United States Patent

Westberg

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[54] TACHOMETER CIRCUIT FOR AN INTERNAL COMBUSTION ENGINE OR THE LIKE

[72] Inventor: **Vivian Luther Westberg,** 3400 Westach Way, Sonoma, Calif. 95476

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[52] **U.S. Cl.** .....**324/169,** 324/78 I

[51] **Int. Cl.** **G01p 3/48**

[58] **Field of Search** .....324/78 I, 78 E, 166–171, 324/173–175; 317/5

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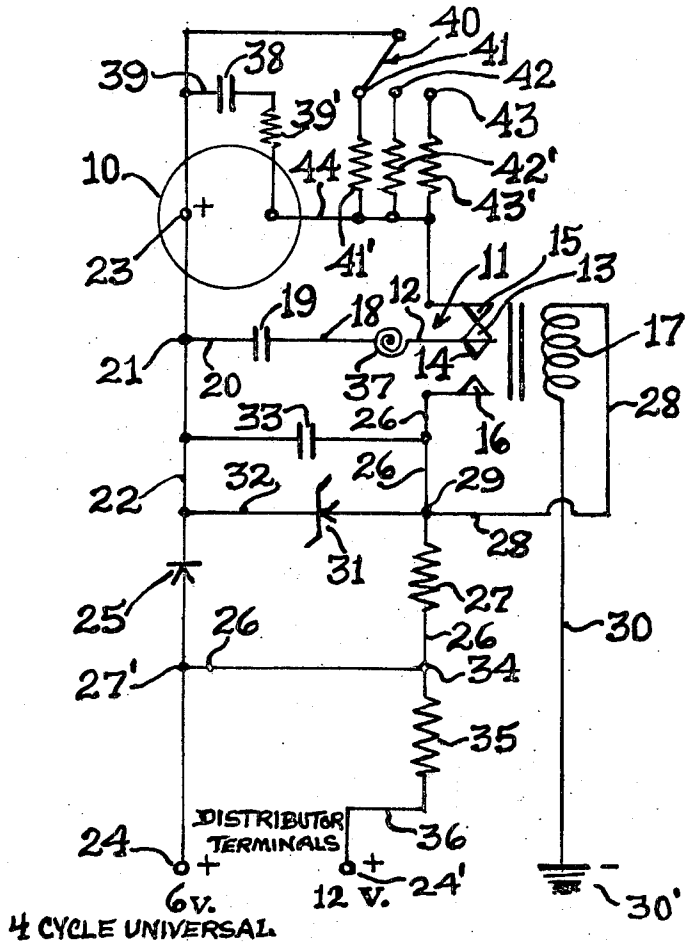
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Primary Examiner—Michael J. Lynch
Attorney—Edward C. Threedy

[57] **ABSTRACT**

A tachometer wherein the current for the charging capacitor of the tachometer measuring circuit and the current for energizing the coil of the relay switch in the circuit, are from a single source, the tachometer having incorporated in its circuit an arrangement to permit its universal use on four-cycle engines with four, six, or eight cylinders, and having the further provision wherein the capacitor may be charged by the multiple pulsing from the center of low-tension magneto, assuring a sufficient amount of current per unit of time for full zener control. A further improvement in switching provides a similar universal feature on three ratios of two-cycle engines.

