GAS CIGARETTE LIGHTER WITH SPARK IGNITION

Fig. 3

Fig. 5

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This invention relates to a gas-fueled cigarette lighter with a spark ignition system including a high-voltage transformer having a secondary winding connected to ignition electrodes and a primary winding connected to its own source of ignition current through a switch, at the primary side. In such cigarette lighters, the source of ignition current is connected to the primary winding of the high-voltage transformer by closing a switch. The current surge which is caused as a result in the primary winding induces the ignition voltage in the secondary winding. In order to have sufficient electrical energy available for the ignition and at the same time to reduce drain of the battery and to keep its dimensions within tolerable bounds, a capacitor is used as the actual source of ignition current in a proposed example of an embodiment. A changeover switch is provided in the primary circuit of the high-voltage transformer, which switch respectively connects the capacitor to a battery for charging of the capacitor and to the primary winding of the transformer to effect ignition.

Special demands have to be made on the switches in the primary circuit. They have to operate quickly in order to achieve as high a battery discharge $db/dt$ as possible. With a view to durability, their contacts are made wholly or partially of gold or covered with platinum or tungsten alloys. In addition, they should not exceed a certain size lest the lighter should become unwieldy.

In order to satisfy all the requirements, switches for gas-fueled cigarette lighters with spark ignition have been proposed which are designed as quick-closing switches and the speed of operation of which is always the same regardless of the manual mode of operation of the cigarette lighter. In this case, contact chattering had to be avoided. In addition, the contacts of the switch had to be insensitive to contact-breaking sparks.

Such switches are precision parts, the manufacture of which is really expensive and more or less severe wear of which cannot be avoided in the long run.

The object of the invention is to develop a gas cigarette lighter with spark ignition wherein the switch in the primary circuit of the high-voltage transformer better meets the demands made on it and can be simpler and smaller in construction than the switches hitherto used.

This problem is solved as a result of the fact that a substantially inertialess electronic circuit element which works without the movement of contacts and the control input circuit of which can be influenced, directly or indirectly, from the outside, is used as a switch in the primary circuit.

The essential advantages consist in that no contact difficulties arise, that the operating speed meets all the requirements and that the control of the control input circuit can be effected by means of the precision and switching accuracy of which does not have to meet such high requirements as is the case in the switches hitherto known and used in the primary circuit.

For the direct control of the control input circuit, a simple switch may be provided which is in operational connection with the mechanical intermediate members, both with the fuel valve and with the actuating mechanism of the cigarette lighter, in such a manner that when the cigarette lighter is operated, first the fuel valve and then the closing switch are actuated.

The switch may comprise quite simple contact elements because it only has to apply a voltage to the control input of the electronic circuit element. Its switching speed has no significance with regard to the production of sparks.

Since, in a cigarette lighter, a single spark is normally sufficient to ignite the gas, the switch may be equipped, to advantage, with self-wiping contacts, known per se, which ensure only a brief contact making.

The embodiment of the invention described so far works on the closing principle. It may be an advantage to use the so-called disconnection principle whereby the spark appears at the electrodes by rapidly disconnecting the high-voltage transformer.

According to the invention, a closing switch is provided in the working circuit of the electronic circuit element for this purpose and a disconnecting switch, which is in operational connection, through mechanical intermediate members, both with the fuel valve and with the actuating mechanism, is provided in the control circuit, in such a manner that, on operation, first the closing switch in the working circuit closes, then the fuel valve is opened and after that the disconnecting switch in the control circuit blocks the electronic circuit element.

The closing switch in the working circuit is normally open in order to reduce drain of the battery. After closing, the high-voltage transformer is connected through a resistor. This takes place so slowly that the battery discharge $db/dt$ is not sufficient to induce the ignition voltage in the secondary winding. Only when the electronic circuit element, which is likewise connected after the closing of the closing switch, is disconnected by the disconnection switch in the control input circuit does the battery discharge $db/dt$, which now results, suffice to produce the ignition voltage.

