No. 617,806. Patented Jan. 17, 1899.

F. E. CANDA.

ELECTRIC IGNITER FOR EXPLOSIVE ENGINES.

(Application filed Aug. 26, 1897.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

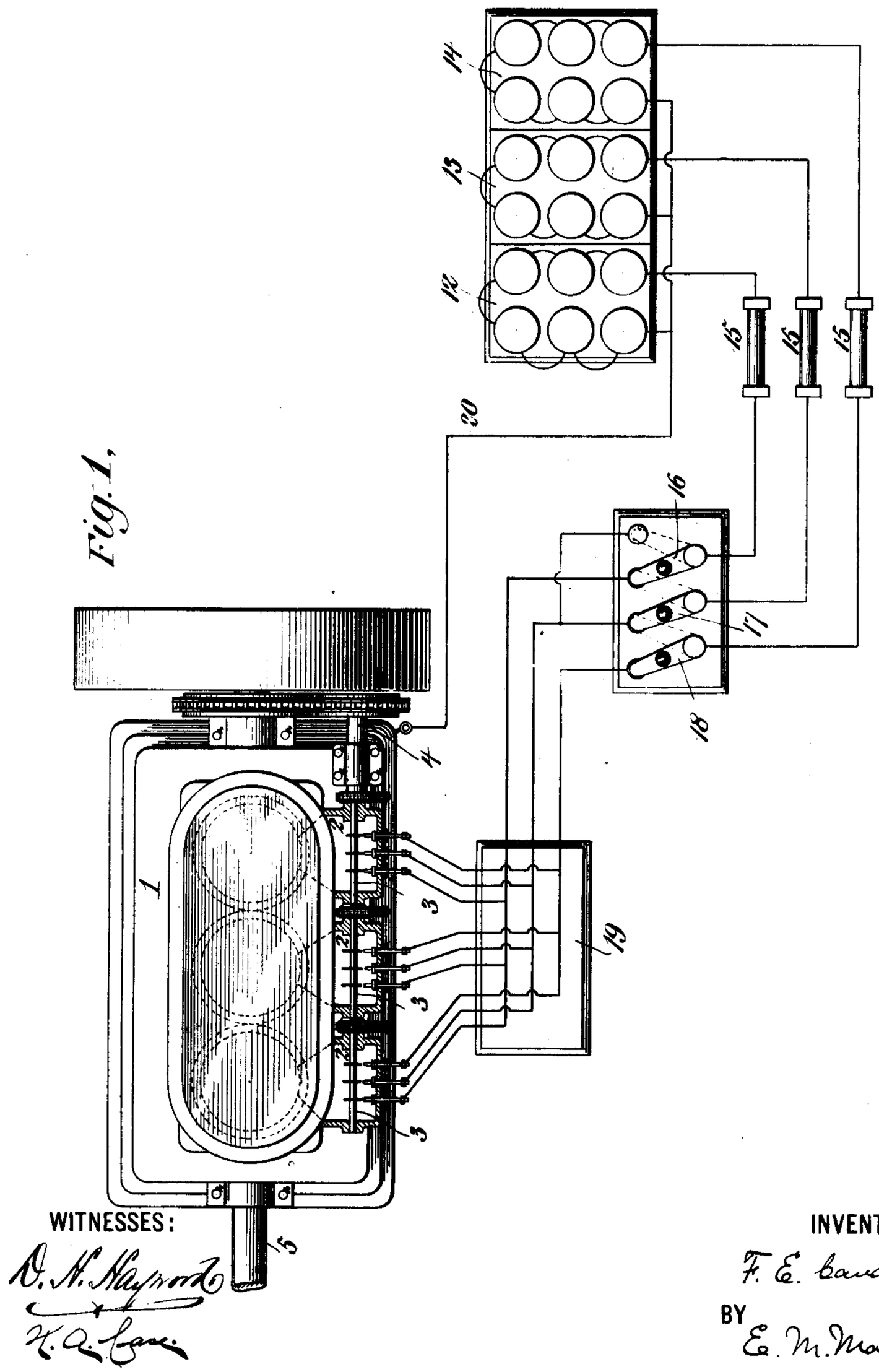

