.

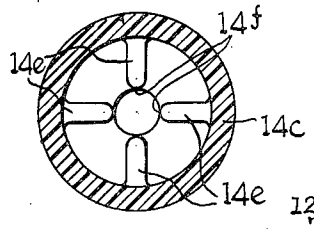


Fig. 5.

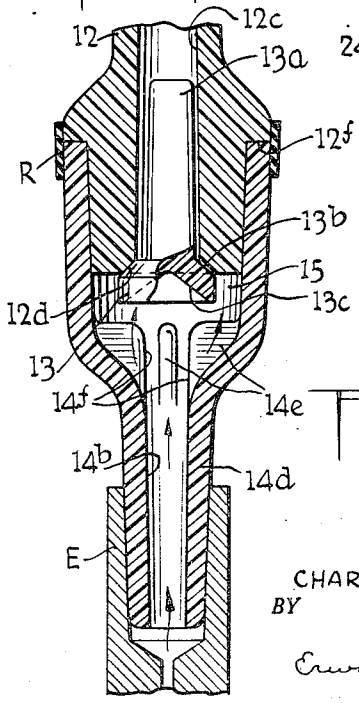


Fig. 1.

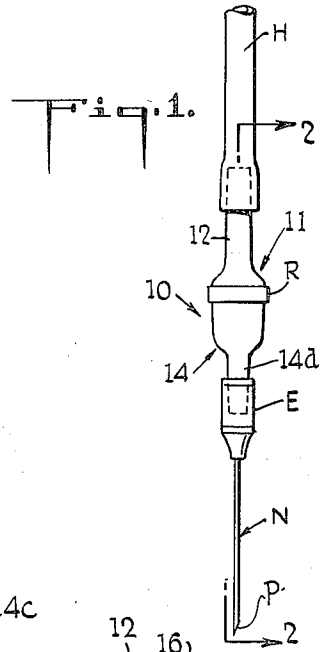
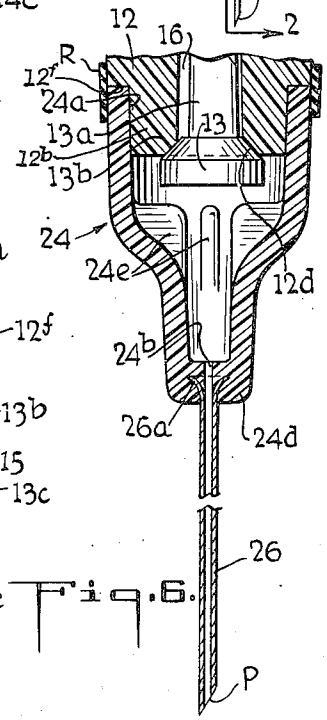


Fig. 6.



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EXPENDABLE VALVE UNIT FOR SURGICAL APPLIANCES

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6 Claims. (Cl. 128—214)

1

This invention relates to surgical apparatus for the intravenous administration of liquids, such as, whole blood, blood plasma, dextrose solutions, and the like, and is directed particularly to improved expendable valve unit constructions used in such apparatus.

Among the objects of the invention is to generally improve valve constructions of the character described, which shall comprise few and simple parts that are easily assembled yet rugged to withstand rough usage, which shall be cheap to manufacture from thermo-plastic resinous material as by injection molding in quantity production so that as a practical matter the article may be used only once and discarded, which shall be sensitive to minute changes in direction of flow at minimum velocity, which will be reliable in operation, which shall be readily adapted to provide valve and valve incorporating hypodermic needle constructions, and which shall be efficient and practical to a high degree in use.

Other objects of this invention will in part be obvious and in part hereinafter pointed out.

The invention accordingly consists in the features of constructions, combination of elements, and arrangement of parts which will be exemplified in the constructions hereinafter disclosed, the scope of the application of which will be indicated in the claims following.

