Oct. 14, 1952 M. R. SHEEN ET AL 2,613,606

CONSTANT DELIVERY PUMP

Filed Oct. 6, 1948 7 Sheets-Sheet 1

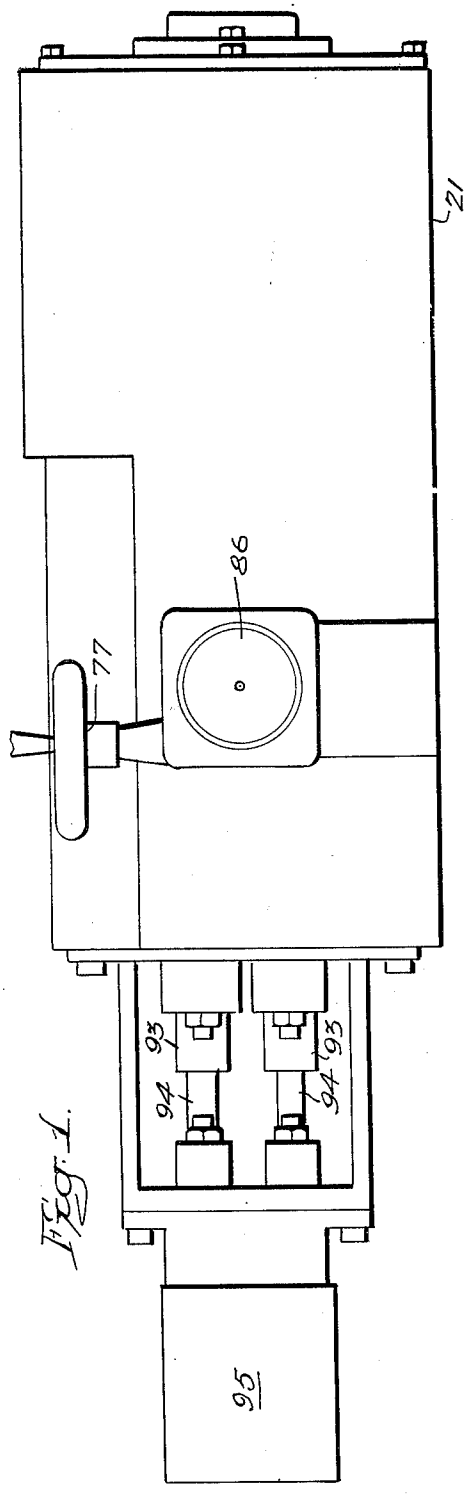


Fig. 1.

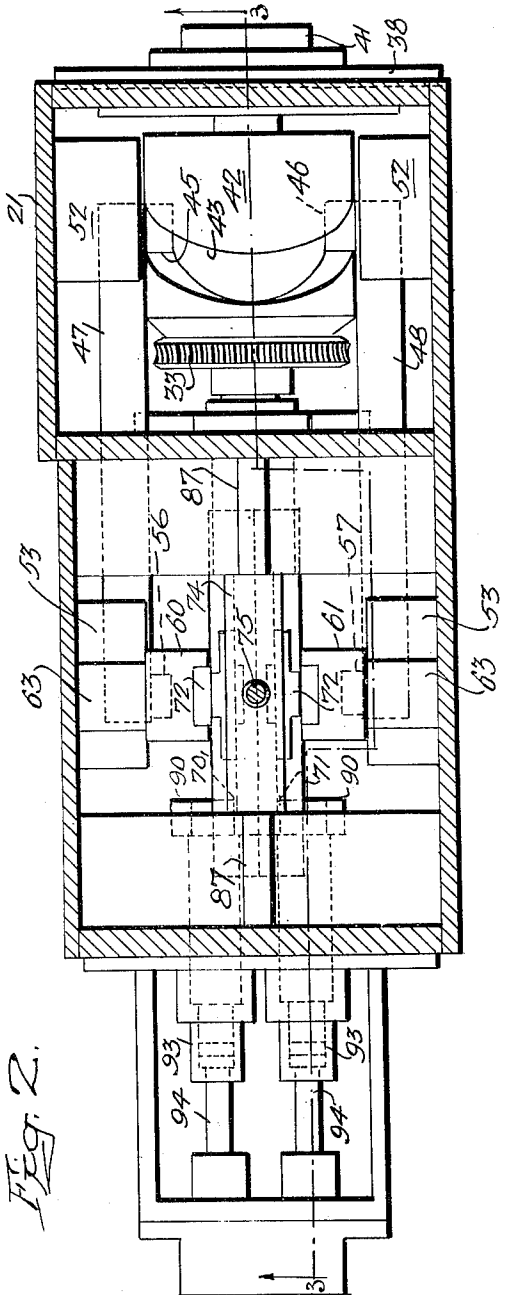


Fig. 2.

Inventors
Milton Roy Sheen, deceased
Emma Elizabeth Sheen Co-Executor,
Robert T. Sheen And
Royal Bartlett Saalfrank
By Dorsey & Alexander
ATTORNEYS

