(No Model.) 2 Sheets—Sheet 1.

N. C. BASSETT.

ELECTRIC IGNITER FOR GAS ENGINES.

No. 359,552. Patented Mar. 15, 1887.

Fig 1.

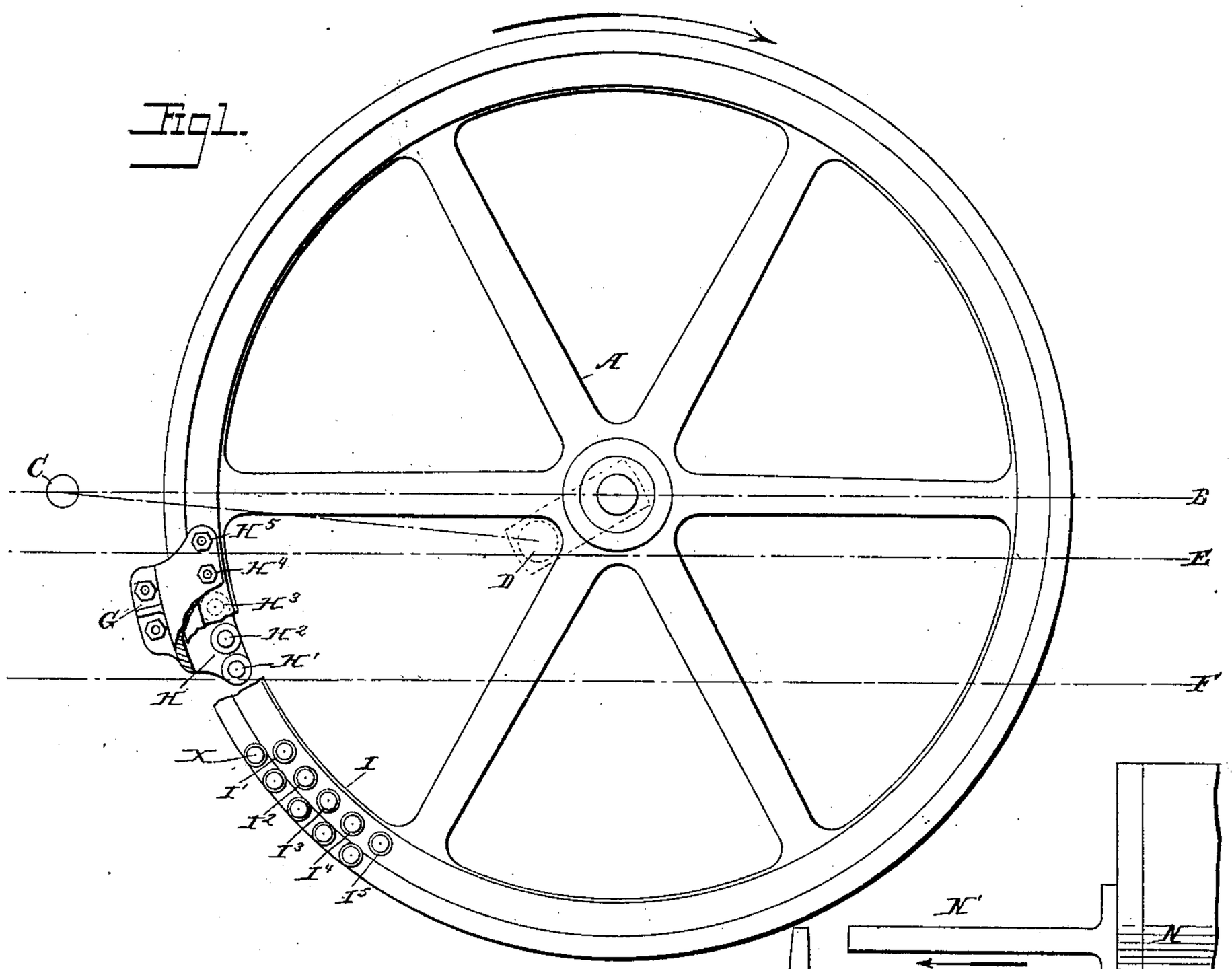

Fig 2.

