No. 685,722. Patented Oct. 29, 1901.

C. A. MARRDER.

ROTARY EXPLOSIVE ENGINE.

(Application filed Nov. 18, 1899.)

(No Model.)

Fig: 1.

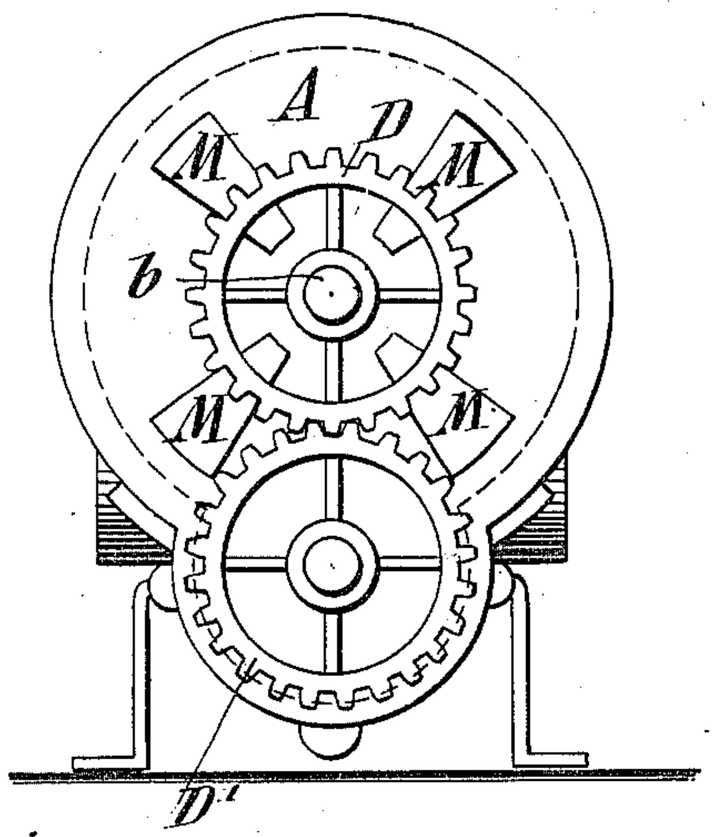


Fig: 2.

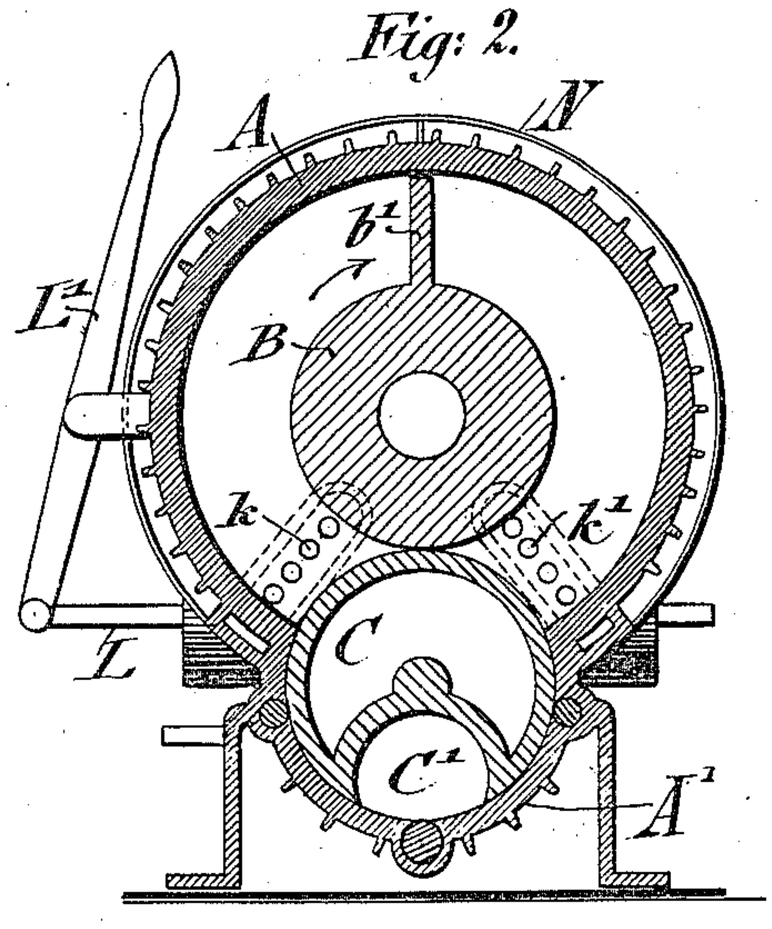


Fig: 3.