In the accompanying drawing in which possible illustrative embodiments of the invention are shown,

Fig. 1 is a plan view of an assembly of a fluid delivery tube, expendable valve unit, and a hypodermic needle apparatus embodying the invention.

Fig. 2 is an enlarged cross sectional view taken on line 2—2 in Fig. 1 showing the valve unit in open position, the directional arrows indicating the flow of fluid toward the needle of said apparatus.

Figs. 3 and 4 are enlarged sectional views taken on lines 3—3 and 4—4, respectively, in Fig. 2 showing the cross sectional structure at an upper and lower portion, respectively, of the valve unit.

Fig. 5 is a fragmentary sectional view similar to Fig. 2 but showing the valve unit in closed position, the directional arrows indicating momentary reverse pressure of fluid away from the needle, and

Fig. 6 is a fragmentary enlarged sectional view similar to Fig. 2 of a modified form of the invention showing the needle construction as part of the valve bonnet.

2

Referring in detail to the drawing, 10 denotes an apparatus constructed to embody the invention such as may be employed for the intravenous administration of physiological fluids from a delivery container (not shown) in any well known manner. Said apparatus 10 may comprise a delivery tube or hose H detachably connected to a valve unit 11, and hypodermic needle N demountably secured to terminate said valve unit 11, the latter being so arranged to permit the free flow of said fluids only in one direction, that is, toward the needle N and preventing backing up or draining of body fluids in an opposite direction.

As seen in Fig. 2, valve unit 11 may comprise an inlet member 12 which connects with delivery hose H at one end 12a of said member 12 and formed with a male coupling portion 12b at the other end thereof, a floating gate 13 having a projecting stem 13a, and a bonnet outlet fitting 14 which is detachably mounted on said coupling portion 12b to extend therefrom and to restrict floating gate 13, to limit movement thereof in an enclosed chamber 15 within unit 11, as is clear from Figs. 2 and 5.

Inlet member 12 may be an elongated tubular structure having an axial through-bore 12c, said member 12 being of less outside diameter at hose connecting end 12a than at coupling end 12b. Said bore 12c terminates within the coupling end 12b in an outwardly tapering surface 12d to provide a seat for a corresponding shaped rim closure surface 13b provided on gate 13, as shown in Figs. 2 and 5.

Coupling end 12b of member 12 may be cut back on the exterior thereof as at 12e to provide shoulder abutment 12f and for forming a frictionally retained tight joint with end and interior surfaces 14a of outlet fitting 14.

Bonnet outlet fitting 14, as seen in Figs. 1 and 2, may have a tubular wall of substantially uniform thickness extending about an axial bore 14b which is expanded at one end, that is, a female end portion, to form with said joint forming surfaces 14a said frictionally retained tight joint. Said fitting 14, when mounted on coupling end 12b, provides the enclosed chamber 15 in which gate 13 freely operates for said limited movement. Fitting 14 may have an intermediate neck 14c adjoining said expanded end, said neck 14c being extended into a relatively short tapering outlet portion 14d sized and shaped to frictionally fit inlet end E of hypodermic needle N opposite beveled pointed end P. Said axial bore 14b, if desired and as here shown, aligns with

axial bore 12c, the latter preferably being of larger cross sectional area than bore 14b.

Gate 13 may be disc shaped having said closure surface 13b formed on one side thereof and said stem 13a of polygonal cross section integrally formed therewith to upstand from the same side of gate 13 as closure surface 13b. Said stem 13a is loosely fitted to extend in bore 12c and as shown in Figs. 2 and 3, when of triangular cross-section, is sized to be inscribed in said bore 12c, the longitudinally extending edges of stem 13a serving as a centralizing guide for keeping floating gate 13 in registering alignment in opening and closing operations thereof. The side opposite closure surface 13b may be formed with hollow 13c to reduce the effective weight of floating gate 13.

