Jan. 12, 1937. W. P. BRUSH 2,067,256

IGNITION TESTING SYSTEM

Filed May 7, 1935 2 Sheets-Sheet 1

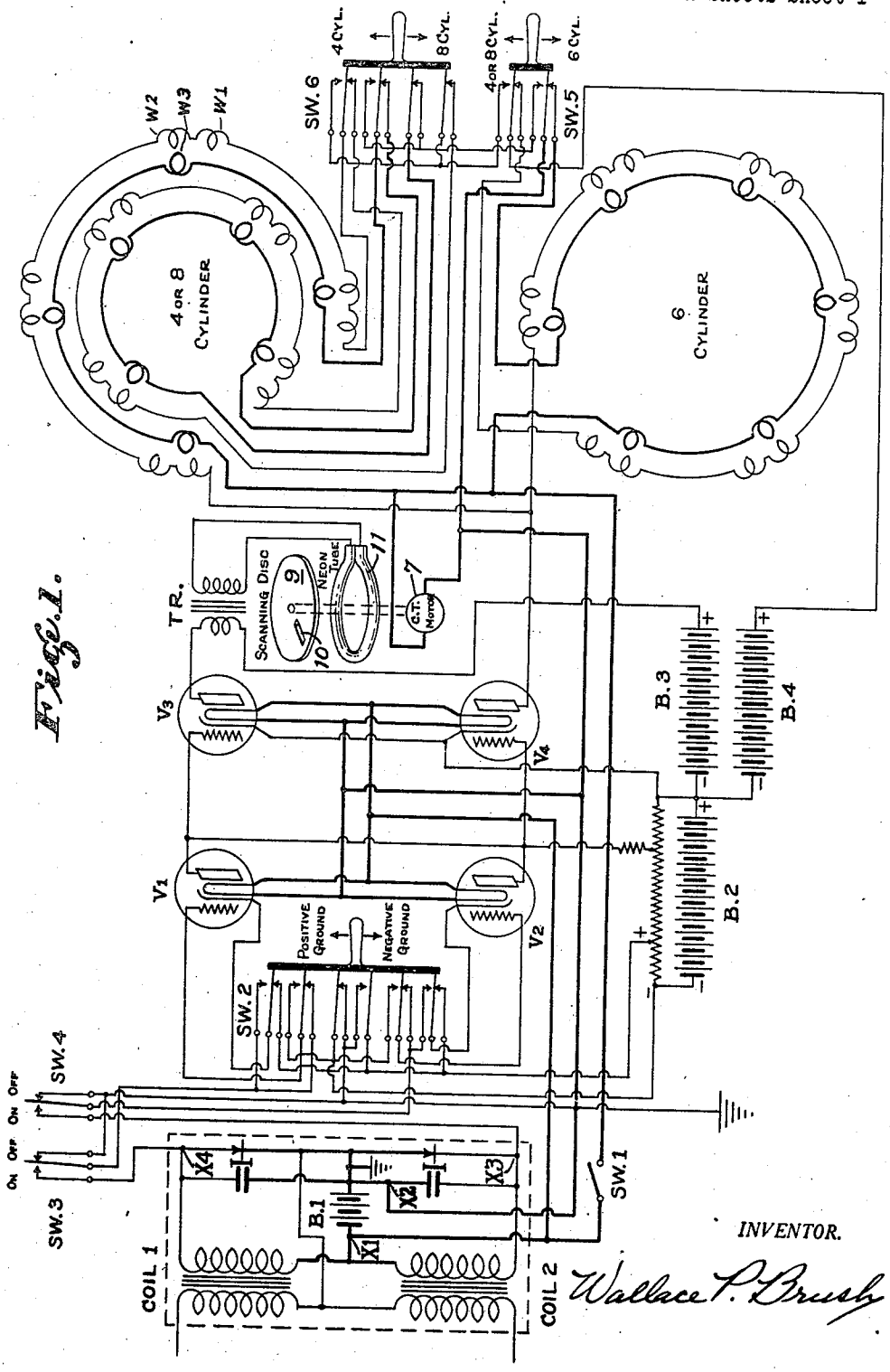


Fig. 1.

