United States Patent

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[54] **PERASTALTIC PUMP**
2 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **417/477**
[51] **Int. Cl.** **F04b 43/12**
[50] **Field of Search** 103/149; 230/168; 91/57; 417/477, 476

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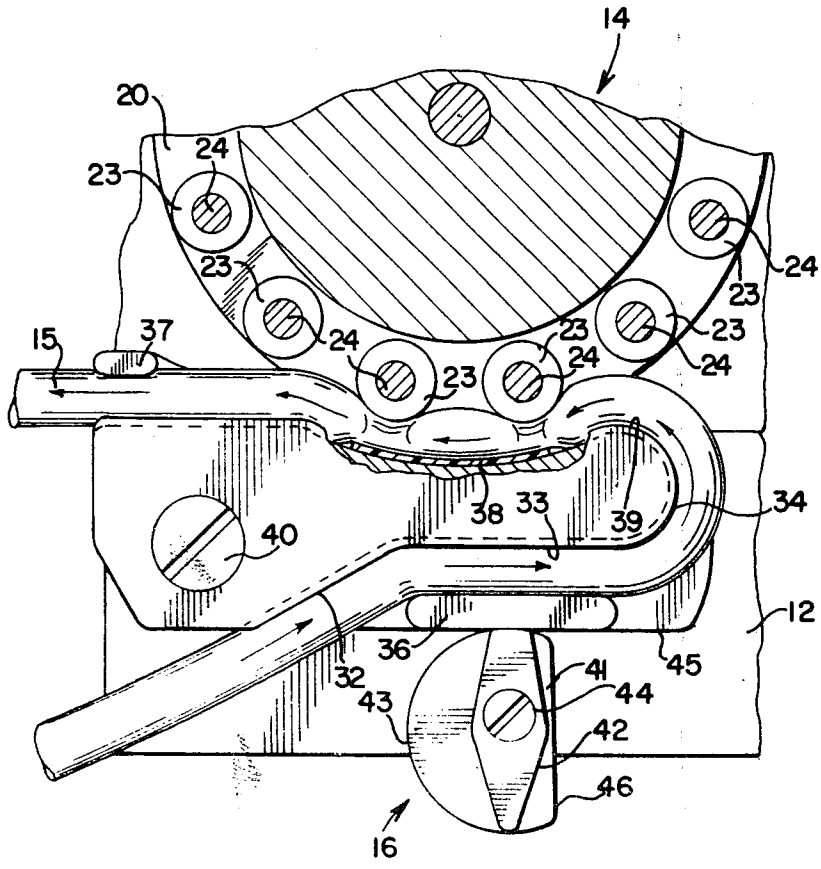
ABSTRACT: A perastaltic pump having a plurality of rollers mounted on a rotating pump wheel. Compressible tubing is supported by a tube support means which is manually operable to move the tubing into engagement with the rollers on the pumping wheel. Through the novel shape of the tubing support means, the tube may be easily installed and removed and functions to prevent tubing creep during operation.



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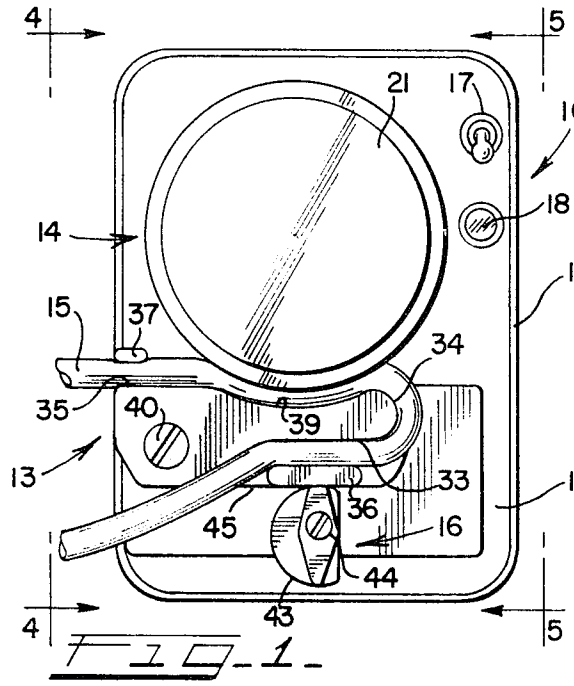

