(No Model.) 2 Sheets—Sheet 1.

H. NAGEL.

ROTARY ENGINE.

No. 548,812. Patented Oct. 29, 1895.

Fig. 1

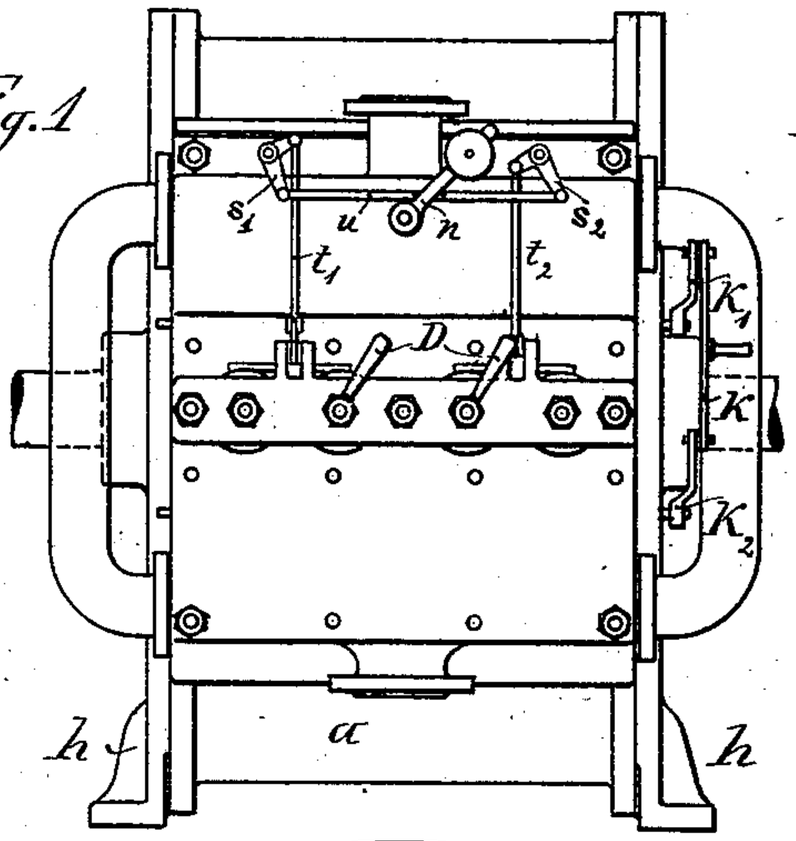


Fig. 2

