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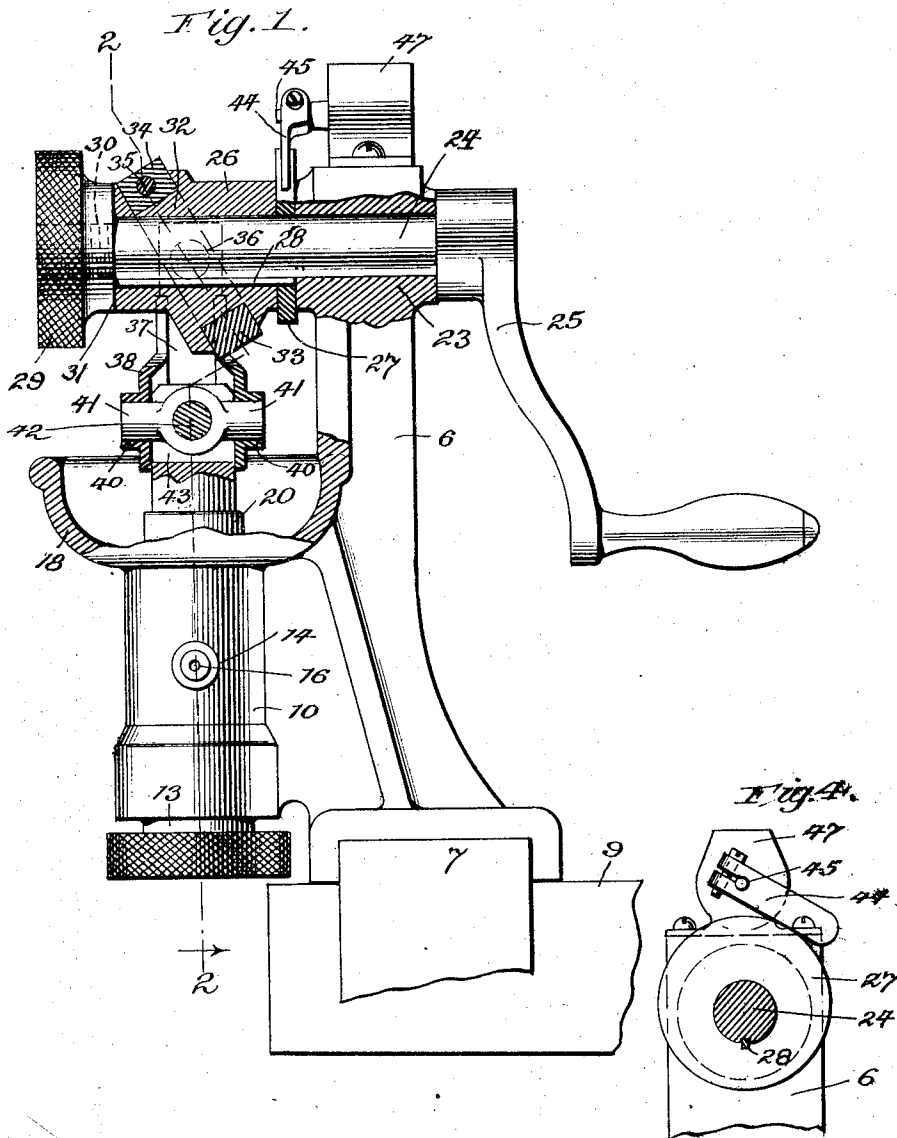
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W. G. COLES