Oct. 14, 1952 M. R. SHEEN ET AL 2,613,606

CONSTANT DELIVERY PUMP

Filed Oct. 6, 1948 7 Sheets-Sheet 2

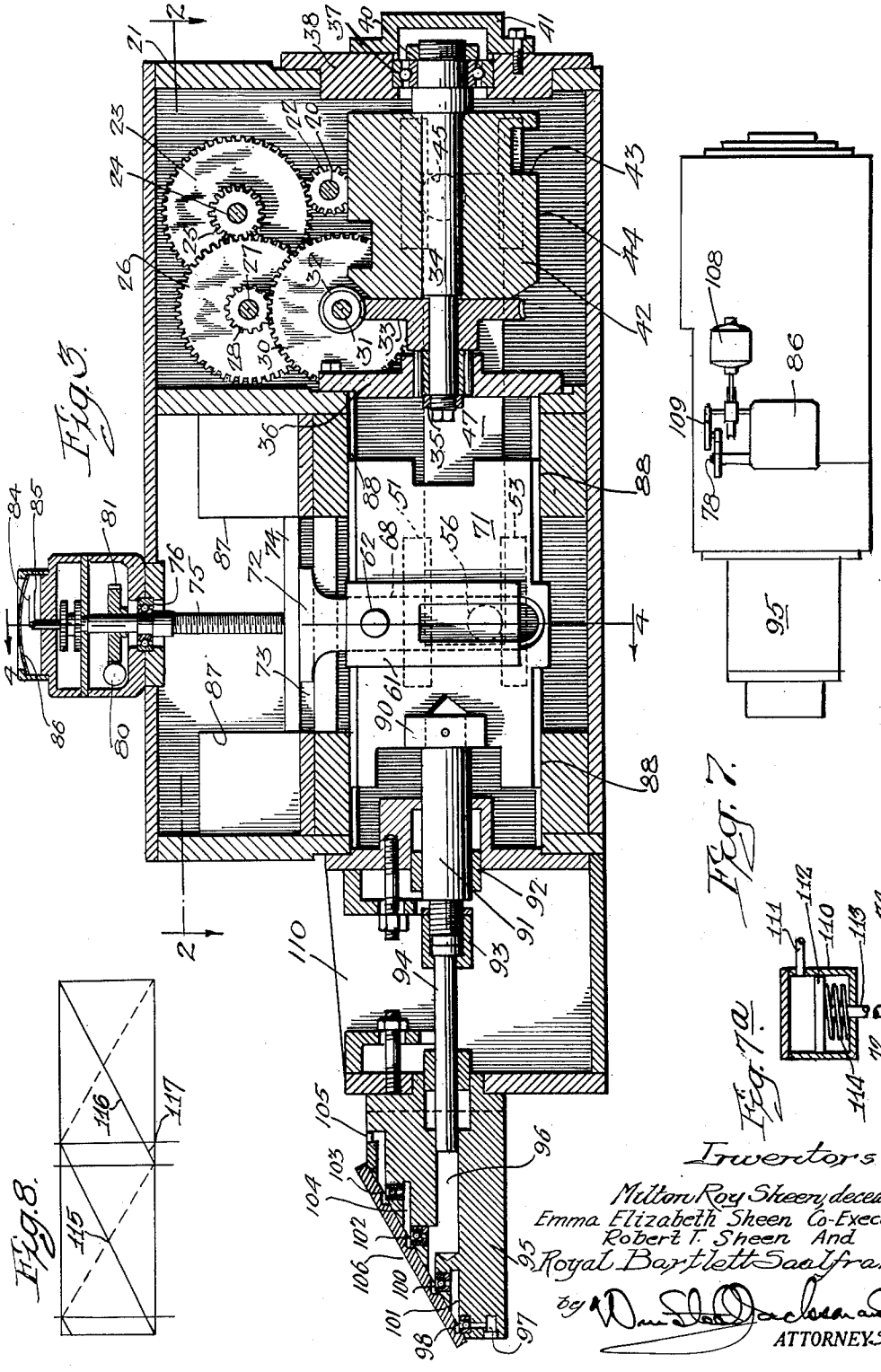


Fig. 5.

Fig. 7.

Fig. 7a.

Fig. 8.

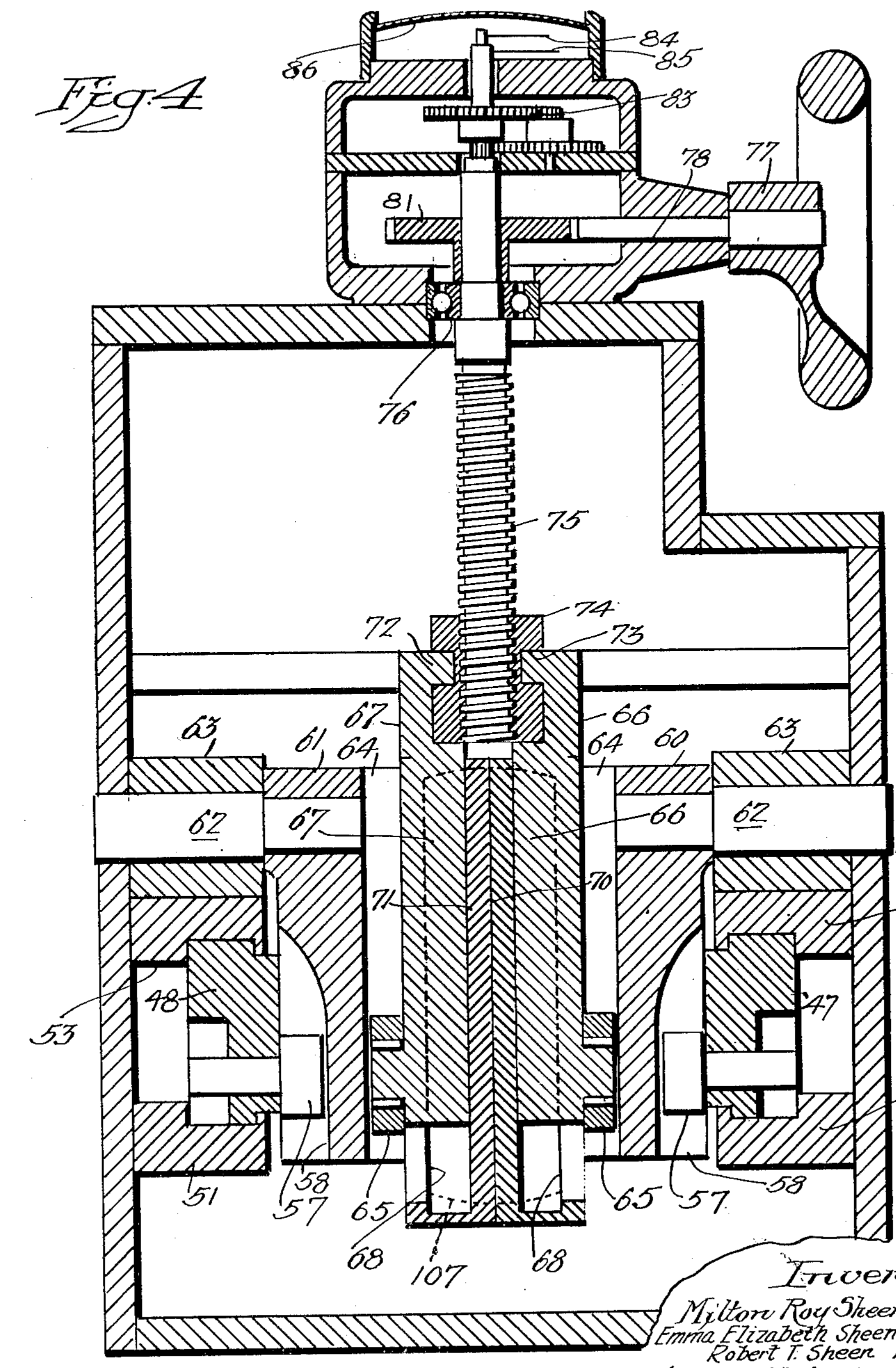
Inventors
Milton Roy Sheen, deceased,
Emma Elizabeth Sheen Co-Executor,
Robert T. Sheen And
Royal Bartlett Saalfrank
by Dan Sheehan & Co
ATTORNEYS

