

March 31, 1925.

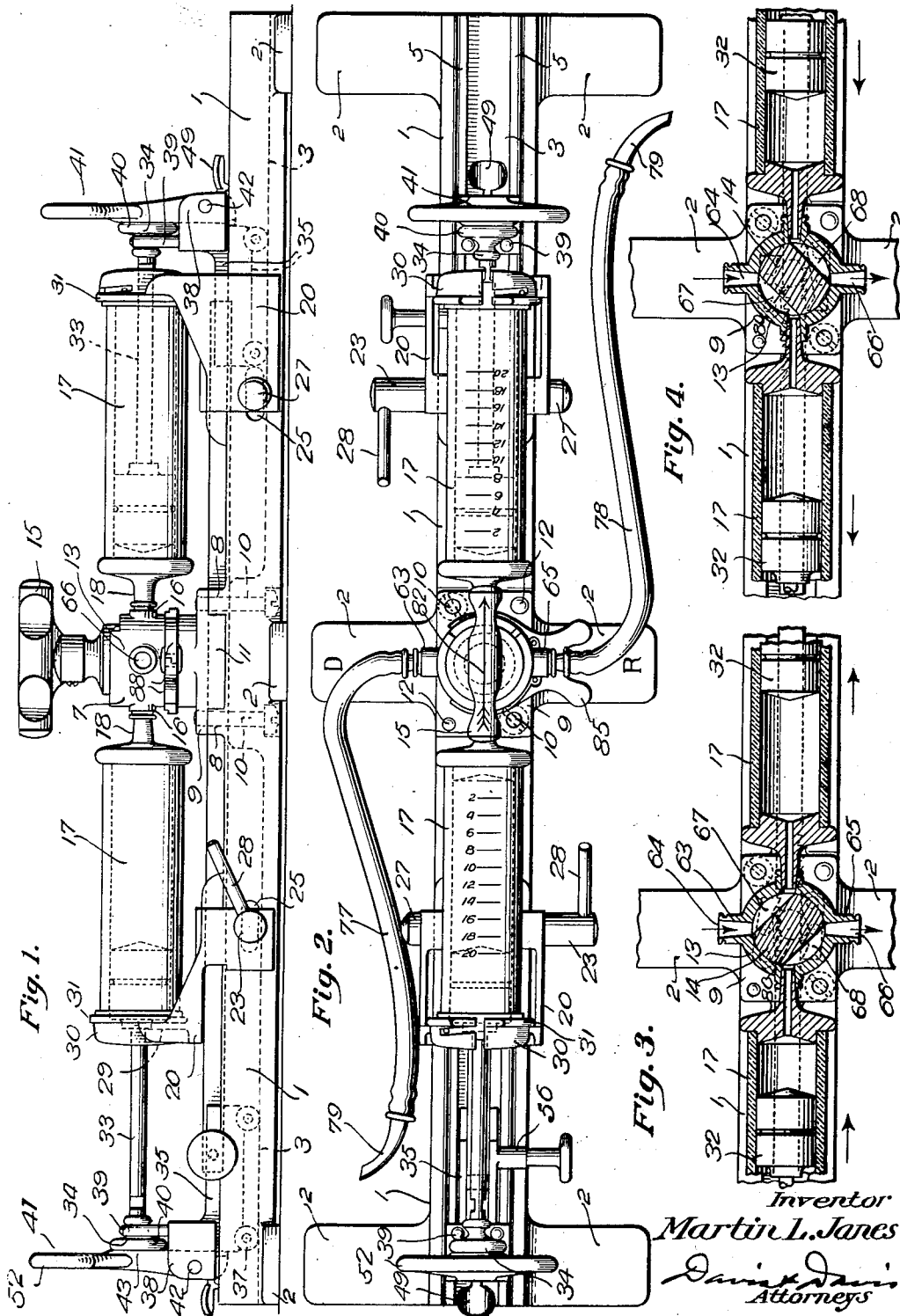
1,531,698

M. L. JONES

BLOOD TRANSFUSION APPARATUS

Filed June 30, 1924

2 Sheets-Sheet 1



March 31, 1925.