In a further embodiment of the invention in which the electronic circuit element is only operated indirectly after actuation of the push-button of the cigarette lighter, a closing switch is provided in the working circuit of the electronic circuit element and an additional feed-back winding on the high-voltage transformer is provided in the control circuit, in which case the closing switch is in operational connection, through the intermediate members, both with the burner valve and with the actuating mechanism in such a manner that when the cigarette lighter is operated, first the burner valve opens and then the closing switch is closed. With correct dimensioning of all the elements in the circuit, a frequency develops which affords an astonishingly high ignition voltage with the minimum dimensions of the high-voltage transformer.

In order to avoid continuous sparking, the closing switch in the working circuit of the electronic circuit element may again comprise self-wiping contacts known per se.

A transistor, an electronic valve, a cold-cathode thyatron or any other equivalent arrangement familiar to one skilled in the art may be used as an electronic circuit element, provided that it functions in accordance with the concept of the invention.

Further features and advantages of the invention are apparent from the following description of examples, to which the drawings relates.

FIGURE 1 shows a diagrammatic arrangement of the elements of the invention working on the closing principle;

FIGURE 2 shows a diagrammatic arrangement of the elements of the invention working on the disconnection principle;

FIGURE 3 shows a diagrammatic circuit diagram with indirect control of the control circuit;
FIGURE 4 shows structural details of the invention and FIGURE 5 shows a perspective view of a cigarette lighter according to the invention.

According to FIGURE 1, an ignition spark gap 12 is defined by electrodes connected to the secondary coil 11 of an high-voltage transformer 9, 10, 11. The primary coil 9 is connected directly to the one pole of a voltage source 1 and through an electronic circuit element 4 to the other pole of the voltage source. If necessary, a resistor 2 may be provided in the energizing circuit thus formed. A capacitor 3 is connected in parallel with the voltage source 1 from which capacitor is derived the energy to produce the ignition spark 12 as a result of the voltage source itself. The capacitor, however, is not absolutely essential for the satisfactory operation of the circuit shown in FIGURE 1. The electronic circuit element 4 comprises a control input circuit which consists of the resistors 5, 6 and a closing switch 7 which is in operational connection, through mechanical intermediate members 8, 16, 17, 18, 20, the form and construction of which are not a subject of the invention, both with a fuel valve 13 and with an actuating push-button 21 of the cigarette lighter. The fuel valve 13 is included in the fuel supply conduit 22 to a burner nozzle 14 which itself is situated opposite the electrodes of the ignition spark gap 12. The fuel tank is designated by 15.

Normally, the electronic circuit element 4, in the present example a transistor, is blocked, because the closing switch 7 in the control input circuit comprising the resistors 5 and 6 is open. Switch 7 may comprise normal blade contacts for it may be provided with self-wiping contacts in order to ensure that the installation is only switched on briefly. The capacitor 3 is constantly charged from battery 1.

After or during actuation of the push button 21 against the force of a spring 20 which bears against the housing 19, the roller 18 rides upon a slanted body 17 as a result of which the fuel valve 13 is opened against the force of a spring 16 so that gas can emerge from the tank 15 and the fuel nozzle 14 and flow between the electrodes of the spark gap 12. A short time later, the closed switch 7 closes and transistor 4 becomes conducting. The capacitor is discharged through the primary winding 9 as a result of which an ignition voltage surge is induced in the secondary winding 11 and ignites the mixture of gas and air in the spark gap 12.

When the contacts of the closing switch 7 are connected in the form of self-wiping contacts, the closing switch 7, which is now open again, blocks the transistor 4 immediately after the spark discharge. The capacitor 3 is charged afresh and the apparatus is ready to produce a further spark.

Any element equivalent to a transistor may be used as an electronic circuit element.

FIGURE 2 shows a modified example of the invention. Whereas, in the preceding example, the spark is produced when the high-voltage transformer is connected, in the circuit shown in FIGURE 2 it occurs when the high-voltage transformer 9, 10, 11 is disconnected. Connected into the circuit of the transistor is the closing switch 30, which is normally open and which is connected, through a mechanical intermediate member 31, to a normally closed disconnecting switch 34 in the control input circuit of the transistor 4. Both switches are in operational connection through mechanical intermediate members 31, 16, 17, 18 and 20. Whenever the fuel valve 13 and with the actuating push-button 21. Also connected into the circuit of the transistor 4 is a resistor 26 and a normally open switch 27 which is in operational connection with a push-rod 28 which is loaded by a loaded spring 29 disposed between housing wall 19 and a collar 28a. The push-rod 28 projects from the bottom 19 of the lighter housing.