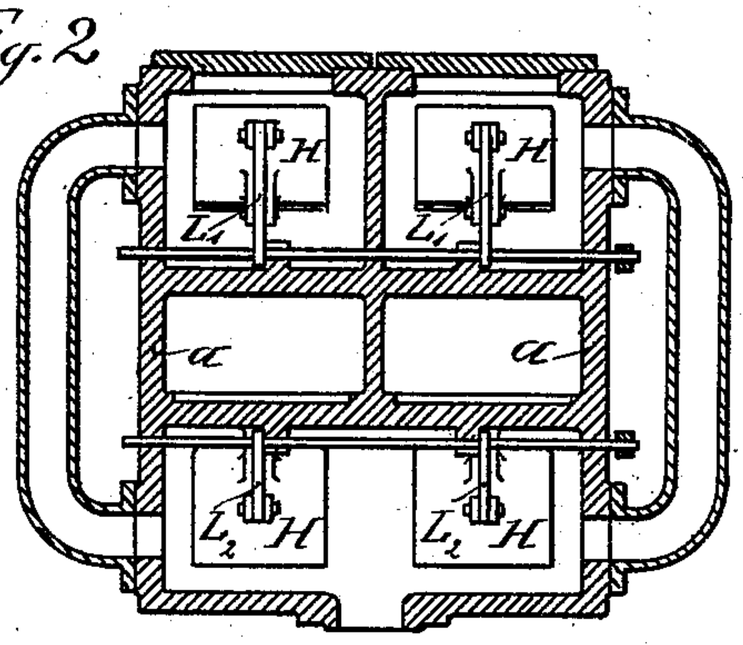


Fig. 3

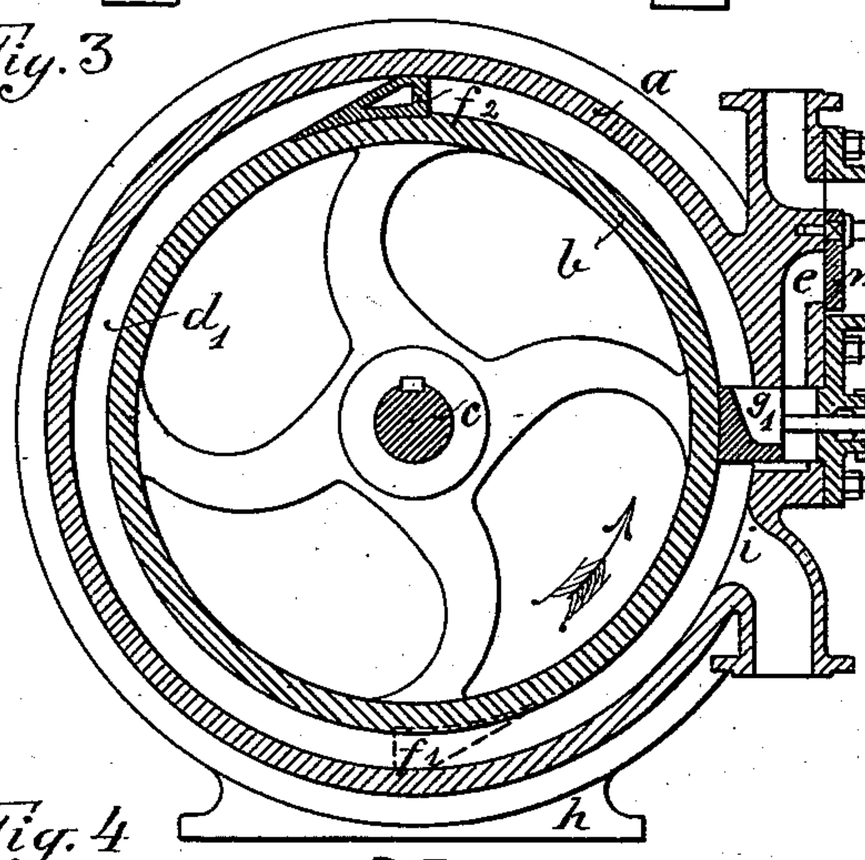


Fig. 5

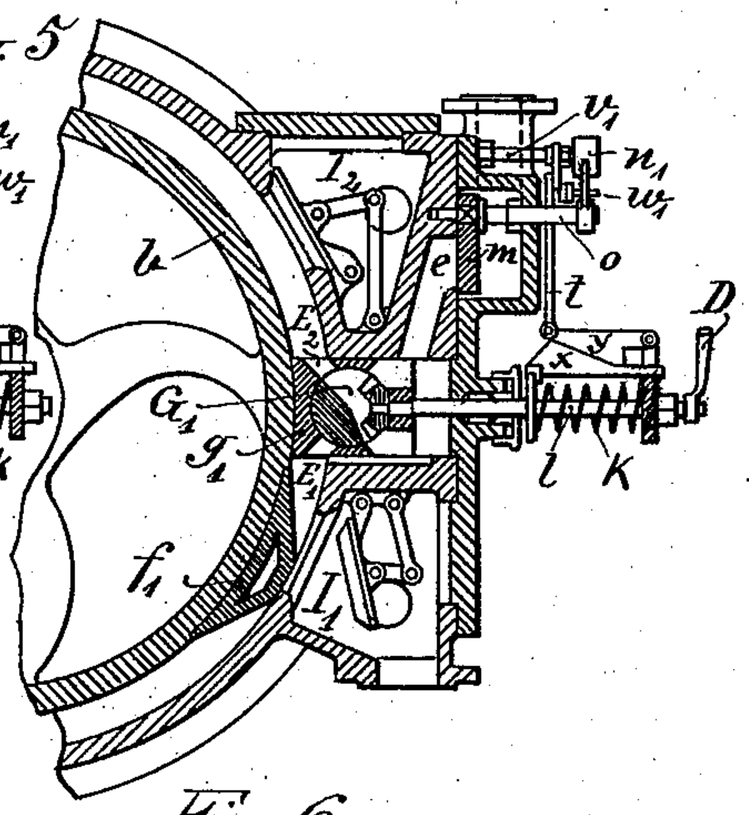


Fig. 4

