

Jan. 23, 1945.

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2,368,013

PUMP OR COMPRESSOR

Filed Feb. 18, 1944

4 Sheets-Sheet 1

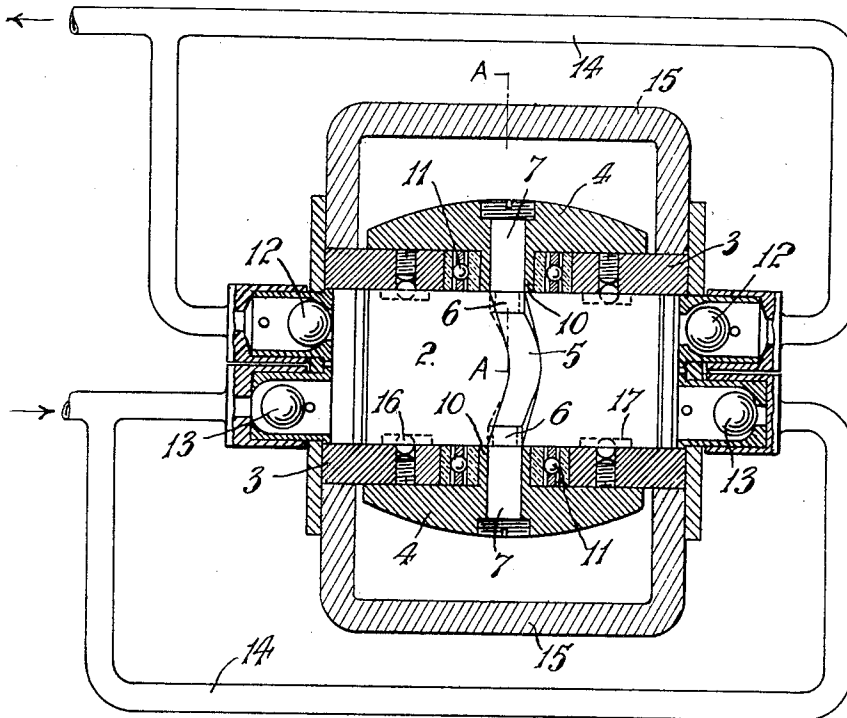


Fig:1.

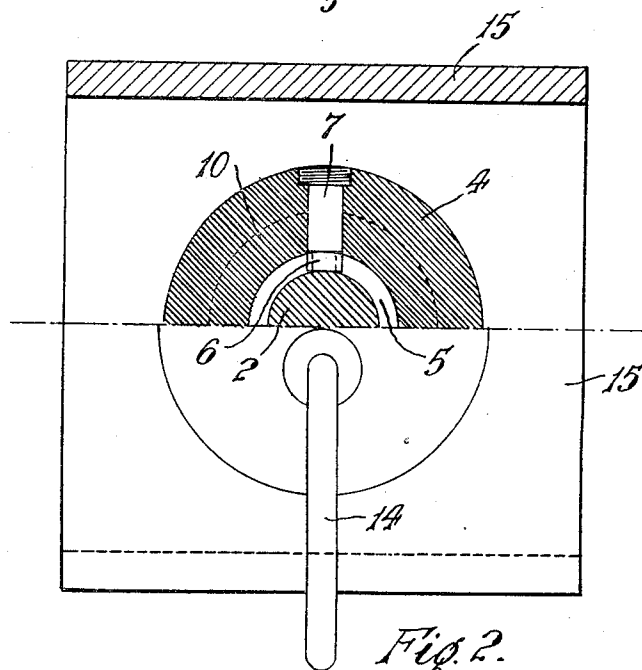


Fig. 2.

