Jan. 29, 1924. 1,482,080

J. M. LEA

IGNITING SYSTEM

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Fig. 1

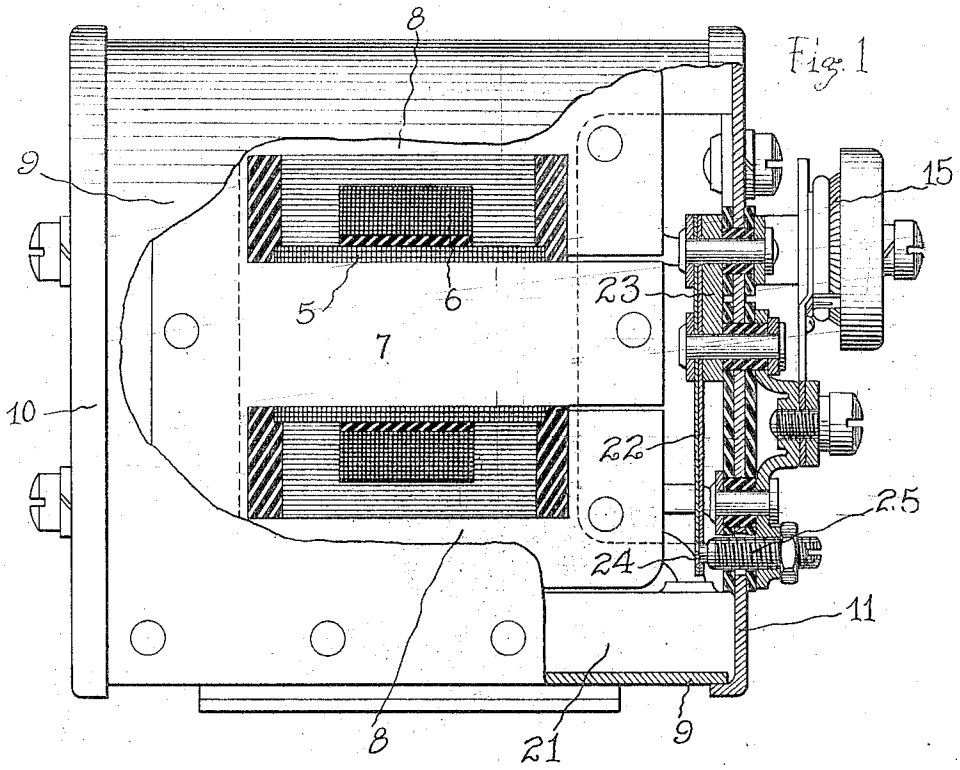
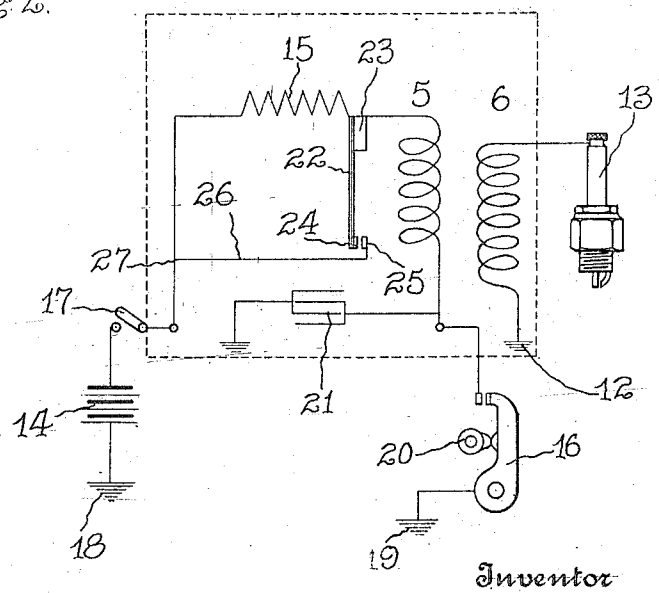


Fig. 2.



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Fig. 3.

