

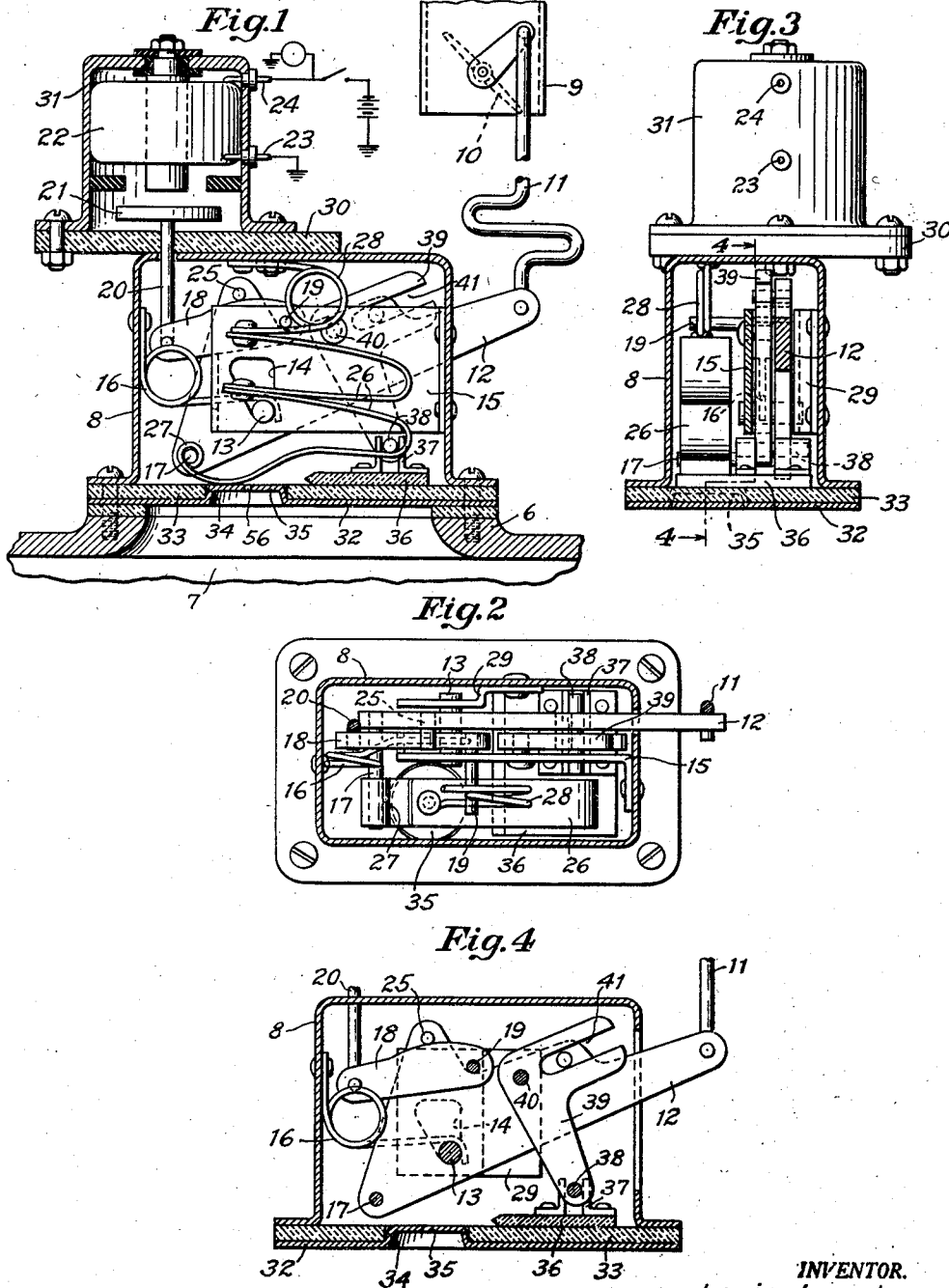
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INTERNAL-COMBUSTION ENGINE

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INTERNAL-COMBUSTION ENGINE

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The title of the invention indicates the general character of the device to which it relates and specifically the invention relates to thermo-electrically controlled automatic chokes for such engines, and an object of my invention, among others, is the provision of a device of this type which will improve performance under varied conditions and which may be produced at a minimum cost, the functions of these chokes being so well understood by those skilled in the art as to need no general description herein for a clear understanding of the operation of the device, its construction being illustrated in the accompanying drawing, in which—

Figure 1 is a side view of my improved device shown enclosed in a case which is cut in section and with the parts in normal inactive positions.

