F. L. HENIG.

ROTARY ENGINE.

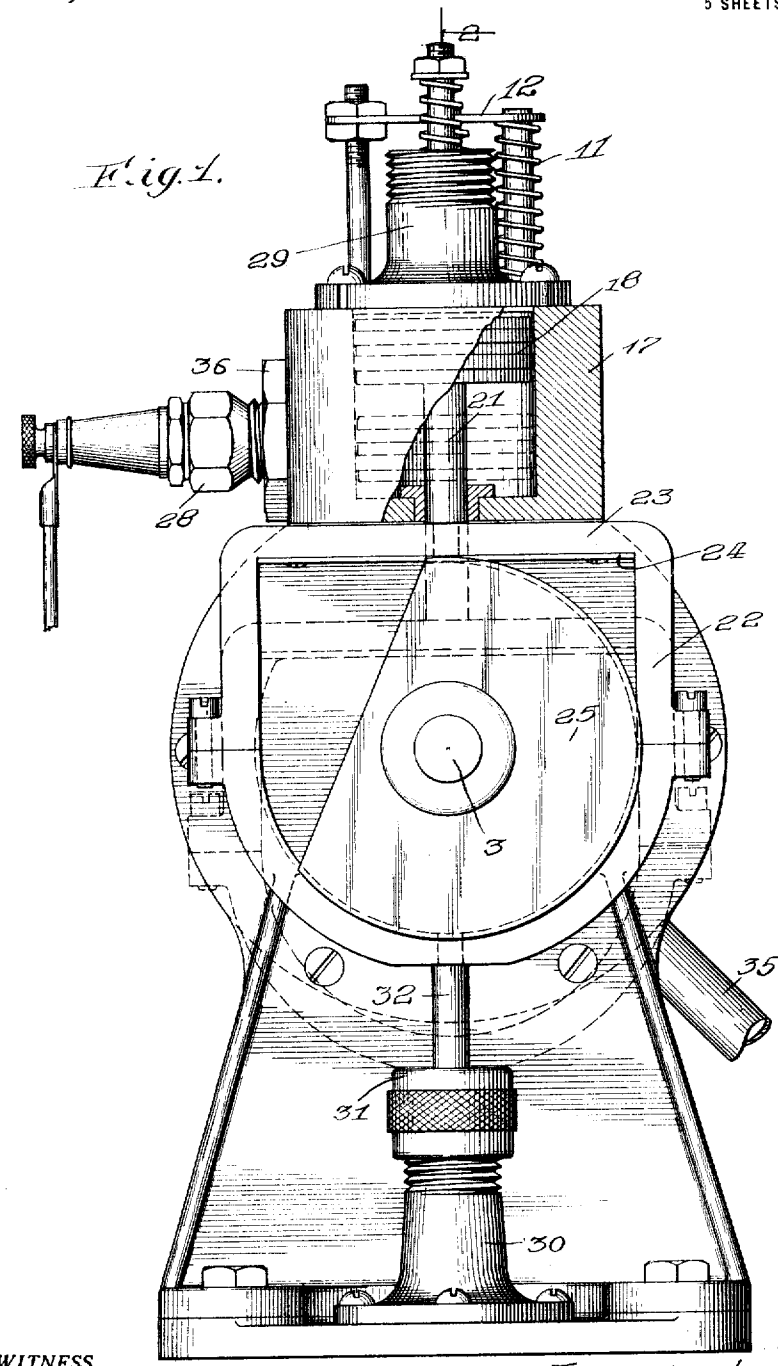
APPLICATION FILED AUG. 14, 1915.

1,309,735.

Patented July 15, 1919.

5 SHEETS—SHEET 1.

Fig. 1.