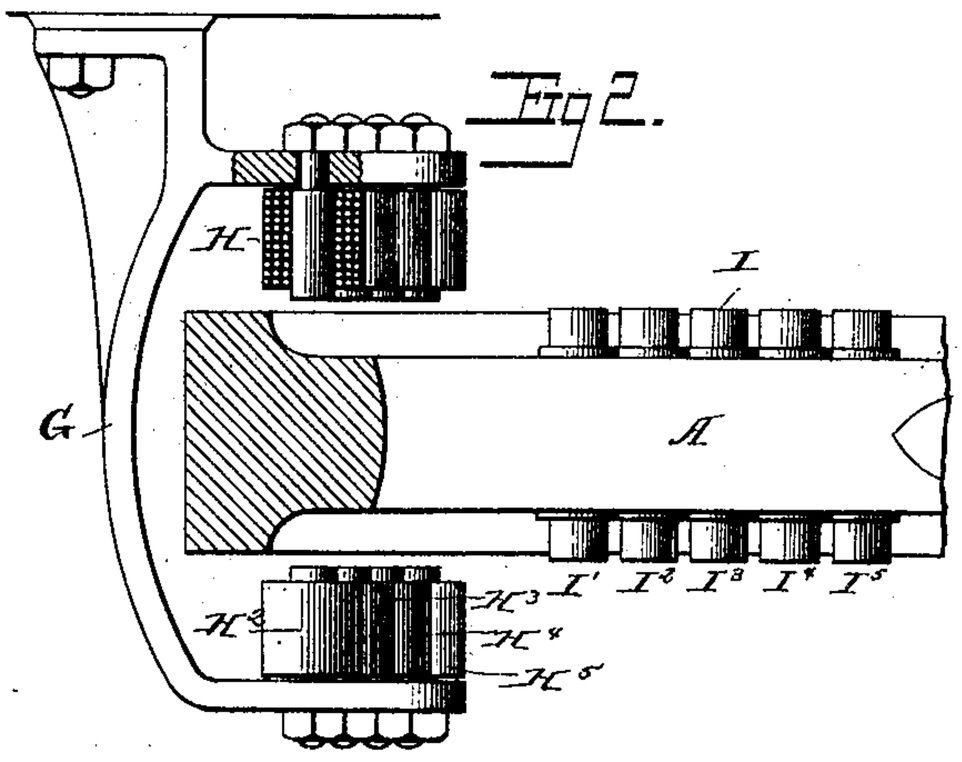

Fig 5.

