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[54] PROPORTIONING PUMP

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[51] **Int. Cl.** **F04b 11/00**

[58] **Field of Search** 92/13.3, 13.4, 13.5, 92/13.6, 13.7, 13.8, 138, 140; 417/429, 521, 539, 215; 74/110, 520

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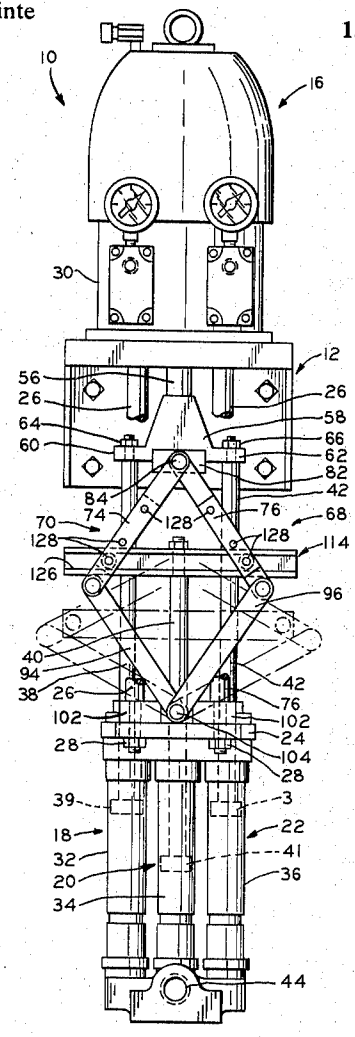
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[57] **ABSTRACT**

A proportional displacement mechanism is disclosed for imparting proportional strokes to the piston rods of a plurality of pump units. A stroke of a first length is imparted to the piston rod of at least one pump unit by reciprocable drive means connected directly to the piston rod, and a stroke of a proportional length is imparted to the piston rod of another pump unit through linkage means interconnected between the drive means and the latter piston rod. The piston rods of the pump units are reciprocable relative to fixed support means, and the linkage means is in the form of a parallelogram of link elements pivotally connected at one point to the drive means and at another point to the support means. The piston rod of the second pump unit carries a cam track component which extends transverse to the axis of the piston rod, and an adjacent pair of the link elements carry cam elements which cooperatively engage the cam track means. In response to reciprocating motion of the drive means, the link elements of the parallelogram linkage means are displaced in a manner whereby the cam elements displace the cam track means and accordingly the piston rod of the second pump unit in the direction of movement of the drive means and a distance proportional to the movement of the drive means.

13 Claims, 5 Drawing Figures



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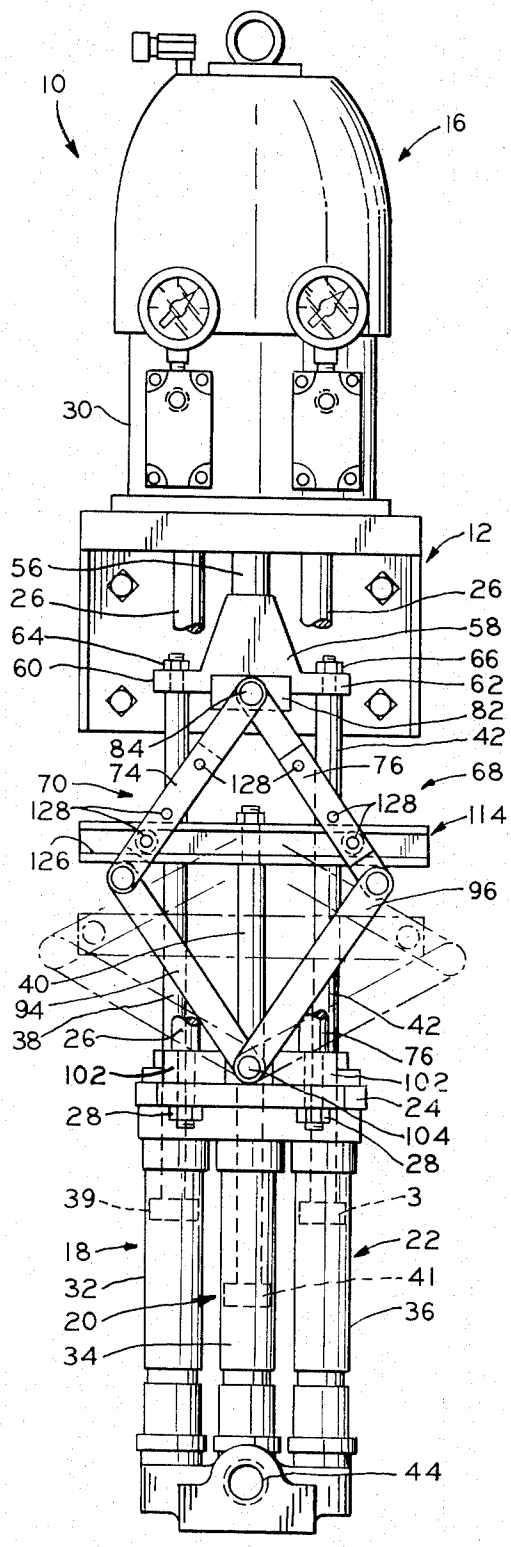


Fig. 1.

