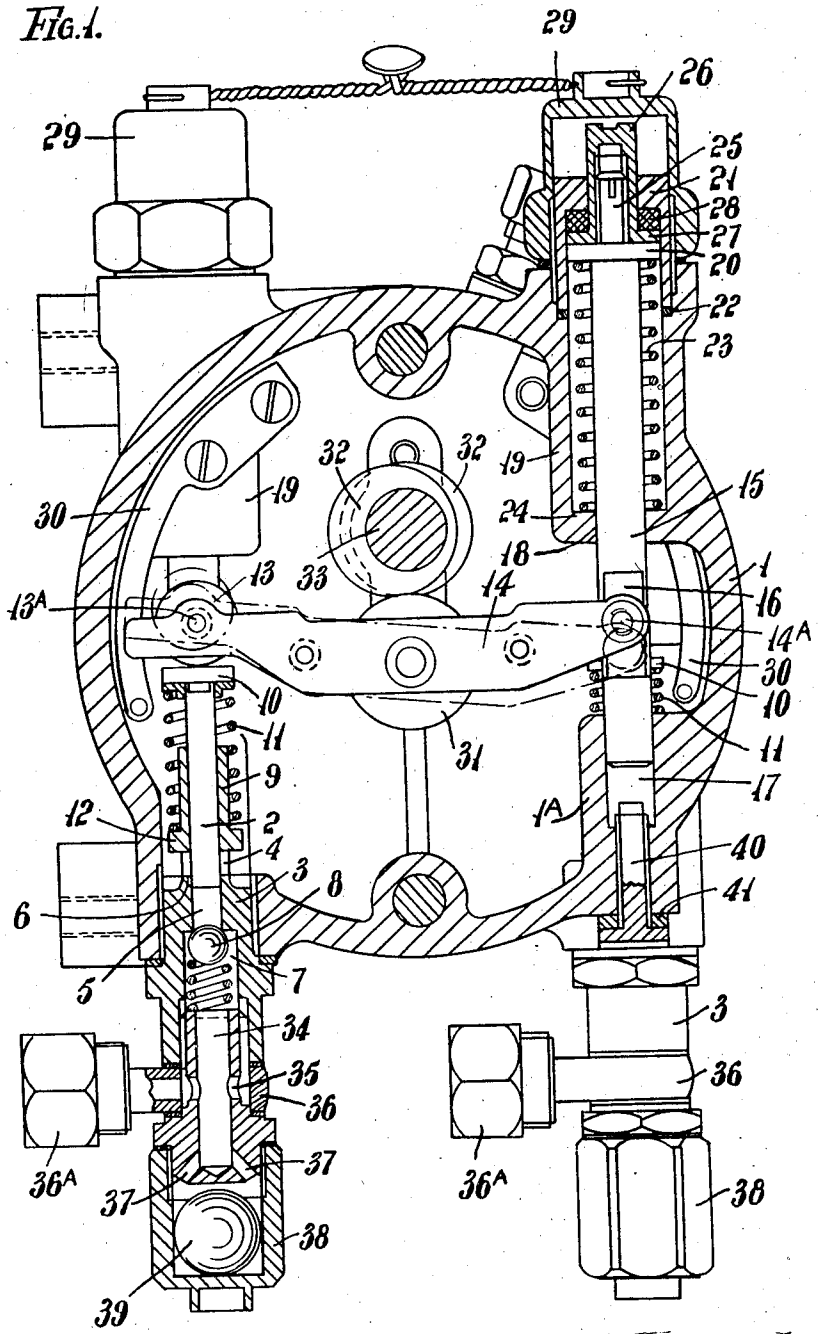
Dec. 11, 1945. C. C. S. LE CLAIR 2,390,798

RECIPROCATING PUMP

Filed Feb. 11, 1943 2 Sheets-Sheet 1

FIG. 1.



