[Second Edition.]

PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION.

Improvements in Pumps.

I, GEORGE CONSTANTINESCO, of "Carmen Sylva", Beechwood Avenue, Oatlands Park, Weybridge, in the County of Surrey, a subject of the King of Great Britain and Ireland, do hereby declare the nature of this invention to be as follows:—

The present invention relates to pumps and has for its object to construct a pump which will give a variable alternating or continuous flow of liquid with a pump piston having a constant displacement.

The invention consists in a pump comprising a double acting piston working in a cylinder or two independent pistons working in two separate cylinders, the cranks driving the piston being 180° apart. The two cylinders are connected to a double acting inertia device comprising a weight carried by two pistons working in cylinders which are in communication with the pump cylinders.

The invention further consists in a pumping device of this type having suction valves leading to the two sides of the pump piston and delivery valves leading to a discharge vessel from the two sides of the pump piston whereby a continuous flow of liquid is delivered from the pump.

The invention further consists in the use of a variable inertia device for varying the maximum pressures in the system without interfering with the speed of the prime mover.

The invention also consists in the improvements in pumps hereinafter described.

In carrying the invention into effect according to one example as applied to a pump in which a continuous flow of liquid is delivered, a double acting piston is reciprocated by a prime mover in any suitable manner. The double acting piston is situated in a cylinder whose two ends communicate with inlet valves and delivery valves and also with two cylinders in which a double acting piston works, this double acting piston carrying a weight or being restrained by a pendulum, flywheel or other inertia device. The two delivery valves lead to a discharge passage in which there may be situated an air vessel and the usual delivery pipe.

The operation of the above described pump is as follows:—

Suppose that the suction valves are each in permanent communication with a liquid tank under a given constant pressure, if the air is expelled from the system and the pump cylinders filled with liquid together with the other pipes and cylinders in communication with these, for any given oscillation of the pump piston the liquid will transmit movement to the inertia device. The liquid columns being supposed to be relatively short, the liquid will practically operate as a flexible connecting rod.

If the frequency of the pump piston increases the inertia will oppose considerable reactance to the motion and considerable pressures would be generated in the pump cylinder. These pressures would be greater or less according to the speed of the pump piston, but the displacement of the inertia device will always be the same as the displacement of the pump piston.

At each suction stroke of the pump piston a fall of pressure will take place on the corresponding side of the piston. The inertia device, however, will not be able to follow the liquid column immediately and thus the suction valve on that side will open and liquid will enter the cylinder. On the pressure stroke of the pump piston the pressure generated would not be able to move the inertia device immediately, and some liquid will therefore be discharged through the delivery valve.

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If the pressure in the air vessel rises to a certain limit, the delivery valve will not open and the inertia device will then simply be kept swinging to and fro, the motion going on without any absorption of power by the prime mover driving the pump. When, however, the pressure in the air vessel diminishes, for example, by utilising the liquid which has been stored there under pressure, the delivery valve will again open and work will be done by the prime mover depending on the amount of flow from the air vessel.

It will be readily seen that the maximum pressure obtained at the delivery valves is a function of the frequency of the pump and therefore by speeding up or slowing down the prime mover, different maximum pressures may be obtained.

If the delivery valves are dispensed with, the apparatus may be used directly as a source of alternating pressures, which can be used to drive various types of machines, ratchet motors and the like, in fact any machine requiring an alternating pressure of liquid.

Instead of using an inertia device merely consisting of a weight as above described, an ordinary pipe filled with liquid and of sufficient length may be employed between the pump cylinders. The inertia of the liquid in this pipe will act in the same way as the weight above described.

In some cases it is desirable to employ a variable inertia device. This may be done by constructing the inertia device as a pendulum, the pistons oscillating the pendulum being attached to a point on the pendulum rod. To vary the inertia this point may be moved relatively to the point of support of the pendulum.

Instead of a pendulum a flywheel may be employed oscillated by a crank of variable or adjustable length, the two inertia pistons acting in opposite directions on this crank.

