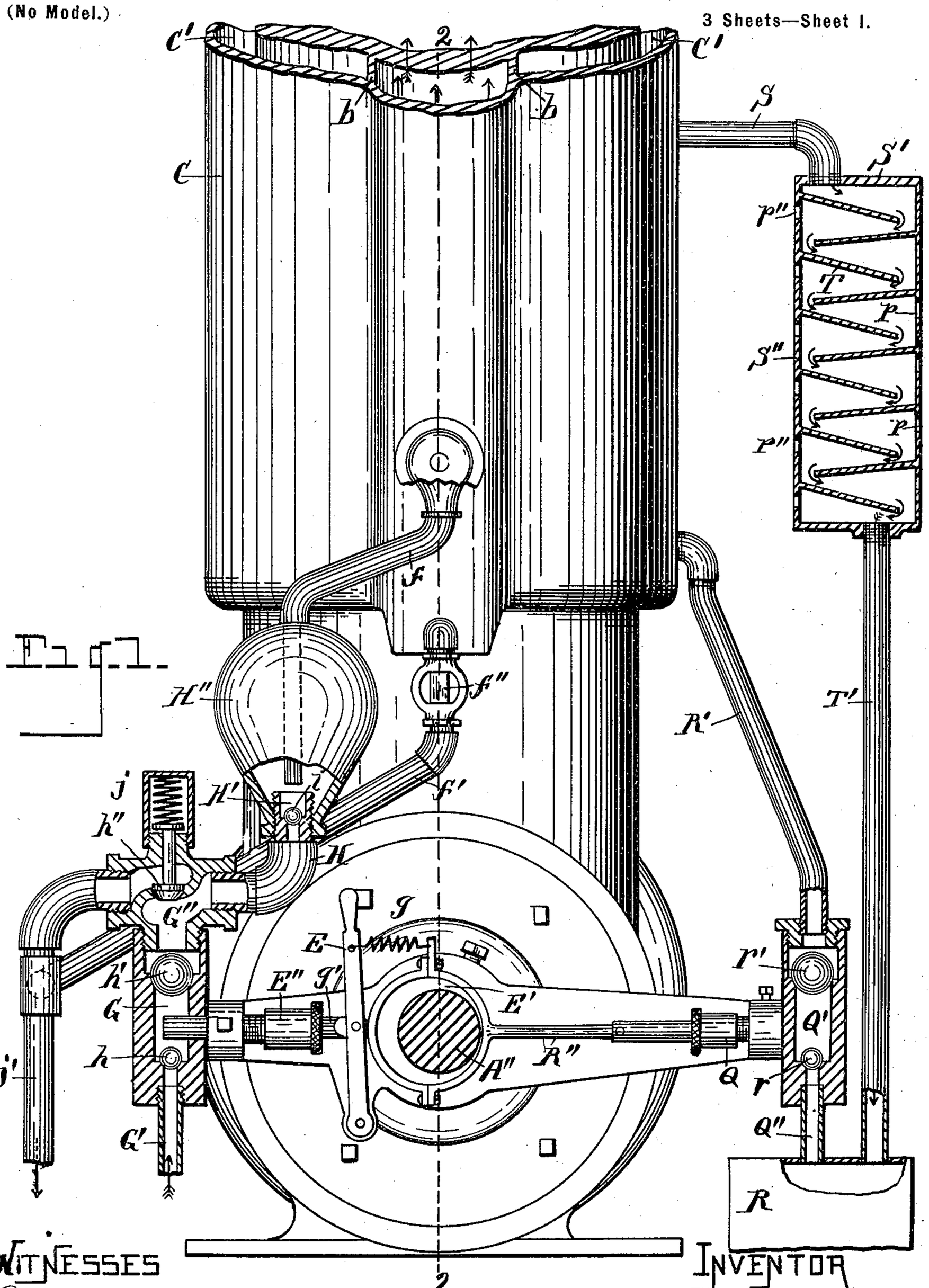
No. 607,536. Patented July 19, 1898.

M. F. BATES.

GAS ENGINE.

(Application filed Nov. 9, 1896.)

(No Model.) 3 Sheets—Sheet 1.



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(No Model.) 3 Sheets—Sheet 2.

