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A. BOUCHER
 DEVICE FOR AUTOMATICALLY STARTING AND
 STOPPING INTERNAL COMBUSTION
 ENGINES IN COLD WEATHER
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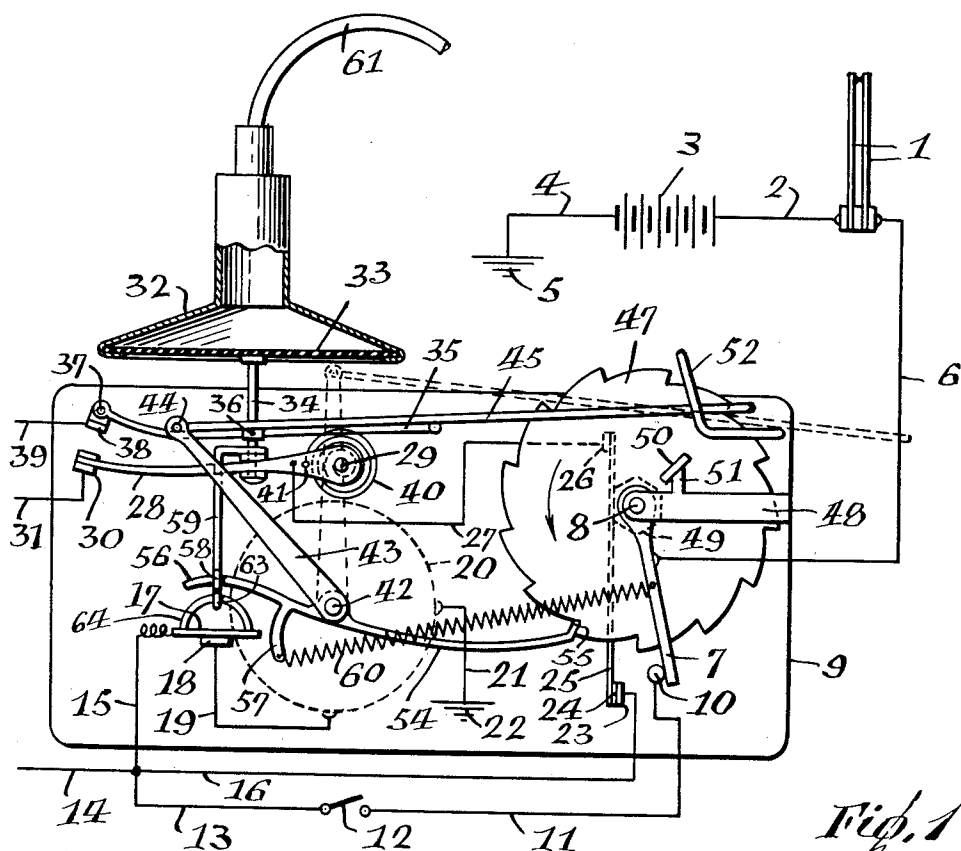


Fig. 1

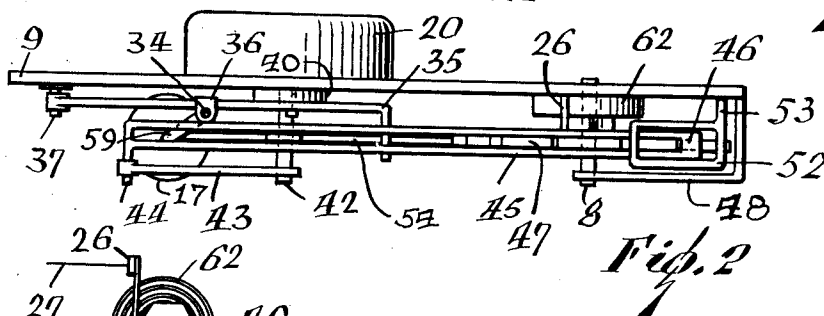


Fig. 2

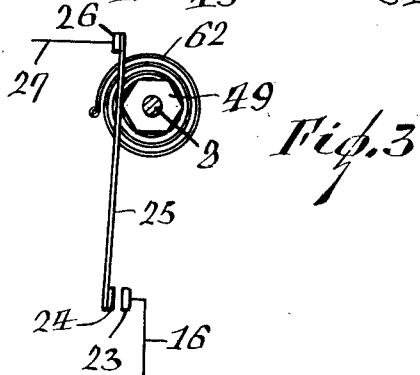


Fig. 3

Inventor
Antonio Boucher
 Agent
Pierre Lesperance

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DEVICE FOR AUTOMATICALLY STARTING AND STOPPING INTERNAL COMBUSTION ENGINES IN COLD WEATHER

Antonio Boucher, Lac Megantic, Quebec, Canada

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6 Claims. (Cl. 290—38)

The present invention relates to a device for automatically starting and stopping internal combustion engines in cold weather, more particularly, engines of motor vehicles.

