

Dec. 5, 1933.

M. C. HANAFIN ET AL

1,937,566

SURGICAL APPARATUS

Filed May 29, 1931

FIG. 1.

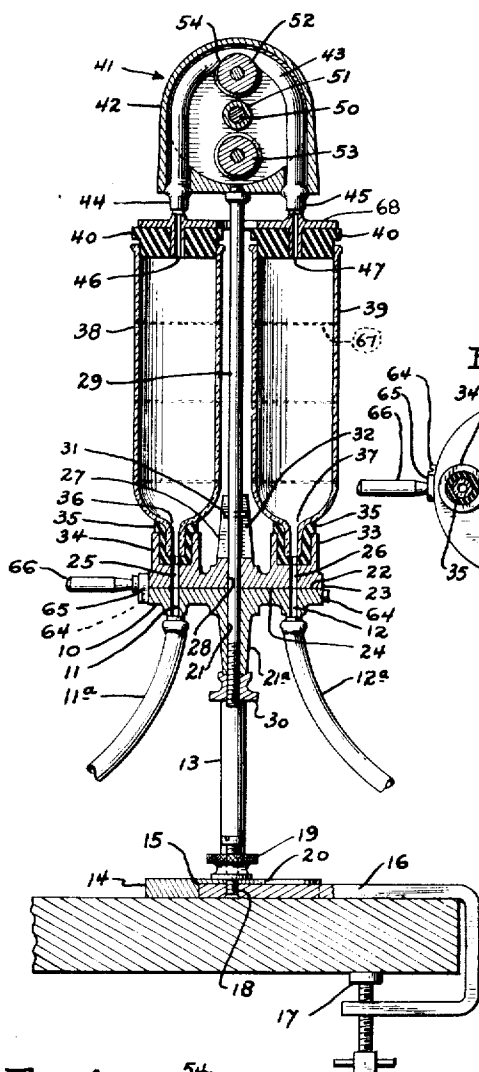


FIG. 2.

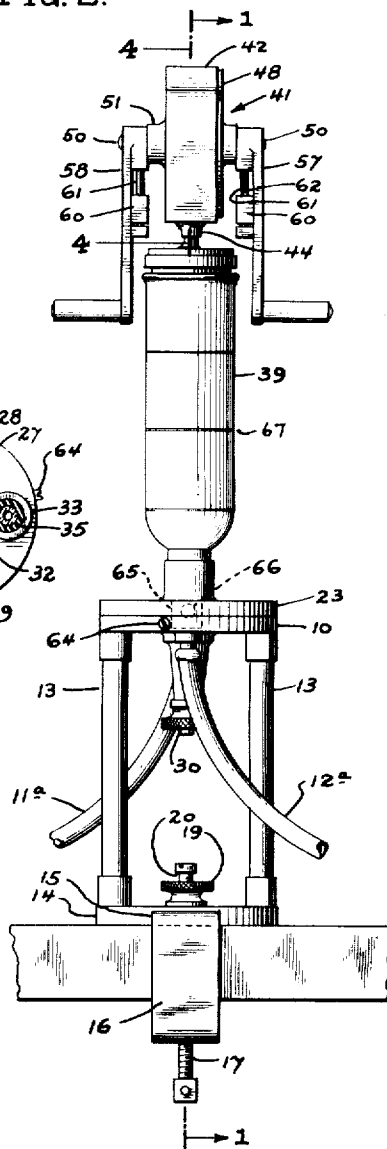


FIG. 3.

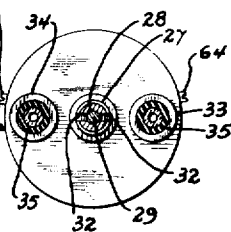


FIG. 4.

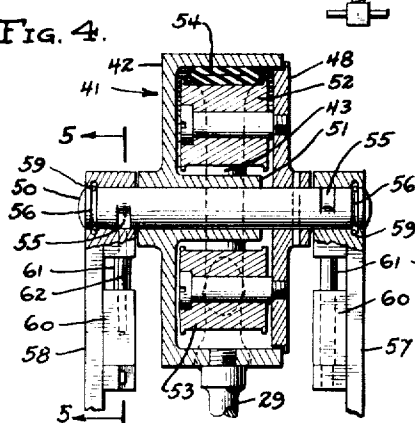
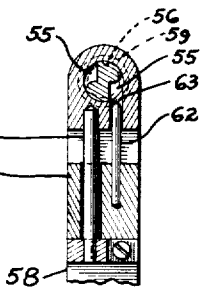


FIG. 5.



