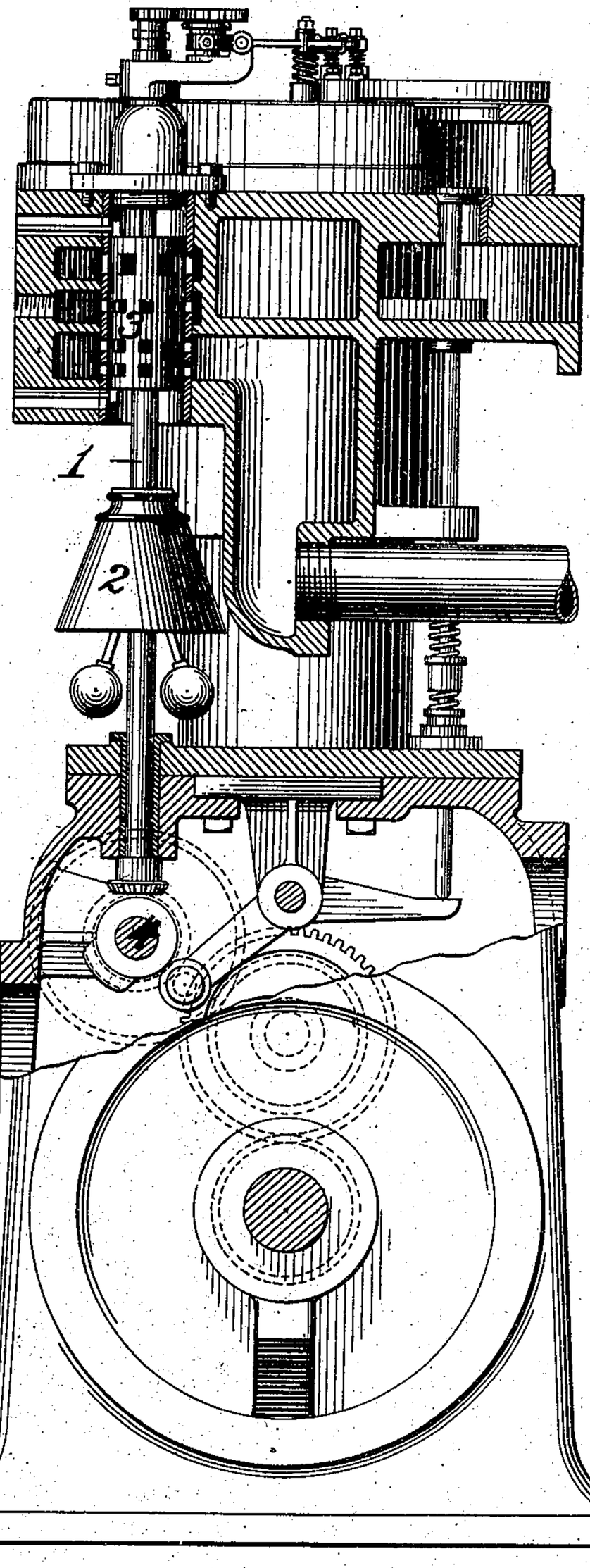
(No Model.) 3 Sheets—Sheet 1.

G. WESTINGHOUSE & E. RUUD.

ELECTRIC IGNITER FOR GAS ENGINES.

No. 583,586. Patented June 1, 1897.

FIG. 1.



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3 Sheets—Sheet 2.