Figure 2 is a top plan view of the enclosing case with the top cut away to show construction of the interior part.

Figure 3 is an end view of the structure as seen in Fig. 1 but with the end wall of the case removed to show construction of the parts within.

Figure 4 is a side view of the case with the rear wall cut away and with parts removed to show construction.

In the accompanying drawing the numeral 6 denotes a part of the exhaust conduit of an internal combustion engine 7 having my improved automatic choke device mounted externally thereon. A portion of the mechanism embodying this device is enclosed in a case 8 which is mounted as shown and described for the purpose of obtaining the best results in making use of engine heat during the starting of the engine and at a time when a high degree of heat is of great advantage in order to secure the best results in such starting operations.

This device is intended to improve and increase the means for obtaining results from the use of heat in the starting operations of internal combustion engines over and above the results which I have obtained in the device shown and described in my Patent No. 2,359,998, issued October 10, 1944.

A trouble with automatic chokes has been slow thermostatic response, tending to cause bucking or stalling of the engine and with great waste of fuel. The thermoelectric type of choke, to which class my invention belongs, permits both proper closing of the choke valve to suck starting fuel into the engine and instant opening to any desired amount when firing starts to admit requisite combustion air, combined with gradual choke valve opening to the wide open position accord-

ing to thermal requirements. The richer fuel-air mixture needed during the engine warming-up period is largely due to poor vaporization in a cold engine, while actual combustion and exhaust gas temperatures are substantially constant and independent of surrounding temperatures.

It is understood that a choke valve is to regulate the fuel-air ratio of an engine.

An object of my present invention is to get substantially correct thermostatic response by direct use of the hot exhaust gas upon the thermostat, which is a new and valuable improvement in automatic chokes of this type and made practical by my method of excess heat control as in my patent of record above noted. As second choice if some specific engage condition makes such use of exhaust gas objectionable, I use a thin wall of some high heat conductivity material, such as copper for example, between the thermostat and the source of heat; for which even a thin section of the exhaust conduit might be used. For practical reasons, when exhaust conduits are cast they must be too thick for best heat transmission, which is in direct proportion to thickness, and some special thin section must be made for this specific purpose as stated.

Another object of my invention is to relieve the thermostatic device of load except that usefully thermostatically functional, as far as consistently practical, for the purpose of functional accuracy and to reduce or eliminate permanent distortion commonly called "set" which affects accuracy. A direct result of this objective is greatly increased useful life of the automatic choke. The purpose of the thermostat is served during the initial warming-up period, whereas cumulative heat of engine operation gradually rises until in some engines the exhaust conduit becomes red hot under heavy load, resulting in structural injury to the thermostat if excess heat motion thereof be prevented, or possibly several times the useful range of thermal motion if the thermostat be allowed to flex as in my present invention and shown and described in my patent of record by having spring support for the thermostat. No two springs are exactly alike and flexibility is slightly affected by temperature, and also some set of the thermostat must be anticipated; therefore my present invention comprises a stop to limit cold motion of the thermostat and to permit some initial spring force for holding the thermostat against said stop to compensate for such errors. Atmospheric temperature changes

affecting the cold motion of the thermostat are so slight by comparison with the heat range of the engine that no difficulties need be anticipated therefrom. The stop herein mentioned is not to be confused with the stop covered by my patent of record above noted, which latter stop is to control the cold position of the choke valve within some limited thermal range, the same function being served in my present disclosure by having the thermostat bottom on gasket 35 and with the up-curved portion of the thermostat providing for desired choke valve correction according to atmospheric temperature. Any serious inaccuracy makes the automatic choke worse than useless and a detriment to engine operation, hence the matter of accuracy means everything; which is true for any controlling instrument for any purpose.