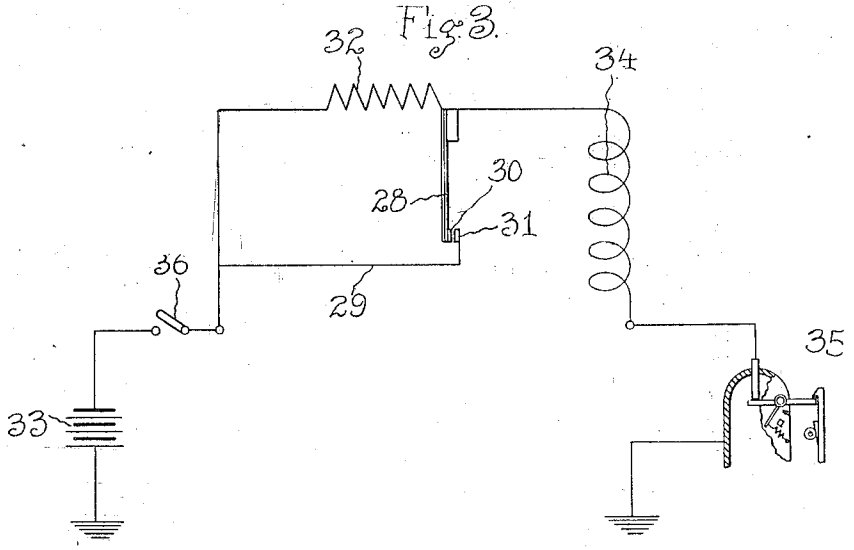
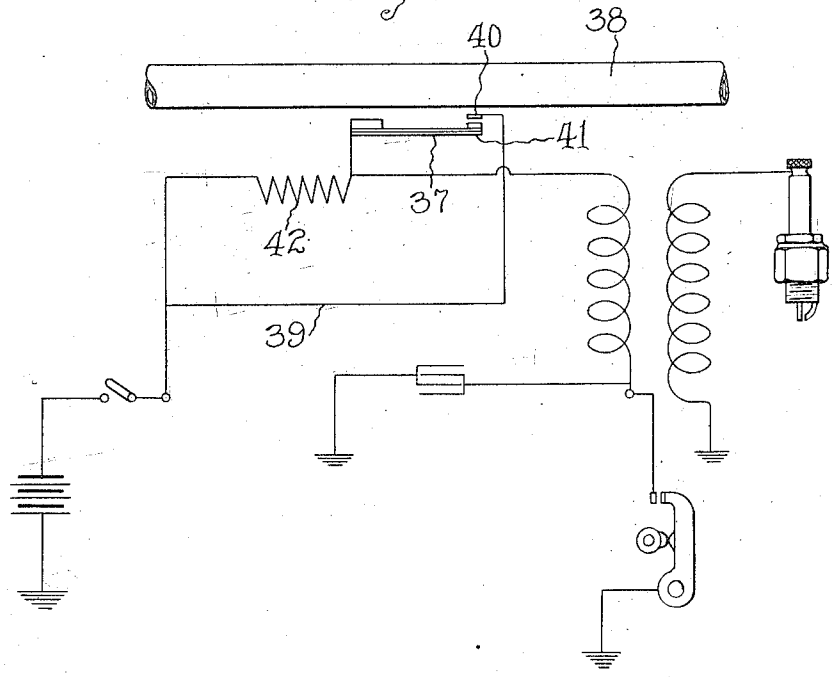


Fig. 4.



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UNITED STATES PATENT OFFICE.

JOHN M. LEA, OF DETROIT, MICHIGAN, ASSIGNOR TO GENERAL MOTORS CORPORATION, OF DETROIT, MICHIGAN, A CORPORATION OF DELAWARE.

IGNITING SYSTEM.

Application filed March 19, 1919. Serial No. 283,458.

To all whom it may concern:

Be it known that I, JOHN M. LEA, a citizen of the United States, and resident of Detroit, Wayne County, State of Michigan, have invented certain new and useful Improvements in Igniting Systems, of which the following is a specification.

