Nov. 2, 1926. 1,605,724

H. C. HEATON

IGNITION SYSTEM DISTRIBUTOR AND INDICATOR

Filed March 21, 1921 2 Sheets-Sheet 1

Fig. 2.

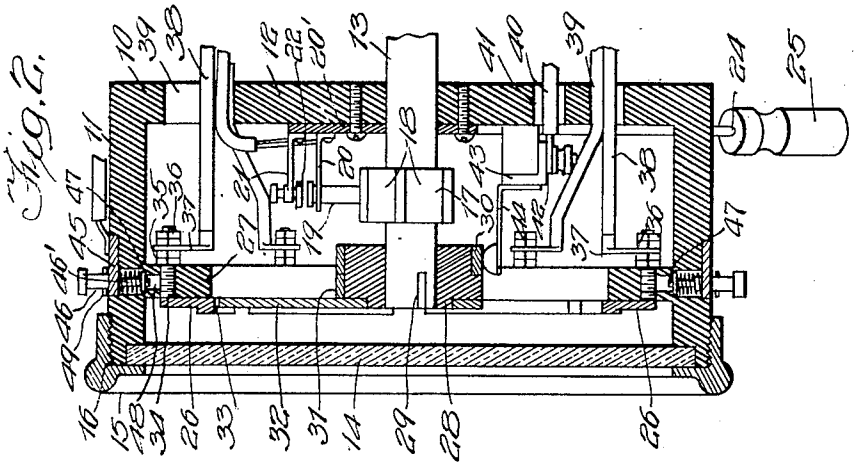
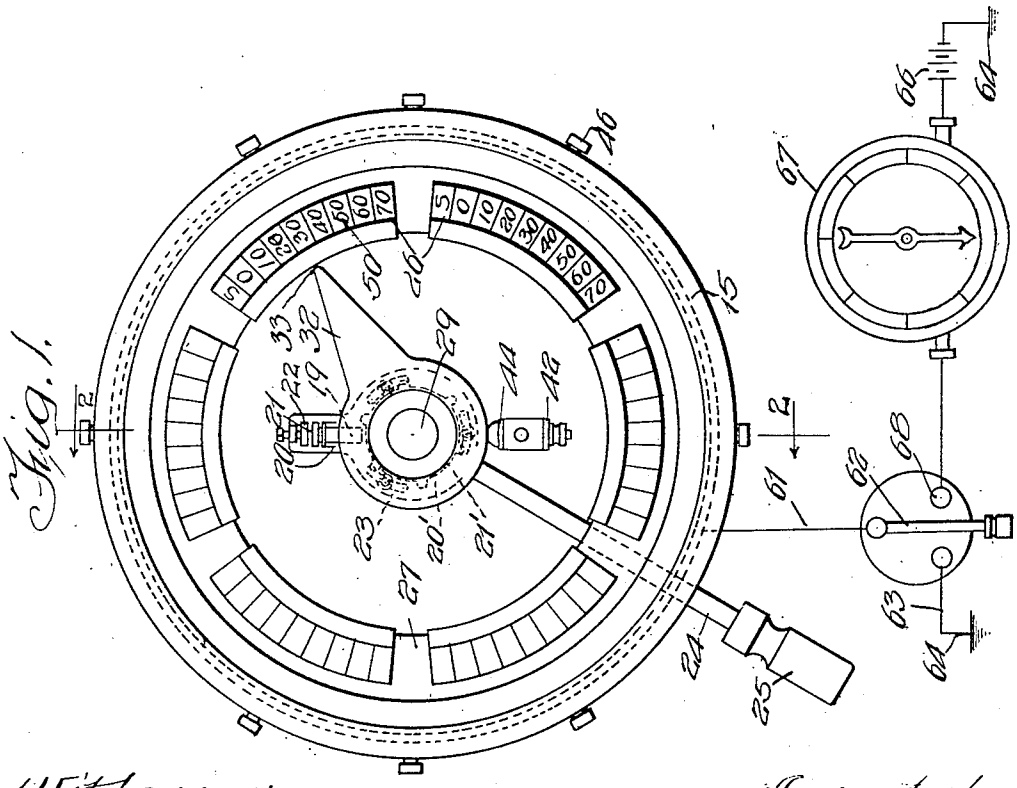


Fig. 1.



