(No Model.) 2 Sheets—Sheet 1

C. W. AGERELL & A. A. WILLIAMS.

GAS ENGINE.

No. 555,355. Patented Feb. 25, 1896.

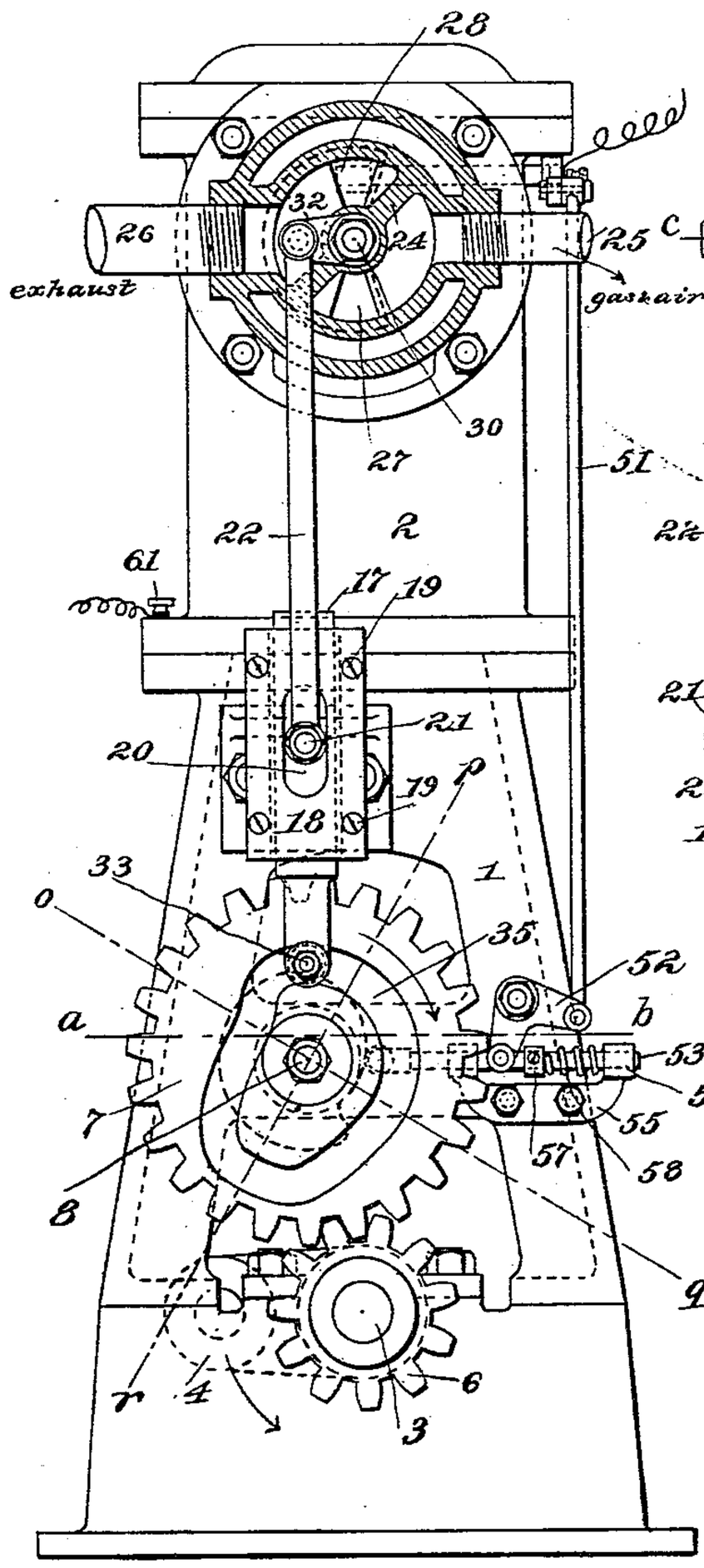

Fig. 1

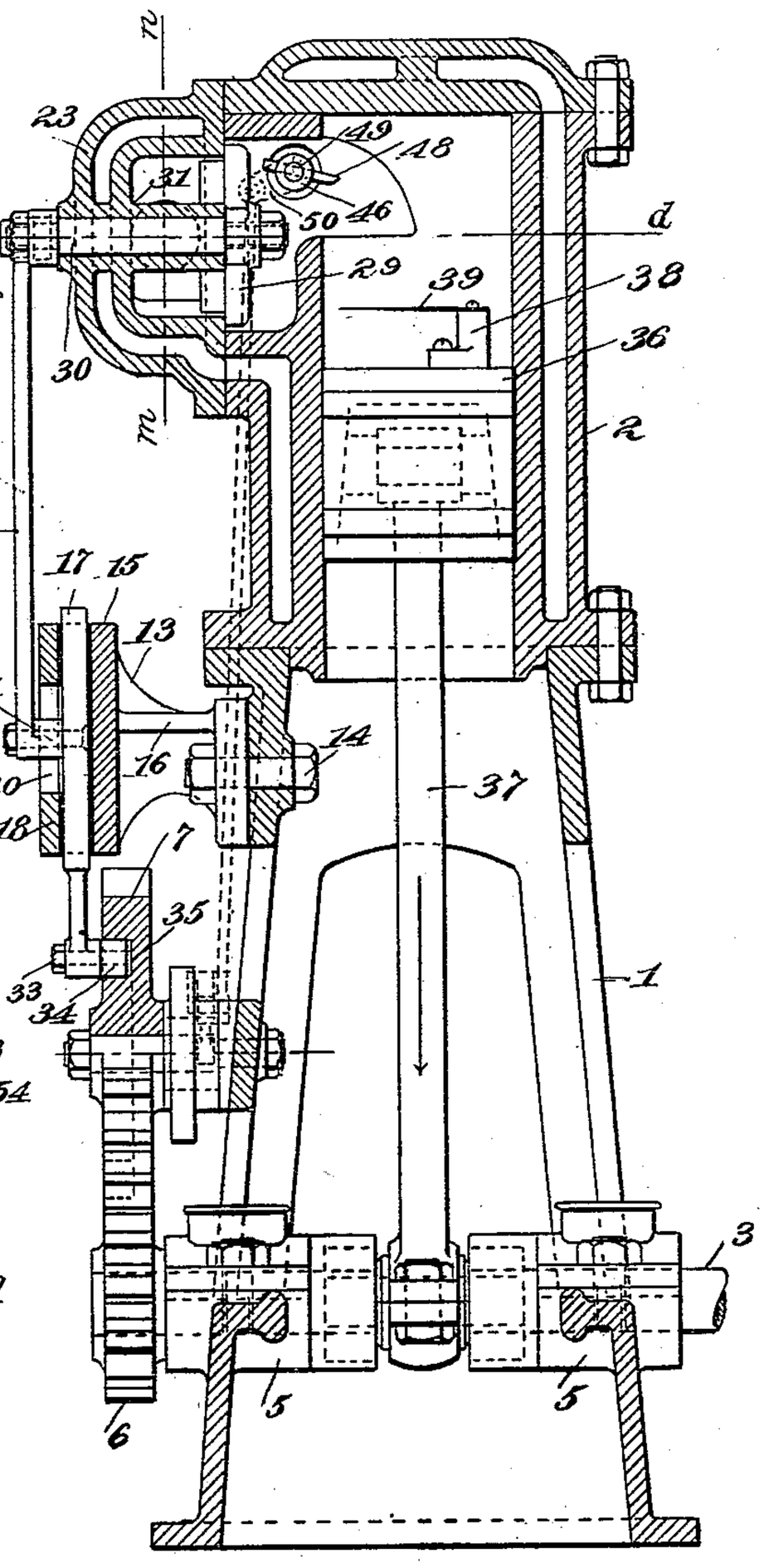

Fig. 2.