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Fig. 3,

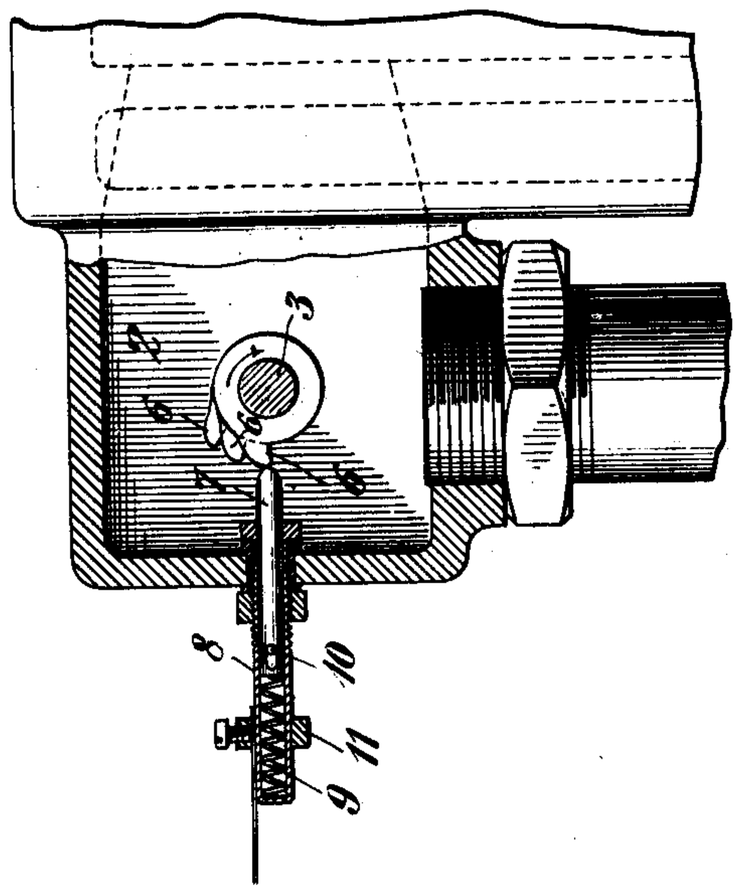


Fig. 4,

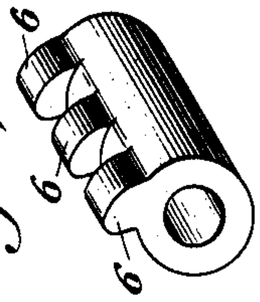
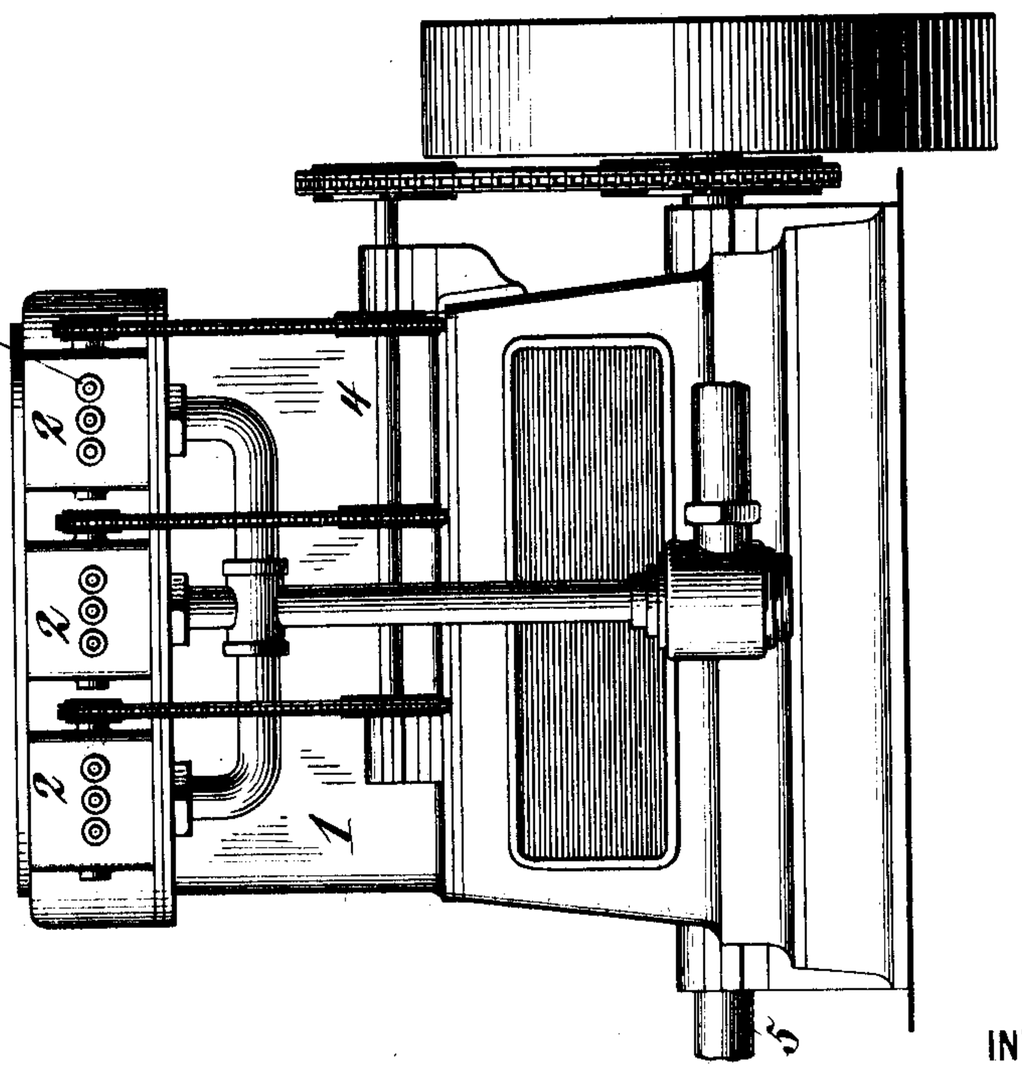


