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TESTING DEVICE FOR INTERNAL COMBUSTION ENGINES

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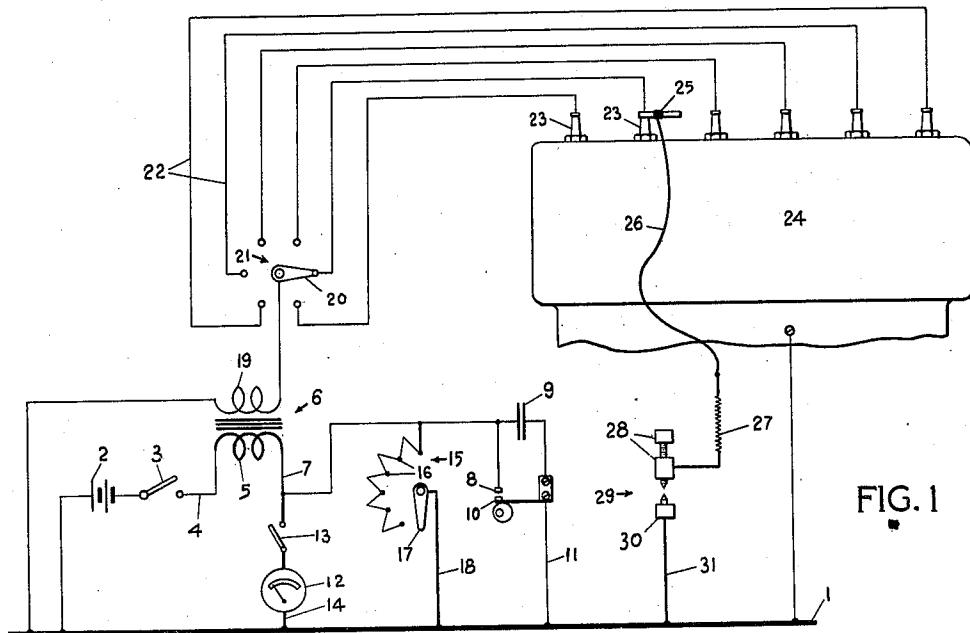


FIG. 1

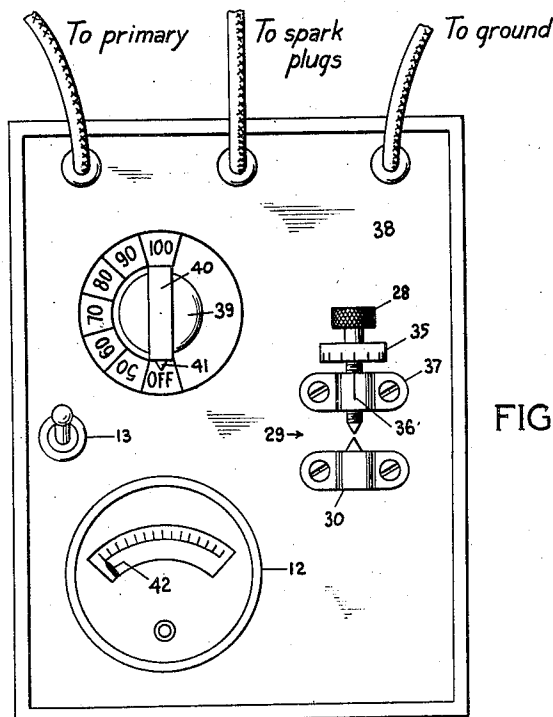


FIG. 2

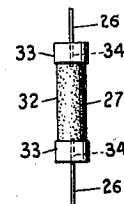


FIG. 3

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TESTING DEVICE FOR INTERNAL COMBUSTION ENGINES

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15 Claims. (Cl. 175-183)

The invention relates to a testing device for internal combustion engines and more particularly to devices illustrated in my Patent Number 1,914,496, dated June 20, 1933, but not claimed therein.

The primary object of the invention is to provide a compact and reliable testing device for internal combustion engines and so arranged as to give a quantitative measure of the ignition coil, condenser, distributor, spark plug operation and carburetor adjustment of the modern type of internal combustion engines.

