

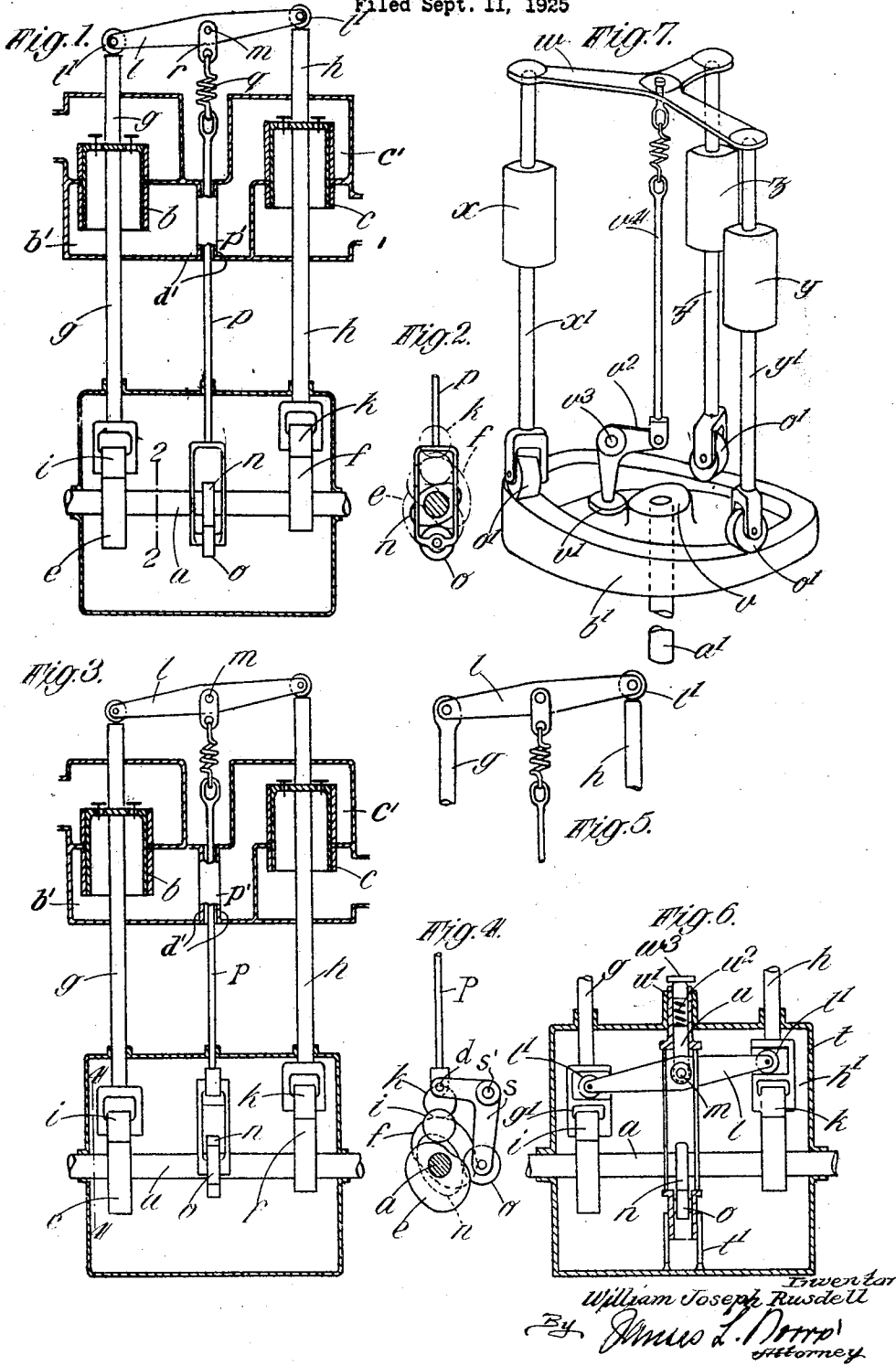
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PUMP FOR LIQUIDS OR HYDRAULIC MOTOR

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PUMP FOR LIQUIDS OR HYDRAULIC MOTOR.