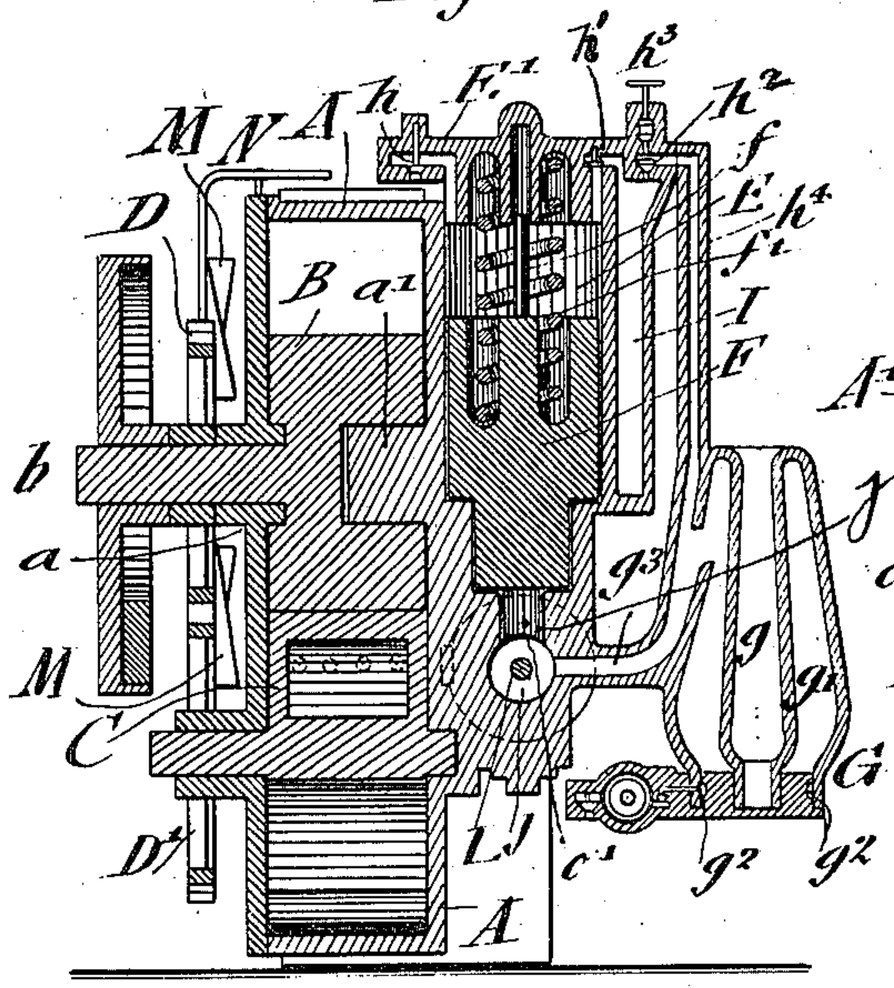
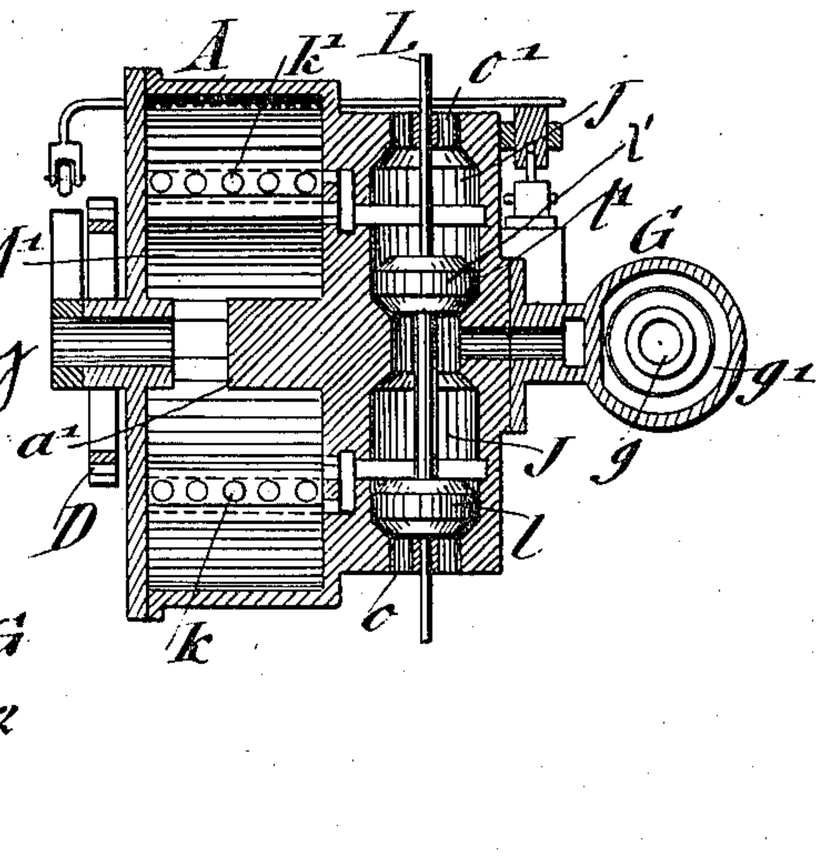


