Oct. 8, 1929. W. G. HARTWIG 1,730,366

ELECTRIC HEATING SYSTEM FOR STREET CARS AND THE LIKE

Filed Dec. 10, 1923 2 Sheets-Sheet 1

Fig. 1.

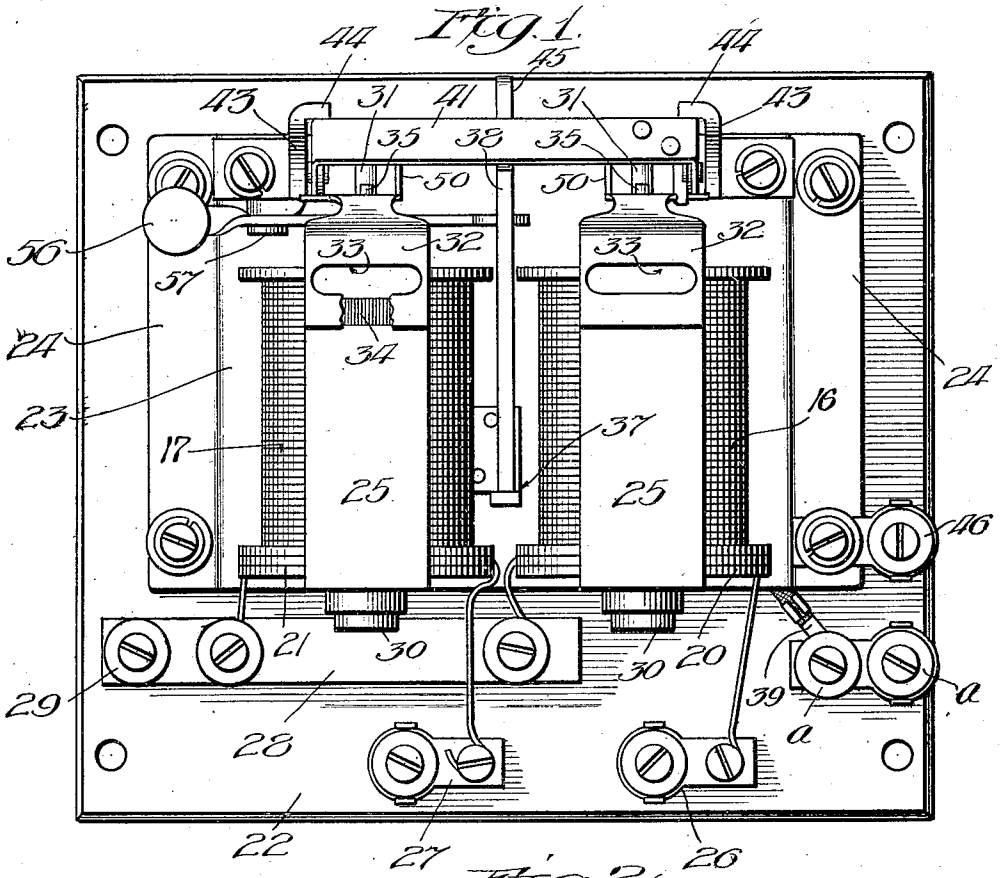
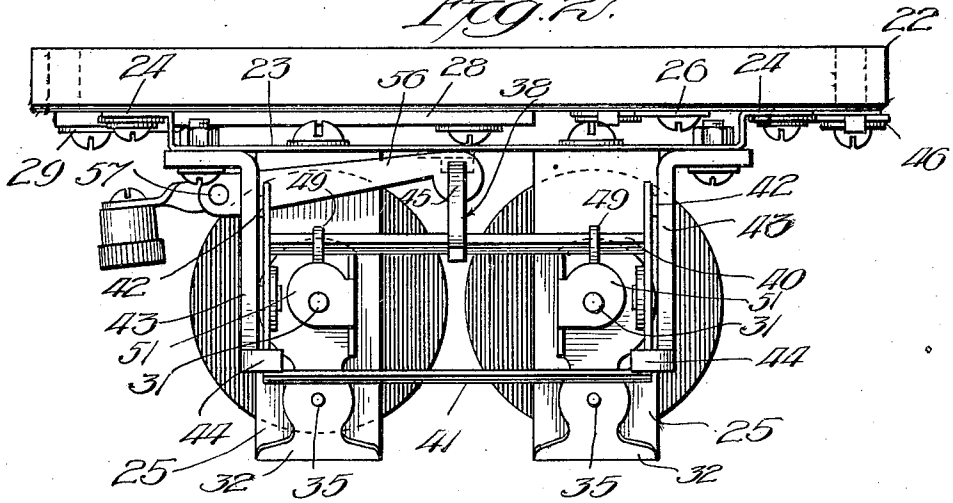


Fig. 2.



