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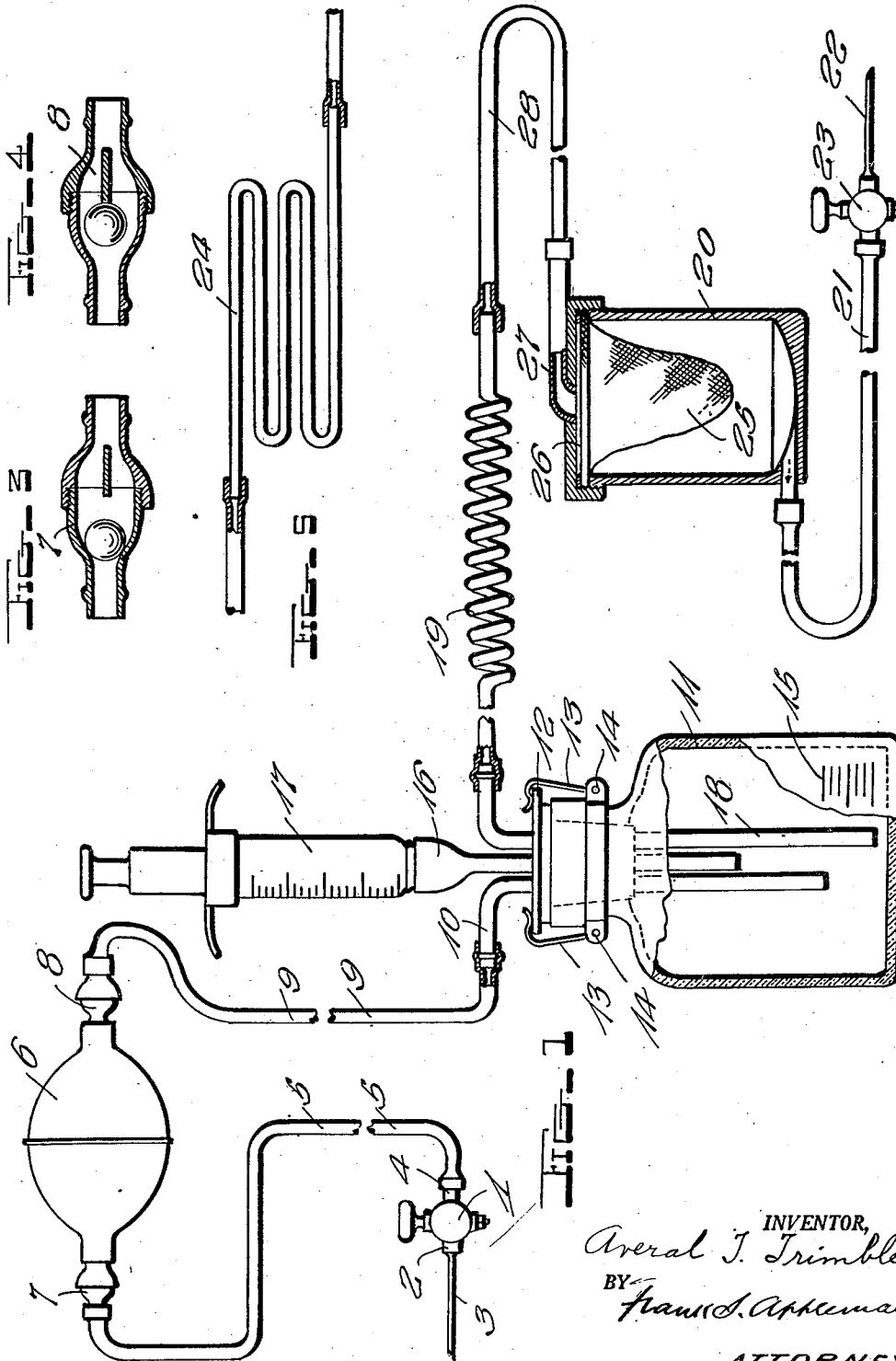
A. T. TRIMBLE