Oct. 14, 1952 M. R. SHEEN ET AL 2,613,606

CONSTANT DELIVERY PUMP

Filed Oct. 6, 1948 7 Sheets-Sheet 3

Fig. 4



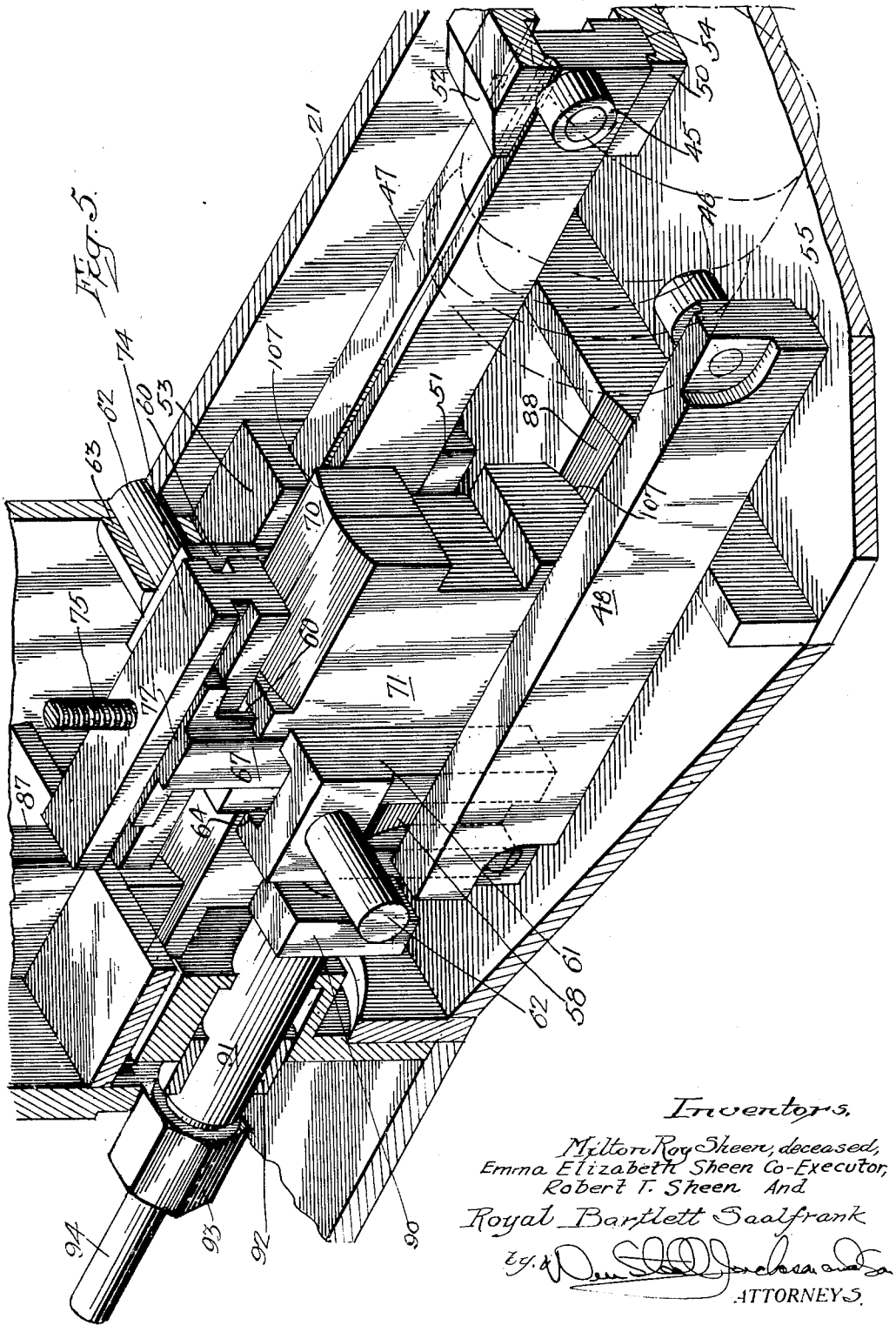
Inventors.
Milton Roy Sheen, deceased,
Emma Elizabeth Sheen Co-Executor,
Robert T. Sheen And
Royal Bartlett Saalfrank

ATTORNEYS

Oct. 14, 1952 M. R. SHEEN ET AL 2,613,606

CONSTANT DELIVERY PUMP

Filed Oct. 6, 1948 7 Sheets-Sheet 4



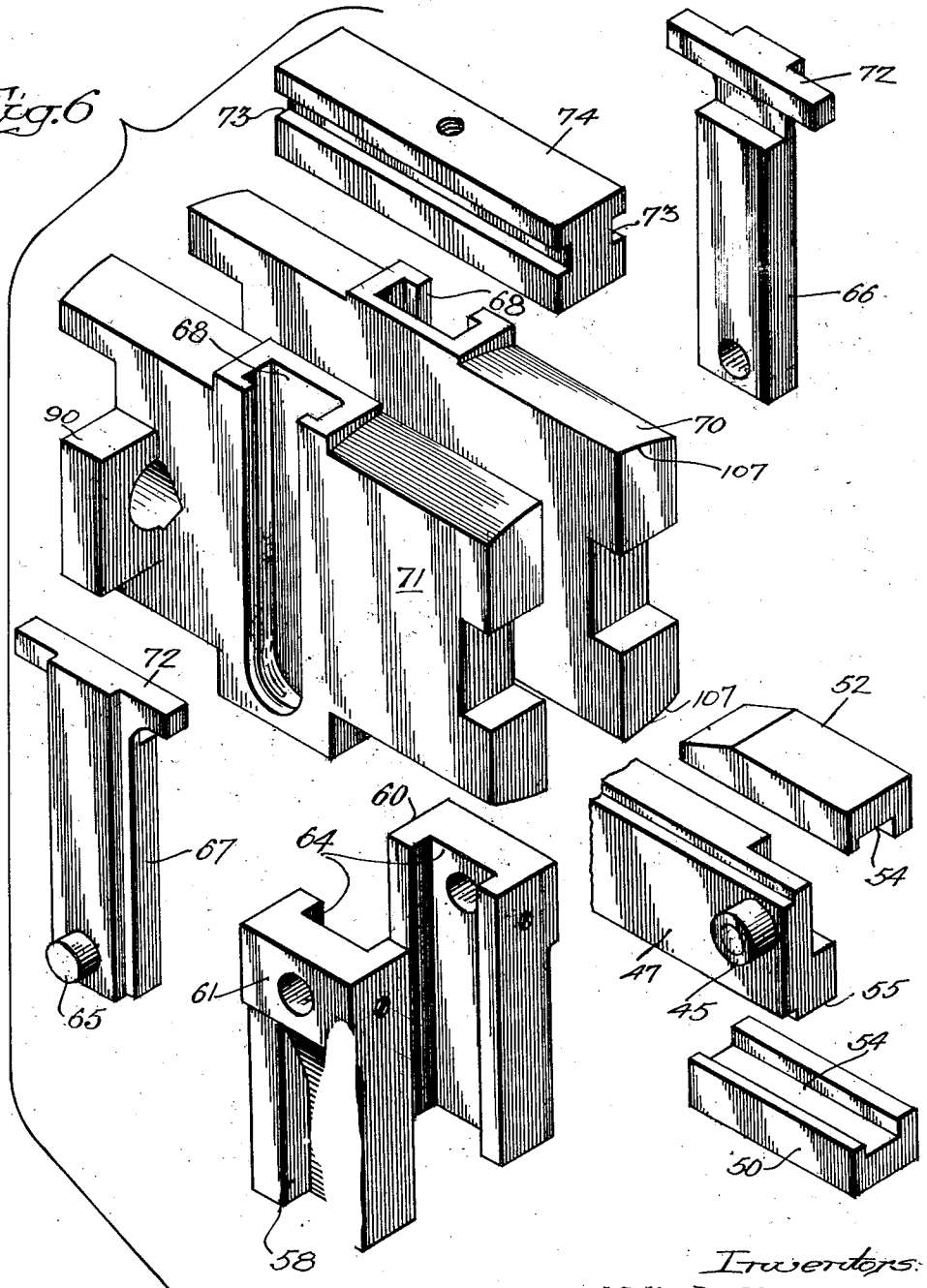
Inventors,
Milton Roy Sheen, deceased,
Emma Elizabeth Sheen Co-Executor,
Robert T. Sheen And
Royal Bartlett Saalfrank
by Dean Sheldon Jackson and Sa
ATTORNEYS.