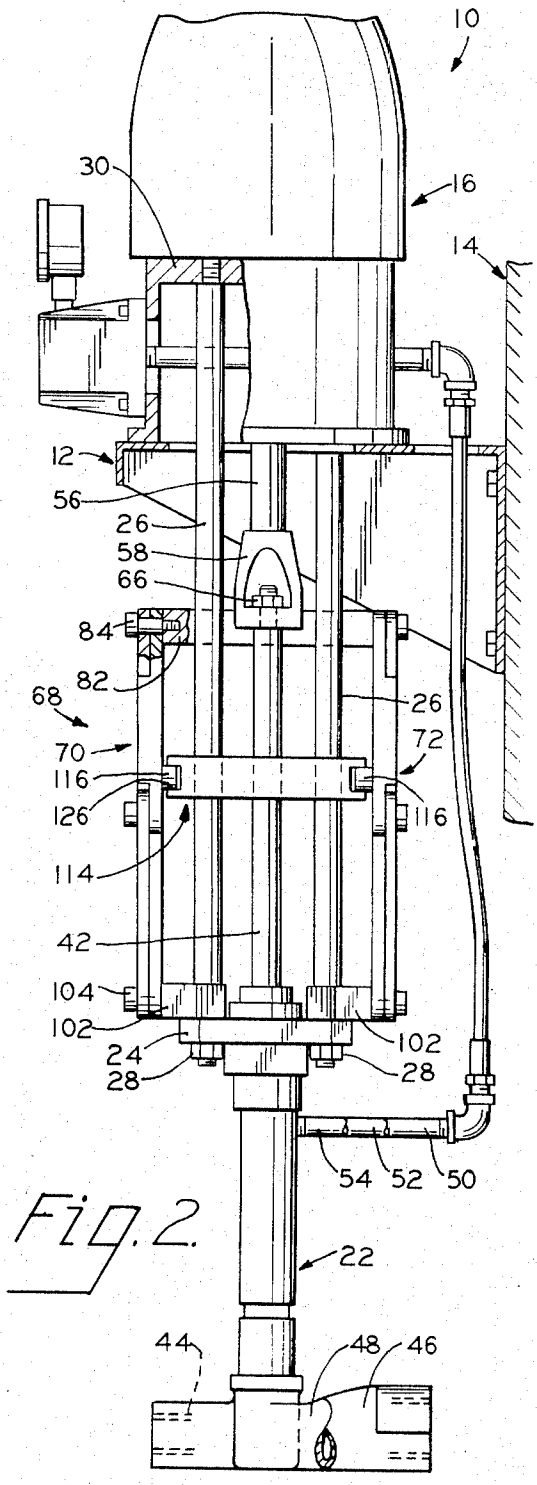
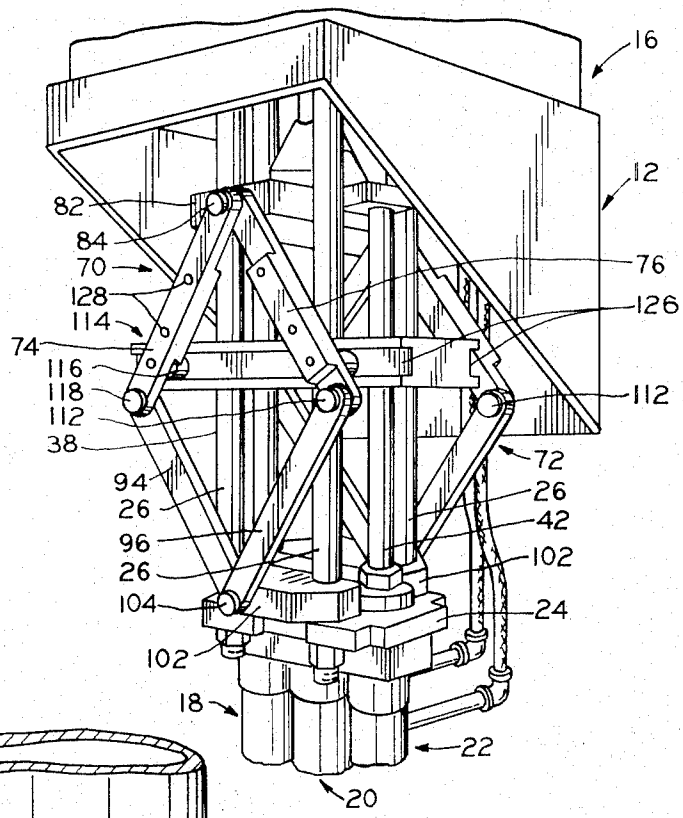


Fig. 2.

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Fig. 3.



