Dec. 29, 1942. R. O. REYMOND 2,306,751

PUMPING APPARATUS

Filed March 23, 1942

Fig. 1.

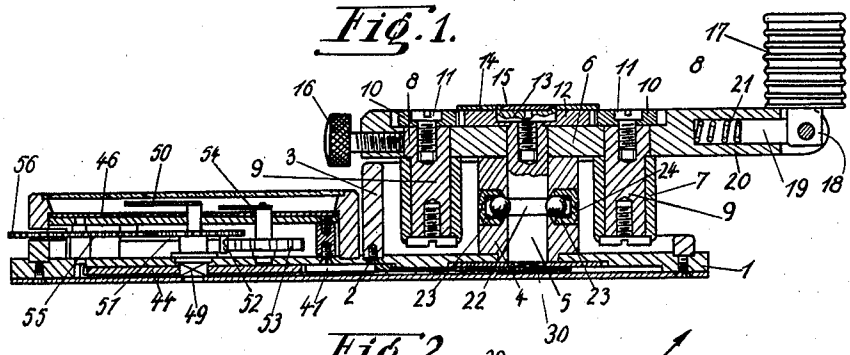


Fig. 2.

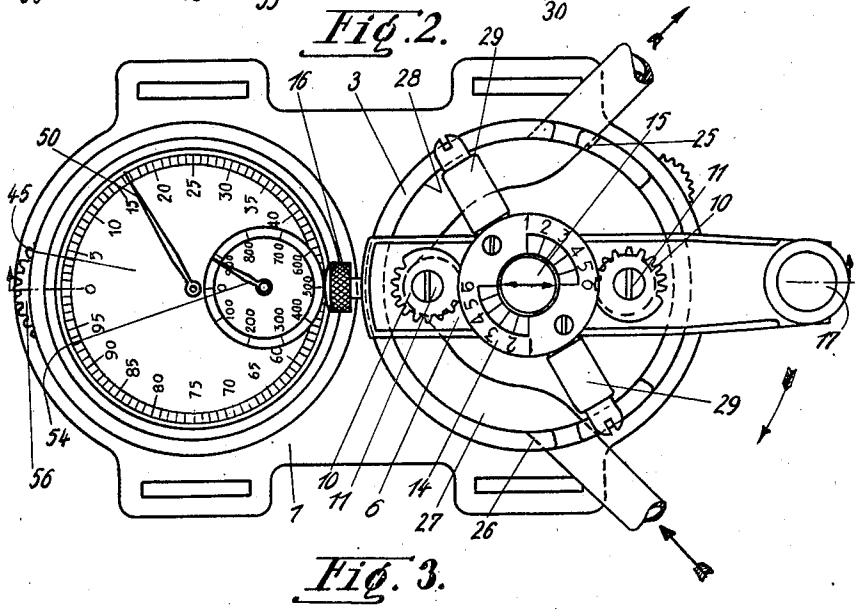
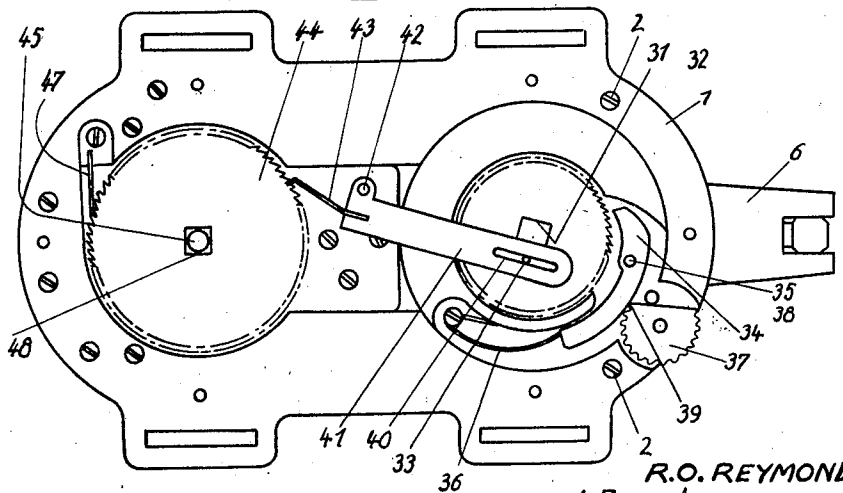


Fig. 3.



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PUMPING APPARATUS

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4 Claims. (Cl. 103—149)

The present invention relates to an apparatus for the extraction of a fluid from the body and for the injection of a fluid into the body.