Oct. 14, 1952 M. R. SHEEN ET AL 2,613,606

CONSTANT DELIVERY PUMP

Filed Oct. 6, 1948 7 Sheets-Sheet 5

Fig. 6



Inventors:
Milton Roy Sheen deceased
Emma Elizabeth Sheen Co-Executor,
Robert T. Sheen And
Royal Bartlett Saalfrank
by
ATTORNEYS.

Oct. 14, 1952 M. R. SHEEN ET AL 2,613,606

CONSTANT DELIVERY PUMP

Filed Oct. 6, 1948 7 Sheets-Sheet 6

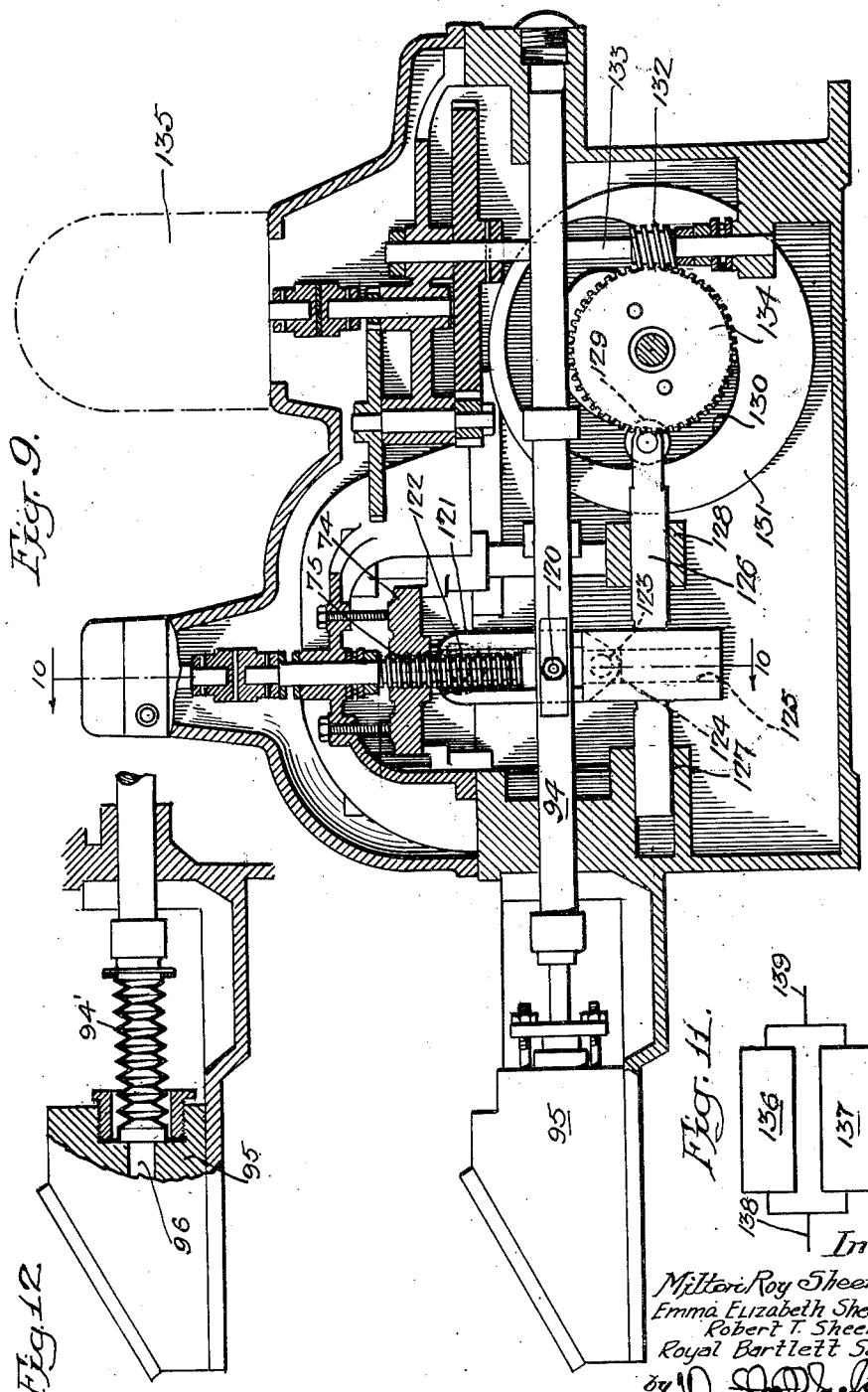


Fig. 9.

Fig. 12

Fig. 11.

