C. C. BADEAU.

NO-VOLTAGE CIRCUIT BREAKER FOR ALTERNATING CURRENT.

APPLICATION FILED JULY 27, 1909.

1,054,330. Patented Feb. 25, 1913.

Fig. 1.

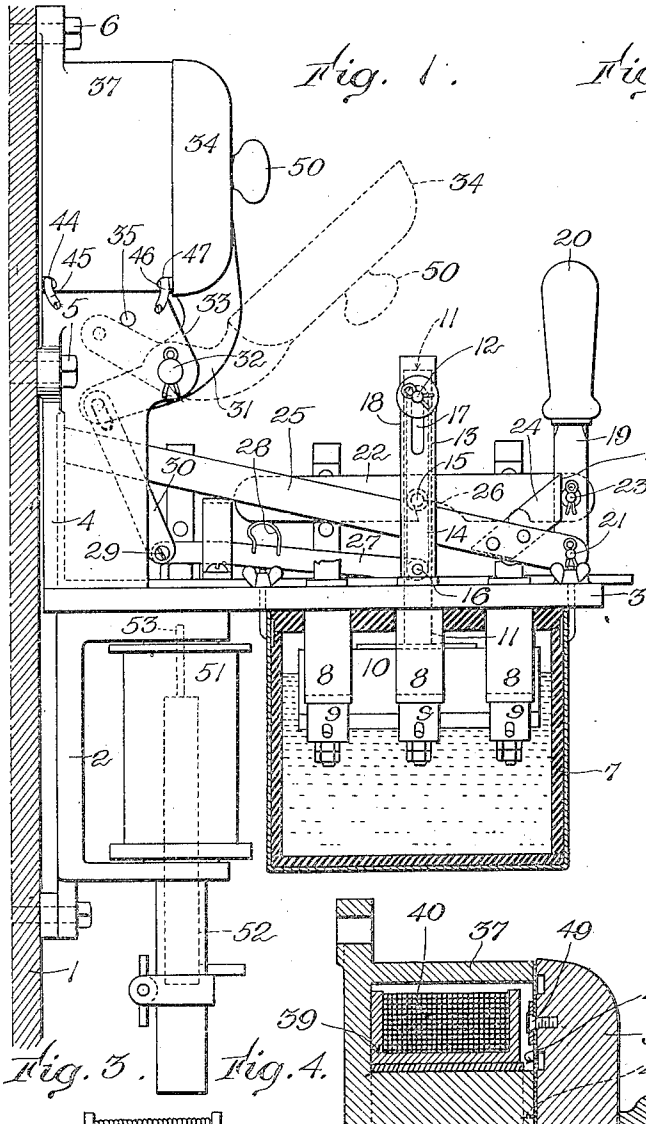


Fig. 2.

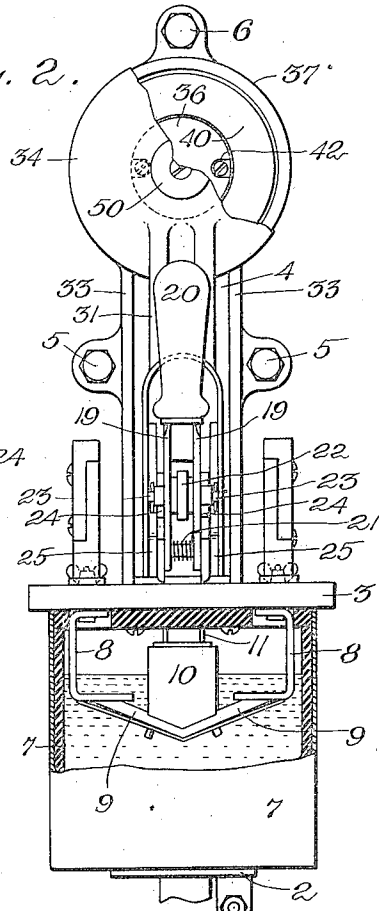


Fig. 3.

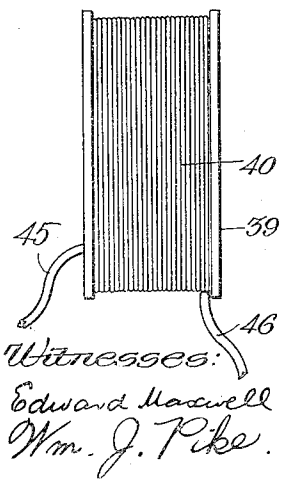


Fig. 4.