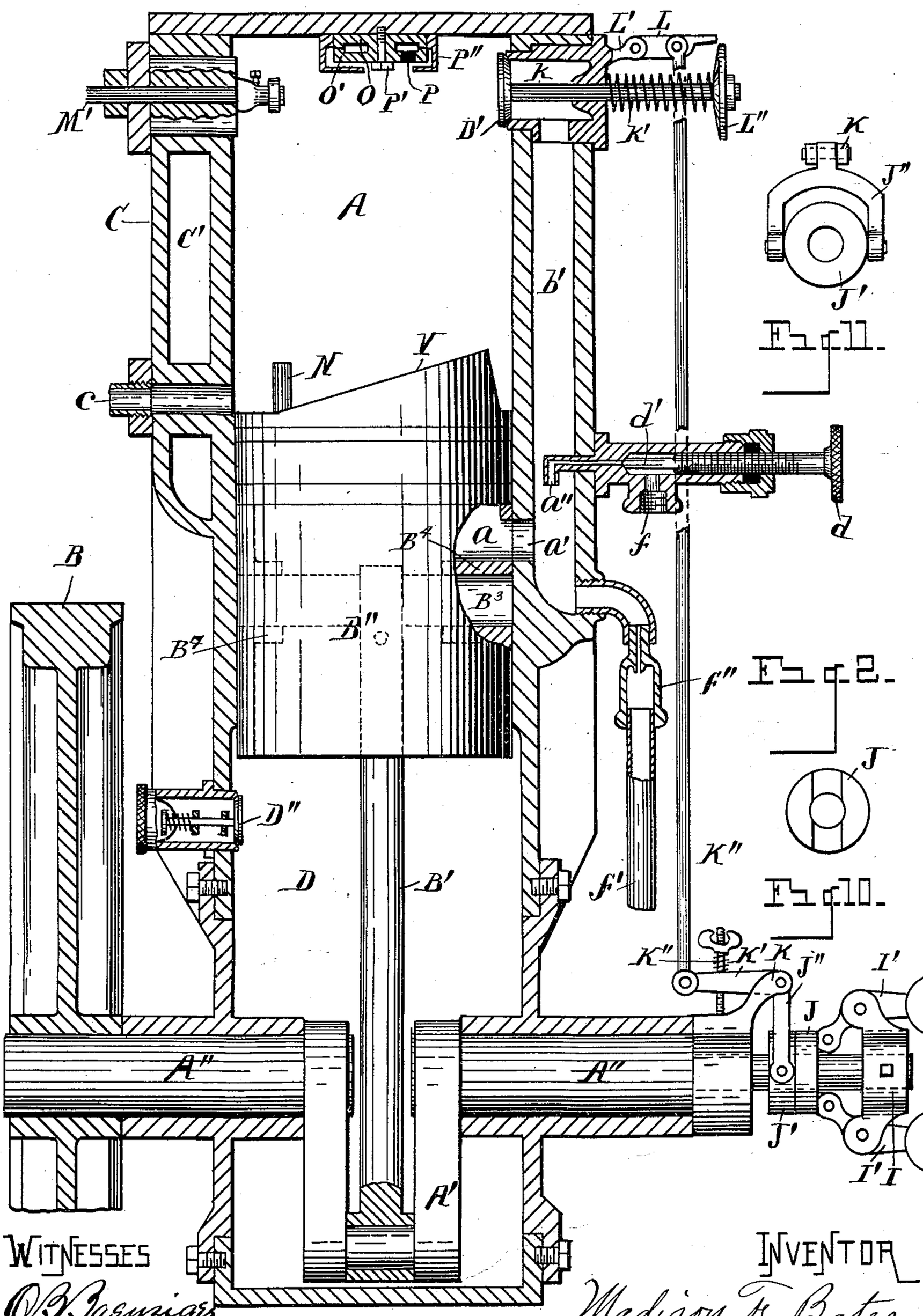

FIG. 1.

FIG. 2.

FIG. 10.

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3 Sheets—Sheet 3.