William G. Hartwig
Inventor
by Albert Kebb Brownell & Co.
his Attorneys

Oct. 8, 1929. W. G. HARTWIG 1,730,366

ELECTRIC HEATING SYSTEM FOR STREET CARS AND THE LIKE

Filed Dec. 10, 1923 2 Sheets-Sheet 2

Fig. 3

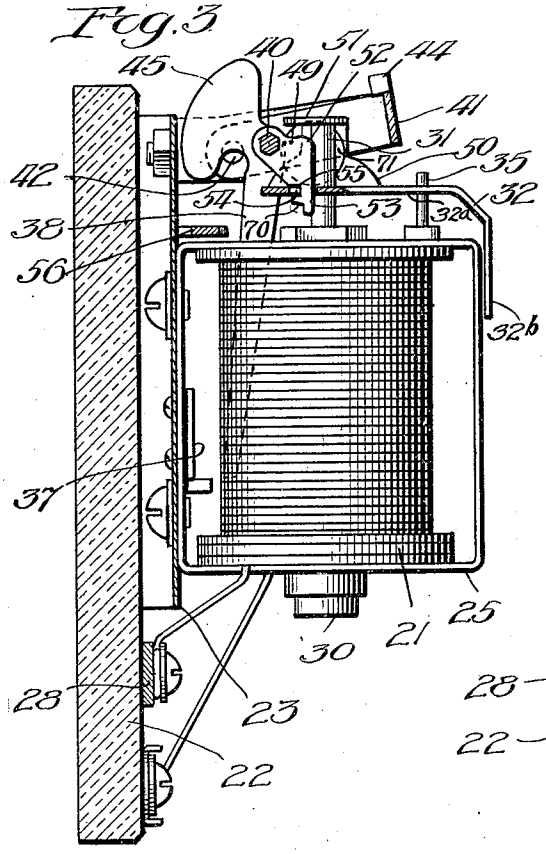


Fig. 4.

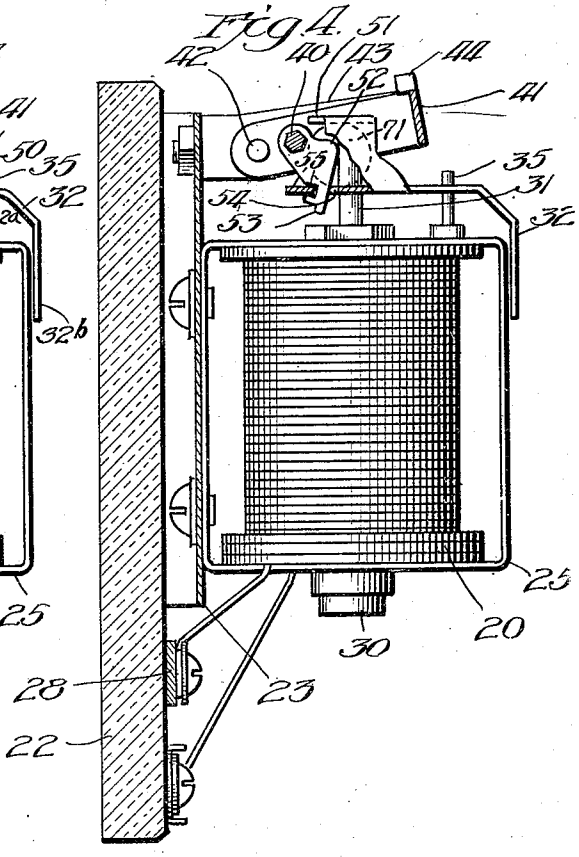
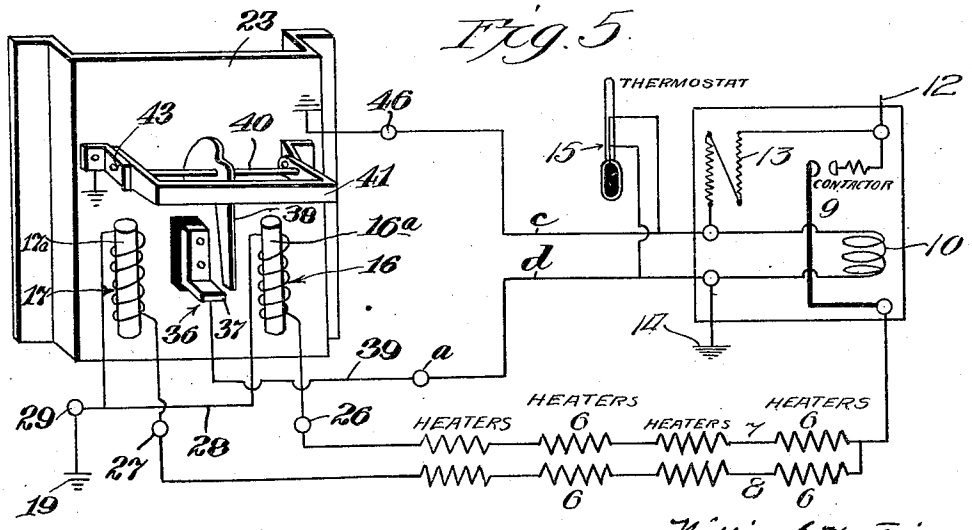


