United States Patent [19]

Catarious et al.

[11] **3,918,854**

[45] **Nov. 11, 1975**

[54] **PERISTALTIC PUMP**

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[73] Assignee: **Alphamedics Mfg. Corporation**, Levittown, Pa.

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[52] **U.S. Cl.** **417/477**

[51] **Int. Cl.**[2] **F04B 43/08**; F04B 43/12; F04B 45/06

[58] **Field of Search** 417/477, 476, 475

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Primary Examiner—C. J. Husar
Assistant Examiner—Richard E. Gluck
Attorney, Agent, or Firm—Lerner, David, Littenberg & Samuel

[57] **ABSTRACT**

A peristaltic pump is disclosed in which a compressible tube is retained between a rotary member and a pumping shoe mounted adjacent thereto. The rotary member includes a series of rollers mounted along the periphery thereof for intermittantly occluding the compressible tube upon rotation of the rotary member. The rotary member disclosed also includes a series of pairs of axially aligned radially disposed pins, the space between each pair of pins varying along the direction of rotation of the rotary member, for reshaping the compressible tube after each occlusion thereof. Means are also disclosed for permitting the easy insertion and removal of the compressible tube between the rotary member and the pumping shoe, including a stationary member and a tube supporting bracket upon which the pumping shoe is mounted, slidably attached to the stationary member, for movement between proximate and distal positions with respect thereto. Reciprocating clamping blocks are also disclosed, disposed on the opposite side of the compressible tube from the pumping shoe, for retaining the compressible tube in a fixed position between the rotary member and the pumping shoe during use.

13 Claims, 9 Drawing Figures

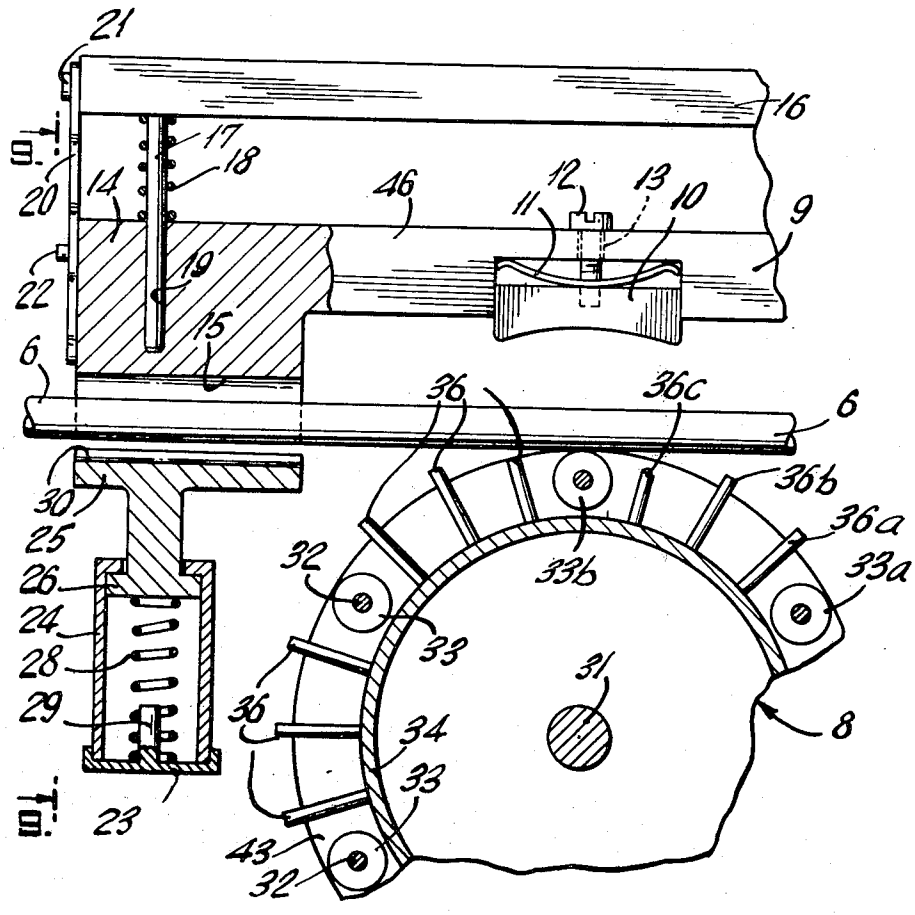


Fig. 1.

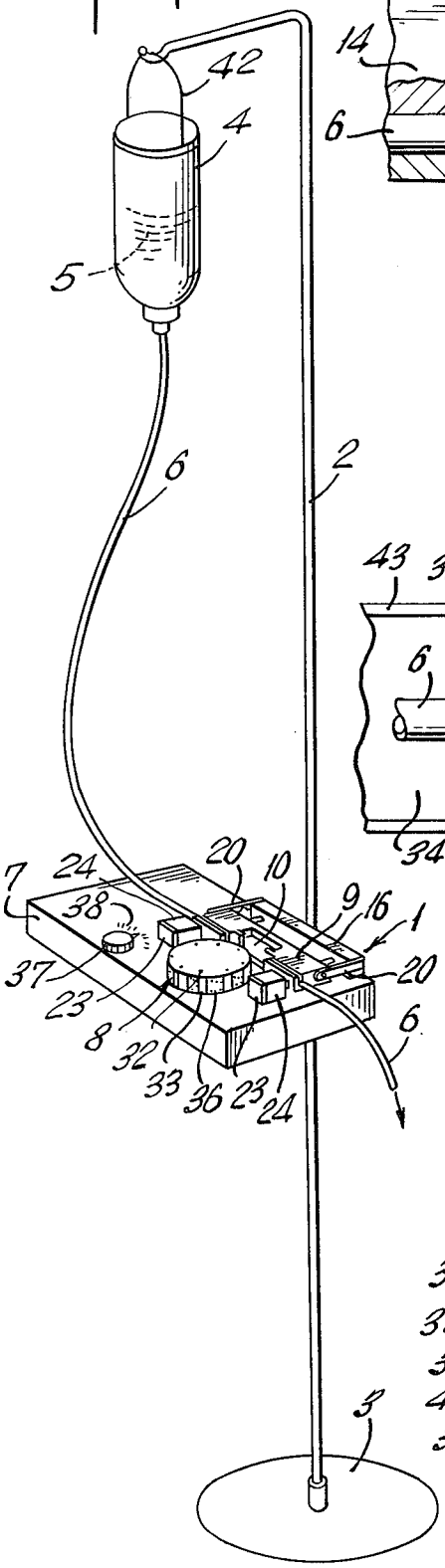


Fig. 4.

