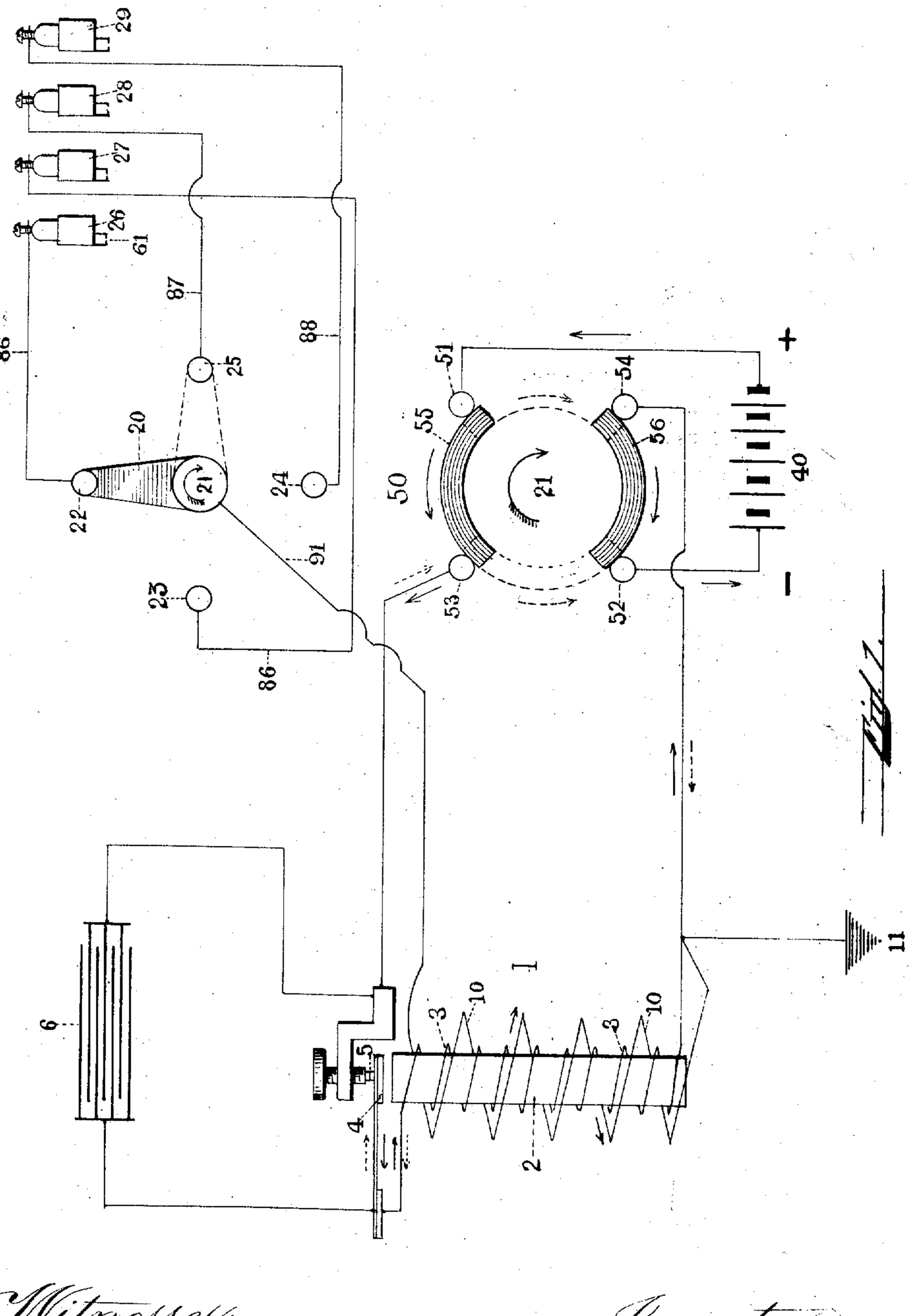
No. 889,305. PATENTED JUNE 2, 1908.

J. O. HEINZE, JR.

REVERSING TIMER AND DISTRIBUTER.

APPLICATION FILED NOV. 30, 1906.