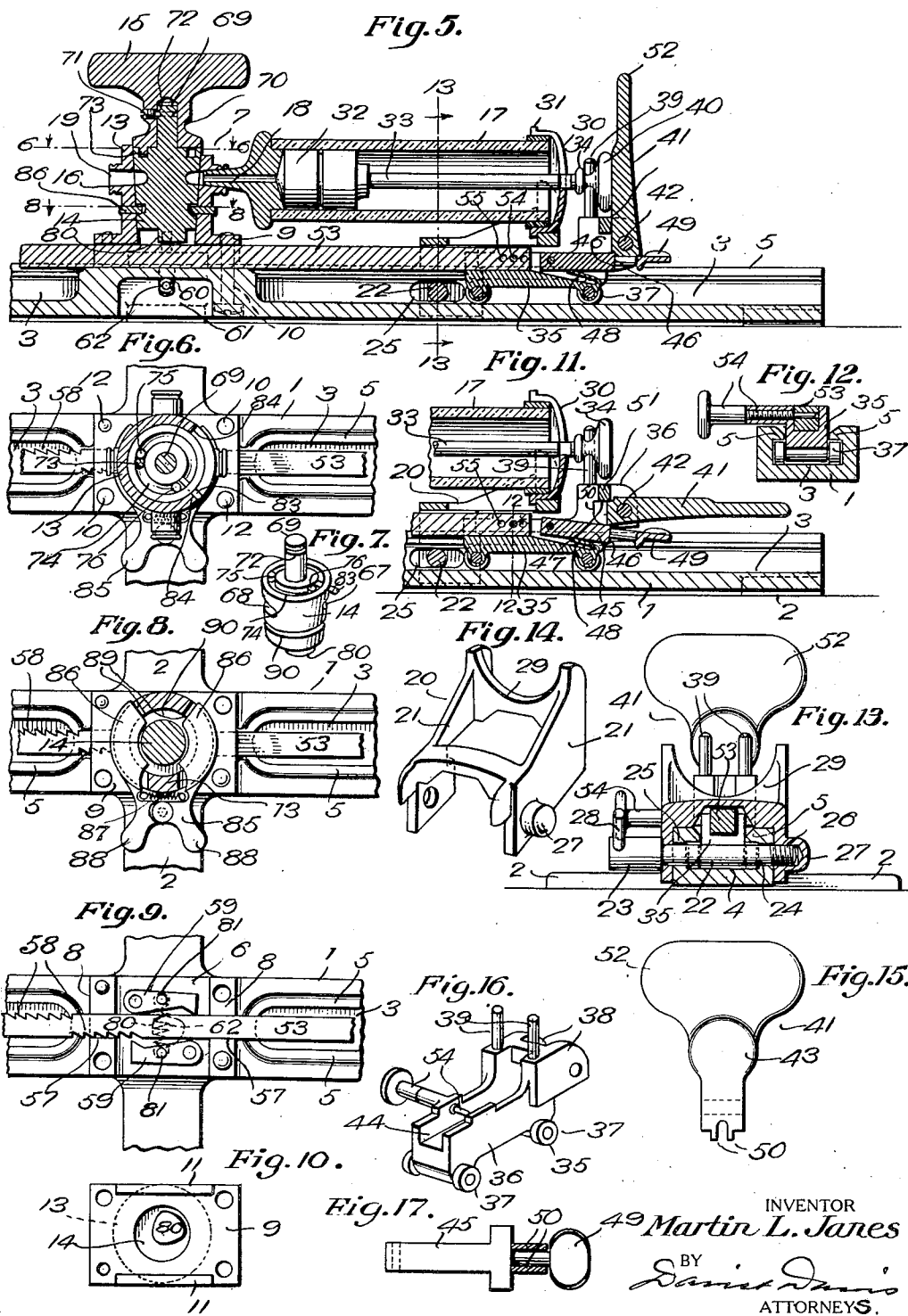
1,531,698

M. L. JANES

BLOOD TRANSFUSION APPARATUS

Filed June 30, 1924

2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE.

MARTIN L. JANES, OF NEW YORK, N. Y.

