(No Model.) 2 Sheets—Sheet 1.

J. W. RAYMOND.

GAS ENGINE.

No. 583,507. Patented June 1, 1897.

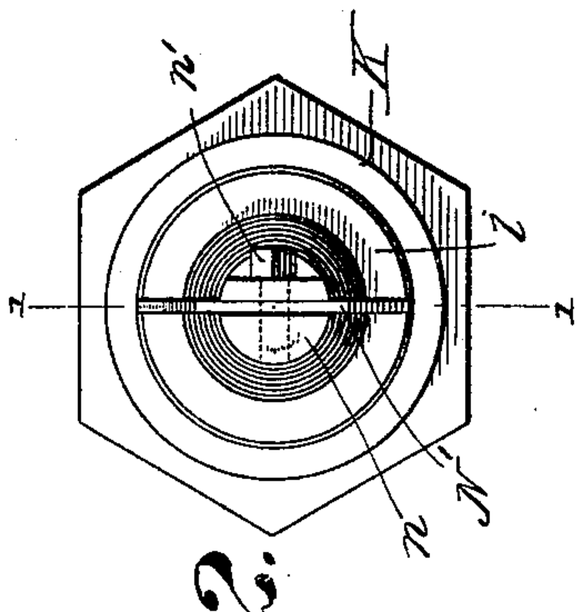

Fig. 2.

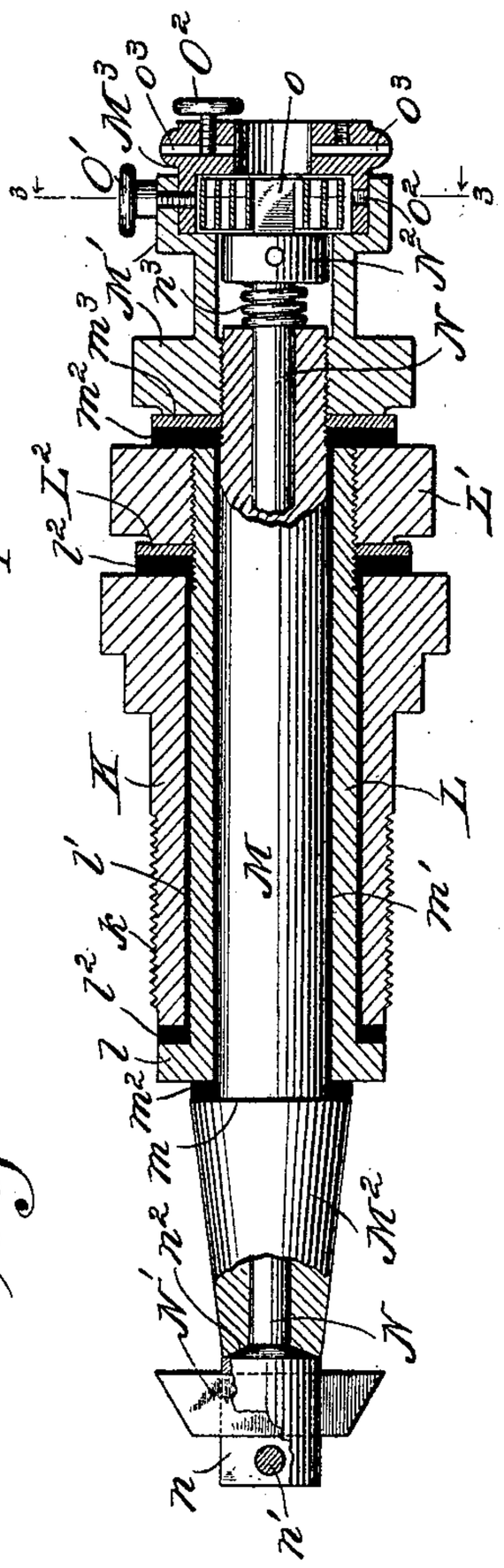

Fig. 1.

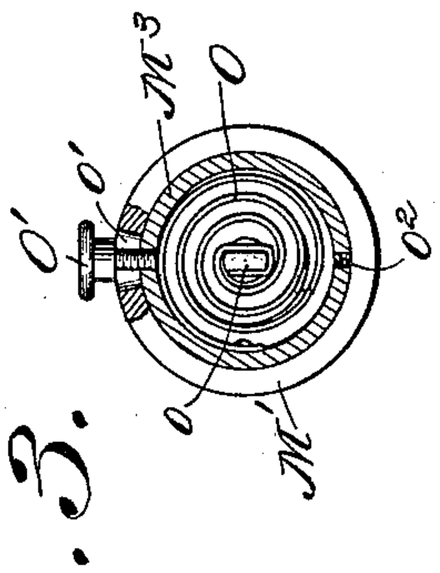

Fig. 3.