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Filed Feb. 11, 1943 2 Sheets-Sheet 2

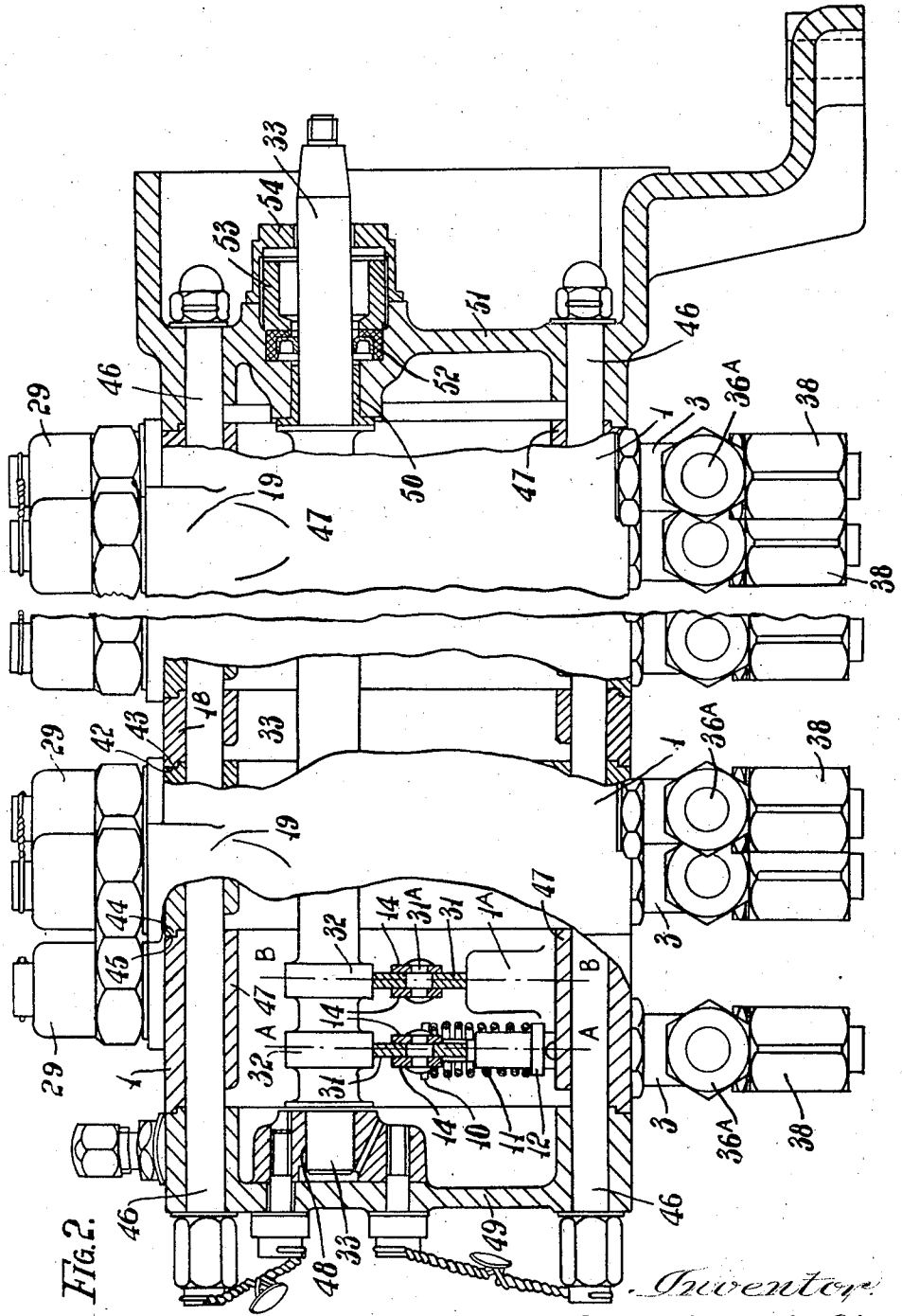


FIG. 2.

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UNITED STATES PATENT OFFICE

2,390,798

RECIPROCATING PUMP

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Application February 11, 1943, Serial No. 475,496
In Great Britain February 14, 1942

16 Claims. (Cl. 103—38)

This invention relates to pumps of the reciprocating piston or plunger type.

The principal object of the present invention is the provision of a novel reciprocating piston pump which operates at high speeds and which delivers pumped liquids at a varying rate depending upon the back pressure or resistance at the discharge port.

Another object is to provide a pump which will respond automatically to variations in the resistance opposed to the discharge of liquid from the pump.

Another object is to provide a pump in which the pumping capacity can be varied in a simple manner and without interrupting the operation of the pump.

