

WILLIAM L. MERRILL.
 ROTARY ENGINE.
 APPLICATION FILED AUG. 24, 1908.

986,641.

Patented Mar. 14, 1911.

2 SHEETS—SHEET 1.

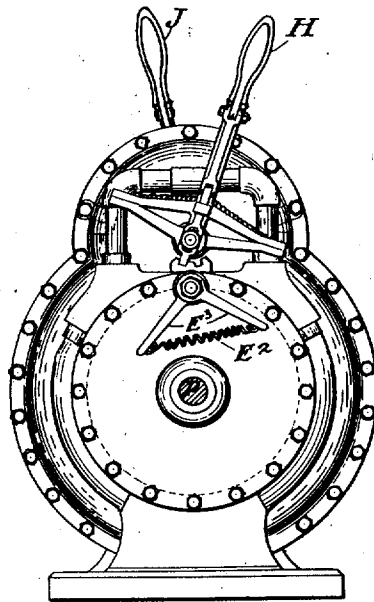


Fig. 1

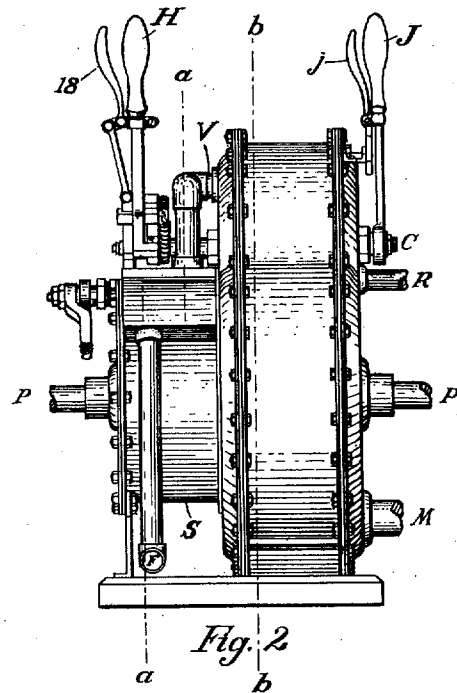


Fig. 2

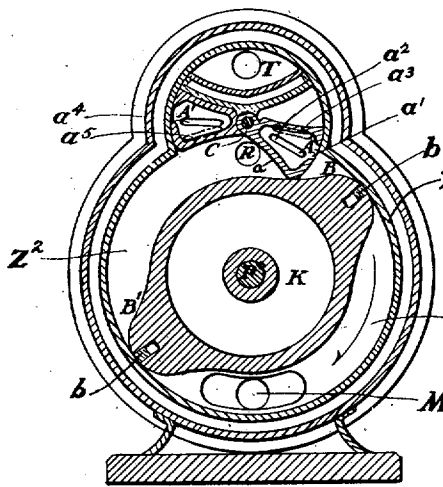


Fig. 3

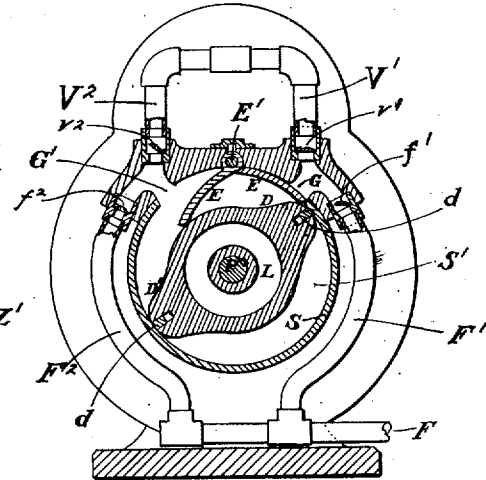


Fig. 4

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Inventor:
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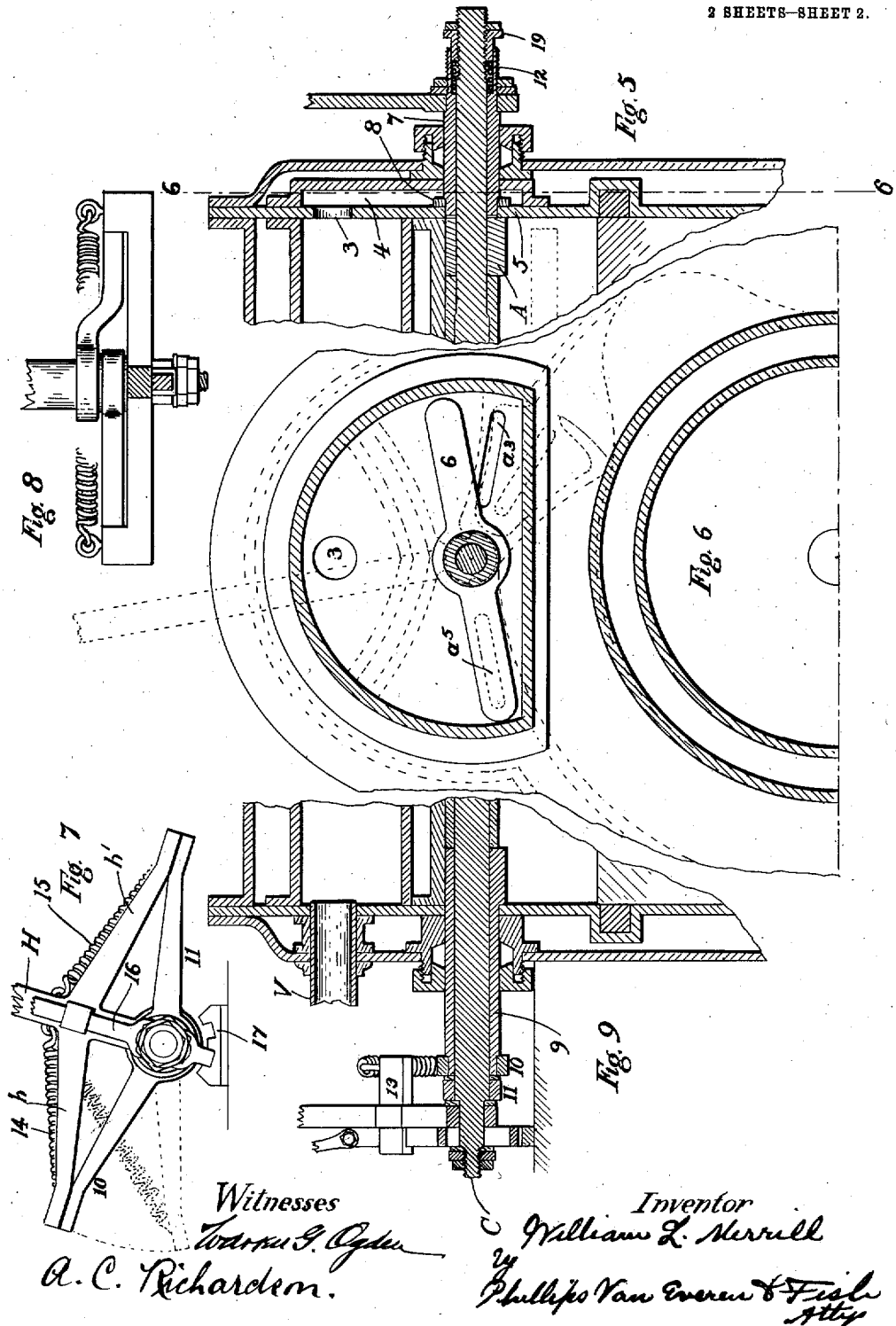
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Witnesses

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UNITED STATES PATENT OFFICE.

WILLIAM L. MERRILL, OF PORTLAND, MAINE.

ROTARY ENGINE.

986,641.

Specification of Letters Patent.

Patented Mar. 14, 1911.

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To all whom it may concern:

Be it known that I, WILLIAM L. MERRILL, citizen of the United States, residing at Portland, in the county of Cumberland and State of Maine, have invented certain new and useful Improvements in Rotary Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The invention relates to rotary engines, and more especially to that class of engines in which the motive fluid consists of an explosive mixture, charges of which are delivered and exploded back of the piston or pistons of the rotor of the engine.

The object of the invention is to provide an engine of this class in which the construction and arrangement of the parts are improved and simplified, with a resulting improvement in the efficiency and mode of operation of the engine.