WITNESSES.

Geo. W. Young.

H. Cameron.

INVENTOR.

John W. Raymond.

BY John C. Wiles.

ATTORNEY.

(No Model.)

2 Sheets—Sheet 2.

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Fig. 3.

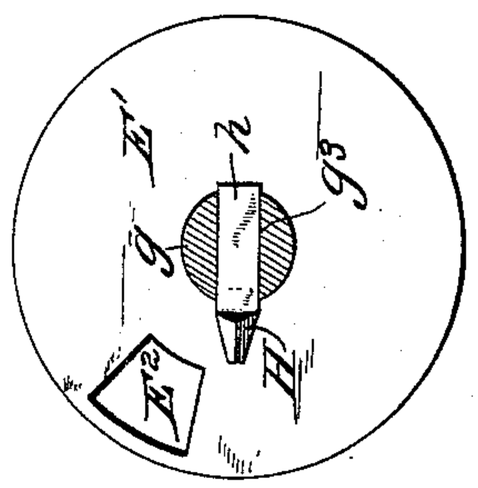
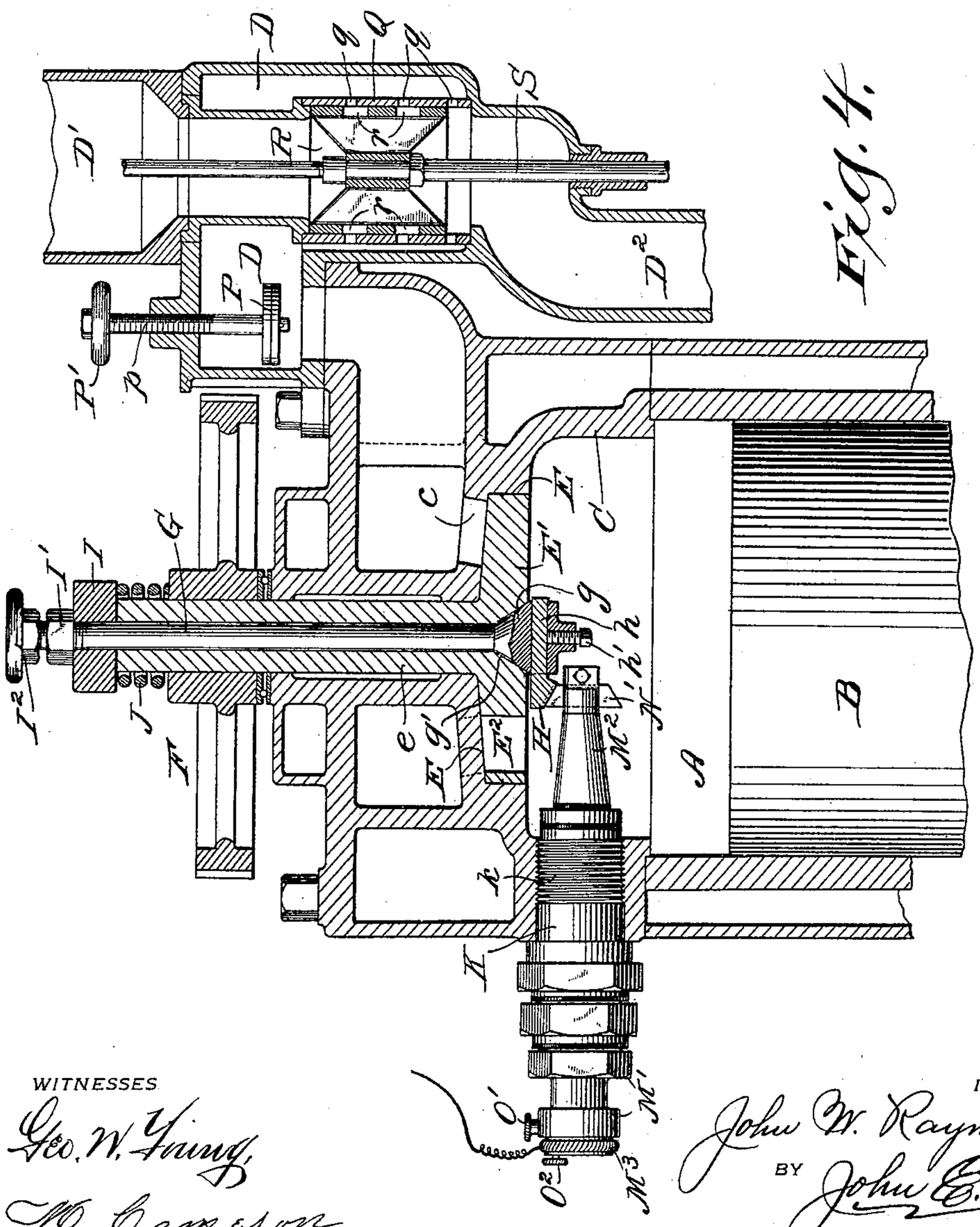