A variable inertia device of the pipe type may be obtained by using telescopic tubes which will permit the length of liquid column to be lengthened or shortened. By using variable inertia devices as above described, the maximum pressures in the system may be varied without varying the speed of the prime mover.

The invention, however, is more particularly applicable to cases in which the prime mover is a machine giving a constant torque but capable of variations of speed between certain limits. Variation of the speed between these limits will produce considerable variation of pressure at the delivery of the pump. The apparatus is thus extremely suitable for traction purposes on vehicles; for example, in a traction engine an internal combustion engine may be provided driving the pump. The two pump cylinders are connected by pipes to another double acting piston driving a ratchet motor. In this case only two suction valves are provided, delivery valves not being required.

Instead of a ratchet motor an ordinary hydraulic rotary motor may be employed and in such case the pump would be provided with two delivery valves as above described in order to secure a continuous flow of liquid. The exhaust frcm the hydraulic motors would then be returned through the suction valves of the pump.

The invention is also applicable to hydraulic installations in which it is required to always maintain a given pressure of liquid. By means of the invention this can be obtained without the use of any safety discharge valve or other form of cut-off. The work done by this pump is automatically regulated by the delivery from the air vessel and delivery reservoir and if higher pressures are required all that is necessary is to accelerate the prime mover or to increase the inertia.

Dated this 16th day of September, 1922.

W. GRYLLS ADAMS,
87, Victoria Street, London, S.W. 1,
Chartered Patent Agent.

COMPLETE SPECIFICATION.

Improvements in Pumps.

I, George Constantinesco, of "Carmen Sylva", Beechwood Avenue, Oatlands Park, Weybridge, in the County of Surrey, a subject of the King of Great Britain and Ireland, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The present invention relates to pumps and has for its object to construct a pump which will give a variable alternating or continuous flow of liquid with a pump piston having a constant displacement

The invention has no relation to apparatus in which the compressibility of liquids is made use of as described in my Patent Specification No. 9029 of 1913.

The invention consists in a pump comprising a double acting piston working in a cylinder or two independent pistons working in two separate cylinders, the cranks driving the pistons being in suitable relative phase apart, while the cylinders are arranged so that they are caused to oscillate an inertia device.

The invention also consists in such a pump in which the inertia device comprises a solid mass carried by two pistons working in cylinders which are in communication with the pump cylinders.

The invention further consists in such pumps in which the inertia is provided by a column of liquid acting as a solid mass in a pipe communicating with the pump cylinders.

The invention further consists in a pumping device of this type having suction valves leading to the two sides of the pump piston and delivery valves leading to a discharge vessel from the two sides of the pump piston whereby a continuous flow of liquid is delivered from the pump.

The invention further consists in the use of a variable inertia device for varying the maximum pressures in the system without interfering with the speed of the prime mover.

The invention further consists in utilising the pumps of the type described for transmitting power from prime movers such as internal combustion engines to driven shafts.

The invention further consists in using for such apparatus in combination with pumps of the type described ratchet motors or hydraulic motors of ordinary types.

The invention also consists in the improvements in pumps and means for applying such improved pumps hereinafter described.

Referring to the accompanying diagrammatic drawings:—

Figure 1 shows one form of pump constructed according to the invention;

Figure 2 is a diagram showing another modification;

Figure 3 shows a modification in which the inertia of the liquid column is employed, while

Figure 4 shows the pump applied to the driving of a ratchet motor;

Figure 5 shows a four-phase arrangement of the pump, while

Figure 6 shows a method of employing a variable inertia.

In carrying the invention into effect according to one example as applied to a pump in which a continuous flow of liquid is delivered, a double acting piston is reciprocated by a prime mover in any suitable manner. The double acting piston is situated in a cylinder whose two ends communicate with inlet valves and delivery valves and also with two cylinders in which a double acting piston works, this double acting piston carrying a weight or being restrained by a pendulum, flywheel or other inertia device. The two delivery valves lead to a discharge passage in which there may be situated an air vessel and the usual delivery pipe.