The present apparatus comprises, in combination, a structure with a cylindrical partition along the interior surface of which a portion of an elastic tube, placed on an arc having a length less than 360°, is being constantly flattened against said partition by at least one of several rollers mounted on a rotary member coaxial with said partition, the point of action of the rollers on the tube moving along this tube portion, during the rotation of the driving member, in order to produce the circulation of a fluid contained therein. The driving member comprises a part cooperating with a part of the structure for rotating the one on the other during the rotation of the driving member, which is separable from the structure by exerting a simple pulling action on it. A retaining means is provided to prevent the driving member from accidentally leaving its working position.

The accompanying drawing shows by way of example an embodiment of the apparatus forming the subject matter of the invention.

Figure 1 is a side elevation in section taken through the center of the apparatus.

Figure 2 is a front view corresponding to Figure 1, and

Figure 3 represents the apparatus as seen from below, the lower base plate being taken away.

The apparatus represented comprises a base plate 1 seen from below in Figure 3. On the upper face of this plate a cylindrical partition 3, extending at a constant height over an arc of about ¾ of a circle, is fixed by means of screws 2. At the center of the space formed by this partition 3, a sleeve 4 coaxial with said partition 3 is fixed to the base plate 1. This sleeve bears a pin 5 fixed at its upper end in a piece 6 forming a rotary driving member of two rollers 7 mounted on the latter as will be indicated below.

The member 6 is arranged radially with respect to the pin 5 and on each of its two radial arms a cylindrical portion of a roller support 8 is mounted. This support 8 comprises cylindrical portions 9 with their axis parallel to the pin or axle 5 but arranged eccentrically with respect to the support 8. It is on these portions 9 that the rollers 7 rotate freely. A pinion 10 is fixed to the support 8 by means of a screw 11. This pinion comprises teeth extending over slightly more than half of its periphery. The two pinions 10 corresponding to the two rollers are in mesh with a common wheel 12 which rotates freely on the head of a screw 13 screwed into the pin 5. A graduation 14 borne by the wheel 12 enables, in cooperation with an index 15 fixed on the head of the screw 13, to determine the angular position of the wheel 12 with respect to the pin 5. It will be easily understood that by turning the wheel 15, which brings about the simultaneous rotation of the two pinions 10, the distance between the rollers 7 and the axis of pin 5 is altered owing to the fact of the eccentric mounting of said rollers with respect to the supports 8.

It is possible to set the position of the supports 8, after having adjusted at will the distance between the rollers, by means of the point of the set screw 16 which may come into contact with the periphery of one of the roller supports 8.

One of the radial arms of the driving member 6 carries at its extremity a handle 17 mounted on an axis 18 in such a manner that it may occupy either the position indicated in Figure 1 or a position symmetric with respect to the axis 18. A small piston 19 arranged in a longitudinal bearing 20 of the arm in question is forced by means of a spring 21 to bear against the rod of the handle 17, keeping the latter in an appropriate position. When the handle 17 is oscillated about the axis 18, the piston 19 is driven back and, therefore, permits such an oscillation. The handle 17 is used to turn by hand the driving member 6 together with the rollers 7 about the axis common to the pin 5 and the cylindrical partition 3.

The pin 5 comprises a peripheral groove 22 in which two balls 23 are partially engaged under the action of the springs 24 which are arranged together with these balls in bearings of the sleeve 4. It may be seen that these balls constitute elastic retaining means preventing an accidental axial movement of the pin 5 with regard to the sleeve 4. On the contrary, if the member 6 is pulled, the balls are deviated and the pin 5 may be extracted from the sleeve 4, thus completely separating the driving member 6 and the rollers 7 from the circular partition 3.

This circular partition 3 is provided with two slots 25, 26 through which the extremities of a portion of an elastic tube 27, for example a rubber tube, are passed. The tube 27 is placed along the preferably knurled interior surface 28 of said partition 3, as represented in Figure 2. This portion 27 of the elastic tube extends on the surface 28 over a length of arc greater than 180° but less than 360°.

The distance of the rollers 7 from the surface 28, which, as has been pointed out above, may be adjusted, is such that these rollers, at least one at a time, compress this tube against this surface, the action point of the rollers on the portion 27 of the tube moving along this portion during the rotation of the member 6. Thus, if the flexible tube contains a liquid, the latter is forced inside this tube in the direction of the arrows under the effect of the displacement of

the point of contact of the rollers on the tube. Radial members 29, comprising a small roller which is able to rotate freely, prevent the portion 27 of the flexible tube from accidentally leaving the interior of the circular partition 3.

The represented apparatus may be used for example for transfusion of blood from a giving to a receiving person, for the elimination of a purulent liquid from the body of a patient and its replacement by a disinfecting liquid, or for supplying of air into the body as it is practised in the case of pneumothorax.