Fig. 4.



WITNESSES.

Geo. W. Young.

M. Carleton

INVENTOR.

John W. Raymond,

BY John C. Wiles,

ATTORNEY.

UNITED STATES PATENT OFFICE.

JOHN W. RAYMOND, OF RACINE, WISCONSIN.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 583,507, dated June 1, 1897.

Application filed January 13, 1896. Serial No. 575,303. (No model.)

To all whom it may concern:

Be it known that I, JOHN W. RAYMOND, a citizen of the United States, residing at Racine, county of Racine, State of Wisconsin, have invented a certain new and useful Improvement in Gas-Engines; and I 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 pertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

My invention relates to new and useful improvements in gas or vapor engines which are designed for operation by the explosion of gas or the vapors of petroleum; and my said invention relates more particularly to an improved form of igniting device for producing the desired explosions of the gas or vapor at a desired period in the stroke of the piston.

My said invention consists in the matters hereinafter described, and pointed out in the appended claims.

In the accompanying drawings, illustrating my invention, Figure 1 is a longitudinal sectional view of the ignition device, taken on line 1 1 of Fig. 2. Fig. 2 is an inner end elevation of the same. Fig. 3 is a transverse vertical sectional view of the same, taken on line 3 3 of Fig. 1. Fig. 4 is a vertical sectional view of a cylinder provided with my improved ignition device and showing in section and partly broken away the gas or vapor supply chamber, together with the valve for governing said supply. Fig. 5 is an inverted plan view of the main distributing-valve with one electrode secured thereto.

The objects of my invention are to provide an improved form of ignition device which shall be positive in its operation and which will admit of a ready adjustment without removal from the cylinder, and to provide an ignition device one member or element of which carries one electrode adapted for contact with the electrode carried by a moving part, said device being so constructed as to admit of a ready adjustment while the engine is in operation, so as to present a new surface or portion of the electrode carried thereby for contact with the moving electrode.

A further object of my invention is to provide an improved ignition device in which the moving electrode is capable of ready adjustment, so as to make contact with the other electrode at any desired period in the stroke of the engine-piston, so as to produce the desired explosions of gas or vapor at any desired period in said stroke.

A further object of my invention is to provide an ignition device in which all of the springs for holding and returning the stationary electrode to its normal position after the moving electrode has passed the same are located wholly without the cylinder and outside of the influence of heat developed by the explosions of gas or vapor within the cylinder, so as to enable said springs to retain their temper and strength, and thereby insure a satisfactory operation of the ignition device.

A still further object of my invention is to provide, in connection with the cylinder, the ignition device, the gas or vapor supply chamber and its regulating-valve, and suitable means for closing the communication between said supply-chamber and the inlet-port which communicates with the cylinder, so as to enable the ignition device to be removed from the cylinder and a new electrode secured thereto without stopping the motion of the engine.

Referring by letter to said drawings, A designates a suitable cylinder within which a piston B is fitted, said cylinder and piston being of any desired or convenient form of construction.

Upon the upper end of the cylinder A is secured a chamber-head C, having induction and eduction ports for gas or vapor of substantially the construction illustrated in my prior patent, No. 491,855, and granted to me on the 14th day of February, 1893, the induction-port *c* thereof being connected with a main supply-chamber D, which latter in turn communicates with any suitable or desired source or supply of gas or vapor.