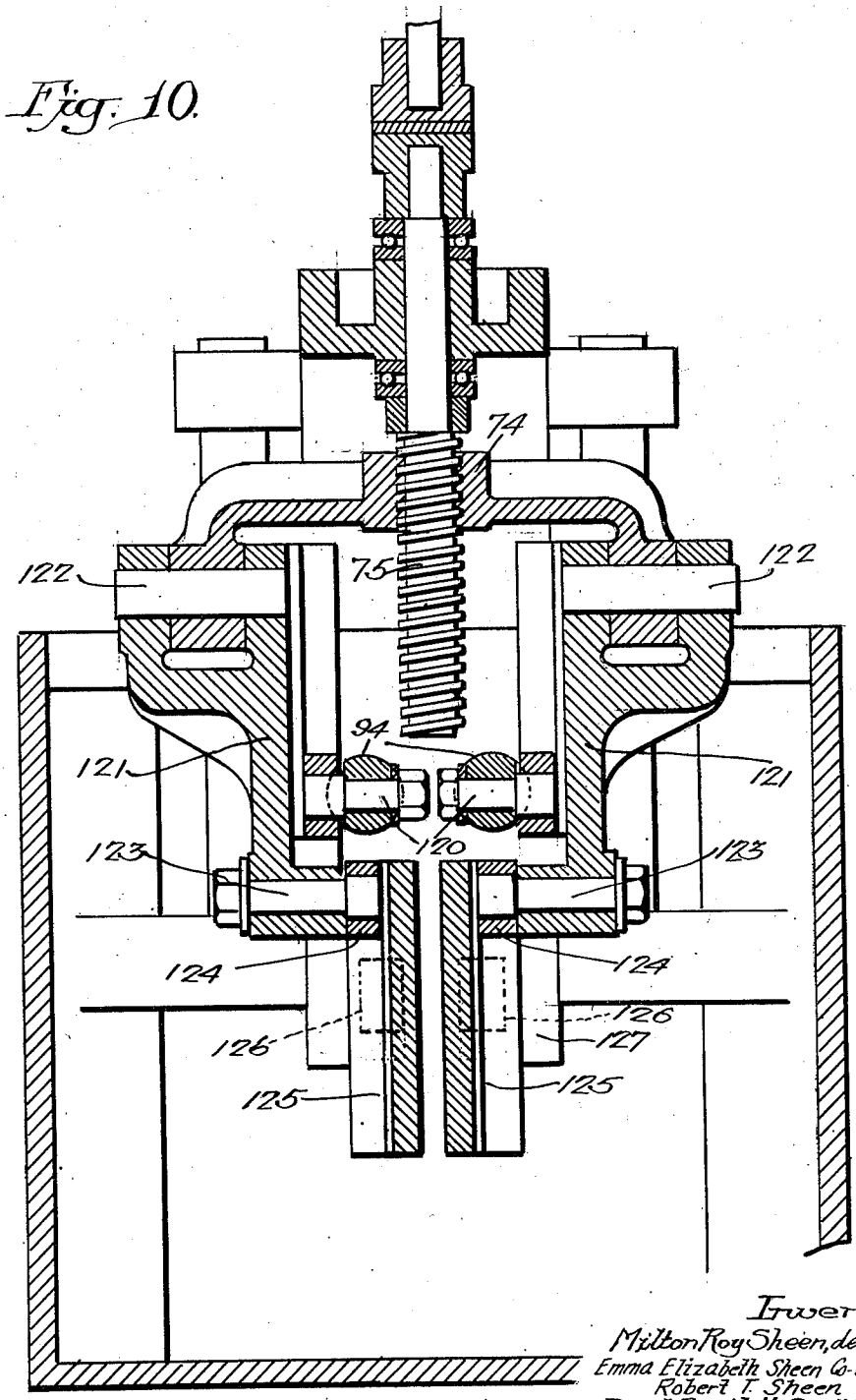
Inventors.
Milton Roy Sheen deceased.
Emma Elizabeth Sheen Co-Executor
Robert T. Sheen And
Royal Bartlett Saalfrank
by Dunlap, Laney, Hessin & Dunlap
Attorneys.

Oct. 14, 1952 M. R. SHEEN ET AL 2,613,606

CONSTANT DELIVERY PUMP

Filed Oct. 6, 1948 7 Sheets-Sheet 7

Fig. 10.



Inventors:
Milton Roy Sheen, deceased,
Emma Elizabeth Sheen Co-Executor,
Robert T. Sheen And
Royal Bartlett Saalfrank
by Wm. Shaw Dawson and Sons
Attorneys.

Patented Oct. 14, 1952

2,613,606

UNITED STATES PATENT OFFICE

2,613,606

CONSTANT DELIVERY PUMP

Milton Roy Sheen, deceased, late of Glenside, Pa., by Emma Elizabeth Sheen, coexecutor, Glenside, Pa., and Robert T. Sheen, Wyndmoor, Pa., and Royal Bartlett Saalfrank, Gulfport, Fla.; said Robert T. Sheen and said Saalfrank assignors to Milton Roy Company, Chestnut Hill, Pa., a corporation of Pennsylvania

Application October 6, 1948, Serial No. 53,122

10 Claims. (Cl. 103—38)

1

The present invention relates to a constant delivery pump.

The present application is a continuation in part of our application Serial No. 778,316, filed October 7, 1947, now abandoned, for Constant Delivery Pump, and supercedes such earlier application.

A purpose of the invention is to permit the use of constant delivery pumps for extremely precise feeding of chemicals and the like in which substantially no change in the flow curve is to be permitted, and in which the high precision in the delivery of liquids over a wide delivery range and in some cases down to unprecedented small delivery quantities are required.

A further purpose is to permit very accurate change of the strokes of a plurality of pumps operating in unison for constant delivery purposes (that is, with common inlet and common discharge) while such pumps are in operation, with or without variation in the speed of the drive, and with intermittent or continuous pumping.

A further purpose is to accomplish adjustment of the stroke of each piston or other pumping element which maintains a directly proportional relationship between the motion of the adjustment and the stroke of the element at the particular adjustment over the entire range of the adjustment so that a dial or other indication of adjustment will directly indicate stroke, and so that the adjustment can be accomplished by a remote control in respect to determination of the volume pumped.

A further purpose is to adjust the position of an adjustment support mechanically connected to the driving connections for each pumping element along a line which maintains the same angular relation with respect to each pumping element for any adjustment at at least one corresponding position in the stroke of all pumping elements.

A further purpose is to adjust the stroke of each pumping element while maintaining an invariable relation between the speed of each element at one part of the stroke and the speed at every other part of the stroke so that a discharge curve for the constant delivery pump which is uniform for one adjustment will be uniform for all other adjustments.

2

A further purpose is to permit the required out-of-phase relation of the two reciprocating pumps in a constant delivery system to be maintained by a cam acting on crossheads, preferably through connecting rods and crank blocks.

A further purpose is to maintain a constant throw on the crank blocks, but to vary the positions of pivotal connection between the crank blocks and the crossheads to control the stroke.

Further purposes appear in the specification and in the claims.

In the prior art constant delivery pumps have been intended primarily for comparatively large volumes in which slight lack of uniformity of delivery can be tolerated. With the increased demands for precise feeding of liquids, especially chemicals, for treatment of materials in process, a demand has arisen for high uniformity and constancy of delivery with permissible wide variation. The present invention is intended primarily to meet the demand for an extremely uniform delivery with practically no change in the delivery curve, while at the same time permitting very wide variation and operation at unbelievably low levels. For example in the pump of the present invention effective operation can be maintained with delivery of as little as a few cubic centimeters per hour, and the invention can likewise be applied to delivery of only a few cubic centimeters per day. Notwithstanding such low delivery levels and the possible requirement for wide variation, while the pump is operating it will maintain a precisely accurate and constant delivery, while at the same time permitting instantaneous change in the delivery during operation.

