Aug. 27, 1963 E. C. WEISKOPF ETAL 3,101,674

MULTIPLE-TUBE PUMP

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FIG. 1

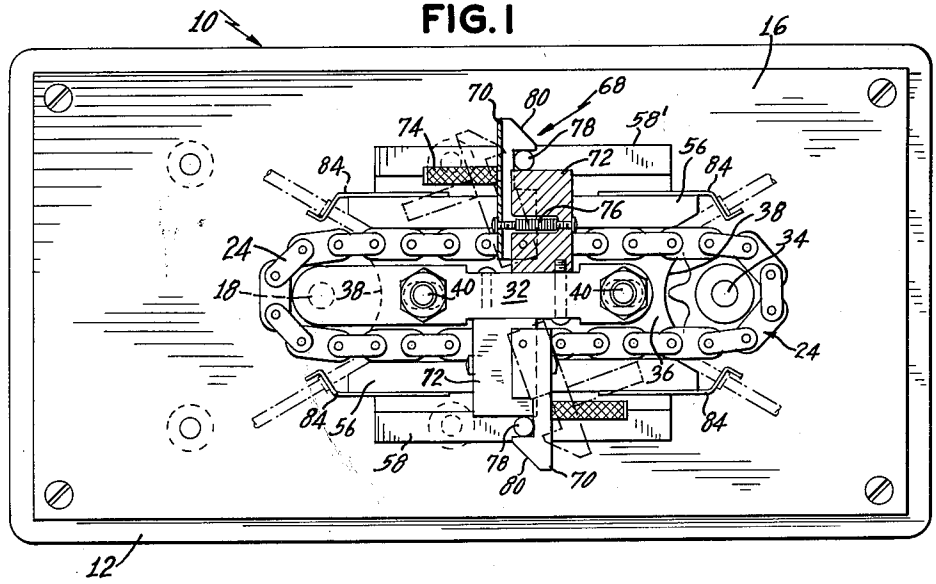

FIG. 2

