No. 639,688. Patented Dec. 19, 1899.

F. C. ROBERTSON.

CIRCUIT BREAKER OR LINE OPENER.

(Application filed June 25, 1898.)

(No Model.)

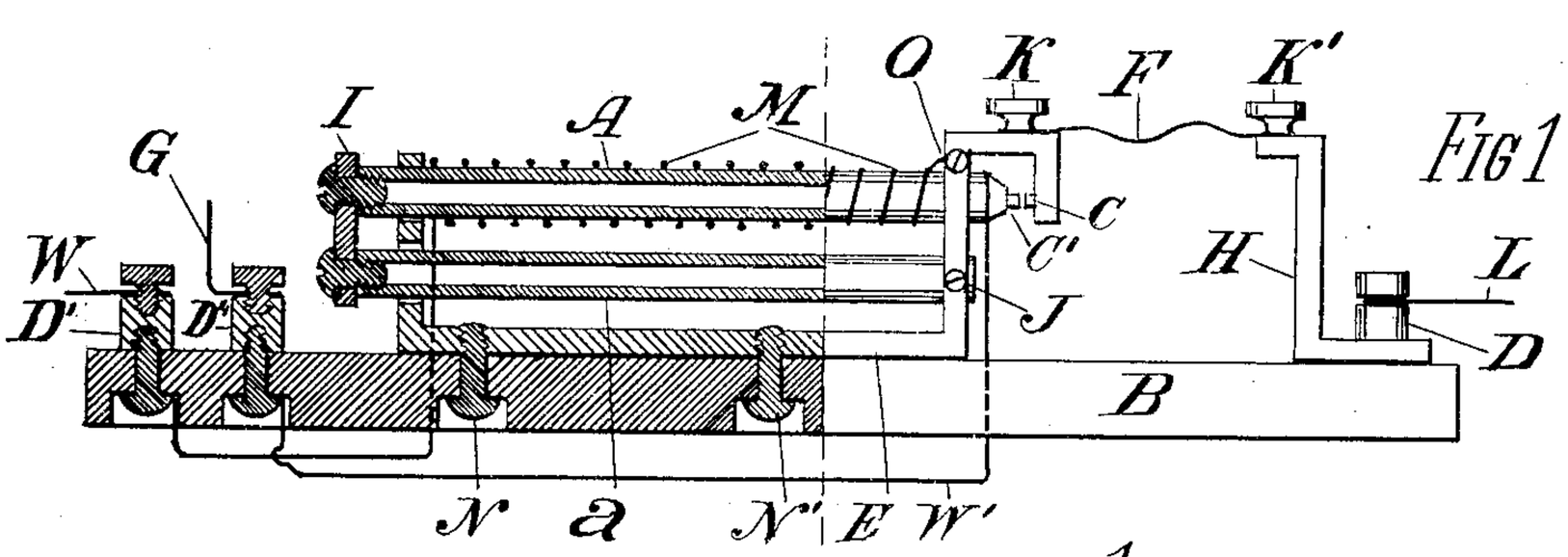

FIG 1

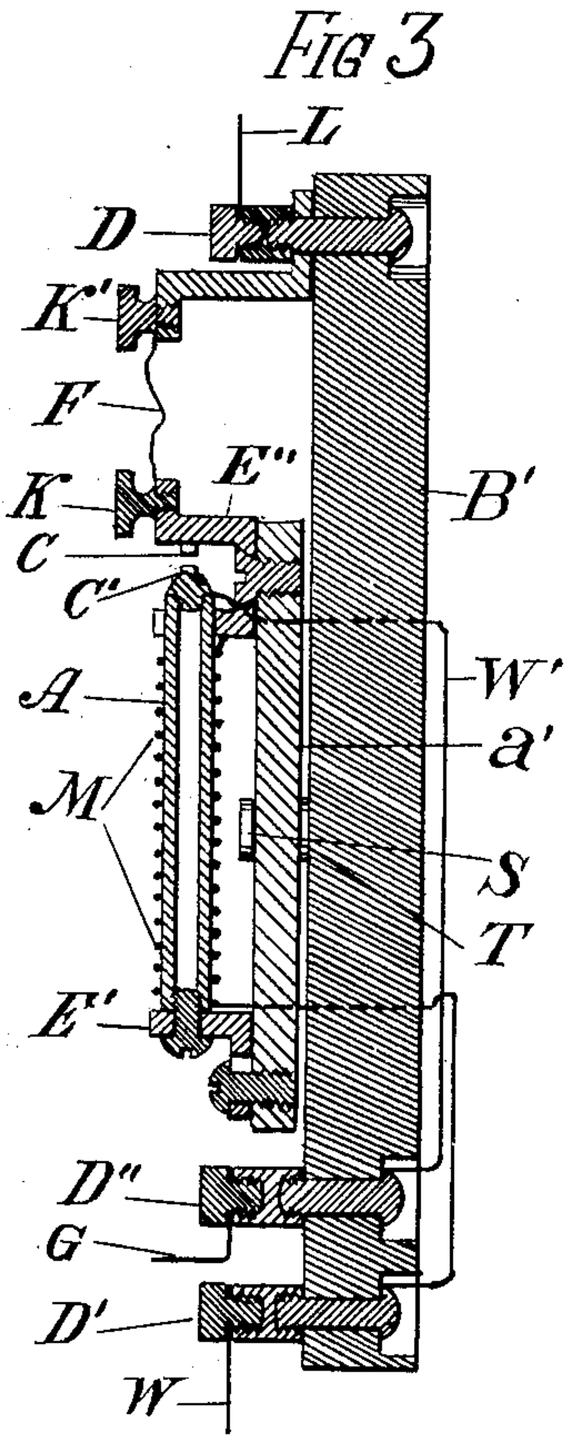

FIG 3

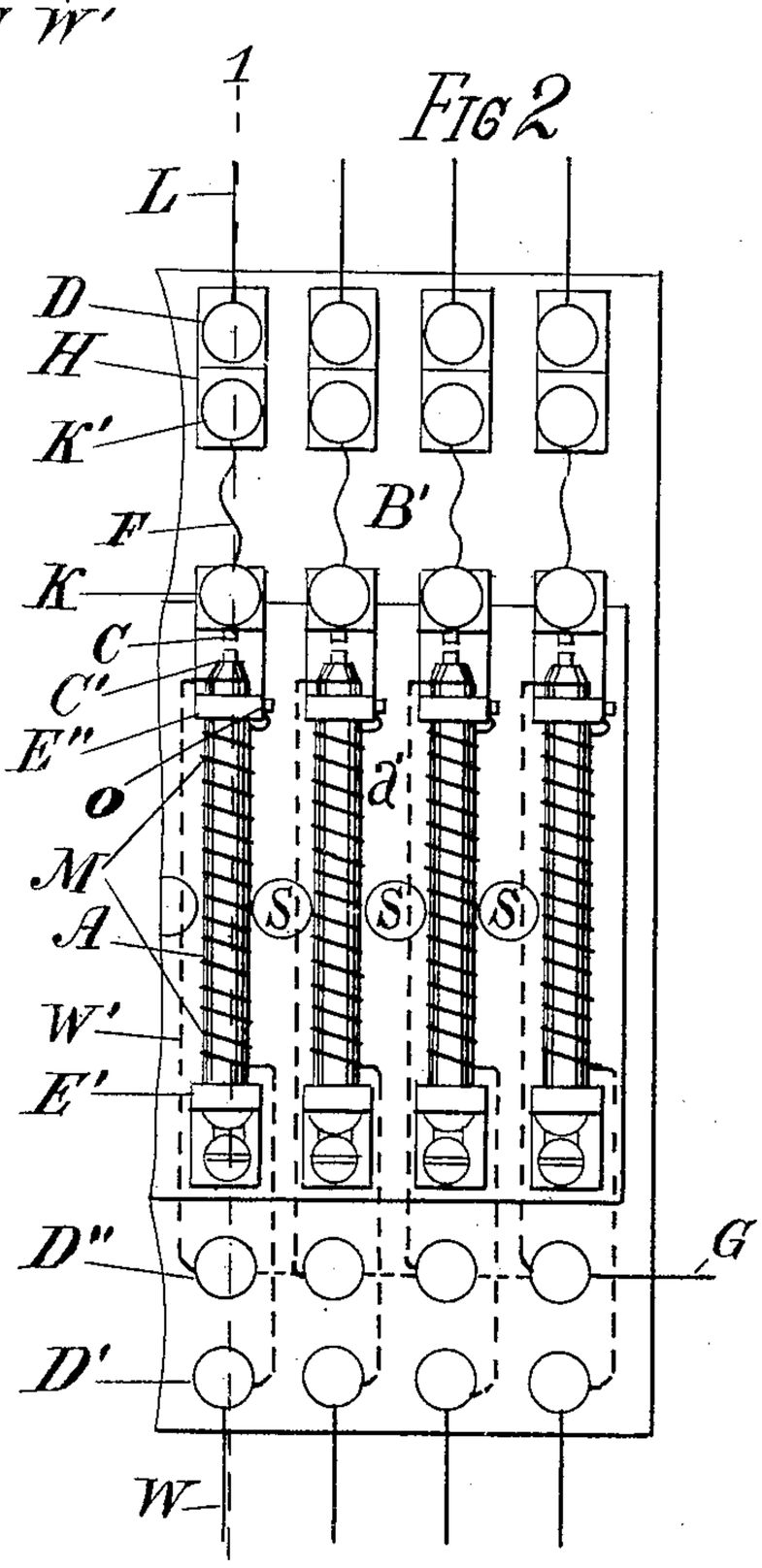

FIG 2

Witnesses

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FREDERICK C. ROBERTSON, OF TORONTO, CANADA.

CIRCUIT-BREAKER OR LINE-OPENER.

SPECIFICATION forming part of Letters Patent No. 639,688, dated December 19, 1899.

Application filed June 25, 1898. Serial No. 684,506. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK CHARLES ROBERTSON, residing at Toronto, in the county of York and Province of Ontario, Canada, have invented a new and useful Improvement in Circuit-Breakers or Line-Openers, of which the following is a specification.

My invention relates to improvements in circuit-breakers or line-openers of the fusible-wire type, adaptable to any telegraph, telephone, or other low-current electric circuit, and has for its object to cause the fusible wire to melt with certainty and open the circuit between line-wire and instrument whenever the current in said circuit becomes augmented to such a dangerous degree as to cause overheating of the magnet-wire of the instruments in circuit through accidental crossing of said line-wire with another line carrying a current of high voltage, such as an electric-light or trolley line.

It is the general practice to protect the instruments on telephone and telegraph circuits against damage liable to be caused by said circuits becoming crossed with an electric-light line, trolley, or other circuit of high voltage by inserting in said telephone or telegraph circuit, between the line-wire and instruments, a section of fusible wire, which when the current in said circuit becomes abnormally increased to a dangerous degree, due to leakage thereto of current from a circuit of high voltage, will become overheated and melt, thereby opening the circuit. It frequently occurs, however, with circuits thus protected that owing to the resistance of the instruments therein the abnormal condition of the current brought about by said accidental crossing does not attain sufficient strength to cause the fusible wire to melt, but at the same time becomes sufficiently strong to dangerously overheat the magnet-winding of the said instruments.

