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C. E. DURYEA.

SPARKING IGNITER FOR EXPLOSIVE ENGINES.

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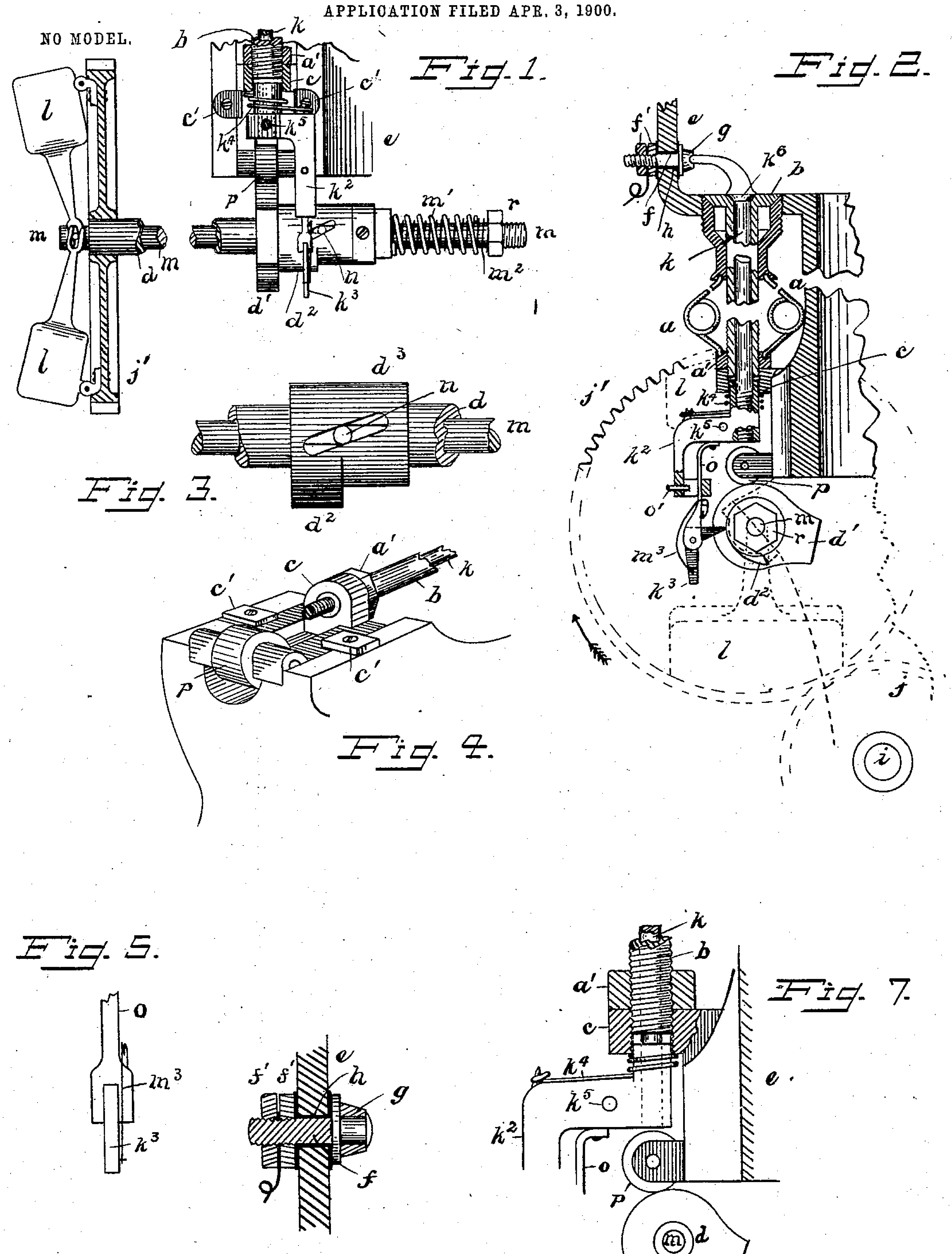
NO MODEL.



WITNESSES -

H. G. Duke

J. E. Walker

INVENTOR

Charles E. Duryea

By E. H. Bond Att'y.

UNITED STATES PATENT OFFICE.

CHARLES E. DURYEA, OF PEORIA, ILLINOIS.

SPARKING IGNITER FOR EXPLOSIVE-ENGINES.

SPECIFICATION forming part of Letters Patent No. 722,005, dated March 3, 1903.

Application filed April 3, 1900. Serial No. 11,313. (No model.)

