

Feb. 25, 1969

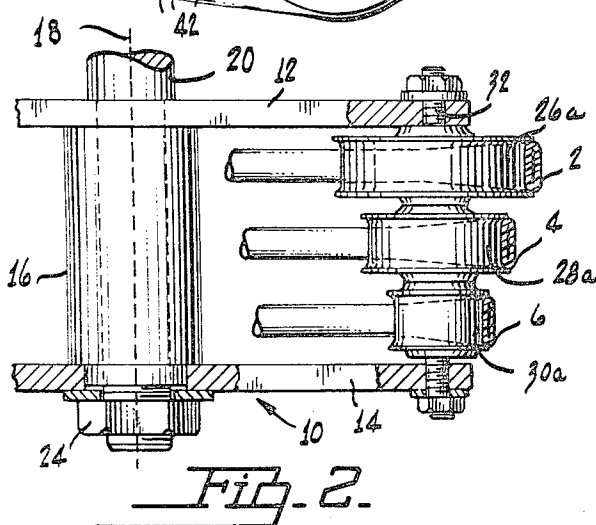
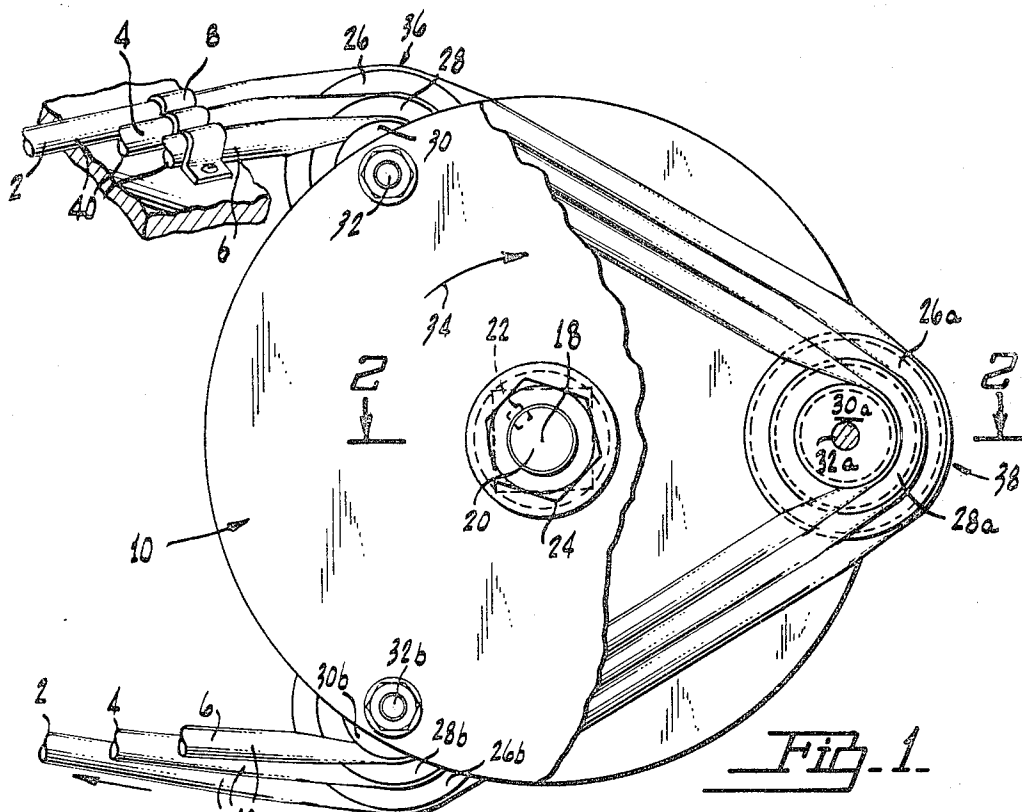
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PERISTALTIC PUMP