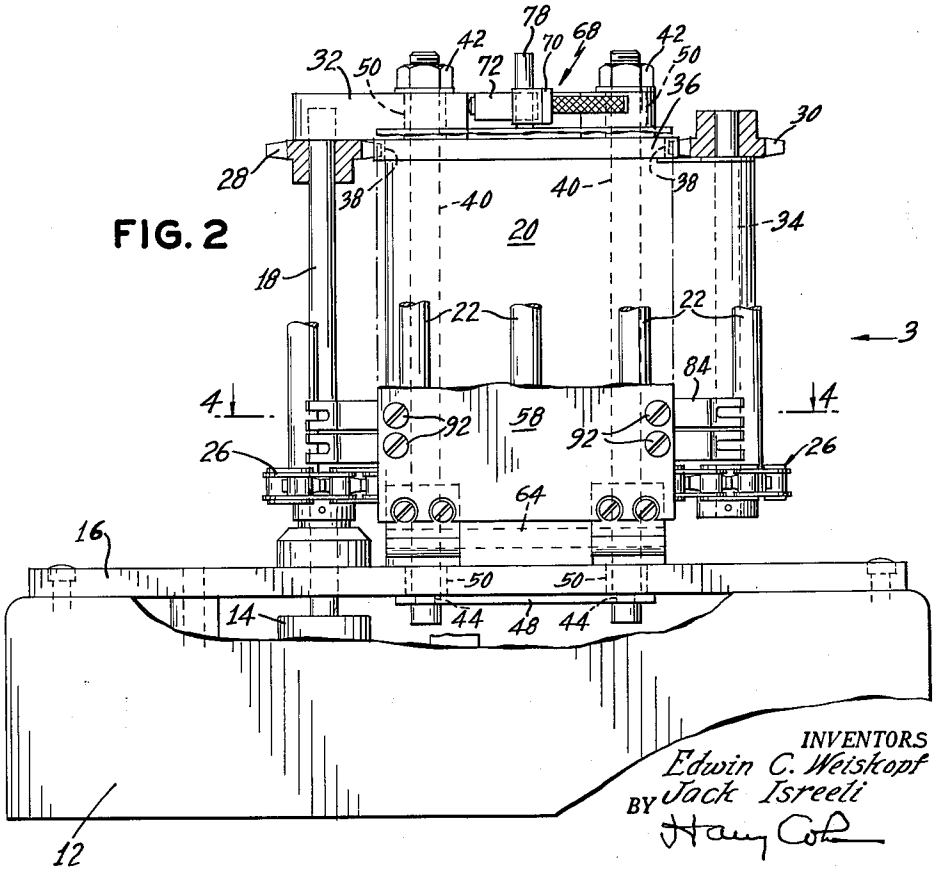

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FIG. 3

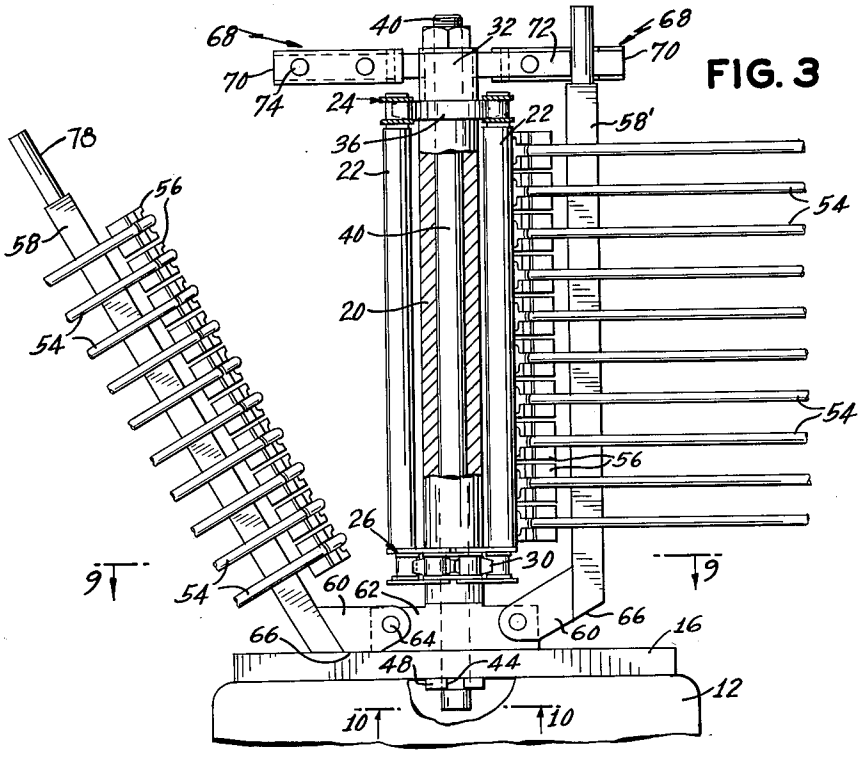
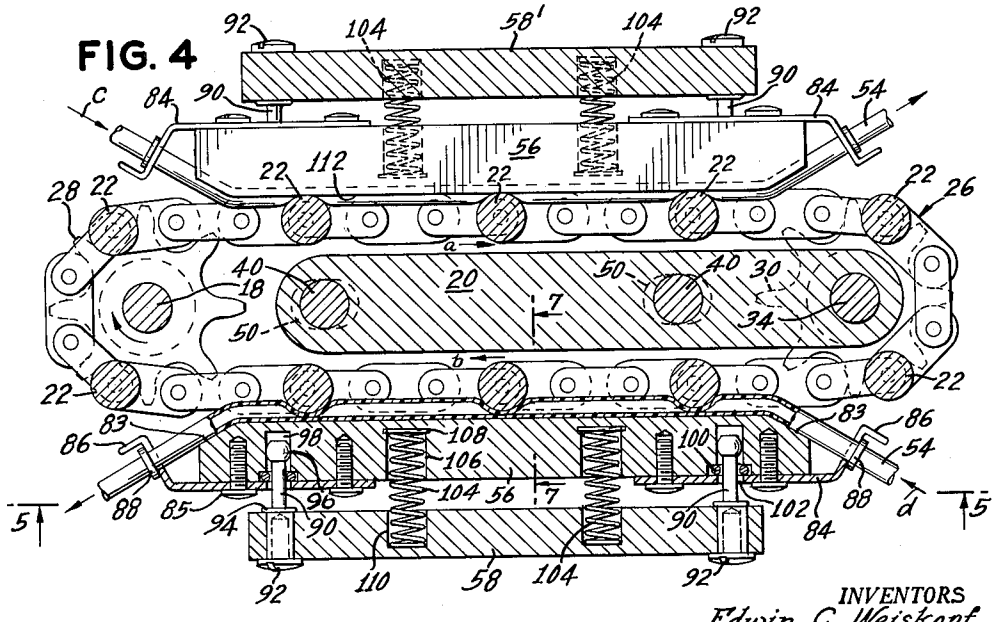