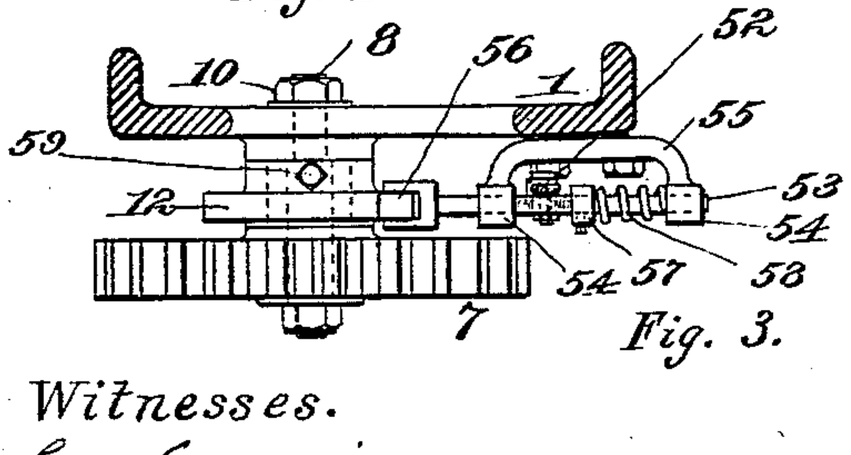

Fig. 3.

Witnesses.
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(No Model.) 2 Sheets—Sheet 2.

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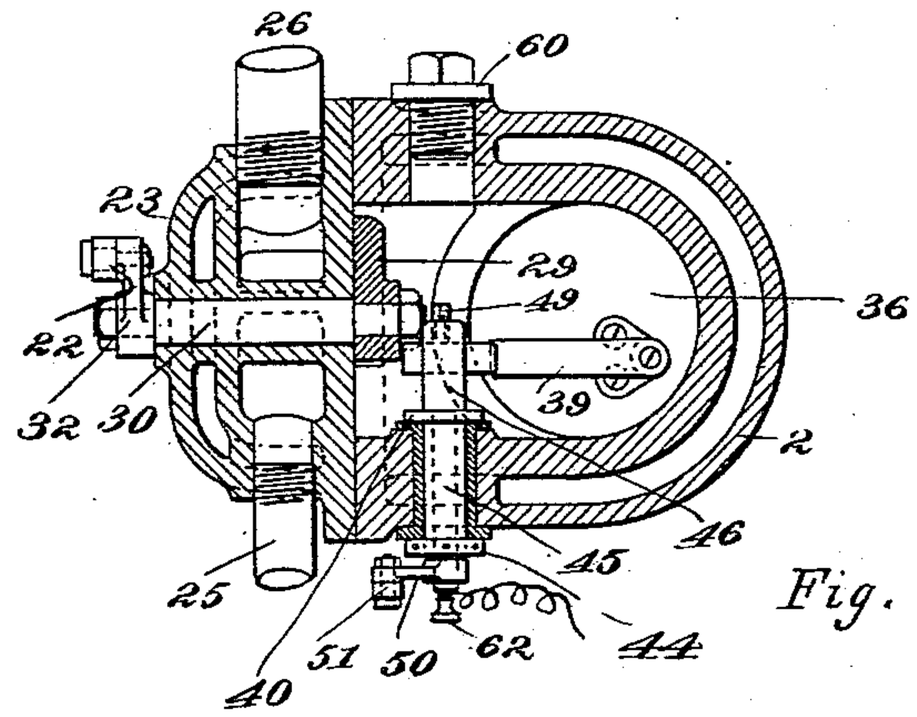

Fig. 4.