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PROCESS AND APPARATUS FOR TREATING BLOOD

Filed Nov. 18, 1943

2 Sheets-Sheet 1



INVENTOR,
Averal J. Trimble,
BY
Francis J. Applemann,
ATTORNEY

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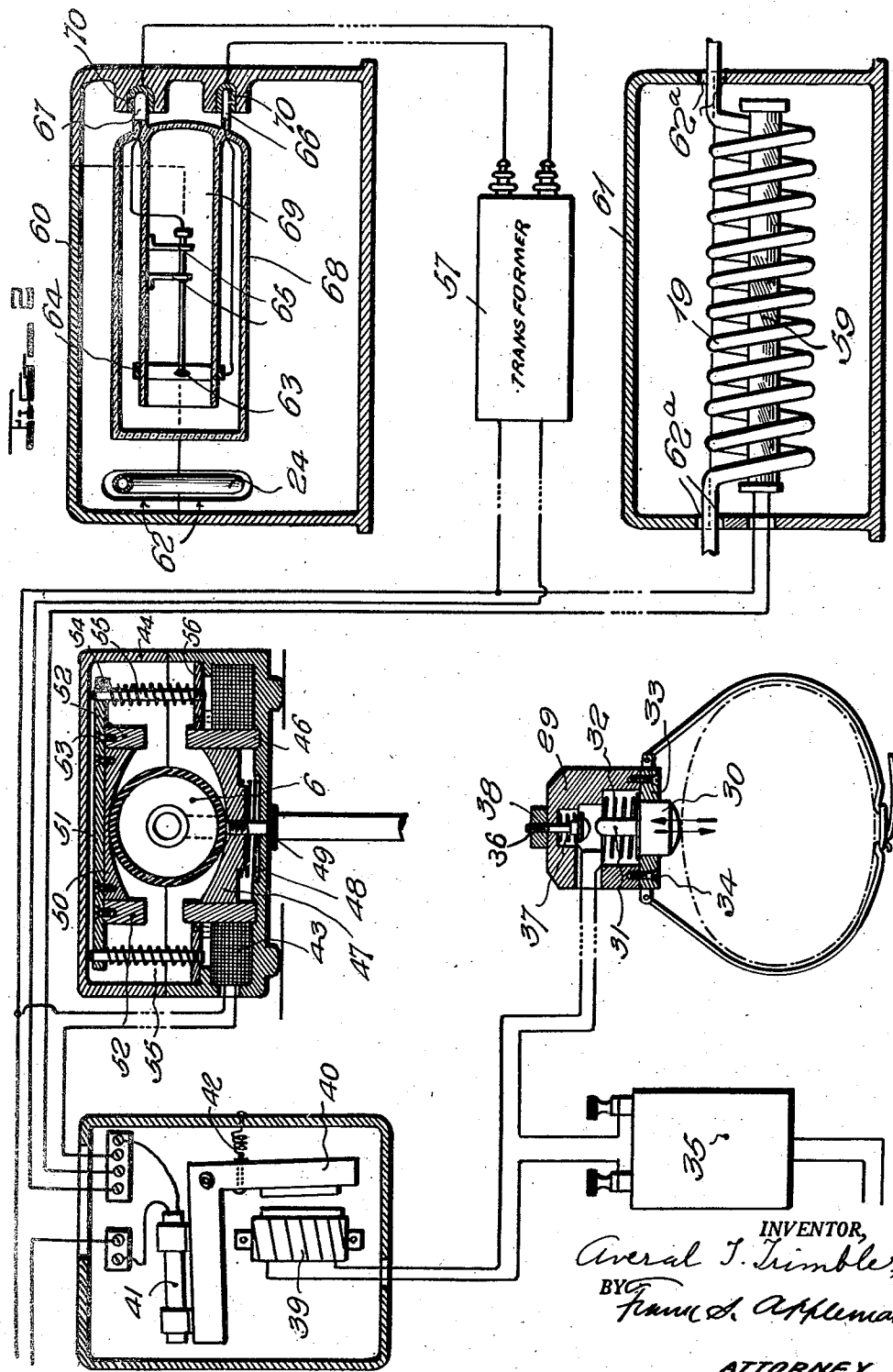
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2 Sheets-Sheet 2