Filed Dec. 5, 1967

Sheet of 2



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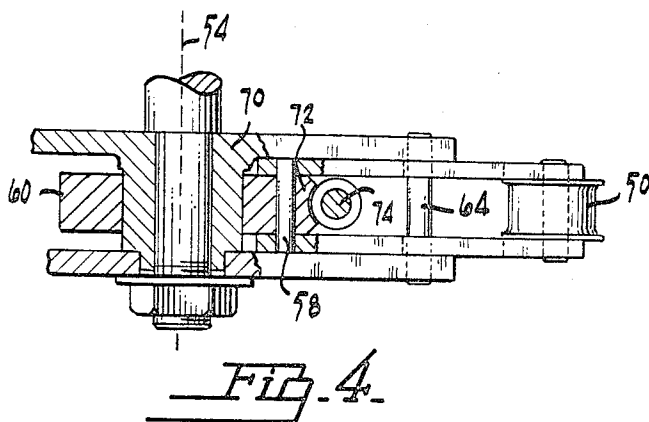
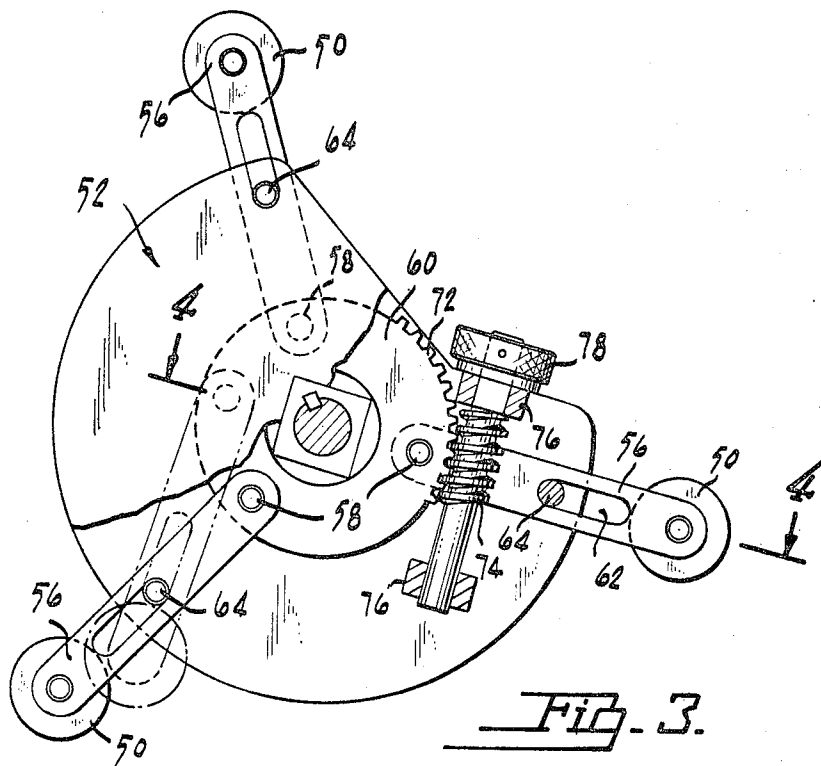
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PERISTALTIC PUMP

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Continuation-in-part of application Ser. No. 603,935,
Dec. 22, 1966. This application Dec. 5, 1967, Ser.
No. 688,135

U.S. Cl. 103-149

Int. Cl. F04b 43/08

8 Claims

ABSTRACT OF THE DISCLOSURE

A peristaltic pump embodying a plurality of compressible tubes engagable by rollers movable longitudinally of the tubes to compress the tubes at spaced points thereof so as to confine and advance fluid through the tubes. The tubes are held against longitudinal displacement whereas the rollers are carried by a member rotatable about a fixed axis and into positions to deflect the tubes sufficiently to compress the tubes as the rollers move longitudinally thereof. The tube engaging portions of rollers engaging different tubes are spaced selected and predetermined distances from the fixed axis of the rotatable member whereby they are spaced selected arcuate distances apart and the amount of fluid advanced through the different tubes may be selectively varied even when the internal diameter of the various tubes is the same.

Related application

This application is a continuation-in-part of applicant's copending application, Ser. No. 603,935.

Field of invention

This invention relates to peristaltic pumps of the type frequently used in the field of pathology, medicine and industry for simultaneously feeding a plurality of fluids in predetermined amounts to a point of use or application.

Prior art

Peristaltic pumps heretofore produced have frequently embodied a plurality of compressible tubes through which the various fluids are advanced by means of rollers or the like which compress the tubes at spaced points thereof while moving longitudinally of the tubes to force the liquid therethrough. Typical equipment of this nature, in addition to that of applicant's copending application, Ser. No. 603,935, are disclosed in U.S. Patent Nos. 2,865,303; 2,935,028; 3,079,868; 3,101,674; 3,116,697 and 3,122,103.

In using equipment of the foregoing type, the amount of each fluid which is advanced in each cycle of operation is controlled by employing compressible tubes of different internal diameter. It is accordingly necessary to provide a large number of tubes of different size in order to permit the wide variation in operation frequently necessary in any operation. Moreover, the differences in such sizes are often so small or inconspicuous that mistakes in the selection of the tubes to be used sometimes take place with results that may be disastrous.

Summary of invention

In accordance with the present invention variations in the amount of fluid delivered through the compressible tubes of a peristaltic pump is readily effected by varying

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the radial distance of rollers engaging the tubes from a fixed axis of rotation. In this way, variation in the arcuate distance between the rollers and the length of the tubes between the points of compression are utilized to cause different volumes of fluid to be pumped through the various tubes on each cycle of operation of the pump while employing compressible tubes all of which have substantially the same internal diameter. In the alternative a much greater range in variation of the fluid delivered may be attained while employing a limited number of different sizes of compressible tubes.

