

Nov. 13, 1962

E. J. DREISKE

3,064,188

TACHOMETER

Filed Feb. 4, 1958

FIG. 1

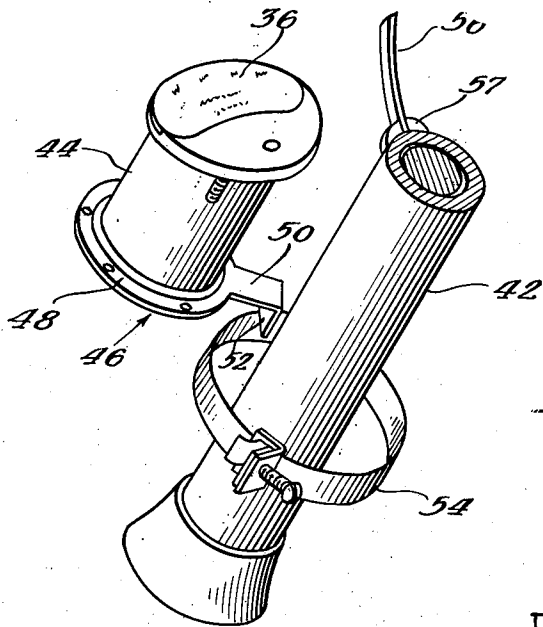


FIG. 3

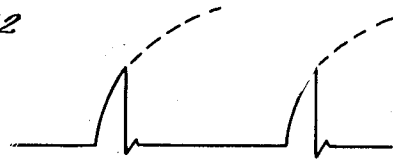


FIG. 2

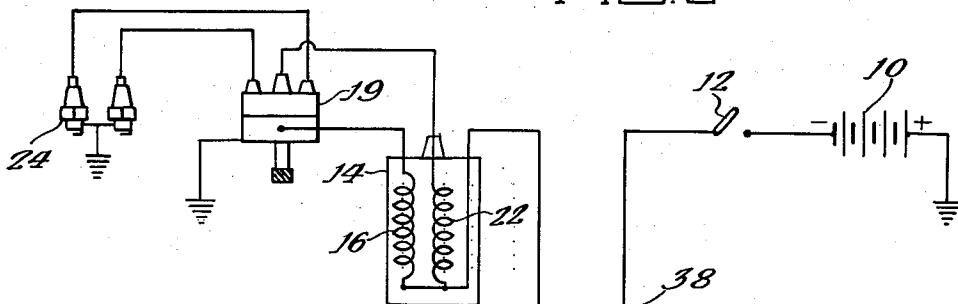
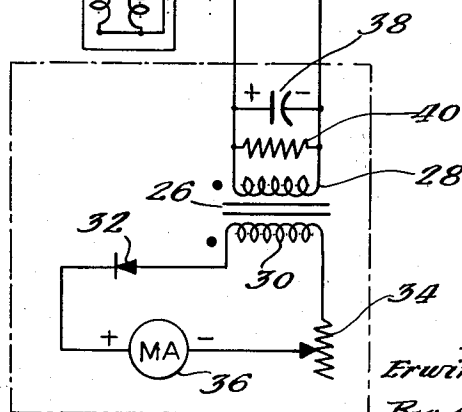
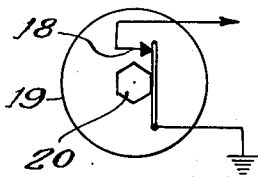


FIG. 2A



Inventor:
Erwin John Dreiske
By: *Prof. M. H. H. & Co.*
Attorneys

1

3,064,188

TACHOMETER

Erwin John Dreiske, Buchanan, Mich., assignor to Electro-Voice, Incorporated, Buchanan, Mich., a corporation of Indiana

Filed Feb. 4, 1958, Ser. No. 713,196

7 Claims. (Cl. 324—70)

The present invention relates to tachometers, and particularly to electrical tachometers suitable for use with internal combustion engines.

Two types of ignition systems are used for internal combustion engines, the magneto, and the battery and coil systems. The electrical tachometer here disclosed is particularly adapted for use with the battery and coil type of ignition system. In such a system, an ignition coil with a primary and a secondary winding is employed, the primary winding being connected in a series circuit with the battery and a circuit interrupter. The secondary winding of the ignition coil is connected in a series circuit with the battery, a distributor, and the spark plugs of the engine. When the circuit interrupter is closed, a current flows through the primary winding of the ignition coil, and when this current is interrupted, a large potential pulse develops across the secondary winding of the ignition coil. It is this pulse that is conducted to one of the spark plugs and develops the ignition spark.

It is one of the objects of the present invention to provide a novel electrical tachometer that utilizes the pulse rate of such an ignition system to determine the rotation rate of the motor. In the past, attempts have been made to connect electrical tachometers in parallel with the interrupter of the ignition system, and to the spark plugs of the motor. Such devices, however, deleteriously affect the operation of the ignition system of the motor.