1 Claims, 8 Drawing Figures



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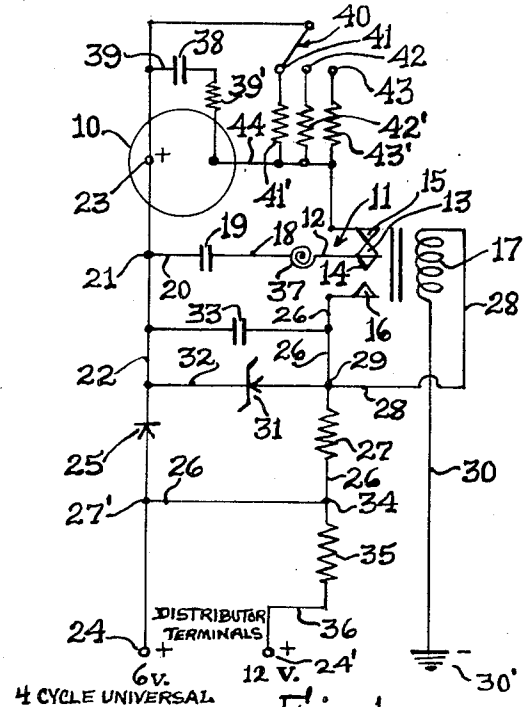


Fig. 1.

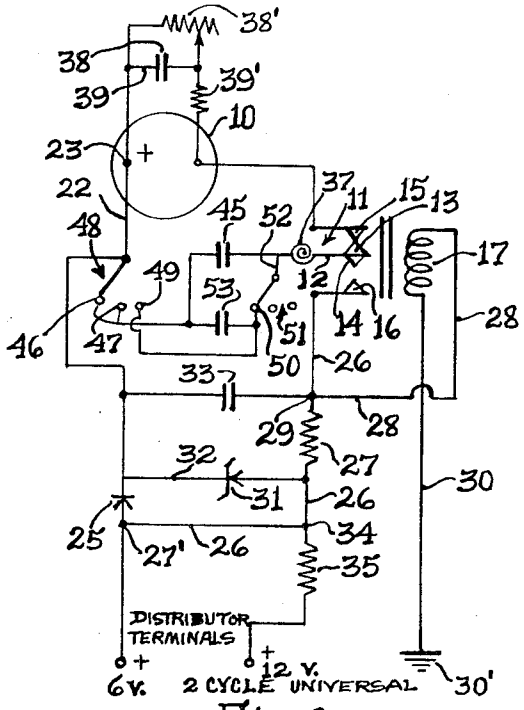


Fig. 2.

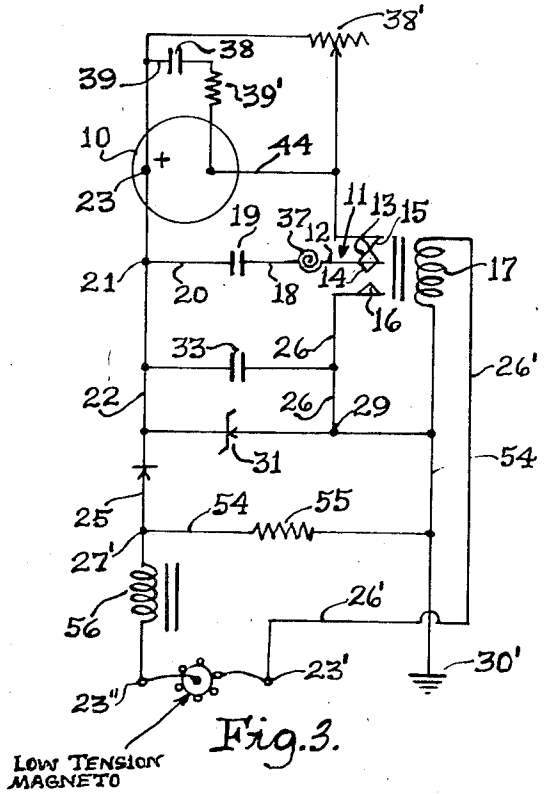


Fig. 3.