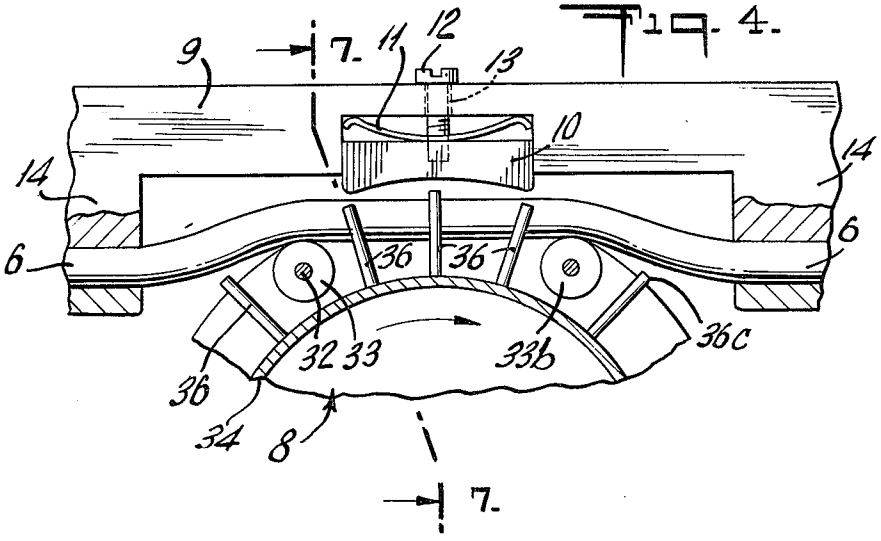


Fig. 5.

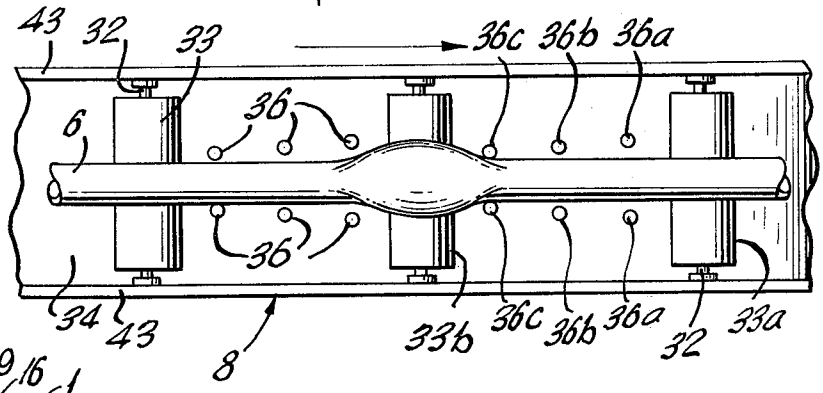


Fig. 6.

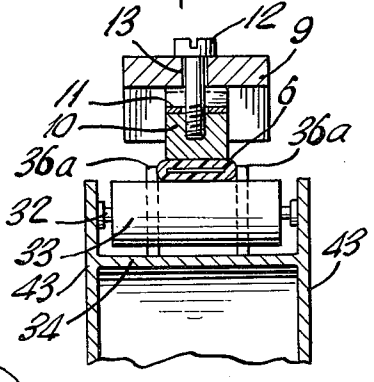
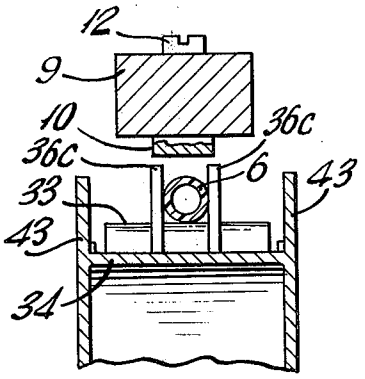


Fig. 7.