INVENTOR,
Averal T. Trimble,
BY
Frank A. Appleman
ATTORNEY

UNITED STATES PATENT OFFICE

2,357,238

PROCESS AND APPARATUS FOR TREATING BLOOD

Averal T. Trimble, St. Petersburg, Fla.

Application November 18, 1943, Serial No. 510,799

3 Claims. (Cl. 128—395)

This invention relates to the treatment of blood, both as to the method and apparatus, and the inventor has for an object the extraction of a quantity of blood from a blood circulatory system such as in the human body and the treatment of the blood or a quantity thereof externally of the circulatory system in which the blood originated, and in employing the treated blood by its re-introduction into a natural blood circulatory system such as that of a human body; the said invention furthermore contemplating the irradiation of the blood, its medication, or such other treatment tending to render it sterile and useful when reintroduced into a circulatory system.

More specifically, the inventor claims as his invention an apparatus for the extraction of a quantity of blood from a human body; the treatment of the quantity of blood after it has been extracted and the returning of this quantity of blood to the same human body in perfect rhythm with the beat of the heart; the extraction of a quantity of blood from a human body, the treatment of this quantity of blood after it has been extracted, and the depositing of this quantity of blood in a blood bank or container; the extraction of a quantity of blood from a blood bank or container, the treatment of this quantity of blood after it has been extracted and the depositing of this quantity of blood in a human body in perfect rhythm with the beat of the heart.

Furthermore, the inventor claims the extraction of a quantity of blood from one human body, the treatment of this quantity of blood after it has been extracted and the depositing of this quantity of blood or a portion thereof to another human body in perfect rhythm with the beat of the heart, and during which there is employed separately, in combination or sequence, a hypodermic needle for the extraction of blood from a vein or artery, a shut-off valve to control the flow of blood into this apparatus, a bulb pump and two valves to cause the blood to flow through this apparatus, a container to extract the air from the blood as it passes therethrough, a hypodermic syringe to insert drugs or fluids into the blood to prevent its coagulation, or other drugs or fluids used in the treatment of blood for pathological or other conditions, depending upon the kind of treatment involved; an exposure tube or tubes for the purpose of subjecting the blood to actinic or other rays, depending upon the kind of treatment involved; a strainer or filter to extract coagulation or foreign substances from the blood; a shut-off valve to regulate the flow of the blood through this apparatus; a hypodermic needle to

return the blood to a predetermined vein or artery in a human body, together with all rubber hoses or conduits necessary to connect the units of this apparatus, one with the other, the order depending upon the kind of treatment involved.

The inventor also employs a low voltage transformer of standard make that gets its supply of current from outside sources, for supplying low voltage current through a pulse switch, causing this pulse switch, when applied to a surface vein or artery or when operated manually, to open and close a circuit of current leading to a relay of standard make, thereby causing the relay to open and close a circuit of current which is obtained from outside sources that leads to a pulsator that forces the bulb pump which is contained therein to gently cause the blood to flow through the apparatus in perfect rhythm with the beat of the heart and, in like manner, the relay opens and closes a circuit leading to a high voltage transformer of standard make, which in turn energizes the 1000 to 4000 A. U. ray lamp portion of a container that has inserted therein an exposure tube and causes the ray lamp to project its rays to the exposure tube containing blood to be treated, all in perfect rhythm with the beat of the heart. In like manner, the relay opens and closes a circuit leading to the germicidal or other lamp portion of a container that has inserted therein an exposure tube and causes the germicidal or other lamp to project its rays to the exposure tube containing blood to be treated, all in perfect rhythm with the beat of the heart, or to remain constant in an on or off position, depending upon the kind of treatment involved; and, in like manner, with the elimination of the ray lamp and germicidal or other lamp containers, the blood may be moved from place to place without being exposed to any rays, depending upon the kind of treatment involved. The pulse switch may be operated in like manner by another person at the will of the operator, depending upon the kind of treatment involved and, in like manner, the pulse switch may be operated by the operator to charge or discharge the entire apparatus.