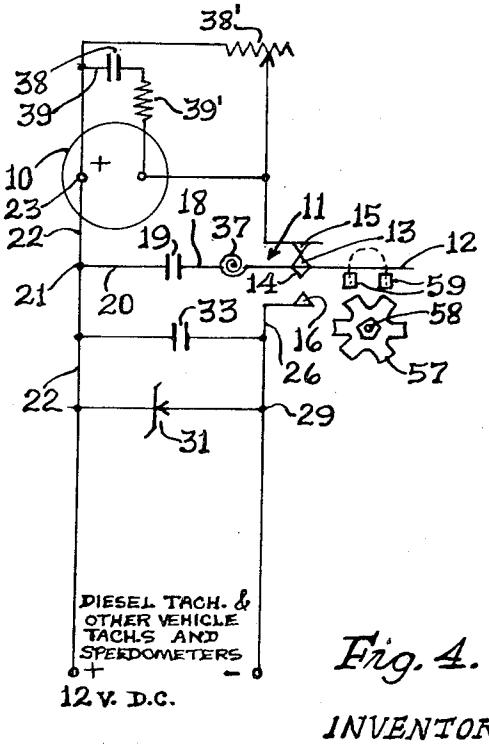


Fig. 4.

INVENTOR.
VIVIAN LUTHER WESTBERG
BY Edward C. Threedy
HIS ATTORNEY.

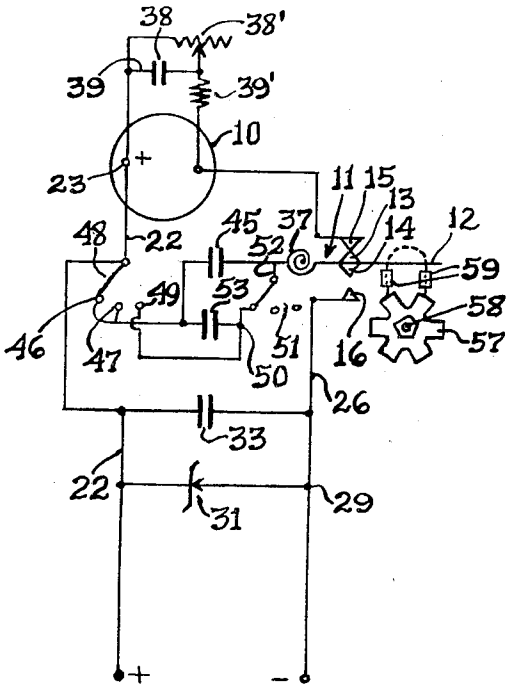


Fig. 5.

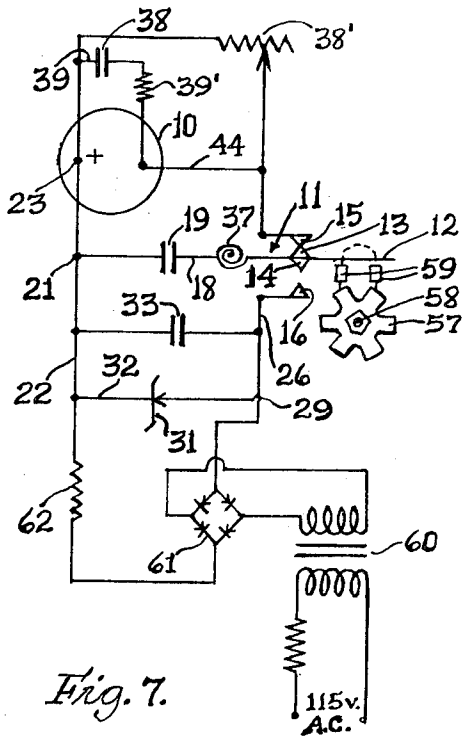


Fig. 7.