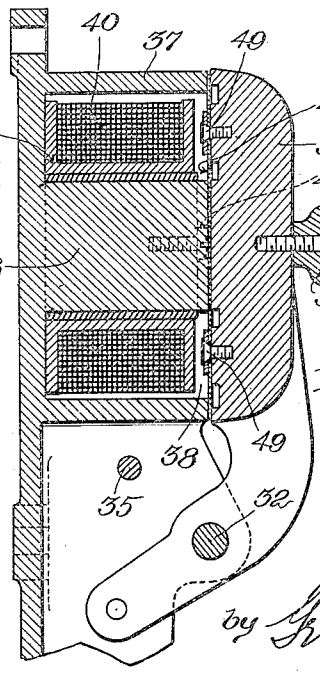


Fig. 5.

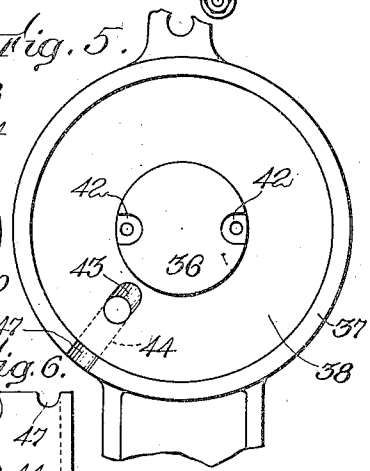
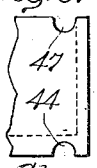


Fig. 6.



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UNITED STATES PATENT OFFICE.

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NO-VOLTAGE CIRCUIT-BREAKER FOR ALTERNATING CURRENT.

1,054,330. Specification of Letters Patent. Patented Feb. 25, 1913.

Application filed July 27, 1909. Serial No. 509,920.

To all whom it may concern:

Be it known that I, CHARLES C. BADEAU, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented an Improvement in No-Voltage Circuit-Breakers for Alternating Currents, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

One of the principal objects of my invention is to prevent the humming noise common in this class of instruments, which is commonly due to the fact that the power supply of the usual single-phase alternating current no-voltage magnet is pulsating, while the opposing force, *i. e.* the weight of the armature or core, etc., is continuous. Accordingly I have devised the hereinafter described circuit breaker containing a special no-voltage magnet of peculiarly economical and simple construction, which, taken with the novel coöperating mechanical arrangements of parts, accomplishes the main object referred to and also requires but little energy to hold the armature, and, when the armature trips, carries sufficient force to open the circuit breaker.

The constructional details, operation, and further advantages of my invention will appear more at length in the course of the following description, taken with reference to the accompanying drawings, in which I have shown a preferred embodiment of the apparatus.

In the drawings, Figure 1 is a view thereof in side elevation, the oil pan being shown in transverse section, and certain parts broken away for clearness of illustration; Fig. 2 is a view thereof looking toward the left, Fig. 1, parts being broken out to show constructional details; Fig. 3 shows in edge view the special bobbin or coil for the electro-magnet; Fig. 4 is a transverse sectional view showing the constructional details of the no-voltage magnet; Fig. 5 shows in front elevation the magnet casting; and Fig. 6 is a fragmentary view in side elevation of a portion of the part shown in Fig. 5.

As already intimated, the principal feature of my present invention is the magnet (and coöperating mechanism), which is of an armature type and made entirely of cast iron, the core and the shell being integral, and the latter, which constitutes the outside of the magnetic circuit, preferably furnishing a complete cover for the coil to protect the same from mechanical injury. Although cast iron is a comparatively poor magnetic conductor, it is likewise an extremely poor electric conductor, and I take advantage of this latter fact, in connection with certain structural details to be explained later, to provide an alternating current magnet which will not unduly heat, the electric resistance of cast iron being so high that the eddy currents set up in the iron will not overheat the iron, but become beneficial. These eddy currents in the cast iron set up innumerable fluxes out of phase with each other, giving a practically constant pull, and therefore entirely obviating the humming previously referred to. The weight of the armature also helps toward noiseless operation, as, because of its inertia, it requires appreciable time to move, and, therefore, even if the current should momentarily drop, let it be supposed, entirely to zero, it would cause no perceptible humming. I employ a large mass of cast iron having large radiating surfaces and keeping the flux density low, the shape of the magnet giving a large area of air-gap, and the core, integral with the rest of the casting, reducing the magnetic reluctance to such an extent that the device is extremely economical. The latter is an important feature in connection with alternating current no-voltage release as it is constantly in circuit and therefore constantly consuming energy. The efficiency is improved by the arrangement of the armature whose effective weight is comparatively small when closed and large when it falls away from the closed position, so that a small magnetic energy tends to keep it in its closed position. Having premised this much as to this leading feature of my invention and its theoretical and practical value and importance, the preferred embodiment of the invention will now be explained, it being understood that my invention is not limited thereto but is capable of a wide variety of mechanical embodiments within the spirit and scope of the invention as herein set forth and hereinafter claimed.