For the same purpose as stated in preceding paragraph another feature of my invention is correlation of the electro-magnetic and thermostatic devices to relieve the force of the former upon the latter while thermostatically regulating the amount of valve closure by electro-magnetic means during some range of choke valve motion, and to permit as desired complete elimination of the electro-magnetic function at some part of the choke valve motion. In my patent of record as above noted, this is done in part by relative disposition of the devices but with the full force of the electro-magnetic device being transmitted through the medium of the thermostat as shown. Some carbureters require considerable magnetic force near closure, while thermostatic force needs are always relatively slight and substantially only the friction of light moving parts. From examination of the drawing herewith it is evident by the laws of leverage that the force reaction of the electro-magnetic device upon the thermostat is relatively slight, and even this slight force reaction may be substantially eliminated by a detail re-arrangement of parts.

Various automatic chokes work well in hot weather when least needed, but with the advent of winter weather functional troubles become obvious from reasons which my invention corrects.

The carbureter intake tube 8 contains the usual choke valve 10 which is connected by a rod 11 with a choke valve operating lever 12 supported by a pivot 13 shiftably mounted in an opening 14 in a bracket 15 secured to and extending inwardly, to the left as shown in Fig. 2, from an end wall of the case. The pivot 13 normally rests in the opening 14 and is held down by a spring 16 which is attached to the end wall of the case opposite to that from which the bracket 15 extends. A pin 17 extends from the lower end of the lever 12 into a loop in a thermostat, to be hereinafter described, for actuating the choke valve operating lever 12.

A cam lever 18 is supported on a pivot 19 projecting from the bracket 15 and is connected by a rod 20 with the armature 21 of an electro-magnet 22 which is suitably connected by wires 23-24 with the electrical equipment of the vehicle. Said cam lever is shaped for contact with a lifting pin 25 extending from the choke valve operating lever 12 as shown in Figs. 1 and 4 of the drawing. The case 31 for the magnet 22 is set upon a heat insulating gasket 30 to protect the magnet from the effects of heat within the case 8.

The stop for cold motion of the thermostat is shown by pin 19, Figs. 1, 2 and 3, projecting over spring 28 to prevent further upward movement of the thermostat 26 as it expands when cooling.

Whether a thermostat flexes inwardly or outwardly as it heats depends simply on the disposition of the bi-metallic elements, and in my prior patent of record noted herein, I show reverse flexure from present disclosure, which is functionally immaterial. Spring 28 has some relatively slight pressure against stop pin 19 in this position, which pin is also the pivot for the cam piece 18.

The word "cold" as used herein simply signifies some atmospheric temperature for a dead engine, as opposed to operative heat of said engine, regardless of absolute temperature. The word "hot" likewise applies to operative heat regardless of atmospheric temperature.

A two-part thermostat 26 has a loop 27 at its lower end engaged with a pin 17 in the lower end of the lever 12, as shown in Fig. 1, this thermostat being supported by a spring 28 in the form of a coiled spring pivotally mounted in the case 8. A bracket 29 mating the bracket 15 is secured to the wall of the case as shown in Fig. 2 for the support of one end of the pin 13, this bracket 29 having an opening similar to the opening 14 in the bracket 15.

It is essential that the thermostat within the case 8 shall be provided with heat without delay and yet at the same time that the parts within said case shall be protected from injury by undue heat. To effect this result I provide a heat conducting gasket 32 composed of copper or similar material supported by the conduit 6, and a heat insulating gasket 33 set upon the gasket 32 with a hole 34 through the gasket 33 and a bulge 35 for direct admission of hot exhaust gas to the thermostat chamber. A hole or holes 56 may be made in the bulge 35, or in any way similar for, functional results in the gasket 32 to fill said hole, the gasket 33 protecting elements within the case 8 from undue heat and at the same time the bulge permitting transfer of quick heat at the proper time to operate the thermostat.

