Oct. 7, 1930. K. G. JOHANSSON 1,777,923

PUMP

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Fig. 1.

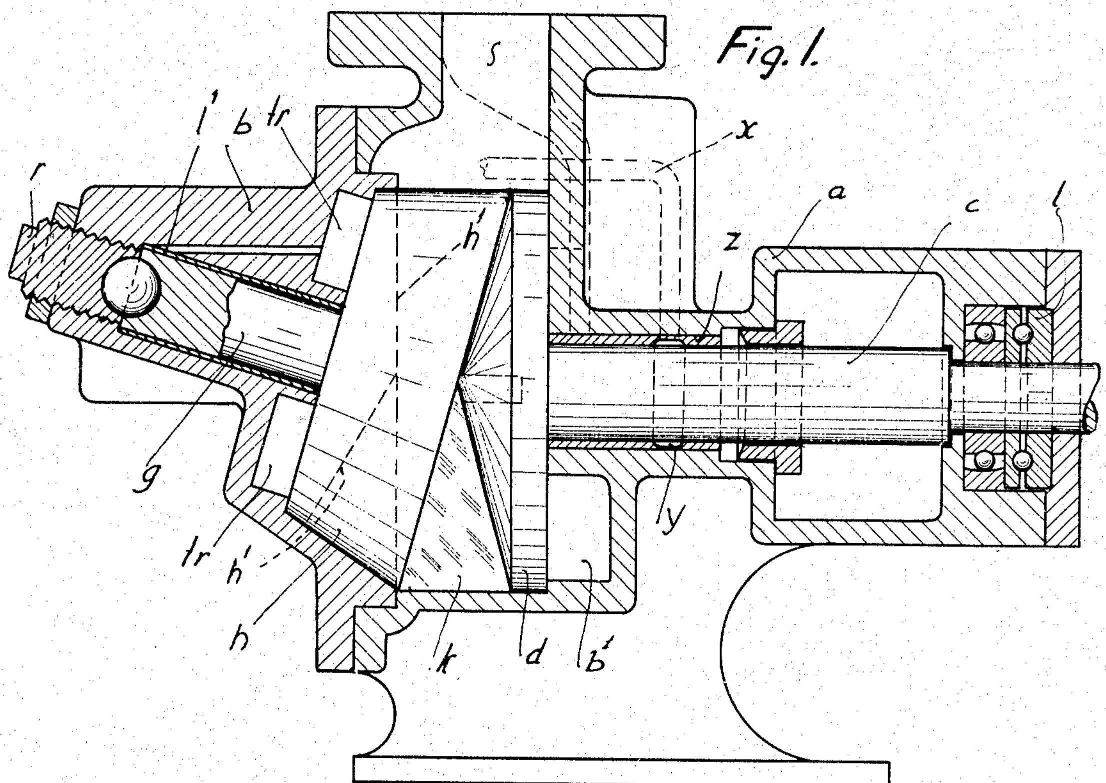

Fig. 11.

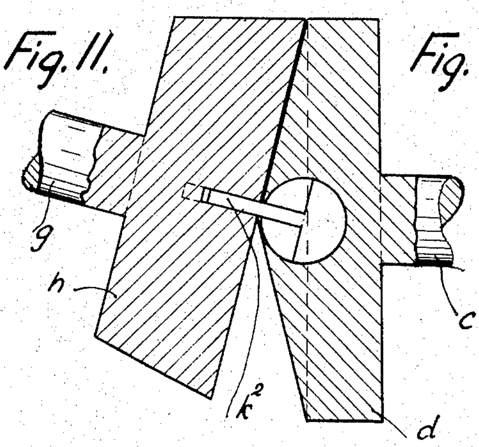

Fig. 12.

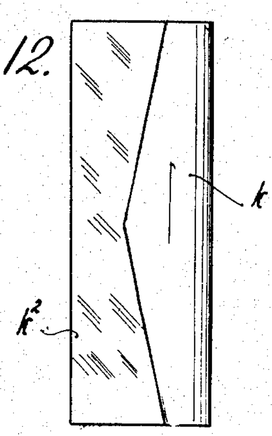

Fig. 13.

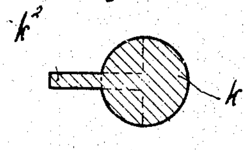

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Fig. 2.