Within the upper part of the chambered head C is provided a suitable valve-seat E, within which is fitted a main distributing-valve E′, having a hollow stem *e*, which extends upward through bearings in said head, and upon the upper end of which is secured a suitable gear-wheel F for communicating a

rotary motion to said stem and valve. One or more ports may be provided in said valve adapted to successively register with the induction and eduction ports in the cylinder-head, the induction-port, however, being the only one illustrated in the drawings.

In practice I find that a single port or opening E^2 in the main distributing-valve is sufficient for the purposes of receiving the charge of explosive gas or vapor through the induction-port *c* and permitting the escape of the exploded gas or vapor through the eduction-port, and, as shown in Fig. 5, I prefer to construct said valve E′ with but one port.

The upper face of the valve E′ is conveniently constructed on a suitable incline and is closely fitted to a correspondingly-shaped under surface of the valve-seat E, said parts being conveniently fitted together with a "ground joint."

A suitable stem G extends vertically through a tubular stem *e* of the main distributing-valve and is provided at its lower end with a cone-shaped enlargement *g*, fitted within a tapered cone-shaped bearing *g′* in the central lower face of the main valve E′, as shown, said cone-shaped enlargement extending sufficiently below the main valve to adapt it for connection with one electrode of the ignition device.

As illustrated in Figs. 4 and 5 of the drawings more particularly, a transverse aperture g^3 is formed in said enlarged lower end of the stem G, and an electrode H, provided with a suitable shank *h*, is secured thereto by having its said shank engaged within said aperture conveniently by a set-screw *h′*.

Upon the upper end of the stem G is conveniently secured a suitable collar I, arranged to rest upon the upper end of the tubular stem *e* of the main distributing-valve, and a lock-nut I′ has a screw-threaded engagement with said upper end of the stem G and is adapted to be turned down upon said collar I, so as to firmly lock the tubular stem *e* and the stem G together in their adjusted positions. Upon the extreme upper end of said stem G is provided a suitable hand-wheel I^2, rigid upon said stem. It follows from this construction that in order to adjust the stem G so as to bring the electrode H, carried thereby, to a desired position with respect to the main distributing-valve the lock-nut I′ may be loosened and the stem, together with said electrode, adjusted to the desired position by means of the hand-wheel I^2, when the parts may be again securely locked together in their adjusted positions by tightening said lock-nut I′.

Beneath the collar I and interposed between the same and the upper side of the gear-wheel F is a suitable spring J, which serves by its upward pressure to hold the valve E′ satisfactorily against its seat, while at the same time permitting a free rotation thereof. It follows also that in order to adjust the electrode H with respect to the stem G it is only necessary to loosen the said screw *h′*, when the shank *h* of said electrode may be adjusted within the aperture in the projecting end of the stem, so as to bring the electrode to the desired position.

I will now proceed to describe the other part or member of the ignition device. This device is illustrated more particularly in Figs. 1 to 3, inclusive. As shown in said figures, the said device comprises a suitable bushing K, screw-threaded at one end, as at *k*, and adapted for engagement with a correspondingly-screw-threaded aperture in the side wall of the cylinder-head C. Within said bushing is located a sleeve L, provided at one end with an annular flange or collar *l*, and at its other end screw-threaded for engagement with a suitable nut L′. The outside diameter of the sleeve L is made sufficiently less than the bore of the bushing to permit the introduction of a filling *l′* of insulating material—such, for instance, as mica—to effectually prevent electrical contact between said bushing and said sleeve. The insulating material is carried outward between the ends of the bushing and the annular collar or flange *l* and the nut L′, as indicated at l^2, and a suitable washer L^2 is interposed between the nut L′ and the end of said insulating-body to prevent abrasion of the insulating-body when the nut L′ is screwed onto the threaded end of the sleeve L. It follows from this construction that the bushing K and the sleeve L may be firmly secured together by means of the nut L′, the latter being screwed forcibly against the washer L^2, and the latter in turn crowded against the insulating-ring l^2. A second sleeve M, of smaller diameter than the bore of the sleeve L, is arranged within said latter sleeve and is provided adjacent to its inner end with an annular shoulder *m*, being screw-threaded at its outer end for engagement with a tubular housing M′, as shown. The inner sleeve M is insulated from the sleeve L by means of a suitable filling or body *m′* of insulating material, terminating at its opposite ends in annular flanges or rings m^2 m^2, and a suitable washer m^3 is interposed between the inner end of the tubular housing M′ and the outer one of the said insulating rings or flanges. By this construction the sleeve M is adapted to be firmly secured within the sleeve L, while being at the same time effectually insulated therefrom.

