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ELECTRIC TACHOMETER USING BIASED PULSE TRANSFORMER

Filed March 28, 1960

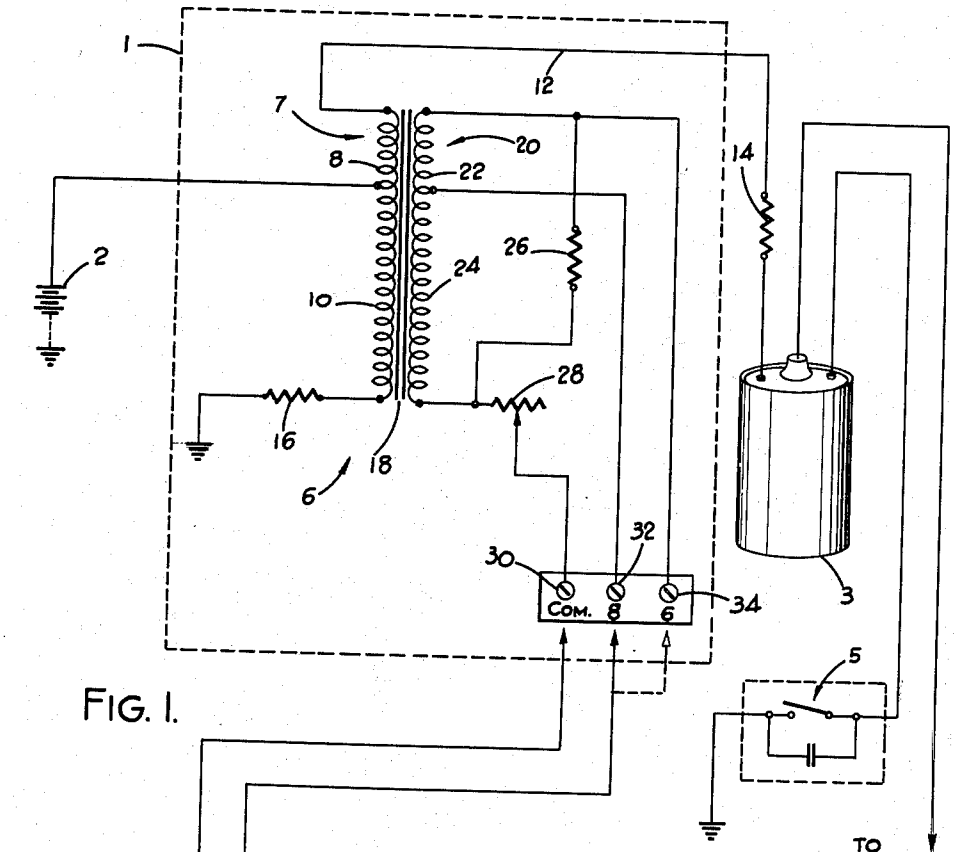
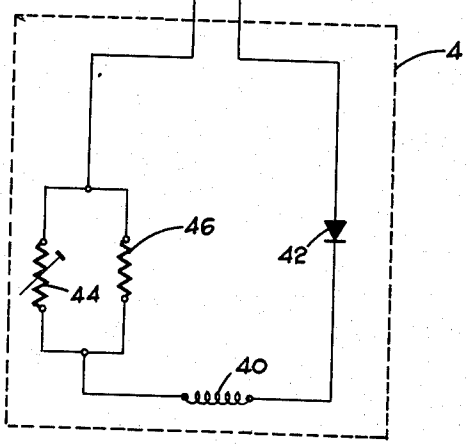


FIG. 1.



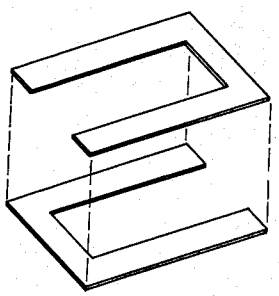


FIG. 2.

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This invention relates generally to electrical tachometers and more particularly to an improved electrical tachometer energized by a vehicle ignition circuit.