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1,937,566

SURGICAL APPARATUS

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Application May 29, 1931. Serial No. 541,026

4 Claims. (Cl. 128—214)

This invention relates to devices for transferring fluid from a source of supply to a receiver therefor by the use of air pressure, and is particularly adapted to use in the medical and surgical professions for blood transfusion wherein blood from one source, usually termed a donor, is transferred to a recipient. This operation requires skillful, medical and surgical practice, and it is of utmost importance that every convenience and ease of operation be afforded the manipulator to facilitate the surgical operation, especially as this operation must sometimes be performed when hospital facilities and professional assistance are not available, and extreme care must be exercised to prevent particles of infected blood from contaminating the blood stream of a donor of blood for the operation.

An object of the invention is to provide an apparatus for blood transfusion in which the blood may be drawn from the source of supply, or a donor, and delivered to its destination, or to a recipient, in substantially an uninterrupted stream. A further object is to provide a blood transfusing device in which the fluid to be transferred from a donor is drawn into the apparatus by air suction and is delivered from the apparatus to a recipient by air pressure, and thus avoid contact of mechanical pressure with the blood cells, and the admission of air bubbles into the blood stream in the course of transit through the apparatus; to provide an apparatus wherein the possibility of inadvertent reversal of flow of the fluid stream is minimized, and flow of fluid is always in the direction of the manual action of the operator in manipulating the device, and in which the receptacle receiving the fluid is nearest the donor or other source of supply, and the receptacle from which the fluid is expelled is nearest the receiver or recipient; to provide a device which may be readily sterilized, and in which the amount of fluid flowing therethrough may be constantly measured and watched by the operator.

With the above mentioned and other objects in view, the invention consists in the novel construction and combination of parts hereinafter described, illustrated in the accompanying drawing and pointed out in the claims hereto appended; it being understood that various changes in the form, proportion, size and minor details of construction within the scope of the claims may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention.

To more fully comprehend the invention, ref-

erence is directed to the accompanying drawing, wherein—

Fig. 1 is a vertical section of the apparatus on line 1—1 of Fig. 2.

Fig. 2 is a vertical side elevation of the apparatus.

Fig. 3 is a plan view of a revoluble table member.

Fig. 4 is a detailed vertical section on line 4—4 of Fig. 2.

Fig. 5 is a detailed vertical section on line 5—5 of Fig. 4.

Referring to the drawing, wherein like characters of reference designate corresponding parts,—10 represents a base of suitable shape but preferably circular in plan, having a pair of independent spaced openings 11 and 12 therethrough which are adapted at their lower ends for connection of conduit tubes 11^a and 12^a, which are adapted at their opposite or free ends to receive incision needles (not shown), of a usual standard type.

Normally, the conduit 11^a would, by means of its terminating needle, be used for the purpose of drawing blood from a donor, and the conduit 12^a would normally be used for conveying blood to a recipient, into whose veins the appendant needle is inserted.

The base 10 is supported on standards 13, which at their lower ends are fixedly mounted in a bracket 14 which is recessed at 15 to receive the arm 16 of a screw clamp 17 by which the apparatus may be removably mounted on a table. The arm 16 of the clamp is provided with a screw 18 having a clamping nut 19. A claw 20 is provided in the bracket 14 which is slidable under the nut 19 and on both sides of screw 18, for the purpose of securely fastening the transfusion device by means of clamp 17, to an operating table, preferably between the donor and the recipient. On the underside, the base 10 is provided centrally with an elongated tubular portion 21^a having a longitudinal opening 21 and the upper or contact face 22 of said base preferably is flat.

A table 23 is provided, the lower face 24 of which has a ground contact fit with the face 22 of the base 10, so as to be rotatable relative thereto and to provide a leak-proof contact which may be facilitated by coating the opposing contact faces with a sterilized lubricant, such as petroleum jelly. The table 23 is provided with a pair of independent spaced openings 25 and 26 which are adapted for selective alignment with the openings 11 and 12 in the base 10 by rotation of table 23 relative to base 10. The table 23 is

also provided centrally with an upwardly extending elongated tubular portion 27, the tubular opening 28 thereof being adapted for alignment with the tubular opening 21 of the base 10. A vertically disposed support shown as a shaft 29 is received through the openings 28 and 21 and is rotatably mounted relative to the base 10 within which it is secured by means of nut 30, said shaft being fixed against rotation relative to the table 23 by means of pin 31 which is engaged by slots 32 in the elongated tubular portion of the table.