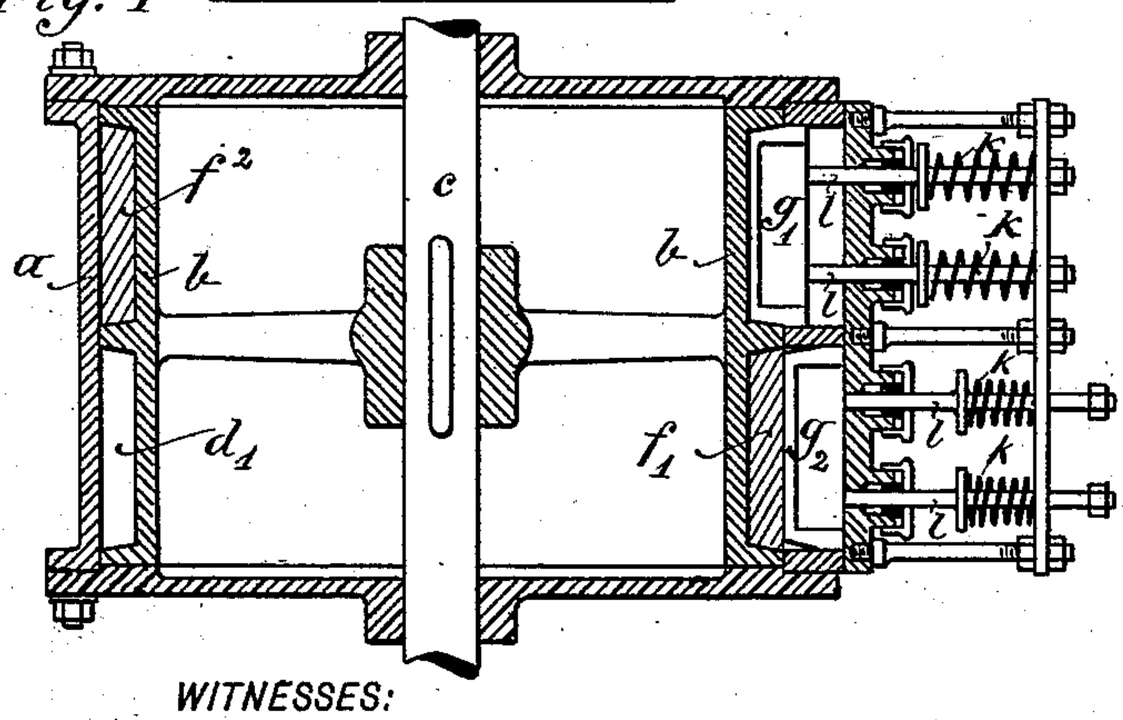
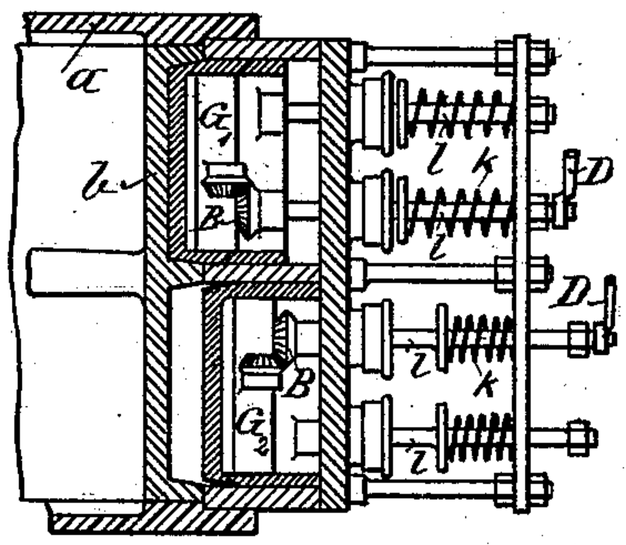


Fig. 6



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ROTARY ENGINE.