The object of my invention is to provide a means whereby the instruments protected will be cut out of circuit within a brief period after the current in said circuit becomes abnormally increased. The effect produced by cutting said instruments out of circuit will be to allow the current through the fusible wire to attain a higher degree of strength, causing it to melt more readily. A device has been invented with a view of producing this result. In such device the cutting out of the instruments at the time the current has assumed an abnormally high degree is effected by the adoption of a relay-magnet interposed in circuit between the fusible wire and protected instrument and so adjusted that its armature will only be attracted when the current becomes abnormally increased. The local contact-points of said relay when closed complete a subsidiary circuit between fusible wire and ground. In my device there are no electromagnets, the cutting out of the instruments being effected in an entirely different manner, and it effectively operates should the incoming foreign current be either of a direct or alternating character, and to effect this result I make use of a bar or tube composed of a material capable of expanding when heated—such as vulcanite, hard rubber, or other similar composition—and having wound on its surface a wire of comparatively high specific resistance, said wire forming part of the circuit between fusible wire and instrument to be protected. The said bar or tube of expansible material being thus placed in close proximity to said resistance-wire absorbs heat therefrom, which is generated in said wire by the action of the current when abnormally increased. The effect of the heat thus absorbed from said wire will be to cause the bar or tube to expand and lengthen. Two contact-points are provided, one of which is secured to one end of said bar or tube. The other contact-point is secured to the other end of said bar or tube through the medium of a bar, tube, or plate composed of similar material and so placed as to be unaffected by the heat generated in said resistance-wire. One of said contact-points is electrically connected to the circuit at a point between the fusible wire and resistance-wire, the other contact-point being connected to a ground-wire, said contact-points being so adjusted that under the normal condition of the circuit they remain separated by an air-gap; but should the current in the circuit become augmented through leakage thereto of a foreign current of high voltage the resistance-wire becomes heated, which imparts heat to the expansible bar or tube, causing it to expand and the contact-points to come together, thus closing the

subsidiary circuit between the fusible wire and earth. The short circuit to earth thus being formed enables the current to attain a higher value, which causes the fusible wire to melt and open the circuit, after which the expanded bar or tube contracts as it cools and finally resumes its normal condition separating the contact-points.

The invention is more fully described, and more particularly pointed out in the claims.

In the drawings, Figure 1 is a side view of the device, partly shown in longitudinal section, arranged to protect a single circuit. Fig. 2 is a top view of the device as arranged to protect a number of similar circuits in which the bar *a* is substituted by the plate *a'*. Fig. 3 is a sectional view of Fig. 2 on the line 1 2.

Like letters of reference refer to like parts throughout.

In Fig. 1 two bars or tubes A and *a*, composed of a material capable of expansion when acted on by heat, such as vulcanite or hard rubber, are placed parallel and firmly yoked together at one end by the yoke-piece I by means of screws which pass through holes in the yoke-piece I into the said bars or tubes. The frame E consists of a strip of metal, bent in the form shown in the drawings, and serves as a support for the bars or tubes A and *a*, being provided with holes through which said bars may pass without binding. Said bars are passed through said holes and fixed in position in frame E by the set-screw J, which clamps securely the bar or tube *a*, near its extremity, to frame E. The frame E is rigidly secured to base B, which is made of wood, porcelain, or other suitable non-conducting material, by the screws N and N', which pass upward through said base B into threaded holes in the lower part of said frame E. The frame E is extended at one end in the form of a rectangular hook, on the inner side of which, near its extremity and in line with the axis of bar A, is soldered or otherwise fixed the platinum contact-point C. On the uppermost side of said extension of frame E is fitted a binding-screw K, by which is connected to said frame E one end of the fusible wire F. The other end of fusible wire F is connected by the binding-screw K' to the connecting-post H, which is secured to the base B, in connection with binding-post D, by a screw passing upward through base B into binding-post D. To the binding-post D is connected the line-wire L. On the free extremity of bar A and facing contact-point C is fixed the contact-point C', which consists of a platinum-tipped piece of metal screwed into the end of bar A. Said contact-point C' is connected by the wire W' to the binding-post D''. Connected to binding-post D'' is the ground-wire G. Spirally wound on the bar A is the German-silver or platinoid wire M, said wire M being connected at one end to the frame E at any convenient point O by solder or binding-screw, the remaining end of wire M being carried through base B and connected by connecting-screw to the binding-post D'. To the binding-post D' is connected the wire W, leading to the instrument to be protected.