The upper end of each of the openings 25 and 26 is provided with a socket 33 and 34, said sockets being provided with resilient gaskets 35, preferably of rubber, which are adapted to receive therein the open throats 36 and 37 of independent fluid receptacles 38 and 39, preferably of transparent material which will stand sterilizing temperatures without fracture. Each receptacle is similarly closed at its upper end by corks 40, which preferably are of rubber or other suitable material to form an air tight seal with the walls of the receptacles. Indication lines or calibrations 67 may be placed on the receptacles for measuring fluid therein.

Mounted upon the upper end of the supporting shaft 29 so as to rotate therewith upon rotation of table 23, is provided a pump means, indicated generally 41, and in the preferred embodiment, comprises a housing 42 secured to the upper end of the shaft 29 and supported thereby. The upper inner wall of the housing is arcuate, and lying thereagainst within the housing is provided a flexible tube 43 preferably of rubber, the respective open ends 44 and 45 of which have communication with the receptacles 38 and 39 through openings 46 and 47 in a plate 68 mounted athwart the upper ends of the receptacles.

The housing 42 has a removable side member 48 which is affixed to a shaft 50, said shaft having a bearing at its opposite end in the opening 51 in the opposite side of the housing. The member 48 is preferably disc-shaped and provides a rotor on which are rotatably mounted, at opposite points adjacent its edges, a pair of rollers 52 and 53 which, upon rotation of the rotor 48, progressively bear against and compress the rubber tube 43, as best shown at 54 in the sectioned view of Fig. 4. Thus by the forcing of air from one receptacle to the other a vacuum or a less than normal air pressure is created in one receptacle and a greater than normal air pressure is created in the other receptacle assuming that the opposite open ends of the receptacles are closed to entry of additional air under atmospheric pressure, as would be the case during a transfusion operation. The shaft 50 is provided adjacent its opposite ends with ratchet teeth 55, and is also provided with an annular groove 56. Crank members 57 and 58 are adapted to be mounted at the opposite ends of the shaft 50 by means of a spring 59 which engages in the annular grooves 56. A gravity ratchet is provided on the shank of each crank member (see Fig. 5), said ratchet comprising a weight 60 which is reciprocally slidable on a bar 61 and has a pawl 62 which slides with the weight through an opening 63 to engage the teeth 55 in the shaft 50, the teeth 55 being so arranged that the pawl will engage the shaft when rotated in one direction, and will freely pass the teeth when rotated in an opposite direction.

Means are provided to delimit the relative rotation of base 10 and table 23, which in the concrete exemplification herein comprises a pair

of lugs 64 mounted on base 10, and the table 23 is provided with a boss 65 which is adapted to engage the lugs 64 when the table 23 is rotated substantially 180° relative to the base 10, by manual operation of a handle member 66.

In operation of the apparatus it is customary to first suck in to the receptacles a warm sterilized salt solution so as to warm the receptacles to normal blood temperature. The receptacle which is to receive blood from a donor is then emptied of the salt solution, and the needles on the free ends of conduits 11^a and 12^a are connected by venous incision to the donor and recipient, respectively, the conduit 11^a being connected with the vein of the donor, and the conduit 12^a being connected by needle with the vein of the recipient. Upon rotation of the shaft 50 by means of one of the cranks 57 or 58, the rollers 52 and 53 revolve about the axis of the shaft and by progressively bearing on the flexible tube 43, create a less than normal air pressure in receptacle nearest the donor, which in the position shown in Fig. 1 of the drawing is receptacle 38. Thus there may be drawn into that receptacle by suction a supply of blood to be transfused.

Simultaneously with this operation a greater than normal air pressure is created in receptacle 39 which expels the charge of salt solution into the vein of the recipient. The status of the transfusion at this point is that receptacle 39 is emptied of salt solution and receptacle 38 contains a supply of donor's blood, the amount of which is measured by lines 67. The table 23 is now rotated relative to base 10 on the common axis of the table and base by means of handle 66 so that the opening 25 of the table aligns with opening 12 of the base.