3 SHEETS—SHEET 1.



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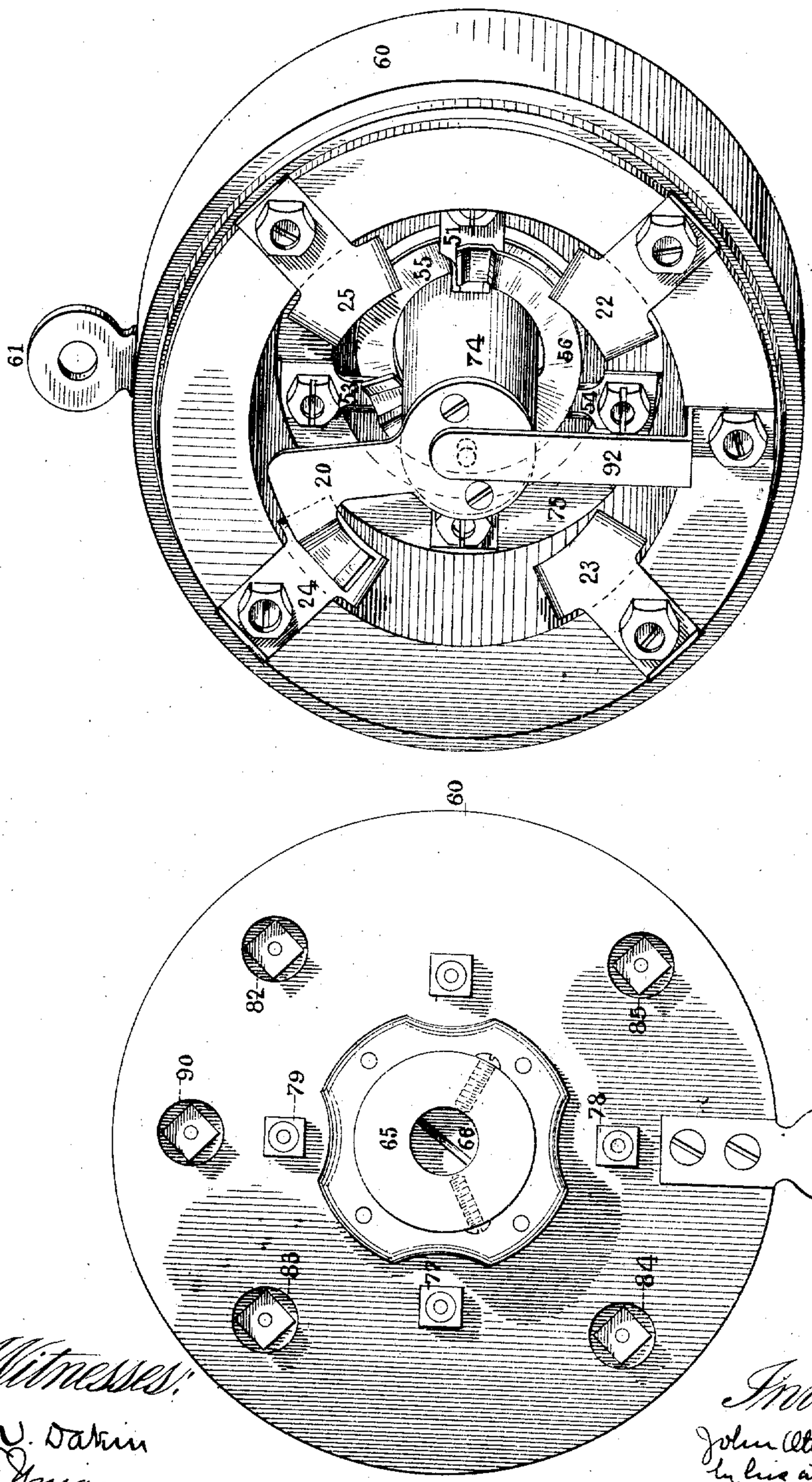

Fig. 2.

Fig. 3.

