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R. W. THAYER

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TRANSFUSION APPARATUS

Filed April 2, 1927

2 Sheets-Sheet 1

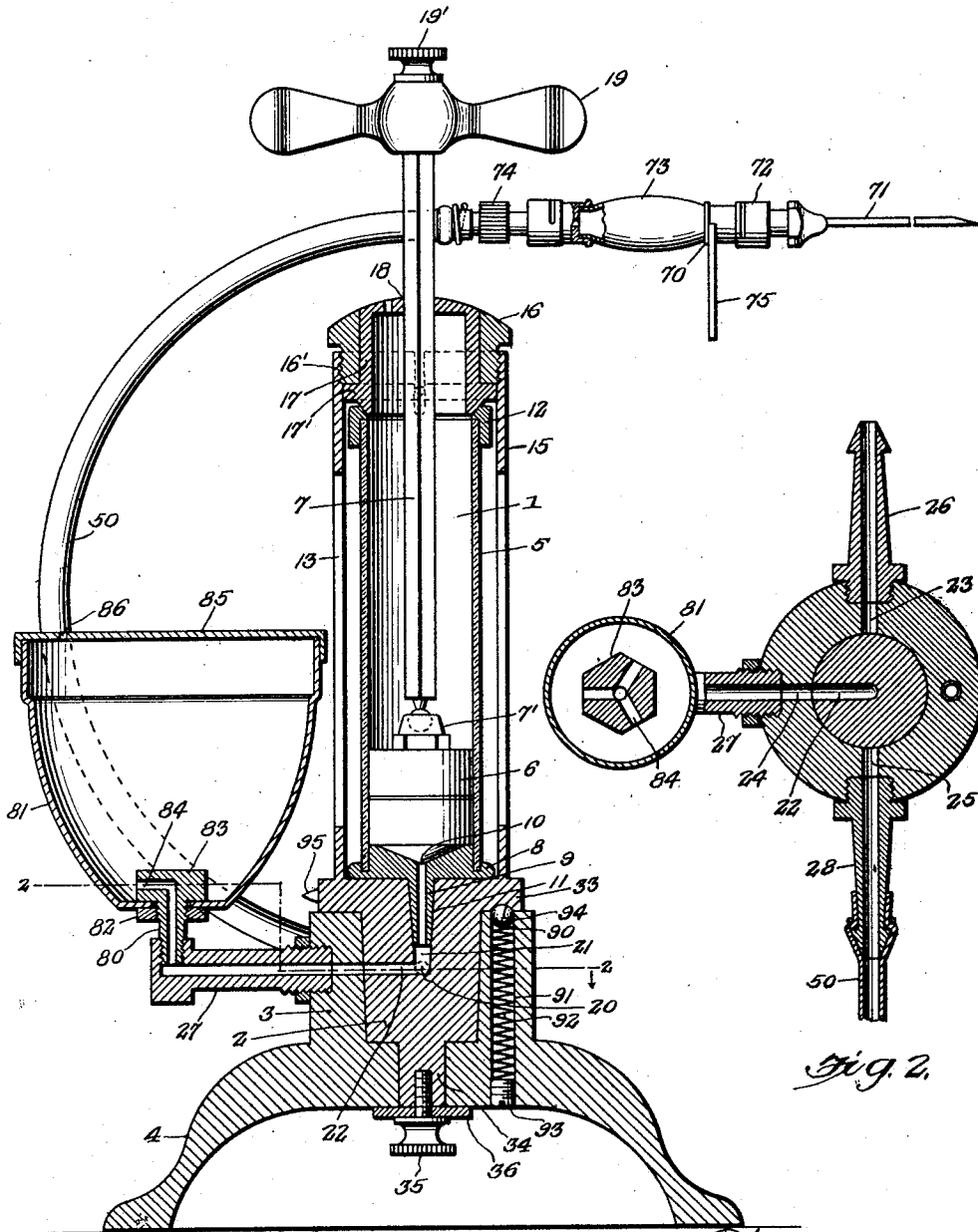


Fig. 1.

R. W. Thayer Inventor

By

A. B. Foster

Attorney

March 22, 1932.