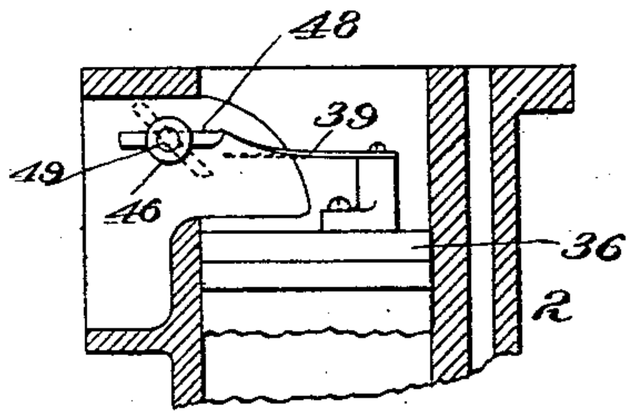

Fig. 5.

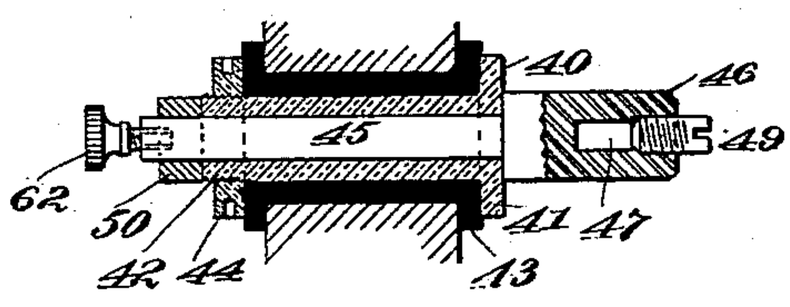

Fig. 6.

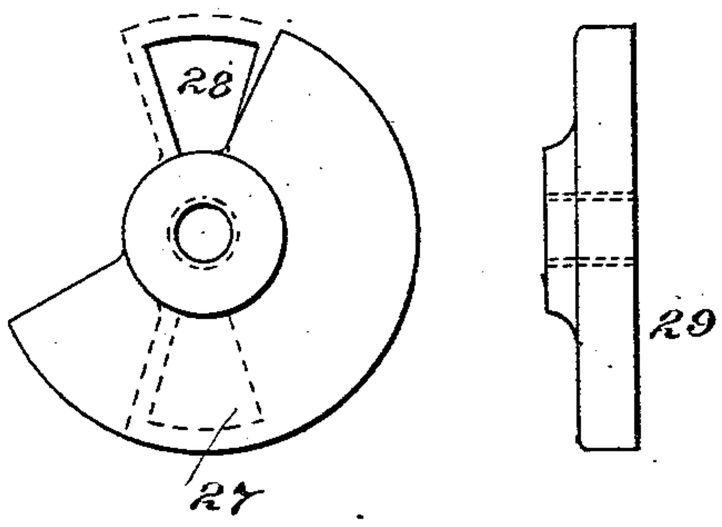

Fig. 7.

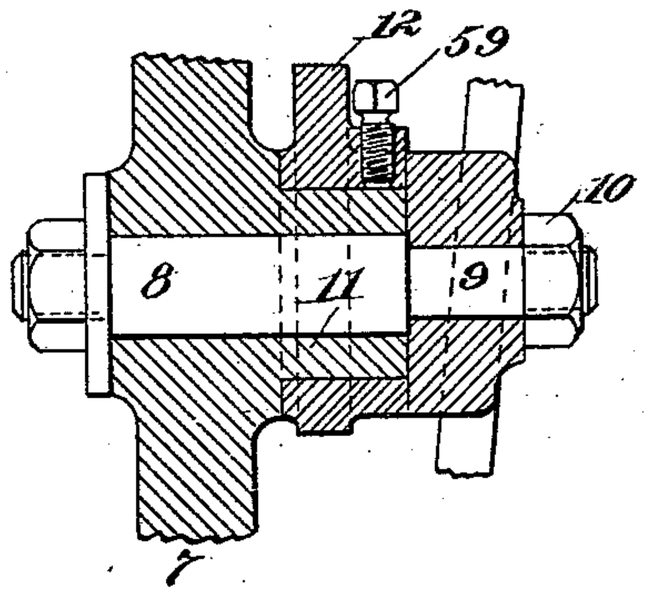

Fig. 8.

