Nov. 21, 1967 J. A. WHALEY ET AL 3,354,387

PORTABLE IGNITION COIL TESTER HAVING A TRANSISTOR OSCILLATOR POWER SUPPLY

Filed March 16, 1964 2 Sheets-Sheet 1

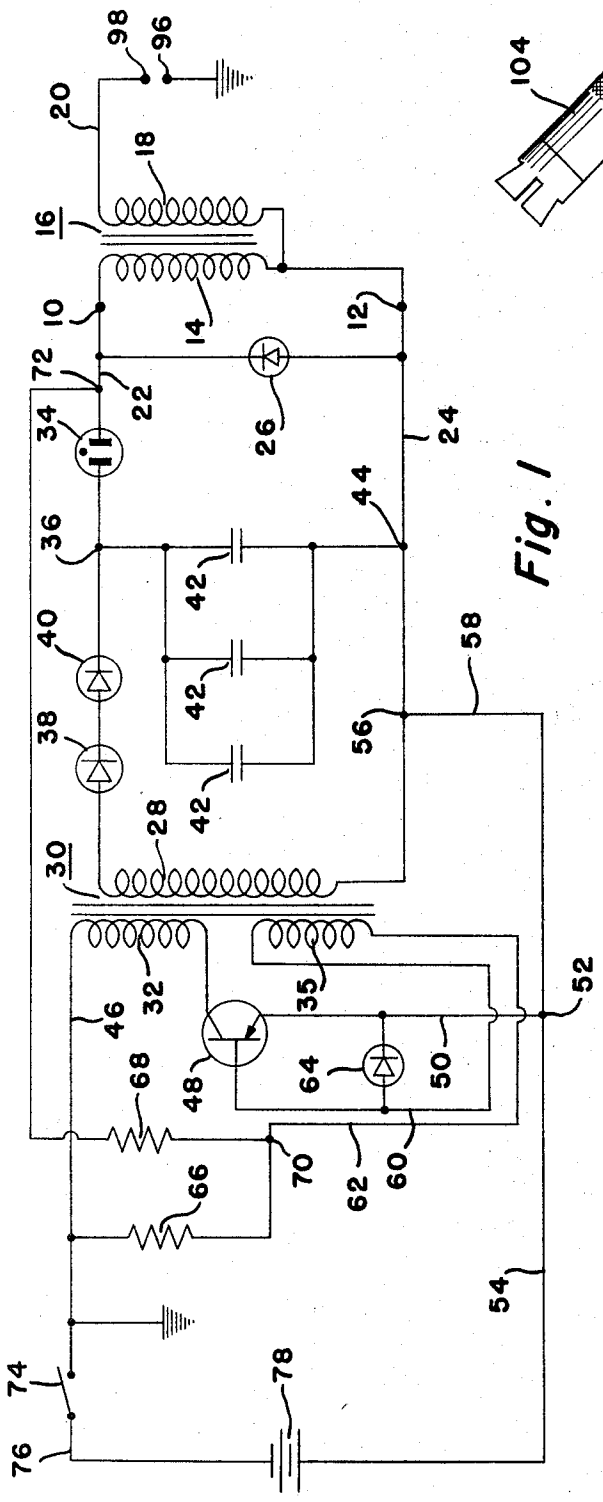


Fig. 1

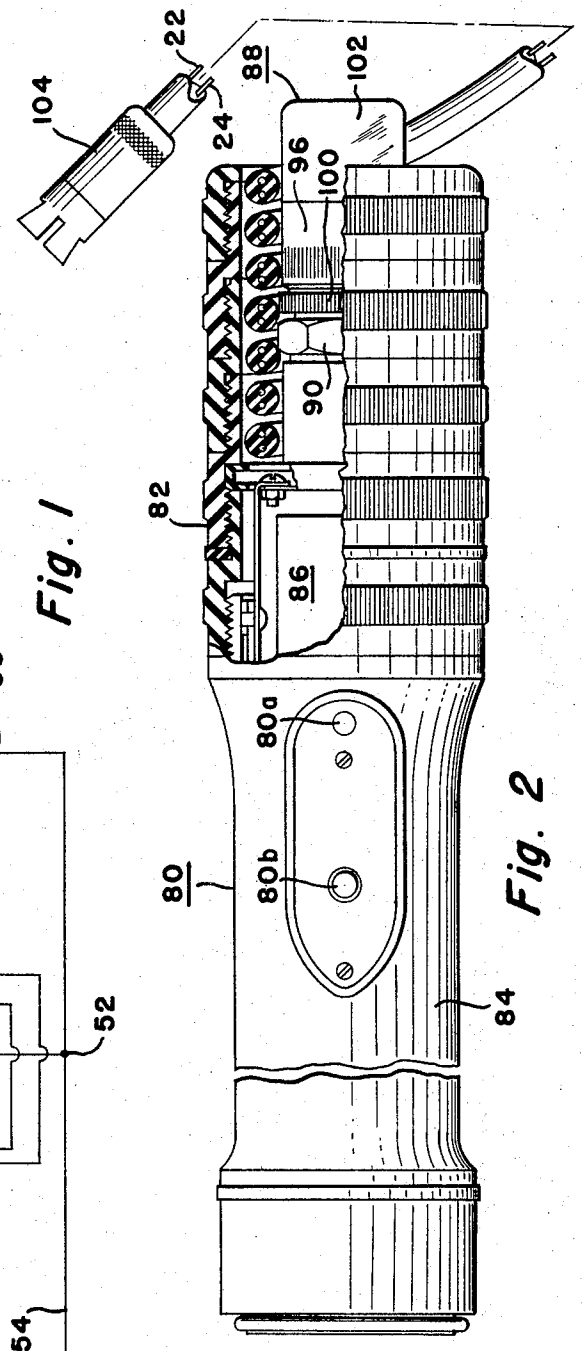


Fig. 2