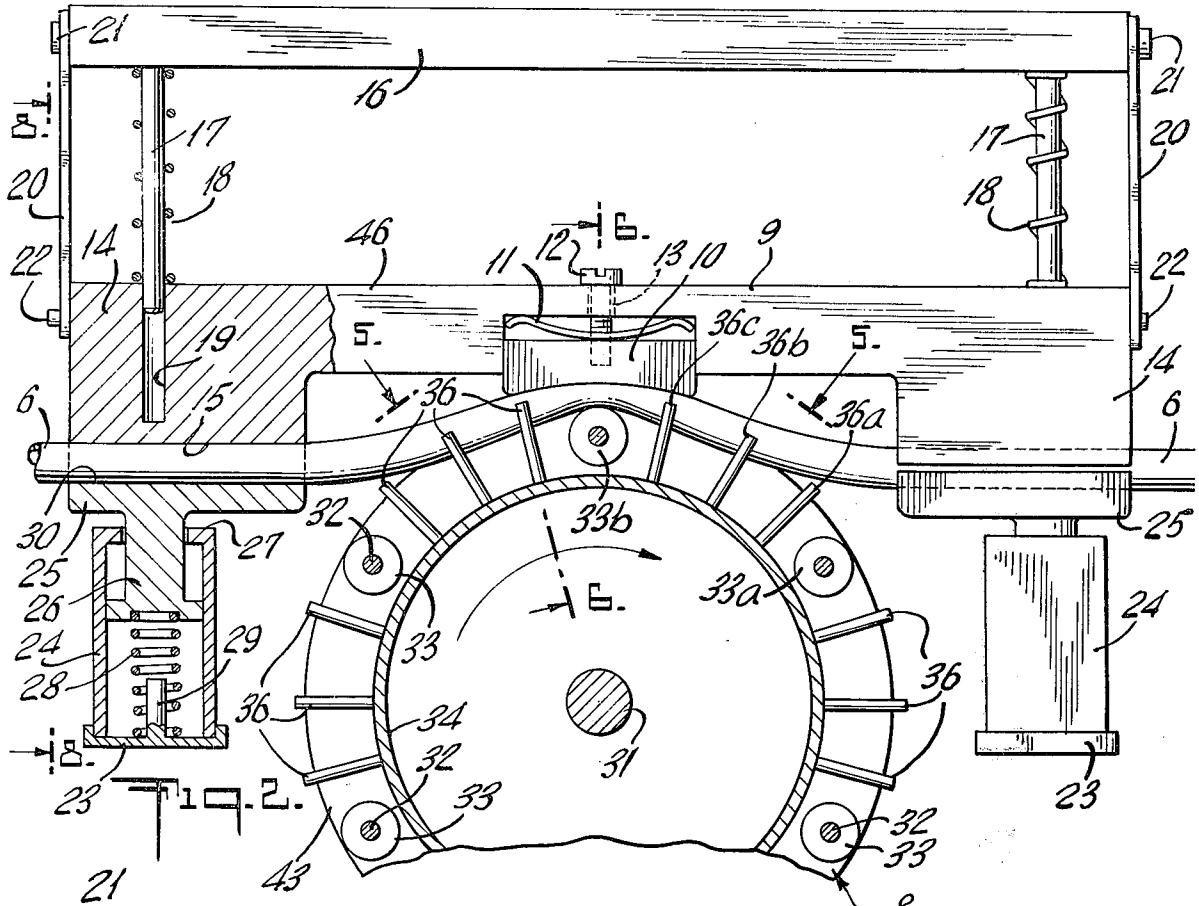

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Fig. 2.

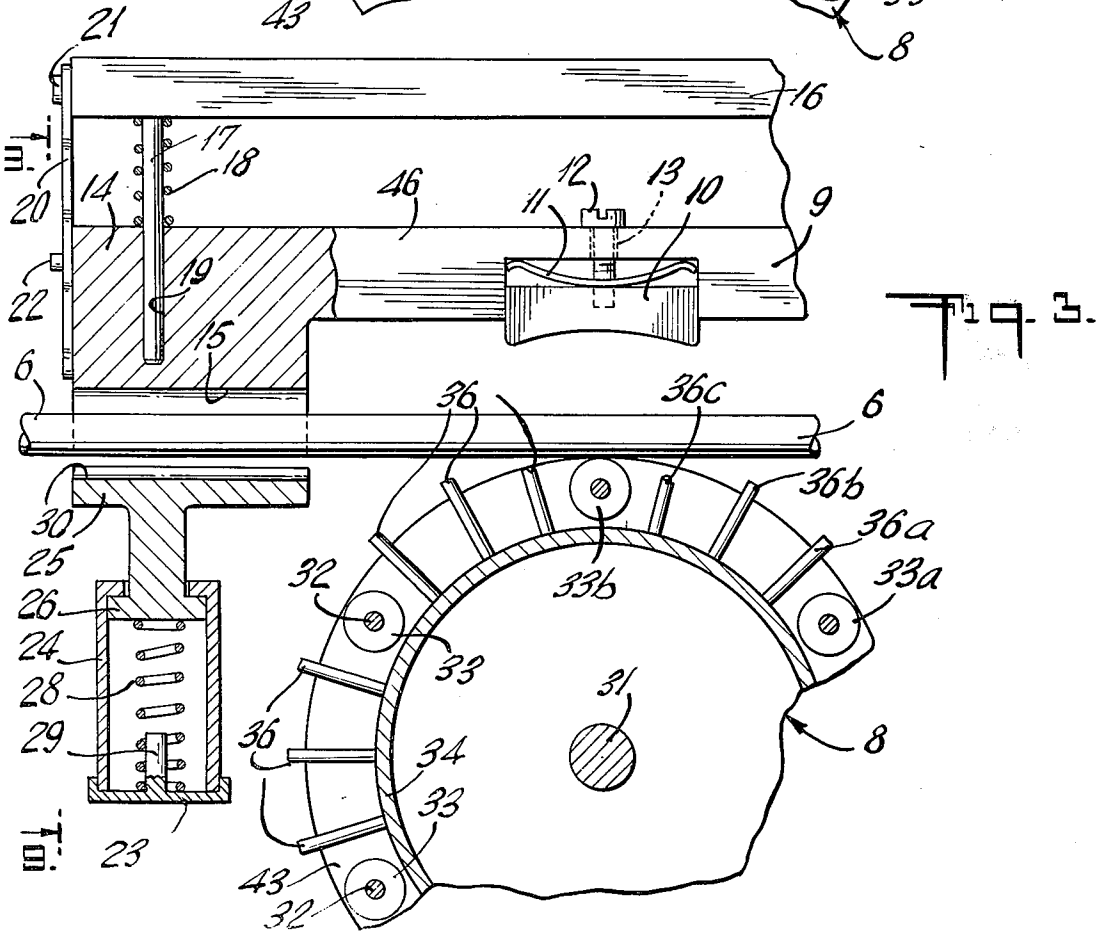

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Fig. 3.

Fig. 8.