By means of it, the switch 27 is always kept open when the cigarette lighter is standing on a table for example, in order to drain of the battery 1. If the operator presses on the push button 21, the closing switch 30 closes first, as can be seen from FIGURE 2, as a result of which the primary winding 9 of the high-voltage transformer is connected through the resistor 26 and the transistor 4, so that an electronic circuit element 4 is formed by the closing switch 34 in the control input circuit 5, 6 is closed, the transistor 4 is conducting. The resistor 26 ensures that, as a result of the low ohmic resistance of the primary winding 9, no quasi short-circuit current appears in the battery. With appropriate construction of the primary winding 9, the resistor 26 can be omitted.

At the same time, the roller 18 rides up on slanted body 17. The arrangement is such that the fuel valve 13 only opens when the primary winding 9 is connected. Last of all, the disconnecting switch 34 opens, as a result of which the transistor 4 becomes non-conducting within a very short time. The magnetic field in the iron core 10 of the high-voltage transformer now ceases so that the ignition voltage is induced in its secondary winding 11.

In both the preceding examples and also in other embodiments of the invention, it is immediately how the mechanical intermediate members 31, 16, 17, 18, 19, 20 etc. are constructed, provided only that they effect the required actuating sequence of operation of the elements 30, 34, 13 and 7, 13 respectively.

FIGURE 3 shows a further embodiment of the invention, wherein the control input circuit of the electronic circuit element 35 is controlled indirectly through a feed-back winding 40. Details of the actuating mechanism for the fuel nozzle 13 are designated by 21, 17, 18 and have been described in more detail above.

The feedback winding is provided on a core 41 in addition to a primary winding 39 and a secondary winding 39 of a high voltage transformer. A variable resistor 45 serves to regulate the frequency. The resistors 36, 37 correspond to the resistors 5, 6 in the previous examples. The closing switch 44, which is connected to the elements 17, 21 through mechanical intermediate members 43, is connected into the circuit of the transistor 35.

On actuation of the push button 21, the fuel valve 13 is first opened by means of the roller 18 and slanted body 17. Then the closing switch 44 closes. The arrangement is such that the potential applied to the base of the transistor 35 at this moment, renders the transistor conducting. The current surge which immediately passes through the primary winding induces voltages in the secondary winding 39 and the feedback winding 40. The ignition voltage of the winding 39 causes an ignition spark across the spark gap 42; the feedback voltage of the winding 40 blocks the transistor 35. The now collapsing magnetic field in the iron core induces a voltage in the feedback winding, which voltage renders the transistor 35 conducting. The cycle begins afresh. The frequency can be adjusted by means of the resistor 45. Extremely high frequencies can be achieved which has the advantage that the dimensions of the high-voltage transformer can be kept small.

In order to avoid a continuous sparking at the spark gap, the contacts of the closing switch 44 may again be constructed in the form of self-wiping contacts.

FIGURE 4 shows details of the actuating mechanism on a larger scale. The circuit shown in FIGURE 2 can be actuated by the arrangement shown in FIGURE 4. With only slight modifications, the arrangement shown in FIGURE 4 can be converted in such a manner that the circuits as shown in FIGURE 1 or 3 as well as other circuits for embodying the idea of the invention but not illustrated, can be actuated.
FIGURE 4 shows the fuel tank 15 with the fuel valve 13 and a valve cap 13a. A valve rocker 51, which is forked at its left-hand end, straddles the stem of the fuel valve 13. The valve rocker 51 is pivotally mounted on a valve-rocker pin 59 which in turn is mounted in the cross member 49.

The right-hand end of a valve rocker 51 in FIGURE 4 carries slanted body 17 which co-ordinates with the correspondingly constructed end of the shank 21a of the actuating push button 21. The push button 21 is subject to the action of spring 20 which bears against the outer wall 19.

