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R. W. THAYER
TRANSFUSION APPARATUS

1,725,318

Filed Sept. 12, 1925

Fig. 1.

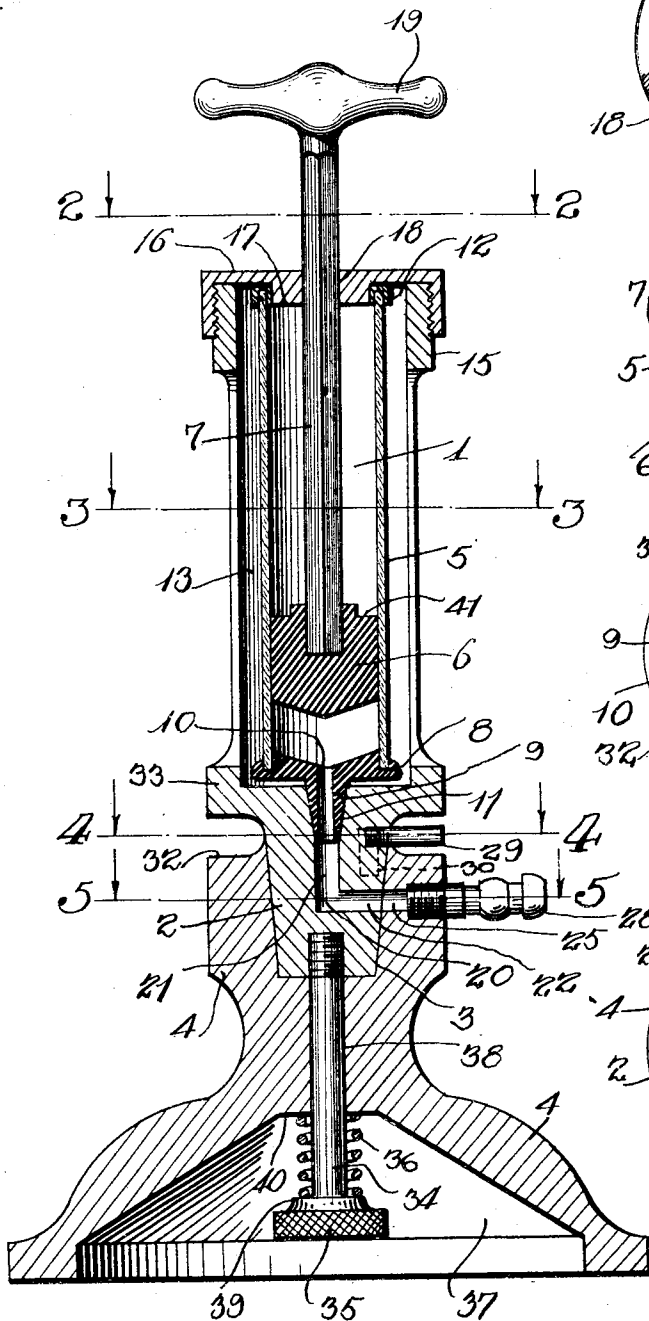


Fig. 2.

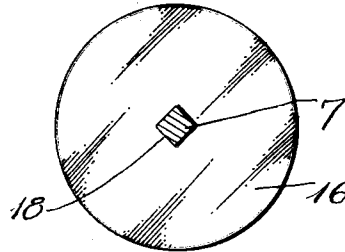


Fig. 3.

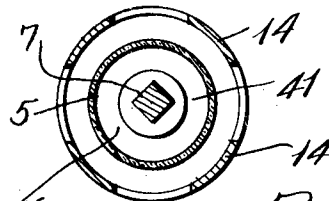


Fig. 4.

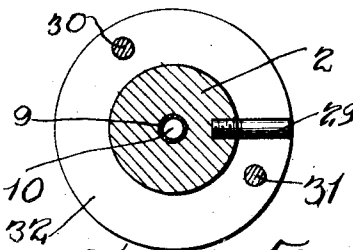
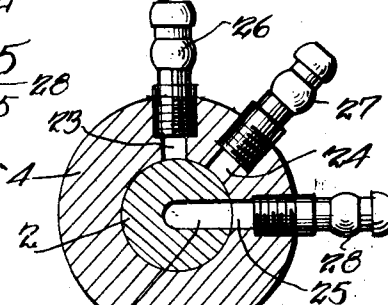


Fig. 5.



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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 disassembled 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 char-

acter described having a vertical pump cylinder or syringe mounted on a relatively large base, whereby stability, strength, ease of operation, prevention of leaks result. Further the invention contemplates the production of a device wholly constructed of metal, 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. 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 drawing which discloses 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 2—2 of Fig. 1, looking in the direction of the arrows;

Fig. 3 is a cross sectional view on the line 3—3 of Fig. 1, looking in the direction of the arrows;

Fig. 4 is a cross sectional view on the line 4—4 of Fig. 1, looking in the direction of the arrows;

Fig. 5 is a cross sectional view on the line 5—5 of Fig. 1, looking in the direction of the arrows.