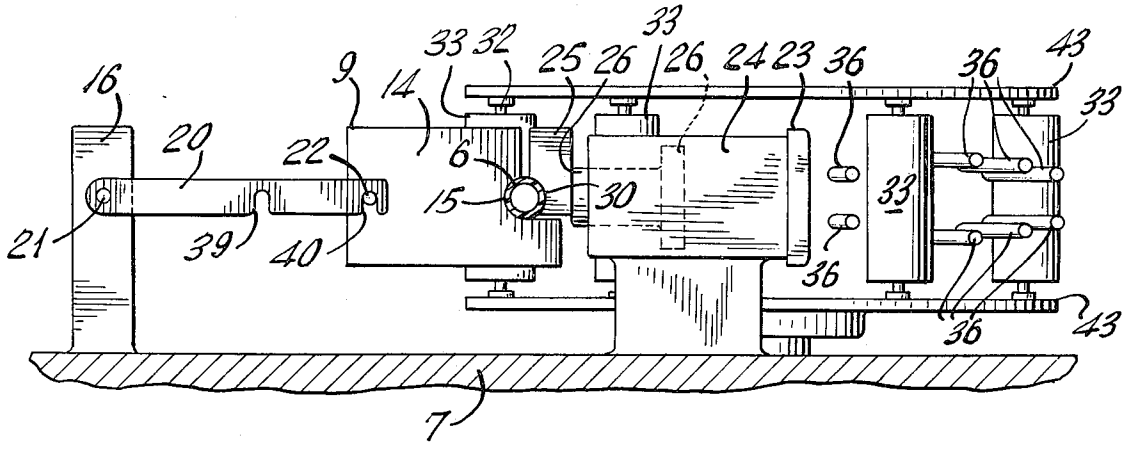
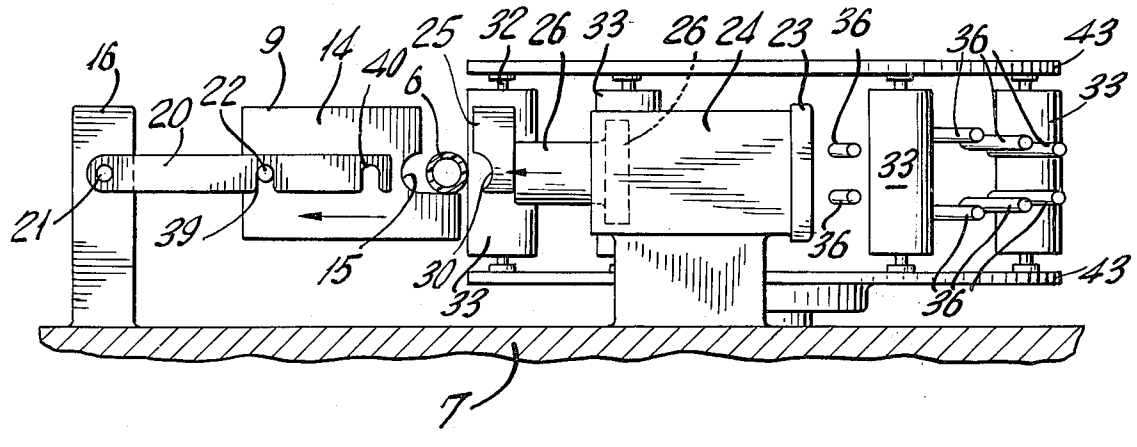

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Fig. 9.


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PERISTALTIC PUMP

FIELD OF THE INVENTION

The present invention relates to peristaltic pumps, and particularly to such pumps which are capable of pumping an accurate predetermined amount of liquid or fluid through compressible tubes. More particularly, the present invention relates to such peristaltic pumps which are capable of pumping such fluids through compressible tubes for relatively long periods of time while maintaining their accuracy. Still more particularly, the present invention relates to such peristaltic pumps which are easily incorporated into standard intravenous units without interrupting their continued use.

BACKGROUND OF THE INVENTION

Peristaltic pumps, have been employed for a number of years in order to produce a flow of liquid through a compressible tube. Generally, these pumps have normally employed a rotary member having rollers thereon for intermittant occlusion of the compressible tube by the rollers upon rotation of the rotary member. In conjunction with the use of standard intravenous (IV) units, such peristaltic pumps have been employed for the infusion of various fluids into a vein or artery of humans or animals through a compressible tube, at controlled rates. Thus, for example, U.S. Pat. No. 2,434,802, which is typical of many of these prior art infusion pumps, discloses a pump whereby a compressible tube **5** is mounted on a block **6,** including an arcuate portion **8,** wherein the tube is intermittantly occluded by the rotation of rotor **10,** which carries cams **11** thereon. As the rotor **10** rotates, each of the cams **11** compresses the tube, and moves fluid in a predetermined direction corresponding with the direction of rotation of the rotor **10.**

A similar pump is shown in U.S. Pat. No. 1,998,337, including means for adjusting the block **4** against which each roller **42** compresses the tube **33** upon rotation of wheel **39.** The adjustment is effected by the movement of wedges **15** and **16,** which urge the carrier **6** in a vertical direction, as seen in FIG. **1** thereof. Furthermore, in U.S. Pat. No. 3,597,124, such a peristaltic pump is disclosed, similarly including a series of rollers **23** mounted on pumping wheel **14,** for intermittantly occluding tube **15.** The peristaltic pump disclosed therein also includes means for inserting the tube **15,** including a cam **16** which in turn moves tube support means **13** to and from the surface of pumping wheel **14.** The application of such peristaltic pumps to the infusion of various liquids intravenously into humans or animals has, however, met with certain difficulties. Thus, for example, the compressible tubes used in these applications are highly flexible, and of a thin-walled construction, such that the continuous intermittant occlusion thereof results in damage thereto. Thus, each time these compressible tubes are so occluded the flexible thin walls thereof return more slowly to their initial circular configuration. The amount of fluid retained within a given portion thereof thus varies, and the controlled infusion of a predetermined amount of fluid is no longer possible therewith. Furthermore, the particular application of such peristaltic pumps to the infusion of various liquids intravenously has also required the easy insertion and removal of the compressible intravenous tubing without intereferring with the flow therethrough. It is thus desired to employ such a pump wherein the compressible tube, even during use, may be simply inserted between the rotor and pumping shoe, without interruption of the fluid flow therethrough.

It is therefore an object of the present invention to provide an improved peristaltic pump.

It is another object of the present invention to provide a peristaltic pump which is capable of delivering accurate predetermined amounts of fluid therethrough for extended periods of time.

