May 2, 1933. H. C. HEATON 1,907,069

INDICATOR MEANS FOR IGNITION SYSTEMS AND THE LIKE

Filed May 25, 1929 4 Sheets-Sheet 1

Fig. 1.

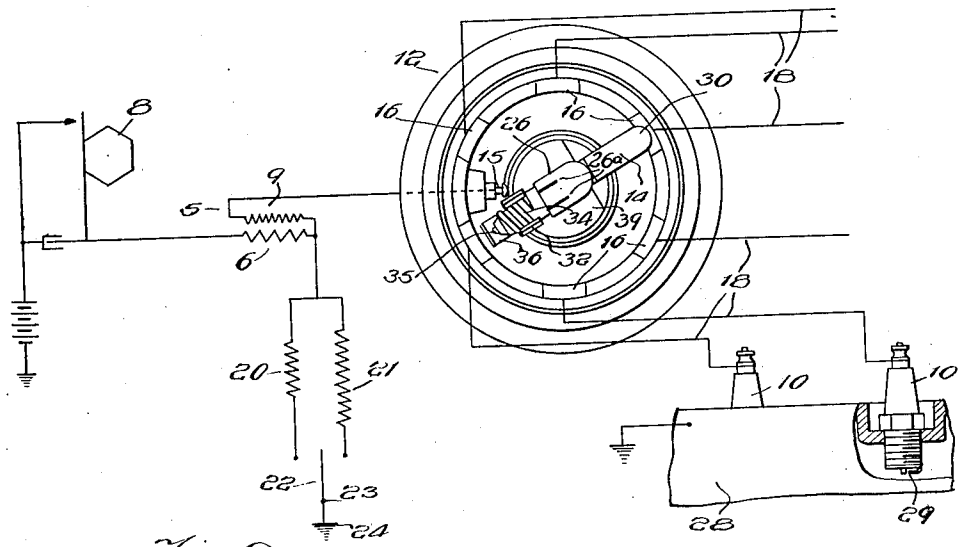


Fig. 2.

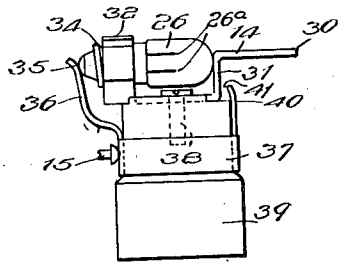
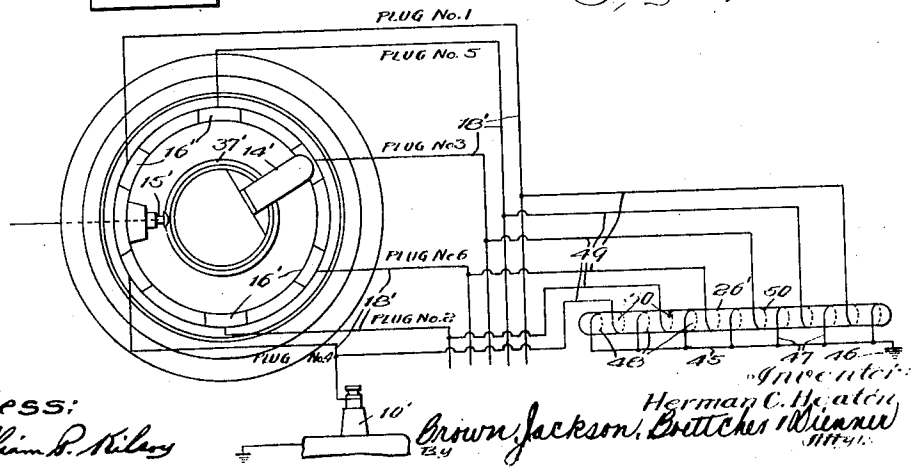


Fig. 3.



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Fig. 4.

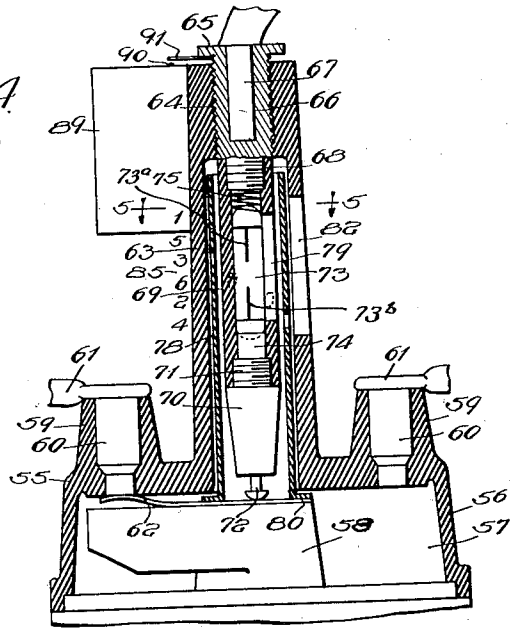


Fig. 5.

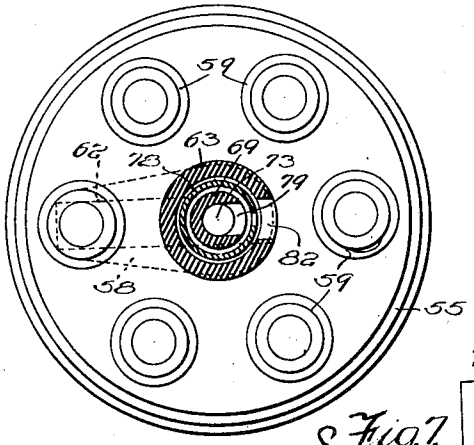


Fig. 6.