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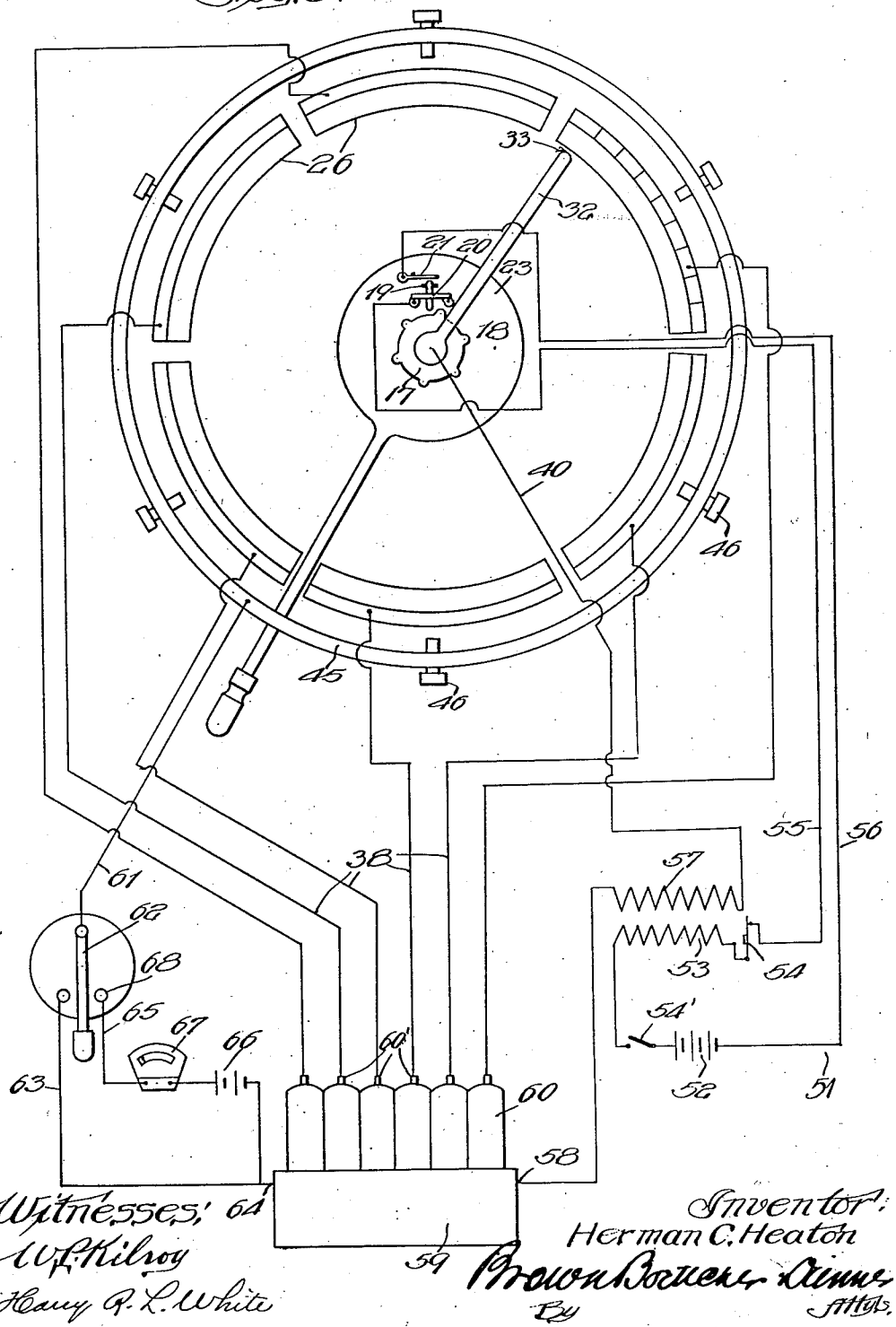
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Fig. 3.



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UNITED STATES PATENT OFFICE.

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IGNITION-SYSTEM DISTRIBUTOR AND INDICATOR.

Application filed March 21, 1921. Serial No. 454,223.

This invention relates to ignition systems of the jump-spark character for internal combustion engines and the like.

The primary aim of this invention is to provide an improved device for distributing current to the several spark plugs of the cylinders of a multi-cylinder internal combustion engine, and for indicating simultaneously to the operator the general operating characteristics of the engine with regard to ignition, combustion, and the like, and to enable him to quickly and conveniently locate faults indicated, either in the system itself or in the individual cylinders of the engine, and to, therefore, enable him to take steps to remedy the same. The device furthermore indicates visually to the operator the timing of the spark, and whether this is the proper timing for the spark at the speed at which the engine or vehicle is running.

Another aim of the invention is to provide a device of the character referred to which may be installed in connection with any jump spark ignition system conveniently and without material modification of structure or circuit connections.