In the form of the invention shown in Figure 1, the driving shaft *a* carries a crank *b* connected by the connecting rods *c d* to opposed pistons *e f* working in co-axial cylinders *g h*, suction valves *k l* being provided in the ends of the cylinders. The ends of the cylinders are in communication with parallel cylinders *n m* having delivery valves *o p* at their ends. Opposed pistons *q r* are provided in these cylinders connected by rods *s t* with a lever *u* carrying a mass *v* and pivoted at a fixed pivot *w*. Springs *y z* are provided tending to keep the swinging mass in its mean position.

The operation of the above described pump is as follows:—

Supposing that the suction valves *k l* are in permanent communication with a liquid tank under given constant pressure, the pump cylinders *g h m n* being filled with liquid together with the other pipes in the system. Then for any given oscillation of the pump pistons *e f* the liquid will transmit movement to the lever *u* and mass *v*. Since the liquid columns are relatively short, the liquid will practically operate as a flexible connecting rod. If the frequency of the pump piston increases the inertia of the mass *v* will oppose considerable reactance to the motion and considerable pressures will be generated in the pump cylinders. When there is no delivery from the pump these pressures will be greater or less according to the speed of the pump pistons *e f*, but the displacements of the point of connection *x* to the inertia device will always be the same as the displacement of the pump pistons *e f*. When the pump is delivering liquid the pressures diminish and the displacement of the inertia will be less than that of the pump pistons *e f*. At each suction stroke of the pump piston a fall of pressure will take place on the corresponding side of the piston. The inertia device, however, will not be able to follow the liquid column immediately and thus the suction valve on that side will open and liquid will enter the cylinder. On the pressure stroke of the pump piston, the pressure generated will not be able to move the inertia device immediately and some liquid will, therefore, be discharged through the delivery valve, if the back pressure is not higher than the pump pressure.

If the back pressure rises to a certain limit, the delivery valve will not open and the inertia device will then simply be kept swinging to and fro, with its maximum stroke, the motion going on without any absorption of power by the prime mover driving the pump except to overcome friction. When, however, the back pressure diminishes, for example, by utilising the liquid the delivery valve will again open and work will be done by the prime mover depending on the amount of flow.

It will be readily seen that the maximum pressure obtained at the delivery valves for constant flow is a function of the frequency of the pump and therefore by speeding up or slowing down the prime mover, different maximum pressures may be obtained for the same flow.

It is obvious that this pump produces pressures even when there is no flow and this property enables it to be used as a governor by allowing such pressure to act on a suitable servo-motor; the pressure rising as the square of the speed.

In the form of the invention shown in Figure 2, a double acting piston is employed in each of the pump cylinders. The crank *b* of the prime mover is connected by the rod 1 with the piston rod 2 carrying a double acting piston 3. The double acting piston 4 is connected by the rod 5 with an oscillating flywheel 6. Suction valves 7, 8 are provided on the suction side and delivery valves, 9, 10 on the delivery side. The small passage 11 leads from the delivery pipe 12 to a piston 13 in a cylinder 14 which is connected by the connecting rod 15 with a swinging flywheel 6 which oscillates about a fixed point 16. The piston 13 serves to maintain the mean position of the oscillating flywheel 6 and it will be seen that as the pressure in the delivery passage increases, the force acting on the oscillating mass is automatically increased, so that forces tending to keep the oscillating flywheel in the mean position are increased automatically with the forces producing the oscillations.

In the form of the invention shown at Figure 3, the weight or mass is dispensed with and the inertia required is obtained by the use of an ordinary pipe filled with liquid and of suitable length.

In this case, as illustrated, the prime mover crank *b* is connected to two opposed pistons *e f* by the connecting rods *c d*. The heads of the pump cylinders *g h* are connected by a long pipe 21 and the suction valves *k l* and delivery valves *o p* are situated in the sides of the cylinders. Liquid is drawn in through the suction passage 23 and delivered at 24.