Another object of my invention is to provide a readily portable device which may be connected in the manner hereinafter described to an engine while the same is operating and which will enable the operator of the testing device to properly evaluate the condition of the various elements of the ignition circuit of the engine, the operation of the carburetor and the operation and condition of the spark plugs.

Further objects of the invention will be pointed out in the detailed description of the mechanism taken in connection with the accompanying drawing, in which:

Figure 1 is a diagrammatic view of the ignition system of an internal combustion engine showing the location and connections of the testing device in connection with said ignition system.

Figure 2 is a top plan view of the panel showing the mechanism by which the condition of the engine may be determined.

Figure 3 is a side elevation of a preferred form of high tension resistance means used with the testing apparatus.

Referring to the drawing, the heavy line at the bottom of Figure 1 represents the common lead to ground and is designated by the reference numeral 1. The battery 2 is of course provided with a lead to ground and the other lead to the ignition switch indicated by the reference character 3. The battery current when the switch is in "on" position passes through the lead 4 through the primary winding 5 of the ignition coil 6 and through the lead 7 to one of the breaker points 8. The numeral 9 indicates the condenser in the primary ignition circuit, 10 the other breaker point and 11 the lead from this breaker point to the common ground 1. The numeral 12 indicates a voltmeter adapted to be connected to the primary ignition circuit by a switch 13 and having its opposite terminal 14 also connected to the common ground 1. The numeral 15 designates a rheostat having a plurality of taps 16 and an operating arm 17. One of the leads from the rheo-

stat is connected to the primary circuit lead 7 at a point between the primary winding 5 of the coil 6 and the breaker point 8. The other lead 18 from the operating arm of the rheostat is of course connected to the common ground 1. The secondary winding of the ignition coil 6 is designated as 19. This secondary winding is connected, of course, to the rotor arm 20 of the distributor head 21, the rotor arm being adapted to sequentially connect the secondary winding to the leads 22 of the spark plugs 23.

Connected to one of the spark plugs 23 by means of a pinch clamp 25 is a lead 26 which is connected to a high tension resistance 27 and which may be connected to the movable arm 28 of an air gap 29, the opposite terminal 30 of said gap being of course connected by the lead 31 to the common ground 1.

A preferred form of high tension resistance 27 is illustrated in Figure 3 and may comprise a wick or fibrous member 32 impregnated with a metallic powder preferably formed from aluminum paint. At opposite ends of the wick 32 I provide terminal caps 33 each of which is adapted to secure the lead 26 or 31 depending of course upon the location of the resistance means. The wires forming the leads pass through the terminal caps and terminate short of each other, as clearly indicated by the dotted lines 34 in Figure 3.

In Figure 2 I have illustrated a convenient form of air gap 29 and it will be observed that the adjustable member 28 is provided with a scale 35 which may be read in connection with an index line 36 on the fixed support 37. It will be obvious of course that by rotating the member 28 the distance of the air gap may be varied so as to interpose in the spark plug circuit a variable resistance which will enable the operator to determine the character and condition of the spark plug.

The resistance to the passage of current between the terminals of a spark plug is of course increased by pressure so that ordinary tests which may be made by short-circuiting a spark plug with a screw driver to cause the spark to jump from the screw driver point to an adjacent point on the engine merely gives an indication that the ignition current is flowing to the spark plug and if the engine is running at idling speed it is possible by this screw driver test to determine whether or not the spark plug has been firing but such a test gives no indication of latent defects of the spark plug. In order that a spark plug may be evaluated when in operating position it is necessary to interpose in the spark plug circuit a high tension resistance, which resistance is

calibrated so as to normally equal the breakdown resistance of the air gap of the spark plug under normal operating conditions. This function is accomplished by inserting in either the lead 26 or the lead 31 the high tension resistance constructed in accordance with my invention. Engines vary in pressure. There are low, medium and high compression engines. It is therefore necessary to provide a variable resistance member which may be adjusted in conjunction with fixed high tension resistance so that the spark plugs of the engines of these various types may be tested accurately and scientifically. This is accomplished in my invention by the variable air gap 29 as hereinbefore described.