Fig. 5.



William G. Hartwig
Inventor.
by Rector, Hibben, Davis & Sherman
his Attorneys

Patented Oct. 8, 1929 1,730,366

UNITED STATES PATENT OFFICE

WILLIAM G. HARTWIG, OF CHICAGO, ILLINOIS, ASSIGNOR TO RAILWAY UTILITY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS

ELECTRIC HEATING SYSTEM FOR STREET CARS AND THE LIKE

Application filed December 10, 1923. Serial No. 679,529.

In the system to which my invention relates it is common practice to connect the heating elements in multiple and also to arrange them in groups, the members of each group being in series and the groups being connected in multiple in the circuit of the heating current. In such system a contactor is employed to control the heating circuit, the contactor in turn being controlled by a thermostat which closes the circuit when the temperature drops below a predetermined minimum and opens the circuit when the temperature rises above a predetermined minimum.

It sometimes happens that one of the units or groups of such a system becomes short-circuited when a break occurs therein which may cause a fire or panic among the passengers. If one of the groups or a heating unit is out of commission the temperature of the car is apt to drop below that which it is required to maintain and it is desirable in any event when the heating circuit becomes imperfect that the car be immediately shifted into the shop for repair. It is the object of the present invention to provide means for automatically opening the heating circuit in such contingencies and at the same time indicating to the inspector or repairman where the trouble is located so that he may lose no time in looking for it. With this in view I provide an automatic cutout and indicating apparatus comprising electro-magnetic coils in the circuits of the respective heating units or groups of units which will immediately open the contactor controlling the supply of current to all of the heaters or groups on failure of current to any of them and at the same time so set an indicator or detector that the faulty unit or group of units will be at once apparent. In the drawings and in the following specification I have disclosed a preferred embodiment of my invention as applied to a thermostatically controlled electric heating system in which the heaters are arranged in two groups or series; it is to be understood, however, that the specific disclosure is for the purpose of exemplification only and that the invention is applicable to other systems and arrangements of heaters and may be embodied in other forms than that disclosed, coming within the scope of the following claims in which I have endeavored to present the invention in the broadest terms which the prior art will permit.

In the drawings accompanying and forming a part of this specification, Fig. 1 is a front elevation of a preferred form of my invention adapted to a two unit or group electric heating system; Fig. 2 a top plan view thereof; Fig. 3 a vertical transverse section thereof showing one solenoid and certain of the parts in one position; Fig. 4 a similar section looking at the other solenoid with certain of the parts shown in a different position, and Fig. 5 a diagram of a thermostatically controlled system embodying said form of the invention. Each part is identified by the same reference numeral in the several views.

Referring first to the diagram, Fig. 5, the heaters are shown at 6 connected in two series 7 and 8, the supply of current thereto being controlled by the contactor 9. It will be apparent hereafter that with an obvious modification any number of series of heaters may be employed. The electro-magnetic coil 10 controlling the contactor is supplied with energizing current through a circuit from the source of the heating current (ordinarily the trolley supplying also the motor) at 12, comprising a suitable resistance 13 and said coil 10 and grounded at 14. A thermostat 15 short-circuits coil 10 when the temperature in the enclosure being heated rises to the point for which the system is designed and set. The heating system as thus far described is one of those in practical use to which my invention is applicable.