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4 Sheets-Sheet 2

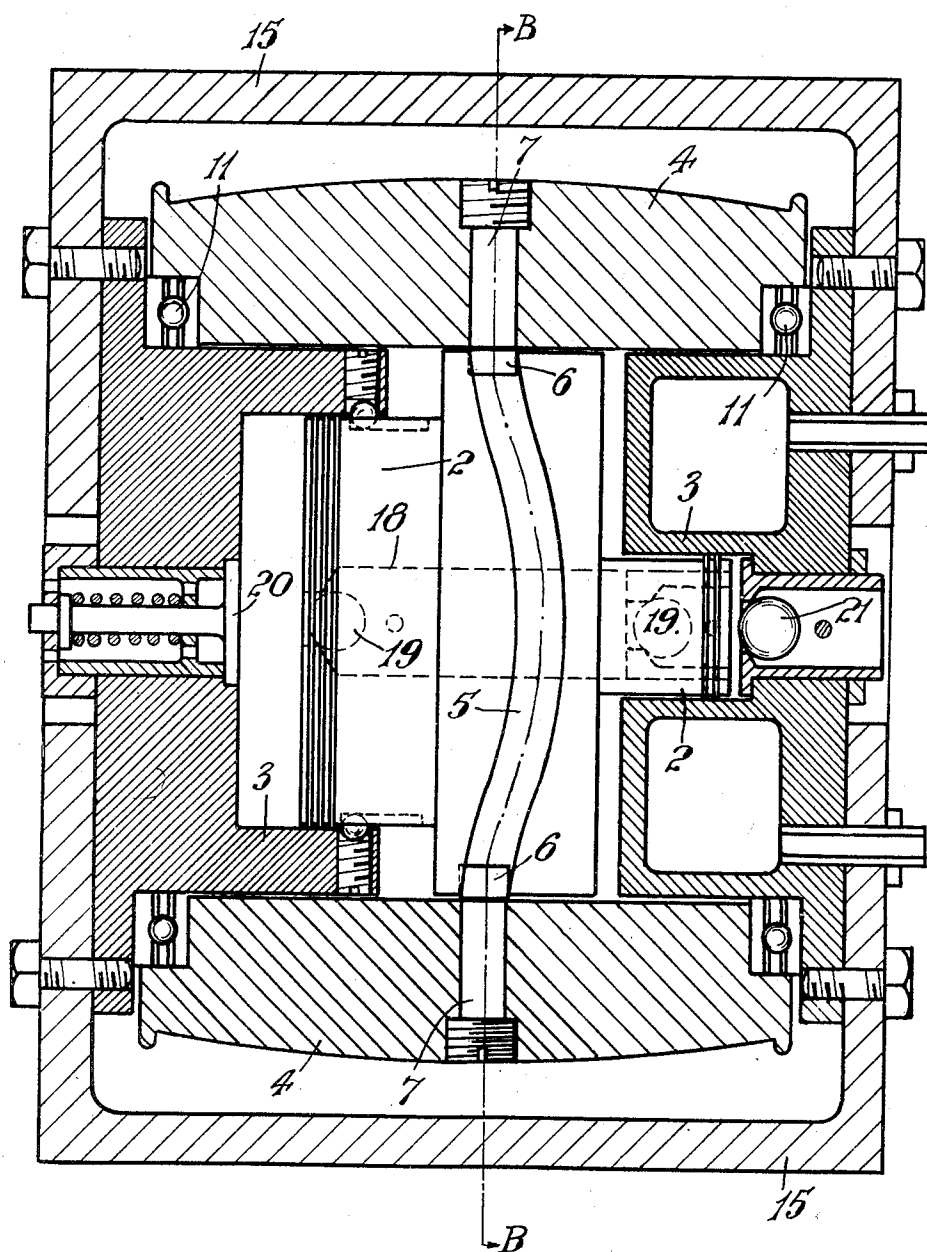


Fig. 3.

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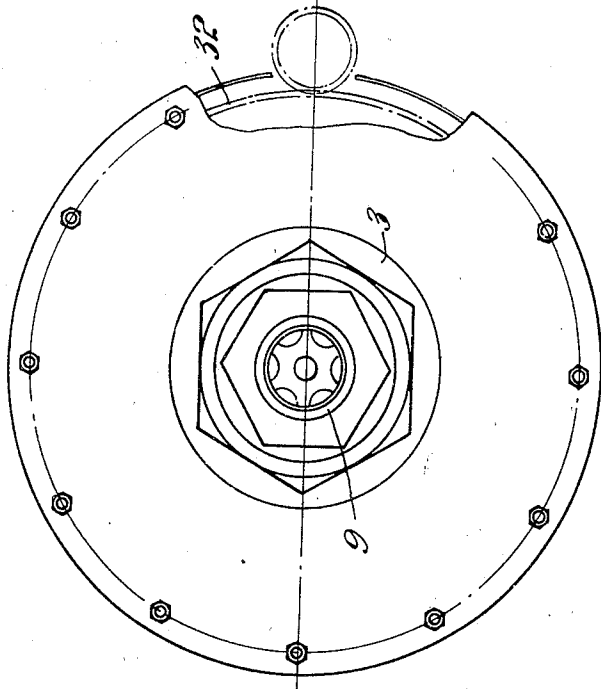


Fig. 6.