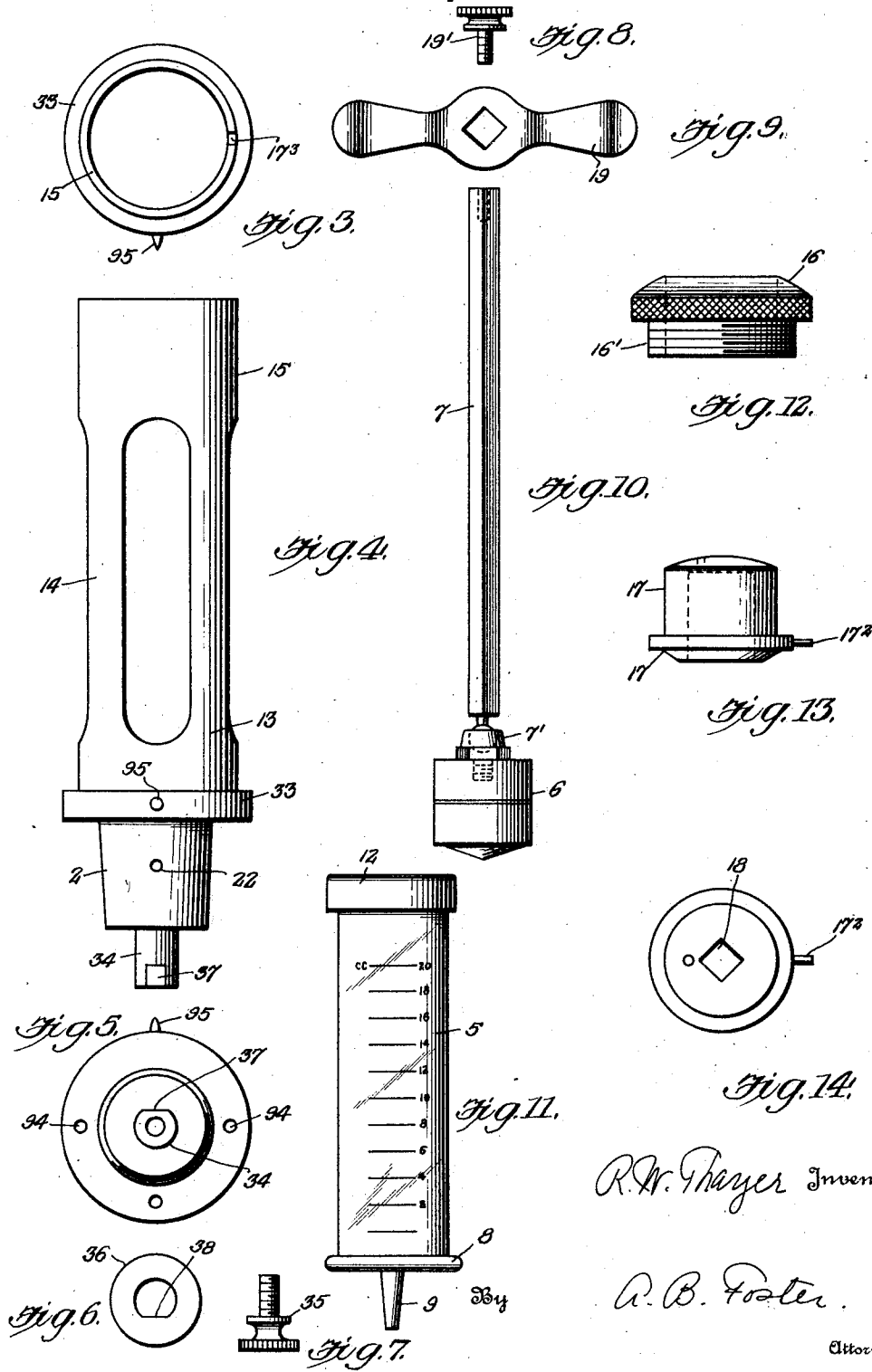
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R. W. Thayer Inventor

A. B. Foster.

Attorney

UNITED STATES PATENT OFFICE

ROBERT W. THAYER, OF LONG ISLAND, NEW YORK

TRANSFUSION APPARATUS

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This invention relates to apparatus for transferring fluids from one body to the other, particularly human bodies and also for withdrawal of liquids therefrom, as the removing of pathological fluids from the pleural, abdominal or other body cavities, or for injecting therein liquid medications. More particularly the apparatus forming the subject matter of this invention relates to means for removing of blood from one person and transferring it to another, a process generally known as blood transfusion.