FIG. 1

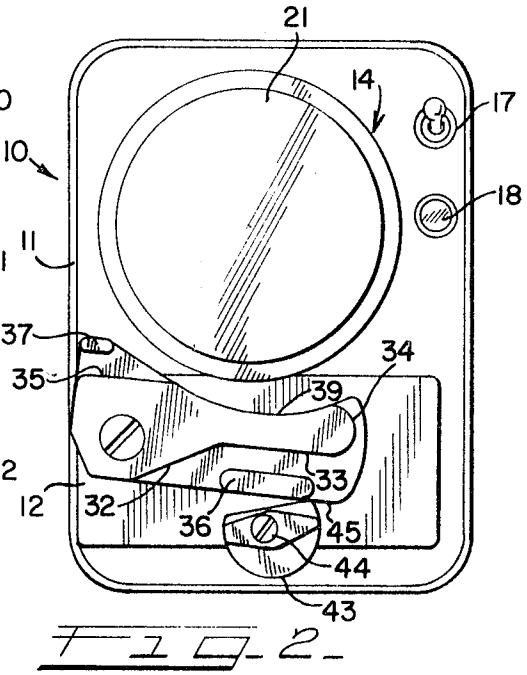

FIG. 2

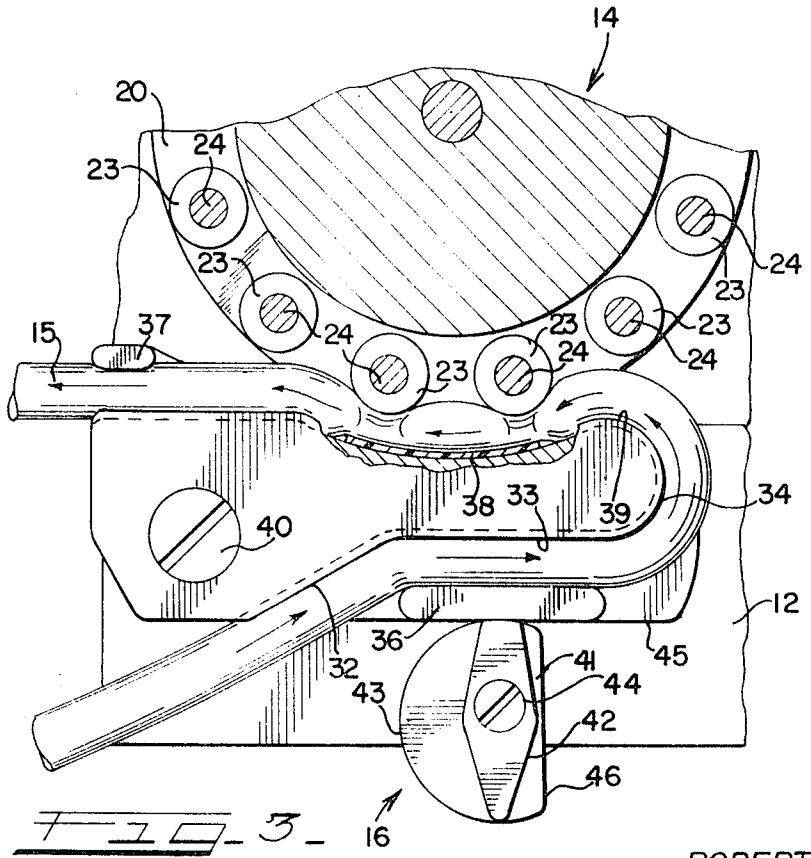

FIG. 3

INVENTOR
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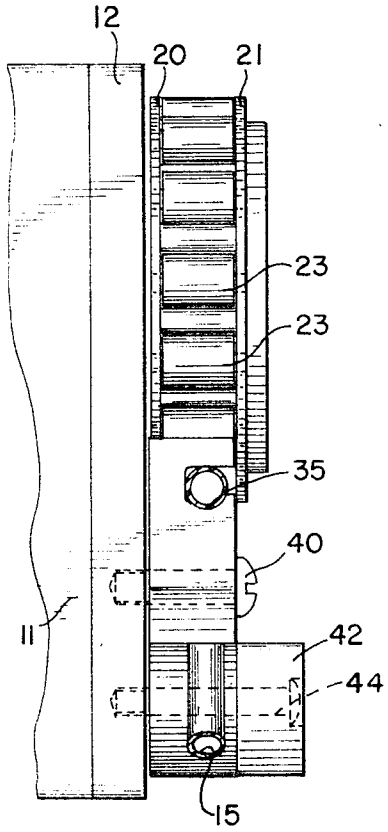

FIG. 4

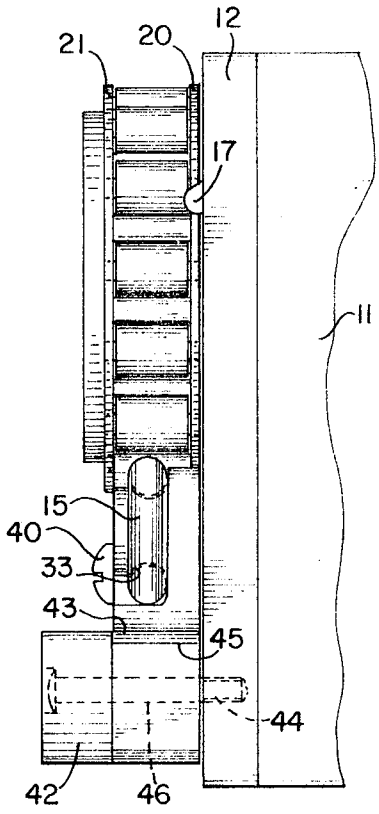

FIG. 5

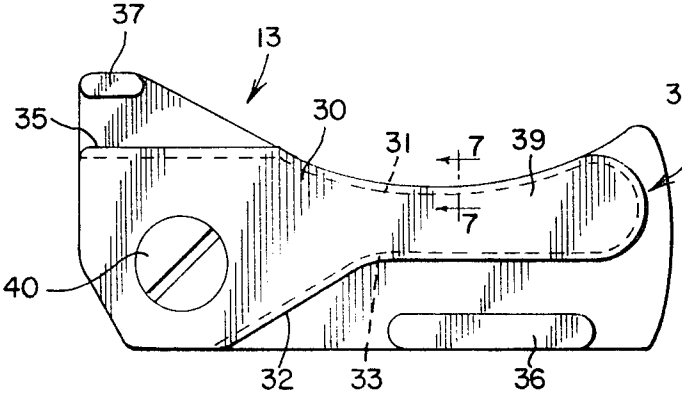

FIG. 6

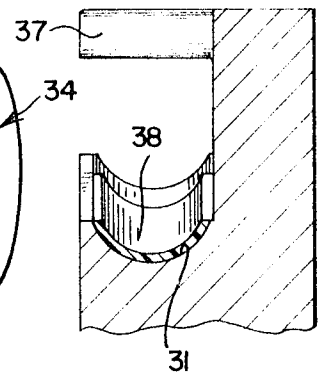

FIG. 7

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PERASTALTIC PUMP

This invention relates to positive-type displacement pumps in general and, more specifically, is directed to a new and improved perastaltic pump of the type commonly used in biological, medicinal, chemical, industrial, surgical, pathological and similar type uses.

