Oct. 9, 1923. 1,470,079

H. A. HOESCHEN

THERMOSTATIC SWITCH

Filed Jan. 3, 1921 2 Sheets-Sheet 1

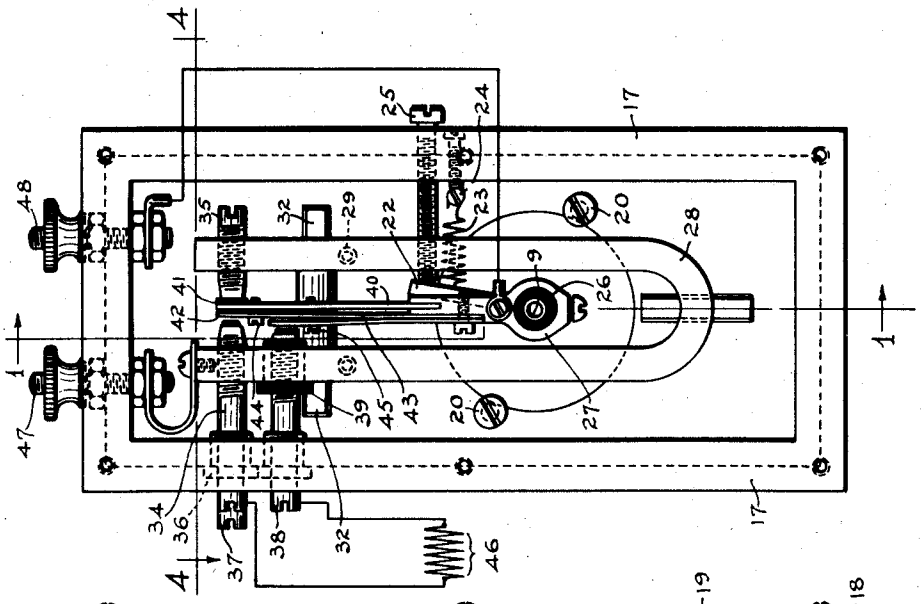

Fig. 2.

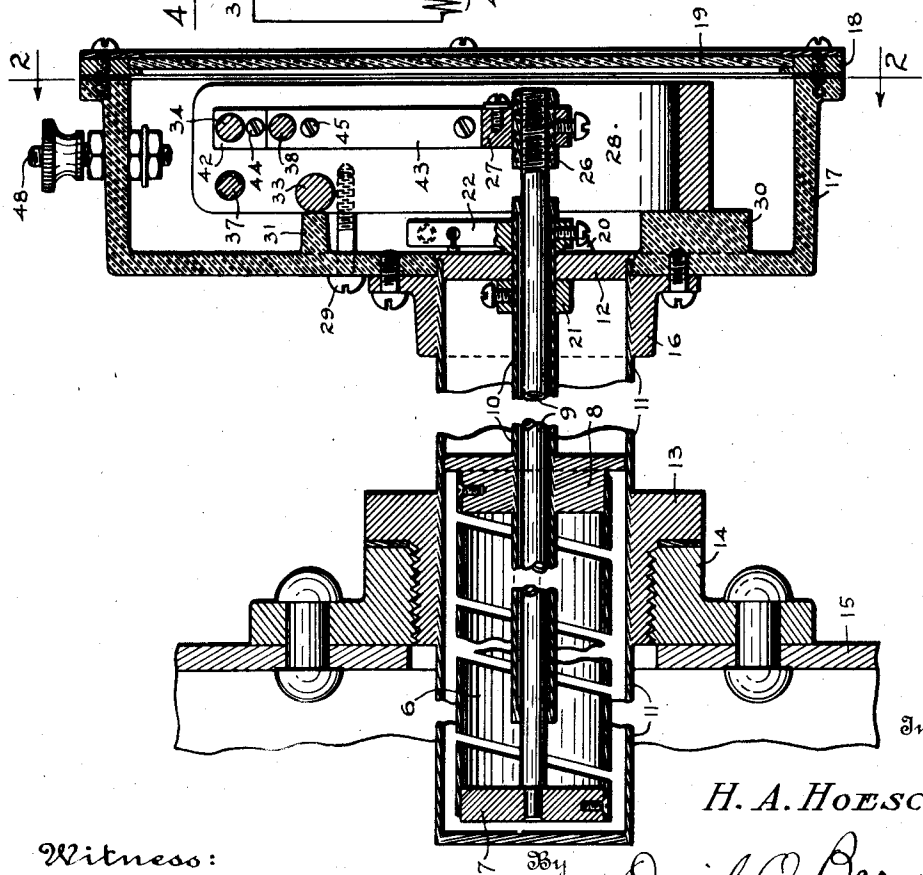

Fig. 1.