Fig: 4.



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ROTARY EXPLOSIVE-ENGINE.

SPECIFICATION forming part of Letters Patent No. 685,722, dated October 29, 1901.

Application filed November 18, 1899. Serial No. 737,459. (No model.)

To all whom it may concern:

Be it known that I, CHARLES A. MARRDER, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Explosive or Internal-Combustion 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.

My invention relates to explosive or internal-combustion engines, and particularly to gas or oil engines; and the objects of the invention are to store efficiently at the beginning of each working stroke of the piston which operates on the driven shaft the energy of explosion or combustion and subsequently to impart such power to the piston and from thence directly to the driven shaft at a later point in the stroke, thereby avoiding shock to the moving parts, comprising the piston and the driven shaft, and increasing the efficiency of the engine, to cool the combustion-chamber and working cylinder or chamber in an improved manner, and generally to improve and simplify engines of this class and make the same durable, efficient, and comparatively inexpensive.

My invention consists of an explosion or internal-combustion engine which comprises the combination of a working cylinder or chamber, a piston therein mechanically connected with the driven shaft, an automatic power-storing device mechanically independent of the piston and of the moving parts connected therewith, said power-storing device being connected by suitable passages at two points with the interior of the working cylinder, automatic valves in said passages whereby the inlet of air to the storing device is controlled and the outlet of compressed air from the storing device is controlled, and means arranged in said passages for supplying a combustible charge to the cylinder and for igniting the same, whereby the power-storing device is adapted to store power during the earlier portion of the stroke of the piston and to impart the stored power to the piston at a later point in the stroke.

My invention consists, further, in the combination, with the working cylinder or casing and rotary heads therein, forming a piston, one having a wing and the other a corresponding recess, of a valve-chamber, means for supplying a combustible mixture to the cylinder and igniting the same and connected with the valve-chamber by the said passage, ports in said cylinder upon opposite sides of said recessed head and adapted to serve either as admission or exhaust ports, and balanced valves arranged one at each side of said passage and adapted to open the port on one side of said head to admission and the port on the other side to exhaust, or vice versa.

The invention also consists of features of construction and combinations of parts to be hereinafter fully described in detail and then particularized in the claims.

In the accompanying drawings, Figure 1 is an elevation of one end of a rotary engine provided with my improvements, portions—namely, the air-concentrating hood and fly-wheel—being removed. Fig. 2 is a vertical transverse section of such engine. Fig. 3 is a central vertical longitudinal section of the same; and Fig. 4 is a horizontal section of the engine, parts being removed, and showing more particularly the reversing-valve.

Similar letters of reference indicate corresponding parts.

Referring to the drawings, A indicates the working cylinder or casing of a rotary engine, in which is mounted a revoluble cylindrical head B, which is formed or connected with an axial or driven shaft *b*, that journals in a suitable bearing *a* of the casing of the engine, and with an axial bore which receives a boss *a'*, formed on the inner wall of the casing. Another head C is revolubly mounted in the casing A, the same being arranged to revolve in a recess A' in the bottom of the casing. The peripheries of the heads B and C are in contact, and gears D D' connect the same and cause them to revolve in unison. The head C has a recess C', which permits the passage of a wing *b'* on the head B. These two heads together form the practical equivalent of a piston of a reciprocating engine and may be considered to constitute a piston.

The rotary engine shown is provided at one end with a storage-cylinder E, the lower portion of which also forms a combustion-chamber, and F is a free or floating piston guided in the storage-cylinder E.

f indicates the piston-rod of the piston F, the same being guided in a bearing in the cylinder-head E'. Coiled around the piston-rod *f* is a helical expanding-spring *f'*, the ends of which are suitably seated in cavities or annular recesses formed, respectively, in the piston-rod F and the cylinder-head E'.