It is yet another object of the present invention to provide a peristaltic pump which is capable of accurately metering the amount of fluids imparted through thin-walled compressible tubes, such as the type used for the intravenous infusion of fluids into humans or animals.

It is yet a further object of the present invention to provide a peristaltic pump which includes means for the easy insertion and removal of compressible tubes thereinto.

It is yet another object of the present invention to provide a peristaltic pump which is capable of maintaining the compressible tube through which fluids are to be pumped in its original configuration, such that the amount of fluid imparted therethrough is maintained substantially constant.

SUMMARY OF THE INVENTION

In accordance with the present invention a peristaltic pump is provided, including a rotary member carrying a plurality of rollers on the periphery thereof and a pumping shoe mounted adjacent thereof. A compressible tube mounted between the rotary member and the pumping shoe is intermittantly occluded by the rollers upon rotation of the rotary member. The rotary member also carries means for reshaping the compressible tube following each intermittant occlusion thereof.

In one embodiment of this invention, at least one pair of axially disposed radially projecting pins are carried by the rotary member between successive pairs of rollers, including a first roller for a first occlusion of said compressible tube, and a second roller for a second occlusion of said compressible tube, said pairs of radially projecting pins straddling the compressible tube. The pairs of radially projecting pins between the rollers are axially spaced a distance approximately equal to the normal diameter of the compressible tube, to thereby urge the compressible tube back into its original configuration between each intermittant occlusion thereof. In another embodiment, two pairs of such axially disposed radially projecting pins are carried by the rotary member between such successive pairs of rollers, the pair adjacent the second roller being axially spaced a distance approximately equal to the normal diameter of the compressible tube, and the pair of radially projecting pins adjacent the first roller being axially spaced a distance greater than the normal diameter of the compressible tube. In the preferred embodiment, three or more pairs of axially disposed radially projecting pins are carried by the rotary member between such successive pairs of rollers. The pairs of radially projecting pins adjacent the second roller are axially spaced a distance approximately equal to the normal diameter of the compressible tube, and each successive pair of radially projecting pins approaching the first roller are axially spaced successively increasing distances.

In another embodiment of the present invention, the pumping shoe is mounted upon a slidable tube support bracket, which is moveable between fixed proximate

and distal positions with respect to said rotary member, said proximate position being the normal operating position of said pumping shoe, and said distal position being a sufficient distance from said rotary member such that the compressible tube may be easily inserted and removed therefrom. Preferrably, a stationary clamping block is provided on the side of said slidable tube support bracket opposite the rotary member, and includes a pair of parallel rods extending therefrom, and inserted in corresponding apertures in the slidable tube support bracket. Spring means are provided between the stationary clamping block and slidable tube support bracket urging these members apart. The slidable tube support bracket is maintainable in the fixed proximate and distal positions with respect to the rotary member by providing latch means for locking the slidable tube support bracket in these fixed positions. The latch means includes a pivoted latch bar containing a pair of notches for engagement with corresponding pins located on either side of the slidable tube support bracket.

In another embodiment of this invention, reciprocating clamping blocks are provided for firmly retaining the compressible tube in a fixed position between the pumping shoe and the rotary member during normal use. The reciprocating clamping blocks thus cooperate with corresponding portions of the slidable tube support bracket to firmly grasp the compressible tube therebetween when the slidable clamping block is in its proximate or normal operating position with respect to the rotary member, and release the compressible tube therefrom when the slidable clamping block is in its distal position with respect to its rotary member, for easy insertion and removal of the compressible tube. Preferrably, the reciprocating clamping blocks include a piston portion thereof, which is retained within a cylinder which thereby limits its movement. Bias means are provided within the cylinder thus urging the clamping blocks towards the slidable tube support bracket, and thus into grasping engagement with the compressible tube there between during normal operation, or when the slidable tube support bracket is in its proximate position with respect to the rotary member. The cylinder limits the movement of the reciprocating clamping blocks towards the slidable tube support bracket, however, and therefore when the slidable tube support bracket is in its distal position with respect to the rotary member, the compressible tube is released therefrom.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the present invention can be had by referring to the following drawings and detailed description of the invention in which:

FIG. **1** is a perspective view of the peristaltic pump of this invention, in conjunction with a standard intravenous apparatus;

FIG. **2** is a partial sectional top view of the peristaltic pump of the present invention, including a disassembled rotary member and pumping shoe, shown in the closed position;

FIG. **3** is a partial top view, partially sectional, of the peristaltic pump of the present invention, shown in the open position;

FIG. **4** is a partial top view of a portion of the rotary member and pumping shoe of the present invention;

FIG. **5** is an isometric side view of the rotary member of the present invention, shown with a compressible tube;

FIG. **6** is a partial side view of a roller portion of the rotary member of the present invention, with the compressible tube shown during its intermittant occlusion taken along line **6—6** of FIG. **2**;

FIG. **7** is a partial side view of a roller portion of the rotary member of the present invention shown with the compressible tube between its intermittant occlusion, taken along line **7—7** of FIG. **4**;

FIG. **8** is a side view of the peristaltic pump of the present invention, including latch means in the closed position taken along line **8—8** of FIG. **2**, and

FIG. **9** is a side view of the peristaltic pump of the present invention including latch means in the open position, taken along line **9—9** of FIG. **3**.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the Figures, in which like numerals indicate like portions thereof, FIG. **1** shows a perspective view of the peristaltic pump of the present invention in conjunction with a standard intravenous apparatus.

The peristaltic pump itself is included within and mounted upon a housing **7**. In this manner, the entire apparatus may be mounted upon an intravenous pole **2**, mounted upon a base **3**, and carrying an intravenous bottle **4** which hangs from the end of the intravenous pole **2** by means of bracket **42**. In a standard intravenous apparatus the fluid **5**, such as liquid nourishment, drugs, etc., within the intravenous bottle **4** flows through a compressible tube **6** and into a vein or artery of a human or animal. Therefore, by merely mounting the present peristaltic pump upon the intravenous pole **2**, or at another location nearby, the compressible tube **6** may be easily inserted thereinto, without interrupting the flow of fluid therethrough, and attached to the infusion pump **4** to regulate the flow of liquid therethrough and into the patient.