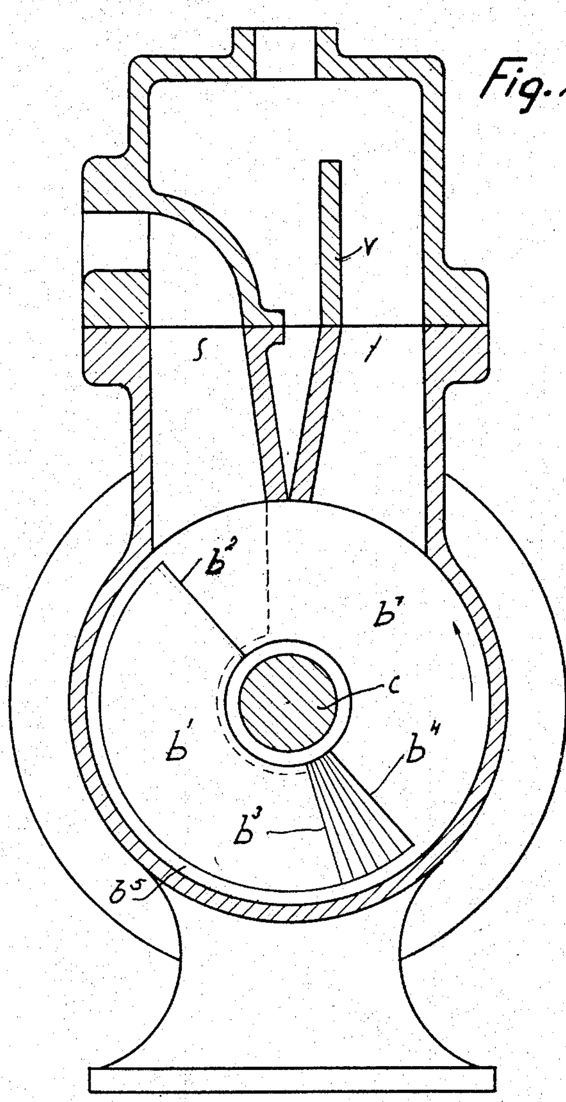

Fig. 3.

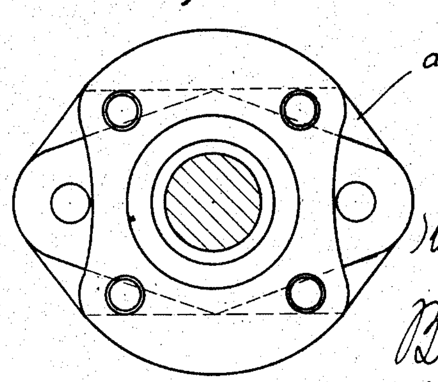

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Fig. 4.

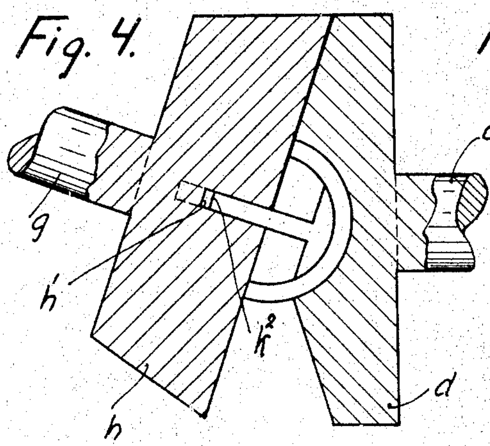


Fig. 5.

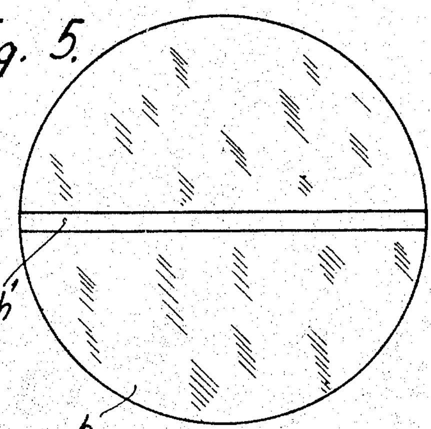


Fig. 6.

