No. 676,099. Patented June 11, 1901.

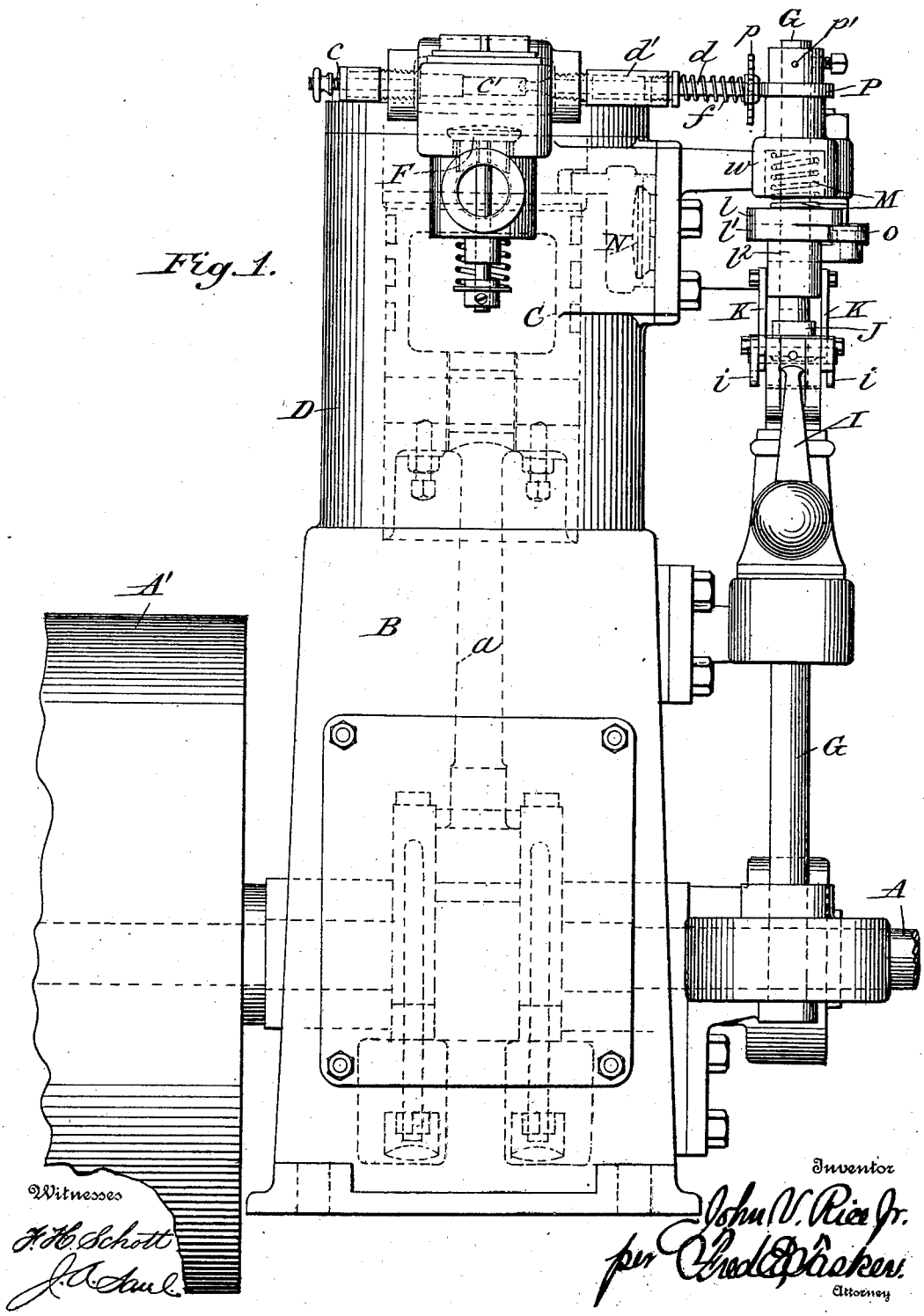
J. V. RICE, JR.