There are certain other conditions which materially affect spark plug operation which have only comparatively recently been appreciated by the spark plug and automobile manufacturers. Certain engines require what is termed a "cold" spark plug and certain other engines require what is termed a "hot" spark plug in order to operate at their highest degree of efficiency. With the variable air gap it is possible to determine whether or not the particular spark plug being tested is suitable for the particular engine being tested. To accomplish this test the air gap 29 is gradually increased until a maximum distance between the terminals of the air gap is approximately $\frac{1}{4}$ ". If the spark continues to jump even at this distance it is a definite indication that the spark plug is too hot for the particular engine.

The air gap 29 is calibrated so as to provide the proper added resistance for high, medium and low compression engines. If, when the air gap 29 is set for the proper engine condition and the spark fails to jump between the terminals but will jump when the air gap is reduced to a point below the normal for that type of engine having a given compression, it indicates that the spark plug is too cold to operate efficiently. The character of the spark jumping between the terminals of the air gap 29 or the failure of the spark to jump enables the operator to determine definitely the condition of the spark plug, both as to leakage, crystallization of the points or carbonization of the points as the case may be.

The spindle for the operating arm 17 of the rheostat 15 is adapted to extend upwardly through the panel 38 and to have fixedly connected thereto an operating member 39 which is preferably formed of bakelite or like material and which has conveniently formed thereon a finger grip portion 40. At one end of the finger grip portion there is an indicator 41 which upon the rotation of the member 39 in a given direction is adapted to connect the arm 17 selectively or sequentially to any one of the taps 16 of the rheostat.

On the panel 38 and arranged concentric with the member 39 are a plurality of indices carrying the numerals 50, 60, 70, 80, 90 and 100. These are mere empirical values and are used by the operator of the testing device to determine the efficiency of the various elements of the ignition system of the engine being tested. It will be obvious from the diagram that a rotation of the member 39 is a clockwise direction from "off" position will bring the arm 17 successively into contact with the taps 16 of the rheostat. It will also be obvious that upon contact between the arm 17 and the first (or 50) tap of the rheostat that only a relatively small amount of current flowing in the primary circuit of the ignition system will be by-passed through the rheostat to ground and that with each successive movement

of the arm 17 the amount of current being by-passed through the rheostat to ground will be increased. It therefore follows that if the coil is unsuited for the particular engine by reason of its low output or is defective the by-passing of a predetermined portion of this current through the rheostat will prevent sufficient current flowing through the breaker and through the primary of the ignition coil to generate in the secondary of the coil sufficient current value to break down the air gap resistance of the spark plugs of the engine being tested. Consequently, if the engine ceases to operate by reason of the by-passing of a portion of the ignition current, as, for example, with the indicating device positioned at 70, the ignition system of that engine is far below that standard which has been previously determined by test or calibration. It is therefore possible by the simple connection of the testing device into the primary circuit of the ignition system and a manual operation of the member 39, to evaluate the engine being tested in comparison with the ignition system of an engine operating under perfect conditions.

The voltmeter 12 is an essential in the complete diagnosis of engine troubles. With the switch 13 in "on" position and the rheostat arm 17 in "off" position, it will be obvious that the voltmeter will be connected in parallel with the primary ignition circuit. If the breaker points do not operate at a uniform rate due to a loose connection in the primary circuit, poor contact at the distributor points, worn distributor cam shaft bushing, loose rubbing block on the breaker arm, to name but a few of the ordinary defects of the ignition system of the ordinary type of internal combustion engine, any one of these deficiencies will be indicated by rapid oscillation of the arm 42 of the voltmeter, whereas, if these parts are in perfect condition the current flow through the voltmeter will be constant and the arm of the voltmeter will therefore remain stationary at a given speed. This test is carried out with the engine operating between 1200 and 1500 R. P. M. At this speed of the engine a faulty carburetor adjustment has little or no effect upon the hand of the voltmeter. It responds only to defects in the ignition system and not to the carburetor. If these parts have been checked and found to be in perfect condition the vibration of the voltmeter needle 42 will indicate faulty carburetor adjustment causing the engine to race or to fire unevenly so that it is possible by observing the operation of the voltmeter needle to determine not only ignition defects but also defects which may arise by reason of faulty carburetor adjustment. The test for carburetor adjustment is made at idling speed rather than at the speed of the engine when testing for defects in the ignition system.