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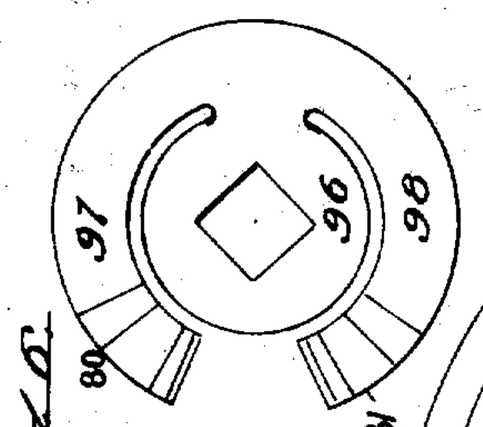

Fig. 6.

Fig. 7.

Fig. 5.

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UNITED STATES PATENT OFFICE.

JOHN OTTO HEINZE, JR., OF LOWELL, MASSACHUSETTS.

REVERSING TIMER AND DISTRIBUTER.

No. 889,305. Specification of Letters Patent. Patented June 2, 1908.

Application filed November 30, 1906. Serial No. 345,661.

To all whom it may concern:

Be it known that I, JOHN OTTO HEINZE, Jr., a citizen of the United States, residing at Lowell, in the county of Middlesex and State of Massachusetts, have invented a certain new and useful Reversing Timer and Distributer, of which the following is a specification, reference being had therein to the accompanying drawing.

My invention relates to apparatus which may be employed for timing the electric ignitions of explosive mixtures in what are known as explosive engines.

One of the principal objects of my invention is to eliminate the so called pitting of the contacts of the vibrating interrupters of induction coils. This pitting has been one of the greatest defects resulting from the use of the vibrating interrupter, for after the coil has been in operation for a number of hours, the pitting becomes so great that the contacts of the vibrator become actually fused together and cease vibrating; they thus do not interrupt the current in the primary wire; and consequently, no currents are induced in the secondary wire for the purpose of causing a spark to jump across the spark gap in the plug and to fire the charge in the cylinder. The pitting is entirely due to the direction of the current flowing between the contacts. If it flows in one direction, particles of metal on one contact are carried away from it and piled up upon the other contact. A hole is therefore formed in one contact and a teat of metal upon the other contact; the teat becoming more and more embedded in the hole, the longer the current continues to flow in one direction. Now if the current is reversed and sent through the vibrator in an opposite direction, the particles of metal move in an opposite direction, and the particles of metal forming the teat, begin to fill up the hole in the other contact.

The vibrators operate most efficiently when the surfaces are flat and smooth, hence one object of my invention, as above described, is to keep these surfaces flat. I accomplish this object by providing means whereby the current flowing through the primary wire of an induction coil and the vibrator, may be caused to flow in one direction after one interruption, and in the opposite direction after the next interruption, and so on. As a result, the sparks at the spark plug do not vary in intensity, heat and frequency, and the fusing of the contacts and the resulting pitting are eliminated. Therefore, resort has been had to a spark coil for each cylinder of the engine; further, resort has also been had to a spark coil combined with a distributing device, whereby the high voltage current through the secondary, may be distributed to each of the cylinders of the engine, thereby simplifying the construction of the apparatus, as by reducing the number of parts, and the consequent cost. But experience has shown that the sparking at the spark plugs was no more efficient in one than in the other of the above forms, because the pitting of the vibrators takes place as fast in one, as in the other.

The value of my invention will now become plain. By providing the primary circuit of the vibrating spark coil, with a reversing current timer, and hence eliminating the objectionable pitting, the simpler construction, viz. that of a single vibrating spark coil, and a device to distribute the high voltage current to several cylinders, becomes available for firing the charges in the several cylinders.

The second object of my invention is therefore to combine in one simple apparatus, a reversing current timer, a single vibrating spark coil and a device for distributing a high potential current successively to spark plugs in one or more cylinders.

Figure 1 is a diagrammatic view showing all of the electrical features of my invention; Fig. 2 shows in perspective the combined reversing timer and distributer; Fig. 3 is a rear view of the same; Fig. 4 is a transverse central section partly in elevation; Fig. 5 is a rear plan; while Figs. 6 and 7 are respectively a plan and an elevation of one of the reversing current segments.