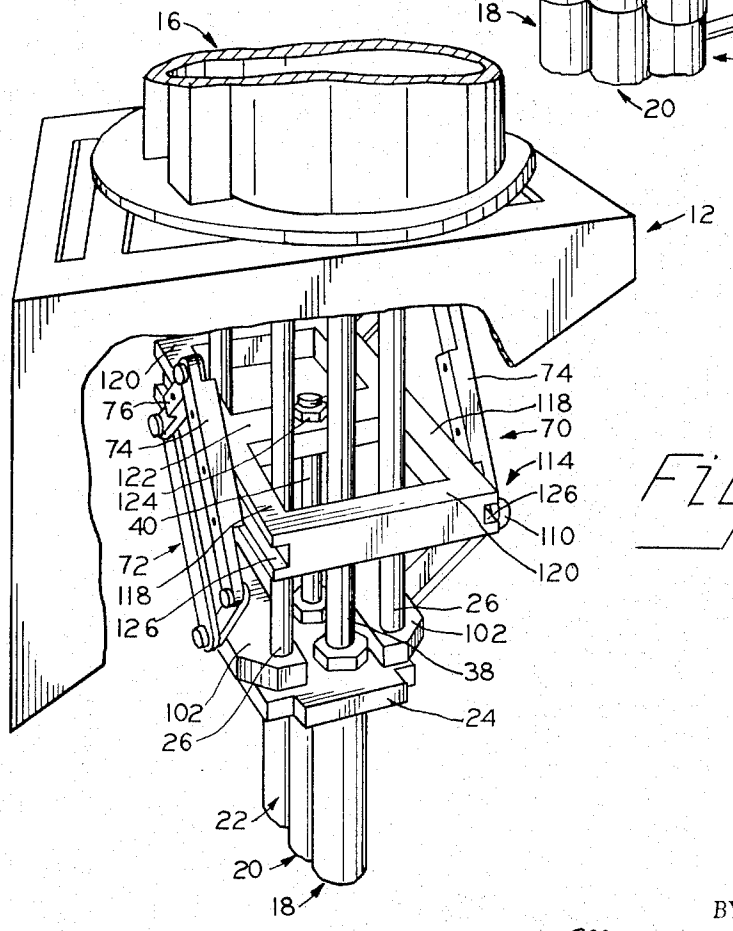


Fig. 4.

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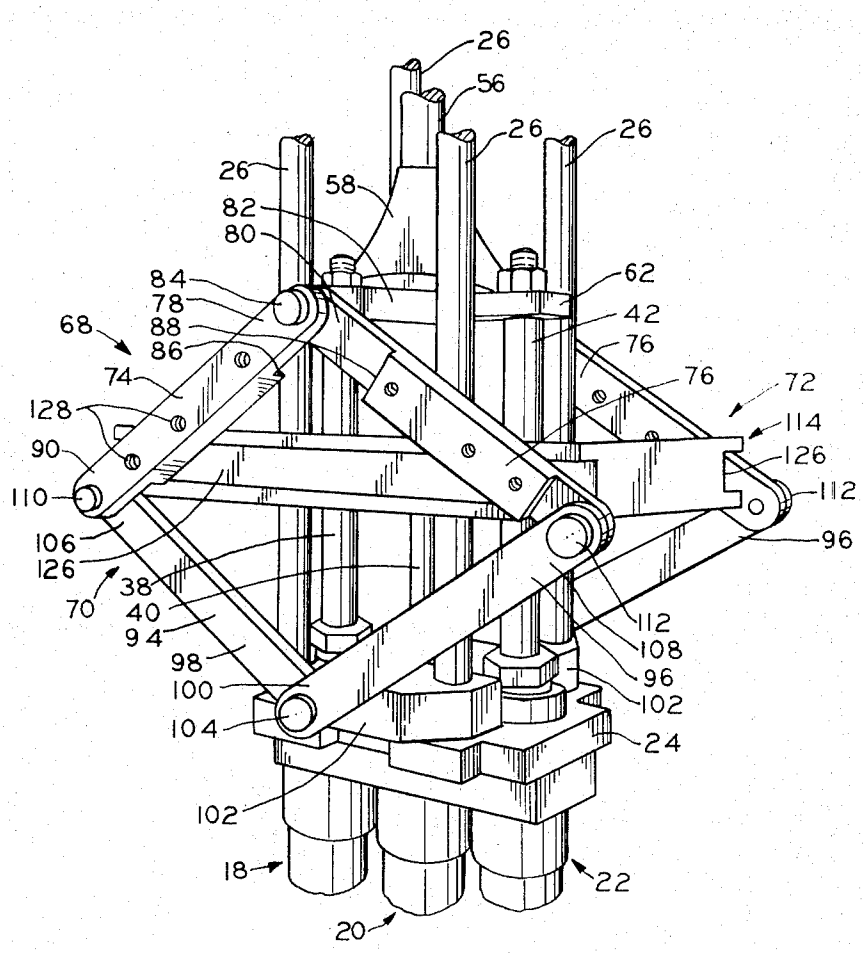


Fig. 5.

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PROPORTIONING PUMP

The present invention relates to the art of proportional displacement mechanisms and, more particularly, to a mechanism for proportioning the output of a plurality of pump units.

Mechanisms have been provided heretofore for the purpose of proportioning the output of a plurality of pump units, whereby different proportions of a fluid or different fluids are delivered from a source or sources to a point or points of use. When the liquids being pumped are different the proportioning generally is for purpose of combining a proper quantity of each of the liquids to achieve a desired mixture thereof downstream from the pump units. Such mixing may be required, for example, in spray painting procedures or in the spraying of resinous materials which must be combined with a fixing, catalyst or hardening agent to assure setting of the material after spray application. Often, the materials being pumped are of a viscous nature, whereby heavy loads are imposed on the pumping units and the drive means therefor during operation thereof.