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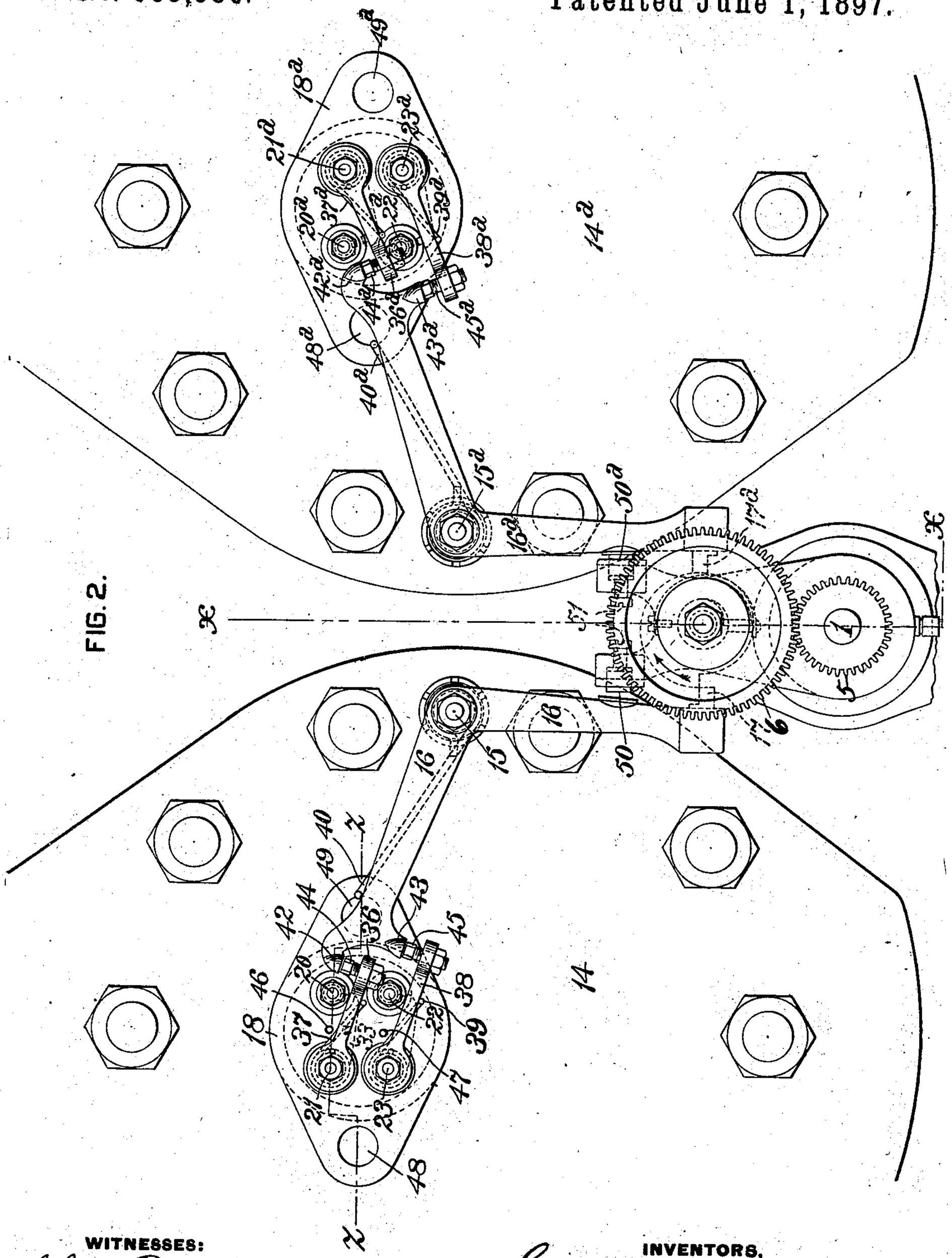

FIG. 2.

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3 Sheets—Sheet 3.

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ELECTRIC IGNITER FOR GAS ENGINES.

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FIG. 3.