It will therefore be seen that by providing in a single apparatus means for testing spark plugs, a rheostat which when operated is adapted to by-pass from the primary ignition circuit selected amounts of current and by providing the same mechanism a voltmeter adapted to be connected in parallel with the primary ignition circuit, I am able to determine all of the latent defects in the operation of an internal combustion engine by a device which is compact and easily portable and which requires no external mechanism or power from other sources than from the engine being tested.

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

1. A testing device for internal combustion engines including a circuit having leads making electrical connection with the terminal of a spark plug and with the grounded side of the said plug, respectively, when the latter is in operating position, said circuit including a high tension resistance whose value is substantially equal to the breakdown resistance of said spark plug under operating conditions, said high tension resistance including an external air gap.

2. A testing device for internal combustion engines comprising a circuit including leads making electrical connections with the terminal of a spark plug and with the grounded side of said plug, respectively, the latter being in operating position, said circuit including a high tension resistance whose value is substantially equal to the breakdown resistance of the said spark plug under operating condition, said resistance including an external air gap adapted to serve as an indicating means.

3. A testing device for internal combustion engines comprising a circuit including leads making electrical connections with the terminal of a spark plug and with the grounded side of said plug, respectively, the latter being in operating position, said circuit including a high tension resistance whose value is substantially equal to the breakdown resistance of the said spark plugs under operating conditions, said resistance including an external air gap and calibrated means for altering the length of said air gap.

4. A testing device for internal combustion engines comprising a panel, a pair of terminals connected to said panel, a lead from one of said terminals to a spark plug of the engine being tested, a second lead from the other terminal to ground, and high tension resistance means including a variable air gap interposed in one of said leads whereby there is interposed in said lead circuit a resistance to the passage of the ignition circuit substantially equal to the breakdown resistance of the said spark plug during normal operation of the engine being tested.

5. A testing device for internal combustion engines comprising a panel, a pair of terminals forming an air gap mounted on said panel, one of said terminals being adjustable, a lead from said adjustable terminal to a spark plug of the engine being tested, a second lead from the other terminal to ground, and high tension resistance means interposed in one of said leads, said high tension resistance means comprising a fibrous member impregnated with a metallic powder, said high tension resistance being calibrated to substantially equal the breakdown resistance of the said spark plug during normal operation of said engine.

6. A testing device for internal combustion engines comprising a panel, a pair of terminals forming an air gap mounted on said panel, one of said terminals being adjustable, a lead from said adjustable terminal to a spark plug of the engine being tested, a second lead from the other terminal to ground, and high tension resistance means interposed in one of said leads, said high tension resistance means comprising a wick impregnated with an aluminum paint, said high tension resistance being calibrated to substantially equal the breakdown resistance of the said spark plug during normal operation of the said engine.

7. A testing device for internal combustion engines comprising a panel, a pair of terminals forming an air gap mounted on said panel, one of said terminals being adjustable, a lead from said adjustable terminal to a spark plug of the engine

being tested, a second lead from the other terminal to ground, and high tension means interposed in one of said leads, said high tension resistance comprising a wick impregnated with aluminum paint and terminals secured to the opposite ends of said wick, said high tension resistance being calibrated to substantially equal the breakdown resistance of the said spark plug during the normal operation of said engine.

8. A testing device for internal combustion engines having an ignition system including means involving primary and secondary windings and means for causing a current having a pulsating component to flow through said primary, said testing device including a panel having a plurality of leads extending therefrom, one of said leads being connected to said primary winding and another of said leads to ground, and means mounted on said panel and interposed in the current of said leads for controlling the value of said pulsating component of said ignition current.

9. A testing device for the ignition system of internal combustion engines, said device including a source of current, means having primary and secondary windings and breaker points in the circuit of said primary winding, and means for bypassing to ground a portion of the current passing through said primary, said means being connected to said primary ignition circuit between said primary winding and said breaker points.

10. A testing device for internal combustion engines having an ignition system including a source of current, an ignition coil having primary and secondary windings, breaker points in the circuit flowing from said primary winding, said breaker points being adapted to modulate the current passing through said primary, and a testing device connected to said primary circuit between said primary winding and breaker points said device including a variable resistance for by-passing to ground calibrated amounts of said current flowing through said primary circuit to said breaker points.

