

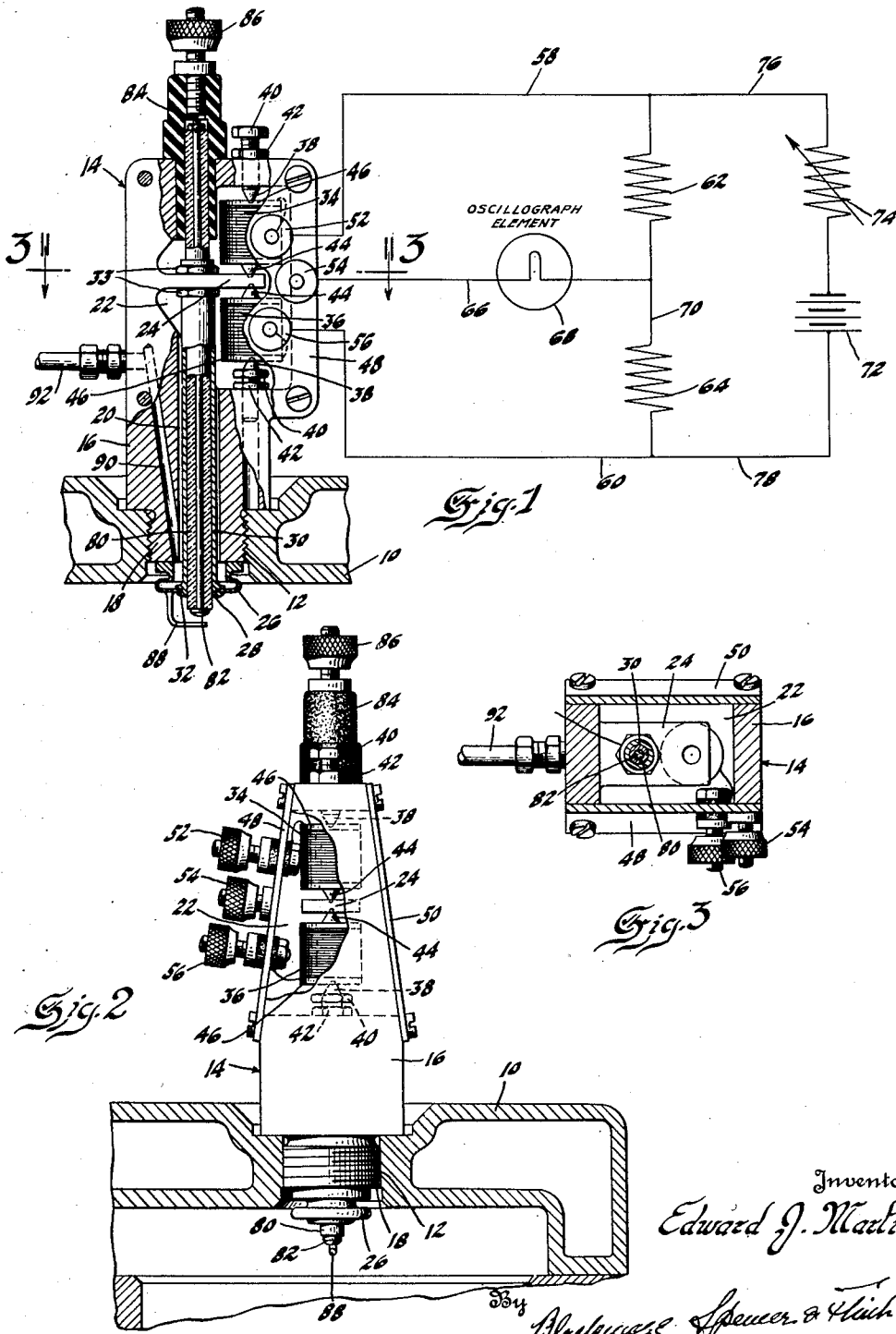
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ENGINE INDICATOR AND SPARK PLUG

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ENGINE INDICATOR AND SPARK PLUG

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This invention has to do with engine indicators of the type disclosed and claimed in my prior application Serial No. 265,452, filed March 28, 1928.

While the indicator disclosed in my prior application operated very satisfactorily it possessed the disadvantage that it was necessary to provide a special hole in the cylinder or cylinder head to receive it. According to my improved design, my engine indicator is combined with a spark plug so that to make use of my indicator it is simply necessary to replace the conventional spark plug with my improved combination spark plug and indicator.

As in my prior design, I have provided an arrangement for cooling the diaphragm by means of a current of air or other cooling fluid. According to my improved arrangement the cooling stream is circulated about the central insulated electrode of the plug, insuring that it will not become so heated as to cause preignition.