To all whom it may concern:

Be it known that I, CHARLES E. DURYEA, a citizen of the United States, residing at Peoria, in the county of Peoria and State of Illinois, have invented certain new and useful Improvements in Sparking Igniters for Explosive-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 that type of motors in which charges of air and fuel of proper proportions are ignited and by their expansion propel the piston.

The objects of my invention are to provide a suitable and satisfactory means of igniting the charge, an automatic means for varying the time of the ignition more or less according to the speed of the motor, to secure simplicity of construction, certainty of action, facility of inspection or repairs, and other objects, as will be set forth in this specification. I accomplish these objects by the mechanism shown in the accompanying drawings, forming part of this specification, in which—

Figure 1 is a plan view showing the secondary or cam shaft, the exhaust-valve, slide, roller and cam, together with the mechanism for operating the sparker. Fig. 2 is an elevation, partly in section, of the same, including the exhaust-valve, the sparker-point, and the insulated anvil. Fig. 3 is a detail showing the adjustable cam for operating the sparker with portions of the cam-shaft and governing-rod. Fig. 4 is a detail of the exhaust-slide with roller and with portion of the valve-stem attached. Fig. 5 is an enlarged plan of sparker-pawl. Fig. 6 is an enlarged section of the insulated anvil with its various fittings; and Fig. 7 is an enlarged detail, partly in section, showing slide, pawl-frame and spring for retracting the sparker-point.

Similar letters refer to similar parts throughout the several views.

In general construction my motor is of the common and well-known type, which fires a charge in each cylinder at every second revolution of the crank-shaft, and my devices, although suitable for a single-cylinder motor, are especially adapted to multiple-cylinder motors having two or more cylinders placed side by side. A crank-shaft is common to all cylinders and is indicated by *i* in Fig. 2. A cam-shaft *d* is placed parallel to the crank-shaft and mounted in suitable bearings. Gears *j j'* are arranged to drive the cam-shaft at one-half the number of turns of the crank-shaft in the well-known manner. A cam *d'* is fixed to the cam-shaft *d*, and adapted to bear against the roller *p* and move the slide *c* and the exhaust-valve and stem *b*. This action is common to other motors; but I increase the rapidity of the opening movement by placing the cam-shaft *d* below the center line of the valve-stem and roller. This placing opens the exhaust-valve suddenly, permitting the charge to escape freely and without any pressure to resist the return movement of the piston, a feature of value in connection with the high-speed motors. It also gives a slow closing of the valve, rendering it less liable to clack and be noisy, a matter of importance when these motors are used for automobile or similar service. The relative position of the cam-shaft *d* to the roller *p* and its line of movement is readily seen by reference to Fig. 2.

The exhaust-valve and stem *b* are provided with a central passage in which the sparker-stem *k* is placed. This sparker-stem is provided at one end with a ground joint, preferably conical, as k^6, Fig. 2, and a bent or cranked portion projecting into the firing-chamber of the motor and adapted to contact with the sparking-surface *g* of the insulated anvil *f*. The other end of the sparker-stem *k* is preferably screw-threaded and adapted to receive the pawl-frame k^2. This frame is provided with a binding-screw k^5, by which it may be fixed firmly in position upon the stem *k*. A spring k^4 is wound around the stem *k* and the encircling boss forming part of k^2, bearing at one end on the slide *c* and at the other end engaging the pawl-frame k^2 and adapted to rotate the sparker-stem in a direction calculated to lift the sparker-point from the surface *g* of the anvil *f*. The pawl-frame k^2 is provided with the pawl k^3, arranged to bear upon a cam d^2, mounted upon the cam-shaft *d* in proximity to the exhaust-cam *d'*. This cam and pawl are placed at one side of the center line of the sparker-stem k, and since the cam-shaft d is below this said center line it will readily be seen that the point of the pawl k^3 is approximately in a plane passing through the said center line in a direction parallel to the cam-shaft d. Because of this fact, the cam d^2 pushes in a tangential direction on the point of the pawl k, which approximately coincides with a radius from the center of the sparker-stem k, although the pawl-frame k^2 in order to clear the slide c and properly support the pawl k^3 does not lie in or near the plane of the radial line approximating the position of the point of k^3. It will readily be seen that the cam d^2, having a fixed height, will raise the pawl k^3 and rotate the sparker k a fixed distance only, so that if in usage the sparking-surface g of the anvil or the sparking-point of the sparker k wear off contact will no longer be made and no spark be produced. This condition could be remedied (until again worn off) by loosening the screw k^5 and adjusting the sparker, so that the sparking-point is in contact with sparking-surface g when the point of the pawl k^3 is on the top of the cam d^2. It is evident that there will be some torsional elasticity in the stem k and the other parts; but to permit a wider range of wear on the sparking-surfaces before adjustment is needed the pawl-frame k^2 does not carry directly the pawl k^3, but is provided with a spring o, which carries said pawl k^3. This spring o is made stiffer than the spring k^4, so that the sparking-points are brought into contact before the pawl k^3 reaches the highest point of the cam d^2, after which the spring o yields, permitting the pawl k^3 to slide over the highest part of the cam d^2 without bending or otherwise damaging any of the sparker parts. In this case as the sparker parts wear off they simply do not contact quite so soon and adjustment from wear is not needed so frequently. A screw o' is mounted in the pawl-frame k, by which the action of the spring o is adjusted, if desired. To permit backward rotation of the cam d^2, as sometimes happens when the motor comes to a stop, the pawl k^3 is not rigid, but is pivoted, is free to move in one direction, and is held in place by a light spring m^3.