The sleeve M is suitably shaped upon its inner end to extend for a suitable distance inside the cylinder-head, being conveniently provided with the extension M^2. (Shown in Figs. 1 and 4.)

A suitable stem N is fitted within the bore of the inner sleeve M and terminates at its inner end in a suitable enlargement *n*, which is slotted, as shown in Figs. 1 and 2, for the reception of an electrode or contact device N′. The cleft end of the stem is adapted to be secured upon the outside of the electrode or contact device N′ by means of a suitable

clamping-screw n' in the manner shown. As shown in Fig. 1 of the drawings, the enlargement upon the inner end of the stem N is conveniently beveled or cone-shaped where it engages with the inner end of the sleeve M and is conveniently fitted to a seat n^2 in the inner end of said sleeve, said fitting being made, preferably, by means of a ground joint, so as to insure a perfectly tight fit between said parts. A suitable collar N^2 is secured to the outer end of the stem N, and a spring n^3 is interposed between said collar and the outer end of the sleeve M, said spring serving to exert an outward pressure upon the stem N, so as to keep the joint between the enlarged inner end of said stem and the inner end of said sleeve always tight and prevent any leakage of gas or vapor or of the products of combustion of the same around said stem.

The outer end of the stem N is made angular in form for engagement with a suitable spring O, said outer extremity of the stem being conveniently flattened, as at *o*. The spring O is conveniently of spiral form and is secured at one end within the housing, being shaped at its inner end so as to embrace the angular extremity of the stem N. It follows from this construction that the stem N may be rocked or oscillated somewhat within the sleeve M, and that when freed the spring O will return said stem and the electrode carried thereby to their normal positions.

When the bushing K is in position within the aperture in the cylinder-head, as shown in Fig. 4, and the parts have been properly adjusted, it will be seen that the electrode N′ carried by the stem N will coöperate with the moving electrode H, which is carried by the stem G, to form electrical contact between said electrode at each rotation of the valve and said stem G. It will also be seen that by the rotation of said valve and stem and the consequent circular motion of the electrode H said electrode will be brought into engagement with the electrode N′, so as to rock or oscillate said electrode, together with the stem N, and that as soon as said electrode H has passed over the end of the electrode N′ the spring O, which engages with the outer end of the stem N, will instantly return the electrode and the stem to their normal positions. This breaking of the electrical contact between said electrodes serves to produce the spark for igniting the charge of explosive gas or vapor at each rotation of the main distributing-valve. It will of course be understood that one terminal of an electric circuit which conveniently includes a spark-coil is connected electrically with the stem N and thus with the electrode N′, while the other terminal of said circuit is similarly connected with the stem G or the electrode H through the medium of the metallic body of the engine.

As a further and separate improvement and in order to provide for the accurate adjustment of the stem N and the electrode N′, carried thereby, I prefer to construct the housing M′ in two parts, the outer end of said housing being formed by a suitable collar M^3, which has an adjustable engagement with the main part M′ of said housing, the spring O being secured at its outer end to the interior of said collar. A suitable slot *o′* is formed in the main part M′ of the housing, as indicated more particularly in Fig. 3, and suitable screw-threaded apertures o^2 o^2 are formed in opposite sides of the collar M^3. By this construction when it is desired to adjust the stem N and the electrode N′ so as to bring said electrode to a particular position with respect to the moving electrode H, so as to insure proper electrical contact between the same at each rotation of the main distributing-valve, the collar M^3 may be adjusted to the precise position necessary to insure the desired return of said stem and electrode to the proper position for contact with the moving electrode, when said collar may be secured in its adjusted position by means of a set-screw O′, passed through said slot *o′* and engaged with one of the screw-threaded apertures o^2 in said collar. The electrode N′ is preferably made so as to extend outward at its opposite ends considerably past the slotted end of the stem, so that either end of said electrode may be arranged to contact with the moving electrode, as may be desired. By this construction I am enabled in case one end of the electrode N′ should become worn or otherwise damaged by continued use to readily and quickly adjust the device so as to bring the other end of said electrode into position for use, it being only necessary, in order to effect said adjustment, to remove the set-screw O′ and to invert the position of the collar M^3. This adjustment, it will be seen, will produce a half-rotation of the stem N and the electrode N′, thereby bringing the other end of said electrode into position for use.