A further object is to provide an engine in which the rotor may be driven in either direction at the will of the operator, and in which the adjustment and manipulation of the parts in starting, stopping or reversing the engine, may be readily and conveniently made.

With these ends in view, one feature of the invention contemplates the provision of an improved means for effecting the compression of the explosive mixture which forms the motive fluid and delivering successive charges thereof back of the piston or pistons of the rotor of the engine. In accordance with this feature of the invention, the explosive mixture is compressed by a rotor arranged within a compression cylinder, and acting during the rotation of the rotor to draw in successive charges and to compress and deliver them into a supply chamber from which charges of the compressed fluid are withdrawn and delivered back of the piston or pistons of the working rotor.

In accordance with a further feature of the invention, means are provided for controlling the supply and delivery of the fluid to the compression cylinder in such manner that the compressing rotor will automatically act to draw in and compress the fluid when running in either direction.

A further feature of the invention contemplates the provision of improved means for supplying charges of motive fluid succes-

sively back of the piston or pistons of the working rotor. In accordance with this feature of the invention, the motive fluid is supplied to the working cylinder through the movements of a charging chamber formed in a movable abutment which is held continuously in engagement with the periphery of the rotor, and which, during the travel of the rotor, is moved outward and inward by its engagement with the piston. In the outward movement of the abutment, communication between the charging chamber therein and the working cylinder is cut off, and communication established between the charging chamber and the supply chamber or other source of fluid supply. As the abutment moves inward after the piston of the rotor has passed, communication between the charging chamber and the fluid supply is cut off, and communication between the charging chamber and the space within the working cylinder back of the piston is established, so that the charge within the chamber is delivered back of the piston. At this time the charge is exploded, and by its expansion drives the rotor forward. The communication between the charging chamber and the working cylinder is so arranged that the pressure of the gases within the working cylinder and chamber tends to force the abutment or member in which the chamber is formed firmly against the periphery of the rotor, thus decreasing the danger of leakage between the abutment and rotor. It is immaterial to this feature in its broader aspects whether the construction is such that the rotor may be driven in only one or in either direction.

In accordance with a further feature of the invention, duplicate abutments, through the movements of which charges of motive fluid may be delivered back of the piston or pistons of the rotor, are provided, and means is also provided for maintaining either of these abutments in continuous engagement with the rotor, and the other out of the path of the piston or pistons of the rotor, according to the direction in which the rotor is to be driven.

These features of the invention, as well as certain further features of the invention which I prefer to employ in embodying the broader features of the invention in a simple and compact construction, will be readily understood from the accompanying drawings.

In these drawings Figure 1 is an end elevation of an engine embodying the various features of the invention in the forms in which I prefer to use them; Fig. 2 is a side elevation of the engine; Fig. 3 is a vertical sectional view on line *b-b*, Fig. 2; Fig. 4 is a vertical sectional view on line *a-a*, Fig. 2; Fig. 5 is a detail vertical sectional view showing the device at the right-hand end of the shaft C; Fig. 6 is a detail vertical sectional view on line 6-6, Fig. 5; Fig. 7 is a detail elevation of the parts secured to the left-hand end of the shaft C; Fig. 8 is a plan view of the parts shown in Fig. 7; and Fig. 9 is a vertical sectional view showing the parts at the left-hand of the shaft C.

The engine shown in the drawings is provided with a cylindrical casing Z within which the working chamber is formed, and with a cylindrical casing S within which the compressing chamber is formed. These two casings or chambers are arranged side by side in axial alinement with each other. The working rotor K is arranged within the cylinder Z, and is provided with two radially projecting portions B, B', which form the rotor pistons. The rotor pistons are arranged diametrically opposite each other, and are provided with packing blocks *b* which engage the outer wall of the chamber. The compressing rotor L is arranged within the cylinder S, and is provided with radially extending projections D, D' forming the pistons of the compressing rotor, and provided with packing blocks *d* which engage the outer wall of the cylinder. The working and compressing rotors are secured upon a shaft I' mounted in suitable bearings in the engine casing, so that the rotors are connected to rotate in unison.