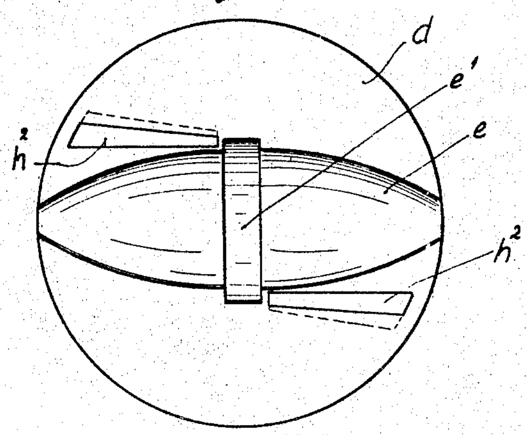


Fig. 7.

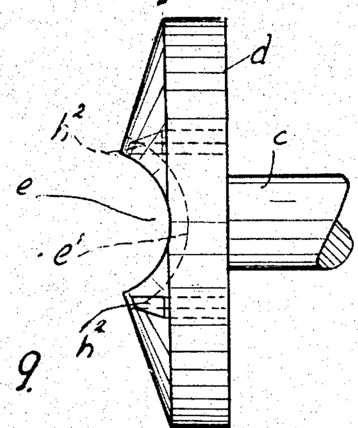


Fig. 8.

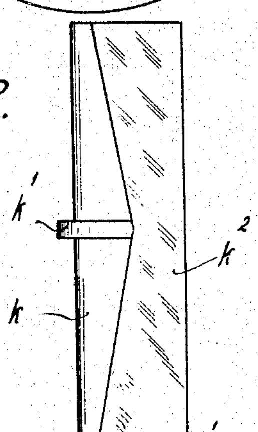
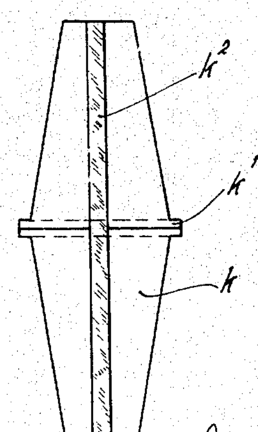


Fig. 9.



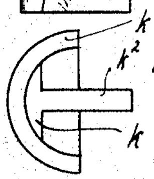


Fig. 10.

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Fig. 14.

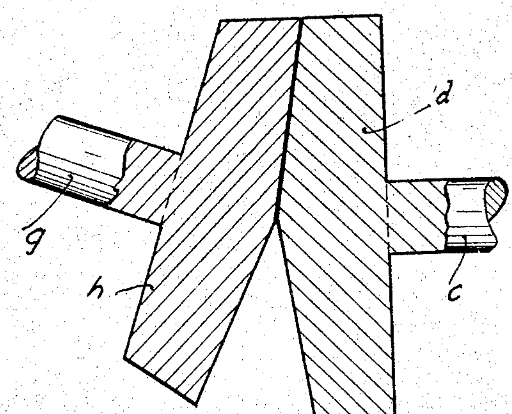

Fig. 15.