G indicates the igniting device, the same consisting of a tube *g*, adapted to be heated by the flame of a Bunsen burner, surrounding which is an annular space or chamber *g'*. The explosive or combustible charge enters this annular chamber through ports g^2 and passes therefrom after being ignited into the lower end of the cylinder E through a passage g^3.

h indicates a check-valve opening inwardly for admitting air into the upper portion of the cylinder E, said check-valve being located somewhat below the top of the upper cylinder-head.

h' is a check-valve interposed between the storage-cylinder E and a storage-reservoir I, arranged to permit passage of air from the cylinder to said reservoir, but to prevent the reverse flow of air.

h^2 is a check-valve interposed between reservoir I and the annular chamber *g'* of the igniter and opening outwardly into a passage h^4, leading to the chamber *g'*. The extent to which it may open is regulated by means of a screw h^3.

The igniter G of the rotary engine is directly connected by aforesaid passage g^3 with a reversing-valve chamber J, which valve-chamber is also connected by a port *j* with the lower end of the cylinder E. Referring to Figs. 2 and 4, it would be apparent that the valve-chamber J is also connected by suitable ports *k k* and *k' k'* with the interior of the working cylinder A. The ports *k k* are located in the rear and the peripheral walls of one side of the working cylinder, so as to be located at one side of the piston-head B, while the ports *k' k'* are arranged in corresponding portions of the working cylinder which are at the other side of the piston-head. A valve-stem L is guided longitudinally in the valve-chamber J and is provided with two valves *l l'*, having seats in said valve-chamber, said valve-stem being operated by means of an operating-lever L'. The ends of the valve-chamber J are provided with openings *o o'*, so that when the valves *l l'* are in the position shown in Fig. 4 the ports *k* are admission-ports and the ports *k'* exhaust-ports, while when the positions of the valves *l* and *l'* are reversed the ports *k* become exhaust-ports and the ports *k'* admission-ports.

The operation of the engine is as follows: When an explosive mixture of gas or oil vapor and air, suitably mixed and forced into the igniter G, enters the annular chamber *g'* of the igniter it encounters the hot tube *g*, this tube being suitably heated by a flame when the engine is first started, and once the engine is running the combustion of the successive charges keeps the tube hot. The mixture of gas and air is ignited by contact with this tube, and therefore expands violently and passes into the valve-chamber J, thus passing through the ports *k* into the interior of the cylinder or casing A and causing the piston therein to revolve in the direction of the arrow shown in Fig. 2. At the same time the gas from the previous charge exhausts through the ports *k'* and out through one end of the valve-chamber J. At each explosion within the igniter, the valve-chamber J, and the inner part of the cylinder E the piston F is driven outward, so as to compress air into the reservoir I. When the pressure in the cylinder A has become lower than that in the reservoir I, the valve h^2 opens, permitting the air within the said reservoir to pass into the cylinder or casing A. The piston B C in being moved causes the mechanism coupled to driven shaft *b* to rotate in the customary manner. The piston F in moving outward compresses the air in the upper part of the chamber or cylinder E into the reservoir I, so that during the first portion of the stroke of the piston within the casing A the pressure in the chamber *g'* and in the lower portion of the cylinder E is much greater than the air-pressure in the reservoir I; but as the gas within the cylinder A and within the combustion-chamber formed by the lower portion of the cylinder E and the chamber *g'* expands the pressure in the cylinder and combustion-chamber becomes lower than that of the air in the reservoir I, and this air then opens the check-valve h^2, as stated, and passing through the chamber *g'* and valve-chamber J into the cylinder or casing A assists in driving the piston forward by raising the pressure in the cylinder A near the end of the stroke. It also cools the cylinder to a considerable extent. When by the opening of the exhaust-valve *l* or *l'*, as the case may be, the gases in the cylinders or casings A and E are exhausted, the piston F is returned to its first position by the spring *f'*, the inlet-valve opening to admit a fresh charge of air into the upper portion of the cylinder E. The engine is then in condition to receive another explosive charge.

The gear-wheel D' carries propeller-blades M, which force the air against the end of the casing or cylinder A, so as to cool the same by circulation. The casing or cylinder A is also provided in the well-known manner with projecting ribs to increase its radiating-surface and is also provided with a hood N, suit-

ably mounted, to direct the air from the fan-blades M over the sides of the casing of the engine.