To limit the free movement of gate 13 in chamber 15 and to bring said gate 13 into most efficient operating position in bonnet fitting 14, chamber 15 may be provided with a plurality of spaced apart integrally formed fins 14e projecting radially inwardly from the tubular wall thereof in the intermediate neck 14c, said fins 14e having edges 14f longitudinally disposed in alignment with bore 14b of outlet portion 14d, thereby providing spaced apart passageways communicating directly said chamber 15 and bore 14b, said gate 13 being of overall smaller diameter than the interior diameter of space in chamber 15 wherethrough said gate 13 moves in the operation thereof as is clear from Figs. 2 and 5.

After forming the parts as described above by injection molding from thermoplastic resin, as for example, polystyrene, nylon or any other suitable material, the valve unit 11 may be readily assembled by inserting stem 13a of gate 13 into bore 12c and then coupling end 12b of member 12 with expanded end of outlet fitting 14, the edge thereof engaging shoulder abutment 12f to provide said frictionally retained tight joint therebetween. If desired in order to further secure said joint against accidental separation and to form an additional seal an elastic rubber band or a suitable adhesive tape means R may be positioned to overlie the jointure of shoulder abutment 12f and expanded end of outlet fitting 14.

Valve unit 11 can, if desired, then be sterilized in any suitable well understood manner either by chemical agents such as alcohol or by heating in an autoclave, and packed in a sterile package ready for use.

The operation of valve unit 11 will now be apparent. After assembling the parts as described above, sterile valve unit 11 is easily mounted in position in surgical apparatus 10 by inserting inlet member end 12a into hose H and outlet portion 14d into inlet end E of hypodermic needle N. Needle N is then inserted for delivery of a physiological fluid into the body and as long as fluid pressure flow is maintained in the direction of the arrows shown in Fig. 1, gate 13 will assume an open position against fins 14e permitting a flow of the fluid through needle N into the body. Upon release of pressure a reversal of the direction of flow takes place and gate 13 will be displaced from the open position shown in Fig. 2 to a fully closed position shown in Fig. 5. In order to increase the sensitivity of the operation of valve unit 11, in all relative positions so that the slightest reversal of flow will close gate 13, the space size in passageways 16 between stem 13a and wall of bore 12c may be of capillary tube dimensions so that the flow of fluid in said reverse direction will act to draw gate 13 closed by so-called "capillary attraction" on the stem 13a to augment the pressure force applied directly to gate 13 by said reverse flow of fluid.

It has been found that valve unit 11 of a practical size substantially like that shown in Fig. 1, bore 12c of about one eighth of an inch in diameter when used with stem 13a of substantially triangular cross-section inscribed within a circle of slightly less diameter, and said stem 13a having a length of about one half of an inch renders satisfactory results.

A modified form of the invention is shown in Fig. 6 in which instead of making the needle N detachable from valve unit 11 a base holder 24 is provided of suitable plastic material with a metallic needle 26 permanently mounted to extend therefrom, said needle being of any conventional construction. As here shown a flared anchored end 26a of needle 26 may be embedded in an end 24d of base holder 24 having a through-passage 24b which aligns with axial bore of needle 26. Like in bonnet outlet fitting 14 above described, base holder 24 may be formed with fins 24e radially spaced with respect to through-passage 24b and base holder interior portion 24a frictionally fitted to coupling portion 12b against shoulder abutment 12f to provide a chamber 15 in which gate 13 operates so that, when closed, closure surface 13b fits against seating surface 12d and gate stem 13a extends into bore 12c of inlet member 12.

Modified form of the invention shown in Fig. 6 may be assembled, sterilized and packaged as described above for valve unit 11 and will operate in a similar manner as a combined valve and needle unit.

By making valve unit 11 or said modification of a transparent thermoplastic resinous material, except needle N, a so-called unbreakable unit is provided and the flow of fluid through the surgical apparatus 10 will be visible at all times.

