(No Model.)

4 Sheets—Sheet 1.

N. N. TVERSKOY.

ROTARY ENGINE AND PUMP.

No. 273,916. Patented Mar. 13, 1883.

FIG. 1

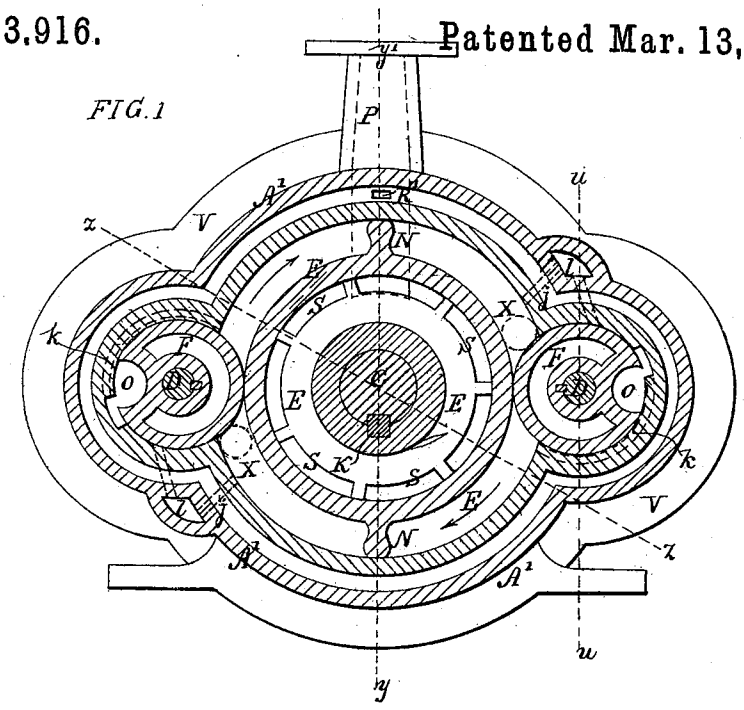
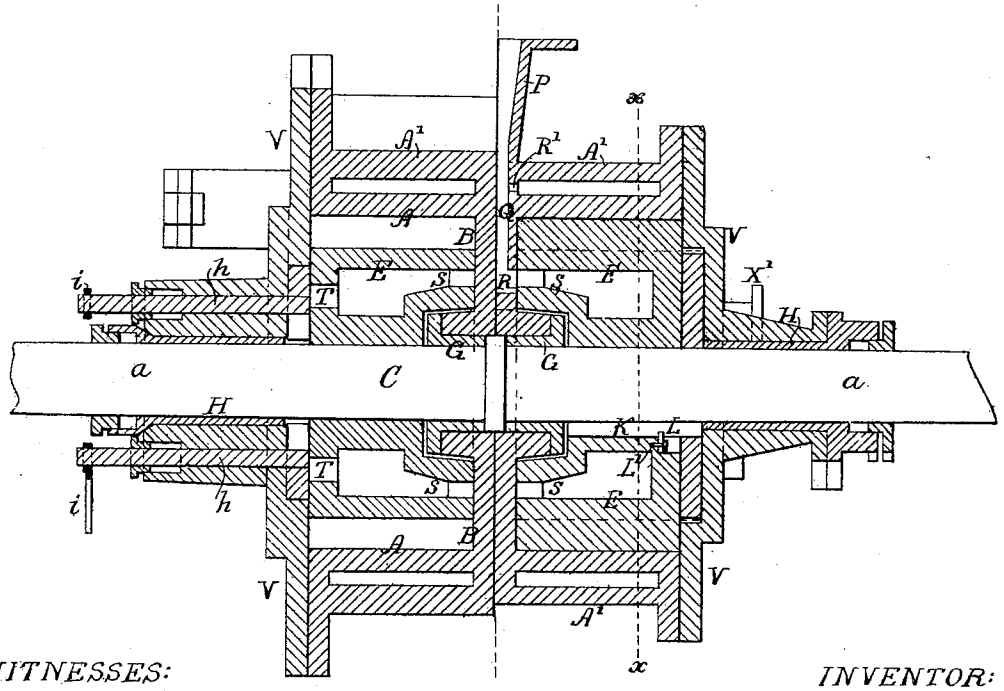


FIG. 2.



