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TEMPERATURE RESPONSIVE CONTROL

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Fig. 1.

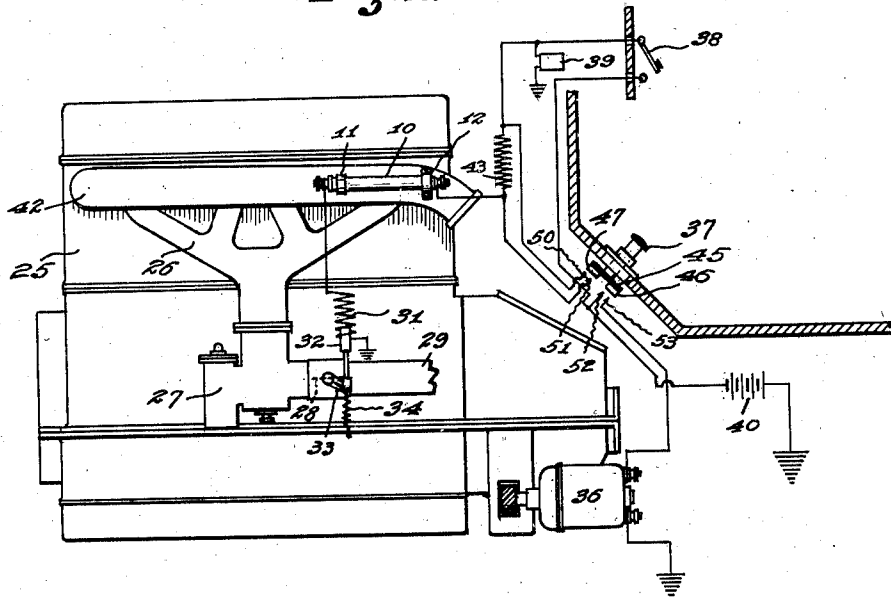
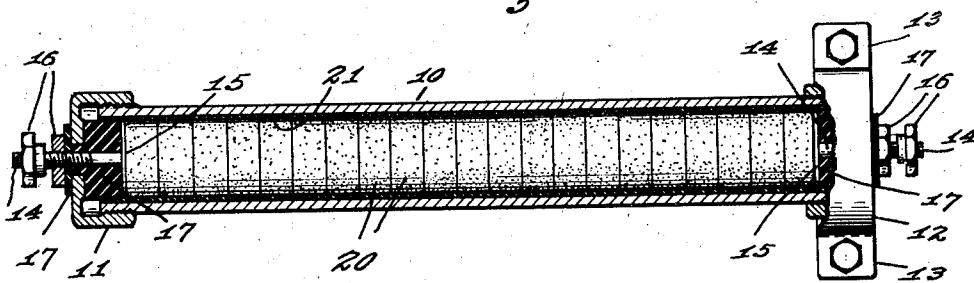


Fig. 2.



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TEMPERATURE-RESPONSIVE CONTROL

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It is the object of my invention to produce a device adapted to be used in association with an internal combustion engine, and particularly in association with the mixture-supplying means of such an engine, which device will enrich the mixture supplied to the engine when the engine is cold and also when the engine is being started. Another object of my invention is to produce, for use in association with my mixture-controlling device, a simple temperature-responsive device for varying an electric current flowing through it.

I accomplish my objects by providing a pressure-responsive resistance element adapted to be clamped between two members which are interconnected by a temperature-responsive element which, as it varies in length upon changes in temperature, will vary the pressure to which the resistance element is subjected and will thus effect changes in the value of the current flowing in a circuit in which the resistance element is connected. In using this device to effect mixture-control in an internal combustion engine, I may connect it in circuit with a current-responsive mechanism arranged to vary the proportions of the mixture supplied to the internal combustion engine. If desired, I may provide in association with such circuit a means for increasing the strength of the current flowing there-through when the usual engine-starting device is operative.

The accompanying drawing illustrates my invention: Fig. 1 is a diagrammatic view illustrating an internal combustion engine in elevation and showing somewhat diagrammatically the arrangement of the electrical connections and devices; and Fig. 2 is a longitudinal section through my temperature-responsive resistance device.