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This invention relates to reciprocating pumps or hydraulic motors having two or more pistons, buckets, rams or the like acting on the liquid in series and operated by cams, for instance apparatus of the kind described in British Patent No. 176,067.

The cams usually operate in one direction only, to give the pumping or power stroke, the return motion being caused by springs. The "throw" of the return cam which causes the pivot to move may be less than the individual movements of the pistons since this cam has only to correct the difference in movement between the power stroke of the one piston and the return stroke of the other.

The movement during the return stroke may be quite different from that of the power stroke and the return stroke may occupy a different (usually shorter) time.

By the present invention the return stroke of each piston is caused partly by the power stroke of the other piston or pistons and partly by another cam or cams, hereinafter called the return cam, acting in conjunction with the said power stroke.

In the case of a pump having two pistons, by the use of a rocking lever the outward motion of one piston acting on the one end "A" of the rocking lever, will cause the other end "B" of the rocking lever to move inwards, but since the outward motion during the power stroke is usually different from the inward motion during the return stroke, the movement of end "B" will not correspond with the return motion of the second piston.

The mounting of the pivot of the lever to slide under action of a spring for the purpose of compensating this lack of correspondence, has been described in the said British Patent No. 176,067.

According to the present invention, the pivot of the rocking lever is moved together with the lever by the return cam so as to correct the difference in motion between the two pistons.

The return cam acting through rollers, rods, levers or the like will give the correct motion to the pivot substantially according to the degree of accuracy of construction and further, by interposing a resilient device, such as a spring, somewhere between the point of application from the return cam and the pivot, any small irregularities of construction may be compensated.

Moreover, a definite tension all in one direction can be applied by the said spring to obviate backlash and thus to keep all working parts in contact, so that any wear which may occur in the working parts may be taken up automatically. The tension of the spring may be adjustable.

The "throw" of the return cam which causes the pivot to move may be less than the individual movements of the pistons since this cam has only to correct the difference in movement between the power stroke of the one piston and the return stroke of the other.

In the case of three pistons, a convenient method of applying the invention is to arrange the pistons equidistant from each other but not necessarily parallel and by employing a rocking plate or frame and locating the pivot to be acted upon by the return cam in the rocking plate at the centre of a triangle formed by the points of contact between the piston rods or their extensions and the rocking plate. A similar arrangement would be suitable in the case of more pistons.

In communicating the motion of the return cam to the pivot this motion may be magnified or reduced by levers or equivalent devices and there are many ways of accomplishing this.

Anti-friction devices for reducing friction such as rollers, or roller bearings, may be used with advantage. The rocking lever or plate may act on the piston rods or their extensions or parts moved thereby and the latter need not be rigidly connected with the rocking arms, but may be merely held in contact by the spring referred to.

The invention is illustrated in the accompanying drawings in which Fig. 1 is a diagrammatic elevation of one form of mechanism suitable for the purpose in view. Fig. 2 is a transverse section on line 2—2 of Fig. 1; Fig. 3 is a view similar to Fig. 1 but showing a modification; Fig. 4 is a transverse section on line 4—4 of Fig. 3; Fig. 5 is a fragmentary view showing a further modification; Fig. 6 is a section through a casing containing the driving shaft and the mechanism of the invention; and Fig. 7 is a perspective diagrammatic view of a mechanism suitable for a pump or motor having three pistons, the pump chambers being omitted for the sake of clearness.

In Figs. 1—6, *a* represents the driving shaft and *b*, *c* the buckets of a pump having chambers *b'* and *c'* communicating by way of a passage *d'* operated as described in British Patent No. 176,067 by cams *e*, *f* on

the shaft; the cams act on the bucket rods g, h through rollers i, k . The lever l is the rocking lever already referred to as described in British Patent No. 176,067; its pivot m is suitably guided to slide towards and away from the shaft a in response to the action of the cam n which operates on the pivot through roller o , rod p , spring q and link r . The rod p slides in a tubular guide p' (shown partly in section in Figures 1 and 3) extending through the passage d' .