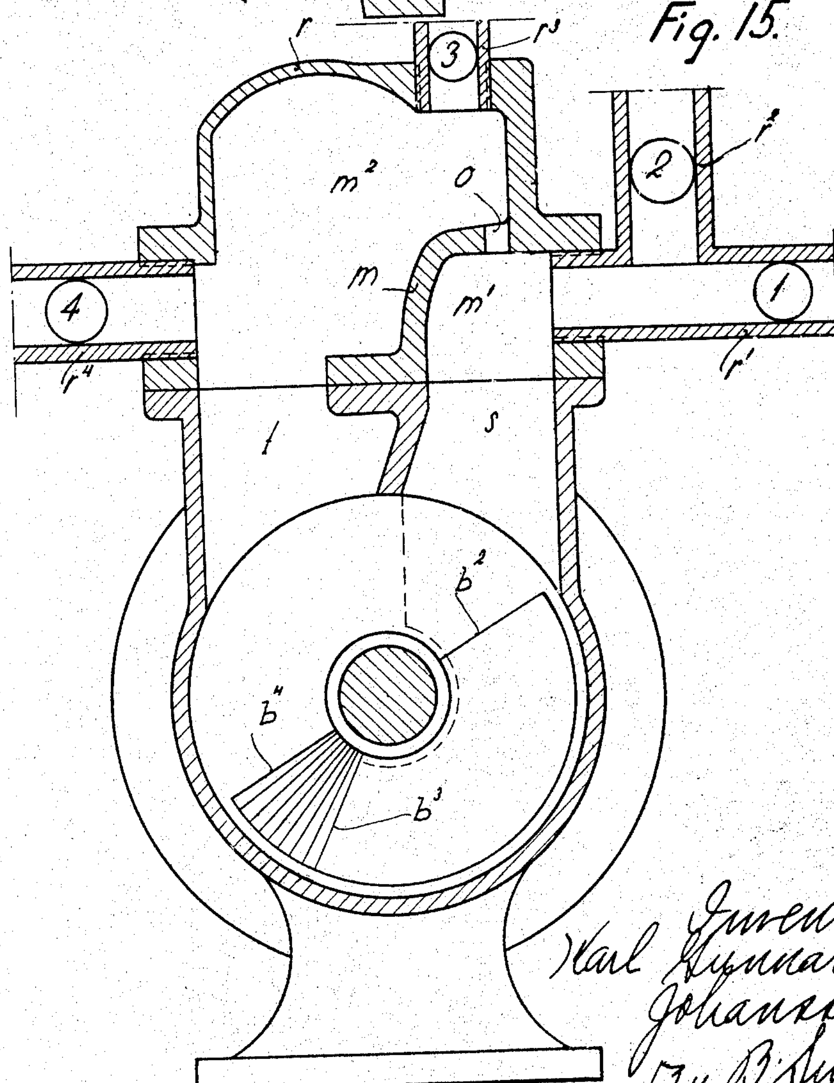

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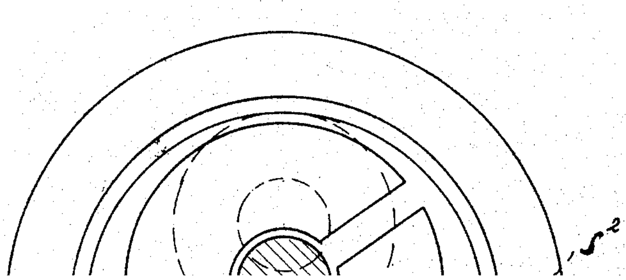
Fig 16.



Patented Oct. 7, 1930

1,777,923

UNITED STATES PATENT OFFICE

KARL GUNNAR JOHANSSON, OF FRIDHEM, STORVRETA, SWEDEN

PUMP

Application filed February 1, 1928, Serial No. 251,207, and in Sweden October 9, 1926.

This invention relates to improvements in rotary pumps, the object of the invention being to provide an improved pump of this class which is simple in construction, is strong and durable, which operates efficiently and which is not likely to get out of order.

With the above and other objects in view, the invention consists in the construction, combination and arrangement of devices hereinafter described and claimed.

In the drawing which shows a detailed example with axially arranged inlet, Fig. 1 is a longitudinal section and Fig. 2 a cross section with the base of the frame uncut and Fig. 3 a view of the right end of the pump. Figs. 4–14 show details. Fig. 15 shows an example of an arrangement which makes possible the using of the pump both as a liquid pump, vacuum pump and air compressor. Fig. 16 shows further a detail.

In a pump casing *a* with a cover *b* are arranged two rotating discs *d* and *h*, the shafts *c*, *g* of which are arranged at an oblique angle to each other.

The shaft *c* of the right disc *d* is journalled by means of a sleeve *l* and ball bearings. The shaft *g* of the left disc *h* is journalled in the cover *b* by means of a sleeve l^1 and rests with its left end against a ball, which in turn is supported by a screw *r* screwed in the cover, which screw makes possible the regulating of the pressure of the discs axially against the tightening surface of the cover. A nut helps lock the screw in the adjusted position.

A piston *k*, Figs. 8–10 (in the example partly prismatic with one cylindrical and five plane surfaces, two of which latter are parallel and situated on a lengthwise running ridge, and with a flange k^1 in the form of a semi cylindrical ring segment in the middle of the cylindrical surface) is sunk in diametrical grooves on both discs and tightens thereagainst. The right disc *d* has a groove *e* and also a recess e^1 for the flange k^1. The bottom h^1 of the groove in the left disc consists of two plane surfaces, which meet at the middle of the disc and form oblique angles to each other. The piston is of such length as to tighten against the inside of the casing and is of suitable diameter.