Referring to the drawings:

Figure 1 is a view, partly in section, showing my improved combination spark plug and indicator applied to an internal combustion engine, and also, diagrammatically, the circuit with which the indicator is used.

Figure 2 is a view similar to Figure 1 but taken at right angles to that figure.

Figure 3 is a section on line 3—3 of Figure 1.

10 represents a portion of the cylinder head of an internal combustion engine of conventional type and 12 indicates the usual threaded aperture provided in the head for the reception of the conventional type of spark plug. 14 indicates, as an entirety, my combined spark plug and engine indicator. This device comprises a frame 16 provided with a threaded extension 18 for engagement in the aperture 12. The frame 16 is provided with a central bore 20 to receive the central electrode of the spark plug, the spark plug insulator, and the rigid thrust member for the indicator. Midway of the length of the bore the frame 16 is provided with a large recess or cavity 22 into which extends a rigid arm 24 integral with the frame. The arm

24 is provided with an aperture in registration with the bore 20 in the frame 16. The lower end of the bore 20 is sealed by means of a diaphragm 26 which may be secured to the frame 16 by welding or brazing. The diaphragm may be of the simple disc type or of the well known sylvon bellows type as illustrated or provided with corrugated sidewall. The diaphragm 26 is provided with a central aperture 28, to the bounding edges of which is secured the rigid thrust element for operating the indicator. This element is in the form of a tube 30, shown as secured to the diaphragm by forming the lower end with a channel 32 into which edges of the diaphragm are fitted, whereupon the walls of the channel are clinched about it. Obviously the connection may be accomplished by welding or brazing if preferred, the only requirement being that the connection shall be secure and gas tight. The upper end of the tube 30 is threaded and is rigidly secured to the arm 24 by means of clamping nuts 33 as shown.

It is now obvious that with this arrangement movement of the diaphragm 26 is transmitted by the tubular thrust member 30 to the rigid arm 24 and this effects operation of the indicating mechanism which is substantially the same as that shown in my prior application and now to be briefly described. The arm 34 is referred to hereinafter as the indicating means since all indications result from the slight movement given to it and the Wheatstone bridge, oscillograph, and other elements of the indicating mechanism merely serve to magnify and analyze its movement.

On opposite sides of the rigid arm 24 are arranged carbon pile rheostats 34 and 36. The rheostats consist of carbon disks clamped between end plates. The end plates remote from the rigid arm are provided with conical recesses 38 to receive the conical ends of adjustable screws 40 threaded in the frame 16. Lock nuts 42 are provided to hold the screws in adjusted position. The adjacent end plates are provided with integral conical studs 44 which engage in recesses formed in opposite sides of the rigid arm 24. The remote end plates are insulated from the frame

16 by means of interposed insulating disks 46. The recess 22 is inclosed by means of cover plates 48 and 50. Upon the cover plate 48 are mounted three terminals 52, 54 and 56.

Terminals 52 and 56 are insulated from the frame 16 but electrically connected to opposite ends of the rheostats 34 and 36 respectively as shown. Terminal 54 is in electrical connection with frame 16. Conductors 58 and 60 lead from terminals 52 and 56 respectively to the ends of fixed resistances 62 and 64 respectively. Conductor 66 leads from the terminal 54 through the oscillograph element 68 to conductor 70 connecting the adjacent ends of the fixed resistances.

Rheostat 34, terminal 52, and conductor 58 constitute one leg of a Wheatstone bridge. Rheostat 36, terminal 56, and conductor 60 constitute another leg of a Wheatstone bridge in series with the first leg. The other legs of the bridge are constituted by the fixed resistances 62 and 64. The bridging circuit consists of the rigid arm 24, frame 16, terminal 54, conductor 66, and oscillograph element 68. Current is supplied to the Wheatstone bridge from battery 72 through variable resistance 74 and conductors 76 and 78. The oscillograph element, which is but diagrammatically indicated, produces movement of a mirror in synchronism with the current fluctuations in the bridging circuit, causing a light ray to be projected and recorded on a traveling photographic roll.

The operation of the indicating mechanism is as follows: Pressure variations in the combustion chamber cause movement of the diaphragm 26 which is transmitted through the tubular thrust member 30 to the rigid arm 24. Movement of the arm effects variations in the pressure applied to the carbon pile rheostats 34 and 36 and this results in corresponding variations in their resistance and, consequently, in the potential at that end of the bridging circuit, causing flow of current through the bridging circuit which operates the oscillograph element 68. The movement of the element is recorded on the photographic roll and gives an accurate record of pressure variations in the combustion chamber.