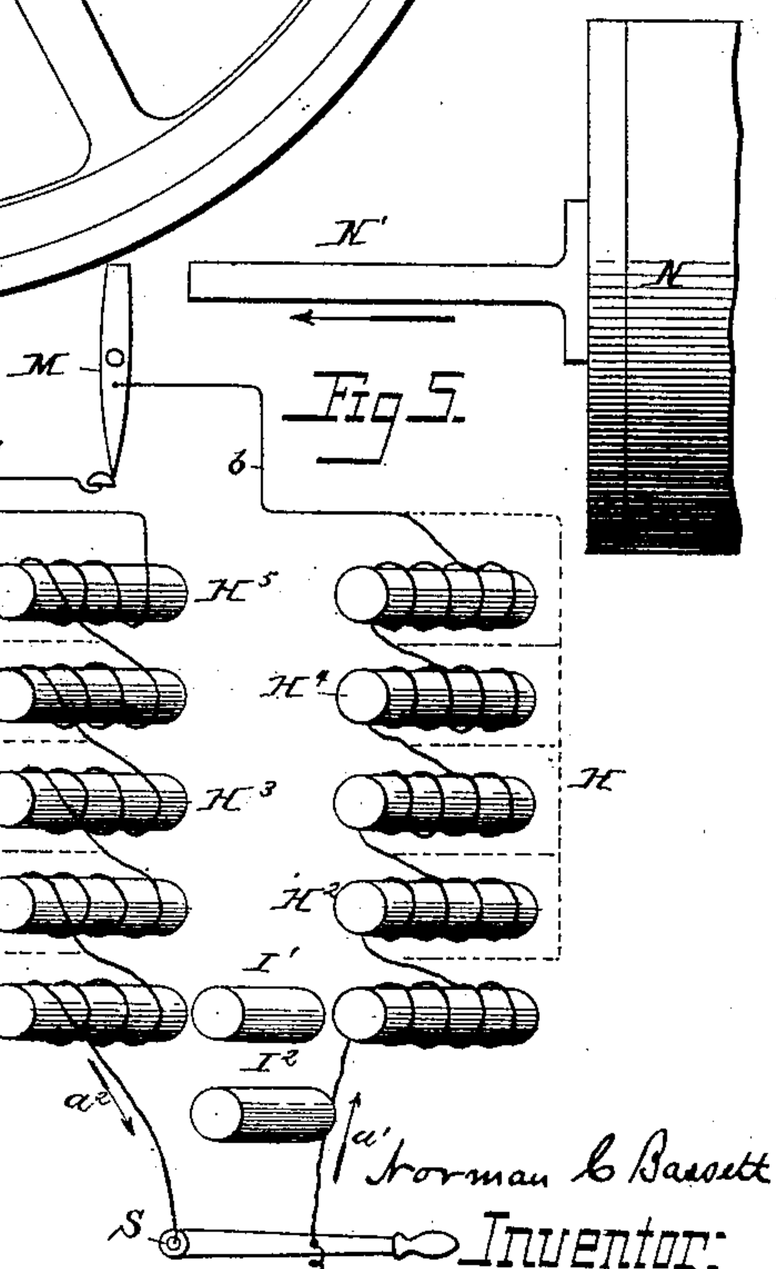

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Fig 3.

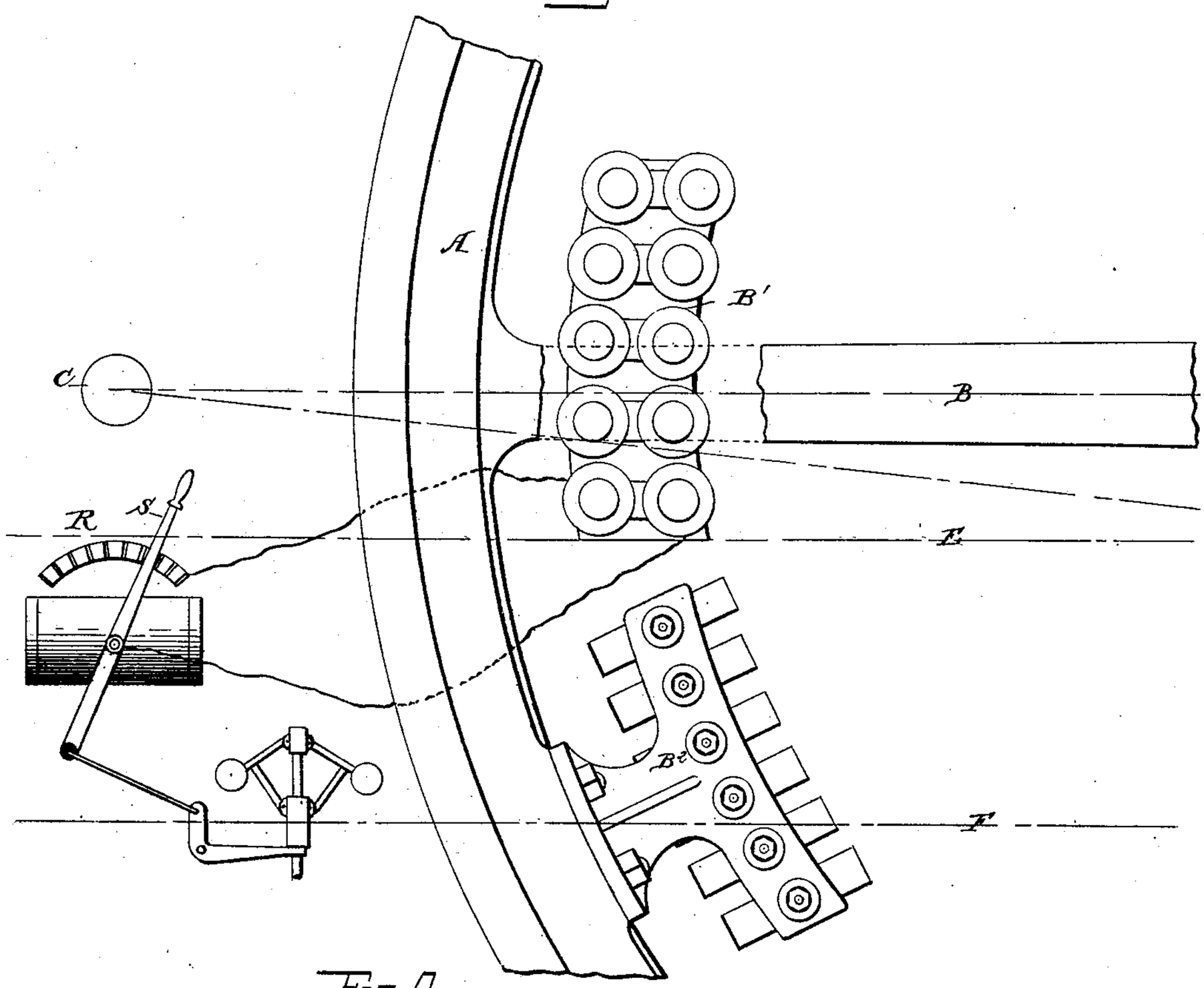
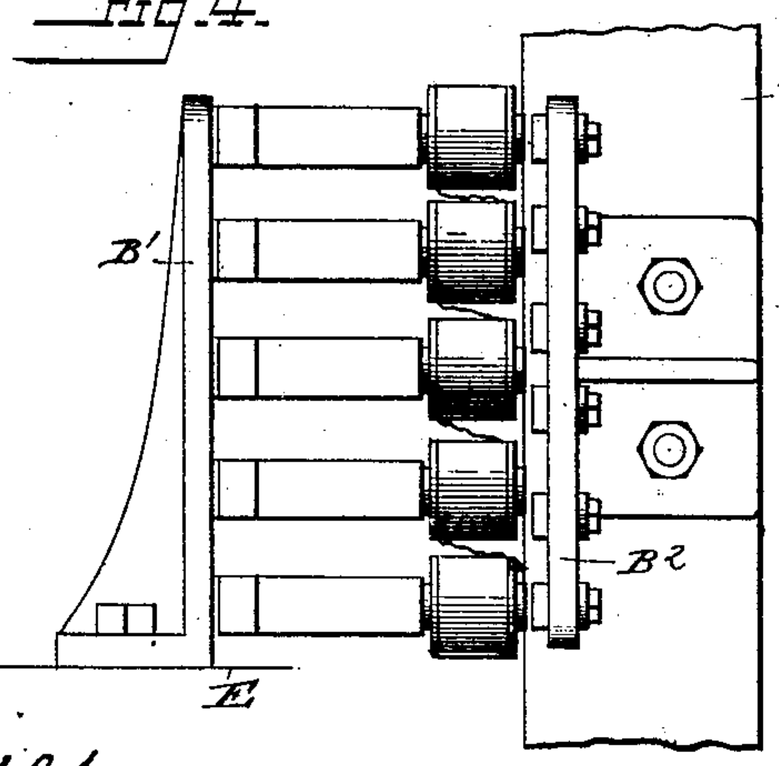