This operation aligns opening 26 of the table with opening 11 of the base, or, in other words, the position of receptacle 38 and 39 is reversed, so that the receptacle containing blood is positioned in communication with discharge opening 12 and conduit 12^a leading to the recipient. It will be noted that shaft 29 rotates with table 23 and that the pump 42 rotates on its vertical axis with the shaft and receptacles, which transposes the position of cranks 57 and 58. As rotation of the shaft 50 is continued by means of the transposed crank, the direction of rotation of the crank is continued in the same direction as previously, the pawl of the right hand crank engaging the right hand ratchet upon rotation in clockwise direction, due to the gravity drop of weight 60 when the crank reaches an upward position, and the left hand crank does not rotate because of the disengagement of the pawl and ratchet due to gravity drop of the weight on the crank. Thus, whichever crank is being used to manipulate the apparatus, the direction of rotation thereof is uniformly in clockwise direction, and the pump action through the tube 43 is continually in one direction. When the empty receptacle 39 which has, by transposition, taken the place of receptacle 38, as positions are shown in Fig. 1, blood from the donor is sucked into the receptacle 39 until a measured amount has been received therein, at which time table 23 is again rotated on its vertical axis, so that opening 26 again coincides with opening 12 and by continuing the rotation of the pump a greater than normal air pressure is created on top of the blood in receptacle 39, so that the fluid is forced outwardly from receptacle 39 and through conduit 12^a to the recipient, and simultaneously

a less than normal atmospheric air pressure is created in receptacle 38, so that an additional supply of blood is received from the donor by suction and the operation of transposing the position of the two receptacles 38, 39, is again made, which operation is repeated until the desired amount of blood has been transferred from donor to recipient.

It will be noted that only one charge of air is in the apparatus, said charge merely being pumped from one cylinder to the other without additional entry of atmospheric air. For that reason it is readily arranged that this charge of air may be first sterilized and thus avoid any possibility of contamination by impurities in the operating room.

We claim:—

1. A surgical apparatus for transferring fluid from a source of supply to a receiver therefor, comprising a pair of conduit members, a pair of independent fluid receptacles each of which is adapted for interchangeable communication with each of said conduit members, means whereby said communication of the respective receptacles and conduit members may be selectively interchanged, and a rotary pump having a flexible tube intercommunicating with each of said receptacles, a rotor in said pump adapted for progressively deforming said tube, and means operative in one direction to rotate said rotor, said last mentioned means being inoperative in an opposite direction.

2. A surgical apparatus for transferring fluid from a source of supply to a receiver therefor, comprising a pair of independent fluid receptacles each provided with a first opening and a second opening, a pair of conduits each of which is adapted for selective communication with the aforesaid first opening of each of said receptacles, means for selectively positioning the first opening of said respective receptacles in communication with the said respective conduits, and an air pump intercommunicating between the second opening of each of said receptacles and adapted for continual operation in one direction for expelling fluid from each of the recep-

tacles upon selective positioning of the first opening of the respective receptacles in successive communication with the same conduit, and means adapted for rendering said pump inoperative in an opposite direction.

3. A surgical apparatus for transferring fluid from a source of supply to a receiver therefor, comprising a pair of independent tubular fluid receptacles, each provided with an opening at opposite end portions, the openings at one end being adapted for communication with a conduit, a pair of conduits, each of which is adapted for selective communication with the last mentioned opening of each of said receptacles, means for revolving said receptacles about a common axis for selectively relatively positioning said respective conduits in communication with the said last mentioned respective openings of the receptacles, and an air pump mounted to revolve with the receptacles, said pump intercommunicating with the other opening of each of said receptacles and being operable so as simultaneously to create an air pressure less than atmospheric in one receptacle and greater than atmospheric in the other receptacle, said pump including automatically operable means whereby said pump is rendered inoperable in one direction.

4. A surgical apparatus for transferring fluid from a source of supply to a receiver therefor, comprising an intake conduit and a discharge conduit, a pair of independent fluid receptacles each of which is adapted for interchangeable communication with each of said conduits, means whereby said communication of the respective receptacles and conduit members may be selectively interchanged, a rotary pump intercommunicating with each of said receptacles, said pump including means whereby said pump may be continuously operated in a predetermined direction, and means whereby said pump operating means are rendered inoperative in a direction opposite to the predetermined direction.

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