Fig. 2,



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UNITED STATES PATENT OFFICE.

FERDINAND E. CANDA, OF NEW YORK, N. Y.

ELECTRIC IGNITER FOR EXPLOSIVE-ENGINES.

SPECIFICATION forming part of Letters Patent No. 617,806, dated January 17, 1899.

Application filed August 26, 1897. Serial No. 649,564. (No model.)

To all whom it may concern:

Be it known that I, FERDINAND E. CANDA, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Gas and Oil 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 invention relates to improvements in gas and oil engines, and particularly to improvements in electric igniting and speed-regulating mechanism for such engines.

My invention consists in employing a plurality of igniting devices for each engine-cylinder and operating, by preference, a plurality of such igniting devices during each working stroke of the cylinder, so as to insure the production of a spark by some one of the igniting devices during each working stroke; in providing separate circuits and batteries for the separate igniting devices of each engine-cylinder and switches by which one or more of the batteries may be disconnected or connected with a different set of igniting devices from that to which it is ordinarily connected, thus making it possible to locate or bridge over any defect in the operation of the igniting mechanism which may occur during the operation of the engine; in so arranging the several igniting devices of each engine-cylinder that ignition may be produced at different periods in the stroke, thus making it possible by throwing one or more of the igniting devices of each engine-cylinder out of circuit to vary the speed of the engine, and in the novel combination, construction, and arrangement of the parts.

The objects of my invention are, first, to provide an igniting mechanism which shall more certainly ignite the explosive charges of oil and gas engines than the igniting devices heretofore in use; second, to provide means for locating defects in the operation of the igniting mechanism and for bridging over such defects without interfering with the operation of the engine; third, to provide simple means for varying the speed of the engine which may be operated at a distance from the engine, and, fourth, to make the igniting and speed-regulating mechanism simple, compact, certain in action, not liable to derangement, easily operated, and comparatively inexpensive. These objects are attained in the invention herein described, and illustrated in the drawings which accompany and form a part of this specification, in which the same reference-numerals indicate the same or corresponding parts, and in which—

Figure 1 is a plan view of a gas or oil engine with my invention applied thereto, the igniting-chambers being sectioned to show the position of the sparking devices and the electrical batteries, switches, and connections being indicated. Fig. 2 is a side elevation of the engine. Fig. 3 is a detail vertical section of one of the igniting-chambers, and Fig. 4 is a detail elevation of a modified form of sparking-cam.