Another object is to provide a pump in which the pumping action of the piston is automatically arrested by resistance to the delivery of pumped liquid exceeding a predetermined value.

Another object is to provide a pump in which the pumping action is automatically restored when the resistance opposing delivery of pump liquid falls below the predetermined value.

Another object is the provision of a multiple pumping unit comprising a number of pumps arranged so that while driven from the same shaft some of the pumps can operate while the others are not operating or are operating at a reduced capacity.

Other objects and advantages will appear from the following description.

One constructional form of the invention, as applied to a pump for use in pumping de-icing liquid to de-icing apparatus on aircraft, is hereinafter described, by way of example, with reference to the accompanying drawings, whereon:

Fig. 1 is a sectional view of one of a number of separate and interchangeable pump units which are adapted to be detachably connected together to form a complete multiple unit of the desired capacity; and

Fig. 2 is a longitudinal elevation, partly in section, of a multiple unit constructed by assembling a number of the pump units shown in Fig. 1.

Referring to the drawings:

Each unit comprises a substantially cylindrical casing 1 containing two piston pumps and their operating mechanisms. One pump and its operating mechanism are shown in Fig. 1 and the other pump and its operating mechanism, parts only of which are shown in Figs. 1 and 2, are arranged on a transverse plane B—B behind and parallel to the transverse plane A—A, see Fig. 2, on which the first mentioned pump and its operating mechanism are arranged. Further, one pump is arranged on one side of the axis of the casing and the other pump is arranged on the opposite side thereof. One of the two pumps will now be specifically described. As shown in Fig. 1, the pump comprises a piston 2 which is slidably arranged in a cylinder 3 screwed into the bottom of the casing. Inlet ports 4 are formed in the wall of the cylinder and provide communication between the interior of the casing and the bore 5 of the cylinder when the bottom end of the piston is in any position above the lower edge 6 of the ports 4. The bottom of the bore, which leads to an outlet passage 7 of larger diameter, is normally closed by means of a spring-loaded, non-return ball valve 8. The piston is slidable in a guide 9 forming an extension of the cylinder, and at its top end the piston is provided with a collar 10. A coil spring 11 is arranged between the collar and a shoulder 12 formed on the guide 9 and thus tends to thrust the piston upwards. The coil spring forces the collar 10 constantly into contact with a roller 13, which is turnably supported, upon a pivot pin 13A, extending between, and through the free ends of, two spaced plates connected by rivets to form a composite rocking lever 14, see also Fig. 2. The lever extends transversely across the pump casing and the opposite ends of the two plates engage with diametrically opposed flats 16 formed on a pivot-bearing plunger or rod 15, the axis of which lies on the same transverse plane as the axis of the piston 2. The plates are pivotally connected to the pivot plunger by a pivot pin 14A. The pivot arm and the piston are parallel and are spaced substantially equidistantly from the centre plane of the casing. The lower end of the pivot plunger is slidably guided in a boss 1A formed inside the casing. Above the flats 16, the pivot plunger extends through a hole 18 in the bottom wall of a housing formed by a hollow boss 19 arranged partly inside and partly outside the wall of the casing. The plunger is formed with a shoulder 20 which is slidably guided in a recess formed in a cap 21 screwed into the upper counter-bored and screw-threaded end of the boss. The bottom end of the cap bears upon an exchangeable joint washer 22 arranged between the bottom end of the cap and the bottom of the counter-bored part of the housing. A coil spring 23 is arranged around the pivot plunger 15 between the shoulder 20 and the bottom 24 of the housing and thus constantly forces the plunger upwardly. Above the shoulder, the pivot plunger is formed with an extension 25 on to which is screwed an adjusting nut or output adjuster 26

extending through a hole in the top of the cap and having a flange 27 at its bottom end. A sealing ring 28 is provided between the flange and the inside of the top of the cap. A hollow cap nut 29 is screwed upon the said cap so as to enclose the output adjuster 26.

The free ends of the plates forming the rocking lever 14 are held against lateral displacement by their slidable engagement on opposite sides of an arcuate guide 30 fixed in the inside of the pump casing. This arrangement acts to prevent the pivot arm turning about its own axis. A turnably mounted roller 31 is carried on a pin 31A fixed between the two plates of the lever 14, the roller being arranged substantially midway between the said roller 13 and the pivotal attachment 14A of the two plates to the pivot plunger 15. By means of the above mentioned coil springs 11 and 23, acting respectively upon the pump piston 2 and the pivot plunger 15, the roller 31 is always held in contact with a cam 32 provided upon an operating shaft 33 extending through the casing.