WITNESS

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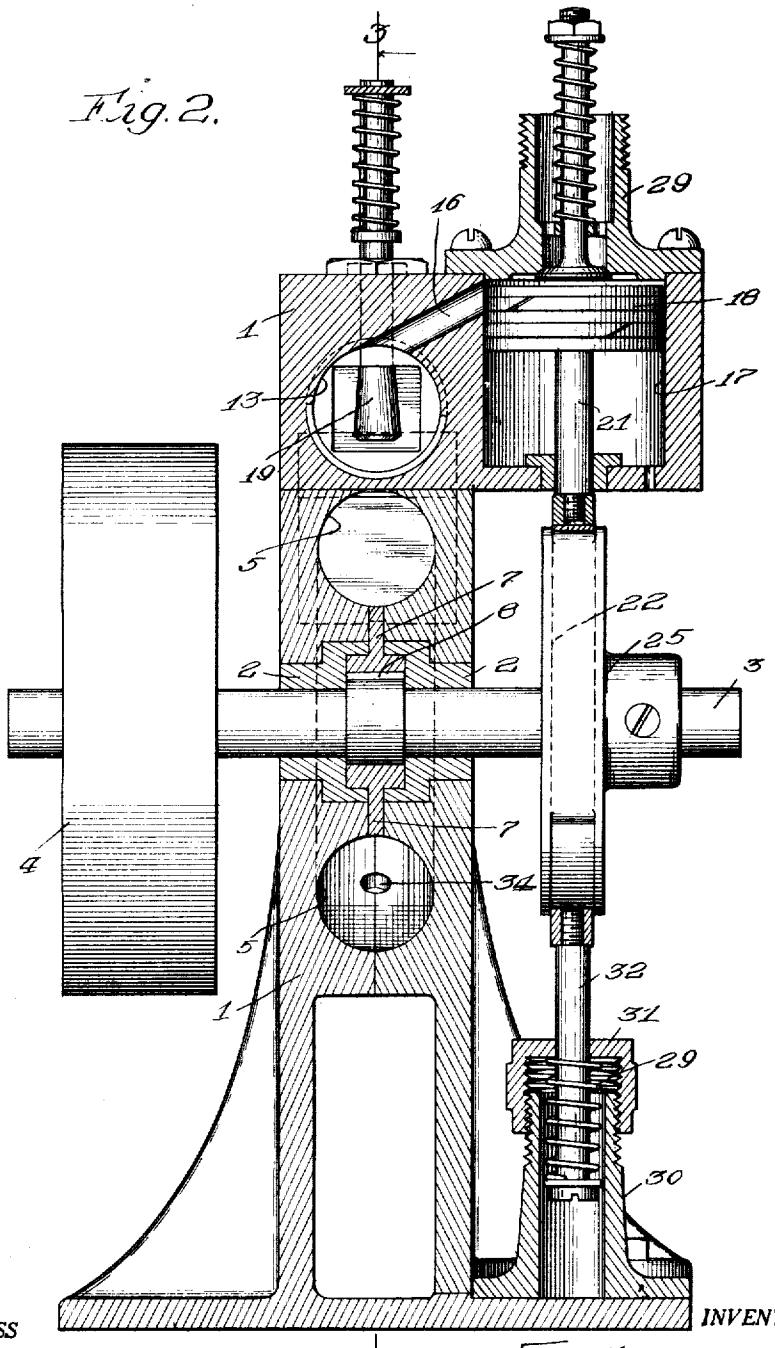
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5 SHEETS—SHEET 2.

Fig. 2.