It is evident that my invention is not necessarily limited to rotary engines, but may be also applied to reciprocating engines and that the invention is susceptible of various changes in the details of construction without departing from the spirit and scope of the invention.

Briefly stated, in addition to the working cylinder or chamber and the piston which is mechanically connected with the driven shaft my invention is characterized by a storage cylinder or chamber likewise provided with a piston, free, however, and suitable passages, valves, and a return-spring, so that at each explosion the storage-piston is driven forward in its cylinder, compressing air into a suitable reservoir, from which said air is caused to pass into the working cylinder or chamber near the end of the stroke of the piston, thereby gently raising the pressure upon the piston near the end of its stroke and at the same time cooling the working chamber. The storage-piston is returned to normal position by the spring or other suitable means during the exhaust period of the engine and in so doing draws into the storage-cylinder a further supply of air, which is utilized during the next stroke of the working piston.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. In an explosive or internal-combustion engine, the combination, with the working cylinder or chamber, and the piston therein mechanically connected with the driven shaft, of an automatic power-storing device mechanically independent of the piston and of the moving parts connected therewith, said power-storing device being connected by suitable passages at two points with the interior of the working cylinder, automatic valves in said passages, whereby the inlet of air to the storing device is controlled and the outlet of compressed air from the storing device is controlled, and means, arranged in said passages, for supplying a combustible charge to the cylinder and for igniting the same, whereby the power-storing device is adapted to store power during the earlier portion of the stroke of the piston and to impart the stored power to the piston at a later point in the stroke, substantially as set forth.

2. In an explosive or internal-combustion engine, the combination, with the working cylinder or chamber, and the piston therein mechanically connected with the driven shaft, of an automatic power-storing device, mechanically independent of the piston and of the moving parts connected therewith, said power-storing device being connected by suitable passages at two points with the interior of the working cylinder, an automatic air-inlet valve for the power-storing device, an air-reservoir, an automatic valve between the power-storing device and air-reservoir for admitting compressed air into the latter, an automatic air-outlet valve leading from the reservoir into one of said passages, and means arranged in the latter passage at a suitable distance from the last-named valve, for supplying a combustible charge to the cylinder and for igniting the same, whereby the power-storing device is adapted to store power during the earlier portion of the stroke of the piston and to impart the stored power to the piston at a later point in the stroke, substantially as set forth.

3. In an explosive or internal-combustion engine, the combination, with the working cylinder or chamber, and a piston therein mechanically connected with the driven shaft, of means for supplying a combustible charge to the cylinder and for igniting the same, passages connecting the latter with the cylinder, an automatic power-storing device connected with said passages, an automatic air-inlet valve for the power-storing device, a compressed-air reservoir, arranged alongside the power-storing device, a passage connecting the power-storing device and the said reservoir, an automatic valve arranged in said passage, a passage connecting the compressed-air reservoir and the means for supplying the combustible charge, and an automatic relief-valve arranged in the last-named passage, all constructed and arranged to cause the power-storing device to store up power during the earlier portion of the stroke of the piston and to impart the stored power to the piston at a later point in the stroke, substantially as set forth.

4. In an explosive or internal-combustion engine, the combination, with a working cylinder or casing, and rotary heads therein forming a piston, one having a wing and the other a corresponding recess, of a valve-chamber, means for supplying a combustible mixture to the cylinder and igniting the same, and connected with the valve-chamber by a suitable passage, ports in said cylinder upon opposite sides of said recessed head and adapted to serve either as admission or exhaust ports, and balanced valves arranged one on each side of said passage, and adapted to open the ports upon one side of said head to admission and the ports on the other side to exhaust, or vice versa, substantially as set forth.

5. In an explosive or internal-combustion engine, the combination, with a working cylinder or casing and a suitable rotary piston in the working cylinder, of means for supplying a combustible charge to the cylinder, passages for connecting the said means with the working cylinder, a valve-chamber, extending transversely of the working cylinder and arranged intermediately of the passages connecting the means for supplying the combustible charge with the interior of the working

cylinder, ports in opposite ends of the valve-chamber, ports in the said cylinder upon opposite sides of its piston, and adapted to serve as admission or exhaust ports, and valves arranged in said valve-chamber and adapted to control suitable outlet-openings in the said valve-chamber, whereby the said ports are adapted to serve either as admission or exhaust ports, or vice versa, substantially as set forth.

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

CHARLES A. MARRDER.

Witnesses:

E. H. TUCKER,

H. M. MARBLE.