No. 548,812. Patented Oct. 29, 1895.

Fig. 7

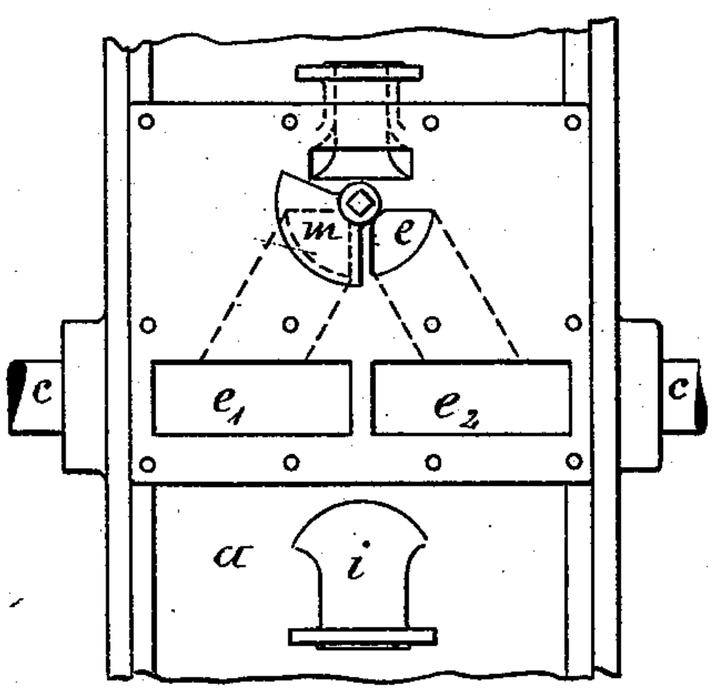
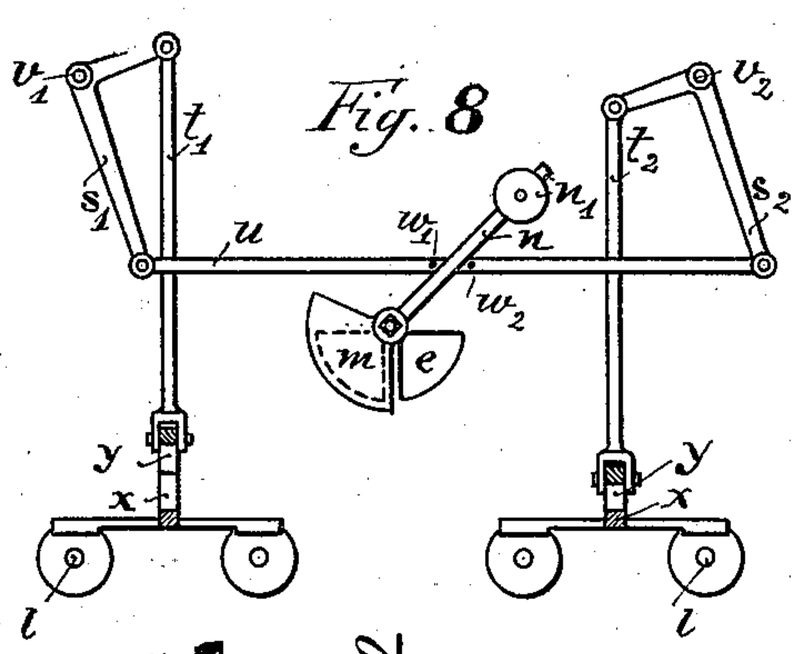


Fig. 8



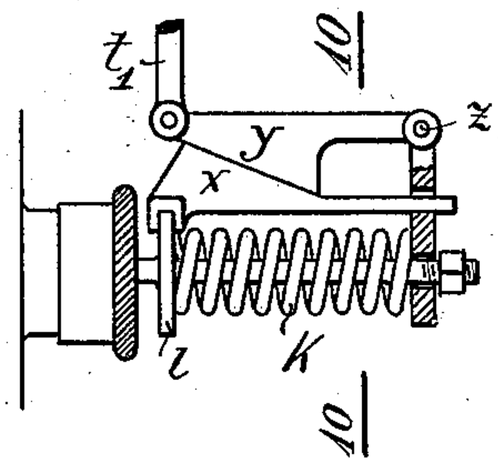


Fig. 9

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UNITED STATES PATENT OFFICE.