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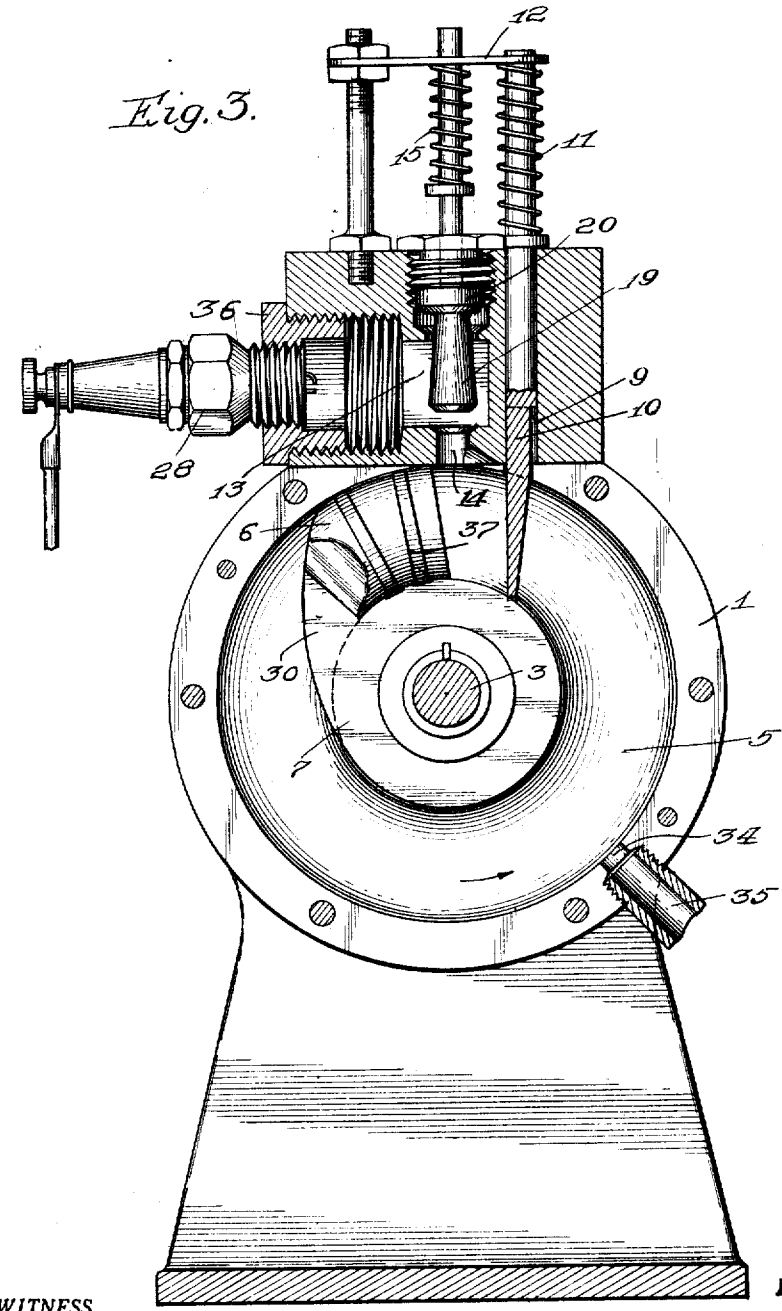
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5 SHEETS—SHEET 3.

Fig. 3.




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5 SHEETS—SHEET 4.

Fig. 4.

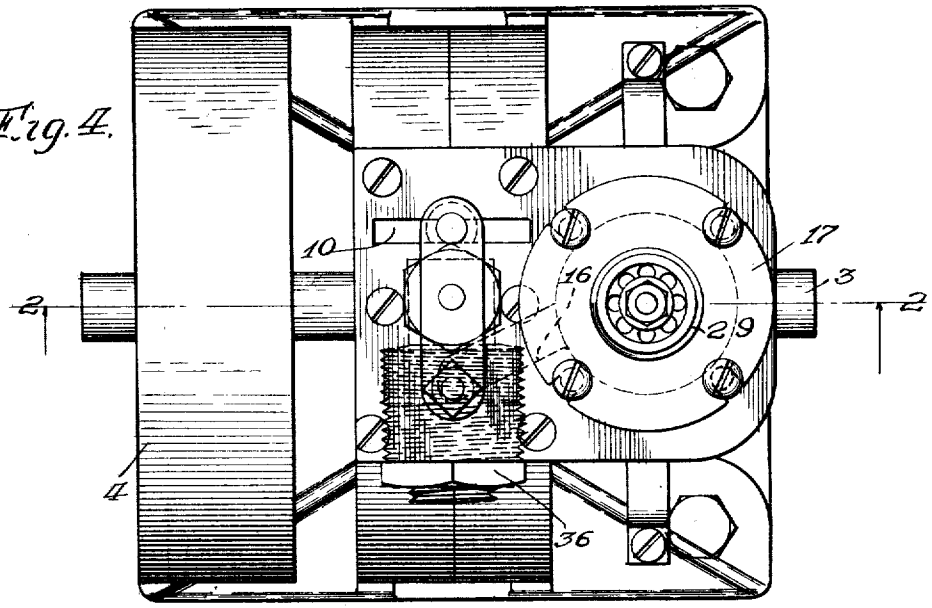



Fig. 5.