It will be seen that with such an arrangement the pressure at the point 25 in the pipe 21 is substantially constant. In a multi-phase arrangement formed of a number of units similar to that illustrated, all these constant pressure points may be interconnected.

If the delivery valves are dispensed with, the apparatus may be used directly as a source of alternating pressures, which can be used to drive various types of machines, ratchet motors and the like, in fact any machine requiring an alternating pressure of liquid.

In the modification of the apparatus shown in Figure 4, the driving crank *b* is connected by the connecting rods *c d* with opposed pistons *e f*, the inertia being provided by the column of liquid in the pipe 21. In this case suction valves *k l* are employed as before, but the delivery valves are dispensed with, the pump cylinders *g h* being in direct communication with the cylinders 31, 32 in which work opposed pistons 33, 34 connected to a swinging lever 35 oscillating about a fixed pivot 36 and actuating a pair of ratchet devices 37, 38 which act on the driven rotor 39 which is pivoted at the fixed pivot 40.

This application is particularly suitable for cases in which the prime mover is a machine giving a constant torque, but capable of variation of speed between certain limits. Variation of speed between these limits will produce considerable variation of pressure at the delivery of the pump. The apparatus is thus extremely suitable for traction purposes of vehicles; for example, in a traction engine, an internal combustion engine may be provided driving the pump the two pump cylinders being connected to the double opposed pistons or double acting piston driving a ratchet motor as above described.

Instead of a ratchet motor an ordinary hydraulic rotary motor may be employed and in such case the pump would be provided with two delivery valves as above described in order to secure a continuous flow of liquid. The exhaust from the hydraulic motors would then be returned through the suction valves of the pump.

In the modification of the invention shown in Figure 5, four pistons 41, 42, 43, and 44 are employed connected to a single driving crank 45. These pistons work in radially arranged cylinders 46, 47, 48 and 49 communicating through suction valves 50, 51 with suction passages 52, 53, and through delivery valves 54, 55 with delivery passages 56, 57. All the cylinders are in direct communication with an inertia pipe 58, the column of liquid in which serves as an inertia. The pipe is broken off in Figure 5 at the points 59, a considerable length of liquid column being provided at this broken off part to provide the necessary length of column to give the inertia required.

The apparatus operates in a similar manner to that above described in connection with the two-phase arrangement.

In some cases it is desirable to employ a variable inertia device. This may be done by constructing the inertia device as a pendulum, the pistons oscillating the pendulum being attached to a point on the pendulum rod. To vary the inertia this point may be moved relatively to the point of support of the pendulum.

If it is desired to provide a variable inertia, this may be effected as shown in Figure 6. The apparatus illustrated in this figure is suitable for attachment, for example, at the points 59 in the apparatus shown in Figure 5, the broken off ends of the pipe being connected to the casting illustrated at the points 60, 61. This casting comprises two branches 62, 63, which are placed in communication by means of a slidable U shaped pipe 64 which is connected to the ends of the branches 62, 63, suitable glands 65, 66 being provided to make liquid tight joints at the junction. The pipe 64 is embraced by a socket 67 connected to a rod 68 which can be raised or lowered by turning the nut 69 by means of the handle 70. With this device the inertia of the liquid column can be increased or decreased by merely turning the handle 70 to raise or lower the U shaped pipe 64.

A pendulum or flywheel may be employed oscillated by a crank of variable adjustable length, the two inertia pistons acting in opposite directions on this crank.

A variable inertia device of the pipe type may be obtained by using telescopic tubes which will permit the length of liquid column to be lengthened or shortened. By using variable inertia devices as above described, the maximum pressures in the system may be varied without varying the speed of the prime mover.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A pump comprising a double acting piston working in a cylinder or two independent pistons working in separate cylinders, the cranks driving the pistons being in suitable relative phase while the cylinders are arranged so that they are caused to oscillate an inertia device.