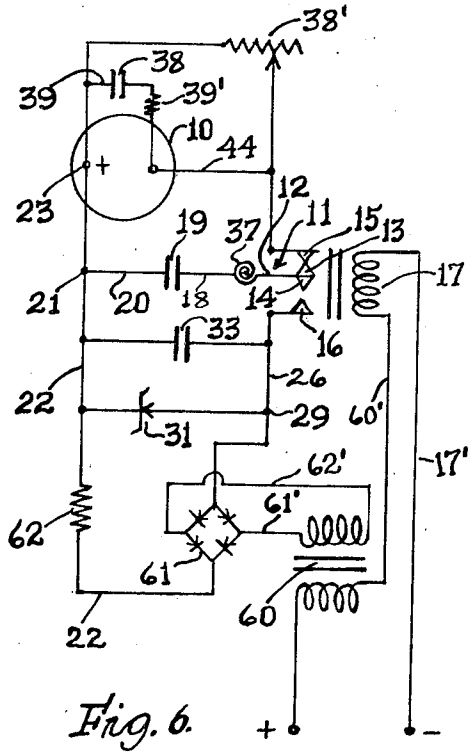


Fig. 6.

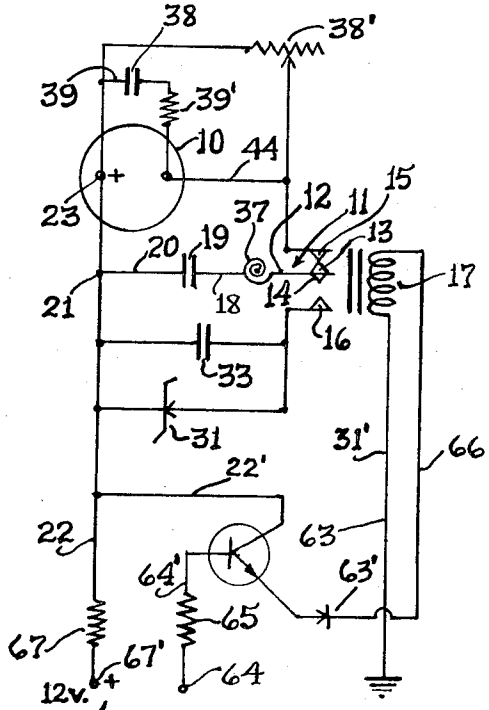


Fig. 8.

INVENTOR.
VIVIAN LUTHER WESTBERG
BY
Edward C. Threedy
HIS ATTORNEY.

TACHOMETER CIRCUIT FOR AN INTERNAL COMBUSTION ENGINE OR THE LIKE

The novelty over the prior art of my improved tachometer circuit resides in the fact that (1) the circuit may be independently charged by a 6 v., 12 v., or magneto source; and (2) by the use of a zener diode, the current required to charge the capacitor of the circuit and that used to operate the relay, is from the same power source. In addition to the foregoing advantages and novelty over the prior art, the employment of a selector switch and the use of precalibrated shunt resistors across the meter provides for selection of four, six, or eight cylinders on four-cycle engines, thus dispensing with a multiplicity of components otherwise required for all four-cycle engines. Another switch arrangement provides selection of three ratios on two-cycle engines.

The invention consists of the combination and arrangement of parts shown in the accompanying drawings, in which:

FIG. 1 is a schematic diagram of my improved four-cycle tachometer circuit;

FIG. 2 is a schematic diagram of my improved two-cycle tachometer circuit showing a variation thereof;

FIG. 3 is a schematic diagram of a tachometer circuit similar to that shown in FIG. 1, but illustrating a further modification for low speed on low tension magnetos;

FIG. 4 is a schematic diagram of a tachometer circuit in which a rotating magnet is used to actuate the relay switch embodied in the circuit;

FIG. 5 is a schematic diagram of a tachometer circuit showing a further modification over that shown in FIG. 2;

FIG. 6 is a schematic diagram of a tachometer circuit similar to that shown in FIG. 1, but showing the employment in the circuit of a full wave rectifier bridge;

FIG. 7 is a schematic diagram of a tachometer circuit similar to that shown in FIG. 6, but illustrating a further modification; and

FIG. 8 is a schematic diagram of a tachometer circuit similar to FIG. 6, but showing incorporated therein a transistor driving network.