For purposes of repair the caps c' c' may be removed from the slide c, the springs a a detached, and the seat in which the exhaust-valve b is mounted may be unscrewed from the motor and the exhaust-valve, with its seat and with the sparker, removed from the motor.

The anvil f is a metallic bolt having a head inside the firing-chamber and a screw-threaded portion, with nuts f' or equivalent fastening devices outside, insulating material h separating all parts of it from the metal wall in which it is placed, and the sparking-surface g placed on an end projecting into the firing-chamber. While it is not absolutely necessary to equip this anvil f with a sparking-surface other than its own material and while it could be made throughout of a refractory conductive metal, I prefer to provide the anvil f with a projecting stud, on which a ring g is placed and fastened by brazing or riveting or in any suitable manner. This ring g I make of suitable metal, preferably something hard and refractory, like platinum. Since the anvil f is circular in cross-section at any point, it may be readily turned, so as to present a new surface for sparking purposes, and will therefore wear a long while before it is necessary to renew the surface g.

By reference to Figs. 2 and 7 it may be readily seen that the exhaust-valve stem b is adjustable in slide c, with a lock-nut a' to fix it in any position. This arrangement permits adjusting the valve to accommodate any wear between it and its seat and permits the roller p to be placed quite close to the cam d, which arrangement renders the stroke of the cam on the roller less noisy, a matter of considerable importance in automobiles.

It will readily be seen that the surface k^6 should form a tight joint with its seat in the exhaust-valve b, and to this end the spring k^4 has a second function—namely, to bear against the slide c and exert a pressure on k^2 in a direction lengthwise the stem k. Because of this function the boss on k^2 should project into the opening in the slide c sufficiently far to insure that the spring k^4 cannot get out of position, slip into the opening in c, and fail to perform its duty.

Because of the fact that for automobile work it is desirable to vary the speed of the motor through wide limits and because it is well known that a charge of fuel requires time to burn after being ignited by the electric spark it is necessary to ignite much earlier in the stroke at high speeds than at slow speeds. If, however, the point of ignition is fixed much ahead of dead-center, the motor may fire soon enough to start backward, and since these small motors are started by turning the crank-shaft by hand-power backward starting is often dangerous. It is therefore preferable that at speeds slower than fifty revolutions, or thereabout, the ignition should take place at the dead-center, while as soon as the speed reaches a point high enough to insure that the momentum of the fly-wheel cannot be overcome and reversed it is desirable that the ignition take place before the dead-center, and as the speed increases toward one thousand revolutions per minute and faster the sparking should take place a proportionately-increased amount earlier. To this end the automatic governing device shown in Figs. 1, 2, and 3 is used. This device consists of a collar d^3, carrying a cam d^2, which is not fixed to the shaft d, as has been assumed in the preceding description, but which is held in a predetermined position by a pin n, fixed in the rod m and adapted to move longitudinally in a slot longitudinally located in the wall of the hollow shaft d and also in a slot diagonally located in the wall of the collar d^3. It will readily be seen from this description and Fig. 3 that longitudinal movement of the rod m will shift the pin n and force the slots in d and d^3 into a new relation to each other, which of course shifts the position of the cam d^2 on the hollow shaft d. This rod m may be shifted in any suitable manner; but I prefer and have shown in Fig. 1 centrifugal weights $l\ l$, pivoted on the gear j', with arms engaging the rod. As the speed of motor increases the gear j' will be rotated faster, causing the weights $l\ l$ to exert a greater pull on the rod m in a direction calculated to compress the springs $m'\ m^2$ and of course shift the cam d^2 an amount proportionate to the movement of the rod m. This cam d^2 is shifted forward in the direction of its rotation and the pawl k^3 is operated earlier in the cycle in proportion to the speed of the motor, causing the earlier ignition desired. As the speed of the motor decreases the springs $m'\ m^2$ should retract the rod m with its pin n, restoring the cam d^2 to its former position. It will be noticed that two springs m' and m^2 are used for this service, one of which, m^2, is both lighter and longer than m'. The object of this is to retract the rod m an increased amount at the standstill position, so as to avoid any possibility of firing sufficiently in advance of the dead-center to cause a reverse rotation of the motor and yet to secure the advantage of the decided lead in the ignition at moderately-slow speeds. The spring m^2 is strong enough to retract the rod m when the weights $l\ l$ have little or no centrifugal action; but immediately after the motor is in motion the weights overcome the slight stiffness of the spring m^2, and an appreciable lead, sufficient to insure combustion before the dead-center has been far passed, is at once secured, after which a farther increased lead proportionate to the speed is secured. The rod m is provided with an adjusting-nut r, whereby the tension of the springs may be regulated.