ELECTRIC IGNITER FOR EXPLOSIVE ENGINES.

(No Model.) (Application filed Aug. 12, 1897. Renewed Nov. 3, 1900.)

3 Sheets—Sheet 1.

Fig. 1.



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3 Sheets—Sheet 2.

Fig. 2.

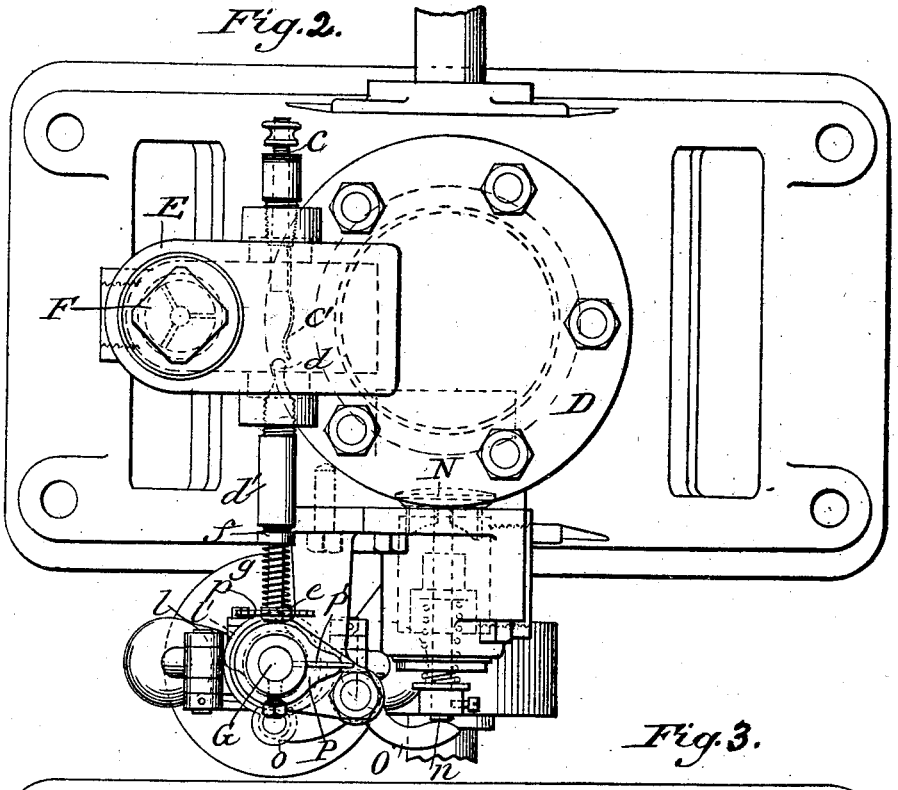
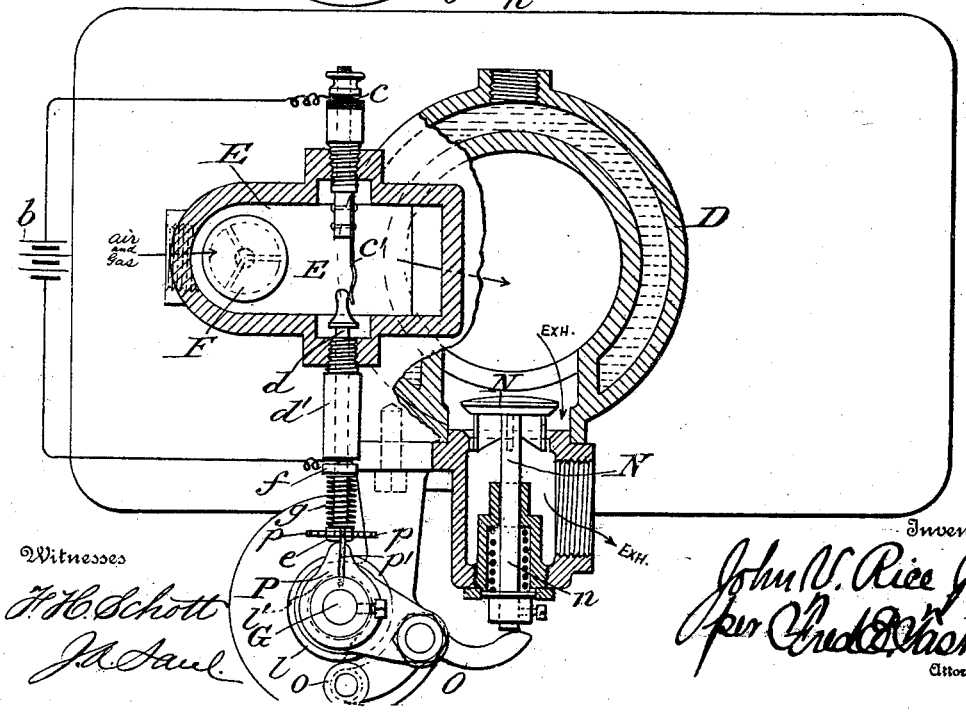