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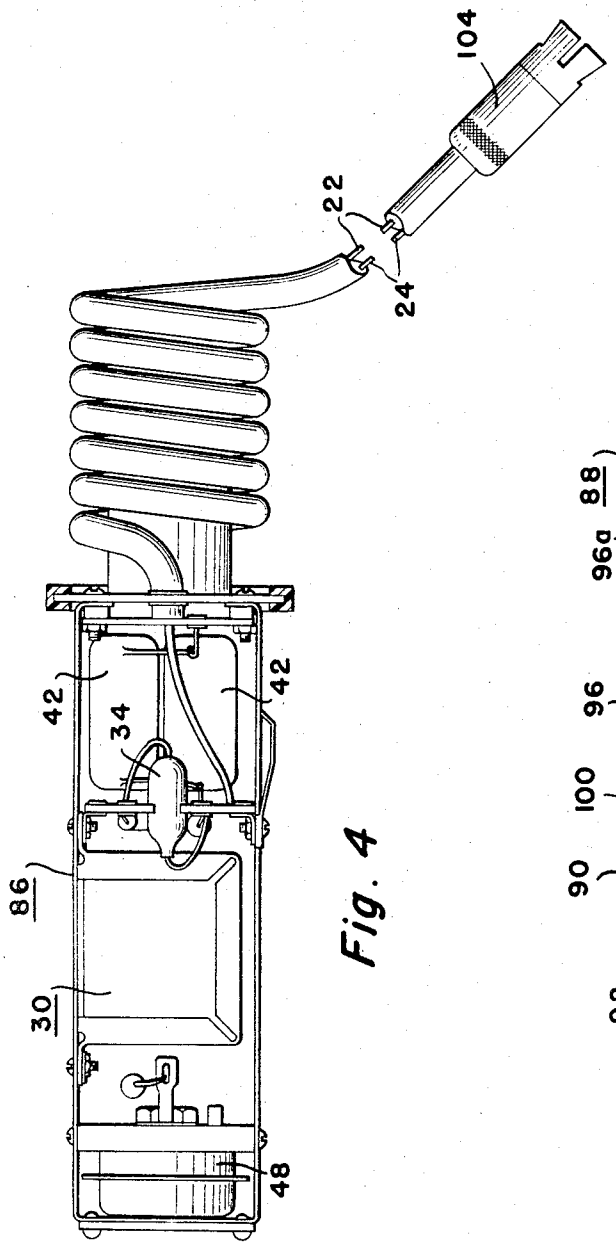


Fig. 4

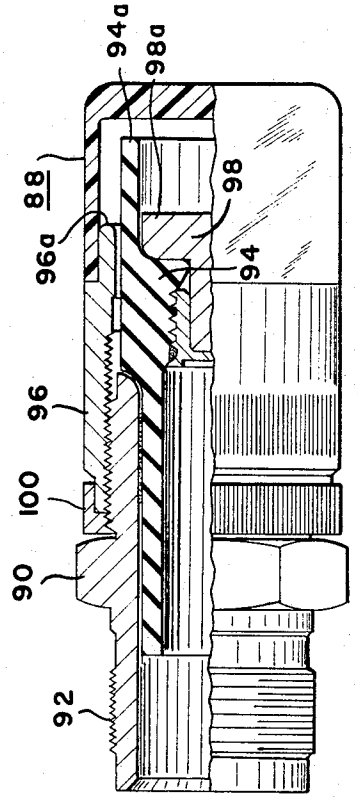


Fig. 3

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PORTABLE IGNITION COIL TESTER HAVING A TRANSISTOR OSCILLATOR POWER SUPPLY