My invention relates to electrical igniting devices or systems designed especially for use with internal combustion engines to ignite the successive combustible charges supplied to the working cylinder thereof, although the same is capable of use in other relations, and in fact in any service wherein an inflammable mixture is to be ignited and burned.

It is a well known fact that in igniting systems used in connection with internal combustion engines much more electrical energy, or a hotter spark is necessary at starting than is necessary after the engine is in operation; and that it is often difficult to ignite the mixture at starting, particularly under conditions of low atmospheric temperature when the adverse conditions due to an abnormally cold mixture are added to the adverse conditions due to low compression of the mixture within the engine cylinder. Under such conditions an igniting device which supplies sufficient electrical energy to ignite the charges without fail after the engine has been started, and has become heated to the temperature at which it normally operates, will be entirely inadequate to secure the ignition of the charges at starting, when the mixture is cold and the compression reduced in the manner necessary at such times.

With the object or end in view of avoiding the difficulties above pointed out and providing a system wherein the charges will be properly ignited at starting, and with a comparatively cold mixture, my invention includes thermostatically controlled means for increasing the quantity or amount of current available for igniting the combustible mixture at such times; which increase of current is accompanied by a corresponding increase in the electrical energy supplied by the system, whereby a hotter spark is produced at the spark plugs or make and break terminals at which the igniting sparks occur; such increase in current being preferably brought about by reducing the resistance of the circuit in which the igniting elements are included at such times, so that more current may then flow therethrough.

The drawing accompanying and forming a part of this specification illustrates the preferred embodiment of my invention, although it will be appreciated that the same may be embodied in various other forms and that my invention includes such variations and modifications of the particular form thereof illustrated as come within the scope of the concluding claims.

In the drawings:

Figure 1 is a view showing my invention as embodied in a high tension induction or spark coil designed to be used in a jump spark igniting system for internal combustion engines;

Figure 2 is a schematic view or diagram ilustrating my invention as used with a single cylinder engine, the various elements thereof being shown in a conventional manner;

Figure 3 is a similar diagrammatic view showing the application of my invention to an engine provided with a make and break igniting system, and;

Figure 4 is a view similar to Figure 2 but modified as to some of the features which enter into my invention.

Referring first to Figures 1 and 2, wherein my invention is shown as embodied in a high tension electrical igniting device or system having primary and secondary coils arranged in inductive relation with one another, and a magnetic core through which the lines of force set up by the primary coil pass, the reference numeral 5 designates the primary and 6 the secondary coils of a high tension or jump spark electrical igniting system; said coils being so arranged as to surround a core 7 made up of laminated soft iron and having exterior portions 8 which extend about the coils and form a path of low resistance for the lines of magnetic force established by the primary coil, all as is usual in induction coil or transformer construction. The coils and magnetic core, as well as various other of the elements of my invention, are enclosed in and protected by a suitable casing 9, the ends of which are closed by heads 10, 11, to the latter of which various of the elements which constitute my invention are secured. One end of the secondary coil is

ordinarily grounded upon the engine or frame of the vehicle, as indicated at 12, while the other end thereof is connected with the insulated terminal of a spark plug 13, the sparking points of which are within the cylinder of the engine with which the device is used. It will be appreciated, however, that if the system is to be used in connection with a multiple cylinder engine, the end of the secondary coil not grounded will be connected with a suitable distributor or commutator adapted to direct the flow of current from the coil to the spark plugs of the several cylinders in proper sequence.

The primary coil 5 is shown as included in a circuit which includes also a suitable source of electricity indicated conventionally by the battery 14, a resistance coil 15, a circuit making and breaking device 16, a suitable switch 17, and suitable connecting elements or wires whereby said members are connected in series with one another; the resistance coil being included in the circuit when the engine is in operation so that all the current flowing through the primary coil then flows therethrough, the two ends of the circuit in question being grounded at 18, 19 in ordinary practice, and the circuit breaker being positively operated as by a cam 20 driven by the engine in the embodiment of my invention illustrated. The usual condenser 21 is also ordinarily included in and forms a part of the igniting system wherein my invention consists.