Fig 4.



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UNITED STATES PATENT OFFICE.

NORMAN C. BASSETT, OF CHICAGO, ILLINOIS, ASSIGNOR TO WILLIAM E. HALE, OF SAME PLACE.

ELECTRIC IGNITER FOR GAS-ENGINES.

SPECIFICATION forming part of Letters Patent No. 359,552, dated March 15, 1887.

Application filed June 3, 1886. Serial No. 204,088. (No model.)

To all whom it may concern:

Be it known that I, NORMAN C. BASSETT, a citizen of the United States, and a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Electric Igniters for Gas-Engines, of which the following is a specification.

My invention is intended for use in that class of gas or flame engines in which the explosive or combustible mixture or substance is ignited by means of an electric spark; and it consists in a magneto-electric generator, the elements of which are mounted partly upon stationary and partly upon moving parts of the engine itself. It further consists in regulating devices for rendering the generated currents as nearly as practicable of uniform strength during the whole phase of generation; and it also consists in the construction and arrangement of devices substantially as hereinafter more particularly set forth.

Heretofore many devices or forms of apparatus have been proposed for the purpose of igniting the combustible material in gas-engines; but these have depended, however, upon the use of some sort of a complete generator, either in the form of batteries or magneto-electric or dynamo machines, or similar generators which were independent in their construction from the gas-engine itself, and were simply arranged in juxtaposition to or upon said engine, and receiving power when necessary from the engine or from some devices connected therewith. When chemical generators have been used, it has been found difficult to keep them in working order, owing to their liability to run down, and it has been almost impossible to keep the current constant, so that the spark would be sure to occur at every desired moment. In using the separate dynamic or magneto-electric generators it has been difficult to insure a constant current, owing to the liability of the belt to slip over the driving-pulley, and also to the wear of the commutators and brushes; and, aside from the comparatively high cost of such machines and the delicate adjustments required, the maintenance of such machine has been found expensive and difficult, so that their use is quite objectionable.