Witnesses.

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UNITED STATES PATENT OFFICE.

CHARLES W. AGERELL AND ADOLPH A. WILLIAMS, OF DULUTH, MINNESOTA.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 555,355, dated February 25, 1896.

Application filed June 10, 1895. Serial No. 552,311. (No model.)

To all whom it may concern:

Be it known that we, CHARLES W. AGERELL and ADOLPH A. WILLIAMS, citizens of the United States, residing at Duluth, in the county of St. Louis and State of Minnesota, have invented certain new and useful Improvements in Gas-Engines; and we do hereby declare the following to be a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

Our invention relates to various new and useful improvements in gas-engines.

The features of novelty in our improved gas-engine relate to the valve mechanism for the same, to the igniting mechanism, and to the general construction and arrangement of the parts.

Our invention is simple in construction and efficient in action.

In order that the construction of our improved gas-engine may be understood, attention is directed to the accompanying drawings, forming a part of this specification, and in which—

Figure 1 is an elevation of the engine, the valve-chest being shown in section on the line *m n* of Fig. 2; Fig. 2, a sectional view showing the operating-rod for the igniting mechanism in dotted lines; Fig. 3, a sectional view taken on the line *a b* of Fig. 1; Fig. 4, a sectional view taken on the line *c d* of Fig. 2, illustrating the igniting mechanism; Fig. 5, a detached view illustrating the igniting mechanism at the instant before ignition; Fig. 6, an enlarged sectional view of the swinging contact comprising part of the igniting device; Fig. 7, front and plan views of the valve, and Fig. 8 a detached view illustrating the manner of adjusting the cam for operating the igniting mechanism.

In all of the above views the several figures and letters represent like parts.

1 is the main frame of the machine made of any suitable construction, preferably of cast-iron, and 2 is a cylinder bolted to the top of the same.

3 is the main shaft provided with a crank 4 and mounted in bearings 5 5. A fly-wheel (not shown) is keyed to the shaft 3.

6 is a gear-wheel keyed to one end of the shaft 3 and engaging with a gear-wheel 7 of twice the size of the gear-wheel 6. The gear-wheel 7 is carried on a pin 8, (see Fig. 8,) which has a contracted portion 9 secured to the frame 1 by a nut 10. The gear-wheel 7, which, since it is provided with a cam-groove therein, to be presently described, will be hereinafter known as the "cam-wheel," is provided with a neck 11, on which is mounted a small cam 12, to be presently described.

13 is a removable bracket bolted to the frame 1 by means of bolts 14 and carrying a slide-head 15 at its outer end. The bracket 13 is provided with a strengthening-rib 16 at each side.

17 is a slide-rod reciprocating in the head 15, being held in position by a face-plate 18, secured to the head 15 by screws 19. The face-plate 18 is provided with a slot 20 therein, through which extends a pin 21, which is secured to the slide-rod 17. A valve-rod 22 is mounted on the pin 21 and operates the valve.

The valve-chest 23 is of the general shape shown, being removably secured to the upper outer side of the cylinder 2 and divided diametrically by an integral plate 24. A pipe 25 leads into the valve-chest 23 on one side of the plate 24 and supplies gas and air to the engine, and a somewhat larger pipe 26 extends out from the valve-chest at the other side of said plate to carry off the products of combustion.

27 is an inlet-port connecting one side of the valve-chest with the cylinder, and 28 is an exhaust-port connecting the other side of said valve-chest with the cylinder.