In the position Fig. 1 the plane surface k^2 of the piston rests against the one, and after half a turn, against the other surface h^1.

In middle position (Fig. 4) the surface k^2 of the piston rests only against the boundary line between the surfaces h^1. Both parallel surfaces of the piston tighten continually against both parallel surfaces in the groove of the left disc, while the cylindrical surface of the piston continually tightens along its entire length against the corresponding groove *e* in the right disc *d*, the recess e^1 of which fits the flange k^1. Hence the piston is rigidly joined to the right disc but makes a rocking movement in axial direction in relation to the left disc.

The left side of the right disc may be conical and the right side of the left disc may be plane, so that a radial tightening line is always formed between the discs, when these are pressed together.

s is the inlet and *t* the outlet in Fig. 2. The inlet is indicated by dotted lines in Fig. 1. The inlet leads to a recess b^1 in the wall in the casing, against which the right side of the disc *d* rests.

This recess can have the form shown in Fig. 2, where it makes a ring segment shaped groove concentrical with the shaft *c*, which groove begins at b^2 and continues with the same axial depth to b^3, where after it becomes less deep, so that its bottom forms a sloping plan from b^3 to b^4, where the groove stops. The groove is limited outwards in radial direction by a concentric bow shaped flange b^5. The groove b^1 is continually connected with the inlet *s*, through a canal. From the groove b^1 the fluid is sucked into the compartment between the discs through two holes h^2 in the disc *d*, each situated eccentrically on its side of the piston *k*, as shown in Figs. 6 and 7.

The discs rotate in the direction of the arrow (Fig. 2). When the piston has passed the tightening line between the discs, a compartment begins to be formed circumferentially between them behind the piston, which compartment widens during the first half of the revolution, so that a vacuum results and fluid is sucked in through the hole h^2. During the other half revolution the volume of the compartment is diminished, and the sucked in fluid is pressed out through the outlet. Between the discs are formed two compartments separated by the piston, both of which compartments function in the same way, but alternately, so that one compartment is enlarged, while the other is made smaller, and hence the fluid is sucked in twice and driven out twice during each rotation.

As a result of the fact that the suction holes in the disc *d* stretch as far towards the centre as space allows, the speed of rotation of the pumps may be very great without danger of the fluids not having time to be sucked in at the proper time or that the suction will be counteracted by the centrifugal force. During the last part of the revolution the hole h^2 is covered by the solid part b^7 in the casing at the ends of the groove b^1, and hence the fluid can not be forced back to the groove b^1 but is forced into the outlet.

As has already been pointed out, the inlet may also be arranged at the disc's circumference, if the speed of the pump does not exceed a certain limit. It has been seen, that by such an arrangement the effect of the pump is lessened, if this limit is passed, possibly because the suction power is neutralized by the centrifugal power. By placing the inlet nearer the shaft this difficulty is avoided, and the speed can be increased as much as may be desired.

A pocket open to the outlet pressure is situated in the wall *v* between the inlet *s* and the outlet *t* and extends over the entire axial length of the outlet opening to contain liquid which serves as a sealing liquid to prevent air leaking back to the inlet when the pump is used for pumping air. A passage t^1 leads from the liquid pocket to a circular recess *tr* on the inside of the cover *b* so that this recess is thus filled with liquid of the same pressure as the pressure in the outlet *t*. As a result of this the left disc *h* is pressed to the left, that is to say, against the disc *d*, with a certain force which contingently can be almost as great as the resistance which the fluid makes, when it is pressed out of the outlet. By this arrangement the friction between the inside of the cover and the left disc and the friction in the axial journal of the shaft *g* is lessened or eliminated.

By an axially arranged inlet one may divide into two parts the ring shaped recess, for instance according to Fig. 16, in order to avoid bending the shaft *g*. Of the two compartments between the discs *h* and *d* separated by the piston *k* one contains pressure fluid at the same time as the other contains suction fluid. As the pressure on the disc *h* from the fluid between the discs thus becomes greater in the former compartment than in the latter, it results in bending stress in the shaft *g*.