WITNESSES:

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FIG. 3

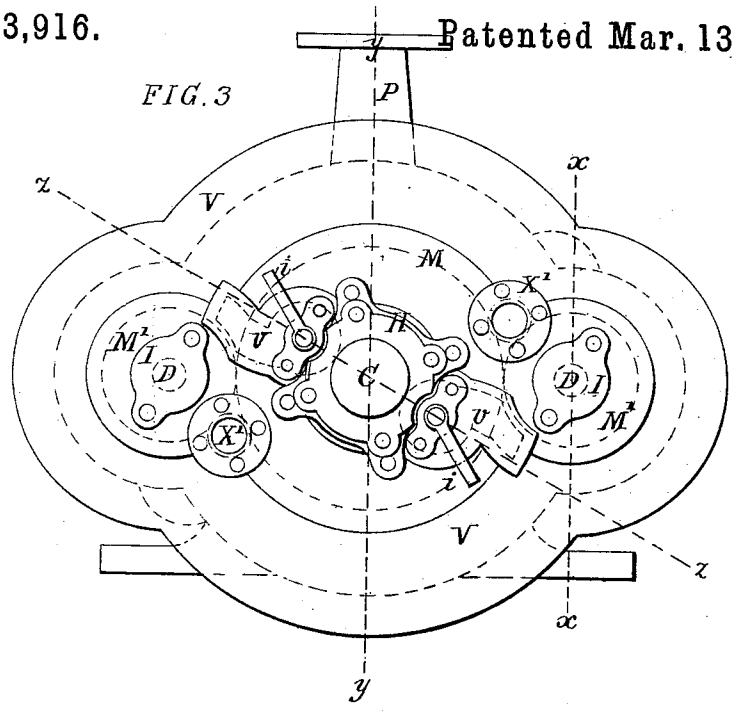

FIG. 4.

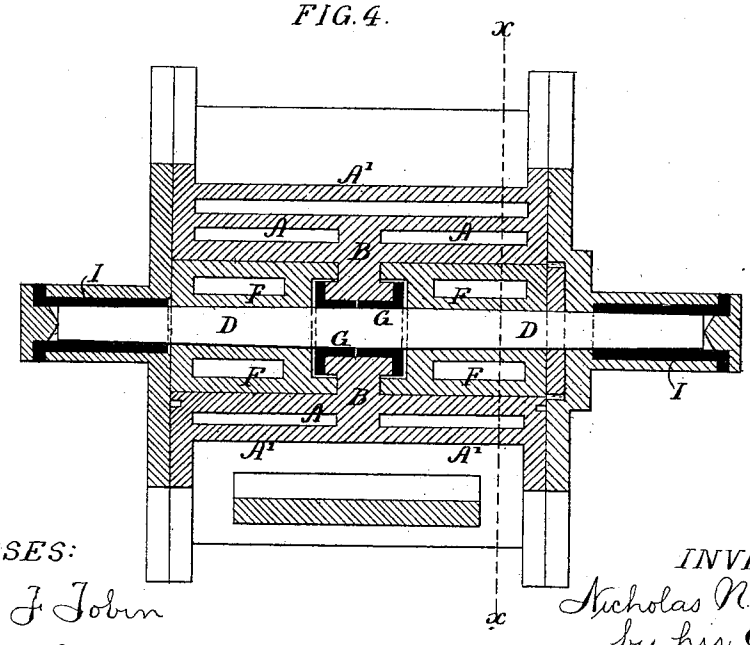

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FIG. 7.