The reference numeral 22 designates a thermostat made up of two strips or bars of metal having different coefficients of expansion secured together, such being a common form of thermostat; said compound bar being secured to a fixed support or block 23 and having a terminal 24 at its free end adapted to contact with a fixed terminal 25 when the thermostat is exposed to an abnormally low temperature, to thereby close a shunt circuit extending from the block 23 to which one end of the primary coil is connected, through the said bar and terminals and through a conductor 26 which connects with the main circuit at 27. This closing of the shunt circuit above traced obviously establishes a path of low resistance around the coil 15 which is of comparatively high resistance and, in effect, cuts out or short-circuits the said coil, thus reducing the resistance of the circuit in which the primary coil 5 is included and permitting an increased current to flow therethrough from the source of current 14.

As above explained, the closing of the shunt circuit at the terminals 24, 25 occurs at abnormally low temperatures; the adjustment of the parts being ordinarily such that the said terminals will be in contact with one another when the temperature in their vicinity is say below 40 degrees Fahrenheit. Under such temperature conditions the resistance coil 15 will be cut out or short-circuited; and it will be appreciated that such conditions can ordinarily be present only after the engine has been at rest for a considerable time, as the heat thereof will keep the temperature in the vicinity of the thermostat well above the temperature mentioned when the engine is in operation.

It therefore follows that in starting the engine under the low temperature conditions above assumed a comparatively large current will flow through the primary coil 5, because of the fact that the resistance coil 15 is short-circuited; and that increased electrical energy, and a hot spark at the spark plug terminals, and a more certain ignition of the combustible mixture, will be secured at such time. After the engine has been started the temperature in the vicinity of the resistance coil and casing therefor will rise to an extent sufficient to bring about the opening of the shunt circuit at the terminals 24, 25, thus re-introducing the resistance coil 15 into the circuit in which the primary is included and cutting down the flow of current to the lesser amount sufficient, however, to secure the ignition of the combustible mixture after the engine is in operation, and has become heated.

Although in describing my invention and explaining the operation thereof, I have referred to a battery as a source of electricity, it will be appreciated that a dynamo, a magneto, and in fact any device whereby a current of electricity is caused to flow through an igniting circuit may be employed; the distinguishing feature of my invention being the provision of thermostatically controlled means for securing an increase in the quantity of current flowing through an igniting circuit at abnormally low temperatures, and when a combustible mixture is to be ignited by an igniting device included in the said circuit.

In the embodiment of my invention illustrated in Figure 3, the thermostat 28 acts to close a shunt circuit 29 at the terminals 30, 31 when the temperature in the vicinity thereof is abnormally low, thereby short-circuiting a resistance coil 32 which at normal temperature is included in an igniting circuit, because of the fact that at normal temperature the shunt circuit is broken at the terminals 30, 31.

The igniting circuit above referred to include a battery or other source of electricity 33, a coil 34 wound upon the usual soft iron core as will be appreciated, and a make and break igniting device indicated conventionally at 35 and comprising two terminals located within the engine cylinder, and means for moving them into contact with and for separating them from one another; the ignit-

ing system shown in this figure being a low tension system. The resistance coil 32 is included in the igniting circuit or not according to whether the contact terminals 30, 31 are separated, or in engagement with one another; and the arrangement and adjustment of the parts is such that the coil 32 will be short-circuited by the thermostat 28 at abnormally low temperature, thus securing an increased flow of current through the igniting circuit at such times. The igniting circuit is shown as provided with a suitable switch 36, and the ends thereof are grounded in accordance with the usual practice in installing such systems.