BLOOD-TRANSFUSION APPARATUS.

Application filed June 30, 1924. Serial No. 723,238.

To all whom it may concern:

Be it known that I, MARTIN L. JANES, a citizen of the United States, and resident of the borough of Manhattan, city, county, and State of New York, have invented certain new and useful Improvements in Blood-Transfusion Apparatus, of which the following is a specification.

This invention relates to improvements in blood transfusing apparatus.

The invention has for one of its objects the provision of a multiple cylinder pumping apparatus so constructed as to provide a continuous flow of blood from the donor to the receiving patient and prevent accidental back-flow of the blood.

Another object of the invention is to provide an apparatus wherein the flow of fluid is controlled by a single valve, the said valve in addition being adapted to control a locking means for preventing a premature reversal of the pump stroke and also adapted to indicate the proper direction of the pump stroke to accord with the valve adjustment.

A further object of the invention is to provide an apparatus in which the various parts through which the fluid passes, while so assembled as to remain true and accurate and to resist strains tending to displace them, may still be easily and quickly separated and removed for cleaning and sterilizing and may be easily re-assembled.

In the drawings:

Fig. 1 is a side elevation of the apparatus;

Fig. 2 a top plan view thereof;

Fig. 3 a horizontal section through the central portion of the apparatus, showing the valve in one of its adjusted positions and the pump pistons moving in the direction to accord with the valve adjustment;

Fig. 4 a view similar to Fig. 3 showing the valve in its other adjustment and the pistons moving in a reverse direction;

Fig. 5 a vertical central section through one end of the apparatus;

Fig. 6 a detail section on the line 6—6 of Fig. 5;

Fig. 7 a detail perspective view of the valve;

Fig. 8 a detail section on the line 8—8 of Fig. 5;

Fig. 9 a detail plan view of the stroke locking mechanism;

Fig. 10 an inverted plan view of the valve casing;

Fig. 11 a detail section through one end of the apparatus showing the manner of releasing the plunger rod from the carriage;

Fig. 12 a transverse section on the line 12—12 of Fig. 11;

Fig. 13 a transverse section on the line 13—13 of Fig. 5;

Fig. 14 a detail perspective view of one of the barrel supporting cradles;

Fig. 15 an elevation of a detail of the apparatus;

Fig. 16 a perspective view of one of the carriages; and

Fig. 17 a detail view of the latch carried by the carriage.

Referring to the various parts by numerals, 1 designates the base or support. The base 1 extends the entire length of the apparatus, is comparatively narrow and is formed at its ends and midway of its length with oppositely projecting lateral extensions 2 upon which the support rests. These extensions give the apparatus stability. The support 1 is formed in its upper face with a pair of longitudinal tracks 3 which extend inwardly from the ends of the support to points adjacent its center. These tracks are formed by grooves having flat bottoms 4, and the side walls of the grooves are formed at the top with inwardly extending retaining flanges 5. Between the inner ends of the tracks 3 the support 1 is formed with a seat 6 for a valve casing 7. This seat is formed with spaced upstanding transverse ribs 8. The valve casing 7 is formed with a base plate 9 that is adapted to rest upon the ribs 8 and be held thereto by a pair of diagonally placed screws 10. The screws 10 are inserted through the under side of the support 1 and extend upwardly therethrough and through the ribs 8 and through the casing plate 9 into which they are threaded. The under face of the plate 9 is formed at opposite sides with longitudinally extending ribs 11. The ribs 11 extend between the ribs 8 upon the support and their outer edges are flush with the longitudinal side edges of the support. These ribs 8 and 11 form, between the opposed faces of the casing plate 9 and the seat 6, an enclosure, the purpose of which will be presently described. A pair of fixed diagonally placed centering studs 12 extend upwardly from the ribs 8 and are adapted to enter open-

ings in the plate 9 to properly position the plate. One of the studs 12 is smaller than the other and serves as a guide to ensure that the plate will be properly placed upon the seat. The body portion 13 of the valve casing 7 is formed on and extends upwardly from the base plate 9, and is substantially in the form of a vertically disposed cylinder. A downwardly tapered bore extends vertically entirely through the valve casing, and seated in said bore is a tapered plug valve 14. The valve 14 has an operating handle 15 mounted upon its upper end. The valve casing is formed at diametrically opposite points with a pair of short branches 16. These branches face toward opposite ends of the support 1.