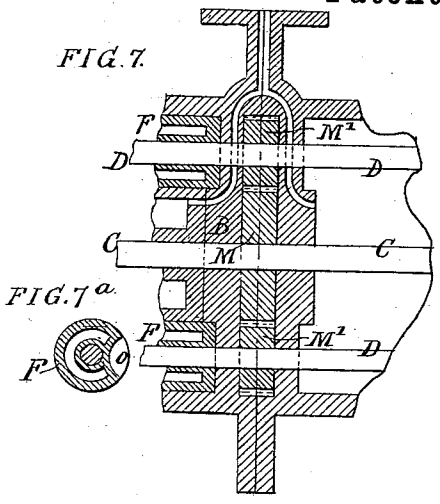


FIG. 8.

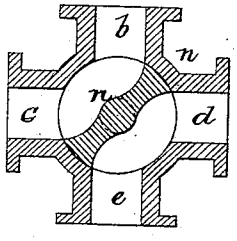


FIG. 9.

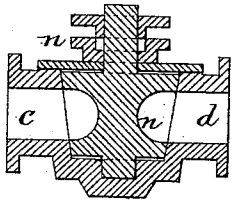


FIG. 11.

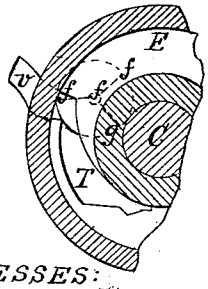


FIG. 10.

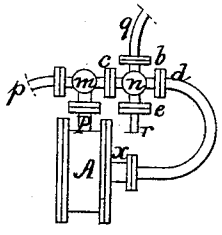
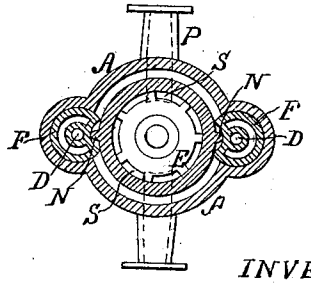


FIG 5.



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ROTARY ENGINE AND PUMP.

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FIG. 6.

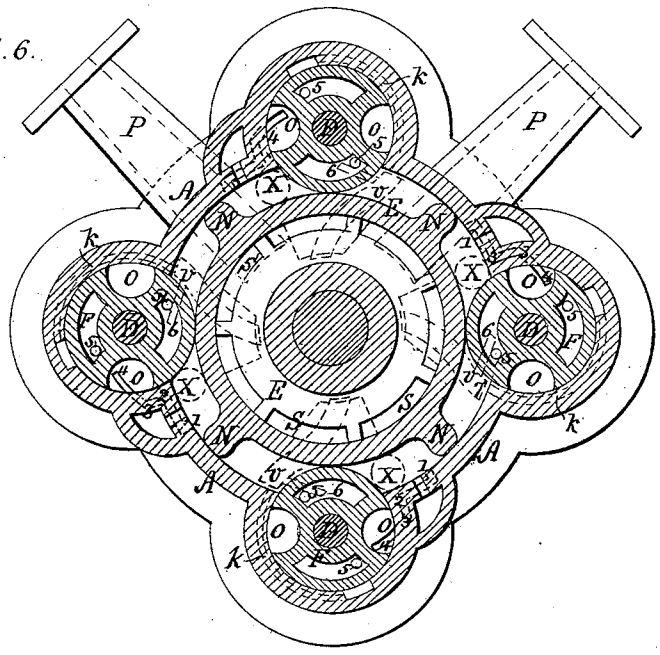
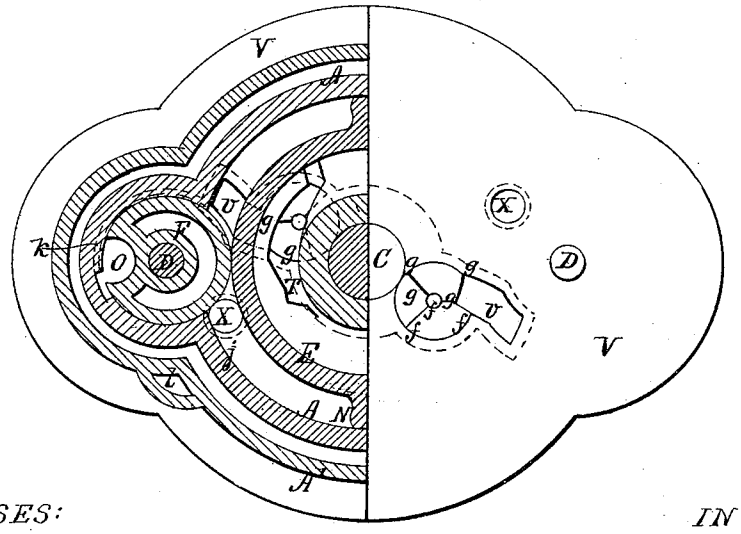