Fig. 3.



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3 Sheets—Sheet 3.

Fig. 4.

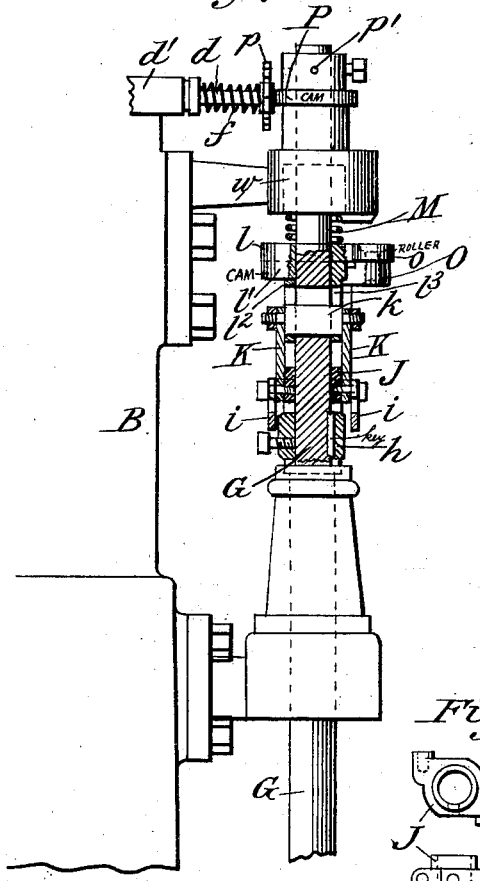


Fig. 5.

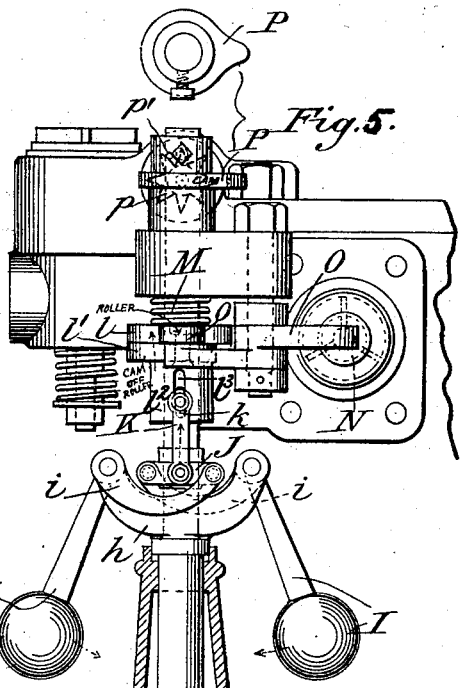


Fig. 10.

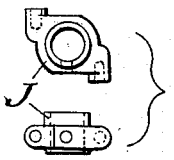


Fig. 9.

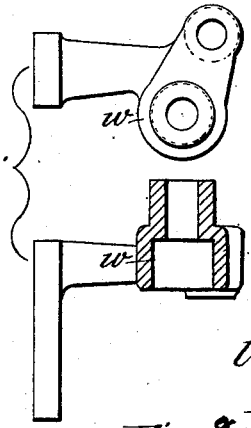


Fig. 7.