The drawings illustrate the principle of my invention, and the best mode now known to me of making use of that principle, but a consideration of the diagrammatic view shown in Fig. 1, will greatly aid the reader in understanding my invention, as embodied in the actual apparatus, shown in the other figures, and later to be described.

A spark coil 1, Fig. 1, of ordinary construction may be employed. It has a magnetic core 2; a primary winding 3; vibrator contacts 4, 5; a condenser 6; and a secondary winding 10, one end of which is grounded, as at 11, while the other is connected to a distributing arm 20, fast to, but insulated from, a

cam shaft 21 of an explosion engine. A series of distributing terminals 22, 23, 24, 25, is arranged so that the distributing arm 20 may engage the distributing terminals successively; the terminals being connected, as by wires, with the insulated centers of their respective spark plugs 26, 27, 28, 29, the latter of which are assumed to be mounted in the wall of the explosion chamber of a gasolene engine. A source of electrical energy, as a battery 40, supplies an energizing current to the primary. Also operatively connected to the cam shaft 21 of the engine, is a reversing current timer 50. The electrical circuit connecting the battery 40 and the primary winding 3 of the spark coil, is broken at two places, the battery ends of the circuit having what may be called two battery terminals 51, 52; and the primary winding ends having two primary terminals 53, 54. The former terminals alternate with the latter, and any two adjacent terminals are ninety degrees apart. Two reversing current segments 55, 56, are mounted upon the cam shaft 21, and are so formed and disposed in relation to the said terminals, that while one reversing current segment 55 completes the circuit between one battery terminal 51, and one primary terminal 53, the other reversing current segment 56 completes the circuit between the other battery terminal 52, and the other primary terminal 54. The circuit being completed, the battery current flows through the primary winding 3 in one direction, as indicated by arrows in full lines. But as the cam shaft 21 moves in the direction indicated by the centrally disposed arrow, each reversing segment breaks contact with one of its respective primary terminals, and the circuit through the primary is broken. In the meanwhile, the core 2 has been magnetized by the current flowing through the primary winding in the direction indicated by the solid arrows, the hammer 4 has been attracted by the core 2, and moved away from the anvil 5, the primary circuit broken, and a spark formed between the hammer and anvil, *i. e.* between the contacts of the vibrator. This interruption of the current has been repeated in succession, during that period of time, the primary circuit is completed through the reversing segments 55, 56; all being done with the result, that particles of metal have moved from the hammer to the anvil until the primary current was broken by the reversing segments moving out of contact with one of their respective terminals. As the cam shaft 21 continues its movement in the direction indicated by the arrow at the center, each segment remains in contact with its battery terminal until after it contacts the primary terminal opposite to that which it just left, and in this manner, each of the battery terminals become connected to the other terminal of the primary winding. Such being the case, an energizing current flows in the direction indicated by the dotted arrows, from battery 40, through the segment 55, the primary winding 3, segment 56, and back to battery. While the circuit is complete the interruptions, between the hammer and anvil, take place, as before, but the current, flowing in an opposite direction, causes these particles of metal which were piled up upon the anvil to be thrown back upon the hammer, and the surfaces of the contacts to assume their normal conditions. As all the currents flowing through the primary are identical except that for equal periods of time, currents flowing in one direction, alternate with those flowing in an opposite direction, the result follows that particles tending to form a teat while the current flows in one direction, are restored from whence they came by the current flowing in an opposite direction, and the surfaces of the hammer and anvil tend to remain smooth.

The distributing arm 20, and the distributing terminals 22, 23, 24, 25, forming part of the secondary circuit, are arranged so that while currents are flowing through the primary, the distributing arm is in contact with some one of the distributing terminals; and hence high potential currents are induced in the secondary winding, and flow from ground 11, through the said winding 10, distributing arm 20, a distributing terminal, as 22, one of the several spark plugs, as 26, and across spark gap 61 to ground, not shown, but assumed to be the cylinder of the engine. As the vibrator is working always under conditions which, except the direction of the primary current, are the same, the resulting currents induced in the secondary, and hence the sparks at the spark gaps at the spark plugs, are correspondingly similar, particularly as to heat, intensity and frequency.