Two oppositely facing glass syringe barrels 17, preferably provided with graduations (as shown) to indicate the capacity thereof, are removably mounted upon the support. The opposed ends of the barrels 17 have rigid nipples 18 projecting therefrom. The ends of these nipples 18 are tapered and are adapted to fit into tapered openings 19 which extend through the branches 16 of the valve casing. The outer ends of the barrels 17 are supported by a pair of cradles 20. These cradles 20 are formed to transversely straddle the support 1 and have depending sides 21 that engage the opposite sides of the support. Each cradle is held to the support by a clamping screw 22. The screw 22 is formed with a shouldered head 23 and a shank 24 threaded at its end. The shank 24 extends through an opening in one of the sides 21 of the cradle, through a pair of longitudinal slots 25 in the support 1 at opposite sides of the track groove therein, and is threaded at its end as at 26 into a threaded opening formed in an outwardly projecting boss 27 formed on the opposite side 21 of the cradle. The shouldered head 23 of the clamping screw carries a relatively long radially extending turning handle 28 by means of which the screw may be caused to tightly compress the sides 21 of the cradle against the opposite sides of the support 1 and hold the cradle securely in place thereon. The cradle is formed with an upwardly and transversely extending abutment web 29 connecting the opposite sides 21 of the cradle. The upper edge of the web 29 is substantially semi-circular in contour and is adapted to engage the circumference of a cap 30 fitted over the outer end of the barrel 17. The cap 30 is formed with a circumferential head or flange 31 against which the web 29 of the cradle is adapted to abut. It will be seen that the outer end of the barrel 17 is thus firmly supported, and that by adjusting the cradle longitudinally of the support the abutment web 29 can be made to bear firmly against

the bead 31 and press the tapered nipple 18 at the opposite end of the barrel firmly into the tapered opening 19 and make a liquid-tight joint. The slots 25 in the support 1 through which the clamping screw passes permit of the said longitudinal adjustment of the cradle. These slots are of material length so that the cradle can be adjusted for barrels of different lengths. The barrel may be easily and quickly removed by merely swinging the handle 28 of the clamping screw to release the cradle and moving the cradle outwardly away from the end of the barrel. The barrel may then be pulled outwardly to remove the nipple 18 from the hole in the valve casing. The barrel is then entirely freed. The cap 30 is held upon the end of the barrel by a pin and bayonet slot connection and is readily removable to permit the withdrawal of the plunger from the barrel.

Plungers 32 are mounted in the syringe barrels, each of said plungers having an operating rod 33 connected thereto and extending outwardly through the barrel cap 30, each of said rods carrying an abutment head 34 at its outer end. A pair of carriages 35 are adapted to travel on the tracks 3 of the support. Each carriage is formed with a body part 36 to which four supporting rollers 37 are pivoted. The intumed retaining flanges 5 overlie the rollers 27 and hold them upon the track. The body part 36 of the carriage is formed at its outer end with a pair of pivot ears 38 and extending upwardly from said ears are a pair of transversely spaced posts 39. The posts 39 are adapted to engage the opposite sides of the head 34 on the plunger rod inwardly of an enlarged end portion 40 of said head and to abut against said enlarged portion. A combination handle and abutment member 41 is pivotally mounted at its lower end between the pivot ears 38 of the carriage. The member 41 is adapted to extend upwardly from its pivotal connection 42 and is formed with an abutment face 43 adapted to engage a flat face upon the outer end of the head 34 of the plunger rod. The carriage 35 is formed with a channel 44 in its upper side and pivoted in the channel is a latch 45. The latch 45 is arranged substantially horizontally and is formed with a shoulder 46 adapted to engage a shoulder 47 on the member 41 below the pivot 42 and hold the member 41 against the head 34. A leaf spring 48 carried by the carriage beneath the latch 45 tends to hold the latch up in locking position. To release the member 41 so that it may be swung away from the head 34 an outwardly extending handle 49 of the latch is pressed downwardly against the spring resistance to disengage the locking shoulders 46 and 47. The member 41 is then free to be swung outwardly. A pair-