Referring specifically to the present peristaltic pump itself, as can be best seen from FIGS. **2** and **3**, it includes a rotor **8** mounted for rotary motion upon the housing **7**. The rotor **8** itself rotates upon shaft **31** projecting through the wall of the housing **7**. The shaft **31** may thus be controlled by a motor, such as the stepping motor described in U.S. Pat. No. 3,737,251, which is incorporated herein by reference. Generally, however, any motor may be employed. A tube support bracket **9**, which is slidably mounted upon the housing **7**, has a pumping shoe **10** mounted thereon and held to an adjustable range of positions by a leaf spring **11** and adjusting screw **12** whose stem projects through an aperture **13** in the tube support bracket **9**, and is then threadably engaged with the pumping shoe **10**.

Adjusting screw **12** is thus used to calibrate the volume of fluid dispensed through the compressible tube **6**. Adjustment is needed to compensate for mechanical variations in the rotor, support bracket, rollers, tubing inside diameter, outside diameter, concentricity and elasticity, fluid viscosity and temperature, all of which is described in U.S. Pat. No. 3,737,251.

The compressible tube **6** is thus mounted between the rotor **8** and pumping shoe **10**, which is itself mounted upon the tube support bracket **9**. The tube support bracket **9** includes end portions **14** of a greater width than the center neck portion **46** thereof, to which the pumping shoe **10** is attached. On the side of the tube support bracket **9** opposite the rotor **8** is mounted a stationary clamping block **16**. The clamping block is fixedly mounted upon the housing **7**, and acts as a fixed locating position with respect to the slidable tube sup-

port bracket **9**. The tube support bracket **9** slides upon a pair of parallel rods **17** projecting from the clamping block **16**, and perpendicular thereto. Each of these rods **17** is inserted into a corresponding aperture **19** in the end portion **14** of tube support bracket **9**. The rods **17** may thus slide within the apertures **19**, thus permitting the tube support bracket **9** to slidably move to and from engagement with the compressible tube **6** mounted adjacent the rotor **8**. Furthermore, each rod **17** is surrounded by a bias spring **18**, which engages the face of both the clamping block **16** and the end portion **14** of the tube support bracket **9**, thus urging these members apart. Since the clamping block **16** is fixedly mounted to the housing **7** the tube support bracket **9** is urged in the direction of the rotor **8**, and this, in turn, urges the pumping shoe **10**, which is mounted on the tube support bracket **9**, towards the rotor **8**, and into engagement with the compressible tube **6**, mounted therebetween.

In order to establish fixed positions for the location of the slidable tube support bracket **9**, namely a normal operating position, or proximate position with respect to rotor **8** as shown in FIG. **2**, and an open tube-loading or distal position with respect to rotor **8**, as shown in FIG. **3**, pivoted latches **20** are provided. Each of these latches, as can best be seen in FIGS. **8** and **9**, comprises a pivoted latch bar **20**, pivoted at pivot pin **21**, mounted on clamping block **16**. The pivoted latch bars **20** include notches **39** and **40** located on the underside thereof. Upon lowering of the latch bars **20** into their horizontal positions, as seen in FIGS. **8** and **9**, these notches, **39** and **40**, engage corresponding pins **22** projecting from the end portions **14** of the slidable tube support bracket **9**. In this manner, depending upon which notches engage the pins **22** projecting from the end portions **14** of the tube support bracket **9**, the tube support bracket **9** will be in either the aforementioned operating or closed positions. This, when notches **40** on latch bars **20** are engaged upon pins **22** extending from the end portions **14** of the tube support bracket **9**, the tube support bracket will be maintained in its normal operating position, proximate to the rotor **8**. In order to insert or remove the compressible tube **6** from between the pumping shoe **10** and the rotor **8**, the latch bars **20** are pivoted upon pivot pins **21**, and raised as shown by the phantom lines in FIG. **8**. The tube support bracket **9** may thus be urged against the normal force of bias springs **18** and towards the stationary clamping block **16**. When the proper position is thus reached, the latch bars **20** are pivoted upon pivot pins **21** and the notches **39** in latch bars **20** are lowered into engagement with pins **22**, thus maintaining the tube support bracket **9** in its open tube-inserting, or distal position with respect to rotor **8**, as shown in FIG. **9**. In this position, the compressible tube **6** may be easily removed from or inserted between the pumping shoe **10** and the rotor **8**.

Referring again to FIGS. **2** and **3**, the rotor **8** includes two spaced apart parallel discs **43** (see FIG. **5**) and a cylindrical surface **34** transverse thereto, connecting the parallel discs **43** at a point within their periphery and a short distance from the ends thereof. A plurality of equally spaced apart rollers **33** are rotatably mounted upon roller bearing pins **32** located along the periphery of the rotor **8**. Thus, each time the rotor **8** makes a complete rotation, such as in the direction shown by the arrow in FIG. **2**, the compressible tube **6** is occluded a number of times equal to the number of rollers **33** located along the periphery of rotor **8**. Occlusion of the compressible tube **6** is thus obtained between each roller **33** as it passes across the surface of pumping shoe **10**.

As described above, it is essential that this intermittant occlusion of compressible tube **6** result in the accurate and reproducible pumping of fluids therethrough. Again, however, as the compressible tubes generally used in standard intravenous units have relatively thin walls, or poor memory characteristics, i.e., they do not immediately return to their initial shape upon each occlusion, apparatus is provided for returning the compressible tube to its original shape between each such occlusion thereof. In this manner, a correct fluid delivery characteristic is retained, and a gradual reduction in the volume of fluid delivered upon each intermittant occlusion thereof due to the tendency of the compressible tubing to become more flattened with each occlusion, or fail to return to its original cylindrical shape prior to each subsequent occlusion thereof, is prevented. Furthermore, variations in the volume of fluid delivered due to the sensitivity of the system to variations in the pressure of fluid remaining in the intravenous bottle **4** is also eliminated.