The general object of the present invention is the provision of a device which automatically starts an internal combustion engine when it has attained a minimum temperature, in order that the engine may heat up to a maximum temperature whereupon it automatically stops and remains non-operative until it again reaches the minimum temperature, the cycle being repeated during all the period of non use of the engine.

An important object of the present invention is the provision of a device of the character described in which intermittent action of the starter is obtained and also the number of successive starting attempts in case of non starting is limited in order to prevent undue drainage of the battery.

Yet another object of the present invention is the provision in a device of the character described of means to automatically cut off the starter when the engine starts.

Still another important object of the present invention is the provision of a device of the character described, of simple construction and small dimensions and which can be used for different makes of engines, all the connections thereto being flexible and consisting of electrical wires and of tubing.

In accordance with the present invention, a heat responsive switch in thermal or heat conducting contact with the engine, closes a circuit when the engine has attained a minimum temperature. This circuit is connected to the starter of the motor vehicle and is alternatively opened and closed at intervals of a few seconds in order to obtain successive starting attempts, each of relatively short duration. The device further comprises a vacuum operated diaphragm switch which opens the circuit to the starter upon starting of the engine. A timing device is also operated which stops the operation of the device and the successive starting attempts should the engine fail to start after a predetermined number of attempts. Means are also incorporated for connecting the electric heater and defroster of the motor vehicle when the engine has started.

The foregoing and other important objects of the present invention will become more apparent during the following disclosure and by referring to the drawings, in which:

FIGURE 1 is an elevational, somewhat schematic view, partly in section, of the device of the invention;

FIGURE 2 is a top plan view thereof; and

FIGURE 3 is a detail of a portion of the device.

Referring now more particularly to the drawings in which like reference characters indicate like elements throughout, reference numeral 1 indicates a bimetal switch which is adapted to be disposed in thermal contact with the internal combustion engine to be controlled, such as the engine of a motor vehicle. For instance switch 1 may be inserted in the liquid cooling system. Switch 1 is connected in series by wire 2 to one pole of

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the motor vehicle battery 3, the other terminal of which is connected by wire 4 to ground 5. The other pole of switch 1 is connected by wire 6 to switch arm 7, which is freely pivoted on a shaft 8 secured to support plate 9.

The free end of arm 7 is adapted to abut a fixed contact 10 supported on plate 9 and electrically insulated therefrom. Fixed contact 10 is connected to wire 11, in turn connected to a manually operated switch 12 disposed for instance on the dash board of the motor vehicle and accessible to the driver. Switch 12 is connected in turn to wire 13 to which are connected wires 14, 15, and 16. Wire 14 goes to the induction coil (not shown) of the motor vehicle. Wire 15 is connected to a movable contact disk 17 adapted to abut fixed contact 18 to supply electricity by means of wire 19 to a small electric motor housed in a housing 20 and including gearing to impart an oscillating motion to output shaft 42 issuing from housing 20. The other terminal of the electric motor in housing 20 is connected by wire 21 to ground 22.

Wire 16 is connected to a fixed contact 23 which movable contact 24 is adapted to abut. Movable contact 24 is mounted at the free lower end of a resilient blade 25 fixed at its upper end 26 to the support plate 9 and electrically insulated therefrom. End 26 is connected by wire 27 to a contact arm 28 pivoted at 29 to the support plate and insulated therefrom and having its free end adapted to abut fixed contact 30 which is connected by wire 31 to the starter of the engine.