Referring particularly to FIG. 1 showing one form of the invention, there is employed in the tachometer circuit a conventional-type meter 10 for indicating the r.p.m.'s of an internal combustion engine. There is also employed in such tachometer circuit a relay 11 of the conventional type comprising an armature 12 having oppositely disposed contacts 13 and 14 engageable with stationary contacts 15 and 16, respectively.

The armature 12 is actuated by a coil 17. The armature 12 by a conductor 18 is connected to one side of a charging capacitor 19. By a conductor 20, the opposite side of the capacitor 19 is connected as at 21 to a conductor 22. The conductor 22 connects one side 23 of the meter 10 to the positive side of a 6 v. distributor of an ignition system of an internal combustion engine when the terminal 24 is connected thereto. If a 12 v. distributor is to be utilized, then terminal 24' is connected thereto in place of terminal 24. In the conductor 22 is a diode 25 which allows passage of current from the power source in the direction of the capacitor 19 but opposes its flow in an opposite direction. A common lead conductor 26 for each of the terminals 24 and 24' when one or the other is used connects the stationary contact 16 to the conductor 22 at a point indicated at 27' below the diode 25. In this conductor 26 is a power resistor 27.

A conductor 28 connects one side of the coil 17 to the conductor 26 at a point indicated at 29 in advance of the resistor 27. The opposite side of the coil 17 is connected by a conductor 30 to the negative side or ground 30' of the distributor of the engine. Extending between the conductor 22 and the conductor 26 and having incorporated therein a zener diode 31 is a conductor 32. A filter capacitor 33 is connected across the zener diode 31.

As a constant-level voltage is essential for accurate meter reading, the zener diode 31 is here used as a voltage regulator for the meter circuit. The capacitor 33 is used to store sufficient power from pulse to insure full full zener-regulated voltage throughout the pulse cycle for charging the capacitor 19.

Connected as at 34 to the conductor 26 below the resistor 27, is a resistor 35 connected by a conductor 36 to the positive side 24' of a 12 v. distributor or other pulsing device.

The purpose or function of the resistor 35 is to drop the voltage to a level compatible with the relay coil 17 and the meter 10, thus to protect the circuit from overload. The resistor 27 forms the power supply for the zener-charging system.

The frequency with which the capacitor 19 is charged and discharged is proportionate to the r.p.m.'s of the engine. By providing the meter 10 responsive to the current transferred by the capacitor 19, the frequency of operation of the relay 11 and therefore the r.p.m.'s of the engine, may be directly indicated on the meter 10. This result is brought about in the following manner:

Normally the contact 13 is in contact with the stationary contact 15, connected by a conductor 44 to one side of the meter 10, with the result that an electric charge or impulse is discharged into the meter 10. Upon energization of the coil 17, the armature 12 is biased against the action of a spring 37, bringing the contact 14 thereof into contact with the contact 16, thus to charge the capacitor 19 at each pulse. Since the voltage of the current to the capacitor 19 is regulated by the zener diode 31, the capacitor 19 is charged to a constant voltage value each time the relay is energized to make and break contact between the contacts 14 and 16 and 13 and 15, respectively, the capacitor 33 being used to insure full zener voltage throughout pulse cycle.

As herein described and as shown in FIG. 1, the tachometer circuit above described may be used with either a 6 v. or a 12 v. source without in any way changing the relationship between the component parts of the tachometer circuit.

A filter capacitor is by line 39 connected across the contacts of the meter 10 to insure complete discharge of the capacitor 19 in minimum time. A resistor 39' of 100 ohms is placed in line 39 to prevent any possible pitting between the contacts of slow-speed tachometers.

Incorporated in the circuit shown in FIG. 1, is a selective switch 40 including a blade 40' adapted to selectively engage contacts 41, 42 and 43 connected to the conductor 44 through precalibrated shunt resistors 41', 42' and 43', each of a different predetermined value requisite to the type engine with which the tachometer is used, to automatically calibrate the meter for corrected reading for either four, six, or eight-cylinder engines.