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Fig. 2.

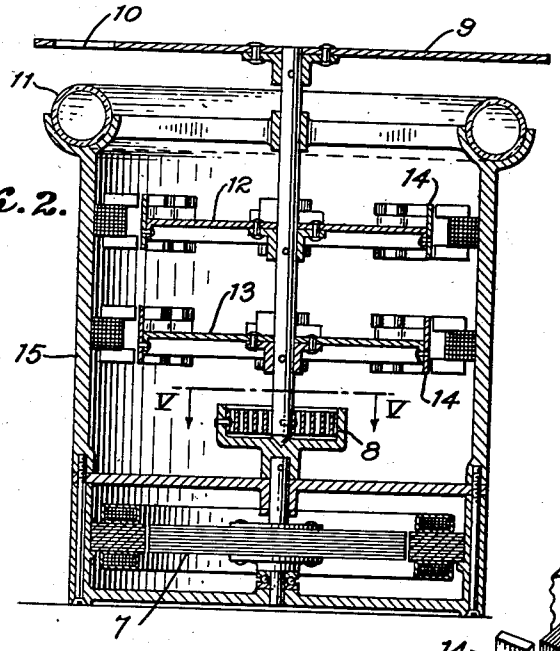


Fig. 4.

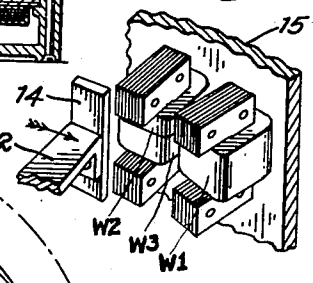


Fig. 3.

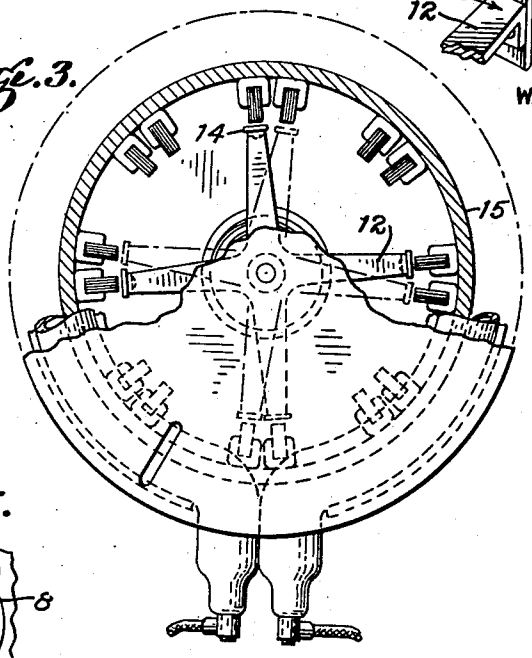
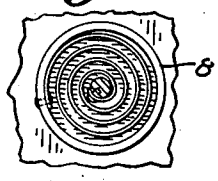


Fig. 5.



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IGNITION TESTING SYSTEM

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Application May 7, 1935, Serial No. 20,218

1 Claim. (Cl. 175—183)

My invention relates to an improved means of obtaining from ignition systems used on internal combustion motors, while in operation, electrical impulses whereby various external apparatus may be operated in coordination with the revolutions of the motor, without disturbing the equipment on the motor, and without introducing into or taking from the ignition circuits, electric current, inductance or capacity, of sufficient magnitude to cause any disturbance in the normal functioning of the ignition system.