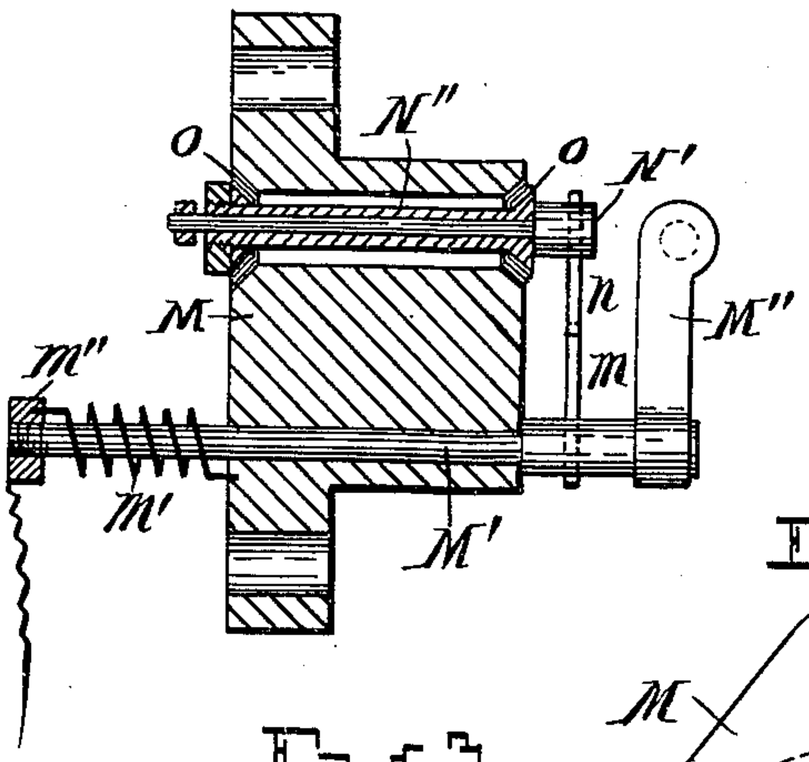


Fig. 2.

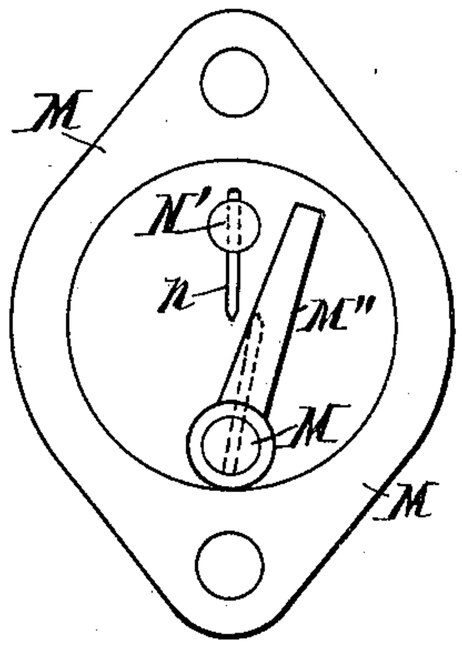


Fig. 5.

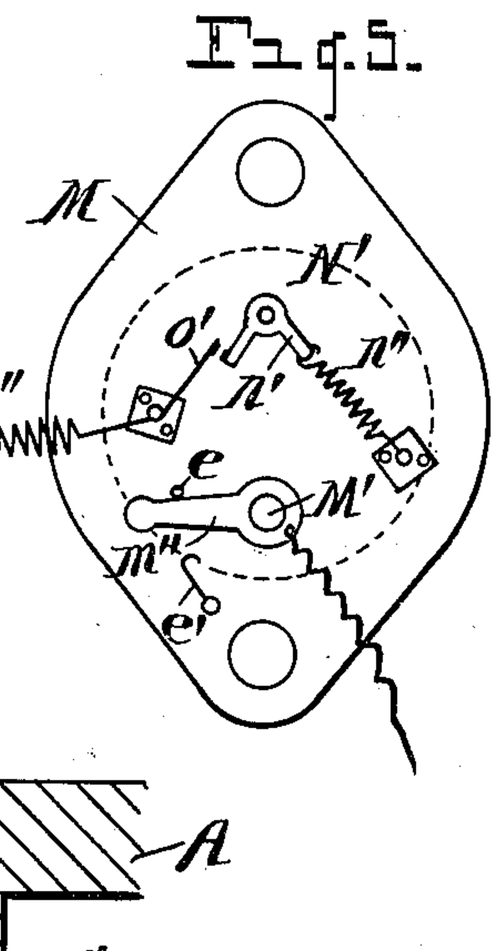


Fig. 3.