The object of my present invention is to overcome these difficulties, and to provide an apparatus that will be practically operative and at the same time be of low cost in itself; and to this end I dispense with the use of belts, commutators, brushes, revolving spindles, and other parts exposed to wear or misadjustment, and provide a simple arrangement of devices which once adjusted will always be ready for use whenever the engine is to be operated.

Another important feature of my invention consists in generating the necessary current to produce the igniting-spark only during a limited portion of the time during which the engine operates, thereby saving a large proportion of the power usually consumed in driving the generator.

While my invention may be applied to many and various styles of engines, and may be applied in various ways, I have illustrated in the accompanying drawings one form which I have found to be practicable, and which involves the essential features of my invention.

In said drawings, Figure 1 represents a side elevation of a portion of the balance or fly wheel of a gas-engine and bed therefor with my generating apparatus attached thereto. Fig. 2 is a plan view, partly in section, of the same. Fig. 3 is a side elevation showing a modified arrangement of my apparatus. Fig. 4 is an end elevation of the part shown in Fig. 3. Fig. 5 is a diagrammatic illustration of the circuit-connections, showing one form of circuit-breaking device.

In the drawings, A is the fly-wheel, and B the center line of the engine or axis of the cylinder; C, the cross-head pin, showing its position relative to that of the crank-pin D when the latter is within thirty degrees of the center line, B, or, more technically expressed, within thirty degrees of the back center.

E represents the upper line of the engine-bed, and F the lower line of the same.

Suitably secured to the bed of the engine, as by a bracket-casting, G, are a number of spools or coils of insulated wire, wound upon soft-iron cores supported in said bracket, and from which the cores may be insulated, if desired. These cores are preferably arranged in pairs, one on each side of the rim of the bal-

ance-wheel, and I have shown five pairs in the drawings, though the number may be varied to suit the exigencies of the case.

Located upon the rim of the fly-wheel are arranged a series of permanent magnets, I, of tempered steel, magnetically insulated therefrom, and preferably placed at a distance from each other equal to the distance between the pairs of spools H, and these are so arranged that as the fly-wheel revolves the permanent magnets I are carried between the pairs of spools H H, the poles of the magnets passing close to but not touching the cores of the spools.

It is well known to those skilled in the art of electrical science that when a permanent magnet is caused to approach a soft-iron core, surrounded by a coil of insulated wire connected in a closed circuit, a current of electricity is induced in the coil in a certain direction, depending upon the approaching pole of the magnet, and a return or reverse current results if the magnet is rapidly drawn away from the core. It is also known that the intensity of these currents varies directly as the speed of approach and withdrawal within certain limits, and inversely as the square of the distance between the magnets and cores. I avail myself of these principles in applying my invention, and as it is well known that the rim of the fly-wheel of a gas-engine is the most rapidly-moving part thereof, and when properly constructed it runs with such truth and steadiness that the variation is scarcely noticeable, I am enabled to so arrange the magnets that they may be made to pass very close to the ends of the cores containing the coils of wire, thus giving the most favorable conditions for the generation of currents of high potential or tension, such as is best adapted, for instance, to ignite a mixture of gas and air under pressure.

It is evident that when the magnet I′ approaches the pair of spools H′, a current is generated in the wire surrounding said spools in the direction, say, of right-hand rotation around the cores; but the instant I′ passes the center of the spools H′ a current is generated in the reverse or left-hand direction of the cores. When the magnet I′ approaches the spools H^2, a right-hand current results in the coils thereof, and at the same time a similar current is generated in the coils of H′, because of the approach toward the latter of the magnet I^2. As the two magnets are now in action, the current generated in the coils will be twice as effective as that resulting from the action of one magnet. It will thus be seen that as the five magnets shown in the drawings are successively brought into action the current increases until the center magnet is opposite the center pair of spools, and then decreases until all are out of action. Now, it is at this point of strongest current, or as near to it as possible, that the igniting-spark should be obtained.

