(No Model.)

F. CORDENONS.

GAS ENGINE.

No. 500,754. Patented July 4, 1893.

Fig. III

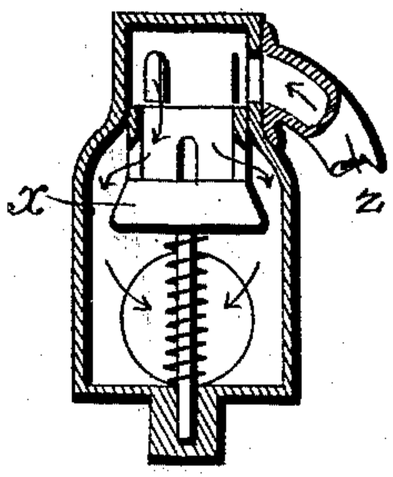


Fig. I.

Fig. IV

Fig. II

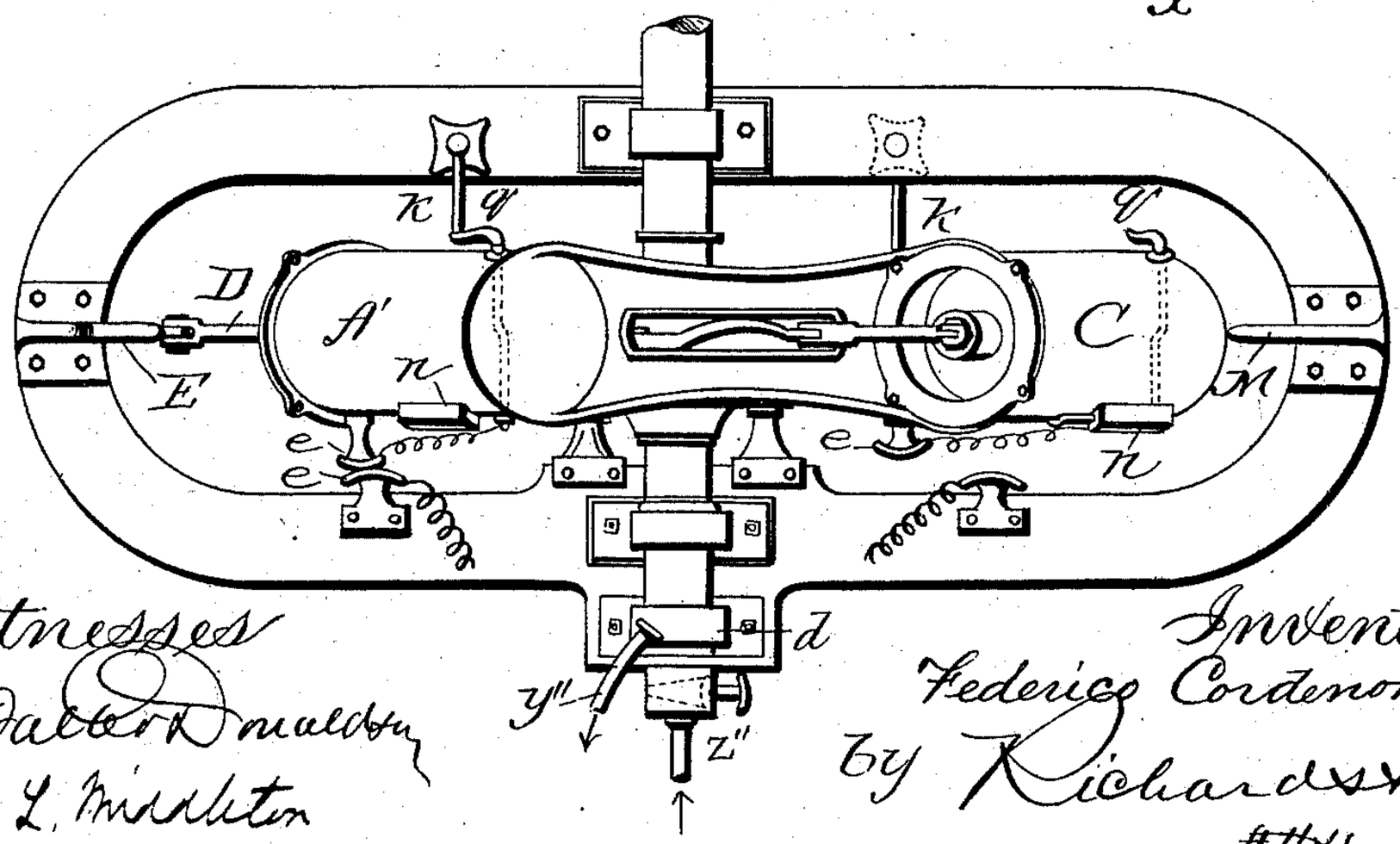
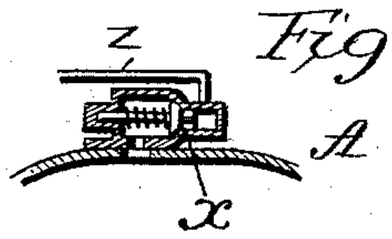


Fig. V.