Having explained the diagrammatic representation of my invention, as applied to the explosion chamber of a gasolene engine, I will now describe the construction of an actual apparatus embodying the combined reversing timer and distributer.

I provide a circular case 60 of fibrous material, which in any suitable manner, may be molded into the desired form about some of the parts hereinafter mentioned. The case may be supported by means of eye-piece 61 fixed in the back of the case. Centrally mounted through the bottom of the case, is a hollow journal 62 which may be operatively connected, as to the cam shaft 21, of a gasolene engine. A long bearing 63 having exterior lateral ribs 64 thereon, is centrally secured to the case by the engagement of the latter with the ribs, brought about by molding the case on to the same. Within the bearing 63 is the shouldered journal 62. The

latter is adapted to receive longitudinally the cam shaft 21, to which the journal may be removably secured, as by screws. To assist in preventing the withdrawal of the shouldered journal, a screw 66 is passed through a hole in the inner end of said journal, and has a lonigtudinal axis, that of the journal. Mounted upon the free end portion of this screw is a block 67 having thereon a rectangular hollow case of insulating material 68 upon which are mounted in turn, a metal ring 69 contacting the end of the long bearing 63; next, a ring of fibrous material 70; next, one of the metal reversing segments 55; next, a piece of insulating material 71; and next, the second metal reversing segment 56. Adjacent to this latter segment is a piece of insulation 72. A metallic distributing arm 20 is made fast to one end of an insulating extension piece 73, adapted to be secured to the shaft 62; the other end of this piece has therein a hole with which said rectangular block 67 is in engagement. This piece has also a nut 74, fixedly molded into the bottom of said hole, and adapted to be engaged by the thread of said screw 66. It will now be plain, that by screwing the threaded portion of the screw 66 into the nut 74, the extension piece is caused to force the rings and segments on the block close together, and bind them securely by compressing the fibrous block and expanding it into locking engagement with said rings and segments.

A shoulder 75, parallel with the bottom of the case and at right angles with the longitudinal axis of the shaft, is molded upon the inside of the case, to sustain the battery terminals 51, 52, and the primary terminals 53, 54, to which are lead, through suitable insulated metallic lugs 76, 77, 78, 79, molded into the case, battery wires and primary wires. The plane of this shoulder 75 is such that when the said terminals are mounted thereon, the arms 80, 81, of one reversing current segment 55 may contact one side of the terminals, and the like arms of the other reversing current segment 56 may contact the other side of said terminals.

Upon what may be termed the top of the case, are mounted the high voltage distributing terminals 22, 23, 24, 25, from which are led through suitable insulated metallic lugs 82, 83, 84, 85, molded into the case, distributing wires 86, 87, 88, 89, to be connected, say with sparking apparatus. These distributing terminals lie in the plane of the movement of the distributing arm 20 for the purpose of being engaged by it, in its rotation with the shaft. There is molded into the case also a fifth insulated metallic lug 90, through which leads a high voltage wire 91 from the secondary of the induction coil, to a stationary connecting arm 92, for connecting the high voltage wire with the distributing arm, by frictional engagement. A cover 93 for the case is provided, and if desired, may have a piece of glass 94 therein, to permit a view of the parts. The cover and the case may be secured together by the use of screw threads 95, as shown in Fig. 4, or the threads may be dispensed with, and reliance placed upon the frictional engagement of the cover and case; the engaging surface of the case being shown in Fig. 2.

The contacting surfaces between distributing arm and at terminals, and between the reversing segments and their terminals, may be of any suitable form. That of the reversing segments shown in the drawings, particularly in Figs. 6 and 7, is simple and efficient. The segment is struck up out of the metal, and may be said to consist of a central portion 96 having a square hole cut therein, and two wing portions 97, 98, integral with the central portion, and having two contact arms 80, 81, ninety degrees apart and depending one from each wing. It will be noticed that one reversing segment is located 180 degrees ahead of the other segment; that the contact arms of one segment engage only one side of the terminals, while the contact arms of the other segment engage the opposite side of said terminals; and that the contact arms of each segment, which are ninety degrees apart, simultaneously engage two terminals or one terminal, thereby completing the primary circuit, in one direction; breaking the said circuit; and then completing the circuit in an opposite direction.