At the same time the construction of the peristaltic pumps is simplified and the cost of production and operation thereof is decreased.

The drawings

FIGURE 1 is a side elevation of a portion of a typical peristaltic pump embodying the present invention,

FIGURE 2 is a sectional view of the construction illustrated in FIGURE 1 taken on the line 2-2 thereof,

FIGURE 3 is a side elevation of a portion of an alternative construction embodying the present invention, and

FIGURE 4 is a sectional view of the construction illustrated in FIGURE 3 taken on the line 4-4 thereof.

Preferred embodiment of the invention

In that form of the invention chosen for purposes of illustration in FIGURES 1 and 2 of the drawings, a plurality of compressible tubes 2, 4 and 6 are shown although the pump obviously may be provided with as many tubes as may be desired for carrying out any operation. Furthermore, while the compressible tubes illustrated all have the same internal diameter, any one or more tubes employed may be either larger or smaller in diameter than other tubes in the assembly. All of the tubes are clamped or otherwise held against longitudinal displacement during operation of the pump by suitable means such as the holding device 8.

The pump embodies a rotatable member 10 which as shown, has side plates 12 and 14 carried by a hub 16 mounted for rotation about a fixed axis 18 extending transversely of the compressible tubes 2, 4 and 6 through which fluids are to be pumped. A drive shaft 20 located on the axis 18 is secured to hub 16 of the rotatable member 10 by the key 22 and nut 24 or any other suitable means. The drive shaft 20 may be rotated by a motor, pulley or the like (not shown) which may be of any conventional or preferred type.

The compressible tubes 2, 4 and 6 are trained over rollers 26, 28 and 30 respectively which are rotatably mounted on a shaft 32 extending between the side plates 12 and 14 of the rotatable member 10. A plurality of groups of such rollers are carried by the rotatable member and disposed at equally spaced arcuate distances about the rotatable member 10 as indicated at 26a, 28a and 30a and at 26b, 28b and 30b. The tubes 2, 4 and 6 are trained over the latter rollers in the same way whereby rotation of the rotatable member 10 in the direction of the arrow 34 of FIGURE 1 will cause the rollers to successively engage the tubes at spaced points thereon. The rollers upon engaging the tubes, deflect the same and bear against the tubes in a manner to compress the tubes at the points of contact therewith as illustrated in FIGURE 2.

Thus, for example, the tube 2 will be compressed and closed by the roller 26 upon contact of the roller therewith. Thereafter as the member 10 rotates the roller 26

will be moved to the position previously occupied by roller 26a in FIGURE 1. At the same time roller 26b will be moved from the position shown in FIGURE 1 to that previously occupied by roller 26 whereupon the roller 26b will engage and compress the tube 2. The tube 2 will thereby be compressed at the two points 36 and 38 by the rollers 26 and 26b so as to confine fluid within the tube between such points. Accordingly, upon continued rotation of the member 10 the rollers 26 and 26b will serve to advance fluid along the tube from the inlet portion 40 thereof toward the outlet portion 42 of the tube. The number of rollers 26, 26a and 26b carried by the rotatable member 10 and engageable with the tube 2 on each cycle of operation of the pump may be varied but as shown it is preferable to locate at least three such rollers at equal arcuately spaced distances (120°) about the circumference of the rotatable member.

The rollers 28, 28a and 28b engage and advance fluid in the same way through compressible tube 4 whereas the rollers 30, 30a and 30b engage and advance fluid through the tube 6. Thus, the pump serves to move fluid simultaneously through all of the tubes in a manner to draw such fluid from various sources to which the tubes are connected and to supply the fluid from each tube one or more points of use such as a mixing, analyzing or other type of equipment.

In accordance with the present invention the tube engaging portions of the various rollers 26, 28, 30, etc. are spaced different radial distances from the axis of rotation 18 of the rotatable member 10. For this purpose it is most convenient to employ rollers of different diameter rotatable mounted on common shafts 32, 32a and 32b secured between the side plates 12 and 14 of the rotatable member 10 and extending transversely of the tubes through which the fluid is to be advanced. As illustrated the rollers 26, 26a and 26b about which tube 2 is trained are larger in diameter than the rollers 28, 28a and 28b about which the tube 4 is trained. Similarly the rollers 28, 28a and 28b may be larger in diameter than the rollers 30, 30a and 30b about which the compressible tube 6 is trained. As a result the arcuate distance between the tube engaging points 36 and 38 of the rollers 26 and 26a engaging the tube 2 is greater than the arcuate distance between the corresponding points on the tube 4 engaged by the rollers 28 and 28a. The arcuate distance between the points on the tube 4 between which fluid is confined by rollers 28 and 28a will at the same time be greater than the arcuate distance between the rollers 30 and 30a engaging tube 6.