Any suitable means may be provided for satisfactorily connecting the terminal of the electric circuit with the stem N and the electrode N′—such, for instance, as shown in the drawings—in which suitable apertures o^3 o^3 are provided in the collar M^3 for the reception of the end of an electric wire, said wire being conveniently secured within a desired one of said apertures by means of a suitable binding-screw O^2. When it is desired to invert the electrode N′, the electric wire may be removed from engagement with one of said apertures, so as to render the collar M^3 freely revoluble, when after the adjustment of said collar said electrical connection may be readily made with the opposite one of said apertures. By this construction I am enabled to provide an improved form of ignition device for producing the spark which ignites the charge of explosive gas or vapor, which device is capable of ready adjustment while the engine is in motion in order to insure a more accurate operation of the ignition device or in order to adjust the electrode

so as to present a new wearing-surface, in case one surface thereof has become worn, without stopping the operation of the engine.

As a separate and further improvement I prefer to provide a suitable valve P for closing the inlet-passage which leads from the supply-chamber D to the inlet-port *c* of the cylinder-head, so as to enable the supply of explosive gas or vapor to be shut off from the cylinder in order that the bushing which carries the electrode may be unscrewed from the cylinder-head and the electrode either adjusted upon the stem or removed, in case it has become worn, and replaced by a new electrode. This valve P is conveniently provided with a screw-threaded stem *p*, which extends outward through a correspondingly-threaded bearing in the casing and is provided upon its extremity with a suitable hand-wheel P′, by means of which said valve may be readily operated to open or close said supply-passage.

As a separate and still further improvement I prefer to provide a valve for controlling the supply of explosive gas or vapor to the chamber D by means of a suitable governor mechanism, and to this end I construct said regulating-valve in substantially the manner shown in Fig. 4 of the drawings. In said figure I have illustrated the supply-chamber D as communicating at its upper end with a tubular connection D′, which leads from a suitable source of supply of mixed air and vapors of petroleum, while the lower end of said chamber is shown as connected by a pipe D^2 with a source of mixed gas and air.

In practice I sometimes build my improved engines for operation either by means of mixed coal-gas and air or the vapors of petroleum, and in such cases both the connections D′ and D^2 are provided upon the supply-chamber D. Within said chamber D, I provide a suitable tubular shell or casing Q, having a series of small apertures or ports *q q* therein, the interior of said casing communicating with the source of supply of explosive vapor or gas and said ports or apertures leading from the interior of said casing to the supply-chamber D. A tubular valve R is fitted within the casing Q and is provided with annular ports *r r*, adapted to permit, when the valve is in the position shown in Fig. 4, the explosive gas or vapor to pass from the interior of the tubular valve through said ports *r r* and the ports or apertures *q q* in the valve-casing, and thus to enter the supply-chamber D.

The valve R is mounted upon a suitable actuating-stem S, which is adapted for connection in a familiar manner with any suitable form of governor mechanism. The annular ports in the valve R are made of somewhat greater width than the apertures or ports *q q* in the casing Q and are so disposed as to cause said ports to successively uncover said apertures as the valve is adjusted upward, the uppermost row of said apertures being first partially uncovered before the next row of said apertures begin to open, and the second row of said apertures being correspondingly uncovered in advance of the succeeding row of said apertures, and so on. In the particular construction shown in the drawings I have illustrated said valve-casing as provided with three sets or rows of the ports or apertures *q q*, the tubular valve R being provided with but two of the annular ports *r r*, and said valve being made of such length that when it is at its highest point, as in the drawings, its lower edge will rest above the level of the lower series of ports or apertures *q q*. By this construction of the regulating-valve and its casing I am enabled to insure a very accurate and satisfactory government of the supply of explosive gas or vapor to the cylinder, the movements of said valves being regulated in a familiar manner by means of a governor mechanism, and the supply of explosive gas or vapor being diminished as the speed of the engine increases and increased when the engine slows down under load.

By the particular construction of the valve and casing described with a series of rows of apertures or ports for the passage of the explosive gas or vapor and the ports in the valve so arranged as to successively uncover said rows of ports or apertures a much more accurate regulation of the supply of the explosive gas or vapor is obtained than would be possible if all of the ports were arranged to be uncovered simultaneously, it being understood, of course, that when a very small amount of the gas or vapor is required, as when the engine is running with a very light load, the valve would be adjusted so as to only partially uncover one or more of the rows of apertures or ports in the valve-casing, the remaining rows of said apertures or ports remaining closed until such time as a greater volume of explosive gas or vapor is required.