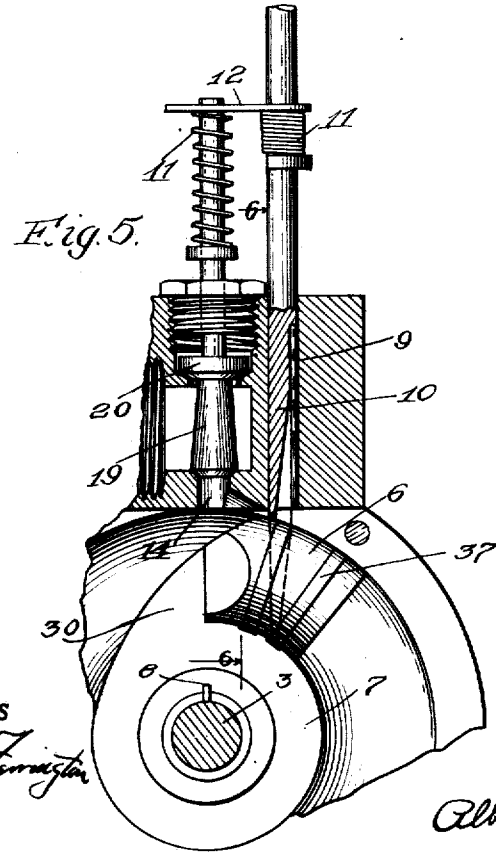
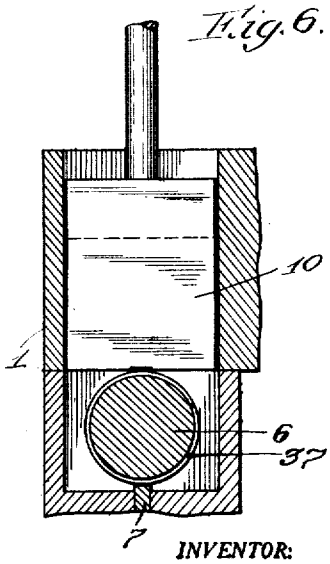



Fig. 6.




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5 SHEETS—SHEET 5.

Fig. 7.

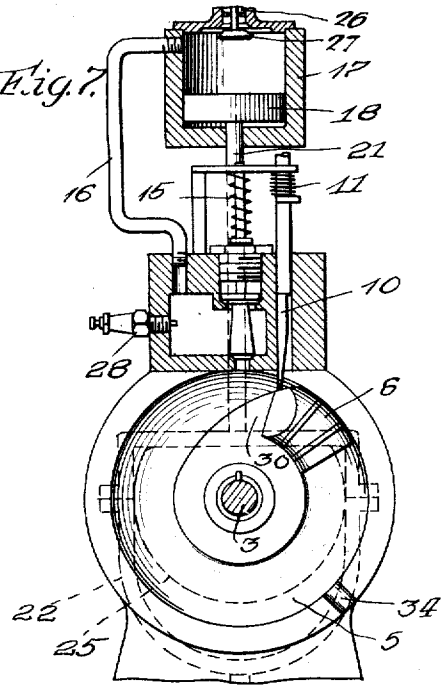



Fig. 8.

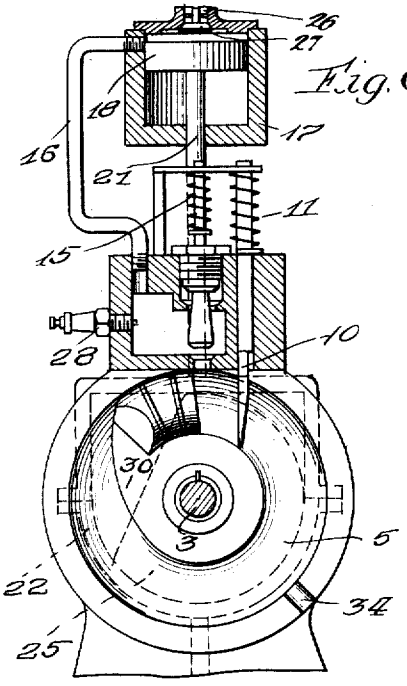



Fig. 9.