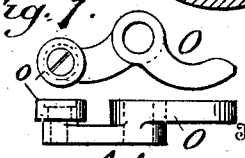


Fig. 6.

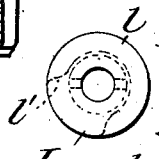
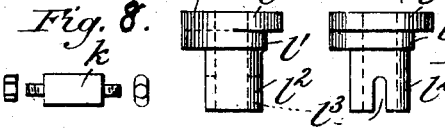


Fig. 8.



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UNITED STATES PATENT OFFICE.

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ELECTRIC IGNITER FOR EXPLOSIVE-ENGINES.

SPECIFICATION forming part of Letters Patent No. 676,099, dated June 11, 1901.

Application filed August 12, 1897. Renewed November 3, 1900. Serial No. 35,390. (No model.)

To all whom it may concern:

Be it known that I, JOHN V. RICE, Jr., a citizen of the United States, residing at Edgewater Park, in the county of Burlington and State of New Jersey, have invented certain new and useful Improvements in Gas-Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My present invention relates to an improvement in gas-engines of the four-cycle type, in which, as is well known, at each alternate revolution of the shaft an explosion takes place.

The object of my present improvement is to simplify the construction of engines of this character and especially to provide efficient igniting means; and the invention therefore consists in the improved igniting mechanism for causing the explosion and in numerous details in the construction and arrangement of the same, substantially as will be hereinafter described and claimed.

In the accompanying drawings, illustrating my invention, Figure 1 is a vertical side elevation of my improved gas-engine, the governor mechanism being represented in edge view. Fig. 2 is a top plan view. Fig. 3 is a horizontal sectional view in partial plan. Fig. 4 is a detail view showing the governor mechanism in side elevation. Fig. 5 is another detail view illustrating the governor mechanism in front elevation. Fig. 6 represents the exhaust-valve cam in plan and also in side elevation. Fig. 7 is a plan and also a side view of the compound lever which coöperates with the stem of the exhaust-valve. Fig. 8 is a view of the key to which the side links of the governor mechanism are connected. Fig. 9 is a plan view and also a sectional side view of the casting that supports certain parts of the governor mechanism. Fig. 10 represents in detail the sliding sleeve on the governor-shaft.

Similar letters of reference designate corresponding parts throughout all the different figures of the drawings.

In carrying my invention into practical operation I employ any suitable kind of general framework, the details of which may vary greatly in size, form, shape, and arrangement.

A denotes the horizontal crank-shaft of the engine, which is supported in suitable bearings in the main frame B, and there being a drive-wheel A′ on the side shaft, and the connecting-rod *a* being pivoted to the cranked portion of the drive-shaft and also connected by a pin or other suitable means to the piston C, which reciprocates within the water-jacketed cylinder D.

In the main frame of the engine, at a point near the upper end of the cylinder D, is situated the explosion-chamber E, which is more clearly represented in Figs. 2 and 3, in which chamber the explosions take place that cause an impulse to be transmitted to the main piston C. The air and gas which are introduced into the explosion-chamber E are mixed at a point outside of said chamber and are introduced thereinto through the air and gas inlet valve F.

I will now describe the electrical igniting means whereby the explosions are caused within the explosion-chamber E.

In Fig. 3 I have shown a battery *b*, having wires run to the electrode-pins *c* and *d*, said electrode-pin *c* having a spring contact-finger *c′* situated within the explosion-chamber E, and said pin *d* working through the wall of the said chamber E within a suitable bearing provided at *d′* for the purpose, the inner end of this pin *d* being rounded, as shown in Fig. 3, and adapted to be brought into close contact with the end of the spring-finger *c′*. The electrode-pin *d* is designed to reciprocate horizontally through the aforesaid bearing *d′* and to make and break contact with the end of the spring-finger *c′*, already mentioned. The outer end of the electrode-pin *d* carries a collar *e*, between which and the nut *f* on the said pin or some other suitable projection is tensioned a coil-spring *g*, the function of which is to normally throw the electrode-pin *d* outward sufficiently to permit its inner rounded contact end to clear the end of the spring-finger *c′*. Whenever any agency throws the electrode-pin *d* inwardly, thereby compressing the spring *g*, a contact will be made with the end of the spring-finger *c′*. Thus by the making and the breaking of contact between the end of the pin *d* and the end of the spring-finger *c′* the neces-

sary sparks will be caused for igniting the mixed air and gas which are introduced into the chamber E through the valve F.