With the foregoing and other objects in view, the invention consists in the method and apparatus to be hereinafter more fully illustrated, described and claimed.

In describing the invention in detail, reference will be had to the accompanying drawings forming part of this application, wherein like characters denote corresponding parts in the several views, and in which:

Figure 1 is a view in elevation, partly in sec-

tion, illustrating parts of an apparatus which may be used simultaneously in sequence or time to remove the blood from a circulatory system and to circulate, medicate, irradiate, filter and return it to a circulatory system;

Figure 2 illustrates an operative means for removing blood from a circulatory system and irradiating it;

Figure 3 illustrates a sectional view of a check valve with the valve in closed position;

Figure 4 illustrates a sectional view of the check valve with the valve thereof in open position; and

Figure 5 illustrates a view in elevation of a circuitous irradiating tube modified as compared with the tube shown in Figure 1.

In these drawings 1 denotes a shut-off valve for regulating the quantity of blood which will be allowed to pass therethrough and the shut-off valve has a shank 2 with a hypodermic needle 3 attached, the said needle being of sufficient size to allow the blood to flow therethrough. The other end 4 of the valve is tubular and a rubber hose or conduit 5 is connected to the tubular end of the valve. The tubes or nipples of the valves are provided with ribs to aid in holding the tubes or connections thereon, but as these are well known mechanical expedients, they will not be described in detail.

A device for exhausting blood from a circulatory system and forcing it back into a circulatory system comprises, in the present embodiment, a rubber or elastic or flexible bulb 6 having check valves 7 and 8 at its ends, which check valves are shown in detail, Figures 3 and 4, in a closed position and in an open position, respectively. A tube 9 connects the valve 8 with a tube 10 leading into a receptacle 11, which receptacle has an airtight stopper 12 that may be held in place by clips 13 pivotally mounted on a collar 14 which encircles the neck of the receptacle 11. The receptacle is preferably of glass and may have graduations 15 thereon so that a reading of the contents of the receptacle may be had. A tube 16 is also inserted through the stopper and it is associated with a hypodermic or other syringe 17 by which medicaments may be applied to the contents of the receptacle and, in practice, citrate, oxylate or other substance may be administered to the blood to prevent it from coagulating, or Penicillin, sulfa or other drugs may be administered for the treatment of the blood, and another tube 18 may be inserted in the receptacle and connected to a coiled tube 19 which may be exposed to rays for irradiating purposes, as will presently appear. The tube 19 is further connected to a filter 20, through which the blood is filtered and a tube 21 connected to the filter is supplied with a hypodermic needle 22, through which blood is returned to the natural circulatory system; it being shown that a valve 23 is interposed between the tube 21 and the hypodermic needle.

In Figure 5 there is shown a modified circulatory tube 24, and the tubes 19 and 24 are of such character that the blood flowing through them can be irradiated. A filter bag 25 is suspended in the filter body and the said bag may be constructed of rayon or other material suitable for the process of filtering blood, and the bag is connected to a ring 26 suspended from the edge of the filter jar and held in place by a screw cap threaded on the filter body; it being shown that the cap has an inlet tube attachment 27 to which a tube 28 is connected.