One way of winding and connecting the spools is illustrated in full lines in the diagram shown in Fig. 5. As the north pole of the magnet I′ approaches the coils H′, a current will be induced therein in the direction indicated by the arrows a' in one coil, and in the opposite coil in the direction indicated by the arrow a^2, and when the magnet passes beyond the center of the cores H′ a reverse current will be induced in the coils thereof. If the wires b b' are connected to a contact-breaker, M, at one end and include the coils H′, and the piston N is located and arranged so that the projection N′ thereon will at the back end of its stroke cause the contact-breaker to open the circuit suddenly, while either the right or left hand currents are passing through the wires, a spark will result, igniting the explosive mixture in the engine-cylinder and imparting an impulse to its piston.

In the diagram referred to it will be seen that the coils of the magnets H^2, H^3, H^4, and H^5 are all connected either in series (full lines) or on each side in multiple arc (dotted lines) in the circuit of the coils H′ and of the circuit-breaker. The cores of said magnet are partially energized by the currents generated in coils H. As the successive permanent magnets approach the cores of the successive coils, the currents generated in the latter will all flow together into the igniting-circuit, and the cumulative action of these currents will give rise to a more powerful spark at the circuit-breaker when operated at this juncture.

It has been found by trial that when one magnet and one pair of spools are used it is extremely difficult to break the circuit at the exact instant when the current is at its height, and therefore either no spark or a feeble spark results. While it has been found possible to produce with a single apparatus explosions at a large majority of the breaks, still to produce this unsatisfactory result such delicate adjustment of the relative motions of the magnet and contact-breaker are required that the apparatus is impracticable from a commercial standpoint.

With the present invention any number of magnets and pairs of coils may be used, thus extending the currents over such an interval of time as to make it certain that one of the currents will be caught at a point sufficiently high to produce the required spark, and the relative motions of the magnet and circuit-breaker have a wider range of adjustment.

In order to make the action of my improved device still more certain, a second series of permanent magnets may be used, whose action shall be intermediate between the first series, and they may be arranged as indicated at X, Fig. 1.

Another arrangement used to produce what may be termed a "differential action" consists in placing a greater number of magnets in the same space as that occupied by a smaller number of pairs of coils, as is indicated in Fig. 3, where I have shown six permanent magnets

occupying the same space as the corresponding five pairs of coils. The action resulting from such an arrangement will be that some of the magnets will be approaching the coils while others are receding from them, as in the former arrangement, but with this difference, that more of the coils will be either approaching or receding than the converse, and the direction of the current in the wire *b b'* will be either right or left hand, according to the preponderance of the effect of the approaching or receding magnets. It will be seen, however, that until I' arrives at the point opposite H^5 this preponderance is in favor of the approaching magnet, and therefore the current will be continuous up to this point in a positive or right-handed direction. It will also be evident that after I' has passed H^5 the superior strength will be with the receding magnets, and a continuous current in the negative or left-handed direction will result until I^5 has passed out of action. By this arrangement and by a proper rotation of the parts relative to each other the spark may be produced with either the positive or negative currents, as desired, and by using a sufficient number of magnets and coils these currents may be continued even to the extent of time required for one-half a rotation of the fly-wheel, affording ample opportunity for obtaining the explosion at almost any point of the stroke of the engine-piston desired, and with absolute certainty. It will be noted, however, that the preponderance of the approaching over the receding magnets, or vice versa, cannot at any time be due to more than one magnet when they are used in the proportion of six to five, and therefore each magnet and pair of spools must be powerful enough to produce the spark with certainty, and the only advantage of this differential arrangement in that case is that the time in which the spark can be produced is greatly extended. However, if the magnets and coils are used in the proportion of seven to five, the preponderance of current will be equal to two magnets, and if used in the proportion of ten to five the excess will be five, and the apparatus may be of the same size as in the first case.

In Figs. 3 and 4 I have illustrated a modified arrangement, in which a series of permanent magnets are secured to a bracket, B', bolted to the frame of the engine. On the ends of these horseshoe-magnets are secured soft-iron cores, wound with insulating-wire, which becomes the poles of the magnet. On a bracket, B^2, which is bolted to the fly-wheel, are secured a series of soft-iron bars, which act as keepers or armatures for the permanent magnets. Now, as the fly-wheel revolves, the keepers pass before the poles of the magnet, changing their magnetic condition and producing currents in the spools thereon, according to the same principles of magnetic induction which have been described in reference to the first arrangement.