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ABSTRACT OF THE DISCLOSURE

In a preferred form, a portable ignition coil tester is provided with a battery powered transistor oscillator circuit coupled with a transformer having input, output and feedback windings. The transformer output winding is connected to parallel connected storage capacitors and a glow discharge tube that provides discharge of the capacitors through a pair of output leads connected to an ignition coil under test. The glow discharge tube and a sparking electrode assembly which is removable from the tester provide visual indications of capacitor discharge to the ignition coil and the coil output impulses.

This invention relates to an ignition coil tester and more particularly to a tester which is capable of testing aircraft ignition coils.

One of the objects of this invention is to provide an ignition coil tester which is capable of testing the transforming ability of an ignition coil and which is also capable of testing an open or a shorted condition of the primary winding of the ignition coil.

Another object of this invention is to provide an ignition coil tester which is completely portable and which has its own power supply for applying a potential to the ignition coil while it is being tested.

Still another object of this invention is to provide an ignition coil tester which is a hand-held battery operated device that is capable of testing aircraft ignition coils while they are still on the airplane and which is capable of testing the spark plug cable.

Another object of this invention is to provide an ignition coil tester which is portable and which includes a transistor oscillator for supplying a testing potential to the ignition coil, the transistor oscillator being energized from one or more small batteries.

Still another object of this invention is to provide an ignition coil tester which has a transistor oscillator which is energized such that when the ignition coil is being tested, the oscillator will not oscillate normally unless the primary winding of the ignition coil is continuous. In carrying this object forward, the circuitry of the transistor oscillator is such that the primary winding of the ignition coil forms a part of the oscillator circuit when the ignition coil is being tested. Therefore if the primary winding of the ignition coil is open, the oscillator will oscillate at an amplitude that is lower than normal which indicates that the primary winding of the ignition coil is open.

Another object of this invention is to provide an ignition coil tester which includes a discharge tube that may be viewed during operation of the ignition coil tester. The arrangement is such that when the ignition coil is being tested, the discharge tube will light when the primary winding is not open indicating that the primary winding is in good condition. The discharge tube grows brighter in the event that the primary winding is shorted and the system which includes the discharge tube is therefore capable of indicating either an open or a shorted condition of the primary winding of the ignition coil.

A further object of this invention is to provide an ignition coil tester which is portable and which contains a removable subassembly that can be connected with a spark plug wire and which includes a spark discharge device, the breakdown of the discharge device indicating whether or not the ignition coil has the proper transforming capability.

In the drawings:

FIGURE 1 is a schematic circuit diagram of an ignition coil tester made in accordance with this invention and shown connected with an ignition coil to be tested.

FIGURE 2 is a plan view with parts broken away of the physical construction of an ignition coil tester made in accordance with this invention.

FIGURE 3 is a view partly in section of an indicator which forms a part of the assembly shown in FIGURE 2.

FIGURE 4 is a plan view of a power supply unit which forms a component part of the ignition coil tester shown in FIGURE 2.

Referring now to the drawings and more particularly to FIGURE 1, the reference numerals **10** and **12** designate the output terminals of the ignition coil tester made in accordance with this invention. When the ignition coil tester is in use, the output terminals **10** and **12** are connected across the primary winding **14** of an ignition coil **16** that is to be tested. The ignition coil **16** has a secondary winding **18** which is connected with a high voltage spark plug wire **20**. The ignition coil is of a type commonly used on aircraft internal combustion engines.

The output terminals **10** and **12** are connected respectively with conductors **22** and **24**. A diode **26** is connected across the conductors **22** and **24**. The conductor **24** is connected to one side of a secondary winding **28** of a transformer generally designated by reference numeral **30**. This transformer has a primary winding **32** and a feedback winding **35**.

The conductor **22** is connected with one of the electrodes of a discharge tube **34**. This tube is of a type which breaks down when a predetermined voltage is applied across its electrodes and is of a type that gives a visible indication of the breakdown by a lighting of the tube. The other terminal of the breakdown tube **34** is connected with a junction **36**. A pair of series connected diodes **38** and **40** connect one side of the secondary winding **28** with the junction **36**. A plurality of capacitors **42** are connected in parallel across the junctions **36** and **44**.