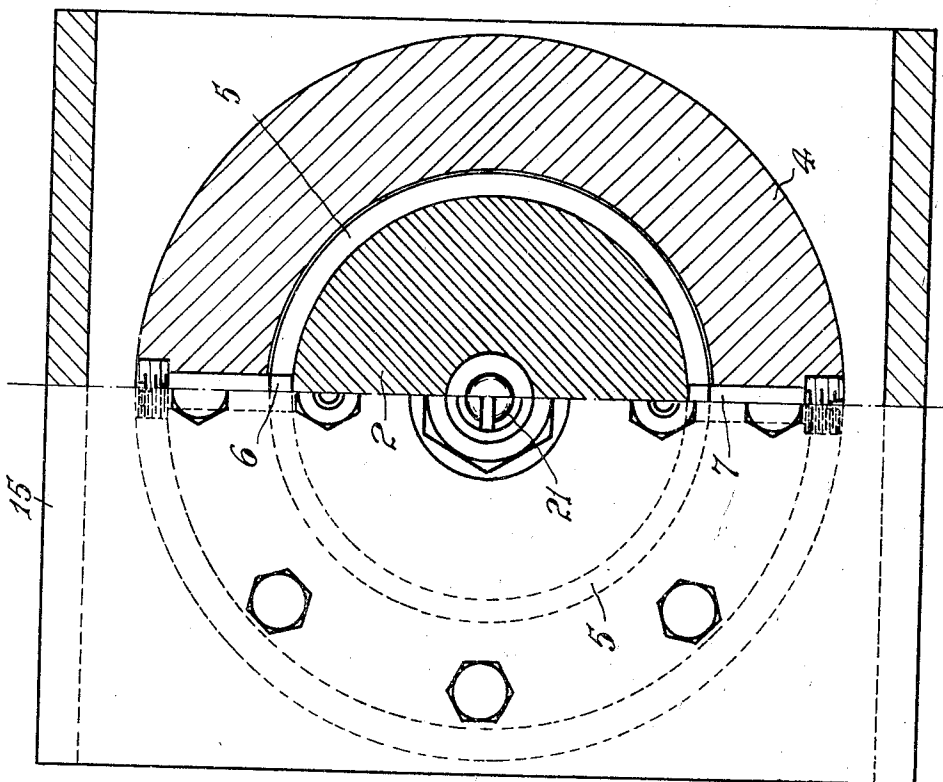


Fig. 4.