Proportional pumping arrangements heretofore known generally do not have the structural integrity and operating efficiency desirable in conjunction with the pumping of large quantities of liquids over extended periods of time. In this respect, certain proportional displacement mechanisms heretofore known involve the use of crank mechanisms and cam elements driven by means such as an electric motor. These mechanisms have structural features which both lend to excessive wearing of components of the system and impose forces on the components and drive means therefor which are detrimental both to the components and the drive means. Moreover, the structural characteristics of the mechanisms heretofore known are such that the various components of the mechanism do not lend to the provision of compactness together with the structural integrity required for a given use of the apparatus.

The disadvantages of proportional displacement pumping mechanism heretofore known, including those disadvantages pointed out specifically hereinabove are overcome in accordance with the present invention. In this respect, a proportional displacement pumping mechanism is provided which has the desired structural integrity to pump large quantities of materials over an extended period of time and in a desired proportion therebetween, and wherein the components thereof are structurally interrelated in a manner whereby the mechanism is compact in nature and forces imposed on the components during operation thereof are advantageously balanced. At the same time, the mechanism is adjustable to provide for varying the ratio of the outputs of the pump units without effecting the structural integrity of the mechanism or altering the manner in which operating forces are balanced and applied back to the drive mechanism.

More particularly, a plurality of pumping units are driven in accordance with the present invention by means including a single drive member which is reciprocated linearly relative to support means for the pumping unit. The output means driven by the drive means are piston rod means for the pump units which extend parallel to one another and to the drive member. At least one of the piston rod means is directly connected to the drive member so as to be reciprocated

thereby through a stroke corresponding to the movement of the drive member, and linkage means is provided between the drive member and a second piston rod means. The linkage means is operable in response to reciprocating movement of the drive member to impart reciprocating movement to the second piston rod means, whereby the latter is displaced through a stroke which is proportional to the stroke of the drive member. The various components of the mechanism, with the exception of the linkage means, have axes extending parallel to one another and are defined by elongated elements of relatively small cross-sectional dimension, whereby the mechanism is compact with respect to the longitudinal axis thereof.

In accordance with another aspect of the present invention the linkage means is adjustable to permit varying the length of the stroke of the second piston rod means, whereby the ratio of displacement between the first and second piston rod means can be varied. Accordingly, the linkage means advantageously provides for varying the ratio of the outputs of the two pumps. Moreover, the various components of the mechanism preferably are symmetrical with respect to the axis of the drive member, whereby operating forces on the components are applied back to the drive member as a balanced load. Thus, a proportional displacement mechanism is provided having a minimum number of parts which are structurally interrelated in a manner to lend structural integrity to the mechanism together with mechanical simplicity and economical production and maintenance.

An outstanding object of the present invention is the provision of a proportional displacement mechanism having structural characteristics which provide greater structural and operational integrity for the mechanism than heretofore possible.

Another object of the present invention is the provision of a proportional displacement mechanism of the above character wherein the components thereof are structurally arranged in a manner which provides for compactness of the mechanism and at the same time provides for the most efficient distribution of forces imposed thereon during operation.

A further object of the present invention is the provision of a proportional displacement mechanism of the above character wherein a drive member directly drives one of a plurality of output elements and indirectly drives another of the output elements proportionally through linkage means therebetween.

Still another object of the present invention is the provision of a proportional displacement mechanism of the above character wherein the linkage means facilitates adjustment of the length of the stroke of the other output element to provide for varying the ratio of the displacement of the output elements.

Yet another object of the present invention is the provision of a proportional displacement mechanism of the above character wherein the components of the mechanism are disposed substantially symmetrically relative to the longitudinal axis of the drive member of the mechanism, whereby forces imposed on the components during operation of the mechanism are applied back to the drive member as a balanced load.

Still a further object of the present invention is the provision of a proportional displacement mechanism of the above character for driving the piston rods of a plurality of pistontype pump units to achieve proportional

displacement of the pistons thereof, and thus proportional pumping of a plurality of liquids thereby, and to provide for varying the ratio of piston displacement and thus the proportions of the liquids being pumped.

The foregoing objects and others will in part be obvious and in part more fully pointed out hereinafter in conjunction with the description of the drawing of a preferred embodiment of the invention and in which:

FIG. 1 is a front elevation view of a proportional displacement mechanism made in accordance with the present invention;

FIG. 2 is a side elevation view of the mechanism illustrated in FIG. 1;

FIG. 3 is a perspective view of the linkage means of the mechanism illustrated in FIGS. 1 and 2:

FIG. 4 is another perspective view of the linkage means in which the linkage means is viewed from another angle; and

FIG. 5 is yet another perspective view of the linkage means of the mechanism illustrated in FIGS. 1 and 2 and depicting the linkage means in the position thereof illustrated by broken lines in FIG. 1;

Referring now in greater detail to the drawings wherein the showings are for the purpose of illustrating a preferred embodiment of the present invention only and not for the purpose of limiting the same, a proprotional displacement mechanism is illustrated in FIGS. 1 and 2 for proportioning the output of a plurality of pump units. The apparatus, indicated generally by the numeral **10**, is suitably attached to bracket means **12** which in turn is attached to support means **14** which may be defined, for example, by a vertical wall or a vertical portion of a support strand or the like. Apparatus **10** includes an operating portion **16** at its upper end and pump means **18, 20** and **22** supported in suspension therebeneath by support means including support plate **24** and a plurality of support rods **26.** Support rods **26** extend vertically between operating portion **16** and support plate **24** and the lower ends of the rods extend through corresponding openings in plate means **24** and are threaded to receive corresponding nut means **28.** The upper ends of rods **26** are suitably interconnected with frame means **30** of operating portion **16,** whereby support plate means **24** is supported in suspension by rods **26.** Frame means **30** may be suitably interconnected with bracket means **12** so as to be retained thereon.

