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2,314,281

PUMPING APPARATUS

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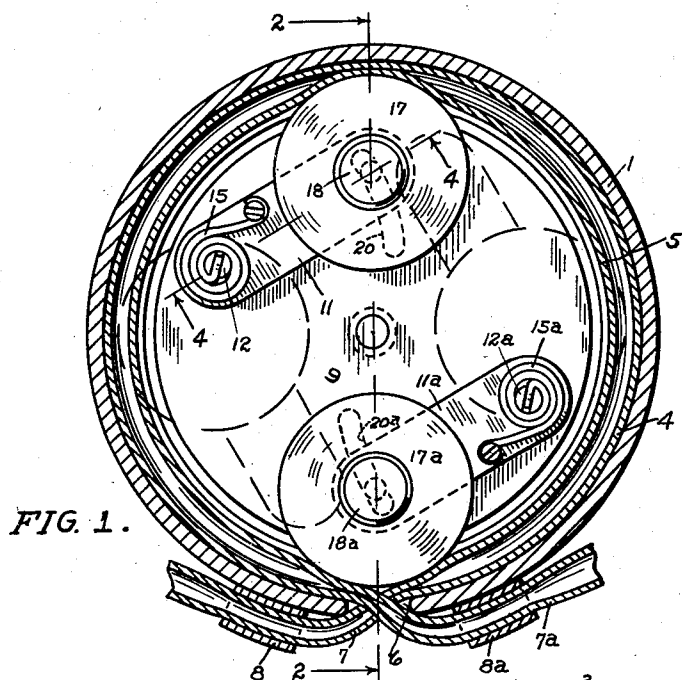


FIG. 1.

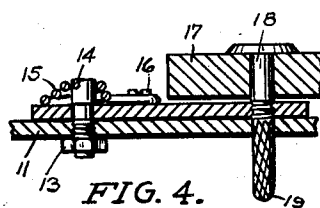


FIG. 4.

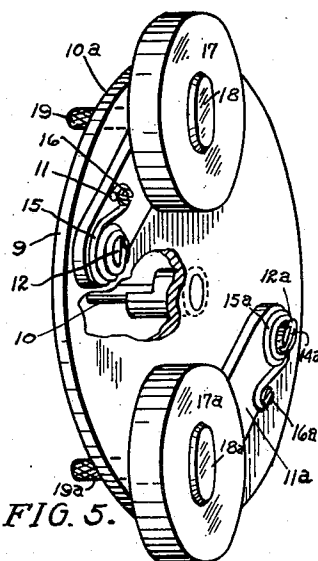


FIG. 5.

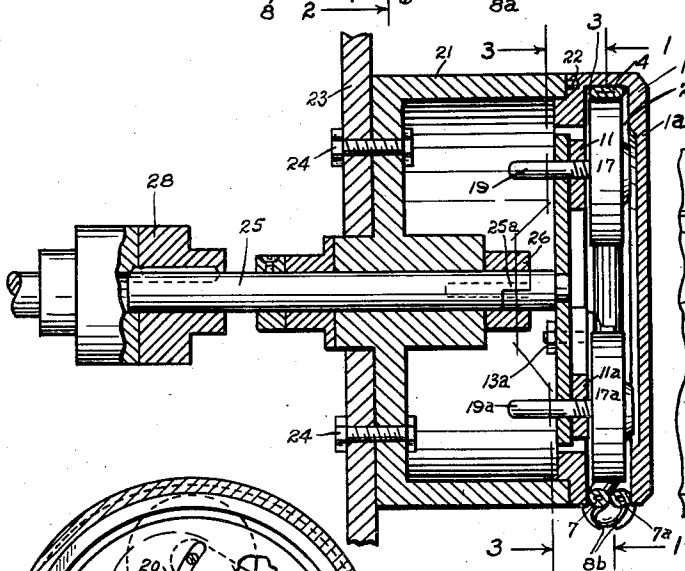


FIG. 2.