In the lower end of the outlet of the pump cylinder is situated a hollow plug member 34 which is screwed into the lower end of the cylinder and which, between its ends, is formed with a number of outlet ports 35 communicating with a banjo fitting 36 to which the liquid discharge pipe is connected by a union 36A. The bottom end of the bore of the said plug is formed with a number of diagonal ports 37 which communicate with the interior of a hollow cap 38 screwed on to the fitting and containing a hollow rubber ball 39, which acts in the manner of an air vessel to prevent pulsations in the column of liquid in the discharge pipe line.

The upper end of the said plug constitutes a support for the spring controlling the outlet valve 8.

The mechanism described above includes means for stopping the operation of the pump or for varying the pumping capacity, if, for example, the flow of liquid from the outlet 36 is resisted by opposing pressure, such, for instance, as might be caused by an obstruction. When the pump is operating normally at its highest capacity, during the suction stroke the bottom edge of the piston 2 moves out of the bore 5 of the cylinder 3 to a position where it uncovers, or almost completely uncovers, the said inlet ports 4 in the cylinder. During this stroke, the roller 31 on the rocking lever 14 is held in contact with the operating cam 32. As the driving shaft 33 rotates, the rise of the cam contacting with the roller 31 forces the rocking lever downwards about its pivotal connection 14A with the pivot plunger 15, the roller 13 at the free end of the rocking lever forcing the piston downwards. Some of the liquid which had entered the pump cylinder 5 during the suction stroke through the inlet ports 4 is trapped in the cylinder after the lower end of the piston has moved past the lower edge 6 of the ports and has re-entered the cylinder. The liquid thus trapped is forced past the spring-loaded ball valve 8 into the hollow of the plug member 34 and thence via the banjo connection 36 to the pipe line. If, however, the delivery of the liquid is opposed by more than a predetermined resistance, there is a corresponding resistance to the entry into or movement of the piston 2 in the lower part of the cylinder. In this case, the motion of the piston being arrested, the operating cam 32 acts to force the end of the rocking lever pivoted to the pivot plunger 15 downwards, and the mechanism thereby protected from injury.

If the resistance to the discharge of liquid from the cylinder 5 is sufficiently great, the piston may be arrested at its entry to the cylinder bore without displacing any liquid therefrom. In these circumstances, the operating cam 32 acts to force the pivot plunger 15 downwards to the maximum extent against the action of its coil spring 23, the rocking lever 14 continues to oscillate but its fulcrum is now formed by the collar 10 at the top of the piston rod 2 upon which bears the roller 13 at the free end of the lever. The pivot plunger 15 is thus reciprocated until the said resistance has been removed.

In either case, as soon as normal pumping conditions have returned, i. e., the resistance removed, the pivot plunger 15 is forced upwards by its coil spring 23 and the piston 2 again operates at full stroke.

The means described above may also be used for adjusting the effective piston stroke while the pump is at rest or when it is working. This is done by removing the above mentioned cap nut 29 enclosing the said output adjuster 26 threaded on to the end of the pivot plunger and by screwing the adjuster in one direction or the other. If the adjuster is screwed upwards, its flange 27 recedes from the shoulder 20 on the pivot plunger 14. The effect of this adjustment is to lower the fulcrum of the rocking lever and to raise the opposite or free end of the rocking lever, thus shortening the effective piston stroke since, when the free end of the rocking lever is moved upwards, the piston is also moved upwards in its cylinder by its coil spring 11. Thus, after such an adjustment, the piston 2 performs a larger proportion of its stroke external to the cylinder 5 and a lesser proportion within the cylinder and can thus only force a reduced quantity of liquid from the cylinder. The output adjuster 26 can be screwed upwards to such an extent that the pivotal connection 14A of the rocking lever 14 to the pivot plunger 15 is moved so far downwards that the piston 2 performs the whole of its stroke external to the cylinder 5, under which conditions that there is no pumping action.