FIG. 12



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UNITED STATES PATENT OFFICE.

NICHOLAS N. TVERSKOY, OF ST. PETERSBURG, RUSSIA, ASSIGNOR OF ONE-HALF TO PETER P. WEINER, OF SAME PLACE.

ROTARY ENGINE AND PUMP.

SPECIFICATION forming part of Letters Patent No. 273,916, dated March 13, 1883.

Application filed September 2, 1882. (No model.)

To all whom it may concern:

Be it known that I, NICHOLAS N. TVERSKOY, a subject of the Czar of Russia, and residing at St. Petersburg, Russia, have invented certain Improvements in Rotary Engines and Pumps, of which the following is a specification.

Figure 1 of the annexed drawings represents the proposed rotary machine in vertical section, taken on the line *x x* of Fig. 2. Fig. 2 is a sectional view of the machine, (the right-hand side of the figure showing a section taken on the line *z z* of Fig. 1, and the left-hand side of the figure showing a section taken on the line *y y* of Fig. 1.) Fig. 3 is an end view of the machine. Fig. 4 is a section on the line *u u* of Fig. 1. Fig. 5 shows in transverse section a modification of the machine. Fig. 6 is a transverse section of another modification of the machine. Figs. 7 and 7ª show details of a modified construction of the central partition and adjacant parts of the machine, &c. Figs. 8 and 9 are two vertical sections at right angles to one another of the cock for regulating the admission of steam. Fig. 10 shows the arrangement of cocks for transforming the motor into a pump, and vice versa.

The machine consists of a casing or body, A A, divided within into two chambers by means of the central partition, B. In the arrangements shown in Figs. 1, 2, 3, 4, and 12 the body of the machine has double sides or walls, the outer side or wall, A′, serving to form a steam-jacket. Figs. 5 and 6 show that the body of the machine may also be made with single sides or walls.

Passing through the body A of the machine are the spindles C and D D, to which are keyed the cylinders E F F, their circumferences touching. By reason of the friction between the surfaces of these cylinders they turn, but with unequal speed, dependent upon their respective diameters. The central portion of the principal spindle or axle, C, (which lies between the points *a a*,) is doubly tapered. The spindles D D are doubly tapered throughout their length. The spindles C D D turn in the bushes G H I. The bushes H also serve to form the stuffing-boxes around the main axle C. The cylinders E F are keyed to their respective axles by means of the keys or pins *k*, which, for additional security, are held in place by means of the small keys L, fixed to their respective cylinders by the screws L′. (See Figs. 2 and 12.) To better regulate the movements of the cylinders E F F, they may be furnished with toothed wheels M M′, gearing into one another, and held by the same pins or keys, *k*, within the casing A. For additional security these wheels are attached to their corresponding cylinders, E F F, by means of screws or rivets. Each cylinder E is provided at its circumference with two or more radially-projecting blades or pistons, N N, and the abutment-cylinders F F are chambered or recessed at O O for the passage of these blades or pistons. Steam is admitted by one or more pipes, P, and enters by the passage Q (formed in the central division, B) both into the interior of the cylinder E and into the steam-jacket A′. To this end the central partition, B, is provided with corresponding openings, R and R′, and the end of the cylinder E adjacent to the partition is pierced with a series of holes, S S S. In the opposite face of the cylinder E are also drilled the openings T T, by which the steam issuing from the cylinder E enters the recesses U U, formed in the inner face of the end plates or covers, V V, of the casing A. The recesses U U finally conduct the steam to the interior of the casing A between the outer surface of the cylinder E and the inner surface of the casing, where the steam acts against the piston blades or projections N N. Owing to the steam-pressure, the blades or pistons N N cause the cylinder E to rotate in the direction shown by the drawn arrows, (or in a forward direction.) At the same time the abutment-cylinders F F, owing to the friction between their peripheries and that of the cylinder E, turn in a contrary direction with a speed such that the pistons N come into regular coincidence with the grooves or recesses O in the cylinders F, and their simultaneous rotation takes place freely. Having done its work, the steam exits by the openings X X and leaves the engine by the pipes or tubes X′ X′, attached to the end plates or covers, V V. By connecting the steam inlet