One of the objects of the present invention is the production of a simplified and easily operated device whereby the operation of blood transfusion may be carried on with certainty, ease and satisfaction by a single operator. Another object of the present invention is the provision of an apparatus of the character described which can be readily prepared or dissembled for sterilization by a person ordinarily skilled in handling surgical and like instruments, and which contains no parts capable of being adversely acted upon by sterilizing heat or fluids. Still another object consists in the provision of an apparatus of the kind described which may be quickly taken apart, wholly or partially, after use, sterilized and quickly reassembled, thereby permitting the use of a single apparatus for several different operations, either of blood transfusion or of a different character. The invention also has in view the provision of a blood transfusion apparatus whereby blood may be removed from the person giving the blood, the donor, and injected into the person receiving the blood, the recipient or donee, at such a rate and regularity that clotting of the blood in the transfusion is eliminated, whereby the cooling action of ether on the blood syringes of prior devices becomes entirely unnecessary. Still a further purpose of the present invention is the production of a device of the kind described in which the control of the flow of the various fluids is under the complete control of a single hand of the operator, thereby leaving completely free the other hand for any purpose whatever. In accomplishing this last object not only is the actual propulsion of the liquids or fluids under the

control of the single hand of the operator but also their directions of flow and destinations are under the control of the same hand. The invention also has for its object the production of a device of the character described having a vertical pump cylinder or syringe mounted on a relatively large heavy base, whereby stability, strength, ease of operation, and prevention of leaks result. Further the invention contemplates the production of a device wholly constructed of metal or glass, without the use of rubber or like washers, gaskets, or packings, capable of destruction or of being attacked by the sterilizing medium or operation. The elimination of the danger of infecting the donor with the blood of the recipient is another object accomplished by the apparatus embodying the present invention. Still other objects of my invention are the production of a transfusion or hollow needle which permits the detection of the flow of blood or fluid therethrough, and the provision of a receptacle for saline or other liquid connected to the apparatus. Further objects and advantages of the invention will be in part obvious and in part specifically pointed out in the detailed description which follows, taken in connection with the accompanying drawings which disclose a preferred embodiment of the invention. Such embodiment is to be taken as illustrative, however, it being understood that variations may be made therein without departing from my invention.

The invention will be clearly understood from the following detailed description in which reference is made to the accompanying drawings wherein like reference characters indicate like parts in the several views or figures. In these drawings forming part of this case,

Fig. 1 is a vertical sectional view along the axis of the apparatus;

Fig. 2 is a cross-sectional view on the line II—II of Fig. 1, looking in the direction of the arrows;

Figs. 3 to 14, inclusive, are detailed views of parts of the apparatus shown in Fig. 1, in which Fig. 3 is a top end view and Fig.

5 a bottom end view of the part shown in Fig. 4.

Referring to the drawings, the apparatus comprises a pump or syringe 1, mounted vertically in a valve plug, cock or male member 2 which in turn is mounted in a valve socket or female member 3 in the wide heavy base member 4.

The pump or syringe 1 comprises a graduated glass or similar cylinder or chamber 5, in which is fitted a metal, glass, or porcelain piston head 6 closely engaging and accurately fitting the cylinder for reciprocating motion. The piston head 6 is attached to the lower end of the piston rod 7 by means of the ball and socket connection 7', whereby actuation of the rod 7 with an up and down motion will cause the piston head to ascend and descend in the cylinder 5. The cylinder 5 is closed at its lower end with a head 8, preferably constructed of metal, and provided with a nozzle or nipple 9 having a longitudinal channel 10. The nozzle 9 is gently tapered and fits accurately in a corresponding opening 11 in the cock or male member 2. The top of the cylinder 5 is open and protected by a metal rim 12. The lower part of the piston 6 is preferably cone shaped, as shown in Figs. 1 and 10, and the top of the head 8, within the cylinder 5, is funnel shaped and so proportioned that all the surface of the lower part of the piston 6 is in contact with the upper part of the head 8 when the piston 6 is in its lowermost position.

Upon the cock or male member 2, and preferably integral therewith as shown in the drawings, is the casing 13, comprising four spaced standards 14 connected at their bases to the upper and horizontal disk-like part 33 of the cock 2, and at their tops to the threaded header 15, with which the ring 16 is in threaded engagement. The ring 16 surrounds a cap 17 which is provided with an abutment 17' for engagement with the rim 12 of the syringe cylinder and the threaded part 16' of the ring 16. By screwing down the ring 16 the cap 17 is brought against the rim 12 of the syringe which becomes centered by the action of the bevelled part of the abutment 17'. The cap 17 carries a pin 17² which fits with a slot 17³ in the header 15 (see Figs. 3, 13 and 14), in order to prevent the rotation of cap 17 with respect to the casing 13 or header 15. The cap 17 is hollow within its interior and is provided with an air outlet opening as will fully appear from an inspection of Figs. 1 and 14. The hollow portion of the cap 17 is provided to accommodate the liquid seal which is usually employed above the piston 6. As the ring 16 is screwed down in position upon the header 15, a pressure is exerted upon the top of the cylinder 5 which securely forces the nozzle or nipple 9 of the head 8 into the open-

ing 11 of the cock 2, thereby producing a firm and leak-proof connection between the pump or syringe 1 and the cock 2. The spaces between the standards 14 of the casing 13 afford windows for viewing the pump cylinder, its contents and graduations as clearly shown in Fig. 4.