The thermostat for securing an increased flow of current through the igniting circuit at abnormally low temperature may be located in any position about the engine or vehicle, so far as its function in short-circuiting a resistance coil is concerned; it being only necessary that the location selected shall be one which will assume a temperature corresponding approximately with the temperature of the atmosphere, in order that the thermostat may operate to short-circuit the coil in question at low temperature. After the engine has been started, however, the current flowing in the igniting circuit should be reduced to the lesser amount sufficient to ignite the mixture after the engine has become heated and the compression is normal, irrespective of atmospheric conditions; which result obviously necessitates that the thermostat shall be heated after the engine has been started, to thereby bring about the opening of the shunt circuit controlled thereby, and the re-introduction of the resistance coil into the igniting circuit. Ordinarily the temperature all about the engine will be sufficiently high, after the engine has been started and is operating normally, to bring about the opening of the contacts controlled by the thermostat and the introduction of the resistance coil into the igniting circuit, and it follows that when the thermostat is located in the coil box or casing as shown in Figure 1, the thermostat will short-circuit the coil under the low temperature conditions assumed, as the entire engine will obviously assume the temperature of the surrounding atmosphere after it has been at rest for a time.

I may, however, locate the thermostat in a position such that it will be heated in a more positive manner than is the case where the rise in temperature all about the engine is depended upon, and, in the embodiment of my invention illustrated in Figure 4, I have shown the thermostat 37 as located adjacent a pipe 38 through which the exhaust gases from the engine, or the hot water of the cooling system thereof, flows, from which it follows that the opening of the shunt circuit 39 at the terminals 40, 41 and the re-introduction of the resistance coil 42 into the igniting circuit will be brought about in a somewhat more positive manner than would be the case if the thermostat were not located in a position especially selected with a view to heating the same after the engine is in operation. In the embodiment of my invention illustrated in this figure the arrangement and operation of the primary and secondary coils, and the other elements concerned with the operation of the high tension igniting system therein illustrated, are precisely the same as in the form of my invention illustrated in Figure 2 and hereinbefore described, which description need not be here repeated.

In view of the premises it will be appreciated that my invention provides an electrical igniting device or system wherein the current flowing through the ignition circuit is automatically increased when the temperature of the surrounding atmosphere is abnormally low; the said end being attained by the use of a thermostatically controlled device the operation of which is dependent, on the one hand, upon the temperature of the surrounding air or upon the external atmospheric temperature conditions, and dependent on the other hand upon the temperature condition of the engine itself; as the thermostat will not operate to cut out the resistance coil unless the temperature of the atmosphere is below the temperature at which the thermostat is adjusted to close the shunt circuit, and, if the thermostat does close the shunt circuit, then the subsequent opening thereof and the re-introduction of the resistance into the igniting circuit is of necessity, in the contemplated operation of the system, brought about by heat emanating from the engine.

Having thus described and explained my invention, I claim and desire to secure by Letters Patent:

1. In a high tension igniting device for internal combustion engines, primary and secondary coils arranged in inductive relation with one another; a circuit in which said primary coil is included and which circuit includes a source of current, a circuit breaking device for interrupting the flow of current through said primary coil, and a resistance coil; a shunt circuit of low resistance as compared with the resistance of said resistance coil; and a thermostat for closing said shunt circuit to thereby short-circuit said resistance coil, and which thermostat is included in and forms a part of said shunt circuit.

2. In a high tension igniting device for internal combustion engines, primary and secondary coils arranged in inductive relation with one another; a circuit in which said primary coil is included and which circuit includes a source of current, a circuit break-

ing device for interrupting the flow of current through said primary coil, and a resistance coil; a shunt circuit of low resistance as compared with the resistance of said resistance coil; and a thermostat for closing said shunt circuit to thereby short-circuit said resistance coil.

3. In a high tension igniting device for internal combustion engines, primary and secondary coils arranged in inductive relation with one another; a circuit in which said primary coil is included and which circuit includes a source of current, a circuit breaking device for interrupting the flow of current through said primary coil, and a resistance coil; and a thermostat adapted to vary the current flowing through said resistance coil.

