

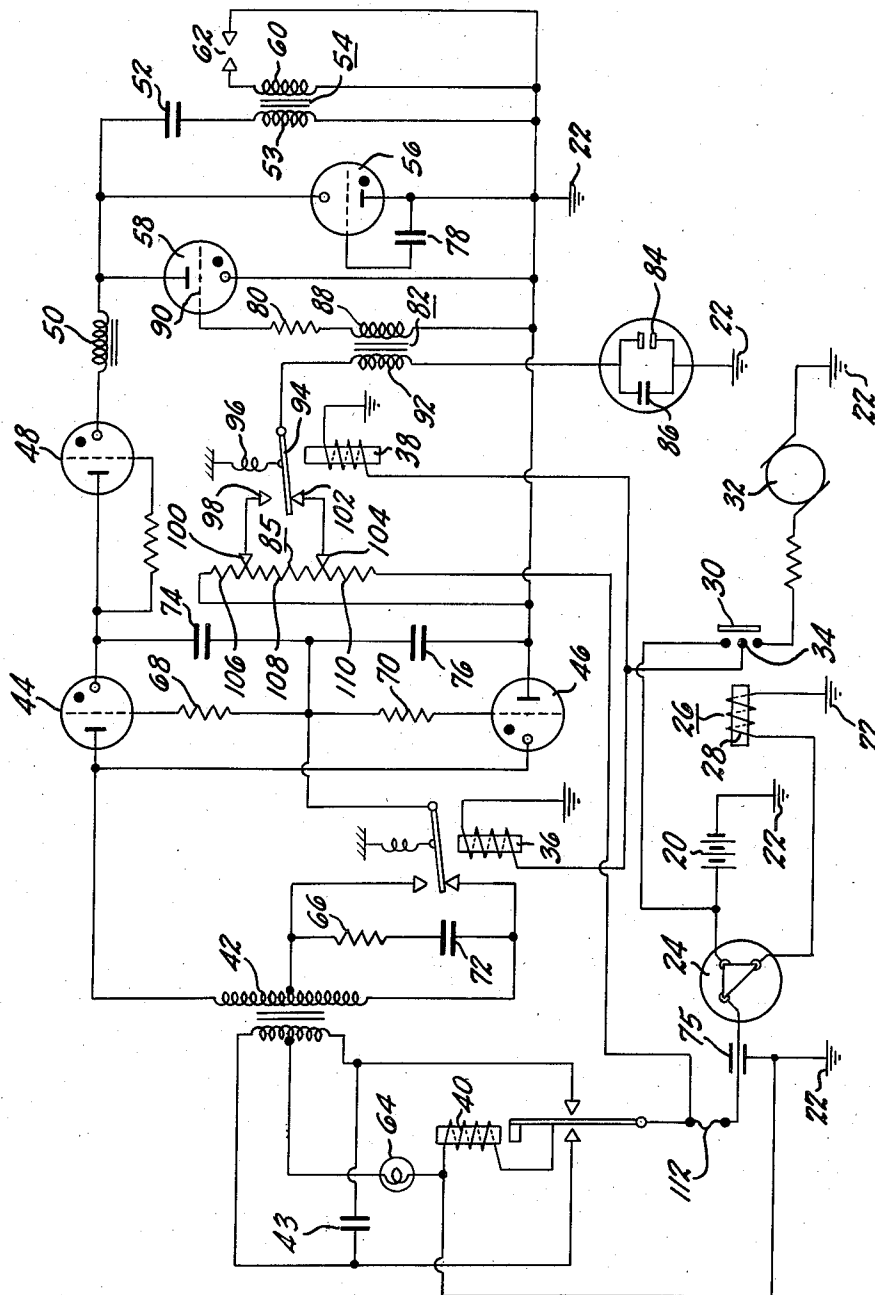
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IGNITION SYSTEM

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IGNITION SYSTEM

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9 Claims. (Cl. 123-179)

This invention relates to ignition systems for internal combustion engines and is more particularly concerned with an improved circuit for causing an electronic switch in an ignition circuit to become conductive.

It is an object of the present invention to increase the voltage of a circuit which controls the triggering of an electronic switch in an ignition circuit for an internal combustion engine during the periods when the starting motor for the engine is energized.

It is another object of the present invention to control the triggering of an electronic switch in an ignition system for an internal combustion engine by a circuit that includes a transformer that has one winding connected with the electronic switch and the other winding connected to the source of current for the ignition system.

A further object of the present invention is to control the conductivity of an electronic switch in an ignition system for an internal combustion engine by a circuit that includes a transformer that has its secondary winding connected to the electronic switch and its primary winding connected in circuit with a pair of breaker points and with the source of current for the ignition system.

A still further object of the present invention is to provide an electronic ignition system for an internal combustion engine with a control circuit that is energized by a low voltage from the source of power for said electronic ignition system, which control circuit includes a transformer that has its secondary winding connected with an electronic switch and its primary winding connected in circuit with a pair of breaker points and a voltage divider which has provisions for changing its ratio so the voltage supplied to the transformer primary is maintained substantially constant even through the voltage at said source is decreased when the starting circuit for the engine is energized.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing wherein a preferred embodiment of the present invention is clearly shown.