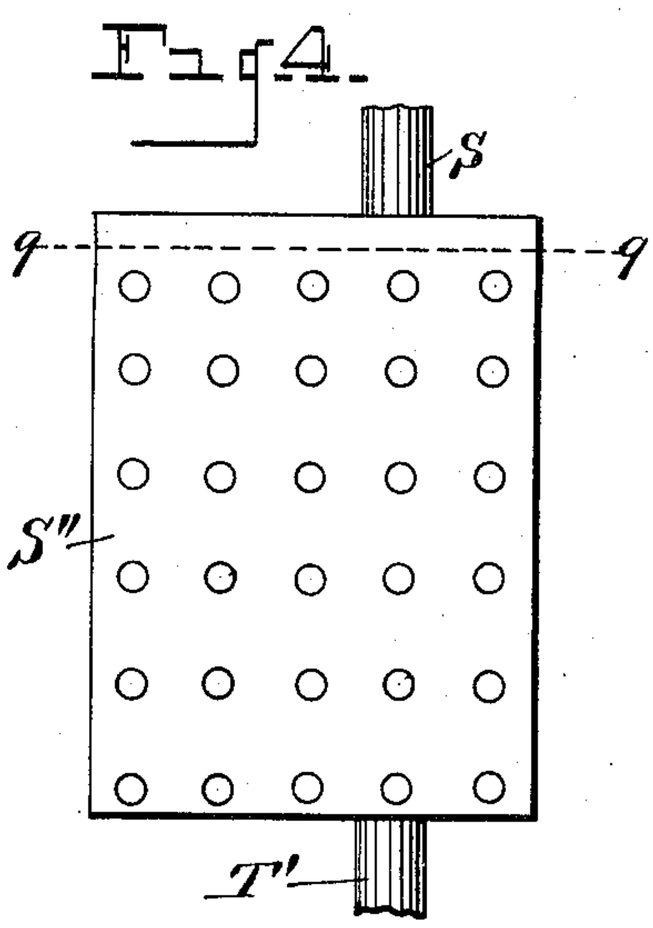


Fig. 4.

Fig. 6.

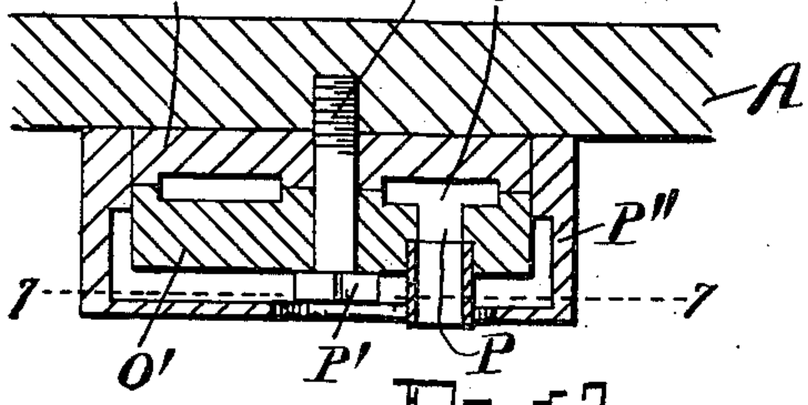
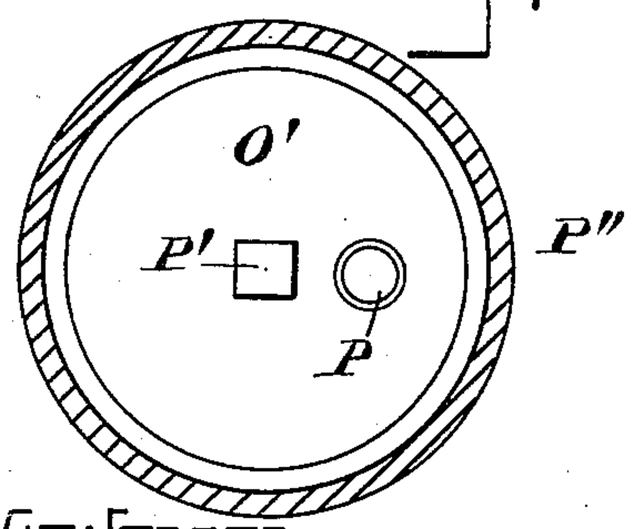


Fig. 8.

Fig. 7.



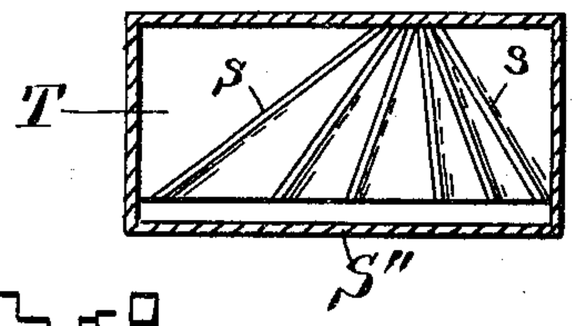


Fig. 9.

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UNITED STATES PATENT OFFICE.

MADISON F. BATES, OF LANSING, MICHIGAN.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 607,536, dated July 19, 1898.