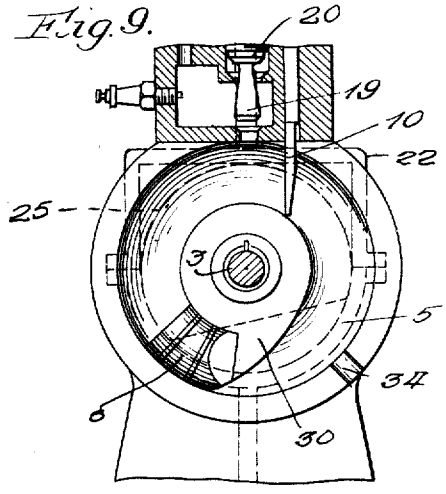
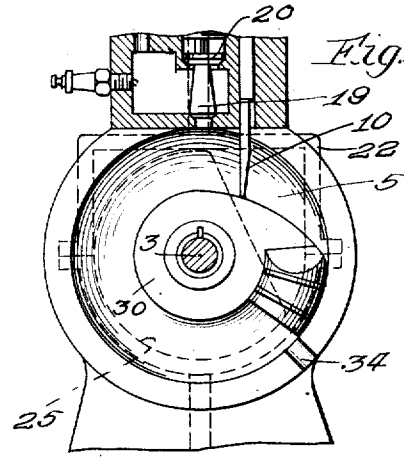



Fig. 10.




WITNESS

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# UNITED STATES PATENT OFFICE.

FRANK L. HENIG, OF CHICAGO, ILLINOIS, ASSIGNOR TO HENIG ENGINE CO., A CORPORATION OF ILLINOIS.

## ROTARY ENGINE.

1,309,735. Specification of Letters Patent. **Patented July 15, 1919.**

Application filed August 14, 1915. Serial No. 45,477.

*To all whom it may concern:*

Be it known that I, FRANK L. HENIG, citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, 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.

My invention relates to prime movers operated by fluid under pressure, (such as steam engines, compressed air motors or internal combustion motors), its general object being to provide a simple and efficient construction in which a rotary motion may be obtained without any reversal of direction of the actuating parts. More particularly, my invention aims to provide a prime mover in which a pressure-actuated piston may move continually in one and the same direction and in which the cylinder head associated with the piston will be automatically moved into and out of the operative position at the right time and for speedily returning it to its operative position; to provide a simple, ample and easily controlled inlet for admitting the actuating fluid to the runway in which the piston travels, and to avoid a catching of the piston rings in the said inlet; to provide simple and effective means for forcing the actuating charge of fluid into the said runway quickly and at the proper period during the travel of the piston, and for adjusting both the volume of the admitted fluid and the pressure or speed of admission of the same; to provide means actuated by the said charge for controlling the admission of the latter to the said runway; to provide simple means for drawing in the desired amount of charge and for compressing the same, and to provide simple means for controlling the exit of the operating fluid from the said runway.

While my invention in one or more of its aspects may be embodied with substantially equal facility and effectiveness in a wide variety of prime movers, it is particularly adapted for embodiment in an internal combustion engine and is shown in this embodiment in the accompanying drawings, which drawings will also serve in disclosing further objects of my invention.

In the drawings, Figure 1 is an end view of an internal combustion engine, with a portion of the charge-compressing cylinder cut away.

Fig. 2 is a vertical section through Fig. 1 along the line 2—2.

Fig. 3 is a vertical section through Fig. 2 along the line 3—3.

Fig. 4 is a plan view of the engine.

Fig. 5 is a fragmentary section similar to Fig. 3 but taken at another point in the operation of the engine.

Fig. 6 is a fragmentary vertical section along the staggered line 6—6 of Fig. 5.

Figs. 7—8—9 and 10 are partially diagrammatic sectional views of the engine taken at four different periods in the rotation of the shaft.

The engine of the drawings has a main or body member 1, preferably made in two substantially symmetrical halves and supporting the bearings 2 for a shaft 3 carrying a fly wheel 4. Concentric with the axis of the shaft 3, the body member 1 has an annular chamber 5 having a cylindrical cross-section in any plane radial of the said axis, which chamber affords a runway for a piston 6 having an axis curved concentrically of the said shaft. The main member 1 also has a passage 9, preferably vertical, which intersects the runway 5 and extends upward from the latter and which is preferably reduced in width toward its lower end. This passage affords a guide-way for a slide 10 normally disposed across the runway 5 (as in Fig. 3) so as to form a closure opposed to one end of the piston corresponding to the cylinder head in a reciprocating engine, which slide is continuously urged in a downward direction not only by its own weight but also by a spring 11 bearing against a thrust bar 12.