Pump units **18, 20** and **22** are cylinder and piston type units comprised of cylinder means **32, 34** and **36,** respectively, which cylinder means have their upper ends suitably interconnected with support plate means **24** in a manner whereby the cylinder means are suspended therebeneath with the axes of the cylinders substantially parallel to the axis of rods **25.** Moreover, the axes of the pump units lie in a common plane disposed substantially midway between the front and rear pairs of rods **26.** It is to be noted too that the axes of pump unit **20** is dispensed substantially centrally of the front pair of rods **26** and that the axes of pump units **18** and **22** are equally spaced from opposite sides of the axis of pump unit **20.** Pump units **18, 20** and **22** further include corresponding piston rod means **38, 40** and **42** defining driven output means for the apparatus. The lower ends of the piston rods extend into the corresponding cylinder means and are provided therein with corresponding piston means **39, 41** and **43** which operate upon reciprocation of the piston rod means to pump fluid through the corresponding pump unit. The interior structure and operation of the pump units may be of a variety of forms designed to achieve flow of liquid through the pump unit in response to reciprocation of the corresponding piston. The particular structure and pumping operation does not form a part of the present invention and, accordingly, is not described in detail. Preferably, however, the several pump units are of the same size and pumping capacity. Moreover, in the particular embodiment illustrated, pump unit **20** is provided with suitable inlet means **44** at its lower end and pump units **18** and **22** are provided with suitable inlet means **46** and **48,** respectively, at the lower ends thereof. The upper ends of the cylinder means of pump units **18, 20** and **22** are provided respectively with suitable outlet means **50, 52** and **54** leading therefrom to a point of use for the fluids being pumped. Thus, it will be appreciated that in response to reciprocating movement of pump piston means **39, 41** and **43** liquid is drawn into the corresponding pump unit from corresponding sources of supply through inlet means **44, 46** and **48** and is discharged for delivery to a point of use through corresponding outlet means **50, 52** and **54.**

In the particular embodiment illustrated, reciprocation of piston rod means **38, 40** and **42** and their pistons is achieved in a manner whereby the outputs of pump units **18** and **22** are the same and the output of pump unit **20** is proportional thereto. More particularly, the proportional displacement mechanism includes vertically reciprocable drive means including vertically reciprocable shaft means **56** depending from operating portion **16.** It will be noted that the axis of shaft means **56** is substantially parallel to the axes of the piston rods and support rods **26,** is axially aligned with the axis of piston rod **40** and is disposed centrally of the four support rods **26.** Shaft means **56** is adapted to be vertically reciprocated relative to the support means including support plate means **24** in any suitable manner such as, for example, by air or hydraulic motor means, not illustrated, disposed within operating portion **16.** It will be appreciated, however, that electric motor means or any other suitable power source may be employed to impart vertical reciprocating movement to shaft means **56.** The drive means further includes a coupling component **58** interconnected centrally thereof with the lower end of shaft means **56** and having ends **60** and **62** thereof interconnected, respectively, with the upper ends of piston rod means **38** and **42** of pump units **18** and **22.** Such interconnection may be achieved in any suitable manner and, in the embodiment illustrated, interconnection is achieved by providing ends **60** and **62** of the coupling with apertures through which reduced diameter end portions of the piston rods extend. The ends of the piston rods which project through end portions **60** and **62** are threaded to receive suitable nut means **64** and **66** to complete the interconnection. It will be appreciated that coupling **58** provides for piston rod means **38** and **42** to be reciprocated vertically through a stroke corresponding in length to the vertical displacement of shaft means **56.** Such vertical displacement of piston rod means **38** and **42** provides for a corresponding displacement of their pistons **39** and **43,** to provide a given displacement of liquid through the corresponding pump unit in response to each up and down stroke of the pistons. Since both piston rods **38** and **42** are directly connected to shaft means **56** through cou-

pling 58, the displacement or output of pump units 18 and 22 is the same.

Proportional displacement of piston rod means 40 and accordingly the proportional displacement of liquid by pump unit 20 is achieved by linkage means 68 interconnected between the drive means and piston rod means 40. Linkage means 68, in the preferred embodiment, includes a pair of parallelogram link element units 70 and 72 disposed on opposite sides of the plane through the axes of drive shaft 56 and piston rods 38 and 42, whereby symmetry of components of the apparatus is maintained to achieve uniform distribution of stresses during operation of the apparatus. Linkage means 68 further includes cam means between the parallelogram units and piston rod means 40 of pump unit 20. As set forth more fully hereinafter, the parallelogram units and cam means are cooperable in response to reciprocation of shaft means 56 to displace piston rod means 40 and its piston 41 a distance proportional to the displacement of piston rod means 38 and 42, whereby the output or displacement of pump unit 20 is proportional to that of pump units 18 and 22.