It will thus be seen that there are provided expendable valve unit constructions for surgical appliances whereby the several objects of this invention are achieved and which are well adapted to meet the conditions of practical use.

As various possible embodiments might be made of the above invention, and as various changes might be made in the embodiments above set forth, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense but any permissible change must fall within the purview of the claims in this application.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. A surgical device of the character described comprising an inlet member formed with an axial bore of substantially uniform cross-section, a tapering hose engaging portion at one end of said member and a male coupling portion of enlarged cross-section with respect to said hose engaging portion terminating in a valve seat surrounding an inner end of said bore at the other end of said member, a bonnet outlet fitting formed with a tubular wall of substantially uniform thickness having a female end portion extending over said male coupling portion to form a tight joint therebetween, said female end portion enclosing a valve chamber therein beyond said valve seat, a floating gate moveably mounted within said chamber having a stem of polygonal cross-section extending part way into said inlet member bore, a surface of said gate disposed with relation to said

valve seat for opening and closing communication between said chamber and said inlet member bore, said bonnet outlet fitting having an axial bore extending from said chamber through an outlet end portion and formed with a neck intermediate said female end portion and said outlet end portion, spaced apart fins integrally formed within said neck, said fins each having edges in longitudinal alignment with said outlet portion bore, said fins having edges extending transverse the chamber for limiting the free movement of said gate, the wall of said inlet member bore and the polygonal contour surfaces of said stem forming passageways therebetween of capillary dimensions along said inlet member bore, and a hypodermic needle having an axial bore mounted on said bonnet fitting outlet end portion with said needle bore in direct aligned communication with said bonnet fitting bore.

2. The surgical device as defined in claim 1 in which said needle is of conventional construction, said bonnet fitting outlet end portion being tapered to size and shape to form a frictional coupling joint for said mounting of the needle thereon.

3. A valve unit of the character described comprising an inlet member formed with an axial bore of substantially uniform cross-section, a tapering hose engaging portion at one end of said member and a male coupling portion of enlarged cross-section with respect to said hose engaging portion terminating in a valve seat surrounding an inner end of said bore at the other end of said member, a bonnet outlet fitting formed with a tubular wall of substantially uniform thickness having a female end portion extending over said male coupling portion to form a tight joint therebetween, said female end portion enclosing a valve chamber therein beyond said valve seat, a floating gate moveably mounted within said chamber having a stem of polygonal cross-section extending part way into said inlet member bore, a surface of said gate disposed with relation to said valve seat for opening and closing communication between said chamber and said inlet member bore, said bonnet outlet fitting having an axial bore of smaller cross-section than said inlet member bore extending from said chamber through an outlet end portion and formed with a neck intermediate said female end portion and said outlet end portion, spaced apart fins integrally formed within said neck to project radially inwardly thereof, said fins each having edges in longitudinal alignment with said outlet portion bore, said fins having edges extending transverse the chamber for limiting the free movement of said gate, the wall of said inlet member bore and the polygonal contour surfaces of said stem forming passageways therebetween of capillary dimensions along said inlet member bore.

4. A valve unit as defined in claim 3 in which said bonnet outlet fitting terminates in a hypodermic needle having an axial bore in direct alignment with said fitting bore.

5. In a surgical device of the character described, a one-piece bonnet fitting having a tubular wall of substantially uniform thickness formed with an expanded female end portion for extending over a male coupling portion to form a valve chamber therein, said fitting having an intermediate neck and an outlet end portion formed with an axial bore extending therethrough from said chamber, spaced apart fins formed within said neck to project radially inwardly therefrom below said chamber, said fins each having edges in longitudinal and radial alignment with said outlet portion bore, and a hypodermic needle having an axial bore terminating said bonnet fitting with said bores in alignment.

6. In a surgical device as defined in claim 5, in which said bonnet fitting is a molded structure, having an end of the hypodermic needle permanently anchored in said outlet end portion.

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