The primary winding **32** of the transformer **30** has one end connected with conductor **46** and has its opposite end connected with the collector of a PNP transistor **48**. The emitter of transistor **48** is connected with conductor **50** and this conductor is connected with a junction **52**. The junction **52** is connected with a power supply conductor **54** and is connected with junction **56** on conductor **24** by the conductor **58**. The base of transistor **48** is connected to one side of the feedback winding **35** via a conductor **60**. The opposite side of the feedback winding **35** is connected to conductor **62**. A diode **64** connects the base and emitter electrodes of the transistor **48**.

A resistor **66** is connected between conductor **62** and conductor **46**. A resistor **68** is connected between the junctions **70** and **72** located respectively on conductors **62** and **22**. It is seen that the conductor **46** is grounded.

The reference numeral **74** designates a control switch for the ignition coil tester and it is connected between conductor **46** and conductor **76**. The power supply for the ignition coil tester takes the form of a battery or batteries **78** which feed the power supply conductors **54** and **76**. The power supply **78** may consist of two D size flashlight batteries with the positive side being connected to conductor **54**.

Referring now to FIGURES 2, 3 and 4, a physical embodiment of the ignition tester shown in FIGURE 1 is

illustrated. In FIGURE 2, the reference numeral 80 designates a housing which has a section 82 and a section 84. The section 84 contains a subassembly which is shown in FIGURE 4, and is generally designated by reference numeral 86. The subassembly 86 contains the power supply components shown in FIGURE 1. The same reference numerals have been used in FIGURE 4 as were used in FIGURE 1 to identify the same parts in each figure. The section 84 also contains two D size flashlight batteries.

The section 82 of the housing 80 supports a removable indicator generally designated by reference numeral 88. The indicator 88 is shown in detail in FIGURE 3 and it is seen that this indicator includes a metal housing 90 having an external threaded section 92. The housing 90 supports an insulator 94. An annular spark electrode 96 has a threaded connection with the tubular member 92 and is adjustable axially relative to the member 92. Another spark electrode 98 is provided and when a voltage is impressed across electrodes 96 and 98, a spark can jump from the end portion 96*a* of the electrode 96 to the wall 98*a* of the fixed electrode 98. This spark must go around the end 94*a* of the insulator 94. The distance that the spark must travel can be adjusted by rotating the electrode 96 relative to the fixed part 92. The electrode 96 can be locked in place by the nut 100. The electrode 96 carries a transparent end cap 102 and this permits the spark to be viewed. The part 88 is designed such that it can be connected with a spark plug wire that has a grounded outer metal sheath and an inner conductor. The sheath is threaded to threaded section 92 while the inner conductor is electrically connected with electrode 98.

When the power supply unit 86 is assembled to the housing 80, the discharge tube 34 is in such a position that it can be viewed through a transparent window 80*a* in the housing 80.

When it is desired to test an ignition coil for an aircraft engine, the conductors 24 and 22 which are connected with a fitting 104 are connected to the ends of the primary winding 14 of the ignition coil 16 to be tested. A spark plug wire is disconnected from a spark plug and the indicator 88 is removed from the housing section 82 and is connected with the shielded spark plug wire so that the electrodes 96 and 98 are connected across secondary 18. The switch 74 is now closed by operating the switch button 80*b*.

If the primary winding 14 of the ignition coil is not open, the power supply system will begin to oscillate normally. The initial energizing circuit for the transistor oscillator can be traced from the positive side of battery 78, through conductor 54, through conductor 58, through conductor 24, through primary winding 14, through junction 72, through resistor 68, and then through resistor 66 and the closed switch 74 to the negative side of the battery. The voltage at junction 70 will now be such that the base of transistor 48 is negative with respect to its emitter and base current will therefore flow in transistor 48 turning it on its emitter-collector circuit.

When transistor 48 turns on, the primary winding 32 is energized and a voltage is induced in the secondary winding 28. This voltage is used to charge the parallel-connected capacitors 42 through diodes 38 and 40. When the capacitors 42 are charged to a voltage sufficient to break down the discharge tube 34, the tube 34 conducts and the capacitors 42 discharge through the primary winding 14.

When the capacitors 42 discharge through the tube 34, the tube 34 becomes lighted and can be viewed through the transparent window 80*a*. This will indicate to the person testing the ignition coil that the primary winding of the ignition coil is not open.

When the capacitors 42 discharge through the primary winding 14 of the ignition coil, a voltage is induced in the secondary winding 18 which is applied to the electrodes 98 and 96 of the indicator 88 since it is now connected

with the spark plug wire 20. If the transforming ability of the ignition coil is up to standard, a spark will jump between electrodes 98 and 96 which can be viewed through the transparent end cap 102 of the indicator 88. If the transforming ability of the ignition coil 16 is not up to standard, there will be no spark produced between electrodes 98 and 96.