In Figs. 1 and 3 the ends of the lever l carry rollers l' resting on the ends of the bucket rods g, h respectively. In Fig. 5 the lever l is pivoted at one end to the bucket rod g while the other end of the lever acts upon rod h through roller l' as before.

If the various velocities of the outward stroke of the one bucket exactly corresponded with the return velocities of the other bucket, pivot m would remain stationary, but since the return stroke of the one is different from the outward stroke of the other, and usually occupies a shorter time, pivot m must move outwards and inwards in order that the rollers l' shall remain in contact with the ends of rods g and h . During the period of overlap the pivot m will have an outward velocity equal to that of the rods themselves.

Cam n may be so shaped that the rod p moves exactly to correspond with the motion of pivot m , in which case the spring q will not alter its length and it is usually desirable to shape the cam substantially in this manner. In certain cases, however, it may be desirable so to shape the cam that the spring q alters its length so as to exert different pressures for different positions of the bucket. If the profile of cam n is very accurately formed, so that the motion of rod p exactly corresponds with that required for pivot m to maintain the rollers l' in contact with the ends of rods g and h , it is possible to dispense with spring q , but it is usually desirable to retain this spring to allow for irregularities in manufacture and it is sometimes desirable to cause the spring to vary its length, as when it is desired to reduce the load on the cams. When a spring is used, it may be in the form of a compression spring instead of the tension spring shown; it is usually desirable to provide means for adjusting the length of the spring so as to vary its tension or compression. In any case the tension must be sufficient to keep all the rollers and cams in contact with the parts against which they work. Any wear which may occur may be automatically taken up by a shortening of the spring.

Figs. 1 and 2 differ from Figs. 3 and 4 in the mode in which the movement caused by the cam n is transmitted to the rod p . In Figs. 1 and 2 the roller o is guided so that its axis moves in a straight line which is an extension of the axis of rod p . In Figs. 3

and 4 the roller o is pivoted on a rocking arm s centred at s' and connected by pivot d with rod p . The profile of the cam and its position relative to shaft a differ from those of the cam in Figs. 1 and 2, owing to the effect of the rocking arm s , but the profile must be such as to give the required movement to rod p .

Referring to Fig. 6, this shows a construction by which the shaft a , its several cams and the rocking lever l can all be enclosed in a casing t through which the rods g and h extend. The pivot m is mounted in a block u which slides in a sleeve u' containing a compression spring u^2 adjustable by a screw u^3 . The sleeve is connected as shown with the roller o and itself slides in a sleeve t' carried by the casing t . The rollers l' are accommodated in slots in the enlargements g', h' of the rods g and h which carry the rollers i and k .

Fig. 7 shows three buckets x, y, z on corresponding rods x', y', z' , the ends of which support a plate w . A revolving shaft a' carries a cam plate b' on which rest the rollers o' on the lower end of the rods x', y', z' . The centre of the cam plate is raised to form a cam v against the face of which rests a roller v' carried by one arm of a bent lever v^2 turning on a stationary pivot v^3 and having its other arm linked by rod v^4 to the centre of the plate w .

The invention has been described in connection with rectilinearly moving pistons or buckets, but is applicable also to pistons having angular or curvilinear motion as described in U. S. Patent No. 1,615,139 of January 18, 1927.

The spring q shown in the drawings is an example of a resilient device; hydraulic or pneumatic pressure may be substituted for the spring.

It will be noted that all the reciprocating parts are kept either in compression or in tension so that no reversal of stress occurs in these parts and there is automatic adjustment for wear.

Having thus described the nature of the said invention and the best means I know of carrying the same into practical effect, I claim:—

1. A pump for liquids or a motor operated by liquid under pressure comprising a number of pump chambers connected in series, a piston in each chamber adapted to reciprocate, rotating cam mechanism adapted to move each piston through its stroke in one direction, a member actuated by each piston during its stroke in the said direction to move another piston through its return stroke and a cam acting on said member to impart to it a movement whereby the movement of each piston through its return stroke is assisted.