The charges of motive fluid are delivered back of the pistons B, B' of the working rotor at proper intervals from one or the other of two charging chambers A, A'. Assuming that the rotor K is to be rotated in the direction indicated by the arrow in Fig. 3, the motive fluid is supplied by the charging chamber A. This chamber is formed in a movable member *a* mounted to swing about a shaft C, and forced yieldingly against the periphery of the rotor. The charging chamber is provided with a port *a'* arranged to control the communication between the chamber and the working cylinder, and is also provided with a port *a''* arranged to control communication between the charging chamber and the supply chamber T.

The member within which the charging chamber is formed is in engagement with the periphery of the rotor back of the piston B, and the port *a'* is in communication with the space within the cylinder back of the piston. At this time the port *a''* is out of communication with the supply chamber

T, and the charge of fluid within the charging chamber is free to enter the cylinder back of the piston. The charge is exploded by an ignition device (not shown), preferably arranged within the chamber A, so that said chamber forms an explosion chamber as well as a charging chamber. At this time the space Z' in front of the piston B is in communication with an exhaust port M, and the space Z² in front of the piston B' communicates with an exhaust port R.

When the charge is exploded it acts against the piston B to drive the rotor forward, the member in which the charging chamber is formed forming an abutment for confining the gases, and against which the expanding gases re-act. The arrangement of the abutment and the port *a'* through which the gases are discharged from the charging chamber into the cylinder, is such that the pressure of the gases tend to force the abutment more firmly against the periphery of the rotor, and thus prevent backward leakage of the gases between the rotor and abutment. The abutment may be, and preferably is, provided with suitable packing blocks (not shown) for engaging the periphery of the rotor. As the rotor is driven forward by the explosion of the gases, the charge which has been previously exploded and has acted upon the piston B' is free to escape through the exhaust port M, and any waste gases which may be carried beyond the port M are ejected through the exhaust port R, so that a complete discharge of the waste gases is insured.

As the piston B' approaches the charging chamber, the piston B passes beyond the port M, so that the gases in the space between the piston and the charging chamber are exhausted. The piston B' in passing the abutment member lifts it, so that communication between the charging chamber and the cylinder Z is cut off, and the chamber is brought into communication with the supply chamber T through the port *a''*, and a port *a'''*, with which the port *a''* is brought into register. The port *a'''* is formed in the wall 5 of the recess within which the abutment member moves, and this port leads from a passage 4 which communicates with the supply chamber T through an opening 3 (Fig. 5). When the port *a''* is brought into register with the port *a'''*, a supply of motive fluid enters the charging chamber A. As the piston B' passes beyond the abutment member *a*, the member swings down into the position indicated in Fig. 3, thus cutting off communication between the supply chamber T, and opening up communication with the cylinder Z back of the piston B'. Thus during the operation of the engine the charging chamber is automatically operated to take charges of motive fluid from the supply chamber T and deliver them back of

the rotor pistons as the pistons come into position to be acted upon by the charges when ignited. When the engine is to be run in the opposite direction, the abutment member in which the charging chamber A' is formed, is swung down into position to engage the periphery of the rotor, and the abutment member in which the charging chamber A is formed is swung up out of the path of the rotor pistons. The construction and mode of operation of the charging chamber A' is the same as the construction and mode of operation of the charging chamber A, the chamber being provided with a port a^4 arranged to cooperate with a port a^5 formed in the wall 5, and communicating with the passage 4. The abutment member in which the chamber A' is formed is secured upon the shaft C, upon which the abutment member in which the chamber A is formed is mounted.

The devices for throwing the charging chambers into and out of operation at will are as follows: The charging chamber A is carried by a sleeve 9 mounted on the shaft C, as indicated in Fig. 9. Loosely mounted on the end of the shaft C is a lever H provided near its lower end with two laterally projecting arms h , h' . The outer end of the arm h is arranged to engage the end of an arm 10 secured to the end of the sleeve 9, and held yieldingly in engagement with the arm h by a spring 14. The outer end of the arm h' is arranged to engage the outer end of an arm 11 secured to the shaft C, and held in engagement with the end of the arm h by a spring 15. The lever H is also provided with a locking bolt 16 arranged to engage one or the other of two notches formed in a fixed locking plate. The locking bolt 16 may be readily operated by an operating handle 18. When the lever is in the position indicated in Fig. 7, the arm h' acting upon the end of the arm 11 holds the shaft C in position with the charging chamber A' out of operation, and in the position indicated in Fig. 3. With the lever in this position, the arm h is raised, so that the spring 14 acts through the arm 10 to force the charging chamber A yieldingly against the periphery of the rotor, as indicated in Fig. 3. By shifting the lever H toward the left in Fig. 7, until the locking bolt engages the other notch in the locking plate, the position of the arms h and h' , and of the charging chambers, is reversed, the charging chamber A' being thrown into operation, and the charging chamber A being moved and held out of operative position. The engine is also provided with a valve plate 6, provided with a central hub 8 by which it is secured to the inner end of a sleeve 7 (Fig. 5). The valve plate 6 is provided with two arms arranged to alternately open or close the ports a^3 and a^5 . The valve plate is