Application filed November 9, 1896. Serial No. 611,472. (No model.)

To all whom it may concern:

Be it known that I, MADISON F. BATES, a citizen of the United States, residing at Lansing, in the county of Ingham, State of Michigan, have invented certain new and useful Improvements in Gasolene or Gas Engines; and I do 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, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to gasolene or gas engines; and it consists in the construction and arrangement of parts hereinafter fully set forth, and pointed out particularly in the claims.

The objects of the invention are to produce an engine of this character of simple and inexpensive construction in which the arrangement is such as to always insure a sufficient supply of explosive mixture and to so regulate said supply as to effect economy in the use thereof, to provide for a positive ignition of the explosive mixture in the cylinder at the proper juncture, and to so govern the admission of the explosive into the cylinder as to at all times maintain the engine at a uniform rate of speed. These objects are attained by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a side elevation of my improved engine, in which a number of parts appear broken away and in vertical section to better show the construction and arrangement thereof. Fig. 2 is a vertical longitudinal section through the engine as on line 2 2, Fig. 1. Fig. 3 is an enlarged detail in section of a portion of the igniting mechanism. Fig. 4 is an elevation of the spark-producing points located within the cylinder and of the actuating-lever by means of which they are brought into contact. Fig. 5 is an elevation of the circuit-closing mechanism located on the outside of the cylinder. Fig. 6 is an enlarged section through the automatic igniter, which is located on the end of the cylinder and is employed to automatically ignite the explosive agent after the cylinder shall have become sufficiently heated by a few minutes' operation. Fig. 7 is a transverse section through said igniter on line 7 7 of Fig. 6. Fig. 8 is a side elevation of the perforated wall of the water-cooler. Fig. 9 is a horizontal section as on line 9 9 of Fig. 8. Fig. 10 is a detail of the governor mechanism hereinafter referred to. Fig. 11 is another detail of said mechanism.

Referring to the letters of reference, A designates the cylinder, which stands in a vertical position and is formed integral with the base or lower end thereof, in which the crank A′ of the main shaft A″ is adapted to turn. Said shaft passes through said base and is suitably journaled therein and carries on one end the fly-wheel B.

B′ indicates the piston-rod, which is pivotally attached at one end to the piston B″ through the medium of the short transverse shaft B^3, crossing the hollow end of said piston and journaled at its ends in the bearing-bosses B^4, as shown by solid and stipple lines in Fig. 2, the other end of said piston-rod being journaled to the crank A′.

Surrounding the cylinder is a water-jacket C, forming a space C′ between said jacket and cylinder through which a circulation of water is maintained to reduce the temperature of the cylinder. A portion of this space between the cylinder and jacket is divided from the remaining portion by two parallel walls *b*, (shown in Fig. 1,) forming a way or port *b*′, through which the explosive mixture or carbureted air is conveyed to the cylinder. The passage of carbureted air into the explosive end of the cylinder is effected by the compression of air in the lower chamber D of the cylinder by the downward stroke of the piston, which is provided with a port *a*, communicating with the hollow end of the piston and opening through the side thereof, which port when said piston shall have reached the limit of its downward stroke is caused to register with a port *a*′, communicating with the port *b*′, so that the compressed air in the base of the cylinder rushes through said ports *a a*′ into the port *b*′ and is carbureted when passing the open end of the small discharge-pipe *a*″, which projects into the port *b*′ and from which a small stream of gasolene is allowed to flow, said stream being regulated by the thumb-wheel *d*, which controls the valve *d*′, which

closes the opening leading to said discharge-pipe, a supply of gasolene being conveyed to said valve through the pipe *f*, as hereinafter stated. The passage of compressed air by the discharge-pipe *a''* vaporizes the gasolene, which, mixing with said air, is carried along said port *b'* through the valve D', which is opened by the pressure of the air and permits the carbureted air to pass into the cylinder A and drives out of the cylinder, through the exhaust-port *c*, the products of combustion remaining from the previous explosion therein. The air exhausted from the chamber D by the downward stroke of the piston is supplied through the valve D'' when said piston is moving upward. The energy stored in the balance-wheel carries the piston upward, so as to close the exhaust-port *c* and compress the explosive mixture in the upper end of the cylinder, when it is ignited at about the time the crank has reached the upper dead-center and gives said piston a downward impulse by the explosion which follows. Communicating with the lower end of the port *b'* is a pipe *f'*, which leads to the gasolene tank or reservoir, (not shown,) and in which is located a small glass section *f''*, which enables the operator to see the flow of the unconsumed gasolene back to the tank, so that he may at all times know that a sufficient amount is being supplied for the use of the engine.