Below the pivot plunger 15, there may be provided a stop screw 40 which is screw threaded through a hole in the casing into the guide passage 17 in which the lower end of the pivot arm is slidable, an exchangeable anvil washer 41 being arranged between the head of the stop screw and the casing.

As previously mentioned, there are two pumps and their associated operating mechanisms in the casing 1 of the pumping unit now being described. For clearness sake, parts only of the internal mechanism of the second pump are shown in Fig. 1 such as the pivot plunger 15, the arcuate guide member 30, the collar 10 on the piston, the piston spring 11 and, of the external parts, the cylinder 3, the hollow caps 38 and 29, the banjo fitting 36 and the union nut 36a. The figure shows that whereas the front pump of the unit is on the left of the axis of the casing, the rear pump is on the right thereof. The two pumps and their operating mechanisms are identical and, therefore, no further description of the rear pump is necessary. That part of the driving shaft which passes through the casing 1 is provided with two cams 32, the rise of one cam being arranged at 180° to the rise of the other cam. Figure 2 shows that one of the cams co-operates with the roller 31 on one rocking lever

14 and that the other cam cooperates with the other roller 31.

The pumping units described above are so constructed that as many of them as may be required may be connected together. To this end, one end face of each casing 1 is formed with an annular recess 42, see Fig. 2, which engages an annular projection 43 on the adjacent casing, the opposite end face of the first mentioned casing being formed with an annular projection 44 adapted to engage with an annular recess 45 in an adjacent casing. Bolts 46 passing through holes formed in diametrically opposite lugs 47, Fig. 1, in the pump casings serve to attach the pump units together. The length of the pump-operating cam shaft 33 varies according to the number of units connected together, there being two cams 32 to each unit. One end of the cam shaft is journalled in a bearing 48 provided in an end cover 49 connected to the adjacent unit casing 1 and the opposite end of the shaft is journalled in a bearing bush 50 which is fitted in an end cover 51 attached to the unit casing 1 at the opposite end of the pump, an oil seal 52 and a gland 53 arranged in a gland nut 54 being provided adjacent to the bush. The interconnected casings 1 and the end covers together form a composite liquid-tight casing which is kept constantly filled with the liquid to be pumped, for example, by gravity or under pressure.

It will be understood that the constructional details of the invention may be varied. For example, the invention is applicable to a single pumping unit containing one pump only or more than two pumps and to a multiplicity of single or double units. Obviously, it is not essential to construct a complete multiple unit from a number of separate interchangeable units, although such a multiple unit construction is of considerable advantage. Further, although in the constructional form of the invention described above separate pipe lines are connected to the outlets 36 from the pumps, the outlets might be connected to a common delivery conduit.

The pump may be driven by petrol engine, electric motor or any other convenient means. The driving motor may either be mounted coaxially with the shaft 33 or alongside the pumping unit on a parallel axis, the two shafts being connected by chain or gearing in accordance with known methods.

I claim:

1. In a pump of the class described, having a cylinder provided with inlet and outlet ports and a pump piston mounted for reciprocation in said cylinder, the combination of a spring-loaded member, a rocking element having one end pivotally connected to said spring-loaded member and having its free end to reciprocate said piston, and an operating member mounted for rotation about a fixed axis, said operating member being in contact with said rocking element at a point intermediate the ends thereof so that rotation of said operating element causes said rocking element to pivot about its pivotal connection to reciprocate said pump piston, whereby the rocking element will reciprocate said spring-loaded member when resistance greater than a predetermined amount to the free discharge of fluid from said cylinder causes the reciprocation of said pump piston to be arrested.

2. The combination set forth in claim 1, in which means are provided to adjust the effective stroke of said pump piston by varying the amount of movement imparted to said free end of said rocking element by said operating member.

3. The combination set forth in claim 1, in which means are provided to adjust the position of said spring-loaded member and said pivotal connection relative to said operating member, whereby the effective stroke of said piston pump is varied.

4. In a pump of the class described, a casing forming a reservoir for liquid to be pumped, a cylinder having inlet and outlet ports disposed on one side of said casing, a pump piston mounted for reciprocation in said cylinder, a spring biasing said pump piston to retracted position, a spring-loaded member mounted for reciprocation and positioned on the side of said casing opposite said cylinder and said pump piston, a rocking element having end pivoted to said spring-loaded member and having its free end mounted to depress said piston against the force of said spring, a cam mounted for rotation about a fixed axis positioned between said cylinder and said piston and said spring-loaded member, said cam being mounted to contact said rocking element intermediate the ends thereof so that rotation of said cam causes said rocking element to pivot about its pivotal connection to actuate said pump piston, whereby the rocking element will reciprocate said spring-loaded member when resistance greater than a predetermined amount to the free discharge of fluid from said cylinder causes the reciprocation of said pump piston to be arrested.