The collar d^3 is maintained in position on the shaft d against longitudinal motion by any preferred method, it being shown in Fig. 1 as between the cam d' and a collar set-screwed on the shaft d. The shaft d and rod m are broken in Fig. 1 to indicate that multiple devices, duplicates of the cams, valves, and sparkers shown, are used in case of multiple cylinders, all being operated from the same shaft d by the same set of gears. It will thus be seen that a multiple-cylinder motor does not increase in complexity in proportion to the number of cylinders added.

While the method of ignition shown is that commonly known as the "make-and-break" spark, other systems of ignition can be used without departing from the spirit of my invention—as, for example, motors using hot-tube ignition can be controlled by the use of some form of timing-valve operated mechanically instead of the sparker.

It will readily be seen that my invention may be used for varying the point of ignition manually while the motor is in operation by applying resistance to the adjusting-nut, which would shift it on the rod and vary the position of the sparker-actuating cams with respect to the springs.

I claim—

1. In an internal-combustion engine, an exhaust-valve and stem, a sparker journaled therein, an adjustable frame affixed to the sparker-stem, a spring for retracting the same, and a pawl carried by said frame, in combination with a yielding portion carrying said pawl and interposed between the cam-shaft and the sparker-stem of greater stiffness than the retracting-spring.

2. An internal-combustion motor having a mechanically-operated sparker, an actuating mechanism for said sparker rotatably mounted, governor-weights, connecting means constructed to actuate said sparker earlier as the speed of the rotating part increases, and springs acting on the governor-rod and constructed to increase the retractile effect when the weights are inactive.

3. In an internal-combustion engine, a mechanically-operated sparker, a sparker-actuating cam controlled by centrifugal weights, means for shifting the sparker-actuating cam by the centrifugal action of the weights, and a retracting-spring counteracting the centrifugal force of the weights, and a spring of different power coöperating therewith.

4. In an internal-combustion engine, a mechanically-operated sparker, a sparker-actuating cam controlled by centrifugal weights, means for shifting the sparker-actuating cam by the centrifugal action of the weights, a retracting-spring counteracting the centrifugal force of the weights, and a secondary spring adapted to increase the retractile effect when the weights are inactive.

5. In an internal-combustion motor, a hollow cam-shaft, a sparker-actuating cam loosely mounted therein, a cam-controlling rod within the said hollow shaft, centrifugal weights adapted to actuate the rod as the shaft revolves, springs of different power acting on the governor-rod for increasing the retractile effect when the weights are inactive, and means for connecting the said rod and sparker-stem.

6. In a governor for gas-engines, the combination with a tubular governor-rod, of a rod within the same and a pin projecting from said rod, centrifugally-acting means connected with the inner rod and two independent springs, one of less power than the other, acting on said rod in opposition to said centrifugal means, a sparking device, and a cam that actuates the sparker and having an angular slot that is engaged by the aforesaid inner rod for the purpose of shifting the cam.

7. In a governor for gas-engines, the combination with a tubular governor-rod, of a rod within the same and a pin projecting from

said rod, centrifugally-acting means connected with the inner rod and two springs each independent of the other and one of less power than the other acting on said rod in opposition to said centrifugal means, a sparking device, a rotary actuating-cam therefor, said cam being shiftable by connection with the aforesaid inner rod, and the exhaust-valve and the cam arranged in connection therewith, said cams having slots through which works a pin carried by the inner rod.

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

CHARLES E. DURYEA.

Witnesses:
RUDOLF PFEIFFER,
R. S. DURYEA.