The main object of the invention is to provide means whereby the number of radial degrees of rotation of the igniter during which the contacts are closed and the number of degrees they are open, may be readily ascertained; without removing any portion of the ignition apparatus and circuit. This is accomplished by noting the number of degrees of revolution of the disc during which the illumination is visible and the number of degrees of darkness. Similar results are obtained in a manner somewhat similar in operation and no claim is made for novelty of the intermittent illumination of the lamp scanned by the disc or drum. The novelty of my invention resides in the means hereinafter described, of obtaining the results while the motor is running, without removing any apparatus from the motor or affecting the functioning of the ignition apparatus or circuit in any way. The great value of the system over those now in common use, is that the functioning of the ignition system is observed when the motor is running, obviating errors in obtaining such information where the igniter is removed from the motor and examined separately, or where such examination is made without the motor in operation. Also there is the saving in labor involved, as with this system it is only necessary to attach clip terminated leads to each terminal of the ignition battery and to the insulated primary circuit contact or contacts on the igniter, and the device is ready for use. The entire group of equipment may be mounted in a case from which the leads last mentioned protrude, and the unit set alongside the motor for use. The control switches are preferably mounted on a top or front panel of the case, and the drum or disc viewed through a hole in same panel.

Another object of the invention is to provide means whereby a revolution counter or speed indicator may be held in definite relationship to the motor revolutions and at a distance from the motor.

A further object of the invention is to utilize the impulses so derived to actuate illuminating devices such as the cathode ray tube or low inertia gaseous tube scanned by a disc, drum, or moving strip, to form a visual picture of the currents flowing in the ignition circuit while the latter is operating the motor.

These results are accomplished as shown on the accompanying drawings, by connecting across the igniter interrupter contacts, the input or grid circuit of a radio type tube or valve, the applied grid potential of which is varied in the amount of the voltage supplied to the ignition primary circuit, at each opening and closing of the interrupter contacts, thereby controlling current surges in the anode circuit of the tube, which are conventionally amplified to supply power impulses in two individual circuits, one for controlling the movement of a disc or drum, and the other circuit for causing the periodic lighting and darkening of an illuminating lamp or tube to be observed through an aperture in the moving member.

Fig. 1 shows the electrical circuits.

Fig. 2 is a side elevation in section showing the motor and control unit.

Fig. 3 is a plan view, partially broken away, of the revolution controlling unit.

Fig. 4 is a fragmentary perspective view of a pair of the electro-magnets and the extremity of one of the arms of the rotor.

Fig. 5 is a section taken on line V—V of Fig. 2, showing the flexible drive coupling between the driving motor and the control units.

Like reference characters indicate like parts throughout the following specification and drawings. In Fig. 1 the conventional ignition primary circuit is shown within the broken lines, a dual coil and breaker type being shown to illustrate the switching arrangement used when applied to motors employing either one or two such circuits. Connections are made to the ignition system at points X1, X2, X3 and X4. Heavy lines throughout the diagram indicate low voltage circuits supplied by the ignition battery, marked B1. B2, B3, and B4 are batteries or voltage supply units to supply the required external power. When two coils and interrupters are used on the motor, switches 3 and 4 are both thrown to the "on" position. Where only one is used, either 3 or 4 is left in the "off" position and the other channel connected and thrown "on". The cathodes and grids of V1 and V2 are connected, with switch 2 in either position, to the voltage divider across B2, to supply the selected negative bias potential to the grids of V1 and V2 when the ig-