and outlet pipes P and X′ by a pipe provided with a four-way cock, as shown in Figs. 8 and 9, with the inlet-pipe for fresh steam and with the condenser, or generally with the exhaust-chamber, it is possible, by a simple movement of the cock, to cause the fresh steam to enter by the pipe P, (passing through the ways *b c* of the cock,) or by the pipe X′, (through the ways *b d* of the cock.) In the first case the steam will leave the engine by the tube X′, (by the way *d e* of the cock,) and the cylinders E F will rotate in the direction indicated on the drawings by the arrows. In the other case the steam exits by the tube P, (by the way *c e* of the cock,) and the engine is rotated in the opposite direction, (reversed.) If the engine is constructed to work at the full pressure of the steam, (without expansion,) the openings T should be sufficiently large or sufficiently numerous to allow of the passage of fresh steam from the cylinder E into the casing A during the entire stroke of the corresponding pistons. Figs. 5 and 6 show two examples of such arrangement. For working under expansion of steam the openings named should be less long, so that the admission of steam to the recesses U may cease at a given point in the course of the pistons N. Finally, for the variable expansion of steam the openings named receive a special form indicated in Figs. 11 and 12, and the recess U terminates (at the end nearest to the spindle C) in a circular cavity, one part of which is filled by a plate, *f f f f*, riveted to the end plate or cover, V. This plate facilitates the boring of the circular cavity and limits the movement of the expansion key or slide, as will be now described. In the free space of the circular cavity works a regulator or slide, *g g g g*, formed in one with a rod, *h*, which serves as its axis of rotation. This key, the form of which is almost the same as that of the plate *f f*, contracts the free space of the recess U, by which the escape of the steam coming from the opening T of the cylinder E takes place.

The position of the expansion-valve indicated at Figs. 11 and 12 corresponds to the expansion of the steam at one-third of the stroke of the pistons N. Fig. 11 shows the position of the parts at the moment (one-sixth of the stroke of the piston) of the greatest section of the steam-passage. Fig. 12 shows the position of the parts at half-stroke, and it will be seen that the passage for the steam is at this moment completely closed. It is evident that it will suffice to turn the regulator *g g* in the direction indicated by the arrows in Figs. 12 and 13, to increase the period during which steam will be admitted by the opening T.

It will be understood that the number of recesses U and of regulators *g g* is equal to the number of piston-projections N in the engine.

The expansion-regulators may be operated by hand or by a governor, and to this end their stems are furnished with handles or levers *i i*, Figs. 2 and 3.

In order to balance the cylinders F F on their axles D D, the passages *k k* are formed in the contiguous walls of the casing A, which passages open out nearly at the opposite ends of diameters passing through the points of contact of the cylinders F and E. Perfect equilibrium of all the pressures acting in the normal direction on the surfaces of the cylinders is obtained in the four-abutment-cylinder machine shown at Fig. 6, each of which abutment-cylinders in this case having two recesses, O, for the pistons N to pass.

