This invention relates to pumps and more particularly to multiple tube proportioning pumps wherein the pump tubes are compressed and completely closed progressively along their lengths for pumping various fluids.

One of the objects of the invention is to provide a pump of the indicated type which is especially well adapted for use with tubes of small internal diameters.

Another object is to provide a pump of the indicated type which is constructed for operation with a plurality of tubes of different internal diameters or of the same internal diameters without the use of a plate or other blocking means frequently employed in multiple tube pumps.

A further object of the invention is generally to provide a multiple tube pump which is compact in construction, efficient in operation, and which is comparatively inexpensive to manufacture.

The above and other objects, features and advantages of this invention will be fully understood from the following description considered in connection with the accompanying drawings which are illustrative of the presently preferred embodiment of the invention.

In the drawings:
FIG. 1 is a side view, in elevation and partly in section on the line 1—1 of FIG. 2 of a pump embodying the present invention;
FIG. 2 is a sectional view on the line 2—2 of FIG. 1;
FIG. 3 is a sectional view on the line 3—3 of FIG. 2;
FIG. 4 is a fragmentary perspective view illustrating parts of the tube compressing members in one range of sizes, as to their internal diameters, and for a tube or tubes of another range of sizes as to their internal diameters; and
FIG. 5 is a sectional view illustrating the compressing action of a tube compressor member on a compressible tube of the pump.

Referring now to the drawings in detail the pump comprises a frame 10 having a base 12 and a rigid vertical panel 14 upstanding from said base and secured thereto in any suitable way. The frame also includes side wall members 15 secured to base 12 and to the opposite edges of panel 14. A block 16 is secured to panel 14 by pins 18 (FIGS. 2 and 3) which pass through holes 20 in mounting plate 22 with a tight fit and through holes 24 in block 16 and into holes 26 in panel 14, said pins 19 having a tight fit in holes 24 and 26. A plate 28 is secured to base 12 in any suitable way and extends to the bottom of block 16, and the lower part of mounting plate 22 is secured to said plate 28 in any suitable way as by a screw 30 (FIG. 2). Thus block 16 and plate 22 are rigidly held as a unit on frame panel 14.

Block 16 has upwardly inclined planar sides 32 on which the tube holders 34 are releasably secured, each of said tube holders being provided with a plurality of grooves 36 in which the pump tubes are positioned and held against longitudinal movement. As shown in FIG. 2, there are two resiliently compressible tubes 38 in contact of the grooves 36, and a resiliently compressible tube 40 of a smaller internal diameter than tubes 38 as shown positioned in one of the grooves 36 of the tube holder 34.

The tubes are provided with collars 42 fixed to the tubes and engageable with the edge of the tube holder near the companion groove for releasably preventing movement of the tube longitudinally of the grooves during the pumping operation. Each tube holder is held in position on the companion surface 32 of the valve block by pins which project into holes 43 (FIG. 2) in the tube holder. Nuts 44 may be employed in releasable engagement with threaded studs 46 secured to block 16 and project from the sides 32 thereof for releasably securing tube holders 34 in position on said block.

The tube compressing means comprises a drum 48 which is secured to a driven shaft 50 mounted for rotation in bearings 52 provided in panel 14 and plate 22. Said drum 48 is provided with a plurality of circumferentially spaced pressure rollers 54 which are journaled at their opposite ends on the side members 56 of the drum 48, said side members being fixed to the drive shaft 50 for rotation therewith. Said drum also includes a mounting member 58 which is fixed to shaft 50 in axially spaced relation to an adjacent side member 56 of the drum. Tube compressor roller 60 of smaller diameter than the rollers 54 are journaled at their opposite ends in bearings side member 58 and in the adjacent side member 56.

Shaft 50 is driven by a pulley 62 having a belt 64 which is driven by the pulley 66 on the shaft of the machine.

Gearing of a motor 68 is mounted on a bracket 70 secured to the panel 14, so that the motor is positioned between the opposite side walls 15 of the frame 10.

In the operation of the pump, when shaft 50 is rotated tube compressing rollers 54 engage the resiliently flexible stationary tubes 38 progressively along their lengths and fully close the tubes as illustrated in FIG. 5, while the tube compressing rollers move longitudinally of the tube during rotation of the drum 48 for transmitting the fluid through the tubes.

It will be apparent from an inspection of the drawings, especially FIG. 1, that the movement of the tube compressor roller members 54 longitudinally of the tubes which are held in taut condition by the engagement of the collars 42 with the edge of the tube holder 34 results in a continuous flow through the tubes toward the right, view FIG. 4. It will also be understood that the same action occurs with reference to the tube or tubes 40 of the smaller diameter which are engaged by the compressor members 60.