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 base member 4.

The pump or syringe 1 comprises a 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 pis-

ton head 6 is attached to the lower end of the piston rod 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 Fig. 1, 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. Above the piston 6 is an annular channel or chamber 41 which serves as a reservoir for sterile water, saline, alboline or other liquid inserted therein for the purpose of preventing the leaking of air below the piston and for the purpose of lubricating the contacting surfaces of the piston 6 and the cylinder 5.

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 top 16 is in threaded engagement. The top 16 is also provided with a cylindrical projecting part 17 which is of such size as to fit exactly, or nearly so, within the top of the cylinder 5, whereby the cylinder 5, and therefore the pump 1, is centered within the casing 13 with respect to the opening 11 in the cock 2. This centering operation results when the top 16 is screwed down upon the header 15, during which operation the cylinder 5 is brought into such position that its top surrounds the part 17. As the top 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 opening 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 heretofore indicated the piston rod 7 is connected to the piston head 6. This piston rod is shown in the drawing as having a cross section of the shape of a square. The top 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 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 top 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 Figs. 1, 4 and 5, 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. It is obvious from the foregoing that the base is of such stability or weight as to resist, without displacement from the support upon which it may be placed, the upward pull of the cylinder, while it is at the same time of such dimensions as to be very 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 90° apart as shown in Fig. 5 and the opening 24 mid-way between them or 45° from either. Connected by threading, or other suitable means, with these three openings are nipples or connectors 26, 27 and 28, to which rubber hose or like connecting means may be securely attached. 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. It is to be understood that the hose connections referred to as connected with nipples 26 and 28 have attached at their free ends suitable hollow needles for entry into the veins or arteries of the donor

or recipient. The opening 24 and the nipple 27 and its connections are to afford means for permitting the use of a saline solution or other solution with the blood transfusion or other operation. It will be obvious from the above that when the handle 19 and piston rod 7 are 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 and 25, when the cock is moved in either of these directions, suitable stop means is provided comprising a horizontal pin 29 connected, below the part 33 as by threading or other suitable means, to the cock or male member 2 and vertical pins 30 and 31 connected to the top part 32 of the base 4. The pins 29, 30 and 31 are so positioned in relations to each other and the openings 23, 24 and 25 that the pins 29 and 30 come into contact with each other when the channel 22 registers with the opening 23 and the pins 29 and 31 come in contact with each other when the channel 22 and opening 25 register. The pin 29 is placed directly above the channel 22 so that when the pin 29 is directly above the nipple 27 the channel 22 registers with the opening 24. 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. Other suitable stop means may be afforded by an arc like channel formed in the lower surface of part 33 of the cock 2 and with which a fixed pin as 30 or 31 is designed to be in sliding engagement. In such a case the ends of the channel engaging the fixed pins act as stops and compel proper registry, as described above. Registry of the channel 22 with the opening 24 is, in such a case, indicated by suitable vertical lines or other indicia formed upon the outermost cylindrical surface of the part 33 of the top part of the cock 2 and the cylindrical top part of the base 4.

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, I provide a thumb screw 34, with milled head 35 and a spiral tensioning spring 36. The thumb screw 35 is positioned within a hollow part 37 of the base 4 and passes loosely through a central opening 38 the axis of which is coincident with the axis of the base 4 and cylinder 1. The upper part of the thumb screw 34 is in threaded engagement, as shown in Fig. 1, with the lower part of the

cock or male member 2. The spiral tensioning spring 36 is placed between the flat part 39 of the milled head 35 and the flat part 40 within the hollow part 37 of the base 4. As a modified construction I may replace the thumb screw 34 by a member of similar construction but fixedly attached to the male member 2 either by being integral therewith or by brazing or other means. When this construction is employed the milled head 35 is omitted and is replaced by two nuts threaded upon the lower end of the fixed member used instead of thumb screw 34. One of the nuts act as a jam nut, retaining securely the compression of the spring 36 between the part 40 and the two nuts.

Instead of the pump or syringe shown in Fig. 1 of the drawing, 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 head 16 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 operation and use of my device in connection with a blood transfusion operation is 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 albolene are 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. 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

nipple 27 for this purpose is connected with a suitable hose connection to a vessel containing sterile normal saline. The needle (not shown) 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, as shown in Fig. 5, 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 pins 29 and 30 are in contact with each other. The hand is not removed from the handle 19, but is then turned, while firmly holding handle 19, through an arc of 90°, or until the pin 29 comes in contact with the pin 31, 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 90° until the pin 29 is again in contact with the pin 30, 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 pin 29 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. 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, as for example the administration of salvarsan.