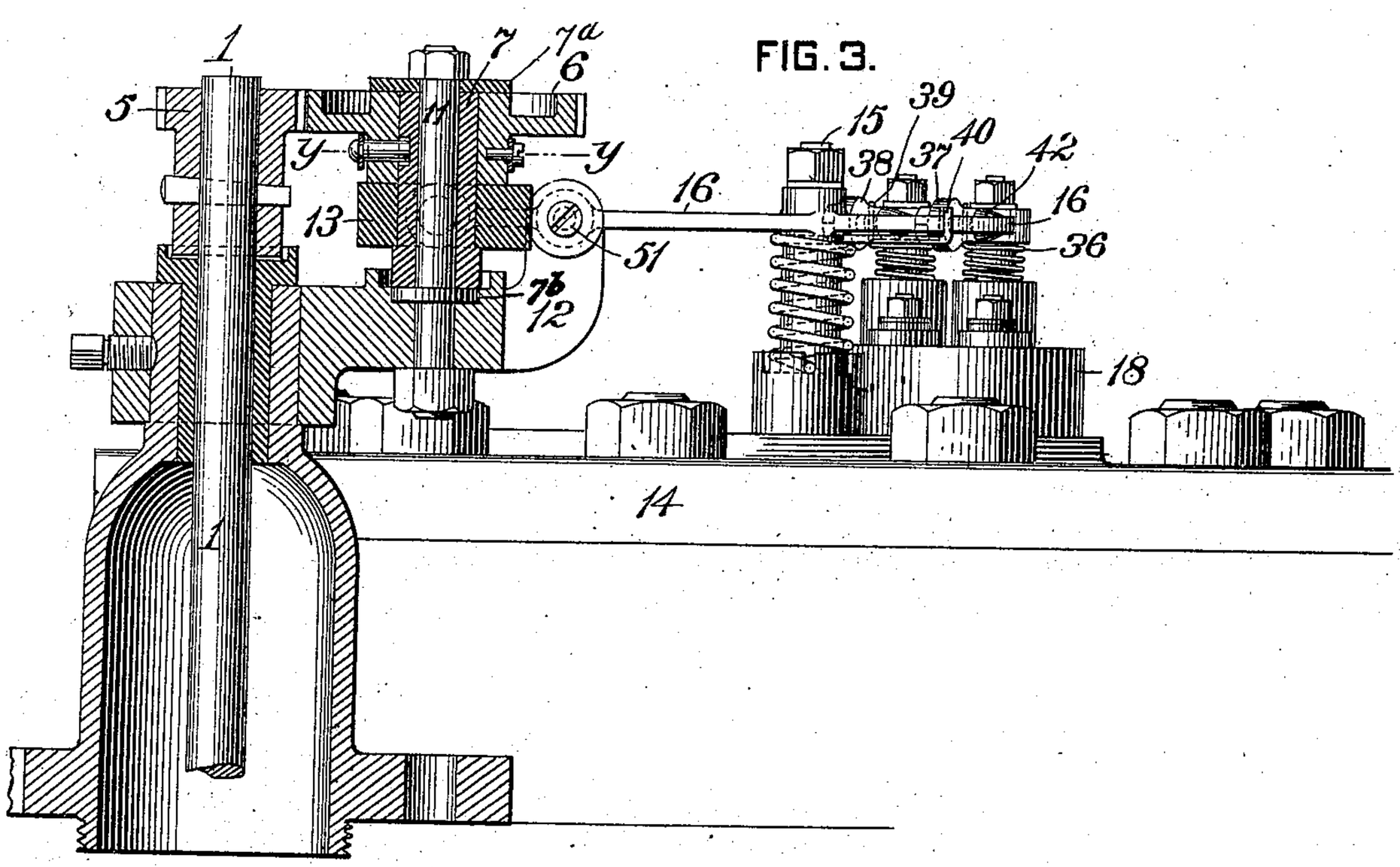


FIG. 4.

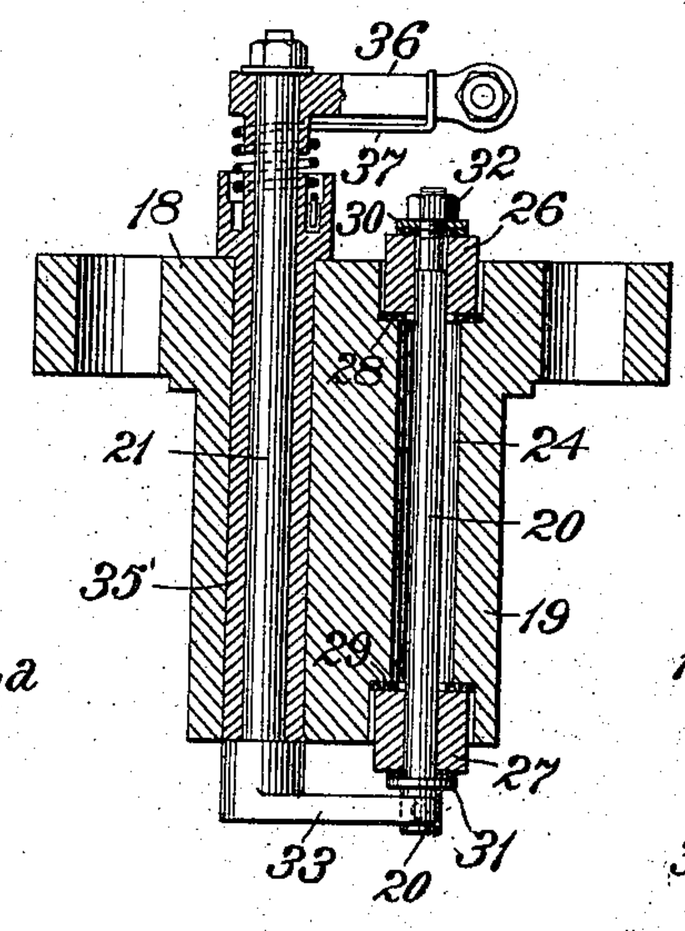


FIG. 5.