29 represents a swinging valve, the construction of which is illustrated more clearly in Fig. 7. This valve consists essentially of a swinging plate of slightly more than a half-circle in circumference, so as to entirely cover both ports 27 and 28 at certain times, as shown in dotted lines, Fig. 7. Said valve is mounted on a stem 30 and is operated by the same, and said stem is mounted in a bearing 31, formed in the plate 24. At the outer end of the stem 30 is a short lever 32, which connects with the upper end of the valve-rod 22.

The lower end of the slide-rod 17 is provided with a pin 33, on which is mounted a roller 34, which works in a cam-groove 35, formed in the front face of the cam-wheel 7. The construction of this cam will be under-

stood from an inspection of Fig. 1, wherein we show by lines *o*, *p*, *q*, and *r* the extent of said cam, corresponding to each down and up stroke of the piston. From the point *q* to the point *p* said cam extends concentric with the periphery of the cam-wheel 7, so as not to affect the movement of the valve 29, which will occupy the position shown in said figure, keeping both ports 27 and 28 closed. This movement of the cam-wheel represents the last upstroke of the piston prior to explosion, whereby air and gas within the cylinder will be compressed. From the point *p* almost to the point *o* the cam extends in the same circular line, so that at the time of explosion and for most of the downstroke the valve will still continue to cover said ports; but as the cam-groove approaches the point *o* it descends sharply toward the center, so as to allow the roller 34 to move downward, swinging the valve and opening the port 28. The exhaust is therefore opened at almost the instant the crank 4 reaches its lowest position. From the point *o* almost to the point *r* the cam-groove gradually recedes from the center and reaches a point close to the periphery of the cam-wheel. The cam-wheel therefore in moving from the point *o* to the point *r* will cause the roller 34 to be elevated to its extreme limit, which movement will gradually close the exhaust-port 28 and gradually open the inlet-port 27. From the point *r* to the point *q* the cam-groove, except for a short distance at the first part of its movement, where it is practically concentric with the cam-wheel, slowly approaches the center thereof until it reaches a point on its face at which both ports will be closed. This descent represents the downstroke of the crank 4, during most of which time the inlet-port will be opened and the mixture of air and gas will be drawn by suction into the cylinder.

We will further explain the action of the cam-wheel 7 when the operation of the invention is described in detail.

36 represents the piston working in the cylinder 2 and preferably of the plunger type, and 37 is the piston-rod, preferably mounted in said piston with a knuckle-joint and connected with the crank 4.

38 is a short standard carried at the top of the piston 36, and 39 is a horizontal leaf-spring screwed on the top of said standard. Said spring is preferably made of platinum, so as not to be injured by the heat of the exploding gas.

40 is a sleeve provided with a flange 41 on its inside and screw-threaded at 42 on its outside. This sleeve is mounted in the walls of the cylinder, near the upper end thereof, and is insulated from said cylinder by insulating material 43. This insulation 43 may be conveniently made of asbestos, or of some other substance which is not readily affected by heat.

44 is a jam-nut engaging the threads 42 for holding the sleeve 40 firmly in place. Mounted in the sleeve 40 is a short shaft 45, having an enlarged head 46 inside of the cylinder, said head being slotted at 47.

48 is a contact-piece adjustably mounted in the slot 47, and adapted to be secured at any position therein by means of the adjusting-screw 49. The outer end of the contact 48 is inclined on the under side, as shown, and is adapted to be engaged by the free end of the leaf-spring 39 at certain times, as will be explained.

50 is a short lever keyed to the outer end of the shaft 45, and 51 is a connecting-rod for operating said lever. The lower end of the connecting-rod 51 is pivoted to a bell-crank lever 52, mounted in the frame 1 of the machine. The other end of said bell-crank lever is forked and is connected to a horizontally-reciprocating rod 53. This rod 53 works in bearings 54 54, carried in a bracket 55, bolted to the frame 1. The inner end of the reciprocating rod 53 is forked, (see Fig. 3,) and mounted in said fork portion is a roller 56, which bears upon the periphery of the cam 12. This cam is illustrated clearly in dotted lines in Fig. 1, and is of a conventional shape, being of a gradually-increasing diameter from one point in its periphery to another point approximately coincident therewith and then descending abruptly between the two points, whereby the rod 54 will be slowly moved outward and then be allowed to quickly return to its original position.