A further aim is to arrange in conjunction with the device means for testing the condition of each of the branches of the ignition circuit which leads to a spark plug, thus indicating the condition of the insulation of the particular circuit tested. This testing feature of the device is important, as it provides a complete system in which troubles are first indicated, then located, and thus placed available for remedy. Of course, the distributor possesses all the usual requisites and characteristics of such a device, means being provided for advancing and retarding the spark as desired, in accordance with the speed. It is quite possible that suitable governing means might be associated with the device for regulating accurately the timing in accordance with engine speeds.

Briefly stated, the invention comprises, in combination with the primary and secondary circuits and induction coil, a distributor having a plurality of electrodes, in number corresponding to the number of cylinders of the engine. A distributor arm connected into the secondary circuit rotates in proximity to these electrodes and serves to deliver current thereto in the nature of a spark, these sparks occurring between the arm and electrodes successively as said arm passes the same, in full view of the operator.

The distributor arm is driven from the engine shaft and in the case of the standard four cycle automobile engine is driven at half the engine speed. In a two-cycle engine, the arm rotates at the same speed as the engine. An interrupter is, in accordance with the usual practice, interposed in the primary circuit, and its timing relative to the revolutions of the engine and said distributor arm is variable, so that the timing of the interrupter depends upon the time of occurrence of a spark between the distributing arm and each of said electrodes. The electrodes are calibrated to indicate the point at which the discharge should take place at a given speed up to the maximum which that particular engine is capable of. Thus, the operator is enabled to determine accurately at all times whether the timing of the spark is correct by watching the distributor and noting the point at which the spark occurs and the speed at which the vehicle is moving at that time.

Various modifications of the invention may be made in adapting the essence thereof to various types of ignition systems, and therefore, while I shall describe in detail a preferred embodiment of the invention, I do not intend to adhere to the details thereof except in so far as the scope of the claims demand.

A more concrete understanding of my invention may be obtained from the following detailed description and the claims, taken in connection with the accompanying drawings, in which:

Figure 1 is a front elevation of the device of my invention, a portion thereof being diagrammatic;

Figure 2 is a section taken on the line 2—2 of Figure 1; and

Figure 3 is a semi-diagrammatic view of the device connected in circuit for normal operation.

Referring more particularly to the drawings, reference being had first to Figures 1 and 2, the device of my invention preferably comprises a casing 10 having a circular wall 11 and a rear wall 12, the latter serving as a bearing for the timer shaft 13 which is suitably geared to the engine shaft (not shown).

The front of the casing 10 is provided

with a transparent cover 14 secured by a flanged member 15 having threaded engagement at 16 with the wall 11.

The timer consists of a cam member 17 mounted on the shaft 13 and provided with a plurality of high points 18, these high points being arranged so that in rotation of the cam they come into contact with the detent 19 which is vertically movable in a bracket 20, which forms one terminal of the primary circuit of the ignition system as will be explained later; the other terminal being formed by a spring member 21, having an adjustable contact point 22. The interrupting switch or timer formed by the members 20 and 21 is carried on a disk 23, of insulating material, which is rotatable about the shaft 13 and has a handle 24 extending therefrom provided with a grip 25 whereby the relation of the switch to the cam member may be changed as desired. The disk is secured to rear walls 12 by screws 20′ passing through arcuate slots 21′ in the disk.

The particular form of the interrupter may be varied since its construction is not of the essence of the invention.

The distributing mechanism proper consists of a plurality of segmental plates 26, corresponding in number to the number of cylinders of the engine and arranged to complete a circle, these plates being carried on a ring 27 of insulating material, this ring being carried by the wall 11 of the casing 10 or made integrally therewith. A hub 28 of insulating material is carried by the forward free end of the shaft 13 and is keyed thereto as at 29. The hub 28 carries a slip or collector ring 30 provided with a lip 31 which contacts with an electrode 32 in the form of a pointer, the free end of the electrode or pointer 32 being in relatively close proximity to the inner marginal edges of the segmental plates 26 to form a spark gap 33 when passing each plate.

The plates are secured to the ring by screws, as best shown in Figure 2, all the plate securing screws being identical. This fastening consists of a threaded stud 34 connected to the plate and extending through a suitable opening in the insulating ring 27. The stud 34 carries locking nuts 35 and retaining nuts 36, the nuts 35 and 36 engaging the terminal member 37 of the conductor 38, said conductor passing through a suitable opening 39 in the rear wall of the casing. A separate opening may be provided for each conductor, or these openings 39 may be elongated to accommodate more than one conductor. The conductor 38 is the high tension cable to one of the spark plugs. The cable 40 entering through the opening 41 leads from the high tension side of the induction coil. The terminal member 42 of the cable 40 engages with a bracket 43 carried by the rear wall 12, said bracket supporting a spring brush 44 which is adapted to contact with the collector ring 30. The spark gap 33 is thus placed in series with the spark gap of the igniting devices.