The mechanism for supplying gasolene to the engine is as follows: The lever E is pivoted to the frame of the engine and is held in contact with the eccentric E' on the main shaft by means of a coiled spring *g*, whereby said lever is actuated by said eccentric through the rotation of said shaft, but is permitted to be operated by the hand independent of said eccentric when necessary to furnish a charge of gasolene before the engine shall have been started. To this lever is connected the piston-rod *g'* of a pump E'', which communicates with the valve-chamber G in the supply-pipe G', leading to the gasolene-tank. (Not shown.) A few strokes of said lever will force the gasolene upward past the valves *h h'*, through the chamber G'' and connecting-pipe H, into the lower port H' of the air-chamber H'', said port being controlled by a check-valve *i*. When the air-chamber shall have partially filled with gasolene, sufficient pressure will have been created therein to raise the valve *h''*, controlling the opening into the chamber G', against the action of the housed spring *g*, bearing upon the stem of said valve, allowing the surplus gasolene supplied by the action of the pump E'' to flow back to the tank through the pipe *j'*, the pressure in the air-chamber H' being always sufficient to force the gasolene therefrom to the pipe *f* and into the carbureting-port *b'* of the cylinder through the discharge-pipe *a''*, as before described. To provide a suitable governor, I employ upon the outer end of said crank-shaft, as shown in Fig. 2, a head I, which is secured to and revolves with said shaft. Pivoted in said head are the governor-arms I', carrying the balls I'', connected by a spring *j''*. The inner ends of the pivoted arms I' engage in a vertically-slotted collar J, mounted on said shaft, adapted to slide thereon and revolve with said arms. Also loosely mounted on said shaft and bearing against the collar J is a second collar J', to which is pivoted a yoke J''. Said yoke is in turn pivoted in a bracket K of the frame and is provided with an integral inwardly-extending arm K', to which is pivoted the lower end of a rod or link K''. The upper end of said link is pivoted to an arm L, which is in turn pivoted to a bracket L' on the cylinder-jacket. The outer end of said arm L is adapted, through the action of said link K''; to be brought into contact with the face of the beveled disk L'' on the stem *k* of the valve D', which valve is normally held upon its seat by the coiled spring *k''*, embracing the stem thereof and bearing against said disk. It will now be understood that in the operation of this governor when the engine is running up to or above normal speed centrifugal force will cause the balls I'' to separate against the action of the connecting-spring *j''*, thereby withdrawing the inner ends of the arms I' and permitting the collars J J' to slide outward by the action of the spring *k''*, which bears upon the arm or lever K' of the yoke J'', thereby drawing downward upon the link K'' and moving the free end of the arm L into engagement with the beveled face of the disk L'', thereby holding the valve D' upon its seat and preventing any passage of the explosive mixture into the cylinder and a consequent impulse to the engine. A diminution in the speed of the engine would cause the centrifugal force of the balls I'' to be overcome by the spring *j''*, thereby actuating the connecting parts, so as to cause an upward thrust of the link K'' and move the free end of the arm L outward upon the beveled face of the disk L'', or such distance as to clear said disk entirely, when the valve D' will be relieved and a charge of the explosive mixture will be forced into the cylinder past said valve by the downward passage of the piston, when the engine will receive an impulse and by reason of its accelerated movement will again close said valve D'.

By means of the beveled face of the disk L'' but a slight opening of the valve D' is permitted as the arm L travels outward on the beveled face thereof, so that a full charge of the explosive is not taken into the cylinder, unless the speed of the engine has so decreased as to carry said arm entirely free from said disk.

The electric igniting device employed to explode the charge of gasolene within the cylinder consists of a heavy plate or block M, located in the side of the cylinder near its upper end and projecting therethrough. Located in this plate or block is a rock-shaft M', which passes therethrough and carries upon its in-