The structure and operation of linkage means 68 will be more clearly understood with reference to FIGS. 3, 4 and 5 in conjunction with the illustrations thereof in FIGS. 1 and 2. Parallelogram units 70 and 72 are structurally similar and, accordingly, like numerals are employed to designate like components thereof. Each parallelogram unit includes a pair of first link elements 74 and 76 having their corresponding ends 78 and 80 pivotally interconnected with coupling 58 of the drive means through a connector block 82 which extends between parallelogram units 70 and 72. Connector block 82 is suitably connected to coupling 58 such as by welding or by bolt means, and ends 78 and 80 of link elements 74 and 76 are pivotally interconnected with connector block 82 such as by threaded pin means 84 extending through suitable apertures in the link elements and into threaded openings in the corresponding end of connector block 82. Preferably, opposed side faces of the ends 78 and 80 of link elements 74 and 76 are notched along a length thereof as indicated at 86 and 88, respectively, to provide for the ends of the link elements to overlap one another. While ends 78 and 80 of link elements 74 and 76 are illustrated as being pivotally connected to cross bar 82 by common pivot pin means it will be appreciated that the link elements could be pivotally attached thereto individually.

The opposite ends of link elements 74 and 76, namely ends 90 and 92 are interengaged with link elements 94 and 96 which define means to constrain link elements 74 and 76 to pivot relative to the drive means in response to reciprocating movement of drive shaft 56. Link elements 94 and 96 have corresponding ends 98 and 100 thereof pivotally interconnected with support plate means 24 through block means 102 attached to support plate means 24 by means of support rods 26. More particularly, the lower ends of support rods 26 have a reduced diameter portion which extends through suitable openings in block means 102 so that the block means are clamped against support plate means 24 when nut means 28 are threaded onto the lower ends of rods 26 in the manner illustrated in FIG. 1 of the drawing. Ends 98 and 100 of link elements 94 and 96 are pivotally interconnected with block means 102 by suitable pivot pin means 104 which extend through apertures in the link elements and have threaded ends in threaded engagement with corresponding threaded openings in the block means in a manner similar to that described hereinabove with regard to pin means 84. The opposite ends of link elements 94 and 96, namely ends 106 and 108, respectively, are pivotally interconnected with the corresponding ends 90 and 92 of link elements 74 and 76 by suitable pivot pin means 110 and 112. Thus, in response to recprocating movement of shaft means 56 link elements 74 and 76 are constrained by link elements 94 and 96, respectively, to pivot about the axis of the corresponding pin means 84. While such constraining pivotal movement is preferably achieved by employing link means such as link elements 94 and 96, it will be appreciated that such constraining movement could be imposed on link elements 74 and 76 by means other than constraining link elements. In this respect, during pivotal movement of link elements 74 and 76 pin means 110 and 112 at ends 90 and 92 thereof follow an arcuate path. Such an arcuate path could be defined, for example, by fixed arcuate guide path means engaged by the pin means in ends 90 and 92 of link elements 74 and 76. Other arrangements for constraining link elements 74 and 76 to pivot in response to reciprocating movement of drive shaft 56 will, of course, be apparent to those skilled in the art.

Linkage means 68, as mentioned hereinabove, further includes cam means between parallelogram units 70 and 72 and piston rod means 40 of pump unit 20. The cam means includes cam track means 114 attached to piston rod means 40 of pump unit 20 and a plurality of cam elements 116 carried by link elements 74 and 76 of parallelogram units 70 and 72. Cam track means 114 is in the form of a rectangular component having opposed parallel side portions 118 interconnected at corresponding opposite ends by end portions 120 and interconnected intermediate the opposite ends thereof by crosspiece 122. Crosspiece 122 is suitably interconnected with the upper end of piston rod means 40 of pump unit 20 and, as illustrated in FIG. 1, such interconnection may be achieved by providing the upper end of piston rod means 40 with a reduced diameter portion extending through a suitable aperture in crosspiece 122 and having thread means thereon to receive nut means 124. Thus, vertical reciprocating movement of cam track means 114 is adapted to vertically reciprocate piston rod means 40 to achieve pumping operation of pump means 20.

Side portions 118 of cam track means 114 are each provided with cam tracks in the form of longitudinally extending recess means 126 adapted to receive a cam element 116 supported by each of the link elements 74 and 76 in a manner whereby the cam elements project into the recesses. Cam elements 116 may be of any suitable contour providing for sliding movement thereof in recess means 126 of cam track means 114. Preferably, cam elements 116 are in the form of rollers removably attached to link elements 74 and 76. Moreover, link elements 74 and 76 are preferably provided with a plurality of pairs of apertures 128 to accommodate support pin means for cam elements 116. Apertures 128 are provided in horizontally aligned pairs which provide for the cam elements to be selectively positioned in pairs along the length of link elements 74 and 76, thus to permit selective positioning of cam track means 114 relative to the pivot axis of link elements 74 and 76 as defined by pin means 84, for the purpose set forth more

fully hereinafter. Cam elements **116** can be removably interconnected with link elements **74** and **76** in any desired manner. For example, fastener means having threaded shanks could extend through apertures **128** from the outer surfaces of the link elements and into threaded engagement with axle pins of the cam elements to draw the axles tightly against the corresponding link element. As a further example, the axle pins of the cam elements could be provided with externally threaded shank means extending through apertures **128** either in threaded cooperation with threads in apertures **128** or for cooperation with threaded nut means attached to the linkage elements exteriorly thereof. It will be appreciated too that side portions **118** of cam track means **114** could themselves define cam tracks and that the cam elements could be C-shaped components mounted on the link elements so as to receive side portions **118** between the legs of the C.