2. A pump for liquids or a motor operated

by liquid under pressure, comprising a number of pump chambers connected in series, a piston in each chamber adapted to reciprocate, rotating cam mechanism adapted to move each piston through its power stroke and to permit each piston to perform its return stroke in a period shorter than that occupied by its power stroke, a member actuated by each piston during its power stroke to move another piston through its return stroke, and a cam acting on said member to impart to it a movement whereby each piston is caused to perform its return stroke in a period shorter than that occupied by the power stroke.

3. A pump for liquids or a motor operated by a liquid under pressure, comprising a number of pump chambers connected in series, a piston in each chamber adapted to reciprocate, rotating cam mechanism adapted to move each piston through its power stroke, a pivoted member actuated by each piston during its power stroke to move about its pivot and so to cause another piston to move through its return stroke, and a cam acting on said member at its pivot to impart to it during the power stroke of each piston a movement whereby the movement of a piston through its return stroke is assisted.

4. A pump for liquids or a motor operated by a liquid under pressure, comprising a number of pump chambers connected in series, a piston in each chamber adapted to reciprocate, a rotating cam actuating each piston to cause it to perform its power stroke, and having a cam profile such that for a substantial portion of the power stroke of a piston, for small equal angular movements of the cam, the piston is caused to move through equal longitudinal distances, and such that each piston is free to perform its return stroke in a period shorter than that occupied by its power stroke, a member actuated by each piston during its power stroke to move another piston through its return stroke, and a rotating cam acting on said member to impart to it a movement whereby each piston is caused to perform its return stroke in a period shorter than that occupied by its power stroke.

5. A pump for liquids or a motor operated by liquid under pressure, comprising a number of pump chambers connected in series, a piston in each chamber adapted to reciprocate, piston rods carrying said pistons, rotating cam mechanism adapted to actuate each piston rod to move the piston carried thereby through its power stroke and to permit each piston to perform its return stroke in a period shorter than that occupied by the power stroke, a member actuated by the piston rod of each piston during its power stroke to move another piston rod and the piston carried thereby through its return stroke, and a rotating cam acting on said

member and having its profile of such shape that the piston rod of each piston is maintained during its return stroke substantially in contact with the cam device by which it is caused to perform its power stroke.

6. A pump for liquids or a motor operated by liquid under pressure, comprising a number of pump chambers connected in series, a piston in each chamber adapted to reciprocate, piston rods carrying said pistons, rotating cam mechanism adapted to actuate each piston rod to move the piston carried thereby through its power stroke, and to permit each piston to perform its return stroke in a period shorter than that occupied by the power stroke, a rocking device actuated by the piston rod of each piston during its power stroke to move another piston rod and the piston carried thereby through its return stroke, a member on which said rocking device is pivoted and a rotating cam imparting a reciprocating motion to said member and, therefore, to the pivot of the rocking device, and having its profile of such shape that the rod of each piston is maintained during its return stroke substantially in contact with the cam device by which it is caused to perform its power stroke.

7. A pump for liquids or a motor operated by liquid under pressure comprising a number of pump chambers connected in series, a piston in each chamber adapted to reciprocate, rotating cam mechanism adapted to move each piston through its stroke in one direction, a member actuated by each piston during its stroke in the said direction to move another piston through its return stroke, a cam acting on said member to impart to it a movement whereby the movement of each piston through its return stroke is assisted and a resilient device interposed between said member and said cam acting thereon.

8. A pump for liquids or a motor operated by liquid under pressure, comprising a number of pump chambers connected in series, a piston in each chamber adapted to reciprocate, rotating cam mechanism adapted to move each piston through its power stroke and to permit each piston to perform its return stroke in a period shorter than that occupied by its power stroke, a member actuated by each piston during its power stroke to move another piston through its return stroke, a cam acting on said member to impart to it a movement, whereby each piston is caused to perform its return stroke in a period shorter than that occupied by the power stroke and a resilient device interposed between said member and said cam acting thereon.