A secondary heat insulating gasket 36 is slidably mounted on the gasket 33 and has ears 37 between which a pivot 38 from a slotted bell crank lever 39 extends, said lever being pivotally mounted on a pin 40 extending from the bracket 15 and engaging within a slot 41 in said bell crank lever for the purpose of operating the lever to move the gasket 36 to cover and uncover the bulge 35.

When starting a cold engine the first operation is to get fuel into the combustion chamber. My device accomplishes this by electro-magnetically closing the choke valve any desired amount when the engine starter is used, permitting the engine suction to draw in fuel. When firing starts and the electric starter stops, the choke valve instantly opens by spring action to any desired cold thermostat position to admit requisite combustion air, and for further opening up to the wide open position the choke valve is solely under thermostatic control. This is accomplished by the thermostat 26 operating the lever 12 to gradually admit more air in proportion to best engine operation as it warms up, while bell-crank 39 likewise moves to cover the bulge 35 or hole 56 as the case may be and to protect the operating parts from excess heat of no functional value. The two-part thermostat is shown merely as a way of obtaining more rapid thermostatic response than for a single thermostat, as a compact arrangement. In Fig. 1 I have shown a hole or holes for admission of exhaust gas to the thermostat. In Fig. 4 I show the gasket 35 solid for

transmission of heat by conductivity. Simultaneously, as lever 12 moves by influence of thermostat 26, pin 25 moves to the right over cam 18 and towards pin 19 which it may pass according to specific proportions of parts. This provides a decreasing lever arm for cam 18, causing less magnetic lift of lever 12 as the thermostat 26 becomes warmer, and in combination therewith cam 18 may be shaped as desired for any local correction of motion at any part of the stroke. When and if pin 25 passes over pin 19, then all magnetic movement of lever 12 ceases. By disposition of parts, it is clear that the electro-magnetic force upon pin 25 is greater than its effect upon pin 17 and thermostat 26, by the laws of leverage. By suitable re-arrangement of parts with the same functional results, it is simple if desired to have lost-motion linkage between the lever 12 and thermostat 26 so that the electro-magnetic force would shift pin 17 in reference to thermostat 26 while pin 13 remained as a stationary fulcrum, which re-arrangement would substantially eliminate all electro-magnetic force upon the thermostat; but it is impractical to attempt to show the almost infinite detail changes possible to serve the same functional effect as herein disclosed.

I claim:

1. For use in an internal combustion engine, means for admitting combustion air to said engine and a valve for regulating the combustion fuel-air ratio, a thermostatic device adapted to function by heat from said engine and operatively connected with said valve for affecting operation thereof, means for restricting the cold thermal motion of said thermostatic device, and yielding means adapted to permit hot thermal motion of said thermostatic device beyond a useful functional thermostatic range and to return said thermostatic device to some original position when cold.

2. For use with an internal combustion engine, means for admitting combustion air to said engine, a valve for regulating the combustion fuel-air ratio, a movable member operatively connected with said valve for affecting operation thereof, an electromagnetic device operatively affecting said movable member and adapted when energized to move said movable member in a direction tending to close said valve, a thermostatic device functioning by engine heat to affect motion of said movable member to permit both opening and closing motion of said valve within some range of thermal motion independently of said electromagnetic device, said range being between partially open and wide open valve positions, means for returning said valve from the position due to electromagnetic action to the position as thermostatically determined, means for thermostatically regulating the amount of valve closure motion only due to electromagnetic action within some range of thermostatic motion, and means adapted to permit moving the movable member thermostatically beyond the operative functional range of said electromagnetic device, said electromagnetic device being adapted to function with greater force upon said movable member than upon said thermostatic device.

3. For use with an internal combustion engine, means for admitting combustion air to said engine, a valve for regulating the combustion fuel-air ratio, a movable member operatively connected with said valve for affecting operation thereof, an electromagnetic device operatively connected with said movable member and adapted

when energized to move said movable member in a direction tending to close said valve, a thermostatic device functioning by engine heat to effect motion of said movable member to permit both opening and closing motion of said valve within some range of thermal motion independently of said electromagnetic device, said range being between partially open and wide open positions, means for returning said valve from the position due to electromagnetic action to the position as thermostatically determined, and means for thermostatically regulating the amount of valve closure motion only due to electromagnetic action within some range of thermostatic motion.