A vacuum operated device comprising a housing 32 provided with a flexible diaphragm 33 is connected by flexible tubing 61 to the intake manifold of the engine to be controlled. The upper end of a plunger rod 34 is attached to diaphragm 33. Said plunger rod 34 is pivotally connected to and supports a cranked lever 35 by means of yoke 36 secured to rod 34. The end of cranked lever 35 is pivotally mounted on a stud shaft 37 secured to support plate 9. An electrically insulated contact 38 is also supported by stud shaft 37 and is connected by wire 39 to the electric heater and/or defroster of the motor vehicle.

Contact 38 is adapted to make contact with the free end of arm 28 when the latter is in raised position under the action of the spirally wound spring 40, the inner end of which is attached to pivot 29 or plate 9 and the outer end of which is attached at 41 to contact arm 28.

The output shaft 42 of the motor unit 20 drives an oscillatable arm 43, the upper free end of which is pivotally connected to the lateral pivot extension 44 of a pawl member 45 in the form of an elongated frame, the pawl end 46 of which is engageable with the ratchet teeth of a ratchet wheel 47 which is mounted for free rotation on shaft 8 between support plate 9 and crank shape support arm 48 which supports the free end of shaft 8.

An hexagonal cam 49 is secured to ratchet wheel 47 and is concentric therewith; its edge faces are adapted to contact the resilient blade 25 so as to alternately move the same in an out of contact with fixed contact 23 under rotation of ratchet wheel 47. Thus contacts 23, 24 and 25 form an intermittently operated switch.

An abutment block 50 is secured laterally on the ratchet wheel 47 and abuts a stop finger 51 in the initial position of the ratchet wheel 47, and is adapted to abut arm 7 and lift the same out of contact with fixed terminal 10 when the ratchet wheel 47 is rotated in anticlockwise direction as seen by the arrow in FIGURE 1. Stop finger 51 projects upwardly from support member 48. A crank shaped guard 52 guides the pawl member 45 at its

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pawl end 46 and is rigidly secured to the support plate 9 by lateral extension 53.

A holding pawl 54 is freely pivoted on the output shaft 42 intermediate its ends and has its end 55 engageable with the ratchet teeth of the ratchet wheel 47 to prevent clockwise rotation of the latter. The other end 56 of holding pawl 54 engages through a loop or eye 58 formed in inverted L-shaped suspension rod 59, the lateral upper portion of which is attached to plunger rod 34. Holding pawl 54 has a branch 57 which is connected by a tension spring 60 to contact arm 7 in order to urge the latter against fixed contact 10. Spring 60 also urges holding pawl 54 with its end 55 in engagement with the teeth of ratchet wheel 47. Spring 60 finally urges downward movement of plunger rod 34 and L-shape rod 59, so that contact disk 17 abuts fixed contact 18.

Contact disk 17 is provided with a semi-circular handle 64 freely passing through eye 63 formed at the lower end of L-shape rod 59.

When holding pawl 54 is out of contact with ratchet wheel 47, the latter is rotated into its initial position wherein block 50 abuts abutment finger 51 under action of spiral spring 62, more particularly shown in FIGURE 3, the inner end of which is secured to shaft 8 and the outer end of which is secured to the ratchet wheel 47.

The device of the invention operates as follows: As previously mentioned, contacts 1 of the bi-metal heat responsive switch in thermal relation with the engine of the motor vehicle, are normally opened when the engine is above a predetermined minimum temperature. The engine being stopped, it gradually decreases in temperature until it reaches said minimum temperature in cold weather, whereupon contacts 1 close and, manual switch 12 having been previously closed by the driver, the following circuits are completed on the element being in the rest position shown in FIGURE 1:

(a) Ground 5, wire 4, battery 3, wire 2, bi-metal switch 1, wire 6, arm 7, contact 10, wire 11, switch 12, wires 13 and 14 to the induction coil of the engine;

(b) wire 16, contacts 23, 24, blade 25, wire 27, contact arm 28, contact 30, wire 31 to the starter of the engine;

(c) wire 15, contacts 17, 18, wire 19, electric motor 20, wire 21 and ground 22. Circuits a, b form the main or starter circuit while circuit c is a secondary circuit for operating the timing means.