forced against the outer face of the wall 5 by a spring 12 mounted in a recess in the end of the sleeve 7, and engaged by an adjusting nut 19 secured on the end of the shaft C. The sleeve 7 may be operated by shifting the valve plate 6 into position to open the port a^3 and close the port a^5 , or to close the port a^3 and open the port a^5 , by means of an operating lever J, provided with a latching device j .

The motive fluid is compressed and supplied to the supply chamber T by the action of the compressing rotor L within the cylinder S. The cylinder is provided with ports G, G' through which the motive fluid is received and discharged, and a movable partition or abutment in the form of plates E, E is arranged between the ports and is held in continuous engagement with the periphery of the rotor. The plates E, E forming the partition or abutments between the cylinder ports are secured to and pivotally mounted on a shaft E', and are forced against the periphery of the rotor by the action of a spring E². The spring E² has its opposite ends connected to arms E³, one of which is secured to the shaft E', and the other to the sleeve which carries one of the plates E. Motive fluid is supplied to one or the other of ports G, G' from a supply pipe F through branch pipes F', F², the communication between the pipes and ports being controlled by check valves f' , f^2 . The compressed fluid discharged through the port G or G' is delivered to the supply chamber T through a pipe V (Fig. 2) and branch pipes V', V². The passage of the fluid through the branch pipes V', V², is controlled by check valves v' , v^2 , which allow the free passage of fluid into the pipes from ports G, G', but prevent back flow of the fluid.

Assuming that the engine is running in the direction indicated by the arrow, Fig. 3, fluid will be drawn in through the pipe F' and port G by the piston D as it advances from the position indicated in Fig. 4, the fluid contained within the space S' between the pistons D, D' will be carried around within the cylinder S, and the fluid within the space in front of the piston D' will be forced out through the port G' and through the pipe V², and be compressed into the supply chamber T. Thus during the rotation of the rotor each piston D, D' will act to draw in a charge of motive fluid through the port G, and to compress and discharge the fluid into the supply chamber T. In case the rotation of the engine is reversed, the pistons D, D' will act in a similar manner to draw in the motive fluid through the port G' and to compress and deliver the motive fluid through the port G and pipe V' into the supply chamber T.

While I prefer to employ the specific con-

struction and arrangement of the parts shown and described in embodying the various features of the invention in a simple and compact construction, it will be understood that this construction and arrangement is not essential to the invention in its broader aspects, and may be varied or modified as found desirable. It will also be understood that the various features of the invention may be embodied with advantage in engines which do not embody the other features, although improved results may be secured by embodying all the features in the same engine.

Having set forth the nature and object of the invention, and specifically described one form of apparatus in which it may be embodied, what I claim is:—

1. A rotary engine, having, in combination, a cylindrical work chamber, a cylindrical compression chamber, connected rotors in the respective chambers provided with pistons engaging the walls of the chambers, and means comprising an oscillating chamber for delivering charges of the fluid compressed in front of the piston of the compressing rotor back of the piston of the working rotor, substantially as described.

2. A rotary engine, having, in combination, a cylindrical working chamber, a cylindrical compressing chamber, connected rotors in the respective chambers provided with pistons engaging the walls of the chambers, a supply chamber into which the fluid in front of the piston of the compressing rotor is compressed, and means comprising an oscillating chamber for delivering charges of the compressed fluid from the supply chamber back of the piston of the working rotor, substantially as described.