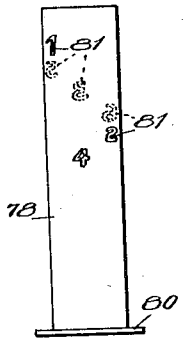


Fig. 8.

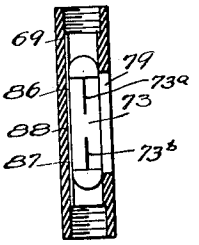
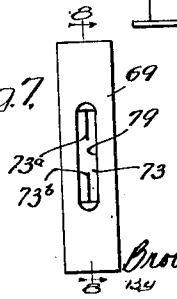


Fig. 7.



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INDICATOR MEANS FOR IGNITION SYSTEMS AND THE LIKE

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Fig. 9.

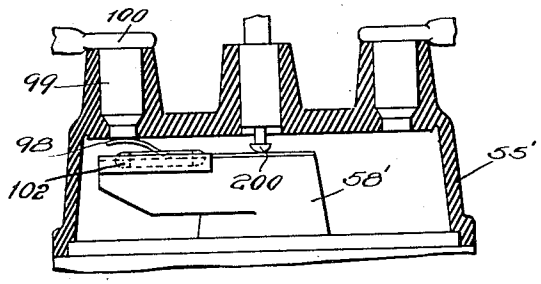


Fig. 10.

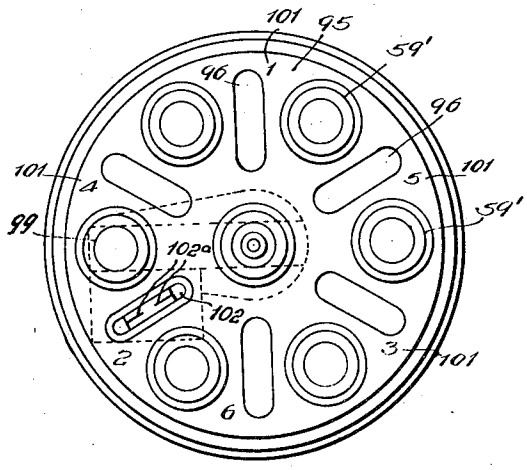
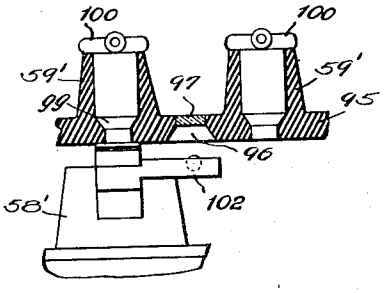


Fig. 11.



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INDICATOR MEANS FOR IGNITION SYSTEMS AND THE LIKE

Filed May 25, 1929 4 Sheets-Sheet 4

Fig. 12.

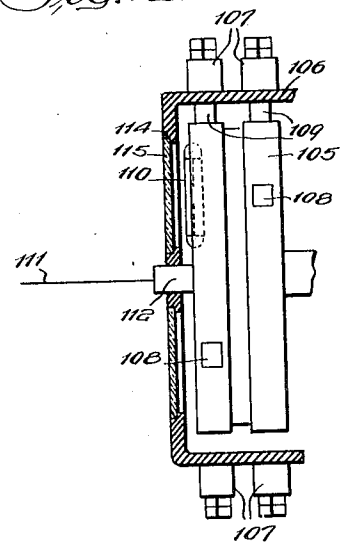


Fig. 13.

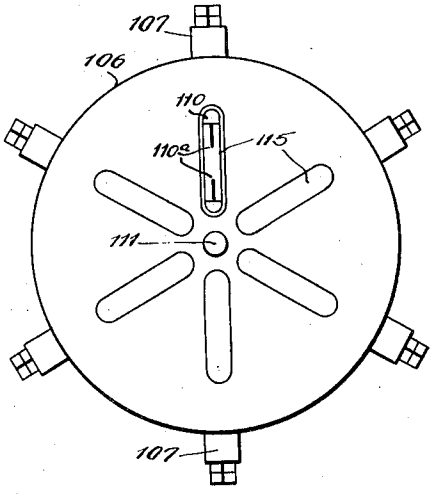


Fig. 14.

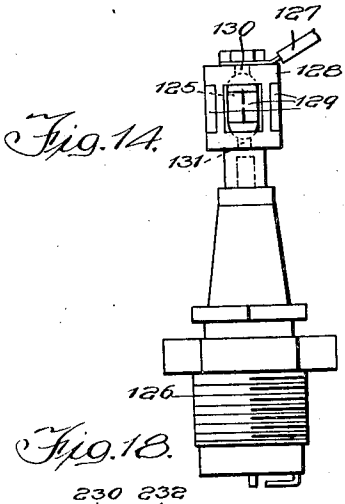


Fig. 15.