In order to prevent this objection the recess, for instance, is divided into two compartments *tr′* and *tr″* by means of a straight dividing flange *f* of the same height as the depth of the recess *tr*, whereby said flange tightens perfectly against the disc *h*.

The flange *f* is then suitably placed according to Fig. 16 at some distance from the centre of the recess *tr* and with substantially the same incline as the border lines b^2, b^4 (Fig. 2) of the groove b^1.

The upper compartment *tr′* is hence situated almost opposite the solid part b^7 and the lower compartment *tr″* is situated almost opposite the groove b^1.

As is evident the compartment between the discs, which is situated opposite the solid part b^7 is connected with the pressure conductor, the other with the suction conductor.

If therefore the upper compartment *tr′* in Fig. 16 is connected with the pressure fluid in the outlet and the lower compartment *tr″*, for instance, is connected by means of a canal s^2 with the suction fluid in the inlet, the advantage gained is that an uneven pressure distribution on the one side of the disc *h* corresponds to a similarly uneven pressure distribution on the other side, and hence the pressure on both sides of the disc *h* wholly or partly counter balance each other, without any bending of the shaft *g* being caused thereby.

It is practical to let the fluid in through a hole in the left disc instead of the right one. The ring shaped recess b^1 then has its place on the inside of the cover to the left of the left disc. In this case the ring shaped recess *tr*, communicating with the outlet of the liquid container, has its place in the casing at the right of the right disc.

If the inlet and outlet are arranged circumferentially (radially) the holes h^2 are unnecessary. It is practical to arrange recesses, communicating with the outlet respectively the liquid container, both in the casing to the right of the disc *d* and on the inside of the cover, that is to say, to the left of the disc *h*, whereby both discs are automatically pressed against each other and the friction is diminished even more.

In order to prevent suction of air along the shaft *c* to the groove b^1, I may provide a sleeve (Fig. 1), provided for the shaft *c* next the disc *d*, with a ring shaped groove *y* on the inside of the sleeve near its outer end. This groove *y*, by means of a canal *x*, is connected with the outlet *t*, whereby pressure fluid is brought to the groove *y* and causes the necessary tightening.

The piston *k* may obviously be made in many different ways. Instead of the embodiment shown in Figs. 1 to 10, I construct the piston however according to Figs. 11–13. This embodiment differs from the other in that the cross section in the middle is circular in shape with the addition of the ridge, against the parallel side walls of which the disc h tightens. In the former case the cross section in the middle was semi-circular in shape with the addition of said ridge. The alteration results in that the flange k^1 is dispensed with, while the piston k must be inserted radially into the groove e on the disc d. By this alteration the piston does not fall out of its groove when the pump is disassembled.

Fig. 14 shows a modification of the construction of the discs. Both discs may obviously be conical and according to this modification they have the same conical angle. The advantage of this is, that the only friction there is between them is rolling friction. As soon as both conical angles are not similar there is necessarily added a sliding friction caused by the pressure between the discs at the radial line of tightening in order to secure sufficient tightening.

My improved pump can be used not only as a liquid pump but also as an air compressor and vacuum pump. For such use a liquid container above the pump's suction and pressure opening is arranged, which container is continually filled with liquid (for instance water or oil), which acts as tightening means, when the pump acts as an air pump the liquid thereby being circulated through the pump.

Fig. 15 shows an example of an arrangement, which makes it possible to use the pump both as a liquid pump and a vacuum pump. r is the liquid container. This has a middle wall m, which divides the container into two compartments m^1 and m^2, of which m^1 has connection with the pump's suction opening s, and m^2 with the pressure opening t. Into the compartment m^1 opens the liquid inlet pipe r^1, which has an ascending branched off pipe r^2, which acts as air supply conductor. The compartment m^2 has an ascending outlet pipe r^3 for the outlet of the air and an outlet pipe r^4 for the liquid. All four pipes have taps 1, 2, 3, 4. Through a hole o in the wall m the two compartments m^1 and m^2 communicate with each other.

When the pump is used as a vacuum pump, for instance as a milking machine, the pipe m^2 is connected with it, whereby the taps 1 and 4 are closed and the taps 2 and 3 are opened. The liquid in the container is then caused, by the action of the pump, to pass through the hole o from the compartment m^2 to m^1 and circulate through the pump in order to serve as a tightening means, while air is sucked from the milking machine through the tap 2 and goes out through the tap 3. The section of the hole o is adjusted (for instance by means of an adjusting screw or a tap attainable from outside), in such a way that only a part of the amount of liquid, that the pump contains, may circulate.