FIG. 4



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MULTIPLE-TUBE PUMP

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FIG. 5

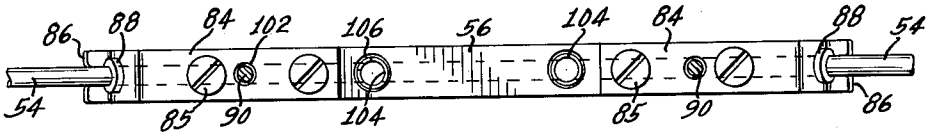


FIG. 6

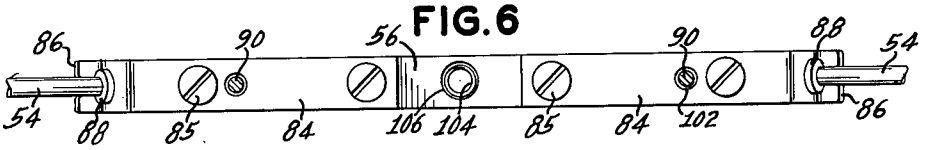


FIG. 9

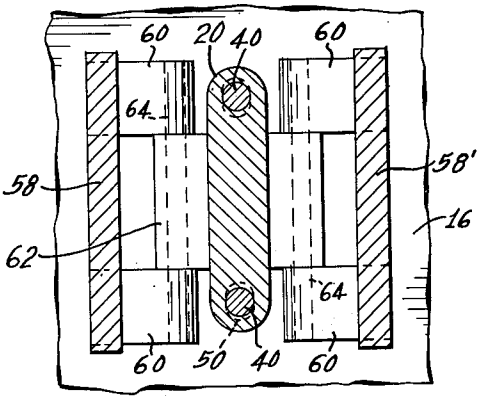


FIG. 7

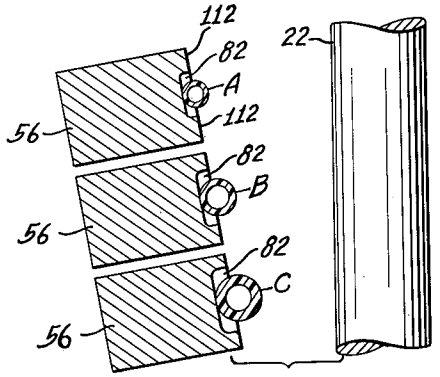
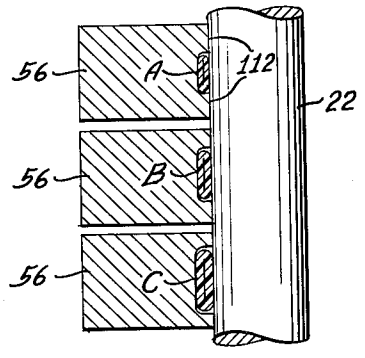


FIG. 8



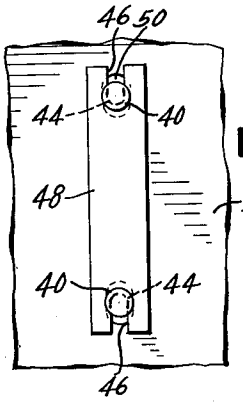


FIG. 10

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3,101,674

MULTIPLE-TUBE PUMP

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Filed Dec. 20, 1960, Ser. No. 77,137
21 Claims. (Cl. 103—149)

This invention relates to pumps of the compressible tube type especially useful in simultaneously pumping a plurality of fluids in predetermined relative proportions or at predetermined flow rates.

One object of the invention is to provide a multiple tube pump wherein a plurality of resiliently compressible tubes disposed laterally of each other can be fully compressed progressively along their lengths, for the pumping operation, by means which includes a compressor which can operate simultaneously on all of the tubes longitudinally thereof without however requiring that tubes of different internal diameters have the same wall thickness. Since, by reason of this invention, tubes of different internal diameters need not have the same wall thickness, it is possible to select the optimum wall thickness for the various internal diameters thereby helping to obtain maximum durability or useful life of the tubes together with optimum resilient rebound of the tubes progressively along their lengths immediately following the above described compression of the tubes.

Another object is the provision of a pump of the indicated type with means for supporting the tubes in a manner which increases the life of the pump tubes and reduces elastic fatigue.

A further object is the provision of a multiple tube pump which is constructed so as to increase the capacity of the pump in respect to the number of tubes which can be provided without a substantial increase in the overall size of the pump.

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

In the drawings:

FIG. 1 is a top plan view of a pump in accordance with the presently preferred embodiment of the invention with parts in section;

FIG. 2 is a side elevational view of the pump with parts broken away, for purposes of illustration;

FIG. 3 is an end view of the pump, partly in section and with portions broken away, looking in the direction of arrow 3 of FIG. 2, with the tubes on one side of the pump in a retracted position;

FIG. 4 is a sectional view on line 4—4 of FIG. 2, on a larger scale;

FIG. 5 is a sectional view on line 5—5 of FIG. 4;

FIG. 6 is a view similar to FIG. 5 but showing a modification thereof;

FIG. 7 is a fragmentary view on line 7—7 of FIG. 4, on a larger scale, illustrating the tubes in an incompressed condition and the platens therefor;

FIG. 8 is a view similar to FIG. 7 showing the tubes in a compressed condition;

FIG. 9 is a detail sectional view taken on line 9—9 of FIG. 3; and

FIG. 10 is a detail bottom plan view taken on line 10—10 of FIG. 3.