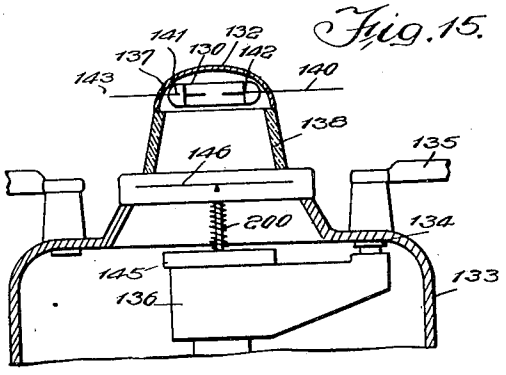


Fig. 17.

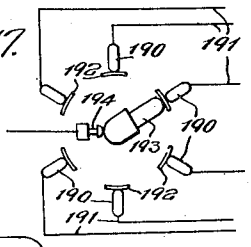


Fig. 18.

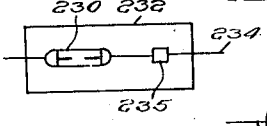
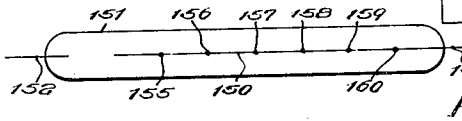


Fig. 16.



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Patented May 2, 1933

1,907,069

UNITED STATES PATENT OFFICE

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INDICATOR MEANS FOR IGNITION SYSTEMS AND THE LIKE

Application filed May 25, 1929. Serial No. 365,935.

This invention relates to indicator means for ignition systems and the like and more particularly to indicator means for indicating the condition of the ignition systems of internal combustion engines.

While the invention is particularly adapted for indicating the condition of the ignition systems for internal combustion engines, the invention is applicable broadly for determining the condition of any electric path or any condition reflected by a change in condition in an electric path or for measuring the resistance of an electric path and the appended claims are, therefore, intended to be interpreted accordingly.

In my prior Patent, No. 1,605,724, granted November 2, 1926, I have provided an ignition system distributor and indicator in which the desired indication is conveyed by a jump spark action.

In my copending applications, Serial No. 333,805, filed January 21, 1929, and Serial No. 365,934, filed May 25, 1929, I have provided a spark plug testing and condition ascertaining method and means and a high potential insulation or leakage testing method and means.

I have conceived the use of a "Neon", or other gaseous tube, for use in making the desired test or measurement, or for indicating the desired condition. It is well understood that the particular gases in tubes of this sort vary widely and by the term "gaseous tube", as used herein, I intend to include any equivalent gaseous tube, regardless of the particular gas employed. For example, "Neon" is now commonly used where a red light is desired, argon and mercury vapor, or the like, for a green light, and argon and some other chemical in "Neon" gas, for a blue light. I find that a gaseous tube of this sort is extremely sensitive and requires but a very slight actuating current. I also find that the slightest differences in current or irregularity of current passed through such a tube will show up at once in the tube and that there is a point where the tube lights or ceases to light. The lagging factor is negligible and these characteristics are all admirably adapted for the purposes of the present invention. There is no afterglow, as compared with that in an incandescent filament lamp, and this is further important in providing a sharp demarcation between indications where the same tube is used for successively conveying different indications as successively the indications of the condition of the different spark plugs of a multi-plug engine, or successively the condition of the circuit connections to the different plugs.

The primary object of the present invention is to obtain an improved indication and more particularly an indication which is extremely sensitive and in which the slightest differences in current will show up at once. Another object is the provision of an indication requiring a very slight actuating current and with which there is a relatively distinct point where the indication is effected, also an indication in which the lagging factor or afterglow is negligible. Another object is the provision of generally improved, simplified, and relatively inexpensive means for adapting the indicator for the purposes intended and particularly a visible indicator system that can be readily installed. Another object is the provision of an indicator system having a low initial installation and maintenance cost, as well as an indicator system having an attractive appearance and which will not interfere with the normal functioning of the motor, but, in fact, promotes maintenance of the motor in a high state of efficiency.

Other objects and advantages of the invention will appear from the following detailed description, taken in connection with the accompanying drawings, in which:

Figure 1 is a schematic circuit diagram, showing an embodiment of the invention;

Figure 2 is a side elevational view of the distributing arm and rotatable post of Figure 1;

Figure 3 is a fragmentary schematic circuit diagram, showing another embodiment of the invention;

Figure 4 is a vertical sectional view, showing another embodiment and taken axially through the distributor cover;

Figure 5 is a horizontal section, taken on the line 5—5 of Figure 4;

Figure 6 is a side elevational view of the sight sleeve of Figure 4;

Figure 7 is a side elevational view of the internal gaseous tube supporting sleeve of Figure 4;

Figure 8 is a vertical section through the internal gaseous tube supporting sleeve, taken on the line 8—8 of Figure 7;

Figure 9 is a view similar to Figure 4, showing another embodiment of the invention;

Figure 10 is a top plan view of the distributor cap shown in Figure 9;

Figure 11 is a fragmentary detail view, partially in section and showing the manner of angularly or positionally directing the light indication in the embodiment of Figures 9 and 10;

Figure 12 is a more or less diagrammatic and fragmentary view, partially in section, showing another embodiment of the invention;

Figure 13 is a front elevational view of the device shown in Figure 12;

Figure 14 is a side elevational view of a spark plug with another embodiment of the invention applied thereto;

Figure 15 is a more or less diagrammatic and illustrative section, similar to Figures 4 and 9 and showing another embodiment of the invention;

Figure 16 is a view of a gaseous tube showing in elevation, and more or less diagrammatically, another embodiment of the invention; and

Figures 17 and 18 are more or less diagrammatic views of two further embodiments of the invention.