Having described my invention, what I claim is:

1. A transfusion apparatus or the like comprising a base carrying a stationary valve member with inlet and outlet channels, a rotatable valve member co-operating with said stationary valve member and having a channel capable of being brought into communication with either an inlet or outlet channel in said stationary valve member, supporting means carried by said rotatable valve member, a pump cylinder having a nipple or nozzle removably connected with the channel in the rotatable valve member, a piston and piston rod of non-circular cross section within said pump cylinder, a cover securable to said supporting means and provided with an opening conforming in cross section with the cross section of said piston rod through which said piston rod passes.

2. A transfusion apparatus or the like comprising a base carrying a stationary valve member with inlet and outlet channels, a movable valve member co-operating with said stationary valve member and having a channel capable of being brought into communication with either an inlet or outlet channel in said stationary valve member, supporting means carried by said rotatable valve member, a removable pump cylinder connected with the channel in the movable valve member, a piston and piston rod of non-circular cross section carried by said cylinder, a cover removably attachable to said supporting means and provided with an opening corresponding to the cross section of the piston rod through which said piston rod passes.

3. A transfusion apparatus or the like comprising a base carrying a female valve member with inlet and outlet channels, a male valve member co-operating with said female valve member and having a channel capable of being brought into communication with either an inlet or outlet channel in said female valve member, supporting means carried by said male valve member, a pump cylinder having a nipple or nozzle removably connected with the channel in the male valve member, a piston and piston rod of non-circular cross section within said pump cylinder, a cover securable to said supporting means and provided with an opening

conforming in cross section with the cross section of said piston rod through which said piston rod passes.

4. A transfusion apparatus or the like comprising a support directly carrying a stationary female valve member with inlet and outlet channels, a rotatable male valve member co-operating with said female valve member and having a channel capable of being brought into communication with either an inlet or outlet channel in said female valve member, supporting means carried by said male valve member, a pump cylinder having a nipple or nozzle removably connected with the channel in the male valve member, a piston and piston rod of non-circular cross section within said pump cylinder, a cover carried by said supporting means and provided with means for centering the pump cylinder and an opening conforming in cross section with the cross section of said piston rod through which said piston rod passes.

5. A transfusion apparatus or the like comprising a base carrying a stationary valve member with inlet and outlet channels, a rotatable valve member co-operating with said stationary valve member and having a channel capable of being brought into communication with either an inlet or outlet channel in said stationary valve member, supporting means carried by said rotatable valve member, a pump cylinder having a nipple or a nozzle removably connected with the channel in the rotatable valve member, a piston and piston rod carried by said pump cylinder, a cover upon said supporting means and means for pressing, and maintaining said pump cylinder in operative position by means of said cover, said cover being provided with an opening through which the piston rod passes.

6. A transfusion apparatus or the like comprising a support carrying a stationary valve member with inlet and outlet channels, a movable valve member co-operating with said stationary valve member and having a channel capable of being brought into communication with either an inlet or outlet channel in said stationary valve member, supporting means carried by said movable valve member and threaded near the end thereof, a pump cylinder removably connected at one end with the channel in the rotatable valve member, a cover provided with an opening upon said supporting means engaging said threads upon said sup-

porting means and also engaging the other end of said pump cylinder for pressing said pump cylinder into position, means carried by said cover for preventing lateral displacement of said pump cylinder, a piston with said cylinder and a piston rod attached to said piston and passing through said opening in said cover.

7. In an apparatus of the character described, the combination of a syringe, a stationary valve member having at least three ports, a rotatable valve member co-operating with said stationary valve member having a channel communicating with said syringe and so positioned that communication can be established between only one of said ports and said syringe at one time.

8. In an apparatus of the character described, the combination of a stationary valve member having a plurality of ports, a rotatable valve member having a channel capable of being connected with the ports in the stationary valve member, a syringe including a piston rod, said syringe being removably connected with said rotatable valve member and leading to said channel, and means for rotating said rotating valve member by rotating said piston.

9. In an apparatus of the character described, the combination of a stationary valve member having a plurality of ports, a rotatable valve member having a channel capable of being connected with the ports, a syringe including a non-circular piston rod, said syringe being removably connected with said rotatable valve member and leading to said channel, and a top for said syringe having an opening corresponding in shape to the cross section of said piston rod through which said piston rod passes.

10. In an apparatus of the character described, the combination of a stationary valve member having a plurality of ports, a rotatable valve member having a channel capable of being connected with the ports, a syringe including a non-circular piston rod removably connected with said rotatable valve member and leading to said channel, a top for said syringe having an opening corresponding in shape to the cross section of said piston rod through which said piston rod passes, and stop means carried by said valve members for limiting the degree of angular displacement of one with respect to the other.

In testimony whereof I affix my signature.
ROBERT W. THAYER.