Briefly described, the pump of the present invention comprises a series of resiliently compressible tubes which are disposed laterally of each other in side-by-side relation and in the illustrated preferred embodiment a similar series of pump tubes is provided in spaced confronting relation to the first mentioned series of tubes. Said tubes are preferably formed of poly vinyl chloride but can be

made of any other material so long as they are resiliently compressible. Certain of the tubes in each series are provided with different internal diameters so that a plurality of fluids in predetermined relative proportions may be simultaneously pumped. Disposed in the space between the series of pump tubes is an endless chain which carries a plurality of tube compressors or rollers which extend transversely of the tubes and are adapted to simultaneously engage all of the tubes and thus operate on all of the tubes by closing them along a common transverse line for the tubes at each side of the chain so that movement of the rollers longitudinally of the tubes causes the fluids in the tubes to be propelled through said tubes by the action of the rollers for the pumping operation. The pump has an individual platen for each tube and each of the platens has a groove in which the tube is disposed. The depth of the groove is slightly less than twice the wall thickness of the tube to be positioned therein so as to limit the pressure of the roller on the tube.

Referring now to the drawings in detail, the pump **10** comprises a base **12** which is in the form of a housing for the electric motor **14** which operates the pump at the desired speed through conventional speed reduction gearing. A rigid plate **16** is secured to the top of the base and a vertical rotary shaft **18** operated by motor **14** extends through the top of the base and through plate **16**. A frame member **20** is adjustably secured at its lower end to plate **16** and also extends vertically upwardly therefrom. Although the pump is shown in its preferred position with frame member **20** and motor operated shaft **18** in vertical positions, it is within the scope of this invention to position the pump so that the frame member and the motor operated shaft are in horizontal or other positions.

A plurality of laterally spaced vertically extending tube compressors, here shown as pressure rollers **22**, are mounted for circulatory movement around frame member **20**. More specifically, the ends of the rollers are mounted for rotational movement in the spaced pivotal connections of the links of the vertically spaced endless sprocket chains **24** and **26**. As here illustrated, the rollers are separated from each other by three links of the sprocket chains which are engaged by the driving sprocket wheels **28** and the driven sprocket wheels **30**. Sprocket wheels **28** are fixed to shaft **18** and the upper end of shaft **18** is mounted in a bearing which is provided in support member **32**. Sprocket wheels **30** are fixed to the ends, respectively, of a shaft **34** which is mounted for rotation in frame member **20**. The upper and lower ends of frame member **20** are provided with end plates **36** over which the sprocket chains move and the ends **38** of the end plates are curved to accommodate the sprocket wheels.

Frame member **20** is adjustably secured on base **12** between plate **16** and support member **32** by the vertically extending bolts **40** whose threaded ends are provided with nuts **42** which can be tightened to clamp frame member **20** between member **32** and plate **16**. The lower ends of the bolts are provided with groves **44** (see FIG. 10) which are engaged by the slotted ends **46** of the strap **48** to prevent rotation of the bolts during tightening of nuts **42**. Slack in the sprocket chains can be eliminated by loosening nuts **42** and moving frame member **20** to the right, as viewed in FIG. 2, and for this purpose support member **32** is provided with elongated slots **50** and plate **16** is also provided with elongated slots **50** through which the bolts **40** extend. It will be understood that strap **48** is slidable on the undersurface of plate **16**.

Platen means for a plurality of vertically spaced horizontally extending pump tubes **54** are disposed at each side of frame member **20**. Preferably, as herein shown, the platen means comprises a plurality of platens **56**, one for each tube, and the platens on one side of the

frame member are removably mounted to a pivoted platen carrier **58** while the platens on the other side of the frame member are also removably mounted to a similar pivoted carrier **58'**. As best seen in FIGS. 3 and 9, the pivot support for each platen carrier comprises the laterally spaced parts **60** which are secured to the lower ends of the carrier and straddle the extensions **62** which are at the lower end of the frame member **20** in surface contact with plate **16**. A pivot pin **64** extends through parts **60** and extension **62**. It will be noted, as best seen in FIG. 3, that the lower ends of the carriers **58** and **58'** and the lower surfaces of parts **60** thereof form flat supporting surfaces **66** for the respective platen carrier which extend upwardly at an angle to the horizontal surface of plate **16** when the platens are in their operative positions wherein the tubes **54** engage the tube compressing rollers **22**, as shown with respect to carrier **58'**. When the carrier is pivoted into its retracted and inoperative position, as shown with respect to the carrier **58**, surface **66** engages the upper surface of plate **16** which acts as a stop and a support for the carrier.