As heretofore indicated the piston rod 7 is connected to the piston head 6. This piston rod is shown in the drawings as having a cross section of the shape of a square. The cap 17 of the casing is provided with a squared opening 18 to receive the square piston rod 7. At the end of the piston rod is the handle 19 permitting the manual operation of the pump by raising and lowering of the piston. The handle 19 is secured to the piston rod 7 by means of the thumb screw 19¹. The piston rod 7 is square in cross section for the purpose of enabling the operator after reciprocation of the piston 6 to turn the cock 2, with its attached casing 13 and syringe 1, from one position to another, whereby blood, in case of a transfusion operation, may be taken from the donor and transferred to the recipient, by the use of a single hand of the operator. It is obvious that the piston rod 7 may have other shapes in cross section, accomplishing the same result, for example its cross section may be in the form of a triangle parallelogram, ellipse or any other shape compelling the cap 17 and its attached parts to follow a rotary motion given to the piston rod 7 by a rotary motion of the hand of the operator grasped to the handle 19. From the above arrangement it will be observed that the piston rod can be given a vertical reciprocating motion and the cock 2 can be changed from one position to another by the operator with but the use of a single hand, and without change of the hold of the hand upon the handle 19.

Referring more particularly to Fig. 1, it will be observed that the cock or male member 2, as heretofore described, is tapered and fits in a stop-cock relationship within the correspondingly tapered socket or female member 3 of the upper cylindrical part of the wide base member 4 which is preferably circular at its base. The base is of such weight, size and stability as to resist, without displacement from or rotation with respect to the support upon which it may be placed, the upward pull and rotation of the piston, while it is at the same time of such dimensions as to be easily manually transported. Such construction enables the apparatus to securely maintain its upright position. The male member 2 has a channel 20, comprising a vertical portion 21, connecting with the channel 10 of the head 8 of the syringe or pump 1, and a horizontal part 22 which may be placed in registry, by rotation of the cock 2 through handle 19, with either of the three openings 23, 24 and 25 in the upper cylindrical part

of base member 4. The openings 23 and 25 are preferably placed 180° apart as shown in Fig. 2 and the opening 24 midway between them or 90° from either. Connected by threading or other suitable means, with two of these three openings are nipples or connectors 26 and 28, the nipple 26 being connected to the opening 23 and the nipple 28 to the opening 25. A rubber hose or flexible fluid conveyor 50 is connected at one end to each of the nipples 26 and 28 and at the other end of each hose is connected a transfusion or hollow needle 70 for entry into the vein or artery of the donor or recipient. The nipple 26 or opening 23 is designed to receive blood, in the case of a transfusion operation, from the donor, which blood is delivered to the recipient through the opening 25 and nipple 28. The opening 24 and connector 27 and its attachments are to afford means for permitting the use of a saline solution or other solution with the blood transfusion or other operation.

The connector 27 is provided with a nozzle 80 which leads to the interior of the saline or other fluid receptacle 81. The nozzle passes through the bottom of the receptacle and is held in leak proof engagement therewith by means of a locking nut 82. The nozzle 80 is provided with a distributing head 83 provided with channels 84 as will appear in Figs. 1 and 2. The head 83 may be attached upon the nozzle 80 by screw-threads or the two parts may be formed from one piece. The purpose of the peculiar construction of the distributing head is to prevent liquid from being ejected from the cup when it is forced therein under great pressure. The force of liquid ejected from the channels 84 is spent against the sides of the receptacle 81. The receptacle 81 is provided with a cover 85 which is provided with an air opening 86.