In many prior art patents of the constant delivery pump type difficulty has been encountered in changing the stroke during operation, and in some the possibility has existed that the stroke will be different in the two pumps.

In accordance with the present invention not only can the speed of drive be changed by the use of a variable speed motor, but also the stroke of both pumps can be changed in unison during operation. Likewise of course the operation can be continuous or intermittent in response to any suitable control which will start and stop or vary the speed of the drive, as well known in the art.

In the drawings a few only of the various em-

bodiments of the invention have been illustrated, choosing the forms shown from the standpoints of convenience in illustration, satisfactory operation and clear demonstration of the principles involved.

Figure 1 is a top plan view of our novel constant delivery pump mechanism.

Figure 2 is a horizontal section of Figure 1 taken on the line 2—2 of Figure 3.

Figure 3 is a longitudinal vertical section taken in the line 3—3 of Figure 2.

Figure 4 is a transverse vertical section taken on the line 4—4 of Figure 3.

Figure 5 is a fragmentary perspective illustrating the connecting rods, crank blocks and crossheads.

Figure 6 is an exploded perspective view illustrating the crank blocks, the sliding bearings of the connecting rod and the crossheads and the crosshead adjustment.

Figures 7 and 7a are views similar to Figure 1 but illustrating modifications.

Figure 8 is a graph useful in explaining the invention.

Figure 9 is a longitudinal section corresponding to Figure 3 showing a variation in the constant delivery pump mechanism.

Figure 10 is a transverse section of Figure 9 on the line 10—10.

Figure 11 is a diagrammatic top plan view showing the inlet and outlet connections to the pump units of the constant delivery pump.

Figure 12 is a fragmentary longitudinal section showing a bellows replacing a piston as the pumping element.

In the drawings like numerals refer to like parts throughout.

Describing in illustration but not in limitation and referring to the drawings:

In the prior art efforts have been made to regulate the stroke of a piston or other reciprocating pump with the purpose of obtaining adjustment of the discharge. The constructions used for such purposes have normally adjusted along an arc or rocker arm, and have not been suitable for application to constant delivery pumps of high accuracy. In such prior art constructions the motion imparted by the adjustment has not produced a stroke adjustment directly proportional to the adjusting motion. This has necessitated the use of non-uniform graduations on a dial indicating adjustment, if the dial is also to indicate stroke or discharge, and has made it impossible to change the adjustment uniformly by remote control or otherwise for the purpose of obtaining proportional change in stroke. If such prior art constructions are applied to constant delivery pumps it is necessary to make elaborate calculations or employ special curves in changing adjustments.

Such prior art connecting and adjusting structures have presented a further serious difficulty. While it is possible to obtain a straight line curve by placing two or more pumps having a common inlet and a common discharge properly out of phase, the constant delivery obtained from such prior art adjustment devices has remained constant only at one adjustment position. Every time the adjustment is changed, the relation of the speed of the piston or other pumping element at one portion of the stroke to the speed at other portions of the stroke has changed, with resulting introduction of errors into the discharge curve.

One of the important advantages of the present invention is that the motion of the adjustment is directly proportional to the stroke of the piston or other pumping element as changed by the adjustment, and this condition obtains throughout the entire range of adjustment. Thus during adjustment, the adjustment support maintains the same angular relation with respect to each pumping element for any adjustment at at least one corresponding position in the stroke of all pumping elements.

Furthermore, in the adjustment of the present invention, an invariable relation is maintained between the speed of each element at one part of the stroke and the speed at every other part of the stroke. Thus although the discharge varies with the adjustment, the uniformity of the discharge curve is the same for all adjustments and there is no tendency, as in the prior art, for the relative instantaneous speed of the piston at some one portion of the stroke to change with respect to that at some other portion of the stroke when the stroke is changed.

Power is applied to the mechanism through any suitable drive on shaft 20 (Figure 3) in suitable bearings mounted on housing 21. A pinion 22 on the drive shaft meshes with a speed reduction train suitably consisting of a gear 23 on shaft 24 in suitable bearings in the housing and carrying a pinion 25 intermeshing with a gear 26 on shaft 27 supported on bearings in the housing, and carrying a pinion 28 intermeshing with a gear 30 on shaft 31 provided with suitable bearings supported on the housing. The shaft 31 carries a worm 32 which meshes with a worm wheel 33 on stud shaft 34 which is mounted at one end in a journal bearing 35 on a removable end plate 36 of the housing, and at the other end is provided with an antifriction bearing 37 mounted on plate 38 and held by retainer 40. A removable cap 41 closes the end.

On the stud shaft 34 and turning with the worm wheel 33 is a cam 42 of any suitable character, here shown as being a barrel cam having a track 43 on the outer circumference 44.

On opposite sides and so positioned with respect to the track of the cam that they are constantly at diametrically opposite positions in the cycle of the pump, followers 45 and 46 are provided which constantly ride the cam slot and transmit the motion of the cam slot longitudinally. The respective followers are suitably rollers which are rotatably supported on studs attached to connecting rods 47 and 48 guided at the bottom at 50 and 51 near the two ends, and guided and supported at the top at 52 and 53. As illustrated the respective guides are provided with ways 54 and the connecting rods are provided with slides 55 which cooperate with the ways so as to provide guiding for reciprocation.

The slide bearings are supported by the sidewalls of the housing as shown.

At opposite ends the connecting rods carry followers 56 and 57, suitably in the form of rollers mounted on studs, and the followers intermesh with slots 58 in crank blocks 60 and 61. The crank blocks are each pivoted on a common axis at 62 on bearings 63 in the housing, the bearings and pivots being suitably located above the slots of the crank blocks so that the crank blocks swing back and forth pendulum fashion below the pivots.

On the opposite side of each crank block is a slot 64 paralleling the slot 58, and providing

guiding ways for follower rollers 65 mounted on sliding blocks 66 and 67 which are guided by vertical ways 68 in crossheads 70 and 71. The sliding blocks 66 and 67 carry at their upper ends T-shaped heads 72 which interlock with slots 73 on the opposite sides of a vertical adjustment block 74 which forms a nut for an adjustment screw 75 mounted on a bearing 76 in the top of the housing. The adjustment screw 75 is suitably rotated by a handle 77 on a shaft 78 which carries a worm 80 gearing with a worm wheel 81 on the shaft of adjustment screw 75. Likewise at the top of the screw 75 is indicating gearing 83 for the stroke adjustment which includes a fast and slow clock drive of conventional character rotating a coarse adjustment hand 84 and a fine adjustment hand 85 under a dial 86.

The adjustment block 74 is held against longitudinal movement and is guided in vertical adjustment by guides 87 supported on the housing. It will be evident that the T-shaped head 72 slides in the slots 73 with the motion of the crosshead.