Within the tubular thrust member 30 there is arranged an insulator 80 surrounding the central electrode 82 of the spark plug. At the upper end of the bore there is provided a second insulator 84 surrounding the first insulator and centering it in the bore of the member 16. The central electrode is provided with the usual terminal 86 which may be connected in the usual manner to the ignition system. The side electrode 88 which cooperates with the central electrode is preferably mounted on the diaphragm 26 although it might, if preferred, be mounted directly on the member 16.

I have shown at 90 a bore communicating

with the central bore 20 and connected at 92 to a conduit leading to a source of compressed air. A cooling blast of air is thus directed against the diaphragm, the air escaping through the clearance provided between the tubular thrust member 30 and the bore 20 into the chamber 22 from which it may escape through suitable apertures, not shown, into the atmosphere. The cooling blast not only cools the diaphragm but also cools the central electrode and its insulator, preventing pre-ignition.

I claim:

1. A combined spark plug and engine indicator comprising a member provided with a bore therein and with a rigid indicating member intercepting the bore and provided with an aperture aligned with the bore, a diaphragm at one end of the bore, a tubular thrust member rigidly connecting the diaphragm and the rigid member, and an insulated electrode mounted in the bore and extending through the diaphragm, said electrode being provided at its upper end with means adapted for connection with a source of electric current.

2. A combined spark plug and engine indicator comprising a member provided with a bore therein and with a rigid indicating member intercepting the bore and provided with an aperture aligned with the bore, a diaphragm at one end of the bore, a tubular thrust member rigidly connecting the diaphragm and the rigid member, and an insulated electrode mounted in the bore and extending through the diaphragm, said electrode being provided at its upper end with means adapted for connection with a source of electric current, said member being provided with a passage for the projection of cooling fluid on the diaphragm, said tubular member loosely fitting the bore to form a passage for the discharge of cooling fluid.

3. A spark plug comprising a central insulated electrode and a side electrode, said plug being provided with passages for circulating a cooling fluid about said central electrode, and with an outlet passage for the discharge of fluid therefrom and means for supplying fluid under pressure to said passages.

4. A pressure indicator comprising a fitting adapted to be secured in an aperture in the wall of a pressure chamber and comprising a rigid indicating element having a free end, a tubular thrust member rigidly connected to the free end of said element and having its lower end extending into the chamber, and an annular diaphragm rigidly secured to the lower end of the tubular thrust member and having an annularly distended portion exposed in the chamber and a constricted neck portion fixed to the fitting.

5. An engine indicator comprising a fitting adapted to be secured within an aper-

ture in the wall of a pressure chamber, said fitting being provided with a bore therein and with a rigid arm extending transversely of the bore, a diaphragm closing the end of the bore exposed in the chamber, a rigid tubular thrust member connecting the diaphragm and arm, an electrode housed within the thrust member and projecting through opposite ends of the bore, a tubular insulator insulating the electrode from the thrust member, said arm being adapted for connection with means for amplifying and displaying the character of the vibrations imparted to said arm by pressure variations in the chamber.

6. An engine indicator comprising an integral fitting adapted to be secured within an aperture in the wall of a pressure chamber, said fitting being provided with a bore therein and with a rigid integral arm extending transversely of the bore, a diaphragm closing the end of the bore exposed in the chamber, a rigid tubular thrust member connecting the diaphragm and arm, an electrode housed within the thrust member and projecting through opposite ends of the bore, a tubular insulator insulating the electrode from the thrust member, a second insulator mounted in the upper end of the bore and insulating the electrode from the fitting, said arm being adapted for connection with means for amplifying and displaying the character of the vibrations imparted to said thrust member by pressure variations in the chamber.

7. An engine indicator comprising an integral fitting adapted to be secured within an aperture in the wall of a pressure chamber, said fitting being provided with a bore therein, and said bore being enlarged intermediate its ends, a diaphragm closing the end of the bore exposed in the pressure chamber, said fitting being provided with an integral arm extending into the enlarged portion of the bore and at a point remote from the exposed end of the bore, a tubular thrust member connecting the diaphragm and arm, an electrode housed within the thrust member and projecting through opposite ends of the bore, a tubular insulator insulating the electrode from the thrust member, said arm being adapted for connection with means for amplifying and displaying the character of the vibrations imparted to said thrust member by pressure variations in the chamber.

8. An engine indicator comprising a fitting adapted to be secured within an aperture in the wall of a pressure chamber, said fitting being provided with a bore therein, and said bore being enlarged intermediate its ends, a diaphragm closing the end of the bore exposed in the pressure chamber, said fitting being provided with an arm extending into the enlarged portion of the bore and at a point remote from the exposed end of the bore, a tubular thrust member connecting the

diaphragm and arm, an electrode housed within the thrust member and projecting through opposite ends of the bore, a tubular insulator insulating the electrode from the thrust member, and a pressure sensitive element housed within the enlarged portion of the bore.