In applying my invention to such a system controller coils of the combined cutout and indicator to be presently described are included in the circuits of the respective heater groups at 16, 17 and preferably between said groups and the ground 19, so that when the heating current is on in the series of heaters 7 the solenoids 16 will be energized and when the current is on through the series of coils 8 solenoid 17 will be energized. In normal operation these solenoid coils will be energized and de-energized together and only when there is a break in one of the branch circuits will either coil be energized without the other.

The coils 16 and 17 are shown diagrammatically in Fig. 5 of the drawings as coils of two solenoids the cores 16^a and 17^a of which together control a switch 36 in a shunt about the coil 10 comprising the wires *c*, *d*. The actual construction as shown in Figs. 1 to 4 inclusive is such that so long as the solenoids are energized and de-energized together the switch 36 remains open, but when one of the solenoids is energized while the other is de-energized the switch 36 is closed, thus shunting the contactor coil 10 and opening the contactor controlling the supply of heating current.

Referring now to Figs. 1 to 4 inclusive, the solenoids 16 and 17 are shown mounted vertically side by side on a sheet-metal support 23, the end flanges 24 of which are screwed to a panel 22. The solenoids are secured to the sheet-metal support by yokes 25. An end of each coil 16, 17 is secured to an individual binding post 26, 27 from which connection may be made to the respective heater groups. The other ends of the respective coils are connected to the strip 28 which may be connected to ground by the binding post 29.

The core 30 of each solenoid is provided with a reduced extension or rod 31 which extends above the upper end thereof and carries an indicator 32 by which the position of the solenoid core is readily observed. The indicator is formed of sheet-metal comprising a horizontal portion 32^a through which the rod 31 extends and an apron 32^b which extends down in front of the strap 25. The apron is perforated as at 33 and a band of distinguishing color 34 is put upon the yokes 25 at a height to be in register with the openings 33 when the indicator and core are in their lowermost positions. Thus the indicator shows the metal color of yoke 25 when the solenoid is energized and the band 34 when the solenoid is de-energized. One end of the flat portion 32^a of the indicator is bent up at 50 and horizontal at 51 to form a shelf or ledge, which is attached to the upper end of the rod 31. 35 is a guide extending through the portion 32^a of the indicator to insure the proper relation of the latter.

The switch 36 in the shunt to the contactor coil 10, controlled by the solenoids is, in the illustrated form of the invention, comprised of a stationary contact 37 and a movable contact arm 38. The former is mounted on, but insulated from, the support 23 and is connected by wire 39 to a binding post *a*. The movable arm 38 is keyed to a rod or rock shaft 40 journaled between the arms of a pivoted carrier or bail 41. Said bail is pivoted at 42 to brackets 43 secured to the support 23 above mentioned and said brackets also comprise stop fingers 44 for limiting the upward movement of the bail. This arm 38 is in electrical connection with the support sheet 23 through rod 40, bail or carrier 41 and brackets 43, and the support sheet 23 is connected to binding post 46. The binding posts 46 and *a* are connected to the respective terminals of the contactor coil by the wires *c* and *d*. The rod 40 also carries a catch or latch 49 to cooperate with each indicator, there being in the present instance two of these catches. Each latch extends at its end into a hole 54 in the corresponding indicator plate and is provided with a notch 55 which is in the horizontal plane of said plate when the latter is in its upper position. Each latch is also provided with a shoulder 70 which is above its indicator plate when the latter is in its lowermost position. Each latch is also formed with a shoulder 52 above which the ledge 51 of the indicator plate extends, said ledge being clear of the shoulder when the indicator plate and core are in their uppermost positions but adapted to engage the shoulder when the solenoid is de-energized and the core falls, as will presently appear. The bail is provided with downwardly projecting discs 71, 71, which are engaged by the respective indicator plates when the latter are raised by their solenoid cores to lift the bail. The rod 40 is provided with a counterbalance, here shown as integral with the contactor arm, at 45, to offset the weight of the latches and normally hold the contactor arm 38 in substantially vertical position and away from the stationary contact 37.