Secured to a switch board or other support 1 is a bracket 2 having a horizontal

ledge or switch support 3 and an upright portion 4 which, as herein shown, is secured to said board or wall 1 by bolts 5, 6. Depending from the support 3 is an oil pan or well 7 of usual or preferred construction, containing stationary contacts 8 and movable bridging contacts 9 corresponding in number and arrangement to the circuit system for which the switch is provided. The movable bridge contacts 9 are secured to a block 10 carried by a post 11 pivotally connected at 12 with the upper ends of toggles, the meeting ends of whose links 13, 14 are pivoted together at 15, the link 14, being mounted on a fixed pivot at 16, and the pivot 12 of the upper link being free to slide in a vertical slot 17 in a rigid standard 18. A handle lever 19 provided with a handle 20 is pivoted at 21 and serves to move a latch plate or bar 22 freely pivoted on a transverse pivot pin 23 which extends through said handle lever 19 beyond the latter at its opposite ends in position to engage stops 24 projecting rigidly upwardly and rearwardly from stationary oblique braces 25 which constitute a part of the supporting frame of the apparatus. The latch plate or bar 22 is shown as having a notch 26 with an obliquely inclined front wall or wedging surface for breaking the toggle when suddenly tripped or swung upward on its pivot 23, said notch embracing or catching over the toggle pivot pin 15 of the toggles for raising and lowering the movable contacts 9 when it is desired to close or open the switch. Pivoted at 16 is a tripping arm or lever 27 shown as provided with a lifting stop or cam projection 28 in position to engage the free end of the latch plate 22, and to the free end 29 of said lever 27 is pivotally connected a link 30 pivoted to the free end of an armature lever 31, herein shown as in the form of integral ears mounted on a pivot 32 between projecting flanges or vertical ribs 33 of the part 4. Said armature lever carries a vertical armature 34 of the cast iron electro-magnet or no-voltage release device previously referred to at length, and shown in enlarged detail in Figs. 3–6. The armature is limited in its falling movement by a stop 35. The core 36 and shell or casing 37 of said electro-magnet are integrally formed in one casting, provided with an annular space 38 for receiving a spool 39 and coil 40 which complete the electro-magnet. As herein shown, said spool and its winding are secured fixedly in place by screws 41 mounted in recesses 42, and the casting which constitutes the casing or shell of the electro-magnet is provided with an oblique hole 43 through from front to back whence a groove 44 leads out, for receiving the lead or terminal 45 from the inner end of the coil, the outer lead or terminal 46 passing out through a groove 47. As herein shown, a diaphragm or thin plate 48 of non-magnetic metal is secured by screws 49 to the face of the armature 34 to keep the same from contacting with the core and sticking thereto, and the latter is provided with a handle 50 for its hand operation. This electro-magnet which constitutes the no-voltage release of the circuit breaker is mounted vertically over the circuit breaker so that the heavy mass of the armature 34 is almost over its pivotal center when in closed position and, upon being released, falls toward the horizontal sufficiently to render its weight effective in tripping the circuit breaker. Preferably the circuit breaker is also provided with a usual overload coil 51 and tripping core 52 in position for its tripping pin 53 to strike against the under side of the lever 27 and thereby trip the circuit breaker in obvious manner. The movement of the lever 27 under the impulse of the tripping pin 53 effects actuation of the circuit breaker without disturbing the armature 34 by reason of a lost-motion device, preferably in the form of a pin and slot connection at the upper end of the link 30.