When the pump acts as a liquid pump, the taps 2 and 3 are closed, and the taps 1 and 4 are opened.

If the pump is adapted to be used only as a vacuum pump, the container r may always be open or connected to the free air and all the taps may be dispensed with, and hence the pipes r^1 and r^4 are unnecessary and the pipe r^2 is directly connected to the compartment m^1.

When the pump shown in Fig. 15 is to be used as an air compressor, the compartment m^2 is connected to the air container and the compartment m^1 with the free air.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A pump comprising a casing, two discs rotatable in said casing with the same number of rotations and arranged at an oblique angle to each other, a piston arranged diametrically between the discs and dividing the compartment between the discs into two compartments separated by the piston, the volume of such compartments, by the rotation of the discs being hence alternately increased and decreased for the sucking of the fluid into the one compartment from an inlet and at the same time for pressing the fluid out of the other compartment to an outlet, an inlet for the fluid communicating with a chamber in the stationary part of the pump, one of the discs being provided with entrance ports situated on either side of the piston and adapted to connect said chamber with the compartments between the discs when the latter are rotating.

2. A pump comprising a casing, two discs rotatable in said casing with the same number of rotations and arranged at an oblique angle to each other, a piston arranged diametrically between the discs and dividing the compartment between the discs into two compartments separated by the piston, the volume of such compartments, by the rotation of the discs, being hence alternately increased and decreased for the sucking of the fluid into the one compartment from an inlet and at the same time for pressing the fluid out of the other compartment to an outlet, the inlet for the fluid communicating with a chamber in the stationary part of the pump, one of the discs being provided with entrance ports situated on either side of the piston and adapted to connect said chamber with the compartments between the discs, when the latter are rotating, a suitable ring-shaped recess being arranged in the pump house on opposite side of the chamber in relation to the rotating discs, said recess being divided into two compartments by means of a dividing flange tightening against the corresponding disc,

one of the last-mentioned compartments being connected with the pressure fluid in the outlet and preferably situated opposite a solid part of the pump house, which part contacts with one of the discs, the other compartment being connected with the suction fluid in the inlet and preferably situated opposite the chamber communicating with the inlet.

3. A pump comprising a casing, two discs rotatable in said casing with the same number of rotations and arranged at an oblique angle to each other, a piston arranged diametrically between the discs and dividing the compartment between the discs into two compartments separated by the piston, the volume of such compartments, by the rotation of the discs, being hence alternately increased and decreased for the sucking of the fluid into the one compartment from an inlet and at the same time for pressing the fluid out of the other compartment to an outlet, the inlet for the fluid communicating with a chamber in the shape of a ring segment-shaped groove in the stationary part of the pump, one of the discs being provided with entrance ports situated on either side of the piston and adapted to connect said groove with the compartments between the discs when the latter are rotating, a suitable ring-shaped recess being arranged in the pump house on opposite side of the ring segment-shaped groove in relation to the rotating discs, said recess being divided into two compartments by means of a straight dividing flange tightening against the corresponding disc, one of the last-mentioned compartments being connected with the pressure fluid in the outlet and the other with the suction fluid in the inlet, the straight dividing flange being suitably placed at the same distance from the center of the ring-shaped recess and with substantially the same incline as the boundary lines of the groove.

4. A pump comprising a casing, two discs rotatable in said casing with the same number of rotations and arranged at an oblique angle to each other, a piston arranged diametrically between the discs and dividing the compartment between the discs into two compartments separated by the piston, the volume of such compartments, by the rotation of the discs, being hence alternately increased and decreased for sucking of the fluid into the one compartment from an inlet and at the same time pressing the fluid out of the other compartment to an outlet, a liquid container with two compartments communicating with each other arranged above the suction and pressure openings of the pump, one of said compartments being connected with the suction opening and the other with the pressure opening, the former having an inlet and the other an outlet for air (or other gas), in order that the pump may be used as a compresser of air or as a vacuum pump.

In witness whereof, I have hereunto signed my name.

KARL GUNNAR JOHANSSON.