It is preferable that A should consist of a tube with a comparatively thin wall in order to possess a large surface in proportion to its mass, thus rendering it readily responsive to the heat generated by action of the current in the wire wound on its surface.

Where it is necessary to protect a number of similar circuits, such as would be the case in a telephone-exchange, the form of the device can be modified, retaining its essential features, as heretofore described in Fig. 1, such modification consisting, substantially, in the substitution of a base-plate in place of bar or tube *a*. Figs. 2 and 3 show this modification, of which Fig. 2 is a top view, and Fig. 3 a sectional view on the line 1 2. In Figs. 2 and 3 the plate *a'*, being composed of similar material to that of bar or tube A, is secured to the base B' by the screws S S S, placed at intervals in a straight line midway of its width. Washers T, through which screws S S S pass, are placed between plate *a'* and base B' in order to raise plate *a'* slightly above base B'. One end of bar or tube A is secured to plate *a'* by means of an L-shaped piece of metal E', to which it is attached by a screw which passes through said piece E' into one end of bar A. The lower portion of supporting-piece E' is secured to plate *a'* by means of a screw which passes through an oblong hole in piece E' into plate *a'*. The purpose of the oblong hole in piece E' is to allow of its adjustment before being clamped in position. The free end of bar A is provided with a contact-point C', as heretofore described. Said bar A passes loosely through a hole in supporting-piece E''. Said supporting-piece E'', consisting substantially of a U-shaped piece of metal, is secured to the plate *a'* by a screw, soldered or otherwise secured to the inner side of supporting-piece E'', and in line with the axis of bar A and contact-point C' is the contact-point C. The support E'' is provided with binding-screw K to secure one end of fusible wire F. Wound on the bar A is the resistance-wire M, one end of which is connected to the supporting-piece E'', the other end of which is connected to the binding-post D'. Connecting the contact-point C' with the binding-post D'' is the wire W'. The connecting-post H is secured to the base B' and connected to the binding-post D by a screw which passes upward through base B' into binding-post D. Post H is provided with binding-screw K', by which is secured the other end of fusible wire F. To the binding-post D is connected the line-wire L, and to the binding-post D' is connected the wire W, leading to the instrument to be protected. Connected to binding-post D'' is the ground-wire G.

Normally the course of the circuit through the device is from the line L to binding-post D, through fuse-wire F to frame E, to con-

nection O, through resistance-wire M to binding-post D′, through wire W to protected instrument, thence to ground. Should the line-wire become crossed with a high-voltage circuit, the course of the current is the same as just described until the bar A becomes expanded by the heat generated in resistance-wire M, when contact-point C′ makes contact with contact-point C, thus establishing a ground connection between fusible wire F and resistance-wire M. The short circuit to earth thus formed reduces the resistance of the circuit between line and ground, enabling the current to attain sufficient strength to melt fusible wire F, which breaks the curcuit. The circuit thus being broken, the current ceases to flow in the wire M. No further heat is generated therein, which allows the bar A to contract and withdraw the contact-point C′ away from contact-point C.

The function of the bar *a*, Fig. 1, which is composed of similar material to that of which bar A is composed, is to effect a correction for expansion or contraction in bar A due to variation in atmospheric temperature, thus preserving a constant length of air-gap between the contact-points C and C′ so long as both bars A and *a* are subjected to an equal degree of temperature. The bar A being parallel to and yoked to bar *a* is held in position in the frame E at extremity of bar *a* by the set-screw J. Any expansion in bar A caused by variation in the temperature of the surrounding air is compensated by a similar expansion in bar *a*, acting in an opposite direction, as the expanding of bar *a* has a tendency to move bar A, with contact-point C′, away from contact-point C, whereas the expanding of bar A tends to bring contact-point C′ toward contact-point C. It is obvious, therefore, that any equal expansion in bars A and *a* will not affect the relative position of contact-points C and C′; but should the bar A alone be expanded, which would be the case should the wire M become hot due to an abnormal increase in the strength of the current circulating through it, the contact-point C′ would gradually approach and ultimately make contact with contact-point C.