In the retracted or inoperative position of the carrier, individual platens may be replaced or removed and individual tubes may be replaced or removed as required or as necessary. A latch mechanism **68** is provided to lock the platen carrier in its operative position. The mechanism comprises a latch **70** pivotally mounted on a block **72** which is secured to the side of member **32**. The latch is provided with a handle **74** and is biased by a tension spring **76** into engagement with the upper pin end **78** of the platen carrier, said pin end providing a catch member for the latch. The end of latch **70** has a slanting cam face portion **80** which is engaged by catch member **78** when the platen carrier is moved from its retracted position into its operative position and latch **70** is moved automatically to a retracted position until catch **78** clears the cam portion **80**, after which latch **70** automatically moves under the force of spring **76** to its carrier locking or retaining position.

Each pump tube is made of poly vinyl chloride or other suitable resiliently compressible material which enables the tubes to be compressed by rollers **22** into a collapsed condition to force the fluids in the respective tubes longitudinally thereof as the rollers move progressively longitudinally of the tubes for the pumping operation. Each platen **56** is a generally elongated member of rectangular cross section and has a longitudinally extending groove **82**, in which the pump tube **54** extends. The ends **83** of the platens are chamfered and the portions of the tubes which extend from the ends of the platens bend away from the plane of the groove and are gripped by the tube retaining members **84** which are secured to the platens by screws **85**. Each member **84** has a slotted bent end **86** and the bent portion of the tube is provided with a collar **88** which engages a surface of end **86** to releasably hold the tube under slight tension longitudinally thereof in the groove of the platen. Each platen is releasably secured to the carrier **58** or **58'** by guide pins **90** which are secured to the carrier by screws **92** screwed into the threaded ends of the pins. The pins are provided with shoulders **94** which are in abutment with one side of the carrier. The other ends of the pins are provided with enlarged portions **96** which extend into recesses **98** provided in the platens and a resilient retaining ring **100** is provided at the entrance to the recess to prevent the enlarged portion of the pin from inadvertently moving out of the recess during the operation of the pump. The retaining ring is held in position by the overlapping portions which define the aperture **102** provided in member **84** through which the body of the pin extends. The pins guide the movement of the platen on its carrier.

Each platen preferably carries a pair of compression springs **104** which provide a resilient mounting for each platen on the carrier. The platen is provided with a recess **106** for each spring and the recess has an enlarged portion **108** at the inner end thereof into which the coil at the inner end of the spring extends for retaining the spring in the platen. The spring extends from the platen into a recess **110** provided in the platen carrier. If desired, a single spring **104** may be provided as shown in FIG. 6 in lieu of the pair of springs shown in FIGS. 4 and 5.

It is apparent from the foregoing that each platen and the pump tube carried thereby may be easily removed from the platen carrier by moving the carrier into its retracted position as shown with respect to carrier **58** in FIG. 3 and pulling the platen away from the carrier while holding the carrier to prevent movement thereof, whereby the resilient retaining means **100** will move past the enlarged portion **96** of the pins **90** and the platen will be disengaged from its carrier. During this disengaging movement the ends of springs **104** will move out of recesses **110** of the carrier so that the springs for each platen are also removed when the platen is removed.

By providing each pump tube with its individual platen and by spring loading each platen individually it is possible to provide pump tubes with different and optimum wall thicknesses corresponding to the internal diameters of the respective tubes which assures maximum life for the tubes and optimum elastic rebound. Referring to FIGS. 7 and 8, tubes A, B, and C are each of different internal diameters to provide different pumping rates and each pump tube can have a wall thickness corresponding to the internal diameter of the tube so that the outer diameters of each tube also vary. The groove **82** of platen **56** for tube A has a depth which is equal to slightly less than twice the wall thickness of the tube and has a width which is wide enough to accommodate the tube in its collapsed condition with a slight amount of clearance between the walls of the groove and the tube, as indicated in FIG. 8. Similarly, the grooves **82** in the platens for tubes B and C are also dimensioned to accommodate their respective tubes.

In the operation of the pump, the endless sprocket chains **24** and **26** move in the direction indicated by the arrows *a* and *b* in FIG. 4 and move rollers **22** along the lengths of the tubes to fully compress the tubes against their respective platens for the pumping operation, as shown in FIG. 8. It will be observed that the rollers which move in the direction of arrow *a* engage the series of tubes carried by carrier **58'** and pump the fluids therein in a direction which is opposite to the direction of movement of the fluids being simultaneously pumped through the tubes carried by carrier **58** by engagement of said tubes by the rollers moving in the direction indicated by arrow *b*. Accordingly, the inlets for the tubes of carrier **58'** and carrier **58** are in opposite positions, the inlets for the tubes of carrier **58'** being indicated by arrow *c* and the inlets for the tubes of carrier **58** being indicated by arrow *d*.