The mechanism thus provided for returning the compressible tubing to its original shape after each intermittant occlusion thereof includes pairs of axially disposed radially projecting pins, projecting from the transverse cylindrical surface **34**. The pairs of pins are disposed on either side of the compressible tube **6** in its normal operating position against the pumping shoe **10**, as seen in FIGS. **5** through **7**. Preferably, a series of three or more pairs of axially disposed radially projecting pins project from the cylindrical surface **34** between successive rollers **30** disposed along the periphery of the rotor **8**. Thus, as seen in FIG. **2**, each such successive pair of rollers **33** will include a first roller **33*a*** resulting in a first intermittant occlusion of compressible tube **6**, and a second roller **33*b***, resulting in a second intermittant occlusion of compressible tube **6**, as a result of the rotation of rotor **8** in a direction shown by the arrow in FIG. **2**. When three pairs of radially projecting pins **36** are employed, as shown in the drawings, the pair of radially projecting pins **36*c*** adjacent the second roller **33*b*** are axially spaced a distance approximately equal to the normal diameter of the compressible tube **6**. The next succeeding pair of radially projecting pins **36*b*** are axially spaced a distance somewhat greater than the normal diameter of the compressible tube **6**, and the pair of radially projecting pins **36*a*** adjacent the first roller **33*a*** are axially spaced a distance greater than that of the pair of radially projecting pins **36*b***. In other words, the pairs of radially projecting pins are axially spaced successively greater distances as one moves from the first roller **33*b*** to the second roller **33*a***.

Thus, in its normal operation, as the rotor **8** rotates in the direction shown in FIGS. **2** and **5**, and as each succeeding roller **33** passes across the surface of the pumping shoe **10**, the compressible tube **6** disposed therebetween is occluded thereby, as can best be seen in FIG. **6**. Subsequent to each such occlusion, the continued rotation of the rotor **8** results in the movement of the roller which has just occluded the compressible tube away from the pumping shoe **10**, and the successive movement of each set of radially projecting pins, **36*a***, **36*b*** and **36*c***, respectively, across the surface of the pumping shoe **10**.

Each such successive pair of radially projecting pins thus causes successively greater pressure to be applied against the compressible tube **6**, thus forcing the compressible tube **6** back into its normal cylindrical configuration, as seen in FIG. **7**.

Subsequently, upon continued rotation of the rotor **8**, the next succeeding roller **33** will move across the surface of the pumping shoe **10**, thus causing the next succeeding intermittant occlusion of the compressible tube **6**, again as shown in FIG. **6**, and the above-described process is repeated between each such succeeding pair of rollers **33**.

In order to also insure that the compressible tube **6** is prevented from slipping through the pump, means are provided for firmly retaining the compressible tube **6** at its location between the pumping shoe **10** and the rotor **8** during normal operation of the pump. These include reciprocating clamping blocks **25** which, in cooperation with the end portions **14** of tube support bracket **9**, engage the compressible tube **6** therebetween. The faces of the end portions **14** of tube support bracket **9** thus include semicircular grooves **15**, as seen in FIG. **9**. These grooves preferably have a high friction surface, for firmly retaining the compressible tube therein without occluding same. The firm retention of the compressible tube will thus be completed by its engagement between these grooves **15** and corresponding semicircular grooves **30** on the face of the reciprocating clamping block **25**.

Furthermore, locating stops **23** are fixedly attached to the housing **7**, and a pair of cylinders **24** are mounted thereon. Each cylinder **24** includes an aperture in its front face **27** thereof facing the end portions **14** of the tube support bracket **9**. The rear faces of reciprocating clamping blocks **25** thus include a piston-shaped portion **26** which thus reciprocates within the cylinders **24**, limited by the front and rear faces thereof, **23** and **27**, respectively. Bias springs **28**, located by spring locating pins **29** attached to locating stops **23**, thus urge the piston-shaped member of the reciprocating clamping block **25** towards the end portions **14** of the tube support bracket **9**, to thereby engage the compressible tube **6** therebetween, as shown in FIG. **8**. In this manner, when the notches **39** on the latch bars **20** are engaged in pins **22** upon the end portions **14** of the tube support bracket **9**, and the tube support bracket **9** is thus in the distal position with respect to the rotor **8**, as shown in FIG. **3**, the reciprocating clamping blocks **25** are prevented from following the end portions **14** of the tube support bracket **9**, and thus maintaining the compressible tube **6** therebetween, by the retention of the piston-shaped member **26** against the front face **27** of the cylinders **24**. The compressible tube **6** is thus released from engagement with the pairs of corresponding grooves, **15** and **30**, upon the faces of the end portions **14** of the tube support bracket **9**, and the reciprocating clamping blocks **25**, respectively, and the compressible tube **6** may be easily removed from or inserted into the peristaltic pump. Upon insertion of the compressible tube **6** between the pumping shoe **10** and the rotor **8**, the notches **40** in latch bars **20** are engaged with pins **22** projecting from the end portions **14** of tube support bracket **9**, thus fixing the tube support bracket **9** in its proximate position with respect to the rotor **8**, or its normal operating position, wherein the compressible tube **6** is firmly engaged between the corresponding grooves **15** and **30** upon the end portions **14** of the tube support bracket **9** and the reciprocating clamping block **25**, respectively. The compressible tube **6** will thus be prevented from slipping through the peristaltic pump during rotation of the rotor **8**.

It should thus be understood that the above embodiment is merely illustrative of the principles of this invention and numerous other embodiments will become obvious to those of ordinary skill in this art.