of cams 50 on the member 41 below its pivot are adapted to ride over the latch and hold it depressed. The downward swing of the member 41 is limited by its shoulder 47 coming into contact with an abutment 51 on the carriage. When the member 41 is swung upwardly the cams 50 ride off of the latch and the spring 48 raises the latch to automatically lock the member in its upright position. The member 41 extends above the abutment face 43 thereof and is widened to provide a suitable handle portion 52, and when the member is locked in its upright position by the latch, the head 34 of the plunger rod is held between the posts 39 and the member 41 and the plungers may be moved back and forth by pulling and pushing said member.

A bar 53 extends longitudinally and centrally of the support 1 beneath the syringe barrels and beneath the valve casing 7. The ends of the bar 53 are fitted in the channel 44 of the carriages 35. A screw 54 holds the end of the bar in the channel. The screw 54 has a reduced end portion that is passed through an opening in the carriage 44 and through one of a longitudinally arranged series of holes 55 in the end of the bar 53. The screw 54 is threaded into a boss 56 formed upon one side of the carriage and has an enlarged head by which it may be turned by hand. The provision of a series of holes 55 at either end of the bar permits the carriages to be adjusted longitudinally of the bar to accommodate plunger rods of different lengths. The plungers of both syringes are compelled to move in unison in the same direction by this carriage connecting bar 53. The cradles 20 are formed to permit the inner ends of the carriages 35 to pass under them at the inner ends of their strokes, and one side of each cradle is cut away to provide clearance for the screw receiving boss 56 on the carriage.

The ribs 8 of the valve casing seat 6 are recessed at the center as at 57 to provide clearance and guide ways for the movement of the bar 53 beneath the valve casing 7. The bar 53 is formed upon opposite sides of the portion its length that is adapted to slide back and forth beneath the casing 7, with ratchet teeth 58. A pair of ratchet dogs 59 are pivotally mounted at opposite sides of the bar 53 upon the valve casing seat 6 and within the enclosure formed by the ribs 8 and the depending ribs 11 upon the casing 7. The two rows of ratchet teeth upon opposite sides of the bar 53 extend outwardly in opposite directions from the medial point of the bar, so that the two rows are staggered lengthwise of the bar. As shown in Fig. 9, one of the dogs 59 is adapted to ride over its respective row of ratchet teeth 58 when the bar 53 is moved to the left but to lock behind the teeth and prevent the

bar from being moved to the right. The other dog is adapted to permit movement of the bar to the right and prevent it from moving to the left. At the end of a stroke the engaging dog is released by means of the valve as will be presently described. The dogs 59 carry studs 60 which extend downwardly through slots in the seat 6 and into a recess 61 in the under side of the support 1. A tension spring 62, within the recess 61, connects the studs 60 and tends to pull the dogs 59 toward each other and into engagement with the ratchet teeth 58.

The valve casing 7 is formed with a nipple 63 extending in a direction transversely of apparatus and formed with an inlet port 64 therethrough. The casing is also formed with a nipple 65 located diametrically opposite the nipple 63 and formed with an outlet port 66. The valve 14 is formed with two diametrically opposite ports 67 and 68, and is also formed with a reduced upwardly extending stem 69. The operating handle 15 is elongated and horizontally disposed and formed with a depending socket 70 into which the valve stem 69 fits. The handle is free to rotate on the stem but is held against withdrawal therefrom by a set screw 71 which is threaded into the socket 70 and engages in a circumferential groove 72 in the stem. A valve operating lug 73 extends downwardly from the handle socket 70 into a circular groove 74 in the top of the valve. Two spaced lugs 75 and 76 on the valve extend upwardly within the groove 74 and are adapted to be engaged by the operating lug 73. The lugs 75 and 76 are so spaced that the operating lug 73 can be moved through an angle of ninety degrees between said lugs without contacting them, thus providing a lost motion connection between the handle and the valve.