Many attempts have been made to provide an accurate tachometer energized from the primary side of a vehicle ignition system. However, so far as is known, each of the prior attempts has been subjected to one of two serious disadvantages. In one instance, it is not possible to provide a tachometer which can provide an accurate indication of engine speed on all types of vehicles and/or accurate indications independent of variations in the voltage of the ignition system and variations in the complex wave forms occurring in the ignition primary circuit. In the other instance where the above disadvantages have been partially alleviated, an unusually high cost electronic circuit means has been necessary to maintain consistent accuracy under all conditions of use. The high cost of the latter approach has rendered its commercial use impracticable insofar as equipping the more common vehicle lines.

Accordingly, it is the primary object of the present invention to provide a simple, low cost electric tachometer which is independent of variations in vehicle battery voltage and variations in the wave forms of the primary circuit of ignition systems. This object is accomplished in the preferred embodiment by connecting the primary winding of a pulse transformer in series with the primary winding of the ignition coil. The transformer is normally biased to saturation in one direction and closure of the breaker points produces saturation of the transformer in the opposite direction to produce a uniform output pulse in the secondary winding of the transformer. A rectifier in the output circuit prevents an output pulse to the indicator when the breaker points are opened. The output pulses of the pulse transformer may be conveniently fed to a voltmeter for speed indication.

Other objects and the various features of the invention will be evident on a perusal of the following description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a schematic diagram of the improved tachometer circuit; and

FIG. 2 is a perspective view of two laminations of the pulse transformer core.

Briefly, the improved tachometer circuit comprises a sender 1 connected to a battery 2, an ignition coil 3 and a receiver 4. The ignition coil in turn is connected to breaker points 5.

The sender 1 includes a transformer 6 with a primary winding 7 having two sections 8 and 10. The transformer section 8 is connected to the primary winding (not shown) of the ignition coil 3 by way of a conductor 12 and a resistor 14. The other end of the section 8 is connected to the ungrounded side of the battery 2. The transformer section 10 is connected across the battery 2 by way of a current limiting resistor 16 whereby the battery normally biases the transformer core 18 to saturation in one direction.

The transformer 6 includes a secondary winding 20 with two sections 22 and 24. A resistor 26 is connected in parallel across the secondary winding 20. An adjusting resistor 28 is connected in series with the lower

terminal of the secondary winding 20. The section 24 is connected across terminals 30 and 32 for connection with the receiver 4 in the event that the tachometer is utilized with an 8-cylinder engine. Both sections 22 and 24 are connected across the terminals 30 and 34 for connection with the receiver in the event that the tachometer is utilized with a 6-cylinder engine.

The receiver 4 comprises a conventional moving coil voltmeter 40, a rectifier 42 and a parallel connected thermistor 44 and resistor 46. As indicated earlier, the rectifier passes a transformer pulse only when the breaker points 5 are closed and prevents a pulse when the breaker points are subsequently opened. The thermistor and resistor combination provide an ambient temperature compensation means for the rectifier and voltmeter. It can also compensate for ambient temperature errors of the transformer in the event that the transformer is positioned so as to be in the same ambient environment as the voltmeter.

In one commercial embodiment, it has been found that components having certain characteristics have provided very desirable operation at minimum cost. Thus the transformer 6 may include a primary section 8 with approximately 40 turns, a primary section 10 with 80 turns, a secondary section 22 with 76 turns and a secondary section 24 with 217 turns. The battery 2 supplies energy at 12 volts. The current limiting resistor may be in the order of 100 ohms. Resistor 26 may be approximately 1,000 ohms. It is noted that this inexpensive resistance permits the use of a very inexpensive rectifier 42 which would otherwise break down under the peak output pulses on secondary winding 20. The maximum resistance of the resistor 28 may be in the order of 25 ohms and is provided for the purpose of adjusting the output of the transformer to a predetermined value with a predetermined number of pulses.

The transformer core 18 is preferably formed of U-shaped laminations as shown in FIG. 2 to assure substantially simultaneous saturation of all core portions. It is important that all core portions saturate substantially simultaneously if consistently accurate indications are to be achieved.