The steam, hot gases, or, generally speaking, the motive-fluid, having done its work in the machine, escapes by the openings or tubes X′ X′. In the case of a motor operated by the expansion of hot gases a portion only of the gases may be allowed to escape by the tubes X′ X′, the rest being preferably connected by the cross-pipes or channels *j j* to the compartments or chambers *l l*, formed in the walls of the casing A. Into the same compartment, *l l*, may escape that portion of the motive-fluid inclosed in the recesses O of the abutment-cylinders F, whereby any irregular pressure of the fluid on the cylinders will be avoided. From the chambers *l l* the hot gases or steam can pass off by special chambers into some heating apparatus, so that for their escape by the openings X there will only remain a relatively weak volume of the motive-fluid.

In every machine in which the piston has a rectilinear movement the stroke of the piston is arrested at a certain distance from the end plates or covers of the cylinder, so that at each extremity of the cylinder there exists a free space or clearance containing what is called a "steam-cushion." Similarly, in the proposed rotary engine a free space is formed at the commencement of each impulse or stroke of the piston between the piston and the abutment-cylinder F. With the object of economizing the volume of motive-fluid filling this steam-cushion or useless space, the fluid is led, before its outlet, by the channels *j* and X, into the interior of the cylinders F, and thence into the space mentioned. This arrangement is shown in Fig. 6 only, and it consists of a series of channels or passages, 1, 2, 3, 4, 6, and 7. When the pistons N, in leaving behind them the recesses U, pass at the end of their stroke beyond the orifices 1 of the channels here named, which are formed in the inner face of the end plates or covers, V V, the gases or steam pass to the interior of the cylinders F by the channels 1 2 3 4, and by the openings 5 made in the ends of the said cylinder F, for at this moment the openings 5 coincide with the orifices 4 of the channels. The moment following this coincidence ceases, and the steam or gases remain imprisoned in the cylinders F until the pistons reach the commencement of their next stroke. At this moment the openings 5 coincide with the orifices 6 of the channels 6 7 (formed also in the inner face of the covers V) and allow the steam or gases to pass from the

cylinders F into the useless space or steam-cushion above referred to.

For a machine constructed as indicated at Figs. 1, 2, 3, and 4, in which the steam imprisoned in the recesses O O escapes into the chambers *l l*, the arrangement of channels 1 2 3 4 should be modified, for otherwise the steam, instead of flowing into the waste-space, would also be able to escape into the chamber *l l*. To remedy this inconvenience the recesses O O are closed by walls or end plates, Figs. 7 and 7ª, at the extremity situate against the covers V or against the central partition, B, according as the channels 1 2 3 4 are formed in the covers or in the partition B. In this case the ends of the abutment-cylinders F are sunk or recessed into the inner face of the covers or of the partition B, in order that the pistons N may freely enter the recesses O.

If the machine is to operate as a suction and force pump, it is preferable to draw in the liquid or gas by the tubes X′ and to force them out by the tubes P P, as takes place when reversing the engine, although the drawing in by the tubes P and the ejection by X′ may also be effected. A pump on this system is provided with an air-reservoir, as usual.

Fig. 10 shows an arrangement of the rotary engine furnished with three and four way cocks *m* and *n*, the four-way cock *n* being similar in construction to that shown in Figs. 8 and 9, and previously described. The three-way cock *m* connects by the tube *p* with the water reservoir or cistern. By closing this communication by means of the cock *m* and opening that between the steam-supply pipe 9 and the pipe P of the machine by means of the cock *n*, we have a rotary steam-engine operating as above described, and capable of being reversed in direction by means of the four-way cock *n*. If, on the contrary, communication be established between the pipe *p* and the pipe P of the machine by means of the cock *m*, and if at the same time the cock *n* be turned so as to connect the tube X′ of the engine with the tube *d* of the cock, the engine can immediately work as a pump, (when the piston-cylinders are driven by hand or by any other motive-power.) drawing in water by the tube *p* and ejecting it by the tube X′ through the cock *n* and into the pipe *r*. It is evident that in this case the shape of the openings or channels T, Fig. 2, should be suitably modified. Thus, then, the proposed engine can work not only as a motor, but also as a pump, fan, or turbine. A simple inspection of the drawings shows that the machine operates equally well in any position, be it vertical, horizontal, or inclined. Its bed-plate therefore may assume a position different from that shown in the drawings. This bed-plate may be hollow to serve as a condenser, or as a reservoir for water or gas. The body or double-walled casing of the machine may be cast in a single piece with the central partition, B, or else may be formed of two separate casings connected together by flanges, their inner spaces being separated by a common partition, B.