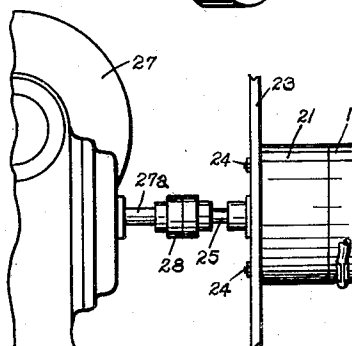


FIG. 6.

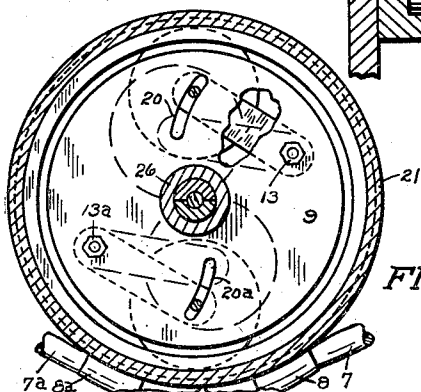


FIG. 3.

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## UNITED STATES PATENT OFFICE

2,314,281

## PUMPING APPARATUS

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Application March 28, 1941, Serial No. 385,727

4 Claims. (Cl. 103-149)

My invention relates generally to pumps for causing a fluid to be forced through a conduit at a uniform rate without permitting the actuating members of the pumping apparatus to come in contact with the fluid and is particularly directed to a so-called blood transfusion pump. To this end, said pumping apparatus comprises a casing in which a length of collapsible but elastic tubing is arranged in a circular course and a rotor is mounted centrally of said circular course with eccentrically arranged tubing engaging elements adapted progressively to move about with said rotor to compress the side walls and to expel the contents of said section of tubing progressively thru said course.

One of the specific objects of my invention is to provide a device of this character in which the force applied by said rollers to compress the walls of said tubing and to thus expel the fluid from said course can be regulated so closely that sufficient force will then be applied to the walls of said tubing to completely collapse them but no greater force will be applied which might injure said tubing walls.

A further specific object of my invention is to provide pumping apparatus of this character in which there is no pulsating of the fluid thru the pumping apparatus. A further object of my invention is to provide a simple and inexpensive apparatus which can be easily and quickly assembled and dismounted so that the parts thereof may be removed for sterilizing and reassembled without destroying the accuracy of the operative relationship of said parts.

A further specific object of my invention is to provide a pump of this character in which the tubing can be easily and quickly inserted and withdrawn and yet said tubing will not be permitted to creep within the casing under the action of the rotor elements in compressing the walls of the tubing and expressing the contents thereof. Further and other details of my invention are hereinafter described with reference to the accompanying drawing, in which:

Fig. 1 is a sectional view thru the casing and tubing of said pumping apparatus showing the manner in which the rotatable operating mechanism is mounted, said section being taken on the line 1-1 in Fig. 2;

Fig. 2 is a section taken thru said apparatus and driving mechanism therefor, taken on the line 2-2 in Fig. 1;

Fig. 3 is a transverse sectional view on a slightly decreased scale taken on the line 3-3 in Fig. 2, a portion of the casing being shown broken

away to disclose details of the construction which would otherwise be obscured;

Fig. 4 is a detailed sectional view taken on the line 4-4 in Fig. 1, illustrating the manner in which the rollers, pivotal arms and manipulating devices therefor are mounted;

Fig. 5 is a perspective view of the rotor for said pumping apparatus with a portion of the disc element therein shown broken away to disclose the short shaft or trunnion mounting therefor; and

Fig. 6 is a fragmentary assembly view illustrating how the pumping mechanism is arranged in operation.