By my improved construction of the ignition device I am enabled to provide a very satisfactory form of such device in which all of the springs for controlling the movements of the electrode are located upon the outside of the cylinder and outside of the influence of the heat generated by the explosions of the gas or vapor within the cylinder. By this means I am enabled to use springs of tempered metal for an indefinite length of time and said springs remain practically uninfluenced by the heat of the explosions within the cylinder, thereby retaining their original strength and serving to satisfactorily operate the ignition device.

By the described arrangement of the oscillating igniter with the retracting-spring located upon the outside of the cylinder-head, the outer end of the stem which carries the electrode, as well as said spring, remains always in plain sight, so that the engineer or attendant may readily ascertain at any time whether the oscillating electrode is operating satisfactorily, as if it is the movements of

the outer end of said stem and the spring will be plainly visible.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In a gas-engine, the combination with the cylinder and a rotary distributing-valve adapted for operation by a moving part of the engine, of an electrode carried by said valve and adjustable thereon, and electrically connected with one terminal of an electric circuit, and a second electrode extending through the cylinder-wall and in electrical connection with the other terminal of said circuit, and mounted upon an oscillating stem and adapted for yielding engagement with said first-mentioned electrode at a predetermined period in the rotation of said valve, substantially as described.

2. In a gas-engine, the combination with the cylinder and a rotary distributing-valve adapted for operation by a moving part of the engine, of an electrode carried by said valve and adjustable thereon, and having electrical connection with one terminal of an electric circuit, an oscillating stem extending through the cylinder-wall but insulated therefrom, and in electrical connection with the other terminal of said circuit, and an electrode carried by said stem and adapted for yielding engagement with the first-mentioned electrode at a predetermined period in the rotation of said valve, substantially as described.

3. In a gas-engine, the combination with the cylinder and a rotary distributing-valve adapted for operation by a moving part of the engine, of an electrode carried by said valve and adjustable thereon, and having electrical connection with one terminal of an electric circuit, an oscillating spring-controlled stem extending through the cylinder-wall but insulated therefrom, and in electrical connection with the other terminal of said circuit, and an electrode carried by said stem and adapted for yielding engagement with the first-mentioned electrode at a predetermined period in the rotation of said valve, substantially as described.

4. In a gas-engine, the combination with the cylinder and a rotary distributing-valve adapted for operation by a moving part of the engine, of an electrode carried by said valve and adjustable thereon, and electrically connected with one terminal of an electric circuit, a bushing or sleeve extending through the cylinder-wall, an oscillating stem mounted therein but insulated therefrom, and carrying upon its inner end an electrode for yielding engagement with the first-mentioned electrode, said stem being electrically connected with the other terminal of said circuit and a spring located outside of the cylinder and operatively engaged with said bushing or sleeve and said stem for returning said stem and the electrode carried thereby to their normal positions after the contact between the electrodes has been broken, substantially as described.

5. In a gas-engine, the combination with the cylinder and a rotary distributing-valve adapted for operation by a moving part of the engine, of an electrode carried by said valve and electrically connected with one terminal of an electric circuit, a bushing or sleeve extending through the cylinder-wall, an oscillating stem mounted in said sleeve but insulated therefrom, and connected with the other terminal of said circuit, an electrode upon the inner end of said stem adapted for yielding engagement with the first-mentioned electrode, a suitable spring for returning said stem and said electrode to their normal positions, and suitable means having operative engagement with said bushing or sleeve and said stem for axially adjusting said stem so as to bring said electrode to a desired position within the cylinder, substantially as described.

6. In a gas-engine, the combination with the cylinder and a rotary distributing-valve adapted for operation by a moving part of the engine, of an electrode carried by said valve and electrically connected with one terminal of an electrical circuit, a bushing or sleeve extending through the cylinder-wall, an oscillating stem mounted in said sleeve but insulated therefrom, and connected with the other terminal of said circuit, an electrode upon the inner end of said stem adapted for yielding engagement with the first-mentioned electrode, a suitable spring for returning said stem and said electrode to their normal positions, and suitable means having operative engagement with said bushing or sleeve and said stem for axially adjusting said stem so as to bring said electrode to a desired position or to invert said electrode within the cylinder, substantially as described.