In the drawings the invention is shown as applied to a three-cylinder vertical engine, but it may be applied to any single or multiple cylinder gas or oil engine of any type, and the particular igniting mechanism employed comprises a series of sparking contact-points, with means for bringing them together and separating them at proper intervals, and suitable circuits and electrical generators therefor.

In former gas or oil engines having electrical igniting devices trouble has been experienced through the occasional failure of the igniting device to cause ignition at the proper times. Entire failure of the igniting device to cause ignition continued for several successive strokes necessarily stops the engine, and the occasional failure of the igniting device to cause ignition at the beginning of a working stroke or ignition at too late a period in the stroke interferes greatly with the efficiency of operation of the engine and causes undesirable fluctuation in speed. As electrical igniting devices have been constructed heretofore it has been difficult to locate any defect in the operation of the igniting device or to bridge over the defect without stopping the engine or otherwise interfering with its operation. I have found that by employing a number of separate igniting devices for each engine-cylinder the effectiveness of the whole igniting mechanism is very much increased, and it is rendered

much more certain in action and the occasional failure to produce ignition is avoided. By connecting the different igniting devices of each engine-cylinder to different batteries and by providing switches by which one or more of the igniting devices of each engine-cylinder may be thrown out of circuit it is easy to locate an igniting device which fails to cause ignition at the proper time, and by so arranging the switches that each igniting device may be connected to more than one battery a defect in the operation of the igniting mechanism, due to the weakening or failure of one or more of the batteries, may be readily bridged over.

By arranging the several igniting devices of each engine-cylinder so that the sparks are produced successively instead of simultaneously I am able, by throwing one or more of the igniting devices out of circuit, to vary to a considerable extent the speed of the engine. The switches by which this is accomplished may be located at a distance from the engine, and for this reason this speed-regulating device is particularly suitable for use on launches when it is desirable to control the speed of the engine from the bow.

In the drawings, 1 is an oil or gas engine, the details of which are not illustrated and form no portion of the invention. As illustrated, it is a three-cylinder engine.

2 2 2 are igniting-chambers connected by suitable ports to the working cylinders and forming in effect parts thereof and which contain the contact-points by which the charges are ignited.

3 3 3 are short shafts within the igniting-chambers and projecting therefrom and which are connected by suitable gearing to a counter-shaft 4, itself driven from the main shaft 5 of the engine. If as is ordinarily the case the engine is so arranged that each alternate stroke in each cylinder is a working stroke—that is, a stroke during which an explosion takes place—the shafts 3 would be geared to revolve at half the speed of the engine-shaft.

Upon each shaft 3 is a series of cams 6, coacting with spring-pressed pins 7. Each of these cams, with its pin, constitutes a separate sparking device. In the drawings I have shown three such sparking devices within each igniting-chamber; but a greater or less number may be used. It is desirable that there should be a plurality of such igniting devices in each igniting-chamber, however, in order to avoid the occasional failure to ignite a charge, to which reference has been made. Each pin 7 may be mounted in a tube 8, projecting from and insulated electrically from a side of the igniting-chamber, and a spring 9 within this tube may be employed to press the pin against its cam, the motion of the pin being limited by a stop 10, working in a slot in the pin. The teeth of the cams are so arranged that they make contact gradually with the pins 7, but break contact somewhat abruptly, so that each sparking device produces its spark promptly. The rubbing of the cams against the ends of the pins tends to keep the contact-surfaces clean, so as to insure the making of good contacts. The end of each cam-tooth and the end of each pin are so rounded that if for any reason the shaft of the engine should be rotated in the reverse direction the pins will nevertheless be pushed backward and will not be broken off.

Each tube 8 may be provided with a suitable binding-post or clamp, such as that numbered 11 in Fig. 3, for the connection of an electrical conductor.