A grounding ring 45 extends about the exterior surface of the wall 11 and has mounted therein a plurality of plungers 46, said plungers being radially movable and maintained normally outward by helical springs 46′. The inner ends 47 of the plungers are adapted to move in suitable openings 48 permitting the plunger end to contact with one of the retaining screws 34 referred to hereinbefore. The plunger is retained depressed against the tension of the springs 46′ by a transverse pin 49 on the plunger, the ends of the pin passing through suitable slots in the ring (not shown). A turn of the plunger when depressed will cause the pin to engage beneath the ring and thus retain the plunger depressed. As will be clearly seen from Figures 1 and 2, there is a plunger for each segmental plate.

Each of the segmental plates is calibrated from the left to the right, as indicated at 50, in terms of miles per hour. The operation and function of these calibrations will appear presently.

With reference to the diagrammatic arrangement disclosed in Figure 3, the segmental plates, electrodes 32, and other parts disclosed in Figures 1 and 2 carry the same numerals in this figure.

The primary circuit is designated 51 and has a battery 52 or other source of electrical energy arranged therein. A primary winding 53 is connected into the circuit 51 and is supplied from the battery 52, the conventional form of vibrator 54 being associated with said primary winding. A manual switch 54′ controls the primary circuit. The circuit 51 is composed of the conductors 55 and 56 which connect to the contact members 20 and 21, respectively. Thus, the primary circuit is interrupted in accordance with the timing which may be required for the particular speed that the engine may be running.

The secondary winding of the induction coil is indicated at 57, one side thereof being connected to the pointer 32, through the brush 44 and the conductor 40, hereinbefore referred to. The other side of the secondary winding 57 is grounded at 58 to the engine crank case 59, or to the chassis of the vehicle. The engine shown is of the six-cylinder type, the cylinders being indicated at 60.

The conductors 38, as hereinbefore explained, serve to connect the various segmental plates 26 to their respective spark plugs 60′.

The ring 45 is connected to ground by the conductor 61 having a switch 62 interposed therein. The conductor 61 is continued at

63 and is connected at 64 to the crank case 59. A second conductor 65 having a battery 66 and voltmeter 67 in series therein extends from the contact 68 of the switch 62 to the crank case. The purpose and function of the voltmeter, battery 66 and switch 62 will be explained presently.

The normal operation of the device is as follows:

Assuming that the vehicle is being driven at the rate of 30 miles per hour and that arm 32 is rapidly revolving to distribute the ignition current to each cylinder in succession, the point at which the spark should appear to the observer should be at the 30-mile mark on each segmental plate. Assume, for example, that the spark does not occur at the 30-mile mark or calibration, but occurs at the 40-mile calibration. This means that the spark is advanced behind the point at which the same should take place for proper efficiency at that speed. The spark must be retarded. To accomplish this, the lever 24 is swung to the left which carries the interrupter away from the high points of the cam 17 and corrects the error. The operation is similar when it is desired to advance the spark, such a case occurring where the correct point would be the 30-mile mark and the device would be sparking at the 20-mile calibration.

A missing cylinder or a spark plug which is inefficiently working may be readily detected by the failure of the corresponding segment on the distributor to show a spark or by the degree of spark observed at that point. There should be even sparking throughout and when this is not the case, the operator is able to observe where the trouble lies and can take steps immediately to remedy the same.

When it is desired to diagnose the operating conditions prevailing in each cylinder individually, all but one of the spark plugs are shunted out by depressing the grounding plungers 46, one being left open for the cylinder to be tested. Then, the tests may proceed on each conductor and plug in succession in a clockwise direction by releasing the plunger of each plug to be tested, thus enabling the operator to discover and identify the inefficient functioning of any particular cylinder of the engine. It will be kept in mind that the switch 62 is connected with the conductor 63 during such tests.

When it is desired to test the insulating condition of high tension cables to plugs and the plugs themselves, the switch 62 is moved to contact the terminal 68 thus connecting the conductors 61 and 65 and causing current to flow from the battery 66 through the voltmeter 67, switch 61, to grounding ring 45. Assuming that the test is made on the cylinder at the extreme right end of the engine (Figure 3), the segment corresponding to the plug of this cylinder will be grounded to the ring 45 and the voltage of the battery 66 impressed upon the plug of that particular cylinder. If the insulation of the high tension cables or the plug is defective, the voltmeter will indicate to the operator that such a condition prevails somewhere on the particular branch, and therefore steps can immediately be taken to remedy the same.