I will now proceed to explain the details of the governor mechanism.

G designates an upright rotary shaft, which may be termed the "governor-shaft," on the lower end of which is a horizontal worm-wheel G', that meshes with the teeth of a vertical worm-wheel H, keyed upon a contiguous portion of the horizontal engine-shaft A. The number of teeth in the wheel H bears a certain ratio to the number in the wheel G', which ratio may vary as desired. In the type of engine I am describing the wheel H makes two revolutions to one revolution of the wheel G'.

I I designate the arms of the governor, the lower ends of which are formed as weights or balls and the upper ends of which are pivoted to a collar or sleeve *h*, which is keyed upon and rotates with the vertical shaft G. Rigid with the weighted arms I I and adapted to move therewith are the short arms *i i*, which are pivoted to a collar J, arranged to slide vertically upon the shaft G. Attached to the sleeve J are two vertical links K K, one on each side of the shaft G, the upper ends of which are connected to a flat key *k*, which passes through the shaft G.

L denotes a cam device, at the top of which is a circular part *l*, immediately below this a cam part *l'*, whose cam-point has a diameter equal to that of the circular part *l*, and below this a sleeve-like extension l^3, provided with lateral vertical slots l^3, that are adapted to engage the horizontal flat key *k*, (see Fig. 11,) said cam device being situated upon and rotating with the governor-shaft G.

When the engine is running at a normal rate of speed, the weighted arms I I will occupy the position shown; but as the speed increases beyond the normal limit and the action of the engine consequently begins to be unsteady and irregular the weighted arms I I will fly out under the action of the centrifugal force, causing in consequence the sleeve J to be depressed, which will pull the links K and also the key *k* downwardly through the slots l^3 in the cam device, it being noted that while the engine is running uniformly the said key *k*, being within the slot l^3, upholds the cam device L in the position in which it appears. The support for the cam device being thus lowered, a spring M, (see Fig. 1,) which appears upon the top of the cam device L, will operate to depress the cam device and force it downwardly to an extent corresponding to the depression of the key *k*, which is sufficient to transfer the circular cam part *l* into the same horizontal plane which has previously been occupied by the cam part *l'*. I will now explain the effect of this change in the position of the parts *l l'*. In the wall of the water-jacketed cylinder D, wherein reciprocates the piston C, is the exhaust-valve N, through which the spent gas finds exit after the various explosions. The end of the stem *n* of this exhaust-valve projects through the end of the exhaust-valve chamber in a position where it is in contact or adapted to be in contact with one end of a double lever O, which is pivoted near its center in a suitable support, while the opposite end carries a roller *o*. The double lever O is shown in plan view and also in edge view in Fig. 7, and it is shown in operative relation with the adjacent parts in Fig. 3. The double lever O occupies such a position—that is to say, is located in such a horizontal plane—that the roller *o* belonging thereto is normally alined with the part *l'* of the cam device L, and hence when the engine is running normally the part *l'* of the cam device L will rotate in contact with the roller *o*, and at each rotation will cause a vibration of the double lever O and an opening consequently of the exhaust-valve N, because it will of course be understood that each time the end of the lever O presses against the outer end of the stem *n* of the exhaust-valve, as shown in Fig. 3, the result will be to temporarily open the exhaust-valve until such time as the double lever O shifts backward again and is released from the stem *n*. Now it will be seen that when the engine runs at such a high rate of speed as to cause the cam device L to be pressed downward under the action of the spring M sufficiently to transfer the circular part *l* into the horizontal plane previously occupied by the cam part *l'* the circular part *l* will be brought into contact with the roller *o* on the double lever O, and inasmuch as the circular part *l* has the same diameter throughout as the largest diameter of the cam part *l'* and inasmuch as the effect of the contact of the largest diameter of the part *l'* with the roller *o* is to open the exhaust-valve N the result will necessarily follow that so long as the circular part *l* remains in contact with the double lever O the exhaust-valve will remain open and the gas within the cylinder have an opportunity to escape. The moment the pressure within the cylinder diminishes sufficiently to diminish the speed of the governor mechanism and the weighted arms I I consequently begin to resume their normal position just at that moment, the cam device L being again elevated, the exhaust-valve will be permitted to close. On account of the peculiar juxtaposition of the part *l'* of the cam device L with the top part *l* thereof the exhaust-valve will be permitted to close at just the instant a sufficient reduction of pressure has taken place to bring about a constant and even movement of the engine, and hence this arrangement of parts will effect a great saving, because oftentimes a large portion of a charge of gas will be saved which otherwise would be lost if it was necessary for the governor mechanism to rotate to a certain predetermined point before the exhaust-valve could again close; but with my construction the exhaust-valve can close at any moment