4. For use with an internal combustion engine, means for admitting combustion air to said engine, a valve for regulating the combustion fuel-air ratio, a movable member operatively connected with said valve for affecting operation thereof, an electromagnetic device operatively connected with said movable member and adapted when energized to move said movable member in a direction tending to close said valve, a thermostatic device functioning by engine heat to effect motion of said movable member to permit both opening and closing motion of said valve within some range of thermal motion independently of said electromagnetic device, said range being between partially open and wide open valve positions, means for returning said valve from the position due to electromagnetic action to the position as thermostatically determined, means for thermostatically regulating the amount of valve closure motion only due to electromagnetic action within some range of thermostatic motion, and a fulcrum for said movable member shiftably mounted in reference to said thermostatic device and adapted for motion of translation by said electromagnetic device.

5. For use with an internal combustion engine, means for admitting combustion air to said engine, a valve for regulating the combustion fuel-air ratio, a movable member operatively connected with said valve for effecting operation thereof, an electromagnetic device operatively connected with said movable member and adapted when energized to move said movable member in a direction tending to close said valve, a thermostatic device functioning by engine heat to effect motion of said movable member to permit both opening and closing motion of said valve within some range of thermal motion independently of said electromagnetic device, said range being between partially open and wide open valve positions, means for returning said valve from the position due to electromagnetic action to the position as thermostatically determined, means for thermostatically regulating the amount of valve closure motion only due to electromagnetic action within some range of thermostatic motion, a fulcrum for said movable member shiftably mounted in reference to said thermostatic device and adapted for motion of translation by said electromagnetic device, said movable member being adapted to permit electromagnetic valve closure movement thereof in any amount desired at any particular thermostatic movement thereof and likewise being adapted to permit thermostatic movement thereof beyond a limit of electromagnetic control according to relative disposition of operative parts.

6. For use with an internal combustion engine, means for admitting combustion air to said engine, a valve for regulating the combustion fuel-air ratio, a thermostatic device adapted to func-

tion by heat from said engine, an operative connection between said device and said valve to effect operation of said valve, said thermostatic device deriving heat from said engine by direct contact with exhaust gas therefrom, and an electromagnetic device adapted to cause motion of said valve towards closure.

7. For use with an internal combustion engine, means for admitting combustion air to said engine, a valve for regulating the combustion fuel-air ratio, a thermostatic device adapted to function by heat from said engine, an operative connection between said device and said valve to effect operation of said valve, said thermostatic device deriving heat from said engine by direct contact with exhaust gas therefrom, an electromagnetic device adapted to cause motion of said valve towards closure, and means for thermostatically affecting the degree of heat affecting said thermostatic device.

8. For use with an internal combustion engine, means for admitting combustion air to said engine, a valve for regulating the combustion fuel-air ratio, a thermostatic device adapted to function by heat from said engine and adjacent to an exhaust gas conduit of said engine, means adjacent to said thermostatic device for a faster rate of heat transfer from said exhaust gas to said thermostatic device than through said conduit elsewhere, and an electromagnetic device

adapted to cause motion of said valve towards closure.

9. For use with an internal combustion engine, means for admitting combustion air to said engine, a valve for regulating the combustion fuel-air ratio, a movable member operatively connected with said valve for effecting operation thereof, an electromagnetic device operatively affecting said movable member and adapted when energized to move said movable member in a direction tending to close said valve, a thermostatic device functioning by engine heat to affect motion of said movable member to permit both opening and closing motion of said valve within some range of thermal motion independently of said electromagnetic device, said range being between partially open and wide open valve positions, means for returning said valve from the position due to electromagnetic action to the position as thermostatically determined, means for thermostatically regulating the amount of valve closure motion due only to electromagnetic action within some range of thermostatic motion, means adapted to permit moving the movable member thermostatically beyond the operative functional range of said electromagnetic device, and means to relieve the force of the electromagnetic device upon the thermostatic device.

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