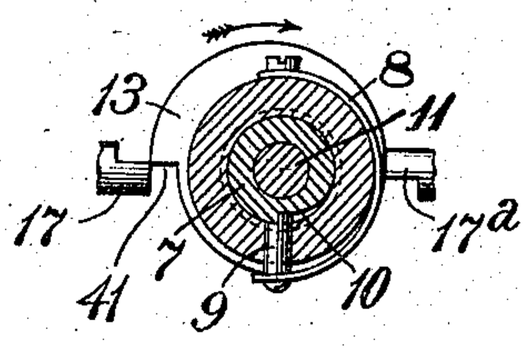
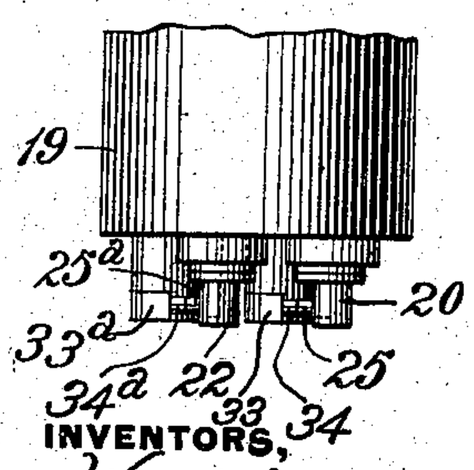


FIG. 6.



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by T. J. Hogan, Att'y.

UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE AND EDWIN RUUD, OF PITTSBURG, PENNSYLVANIA.

ELECTRIC IGNITER FOR GAS-ENGINES.

SPECIFICATION forming part of Letters Patent No. 583,586, dated June 1, 1897.

Application filed September 22, 1896. Serial No. 606,624. (No model.)

To all whom it may concern:

Be it known that we, GEORGE WESTINGHOUSE and EDWIN RUUD, citizens of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented or discovered a certain new and useful Improvement in Electric Igniters for Gas-Engines, of which improvement the following is a specification.

The object of our invention is to provide an improvement in gas-engines; and to this end it consists in new and improved means for effecting the ignition of the gases in the cylinder or combustion-chamber of a gas-engine and in certain combinations and features of construction, all as hereinafter fully set forth.

In the accompanying drawings, which illustrate an application of our invention, Figure 1 is a view, partly in section and partly in elevation, of an engine with our improvement applied thereto; Fig. 2, a plan view of our improved igniting device shown applied to a two-cylinder engine; Fig. 3, a view, partly in elevation and partly in section, on the line $x\,x$ of Fig. 2; Fig. 4, a section through the cap or bonnet in which the igniting-electrodes are mounted; Fig. 5, a cross-section through the cam-shaft of the igniting device on the line $y\,y$ of Fig. 3, and Fig. 6 a side elevation of the igniting points or electrodes and the inner end of the plug which forms an extension of the cap or bonnet in which the electrodes are mounted.

Our improvement provides simple and efficient means for igniting the gases in the cylinder or combustion-chamber of a gas-engine by means of an electric spark caused by breaking contact between the points of fixed and movable electrodes which are mounted in a detachable cap or bonnet fitted to and closing an opening in the cylinder-wall or in the head of the cylinder of the engine.

In Fig. 2 of the drawings we have shown an application of our improvement to a two-cylinder gas-engine in which two symmetrically-disposed portions of the igniting mechanism engage with and are operated by the same mechanism for transmitting motion from the main shaft of the engine; but it will be obvious that by merely omitting some of the parts, and without any change in the construction of the remaining parts, the mechanism may be applied to a single-cylinder engine. One of the advantages of our improvement, however, is its special adaptability to a multiple-cylinder engine.

In the construction shown in the drawings the mechanism is operated by the movement of a rotating shaft 1, which is driven from the main shaft of the engine and carries a governor 2 for controlling the regulating-valve device 3. The shaft 1 is geared to a rotary cam-shaft 4, which receives motion from the main shaft by means of gearing and is adapted to operate the exhaust-valve mechanism of the engine, as shown and described in our pending application, Serial No. 588,539, filed April 22, 1896. Our improvement is, however, not limited to this particular construction or means for transmitting motion.

To the upper end of the shaft 1 is secured a gear-wheel 5, which engages with a gear-wheel 6, mounted on a sleeve 7, and connected therewith in such a manner that when the wheel 6 is rotated in one direction it causes rotation of the sleeve in the same direction, but when the wheel 6 is rotated in the reverse direction the sleeve remains stationary. For this purpose the spring 8 (shown in Figs. 3 and 5) is fixed at one end to the hub of the wheel 6, and at its other end is secured to a pin 9, which passes through a hole in the hub and engages with a shoulder at one end of a groove or recess 10, formed on the sleeve 7. When the wheel 6 is turned in one direction, the pin 9 bears against the shoulder and turns the sleeve with the wheel 6, and when the wheel 6 is turned in the opposite direction the end of the pin slides over the rounded inner surface of the groove and the outer surface of the sleeve without imparting motion to the sleeve. The sleeve 7 is mounted on a shaft 11, secured to a bracket 12, and rigidly secured to the sleeve is a cam 13 for operating the levers of the igniting mechanism. The cam 13 and the parts with which it engages are of such form that a reversal of the motion of the cam might cause damage to the mechanism, and for this

reason the wheel 6 is connected with the sleeve 7 in the manner described.