In operation of the mechanism, shaft means **56** is reciprocated relative to the support means including support plate **24** to impart reciprocating movement directly to piston rod means **38** and **42** and indirectly to piston rod means **40** through linkage means **68.** More particularly, with regard to reciprocation of piston rod means **40,** as shaft means **56** descends relative to support plate means **24,** pivot pin means **84** descends correspondingly relative to both the support plate means **24** and the pivot pin means **104** of link elements **94** and **96** which are fixed relative to the support plate means. Because of the fixed pin means **104** and the pivotal interconnection between the outer ends of the several link elements as defined by pivot pin means **110** and **112,** link elements **94** and **96** constrain link elements **74** and **76** to pivot clockwise and counterclockwise, respectively, relative to the axis of pivot pin means **84.** Such pivotal movement of link elements **74** and **76** causes cam elements **116** thereon to move longitudinally in recess means **126** toward the corresponding end portion **120** of the cam track means from the position thereof illustrated in FIG. **1** to the position illustrated in FIG. **5.** Such diverging movement of cam elements **116** drives cam track means **114** vertically downwardly a distance which is proportional to the vertical distance traveled by shaft means **56** during its descent stroke. Accordingly, piston rod means **40** of pump unit **20** and its piston **41** are displaced vertically downwardly a distance which is proportional to the vertical downward displacement of piston rod means **38** and **42** and pistons **39** and **43** of pump units **18** and **22.** Similarly, upward movement of shaft means **56** relative to support plate means **24** moves piston rod means **38** and **42** upwardly the same distance due to the direct interconnection therebetween through coupling **58.** Vertical upward displacement of shaft means **56** causes pivot pin means **84** to move upwardly a corresponding distance, and link elements **94** and **96** now constrain link elements **74** and **76** to pivot counterclockwise and clockwise, respectively, whereby cam elements **116** are moved along recess means **126** of cam track means **114** toward one another. Such converging movement of cam elements **116** causes cam track means **114** to rise a distance which is proportional to the extent of upward displacement of shaft means **56.** Accordingly, piston rod means **40** of pump unit **20** and its piston **41** are displaced vertically upwardly a distance proportional to the upper displacement of piston rod means **38** and **42** of pump units **18** and **22.** Therefore, it will be appreciated that as shaft means **56** is reciprocated vertically downwardly and upwardly, pump units **18, 20** and **22** are operated to pump liquid therethrough and the displacement of pump units **18** and **22** is the same and that of pump unit **20** is proportionally less. Further, by providing a plurality of pairs of horizontally aligned apertures **128** in link elements **74** and **76,** the position of cam track means **114** relative to pivot pin means **84** can be adjusted, whereby the vertical displacement of piston rod means **40** relative to support plate means **24** can be varied. This, of course, provides for varying the displacement of pump unit **20** relative to that of pump units **18** and **22.** Thus, various ratios of displacement can be established by repositioning cam elements **116** along the length of link elements **74** and **76.** Further, it will be appreciated that apertures **128** provided in the link elements for this purpose may be provided in any desired number with any desired spacing therebetween to achieve the different ratios desired. It will be further appreciated, of course, that the positioning of the cam elements, and accordingly cam track means **114,** closer to pivot pin means **84** results in increasing the extent of vertical displacement of piston rod means **40** in response to a given vertical displacement of shaft means **56,** whereby the ratio of the output of pump units **18** and **22** relative to the output of pump unit **20** is decreased.

It will be appreciated that a symmetrical relationship of the several components of the mechanism is provided for by lateral alignment of the pump units and piston rod components thereof, the provision of the drive shaft means in axial alignment with the center pump unit, the positioning of the vertical support post **26** relative to the axis of the drive shaft means, the provision of parallelogram units on opposite sides and equal distances from the plane of the axes of the cam piston rod means and the structural configuration of the cam track means between the parallelogram units. Such symmetrical relationship provides for forces imposed on the several components during operation of the mechanism to be equally distributed through the support plate means to the vertical support rods and through the components to the drive shaft means in a manner to reduce component wear, prevent undesirable stress concentrations in the components, and permit continuous operation of the mechanism with a minimum of noise and vibration.

While considerable emphasis has been placed herein on the fact that the upper link components of the parallelogram units are pivotally interconnected with the drive means and the lower link elements have a fixed pivotal interconnection with the support plate means, it will be appreciated that the pivot axis of the upper link elements as defined by pivot pin means **84** could be fixed relative to the support means and the lower pivot axis as defined by pivot pin means **104** could be interconnected with the drive means for vertical movement therewith. In such an arrangement, upper links **74** and **76** would define means to constrain pivotal movement of lower links **94** and **96.** Moreover, in the latter arrangement or in the preferred arrangement described herein, cam track means **114** and cam elements **116** could be associated with the lower link elements of the parallelogram units as opposed to being associated with the upper link elements, the latter arrangement merely being the preferred arrangement. Still further, while it is preferred to have the axes of the pump units, shaft

means and support rods vertically oriented as illustrated herein, it will be appreciated that the apparatus could be oriented with these axes horizontal or inclined relative to vertical. It will be appreciated too that while it is preferred to employ a pair of parallelogram link units, only one such unit is necessary to provide the mechanical movement by which proportional displacement of the output means is achieved.