When the plungers are being moved to the right as shown in Fig. 3, the valve 14 has been adjusted so that its port 67 connects the inlet port 64 with the passage through nipple 18 of the syringe barrel to the right, and the port 68 of the valve connects the syringe barrel to the left with the outlet port 66.

Two flexible conduits such as rubber tubes 77 and 78 are connected to the nipples 63 and 66 respectively of the valve casing, and said tubes are provided at their free ends with curved tapered needles 79 which are inserted in the veins of the donor and receiving patient, and are frictionally connected in the usual manner.

When the plungers are moved to the right as shown in Fig. 3 the blood is drawn through the tube 77 and into the barrel 17 to the right. Simultaneously the blood is forced from the barrel to the left out through the tube 78. One of the dogs 59 is riding over the ratchet teeth 58 and will

prevent a reversal before the stroke is completed. Formed upon the lower end of the valve 14 is a cam 80. This cam 80 is adapted in the position of the valve shown in Fig. 3 to engage an upward extension 81 upon the lower dog 59 and hold the dog away from the bar 53 and the ratchet teeth. When the plungers have reached the end of their stroke to the right they cannot be reversed owing to the locking action of the upper dog 59 until the valve has been completely turned by its operating handle to the position shown in Fig. 4. In this position of the valve the cam has moved away from the lower dog 59 and has engaged the upward extension 81 upon the upper dog and forced the dog away from the teeth 58 against the spring resistance. The cam is so designed that it does not release either dog until the valve has been turned sufficiently to completely register its ports with the ports in the valve casing. When the valve is adjusted as in Fig. 4 the plungers may be moved to the left. The valve port 67 now connects the inlet port 64 with the left barrel so that the blood will be drawn through the tube 77 into said barrel. The port 68 connects the barrel to the right with the outlet port 66 and blood will be forced out therefrom through the tube 78. There is thus a continuous flow of blood in one direction from the donor to the patient through the tubes 77 and 78. The dogs and ratchets prevent an accidental back flow of blood by preventing a premature reversal of the plunger stroke and thus prevent the accidental creation of a vicious cycle, that is, the return of the blood from the recipient to the donor.

The elongated, horizontal operating handle 15 of the valve has an arrow 82 thereon to indicate the direction the plungers are to be moved in accordance with the adjustment of the valve. To properly register the ports in adjusting the valve for a reversal of the plunger stroke the valve is given only a quarter turn, while to properly indicate the reversal by means of the arrow on the handle it is necessary that the handle be given a half turn to completely reverse the arrow. The lost motion connection between the handle and the valve permits this greater movement of the handle. The arrow serves as a guide for the proper manipulation of the apparatus and the locking action of the dogs and ratchet prevents the plungers from being moved in a reverse direction to that indicated by the arrow. The valve carries an outwardly projecting pin 83 that is adapted to contact either of a pair of circumferentially spaced abutments 84 formed by a recess at the upper end of the valve casing, and thereby accurately stop the valve in either of its adjustments.

The valve is removably held within the casing by means of an expansible scissors-

like locking device 85. The member 85 is formed with opposed jaws 86 that are pulled toward each other by a spring 87, and are adapted to be expanded by compressing together a pair of outwardly diverging handle lugs 88 located on the opposite side of the pivot from the spring. The jaws 86 extend inwardly through openings 89 at opposite sides of the valve casing and engage in a circumferential groove 90 formed in the valve. The lower wall of the groove 90 is inclined downwardly and outwardly as shown in Fig. 5 in order that when the jaws 86 are drawn inwardly by the spring 87 they will engage said inclined wall and cam the valve down snugly within its tapered seat. The valve is thus held against withdrawal from the casing but may be readily released by simply expanding the locking device.

It will be seen that all of the parts of the apparatus through which the blood passes may be easily and quickly separated and removed from the support for the purpose of cleaning and sterilizing them. It will also be seen that while the parts may be quickly removed and replaced they are so mounted as to be held firmly in alignment upon the support.

The apparatus may be used for other purposes besides the transfusion of blood, such as aspirating or pumping various fluids or pus from cavities or passages in the body.