The main member 1 also has an explosion chamber 13 connected to the chamber 5 by a port 14 and also connected by an inlet passage 16 to a charging cylinder 17 housing a plunger or charge-compression piston 18. The port 14 is controlled by a reciprocable valve member 19 which is normally pressed into closed position by a spring 15 but adapted to be raised out of this position by the upward pressure of fluid in the explosion chamber against an enlargement 20 on the said member 19. The plunger 18 is connected by a stem 21 to a strap 22 encircling the shaft 3, which strap comprises a lower

semi-circular portion and an upper rectangular portion, the latter having a flat horizontal top 23 equipped on its lower face with a strip 24 of raw-hide or other suitable cushioning material. Fast upon the shaft 3 and slidably encircled by the strap 22 is a segmental cam 25 having a periphery composed of a curved portion concentric with the shaft and preferably extending more than half way around the latter, and a straight side. The greatest vertical inside measurement of the strap 22 is preferably equal to the diameter of the curved portion of the cam 25, so that the lower curved portion of the strap and cushioning strip 24 will be continuously engaged by the cam 25 during the larger part of the rotation of the latter, thereby holding the stem 21 and the plunger 18 immovable in the uppermost position of the latter, as shown in Fig. 1. However, when the cam reaches a position where its straight edge becomes substantially parallel to the top 23 of the strap, the latter will drop by gravity into the position shown in dotted lines in Fig. 1, thereby drawing the plunger 18 downward and sucking a charge (as of gas) through an opening 26 which is normally kept closed by a spring-pressed valve 27. Then a continued rotating of the cam 25 will soon bring its curved edge again into contact with the upper part of the strap (or a cushioning on the latter), thereby raising the plunger 18 so as to compress the charge of gas in the cylinder 17 and to force this compressed charge through the inlet passage 16 into the explosion chamber 13. There the charge is exploded by a spark plug 28 controlled by a timer suitably mounted on the shaft of the engine but not shown in the drawings.

In starting its descent, the plunger 18 tends to produce a vacuum in the charging cylinder 17, hence I preferably do not depend entirely on gravity for actuating this plunger, but supplement the pull of gravity by a spring 29 engaging a portion of a stem 32 extending downwardly from the strap 22. This spring bears upwardly against a threaded cap 31 on a tubular riser 30, so that by adjusting the position of this cap I can vary the tension of the spring and consequently the speed of descent of the plunger 18. I can also use the top of this cap 31 as a stop for the lower end of the strap, thereby reducing the descent of the strap and the plunger 18, and hence reducing the volume of charge drawn into the cylinder 17.

In the diagrammatic views, Fig. 7 shows the engine just after gravity (accelerated by the spring 29) has dropped the plunger 18, thereby drawing a charge into the charging cylinder 17, which is connected at its upper end 29 to a suitable supply of gas, such as a gas main or a carburetor fed with a mixture of air and vaporized gasolene. While the charge is being drawn into the cylinder 17, the slide or partition 10 is being raised by a cam 30 projecting from the front end of the piston 6, and preferably integral with the flange 7, which cam raises the partition until the latter entirely clears the runway 5 and rides upon the outer surface of the piston, as shown in Fig. 6. Then, as soon as the momentum of the rotating piston has carried the rear end of the latter past the forward face of the slide 10, the latter will drop by gravity into the normal position in which it forms a closure across the runway. While this is occurring (that is to say, while the piston is passing under the partition, and while the latter is dropping to its normal position) the cam 25 is raising the strap 23 (and hence the plunger 18) to the position of Figs. 1 and 8, thereby compressing the charge within the cylinder 17, and forcing this charge into the explosion chamber 13, where the charge is exploded and the resulting increased pressure raises the valve 19 and admits the gases under high pressure through the port 14 to the runway 5. Then the expansion of the gases between the slide 10 and the rear end of the piston will forcibly propel the latter to the position of Fig. 9, or even of Fig. 10, after which the momentum of the rotating parts (which parts are preferably steadied by a fly-wheel 4) will complete the rotation to the point where the actuating gas is again admitted to the runway. However, as soon as the piston has passed the exhaust port 34, the actuating fluid will be discharged from the runway through the exhaust pipe 35, thus reducing the pressure in the runway and the explosion chamber 13, whereupon gravity assisted by the spring 15 will drop the valve 19, and disconnect the explosion chamber from the runway.