In the arrangements described the magnetic action is intended to be sufficiently strong to produce a spark while the fly-wheel is revolving at such a speed as a man can give it in starting the engine—say at the rate of a hundred revolutions a minute. If the generator is made sufficiently strong to produce an explosion at this speed—at a hundred and sixty or two hundred revolutions—the spark will be so strong as to endanger the durability of the parts of the contact-breaker, and I therefore introduce into the circuit a rheostat or resistance-coil and provide suitable mechanism for varying the resistance of the circuit. This may be accomplished by hand or may be controlled automatically by the speed of the engine in various ways, one of which is illustrated in Fig. 3. In starting the engine the whole resistance-coil is thrown out of the circuit, and as the speed of the engine increases the resistance is gradually thrown into the circuit in proper proportion, so that the current will be regulated to produce the spark.

In Fig. 3 I have illustrated one form of the resistance-coil (lettered R) having a short-circuiting bar or lever, S, which may be moved by hand or connected to the governor of the engine, as shown in Fig. 3. In the diagram Fig. 5 I have represented this resistance coil and lever.

If desired, in place of the resistance or in connection therewith, a shunt-circuit may be provided, which shall be connected with coils arranged upon the permanent magnets, and the current passing through the coils will strengthen said permanent magnets in a manner well understood.

When the permanent magnets are arranged upon the bed of the machine, as shown in Fig. 3, the shunt-circuit may pass directly to the coils on said magnets; but when they are arranged on the rim of the fly-wheel, as shown in Fig. 2, some means must be provided for conveying the current to the magnets, and this may be done by placing an insulating-ring upon the hub of the wheel and connecting it to the coils on the magnet, or contact-brushes may be arranged in juxtaposition to the rim of the wheel, which will convey the current as desired.

While I have thus described my invention with sufficient detail in reference to the drawings, so that the principle thereof may be clearly understood, I do not desire to limit myself to any of the details shown, as it is evident that one skilled in the art can arrange the co-operating parts necessary to carry out my invention in many and various ways other than those shown without departing from the principle of my invention. For instance, the moving part of the generator, whether it be the armature or feed-magnet, may be mounted upon any moving part of the engine, whether a rotary part, as shown, or a reciprocating or vibrating part.

What I claim is—

1. A sparking device for gas-engines, consisting, essentially, of a magneto-electric gen-

erator, part of which is mounted upon a stationary portion and part upon a moving portion of the engine, and a circuit-breaker operated by the engine, substantially as described.

2. A sparking device for gas-engines, consisting of a magneto-electric generator, partly mounted upon a stationary portion and partly mounted upon a shaft of the engine, and a circuit-breaker operated by a moving part of the engine, substantially as described.

3. An electric igniter for gas-engines, consisting of a magneto-electric generator, partly mounted upon and partly in operative relation to the fly-wheel of the engine, and a circuit-breaker operated by a moving part of said engine, substantially as described.

4. An electric igniter for gas-engines, consisting of a magneto-electric generator, the generating-coils of which are mounted upon a stationary portion of the engine, and the armature of which is mounted upon a moving portion of the engine, and a circuit-breaker connected to said generator, substantially as described.

5. An electric igniter for gas-engines, consisting of a series of electro-magnets upon a stationary part of the engine, and a series of armatures upon a moving portion thereof, the said magnets and armatures arranged to successively approach and recede from each other, as described, for accumulative action, and a circuit-breaker.

6. An electric igniter for gas-engines, consisting of a number of generating electro-magnets mounted upon a stationary part of the engine, a greater number of armatures mounted upon a moving part of said engine, arranged to successively approach and recede from each other for cumulative differential action, and a circuit-breaker, substantially as described.

7. The combination, in an electric igniter for gas-engines, of a magneto-electric generator, a circuit-breaker, and a rheostat and switch operating to throw more or less resistance into the circuit, substantially as described.

8. The combination, in an electric igniter for gas-engines, of a bracket secured to the frame of the engine and carrying a series of pairs of electro-magnets, and a fly-wheel carrying a series of permanent magnets secured to the rim thereof and adapted to operate as armatures and to pass in close proximity to the electro-magnets on the brackets as the fly-wheel revolves, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

NORMAN C. BASSETT.

Witnesses:
WILLIAM E. SLOSSOM,
EDGAR L. HANCE.