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PUMP OF THE TUBE COMPRESSING TYPE

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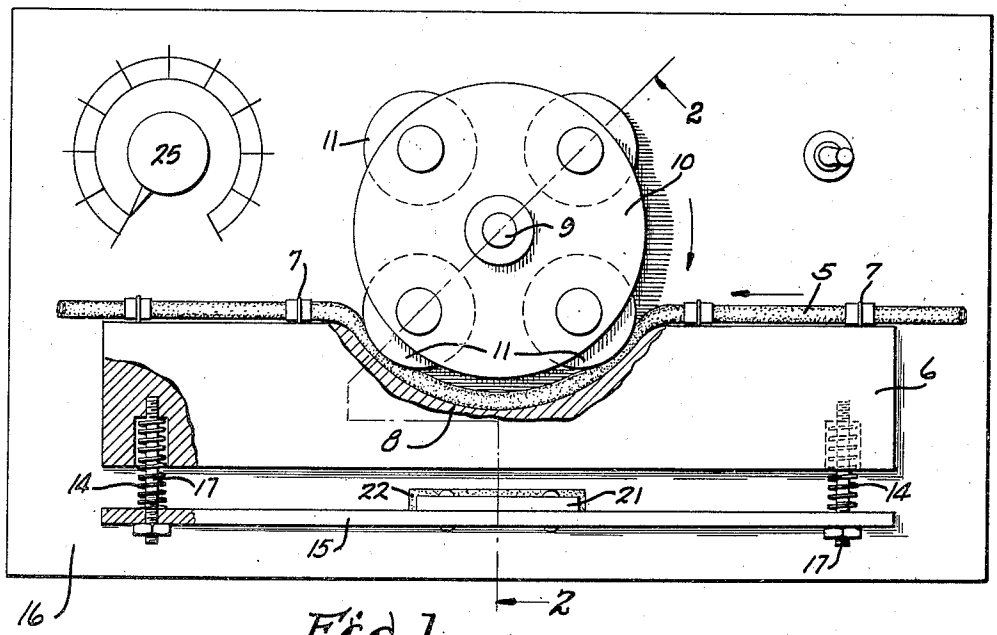

Fig. 1.

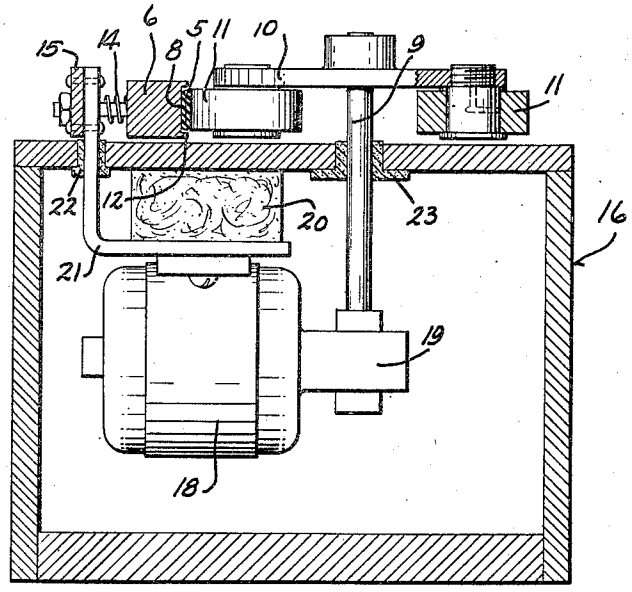

Fig. 2.

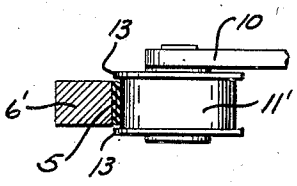

Fig. 3.

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PUMP OF THE TUBE COMPRESSING TYPE

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6 Claims. (Cl. 103—149)

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This invention relates to improvements in pumps of the tube compressing type. The preferred embodiment herein disclosed may also be used to regulate rather than to effect flow and is particularly adapted for hospital use to provide variable means for flowing liquids to a patient at a controlled rate for venous or intravenous injection.

Primary objects of the invention are to provide a device of the character described which is valveless, has no moving parts in contact with the liquid, is quickly and easily cleaned, is completely corrosion proof and sterile, and is quiet and easily variable as to output.

In the drawings:

Fig. 1 is a view in plan of apparatus embodying the invention, parts being broken away.

Fig. 2 is a view in section, taken on line 2—2 of Fig. 1.

Fig. 3 is a fragmentary detail, showing a slight modification of Fig. 2.

The elastically flexible tube 5 of natural or synthetic rubber or the like conveys the liquid to be pumped or regulated. This tube may be conveniently supported detachably on block 6 by clips or staples 7. Block 6 has an arcuate notch at 8 to which the tube more or less conforms. The arc of notch 8 is drawn about a center on which shaft and rotor 10 are rotatable. The rotor carries a number of cams 11, preferably in the form of rollers, located at such a radius as to compress and flatten tube 5 against the arcuate wall 8 of block 6. The arcuate extent of wall 8 and the arcuate angle between radii drawn to the respective rollers are such that one roller cannot release the flattened tube 5 in the course of rotor rotation before the next roller is also flattening the tube. As shown, the rollers are 90° apart and the wall 8 has an arcuate extent of 90° or more.