niter contacts (I) are closed, and with switches 3 and 4 in either position. With one or both of the latter in the "on" position, when the associated interrupter contacts I open, this bias is reduced in effect on the grids by the potential of the ignition battery; the reversing switch SW2, permitting connection of the apparatus to ignition circuits wherein either positive or negative terminal of the battery faces the ignition coil. The resultant current surges in the anode circuits of V1 and/or V2 are amplified by the power valves V3 and V4, the outputs of which are used individually, one being used as shown to excite the primary of transformer TR, the secondary of which causes illumination of the glow tube, and the other tube output being used to control the moving disc or drum, thus preventing the possibility of reactant currents in the latter circuit being reflected into the tube illuminating circuit, with consequent error, if the two were not so isolated. In Fig. 2 a conventional series connected, direct current, electric motor of sufficiently low power to be held motionless, with power on, by the magnetic attraction of the controlling device, is shown 7, connected through flexible coupling 8, (detail Fig. 5) to a floating shaft to which is fixed a disc 9 with a radial slit 10 through which the illumination of glow tube 11 is viewed. Also integral with the shaft are two spiders or rotors 12 and 13 of non-magnetic material, to the extremities of which are fixed vertical strips of magnetic metal 14. Twin coils with cores as shown in Fig. 4 are affixed at determined intervals to the circular frame 15, eight pair being used with a rotor of four arms, (No. 12, Fig. 3) as one unit, and six pair with a three arm rotor 13 as another unit. Switch 5, Fig. 1 selects which unit shall be operative when using the device with an internal combustion motor of four cylinders, or a multiple thereof, or with a six cylinder or multiple. With switch 5 in the lower position the unit comprising six pairs of coils is operative for a six cylinder motor. With switch 5 in the upper position, switch 6 connects four pairs of coils at 90 degree intervals into use for a four cylinder motor; or eight pairs at 45 degree intervals for use with an eight cylinder motor. Coils W1 and W2 in Figs. 1 and 4 are in series with each other in each group, and receive current via the anode circuit of vacuum tube V4. Coils W3 are continuously excited by low voltage supplied by battery B1 when switch SW1 is closed. Assuming right hand rotation of motor 7, the left hand coil of each pair is compound wound, the tube anode circuit winding being opposed in relation to the low voltage winding, and so proportioned that when both windings are excited neutralization of magnetic flux in the core is produced. The winding of the second or right hand coil of each pair is in the tube anode circuit, is in series with and functions simultaneously with the neutralizing winding of the first coil of the pair.

With connections made to the ignition system and with switches 3 or 4 or both in the "on" position as required, closing switch 1 supplies power from battery B1 to motor 7 and to the low voltage winding on the left hand coil of each pair, the latter locking the movement of the rotor against the pull of motor 7, assuming that igniter contacts I are in the closed position. Upon their opening a surge of current in the anode circuit of V4, in which the coils are connected as described, causes neutralization of flux in the left hand coils, permitting the rotor to move to the right hand coil where it would again be locked, until the closing of the ignited contacts drops the current in the anode circuit of V4, thereby dropping the flux in the right hand coils, permitting the rotor to move forward to the next pair of coils where it is again stopped by the constant flux in the first coil of each pair, maintained by B1; provided that during this interval of rotation the igniter contacts have closed. In the event that these were still open, with consequent current flowing in the anode circuit of V4, the rotor would pass the then neutralized first coil, but would be held by the right hand one of the pair, until closing of the igniter contacts caused stoppage of the exciting current. In this manner synchronous rotation in relation to the opening and closing of the interrupter contacts is maintained, and proper apportionment of weight of revolving member affecting its inertia, power of motor 7, and design of flexible coupling 8, makes possible satisfactory observance of the action of currents in the ignition circuits. The amplification circuits are conventional and no claim is made in that connection for originality other than those portions specified in the following claim.

Having described my invention, that which I claim to be new and desire to procure by Letters Patent is:

An ignition testing device comprising a three or more element vacuum tube, connections from the grid-cathode circuit of said tube adapted for connection to the contacts of the interruptor of an internal combustion motor ignition system, an illumination element, a rotating apertured element for viewing the illumination element, and means connected to the plate circuit of said vacuum tube for enabling surges in the said plate circuit to operate separately but synchronously the said respective illumination and rotating elements, whereby the voltage variations attendant upon the normal opening and closing of the interruptor contacts produce visible indication of electrical conditions in the ignition system without disturbing the functioning of that system.

WALLACE P. BRUSH.