What I claim is:

1. An apparatus of the class set forth comprising a support, a pair of syringes mounted on the support, means connecting the plungers of said syringes for simultaneous movement in opposite directions relatively to the syringe barrels, a valve casing mounted on the support and connected to the syringe barrels, and a valve mounted in said casing, the casing having an inlet port and an outlet port and the valve having two operating positions and adapted in one position to connect one of the syringes to the inlet port of the casing and the other to the outlet port and in its reverse position to connect the first syringe to the outlet port and the second syringe to the inlet port.

2. An apparatus of the class set forth comprising a pair of syringes, means connecting the plungers of said syringes to cause one of said plungers to move on its suction stroke while the other plunger moves on its ejecting stroke, a valve casing connected to the syringe barrels, a valve mounted in said casing, the casing having an inlet port and an outlet port and the valve having two operating positions and adapted in one position to connect one of the syringes to the inlet port and the other the outlet port and in its reverse position to connect the first syringe to the outlet port and the second to the inlet port, and means con-

needed to the valve to indicate the direction the plungers are to be moved in accordance with the position of the valve.

3. An apparatus of the class set forth
5 comprising a pair of syringes, means connecting the plungers of said syringes to cause one of said plungers to move on its suction stroke while the other plunger moves
10 on its ejecting stroke, a valve casing connected to the syringes, a valve in said casing, the casing having an inlet port and an outlet port and the valve having two operating positions and adapted in one position to connect one of the syringes to the
15 inlet port of the casing and the other to the outlet port and in its reverse position to connect the first syringe to the outlet port and the second to the inlet port, and means to prevent a reversal of the movement of
20 the plungers at the end of a stroke until the valve has been accurately adjusted to its proper operating position for said reversal.

4. An apparatus of the class set forth
25 comprising a pair of syringes, means connecting the plungers of said syringes to cause one of said plungers to move on its suction stroke while the other plunger moves on its ejecting stroke, a valve casing connected to the syringes and having an inlet
30 port and an outlet port, and a valve adapted to be operated to connect the syringes with the inlet and outlet ports of the casing to provide for a continuous flow through said
35 ports in one direction during the operation of the plungers in either direction.

5. An apparatus of the class set forth comprising a pair of syringes, means connecting the plungers of said syringes to
40 cause one of said plungers to move on its suction stroke while the other plunger moves on its ejecting stroke, a valve casing connected to the syringes and having an inlet port and an outlet port, a valve in
45 said casing adapted to be operated to connect the syringes with the inlet and outlet ports of the casing to provide for a continuous flow through said ports in one direction during the operation of the plungers
50 in either direction, and locking means adapted to automatically prevent the reversal of the plungers at the end of a stroke before the valve has been operated, the said valve being designed when operated to engage and release said locking means.
55

6. An apparatus of the class set forth comprising a pair of opposed syringes, means connecting the plungers of said syringes for simultaneous movement in the
60 same direction to cause one plunger to move on its suction stroke while the other plunger moves on its ejection stroke, a valve casing connected to the syringes and having an inlet port and an outlet port, a valve in said casing
65 having two operating positions and

adapted to connect the syringes with the inlet and outlet ports of the casing to provide for a continuous flow through said ports in one direction during the operation of the plungers in either direction, locking
70 means adapted to automatically prevent the reversal of the plungers before the valve has been accurately adjusted to the proper operating position for said reversal, said valve being designed to engage and release
75 said locking means when operated for adjustment and having means carried thereby to indicate the direction the plungers are to be moved in accordance with the valve adjustment.
80

7. An apparatus of the class set forth comprising a pair of opposed syringes, means connecting the plungers of said syringes for simultaneous movement in the
85 same direction to cause one plunger to move on its suction stroke while the other plunger moves on its ejection stroke, a valve casing connected to the syringes and having an inlet port and an outlet port, a plug valve mounted in said casing to be rotated on a
90 vertical axis and having two operating positions and adapted in one position to connect one of the syringes to the inlet port of the casing and the other to the outlet port and in its reverse position to connect the
95 first syringe to the outlet port and the second to the inlet port, automatic locking means to prevent the reversal of the plungers before the valve has been accurately adjusted to its proper operating position for
100 said reversal, means carried by the lower end of the valve to release said locking means when the valve is operated for adjustment, from one operating position to the other, and means carried by the upper end
105 of the valve to indicate the direction the plungers are to be moved in accordance with the valve adjustment.