As has been stated, the bulb 6 is flexible and sufficiently resilient to cause it to resume its natural or original shape as shown in Fig. 1 and when it is compressed, the valve 7 is closed and the valve 8 is open so that any fluid within the bulb will be forced out of the bulb and through the tube 9 to the receptacle. Upon removal of pressure from the bulb, it will expand and create a partial vacuum which will open the valve 7 and close the valve 8 so that blood from an artery or vein in which the hypodermic needle 3 is lodged will be drawn from the circulatory system and, upon pressure being applied to the bulb, a reversal of action will occur, in that the valve 7 will close and the valve 8 open so that blood will be discharged from the bulb.

It is an object of the inventor to provide means for operating the bulb to alternately compress and remove pressure from the bulb in synchronism with the pulsations of the blood circulatory system from which the blood is extracted, and it is furthermore the purpose to control the operation through the pressure of the pulsations occurring in the circulatory system.

To the end just stated, a pulse contact switch consists of a plastic or composition case 29 in which is assembled a pulse contact push button 30 having a contact pin 31, the said push button and pin being held by a spring 32. The push button assembly 30, 31 and 32 is held securely in position by a cover plate 33 and screws 34 and is connected to a low voltage transformer 35. When the push button is pressed inwardly, it will engage a second contact pin 36 which is held in place by a spring 37 which can be adjusted by a nut 38. By the foregoing means, the switch places the low voltage transformer in circuit with a magnetic coil 39 of a relay which may be of standard construction. When the magnetic coil 39 is energized through current from the low voltage transformer 35, the magnetic bar 40 is oscillated, carrying the mercury tube 41 with it, thereby closing the circuits of current obtained from the outside sources leading to parts of the apparatus, to be presently described. Likewise, when this low voltage magnetic coil 39 is not energized, the magnetic bar is pulled outwardly to break contact by a spring 42, thereby returning it to its normal position and, in like manner, opening, the circuit of current obtained from outside sources, to which reference has been made.

One of the circuits from outside sources is employed to energize a magnetic coil 43, but the circuit through it is controlled by the opening and closing of the circuit from the low voltage transformer, since it is connected to and is controlled by the action of the mercury tube 41.

The case and cover 44 are preferably constructed of plastic or other composition, in which there is assembled certain stationary and movable parts operative to compress the bulb. The bulb has its ends supported between the case and cover and lies therein and is operated as a fluid pump. A set of stationary magnetic bars 46 is located in the casing and is held in place by a yoke 47 of plastic or other composition. The plastic yoke is under the influence of a spring 48 and an adjusting pin 49. The position of the yoke is regulated by the adjusting nut, thereby increasing or decreasing the distance between the yoke 47 and a corresponding yoke 50 in the movable portion of this part of the equipment. The said movable part consists of a flat plate 51, to which there is attached a set of magnetic bars 52 and a yoke held as-

sembled by screws 53. The magnetic bars and yoke are made to correspond with those of the stationary portion having the yoke and magnetic bars, and the plate 51 is apertured near each end to receive pins or standards 54 on which the plate is guided in its movement under the influence of the magnets and alternately under the influence of springs 55 which encircle the pins and about a base plate 56 at their lower ends and the said movable plate 51 at their upper ends, so that by the action of these springs the plate 51 is forced upwardly to remove pressure from the bulb after each impulse due to the action of the energized magnetic coil 43. It will thus be seen that as the circuit is closed by the switch operated by the pulsations of the circulatory system, the bulb is operated synchronously therewith for the accomplishment of the purposes and objects stated.

The conductors through which current is controlled by the switch may be used in connection with low voltage or high voltage lamps, according to the desired results. A low voltage lamp 59 is located in a container 61 including a cover with lead or other material of suitable thickness to prevent light rays from penetrating the outer surface. The low voltage lamp 59 may be encircled by the tube 49 having its ends extending through apertures 62a between the casing and its cover. The lamp 59 derives its current through the mercury tube 41, as shown.