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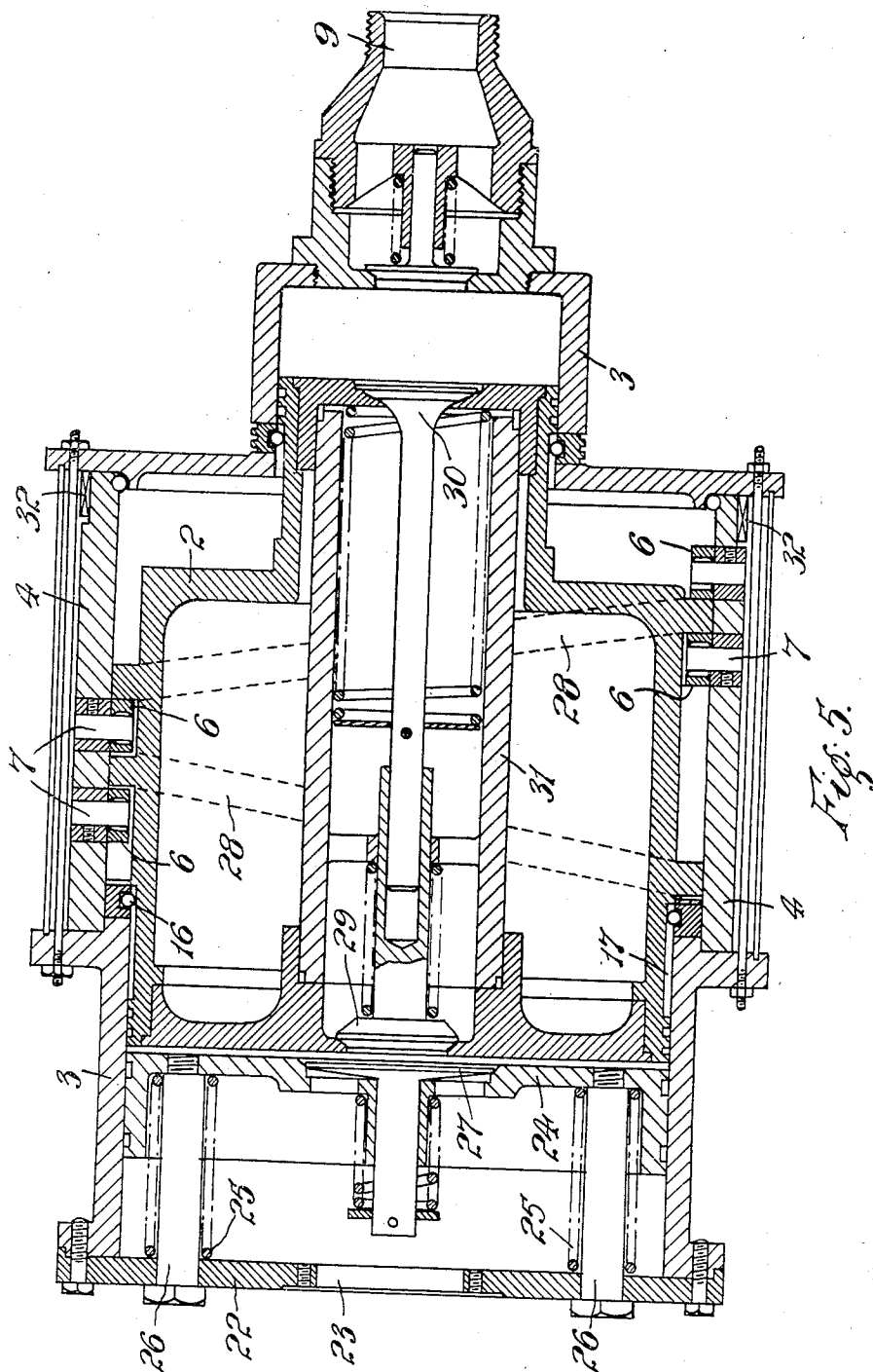
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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,368,013

PUMP OR COMPRESSOR

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EnglandApplication February 18, 1944, Serial No. 522,945
In Great Britain December 16, 1942

6 Claims. (Cl. 103—175)

The object of the present invention is to improve the efficiency of pumps or compressors of the reciprocating plunger type and at the same time to provide a novel, simple and compact construction therefor, the improved pump or compressor being capable of application for a wide variety of purposes, especially where high pressures are required.

A further object of the invention is to avoid the present necessity in pumps and compressors of the type referred to for the use of glands and stuffing boxes and to provide a pump or compressor which can be continuously operated for long periods of time with the minimum of attention and the maximum of efficiency.

Another object of the invention is to maintain a predetermined constant pressure of the fluid at the delivery end of the pump in cases where the density of the fluid entering the pump is subject to variation, such, for example, as is experienced with air pumps or compressors on aircraft where the barometric pressure varies with the altitude of the machine.

In a pump or compressor of the kind herein referred to embodying the present invention the movement of the plunger in each direction is derived directly and in a positive manner from a rotatable driving member arranged co-axially therewith.

For this purpose the co-action between the rotatable driving member and the plunger is by means of cam surfaces on the one part co-operating with projections or rollers on the other part. For example, the plunger may be provided around its periphery with a cam-shaped groove adapted for engagement by one or more rollers or projections on the driving member, or vice versa. Alternatively, the plunger may be provided around its periphery with a cam-shaped rib or flange adapted for engagement by or with one or more pairs of rollers or projections on the driving member, or vice versa.

In every case the formation of the cam surfaces is such that the plunger makes one or more complete reciprocations during each complete revolution of the driving member.

In the accompanying drawings,

Figure 1 is a view in axial plane section of a single stage double-acting pump or compressor embodying the present invention.

Figure 2 is a part transverse sectional view thereof on the line A—A.

Figure 3 is a view in axial plane section illustrating the application of the present invention

to a pump or compressor constructed for two-stage compression.

Figure 4 is a part cross-sectional view thereof on the line B—B.