8. An apparatus of the class set forth comprising a pair of opposed syringes,
110 means connecting the plungers of said syringes for simultaneous movement in the same direction to cause one plunger to move on its suction stroke while the other plunger moves on its ejection stroke, said means
115 including a longitudinally extending bar connecting the plungers, a valve casing located over said bar and connected to the syringes said casing having an inlet port and an outlet port, a plug valve mounted
120 in said casing to be rotated on a vertical axis and having two operating positions and adapted in one position to connect one of the syringes to the inlet port of the casing and the other to the outlet port and
125 in its reverse position to connect the first syringe to the outlet port and the second to the inlet port, automatic locking means to prevent the reversal of the plungers before the valve has been adjusted to the proper
130

operating position for said reversal, said locking means comprising a pair of opposed locking dogs adapted to engage teeth formed at opposite sides of the said plunger connecting bar, a spring tending to force the dogs into engagement with said teeth, and means carried by the lower end of the valve to disengage the dogs from the teeth when the valve is operated for adjustment from one operating position to the other.

9. An apparatus of the class set forth comprising a support, a pair of syringes mounted on the support, a valve casing detachably mounted on the support, a vertically disposed valve in said casing for controlling the flow of blood through the apparatus, said valve being insertable through an opening in the upper end of the casing and formed with a circumferential groove, and a locking device adapted to extend inwardly through a transverse opening in the casing to engage in the said circumferential groove of the valve and hold the valve in place, said locking device being yieldingly forced into engagement with the groove and being expandible to disengage it therefrom.

10. An apparatus of the class set forth comprising a support, a valve casing detachably mounted upon the support and formed with inwardly tapered openings at diametrically opposite points, a pair of opposed syringe barrels at opposite sides of the valve casing and having rigid tapered nipples extending from their opposed ends adapted to be received in said tapered openings in the casing, a pair of syringe barrel cradles mounted upon the support and adjustable thereon longitudinally of the barrels and adapted to support the barrels at the outer ends thereof and to hold the barrels pressed toward each other with their tapered nipples tightly engaged in the holes in the valve casing, a valve mounted in the casing for controlling the flow of blood through the apparatus, and a plunger in each syringe barrel.

11. An apparatus of the class set forth comprising a pair of opposed syringes, means connecting the plungers of said syringes for simultaneous movement in the same direction, a valve casing having an in-

let port and an outlet port, a valve mounted in said casing for rotation about a vertical axis, and adapted to be operated to provide for a continuous flow through said inlet and outlet ports in the same direction for both strokes of the plungers, an operating handle mounted on the valve, direction indicating means carried by the handle to indicate the direction of the plunger stroke, and a lost motion connection between the handle and the valve whereby the handle may be rotated further than the valve to completely reverse the said direction indicating means when the plunger stroke is reversed.

12. An apparatus of the class set forth comprising a support, a pair of syringes mounted on the support, a valve casing connected to the syringes and formed with a tapering valve seat, a tapering plug valve within the said seat and formed with a circumferential groove, a locking device adapted to engage in the said circumferential groove in the valve, and a spring adapted to hold the locking device in engagement with said groove, one wall of the groove and the engaging portion of the locking device being relatively inclined whereby the locking device under the influence of the spring will cam the tapered valve upon its seat, the locking device being retractible from the groove to permit the removal of the valve.

13. An apparatus of the class set forth comprising a support, a pair of syringes mounted on the support, a valve casing connected to the syringes, a rotatable plug valve within the casing and formed with a circumferential groove, a scissors-like locking device adapted to hold the valve in place within the casing, said locking device comprising a pair of opposed jaws pivoted together and adapted to engage in the circumferential groove of the valve at diametrically opposite points, and a spring adapted to contract said jaws into the groove, the jaws being expandible to permit the removal of the valve.

In testimony whereof I hereunto affix my signature,

MARTIN L. JANES.