The sleeve 7 is clamped between a washer 7^a and a collar 7^b on the shaft 11 and is secured by a nut on the end of the shaft. By removing the nut and lifting the wheel 6 out of gear with the wheel 5 the wheel 6, sleeve 7, and cam 13 may be turned independently of the wheel 5, and the cam 13 thereby adjusted to vary its times of action.

Secured to each of the cylinder-heads 14 and 14^a is a stud 15 or 15^a, which forms a fulcrum for one of the tappets or levers 16 or 16^a. Each of these tappets or levers is provided on one end with a pin or projection 17 or 17^a, which engages with the cam 13, and the opposite ends of the levers extend into position to operate the movable electrodes of the igniting mechanism.

The levers or tappets 16 and 16^a are acted on by the springs 40 and 40^a, which tend to hold the adjacent ends of the levers in engagement with the cam 13, and the opposite ends of the tappets 16 and 16^a are provided with fingers or projections adapted to act on the outer arms of the movable electrodes, so as to break contact between the sparking-points of the movable and fixed electrodes at the proper time.

Mounted on each of the cylinder-heads 14 and 14^a is a removable cap or bonnet 18 or 18^a, provided with a cylindrical extension 19, as shown in Figs. 4 and 6, and fitted in each of the bonnets 18 and 18^a are two fixed and two movable electrodes, each of the movable electrodes being adapted to coact with one of the fixed electrodes to make and break a circuit and cause a spark for igniting the gases.

As shown in Fig. 2, the movable electrode 21 and the fixed electrode 20, which are mounted in the cap 18, coöperate to make or break a circuit by the contact or separation of the sparking-points on their inner ends, and the movable electrode 23 in the cap 18 similarly coöperates with the fixed electrode 22. In the cap 18^a the sparking-points of the movable electrodes 21^a and 23^a similarly coact with the sparking-points on the fixed electrodes 20^a and 22^a, respectively.

As shown in Fig. 4 of the drawings, which is a section through the cap 18 and its extension 19 on the line $z\,z$, the fixed electrode consists of a rod 20, which extends through a hole or passage 24 in the removable cap or bonnet 18 and is provided on its inner end with a projecting pin or sparking-point 25. The hole or passage 24 through the cap 18 is considerably larger in diameter than the rod 20, which passes centrally therethrough, so that the rod is not in contact with the sides of the passage, and the ends of the passage are enlarged to receive the insulating-sleeves 26 and 27 and the packing-gaskets 28 and 29, which bear against the shoulders formed by the enlargements of the passage 24. A tight joint is formed around the ends of the rod 20 by the packing-gaskets 30 and 31, and when the nut 32 is screwed up on the rod the insulating sleeves and packing and the rod 20 are tightly clamped in place.

The movable electrode 21 (shown in Fig. 4) passes through a metallic tube or bearing 35, which is fitted in the cap 18, and an arm 33, secured on the inner end of the rod 21, is provided with a sparking-point 34, which is adapted to make contact with the point 25 on the fixed electrode 20, as shown in Fig. 6 and in dotted lines in Fig. 2. In Fig. 6 the inner ends of the fixed electrodes 20 and 22 are shown in elevation with their sparking-points 25 and 25^a each in contact with a point on one of the arms 33 or 33^a of the corresponding movable electrode.

Rigidly secured to the outer end of the movable electrode 21 is an arm 36, which is engaged by one end of a spring 37, tending to move the arm 36, the electrode 21, and the arm 33, so as to make contact between the sparking-points 34 and 25 of the movable and fixed electrodes. Each of the movable electrodes 23, 21^a, and 23^a is provided at its outer end with a similar arm 38, 36^a, or 38^a, which is similarly acted on by a spring 39, 37^a, or 39^a

That end of the lever or tappet 16 which operates the movable electrodes is provided with two projections or fingers 42 and 43, adapted to engage with the heads of the adjustable screws 44 and 45, respectively, which are mounted in the ends of the arms 36 and 38 of the movable electrodes 21 and 23. As shown in Fig. 2, the arms 36 and 38 are in the positions which they will occupy when the sparking-points of the movable electrodes to which they are secured are in contact with the sparking-points of the corresponding fixed electrodes, and the fingers 42 and 43 of the lever or tappet 16 are shown out of contact with the adjustable screws 44 and 45 and at equal distances therefrom. Either of the arms 36 or 38 may, however, be released from the pressure of its spring 37 or 39 and moved out of the path of the projection or finger on the lever 16, and either of the screws 44 or 45 may be adjusted so as to vary the time at which the electrode is operated by the lever.

