

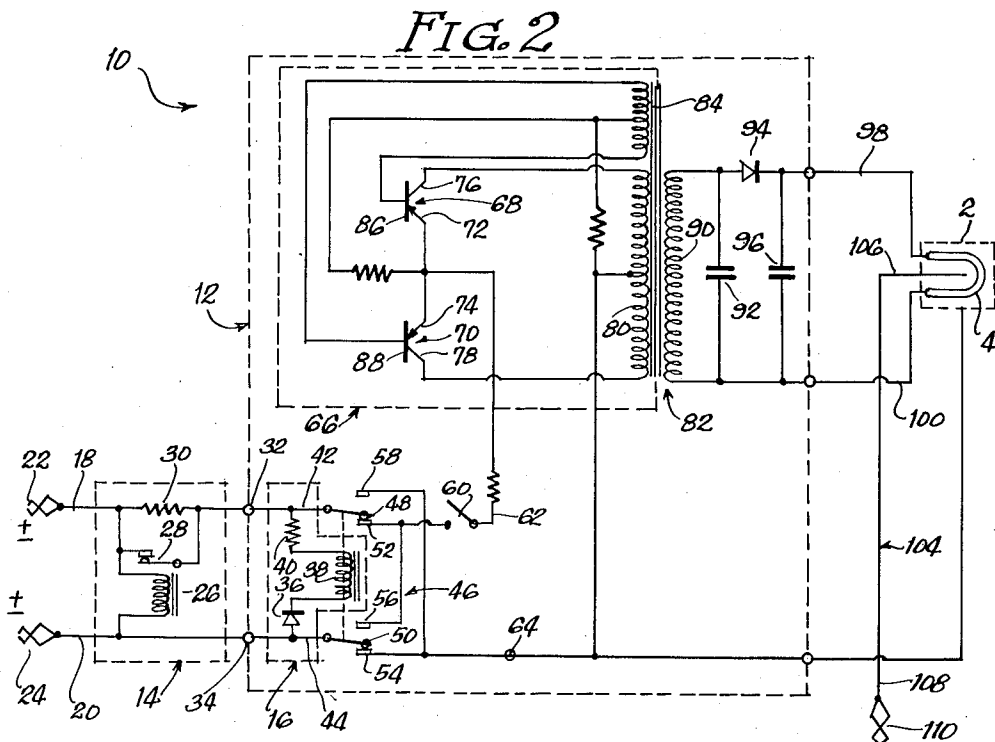
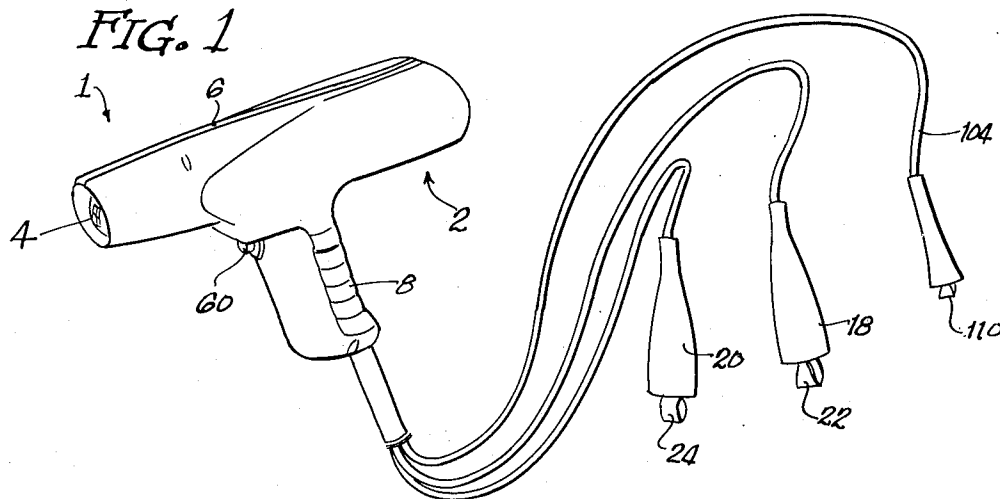
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BATTERY POWERED TIMING LIGHT

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BATTERY POWERED TIMING LIGHT

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1 Claim. (Cl. 315-171)

This invention relates to a battery powered timing light, and more particularly to such a timing light which is provided with an improved power supply and related circuitry.

Timing lights are well known instruments for determining the timing of the spark ignition in internal combustion engines relative to engine rotation. The light source usually is a gas tube which flashes rapidly so as to provide a stroboscopic effect. In order for the gas tube to function in such an instrument, the potential across the tube must be maintained just below the ionization potential, which usually is on the order of several hundred volts. Since the most convenient source of available electric power is the battery of the internal combustion engine, and the batteries most commonly used have a potential of either 6 or 12 volts, a power supply fed by the engine storage battery is necessary to raise the potential at the lamp to the required value.