The arrangement of the electrical circuits is indicated in Fig. 1. Three separate batteries 12, 13, and 14 are provided, each corresponding to one of the sparking devices of each engine-cylinder. From one of the poles of each battery a circuit passes through a sparking-coil 15 and through one of three switches 16, 17, and 18 and thence to a suitable terminal board 19, from whence it is connected to one of the three contact-pins of each engine-cylinder, the return being through a conductor 20, connected to the base-plate of the engine, the several cams being in electrical connection with the shafts 3, which are in electrical connection with the body of the engine. The switches 16, 17, and 18 are of ordinary construction, consisting each of a spring-lever provided with a knob by which it may be moved and arranged to make contact with a suitable contact-piece in the base-plate, and the relative positions of these switches should be such that each switch-lever may make contact with its own contact-piece or with the contact-piece of an adjoining switch, as indicated in dotted lines. It is therefore possible to throw each battery out of circuit with its sparking device or to connect each battery with a different set of sparking devices from that to which it is ordinarily connected, and by springing one switch-lever over an adjoining switch-lever two batteries may be connected to the same set of sparking devices, if desired.

As shown in Fig. 3, the several cams in each igniting-chamber may be staggered upon the cam-shaft, so that the three sparking devices produce their sparks at different times. In such cases the charge will ordinarily be ignited by the spark first produced, and to save battery-power the other igniting devices may be thrown out of circuit, although it is better to keep them in circuit when the engine is under heavy load, and is for this reason likely to stop or to slow down considerably if it misses an explosion. If it is desired to reduce the speed of the engine, that sparking device of each cylinder which produces the first spark in each working stroke may be thrown out of circuit and the second sparking device employed to ignite the charge. Since this second igniting device produces a spark a little later than that which would be produced by the

first device, the explosion takes place somewhat after the piston has begun its stroke, and the explosion is not quite so effective as though it took place close to the beginning of the stroke. In the same way if it is desired to still further reduce the speed both the first and second sparking devices of each engine-cylinder may be thrown out of circuit and the charge ignited by the third sparking device. By this means the speed of the engine may be reduced very considerably, and since the switches 16, 17, and 18 may be located at a distance from the engine they may be placed at any point from which it is desirable to control the engine. This speed-regulating device is particularly applicable for use upon launches, where it is often desirable to regulate the speed of the engine from the bow of the boat. It may also be used on motor-wagons.

Where the utmost certainty in the operation of the igniting apparatus is required and it is less important to be able to regulate the speed of the engine by means of the igniting apparatus, the cams of each igniting-chamber may be formed in one piece, as shown in Fig. 4.

The cams are so shaped and the motion of the pins 7 is so limited that the pins are in contact with the cams for only a small portion of the revolution of the cams. I thereby avoid waste of battery-power.

In place of battery-currents dynamo-currents may be used, if desired; but ordinarily it is more convenient to use batteries.

The operation of my invention is as follows: The engine being in operation and all of the sparking devices being in circuit, the cam-shafts 3 are revolved by the gearing by which they are connected to the main shaft of the engine, their speed, however, in engines of the ordinary type being but half the speed of the engine-shaft. Therefore the sparking devices of each cylinder will produce a spark only on every alternate forward stroke in that cylinder. The sparking-cams of each cylinder are so set upon their shaft that they produce sparks at or very shortly after the beginning of the stroke, or if the sparking-cams be staggered on the shaft, as shown in Fig. 3, the first cam is adjusted so that it produces a spark at or very shortly after the beginning of the stroke, and the other cams are adjusted to produce sparks at later periods. As the cam-shafts 3 revolve, therefore, the contacts between the pins 7 and the cams 6 are broken at intervals, when these pins ride over the ends of the teeth of the cams, thus producing sparks which ignite the explosive charges in the igniting-chambers and engine-cylinders. The intensity of these sparks, and therefore their effectiveness in igniting the charges, is greatly increased, as is well known, by the use of the sparking-coils 15 in the circuits.

Ordinarily the cranks of a multiple-cylinder engine such as that shown in the drawings will not be in line, and therefore the explosions in the different cylinders will not take place simultaneously, but at different times, thus securing a nearly uniform effort upon the engine-shaft.