The chamfered or inclined ends **83** of the platens permit the rollers **22** to engage the tubes gradually for the pumping operation and to disengage the tubes gradually, thus avoiding abrupt increases and decreases in pressures which might otherwise occur. A minimum of two rollers are always engaged with the pump tubes and help keep the platens in parallel alignment with each other and movement of the platens on their springs is guided by pins **96** in recesses **98**. As will be readily apparent from FIG. 8, the pressure rollers **22** are prevented from exerting excessive pressures on the tubes since the edge surfaces **112** at the sides of the grooves in the platens provide stops for the rollers which limit their compressing movement and in this manner excessive spring pressure is prevented from being applied to the tubes, thereby helping increase tube life. Because excessive pressure is prevented from being applied to the tube, the tubes do not stretch during use and the tension of the tubes remains fairly constant thereby eliminating the necessity of increasing tension to maintain the tubes against the bottom surface of their respective grooves.

While we have shown and described the preferred embodiment of our 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.

We claim:

1. A pump, comprising a series of flexible resilient tubes disposed laterally of each other for the delivery of a plurality of fluids, another series of flexible resilient tubes disposed laterally of each other for the delivery of a plurality of fluids, means supporting said two series of tubes in spaced relation, and means disposed in the space between said two series of tubes engageable simultaneously with each of said tubes at points intermediate their lengths, respectively, for simultaneously closing the tubes of one series along a common transverse line and for simultaneously closing the tubes of the other series along another common transverse line, said tube engageable means being movable progressively along the lengths of said tubes for progressively closing said tubes and thereby propelling the fluids through their respective tubes for the pumping operation.

2. A pump, comprising a series of flexible resilient tubes disposed laterally of each other for the delivery of a plurality of fluids, another series of flexible resilient tubes disposed laterally of each other for the delivery of a plurality of fluids, means supporting said two series of tubes in spaced relation, and means disposed in the space between said two series of tubes engageable simultaneously with each of said tubes at points intermediate their lengths, respectively, for simultaneously closing the tubes of one series along a common transverse line and for simultaneously closing the tubes of the other series along another common transverse line, said tube engageable means being movable progressively along the lengths of said tubes for progressively closing said tubes and thereby propelling the fluids through their respective tubes for the pumping operation, said supporting means comprising a series of platens for said tubes, respectively, against which said tubes are collapsed by said tube engageable means.

3. A pump, comprising a series of flexible resilient tubes disposed laterally of each other for the delivery of a plurality of fluids, another series of flexible resilient tubes disposed laterally of each other for the delivery of a plurality of fluids, means supporting said two series of tubes in spaced relation, some of said tubes of each series having different internal diameters and different wall thicknesses, respectively, and means disposed in the space between said two series of tubes engageable simultaneously with each of said tubes at points intermediate their lengths, respectively, for simultaneously closing the tubes of one series along a common transverse line and for simultaneously closing the tubes of the other series along another common transverse line, said tube engageable means being movable progressively along the lengths of said tubes for progressively closing said tubes and thereby propelling the fluids through their respective tubes for the pumping operation.

4. A pump, comprising a series of flexible resilient tubes disposed laterally of each other for the delivery of a plurality of fluids, another series of flexible resilient tubes disposed laterally of each other for the delivery of a plurality of fluids, means supporting said two series of tubes in spaced relation, some of said tubes of each series having different internal diameters and different wall thicknesses, respectively, and means disposed in the space between said two series of tubes engageable simultaneously with each of said tubes at points intermediate their lengths, respectively, for simultaneously closing the tubes of one series along a common transverse line and for simultaneously closing the tubes of the other series along another common transverse line, said tube engageable means being movable progressively along the lengths of said tubes for progressively closing said tubes and thereby propelling the fluids through their respective tubes for the pumping operation, said supporting means comprising a series of platens for said tubes, respectively, against which said tubes are compressed by said tube engageable means.

5. A pump, comprising a series of flexible resilient tubes disposed laterally of each other for the delivery of a plurality of fluids, some of said tubes having different internal diameters and different wall thicknesses, respectively, means for supporting said tubes in said laterally disposed relation comprising a plurality of spring supported members each having a longitudinally extending groove in which a tube extends, said grooves each having a depth equal to about twice the thickness of the wall of the tube therein, means engageable simultaneously with all of said tubes at points intermediate their lengths, respectively, for simultaneously closing said tubes along a common transverse line and movable progressively along their lengths to simultaneously and progressively close said tubes for the pumping operation, and means engageable with said tube engageable means for limiting the tube closing pressure applied by said tube engageable means to said tubes.