HENRY NAGEL, OF CHICAGO, ILLINOIS.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 548,812, dated October 29, 1895.

Application filed February 12, 1895. Serial No. 538,124. (No model.)

To all whom it may concern:

Be it known that I, HENRY NAGEL, a citizen of the United States, residing at Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Rotary Engines; and I declare that the following is a clear, full, and exact specification of my invention, reference being had to the accompanying drawings, wherein—

Figure 1 is a front view of my rotary engine; Fig. 2, a vertical section through the valve-chest; Fig. 3, a vertical and Fig. 4 a horizontal section through an engine designed to run in one direction only; Fig. 5, a vertical and Fig. 6 a horizontal section through a reversible engine constructed on the same principle. Fig. 7 is a detail showing arrangement of ports and of the oscillating valve opening and closing them. Figs. 8 and 9 are details of gear operating the oscillating valve and regulating the speed of the engine.

Similar letters of reference indicate corresponding parts.

My invention relates to rotary engines; and it consists of combinations of parts usually employed in construction of this class of engines with new parts devised for the purposes desired to be obtained by my invention.

Engines constructed in the manner as I have shown in the accompanying drawings are capable of being driven by any of the known elastic agents—as steam, hot air, gas, &c.—and may also be constructed in such manner to serve as pumps, ventilators, compressors, &c.

The non-reversible engine shown in sections in Figs. 3 and 4 consists, principally, of the cylinder *a*, mounted on a suitable base *h*, and of the revolving piston *b*, rigidly keyed to the shaft *c*, projecting through both ends of the cylinder *a* and revolving in bearings pillowed on suitable columns arranged on both sides of the cylinder. Piston *b* is fitted snugly into the inner space of the cylinder *a* and provided with channels d' and d^2, into which the elastic agent (steam, hot air, gas, &c.) is admitted through ports E' and E^2 alternately. Abutments f' and f^2 are set in channels d' and d^2. These abutments are set on diametrically-opposite points, one in each channel, and are provided with slanting planes on their sides in the direction in which the piston *a* revolves. Valves g' and g^2 are fitted into and close the channels d' and d^2, while they open inlets *e* and admit the elastic agent to exert its power upon the piston. These valves g' and g^2 are pressed against the piston *b* by spiral springs *k*, set upon their stems *l*. The abutments f' and f^2 when passing by push them back and thus automatically close inlet-ports *e*, thus preventing the escape of the driving agent into exhaust. These ports are immediately opened again, the springs *k* pressing the valves inward again when the abutment has passed by. Valve *m*, oscillating on stud *o*, opens and closes ports *e* simultaneously with the movements of the valves g' and g^2 and cuts off the driving fluid at the end of the first half of the revolution of the piston.

The gear operating the oscillating valve *m* is shown in Figs. 10 and 11. It consists of the bell-crank levers s' and s^2, fulcrumed on pivots v' and v^2 and actuated by rods t' and t^2, moving up and down. Levers s' and s^2 rock the connecting-rod *u* and with it the weighted lever *n*, set on the stem *o* of the valve *m* and held between the studs w' and w^2 correspondingly with the movements of the valves g' and g^2, whose motions are imparted to the rods t' and t^2 by means of the slides *x* lifting levers *y*, pivoted on bolts *z* and linked to rods t' and t^2, respectively. It will be observed that the abutments f' and f^2 and the movements of valves g' and g^2 and of the oscillating valve *m* are so arranged that while in the first half of the revolution the piston is driven directly by the force of the instreaming elastic fluid the inlet-port *e* is then closed and the fluid allowed to fully exert its expanding power upon the piston during the remaining part of the revolution of the piston.