Referring, first, to the diagram of Figure 1, the particular circuit therein illustrated includes a spark coil 5, having a primary winding 6, which is intermittently connected to a source of low potential current by means of an interrupter 8 and a secondary winding 9, which forms a source of high potential ignition current for the spark plugs 10.

The ignition current is distributed to the spark plugs 10 by means of a distributor 12. The distributor 12 shown has a distributing arm 14, which is maintained in permanent connection with the secondary winding of the coil 5 by means of a slip ring connection 15 and distributes the ignition current by rotation past and into successive cooperation with the contacts 16, to which the spark plugs 10 are individually connected by means of leads 18.

The end of the distributing arm 14 preferably contacts directly with the contacts 16 successively in its rotation, but it is to be understood that the successive cooperation of the arm 14 with the contacts 16 may be through relatively small gaps to avoid unsatisfactory contact through carbonization or otherwise, after use. The distributor 12, as well as the interrupter 8 may be operated from the timing gears of the engine in the usual or any preferred manner, as well understood in the art.

The circuit, as thus far described, is merely illustrative for the purpose of acquainting those skilled in the art with one embodiment of the present invention. This circuit may constitute any suitable or preferred ignition system and may vary, as desired. The impedances 20 and 21 correspond to the impedances 20 and 21 of Figure 1 of my copending application, Serial No. 365,934, filed May 25, 1929, and are provided for plug and circuit testing purposes, in accordance with the disclosure of that application. A suitable switch arm 22, pivoted at 23, is adapted for selectively completing either of the parallel or shunt impedances 20 or 21 to a ground connection 24.

For the purposes of the present application, suffice it to say that the impedance 20 may be of relatively low ohmic resistance, say of the order of 125,000 ohms, or of such a value that, when applied in shunt or parallel to the ignition system by means of the switch 23, the current flow to a normally or satisfactory operating plug will be shunted wholly or partially through the impedance to ground 24. This entire or partial shunting of the current through the impedance 20, as the distributor arm 14 moves successively into cooperation with the plug contacts 16, will either extinguish or reduce the illumination of the gaseous tube indicator 26 and the extinguishment or reduction in illumination of the indicator 26 will indicate that the plug 10, which is connected through the indicator 26, when the extinguishment or reduction in illumination occurs, is operating satisfactorily, or at least will indicate the condtion of the plug.

For example, if sufficient carbonization has occurred at the contacts of the particular plug 10 to lower the impedance at the jump gap of the plug below the desired standard, the tube 26 will be illuminated relatively brightly when the impedance 20 is applied. This relatively bright illumination of the tube 26 will indicate that the particular plug 10 connected therewith is defective, or at least not in normal operating condition.

The other impedance 21 may be in the form of a suitable resistance or other potential limiting device. It might even be a potential limiting gap, but in the illustrated embodiment is shown in the form of a resistance, say, for example, a 250,000 ohm resistance, or a resistance or other limiting

device of a value higher than that of the particular normal jump gaps 29 at the plugs 10, when said gaps 29 are in normal operating condition.

The plug gaps 29 may be adjusted as more fully disclosed in my copending application, Serial No. 365,934, filed May 25, 1929, to increase the resistance of these gaps beyond the value of the impedence 21, which impedance 21 thereupon forms a limiting device for preventing breaking down of the entire system. At the same time, when the gap 29 at any particular plug 10 is increased beyond the value of the impedance 21, the current flow will be shunted entirely by the impedance 21 and with the insulation of the ignition system and particularly the leads 18 in proper or suitable condition, the bulb 26 will be substantially extinguished.

If there are objectionable stray or leakage paths, for example, in the insulation of the leads 18, the current will continue to flow through the tube 26, when the gap 29 is thus increased, and the continued illumination of the bulb 26 will indicate that the insulation to the particular plug 10 is not satisfactory. At the same time, due to the sensitive character of the "Neon" or other gaseous tube 26 and the ability of said tube 26 to show or reflect the slightest differences in current passed therethrough, the particular resistance or amount of leakage in any plug circuit may be ascertained by inspection of the action of the tube 26. If, for example, with the plug gap 29 increased beyond the impedance 21, the bulb 26 burns at relatively great brilliancy when the circuit to that plug is completed, this will indicate that the leakage in that circuit is of relatvely great magnitude, whereas, if the tube 26 continues to burn, but at lower brilliancy, this will indicate that there is a leakage path of less magnitude.

In Figures 1 and 2, the distributing arm 14 is shown as comprising a thin, metallic strip, having the contact making end 30 offset downwardly at 31 and provided, at its opposite end, with integral clip forming tongues 32, which are turned up and suitably formed to yieldingly receive, as well as hold and contact with, the plug 34 of the "Neon" or other gaseous tube 26. The tube 26 is, in this case, preferably a low resistance "Neon" or other gaseous tube and the threaded contact shell 34 of the tube is connected with the arm 30 by its contact with the sides of the clip portion 32 and the other side of the tube 26 is connected with the contact 35, which, in turn, contacts with the contact 36 of the slip ring 37, which cooperates or contacts with the slip ring brush 15 (Figure 1).