Conductors through which current is controlled by the switch also lead to a high voltage transformer 57 which, in the present embodiment of the invention, is shown as electrically connected to a ray lamp located in a casing or container 60, and constructed of material suitable to allow the ray lamp to be contained therein. The casing includes a cover with lead or other material of suitable thickness to prevent the actinic or other rays generated by the ray lamp from penetrating the outer surface. The casing or cover has apertures such as 62 to allow the ends of the tube 24 to be inserted therein so that blood may be circulated through the tube in the zone of influence of the rays from the said lamp. The ray lamp of this embodiment is made entirely of heat resisting glass with the exception of the electrodes 63 and 64, the supporting arms 65, the connecting posts 66 and 67, and the electric connections from the electrodes to the connecting posts.

The glass portion of the ray lamp is composed of two chambers, cylindrical in shape, one within the other. The outer cylinder 68 is closed at both ends, thereby sealing gases contained therein from escaping into the atmosphere and giving the appearance of a capsule with flattened ends. An inner cylinder 69 is integral with the outer cylinder at the end of the outer cylinder having the posts, and its opposite end is open. The electrode 63 has an enlarged end of tungsten steel or other heat resisting metal and it is suspended in the central portion of the innermost cylinder or chamber by the supporting arms 65. The electrode 63 is electrically connected through the glass to the large connecting post 67, it being shown that the connecting post 66 is slightly less in diameter. The connecting posts are originally fastened to one wall of a casing in which they are installed at the terminals or posts 70 of the electric conductors. The electrode 64 is in the

shape of a band and constructed of copper or other metal and encircles the larger end of the electrode 63. The second electrode 64 is placed on the outside of the inner glass cylinder 69 and is thereby located in the outer chamber of the ray lamp. The electrode 64 is connected through the glass to the smaller of the two connecting posts 66, rigidly fastened to the side or end of the ray lamp as at 70. The feature of having these two electrodes separated by a glass cylinder is to break up the spark gap which normally would arc across from one electrode to the other into minute hair-like partially invisible rays in a sunburst effect, as the high voltage current supplied to the ray lamp is forced to pass from the tungsten electrode 63 to the copper electrode 64. The said rays are then permitted to leave the ray lamp at the inner end of the glass cylinder 69 and proceed through the glass surface of the outer chamber at right angles to the two electrodes 63 and 64. The purpose of this ray lamp when energized with high voltage current is to destroy destructive germs, bacteria or fungi by means of its penetrating rays, and the purpose of the ray lamp in conjunction with the other equipment is to treat the contents of tube 24 for infectious bacteria, germs or fungi that may be contained in the blood.

As has been stated, the details of one form of lamp are shown and described and it is the purpose of the inventor to substitute other lamps of known character that may be suitable for treating blood to destroy destructive germs, bacteria or fungi by means of their penetrating rays.

It is also understood that the circuits through the conductors will be controlled by suitable switches or the like which are commonly employed in systems of this character.

I claim:

1. A blood treating apparatus comprising a hypodermic needle for extracting blood from a vein or artery of a blood circulatory system, a shut-off valve to which the hypodermic needle is connected for regulating the quantity of blood which will be allowed to flow therethrough, a conduit connected to the valve, an inlet valve to which the conduit is connected, a fluid pump operative to draw blood through the needle, said pump comprising a flexible bulb, yokes between which the bulb is located, one of said yokes being movable with relation to the other, magnetic bars associated with the two yokes, means for energizing one of the bars whereby the opposed bar is drawn toward it, a resilient means for forcing the bars apart, and a switch actuated by the pulsations of the circulatory system from which blood is extracted for making and breaking a circuit to the pump operating means, the said pump being in communication with the inlet valve which allows the blood to pass from the shut-off valve to the fluid pump and prevents backflow of the blood from the fluid pump, an outlet valve connected to a discharge end of the fluid pump which is closed by the intake stroke of the fluid pump and opened under the discharge stroke of the fluid pump, a glass container in communication with the outlet valve, the said outlet valve checking the backflow of blood from the container, the said glass container acting as a receptacle for air extracted from the blood, a tube in the container through which blood escapes from it, a spiral tube connected to the last mentioned tube through which the blood from the

container is circulated, means for irradiating the blood in the spiral tube, and a hypodermic needle connected to the spiral tube for returning blood to a circulatory system.