As many possible embodiments of the present invention may be made and as many possible changes may be made in the embodiment herein set forth, it is to be distinctly understood that the foregoing descriptive matter is to be interpreted merely as illustrative of the present invention and not as a limitation.

I claim:

1. A proportional displacement mechanism comprising, support plate means, first driven output means reciprocable relative to said support plate means, drive means for displacing said first output means a first distance relative to said support plate means, second driven output means reciprocable relative to said support plate means, and linkage and cam means interconnecting said drive means and said second output means for said second output means to be displaced a second distance relative to said support plate means when said drive means displaces said first output means said first distance, said second distance being proportional to said first distance, said drive means including shaft means reciprocable relative to said support plate means, said first driven output means being connected to said shaft means for movement therewith, said linkage and cam means including first link elements each having one end thereof pivotally interconnected with one of said drive means and support plate means and the other end thereof interengaged with means to constrain said first link elements to pivot relative to said one of said drive means and support plate means in response to movement of said shaft means relative to said support plate means, said linkage and cam means further including cam means interconnecting said first link elements and said second output means and operable in response to pivotal movement of said first link elements to impart reciprocating movement to said second output means, said cam means including cam track means connected to said second output means and cam elements carried by said first link elements and interengaged with said cam track means to reciprocate said cam track means and thus said second output means in response to pivotal movement of said first link means.

2. The mechanism of claim 1, wherein said cam elements are selectively positionable along said first link elements between said ends thereof to vary the length of said second distance and thus the proportional displacements of said first and second output means.

3. The mechanism of claim 1, wherein said means to constrain said first link elements includes second link elements each having one end thereof pivotally interconnected with the other of said drive means and support plate means and the other end thereof pivotally interengaged with said other end of one of said first link elements.

4. The mechanism of claim 3, wherein said cam elements are selectively positionable along said first link elements between said ends thereof to vary the length of said second distance and thus the proportional displacement of said first and second output means.

5. The mechanism of claim 4, wherein said one ends of said first link elements are pivotally interconnected with said drive means and said one ends of said second link means are pivotally interconnected with said support plate means.

6. A proportional displacement mechanism for use with a plurality of pump means each having cylinder and piston means including cylinder means and piston means reciprocable in said cylinder means through a stroke definitive of pump displacement, said mechanism comprising, support means for said cylinder means, at least one first driven output means reciprocable relative to said support means and interconnected with a first piston means in one of said cylinder means, drive means for displacing said first output means whereby said first piston means is displaced a first distance relative to said one cylinder means, second driven output means reciprocable relative to said support means and interconnected with a second piston means in another of said cylinder means, and linkage means interconnecting said drive means and said second output means for displacing said second output means whereby said second piston means is displaced a second distance relative to said another of said cylinder means when said drive means displaces said first output means said first distance, said second distance being proportional to said first distance, said drive means including shaft means reciprocable relative to said support means, and said first output means including first piston rod means having opposite ends interconnected one with said shaft means and the other with said first piston means, whereby said first distance corresponds to the displacement of said shaft means relative to said support means, said second output means including second piston rod means having opposite ends one of which is interconnected with said second piston means, and said linkage means including first link elements each having one end thereof pivotally interconnected with one of said drive means and support means and the other end thereof interengaged with means to constrain said first link elements to pivot relative to said one of said drive means and support means in response to movement of said shaft means relative to said support means, said linkage means further including cam means interconnecting said first link elements and the other of said opposite ends of said second piston rod means and operable in response to pivotal movement of said first link elements to impart reciprocating movement to said second piston rod means to displace said second piston means said second distance.

7. The mechanism of claim 6, wherein said cam means includes cam track means interconnected with said other end of said second piston rod means and cam elements carried by said first link elements and engaging said cam track means to reciprocate said cam track means and thus said second piston rod means in response to pivotal movement of said first link elements.

8. The mechanism of claim 7, wherein said cam elements are selectively positionable along said first link elements between said ends thereof to vary the length of said second distance and thus the proportional displacements of said first and second piston means.

9. The mechanism of claim 7, wherein said means to constrain said first link elements includes second link elements each having one end thereof pivotally interconnected with the other of said drive means and support means and the other end thereof pivotally inter-

connected with said other end of one of said first link elements.

10. The mechanism of claim **9,** wherein said cam elements are selectively positionable along said first link elements between said ends thereof to vary the length of said second distance and thus the proportional displacements of said first and second piston means.

11. The mechanism of claim **10,** wherein said one ends of said first link elements are pivotally interconnected with said shaft means and said one ends of said second link elements are pivotally interconnected with said support means.

12. The mechanism of claim **11,** wherein two first driven output means are included, said first and second output means being aligned side by side with said second output means between said two first output means, and said piston rod means of said first and second output means being disposed substantially parallel to one another.

13. The mechanism of claim **12,** wherein said first link elements include parallel paris of first link elements on opposite sides of said aligned first and second output means, said second link elements include parallel pairs of second link elements on opposite sides of said alinged first and second output means, and said cam track means is disposed between said parallel pairs of first link elements.

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