BLOOD TRANSFUSION MACHINE

Filed May 6, 1926

2 Sheets-Sheet 1



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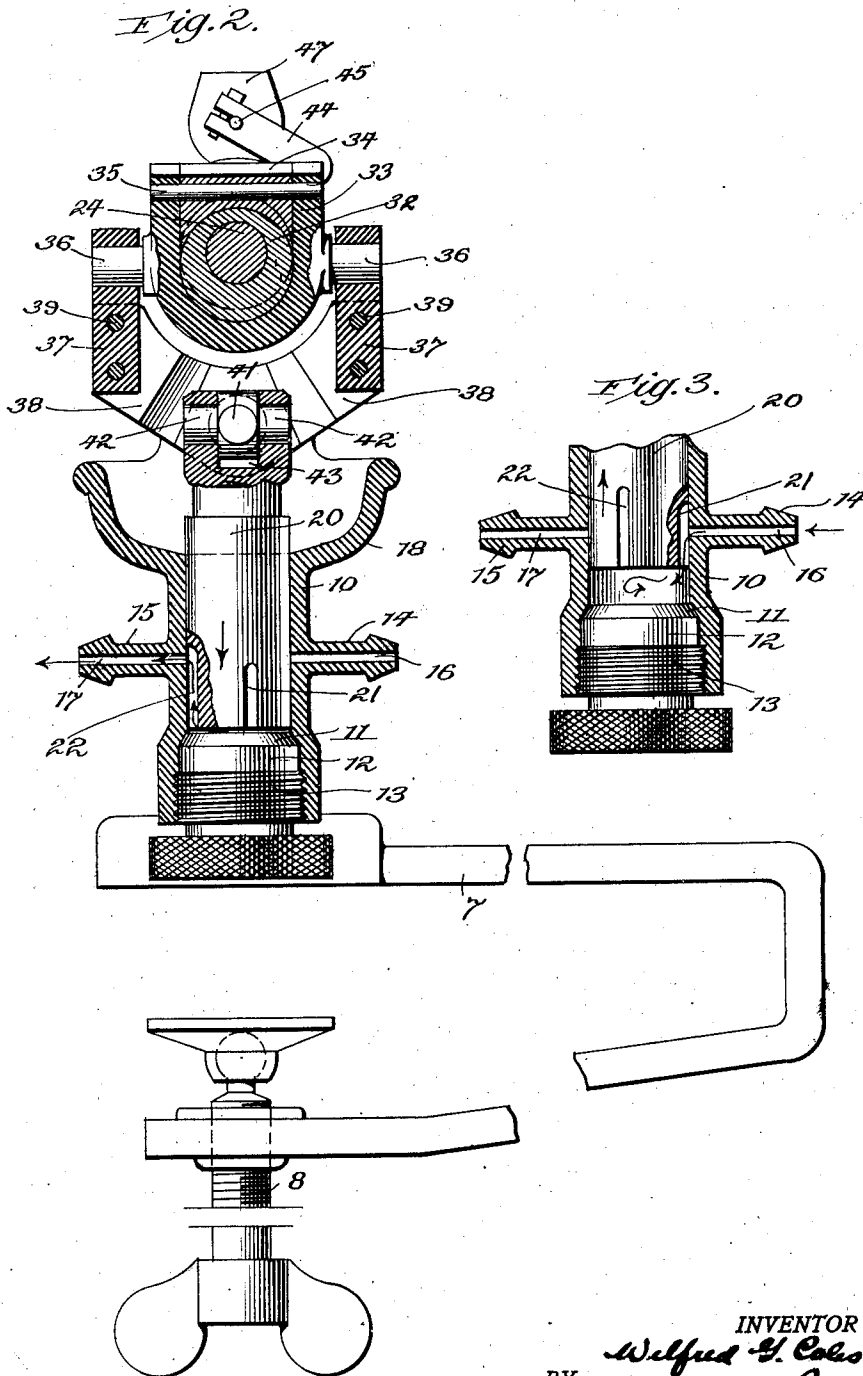
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BLOOD-TRANSFUSION MACHINE.

Application filed May 6, 1926. Serial No. 107,219.

This invention relates to a pump for use in blood transfusion operations and to a method of sealing such pumps against the leakage of air, and of maintaining the temperature of the pump during the operation.

In prior devices difficulty has been encountered, occasioned partly by clotting of the blood due to delay and cooling, and partly to inleakage of air into the pump on the suction stroke, with very harmful results, and partly to the failure of automatic valves to function, which makes it impossible to determine from the number of strokes of the pump the quantity of blood transfused.