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UNITED STATES PATENT OFFICE.

FEDERICO CORDENONS, OF PADUA, ITALY.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 500,754, dated July 4, 1893.

Application filed March 6, 1891. Serial No. 384,058. (No model.) Patented in Germany January 18, 1889, No. 48,640.

To all whom it may concern:

Be it known that I, FEDERICO CORDENONS, teacher, a subject of the King of Italy, and a resident of Padua, Italy, have invented certain new and useful Improvements in Gas-Engines, of which the following is a full, clear, and exact description.

The invention has been patented in Germany, No. 48,640, dated January 18, 1889.

My invention relates to a new or improved rotary engine wherein the expansion of the gas or petroleum vapor which is used as motive power causes the motor cylinders to move backward and as these cylinders are fixed to the fly wheel the latter transmits a rotary motion directly to the motor shaft. To obtain this action when expansion takes place in the cylinders, rods connected with the pistons bear upon brackets or supports fixed to the frame of the engine, this taking place in turn in each cylinder. It will therefore be sufficient to follow the cycle of movements in one of the three cylinders, as it is obvious that the other two cylinders will act similarly when passing through corresponding points.

Figure 1 is a front view of my improved rotary engine actuated by gas and Fig. 2 is a plan of the same. Figs. 3 and 4 are views of the valves controlling the admission and outlet of the mixture. Fig. 5 is a sectional view of the valve shown in Fig. 3 illustrating its relation to the cylinder, a portion of the shell of said cylinder being also shown in said figure.

There are three cylinders A. B. and C divided internally by the corresponding pistons A′, B′, C′ in two parts, the rear part *a* which is the combustion chamber and the fore part 10 which is a pumping as well as a compressing chamber and is accordingly closed hermetically. We will now follow the motion of the cylinder A Fig. 1. It is shown at the moment that the expansion takes place and the end of the connecting rod D is already bearing by means of its roller against the fixed support E and rests against the latter until owing to the rearward motion of the cylinder the piston arrives close to the mouth of the cylinder that is to say at the end of its stroke. During this motion the charge which is composed of air and gas and was located in the pumping chamber 10 in the fore end of the cylinder wherein it had been pumped during the previous motion in a reverse direction to that of the piston is forced under pressure along the pipe *i* into the cylinder B. when the expulsion of the burned gases is terminated therein. The expulsion of the burned gases and the pumping in of the fresh gaseous mixture are effected during the rearward motion of the pistons.

The alternate rearward motion of the pistons is obtained by means of the levers L actuated by the cam H riveted with the other cam J which actuates the slide valve *n* hereinafter described to the fixed frame of the engine. It is thus possible to secure two explosions for each cylinder at each rotation of the engine, so as to reduce the motions of the piston to two for each explosion instead of the four motions required in ordinary compressive gas engines, that is to say as there are three cylinders, there are six active impulses following one another nearly uninterruptedly so that when one has acted the next has already commenced acting, and so on. The second explosion takes place when the ends of the connecting rods come before the second fixed support M which has the same curve as the former for the rollers of the connecting rods to run against but is arranged upside down on account of its position being diametrically opposite that of the former support.

The valves *x*, of which one is shown in section on an enlarged scale Fig. 3, serve for the admission of the mixture into the pumping chambers on the rearward stroke of the piston under the action of the cam H and the intermediate lever L. The slide valve *n* serves for the admission of the charge into the combustion chambers through the pipes *i* and for the escape of the burned gases from said chambers through the pipes *y*. The valves *x* act automatically, being opened in consequence of the return of the piston which tends to form a vacuum in the pumping chamber, and draws the air from the outside and the gas from the gas pipes *z* (Fig. 3), through suitably graduated ports which remain open during the motion of the valves. The said valves *x* act also as governors being so placed that their stems

coincide with the radii of the revolving frame in such a manner as to be subjected to the action of centrifugal force and tend to remain more or less fast to their seats according to the rotary speed of the engine. It is thus sufficient to adjust their spiral springs to cause the engine to turn at the desired speed.