6. A pump, comprising a series of flexible resilient tubes disposed laterally of each other for the delivery of a plurality of fluids, some of said tubes having different internal diameters and different wall thicknesses, respectively, means for supporting said tubes in said laterally disposed relation comprising a plurality of spring supported members each having a longitudinally extending groove in which a tube extends, said grooves each having a depth equal to about twice the thickness of the wall of the tube therein, and a roller engageable simultaneously with all of said tubes and movable progressively along their lengths to simultaneously compress said tubes for the pumping operation, said grooves having flat surfaces along the side edges thereof which provide stops for said roller to prevent the application of excessive pressures to said tubes by said roller during the pumping operation.

7. In a pump, platen means for a plurality of resiliently compressible tubes, said platen means having a plurality of longitudinally extending grooves disposed laterally of each other to receive the compressible tubes in corresponding lateral relation, means operable in conjunction with said platen means to simultaneously close the tubes in the grooves along a common transverse line and progressively along the lengths of the tubes for the pumping operation, said last mentioned means comprising a series of tube compressing rollers extending transversely of said grooves in confronting relation therewith and movable longitudinally of said grooves for said pumping operation, and means operable to engage said pressure rollers and limit the pressure applied by said tube closing means to said tubes after the latter have been closed for the pumping operation, said last mentioned means having roller engaging surfaces for limiting the movement of said rollers against said tubes when said tubes are closed during said pumping operation.

8. In a pump, platen means for a plurality of resiliently compressible tubes, said platen means having a plurality of longitudinally extending grooves disposed laterally of each other to receive the compressible tubes in corresponding lateral relation, the depth of each groove being slightly less than twice the wall thickness of the tube to be positioned in the groove, and means operable in conjunction with said platen means to simultaneously close the tubes in the grooves along a common transverse line and progressively along the lengths of the tubes for the pumping operation, said last mentioned means comprising a series of tube compressing rollers extending transversely of said grooves in confronting relation therewith and movable longitudinally of said grooves for said pumping operation.

9. In a pump, platen means for a plurality of resiliently compressible tubes, said platen means having a plurality of longitudinally extending grooves disposed laterally of each other to receive the compressible tubes in corresponding lateral relation, means operable in conjunction with said platen means to simultaneously close the tubes in the grooves along a common transverse line and progressively along the lengths of the tubes for the pumping operation, said last mentioned means comprising a series of tube compressing rollers extending transversely of said grooves in confronting relation therewith and movable longitudinally of said grooves for said pumping operation, means providing a resilient force on said platen means during the operation of said tube compressing rollers in conjunction with said platen means, and means operable to engage said pressure rollers and limit the pressure applied by said tube closing means to said tubes after the latter have been closed for the pumping operation, said last mentioned means having roller engaging surfaces for limiting the movement of said rollers against said tubes when said tubes are closed during said pumping operation.

10. In a pump, platen means for a plurality of resiliently compressible tubes, said platen means having a plurality of longitudinally extending grooves disposed laterally of each other to receive the compressible tubes in corresponding lateral relation, the depth of each groove being slightly less than twice the wall thickness of the tube to be positioned in the groove, means operable in conjunction with said platen means to simultaneously close the tubes in the grooves along a common transverse line and progressively along the lengths of the tubes for the pumping operation, said last mentioned means comprising a series of tube compressing rollers extending transversely of said grooves in confronting relation therewith and movable longitudinally of said grooves for said pumping operation, and means providing a resilient force on said platen means during the operation of said tube compressing rollers in conjunction with said platen means.

11. In a pump, platen means for a plurality of resiliently compressible tubes, said platen means comprising a plurality of individual spring loaded longitudinally extending platen members disposed laterally of each other for the compression of the tubes individually against a companion platen member and with the tubes disposed laterally of each other corresponding to the lateral disposition of the platens, and means for releasably mounting said platen members in said laterally disposed relation, and means operable in conjunction with said platen means to simultaneously close said tubes along a common transverse line and progressively along the lengths of the tubes for the pumping operation.

12. In a pump, platen means for a plurality of resiliently compressible tubes, said platen means comprising a plurality of individual spring loaded, longitudinally extending platen members disposed laterally of each other for the compression of the tubes individually against a companion platen member and with the tubes disposed laterally of each other corresponding to the lateral disposition of the platens, each of said platen members having a longitudinal groove to receive the companion tube, and means operable in conjunction with said platen means to simultaneously close the tubes in the grooves along a common transverse line and progressively along the lengths of the tubes for the pumping operation.

13. In a pump, platen means for a plurality of resiliently compressible tubes, said platen means comprising a plurality of individual spring loaded longitudinally extending platen members disposed laterally of each other for the compression of the tubes individually against a companion platen member and with the tubes disposed laterally of each other corresponding to the lateral disposition of the platens, means for releasably mounting said platen members in said laterally disposed relation, and means operable in conjunction with said platen members to simultaneously close the tubes along a common transverse line and progressively along their lengths for the pumping operation.