In order to render either of the electrodes 21 or 23 inoperative by the tappet 16, it is only necessary to disengage that end of the spring 37 or 39 which bears against the arm 36 or 38 and to move the arm out of the path of the corresponding finger on the tappet 16. The spring 37 or 39 may then bear against the pin 46 or 47, projecting from the cap 18. The construction of the fingers on the operating-lever or tappet and of the adjusting devices on the arms of the movable electrodes for the other cylinder are preferably in all respects similar to those described as being mounted on the cylinder-head 14. The fingers on the ends of the levers may be given any preferred form, or they may be dispensed with if the outer arms on the movable electrodes and the ad-

justable screws on the arms be given such form and proportions as is necessary to permit the desired engagement with the levers.

Referring to that portion of the mechanism shown mounted on the cylinder-head 14, it will be seen that the movable electrode 21 and fixed electrode 20 and their coöperating parts form one sparking device or a make-and-break device for one circuit, and the movable electrode 23 and the fixed electrode 22 form another sparking device, or a make-and-break device for another circuit, and that either of these devices may be employed while the other is inoperative, or, if preferred, both devices may be operated to produce two simultaneous sparks, or the adjustment may be such that two sparks may be produced for each explosion, with a slight interval between the sparks.

It will not usually be necessary to keep in operation more than one movable electrode for each cylinder, and it will therefore be preferable to have the other disengaged, as described, in order to prevent wear. In case of accident to the one in operation the disengaged electrode may be quickly brought into action by merely engaging the end of its spring with the arm of the electrode, and the other may then be disengaged.

In case it is necessary to remove one of the caps 18 or 18ª to inspect or repair any portion of the sparking devices the caps 18 and 18ª may be readily removed and, if desired, may be replaced by a similar cap and electrodes.

The cam 13 rotates in the direction indicated by the arrow in Fig. 5, and during about one-half of a revolution of the cam, after the projection 17 on the end of the lever 16 passes the shoulder 41 on the cam, the lever 16 is in position to hold open the circuit or circuits controlled by the movable electrodes. One of the fingers or projections 42 or 43 on the lever 16 is then in contact with the corresponding adjustable screw 44 or 45 on the arm 36 or 38, and the sparking-point on the inner end of the movable electrode is held out of contact with the point on the corresponding fixed electrode. During the next half of a revolution of the cam 13 that end of the lever which engages with the cam is gradually moved outward from the center of the cam, the fingers on the other end of the lever are moved to permit the springs bearing on the arms of the movable electrodes to gradually close the circuits by bringing the movable sparking-points into contact with the fixed sparking-points, and when the points have made contact the fingers on the lever are moved a little farther, so as to be out of contact with the adjusting-screws on the arms of the movable electrodes, as shown in the device applied to the cylinder-head 14 in Fig. 2. The sparking-points being in contact and closing the circuits controlled by them and the fingers on the lever having been moved away from the adjusting-screws, the rotation of the cam 13 causes the shoulder 41 on the cam to pass the projection 17 or 17ª on the end of the lever, the spring 40 or 40ª suddenly throws the lever into position to engage with that part of the cam beyond the shoulder 41, and by the same movement of the lever the adjusting-screws on the arms of the movable electrodes are struck by the fingers on the end of the lever, the contact of the sparking-points is suddenly broken, and a spark is produced.

As shown in Figs. 2 and 5, the shoulder 41 on the cam is just about to pass the projection or pin 17 on the lever 16.

On the right of Fig. 2 the lever 16ª and the arms 36ª and 38ª of the movable electrodes 21ª and 23ª are shown in the positions which they will occupy at the beginning of the movement by which the sparking-points are put in contact and the circuits closed.

Although both of the movable electrodes in each of the caps 18 and 18ª are shown in position to be operated by the levers 16 and 16ª, it will be understood that the simultaneous employment of two sparking devices for each cylinder is not essential, and the preferred practice is to employ but one at a time in each cylinder and to keep the other disengaged and in readiness to be brought into action when desired, as, for example, when the other device is inoperative or requires adjustment or for any other reason.