The gas pipes *z* communicate with the gas tanks or with a suitable gas conduit the gas passing through the hollow motor shaft and through the ring *d* (Fig. 2) fixed to the frame and which surrounds the mouth of the shaft and then through the said pipes *z* to the valves *x*. A similar arrangement is used for the burned gases which pass through the slide valves *n*, along the pipes *y* and through the shaft whence they escape through the discharge pipe *y''* (Fig. 2.)

The slide valve *n* and pipes *i* and *y* are shown separately on an enlarged scale in the partial section Fig. 4. Each slide valve has the two parts 11—12. In the position shown these ports are in position so that the one marked 11 forms a communication between the combustion chamber of the cylinder and the pipe *y* for the escape of the burned products while the pipe *i* is closed against the inlet of the fresh charge to the cylinder. When the valve is slid to its other position the port 12 comes opposite the pipe *i* and the fresh mixture is then free to pass into the combustion chamber while the pipe *y* for the exhaust of the foul mixture is closed. The slide valves *n* are actuated by the levers *r* which are operated by the cam J. riveted upon the other and larger cam and the diametrically opposite and most eccentric curves of which cause the lever to open the exhaust ports while the two most eccentric curves cause the admission ports to be opened and when the rollers move upon the two other parts of the eccentric all the ports remain closed. A strong spiral spring compels the lever to bear constantly against the cam. The other larger levers L serve as already stated for the return stroke of the piston which takes place when the corresponding roller moves upon the ascending curve of the large cam H. When the roller has reached the summit of the curve, the return stroke of the piston ceases and the latter is closed so long as the admission of the charge takes place wherefor the cam is furnished with a concentric curve following the ascending curve aforesaid. After the admission has taken place the connecting rod comes to bear against one of the two fixed supports or abutment A or M, the lever ceasing now to operate and abandoning the cam which it takes up again when the expansion is completed and the piston returns to its normal position. The compression of the mixture is caused by the power of the explosion which propels the piston forward.

To set the engine in motion it is requisite that the forward motion of the piston should also take place without expansion. For this purpose the lever L is furnished with a second arm which in this case or in that of a stroke being missed comes to bear upon the ascending curve of the great cam. The ignition is effected by electricity the spark being generated when the circuit is broken. This circuit is established when the suitably insulated pieces *e* come in contact one with the other, and it is broken when the pieces Q (Fig. 2.) strike the pieces *k* (Fig. 2) the points being separated in the combustion chamber and spark formed.

The electric current is supplied by a battery as shown in the drawings or by any other suitable dynamo which may rotate with the engine.

I claim—

1. In a rotary gas engine, the revolving frame, a series of cylinders carried thereby each having a combustion chamber and a pumping chamber separated from each other by the pistons, the valved gas supply leading to the pumping chamber of each cylinder, the pipe leading from the pumping chamber of each cylinder to the combustion chamber of the adjacent cylinder and suitable exhaust passages and igniting means, substantially as described.

2. In a rotary gas engine, the revolving frame, a series of cylinders carried thereby each having a combustion chamber and a pumping chamber separated from each other by the pistons, the valved gas supply leading to the pumping chamber of each cylinder, the connections between each pumping chamber and the combustion chamber of the next cylinder, the exhaust conduits leading from the cylinders and the valve with positive operating means therefor for controlling the exhaust and also the supply of gas from the pumping chambers to the combustion chambers and suitable igniting devices, substantially as described.

3. In combination in a rotary gas engine, the revolving frame, a series of cylinders carried thereby and having pistons, the rods having rollers and connected to the piston rods, and projecting from the cylinders, the abutments on the stationary frame in line with the said roller rods, the means for returning the pistons after each explosion consisting of the levers in connection with the piston rods and the central cam, each cylinder being divided by the pistons into a combustion chamber and a pumping chamber, the valved gas supply leading to each pumping chamber, the pipe connections between the pumping chamber of each cylinder and the combustion chamber of the next cylinder, the exhaust pipes from the combustion chambers, the valves for controlling the said exhaust pipes and the pipes leading to the combustion chamber and the means for operating the said valve consisting of the central cam and the lever connections thereto, substantially as described.

4. In combination the rotary frame, the se-

ries of cylinders thereon, the pistons, the projecting roller rods, the abutments on the stationary frame to be engaged thereby, the gas supply and exhaust connections to the cylinders and the means for returning the pistons after each explosion consisting of the central cam and the lever connections between the piston rod and the same, substantially as described.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

FEDERICO CORDENONS.

Witnesses:
H. ABERT JOHNSON,
VIRGINIA LEVIS.