By such an arrangement, only one tachometer is required for accurate reading of r.p.m.'s of four, six, or eight-cylinder engines.

A tachometer having the features herein described performs with a high degree of accuracy due to zero resistance of silver contacts of relay. This is not true with transistor or similar energy transfer units. This zero resistance also eliminates errors of other systems with change of temperature from −150° F. to +150° F.

The tachometer circuits illustrated in FIGS. 2 to 8 inclusive are similar to that shown in FIG. 1, with certain modifications which will be presently made apparent. The components included in each of the circuits of FIGS. 2 to 8 inclusive which are common to those used in the circuit of FIG. 1, will be referred to by the same reference numerals.

In this connection, referring specifically to FIG. 2, the armature 12 of the relay 11 is connected to one side of a capacitor 45, the opposite side of such capacitor being connected to two contacts 46 and 47 of a three-point switch 48. The third point 49 of the switch 48 is connected to a contact 50 of a switch 51, the switch 51 being connected as at 52 to the armature 12. A second capacitor 53 is connected between the contact 50 and the contacts 46 and 47 of switch 48, which switch 48 is connected to the conductor 22. Connected across the capacitor 38 is a variable resistor 38' to calibrate the meter 10 when switch 48 is in the position shown in FIG. 2, with the contact 46 engaged.

The arrangement is such that by adjustment of the switches 48 and 51, the equally matched capacitors 45 and 53 are con-

nected in parallel, connected singly, and then both connected in series when the contact 49 is engaged. Thus only one calibration by resistor 38' provides accurate calibration of all three ratios, one-half, 1 and 2 on two-cycle engines and engines inherent with such capacitor connections. This simplified calibration and ease of selecting equal matched capacitors insures manufacturing economy.

The tachometer circuit illustrated in FIG. 3 is especially designed for use in connection with low speed engines, for example, 500 r.p.m.'s., where the relay pulse is taken from each cylinder and the zener power from all cylinders. This multiple pulse provides sufficient power coverage across the zener diode 31 and the capacitor 33 for zener voltage control.

One side of the coil 17 is by a conductor 54 connected to the conductor 22 and to the ground side indicated at 30'. The opposite side of the coil 17 by a conductor 26' is connected through a cylinder terminal 23' to the positive side of the single coil of a low-tension magneto. In the conductor 54 is incorporated a resistor 55 which powers the zener diode 31 from the undistributed center of the low-tension magneto, the resistor 55 being the same as the dropping resistor 27.

To prevent ignition cutout there is incorporated in the conductor 22 a choke coil 56 that is connected to one side 23'' to the center contact of a magneto. The multiple pulse system shown in FIG. 3 is connected to the center of the distributor such that a sufficient number of pulses from the distributor assures an adequate supply of current per unit of time (for example, the distributor is operating to supply eight pulses per second), to supply enough current to the zener diode to maintain the proper voltage for the meter circuit.

The tachometer circuit shown in FIG. 4 basically is the same as that shown in FIG. 1 except that in lieu of the use of a coil for actuating the armature of the relay 11, there is employed a permanent magnet 57 fixed to and rotatable with a shaft 58 connected to the device or engine, the speed of which is to be indicated by the meter 10. This permanent magnet 57 cooperates with a pair of posts 59 for vibrating the armature 12 to alternately engage the contacts 13 and 14 thereof with the contacts 15 and 16. The component parts of FIG. 1 which are used in the circuit shown in FIG. 4 are designated by the same reference numerals. To this circuit of FIG. 4 can be added the switches 48, 51 to provide a universal diesel tachometer.

The tachometer circuit shown in FIG. 5 is a variation of the circuit shown in FIG. 2 and principally differs therefrom in that in lieu of the relay switch of FIG. 4, the armature is actuated by the rotating permanent magnet employed in FIG. 4.