4. In a high tension igniting device for internal combustion engines, primary and secondary coils arranged in inductive relation with one another; a circuit in which said primary coil is included and which circuit includes a source of current, a circuit breaking device for interrupting the flow of current through said primary coil, and a variable resistance; and a thermostat for varying the amount of resistance included in said circuit and through which the current flowing through said primary coil flows in one position of the thermostat.

5. In a high tension igniting device for internal combustion engines, primary and secondary coils arranged in inductive relation with one another; a circuit in which said primary coil is included, and which circuit includes a source of current and a circuit-breaking device for interrupting the flow through said primary coil; a thermostat; and means controlled by said thermostat for varying the resistance of the circuit in which said primary coil is included during the operation of said igniting device.

6. In a high tension igniting device for internal combustion engines, primary and secondary coils arranged in inductive relation with one another; a circuit in which said primary coil is included, and which circuit includes a source of current and a circuit-breaking device for interrupting the flow through said primary coil; and means operated by the heat generated in said engine and independent of current flowing in said circuit for varying the current flowing in said circuit during the operation of said igniting device.

7. In a high tension igniting device for internal combustion engines, primary and secondary coils arranged in inductive relation with one another; a source of current for supplying said primary coil; circuit-breaking mechanism for interrupting the flow of current through said primary coil; and thermostatically controlled means for varying the current flowing through said primary coil during the operation of said igniting device.

8. In an igniting device of the class described, an igniting circuit including a source of current, and means for igniting a combustible mixture; and means controlled by the heat generated by the combustion of said mixture and independent of current flowing in said circuit for varying the current flowing through said igniting circuit during the operation of said igniting means.

9. In an igniting device of the class described, an igniting circuit including a source of current, and means for igniting a combustible mixture; a resistance coil included in said igniting circuit; a thermostat; and a shunt circuit controlled by said thermostat and adapted to short-circuit said resistance coil.

10. The combination of an igniting circuit including a source of current and an igniting device, means permitting normally a flow of current through said circuit, and means made operative by environment conditions only rendering a hotter spark desirable and operative to provide an increased flow of current in said circuit.

11. In an igniting device of the class described, an igniting circuit; and means dependent upon the temperature of the surrounding atmosphere and independent of current flowing in said circuit for increasing the flow of current through said igniting circuit at abnormally low temperature.

12. In an igniting device of the class described, an igniting circuit, a thermostat associated therewith, and means associated with said thermostat for securing an increased flow of current through said circuit at abnormally low temperature, substantially as shown and described.

13. In an igniting device for internal combustion engines, an igniting circuit, and a thermostat adapted to vary the flow of current through said circuit; said thermostat being so arranged as to be influenced by the surrounding atmosphere to bring about an increased flow through said circuit at abnormally low temperatures, and by heat emanating from the engine to bring about a reduced flow through said circuit.

14. In an ignition system for internal combustion engines, a sparking device, means for supplying current thereto, and means for insuring an increased supply of such current to said sparking device when the environment temperature falls below a predetermined minimum.

15. In an ignition system for internal combustion engines, a sparking device, means for supplying current thereto, and automatically controlled means for insuring an increased supply of current to said sparking device when the environment tem-

perature falls below a predetermined minimum, said means being inoperative when the surrounding temperature rises above said minimum.

16. In an ignition system for internal combustion engines, a sparking device, means for supplying current thereto including a circuit and a source of current, a resistance in said circuit, a shunt, and means in said shunt for permitting such current to pass around said resistance when the environment temperature falls below a predetermined degree.

17. In a device of the class described, a circuit making and breaking device, means for supplying current thereto including a circuit and a source of current, and means for insuring an increased supply of such current to said making and breaking device when the environment temperature falls below a predetermined minimum.

18. In a device of the class described, a circuit making and breaking device, means for supplying current thereto including a circuit and a source of current, and thermally controlled means for insuring an increased supply of such current to said making and breaking device when the environment temperature falls below a predetermined minimum, said last named means operating independently of the heat generated by said current.

In testimony whereof I affix my signature.

JOHN M. LEA.