Also mounted for pivoting about a valve-rocker pin 59 is one end of a pawl 47, the other end of which comprises a lug 46 which can co-operate with a recess 21b in the shank 21a of the push button 21. The pawl 47 is subject to the influence of a spring 48. An extension 60 is secured to the push-button 21 and acts on the switches 30 and 34 (see FIGURE 2). The connection between the two switches is established by means of a trip cam 60a.

The push-rod 28 extends through the lower wall 19 of the lighter casing. It is subject to the influence of loaded spring 29 which is disposed between the push-rod 28 and the collar 28a. If the cigarette lighter is picked up, the push-rod 28 follows the force of the spring 29 as a result of which the pawl 47 is released and the switch 27 is closed by the collar 28a (see FIGURE 2).

After the cigarette lighter has been lifted and the switch 27 closed, the push-rod 281 is actuated. The arrangement is such, as shown in FIGURE 4, that the closing switch 30 is first closed by extension 60, then the fuel valve 13 is opened by means of the valve rocker 51 pivoted about its pin 59, and subsequently the switch 34 is opened through the trip cam 60a. In this operating condition, the switch 27 is closed as a result of the force of the spring 48, as a result of which the operating position is locked. Not until the cigarette lighter is placed on a support does the push-rod 28 move upwards and disengage the lug 46 from the recess 21b.

The members of the arrangement shown in FIGURE 4 return to their original position of rest.

It is easy to see that by varying the members 31, 31a, by displacing the switches 30, 34, by varying the slope of the body 17 or the lever arms of the valve rocker 51 or by adjusting the collar 28a or the switch 27, any conceivable operating sequence of the members 13, 17, 27, 28a, 30, 34 can be obtained.

Finally, FIGURE 5 shows, partially in section, the arrangement of the individual parts in the cigarette lighter. The burner nozzle 14, which is connected to the valve head 13a through a resilient tube 14a, is situated above the fuel tank 15 with the fuel valve 13. The spark gap 12, the electrodes 12a of which is supported by a carrier 12b and connected to the high-voltage winding 11 of the high-voltage transformer, is situated above the burner nozzle 14. The switches 30 and 34 are accommodated in the cigarette lighter at the top right in accordance with FIGURE 4. The battery 1, and if necessary the capacitor 3 and the electronic circuit element 4 or 35, is situated below the switches 30, 34. The valve rocker 51 and the bearing bracket 49 can be seen above the capacitor 3. The switches 27, 28a and the push-rod 28 are mounted between the fuel tank 15 and the capacitor 3. The push button 21 is not shown because it lies in the side wall or front wall, not shown, in the example shown in FIGURE 5. The slope of the body 17 must be constructed appropriately.

 Naturally, other advantageous possible arrangements of the elements within the cigarette-lighter housing are possible without altering the concept of the invention at all.

What is claimed is:

1. An ignition assembly for a gas-fueled electrically ignited lighter comprising, in combination, a fuel valve; an actuator for controlling the release of fuel by the valve and ignition of released fuel; a step-up transformer having a primary winding and a secondary winding; a battery connected to the primary winding of the transformer in a power supply circuit; electronic switching means included in said power supply circuit, said switching means having a state of conductivity and a state of non-conductivity; a control circuit means coating with said electronic switching means to control the state of conductivity thereof; a normally open control switch, closing of said switch actuating the control circuit means thereby changing the state of conductivity of said electronic switching means, maintaining said electronic means coupled said actuator to said normally open control switch and to the fuel valve of the lighter, operation of said actuator causing the transmission means first to open the fuel valve of the lighter for releasing fuel through the same and then to close the control switch; and an ignition circuit including a spark gap connected to the secondary winding of the transformer, said change in the conductivity of the electronic switching means by closing of said control switch inducing a voltage surge in the secondary transformer winding, said voltage surge means to render the electronic switching means conductive for the purpose aforesaid.

2. An ignition assembly according to claim 1 wherein said control circuit means renders said electronic switching means non-conductive when said control switch is open, closing of said switch causing the control circuit means to render the electronic switching means conductive for the purpose aforesaid.