7. In a gas-engine, the combination with the cylinder, a rotary distributing-valve carrying an adjustable electrode electrically connected with one terminal of an electric circuit, of an oscillating stem extending through the cylinder-wall and having removable engagement therewith but insulated therefrom, and connected with the other terminal of said circuit, and an electrode for yielding engagement with the first-mentioned electrode, and adjustably and removably engaged with the inner end of said stem, substantially as described.

8. In a gas-engine, the combination with the cylinder, a rotary distributing-valve and an electrode carried thereby, of a suitable bushing or sleeve removably engaged within an aperture in the cylinder-wall, an oscillating stem mounted in said bushing but insulated therefrom, and carrying upon its inner end an electrode adapted for yielding engagement with the first-mentioned electrode, a suitable housing upon the outer end of said bushing or sleeve, a spring within said housing operatively connected with said stem, and suitable means for adjusting said spring within

the housing to normally return the stem together with its electrode to a desired position, substantially as described.

9. In a gas-engine, the combination with the cylinder, a rotary distributing-valve and an electrode carried thereby, of a bushing removably engaged within an aperture in the cylinder-wall, a sleeve within said bushing but insulated therefrom, an oscillating spring-controlled stem mounted within said sleeve and carrying upon its inner end a suitable electrode adapted for yielding engagement with the first-mentioned electrode, a housing upon the outer end of said sleeve, and a suitable device operatively connected with said housing and said stem for adjusting the latter together with its electrode to a desired position or inverting said electrode within the cylinder, substantially as described.

10. In a gas-engine, the combination with the cylinder, and a rotary distributing-valve having a hollow stem, of a second stem fitted within said hollow stem and axially adjustable therein, an electrode having an adjustable and removable engagement with the inner end of said stem, and an oscillating stem extending through the cylinder-wall and carrying a second electrode for yielding engagement with the first-mentioned electrode, substantially as described.

11. In a gas-engine, the combination with the cylinder, the distributing-valve and an electrode adjustably and removably secured thereto, and a second electrode removably engaged within an aperture in the cylinder-wall, of a supply-chamber for an explosive gas or vapor, a port or passage leading therefrom to the cylinder, and a suitable shut-off valve adapted for operation by hand for closing said port or passage, substantially as and for the purpose described.

12. In a gas-engine the combination with the cylinder, the distributing-valve and the ignition devices, of a supply-chamber for explosive gas or vapor, a valve-casing interposed between said chamber and a source of supply of said gas or vapor said casing being provided with a plurality of ports or apertures for the passage of said gas or vapor, and a regulating-valve having operative engagement with said casing and adapted for actuation longitudinally by a governor mechanism, and provided with a plurality of ports or openings adapted to successively uncover the ports or apertures in said casing, substantially as and for the purpose described.

13. In a gas-engine, the combination with the cylinder, the distributing-valve and the ignition devices, of a supply-chamber for explosive gas or vapor, a valve-casing interposed between said chamber and a source of supply of said gas or vapor, said casing being provided with a plurality of annular rows of apertures or ports for the passage of said gas or vapor, and a regulating-valve operatively engaged with said casing and adapted for actuation longitudinally by a governor mechanism, and provided with a plurality of annular ports or openings adapted to successively uncover said apertures or ports in said casing substantially as and for the purpose described.

14. In a gas-engine, the combination with the cylinder or combustion-chamber thereof, of a moving electrode within the said cylinder or combustion-chamber actuated by a moving part of the engine, a bushing or sleeve extending into the combustion chamber or cylinder, an oscillating stem extending through said bushing or sleeve, and provided adjacent to its inner end, with a bearing-shoulder for engagement with the end of the sleeve, an electrode upon the inner end of said stem adapted for yielding engagement with the first-mentioned electrode, a spring for returning said oscillating stem and its electrode to their normal positions after contact of said electrodes has been broken, and a retractile spring engaged with said stem for holding the shoulder thereof to its seat upon the sleeve, substantially as described.

15. In a gas-engine, the combination with the cylinder or combustion-chamber thereof, and an oscillating electrode extending into said cylinder or chamber, of a suitable stem or carrier also extending into said cylinder or chamber and adapted for actuation by a moving part of the engine, and an electrode or contact device adjustably and removably engaged with the inner end of said stem or carrier, and adapted for engagement with the first-mentioned electrode, substantially as described.

In testimony whereof I sign this specification in the presence of two witnesses.

JOHN W. RAYMOND.

Witnesses:
JOHN E. WILES,
H. J. ROGERS.