What is claimed is:

1. In a peristaltic pump for intermittantly occluding a compressible tube including:

a housing;

a rotary member mounted for rotation on said housing, said rotary member including a pair of spaced apart disc members and a transverse wall member;

a plurality of rollers carried by said rotary member for sequentially occluding said compressible tube, including a first roller for initially occluding said compressible tube, and a second roller for subsequently occluding said compressible tube, and;

a pumping shoe mounted on said housing adjacent said rotary member, whereby said compressible tube mounted on said housing between said rotary member and said pumping shoe is intermittantly occluded upon rotation of said rotary member, said pumping shoe projecting between said pair of spaced apart disc members, and being substantially narrower than the distance therebetween, the improvement which comprises;

a plurality of pairs of spaced radially projecting pins between each succeeding pair of rollers, said radially projecting pins mounted upon said transverse wall member, and including a first pair of radially projecting pins adjacent said second roller, the pins of said first pair being spaced a distance approximately equal to the diameter of said compressible tube, and wherein the pins of each succeeding pair of said radially projecting pins approaching said first roller being spaced a distance greater than that of said preceding pair of radially projecting pins.

2. The peristaltic pump of claim **1** including three pairs of said spaced radially projecting pins between each succeeding pair of said rollers.

3. In a peristaltic pump for intermittantly occluding a compressible tube including:

a housing;

a rotary member mounted for rotation on said housing;

a plurality of rollers carried by said rotary member; and

a pumping shoe mounted on said housing adjacent said rotary member, whereby said compressible tube mounted on said housing between said rotary member and said pumping shoe is intermittantly occluded upon rotation of said rotary member, the improvement which comprises;

means for slidably mounting said pumping shoe adjacent said rotary member for movement between fixed proximate and distal positions with respect to said rotary member, said proximate position being the normal operating position of said pumping shoe, and said distal position being a sufficient distance from said rotary member for the insertion and removal of said compressible tube therebetween;

said means for slidably mounting said pumping shoe including a slidable tube support bracket upon which said pumping shoe is mounted;

latch means for rigidly maintaining said tube support bracket in its proximate and distal positions with respect to said rotary member; and

reciprocating clamp means and bias means urging said reciprocating clamp means into cooperating engagement with said tube support bracket to retain said compressible tube therebetween when said tube support bracket is in its proximate position with respect to said rotary member.

4. The peristaltic pump of claim **3** wherein said reciprocating clamp means and said tube support bracket include groove means on the cooperating portions thereof to firmly retain said compressible tube therebetween without occluding said compressible tube.

5. The peristaltic pump of claim **3** including cylinder means, and wherein said reciprocating clamp means includes a piston portion for reciprocating motion within said cylinder means.

6. The peristaltic pump of claim **3** including a pair of said reciprocating clamp means for firmly retaining portions of said compressible tube in either side of said rotary member.

7. In a peristaltic pump for intermittantly occluding a compressible tube including:

a housing;

a rotary member mounted for rotation on said housing, said rotary member including a pair of spaced apart disc members and a transverse wall member;

a plurality of rollers carried by said rotary member for sequentially occluding said compressible tube, including a first roller for initially occluding said compressible tube, and a second roller for subsequently occluding said compressible tube, and;

a pumping shoe mounted on said housing adjacent said rotary member, whereby a compressible tube mounted on said housing between said rotary member and said pumping shoe is intermittantly occluded upon rotation of said rotary member, said pumping shoe mounted substantially between said pair of spaced apart disc members, the improvement which comprises;

a plurality of pairs of spaced radially projecting pins between each succeeding pair of said rollers, said pins mounted upon said transverse wall member, including a first pair of radially projecting pins adjacent said second roller, the pins of said first pair being spaced a distance approximately equal to the diameter of said compressible tube, and wherein the pins of each succeeding pair of said radially projecting pins approaching said first roller being spaced a distance greater than that of said preceding pair of radially projecting pins, and

means for slidably mounting said pumping shoe adjacent said rotary member for movement between proximate and distal positions with respect to said rotary member, said proximate position being the normal operating position of said pumping shoe, and said distal position being a sufficient distance from said rotary member for the insertion and removal of said compressible tube therebetween.

8. The peristaltic pump of claim **7** wherein said means for slidably mounting said pumping shoe adjacent said rotary member includes a slidable tube support bracket upon which said pumping shoe is mounted.

9. The peristaltic pump of claim **8** including reciprocating clamp means and bias means urging said reciprocating clamp means into cooperating engagement with said tube support bracket to retain said compressible tube therebetween.

10. The peristaltic pump of claim **8** including a stationary member mounted on said housing, slide means communicating with said stationary member for slidable engagement with said tube support bracket, and bias means disposed between said stationary member and said tube support bracket urging said tube support bracket towards said rotary member.

11. The peristaltic pump of claim **10** including reciprocating clamp means and bias means urging said reciprocating clamp means into cooperating engagement with said tube support bracket to retain said compressible tube therebetween.

12. In a peristaltic pump for intermittantly occluding a compressible tube including:

a housing;

a rotary member mounted for rotation on said housing;

a plurality of rollers carried by said rotary member for sequentially occluding said compressible tube, including a first roller for initially occluding said compressible tube, and a second roller for subsequently occluding said compressible tube, and;

a pumping shoe mounted on said housing adjacent said rotary member, whereby a compressible tube mounted on said housing between said rotary member and said pumping shoe is intermittantly occluded upon rotation of said rotary member, the improvement which comprises;

means carried by said rotary member for reshaping said compressible tube following each intermittant occlusion thereof, and

means for slidably mounting said pumping shoe adjacent said rotary member for movement between proximate and distal positions with respect to said rotary member, said proximate position being the normal operating position of said pumping shoe, and said distal position being a sufficient distance from said rotary member for the insertion and removal of said compressible tube therebetween,

said means for slidably mounting said pumping shoe including a slidable tube support bracket upon which said pumping shoe is mounted, and

reciprocating clamp means and bias means urging said reciprocating clamp means into cooperating engagement with said tube support bracket to retain said compressible tube therebetween.

13. The peristaltic pump of claim **12** including a stationary member mounted on said housing, slide means communicating with said stationary member for slidable engagement with said tube support bracket, and bias means disposed between said stationary member and said tube support bracket urging said tube support bracket towards said rotary member.

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