The temperature-responsive resistance device, as illustrated in Fig. 2, comprises a hollow tube 10, preferably of aluminum or some similar material which has a relatively high coefficient of expansion. At its ends the tube 10 is provided with caps 11 and 12, which are conveniently screw-threadedly mounted on the ends of the tube. One of such caps, here shown as the cap 12, is provided with out-

wardly extending feet 13 which adapt it for use as a bracket by which the device can be mounted in any suitable location. Passing through each of the caps 11 and 12 is the stem 14 of a connector which has on its inner end a plate or head 15. The outer end of each of the stems 14 is screw-threaded to provide for the reception of nuts 16 which serve to secure the connector to the associated cap and also serve to clamp the connecting wires in place. Suitable insulation 17 is provided to insulate at least one and preferably both of the connectors from the associated caps 11 and 12.

Located within the tube 10 and adapted to be clamped between the heads 15 of the connectors is a pressure-responsive resistance element. As shown in the drawing, this resistance element comprises a series of carbon disks 20 which fill the space between the heads 15 of the connectors at each end of the device. The carbon disks 20 are insulated from the tube 10 as by means of a tube 21 of insulating material which surrounds the disks.

The operation of this temperature-responsive current-controlling device will be evident. At low temperatures, when the tube 10 is relatively short, a considerable pressure will be exerted on the pile of carbon disks 20, with the result that there resistance will be relatively low. As the tube 10 is heated, either from an external source or as a result of the passage of current through the carbon disks 20, it will increase in length, and relieve the pressure on the pile of disks 20. As a result of this decrease in pressure, the resistance of the device will increase to effect a reduction in the strength of current flowing through it, and this variation of current-strength can be utilized as desired.

One use for the temperature-responsive current-controlling device shown in Fig. 1 is in conjunction with a mixture-controlling means for an internal combustion engine. Such a structure is illustrated in Fig. 1.

In the arrangement illustrated in Fig. 1, an internal combustion engine 25 is supplied through an intake manifold 26 with a combustible mixture from a carbureter 27. The carbureter 27 has some suitable mixture-varying device, here shown as a choke valve

28 located in an air intake passage 29. This choke valve 28 operates in the usual manner, and, during normal operation of the engine 25, is open and does not obstruct the free flow of air through the passage 29. To enrich the mixture, the choke valve 28 is moved to or toward closed position, depending upon the amount of mixture-enrichment desired, and the resultant decrease in air flow through the passage 29 results in enriching the mixture supplied to the engine 25.

In association with the mixture-varying device of the carbureter 27, I provide an electrical device adapted to be supplied with current and arranged to control the mixture-varying device of the carbureter in such a manner that the proportions of the mixture formed in the carbureter will depend upon the strength of the current flowing through the electrical device. As shown in the drawing, the electrical device consists of a solenoid 31 having a movable core 32 which is operatively connected to an arm 33 mounted on the shaft which carries the choke valve 28. A spring 34 serves normally to maintain the choke valve 28 in open position and is so proportioned that the choke valve position is dependent on the strength of the current supplied to the solenoid 31.

The internal combustion engine illustrated in Fig. 1 may be an engine for an automobile; and as such, it is shown as having associated with it a starting motor 36, the supply of current to which is controlled by a starter switch 37. The usual ignition switch 38 is illustrated, this switch serving to control the supply of current to the ignition system indicated diagrammatically at 39. The starter and ignition system are supplied with current from the usual battery 40.

In embodying my temperature-responsive current-controlling device in such an engine, I desirably mount it in a position such as on the exhaust manifold 42, where it will be responsive to engine temperature. When so mounted, the temperature responsive current-controlling device is connected in series with the battery 40, ignition switch 38, a resistance 43, and the solenoid 31. When so connected, this temperature-responsive device serves to control the amount of current flowing through the solenoid 31, and thus controls the position of the choke valve 28 and the relative proportions of air and gas in the mixture produced in the carbureter 27. When the engine is cold, the resistance of the temperature-responsive device is relatively low, and sufficient current flows through the solenoid 31 to effect a partial closing of the choke valve 28. As the tube 10 is heated, either by the external heat from the exhaust manifold 42 or as a result of the passage of current through the carbon blocks 20, the resistance in the circuit increases, and the current is correspondingly reduced. As

a result, the spring 34 serves to move the choke valve 28 toward its open position.