Perastaltic pumps, as such, are well known in the art and have filled a definite need in the industry over the years where it is desirable to isolate and control the flow through flexible tubing. Since the tubing forms the path for the fluid pumped and is readily removed, it may be autoclaved as a unit or fresh sterilized tubing substituted when required for diverse uses or experiments.

One problem which has existed in the prior art is the difficulty encountered in installation and removal of the tubing in prior art designs. No doubt, this difficulty was a result of proposed solutions to the problem of preventing tubing creep during the pumping cycle. Various means have been proposed to eliminate these problems, however, prior to the present invention, no solution has been proposed which would offer a simple and satisfactory answer.

The present invention provides a new and improved tube-mounting arrangement in a perastaltic pump which permits the tubing to be easily installed and removed while preventing tubing creep without the use of complicated clamps or the like. A relatively simple cam-biased tube support is mounted for angular movement to disengage the tubing from the rollers carried on the pump wheel and permits lateral removal and installation. The cam permits the pressure on the tubing to be adjusted to the requirements of the tubing used.

It is an object of this invention to provide a new and improved perastaltic pump.

It is a further object of this invention to provide a new and improved tube-mounting arrangement for a perastaltic pump which permits removal and installation of the tubing with unequalled ease.

It is a still further object of this invention to provide a new and improved perastaltic pump having a simplified cam-biased tubing support means which prevents tubing creep during the pumping operation.

Objects in addition to those heretofore stated will appear from the following description made in reference to the accompanying drawings wherein:

FIG. 1 is a front elevational view of the perastaltic pump of the present invention with the tubing in position for pumping;

FIG. 2 is a view similar to FIG. 1 with the tubing removed;

FIG. 3 is an enlarged fragmentary elevational view with the pumping wheel broken away to show the cooperation of the rollers with the tubing and tubing support means;

FIG. 4 is a fragmentary side elevational view taken generally along the line 4–4 of FIG. 1;

FIG. 5 is a fragmentary side elevational view taken generally along the line 5–5 of FIG. 1;

FIG. 6 is a free body front elevational view of the tubing support means; and

FIG. 7 is a cross-sectional view taken generally along the line 7–7 of FIG. 6.

Referring now to FIG. 1, reference numeral 10 indicates the perastaltic pump of the present invention including a pump housing 11 and front cover 12 which mounts a tubing support means indicated generally at 13 and a pumping wheel indicated generally at 14. The cover 12 also forms a mounting area for a switch 17 for turning the pump on and off and which may also have an indicator light 18 included in the circuit for visually detecting the condition of the pump.

A tube 15 is wrapped around the tubing support means 13 in a manner to be described in greater detail in connection with FIGS. 3 and 6. A manually operated cam means 16 is mounted at the lower end of the housing 12 and cooperates with the tubing support means in a manner to become apparent.

Referring now to FIGS. 3—5, it can be seen that the pump wheel 14 includes spaced-apart plates 20 and 21 held on a shaft 19 and mounting a plurality of rollers 23 for rotation about individual shafts 24. As the pumping wheel 14 rotates, the rollers 23 are brought into engagement with the tubing 15, compressing it in a manner similar to that shown in FIGS. 1 and 3 and forcing the liquid through the tube 15. This function will be described in greater detail when the operation of the pump is given.

Referring now to FIG. 6, it can be seen that the tube support means 13 includes a tube-mounting portion 30 which may be formed with a shallow groove 31 which may be generally arcuate in cross section, conforming generally to the shape of the tubing to be supported. When viewed along its length, the groove 31 extends at an angle 32 to a point where the tube-supporting surface is generally tangential to, however, spaced from the path generated by pumping wheel 14. The tangential portion 33 merges with a smooth arcuate tube-reversing portion 34 which changes the direction of the tube support slightly in excess of 180°. The tubing 15 then enters the arcuate portion 34 formed on a radius of curvature substantially congruent to the path traced by the rollers 23 at their outer extremity. The arcuate portion 34 terminates smoothly, merging into a straight or linear section 35 for leading the tube 15 away from the pumping area to the discharge area where the flow is directed. Retaining lugs 36 and 37 cooperate with the straight or linear mounting sections 33 and 35, respectively, to maintain the tube 15 positioned in the groove 31 on the tube-mounting means.