In the drawing, the single figure shows a wiring diagram of an ignition system for an internal combustion engine according to the present invention.

In the drawing, the numeral 20 designates a storage battery which has one terminal connected to ground 22 and the other terminal connected to a suitable ignition and starter switch 24 which may be of the type disclosed in U. S. Patent 2,655,570, Brown et al., which has been assigned to the assignee of the present invention. The switch 24 is arranged to either close the ignition circuit only or simultaneously close the circuits to both the ignition and the starting motor circuits, which will be hereinafter described, or may break the starting motor circuit and maintain the ignition circuit or may break both circuits. Obviously, two switches may be used instead of the single switch 24 and, when so used, the two switches will individually control the starting and ignition circuits.

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The starting motor circuit includes a solenoid switch 26 which has its actuating winding 28 circuit controlled by the switch 24. When the winding 28 is energized, the solenoid armature 30 is moved to directly connect the starter 32 with the battery 20. When the armature 30 closes the starting motor 32 circuit, it also, through contact 34, closes a circuit to the windings of solenoids 36 and 38, the function of which will be later set forth.

The primary circuit ignition system shown includes; a vibratory coil 40, a transformer 42, a condenser 43, a pair of rectifier tubes 44 and 46, a cold cathode tube 48, an inductance 50, a condenser 52, the primary winding 53 of an ignition coil 54, a reverse tube 56 and a triggering tube 58. The secondary ignition circuit includes the secondary winding 60 of the ignition coil 54, a distributor, not shown, and spark plugs diagrammatically shown as 62 on the drawing. The ignition system, if desired, may include a ballast lamp 64 and the solenoid 36, which is used to increase the voltage impressed on the ignition system during periods when the engine starter 32 is energized. The solenoid 36, when used, is suitably connected to the taps of the transformer 42 as shown. The condenser 75 is a feed through condenser and is included to reduce interference with surrounding radio or other similar electrical equipment.

The connections and functions of resistances 66, 68 and 70 and condensers 43, 72, 74, 76 and 78 as well as the functions and operations of the ballast lamp 64 and use of the solenoid 36 to control the taps of transformer 42 are all set forth in application, S. N. 402,910, filed January 8, 1954, by Brooks H. Short, who has assigned the application to the assignee of the present invention. This application also clearly discloses how the various heretofore mentioned parts of the primary and secondary ignition systems are interconnected and their operation in the systems.

The present invention is directed to a means or system for controlling the triggering or conductivity of the triggering tube 58 so that the condenser 52 will discharge through the primary winding 53 of coil 54. This will cause the spark plugs to ignite as is well known to those skilled in the art. The control circuit or means for the tube 58 includes a resistance 80, a transformer 82, a potentiometer resistor 85, solenoid 38, breaker points 84, condenser 86 and battery 20.

The secondary winding 88 of the transformer 82 has one end connected through resistance 80 with the grid 90 of tube 58. The other end of winding 88 is connected to ground 22. The primary winding 92 of transformer 82 has one of its ends connected with the armature 94 of solenoid 38 and the other end connected through breaker points 84 to ground 22. The condenser 86 is connected across points 84 to minimize arcing between the points 84 as they open and close.

The armature 94 of the solenoid 38 is normally held by spring 96 to engage contact 98 and complete a circuit with tap 100 of the potentiometer resistance 85. The armature 94 is moved, when the coil of the solenoid is energized, to engage the contact 102 which is connected with tap 104 of the potentiometer resistance or voltage divider 85. The resistance 85 preferably has a total value of 15 ohms and the taps 100 and 104 divide the potentiometer resistance 84 into three sections 106, 108 and 110 which, preferably and respectively, have values of 2, 6 and 7 ohms. The free end of section 110 is directly connected through fuse 112 and the ignition switch 24 to the battery 20. The free end of section 106 is connected to ground 22. The resistance 80 preferably has a value of 330K ohms.

With the above circuit arrangement in mind, the operation of the triggering of tube 58 will now be described.

Every time the firing of spark plug 62 is required, the secondary winding 88 of transformer 82 supplies a positive voltage pulse to the grid 90 of tube 58 through the resistance 80. This positive voltage pulse will cause the tube 58 to be conductive so that condenser 52 discharges.

When the breaker points 84 close, current will flow through the primary winding 92 of the transformer 82. This current will build up along an exponential curve, and will store energy in the magnetic field surrounding both windings of transformer 82. At the instant ignition is required, the contact points 84 open. This action causes a relatively high voltage to be developed in the primary 92 of transformer 82. This voltage is further stepped up in the proper phase so that the opening of contact points 84 results in a higher voltage of positive polarity with respect to ground to appear at the ungrounded terminal of secondary winding 88. This high voltage is transferred through resistor 80 to the grid 90 of controlled tube 58 and causes tube 58 to become ionized, thereby permitting the energy which previously had been stored in condenser 52 to be discharged through the primary 53 of ignition coil 54. When the transient voltage disappears from the secondary 88, the grid 90 of tube 58 again assumes the potential of ground 22, thereby extinguishing the tube 58.