It is a further object of the present invention to provide a novel electrical tachometer which totally derives its electrical energy from the ignition system of an internal combustion motor, and which does not adversely affect the operation of the motor. This is achieved in accordance with the present invention by connecting the primary winding of a transformer in series with the primary winding of the ignition coil and employing the pulses created by the closing of the ignition interrupter to produce pulses in the tachometer of equal amplitude. The transformer is designed to saturate at a lower current than develops in the primary winding of the ignition coil, so that pulses of equal amplitude are developed in the secondary winding of the transformer. The patent to Petroff et al., No. 2,773,238, also discloses a tachometer which employs a transformer in series with the primary winding of the ignition coil, however, the Petroff device employs the transformer as a step up transformer in a power source for operating a frequency meter.

It is a further object of the present invention to provide a tachometer for use with an internal combustion motor with means for calibrating the tachometer to the motor.

Additional advantages and objects of the invention will become apparent from a further reading of this disclosure, particularly when viewed in the light of the drawings, in which:

FIGURE 1 is a fragmentary exploded view of a tachometer constructed according to the present invention applied to an automobile engine, the meter of the tachometer being mounted to the steering column of the automobile;

FIGURES 2 and 2A are schematic electrical circuit diagrams of the tachometer illustrated in FIGURE 1 and the automobile ignition system; and

FIGURE 3 is a graph illustrating the time-amplitude characteristic of the potential produced in the secondary winding of the transformer of the tachometer.

2

FIGURE 2 schematically illustrates the ignition system of an internal combustion engine and a tachometer constructed according to the teachings of the present invention connected thereto. The ignition system has a power source or battery 10 connected through a switch 12 (which usually is provided with a lock) to the ignition coil 14. The ignition coil 14 has a primary winding 16 connected to the switch 12 and to one of a pair of contacts 18 which form the circuit interrupter and are located in a distributor 19. The other contact 18 is connected to the frame of the motor, as is the other terminal of the battery 10, thereby completing the circuit. The pair of contacts 18 are normally closed, and are opened by a cam 20 rotatably journaled on the axis of the distributor. The ignition coil 14 also has a secondary winding 22 which is connected at one end to the end of the primary winding 16 which is connected to the battery 10, and at the other end to the spark plugs 24 of the motor through the distributor 19.

The tachometer employs a transformer 26 with a primary winding 28 connected between the coil 14 and switch 12, and thus in series with the low voltage circuit of the ignition system. The transformer 26 has a secondary winding 30 connected through a diode rectifier 32 across a calibratable or adjustable voltmeter in the form of a variable potentiometer 34 and current meter 36.

Each time the contacts 18 close, a current builds up in the primary winding 16 of the ignition coil 14, and hence also in the primary winding 28 of the transformer 26. The rate at which the current builds up depends upon the inductance and resistance of the primary circuit. The transformer 26 is designed to saturate with a current flowing through its primary winding 28 which is substantially less than the steady state current when the contacts 18 are closed. As a result, the voltage induced in the secondary winding 30 of the transformer 26 drops to zero when saturation is achieved, even though the current flowing through the primary winding is increasing. FIGURE 3 illustrates the shape of the voltage pulses induced in the secondary winding 30 of the transformer 26, the dotted extension lines indicating the current in the primary winding. Since the maximum amplitude of the pulses depends upon a characteristic of the transformer, i.e. the saturation current thereof, the pulses are of uniform maximum amplitude. Also, since there is no spark discharge produced in the ignition system by the closing of the contacts 18, the shape of the pulses is uniform.

When the contacts 18 open, a current is again induced into the secondary circuit, but the meter 36 does not respond to this current since it is in the opposite direction and will not flow through the diode 32. The pulse created by opening the contacts 18 is oscillatory in nature, and a capacitor 38 and resistor 40 are connected in parallel with the primary winding of the transformer 26 to damp out this pulse. Opening of the contacts 18 also causes the spark discharge to occur between the electrodes of the spark plugs 24, and the energy of the pulse induced into the secondary winding 30 of the transformer 26, on breaking of the contacts 18, depends upon the spark plug condition and the combustion chamber environment. It is thus clear that the tachometer here disclosed is independent of these factors.

FIGURE 1 illustrates the meter 36 of the tachometer mounted to the steering column 42 of an automobile. The meter 36 has a cylindrical housing 44, and a mounting bracket 46 is secured to one end of the housing. The bracket 46 has an outwardly extending perforated flange 48 for applications requiring the meter to be mounted flush with a surface, and an arm 50 extends therefrom. The arm 50 has an end portion 52 normal to the rest of the arm, and the end portion 52 is wedged between a

strap clamp 54 and the steering column 42 of the automobile.