The tube 26 preferably has a pair of electrodes 26^a, one connected with the contact shell 34 and the other connected with the contact 35. The gaseous content of the tube forms the connecting path between the electrodes internally of the tube.

In the embodiment of Figures 1 and 2, the arm 14 is secured by means of a screw 38 to the post 39, which constitutes the usual or any preferred distributor post well known in the art and the slip ring 37 embraces this post and is suitably secured thereon. It is to be understood that, in this form of the invention, the gaseous tube 26 rotates with the distributor arm 14 and is thereby applied successively to the plug leads 18 in the particular order of timing of the engine. As already pointed out, with the impedance paths 20 and 21 eliminated, the gaseous tube itself will give a valuable indication of the actual functioning of the ignition system.

The slip ring 37 is preferably provided with a contact finger 40 turned up with a gap at 41, across which the current is adapted to jump to complete the circuit to the plug across this gap 41 in the event the tube 26 is burned out or fails. This prevents the possibility of failure of the current supply to the plugs 10, in case the gaseous tube 26 burns out, or otherwise fails.

In the embodiment of Figure 3, the engine plugs 10′ are connected through leads 18′, with the contacts 16′ and the contact arm 14′ rotates successively into contact or cooperation with the contacts 16′, as before.

The circuit to the distributor arm 14′ is not shown beyond the slip ring 37′ and cooperating brush 15′ contacts. In this case, the "Neon" or other gaseous tube 26′, instead of being disposed directly in the distributor arm for rotation therewith, as before, is adapted for stationary positioning away from the distributor, as, for example, upon the dash of the vehicle, or otherwise, as desired. A single tube 26′ is shown for all of the plugs 10′ of the engine, but it is to be understood that separate "Neon" or other gaseous tubes might be provided in the several plug circuits 18′. A conducting wire 45 is grounded at 46 and is provided with a plurality of leads 47, which I find need only be wrapped around the external surface of the tube 26′, as indicated at 48. Conducting leads 49, one wrapped at 50 externally around the tube 26′ between each of the respective pairs of leads 47, are connected with the respective plug leads 18′. The leads 49 may either be given metallic contact with the plug leads 18′ or or preferably need only be given a wrap around the insulation of cables forming the leads 18′, forming in effect inductive or condenser connections therebetween. When a spark impulse occurs, for example, in the particular plug 10′ shown in Figure 3, the discharge within the tube 26′ will occur between the wrapped end 50 of the lead 49 extend-

ing from the connection 18′ to that plug and the wrapped ends 48 of the ground leads 47 on opposite sides of the lead 49. Similarly, the discharge within the tube 26 for plug 6 will occur between the lead 49 for that plug and the wrapped ends of the ground leads on opposite sides of that lead. The ground wire 45 may extend internally through the tube.

Considering the distributor arm 14′ as rotating in a clockwise direction in Figure 3, the usual firing order is designated by appropriate markings in that figure.

In the embodiment of Figures 4 to 8, the entire indicating system of the present invention is carried by a cover 55, which may be of suitable insulating material and possibly adapted to be substituted for the usual distributor cover now employed. The cover 55 has the usual depending flange 56, forming the space 57 within which the distributor arm 58 rotates. The arm 58 is the usual or any preferred distributor arm and the cover 55 is provided with upstanding hollow bosses 59, carrying contacts 60, one of which is connected with each of the engine plugs by means of a lead 61. The arm 58 usually has a spring contact element 62, which rotates with the arm 58 into successive contact with the contacts 60 to distribute the current to the plugs in the usual manner.

Integral with the top of the cover 55 is an upstanding hollow post 63, which may be internally reduced and internally threaded at its upper end at 64 to receive a terminal nut 65, which is metallic and has a socket 66 in which the bared end of the lead 67 from the spark coil is secured mechanically and in good electrical contact with the nut 65 for supplying to the distributor the high potential ignition current for the spark plugs. The lower end of the nut 65 is reduced and externally threaded at 68 to receive an insulating sleeve 69, which may be of fiber, "Bakelite," or the like. A metallic post 70, having a reduced and externally threaded upper end threaded into the lower end of the sleeve 69, as indicated at 71, extends downwardly and has a constant electrical contact, as by means of a spring pressed or yieldable brush contact 72 with the distributor arm 58, or with the contact 62 thereof.

The "Neon" or other gaseous tube is indicated at 73 and is again, preferably, a relatively low resistance gaseous tube, although this may vary. This tube 73 is mounted within the sleeve 69, with one end in contact with a reduced integral extension 74 of the post 70, or with a metallic spacer or connecting element therebetween. For the purpose of holding the tube against rattling or vibration within the sleeve 69 and to provide good electrical connection between the terminal nut 65 and the opposite end of the tube, a coiled spring 75 is interposed between the inner reduced end 68 of the nut 65 and the adjacent end of the tube 73. The spring 75, in addition to holding the tube 73 firmly in place and making good electrical contact therewith presses the opposite end of the tube into proper contact with the post 70 and maintains that contact, at all times. From the foregoing, it will now be apparent that every time that the distributor arm 58 or contact 62 thereof contacts with one of the contacts 60, a circuit is completed through the gaseous tube 73 and the action of the tube 73 will indicate the condition of the particular plug, plug circuit or other factor reflected in the current flow through the tube 73. The tube 73 is preferably provided with electrodes 73^a and 73^b.

