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A SIMPLE CONTINUOUS-FLOW BLOOD TRANSFUSION INSTRUMENT*

MICHAEL DEBAKEY, M.D.
NEW ORLEANS

The ideal method of blood transfusion; that is, one characterized by simplicity of technic and facility of performance by which a readily determinable and known quantity of whole, unmodified blood could be quickly and easily transfused has long been the desideratum of transfusionists. This is evinced by the expositions of innumerable and ingenious apparatuses abounding in the literature. If it were not for the technical difficulty, the sacrifice of an artery and the inability of calibration, the direct method would be physiologically the most desirable. Thus, the optative method is one which most closely approaches the direct method and for this reason there have been attempts to utilize the "milking-tube" principle in blood transfusion. However, up to the present time these have been bulky, impractical, and have always had the added objectionable feature of "creeping" of the tube. The method described here is based on this principle, but is of such simple construction as to be free of the previously attributed disadvantages.

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* From the Department of Surgery, Tulane University School of Medicine, New Orleans.

DESCRIPTION

The instrument consists of a circular base section, 2 (Figs. 1, 2, 3) having a right angled

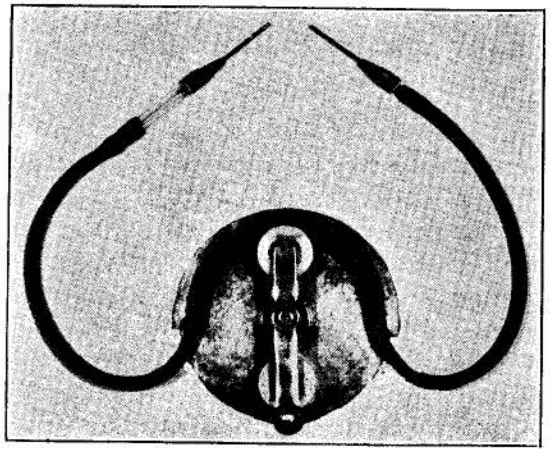

Figure 4. Photograph of instrument. Note the donors' needle on glass adaptor.

peripheral projection, 4 (Figs. 2, 3) throughout approximately 180° of its periphery. An approximate semicircular member, 6 (Figs. 1, 2, 3) is adapted to be placed over the right angled peripheral projection, 4 (Figs. 2, 3) of the circular base, 2 (Figs. 1, 2, 3) and bolted into position by means of studs, 8 (Figs. 2, 3) and thumb screws, 10 (Figs. 2, 3). The rubber tube, 12 (Figs. 1, 2, 3 a) having a flange, 14 (Figs. 2, 3, 3a) on one side is placed against the inside portion of the right angled peripheral projection, 4 (Figs. 2, 3) and secured by placing the semicircular member, 6 (Figs. 1, 2, 3) over the flange, 14 (Figs. 2, 3, 3 a) of the

rubber tube, 12 (Figs. 1, 2, 3 a) and bolting the semicircular member, 6 (Figs. 1, 2, 3) to the right angled peripheral projection, 4 (Figs. 2, 3).

The rubber tube is made of a semitransparent pure gum rubber, having a lumen of 1/8" in diameter of constant size throughout and surmounted by a flange substantially as shown in the cross-section (Fig. 3 a), which flange is an integral part of the tube and is of the same material. The tubing is glass hardened so that its inside surface is as smooth as glass. The flange, 14 (Fig. 3 a) is securely fitted between the right angled peripheral projection, 4 (Figs. 2, 3) and the bolted semicircular member, 6 (Figs. 1, 2, 3), thus stabilizing the rubber tubing and preventing any "creeping", which has been an objectionable feature in those previously described instruments utilizing this principle. The tube is also calibrated to pump 2cc. of fluid with each complete revolution of the crank.

A hinged crank arm, 16 (Figs. 1, 2, 3) is pivotally secured to the circular base, 2 (Figs. 1, 2, 3) by means of the crank pin, 18 (Fig. 3) being placed through a bearing, 20 (Fig. 3) upstanding from the center of the circular base, 2 (Figs. 1, 2, 3). The crank arm, 16 (Figs. 1, 2, 3) is provided with two rollers, 22 and 24 (Figs. 1, 3), spaced equally apart from the crank pin, 18 (Fig. 3) and in such a way as to compress the rubber tube, 12 (Fig. 1) between either roller, 22 or 24 (Fig. 1) and the right angled peripheral projection, 4 (Figs. 2, 3) and the semicircular member, 6 (Figs. 1, 2, 3). As

Fig. 1.

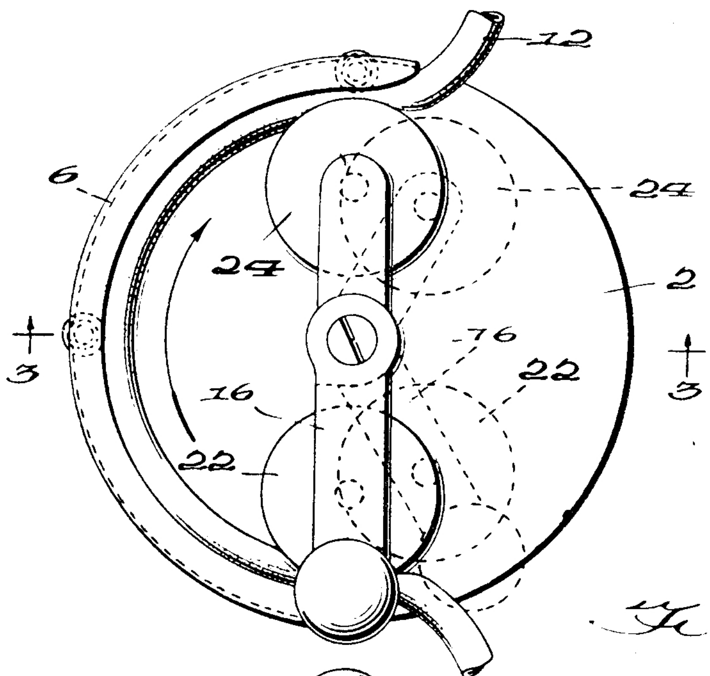

Fig. 3a.