The tachometer may be readily calibrated to internal combustion motors with battery and coil type ignition systems, without regard to the number of cylinders in the motor or the voltage of the battery. A vibratory reed, having a known resonant frequency within the range of rotation rates of the motor, is mounted in contact with a part of the automobile, such as the steering column 42 as indicated at 56. The reed may be permanently mounted, as by a rubber vacuum cup 57, to give a continuous check on calibration, or merely held in place for a single adjustment of the tachometer. Since internal combustion engines are never perfectly balanced dynamically, the engine sets up vibrations at a rate equal to its rotation rate. The motor speed is adjusted to produce maximum amplitude vibration of the reed, and under these conditions the engine is rotating at the resonant frequency of the reed. The variable potentiometer 34 is then adjusted to cause the meter 36 to indicate this rotation rate, and the tachometer is calibrated to the engine. It will be appreciated that this calibration device is particularly useful with tachometers that have means for generating an average potential which is proportional to the rotation rate of the motor and an adjustable voltmeter, and not limited to the particular embodiment of the tachometer here described in detail.

From the foregoing disclosure, those skilled in the art will readily devise many modifications and applications of the invention not herein set forth. It is, therefore, intended that the scope of the present invention be not limited by the foregoing disclosure, but rather only by the appended claims.

The invention claimed is:

1. A tachometer for use on an internal combustion motor having an ignition system with a first series circuit including a direct current power source, the primary winding of an ignition coil, and a circuit breaker, and a second series circuit including the secondary winding of the ignition coil and a spark plug comprising a transformer having a core, primary winding and secondary winding, the primary winding of said transformer being adapted to be connected in series with the first series circuit of the ignition system and the core of said transformer saturating at a current less than the steady state current of said first series circuit, means connected to the secondary winding of the transformer for measuring the average potential developed thereacross, and means connected between the potential measuring means and the transformer for isolating the potential measuring means from pulses produced by the opening of the circuit breaker in the first series circuit of the ignition system.

2. A tachometer for use on an internal combustion motor having an ignition system with a series circuit including a direct current power source, the primary winding of an ignition coil, and a circuit breaker comprising a transformer having a core, primary winding, and secondary winding, the primary winding of said transformer being adapted to be connected in series with the series circuit of the ignition system and the core of the transformer being adapted to saturate from the current of said series circuit flowing through said primary winding, and a current responsive meter, and means connected in series with the current responsive meter and the secondary of the transformer for measuring only the pulses produced by the closing of the circuit breaker of the ignition system including a diode.

3. A tachometer comprising the elements of claim 1 wherein the means for isolating the potential measuring means from pulses produced by the opening of the circuit breaker in the first series circuit of the ignition system

comprises a rectifier connected in series with the secondary winding of the transformer and a damping circuit connected in parallel with the primary winding of the transformer.

4. A tachometer adapted to be coupled to a motor comprising means for generating a potential monotonically related to the rotation rate of the motor, a voltmeter electrically connected to the potential generating means provided with means for adjusting the sensitivity of the meter, and a vibratory member having a resonant frequency adapted to be placed in contact with the motor to calibrate the tachometer and motor at the resonant frequency of the vibratory member.

5. A tachometer for use on an internal combustion motor having an ignition system with a first series circuit including a direct current power source, the primary winding of an ignition coil, and a circuit breaker, and a second series circuit including the secondary winding of the ignition coil and a spark plug comprising a transformer having a core, primary winding, and secondary winding, the primary winding being adapted to be connected in series with the first series circuit of the ignition system and the core of said transformer saturating at a current less than the steady state current of the first series circuit of the ignition system, a capacitor and resistor connected in parallel with the primary winding of said transformer, a current meter, variable potentiometer and diode connected in a series circuit with the secondary winding of the transformer, the diode being connected to pass pulses caused by closing of the circuit breaker and discriminate against pulses resulting from opening of the circuit breaker, and a vibratory reed adapted to be mounted to the motor to calibrate the motor and tachometer at the resonant frequency of the reed.

6. The combination of a motor, tachometer, and calibration means comprising, in combination, an internal combustion engine having an ignition system with a first series circuit including a direct current power source, the primary winding of an ignition coil, and a circuit breaker, and a second series circuit including the secondary winding of the ignition coil and a spark plug, a transformer having a primary winding connected in series with the first series circuit of the ignition system, a core and a secondary winding, the core of said transformer saturating at a current less than the steady state current of the first series circuit of the ignition system, a capacitor and resistor connected in parallel with the primary winding of the transformer, a current meter, potentiometer and diode connected in a series circuit with the secondary winding of the transformer, the diode discriminating against pulses formed by opening of the circuit breaker, and a vibratory reed mounted to the motor having a resonant frequency within the range of rotation rates of the motor.

7. A tachometer comprising the elements of claim 3 wherein the damping circuit comprises a capacitor and a resistor connected in parallel with the primary winding of the transformer.

References Cited in the file of this patent

UNITED STATES PATENTS

2,751,553	McEntee	June 19, 1956
2,833,987	Shepard	May 6, 1958
2,908,864	Shepard	Oct. 13, 1959

OTHER REFERENCES

Tuning Fork Standards for Meter Calibration by Donald E. Anderson, Electrical World, January 8, 1944, page 92.

"Resonance-Type Vibration Calibrator," pages 78-79. NBS Technical News Bulletin, May 1953.