Upon closing of bi-metal switch 1 the starter is operated. However, motor unit 20 is also started whereby arm 43 is oscillated between the positions shown in dotted lines and in full lines in FIGURE 1, whereby pawl end 46 engages another tooth of ratchet wheel 47 and rotates the latter until an edge of cam 49 engages blade 25 thereby opening contacts 24, 23, as shown in FIGURE 3. Thus, the circuit to the starter of the engine is opened and the starter is stopped until contacts 23, 24 again close due to continued rotation of ratchet wheel 47 under action of electric motor unit 20. Successive intermittent attempts at starting the engine are thus obtained.

If the engine fails to start after, for example, four or five attempts, block 50 lifts contact arm 7 out of engagement with fixed contact 10 thereby opening the main circuit and the starting operation is discontinued. The ratchet wheel is maintained in its limit position under action of holding pawl 54. Similarly, holding pawl 54 prevents clockwise rotation of the ratchet wheel 47 at every starting attempt.

When the engine starts anytime during the starting cycle, vacuum is produced within diaphragm assembly 32 and 33 whereby plunger rod 34 is lifted; this raises disk 17 which opens the circuit to the electric motor unit 20. Thus, further rotation of wheel 47 is stopped. Also, crank lever 35 is raised and lifts pawl member 45 out of engagement with ratchet wheel 47. Furthermore, holding pawl 54 is pivoted in clockwise direction out of engagement with the ratchet wheel 47 whereby the latter

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is now free to rotate back to its initial position under the action of its spiral spring 62. Finally, contact arm 28 which was held in lowered position in abutment with contact 30 by rod 59 against the action of spiral spring 40 is now allowed to pivot upwardly thereby opening the circuit to the starter of the engine and to engage upper fixed contact 38 thereby closing the electrical circuit to the heater of the motor vehicle. Contact arm 28 is maintained in engagement with contact 38 under action of its spiral spring 40, thus the windshield defroster or heater of the vehicle is allowed to operate during the time the engine is running. The latter heats up until it attains the maximum set temperature upon which contacts 1 open cutting off the circuit to the induction coil. The engine stops, diaphragm 33 and plunger rod 34 drop into their lowermost position whereby all the elements assume their initial position as shown in FIGURE 1. The starting cycle is started all over again when the engine again cools down to the minimum set temperature.

Obviously, the shape of the cam 49 and the number of teeth of ratchet wheel 47 may be varied in accordance with the number of starting attempts desired and in accordance with the time interval desired between successive starting attempts.

While a preferred embodiment in accordance with the present invention has been illustrated and described, it is understood that various modifications may be resorted to without departing from the spirit and scope of the appended claims.

What I claim is:

1. A temperature responsive device for starting and stopping, in cold weather, an internal combustion engine having an electric starter in order to maintain said engine above a predetermined minimum temperature, comprising a main electrical circuit consisting of the following elements connected in series: a heat responsive switch in thermal contact with the engine and having a terminal adapted to be connected to a power supply, an intermittently operated switch and a first vacuum operated switch having a terminal for connection to the starter of the engine; a secondary circuit including a second vacuum operated switch and motor means; and timing means operated by said motor means for intermittently opening and closing said intermittently operated switch to thereby effect successive actuations of said starter upon closing of said heat responsive switch, said vacuum operated switches being connected to a source of vacuum of the engine and opening said main and secondary circuits upon starting of the engine.

2. A device as claimed in claim 1, wherein said main circuit further includes a time delay switch connected in series therein, and operated by said timing means after a predetermined delay for opening said main and secondary circuits after a predetermined number of successive actuations of said starter.

3. A device as claimed in claim 2, wherein said timing means include a ratchet wheel, a spring urging said wheel into an initial position, a pawl member operated by said motor means for rotating said ratchet wheel against said spring in a step by step manner, and a cam rotating with said ratchet wheel and engaging said intermittently operated switch for successively opening and closing the latter upon step by step rotation of said ratchet wheel.

4. A device as claimed in claim 3, further including a holding pawl to prevent rotation of said ratchet wheel under the action of said spring, said holding pawl operable to release said ratchet wheel upon actuation of said vacuum operated switches whereby said wheel may return to its initial position.

5. A device as claimed in claim 4, wherein said ratchet wheel has abutment means mounted thereon engageable with said time delay switch when said wheel reaches an end limit position to cause opening of said time delay switch.

6. A device as claimed in claim 5, further including an operator for said vacuum operated switches and means connected to and operable by said operator for moving said pawl member out of engagement with said ratchet wheel upon opening of said vacuum operated switches.

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