2. A pump as claimed in Claim 1 in which the inertia device comprises a weight or weights carried by two pistons working in cylinders which are in communication with the pump cylinders.

3. A pump as claimed in Claim 1 in which the inertia is provided by a column of liquid oscillating substantially *en bloc* in a pipe or pipes communicating with the pump cylinders.

4. A pump device as claimed in Claim 1 having suction valves leading to the two sides of the pump pistons and delivery valves leading to a discharge vessel from the two sides of the pump piston whereby a continuous flow of liquid is delivered from the pump.

5. In a pump as claimed in Claim 1 variable inertia devices for varying the maximum pressures in the system without interfering with the speed of the prime mover.

6. A pump of the type claimed in Claim 1 applied to the transmission of power from prime movers such as internal combustion engines to driven shafts.

7. In combination with a pump as claimed in Claim 1 a ratchet motor or hydraulic motor for transmitting power from a driving shaft to a driven shaft.

8. The improved pump hereinbefore described and illustrated at Figure 1 of the accompanying drawings.

9. The improved pump hereinbefore described and illustrated at Figure 2 of the accompanying drawings.

10. The improved pump hereinbefore described and illustrated at Figure 3 of the accompanying drawings.

11. The improved means for transmitting power hereinbefore described and illustrated at Figure 4 of the accompanying drawings.

12. The improved means for transmitting power hereinbefore described and illustrated at Figure 5 of the accompanying drawings.

13. The improved inertia device hereinbefore described and illustrated at Figure 6 of the accompanying drawings.

Dated the 16th day of June, 1923.

W. GRYLLS ADAMS,
87, Victoria Street, London, S.W. 1,
Chartered Patent Agent.

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Fig.1.