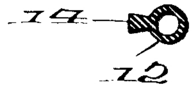

Fig. 2.

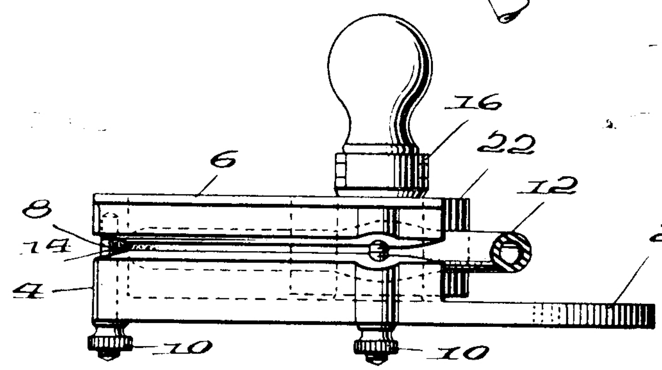

Fig. 3.

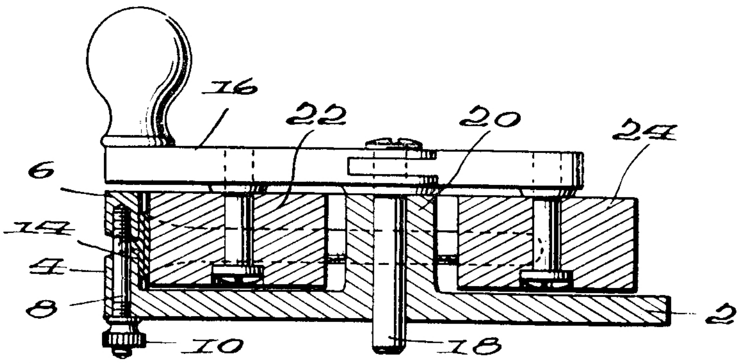

Figure 1. Plane view. Diagrammatic representation of instrument.
Figure 2. Side view of instrument.
Figure 3. Cross-section of instrument.
Figure 3a. Cross-sectional representation of tube.

the crank arm, 16 (Figs. 1, 2, 3) is rotated in a clockwise direction, the rollers, 22 and 24 (Fig. 1) will successively compress the rubber tube, producing a "milking" effect and thus force the fluid content in a clockwise direction. If the crank arm, 16 (Fig. 1) should be rotated in a counter clockwise direction, the crank arm, 16 (Fig. 1) and the rollers, 22 and 24 (Fig. 1) will assume the position disclosed in dotted lines in Fig. 1, thus releasing compression of the tube and preventing the flow. This flexing will be immediately perceptible to the operator and the counter-clockwise direction of rotation will be promptly discontinued. This flexing of the crank arms and rollers is also of useful advantage in installing and removing the rubber tube by eliminating the necessity of dissembling and assembling any part of the instrument when changing the tube.

OPERATION

After placing the flange of the tubing between the right angled peripheral projection, 4, and the semicircular member, 6, the nut screws, 10, are tightened and the instrument is sterilized in the autoclave or by immersion in 95 per cent alcohol. The instrument is now ready for use (Fig. 4). Sterile liquid petrolatum is first pumped through the tube by immersing the donor's end of the tube in a small container of this material and revolving the crank in a clockwise direction. Then by immersing this same end of the tube in a container of sterile normal saline the liquid petrolatum is washed

out, leaving the tube filled with saline and having an inert coating of mineral oil. The venepunctures are then performed and the respective needle adaptors fitted into the needles of the donor and the recipient and the transfusion begun by turning the crank in the clockwise direction. Each complete revolution gives 2 cc. of blood so that in order to give a transfusion of 500 cc. of blood two hundred and fifty revolutions are made. The donor and recipient ends of the tube are easily recognized by the fact that the former end of the tube emerges in a counter-clockwise direction, whereas the latter emerges in the clockwise direction.

COMMENT

The safety and efficiency of this instrument were first proven satisfactory by proper animal experiments and then put into use on the Tulane Surgical Services at the Charity Hospital and the Touro Infirmary. Up to date one hundred transfusions have been given, varying from repeated small transfusions of 250 cc. to as much as 850 cc. at one sitting. In every instance the transfusion was completed in a very short space of time with an average of approximately three minutes for the actual tranference of 500 cc. of blood. There was only one mild reaction in this group.

The advantages of this instrument are:

1. The assembly of the instrument consists only of securely placing the flange of the tube in its proper place.
2. Cleansing of the instrument merely means cleaning the tube and the needles.

3. The operation is extremely simple, consisting merely of revolving the crank.
4. Since the circuit of the instrument is so short, being the length of the tubing, about 18 inches, and the flow of blood constant, blood remains out of the body a correspondingly short time and the risk of clotting in turn is very slight. Moreover, there is no dead space in which clotting can initiate and no trauma or fragmentation of red blood cells by valve mechanism or syringe, the blood flowing continuously through a lumen of constant size.
5. ·The only necessarily sterile parts of the instrument are the tubes and the needles. These can be kept sterile in separate wrappers, thus eliminating the necessity parts.
   for several transfusion instruments.
6. The instrument can be manufactured at a very low cost and the up-keep is almost negligible as the only replacable part is the rubber tube, there being no breakable