For the purpose of cyclically exposing the light and indicating which plug, plug circuit or other condition reflected therein is indicated, an upright sleeve 78 is provided concentrically within the hollow post 63 and around the sleeve 69. The sleeve 69, which has relatively fixed position in operation, that is, it need not rotate, is provided with an elongated sight opening 79. The sleeve 78 is flanged and secured at its lower end at 80 to rotate with the arm 58 and within the vertical length of the slight opening 79, the sleeve 78 is provided with a plurality of individual sight openings 81.

The openings 81 are equal in number to the number of engine plugs or plug circuits, or other conditions which it is desired to indicate, and these openings 81 are equally spaced helically around the sleeve 78, as shown in Figure 6. The openings 81 are, preferably, in the form of numbers corresponding with the respective spark plug circuits indicated thereby, as indicated in Figure 6, but this may be varied by using ordinary openings, as indicated in Figure 4, in which case the post 63 may be calibrated as indicated more or less diagrammatically at 85 in Figure 4. In operation, the "Neon" or other gaseous tube 73 is lighted as the distributor arm or contact 72 contacts successively each of the contacts 60 and the sight openings 81, as they pass the vertically elongated sight opening 79 and the registering vertically elongated sight opening 82 in the tubular post 69 will cyclically indicate, by the action of the plug, the condition which it is desired to determine. The position vertically of the opening 81 will indicate which plug or which plug circuit it is, the condition of which is indicated. For example, as the upper opening 81 (Figure 6) passes the registering sight openings 79 and 82, the relatively high position of the indication will indicate that the indication is for plug No. 1 or plug cir-

cuit No. 1. As the lower opening 81 passes the openings 79 and 82, the low position of the indication will indicate that the indication is for plug or plug circuit No. 4 and the relative vertical positions of the indications therebetween will indicate the particular plug or plug circuit which is indicated. Where the openings 81 are in the form of numbers, as shown in Figure 6, the vertical position of the indication is not so important.

In Figure 8, the sleeve 69 is shown as being provided with conductor means 86 and 87 connected respectively with the terminal nut 65 and post 70 and separated at 88 to form a small gap across which the plug circuits are completed in the event the tube or lamp 73 is burned out or fails.

Where the impedances 20 and 21 of the form of the invention illustrated in Figure 1 are employed, these may be housed within a suitable insulating box 89, which may be attached directly to the cap 55, as indicated more or less diagrammatically in Figure 4. For applying these impedance paths selectively in shunt to the ignition system; each impedance may have a contact 90 extending upwardly from the box 89 and the head of the terminal nut 65 may be provided with a contact finger 91, adapted to be engaged with either of the contacts 90 by rotation of the nut 65 within the upper end of the post 63. It is to be understood that the indicating means illustrated in Figures 4 to 8 may be mounted upon the dash of the vehicle or otherwise, as desired, and connected either direct or through "phantom" circuits with the ignition system. The indicating sleeve 78 may be driven synchronously with the distributor arm, either mechanically or electrically, or otherwise. Either system may be used with the ground or parallel shunt provision independently connected, or without these provisions.

In the embodiment illustrated in Figures 9 to 11, the distributor post 63′ may be of substantially standard or any suitable or preferred form, with the central connection at 200 to the distributor arm 58′. The arm 58′ has a contact spring 98 for contact with the terminals 99, which are, in turn, connected by leads 100 with the respective spark plugs of the engine.

The top 95 of the distributor cap 55′ is provided with a plurality of sight openings 96, one for each of the engine plugs or plug circuits and disposed alternately between the hollow plug contact bosses 59′. The openings 96 may be provided with suitable panes 97, as indicated in Figure 11 and the distributor arm 58′ carries a "Neon" or other suitable gaseous tube 102, which is successively connected in the circuit from the center supply connection to the respective spark plug circuits, as the distributor arm successively contacts the terminals 99. When the distributor arm is in contact with the particular terminal 99, as shown, for example, the tube 102 is positioned beneath the opening 96 corresponding with that terminal 99 and the spark plug circuit connected therewith and a positional indication is given thru the opening 96. The sight openings 96 may be marked to correspond with the firing order of the engine, as indicated at 101 and the illumination will not only convey or indicate the condition, but the particular opening through which the illumination is directed will indicate which plug or which plug circuit it is. The tube 102 preferably has electrodes 102a.

In the embodiment of Figures 12 and 13, the rotatable distributor spool is indicated more or less diagrammatically at 105 and operates within an enclosure 106. The distributor terminals 107 are connected with the respective engine plugs and the spool contacts 108 are cooperable with the brushes 109 connected with the terminals 107 for successively completing the circuits to the respective plugs. This embodiment is particularly adapted for application to a high tension magneto system. The tube 110 of this form preferably has electrodes 110a.