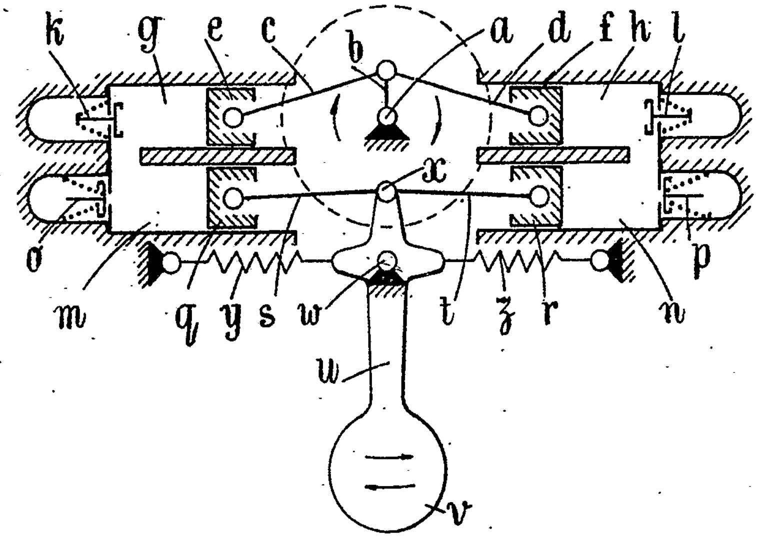


Fig.2

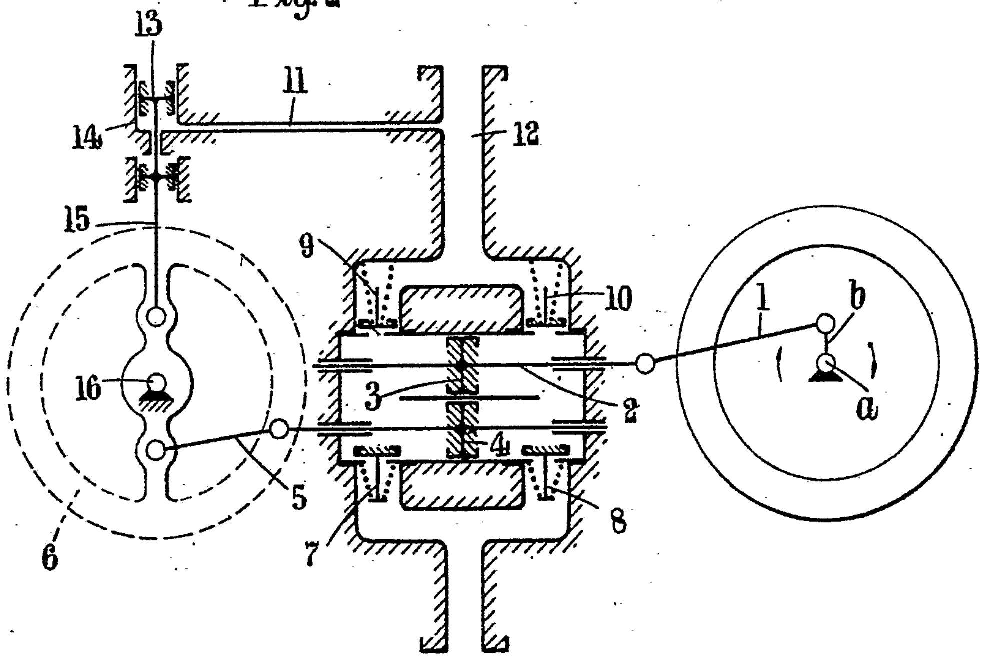


Fig. 3.

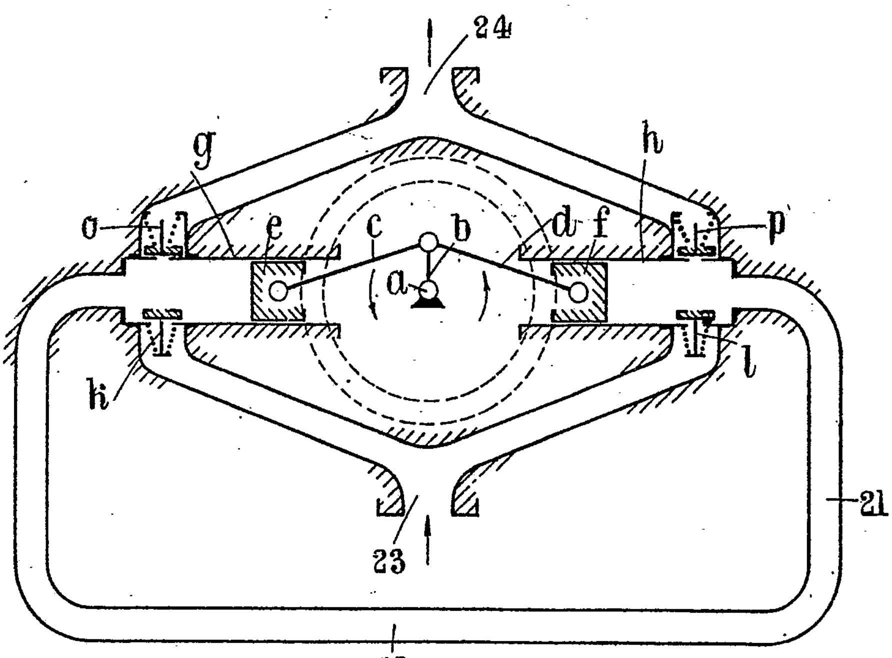
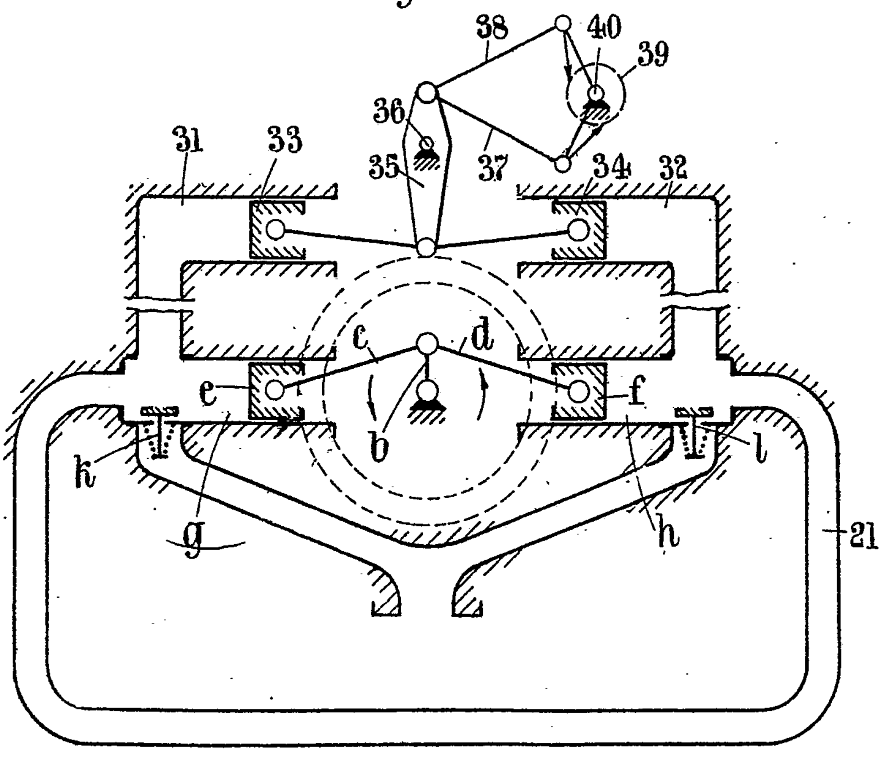