The present invention provides a pump which is very easily cleaned and sterilized and all parts of which are accessible for inspection. The valve mechanism is absolutely positive in action.

The pump is provided with means for sealing it against the inleakage of air by the use of a saline solution which serves as a sealing bath. If any of the solution is drawn into the pump the quantity will be minute and the effect negligible. By heating the saline solution to a proper temperature it serves as a heat reservoir to maintain the temperature of the pump at the optimum value.

A practical embodiment of the invention is illustrated in the accompanying drawings, in which—

Figure 1 is an elevation of the complete pump device with certain portions sectioned to show the internal construction.

Figure 2 is a section on the line 2—2 of Figure 1. In this figure the plunger is shown in its lowermost position.

Figure 3 is a fragmentary view similar to a portion of Figure 2, showing the position assumed by the parts after the plunger has commenced its upward movement.

Figure 4 is a detail showing how a counting mechanism associated with the pump is actuated.

The main frame member of the device is indicated at 6 and is provided with a bow member 7 and clamping screw 8 by which it may be fixed in position on an operating table, part of which is indicated by the numeral 9 in Figure 1. Any suitable clamping mechanism might be substituted.

Formed integrally with the frame member 6 is a vertical cylinder 10. This cylinder is slightly enlarged at its lower end and counterbored to form a tapered seat 11 against which seats the tapered end of a plug 12 which is threaded at 13 into the counterbored end of the cylinder 10. A knurled head offers a convenient means for screwing the plug 12 up until its conical end seats in 11.

The cylinder 10 is formed with a nipple 14 to receive the suction or inlet tube (not shown) and a diametrically arranged nipple 15 for the discharge tube (not shown).

It will be understood that the usual tubing and transfusion needles will be used by the surgeon conducting the operation. The nipples 14 and 15 are provided with passages 16 and 17, which are aligned with each other. So far as the operation of the pump is concerned they might be otherwise arranged but there is a definite advantage in the alignment, as it permits inspection of the passages 16 and 17 from end to end. The upper end of the cylinder 10 merges into a flaring cup or reservoir 18 which is used to maintain a sealing bath of saline solution around the piston or plunger 20, where this emerges from the cylinder 10.

The plunger 20 is formed on its surface with two longitudinally extending grooves, one of which, 21, is the inlet port and the other of which, 22, is the outlet port.

The plunger 20 is not only reciprocated vertically but it is also oscillated about its longitudinal axis so that on its up-stroke the inlet port 21 registers with the inlet passage 16 and on the down-stroke the outlet port 22 registers with the outlet passage 17.

It is obvious from an inspection of Figures 2 and 3 that only one of the ports 21 or 22 can register with the passages 16 and 17 respectively at one time. The plunger 20 is reciprocated and given a timed oscillation by means of an oblique eccentric, and the parts are so mounted that the drive mechanism may be readily dismantled in such a way that the plunger 20 may be withdrawn from the cylinder 10 for cleaning and sterilizing.

In the upper end of the frame member 6 a bearing 23 is formed for a shaft 24, on

which there is fixed an ordinary hand crank 25. The shaft 24 projects through the bearing 23 and overhangs the plunger 20. Above such plunger, shaft 24 carries a sleeve 26 and an eccentric disk 27, both of which are held against rotation on the shaft by a removable key 28. The sleeve 26, eccentric disk 27, and key 28 are all held in place by a knurled nut 29 which is threaded on a reduced end 30 of shaft 24, as indicated in Figure 1. The nut 29 thus seats against a shoulder 31 on the shaft 24 and the necessary clearance is thus preserved to permit the free rotation of the shaft 24 in its bearing 23.