As shown in FIGS. 3 and 7, an elastomeric pad 38 may line at least a part of the arcuate groove 34 to back the tube 15 in the area where the rollers 23 are actively squeezing the tube to perform the pumping function. The tube support means 13 is mounted for pivoting movement on the face 12 of the pump housing 11 through a bearing bolt 40 or the equivalent.

As best seen in FIGS. 1—3, the cam means 16 consists of a knoblike member 41 mounted through a pivot pin 44 and having a handle 42 which extends well outwardly of the housing cover 12 for ease of operation by the lab assistant or technician. The knob 41 is provided with a slow rise cam surface 43 and flat side 46. As the handle 42 is manually rotated, the cam surface 43 engages a cooperating or follower surface 45 on the tube support means 13 to move the tube support means about the pivot 40 and bring the tube 15 into engagement with the rollers 23. As shown in FIG. 2, when the cam is rotated to a position where the flat side 46 opposes the cam follower 45, the tube support means moves to the condition shown to facilitate easy removal and installation of the tube.

Operation of the perastaltic pump of the present invention is easily accomplished. A tube partially filled with a liquid is placed on the tube support means 13. The cam means 16 is rotated to bring the tube support and installed tubing 15 into engagement with the rollers 23 as shown in FIGS. 1 and 3—5. The pumping wheel 14 may then be turned on via switch 17 for rotation or, if desired, the pumping wheel 14 can be started in advance of moving the tubing into engagement with the rollers 23. Pumping of the liquid will continue so long as a fluid supply is available at the intake.

If desired, the pumping rollers 23 may be increased in overall length and multiple tracks provided on a single tubing support means of the same shape as that shown with the grooves supporting the tubing being parallel to each other. In this manner, uniform engagement of the tubing and rollers is assured for uniform pumping. This is especially helpful in those situations where the liquid is to be withdrawn while another is to be added at an equal rate. Through the use of a tubing support means of the type described herein, the tubing may be readily installed and removed, eliminating the need for special clamps and the like. Tubing creep is positively prevented without any need to constrict the tubing. Lateral stability is provided by the elastomeric pad 38 in the pumping region. The simplified design provides for a relatively inexpensive pump which is capable of extremely high performance

characteristics. In the present design, a motor available on the open market having a mechanical brake is used to permit microvolumes to be pumped at desired intervals when coupled to a suitable timer.

Upon a consideration of the foregoing, it will become obvious to those skilled in the art that various modifications may be made without departing from the invention embodied herein.

I claim:

1. In a perastaltic-type pump having a pump housing supporting a pumping wheel, said pumping wheel having means for engagement with a flexible tube through which material is pumped, the improvement comprising a tube support means mounted on said housing for movement toward and away from said pumping wheel, a tubing support surface on said tube support means, said tubing support surface being of generally U-shaped configuration to reverse the direction of the tube thereon and thereby prevent tubing creep during operation of said pump, said tube support surface including an angular entrance portion merging into a substantially linear section radially spaced from said pumping wheel, said linear section merging with a generally U-shaped end portion leading into a smooth arcuate portion adapted to be moved to a position closely spaced from said pumping wheel and a generally linear portion exiting from said arcuate portion.

2. The improvement is perastaltic-type pumps as defined in claim 1 wherein lug means is provided an opposition to each of said linear sections, said lug means maintaining said tube in contact with said linear sections to prevent tube creep during operation of said pump.