The operation of the improved tachometer will now be described in detail. The breaker points 5 are intermittently interrupted in a well known manner to cause pulses in the primary winding of the ignition coil 3. These pulses in turn produce very high potential pulses in the secondary winding of the ignition coil. These high potential pulses are applied sequentially to a series of spark plugs in a well known manner by a distributor. The pulse applied across each spark plug ignites a combustible fuel mixture in its corresponding engine cylinder.

The primary winding pulse is also applied to the series connected transformer winding section 8. This pulse is of a polarity and of an energy level such as to drive the transformer core from saturation in the biasing direction to saturation in the opposite direction. A corresponding pulse of uniform voltage is produced in the secondary winding 20. The value of this voltage depends upon whether one section 24 or both sections 22 and 24 are connected in the receiver circuit. This energy is delivered to the moving coil meter 40 by way of the rectifier 42 and the thermistor 44 and resistor 46. When the breaker points 5 subsequently open, the battery 2 returns the transformer 6 to its biased saturation condition. This would normally produce a corresponding output pulse in the secondary winding 20. However, the rectifier 42 prevents passing of this energy to the meter 40.

In this regard, applicant wishes to set forth what he believes to be the reason for the requirement of rectifier 42 in more detail. However, it is to be understood

that he is not to be bound by such explanation. When the breaker points 5 close, it has been observed that the ignition coil primary circuit produces a high voltage, low energy level pulse of short time duration followed by a reasonably consistent, substantial energy level normal pulse. The improved circuit has displayed an ability to give accurate indications even though the two wave forms vary for different vehicle installations. Hence constant accuracy of indication by the meter 40 can be relied upon insofar as the energy transferred thereto upon closure of the breaker points is concerned.

However, upon the subsequent opening of the breaker points 5, it has been observed that intolerably inconsistent signals are produced. The improved circuit, wherein the transformer is driven from one saturated condition to the opposite saturated condition and wherein the rectifier 42 prevents pulses when the breaker contacts are opened, has exhibited the feature of eliminating noticeable error caused by the spurious signals.

While there has been described what is at present believed to be the preferred embodiment of the invention, it will be understood that various changes and modifications may be made therein; and it is contemplated to cover in the appended claims all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. In an electrical tachometer of the type in which an engine ignition system breaker points are cyclically opened and closed to produce ignition primary pulses and in which an electrical meter is energized in accordance with the pulses to indicate engine speed, the combination with the meter of a pulse transformer having a primary winding adapted for connection with the breaker points and having a secondary winding connected to the meter, means connected to at least a portion of said primary winding normally biasing the transformer to saturation in one direction, primary ignition pulses effective upon closure of the breaker points driving the transformer to saturation in the opposite direction to produce output pulses in the secondary winding substantially independent of variances in the magnitude and wave form of the ignition pulses for energizing the meter, and a half-wave rectifier in series connection with said meter and said secondary winding for preventing application of pulses to the meter incident to opening of the breaker points.

2. The combination of claim 1 together with a resistance shunting the secondary winding to inhibit excessive induced voltages in the secondary winding, and a calibrating resistor connected in series with the secondary winding.

3. In an electric tachometer of the type in which an engine ignition system breaker points in series with a D.C. voltage source are cyclically opened and closed to produce ignition primary pulses and in which an electrical meter is energized in accordance with the pulses at indicated engine speed, the combination with the meter of a pulse transformer having a secondary winding connected to the meter and a primary winding connected at one end to said breaker points and at its other end to ground, a tap on said primary winding connected to said D.C. source whereby one portion of said primary winding is in series with said voltage source and said breaker points and the other portion of said winding is connected in series between said voltage source and ground to normally bias said transformer to saturation in one direction, primary ignition pulses driving the transformer to saturation in the opposite direction to produce output pulses in the secondary winding substantially independent of variances in the magnitude and waveform of the ignition pulses for energizing the meter, and a halfwave rectifier series connected with said secondary winding and the meter to prevent application of pulses to the meter incident to opening of the breaker points.

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