The "Neon" or other gaseous tube or indicating lamp 110 is successively connected between the current supply conductor 111 and the distributor terminals 107 and is preferably carried by the spool 105 for rotation therewith past sight openings or apertures 115. The central terminal is indicated more or less diagrammatically at 112 and the circumferentially spaced sight openings corresponding with the respective spark plug circuits for positional indication, as in the previous embodiment may be provided thru the front of the enclosure 106 and may be covered with glass or other suitable transparent windows thru which the tube 110 may be visible or the light emitted for positionally indicating the condition of the spark plug circuits. The showing of this form of the invention is diagrammatic, but is believed sufficient for acquainting those skilled in the art with this form of positional indication. The spool 105 and enclosure 106 may be provided with cooperating contacts for selectively applying the shunt impedances 20 and 21 of Figure 1 by relative movement between the spool 105 and the case or enclosure 106.

This relative movement may be either relative rotational movement or relative axial movement, contacts being preferably arranged to complete a circuit through the tube 110 first, so that it may be determined through the opening 116 whether the tube 110 is functioning and thereafter the relative movement between the spool and case bringing contacts into cooperation for ap-

plying the relatively high impedance to the ignition circuit, whereupon the tube 110 will be extinguished or diminished in action, where the system is functioning normally or suitably.

In Figure 14, I have shown an independent gaseous tube 125 for each spark plug 126. In this case, I have shown the individual tube as connected between the plug and the lead 127 thereto and as being supported directly upon the plug. The tube 125 may be properly protected against mechanical injury, as by means of a metal lantern 128 having sight openings 129 and the tube 125 may be provided with suitable terminal connections 130 and 131 for connecting it between the high tension lead or cable 127 and the plug electrode. Each tube 125 will light as the corresponding plug fires and will indicate the functioning and condition of the particular plug with which it is associated and the ground shunt tester is preferably used in combination with this system.

In the embodiment of Figure 15, the gaseous or indicating tube is indicated at 140 and a reflector therefor is indicated at 132. The distributor cover is indicated at 133 and is provided with contact terminals 134 connected by leads 135 with the spark plugs.

The rotatable distributor arm is indicated at 136 and the bulb 130 is provided with a lantern case 137 provided with sight openings 138, through which the illumination or light produced by the tube 130 is viewed. The central ignition wire to the distributor arm, indicated at 140, is connected with the terminals 141 and 142 of the tube 130 and this wire may be connected to a ground shunt through a lead 143. The distributor arm 136 is provided with a permanent magnet 145, which rotates therewith and a compass needle is provided at 146. In this case, the compass needle is rotated by the magnetic influence of the magnet 145 on the distributor arm and turns therewith in the rotation of the distributor arm and the illumination from the bulb 130 shows the position of the compass needle at each ignition point, thereby providing a positional indication, the compass needle preferably being a mirrored or reflecting needle for reflecting the illumination from the lamp. As an alternative, the needle 146 may be driven mechanically, or otherwise, by the distributor arm. This scheme for illuminating the rotating needle or arm from the bulb 130 in the ignition circuit may be carried out on the instrument board by means of a small motor (synchronous) driven from the synchronous generator on the cam shaft or distributor shaft.

In Figure 16, a high resistance circuit, indicated diagrammatically at 150, is located preferably inside of the tube 151 and is placed in parallel with the gaseous path circuit through the tube and in electrical or electrostatic relation thereto. The tube terminals are indicated at 152 and 153 and the parallel high resistance 150 may be connected with one of these terminals as, for example, the terminal 153, as shown.

With such an arrangement, a relatively strong charge will follow the high resistance path 150 and will also follow the "Neon" or gaseous path through the entire length of the tube, whereas a weak, or relatively weak, charge will follow the high resistance path and will also follow the gaseous path, but only part way the length of the tube. The gas discharge will travel from the terminal 152 to different points, for example, 155, 156, 157, 158, 159, 160, along the high resistance path 150, depending upon the strength of the charge. This arrangement provides for weighing or measuring the strength of the charge through the tube and, in view of the extreme sensitiveness of the tube 151, very slight variations may be ascertained relatively. The high resistance path 150 may be calibrated, as at 155 to 160. The device of 116 is in the nature of a volt meter.

In Figure 17, I have shown individual "Neon" or other suitable gaseous tubes 190 arranged at the distributor with one tube 190 connected between each of the individual spark plug connections or leads 191 and the stationary circumferentially spaced contacts 192 of the distributor. The rotating distributor arm is indicated at 193 and the center lead or circuit connection thereto is indicated at 194.

In Figure 18, a single "Neon" or other gaseous tube 230 is mounted upon the dash 232 of a motor vehicle and connected into the ignition circuit 234 leading to the distributor (not shown). A grounding or test circuit connection may be applied to the circuit 234 ahead of the tube 230, as indicated at 235, and this grounding or test circuit connection means may also be mounted upon the dash 232 of the vehicle. The single tube 230 serves, in this case, as a common indicator for all of the spark plug lines of the ignition system.

In any of the cases herein described, the firing or ignition point in the cycle of the internal combustion engine may be indicated by the angular position of the gaseous bulb at the time of lighting. Variations in the shape of the gaseous bulb and the related density of gaseous illuminosity may be used for comparative determinations of current density. Variations in the size, shape and relative positionment of the electrodes, in connection with the relative location and intensity of gaseous illumination may also be used for comparative determinations of current density.

I do not intend to be limited to the precise details shown or described.