Fig. 4.



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SHEET 1

Fig.1.

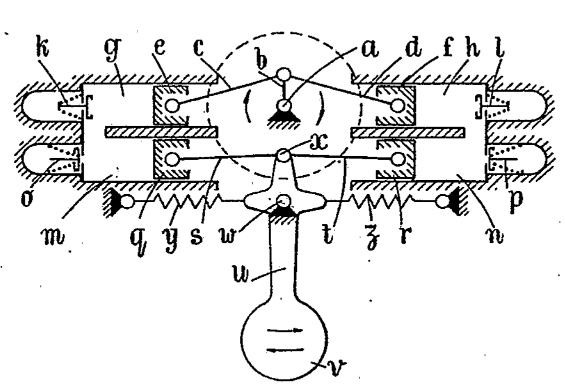
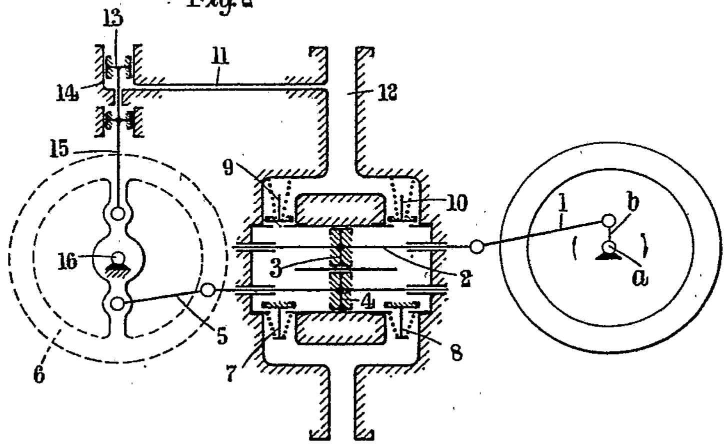


Fig.2



SHEET 2

Fig.3.