whenever the other conditions of regularity and uniformity of motion for the engine make it necessary for it to close.

On the upper end of the governor-shaft G, at a point somewhat above the cam device L, is fixed another horizontal cam P, (see Fig. 3,) which is opposite to the outer end of the reciprocatory electrode-pin *d*. At each revolution of the governor-shaft G the cam P acts against the pin *d* and thrusts the latter inward, so as to make contact between it and the spring-finger *c'*. Hence at each revolution of the governor-shaft G a spark is created within the explosion-chamber E. The collar *e* on the outer end of the electrode-pin *d* is furnished with a set of radial arms *p*, and the cam P or its collar is provided with a horizontal projecting pin *p'* of sufficient length to strike one of the radial arms *p* at each revolution of the cam. Therefore every time the cam revolves the electrode-pin *d* will be partially rotated. The object of this is to prevent the constant sliding of the same side of the inner end of the electrode-pin *d* against the spring-finger *c'*, which would otherwise take place, and this construction permits the various sides of said inner end of the pin to be presented to the action of the spring-finger, so that the friction between the two parts is not injurious and does not wear the round-ended electrode-pin disadvantageously.

Many changes may be made in the precise arrangement, form, and location of the several parts without varying from the scope and intent of the invention as here presented, and I therefore reserve the right to make all such changes as experience may suggest to be desirable.

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

1. In a gas or explosive engine, the combination with the cylinder, the piston, and the explosion-chamber, of the fixed and the reciprocating electrodes, one of which is rounded and horizontally rotative to prevent wear by friction, and the other of which has a spring contact-finger that is adapted to bear against the rotative electrode when contact is made, substantially as described.

2. In a gas or explosive engine, the combination with the explosion-chamber, of the fixed and the reciprocating electrodes, one of which is horizontally rotative, its outer end being provided with a star-wheel, and means for intermittently rotating said star-wheel, substantially as described.

3. In a gas or explosive engine, the combination with the explosion-chamber, of the fixed and the reciprocating electrodes, one of which is horizontally rotative, a star-wheel on the outer end of said electrode, and an electrode-actuating cam, said cam being provided with a pin for engaging and intermittently rotating the aforesaid star-wheel, substantially as described.

4. In a gas or explosive engine, the combination with the explosion-chamber, of the fixed and the reciprocating electrodes, one of which is provided with a spring contact-finger adapted to bear against the other when contact is made, while the other is rounded and horizontally rotative to prevent wear by friction, said latter electrode having a spring for normally keeping it out of contact with the other, and being provided on its outer end with a star-wheel, and an electrode-actuating cam, said cam being provided with a pin for engaging and intermittently rotating the aforesaid star-wheel, substantially as described.

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

JOHN V. RICE, JR.

Witnesses:
G. M. INMAN,
THEO. B. MARTIN.