ner end, which projects into the cylinder, an arm M″, which projects into the path of the pin N, fixed in the end of the piston, said shaft also carrying upon its inner end an electrode *m* and having upon its outer end a coiled spring *m′*, which normally retains said shaft in position. Upon the outer end of said shaft is a lever *m″*, by means of which the shaft may be operated by hand when desired. Also passing through the plate or block M is a rock-shaft N′, which is journaled in a sleeve N″, said sleeve being insulated from the plate M at each end thereof by alternate layers of mica and asbestos, as shown at *o*. The inner end of the shaft N′, which extends within the cylinder, is provided with an electrode *n*, which projects into the path of the electrode *m*, carried by the rock-shaft M′. The outer end of the shaft N′, which projects outside of the cylinder, is provided with a right-angled lever *n′*, to one end of which is attached a coiled spring *n″*, by means of which it is normally retained in position. The other end of said lever *n′* stands adjacent to a spring *o′*, which is connected with the wire *o″* of the electric circuit. By means of this construction and arrangement of parts as the piston is finishing its upward stroke the pin N thereon engages the arm M″ of the rock-shaft M′ and carries electrode *m* thereon into contact with the electrode *n* on the rock-shaft N′. A further upward movement of the piston through the engagement of said electrodes rocks said shaft N′ and carries the end of the lever *n′* thereon into contact with the spring *o′*, thereby closing the electric circuit on the exterior of the cylinder and causing a current to pass through the electrodes and their respective shafts, whereby by a continuous upward movement of the piston and at about the time it reaches its extreme upward stroke the engaging electrodes are allowed to slip past each other, producing as they separate a spark, which ignites the explosive compressed in the upper end of the cylinder, imparting an impulse to the engine. As said electrodes separate the spring *n″* returns electrode *n* to its normal position and breaks the contact of the lever *n′* with the spring *o′*. As the piston moves downward the action of the spring *m′* will cause the arm M″ on rock-shaft M′ to follow the pin N of the piston downward, carrying the electrodes past each other, but at this time causing no spark, owing to the breaking of the circuit at the spring *o′*. The return of the shaft M′ by the spring *m′* continues until the lever *m″* on the outer end thereof strikes the arresting-pin *e*, when said parts are in position for a succeeding operation.

To provide an automatic igniter for the engine without the use of an electric spark, I employ two heavy cast plates O and O′, which are provided with an annular recess O″ between their meeting faces, with which an outer opening P communicates, which passes through the outer plate O′. These plates are secured to the upper end of the cylinder by means of a bolt P′ and are inclosed by a circular housing P″, having a central opening. When the engine shall have been in operation for a few minutes, these plates become intensely heated, and because of their bulk and the inclosure around them their heat is sufficiently retained to cause the igniting of the explosive mixture when forced into the inner recess O″ between said plates through the opening P by the upward movement of the piston, thereby causing the explosive charge to automatically ignite at the moment when the piston shall have reached the limit of its upward stroke. By means of this automatic igniter the explosive mixture may be exploded in the cylinder at the proper time without the use of an electric current except at the initial starting of the engine, and when the automatic igniter shall have become properly heated to explode the gas within the cylinder the electric igniter may be thrown out of service by drawing back the lever *m″* and securing it by means of the hook *e′*, (shown in Fig. 5,) by which means the arm M″ is moved out of the path of the pin N of the piston, so that no engagement of the electrodes takes place.

For the purpose of reducing the temperature of the cylinder it is necessary to pump water, so as to cause a circulation thereof through the space C′ between the cylinder and the jacket C. To accomplish this, I employ a suitable pump Q, mounted on the frame of the engine, which connects with a valve-chamber Q′, having a pipe Q″ communicating with the water-tank R. Located in said valve-chamber are the ball-valves *r* and *r′* to prevent backflow of water, and connecting said valve-chamber with the water-space C′ between the jacket and cylinder is a pipe R′. The pump is driven through a rod R″, operated by the eccentric E′. The water is forced upward by said pump through the space C′, surrounding the cylinder, and flows out at the upper end through the pipe S, which communicates with the water-cooler S′. This cooler consists of a case in which is located a series of alternating inclined plates T, over which the water is adapted to travel back and forth in its descent, as shown by the arrows in Fig. 1. The side plates S″ of the case are provided with a series of apertures *r″* to provide for a circulation of air therethrough, so that when the water is finally returned to the water-tank through the pipe T′ it is cooled to atmospheric temperature and may be used over again, thereby effecting economy in the use of water for reducing the temperature of the cylinder. The upper of said inclined plates T (shown in Fig. 9) is provided with a series of radiating ribs *s*, whereby the water when falling thereon from the pipe S is spread out and caused to fall in a thin sheet over the succeeding plates in the cooler.

On referring to Fig. 2 it will be seen that the upper end of the piston B″ is provided

with an inclined face V, which rises to some height on the side of the cylinder opposite the exhaust-port *c*, whereby the products of combustion are more perfectly directed out of said port by the pressure of the inflowing air and vapor and an accumulation thereof against the end of the piston next to the side of the cylinder opposite the exhaust-port is obviated.