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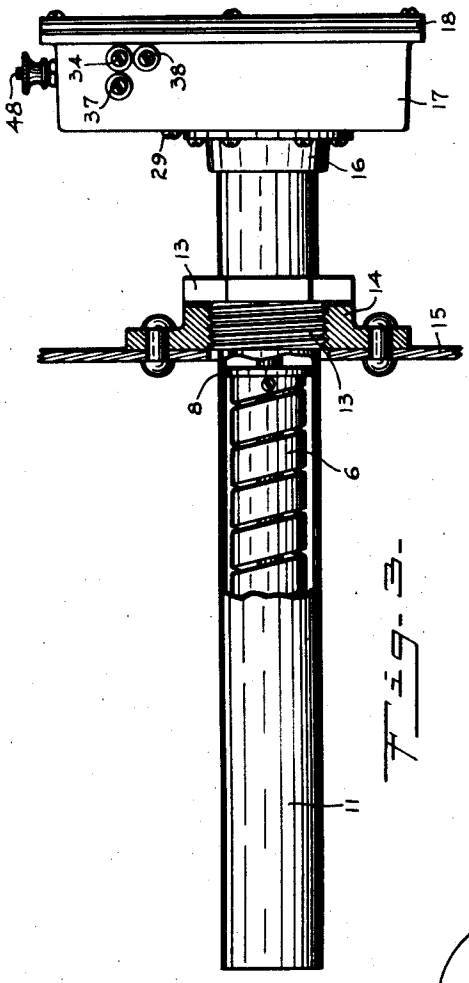

Fig. 3.

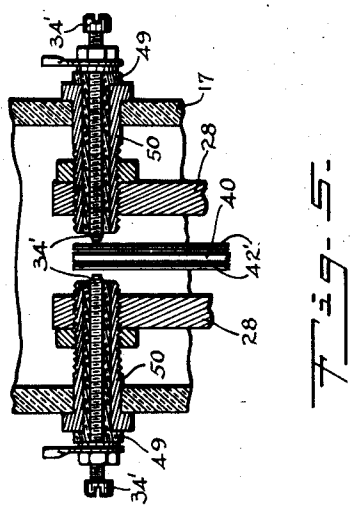

Fig. 5.

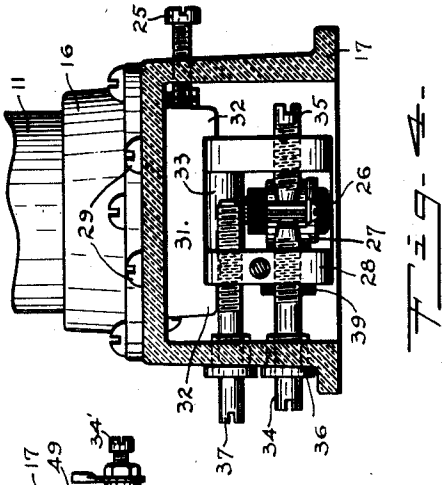

Fig. 4.

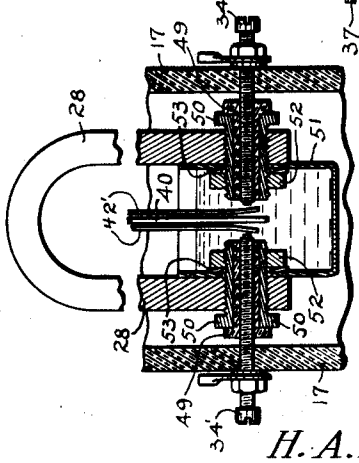

Fig. 6.

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UNITED STATES PATENT OFFICE.

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THERMOSTATIC SWITCH.

Application filed January 3, 1921. Serial No. 526,715.

To all whom it may concern:

Be it known that I, HENRY A. HOESCHEN, a citizen of the United States, and a resident of Omaha, in the county of Douglas and State of Nebraska, have invented certain new and useful Improvements in Thermostatic Switches, of which the following is a specification.