3. An ignition assembly for a gas-fueled electrically ignited lighter comprising, in combination, a fuel valve; an actuator for controlling the release of fuel by the valve and ignition of released fuel; a step-up transformer having a primary winding and a secondary winding; a battery connected to the primary winding of the transformer in a power supply circuit; electronic switching means included in said power supply circuit, said electronic switching means having a state of conductivity and a state of non-conductivity; a normally open first control circuit switch included in said power supply circuit; a control circuit means coating with said electronic switching means to control the state of conductivity thereof, said control circuit means including a second normally closed control switch; mechanical transmission means coupling said actuator to said first and second control switches and to the fuel valve of the lighter first, operation of said actuator causing the transmission means first to close said first control switch for rendering conductive said electronic switching means, then to open said fuel valve for releasing fuel through the same and finally to open said second control switch thereby opening said control circuit means, opening of said control circuit means, opening of said control circuit means rendering said electronic switching means non-conductive; and an ignition circuit including a spark gap connected to the secondary winding of the transformer, whereby the non-conductivity of the electronic switching means upon opening of the control circuit means induces a voltage surge in the secondary transformer winding; said voltage surge causing a spark discharge across said gap for igniting fuel released by the fuel valve.

4. An ignition assembly for a gas-fueled electrically ignited lighter comprising, in combination, a fuel valve; an actuator for controlling the release of fuel by the valve and ignition of released fuel; a step-up transformer having a primary winding and a secondary winding; a battery connected to the primary winding of the transformer in a power supply circuit; electronic switching means included in said power supply circuit, said switching means having a state of conductivity and a state of non-conductivity; a control circuit means coating with said electronic switching means to control the state of conductivity thereof; a normally open control switch also included in said power supply circuit, closing of said switch rendering
said electronic switching means conductive; a feedback winding at the transformer connected to said control circuit means; mechanical transmission means coupling said actuator to said control switch and said fuel valve, operation of the actuator causing the transmission means first to open the fuel valve of the lighter and then to close said control switch thereby rendering the electronic switching means conductive, said conductivity of the electronic switching means inducing a voltage surge in the secondary transformer winding and also a voltage surge in the feedback winding; and an ignition circuit including a spark gap connected to the secondary transformer winding, said voltage surge in the secondary transformer winding causing a spark discharge across said spark gap and said voltage surge in the feedback winding rendering said electronic switching means again non-conducting thereby causing a collapse of the magnetic field of the transformer, said collapse inducing again a voltage surge in the feedback winding and rendering the electronic switching means again conducting, thereby initiating a repetition of the aforesaid switching operations.

5. An ignition assemblage according to claim 4 and comprising a variable resistance means included in said control circuit means for varying the repetition frequency of said switching operations.

6. An ignition assemblage according to claim 1 wherein said control switch has self-wiping switch contacts for controlling the state of conductivity of the electronic switching means by opening and closing the control switch.

7. An ignition assemblage according to claim 1 wherein said electronic switching means comprises a transistor having its base and its emitter connected to said power supply circuit and its collector and base connected to said primary transformer winding.

8. An ignition assemblage according to claim 1, wherein said electronic switching means comprises an electron tube.

9. An ignition assemblage according to claim 8, wherein said electron tube is a cold cathode thyratron.

10. An ignition assemblage according to claim 1, wherein said normally open control switch and a normally open second control switch are serially included in said power supply circuit, and comprising a displaceable spring-loaded actuating member coupled to said second control switch for controlling the opening and closing thereof, said actuating member retaining said second control switch in its open position when the actuating member is retained in a predetermined position of displacement against the spring action and moving said second control switch into its closing position when the actuating member is released.

11. An ignition assemblage according to claim 10, wherein said actuating member comprises a spring-loaded push rod protruding at one end from the lighter for applying a pressure to the rod holding the same in said predetermined position against the spring action by placing the lighter in a position on a supporting surface in which position the lighter rests on said protruding rod end, lifting of the lighter above said surface freeing the spring action for displacing the rod out of said predetermined position.

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