Formed on the sleeve 26 is an oblique eccentric channel 32 in which runs a strap made up of a U-shaped member 33 and an insert 34 which is held between the branches of the U-shaped member 33 by means of an inserted pin 35. The member 33 carries aligned trunnions 36 on which are journaled the arms of a yoke or fork. This fork is made up of a pair of blocks 37 each having a bearing to receive a corresponding one of the trunnions 36 and a pair of sheet metal stampings 38 which embrace the blocks 37 and are riveted thereto as indicated at 39. The stampings 38 are formed with bearings 40 to receive the aligned trunnions 41. These are formed on a member which comprises the floating element of a Hooke's joint. On this member are two other aligned trunnions 42 which are perpendicular to the trunnions 41. Trunnions 42 are journaled in bearings formed in the upper end of plunger 20, which is forked as indicated at 43.

There is thus a universal connection between the plunger 20 and the yoke made up of the members 37 and 38. This yoke is in turn pivotally connected to the eccentric strap 33, 34. The eccentric 32 as it rotates, imparts a cyclic rotary oscillation and longitudinally reciprocation to the plunger 20. By properly choosing eccentricity and angularity of the eccentric 32 the desired ranges of motion are secured for plunger 20. The obliquity of the eccentric determines the degree of rotary oscillation imparted to the plunger 20, and the ports 21 and 22 are so spaced as to register with the ports 16 and 17, on the up and down strokes, respectively.

The effect is to produce a pump in which the valves are positively actuated in a fixed time relation to the oscillations of the plunger. There consequently can be no failure of any valve to open or close at the proper time.

The eccentric 27 operates, through a lever 44, the shaft 45 of a ratchet driven counter 47 mounted on the upper end of the frame member 6.

It will be observed that the effective displacement of the pump per stroke is absolutely fixed and the counter therefore will give a correct indication of the amount of blood de-

livered by the pump. The cup 18 is to retain a bath of saline solution around the plunger 20 where this emerges from the cylinder 10. This prevents any inleakage of air. Should any inleakage of saline solution occur it obviously will be so small in quantity as to have no material effect. By properly warming the pump and the saline solution the best conditions for the operation may be had and maintained.

To clean the pump the nut 29 is removed, after which the shaft 24 may be withdrawn. This releases the sleeve 26 and permits the plunger 20 to be withdrawn from the cylinder 10. The removal of the plug 12 opens the cylinder 10 from end to end for cleaning and inspection. Since the passages 16 and 17 are aligned they are also subject to thorough cleaning and inspection.

The groove ports 21 and 22 are preferably made of semi-circular contour, so that they may be readily cleaned.

It will be observed that the threads on the plug 13 are isolated from the interior of the cylinder 11 by the sealing of the plug 12 against the seat 11.

Minor structural variations may be made without departing from the spirit of my invention, and I do not limit myself to the exact embodiment shown except to the extent specified in the claims.

While I prefer the structure as shown, the sealing and heating bath might be used with any type of pump, and the receptacle which retains it may be variously located relatively to the cylinder. For sealing it is essential that the joint be submerged. For heating it is essential that the bath be in heat conducting relation to the parts of the pump.

What is claimed is:

1. The method of preventing harmful inleakage through a joint of a mechanical pump used in transfusion operations, which consists in submerging said joint in a solution miscible without harmful effect with the transfused blood.

2. The method of maintaining a desired temperature and preventing harmful inleakage through a joint of a mechanical pump used in transfusion operations, which consists in submerging said joint in a heated solution miscible without harmful effect with the transfused blood.

3. In a blood transfusion machine, the combination of a cylinder open at both ends and having an internal working surface which is smooth throughout its length save for inlet and discharge ports; means for connecting supply and discharge connections to said ports; a closure for one end of said cylinder adapted when in place to seal the end of the working portion of said cylinder to preclude the existence of recesses or crevices open to the interior of the cylinder; a plunger mounted for rotary oscillation in said cylinder, said

plunger forming a seal with said cylinder by the closeness of fit between the two, said plunger being formed with grooved ports in its surface which coact respectively and alternately with the inlet and discharge ports upon rotary oscillation of the plunger in the cylinder; a solution miscible without harm with blood passing through the pump; and a receptacle for retaining said solution in position to submerge the sliding joint between said plunger and cylinder. 10

In testimony whereof I have signed my name to this specification.

WILFRED G. COLES.