I claim:

1. In combination, an ignition system, a source of current for said system, a plurality of ignition circuits leading from said system and having ignition devices therein, means for distributing the current to said ignition devices, indicating means including a gaseous tube connected with said system and adapted for individually indicating the condition of said ignition circuits, and means operable synchronously with the distributor for changing the position of indication for the respective circuits, said means comprising a rotating shield having helically arranged openings.

2. In combination, an ignition system, a source of current for said system, a plurality of ignition circuits leading from said system and having ignition devices therein, means for distributing the current to said ignition devices, indicating means including a gaseous tube connected with said system and adapted for individually indicating the condition of said ignition circuits, means operable synchronously with the distributor for changing the position of indication for the respective circuits, said means comprising an enclosure having spaced openings therethrough, and a mirrored member operated synchronously with the distributor for reflecting the illumination through the opening corresponding with the ignition circuit.

3. In combination, an ignition system, a source of current for said system, a plurality of ignition circuits leading from said system and having ignition devices therein, means for distributing the current to said ignition devices, said means including a rotatable distributor arm and indicating means comprising an electric lamp mounted on said arm and connected into said system through said arm for indicating the condition of said ignition circuits.

4. In combination, an ignition system, a source of current for said system, a plurality of ignition circuits leading from said system and having ignition devices therein, means for distributing the current to said ignition devices, said means including a rotatable distributor arm having a distributor case, a cover for said case, a tubular extension on said cover, and indicating means comprising an electric lamp mounted in said extension and having a contact contacting with said arm for connection in the system therethrough to indicate the condition of said ignition circuits.

5. In combination, an ignition system, a source of current for said system, a plurality of ignition circuits leading from said system and having ignition devices therein, means for distributing the current to said ignition devices, said means including a rotatable distributor arm and a distributor case a cover for said case, a tubular extension on said cover, indicating means comprising an electric lamp mounted in said extension and having a contact contacting with said arm for connection in the system therethrough to indicate the condition of said ignition circuits, said tubular extension having a sight opening, and a shield surrounding said lamp and driven synchronously with said distributor arm, said shield having openings in different positions, one for each of said ignition circuits for exposing the indication of said lamps positionally.

6. In combination, an ignition system, a source of current for said system, a plurality of ignition circuits leading from said system and having ignition devices therein, means for distributing the current to said ignition devices, said means including a rotatable distributor arm and a distributor case, a cover for said case, a tubular extension on said cover, indicating means comprising an electric lamp mounted in said extension and having a contact contacting with said arm for connection in the system therethrough to indicate the condition of said ignition circuits, said tubular extension having a sight opening, a shield surrounding said lamp and driven synchronously with said distributor arm, said shield having openings in different positions, one for each of said ignition circuits for exposing the indication of said lamps positionally, and a holder for said lamps mounted within said shield and having a sight opening registering with the sight opening in said tubular extension.

7. In combination, an ignition system, a source of current for said system, a plurality of ignition circuits leading from said system and having ignition devices therein, means for distributing the current to said ignition devices, said means including a rotatable distributor arm and a distributor case, a cover for said case, a tubular extension on said cover, indicating means comprising an electric lamp mounted in said extension and having a contact contacting with said arm for connection in the system therethrough to indicate the condition of said ignition circuits, said tubular extension having a sight opening, a shield surrounding said lamp and driven synchronously with said distributor arm, said shield having openings in different positions, one for each of said ignition circuits for exposing the indication of said lamp positionally, a holder for said lamp mounted within said shield and having a sight opening registering with the sight opening in said tubular extension, and a shunt path in said lamp holder of greater impedance than the lamp and connected around

the lamp to complete the system in the event of failure of said lamp.

8. In combination, an ignition system, a source of current for said system, a plurality of ignition circuits leading from said system and having ignition devices therein, means for distributing the current to said ignition devices, said means including a rotatable distributor arm and a distributor case, a cover for said case, a tubular extension on said cover, indicating means comprising an electric lamp mounted in said extension and having a contact contacting with said arm for connection in the system therethrough to indicate the condition of said ignition circuits, an impedance box mounted upon said cover and having contact means and a terminal nut for the lamp mounted upon said cover and having cooperating contact means movable into and out of contact with said first contact means by adjustment of said nut.

9. In combination, an ignition system, a source of current for said system, a plurality of ignition circuits leading from said system and having ignition devices therein, means for distributing the current to said ignition devices, said means including a rotatable distributor arm, indicating means comprising an electric lamp mounted adjacent said arm and connected into said system through said arm for indicating the condition of said ignition circuits, a distributor having a distributor case, a distributor arm rotatable within said case, and means carried by said case and enclosing said lamp, said means having a plurality of sight openings in different positions and one for each of said ignition circuits.

10. In combination, an ignition system, a source of current for said system, a plurality of ignition circuits leading from said system and having ignition devices therein, means for distributing the current to said ignition devices, said means including a rotatable distributor arm, indicating means comprising an electric lamp mounted adjacent said arm and connected into said system through said arm for indicating the condition of said ignition circuits, a distributor having a distributor case, means carried by said case and enclosing said lamp, said means having a plurality of sight openings in different positions and one for each of said ignition circuits, and a mirrored member rotatable synchronously with the distributor arm and adjacent said openings for positionally reflecting the illumination of said lamp therethrough.

In witness whereof, I hereunto subscribe my name, this 22nd day of May, 1929.

HERMAN C. HEATON.