The rod 54 is provided with an adjustable collar 57 thereon, and mounted on said rod, between said collar and one of the bearings 54, is a spring 58 for keeping the roller 56 in constant engagement with the cam 12. Said cam 12, as before explained, is mounted on the neck 11 of the cam-wheel 7, and in order that its position may be adjusted so as to secure the making of the spark between the spring 39 and the contact 48 at the proper time said cam is allowed to be secured at any position on said neck by means of an adjusting set-screw 59.

In order that the contact 48 may be adjusted within the slot 57 as either it or the spring 39 becomes worn, we provide a large plug 60 in the walls of the cylinder 2 in line with said contact, and through which with any suitable instrument said contact may be reached and adjusted.

61 is a binding-post for connecting the main frame of the machine with one pole of the battery or other source of electric supply, and 62 is another binding-post connecting the shaft 45 with the other pole of said battery or source. Since the shaft 45 is insulated from the rest of the engine, it is obvious that no current will flow between the binding-posts until the spring 39 is in contact with the contact-piece 48.

The operation of our improvement is as follows: The engine is started by hand in the usual way for the first few revolutions, the crank 4 turning in the direction of the arrow

shown in Fig. 1 beneath it. Since the gear-wheel 6 is of half the diameter of the cam-wheel 7, the engine will make two complete strokes while said cam-wheel revolves once. The first downstroke of the engine, as shown in Fig. 1, is produced by the explosion and moves the cam-wheel from the point *p* to the point *o*, the ports being closed for the most of this time, and then near the completion of the downstroke the exhaust-port is quickly opened. On the first upstroke the cam-wheel 7 passes from the point *o* to the point *r* and slowly closes the exhaust-port, the products of combustion being forced out of the cylinder by the upward movement of the piston, and near the completion of the first upstroke the exhaust-port 28 is closed and the inlet-port 27 is opened. The second downstroke moves the cam-wheel from the point *r* to the point *q*, the inlet-port being wide open at first and then slowly closing, and the piston moving downward will draw into the cylinder by suction a mixture of air and gas. The second upstroke of the piston moves the cam-wheel 7 from the point *q* to the point *p*, during which time both ports will be closed, and the air and gas which was admitted into the cylinder during the previous downstroke will be compressed therein. This gas is then exploded at the commencement of the third downstroke, and the operation is then continuous. When the piston has reached the top of its movement on the second upstroke, the cam 12 will have forced the rod 53 to its farthest limit, elevating the connecting-rod 51 and lever 50 and moving the contact 48 to its most oblique direction. At the moment the piston 36 commences to descend the roller 56 will be forced by the spring 58 from the highest point on the cam 12 to the lowest point thereon, reversing the movements mentioned and drawing the contact 48 in a substantially horizontal position. This contact will therefore be engaged beneath the spring 39 and a circuit will be established in the engine, and when the spring 39 moves slowly farther downward it will be disengaged from the contact 48, and the spark will be formed between these elements which will ignite the air and gas. By the time the spring 39 has returned again to the top of the cylinder 2 the contact 48 will have been moved to a position outside of the path of said spring and there will be no contact between the parts. It will therefore be seen that we produce a spark in the engine, one at the commencement of every second downstroke.

The elements which we have described above are those which constitute our invention, and it is to be understood that the engine should be provided with the other appliances necessary for successful operation, such as a governor for admitting the proper mixture of gas and air and for controlling the speed of the engine and means for properly mixing the air and gas prior to or simultaneously with their entrance into the cylinder.

The cylinder, valve-chest and other necessary parts are preferably provided with water-jackets, as we have illustrated, although this is not strictly necessary.