The multiple tube pump of the present invention is especially well adapted for pumping liquids through tubes of smaller inner diameter, for example, as proportioning pumps in automatic analysis apparatus of type shown by the U.S. patent to Skeggs, No. 2,797,149 owned by the assignee of this application. By way of a non-limitative example, it may be noted that the small rollers or presser members 60 have a diameter of one-sixteenth of an inch and these rollers are effective to fully close the small tubes 40 progressively along their lengths during the rotation of drum 48, the inner diameter of tubes 40 being in the order of three-hundredths of an inch and smaller. Said tube of the small diameter are particularly useful for the transmission of body fluid samples, for example small quantities of blood which are to be analyzed quantitatively with respect to various constituents of the blood sample. The larger rollers or tube compressors 54 have a diameter of the order of three-sixteenths of an inch and are intended primarily for compressing tubes, which have an internal diameter greater than three-hundredths of an inch, such tubes being used for the transmission of diluents and reagents employed in the analysis of the body fluid samples in the analysis apparatus.

While I have shown and described the preferred embodiment of my invention, it will be understood that the invention may be embodied otherwise than as herein specifically illustrated or described, and that certain
changes in the form and arrangement of parts and in the specific manner of practicing the invention may be made without departing from the underlying idea or principles of this invention within the scope of the appended claims.

What is claimed is:

1. In a multiple tube pump comprising a plurality of resiliently compressible tubes at least one of which has a smaller internal diameter than the other of said tubes, a first set of a plurality of circumferentially spaced rollers, a second set of a plurality of circumferentially spaced rollers, the diameters of the rollers of one of said sets being smaller than the diameters of the other of said sets of rollers, means for holding at least one resiliently compressible tube in taut condition in engagement with certain of the rollers of said first set, means for holding said one resiliently compressible tube of smaller internal diameter in longitudinally taut condition and in engagement with certain rollers of said second set, and means cooperatively associated with said two sets of rollers for rotating the same to simultaneously compress said tubes progressively along their lengths for the pumping operation.

2. In a multiple tube pump comprising a plurality of resiliently compressible tubes at least one of which has a smaller internal diameter than the other of said tubes, a first set of a plurality of circumferentially spaced rollers, a second set of a plurality of circumferentially spaced rollers, the diameters of the rollers of one of said sets being smaller than the diameters of the other of said sets of rollers, means for holding said one resiliently compressible tube of smaller internal diameter in taut condition in engagement with certain of the rollers of said first set, means for holding at least one resiliently compressible tube other than said first mentioned tube in longitudinally taut condition and in engagement with certain rollers of said second set, and means cooperatively associated with said two sets of rollers for rotating the same to simultaneously compress said tubes progressively along their lengths for the pumping operation, said tube holding means comprising a block mounted below said rollers and having opposite sides disposed in planes extending toward said rollers, and means on said block for positioning said tubes so that they extend upwardly from one of said sides of the block, then across at least two of said rollers, and then downwardly from said rollers to the other side of the block.

3. In a multiple tube pump comprising a plurality of resiliently compressible tubes at least one of which has a smaller internal diameter than the other of said tubes, a rotary drum, first and second sets of circumferentially spaced rollers carried by said drum and rotatable therewith, the diameters of the rollers of one of said sets being smaller than the diameters of the other of said sets of rollers, means for holding at least one resiliently compressible tube of smaller internal diameter than said other tubes in longitudinally taut condition and in engagement with certain rollers of said second set, and means for rotating said drum and thereby rotating said two sets of rollers to simultaneously compress said tubes progressively along their lengths for the pumping operation.

4. In a multiple tube pump comprising a plurality of resiliently compressible tubes at least one of which has a smaller internal diameter than the other of said tubes, a rotary drum, first and second sets of circumferentially spaced rollers carried by said drum and rotatable therewith, the diameters of the rollers of one of said sets being smaller than the diameters of the other of said sets of rollers, means for holding at least one resiliently compressible tube in taut condition in engagement with certain of the rollers of said first set, means for holding said one resiliently compressible tube of smaller internal diameter than said first mentioned tube in longitudinally taut condition and in engagement with certain rollers of said second set, and means cooperatively associated with said drum for rotating said two sets of rollers to simultaneously compress said tubes progressively along their lengths for the pumping operation, said tube holding means comprising a block mounted below said drum and having upwardly inclined opposite sides at opposite sides, respectively, of the axis of rotation of said drum, and means on said inclined sides of the block for positioning said tubes so that they extend upwardly from one of said inclined sides toward the axis of said drum, then across at least two of said rollers, and then downwardly from said rollers to the other side of said block.

References Cited in the file of this patent

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