9. A pump for liquids or a motor operated by a liquid under pressure, comprising a number of pump chambers connected in

series, a piston in each chamber adapted to reciprocate, rotating cam mechanism adapted to move each piston through its power stroke, a pivoted member actuated by each piston during its power stroke to move about its pivot and so to cause another piston to move through its return stroke, a cam acting on said member at its pivot to impart to it during the power stroke of each piston a movement whereby the movement of a piston through its return stroke is assisted and a resilient device interposed between said member and said cam acting thereon.

10. A pump for liquids or a motor operated by a liquid under pressure, comprising a number of pump chambers connected in series, a piston in each chamber adapted to reciprocate, a rotating cam actuating each piston to cause it to perform its power stroke and having a cam profile such that for a substantial portion of the power stroke of a piston, for small equal angular movements of the cam, the piston is caused to move through equal longitudinal distances and such that each piston is free to perform its return stroke in a period shorter than that occupied by its power stroke, a member actuated by each piston during its power stroke to move another piston through its return stroke, a rotating cam acting on said member to impart to it a movement whereby each piston is caused to perform its return stroke in a period shorter than that occupied by its power stroke and a resilient device interposed between said member and said cam acting thereon.

11. A pump for liquids or a motor operated by liquid under pressure, comprising a number of pump chambers connected in series, a piston in each chamber adapted to reciprocate, piston rods carrying said pistons, rotating cam mechanism adapted to actuate each piston rod to move the piston carried thereby through its power stroke and to permit each piston to perform its return stroke in a period shorter than that occupied by the power stroke, a member actuated by the piston rod of each piston during its power stroke to move another piston rod and the piston carried thereby through its return stroke, a rotating cam acting on said member and having its profile of such shape that the piston rod of each piston is maintained during its return stroke substantially in contact with the cam device by which it is caused to perform its power stroke and a resilient device interposed between said member and said cam acting thereon.

12. A pump for liquids or a motor operated by liquid under pressure comprising a number of pump chambers connected in series, a piston in each chamber adapted to reciprocate, rotating cam mechanism adapted to move each piston through its stroke

in one direction, a member actuated by each piston during its stroke in the said direction to move another piston through its return stroke, a cam acting on said member to impart to it a movement whereby the movement of each piston through its return stroke is assisted and a resilient device interposed between said member and said cam acting thereon and subjected to a stress which is in the same direction at all stages in the operation of the apparatus.

13. A pump for liquids or a motor operated by liquid under pressure, comprising a number of pump chambers connected in series, a piston in each chamber adapted to reciprocate, rotating cam mechanism adapted to move each piston through its power stroke and to permit each piston to perform its return stroke in a period shorter than that occupied by its power stroke, a member actuated by each piston during its power stroke to move another piston through its return stroke, a cam acting on said member to impart to it a movement whereby each piston is caused to perform its return stroke in a period shorter than that occupied by the power stroke and a resilient device interposed between said member and said cam acting thereon and subjected to a stress which is in the same direction at all stages in the operation of the apparatus.

14. A pump for liquids or a motor operated by a liquid under pressure, comprising a number of pump chambers connected in series, a piston in each chamber adapted to reciprocate, rotating cam mechanism adapted to move each piston through its power stroke, a pivoted member actuated by each piston during its power stroke to move about its pivot and so to cause another piston to move through its return stroke, a cam acting on said member at its pivot to impart to it during the power stroke of each piston a movement whereby the movement of a piston through its return stroke is assisted and a resilient device interposed between said member and said cam acting thereon and subjected to a stress which is in the same direction at all stages in the operation of the apparatus.