Figure 5 is a view in axial plane section of a two-stage compressor embodying this invention and provided with means for varying the cubic capacity of the barrel at the intake end thereof.

Figure 6 is an end view thereof as seen from the right-hand.

Referring to the single-stage double-acting pump or compressor shown in Figures 1 and 2, the movement of the plunger 2 in each direction in the barrel 3 is derived directly and in a positive manner from a rotatable driving member 4 arranged co-axially therewith. For this purpose the plunger, in the specific example shown, is provided around its periphery with a cam-shaped groove 5 adapted for engagement by rollers 6 carried by radial pins 7 secured to the driving member 4 so that as the latter rotates the co-action between the said rollers and groove causes the plunger to be reciprocated in the barrel. A similar result may be obtained by forming the plunger with a cam-shaped rib or flange instead of a groove. In each case the arrangement may be reversed, that is to say, the groove or rib may be formed in or on the driving member and the rollers carried by the plunger, the effect produced being the same in each case. By a suitable formation of the cam surfaces formed by the groove or rib the plunger may be caused to make one or more complete reciprocations for each complete revolution of the driving member.

The barrel 3 is made in two transversely divided parts each having inlet and outlet connections 8, 9 respectively at its otherwise closed outer ends. It will be observed that no glands or stuffing boxes are required to maintain the improved pump in efficient working order.

The driving member 4, which may take the form of a belt pulley, as shown, or of a toothed gear member, is mounted so as to be free to rotate upon the two parts of the divided barrel 3 and is formed with an internally projecting annular web 10 or flange which protrudes between the inner ends thereof and carries the pins 7 for the rollers 6. Ball thrust bearings 11 are preferably provided between this web or flange on the driving member 4 and the adjacent inner ends of the two parts of the divided barrel.

The inlet and outlet connections 8, 9 at each end of the barrel are each provided with a one-way valve and in order to ensure that the outlet valve 12 at each end is firmly closed when the

inlet valve 13 is open and to avoid the use of springs for this purpose, the said inlet and outlet connections at one end of the pump may, as shown, be inter-connected by piping 14 with those at the other end thereof so that the outlet valve at one end of the pump is held on its seat by the pressure of the fluid at the other end thereof.

The two parts of the barrel may be mounted in and secured to a suitable frame or base member 15. The plunger may be prevented from rotation in any suitable manner, as by means of balls 16 carried by the barrel and engaging axial grooves 17, in the plunger, or vice versa.

Where pressures higher than can be obtained with single stage compression are required, multi-stage compression may be employed and an example of this form is shown in Figures 3 and 4. In this case the opposite ends of the plunger 2 are made of different diameters and the low pressure end of the barrel, which, as before, is arranged co-axially with the driving member 4, is connected with the high pressure end by means of a transfer passage 18 which, as shown, may be made through the plunger, or in the wall of the barrel, or, if desired, may take the form of an outside pipe, and in any case is controlled by one or more one-way valves, such as the ball valves 19. Otherwise the general construction and operation of the pump or compressor is substantially the same as above described, the plunger 2 being reciprocated by the co-action between a cam-shaped groove 5 therein and rollers 6 carried by the rotatable driving member 4. Ball thrust bearings 11 are employed between the latter and the flanged outer ends of the two parts of the barrel 3. In the example shown, the fluid enters the low pressure end of the barrel by means of a non-return spring-controlled valve 20 of the poppet type and is delivered at the high pressure end of the barrel, which is preferably hollow and water-cooled, through a one-way valve, such as the ball valve 21. The intermediate part of the plunger in which the cam-shaped groove 5 is formed, may, as shown, be made of a larger diameter than that of its low pressure end.

Where the density of the fluid entering the pump is subject to variation and it is desired to maintain a pre-determined constant pressure of the fluid at the delivery end of the pump, means may be incorporated therein whereby the cubic capacity of the pump varies automatically and inversely as the density of the fluid entering the barrel. The application of this part of the invention to a two-stage pump or compressor, embodying the other features of the invention hereinbefore described, is shown in Figures 5 and 6. In this case the low pressure end of the barrel, 3, which is closed by a fixed plate 22 having a fluid inlet orifice 23, is fitted with a piston 24 which seals the end of the barrel and is normally and yieldably held in position by means of springs 25 carried by guide pins 26 secured to the piston and slidably mounted in the fixed plate 22. The said piston is provided with a non-return inlet valve 27, and the arrangement is such that when the pressure of the fluid delivered at the high pressure end of the barrel tends to rise above or fall below a pre-determined value the piston automatically adjusts its position in the end of the barrel to decrease or increase the cubic capacity thereof at the intake end, thereby maintaining the delivery pressure at the predetermined value irrespective of the density of the

fluid entering the pump. Instead of using springs the position of the piston may, if desired, be automatically adjusted by mechanical, electrical, hydraulic or pneumatic means controlled by the delivery pressure.