The free extremity of pin 5 ends into a square portion 30 extending through a hole in the plate 1 and engaged with a square opening 31 of a ratchet wheel 32 bearing an eccentric knob 33. A pawl 34 pivoting about 35 against the inferior face of the plate 1 and under the action of a spring 36, may be brought into a position of cooperation with the ratchet wheel or, on the contrary, may be disengaged from this ratchet wheel (this second position is the one represented in Figure 3). In order to force the pawl 34 from one of its positions into the other, a knurled piece 37 with its periphery slightly projecting over the edge of plate 1 (see Figures 1 and 2), is provided. This piece cooperates with a stop 38, in such a manner that in one of its positions (the one represented in Figure 3) its portion 39 acts on the pawl 34 against the spring 36 in order to separate from the ratchet, whereas in its other extreme position this portion 39 is kept apart from the pawl and consequently leaves it under the action of the spring 36 and free to engage with the ratchet wheel 32. When the pawl is cooperating with the ratchet wheel, the rollers may rotate only in one direction about the axis of the pin 5, any backward movement being impossible. The eccentric knob 33 engages with a slot 40 of a lever 41 pivoting about 42 and mounted in a bearing provided between the plate 1 and a second plate, the whole forming a base on which the partition 3 and the meter described below are fixed. The lever 41 bears at its extremity, opposed to the one having the slot 40, a member 43 forming a sort of pawl which engages the teeth of a wheel 44 rotating about the axis 45 of a meter 46 fixed on the plate 1 near the partition 3, as may be seen in Figure 2. It will easily be seen that at every revolution of the driving member 6 and consequently of the ratchet wheel 32, the member 33 brings about an oscillatory movement of the lever 41 in such a manner that the member 43 rotates the ratchet wheel 44 corresponding to the distance of one tooth in the anticlockwise direction in Figure 3. A pawl 47, which is also in engagement with the teeth of wheel 44, prevents any backward motion of this wheel. The wheel 44 has in its center a square hole 48 in which the square extremity of a shaft 49, carrying the large finger 50 of the meter, is engaged. This large finger indicates the number of revolutions carried out by the driving member 6. The shaft 49 carries a gear wheel 51 with a pin 52 which, at every revolution of this wheel, advances to the amount of one tenth of a revolution a second gear wheel 53 bearing a small finger 54 indicating the number of tens of revolutions of the driving member 6. On the meter dial visible on Figure 2, the fingers are in a position corresponding to some 917 revolutions carried out by the driving member and by the rollers which it bears. For adjusting the meter to zero, a wheel 55 is provided engaging with a wheel 51, which itself is in engagement with a pinion 56 with its periphery slightly projecting over the wall of the meter, as may be seen in Figure 2. By acting with the finger on the wheel 56, the meter may be moved forward (the pawl 47 and the member 43 also forming a pawl being not opposed to this movement) until the fingers are brought into the zero position.

The arrangement of the meter adjacent to the mechanism producing a flow of the fluid in the tube 27, as represented in the drawing, is very convenient, as in the case of a blood transfusion, the quantity of the blood may easily be watched. It is evident that the number of rollers may be different from two, that the elastic retaining means preventing the pin 5 from accidentally leaving the sleeve 4 may also be different from those represented, and that the meter 46 may be arranged in a position different from the one indicated in the drawing. The connection between the meter 46 and the pin 5 may also be different from the one described.

It will be noted that, due to the instantaneous extraction of the member 6 and of the pieces which it bears, it is possible to easily extract the tube 27 from the interior of the partition 3 and to clean the apparatus, the tube 27 and the member 6 may then be put back almost instantaneously into position.

What I claim is:

1. In a liquid pump, the combination of, a base plate; a wall fixed on said base and curving through an arc having a length less than 360°; a liquid conduit comprising an elastic tube lying on said base plate and positioned against the concave surface of said wall; a rotatable member positioned coaxially with said concave surface, means to rotate said rotatable member; a plurality of freely rotatable rollers mounted on said rotatable member and positioned to compress said tube progressively along the length which is positioned against said wall; said rotatable member having an axially positioned cylindrical member depending therefrom, and a fixed upstanding member projecting from said base plate and supporting the rotating and depending members in operative position, said depending and upstanding members being rotatable in concentric relation to each other and having means for normally maintaining said members in said relation but premitting separation thereof when axial tension is exerted on one of said members.

2. A liquid pump as recited in claim 1 in which the means for normally maintaining the depending and upstanding members in concentric rotatable relation comprises a ball positioned in cooperating recesses formed in the contiguous arcuate surfaces of said members, and means to permit the ball to move laterally into one of said recesses when axial tension is exerted on one of said members.

3. A liquid pump as recited in claim 1 in which the means for normally maintaining the depending and upstanding members in concentric rotatable relation comprises a recess formed in the interior face of the upstanding member, a corresponding peripheral groove in said depending member, a ball and a spring positioned in said recess arranged to nomally urge said ball against said groove of the depending member.

4. A liquid pump as recited in claim 1 in which the tube-compressing rollers are eccentrically mounted.

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