It will be obvious from the above that when the handle 19 and piston rod 7 is given a rotating motion that the horizontal portion 22 of the channel 20 of the cock or male member 2 can be brought into registry with either of the three openings 23, 24 or 25. In order to limit the motion of the cock 2 so that its horizontal channel 22 will not escape registry with the openings 23, 24 and 25, when the cock is moved in either of these directions, suitable stop means is provided comprising a ball stop 90 pressed against the lower part of the disk-like part 33 of the stop cock member 2. The ball 90 is of sufficient size as to fit freely within the channel 91 in the base member 4 and female member 3, but is of sufficient size to prevent ejection from the top of said channel through the action of the pressing spring 92 held in position by means of the screw 93. This preventing of ejection of the ball stop 90 is accomplished by constricting the channel 91 at its upper end. The ball stop 90 is adapted to engage three depressions 94 in the lower

surface of the part 33 of the male cock member 2. See Figs. 1 and 5. The depressions 94 and ball stop 90 are so positioned that they will register with each other, and produce a distinct snap or arresting of motion, when the channel 22 is brought in registry with either of the openings 23, 24 and 25. The engagement of the ball 90 with the depression 94 is such as to only require a small amount of additional rotary force or torque on the handle 19 to disengage the connection. By this means the operator can easily judge when the channel 22 is in registry with any of the openings 23, 24 and 25. In order to advise the operator as to the position of the channel 22 with respect to the openings 23, 24 and 25, a pointer or indicator 95 is provided. See Figs. 1, 3, 4 and 5. Obviously other stop means may be employed accomplishing similar functions as the stop means above described and I do not intend to limit myself specifically to those described.

In order to secure from vertical displacement the cock or male member 2 and maintain a tight connection between the outer surface of the male member 2 and the surface of the female member 3, thereby preventing leaking while permitting free rotation of the male member 2, the parts 34, 35, 36, 37 and 38 are provided. See especially Figs. 1, 4, 5, 6 and 7. As will be seen from these views, the valve member 2 is provided with a stud 34 passing through an opening in the base member and the female valve member 2. The stud 34 has a flat portion 37 which engages the flat portion 38 in the metal washer 36 which surrounds the stud 34. The metal washer 36, which resists upward pulls upon the valve member 2, is held in position by means of the thumb-screw 35. The adjustment of the length of the stud 34 is such as to secure a tight fit of the valve members so as to prevent leaks, but the engagement is not so tight as to prevent relative rotation of the valve members 2 and 3.

Instead of the pump or syringe shown in Fig. 1 of the drawings, which is generally known to the medical profession as a Record syringe, there may be used a syringe whose piston entirely or practically entirely fills the cylinder in which it fits, the piston usually being made of glass, although for the purposes of this invention it may be made of metal or other suitable substance. Syringes of this latter type employing glass pistons are generally known to the profession as Leuer syringes. When syringes of this type are used the cap 17 is provided with a sufficiently large opening 18 to permit the piston to be elevated and depressed. In this case the shifting of male member 2 is not performed by means of the rotation of the piston, but must be performed independently.

The transfusion needle which I may employ is indicated by the numeral 70 in Fig. 1.

It consists of a steel or metal part 71, provided with a channel or hollow part. The needle is provided with a connector or lock, indicated generally by the numeral 72, connecting it with a transparent portion 73. The end of the transparent portion away from the needle is connected to the tube 50 by another connector or lock 74. The transparent portion 73 may be made of glass or other transparent resistant material and is cemented or secured in any suitable manner in the connectors 72 and 74. A winged portion 75 is provided as a rest or abutment for the finger when the needle is being inserted in the vein or artery. The connectors which I preferably employ for 72 and 74 are of a variety which permit of easy connection and disconnection of the needle part 71 or the hose part 50. The form of connector known as the Leuer lock is very suitable. I may omit the connector 72 and join the part 71 to the part 73 in a direct manner. In this last modification the transparent part becomes a part or an extension of the needle part 71. The purpose of the transparent portion is to indicate the exact instant that blood begins to pass through the needle, either from the donor or to the recipient. In this manner it can be ascertained with exactness and speed whether the needles are inserted in the donor or recipient in the proper position. Furthermore, the presence of air in and about the needle point can be detected.

The structure of the transparent portion of the needle may be modified by reducing the volume of the transparent section by making the glass walls thicker and the channel for the passage of fluids of substantially uniform diameter throughout its length. The diameter may be substantially equal to, or greater or less than the diameter of the channel in the hose 50.