If it be desired to throw one of the batteries out of circuit, so as to economize battery-power, or if it be desired to reduce the speed of the engine, one of the switch-levers—as, for instance, that of switch 18—may be moved either to the right or to the left until it is out of contact with its contact-post. If it be desired to throw a second battery out of circuit for similar reasons, the lever of the switch 17 may be moved to the right or to the left until it is out of contact with its contact-post. In the same way battery 14 may be thrown out of circuit by operating the switch 16, and this may be done, if desired, while batteries 12 and 13, or either of them, are in circuit. If it be desired to determine whether one of the batteries or one of the sparking devices is not working properly, the switches may be operated so as to supply current to but one of the sparking devices at a time. If when only one of the sparking devices in each cylinder is in circuit no explosions in one of the engine-cylinders take place, then it is evident that its sparking device is not operating properly, and by connecting it with a different battery from that to which it is ordinarily connected it is possible to determine whether the fault is with the sparking device or with the battery. Thus if it be suspected that one of the sparking devices in the circuit controlled by switch 16 is not working properly switches 17 and 18 may be opened, and if when this is done there are no explosions in one of the engine-cylinders or if the explosions are irregular then it is evident that the sparking device of that cylinder is not operating properly. If all of the sparking devices in a single circuit fail to operate when thus tested, the fault will ordinarily be with the battery, and this may be determined by opening the switch 16 and by moving the lever of the switch 17 into contact with the contact-post of the switch 16, thus throwing battery 13 into what is normally the circuit of battery 12, or the lever of switch 17 may be sprung over the lever of switch 16, in which case batteries 12 and 13 will be placed in multiple, or the engine may be set at one of the points where the igniting contact-points are in contact and the circuit of the suspected battery closed through its switch and then broken. If when the circuit is broken by the switch no spark is produced at the switch, it is certain that either the battery or the circuit is defective.

I do not limit myself to the particular type of igniting devices herein shown and described or to the particular type and arrangement of the switches.

The use of a plurality of igniting devices to each engine-cylinder instead of but a single igniting device, as has been the case heretofore, and the placing of these sparking de-

vices in different portions of the igniting-chamber besides rendering the ignition more certain insures a more nearly instantaneous ignition and explosion of the whole charge, thus increasing the efficiency of operation in the engine. If the engine be a single-cylinder engine instead of a multiple-cylinder engine, as illustrated, there will be but one igniting-chamber 2 and but one cam-shaft 3, and the electric circuits and connections will be the same as those shown in Fig. 1 if it be supposed that the connections to the sparking devices of two of the cylinders are omitted. I intend the following claims to cover the invention whether applied to a single or to a multiple cylinder engine.

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

1. An igniting mechanism for the working cylinders of gas and oil engines, comprising a plurality of separate electrical igniting devices having separate circuits, means for supplying current thereto, and means for throwing said igniting devices into and out of action, and for throwing each into action independently of the others, substantially as described.

2. An igniting mechanism for the working cylinders of gas and oil engines, comprising a plurality of separate electrical igniting devices having separate circuits, means for supplying current thereto, and switches in said circuits for throwing each igniting device into and out of action independently of the others, substantially as described.

3. An igniting mechanism for the working cylinders of gas and oil engines, comprising a plurality of separate electrical igniting devices having separate circuits and separate electrical generators, and switches in said circuits adapted to throw each igniting device into and out of circuit with its own generator and also into and out of circuit with the generator of a different igniting device, substantially as described.

4. A speed-regulating mechanism for gas and oil engines, comprising a plurality of separate electrical igniting devices, adapted to ignite the charges at different periods in the stroke, and means for throwing the several igniting devices into and out of action, at will, substantially as described.

5. In an internal-combustion engine, the combination with an engine-cylinder, of a plurality of separate electrical igniting devices for said cylinder, set to ignite the charges at different periods in the stroke, and having separate circuits and separate electrical generators, and switches in said circuits adapted to throw each igniting device into and out of circuit with its own generator, and also into and out of circuit with a generator of a different igniting device, substantially as described.

6. In an electrical igniting mechanism for gas and oil engines, the combination, with a cam-shaft within the engine-cylinder, a series of cams thereon and staggered with reference to each other, and means for rotating said shaft, of a series of movable pins opposite said cams, means for pressing said pins toward and against said cams, and means for limiting the motion of the pins, said pins being insulated from the cams except at the points of contact, substantially as described.

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

FERDINAND E. CANDA.

Witnesses:
MAY F. PETITTE,
HARRY M. MARBLE.