The crossheads 70 and 71 are guided in ways 88 extending longitudinally, and at their forward ends carry lugs 90 which receive and retain push rods 91 having sliding bearings 92 and removably connected at 93 to a piston 94 of a pump 95. There are two pumps side by side with their pistons parallel and directed in the same direction. While each pump may be of any suitable reciprocating type, it will preferably be of the character shown in Milton Roy Sheen's United States Patents Nos. 2,263,429 and 2,367,893, and having a cylinder 96, an inlet port 97, inlet check valves 98 and 100 in series and connected by a passage 101, outlet check valves 102 and 103 in series and connected by a passage 104 and an outlet port 105. The respective check valves may all be of ball type, inspected through a cover plate 106.

In operation power supplied through the main shaft 20 is transmitted through the speed reduction 22, 23, 25, 26, 28, 30 to the worm 32 and worm wheel 33 for rotating the cam 42. As the cam 42 turns it reciprocates at each side one of the connecting rods 47, 48 through the cam follower 45, 46, the connecting rod positions being such that each pump is always at the opposite portion of the cycle, one pump being on suction when the other is on compression, so as to maintain a constant delivery.

Each of the connecting rods 47, 48 operates independently and as soon as the motion is transmitted to the connecting rods further motion is entirely independent except for the adjustment of the adjustment block, which takes place on both sides of the mechanism in unison.

Each connecting rod through its follower swings one of the crank blocks 60, 61 through a pendulum-like stroke which is determined by the throw of the cam 42. Each of the crank blocks 60, 61 has a slot which interconnects with the follower roller 65 on one of the sliding blocks, which is accordingly caused to slide back and forth through a variant stroke depending upon its vertical position and the point of engagement of its roller follower with the slot of the crank block. The vertical position of the sliding block is determined by the adjustment block and adjustment screw engaging with the T-head on the sliding block.

As the sliding blocks move vertically they are supported and guided in the vertical slots of the crossheads 70, 71 and as they are reciprocated by the motion of the followers they carry with them the reciprocation of the crossheads, and correspondingly the motion of the pump pistons.

In order to permit slight angular adjustment of the crossheads in their ways 68, the crossheads and both ways are arcuately formed as shown at 107.

Where it is desired to shorten the piston stroke, the screw 75 is manipulated so as to raise the adjustment block, thus bringing the engagement of the roller follower on the sliding block closer to the rocking center of the crank block. Likewise for lengthening the stroke, the adjustment block will be lowered.

It will be understood of course that the electric driving motor which operates the drive shaft 20 will be controlled in any suitable manner to turn it off and on or to vary its speed if required. The control mechanism can of course be a remote control as well known in the art. Likewise the stroke can be varied by a remote control which will operate on the adjustment shaft 78. This is suggested in Figure 7 by a remote control electric motor 108 which is shown with its speed reducer 109 to manipulate the shaft 78 in response to the operation of any well known remote control mechanism, and in Figure 7a by a pneumatic cylinder 110 having a remote pneumatic connection 111 acting on a piston 112 having a rod 113 directly connected to the adjustment block 74 (omitting the screw 75) and opposed by a spring 114.

In the preferred embodiment shown the main drive operates a speed reduction which in turn drives a cam and the cam through opposite connecting rods swings crank blocks which in turn move the pump piston crossheads through sliding blocks, the sliding blocks being themselves adjusted in unison.

It will be understood, however, that other forms of cam, other interconnections between the cam and the crossheads and other adjustments of the crosshead strokes may be used to obtain part of the advantage of the invention, as well known.

Since the device of the invention in many cases will be used for chemicals, it will be evident that a liquid seal may be introduced at 110 around the outer ends of the pistons if necessary in the handling of particular chemicals.

Figure 8 illustrates in developed diagrammatic form cam angle, as abscissae and stroke on both pumps as ordinate. The pumping stroke 115 on one pump overlaps the pumping stroke 116 of the other pump by an amount 117 which maintains constancy of discharge notwithstanding a lag in seating of the valves and reduces the pressure angle of the cam.

Figures 9 and 10 illustrate a variation applying the general principles of the invention to a structure of somewhat different design, coming broadly within our invention, although some features shown are the sole invention of one of us. Figure 9 shows the structure for operating one piston, and it will be understood that the structure for operating the other piston or pistons will be identical except that it operates from another cam track preferably located on the opposite side of the cam. The piston 94 is pivotally connected at 120 at an intermediate point on an adjustment rocker 121 which pivotally connects at 122 to an adjustment support or block 74 which is common to the other rocker or rockers for the other piston or pistons, which are suit-

ably located on a common axis with the pivot 122. The adjustment support 74 is manipulated by a screw 75 and has the clock mechanism for showing the adjustment position as indicated in Figures 1, 3 and 4. At the outer end the adjustment rocker 121 carries a pivot 123 which pivotally connects with a block 124 sliding in guides 125 extending suitably transversely of a plunger slide 126 guided for reciprocation in sliding guides 127 and 128. The guides 125 are mounted as part of the slide 126. The plunger slide carries a cam follower 129 at one end which follows the track 130 in a suitable face cam 131. The cam is driven by a worm 132 on a shaft 133 to a worm gear 134 mounted on the cam. A motor 135 drives the shaft 133 through suitable speed reduction as shown in Figure 3.

In operation it will be seen that the drive turns the cam 131 which moves all of the plunger slides for the different pistons in accordance with the predetermined out-of-phase relationship of the cam tracks 130. For example, if there are two pumps having common inlet and outlet, the cams will be substantially 180° out of phase, and if there are three pumps, they will be substantially 120° out of phase, not for the moment considering the overlap. Each plunger slide will move the corresponding rocker back and forth and the rocker swinging about the pivot 122 will reciprocate the corresponding piston. Motion of the adjustment support axially of the screw will lengthen or shorten the arm of the rocker between the pivot and the piston and therefore will lengthen or shorten the throw of the piston.

It will be evident that this construction has the advantage of providing straight line proportional relationship between the adjustment support motion and the pump stroke. The direction of adjustment of the adjustment support is along a line which maintains the same angular relation with respect to each piston or other pumping element for any adjustment at at least one corresponding position in the stroke of all pumping elements (actually in this case for every position where the pumping elements are operating side by side in the same direction). Also in this form as in the main form the mechanism during adjustment of the stroke maintains an invariable relation between the speed of each element at one part of the stroke and the speed at every other part of the stroke, so that the delivery curve is uniform at all times, instead of being uniform for only one adjustment as in the prior art.

The number of pumping units making up the constant delivery pump will vary, Figure 11 illustrating two such units 136 and 137 having a common inlet connection 138 and a common outlet connection 139, so that the inlet is drawn from the same source and the outlet is discharged to the same source.

The pumping elements will normally be pistons 94 as shown, but as indicated in Figure 12 the invention may employ some other type of reciprocating pumping element such as a bellows 94' as shown in Figure 12.

In view of our invention and disclosure variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of our invention without copying the structure shown, and we, therefore, claim all such insofar as they fall within the reasonable spirit and scope of our claims.