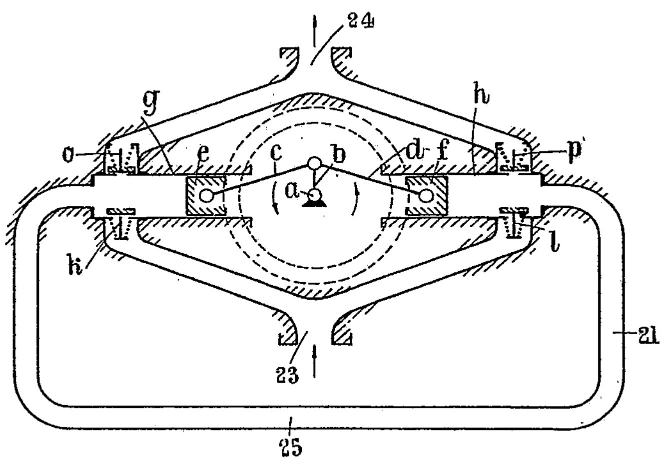


Fig.4.

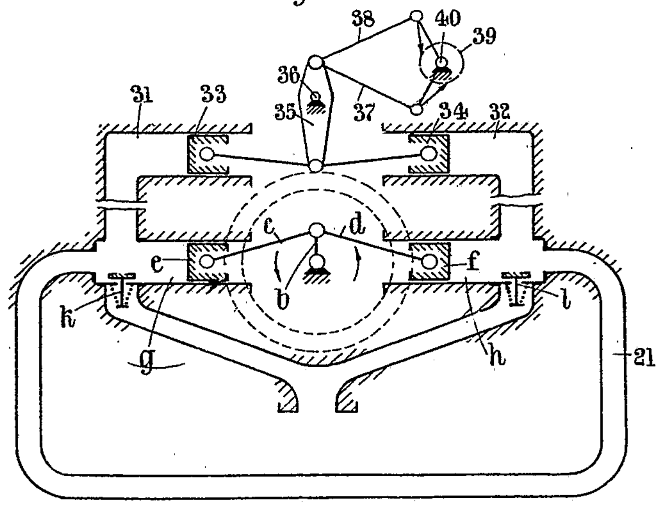


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Fig.5.

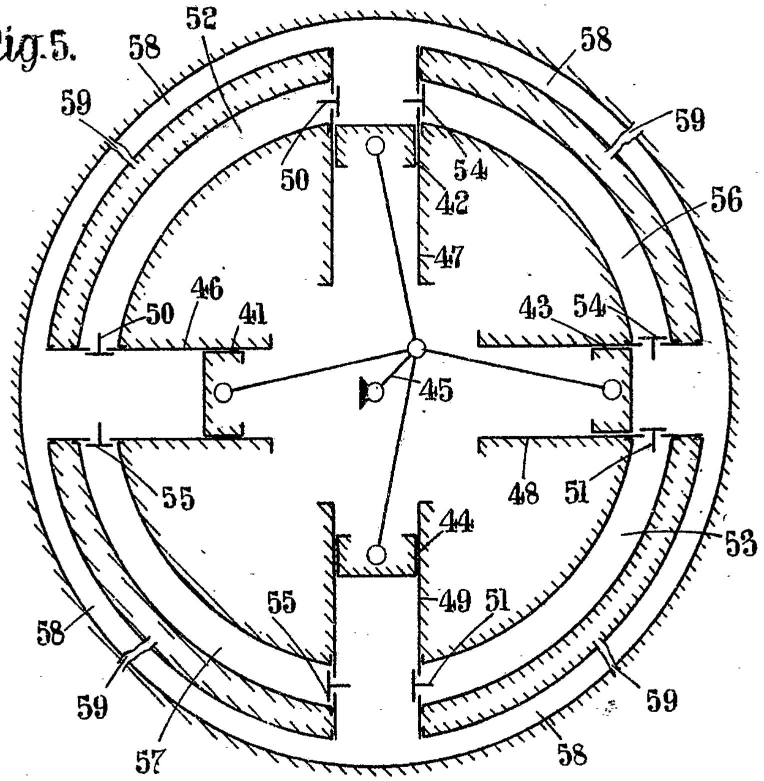

Fig.6.