When used in this way, the voltmeter does not function primarily as an instrument for measuring potential, but as an indirect indicator of the insulation resistance of that part of the high tension circuit with which it is connected. It will be apparent, that the voltage of the battery will be distributed between the voltmeter terminals, and the insulation of the high tension wiring, in substantially inverse proportion to their effective resistances. As the resistance of an ordinary voltmeter is of the order of magnitude of ten or twenty thousand ohms, with the insulation in substantially perfect condition, a negligible deflection of the needle will occur, when the voltmeter is connected between the battery and the high tension wiring. If, however, any part of the insulation is so weak that it would be apt to rupture when the spark voltage is impressed on the high tension wiring, a material fraction of the battery voltage would be registered by the voltmeter, and a ground would give the full battery voltage as the voltmeter reading.

Without further elaboration, the foregoing will so fully explain the gist of my invention, that others may, by applying current knowledge, readily adapt the same for use under various conditions of service, without eliminating certain features which may properly be said to constitute the essential items of novelty involved, which items are intended to be defined and secured to me by the following claims:

I claim:—

1. The combination with a multi-cylinder internal combustion engine, having an ignition system including primary and secondary circuits, ignition devices in the latter circuits for each cylinder, and an interrupter in the primary circuit, of means for distributing current to the various ignition devices in the secondary circuit and exposed to view to give an indication of the timing of the interrupter, and means for varying the position of said interrupter relative to said distributor.

2. The combination with a multi-cylinder internal combustion engine having an ignition system including primary and secondary circuits, ignition devices in the latter circuit for each cylinder, and an interrupter in the primary circuit, of means for distributing

current to the various ignition devices in the secondary circuit, comprising a timer shaft driven by the engine, an arm extending radially from the shaft, a plurality of insulated segmental plates, defining a circular path about the free end of the arm, and corresponding in number to the number of cylinders of the engine, said plates being connected individually to the ignition devices, and calibrated in terms of engine speeds, said arm being connected to one side of the source of secondary current and passing during rotation in close proximity to said plates, and means for shifting said interrupter for changing the period of current flow between said arm and segments in accordance with engine speeds.

3. In combination, a multi-cylinder internal combustion engine, an ignition system therefor comprising primary and secondary circuits, an interrupter in the primary circuit, means for changing the timing of said interrupter, a plurality of ignition devices, one for each cylinder arranged in said secondary circuit, a distributor in the secondary circuit comprising a rotating electrode, a plurality of stationary electrodes equal in number to the number of engine cylinders and connected to said ignition devices, said stationary electrodes defining a circle about the path of movement of said rotating electrode, and calibrations on said stationary electrodes in terms of engine speeds, for indicating on said stationary electrodes the point at which ignition occurs in each cycle of engine operation.

4. The combination with an internal combustion engine having a high tension ignition system including a primary circuit having a timing interrupter therein, and a secondary circuit having ignition devices therein, of means in the secondary circuit for distributing current to the ignition devices, and means associated therewith and calibrated in engine speeds for indicating the timing of the current passing through said distributor.

5. The combination with an internal combustion engine having a high tension ignition system including a primary circuit having a timing interrupter therein, and a secondary circuit having ignition devices therein, of means in the secondary circuit for distributing current to the ignition devices, a casing for said distributing means, and means associated with said distributing means and exposed to view externally of said casing for indicating the timing of the current passing through said distributor.

6. In combination, primary and secondary circuits, a distributor arm in the secondary circuit, a stationary segment receiving the spark from said arm, and means for varying the timing of the spark impulse through said distributor arm, said segment being calibrated to indicate the correct sparking point for various speeds.

7. In combination, a primary circuit, a secondary circuit leading from ground and comprising in the order named, a secondary winding, a distributor arm connected therethrough, stationary segments receiving the spark from said arm, and individual connections from the segments to the spark plugs, a common ground ring encircling said segments, individual means for grounding said segments to said ring, a battery and volt meter in series, and means for connecting said ring to ground either direct or through said volt meter and battery.

8. In combination, primary and secondary circuits, a distributor arm in the secondary circuit, a stationary segment receiving the spark from said arm, a battery and volt meter connected in series, and means for grounding said segment either direct or through said battery and volt meter.

9. In combination, primary and secondary circuits, a distributor arm in the secondary circuit, stationary segments receiving the spark from said arm, a battery and volt meter connected in series, and selective means for grounding said individual segments either direct or through said battery and volt meter.

In witness whereof I hereunto subscribe my name this 10th day of March, 1921.

HERMAN C. HEATON.