15. A pump for liquids or a motor operated by liquid under pressure, comprising a number of pump chambers connected in series, a piston in each chamber adapted to reciprocate, a rotating cam actuating each piston to cause it to perform its power stroke and having a cam profile such that for a substantial portion of the power stroke of a piston, for small equal angular movements of the cam, the piston is caused to move through equal longitudinal distances, and such that each piston is free to perform its return stroke in a period shorter than that occupied by its power stroke, a member

actuated by each piston during its power stroke to move another piston through its return stroke, a rotating cam acting on said member to impart to it a movement whereby each piston is caused to perform its return stroke in a period shorter than that occupied by its power stroke and a resilient device interposed between said member and said cam acting thereon, and subjected to a stress which is in the same direction at all stages in the operation of the apparatus.

16. A pump for liquids or a motor operated by liquid under pressure, comprising a number of pump chambers connected in series, a piston in each chamber adapted to reciprocate, piston rods carrying said pistons, rotating cam mechanism adapted to actuate each piston rod to move the piston carried thereby through its power stroke and to permit each piston to perform its return stroke in a period shorter than that occupied by the power stroke, a member actuated by the piston rod of each piston during its power stroke to move another piston rod and the piston carried thereby through its return stroke, a rotating cam acting on said member and having its profile of such shape that the piston rod of each piston is maintained during its return stroke substantially in contact with the cam device by which it is caused to perform its power stroke and a resilient device interposed between said member and said cam acting thereon, and subjected to a stress which is in the same direction at all stages in the operation of the apparatus.

17. A pump for liquids or a motor operated by liquid under pressure comprising a number of pump chambers connected in series, a piston in each chamber adapted to reciprocate, rotating cam mechanism adapted to move each piston through its stroke in one direction, a member actuated by each piston during its stroke in the said direction to move another piston through its return stroke, a cam acting on said member to impart to it a movement whereby the movement of each piston through its return stroke is assisted and a resilient device interposed between said member and said cam acting thereon and subjected to stress, and means for adjusting the resilient device with respect to the stress to which it is subjected.

18. A pump for liquids or a motor operated by liquid under pressure, comprising a number of pump chambers connected in series, a piston in each chamber adapted to reciprocate, rotating cam mechanism adapted to move each piston through its power stroke and to permit each piston to perform its return stroke in a period shorter than that occupied by its power stroke, a member actuated by each piston during its power stroke to move another piston through its return stroke, a cam acting on said member to im-

part to it a movement whereby each piston is caused to perform its return stroke in a period shorter than that occupied by the power stroke, a resilient device interposed between said member and said cam acting thereon and subjected to stress, and means for adjusting the resilient device with respect to the stress to which it is subjected.

19. A pump for liquids or a motor operated by a liquid under pressure, comprising a number of pump chambers connected in series, a piston in each chamber adapted to reciprocate, rotating cam mechanism adapted to move each piston through its power stroke, a pivoted member actuated by each piston during its power stroke to move about its pivot and so to cause another piston to move through its return stroke, a cam acting on said member at its pivot to impart to it during the power stroke of each piston a movement whereby the movement of a piston through its return stroke is assisted, a resilient device interposed between said member and said cam acting thereon and subjected to stress, and means for adjusting the resilient device with respect to the stress to which it is subjected.

20. A pump for liquids or a motor operated by a liquid under pressure, comprising a number of pump chambers connected in series, a piston in each chamber adapted to reciprocate, a rotating cam actuating each piston to cause it to perform its power stroke, and having a cam profile such that for a substantial portion of the power stroke of a piston, for small equal angular movements of the cam the piston is caused to move through equal longitudinal distances, and such that each piston is free to perform its return stroke in a period shorter than that occupied by its power stroke, a member actuated by each piston during its power stroke to move another piston through its return stroke, a rotating cam acting on said member to impart to it a movement whereby each piston is caused to perform its return stroke in a period shorter than that occupied by its power stroke, a resilient device interposed between said member and said cam acting thereon and subjected to stress and means for adjusting the resilient device with respect to the stress to which it is subjected.