When so constructed and arranged, even though the tubes 2, 4 and 6 all have the same internal diameter, the amount of fluid advanced through each tube on each cycle of operation of the rotatable member 10 will differ and be proportional to the differences in the arcuate distances between the rollers engaging the various tubes. It is therefore possible to employ compressible tubes of uniform internal cross section and yet cause different and predetermined amounts of fluid to be advanced through each tube on each cycle of operation of the pump. The amount of fluid delivered through any tube can therefore be controlled by suitable selection of a roller of the proper diameter for engagement with that tube.

In the alternative, when it is desired to deliver a relatively large volume of fluid through one tube and a relatively small volume of liquid through another tube, it is of course, possible to employ tubes of different internal diameter if desired. In this way, the present invention serves to permit wide variation in the amounts of fluids being handled by the pump without resorting to the use of the large number of differently sized tubes heretofore required.

While the construction shown in FIGURES 1 and 2 employs rollers of different diameter for the purpose of varying the radial spacing of the tube engaging points on the rollers from the axis of rotation and the arcuate

spacing of the rollers with respect to each other, such variations may obviously be effected by other means and arrangements of the rollers and tubes employed in peristaltic pumps. Thus, for example, in the alternative construction illustrated in FIGURES 3 and 4, instead of employing rollers of different diameter, the radial distance of the tube engaging portions of the rollers 50 is variable by adjustment in the positions of the rollers with respect to the rotatable member 52 and its axis of rotation 54. For this purpose the rollers 50 are each carried by an arm 56 pivotally connected at 58 to a rotatable collar 60. The arms 56 each have a slot 62 therein through which a pin 64 mounted between side plates 66 and 68 of rotatable member 52 extends. The collar 60 is rotatable about the hub 70 of the rotatable member and is provided with a worm gear 72 engaged by the threads of a worm 74 mounted in bearings 76 carried by side plate 66 of the rotatable member 52.

With this construction the thumb nut 78 of the worm screw 70 may be turned to rotate collar 60 so that the arms 56 will be caused to swing in or out about the pivots 58 as indicated in dotted lines in FIGURE 3. All of the rollers 50 may thus be positioned at accurately adjusted radial distances from the axis 54 about which the rotatable member 52 is rotated.

Such adjustment means may be utilized to vary the positions of each of the sets of rollers engageable with each of the tubes of a peristaltic pump. The accuracy of the pumping operation can thus be increased and the volume of fluid advanced through any one or more tubes can be varied over a continuous range to attain more effective control of the flow of fluids through the tubes and greater precision in any particular operation wherein the equipment is employed.

While the peristaltic pumps illustrated and described represent typical and preferred embodiments of the invention, it will be apparent that numerous changes and modifications in the form, construction and arrangement of the various elements of the combination may be made. In view thereof it should be understood that the particular forms of the invention shown in the drawing and described above are intended to be illustrative only and are not intended to limit the scope of the invention.

I claim:

1. A peristaltic pump embodying a rotatable member mounted for rotation about a fixed axis, a plurality of circumferentially spaced rollers carried by said rotatable member, a plurality of parallel compressible tubes extending about said rotatable member and presenting unsupported portions thereof trained over said rollers in positions to be engaged and deflected by at least two of said circumferentially spaced rollers, to an extent sufficient to close the tubes at spaced points thereof, said rollers being movable longitudinally of said tubes upon rotation of said rotatable member to advance fluid through the tubes, the tube engaging portions of those rollers which engage one of said tubes being spaced a different radial distance from said fixed axis than the tube engaging portions of the rollers engaging another of said tubes.

2. A peristaltic pump as defined in claim 1 wherein the tube engaging portions of those rollers engaging different tubes are spaced different arcuate distances apart.

3. A peristaltic pump as defined in claim 1 wherein said rotatable member has adjusting means thereon for varying the radial distance of the tube engaging portions of at least some of said rollers from the axis of rotation of the rotatable member.

4. A peristaltic pump as defined in claim 3 wherein said rollers are carried by arms pivotally connected to said rotatable member and said adjusting means are movable to vary the angular position of said arms with respect to said rotatable member.

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5. A peristaltic pump as defined in claim 1 wherein the rollers are of different diameter and are concentrically mounted on said rotatable member.

6. A peristaltic pump as defined in claim 1 wherein said tubes are held against longitudinal displacement and said rollers engage and deflect said tubes to an extent sufficient to compress the tubes and confine the fluid therein between adjacent rollers as said rollers move longitudinally of the tubes upon rotation of said rotatable member.

7. A peristaltic pump as defined in claim 1 wherein at least a portion of said compressible tubes have substantially the same internal diameter.

8. A peristaltic pump as defined in claim 3 wherein at

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least a portion of said compressible tubes have substantially the same internal diameter.

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