3. A rotary engine, having, in combination, a cylindrical working chamber, a cylindrical compression chamber, connected rotors in the respective chambers each provided with duplicate pistons engaging the walls of the chambers, means for supplying motive fluid back of the pistons of the compressing rotor and delivering the fluid from in front of the pistons during the rotation of the rotor in either direction, a supply chamber into which the compressed fluid is delivered, duplicate charging chambers for taking charges of fluid from the supply chamber and delivering them back of the piston of the working rotor, and means for rendering said charging chambers alternately active and inactive according to the direction in which the rotor is to be driven, substantially as described.

4. A rotary engine, having, in combination, a cylindrical working chamber, a cylindrical compressing chamber, connected rotors in the respective chambers provided with

pistons engaging the walls of the chambers, an intermediate supply chamber, ports in the compression cylinder, a pivoted partition between the ports held in continuous engagement with the compressing rotor, means for controlling the communication between the ports and the intermediate supply chamber, and means for delivering charges of the compressed fluid from the supply chamber back of the pistons of the working rotor, substantially as described.

5. A rotary engine, having, in combination, a cylindrical working chamber, a rotor provided with a rigid piston in contact with the walls of the chamber, duplicate abutments mounted for radial movement by the piston means for holding either abutment in continuous contact with the rotor and maintaining the other out of the path of the piston and means for supplying motive fluid through either abutment, substantially as described.

6. A rotary engine, having, in combination, a cylindrical working chamber, a rotor provided with a piston in contact with the walls of the chamber, a movable abutment in continuous contact with the rotor, a charging chamber within the abutment, a supply chamber, and ports for alternately opening and closing communication between the supply and charging chambers and between the charging chamber and the working chamber, substantially as described.

7. A rotary engine, having, in combination, a cylindrical working chamber, a rotor provided with duplicate rigid pistons in contact with the walls of the chamber, duplicate abutments mounted for radial movement by the pistons, means for maintaining either abutment in continuous contact with the rotor and the other out of the path of the pistons, according to the direction of rotation of the rotor, and ports in said abutments through which successive charges are delivered back of the piston, substantially as described.

8. A rotary engine, having, in combination, a cylindrical working chamber, a rotor provided with pistons in contact with the walls of the casing, an oscillating abutment member provided with a charging chamber formed therein, means for holding the charging chamber yieldingly in contact with the periphery of the rotor, a port for controlling communication between the charging chamber and working chamber arranged to be closed by the outward movement of the abutment, and to be opened by the inward movement thereof, and a port arranged to be brought into communication with a fluid supply by the outward movement of the abutment and to be cut off from said supply by the inward movement of the abutment, substantially as described.

9. A rotary engine, having, in combination,

- tion, a cylindrical working chamber, a rotor provided with a piston in contact with the walls of the chamber, duplicate abutments on the same side of the chamber, means for holding either abutment in continuous contact with the rotor and maintaining the other out of the path of the piston, and means for supplying motive fluid through either abutment, substantially as described.
- 10 10. A rotary engine, having, in combination, a cylindrical working chamber, a cylindrical compressing chamber, rotors in the respective chambers provided with pistons engaging the walls of the chambers, an intermediate supply chamber, ports in the compression cylinder communicating with a source of fluid supply and with the intermediate supply chamber, a partition between the ports held in continuous engagement with the compressing rotor, means for controlling the communication between the ports and the fluid supply and between the ports and the intermediate supply chamber, and means for delivering charges of the

compressed fluid from the supply chamber back of the piston of the working rotor, substantially as described. 25

11. A rotary engine, having, in combination, a cylindrical working chamber, a cylindrical compressing chamber, rotors in the respective chambers provided with pistons engaging the walls of the chambers, an intermediate supply chamber, ports G G' in the compression cylinder, a partition E between the ports, valves f' f'' for controlling the supply of fluid to the ports, valves v' v'' for controlling the supply of fluid from the ports to the intermediate supply chamber, and means for delivering the charges of the compressed fluid from the supply chamber back of the piston of the working rotor, substantially as described. 30 35 40

In testimony whereof I affix my signature, in presence of two witnesses.

WILLIAM L. MERRILL.

Witnesses:

GILES C. GRANT,
RANSOM E. McDONOUGH.