Desirably I provide some means for increasing the strength of the current flowing through the solenoid 31 when the engine is being started, in order to provide the over-rich mixture generally necessary to start a cold engine. To this end, I may construct the starter switch as illustrated in Fig. 1, where the movable member 45 of such switch has mounted upon it two contact plates 46 and 47. The contact plate 47 is arranged to close the circuit between two contacts 50 and 51 when the movable member 45 is depressed. The two contacts 50 and 51 are connected to opposite sides of the resistance 43, so that this resistance is short-circuited when the movable member 45 of the starter switch 37 is depressed. This short-circuiting of the resistance 43 effects an increase in current flowing through the solenoid 31, and enables such solenoid to move the choke valve 28 toward closed position, the exact position of the choke valve depending upon the temperature of the temperature-responsive current-controlling device mounted on the exhaust manifold 42.

The contact plate 46 is adapted, when the movable member 45 of the starter switch is depressed, to close a circuit between two contacts 52 and 53 which are connected in series with the battery 40 and starter motor 36 in the usual manner.

When the engine 25 is not in operation, the switch 38 is open, and no current flows through the circuit including the solenoid 31. When, however, it is desired to start the engine, the ignition switch 38 is closed, with the result that current flows through the solenoid 31 and moves the choke valve 28 toward closed position. The amount of this movement can be varied as desired by adjustment of either of the caps 11 and 12 which regulate the pressure on the carbon blocks 20 and thus control the resistance in circuit with the solenoid 31. When the starter switch 37 is depressed, the resistance 43 is short-circuited, and the resultant increase in the strength of current which flows through the solenoid 31 produces a still further closing movement of the choke valve. When the engine starts, and the starter button 37 is released, the resultant inclusion of the resistance 43 in the circuit of the solenoid 31 produces a decrease in the current flowing through such solenoid, with the result that the choke valve 28 moves toward open position, the exact amount of this opening movement depending upon the resistance of the temperature-responsive element. As the temperature-responsive element is heated, its resistance increases to decrease the amount of current flowing through the solenoid 31; and when the engine 25 has reached normal running temperature, current flow through the solenoid 31 has ceased,

and the spring 34 holds the choke valve 28 in open position.

It is a well known fact, that in starting an engine which is already warm an excessively rich mixture is not only unnecessary but also may be detrimental to successful starting. My invention takes care of this; for when the engine is warm the tube 10 is elongated, the pressure on the carbon blocks 20 is reduced, and the resistance of the circuit including the solenoid 31 is so great that little if any closing movement of the choke valve 28 which occurs when the resistance 43 is short-circuited incidentally to the closing of the starter switch is not great enough to produce undesirably excessive enrichment.

The arrangement illustrated in Fig. 1 has another advantage in that it prevents flooding of the carbureter should there be continued unsuccessful attempts to start the engine. Such flooding would occur if the carbureter choke valve were closed throughout the duration of a relatively long and unsuccessful attempt to start the engine; but in my invention as illustrated in Fig. 1, the choke valve cannot remain closed for an excessively long interval during the operation of the starter. This is because the heat generated by the passage of current through the carbon disks or blocks 20 heats the enclosing tube 10, thus causing it to expand and to decrease the pressure on the disks 20. As a result of this, the current supplied to the solenoid 31 is gradually decreased in accordance with a function of time, whether or not the engine starts and heats the temperature-responsive current-controlling device.

I claim as my invention:—

1. In combination with an internal combustion engine having a carbureter, an ignition switch, an electric starter, and a starter switch; an electro-magnetic device for varying the proportions of the mixture produced in said carbureter, a temperature-responsive resistance element arranged to be affected by engine temperature, a fixed resistance, a source of current connected in series with said fixed resistance, ignition switch, temperature-responsive resistance element, and electro-magnetic device, and means operative when said starter switch is closed for short-circuiting said fixed resistance.