The operation of the device will now be described. During normal operation the solenoids will be energized and de-energized together as the heating current is turned on or off by the contactor. When the current is on, the solenoid cores and indicators will, of course, be in their uppermost positions as will also the bail 41 and the parts carried thereby, the bail being supported in its uppermost position by the engagement of the discs 71 with the upper face of the indicator members 32^a. The latch members and contact arm will be in substantially the position shown in Fig. 3. When current is cut off from both solenoids by opening of the

contactor as in normal operation the solenoid cores and indicators will drop until the ledges 51 of the respective indicators engage the shoulders 52 of the respective latches. The weight of the solenoid cores and connected parts in further descent will carry down the latches and the bail, the latter swinging downwardly on its pivots 42, but the contactor arm will not be swung into contact with the fixed contact 37 because of the counterbalance 45. When the two solenoids are again energized together they return to the positions shown in Fig. 3, lifting the bail and without substantial movement of the latches and movable contact about the axis of rod 40. When, however, current through one of the solenoid coils fails while the other remains energized the core of the de-energized coil drops, carrying with it its indicator. The ledge 51 of the falling indicator engages the shoulder 52 of the latch beneath it and the latter receives the pull of the weight of the core and attached parts. The bail, however, is held in its uppermost position as before, by the core and indicator of the solenoid which has not been de-energized. The weight of the dropping core, therefore, exerted on the shoulder of the corresponding latch causes the latter, the rod 40 and the contact arm 38 to swing about the pivots of rod 40 so that the contact arm makes contact with the stationary contact 37. As will be obvious from an inspection of Fig. 3, before the ledge 51 of the falling indicator engages the shoulder 52 of the corresponding catch the plate 32^a is beneath the level of the shoulder 70. The oscillation of the rod 40 produced in the manner above described swings the other latch 49 keyed thereto into the position shown in Fig. 4, in which the notch 55 thereof engages the corresponding indicator plate. Thus this indicator plate is held in raised position even after the solenoid is de-energized by the opening of the contactor through the closing of the shunt by means of the contact arm 38 and contact 37. The inspector observing that one of the indicators is down while the other is up can readily locate the trouble, the entire heating current having been cut off in the meantime.

In the event that one of the heater circuits becomes defective while the heating current is off the instrument will signal the difficulty likewise when the current is again turned on. The energized solenoid will raise the bail but the weight of the core and attached parts of the unenergized solenoid acting on the corresponding latch will close the contact arm 38 against the stationary contact and the indicator remaining down will give the proper indication. The parts may be restored to normal position by key 56 which engages the contact arm 38.

I claim:

1. In a device of the class described, a plurality of solenoids the cores of which are independently movable, a vertically movable carrier, a switch member pivoted thereto, a stationary contact, a plurality of latches in fixed relation to said switch member and adapted respectively to engage and hold in raised position the respective cores of the solenoids, means on the respective cores for raising said carrier and means on the cores for engaging the respective latches to cause the latter to sustain the weight of the respective cores whereby when one of said solenoids is de-energized while the others remain energized the descent of its core swings the latches and the contact arm to engage the stationary contact and when all of the solenoids are de-energized the weight of the cores lowers said carrier.

2. In a device of the class described, a plurality of solenoids, the cores of which are movable from a lower to an upper position when the respective solenoids are energized, a carrier element mounted above the solenoids and adapted to be engaged and raised by either of the cores when the solenoid thereof is energized, a rock shaft mounted on said carrier, a latch for each core mounted upon said shaft and adapted and arranged when the carrier and core are in the upper position to engage said core and hold it in the upper position and also to be engaged by said core when the latter drops to rock said shaft, and a switch, the movable element of which is likewise mounted on said shaft and adapted to close against the stationary contact of said switch when said shaft is rocked.

3. In a device of the class described, a pair of solenoids the axes of which are substantially vertical, cores for said solenoids adapted to be raised when the solenoids are energized, a bail pivoted above the solenoids, an indicator mounted on each solenoid core, and adapted to engage and lift the bail when the indicator is raised, a rock shaft mounted in the bail, detents on the rock shaft adapted when the latter is oscillated to engage the respective indicators, but normally out of contact therewith, said detents being also arranged to be engaged by the respective indicators when the latter fall to rock the shaft, a stationary contact and a movable contact, the latter being mounted on the shaft, whereby when the solenoids are energized and de-energized together the bail is raised and lowered without rocking the shaft, and when one of said solenoids is deenergized and the other remains energized, the shaft is rocked to close the contact and engage the indicator of the energized solenoid.

4. In a device of the class described, a plurality of vertical solenoids with vertically movable cores, a yoke pivoted above the solenoids in the path of movement of the respective cores, and adapted to be raised thereby

when the solenoids are energized, an oscillatory member on said yoke, a catch for each solenoid core secured to said oscillatory member and adapted to swing therewith into position to engage its core and hold it in elevated position, means on each core to engage the catch associated therewith when the core falls to swing the catches and oscillatory member into engaging position and a switch the movable member of which is fixed to said oscillatory member and adapted to engage the fixed member thereof when the catches are swung to engaging position.

WILLIAM G. HARTWIG.