11. A testing device for internal combustion engines comprising a panel, a plurality of leads extending from said panel, one of said leads being adapted to be connected to the primary circuit of the ignition circuit of an engine being tested between the primary ignition coil and the breaker points of said ignition system, another of said leads being grounded on said engine, and a resistance interposed in the circuit between said leads said resistance having a plurality of taps so that the resistance may be graduated, each of said graduated resistances represented by said taps being calibrated, means for operating said resistance whereby any one of said taps may be connected in parallel with said ignition circuit, each of said taps being calibrated so as to reduce the output of the current flowing to said breaker points a predetermined amount to prevent firing of the spark plugs of said engine unless the reduced current flow from said primary ignition circuit will break down the resistance interposed by the spark gaps of the said spark plugs of said engine operating at a predetermined speed.

12. A testing device for internal combustion engines comprising a panel, a plurality of leads extending from said panel, one of said leads being adapted to be connected to the primary circuit of the ignition circuit of an engine being tested between the primary ignition coil and the breaker points of said ignition system, another of said leads being grounded on said engine, and a

rheostat interposed between said leads of said
 tester, said rheostat having a plurality of taps
 and an indicating device connected with the op-
 erating member of said rheostat, said indicating
 5 device having a plurality of indices corresponding
 to said rheostat taps, said taps being calibrated
 so as to interpose in said tester circuit a plu-
 rality of predetermined graduated resistances,
 10 whereby upon movement of said indicating de-
 vice any one of said calibrated resistances may
 be interposed in parallel with the primary igni-
 tion circuit of the engine being tested, the calibra-
 15 tion of said taps being such as to reduce the cur-
 rent flowing to said breaker points a predeter-
 mined amount which will prevent the firing of
 the spark plugs of said engine unless the reduced
 current flow from said primary ignition circuit
 20 will break down the resistance interposed by the
 spark gaps of the said spark plugs during the
 operation of said engine at a predetermined speed.
 13. A testing device for internal combustion
 engines comprising a portable housing and a pan-
 el member carried by said housing, a plurality of
 25 leads extending from said housing, one of said
 leads being adapted to be connected to the pri-
 mary circuit of the engine being tested at a point
 between the primary winding of the ignition coil
 and the breaker points, a rheostat mounted be-
 30 neath said panel and having an operating mem-
 ber extending through said panel, an indicating
 device connected to said rheostat operating mem-
 ber and adapted to move over indices carried by
 said panel, said rheostat having a plurality of
 35 taps each of which is adapted to interpose in said
 tester circuit a resistance of definite predeter-
 mined value whereby the ignition circuit of the
 engine being tested may be evaluated during the
 operation of said engine by a movement of said

indicating device through the range of said in-
 dices.

14. A tester for internal combustion engines
 comprising a panel, a voltmeter mounted on said
 panel, a plurality of leads extending from said
 panel, one of said leads being connected to the
 primary ignition circuit of an engine being test-
 ed between the primary winding of the ignition
 coil and the breaker points of said engine, another
 of said leads being connected to ground, and a
 switch interposed in said tester leads for oper-
 atively connecting and disconnecting said volt-
 meter from said leads, said voltmeter when con-
 nected to said leads being arranged in parallel
 with the primary ignition circuit of said engine.

15. A testing device for internal combustion
 engines comprising a panel member having a plu-
 rality of leads therefrom, one of said leads being
 connected to the terminal of a spark plug of the
 engine being tested, another of said leads being
 20 connected to the primary ignition circuit of said
 engine between the primary winding of the ig-
 nition coil and the breaker points of said engine,
 a third lead being connected to ground common
 to both of said first named leads, a rheostat hav-
 25 ing a plurality of taps interposed in said circuit
 between said lead from said primary ignition
 circuit and ground, a voltmeter mounted on said
 panel, switch means for connecting and discon-
 necting said voltmeter from the primary igni-
 30 tion circuit lead to ground, and means for oper-
 ating said rheostat for interposing in parallel
 with said primary ignition circuit a plurality of
 graduated and calibrated resistances, said switch
 means when moved to connect said voltmeter to
 35 said primary ignition circuit being adapted to
 short-circuit said rheostat.

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