21. A pump for liquids or a motor operated by liquid under pressure, comprising a number of pump chambers connected in series, a piston in each chamber adapted to reciprocate, piston rods carrying said pistons, rotating cam mechanism adapted to actuate each piston rod to move the piston carried thereby through its power stroke and to permit each piston to perform its return stroke in a period shorter than that occupied by the power stroke, a member actuated by the piston rod of each piston during its power

stroke to move another piston rod and the piston carried thereby through its return stroke, a rotating cam acting on said member and having its profile of such shape that the piston rod of each piston is maintained during its return stroke substantially in contact with the cam device by which it is caused to perform its power stroke, a resilient device interposed between said member and said cam acting thereon and subjected to stress, and means for adjusting the resilient device with respect to the stress to which it is subjected.

22. A pump for liquids or a motor operated by liquid under pressure, comprising a number of pump chambers connected in series, a piston in each chamber adapted to reciprocate, piston rods carrying said pistons, rotating cam mechanism adapted to actuate each piston rod to move the piston carried thereby through its power stroke, and to permit each piston to perform its return stroke in a period shorter than that occupied by the power stroke, a rocking device actuated by the piston rod of each piston during its power stroke to move another piston rod and the piston carried thereby through its return stroke, a member on which said rocking device is pivoted, a rotating cam imparting a reciprocating motion to said member and therefore to the pivot of the rocking device, and having its profile of such shape that the rod of each piston is maintained during its return stroke substantially in contact with the cam device by which it is caused to perform its power stroke, and a resilient device forming a part of said member on which the rocking device is pivoted and situated intermediately of the rocking device and the cam actuating said member, so that the cam must transmit motion to the rocking device through the said resilient device

23. A pump for liquids or a motor operated by liquid under pressure, comprising a number of pump chambers connected in series, a piston in each chamber adapted to reciprocate, piston rods carrying said pistons, rotating cam mechanism adapted to actuate each piston rod to move the piston carried thereby through its power stroke, and to permit each piston to perform its return stroke in a period shorter than that occupied by the power stroke, a rocking device actuated by the piston rod of each piston during its power stroke to move another piston rod and the piston carried thereby through its return stroke, a member on which said rocking device is pivoted, a rotating cam imparting a reciprocating motion to said member and therefore to the pivot of the rocking device, and having its profile of

such shape that the rod of each piston is maintained during its return stroke substantially in contact with the cam device by which it is caused to perform its power stroke, and a resilient device forming a part of said member on which the rocking device is pivoted and situated intermediately of the rocking device and the cam actuating said member, so that the cam must transmit motion to the rocking device through the said resilient device, said resilient device being under a stress whereby it is adapted to maintain, during operation of the pump, continuous contact between each piston rod and the rocking device, between each piston rod and the cam mechanism acting thereon and between said member on to which the rocking device is pivoted and the cam acting thereon.

24. A pump for liquids or a motor operated by liquid under pressure, comprising a number of pump chambers connected in series, a piston in each chamber adapted to reciprocate, piston rods carrying said pistons, rotating cam mechanism adapted to actuate each piston rod to move the piston carried thereby through its power stroke and to permit each piston to perform its return stroke in a period shorter than that occupied by the power stroke, a rocking device actuated by the piston rod of each piston during its power stroke to move another piston rod and the piston carried thereby through its return stroke, a member on which said rocking device is pivoted, a rotating cam imparting a reciprocating motion to said member and therefore to the pivot of the rocking device, and having its profile of such shape that the rod of each piston is maintained during its return stroke substantially in contact with the cam device by which it is caused to perform its power stroke, a resilient device forming a part of said member on which the rocking device is pivoted and situated intermediately of the rocking device and the cam actuating said member, so that the cam must transmit motion to the rocking device through the said resilient device, said resilient device being under a stress whereby it is adapted to maintain, during operation of the pump, continuous contact between each piston rod and the rocking device, between each piston rod and the cam mechanism acting thereon and between said member on to which the rocking device is pivoted, and the cam acting thereon, and means for adjusting the said resilient device with respect to the stress to which it is subjected.

In testimony whereof I have signed my name to this specification.

WILLIAM JOSEPH RUSDELL.