Having fully described my invention, what I claim, and desire to secure by Letters Patent, is—

1. Two parallel heat-expansive bars or tubes having one each of their adjacent ends rigidly connected by a yoke-piece, one of said bars or tubes having spirally wound on its surface a section of conductor and provided at its free end with a contact-point, the other bar or tube secured (at its end distant from yoke-piece) to a standard carrying a contact-point facing contact-point carried on bar, said standard secured to a base, said contact-points being normally open and become closed when said bar on which conductor is wound is expanded in advance of other said bar by heat generated by action of current in said conductor.

2. A fusible wire in circuit with a line-wire and protected instrument, a heat-expansive bar or tube secured at one end to a base and carrying a contact-point at its free extremity, facing said contact-point a contact-point carried on a standard secured to said base, a conductor spirally wound on said bar or tube and interposed in the circuit between said fusible wire and protected instrument, one of said contact-points being electrically connected to circuit between fusible wire and conductor wound on said bar or tube, the other contact-point being connected to a ground-wire said contact-points being normally open and become closed when said bar or tube is expanded by heat generated in said conductor by action of an abnormally-increased current circulating therein.

3. A fusible wire in circuit with a line-wire and protected instrument, two parallel heat-expansive bars or tubes (preferably composed of vulcanite or hard rubber) having one each of their adjacent ends rigidly connected by a yoke-piece, one of said bars or tubes being provided at its free end with a contact-point and having spirally wound on its surface a conductor interposed in the circuit between said fusible wire and protected instrument, the other bar or tube secured (at its end distant from yoke-piece) to a standard carrying a contact-point facing said contact-point carried on bar, said standard secured to a base, one of said contact-points being electrically connected to the circuit between said fusible wire and said conductor which is wound on bar, the other contact-point being connected to a ground-wire, said contact-points normally being open and become closed when said bar or tube on which conductor is wound is expanded in advance of other said bar or tube by heat generated in said conductor by action of an abnormally-increased current circulating therein.

4. A heat-expansive bar or tube (preferably composed of vulcanite or hard rubber) carrying an electric-contact point at one of its ends and connected at its other end by a yoke-piece to a bar or tube composed of similar material and secured to a standard carrying a contact-point facing contact-point on end of said bar, a conductor spirally wound on said bar or tube which carries contact-point, said contact-points being normally open so long as both bars or tubes are subjected to equal temperatures but adapted to become closed by the expanding of bar or tube on which is wound conductor by heat generated in said conductor through action of current therein.

5. One or more similar heat-expansive bars or tubes (preferably composed of vulcanite or hard rubber) each of which being secured at one end to a common base-plate composed of similar material to that of which said bars or tubes are composed, said bars being parallel to said base and parallel to each other, the respective free ends of said bars or tubes be-

ing provided each with a contact-point said contact-points being connected to a ground-wire, one or more standards (as many as there are bars) each carrying a contact-point said contact-points respectively facing contact-points on bars, each of said bars having spirally wound on its surface a conductor one end of which being in electrical connection with its respective standard carrying contact-point the respective ends of said conductors being connected each to a protected instrument, said standards being connected respectively one end each to a fusible wire the other respective ends of fusible wires being respectively connected each to a line-wire.

6. A heat-expansive bar or tube (preferably composed of vulcanite or hard rubber) adapted to be expanded by heat generated in a conductor spirally disposed thereon, a contact-point carried on one end of said bar adapted to make contact with a second contact-point when said bar or tube is in said manner expanded, means for maintaining contact-points in normal relative position when said bar is expanded or contracted through variation in temperature of surrounding air by connecting said bar or tube at its end distant from its contact-point with a bar tube or plate (composed of similar material as that of which said bar or tube is composed) to the support carrying the second contact-point.

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Witnesses:
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