Weight n' is adjustably attached to lever *n*, set on the stem of the valve *m*. Its function is to complete the swing of the valve and to throw it fully over when the comparatively slow motion of the connecting-rod *u*, started by the repulsion of the valves g' and g^2 by the corresponding abutment, has lifted it and pushed the lever over the center and to hold it in that position until another movement of the rod *u* is started in opposite direction by the motion of the other valve. By this arrangement an effective cut-off is pro-

vided, and also regulation of the speed of the engine, because by increase of speed in the revolution of the piston *b* the swing of the oscillating valve *m* will be diminished, and consequently the area of the opening of the ports *e*. Thus a smaller quantity of the driving fluid will be admitted into channels *d'* and d^2; and, again, if by increasing the load on the engine or by diminished pressure of the driving agent the speed of the rotary piston *b* is reduced the swing of the oscillating valve *m* will be accordingly longer, and thus the whole area of the ports *e* will be opened and a correspondingly larger quantity of the driving agent admitted into the channels *d'* and d^2 for driving the engine.

The reversible engine shown in Figs. 1, 2, 5, and 6 is similarly constructed in its principal parts as the non-reversible described above. In this engine the abutments *f'* and f^2 are made slanting to both sides to permit their abutting the valves *g'* and g^2 in both ways. In connection with valves *g'* and g^2 cylindrical valves G' and G^2 are provided for the purpose of changing the ports E' and E^2 accordingly as it is required to run the engine in one or the other direction. Valves G' and G^2 are operated by reversing gears B and B', the bevel-wheels B being set upon the stems *l* of valves *g'* and g^2 and revolving by handles D, thus causing the valves G' and G^2 to change the inlets E' and E^2 and thereby to reverse the motion of the piston. In accordance with reversing the motion of the piston *b* by changing the inlet from E' to E^2, also the exhaust-ports I' and I^2 are changed. This is accomplished by means of the lever movement K, arranged on one side of the chest and connected by rods K' and K^2 to link-levers L' and L^2, respectively, operating clack-valves H, which open and close the exhaust-ports. When these clack-valves are closed, the link-levers L' and L^2 act as braces, holding them securely in position. This type of my rotary engine is especially adapted for ventilators, compressors, dynamos, and for such purposes generally where high speed is required.

Having thus described the nature of my invention and its application in the art of constructing engines, I claim as new and desire to secure by Letters Patent—

1. In a rotary engine, the combination of an inclosing cylinder provided with inlet and exhaust ports, a rotary piston adapted to fit therein and provided with peripheral channels for the driving fluid disposed side by side, and with abutments for said channels at diametrically opposite points, spring pressed valves extending into said channels adjacent to the exhaust ports thereof, said valves being provided with ports connecting said inlet ports with said channels in rear of said abutments, said abutments having slanting front surfaces adapted to operate said valves, inlet valves for said inlet ports, and mechanism connecting said inlet valves with said spring pressed valves.

2. In a rotary engine, the combination of an inclosing cylinder provided with inlet and exhaust ports, a rotary piston adapted to fit therein and provided with peripheral channels for the driving fluid disposed side by side, and with abutments for said channels at diametrically opposite points, spring pressed valves extending into said channels adjacent to the exhaust ports thereof, said valves being provided with ports connecting said inlet ports with said channels in rear of said abutments, said abutments having slanting front surfaces adapted to operate said valves, inlet valves for said inlet ports, mechanism connecting said inlet valves with said spring pressed valves, and reversing mechanism for said ports.

3. In a rotary engine comprising a rotary piston rigidly keyed to a shaft and revolving in a fixed cylinder under pressure of elastic fluid, admitted through valves into channels provided on the spherical surface of the piston, the combination with the valves closing and opening the inlets into the channels of an oscillating valve closing and opening the ports admitting the elastic fluid into the valve-chest and provided with a weighted lever, set on the stem of this valve and held between studs, attached to a connecting rod, rocked to and fro by bell crank levers operated by rods moved up and down by the action of the valves opening and closing the inlets into the channels of the rotary piston.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

HENRY NAGEL.

Witnesses:
F. R. HEUPF,
ARTHUR CALDER.