9. A combined spark plug and engine indicator comprising a tubular shell adapted to be secured in the usual spark plug aperture in the wall of the combustion chamber of an internal combustion engine, a central electrode in the shell provided at its upper end with means for connection with a source of current, an insulator within the shell surrounding the electrode, a second electrode in conductive relation with the shell and providing in conjunction with the lower end of the first named electrode a spark gap normally exposed in the combustion chamber, a movable wall member surrounding the insulator and in sealing relation with the shell, indicating means, and means directly connecting said movable wall member with said indicating means so that the motion of the wall member in response to pressure variations in the chamber is transmitted to the indicating means independently of said insulator.

10. A combined spark plug and engine indicator comprising a tubular shell adapted to be secured in the usual spark plug aperture in the wall of the combustion chamber of an internal combustion engine, a central electrode in the shell provided at its upper end with means for connection with a source of current, an insulator within the shell surrounding the electrode, a second electrode in conducting relation with said shell and providing in conjunction with the lower end of the first named electrode a spark gap normally exposed in the combustion chamber, a movable diaphragm surrounding the insulator and secured to the shell, indicating means, and means directly and rigidly connecting said movable wall member with said indicating means so that the motion of the diaphragm in response to pressure variations in the chamber is transmitted to the indicating means independently of said insulator.

11. A combined spark plug and engine indicator comprising a tubular shell adapted to be secured in the usual spark plug aperture in the wall of the combustion chamber, a central electrode in the shell provided at its upper end with means for connection with a source of current, an insulator within the shell surrounding the electrode, a second electrode in conducting relation with the shell and providing in conjunction with the lower end of the first named electrode a spark gap normally exposed in the combustion chamber, a movable wall member surrounding the insulator and in sealing relation with the shell, indicating means includ-

ing a rigid arm, and means directly and rigidly connecting said movable wall member with said indicating means so that the motion of the wall member in response to pressure variations in the chamber is transmitted to the indicating means independently of said insulator.

12. A combined spark plug and engine indicator comprising a tubular shell adapted to be secured in the usual spark plug aperture in the wall of the combustion chamber, a center electrode in the shell provided at its upper end with means for connection with a source of current, an insulator within the shell surrounding the electrode, a second electrode in conductive relation with said shell and providing in conjunction with the lower end of the first named electrode a spark gap normally exposed in the combustion chamber, a tubular thrust member surrounding the insulator, a movable wall member secured to the thrust member and in sealing relation with the shell, indicating means, said tubular thrust member being directly and rigidly connected to said indicating means so that motion of the wall member in response to pressure variations in the chamber is transmitted to the indicating means independently of said insulator.

13. A combined spark plug and engine indicator comprising a tubular shell adapted to be secured in the usual spark plug aperture in the wall of the combustion chamber, a center electrode in the shell provided at its upper end with means for connection with a source of current, an insulator within the shell surrounding the electrode, a tubular thrust member surrounding the insulator, a diaphragm secured to the thrust member and to the shell, a second electrode mounted on the diaphragm and providing in conjunction with the lower end of the first named insulator, a spark gap normally exposed in the chamber, indicating means, said tubular thrust member being directly and rigidly connected to said indicating means so that motion of the wall member in response to pressure variations in the chamber is transmitted to the indicating means independently of said insulator.

14. A combined spark plug and engine indicator comprising a tubular shell adapted to be secured in the usual spark plug aperture in the wall of the combustion chamber, a center electrode in the shell provided at its upper end with means for connection with a source of current, an insulator within the shell surrounding the electrode, a second electrode in conductive relation with said shell and providing in conjunction with the lower end of the first named electrode a spark gap normally exposed in the combustion chamber, a tubular thrust member surrounding the insulator, a movable wall member secured to the thrust member and in sealing

relation with the shell, indicating means including a rigid arm projecting adjacent the thrust member, said thrust member being directly and rigidly connected to said indicating means so that motion of the wall member in response to pressure variations in the chamber is transmitted to the indicating means independently of said insulator.

15. A combined spark plug and engine indicator comprising a member provided with a bore therein and with indicating means including a rigid arm projecting adjacent the bore, a diaphragm at one end of the bore, a tubular thrust member rigidly connecting the diaphragm and the arm, and an insulated electrode mounted in the bore and extending through the diaphragm, said electrode being provided at its upper end with means adapted for connection with a source of electric current.

16. A pressure indicator comprising a member adapted for insertion in the wall of a pressure chamber and provided with a bore therein and with a rigid indicating arm extending adjacent the bore, a tubular thrust member extending through the bore and rigidly connected with the arm, an annular diaphragm connecting the thrust member and the first named member and an auxiliary device fitting the interior of the tubular member.

In testimony whereof I affix my signature.
EDWARD J. MARTIN.