The operation and use of my device in connection with a blood transfusion operation may be as follows:

The apparatus is sterilized by the ordinary methods. The donor and recipient are preferably placed opposite each other head to feet on beds or supports of the same height. The apparatus is placed between them preferably supported upon a board placed between donor and recipient. A few drops of sterile alboline may be placed on the valve parts 2 and 3 and in the inner surface of the pump or syringe 1 for the purpose of lubricating these parts. The apparatus is then assembled and the pump cylinder 5 filled with sterile normal saline by bringing the channel 22 in registry with the opening 24 and then raising the piston 6 from the fully depressed position by means of the handle 19 attached to the piston rod 7. A few centimeters of the saline should be inserted through the opening in the cap 17 upon the top of the piston 6 to seal it. It is likely that all the air will not be removed

from the cylinder by this one operation, due to the air in channels 10 and 20 which has not been expelled through depression of the piston 6. Accordingly it is necessary to elevate and depress the piston several times to make sure that all air has been expelled. If any is present it will usually accumulate directly below the piston 6 and can be readily observed through the openings between the standards 14. The saline used in the operation is placed in the receptacle 81 which connects with the opening 24. The needle for the recipient and the tube connecting it to nipple 28 are then filled with the saline by placing the channel 22 in registry with the opening 25, and gently depressing the handle 19 until the flow of saline is observed to take place from the end of the needle. In a similar manner the needle for the donor and the tube connecting it with the nipple 26 are filled with saline by bringing the channel 22 in registry with the opening 23. After the apparatus has thus been filled with saline, to avoid injection of air in the recipient, the needle connected to nipple 28 is inserted in the recipient and the recipient's vein treated with saline. The donor's vein is then entered with the needle connected to the nipple 26 and opening 23. It is important to get the proper flow of blood from the donor for the success of the operation. By pulling up on the plunger, comprising the parts 6, 7 and 19, when the channel 22 is in registry with the opening 23, the syringe or pump 1 is filled with blood from the donor. In this position the indicator 95 is above the nipple 26. The hand is not removed from the handle 19, but is then turned, while firmly holding handle 19, through an arc of 180°, or until the indicator 95 comes above the nipple 28, to rotate the valve member 2 into the position where the channel 22 registers with the opening 25 leading to the needle inserted in the recipient. The blood is then delivered to the recipient by depressing the plunger. Still keeping the hand firmly grasping the handle 19 of the plunger, it is rotated back through the same arc of 180° until the indicator is again above the nipple 26, that is, until the channel 22 is again in registry with the opening 23, whereupon the syringe is again filled with the blood of the donor by elevating the plunger. The above manipulation is repeated until the desired amount of blood is transferred to the recipient, the amount of blood being estimated by multiplying the capacity of the syringe by the number of fillings of the syringe with the donor's blood.

In case saline is wanted for any purpose, (for example to clean the syringe, to wash out needles, to increase the volume of fluid sent to recipient, to inject in donor, or for any other purpose or emergency) the valve member 2 is turned so that the channel 22 registers with the opening 24, in which position

the indicator 95 will be directly above and in alignment with the nipple 27, whereupon by lifting the plunger any desired height regulated quantities of saline may be drawn into the syringe from the receptacle 81. The movement of the valve member 2 in either direction by rotation of the handle 19 will permit delivery of the saline either to the opening 23 leading to the donor's needle or to the opening 25 leading to the recipient's needle.

It is to be understood that the use of my apparatus is not limited to blood transfusions but may also be used for the other purposes mentioned above, its use in these applications being obvious from the foregoing description. It is particularly suitable for intravenous medication, for example the administration of salvarsan; for aspiration of fluid from body cavities, or irrigations, and is very conveniently used for infiltration in local anesthesia.

What I claim is:

1. In an apparatus of the class described, the combination of a cylinder, a hollow cap for said cylinder extending the volume thereof, a casing surrounding said cylinder and means for connecting said cap with said casing to prevent relative rotary motion between them.

2. In an apparatus of the class described, the combination of a cylinder, a hollow cap for said cylinder extending the volume thereof, casing means surrounding said cylinder and means for connecting said cap with said casing means to prevent relative rotary motion between them and means for rotating said cylinder and casing means in unison.

3. In an apparatus of the class described, the combination of a cylinder, a hollow cap therefor increasing the volume of said cylinder, a valve member, means for connecting said cylinder with said valve member, securing means connected with said valve member for securing said cap upon said cylinder and means for preventing relative rotary motion between said cap and said securing means.

4. In an apparatus of the class described, the combination of a cylinder, a cap therefor, a valve member connected with said cylinder, a frame carried by said valve member, a ring surrounding said cap and engaging said frame for securing said cap in position, and means for preventing relative rotation between said frame and said cap.

In testimony whereof I affix my signature.

ROBERT W. THAYER.