Since the tube 58 may be adversely affected by negative potential at the grid 90, the entire triggering circuit has been arranged with the voltage divider so that the voltage produced at the ungrounded terminal of secondary winding 88 is of negligible value at the instant points 84 close for the establishment of the magnetic field in the winding 82.

As has been previously pointed out, solenoids 36 and 38 are both energized when the starter solenoid 26 is energized. The energization of solenoid 36 will cause higher voltage to be impressed across the primary ignition circuits during the periods when the starter 32 is energized. This result is clearly set forth in the Short application supra.

When the solenoid 38 is energized, the armature 94 will be moved from its engagement with contact 98 into engagement with contact 102 so that the division ratio of the divider is changed from $\frac{2}{15}$ to $\frac{1}{15}$. This increasing division ratio when coupled with the decreasing battery voltage during cranking, results in sufficient energy and voltage for triggering the grid 90 of tube 58 during the cranking period.

While the embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adapted.

What is claimed is as follows:

1. In an ignition system for an internal combustion engine having; a source of D. C. current and voltage, a means for increasing the voltage of said source to a higher voltage, a load connectable to said source for decreasing the voltage of said source, a primary circuit connected with said higher voltage means, and an electronic switch connected in said primary circuit for controlling current flow in said primary circuit from said higher voltage means, means including a transformer having a primary winding connected in circuit with said source lower means and a secondary winding connected with said electronic switch for controlling current flow through said switch and a means in the circuit between the source and primary winding for increasing the voltage across the primary winding when the load is connected to said source.

2. In an ignition system of the character described wherein an electronic switch controls the flow of current from a D. C. source through a primary ignition circuit, a means for controlling the operation of the electronic switch, comprising in combination; a set of breaker points, and a transformer having a primary winding connected in circuit with said source, breaker points and a secondary

winding connected in circuit with said electronic switch and means for increasing the voltage across the primary winding when a load is connected to said source.

3. In an ignition system of the character described wherein an electronic switch is used to control the flow of current from a D. C. current source through a primary ignition circuit, the combination comprising; a set of breakerpoints, a transformer having a primary winding connected in circuit between said source and breaker points and a secondary winding connected in circuit with a grid of said electronic switch for controlling current flow in said primary ignition circuit in response to current flow in the primary winding of said transformer and a voltage dividing network arranged to limit the voltage in the primary winding to a predetermined maximum for limiting the negative potential on said grid.

4. In an ignition system of the character described for an internal combustion engine wherein an electronic switch is used to control the flow of current from a D. C. source through a primary ignition circuit, the combination comprising; an external load connectable to said source, a set of breaker points, a multitap resistance voltage divider, a transformer having primary connected with said breaker points and a secondary winding connected with said switch and means for selectively connecting said primary with taps on said resistance for maintaining a constant voltage across the primary winding when said load is connected and disconnected with said source.

5. In an ignition system of the character described, the combination comprising, a source of D. C. current, an ignition coil and an electronic switch having a variable potential grid arranged for controlling the flow of current between said source and coil, a means including a transformer for changing the potential of said grid, said transformer having a primary coil winding connected with said source and a set of breaker points and a secondary connected with said grid for controlling current flow through said switch in response to current flow changes in said primary winding and means connected between the primary winding and the source for limiting the voltage across the primary winding to a predetermined value.

6. In an ignition system of the character described wherein an electronic switch is used to control the flow of current from a D. C. source to a primary ignition circuit, the combination comprising; a transformer having a secondary winding connected with said switch and a primary winding connected with said source and a means connected in circuit with said source and primary winding for limiting the voltage to said primary winding from said source and thereby to limit negative voltage in said secondary circuit.

7. The combination as set forth in claim 4 wherein the external load includes a starting motor and the means which connects the primary coil of the transformer with the multi-tap resistance is operatively connected with a circuit which causes a starter for the internal combustion engine to be energized for increasing the current flow through said primary transformer coil whenever the said starter is energized.

8. In an ignition system of the character described wherein an electronic switch is used to control the flow of current from a D. C. source to a primary ignition circuit, the combination comprising; a transformer having a secondary winding connected with said switch and a primary winding connected with said source, and a means including a multi-tap resistance for limiting and varying the source voltage to said primary winding to limit negative voltage in said secondary.

9. In an ignition system of the character described for an internal combustion engine the combination comprising a starting motor circuit for cranking said engine, an electronic switch in control a flow of current to a primary ignition circuit, a common D. C. current source for said starting motor and said primary ignition circuit, a

means to increase the current flow from said source to said primary ignition circuit and a means to increase the current flow from said source to a control circuit for said electronic switch during periods when said starting motor is energized by current from said source.

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References Cited in the file of this patent

UNITED STATES PATENTS

1,842,815	Arthur	Jan. 26, 1932
1,957,127	Arthur	May 1, 1934
2,175,900	Knight	Oct. 10, 1939
2,536,143	Short et al.	Jan. 2, 1951
2,550,026	Short	Apr. 24, 1951
2,586,962	Kleis	Feb. 26, 1952