2. In combination with an internal combustion engine having a carbureter, an ignition switch, an electric starter, and a starter switch; an electro-magnetic device for varying the proportions of the mixture produced in said carbureter, a temperature-responsive resistance element arranged to be affected by engine temperature, a source of current connected in series with said ignition switch, temperature-responsive resistance element, and electro-magnetic device, and means operative when said starter switch is closed

for increasing the current flowing through said electro-magnetic device.

3. In combination with an internal combustion engine having a carbureter, means for starting said engine, an electro-magnetic device for varying the proportions of the mixture produced in said carbureter, a temperature-responsive resistance element arranged to be affected by engine temperature, a fixed resistance, a source of current connected in series with said fixed resistance, temperature-responsive resistance element, and electro-magnetic device, and means for short-circuiting said fixed resistance when said starting means is operated to start the engine.

4. In combination with an internal combustion engine having a carbureter, means for starting said engine, an electro-magnetic device for varying the proportions of the mixture produced in said carbureter, a temperature-responsive resistance element arranged to be affected by engine temperature, a source of current connected in series with said temperature-responsive resistance element, and electro-magnetic device, and means for increasing the flow of current through said electro-magnetic device when said starting means is operated to start the engine.

5. In combination with an internal combustion engine having a carbureter, an ignition switch, an electro-magnetic device for varying the proportions of the mixture produced in said carbureter, a temperature-responsive resistance element arranged to be affected by engine temperature, a fixed resistance, a source of current connected in series with said fixed resistance, ignition switch, temperature-responsive resistance element, and electro-magnetic device.

6. In combination with an internal combustion engine having a carbureter, an electro-magnetic device for varying the proportions of the mixture produced in said carbureter, a temperature-responsive resistance element, and a source of current connected in series with said temperature-responsive resistance element, and electro-magnetic device, said resistance element being responsive to engine temperature and being arranged to effect a gradual increase in resistance as the engine temperature increases.

7. In combination with an internal combustion engine having a carbureter, an ignition switch, an electric starter, and a starter switch; an electro-magnetic device for varying the proportions of the mixture produced in said carbureter, a temperature-responsive resistance element, a source of current connected in series with said ignition switch, temperature-responsive resistance element, and electro-magnetic device, and means operative when said starter switch is closed for

increasing the current flowing through said electro-magnetic device.

8. In combination with an internal combustion engine having a carbureter, means for starting said engine, an electro-magnetic device for varying the proportions of the mixture produced in said carbureter, a temperature-responsive resistance element, a source of current connected in series with said temperature-responsive resistance element, and electro-magnetic device, and means for increasing the flow of current through said electro-magnetic device when said starting means is operated to start the engine.

9. In combination with an internal combustion engine having a carbureter, an electro-magnetic device for varying the proportions of the mixture produced in said carbureter, a temperature-responsive resistance element, and a source of current connected in series with said temperature-responsive resistance element, and electro-magnetic device, said resistance element effecting a gradual control of the current supplied to said electro-magnetic device upon changes in temperature.

10. In combination, an internal combustion engine, a starter device therefor, means for supplying air and fuel to said engine, current-responsive means for varying the relative proportions of air and fuel supplied to said engine, a source of current for said current-responsive device, temperature-responsive means for modifying the strength of current supplied to said current-responsive device, said temperature-responsive means being arranged to be responsive to engine temperature, and means for increasing the strength of current supplied to said current responsive device upon operation of said starter device.

11. In combination, an internal combustion engine, a starter device therefor, means for supplying air and fuel to said engine, current-responsive means for varying the relative proportions of air and fuel supplied to said engine, a source of current for said current-responsive device, temperature-responsive means for modifying the strength of current supplied to said current-responsive device, and means for increasing the strength of current supplied to said current responsive device upon operation of said starter device.

12. In combination, an internal combustion engine, a starter device therefor, means for supplying air and fuel to said engine, current-responsive means for increasing the proportion of air to fuel upon a decrease in the strength of the current supplied to it, a source of current for said current-responsive means, temperature-responsive current-modifying means arranged to be responsive to engine temperature and to decrease the current supplied to said current-responsive means upon an increase in engine tempera-

ture, and means for increasing the strength of current supplied to said current-responsive device upon operation of said starter device.