The tachometer circuit shown in FIG. 1 has been modified in the manner illustrated in FIG. 6. In the circuit shown in FIG. 6, there is incorporated in addition to most of the components shown in FIG. 1, a transformer 60 connected by a conductor 60' to one side of the coil 17 and a full-wave rectifier network 61 connected by conductors 61' and 62' to the secondary side of the transformer 60 and by conductors 29 and 22 to the circuit of the tachometer. The opposite side of the coil 17 by conductor 17' is connected to the negative side of a 115 v. AC power source 18'. Thus, the relay operation is in phase with the pulsing of the power source 18' in the manner of a frequency meter. Such an arrangement develops a constant regulated voltage across the zener diode 31. The resistor 62 is used to drop the 115 v. AC current to a value compatible with the regulated voltage of the meter circuit.

The tachometer circuit shown in FIG. 7 differs from that shown in FIG. 6, in that in lieu of the relay switch there is employed the rotating permanent magnet of the circuit shown in FIG. 4, for actuating the armature.

The tachometer circuit shown in FIG. 8 is a variation over that shown in FIG. 6, in that in lieu of the full-wave rectifier network and transformer as employed in the circuit shown in FIG. 6, there is employed in FIG. 8 a transistor 63. The base of the transistor 63 is connected by a conductor 64' to a terminal 64 of an ignition coil (not shown). The conductor 64' has incorporated therein a power resistor 65. The emitter of the transistor 63 is by a conductor 66 connected to one side of the relay coil 17. The conductor 66 has incorporated therein a diode 63' permitting flow of current only to the relay coil 17. The collector of the transistor 63 by a conductor 22' is connected to the conductor 22 in turn connected to one side 23 of the meter 10. In the conductor 22 is incorporated a resistor 67, the conductor 22 being connected to a 12 v. positive terminal 67'. The coil 17 is grounded by the conductor 31'. In this circuit the current is amplified in magnitude by the transistor 63 to a value which is sufficient to operate the relay coil 17 for obtaining accurate meter reading.

The amplification of the current is desirable where the effective power on the primary of an ignition coil is of insufficient duration to actuate the relay, with the result that without such amplification an inaccurate reading on the meter would result.

The conductors incorporated in the various circuits shown in FIGS. 1 to 8 inclusive are relatively short and when the components are assembled as a unit, a compact unit results.

While I have illustrated and described the preferred form of construction for carrying my invention into effect, this is capable of variation and modification without departing from the spirit of the invention. I, therefore, do not wish to be limited to the precise details of construction set forth, but desire to avail myself of such variations and modifications as come within the scope of the appended claims.

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

1. An improvement in a tachometer circuit including a meter, a relay switch operated by a relay coil to alternately engage contacts to actuate the meter, wherein the improvement comprises

a. a pair of terminal connectors for selectively connecting one side of the meter to a positive terminal of an electrical pulsing power source of determined voltage,

b. a conductor connected to one of said pair of terminal connectors and connected to one side of the meter 10 and including a diode that permits flow of current through the conductor in the direction of the meter,

c. a line connection including a series of bleeding resistors connected in parallel with the other side of the meter and one stationary contact of the relay switch and having a switch for selectively connecting one of the resistors to the meter,

d. a second line connection between the other stationary contact of the relay switch and said first-mentioned conductor at a point between the meter and the diode and including a voltage dropping resistor,

e. a second conductor connecting one side of the relay coil to said first-mentioned conductor between the diode and the meter and including a zener diode,

f. a ground connection for the opposite side of the relay coil,

g. a movable contact of the relay switch connected to said first-mentioned conductor and including a capacitor having one side connected to said first-mentioned conductor and an opposite side to the movable contact, h. a filter capacitor connected between said second line connection and said first-mentioned conductor in parallel to said capacitor and said zener diode,

i. and a line connection for said other of said pair of terminal connectors including a dropping resistor connected to said first-mentioned conductor between said one of said terminal connectors and said diode.

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