It is pointed out that if the primary winding 14 of the ignition coil is not open, the interaction of the circuit which includes the transformer and transistor is such as to switch the transistor 48 on and off continuously. This provides a periodic break down of the tube 34 which can be viewed as noted above and a periodic sparking of the electrodes by the indicator 88.

If the primary 14 of the ignition coil is shorted, this is detected by the fact that the discharge tube 34 glows brighter than when it is connected to an acceptable ignition coil.

If the primary 14 of the ignition coil is open, this fact will be detected because the transistor oscillator will oscillate at a low amplitude which is not sufficient to charge capacitors 42 to a potential that is sufficient to ionize tube 34. The open condition is therefore indicated when tube 34 does not break down.

The diode 26 improves the operation of the system and is a PN junction semiconductor diode and preferably of the silicon type.

The tester itself can at any time be tested by shorting the leads 22 and 24 which causes the oscillator to oscillate normally if it is in good order and therefore causes a glow in the discharge tube 34.

From the foregoing, it can be seen that a portable ignition coil tester has been provided which is capable of testing aircraft ignition coils while they are in place on the airplane and is also capable of testing the spark plug cable. In addition, the tester is completely portable and can be operated by two D size flashlight batteries each of which are 1.5 volts, giving a total DC input voltage of three volts.

While the embodiments of the present invention as herein disclosed constitute a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. An ignition coil tester having an oscillator power supply comprising, a transformer having a primary winding, a secondary winding and a feedback winding, a transistor having emitter, collector and base electrodes, a source of direct current, means connecting the emitter and collector electrodes of said transistor in series with said source of direct current and in series with said primary winding, means connecting said feedback winding with the base of said transistor and with one terminal of said source of direct current, at least one capacitor, a charging circuit including a diode connecting said capacitor across said secondary winding, a discharge tube having a predetermined break down voltage, a pair of output terminals for said tester adapted to be connected across the primary winding of an ignition coil to be tested, means connecting said discharge tube in a series discharging circuit including said capacitor and said pair of output terminals of said tester, the junction of said battery source and an electrode of said transistor being connected in series with one of said output terminals, and circuit means serially connecting the other of said output terminals with the means connecting said feedback winding with said one terminal of said direct current source terminal and said transistor base electrode so that said oscillator is operating normally when connected to a normally closed primary of said ignition coil and is operating abnormally when connected with the primary winding of an ignition coil that is open.

2. The ignition coil tester according to claim 1 where a diode is connected across the output terminals of the tester.

3. The ignition coil tester according to claim 1 where the initial biasing circuit for the transistor is through the

primary winding of the ignition coil when the ignition coil is connected with the output terminals of the tester.

4. A portable ignition coil tester having a housing capable of being grasped within the hand of a user and including an oscillator power supply circuit comprising, a transformer having a primary winding, a secondary winding and a feedback winding, a transistor having emitter, collector and base electrodes, a source of direct current including flashlight battery cells mounted within said housing, a pair of output terminals adapted to be connected to the input winding of an ignition coil to be tested, said emitter and collector electrodes of said transistor being serially connected with said direct current source through said primary winding and a pair of switch actuated contacts of a switch mounted within said housing, said base electrode of said transistor being connected through said feedback winding to a circuit junction connected to both one terminal of said direct current power source and one of said output terminals with the other of said output terminals being connected to an opposite terminal of said direct current power source, a plurality of capacitors connected in a series circuit including said secondary winding and a diode, circuit means including a two terminal glow discharge tube connecting said output terminals across said plural capacitors, said oscillator circuit operable for periodically charging said capacitors through said transformer and said glow discharge tube discharging said capacitors through said output terminals when the output terminals are connected to a normal closed ignition coil primary to be tested and said switch contacts are closed whereby said oscillator operates normally and breakdown of said discharge tube provides a visual indication of the proper condition of the primary of said ignition coil, and said oscillator operating at low

amplitudes not sufficient to charge said capacitor when said output terminals are connected to an open primary of an ignition coil to be tested.

5. The portable ignition coil of claim 4 wherein said housing includes an internal threaded portion and a removable spark indicator means is provided including a complementary external threaded portion for attaching said spark indicator means to said housing, a pair of sparking electrodes, a transparent cap portion providing a visual indication of current passing across said sparking electrodes, and said threaded portion being associated with one of the sparking electrodes to provide a terminal for mating connection with a spark plug wire connected to the output of an ignition coil to be tested.

6. The ignition coil tester according to claim 4 wherein said two terminal glow discharge tube is visibly mounted within said housing for providing a glow indication upon discharge of said capacitor through said tube.

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