In the past, the high voltage power supply for battery powered timing lights relied on vibrators which were driven by the battery of the internal combustion engine and which had the effect of changing the constant battery potential to a pulsating voltage which conveniently could be raised to any desired value by means of a transformer. The high voltage output of the transformer was generally rectified and connected to the terminals of the gas tube flash lamp.

The use of vibrators in the high voltage power supply was objectionable because of relatively short life and other service problems. As an alternative, the use of circuits employing electron tubes instead of vibrators would be even more objectionable, both because of cost and because rough handling would damage the electron tubes more easily than the vibrator, thereby creating even more service problems.

What is needed therefore, and comprises an important object of this invention, is a timing light for internal combustion engines which is powered by the engine storage battery and which does not use vibrators or electron tubes in the power supply.

A further object of this invention is to provide a transistorized power supply for a timing light which is energized by the storage battery of an internal combustion engine and which is provided with means for applying voltage of the correct polarity to the transistors regardless of the polarity of the leads connected to the storage battery.

Still another object of this invention is to provide a transistorized power supply with means automatically responsive to voltages of the storage battery in excess of a predetermined amount for maintaining the voltage at the input of the power supply below a predetermined maximum.

These and other objects of this invention will become more apparent when read in the light of the specification and drawing wherein:

FIG. 1 is a perspective view of the battery powered timing light, and

FIG. 2 is a circuit diagram of a battery powered timing light embodying the invention.

Referring now to FIG. 1 of the drawing, the battery powered timing light indicated generally by the reference numeral 1 is typically mounted in a pistol shaped housing 2 for convenience in handling, although it is understood

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that the shape of the housing is optional. A flash lamp 4 is mounted in one end of the barrel 6 of the housing, and this barrel also contains circuit elements which are connected together as shown in FIG. 2.

The circuit diagram for the battery powered timing light indicated generally by the reference numeral 10 comprises a power supply 12, a voltage regulating circuit 14, and a polarity regulating circuit or polarity relay 16, all shown enclosed in dotted rectangles.

The voltage regulating circuit 14 is provided with power leads 18 and 20 which terminate in clips 22 and 24 for connection to the terminals of a 6 or 12 volt storage battery (not shown). The leads are shown as projecting out of the pistol grip 8 of the housing although this is not a necessary arrangement.

A solenoid 26 is connected across the leads 18 and 20, and this solenoid, when energized with the proper magnitude of voltage opens switch contacts 28. Switch contacts 28 when closed short circuit a voltage dropping resistor 30 connected to lead 18. As stated above, storage batteries for internal combustion engines are either 6 or 12 volts, and solenoid 26 is designed to open contacts 28 only when the leads 18 and 20 are connected to a battery whose potential is in excess of 6 volts. More particularly, the solenoid is designed so it opens contacts 28 when the battery voltage is around 9 volts or higher as when leads 18 and 20 are connected to a 12 volt battery. When contacts 28 open the current in lead 18 must flow through resistor 30. This resistor is designed to cause a voltage drop in lead 18 so that the voltage at the output of the voltage regulating circuit is no more than 6 volts.

In contrast to this behavior, when leads 18 and 20 are connected to a 6 volt battery, the solenoid 26 will not have enough energy to open contacts 28 and resistor 30 will remain short circuited. With this arrangement, regardless of whether leads 18 and 20 are connected to a 6 or 12 volt battery, the output of the voltage regulating circuit will never be greater than 6 volts so that the output of the voltage regulating circuit may be regarded as the constant potential source for the power supply.

As seen in the drawing, the output of the voltage regulating circuit 14 is connected to the input terminals 32 and 34 of the high voltage power supply 12 in general, and to the polarity relay 16 in particular.

The polarity relay 16 includes a rectifier 36, a solenoid 38, and a current limiting resistor 40 connected in series across the power supply input leads 42 and 44. The solenoid 38 is mechanically connected to the movable contacts 48 and 50 of a double pole, double throw reversing switch 46 so that when the polarity relay operates the reversing switch will be actuated.

It is evident from a consideration of the connection of the rectifier 36 to solenoid 38, that if lead 20 is connected to the negative terminal of the storage battery, then the polarity of the power supply input lead 44 will be negative with respect to lead 42, so that rectifier 36 will be non-conductive. As a result solenoid 38 will not operate reversing switch 46. In contrast, if lead 20 is connected to the positive lead of the storage battery, then lead 44 will be positive with respect to lead 42 and rectifier 36 will permit current to flow through and operate solenoid 38. This will actuate reversing switch 46 and cause movable contacts 48 and 50 to leave contacts 52 and 54 and move to contacts 56 and 58.