It will be evident from the drawings that by suitably adjusting the tension of the spring 11, the rate of descent of the slide 10 can be accelerated, so that this slide will form an effective closure across the runway (corresponding to the cylinder head in a reciprocating engine) even if the engine is running at a fairly high speed. Also, that by varying the amount of charge, the proportion of rotational movement accorded to the piston by direct action of the gas pressure between the latter and the partition may be varied, thus enabling the engine to be used at various rates of expansion of the actuating fluid. Moreover, since the firing takes place in the chamber 13, any resulting carbonization can practically be confined to this chamber, and the latter can easily be cleaned out by removing the nipple 36, which carries the spark plug 28, thus keeping the runway clear of such deposit.

To avoid having the slide 10 catch on the piston rings 37, I preferably dispose the passage 9 out of alinement with the axis of the shaft 3, so that the slide will be angularly disposed to the piston rings passing under the same, as shown in Fig. 5. However, I do not wish to be limited to this precise arrangement, nor to other of the details herein disclosed, it being obvious that the same might be varied in many respects without departing from the spirit of my invention. For example, instead of connecting the chamber 13 through a cylinder 17 with a supply of explosible gas, this chamber might be connected directly to a supply of steam or of compressed air, thus adapting my invention for use as a steam engine or as a compressed air motor. It will also be obvious that in using the term engine in my claims, I am using this in the broad sense in which it includes a great variety of prime movers, besides those actuated by gas pressure due to internal combustion.

I claim as my invention:

1. In a rotary engine, a body having an annular chamber, a piston slidable in the chamber, a charging cylinder formed in the body and projecting outwardly from a side thereof, an explosion chamber communicating with the annular chamber and with the cylinder, a slide coöperating with the piston, a plunger in the cylinder having a depending stem extending along one side of the body, a shaft carrying the piston, a cam on the shaft, a strap connected to the depending stem and encircling the cam, a stem depending from the bottom portion of the strap, a tubular riser receiving the last-named stem, a spring encircling and connected at one end to said last-named stem, and a cap adjustable on the riser and engaging the other end of the spring and engageable with the strap to restrict the downward movement thereof.

2. In a rotary engine, a body having an annular chamber, a piston slidable in the chamber, a charging cylinder formed in the body and projecting outwardly from a side thereof, an explosion chamber communicating with the annular chamber and with the cylinder, a slide coöperating with the piston, a plunger in the cylinder having a depending stem extending along one side of the body, a shaft carrying the piston, a cam on the shaft, a strap connected to the depending stem and encircling the cam, and an adjustable spring device connected to the bottom portion of the strap to tension the latter in a downward direction.

3. In a rotary engine, a body having an annular chamber, a piston slidable in the chamber, a charging cylinder formed in the body and projecting outwardly from a side thereof, an explosion chamber communicating with the annular chamber and with the cylinder, a slide coöperating with the piston, a plunger in the cylinder having a depending stem extending along one side of the body, a shaft carrying the piston, a cam on the shaft, a strap connected to the depending stem and encircling the cam, and a combined adjustable device for tensioning the strap in a downward direction and for engaging the strap to restrict the downward movement thereof and accordingly the downward movement of the plunger.

4. In combination with a body having an annular chamber and a piston slidable therein, a charging cylinder, a plunger in the cylinder, a cam connected to the piston, means connected to the plunger and encircling the cam to actuate the plunger by the cam movements, means to tension said first means, and combined adjustable means to effect adjustment of the tension of the tensioning means and to engage said first means to limit the downward movement of the plunger.

5. In combination with a body having an annular chamber and a piston slidable therein, a charging cylinder, a plunger in the cylinder, a cam connected to the piston, means connected to the plunger and encircling the cam to actuate the plunger by the cam movements, means to tension said first means, including a spring, and a turnable cap engaging one end of the spring to adjust the tension of the latter and being engageable with the bottom portion of the strap to restrict the downward movement of the latter and thereby the downward movement of the plunger.

FRANK L. HENIG.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."