In any of the above described constructions the plunger may, as shown in Figure 5, be formed or provided with two cam-shaped ribs 28 (or grooves 5) of opposite sense and the driving member 4 with pairs of rollers 6 for co-operation therewith. Figure 5 also shows an alternative arrangement for establishing communication between the low and high pressure ends of the barrel by means of spring-loaded non-return poppet valves 29, 30 and a tubular member 31 arranged between the large and small ends of the plunger. The same figure also shows a driving member 4 provided with gear teeth 32 for driving purposes.

Instead of the piston 24 shown in Figure 4, a similar spring-loaded member may be mounted in a recess in the low pressure end of the plunger and in this case a non-return valve controlling a transfer passage through the plunger may be conveniently mounted in said member.

I claim:

1. A pump or compressor of the kind herein referred to comprising a transversely divided barrel closed at its outer ends and having valve-controlled inlet and outlet ports at each of said outer ends, a plunger free to be reciprocated in said barrel and having a peripheral groove inclined to the axis thereof, a driving member rotatably mounted on said barrel co-axially therewith, and means carried by said member and protruding between the parts of the divided barrel for engagement with the groove in said plunger.

2. A pump or compressor of the kind herein referred to comprising a transversely divided barrel closed at its outer ends and having valve-controlled inlet and outlet ports at each of said outer ends, a plunger free to be reciprocated in said barrel and having a peripheral flange inclined to the axis thereof, and protruding between the parts of said divided barrel, a driving member rotatably mounted on said barrel co-axially therewith, and rollers carried by said barrel and adapted to bear against each side of the inclined flange on said plunger.

3. A pump or compressor comprising a barrel divided transversely into high and low pressure chambers of different diameters, said low pressure chamber being provided with a valve controlled inlet port and said high pressure chamber having a valve-controlled outlet port, a plunger having high and low pressure ends of different diameters adapted for reciprocation in the high and low pressure chambers respectively of said divided barrel, means for establishing valve-controlled communication between said low and high pressure chambers, and a driving member rotatably mounted on said divided barrel co-axially therewith, said driving member and plunger having co-operating parts adapted on rotation of the former to cause reciprocation of the latter in said barrel.

4. A pump or compressor comprising a barrel divided transversely into high and low pressure chambers of different diameters, said low pressure chamber being provided with a valve controlled inlet port and said high pressure chamber having a valve-controlled outlet port, a plunger having high and low pressure ends of different diameters adapted for reciprocation in the high and low pressure chambers respectively of said

divided barrel, said plunger having an intermediate portion formed with peripheral cam surfaces, means for establishing non-return valve-controlled communication between said low and high pressure chambers, and a driving member rotatably mounted on said divided barrel co-axially therewith, said driving member co-operating with the cam surfaces on said plunger to cause reciprocation of the latter in said barrel.

5. A pump or compressor of the kind herein referred to comprising a barrel having high and low pressure chambers, a plunger having high and low pressure ends free to be reciprocated in said chambers respectively, valve-controlled means for establishing non-return communication between the low and high pressure chambers of said barrel, means for varying the cubic capacity of the low pressure chamber according to the density of the fluid entering the same, and a rotatable driving member mounted co-axially with said barrel, said driving member and

plunger having co-operating parts adapted on rotation of the former to cause reciprocation of the latter in said barrel.

6. A pump or compressor of the kind herein referred to comprising a barrel having high and low pressure chambers, a plunger having high and low pressure ends free to be reciprocated in said chambers respectively, said plunger being also provided with peripheral cam surfaces, valve-controlled means for establishing non-return communication between the low and high pressure chambers of said barrel, a spring loaded piston closing the outer end of said low pressure chamber, a fluid inlet valve in said piston opening to said low pressure chamber, and a rotatable driving member mounted co-axially with said barrel and adapted for co-operation with the cam surfaces on said plunger to cause reciprocation thereof in said barrel.

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