Assuming the shaft and rotor to be in clockwise rotation, the roller 11 flattening the tube near the right hand end of the arcuate wall 8 (as viewed in Fig. 1) will completely close the tube, as shown in Fig. 2, and the zone of compression will progressively advance clockwise driving ahead of it from right to left the fluid (gas or liquid) in the tube. Before the pressure is relieved by disengagement of a cam roller from the tube at the left end of the arcuate wall, the next successive cam roller will establish a new and progressively advancing pressure zone as shown in Fig. 1. Obviously, the device will function in either direction of rotation.

To provide support for the tube 5, when the apparatus is horizontal as shown, the block or the

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cam may be flanged. Fig. 2 shows the block 6 provided with one or more flanges 12, while Fig. 3 differs only in that the block 6' has no flange and the cam roller 11' is flanged at 13. There would be no necessity for any such flanges but for the fact that in the particular device illustrated the rotor operates in a horizontal rather than a vertical plane.

While the block 6 may be rigidly mounted with its wall 8 at a fixed radius from the shaft 9, it is preferred that, for emergencies, the block 6 be supported by springs 14 from flange 15 of case 16. Rods 17 extend thru the springs to guide the block 6 and are provided with nuts engaging flange 15 to adjustably fix the position at which the springs yieldably hold the block. The springs are strong enough to hold the block against all pressure required to flatten tube 5 unless some relatively non-compressible matter is traversing the tube.

For the purposes of the particular embodiment disclosed, silence of operation is important. Accordingly the motor 18, which drives shaft 9 through the reduction gear set 19, is mounted on a cushion 20, its freedom of movement on the cushion being restrained only by an arm 21 engaged in grommet 22 in an aperture in case 16. The shaft 9 passes through grommet 23 to the outside of the case. If flange 15 is mounted on arm 21 as indicated in Fig. 2, the entire mechanical apparatus is floated on cushion 20 and grommets 22, 23 without any noise-transmitting connection to the case. The knob 25 controls the speed of motor 18, the connections being omitted.

The fluid to be pumped or regulated as to flow has no contact with the air or with any metal part but is moved within tube 5 at all times. Thus the pump is particularly adapted for handling fluids where absolute sterility is essential or where corrosion would otherwise occur. The apparatus may be regarded as an entity without the tube 5, for, despite the importance of the tube in the use of the device, the tube is an interchangeable part of the assembly and may be supplied by the user and even renewed for each use.

The pump will draw a substantial vacuum but may also be used to regulate with great accuracy the flow through a tube of liquid under pressure. The method of flattening the tube in successive zones, progressively advanced, produces substantially continuous and uniform flow which may be closely regulated by controlling the motor speed.

I claim:

1. In combination, a case, an exterior arcuate tube support, a tube supported thereon, a rotor co-axial with said support and provided with arcuately spaced tube compressing cams, a shaft for the rotor, a motor within the case, driving connections from the motor to the shaft, and means for the cushioned unitary support from the case of the interior motor and driving means and the external tube support, tube, and rotor.

2. In combination, a case, a motor within the case provided with a transmission and a driven shaft projecting from the case, an elastically yieldable mounting for the motor and transmission, a bracket supported from the same mounting and projecting from the case, an arcuate tube support carried by the bracket exteriorly of the case and substantially coaxial with said driven shaft, arcuately spaced cams operatively mounted on the shaft and cooperative with said support, the motor, bracket, tube support, transmission, shaft and cams being unitarily carried by said mounting whereby said case is protected against vibration.

3. The combination set forth in claim 2 in which the case has openings through which the bracket and shaft project, and yieldable grommets in said openings closing the openings about the bracket and shaft respectively while protecting the case against communication of vibration thereto from the shaft or bracket.

4. The combination with a case and yieldable mounting means therein, of a motor and a tube support bracket operatively supported by said mounting means, said case being apertured and said bracket extending therethrough, yieldable grommet means closing the case about the bracket, a transmission unit operatively connected with the motor, a driven shaft projecting therefrom substantially parallel to the bracket, the case being apertured and provided with grommet means through which such shaft extends, a cam support mounted on the shaft and provided with

angularly spaced cams, a tube support having an arcuate wall substantially concentric with said shaft and with which such cams coact, a flexible tube disposed between said wall and the path of movement of said cams, a spring seat member carried by the bracket, and spring means acting on said tube support in a direction to bias said support toward said shaft, said support carrying said flexible tube in a position to be compressed between said cams and support.

5. The device set forth in claim 4 in which the shaft and bracket extend vertically through the case and the tube support is yieldable substantially horizontally across the top of the case and is provided with means guiding it for such movement respecting the spring seat member.

6. The device set forth in claim 4 in which the shaft and bracket extend vertically through the case and the tube support is yieldable substantially horizontally across the top of the case and is provided with means guiding it for such movement respecting the spring seat member, and comprising bolts connected with the tube support and extending through apertures in the spring seat member and provided with nuts limiting the movement of the tube support away from the spring seat member in response to the bias of such spring.

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