Having thus fully set forth my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a gasolene-engine, the combination with the cylinder, a piston therein, the air-chamber at the lower end of said cylinder, a passage-way extending along the side of the cylinder and communicating through a valve with the upper end thereof, the pipe for conveying gasolene or the explosive mixture projecting into said way, the port through the side of the cylinder communicating with said way, and the port in the piston communicating with the air-chamber in the cylinder and adapted to register at the lower point of its stroke with the port in the cylinder communicating with said passage-way.

2. In a gasolene-engine, the combination with the cylinder, the piston therein having an air-chamber at the lower end thereof, means for supplying air thereto, the way extending longitudinally of the cylinder and communicating through a valve with the upper end thereof, a port through the wall of the cylinder communicating with the lower end of said way, a port in the piston communicating with the air-chamber in the cylinder and adapted to register with the port communicating with said way, the gasolene or gas discharge pipe entering said way above the port in the lower end thereof which communicates with the cylinder, means for supplying gasolene to said discharge-pipe so as to cause a continuous flow of gasolene therefrom, and the pipe communicating with said way below the point of the discharge of gasolene therein, and with the gasolene-tank.

3. In a gasolene-engine, the combination with the cylinder having an air-chamber in the base thereof, the piston in said cylinder, the way extending longitudinally of the cylinder communicating at its upper end with the interior of the cylinder through a valve-controlled opening, the port in the lower end of said way communicating with the cylinder, the port in the piston communicating with said air-space and with the port through the wall of the cylinder which communicates with said way, the gasolene-discharge pipe entering said way above said port, the air-chamber located in said supply-pipe, the pump for forcing gasolene into said air-chamber, and the overflow-pipe connected by a valve-controlled opening with the gasolene-supply pipe below said air-chamber therein.

4. In a gasolene-engine, the combination with the cylinder and movable piston therein, means for supplying the explosive mixture at proper intervals to said cylinder, the two rock-shafts extending into the upper end of said cylinder, the electrodes on said shafts adapted to be moved into and out of contact, the arm on one of said shafts, and the pin on the piston adapted to engage said arm, a lever on the outer end of one of said shafts, a spring forming a terminal of an electric circuit standing adjacent to said lever, the springs for returning said rock-shafts to their normal position whereby, as the piston moves upward said mechanism is caused to produce an electric spark to ignite the explosive in the cylinder substantially as set forth.

5. In a gasolene-engine, the combination with the cylinder, the movable piston therein, and means for conveying the explosive mixture to said cylinder, of the automatic igniter consisting of heavy plates having a recess between their inner faces secured to the end of the cylinder and provided with an opening communicating with said inner recess, and a tube projecting from said opening.

6. In a gasolene-engine, the combination with the cylinder, the movable piston therein, and means for supplying the explosive mixture to said cylinder, of the automatic igniter consisting of heavy plates having a recess between their adjacent faces and secured to the end of the cylinder, an opening through the outer plate communicating with said inner recess, a tube projecting from said opening and a housing embracing said plates.

7. In a gasolene-engine, the combination with the cylinder and piston therein and means for supplying gasolene-vapor to the cylinder, the crank and crank-shaft, the governor consisting of a head mounted on said shaft having angle-arms pivoted therein carrying the balls connected by a restraining-spring, a sliding collar on said shaft engaging said arms and rotated therewith, a second collar bearing against said first collar and loosely mounted on the shaft, the yoke pivoted thereto, the pivoted arm extending from said yoke, the link connected with said arm, and the spring bearing upon the upper face thereof, the valve controlling the ingress-port of the explosive mixture, the disk on the outer end of the stem thereof, the pivoted arm L connected to said link and adapted to move into the path of said disk and lock said valve upon its seat when the engine is running at normal speed.

8. In a gasolene-engine, the combination with the cylinder, the jacket surrounding said cylinder forming a water-space, the pump and connecting-pipe for forcing the current of water through said space, the discharge-pipe leading therefrom, the cooling device located in said pipe having a series of alternately-inclined plates therein over which the water falls, and having perforations through the sides thereof to permit a circulation of air therethrough, and the pipe communicating with the water-supply.

9. In an engine of the character described,

the combination with the cylinder, the water-jacket around said cylinder forming a water-space, means for causing a circulation of water through said space, the discharge-pipe leading from the upper end of the water-space and communicating with the perforated case, the series of alternately-inclined plates located in said case between the rows of perforations therein, the upper of said plates having a series of diverging ribs for the purpose set forth.

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

MADISON F. BATES.

Witnesses:
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BARTLETT WILEY.