The removable caps 18 and 18ª may be easily and quickly removed from the cylinder-heads and others may be as easily and quickly secured in their places by means of bolts through the holes 48 and 49 or 48ª and 49ª. The bolts are omitted from the drawings because they might tend to confuse the lines of the drawings. Each of the removable caps with its two fixed and two movable electrodes may constitute an article of manufacture which is adapted to be applied to any form of gas-engine, which is of such form that it requires no special manipulation in its application and no special construction of the part to which it is applied, and which, on account of its simplicity and therefore comparatively inexpensive construction, involves but little expense in case removal or the substitution of one for another is required. The necessity of such renewal or substitution will, however, be much less frequent than is the case when employing any of the usual igniting devices, since one of the fixed and one of the movable electrodes in each of the removable caps may be held in reserve or out of action, to be brought into action only when the other igniter in the same cap is either accidentally or intentionally rendered inoperative.

It will be seen that the construction of the igniting mechanism is such that there is comparatively little danger of breakage or of damage to any of the parts by shocks or by jarring caused by the operation of the mechanism itself. Each of the movable electrodes is rigidly connected with the arms on its opposite ends, one within and the other with-

out the cylinder, and forms therewith a rigid integral structure. The only parts within the cylinder that make contact with one another are the sparking-points, and their approach to one another is so gradual that the impact between them is exceedingly small, the comparatively light springs which act on the outer arms of the movable electrodes merely acting to keep the adjustable screws on those arms in contact with the fingers on the levers 16 and 16ª as they gradually recede after breaking the circuit and until the sparking-points are in contact.

The sudden action of the levers 16 and 16ª on the outer arms of the movable electrodes has no injurious effect on any of the internal parts, which are merely separated thereby, and the action on the outer arms is to a certain extent cushioned by the springs which bear on those arms. If, however, the outer arms should become damaged or loosened in any way, they are in position to be removed or repaired, and while this is being done one of the other movable electrodes which has been in reserve may be put in action.

On opposite sides of the bracket 12, above which the rotating cam is mounted, are fitted cushioning devices of rubber or other suitable material which are adapted to diminish or prevent noise and shock which might be caused by the projections or pins 17 and 17ª on the levers 16 and 16ª being thrown against the cam after the passing of the shoulder on the cam. In the drawings the cushioning device 50 and 50ª, of rubber or other suitable material, is mounted in a recess in the bracket 12, and an adjusting-screw 51 51ª is fitted in position to bear on the cushioning material for the purpose of adjusting it. On one side of each of the levers 16 and 16ª is formed a flattened projection or tup 52 or 52ª, which is adapted to strike the cushioning device just before the pin or projection 17 or 17ª on the lever comes in contact with the cam after slipping over the shoulder on the cam.

The time of ignition of the gases may be varied by adjusting the cam 13 and the wheel 6 relative to the wheel 5, as already described, and any more delicate adjustment of the sparking devices may be effected by means of the adjusting-screws on the arms of the movable electrodes.

The breaking of contact between the sparking-points is effected in the most efficient manner by the sudden blow delivered by the lever 16 or 16ª under the action of a comparatively strong spring, and the return movement, by which the contact is again made under the action of the weaker spring, is not only gradual, but the pressure between the points when in contact is such as to cause no injurious effect.

We claim as our invention and desire to secure by Letters Patent—

1. In a gas-engine, the combination, in an igniting mechanism, in which a spark is produced within the cylinder by breaking an electric circuit, of two movable electrodes each adapted by its movement to cause a spark within the cylinder, actuating mechanism for imparting motion to the movable electrodes, and means whereby either of the movable electrodes is adapted to be operated by the actuating mechanism, substantially as set forth.

2. The combination, with a gas-engine cylinder, of a removable cap, or bonnet, two movable electrodes mounted in the cap, or bonnet, each adapted by its movement to make and break a circuit, and an actuating mechanism for operating either of the movable electrodes, substantially as set forth.

3. The combination, with a gas-engine cylinder, of a removable cap, or bonnet, two movable electrodes mounted in the cap, or bonnet, each adapted by its movement to make and break a circuit, and mechanism operated by the engine for transmitting motion to the movable electrodes, substantially as set forth.

4. The combination, with a gas-engine cylinder of an igniting mechanism comprising two movable electrodes, each adapted by its movement to make and break an electric circuit, a cam operated from the engine, and a lever, or tappet, engaging with the cam and adapted to transmit motion to one or both of the movable electrodes, substantially as set forth.