Having thus described our invention what we claim as new and desire to secure by Letters Patent is:

1. In a constant delivery pump, a pair of reciprocating pumps having common inlet and outlet and having reciprocating elements, a drive, cam means turned by the drive, followers engaging the cam means and respectively at different portions of the pump cycle, connecting rods carrying the followers and guided for reciprocation, pivoted crank blocks interconnected with and swung by the connecting rods, crossheads reciprocating and connected with the individual elements, sliding blocks slidable in the crossheads transversely to the direction of crosshead motion, followers making pivotal interconnection between the sliding blocks and the crank blocks and means for adjusting the sliding blocks to change the pivotal connection of the sliding blocks with the crank blocks.

2. In a constant delivery pump, a pair of reciprocating pumps having common inlet and outlet and having reciprocating elements, a drive, cam means turned by the drive, followers engaging the cam means and respectively at different portions of the pump cycle, connecting rods carrying the followers and guided for reciprocation, pivoted crank blocks interconnected with and swung by the connecting rods, crossheads reciprocating and connected with the individual reciprocating elements, sliding blocks slidable in the crossheads transversely to the direction of crosshead motion, followers making pivotal interconnection between the sliding blocks and the crank blocks, the sliding blocks having heads, an adjustment block making sliding interconnection with the heads of both sliding blocks and mechanism for moving the adjustment block toward and away from the crosshead to adjust the stroke of both pumps in unison.

3. In a constant delivery pump, a pair of reciprocating pumps having common inlet and outlet and having reciprocating elements, a drive, cam means turned by the drive, followers engaging the cam means and respectively at different portions of the pump cycle, connecting rods carrying the followers and guided for reciprocation, pivoted crank blocks interconnected with and swung by the connecting rods, crossheads reciprocating and connected with the individual reciprocating elements, sliding blocks slidable in the crossheads transversely to the direction of crosshead motion, followers making pivotal interconnection between the sliding blocks and the crank blocks, the sliding blocks having heads, an adjustment block making sliding interconnection with the heads of both sliding blocks, a screw for moving the adjustment toward and away from the crossheads and guides for the motion of the adjustment block.

4. In a constant delivery pump, a pair of reciprocating pumps having common inlet and outlet and having reciprocating elements, a drive, cam means turned by the drive, followers engaging the cam means and respectively at different portions of the pump cycle, connecting rods carrying the followers and guided for reciprocation, pivoted crank blocks interconnected with and swung by the connecting rods, crossheads reciprocating and connected with the individual reciprocating elements, sliding blocks slidable in the crossheads transversely to the direction of crosshead motion, followers making pivotal interconnection between the sliding blocks and the crank blocks, the sliding blocks having heads, an adjustment block making slid-

ing interconnection with the heads of both sliding blocks, guides for the motion of the adjustment block toward and away from the crossheads, a screw for moving the adjustment block, a drive for the screw and an indicator for the adjustment position.

5. In a constant delivery pump, a pair of reciprocating pumps having common inlet and outlet and having reciprocating elements, blocks pivoted to swing in arcs whose outer ends conform generally to the back and forth motion of the reciprocating elements, means for swinging the blocks back and forth and means for pivotally interconnecting the reciprocating elements with the blocks.

6. In a constant delivery pump, a pair of reciprocating pumps having common inlet and outlet and having reciprocating elements, blocks pivoted to swing in arcs whose outer ends conform generally to the back and forth motion of the elements, means for swinging the blocks back and forth, means for pivotally interconnecting the elements with the blocks and means for adjusting the pivotal interconnections with respect to the pivots of the blocks.

7. In a constant delivery pump, a pair of reciprocating pumps having common inlet and outlet and having reciprocating elements, blocks pivoted to swing in arcs whose outer ends conform generally to the back and forth motion of the elements, means for swinging the blocks back and forth, means for pivotally interconnecting the elements and the respective blocks and common means for adjusting the positions of both pivotal interconnections with respect to the pivots of the blocks in unison.

8. In a constant delivery pump, a pair of reciprocating pumps arranged side by side having common inlet and outlet reciprocating elements side by side and adjacent, the elements being directed in the same direction, crossheads, one for each element guided for reciprocation parallel to one another and in the paths of the elements, interconnections between the respective crossheads and the respective elements, blocks one for each crosshead swingably pivoted on the same axis transverse to the direction of motion of the crossheads, pivotal interconnections between each block and the corresponding crosshead at a point remote from the crosshead pivot and the same on each block, means for adjusting the positions of the pivotal interconnections between the respective blocks and the crossheads in unison and means for rocking the blocks back and forth, the respective blocks being at opposite positions with respect to the pump cycle.

9. In a constant delivery pump, a pair of reciprocating pumps arranged side by side having common inlet and outlet and having reciprocating elements side by side and adjacent, the elements being directed in the same direction, crossheads, one for each element guided for reciprocation parallel to one another and in the paths of the elements, interconnections between the respective crossheads and the respective elements, blocks one for each crosshead swingably pivoted on the same axis transverse to the direction of motion of the crossheads, pivotal interconnections between each block and the corresponding crosshead at a point remote from the crosshead pivot and the same on each block, means for adjusting the positions of the pivotal interconnections between the respective blocks and the crossheads in unison, connecting rods for rocking the blocks back and forth and cam means for moving the connecting rods at respectively opposite positions with respect to the pump cycle.

10. In a constant delivery pump, a pair of reciprocating pumps arranged side by side having common inlet and outlet and having reciprocating elements side by side and adjacent, the elements being directed in the same direction, crossheads, one for each element guided for reciprocation parallel to one another and in the paths of the elements, interconnections between the respective crossheads and the respective elements, blocks one for each crosshead swingably pivoted on the same axis transverse to the direction of motion of the crossheads, pivotal interconnections between each block and the corresponding crosshead at a point remote from the crosshead pivot and the same on each block, means for adjusting the positions of the pivotal interconnections between the respective blocks and the crossheads in unison, connecting rods one for each pump guided for reciprocation parallel to the direction of motion of the elements, followers interconnecting each connecting rod with one of the blocks, and a parallel cam drive including a cam track for manipulating the connecting rods back and forth in opposite positions with respect to the pump cycles.

EMMA ELIZABETH SHEEN,
Co-Executor for Estate of Milton Roy Sheen, Deceased.

ROBERT T. SHEEN.
ROYAL BARTLETT SAALFRANK.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
989,775	Fraser	Apr. 18, 1911
1,050,745	Moore	Jan. 14, 1913
1,132,284	Persson	Mar. 16, 1915
1,382,450	Baker	June 21, 1921
1,909,955	Herbsman et al.	May 23, 1933
2,130,521	Brunner	Sept. 20, 1938
2,263,429	Sheen	Nov. 18, 1941
2,367,893	Sheen	Jan. 23, 1945