15 A pumping apparatus embodying my invention comprises casing 1 closed upon one face 1a and open on the other face. Said casing defines a chamber 2 a portion of which is an internal circular groove 3. In said groove a section of collapsible elastic tubing 4 is formed into an annular course. The portions of said tubing immediately adjacent said annular course 5 extend thru a lateral perforation 6 leading thru the walls of the casing. Said lateral perforation extends into 25 said groove and is of a width approximating twice the outside diameter of the tubing and of a length slightly greater than its width. The portions 7-7a of said tubing immediately adjacent the annular course 5 cross in said lateral perforation and are releasably held by C-shaped clips 8-8a. Said clips are integral with or firmly secured to the casing and each has an inside diameter closely approximating the outside diameter of the tubing. As a matter of fact, said 35 inside diameter of the clip should be slightly smaller than the tubing so as to grip said tubing in the manner illustrated in Fig. 1. Said tubing preferably is high grade pure rubber tubing, such for example as is used in blood transfusion work and is highly compressible and resilient. Into 40 each of said clips 8-8a is a notch 8b thru which said tubing can be forced laterally to seat the tubing in said clips or thru which said tubing can be removed laterally to disengage the tubing from the clips. Said notch is substantially narrower than the outside diameter of the tubing and thus the tubing cannot inadvertently be detached from the clips thru said notch. The tubing is formed into an annular course and is adjusted in the circular groove so as to completely fill the groove circumferentially. The tubing can then be anchored by having the portions 7-7a placed in the clips.

A rotor 10a, including a disc 9, is journaled in the casing being supported by a stepped or other-

wise split shaft 10. On one face of said disc is a pair of arms 11—11a each pivotally mounted at one end to the face of said disc 9. The pivotal mounting of said arms and the securing of said arms to the disc is accomplished thru pins 12—12a, respectively. Each of said pins is secured to its arm and the disc by a threaded nut and bolt structure 13—13a as is illustrated in Fig. 4. The upper end of each of said pins is slotted, respectively, as at 14—14a and one end of a coiled spring 15—15a, respectively on said pins, is secured in said slot. The other end of each of said springs, respectively, is hooked about a screw 16—16a, respectively, tapped into the arm. Each spring is wound so as to press arm 11—11a and roller 17—17a, carried upon the free end of each of said arms, outwardly. The pins are rotated so as to put substantial tension in the springs to which they are secured and said pins are then locked into position by setting the nuts 13—13a, respectively, down tightly against the outside face of disc 9. Sufficient tension is applied to the springs so that the rollers will be forced outwardly with sufficient force to compress the walls of tubing 4 and to express the contents of the tubing when said rotor is actuated.

The degree of compression of said tubing and the manner in which each roller engages the walls thereof are indicated in Fig. 1. Each of rollers 17—17a is journaled upon a depressor pin 18—18a threaded in the free end of arms 11—11a, respectively, and each has a knurled end 19—19a, respectively, which extends thru an elongated arcuate slot 20—20a in disc 9. Said knurled ends are alined with each other at the sides of the disc opposed to the arms 11—11a so that said depressor pins can be gripped between the fingers and moved longitudinally of the arcuate slot to bring the rollers 17—17a out of engagement with the internal circular groove, in the manner illustrated in Fig. 1. This action is diagrammatically illustrated in dotted outline in Fig. 3.

It is the engagement of the faces of the rollers 17—17a with the side of the internal circular groove 3 which holds the rotor in engagement with the casing. Disengagement can be effected merely by moving said depressor pins towards each other and then displacing the rotor laterally from the casing to disengage said parts.

Said casing and the rotor mounted therein, preferably engages a cup-shaped base shell 21 in the manner illustrated in Fig. 1. Said base shell and the casing have a good sliding fit so as to prevent lateral separation and relative rotation is prevented by a pin 22 which seats in a recess in the casing in the manner illustrated in Fig. 2. Said cup-shaped base shell is secured to a wall or other fixed member 23 by bolts 24. Thus, said shell and said casing are held against rotation. Journaled in said shell is a drive shaft 25 having a stepped end 25a adapted to engage the stepped end of shaft 10. Said parts are held in engagement by a slip coupling 26. Said drive shaft 25 may be driven by an electric motor 27, the shaft 27a of which can be operatively joined to drive shaft 25 by means of a coupling 28. Thus the motor shaft, the drive shaft, coupling 28, stepped shaft 10 and rotor 10a are joined together and rotate as a unit. The shell, casing and wall are fixed and thus the rollers 17—17a rotate about the axis of rotation of stepped shaft 10 and progressively collapse the tubing 4 lying in internal circular groove 3. Thus the contents

of said tubing are progressively expressed and experience has demonstrated that there is no slippage and said pumping apparatus functions as a positive displacement element when pressures are utilized within an operating range dictated by the inherent strength of the tubing walls.