By employing a valve 29 of the character described seated on the inside of the valve-chest we are enabled to effectively prevent leakage of gas and air through the same at the moment of explosion, since the valve tends to seat itself at that time very firmly by the pressure of the exploding gas.

In operation it will be noticed that the movements of the valve take place when there is least pressure in the cylinder, so that the valve is very durable.

Having now described our invention, what we claim as new, and desire to secure by Letters Patent, is as follows:

1. In a gas-engine, the combination of the engine-shaft, a gear-wheel mounted thereon, a cam-wheel in engagement with said gear-wheel, a slide-head carried in a supporting-frame secured to the engine-frame, a removable face-plate 18 on said slide-head, a slot 20 in said face-plate, a slide-rod mounted in said slide-head and engaging at its lower end with said cam-wheel, a pin 33 on said slide-rod extending through the slot 20, a valve-chest and valve, and a connecting-rod connecting the valve with the pin 33, substantially as set forth.

2. The combination with the piston of a gas-engine and a spring carried thereon, of a swinging contact, adapted to be moved to a position to be engaged by said spring, and, after the spark is produced, to be moved out of that position, substantially as set forth.

3. The combination with the piston of a gas-engine and a spring carried thereon, of a swinging contact, adapted to be moved to a position to be engaged by said spring, and, after the spark is produced, to be moved out of that position, a cam operated by the engine and connections between said cam and said swinging contact, substantially as set forth.

4. The combination with the piston of a gas-engine and a spring carried thereon, of a swinging contact, adapted to be moved to a position to be engaged by said spring, and, after the spark is produced, to be moved out of that position, an adjustable cam operated by the engine and connections between said cam and said swinging contact, substantially as set forth.

5. The combination with the piston of a gas-engine and a spring carried thereon, of a shaft 45 mounted in the cylinder of the engine and insulated therefrom, a contact 48 carried by said shaft and adapted to be moved to a position to be engaged by said spring, and, after the spark is produced to be moved out of that position, and means for operating said shaft, substantially as set forth.

6. The combination with the piston of a gas-engine and a spring carried thereon, of a shaft 45 mounted in the cylinder of the engine and

insulated therefrom, an adjustable contact 48 carried by said shaft and adapted to be moved to a position to be engaged by said spring, and, after the spark is produced, to be moved out of that position, and means for operating said shaft, substantially as set forth.

7. The combination with the piston of a gas-engine and a spring carried thereon, of a sleeve 40 secured in the cylinder of the engine and insulated therefrom, a shaft 45 mounted in said sleeve, a contact 48 carried by said shaft and adapted to be moved to a position to be engaged by said spring, and, after the spark is produced, to be moved out of that position, and means for operating said shaft, substantially as set forth.

8. The combination with the piston of a gas-engine and a spring carried thereon, of a shaft 45 mounted in the cylinder of the engine and insulated therefrom, a contact 48 carried by said shaft and adapted to be moved to a position to be engaged by said spring, and, after the spark is produced, to be moved out of that position, a cam operated by the engine, a reciprocating rod 53 one end of which is in engagement with said cam, and connections between said reciprocating rod, and the shaft 45, substantially as set forth.

9. The combination with the piston of a gas-engine and a spring carried thereon, of a shaft 45 mounted in the cylinder of the engine and insulated therefrom, a contact 48 carried by said shaft and adapted to be moved to a position to be engaged by said spring, and, after the spark is produced, to be moved out of that position, a lever 50 on the shaft 45, a cam operated by the engine, a reciprocating rod 53 one end of which is in engagement with said cam, a spring 58 on said rod, a bell-crank lever 52 mounted on the engine-frame, one end being connected to said reciprocating rod, and a connecting-rod 51 connecting the other end of said bell-crank lever with the lever 50, substantially as set forth.

In testimony whereof we affix our signatures in presence of two witnesses.

CHARLES W. AGERELL.
ADOLPH A. WILLIAMS.

Witnesses:
F. D. CULVER,
FRANK HAYES.