13. In combination with an internal combustion engine having an ignition system including an ignition switch; a carbureter for supplying an explosive mixture to said engine, electro-magnetic means for varying the proportions of the mixture produced by said carbureter, a source of current connected to said electro-magnetic means through said ignition switch, and means for decreasing the strength of the current supplied to said electro-magnetic means in accordance with a function of time.

14. In combination with an internal combustion engine, means for supplying said engine with gas and air, current-responsive means for varying the relative proportions of gas and air supplied to said engine, a source of current normally connected to said current-responsive means when the engine is in condition for operation, and means for gradually decreasing the current supplied to said current-responsive means in accordance with a function of time.

15. In combination with an internal combustion engine having an ignition system including an ignition switch, means for supplying said engine with fuel and air, adjustable means for varying the relative proportions of fuel and air thus applied to the engine, and means operated jointly with said ignition switch for changing the adjustment of said adjustable means.

16. A mixture enriching device for the carburetor of an internal combustion engine, comprising a source of current, a current-responsive device for varying the proportions of the mixture produced in said carburetor, and a temperature-responsive variable resistance connected in circuit with said current source and current-responsive device.

17. A mixture enriching device for the carburetor of an internal combustion engine, comprising a source of current, a current-responsive device for varying the proportions of the mixture produced in said carburetor, and arranged to increase the relative proportion of fuel to air as the current supplied it is increased, and a temperature-responsive variable resistance connected in circuit with said current source and current-responsive device and arranged to decrease gradually the current supplied to said current-responsive device upon an increase in temperature.

18. A mixture enriching device for the carburetor of an internal combustion engine, comprising an electric circuit including a source of current, a current-responsive device for varying the proportions of the mixture produced in said carburetor, and temperature-responsive means controlling the current supplied to said current-responsive de-

vice, said temperature-responsive device being arranged to be heated by the passage of current through the circuit.

19. In combination with the carburetor of an internal combustion engine having an associated engine starter, a device operative with said starter for enriching the mixture produced in said carburetor, and means operating independently of the engine for gradually decreasing the mixture-enriching effect of said device in accordance with a function of time.

20. In combination with the carburetor of an internal combustion engine having an associated engine starter, a device operative with said starter for enriching the mixture produced in said carburetor, and means operating independently of the engine for limiting the time during which said device is operative to enrich the mixture.

21. In combination with a carburetor for an internal combustion engine having an associated engine starter, a device for controlling the proportions of the mixture produced in said carburetor, said device including an operating member movable in one direction to increase the proportion of fuel to air and in the other direction to decrease such proportion, yielding means tending to move said member in the latter direction, mechanism jointly operative with said starter for moving and holding said member in opposition to said yielding means, and means operating independently of the engine for limiting the time during which said mechanism is operative.

22. In combination with an internal combustion engine having an ignition system including an ignition switch; a carburetor for supplying an explosive mixture to said engine, electro-magnetic means for varying the proportions of the mixture produced by said carburetor, and a source of current, said electro-magnetic means being arranged to be connected to said current-source only when said ignition switch is closed.

23. In combination with an internal combustion engine having an ignition system, means for supplying an explosive mixture of fuel and air to said engine, electro-magnetic means for varying the proportions of the mixture supplied by said mixture-supplying means, a source of current, and a switch for jointly controlling the connection of said ignition system and said electro-magnetic means to said current-source.

24. In combination with an internal combustion engine having an ignition system including an ignition switch, a starting device for said engine, means for supplying an explosive mixture of fuel and air to said engine, and mechanism operative jointly with said starting device and only when said ignition switch is closed for varying the proportions

of the mixture produced in said mixture-supplying means.

In witness whereof, I have hereunto set my hand at Indianapolis, Indiana, this 11th day of May, A. D. one thousand nine hundred and twenty-eight.

GLEN R. SISSON.

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CERTIFICATE OF CORRECTION.

Patent No. 1,913,131.

June 6, 1933.

GLEN R. SISSON.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, line 98, claim 15, for "applied" read "supplied"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 8th day of August, A. D. 1933.

M. J. Moore.

(Seal)

Acting Commissioner of Patents.