The operation of the circuit breaker is as follows: To open it by hand, the handle 20 is swung to the right, Fig. 1, thereby breaking the toggle 13, 14 and lowering the post 11 and the movable contacts 9 away from the fixed contacts 8. To close the circuit breaker, the armature 34 of the no-voltage release is first raised into its full line position as shown in Fig. 1, thereby moving the tripping arm 27 and projecting cam 28 down out of the path of the latch plate 22, and then while these parts are held in said position, the switch handle 20 is raised or moved forward to the left to the position shown in Fig. 1, thereby restoring the toggles to their vertical position and closing the contacts 9 against the contacts 8. As long as the current is passing properly through the circuit breaker, the armature 34 is held in its raised or closed position as shown in full lines in the drawings, and all humming is obviated by reason of the fact that the no-voltage release device or magnet is made of cast iron, so that the eddy currents therein produce a practically constant pull on the armature and hence prevent the latter from chattering or humming. Also, as the magnet is of the armature type and the latter has large mass, also of cast iron, it is necessarily sluggish in response to variations of current in the coil. The large mass of the magnet core and case, and hence the large radiating area thereof, keeps the flux density low and prevents undue heating. By having the core and case integral, as distinguished from being riveted or screwed or otherwise secured to each other as separate parts, the magnetic reluctance is reduced so as to render the operation economical, although the magnet is

continuously in circuit and therefore constantly consuming energy, and this result of economy is still further aided by the vertical arrangement and construction of the armature and magnet whereby small magnetic energy keeps the armature in closed position and yet effective weight is available to trip the breaker when the armature falls. When the armature falls to its dotted line position, Fig. 1, it thereby raises the tripping cam or stop 28, which lifts the latch plate 22, so that as it moves out of engagement with the toggle pin 15 the inclined front wall of its notch 26 breaks the toggle and permits the circuit breaker to open. As long as the armature remains down and hence the cam stop 28 remains up, the latch plate 22 cannot be engaged with the toggle pin 15 but when reciprocated simply moves idly by the same. The special arrangement of separating the leads or coil terminals of the magnet renders the apparatus still more simple, economical and certain, as thereby the internal lead 45 does not cross the outside lead 46 but is brought from the center of the core through the slot 43, 44 to the outside of the magnetic shell with the whole width of the coil and magnet between them so that, although the full voltage is between said two leads or wires, the usual danger of breaking or puncturing the coil is eliminated.

Having described my invention, what I claim as new, and desire to secure by Letters Patent is:

1. In an alternating current electromagnetic switch, contacts, and a cast iron armature having sufficient size and mass to prevent humming and overheating connected for controlling the same.

2. An electromagnetic switch, for use in normally closed alternating current circuits, comprising circuit controlling contacts, an electromagnet having an armature connected for controlling said contacts, the magnetic circuit of said magnet being composed of high electric resistance magnetic material of crystalline texture having relatively large area and low flux density and being of sufficient size and mass to prevent overheating and humming when used in a closed magnetic circuit.

3. An electromagnetic switch for alternating current circuits, comprising circuit controlling contacts, a magnet having a cast iron core, and a cast iron armature of sufficient size and mass to prevent humming and overheating coöperative therewith connected for controlling said contacts.

4. In an alternating current electromagnetic switch, circuit controlling contacts, and an electromagnet, having a relatively large cast iron core, an integral cast iron casing, and a cast iron armature of sufficient size and mass to prevent humming and overheating, said armature being connected for controlling said contacts.

5. In combination an alternating current circuit, an electromagnet having a cast iron armature of sufficient size and mass to prevent humming and overheating with its coil connected in said circuit, a circuit controlling device, and a connection from said armature for governing said circuit controlling device.

6. The combination with a normally closed single phase alternating current circuit, of a tripping electromagnet connected therein having a relatively large cast iron core with a cast iron armature of sufficient size and mass to prevent humming and overheating pivoted to stand substantially vertical when in closed position, mechanism for controlling said circuit, and a connection from said armature for governing the same.

7. The combination with a normally closed alternating current circuit, of a tripping electromagnet connected therein having a relatively large cast iron core, integral cast iron casing and massive cast iron armature, said cast iron parts being of a size and mass to prevent humming and overheating of the armature, a mechanism for controlling said circuit, and a connection from said armature for governing the same.

8. An alternating current system of control for electric circuits, consisting of a controlling device biased to remain closed when full voltage is present on said system, and tripping means for said controlling device, consisting of a magnet of cast iron construction having a mass and proportions adapted to prevent humming and overheating with a closed magnetic circuit, said magnet operating to govern said controlling device upon the cessation of the voltage flow.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

CHARLES C. BADEAU.

Witnesses:
M. J. SPALDING,
EDWARD MAXWELL.