I have now shown how I accomplish the second object of my invention, namely, a reversing timer and distributer, conveniently simple, and efficiently combined in one piece of mechanism.

What I claim is:—

1. An induction coil used in connection with a gas engine, and having a core of magnetic material; a primary winding thereon; a vibrator connected to said primary winding to interrupt an electrical current through said primary winding; a battery; two battery terminals connected to said battery; two primary terminals connected with said primary winding; the battery terminals and the primary terminals, in arrangement, being alternate; two reversing current segments mounted upon a shaft, driven by said engine, whereby each of the battery terminals may be connected to one of the two primary terminals, and then to the other of said primary terminals; all designed for the purpose of causing the regular automatic reverse of the several connections and the direction of the current through the primary winding to prevent the formation of a teat and a pit in the contacts of the vibrator, through which the primary current passes.

2. An induction coil used in connection with a gas engine, and having a core of magnetic material; a primary winding thereon; a

vibrator connected to said primary winding to interrupt an electrical current through said primary winding; a battery; two battery terminals connected to said battery; two primary terminals connected with said primary winding; the battery terminals, and the primary terminals, in arrangement being alternate; two reversing current segments mounted upon a shaft, driven by said engine, whereby each of the battery terminals may be connected to one of the two primary terminals, and then to the other of said primary terminals; a secondary winding wound about said core and said primary winding; all designed for the purpose of inducing in the secondary winding high voltage currents having the same frequency and intensity therein.

3. An induction coil used in connection with a gas engine, and having a core of magnetic material; a primary winding thereon; a vibrator connected to said primary winding to interrupt an electrical current through said primary winding; a battery; two battery terminals connected to said battery; two primary terminals connected with said primary winding; the battery terminals, and the primary terminals, in arrangement, being alternate; two reversing current segments mounted upon a shaft, driven by said engine, whereby each of the battery terminals may be connected to one of the two primary terminals, and then to the other of said primary terminals; a secondary winding, wound about said core and said primary winding, and grounded; a sparking device which is grounded; and means whereby the secondary winding may be connected to the insulated metallic portion of the sparking device, whereby there may be formed at the spark gap of said sparking device, sparks having substantially the same heat, intensity and frequency.

4. An induction coil used in connection with a gas engine, and having a core of magnetic material; a primary winding thereon; a vibrator connected to said primary winding to interrupt an electrical current through said primary winding; a battery; two battery terminals connected to said battery; two primary terminals connected with said primary winding; in arrangement the battery terminals, alternating with the primary terminals; two reversing current segments mounted upon a shaft, driven by said engine, whereby each of the battery terminals may be connected to one of the two primary terminals and then with the other of said primary terminals; a secondary winding wound about said core and said primary winding, and grounded; a series of grounded sparking devices; a series of distributing terminals each of which is electrically connected with the insulated metallic portion of its respective sparking device; a distributing arm electrically connected to said secondary winding; means whereby said distributing arm is operatively connected to said shaft operating the reversing current segments; said distributing terminals being arranged in their relation to the distributing arm, so that the distributing arm successively engages the distributing terminals when the battery current is flowing through the primary winding.

5. A shaft of a gas engine, mounted in a casing; reversing segments mounted on said shaft and insulated therefrom; a distributing arm mounted upon said shaft and insulated therefrom; battery terminals and primary terminals, alternately arranged within said case, and insulated therefrom, and adapted to be engaged by said reversing current segments; distributing terminals mounted in said case, insulated therefrom, and designed to be successively engaged by said distributing arm; a high voltage terminal mounted in said case and insulated therefrom; and a connecting arm, whereby electrical connection may be made between said high voltage terminal and said distributing arm; said distributing segments, the battery terminals, and the primary terminals, all being so arranged that an electrical current may flow through the primary terminals in one direction, and then in an opposite direction, while the distributing arm is in contact with any one of the distributing terminals.

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

JOHN OTTO HEINZE, JR.

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