5. The combination, with a gas-engine cylinder, of a removable cap, or bonnet, two movable and two fixed electrodes mounted in the cap, or bonnet, a lever, or tappet, for imparting motion to the movable electrodes, and a cam with which the lever or tappet engages and which is adapted to be operated from the engine, substantially as set forth

6. The combination, with a gas-engine cylinder, of a movable electrode which is adapted to make and break a circuit, a lever, or tappet, for actuating the movable electrode to break the circuit, a spring unconnected with the movable electrode, for moving the tappet in one direction, a cam engaging with the lever, or tappet, and means whereby the cam may be adjusted to vary the time of action of the movable electrode, substantially as set forth.

7. The combination, in an igniting mechanism for a gas-engine, of a movable electrode, a lever, or tappet, for actuating the movable electrode, a cam with which the lever, or tappet, engages, and a gear-wheel operated from the engine and so connected with the cam as to be capable of rotating the cam in one direction only, substantially as set forth.

8. In a gas-engine, the combination, with a removable head, or bonnet, of a movable electrode mounted in the head, or bonnet, rigidly-connected arms mounted on the opposite ends of the electrode, a lever, or tappet, for engaging the arm on the outer end of the electrode, a spring, unconnected with and disengaged from the movable electrode, for moving the lever or tappet to break the circuit, and means for actuating the lever, or

tappet to close the circuit, substantially as set forth.

9. In a gas-engine, the combination, with a removable cap or bonnet, of a movable electrode having rigidly-connected arms on or near its opposite ends and which is adapted to make and break a circuit, an adjusting device on the outer arm, a spring for actuating the movable electrode and tending to close the circuit, a spring engaging a lever or tappet and tending to open the circuit, and means for actuating the movable electrode from the engine, substantially as set forth.

10. The combination, with a removable cap or bonnet, which is adapted to be applied to an opening in the wall or head of a gas-engine cylinder, of two movable electrodes having rigidly-connected arms on, or near, their opposite ends, and adjusting devices on the outer arms, substantially as set forth.

11. The combination, with a removable cap, or bonnet, which is adapted to be applied to an opening in the wall or head of a gas-engine cylinder, of two movable electrodes mounted in the cap, or bonnet, and having rigidly-connected arms on their opposite ends, and two fixed electrodes adapted to be engaged by two of the arms on the movable electrodes, substantially as set forth.

12. In a gas-engine, the combination, with a movable electrode, of a lever, or tappet, movable independently of but adapted to engage with the movable electrode, a cushioning device for the lever, or tappet, a cam with which the lever engages, and a spring tending to hold the lever in engagement with the cam, substantially as set forth.

13. The combination, in an igniting mechanism, of a fixed electrode, a movable electrode, adapted to coöperate with the fixed electrode to make and break a circuit, a spring acting on the movable electrode and tending to close the circuit, and mechanism for operating the movable electrode which is actuated by a spring for breaking the circuit, substantially as set forth.

14. The combination, in an igniting mechanism, of a fixed electrode, a movable electrode, adapted to coöperate with the fixed electrode to make and break a circuit, a spring acting on the movable electrode and tending to close the circuit, a rotating cam, a lever, or tappet, engaging with the cam, and a spring for actuating the lever to break the circuit substantially as set forth.

15. The combination, in an igniting mechanism for a two-cylinder gas-engine, of a fixed and a movable electrode for each cylinder, a lever, or tappet, for operating each of the movable electrodes, a cam engaging with and imparting motion to both levers, or tappets, and a counter-shaft on which the cam is mounted and which receives motion from the engine, substantially as set forth.

16. In a gas-engine, the combination, with a governor-shaft operated from the main shaft, of a cam-shaft geared to the governor-shaft, a cam on the cam-shaft which engages with a lever, or tappet, and a movable electrode which is actuated by the lever or tappet, substantially as set forth.

17. In a two-cylinder gas-engine, the combination, with a counter-shaft operated from the main shaft of the engine, of a cam-shaft driven by the counter-shaft, a cam on the counter-shaft, two levers or tappets engaging with the cam, and two movable electrodes extending into each cylinder and adapted to be actuated by one of the levers, or tappets, substantially as set forth.

18. In a gas-engine, the combination, with a governor-shaft, operated from the main shaft of the engine, a governor and a governor-valve on the shaft, a cam operated by gearing from the governor-shaft, a lever, or tappet, engaging with the cam, and a movable electrode operated by the lever, or tappet, substantially as set forth.

In testimony whereof we have hereunto set our hands.

GEO. WESTINGHOUSE
EDWIN RUUD.

Witnesses:
JAMES B. YOUNG,
WESLEY G. CARR.