In the case of the proposed engine being required to work as a compound engine, one of the two casings would be larger than the other. If the machine consists of two separate casings, the toothed wheels M M′ may be arranged between them, as indicated in Fig. 7.

The spindles or axles D D, instead of being fitted entirely within the machine, may pass through stuffing-boxes and be prolonged to the outside. In the case of connected axles the gear-wheels M M′ may serve instead of coupling-boxes.

The rubbing-surfaces of the cylinders E F may be polished or grooved to assure their close contact, or they may be covered with leather or rubber when used for pumps and fans. In these cases the gear-wheels M M′ may be dispensed with.

The pipes X′ for the outlet of the steam may be situated on the two end plates or covers V, or, for greater simplicity, on one of them only. Thus, for example, in compound engines it will suffice to have the tube X′ on the end plate or cover of the larger casing only. In this case the steam, having done its work in the smaller casing, which is not fitted with the pipe X, should be conducted into the larger casing by corresponding orifices drilled in the central partition, B.

In order to suit the circumstances attending the placing in position and fitting up of the machine, according as its position is vertical, horizontal, or inclined, following, in fact, the varying local conditions, there may be one or more steam inlet and outlet pipes, and these pipes may be arranged in any suitable position and take a straight or bent form, as desired.

To facilitate adjustment and repairs, all the plane rubbing-surfaces, or those which make air-tight joints—as the surfaces of the ends of the cylinders, the sides of the casing, &c.—are provided with fine grooves or hatchings, (after the manner of files,) and covered by soldering or otherwise with a suitable metal or alloy or other material, with the view of diminishing the friction.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. The combination of a casing, A, provided with a steam-inlet, P, near the center of its circumference and outlets X′ on the end plates, with cylinders F, having recesses O, and a hollow cylinder, E, having abutments and steam-passages forming communications between the inlet and outlet ports, all substantially as described.

2. The combination of a casing, A, having steam-inlet passages P Q R and outlets X, with cylinders F and hollow cylinder E, having abutments N and passages S T, and recesses U in the casing, substantially as set forth.

3. The combination of a casing, A, having inlet and exhaust ports, and a hollow cylinder, E, having four abutments, with four recessed cylinders, F, and steam-passages, substantially as described, whereby equilibrium of the radial pressures is obtained.

4. The combination of a casing having inlet and exhaust ports and recesses U with a hollow rotary cylinder, E, having abutments and steam-passages T, with regulators *g*, substantially as set forth.

5. The combination of a casing and cylinder, E, having abutments, with a recessed cylinder, F, the said casing having passages *j k l* about the latter cylinder, as and for the purpose specified.

6. The combination of a casing and cylinder, E, having abutments, with a hollow recessed cylinder, F, having openings 5 in its end, the said casing having recesses U and passages 1, 2, 3, 4, 6, and 7, adjacent to the end of the said hollow cylinder F, substantially as described.

7. The combination of a casing, A, having inlet and exhaust pipes P X′, and rotating cylinders E F, with a four-way cock connected to said inlet and exhaust pipes, as and for the purpose set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

NICHOLAS N. TVERSKOY.

Witnesses:

F. KAUSSE,

N. TSCHEKALOFF.