My invention relates to electrical circuit-controlling devices for motors and the like which are employed in the operation of refrigerating mechanism, and for other purposes where it is desirable to open and close an electrical circuit or circuits in accordance with changes of temperature. It is the general object of my invention to provide a thermostatic switch capable of directly opening and closing electrical circuits carrying currents of considerable amperage, and to thus enable the automatic starting and stopping of motors large enough to operate commercial refrigerating machines, without the use of relays, or so-called "automatic" switches which control the motor circuits and are controlled, in turn, by thermostatic switches adapted only for use in circuits of low amperage. More particular objects of my invention are to provide a switch having a relatively light and delicate member movable between opposed contacts which are but slightly spaced therefrom, and which is held against one or the other of said opposed contacts by magnetic attraction so as to be disengageable therefrom only by the application of such a force as to cause its immediate engagement with the opposed contact; and to provide means for preventing arcing between the contacts when a circuit is opened by the separation thereof. A further object of my invention is to provide an electrical switch having a thermically actuated member of magnetic material which is movable within a permanent magnetic field, and of which the contacts which are engaged to open and close the controlled electrical circuits are in effect the poles of said permanent magnetic field. A further object of my invention is to provide in a switch having the characteristics last above mentioned means for varying the intensity of the magnetic field, whereby to increase or decrease the temperature-range within which the thermically actuated member will be operated. Further and more particular objects of my invention will be set forth hereinafter.

In the accompanying drawings Fig. 1 is a longitudinal vertical section of a device embodying my invention, portions thereof being broken away to avoid undue extension of the figure, Fig. 2 is a front view of the device with the cover of the casing removed, Fig. 3 is a side view of the entire device, a portion of the housing-tube being broken away to show the enclosed thermo-sensitive member, Fig. 4 is a horizontal section on the line 4—4 of Fig. 2, Fig. 5 is a detail vertical section of a slightly modified form of the device, showing the same as arranged for controlling two circuits, and Fig. 6 is a detail vertical section, showing a further modification of the structure, wherein the contacts are immersed in oil.

In the illustrated embodiment of my invention the thermo-sensitive member is a helical coil of metallic ribbon 6 formed by uniting strips of two metals having different thermal expansibility, whereby relative rotational movements of the two ends of the coil are caused by very slight changes of temperature, the movements being opposite in direction as the temperature increases and decreases. The ends of the coil 6 are secured to the disks 7 and 8 and the latter are fixedly connected, respectively, with the tubes 9 and 10, the former fitting rotatably within the latter and extending beyond the same at both ends.

For convenience in mounting the thermo-sensitive member in suitable proximity to the material of which the temperature is to be controlled, as for instance the brine in a tank surrounding the expansion-coils of a refrigerating apparatus, and at the same time to prevent injury to the sensitive member by direct contact therewith of the brine or other material, the thermo-sensitive member is disposed within a tubular housing 11 which is closed at the end adjoining the disk 7, and at the opposite end is fitted with a removable plug 12 through which the tube 10 extends rotatably. The disk 8 has a projecting flange-portion which engages the inner wall of the housing-tube and serves to support the thermo-sensitive member in slightly spaced relation to the wall of the housing. A threaded collar 13 is integrally united with the housing-tube 11, as by welding the