5. The combination set forth in claim 4, in which said spring-loaded member comprises a plunger slidably mounted in said pump casing and having its axis parallel to the axis of said cylinder and said piston.

6. The combination set forth in claim 4, in which said spring-loaded member comprises a plunger slidably mounted in said pump casing and having its axis parallel to the axis of said cylinder and said pump piston, and said pump piston and said spring-loaded member being biased by the springs in the same direction, whereby said rocking element is maintained in operative position against said cam and the end of said pump piston.

7. The combination set forth in claim 4, in which said inlet ports communicate with the interior of said casing and are adapted to be uncovered by said piston in its retracted position to allow fluid to enter said cylinder, whereby fluid is trapped in said cylinder on the discharge stroke of said pump piston by masking said ports.

8. The combination set forth in claim 4, in which a roller is mounted on said rocking element intermediate the ends thereof to contact said cam, and a second roller is mounted on the free end of said rocking element to contact the end of said pump piston.

9. The combination set forth in claim 4, in which said spring-loaded member comprises a plunger slidably mounted in said pump casing and having its axis parallel to the axis of said cylinder and said pump piston, a spring associated with said plunger to bias said plunger to a position wherein said rocking element will impart a maximum pumping stroke to said pumping piston, and an adjustable stop mounted on said plunger and adapted normally to contact an abutment, whereby the effective pumping stroke of said pumping piston may be varied by adjusting

the position of said stop to vary the axial position of said pivotal connection.

10. The combination set forth in claim 4, in which said spring-loaded member comprises a plunger slidably mounted in said pump casing and having its axis parallel to the axis of said cylinder and said pump piston, a spring associated with said plunger to bias said plunger to a position wherein said rocking element will impart a maximum pumping stroke to said pump piston, a threaded end on said plunger, an adjustable stop threaded onto said plunger and having a portion projecting from said casing and having a flange adapted to engage an abutment to limit the spring pressed movement of said plunger.

11. The combination set forth in claim 4, in which said free end of said rocking element is bifurcated, and a guide is mounted within said casing adapted to be passed between said bifurcated ends to prevent lateral displacement of said rocking element.

12. In a pump of the class described, a pumping unit comprising an open ended casing, a cylinder provided with inlet and outlet ports provided in said casing at one side thereof, a pump piston mounted for reciprocation in said cylinder and a spring-loaded member slidably mounted in said casing on the side opposite said cylinder, a rocking element having one end pivotally connected to said spring-loaded member and having its free end mounted to reciprocate said pump piston, and an operating member mounted for rotation about a fixed axis, said operating member being in contact with said rocking element at a point intermediate the ends thereof so that rotation of said operating member causes said rocking element to pivot about its pivotal connection to reciprocate said pump piston.

13. A pump of the class described, comprising a plurality of pump units of the type set forth in claim 12 mounted with their open ends in axial alignment, a cover plate for each of said units forming the end unit, and means for holding said pump units and said end plates in assembled position to form a reservoir for fluid to be pumped.

14. The combination set forth in claim 4, in which there is provided at least two pumps arranged so that said cylinders and said spring-loaded members are disposed in alternate position along each side of said casing.

15. The combination set forth in claim 4, in which there is provided at least two pumps arranged so that said cylinders and said spring-loaded members are disposed in alternate position along each side of said casing, and in which said cams for rocking said rocking element are mounted on a single shaft, said shaft being journaled in the end walls of said casing.

16. A pump of the class described, comprising a plurality of pump units of the type set forth in claim 12 mounted with their open ends in axial alignment, a cover plate for each end unit, bearing members in each cover plate, at least one intermediate ring disposed between pumping units, said ring having a bearing member coaxial with said bearings in said cover plates, a single shaft journaled in said bearings and mounting said operating members, and means for holding said pump units, said rings, and said end plates in assembled position to form a reservoir for liquid to be pumped.

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