14. In a pump, platen means for a plurality of resiliently compressible tubes, said platen means comprising a plurality of individual spring loaded longitudinally extending platen members disposed laterally of each other for the compression of the tubes individually against a companion platen member and with the tubes disposed laterally of each other corresponding to the lateral disposition of the platens, means for releasably mounting said platen members in said laterally disposed relation, means operable in conjunction with said platen members to simultaneously close the tubes along a common transverse line and progressively along their lengths for the pumping operation, and means mounting said platen means and said tube closing means for relative movement toward and away from each other to permit the mounting and removal of said platen members.

15. In a pump, platen means for a plurality of resiliently compressible tubes, said platen means having a plurality of longitudinally extending grooves disposed laterally of each other to receive the compressible tubes in corresponding lateral relation, means operable in conjunction with said platen means to simultaneously close the tubes in the grooves along a common transverse line and progressively along the lengths of the tubes for the pumping operation, said last mentioned means comprising a series of tube compressing rollers extending transversely of said grooves in confronting relation therewith and movable longitudinally of said grooves for said pumping operation, means for mounting said platen means and said tube compressing rollers for relative movement to relatively retracted positions for the insertion of tubes therebetween and means operable to engage said pressure rollers and limit the pressure applied by said tube closing means to said tubes after the latter have been closed for the pumping operation, said last mentioned means having roller engaging surfaces for limiting the movement of said rollers against said tubes when said tubes are closed during said pumping operation.

16. In a pump, platen means for a plurality of resiliently compressible tubes, said platen means comprising a plurality of individual spring loaded, longitudinally extending platen members disposed laterally of each other for the compression of the tubes individually against a companion platen member and with the tubes disposed laterally of each other corresponding to the lateral disposition of the platens, means operable in conjunction with said platen members to compress the tubes progressively along their lengths for the pumping operation, a carrier for said platen members, means for releasably supporting said platen members on said carrier, and means mounting said carrier and said compressing means for relative movement to and from relatively retracted positions.

17. In a pump, first platen means for a plurality of resiliently compressible tubes, second platen means for a plurality of resiliently compressible tubes, means supporting said first and second platen means in spaced relation, and means disposed in the space between said first and second platen means and operable in conjunction with said platen means to simultaneously close the tubes progressively along their lengths for the pumping operation.

18. In a pump, first platen means for a plurality of resiliently compressible tubes, second platen means for a plurality of other resiliently compressible tubes, means supporting said first and second platen means in spaced relation, and means disposed in the space between said first and second platen means and operable in conjunction with said platen means to simultaneously close all of the tubes of said first platen means along a common transverse line and progressively along their lengths for the pumping operation and to simultaneously close all of the other tubes along a common transverse line and progressively along their lengths for the pumping operation.

19. A pump, comprising a series of flexible resilient tubes disposed laterally of each other for the delivery of a plurality of fluids, another series of flexible resilient tubes disposed laterally of each other for the delivery of a plurality of fluids, means supporting said two series of tubes in spaced relation, and a series of pressure rollers disposed in the space between said two series of tubes engageable simultaneously with each of said tubes at points intermediate their lengths, respectively, for simultaneously closing the tubes of one series along a common transverse line and for simultaneously closing the tubes of the other series along another common transverse line, said pressure rollers being movable progressively along the lengths of said tubes for progressively closing said tubes and thereby propelling the fluids through their respective tubes for the pumping operation.

20. A pump, comprising a series of flexible resilient tubes disposed laterally of each other for the delivery of a plurality of fluids, another series of flexible resilient tubes disposed laterally of each other for the delivery of a plurality of fluids, means supporting said two series of tubes in spaced relation, some of said tubes of each series having different internal diameters and different wall thicknesses, respectively, and a series of pressure rollers disposed in the space between said two series of tubes engageable simultaneously with each of said tubes at points intermediate their lengths, respectively, for simultaneously closing the tubes of one series along a common transverse line and for simultaneously closing the tubes of the other series along another common transverse line, said pressure rollers being movable progressively along the lengths of said tubes for progressively closing said tubes and thereby propelling the fluids through their respective tubes for the pumping operation,

21. In a pump, platen means for supporting a plurality of laterally spaced resiliently flexible tubes, a series of pressure rollers operable in conjunction with said platen means and movable longitudinally along the lengths of said tubes to simultaneously close said tubes along a common transverse line and progressively along the lengths of the tubes for the pumping operation, and means operable to engage said pressure rollers and limit the pressure applied by said tube closing means to said tubes after the latter have been closed for the pumping operation, said last mentioned means having roller engaging surfaces for limiting the movement of said rollers against said tubes when said tubes are closed during said pumping operation.

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