same thereon, said collar being adapted to be screwed into a flange-plate 14 on the side of a brine-tank 15, so that the end of the housing containing the thermo-sensitive member will extend into the tank, while the opposite end will project more or less beyond the side of the tank. The outer end of the housing-tube is provided with a flanged collar 16 to which is secured the switch-casing or housing 17, the latter being preferably of an impervious or moisture-proof moldable insulating material such as bakelite. The casing 17 is of oblong rectangular form, and at the front side has a removable cover 18, of which the central portion is preferably a plate 19 of transparent glass or the like, through which the switch mechanism may be observed without opening the casing. The removable plug 12 at the front end of the housing-tube 11 is preferably flush with the rear inner surface of the casing, the plug being retained by means of screws 20 as shown in Fig. 2, so that by first removing said screws the parts 6, 7, 8, 9, 10 and 12 may be withdrawn from the front end of the housing without disconnecting said parts from each other. The tube 10 is held in fixed longitudinal relation to the plug 12 by means of a collar 21 which is secured to said tube at the inner side of the plug, and an arm 22 which is secured upon the tube at the front side of the plug within the casing 17. A coil spring 23 is connected with the arm 22 and extends to a post 24 near one side of the casing, the tension of said spring holding the upper portion of the arm against the end of an adjusting-screw 25 which extends through the side of the casing, as best indicated in Fig. 2. The connecting tube 10, and the end of the thermo-sensitive member to which it is connected by the disk 8, are thus held in fixed relation to the stationary parts of the device, subject to adjustment by means of the screw 25 which, when screwed inwardly of the casing 17, rotates the tube 10 to the left or counter-clockwise as viewed in Fig. 2. The end of the tube 9, which projects forwardly beyond the tube 10, is provided with an insulating sleeve 26 to which is secured the arm 27, the latter extending upwardly and carrying the movable members of the switch mechanism. The latter operate in a magnetic field formed between the terminals of a U-shaped permanent magnet 28. Said magnet is fixedly secured in the casing 17 by means of screws 29 which extend through the rear side of the casing and enter threaded openings in the edges of the magnet, holding the same against the lugs 30 and 31 which project from the back of the casing, so that the magnet is spaced from the rear wall thereof. The upper transversely extending lug 31 has lips 32 at the ends thereof which extend over the side-portions of the magnet, as shown in Fig. 4, whereby to prevent spreading of the terminals or poles thereof, and a bar or rod 33 of non-magnetic material such as brass is arranged between the sides of the magnet adjacent to the lug 31, whereby to positively prevent any displacement of the poles toward each other. Near the ends of the magnet, at opposite sides and in alinement with each other, are threaded openings in which are disposed the screws 34 and 35, said screws being of iron or soft steel so that adjacent ends thereof form pole-pieces for the magnet, and the strongest portion of the magnetic field is at the gap between said ends of the screws. The screw 34 extends through a package-sleeve 36 in the side of the casing 17, so that said screw may be turned from the outside of the casing, for adjusting the polar gap. Directly behind the screw 34 there is a screw 37 which passes through a second threaded opening in the magnet-terminal, the inner portion of said screw extending across toward the opposite side of the magnet, and the outer portion of the screw extending outside the casing so that it may be adjusted without opening the same. Said screw 37 is also of magnetic material and is employed for varying the strength of the magnetic field between the ends of the screws 34 and 35, it being obvious that a part of the magnetic force will be diverted or shunted to form a secondary field adjoining the end of said adjusting-screw 37, the intensity of the secondary field being inversely proportional to the width of the air-gap at the point of the screw, and the intensity of the main field being decreased as that of the secondary field is increased. Below the screw 34 there is a screw 38 which fits in a bushing 39 of insulating material extending through the side of the magnet, the outer or slotted end of the screw extending through a packing-sleeve in the side of the casing 17, similarly to the screw 34. To the arm 27 which is carried on the front end of the tube 9 there is secured a flat strip or bar 40 of magnetic material such as soft iron, which extends up between the ends of the screws 34 and 35, a thin plate 41 of insulating material being secured to one side of the bar adjoining the screw 35, whereby to prevent electrical contact between said screw and the bar. At the opposite side of the bar 40 are two contact-springs 42 and 43, of which the lower ends are attached to the arm 27, and the upper ends are adjacent, respectively, to the ends of the screws 34 and 38. Small screws 44 and 45 pass loosely through openings in the contact-springs near the free ends thereof and extend into threaded openings in the bar 40. By means of said screws 44 and 45 the contact-springs are so adjusted that upon movement of the same away from the screws 34 and 38, the contact will be first broken between the spring 42

and screw 34, and then between the spring 43 and screw 38. The screws 34 and 38 are electrically connected to each other through a resistance 46, represented diagrammatically in Fig. 2. At the upper end of the casing 17 are binding-posts 47 and 48, of which the first is connected with the body of the magnet (and thus to the screw 34), and the other is connected with the arm 27, as diagrammatically indicated, so that the switch may be disposed in any electrical circuit by merely connecting terminals thereof to the binding-posts.