As is apparent from an inspection of the connections in reversing switch 46, the effect of the operation of the switch is to change the polarity of control switch 60 and the connected polarity switch output lead 62 from negative to positive with respect to polarity switch output lead 64. On the other hand, as stated above, if lead 20 is connected to the negative terminal of the storage bat-

tery and lead 18 is connected to its positive terminal, lead 42 in the polarity relay 16 will be positive with respect to lead 44, and since contact 48 remains in engagement with contact 52, the polarity of the polarity switch output lead 62 will remain positive. Thus regardless of the polarity of the leads 18 and 20, the effect of polarity relay 16 is to maintain control switch 60 and polarity relay output lead 62 at a positive polarity with respect to polarity relay output lead 64.

The power circuit 12 includes an oscillator 66 shown enclosed in a dotted rectangle, and in this embodiment the oscillator comprises two PNP type transistors 68 and 70, such as the Deleo 2N277. The emitters 72 and 74 of these transistors are connected together and to lead 62. This connection determines the selection of the polarity of lead 62. It is apparent that if the oscillator were built around NPN transistors, the polarity of lead 62 would have to be negative.

As shown, the collectors 76 and 78 of these transistors are connected to the ends of primary 80 of a power transformer 82, which in this particular embodiment may be a SNC #P-4024. The primary 80 of the transformer is coupled to feed back coils 84 which are connected back to the bases 86 and 88 of the transistors, as shown in FIG. 2. The circuit constants are selected in a manner well known in the art to provide a suitable oscillator frequency, and in this particular embodiment the oscillator is designed to operate at a frequency of 2.5 kc.

Secondary 90 of transformer 82 is in parallel with buffer condenser 92 for reducing large current peaks. The output of the ends of secondary 90 and buffer condenser 92 is connected to the storage circuit which includes a rectifier 94, such as an International #61-1518, and a storage capacitor 96, as shown in the drawing.

Power supply output leads 98 and 100 which are connected to the terminals of capacitor 96 are connected to the ends of flash lamp 4, for reasons to be described below. As shown, housing 2 is connected to the negative or ground potential of the instrument. In addition, the power supply is designed so the magnitude of the rectified high voltage output is a value just below the ionization potential of flash lamp 4 as described above.

A high voltage trigger lead 104 is provided with one end 106 positioned adjacent the flash lamp 4 and the other end 108 secured to a clip 110 for connection to a spark plug of an engine under test. With this arrangement, as a high voltage discharge occurs in the spark plug to which clip 110 is connected, lead 104 will be energized so that the capacitive coupling between lead end 106 and flash lamp 4 ionizes the gas therein and produces a low impedance discharge path in the lamp causing it to flash.

The ionization of the gas in the flash lamp, and its drop in impedance will cause the storage capacitor 96 to discharge rapidly. When the potential across the capacitor 96 falls below the extinction potential of the lamp, the lamp will go out. Once the lamp becomes extinguished, the capacitor 96 due to the action of the power supply begins to recharge. The potential across this capacitor returns to its initial value, which is just below the ionization potential of the lamp before the next firing of the spark plug in the engine.

This happens very rapidly so the flash lamp will flash for a time which is less than the intervals between the firing of the spark plug. In this manner the desired stroboscopic effect of the flash lamp is obtained and

the flash lamp can be used to time the engine ignition system in a manner well known in the art.

This power supply, by eliminating the vibrator used in prior timing lights, has eliminated many objectionable service problems. In addition, the employment of the transistorized oscillator permits a greater simplification in the circuit and a resulting economy in manufacture. Furthermore, the automatic voltage regulating and polarity regulating circuits eliminate sources of possible error and damage to the instrument by inexperienced servicemen who might otherwise connect the timing light to storage batteries having incorrect voltages for the instrument, or who might connect the timing light power leads to the wrong terminals of the battery.

The invention may be embodied in other forms without departing from the spirit or essential characteristics thereof as set forth in the claim, and the present embodiment is therefore to be considered as illustrative and not restrictive and it is intended to include all changes which come within the scope of the claim.

I claim:

A battery powered timing light for internal combustion engines comprising in combination:

- a flash lamp;
- a pair of leads adapted to be connected with random polarity to a battery;
- a rectifier and control solenoid connected in series between said leads whereby said solenoid is energized when said leads are connected to the battery with one polarity and is not energized when said leads are connected with opposite polarity;
- a reversing switch having a pair of movable contacts and two pairs of fixed contacts, one pair in association with each movable contact, said movable contacts respectively connected to said leads and engaging a first fixed contact of each pair when said solenoid is deenergized, said movable contacts mechanically connected to said solenoid and respectively movable into engagement with the second fixed contacts of each pair when said solenoid is energized;
- the second fixed contacts of each pair connected respectively to said first fixed contact of the other pair whereby said first fixed contacts of each pair constitute output switch terminals having constant polarity regardless of the polarity of said leads;
- a transistorized high voltage power supply requiring a supply voltage of predetermined polarity connected to said output switch terminals and to said flash lamp; and
- a high voltage trigger lead having one end positioned adjacent said flash lamp and the other end adapted to be connected to a high voltage component of an operating engine.

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