2. A blood treating apparatus comprising a hypodermic needle for extracting blood from a vein or artery of a blood circulatory system, a shut-off valve to which the hypodermic needle is connected for regulating the quality of blood which will be allowed to flow therethrough, a conduit connected to the valve, an inlet valve to which the conduit is connected, a fluid pump operative to draw blood through the needle, said pump comprising a flexible bulb, yokes between which the bulb is located, one of said yokes being movable with relation to the other, magnetic bars associated with the two yokes, means for energizing one of the bars whereby the opposed bar is drawn toward it, a resilient means for forcing the bars apart, and a switch actuated by the pulsations of the circulatory system from which blood is extracted for making and breaking a circuit to the pump operating means, the said pump being in communication with the inlet valve which allows the blood to pass from the shut-off valve to the fluid pump and prevents backflow of the blood from the fluid pump, an electrically impelled means for operating the fluid pump, an electric switch actuated by the pulsations of the circulatory system for closing a circuit to the pump operating means in rhythm with the pulsations in the circulatory system, an outlet valve connected to a discharge end of the fluid pump which is closed by the intake stroke of the fluid pump and opened under the discharge stroke of the fluid pump, a glass container in communication with the outlet valve, the said outlet valve checking the backflow of blood from the container, the said glass container acting as a receptacle for air extracted from the blood, a tube in the container through which blood escapes from it, a spiral tube connected to the last mentioned tube through which the blood from the container is circulated, means for irradiating the blood in the spiral tube, and a hypodermic needle connected to the spiral tube for returning blood to a circulatory system.

3. In a blood treating apparatus, a hypodermic needle for insertion in a vein or artery, a tube through which the blood is moved, a valve interposed between the hypodermic needle and said tube, a flexible bulb having a check valve at

one end to which the tube is connected, a check valve at the other end of the bulb, a tube leading therefrom, a receptacle in communication with the last mentioned tube whereby blood is delivered to the receptacle, a syringe communicating with the receptacle for delivering medicament to blood in the receptacle, a blood discharging tube communicating with the interior of the receptacle, an irradiating tube through which blood is transmitted, a ray lamp of, 1000 to 400 A. U. in proximity to which the irradiating tube is stationed for treatment of blood flowing through the tube, a filter having means through which blood is transmitted in the course of its treatment, a hypodermic syringe in communication with the filter for returning blood to a blood circulatory system with a regulating valve for controlling the flow of blood, means for pressing and releasing the bulb including a magnetic coil, a set of magnetic bars stationary with relation to the coil and magnetized by the coil, a yoke for holding the magnetic bars in place, a movable plate having magnetic bars coacting with the first mentioned magnetic bars, a yoke between the second mentioned magnetic bars, the said bulb being interposed between the yokes whereby when one set of magnetic bars is moved toward the other the bulb is compressed, springs for forcing the yokes apart when the magnetic bars are demagnetized, a source of current for the magnetic coil and for the said ray lamp including a circuit, a mercury tube operative to make and break the circuit, an oscillatively mounted bar on which the mercury tube is mounted and whereby the mercury tube is tilted to make or break the circuit, a magnetic coil for attracting and releasing the bar, a spring for retracting the bar when the magnet is deenergized, an electric circuit for the magnetic coil including a source of electricity, an interposed low voltage transformer and a switch for making and breaking the circuit through the low voltage transformer and the magnetic coil, the said switch having a movable part actuated by the pulsations of blood circulatory system coacting with a terminal of a conductor leading to the magnetic coil whereby the pulsations in the circulatory system establish a circuit for operating the bulb and intermittently furnishing current to the ray lamp, and a high voltage transformer in the said circuit with the ray lamp.

AVERAL T. TRIMBLE.