When the pumping apparatus is assembled, as is illustrated in Fig. 2, and it is wished to remove the casing, all that it is necessary to do is to pull the casing laterally from the shell which coincidentally disengages the stepped shaft 10 from engagement with drive shaft 25. The rotor can be disengaged from the casing merely by pulling the depressor pins 18—18a towards each other until the rollers clear the sides of the internal circular groove 3. The rotor can then be removed. If the tubing 4 is to be removed, this can quickly be done by detaching the ends from clips 8—8a and all of the separate parts can then be washed and placed in a sterilizer, separately. When the pumping apparatus is to be reassembled, a portion of the tubing can be arranged in an annular course with the ends thereof extending thru the lateral perforation 6 and when the course is extended to completely fill the internal circular groove 3 circumferentially, the ends can be slipped laterally into the clips and the rotor can be mounted in place by pulling said depressor pins towards each other, moving said rotor laterally into the casing and releasing said depressor pins permitting springs 15—15a to space the rollers apart and to seat in the internal circular groove 3. The tension of springs 15—15a may be varied by backing off nuts 13—13a and turning pins 12—12a to the desired position where they may be locked in place by setting the nuts 13—13a down tightly into position.

I claim:

1. Pumping apparatus comprising a casing defining an internal circular groove, a rotor element journaled in said casing, a length of collapsible elastic tubing formed into an annular course within said casing and lying in said groove, said rotor comprising a disc, a pair of spring extended arms each pivotally mounted at one end on said disc, a roller carried by the free end of each of said arms, and depressor pins carried by said arms extending thru slotted apertures formed in said disc, said rollers normally being adapted to ride in and to engage the sides of said casing groove, said depressor pins constituting manual manipulating means for moving said rollers into and out of engagement with said casing groove.

2. Pumping apparatus comprising a casing defining an internal circular groove, a rotor element journaled in said casing, a length of collapsible elastic tubing formed into an annular course within said casing and lying in said groove, said rotor comprising a disc, a pair of spring extended arms each pivotally mounted at one end on said disc, a roller carried by the free end of each of said arms, and aligned depressor pins carried by said arms extending thru slotted apertures formed in said disc, said rollers normally being adapted to ride in and to engage the sides of said casing groove, said depressor pins constituting manual manipulating means for moving said rollers into and out of engagement with said casing groove.

3. Pumping apparatus comprising a casing defining an internal circular groove, a rotor element journaled in said casing, a length of col-

lapsible elastic tubing formed into an annular course within said casing and lying in said groove, said casing being perforated laterally of said groove to define an opening thru which the portions of said tubing adjacent the ends of said annular course may extend to the exterior of said casing, said rotor comprising a disc, a pair of spring extended arms each pivotally mounted at one end on said disc, and a roller carried by the free end of each of said arms, said rollers normally being adapted to ride in and to engage the sides of said casing groove, each of said rollers being substantially larger in diameter than said casing opening, said tubing portions extending thru said opening, crossing each other within said opening.

4. Pumping apparatus comprising a casing defining an internal circular groove, a rotor element journaled in said casing, a length of collapsible elastic tubing formed into an annular course within said casing and lying in said groove,

said casing being perforated laterally of said groove to define an opening thru which the portions of said tubing adjacent the ends of said annular course may extend to the exterior of said casing, clips extending laterally from the exterior of said casing adapted to engage said last mentioned tube portions, said clips being proportioned to pass and release said tubing when the latter is collapsed but to retain said tubing when it is extended, said rotor comprising a disc, a pair of spring extended arms each pivotally mounted at one end on said disc, and a roller carried by the free end of each of said arms, said rollers normally being adapted to ride in and to engage the sides of said casing groove, each of said rollers being substantially larger in diameter than said casing opening, said tubing portions extending thru said opening, crossing each other within said opening.

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