The described arrangement of contacts and electrical connections is suitable for use with motors or other devices where the same are to be controlled directly by the thermostatic switch, without the interposition of relays, automatic electrically operated switches, or similar devices, and I have found it entirely practicable to operate motors of sizes up to 5 horse-power with the motor-circuit connected directly through the described switch mechanism, without causing appreciable arcing at the contacts, and without causing sticking, heating or fusing thereof by continued use. The mode of operation of the mechanism will be apparent. The bar 40, being in effect an armature, tends to adhere or press firmly toward one or the other of the magnet poles formed by the terminal portions of the screws 34 and 35, according to the direction in which the arm 27 is last actuated by the thermo-sensitive member. Upon a change of temperature such as to tend to actuate the arm 27 in the opposite direction, the armature will continue to adhere to the engaged pole until the actuating force is sufficient to overcome the magnetic attraction between the parts, whereupon the armature will instantly move across the gap and engage the opposite pole, remaining in engagement therewith until the temperature is again increased or decreased, as the case may be, sufficiently to cause a reversal of the movement. It should be noted that the arm 27 is not positively actuated by the thermo-sensitive member 6, the coil of the latter having a certain resilience which readily permits the deferred movement of the switch-parts until the accumulation of the force necessary to effect a rapid movement thereof. When the controlled circuit is closed by the engagement of the contact-springs 42 and 43 with the terminal-screws 34 and 38, a firm and efficient contact is formed between the parts and maintained constantly for the desired period, without being subject to partial opening or chattering as a result of jarring or vibration of the mechanism. The opening of the circuit occurs only upon a full movement of the parts, which is rapidly effected, since the same is caused not only by the accumulated force necessary to overcome the magnetic attraction of the engaged pole, but also by the counter attraction of the opposite pole, which becomes effective as soon as the movement is commenced. The described characteristics of the circuit-opening movement tend to prevent arcing between the contacts, and a further tendency to suppress arcing results from the presence of the magnetic field, which tends in a well-known manner to inhibit the formation of an arc therein. Liability of arcing is further reduced by the use of the second or auxiliary contact-screw 38 which is connected with the main contact-screw 34 through the resistance 46. As before mentioned, the springs 42 and 43 are so adjusted that the connection is first broken between the spring 42 and screw 34, thus throwing the resistance 46 into the circuit, which remains closed momentarily, however, until the separation of the spring 43 and screw 38.

Referring now to Fig. 5, there is shown a modified arrangement of the switch mechanism, adapted for use in connection with automatic switches, wherein the main switch which opens and closes the motor-circuit is actuated by control-circuits connected through the thermostat, the latter serving to close two control-circuits alternately, each control-circuit being opened by the same action of the automatic switch effected by the closing of said circuit at the thermostat, and the other control-circuit being at the same time re-established at the automatic switch so as to be closable by the reverse movement of the thermostat. In said modified structure the movable armature-bar 40 carries a contact-spring 42′ at each side thereof, said springs being engageable with contact-screws 34′ which extend through insulating bushings 49 to the outside of the casing 17. The bushings 49 extend through the tubular screws or sleeves 50, which are of magnetic material such as iron or steel and are screwed through the terminal portions of the magnet 28, so that they constitute pole-pieces for the same and thus serve to attract the armature-bar 40 and hold the contact-springs and screws in firm engagement with each other at one side or the other of the polar gap. The arrangement of circuits with this form of the device is common and well known in the art and need not be herein set forth in detail.

As a further means of preventing arcing between the switch-contacts, the same may be immersed in oil, which may be easily effected by the arrangement shown in Fig. 6. As indicated in said figure the magnet 28 is inverted so that the ends thereof extend downwardly, and between said ends there is disposed a cup 51 of non-magnetic material such as brass, in which the oil is contained. The cup 51 is held in position by means of lock-nuts 52 screwed upon the inner end-por-

tions of the sleeves 50 within the cup, suitable gaskets 53 being arranged between the nuts and the sides of the cup to prevent leakage of the oil. In this form of the device it is preferred that the end-portions of the contact-springs 42′ be slightly bent or turned outwardly adjoining the ends of the contact-screws 34′, as by this means it is possible to cause a slight rubbing or sliding of the contact-surfaces upon each other as the same move into and out of engagement.

Now, having described my invention, what I claim and desire to secure by Letters Patent is:

1. In a device of the class described, the combination with a thermically actuated member movable reciprocatingly by increase and decrease of temperatures, of an armature of magnetic material carried by said member, a permanent magnet having its poles extending on opposite sides of said armature whereby to attract the same alternatively, a pair of yieldable contacts connected with said armature and having portions extending into the magnetic field between the magnet poles, a pair of fixed contacts engageable by said yieldable contacts in the magnetic field, and disengageable therefrom consecutively, and an electrical resistance connecting said pair of fixed contacts.

2. In a device of the class described, a thermo-sensitive member, an armature of magnetic material connected therewith and movable thereby in opposite directions according to increase and decrease of temperature, a U-shaped permanent magnet arranged with its poles at opposite sides of said armature whereby to attract the same alternatively, contacts controlled by said armature and adapted to open and close circuits at the limits of movement thereof, and magnet-adjusting means for varying the intensity of the magnetic field in which the armature moves.

HENRY A. HOESCHEN.