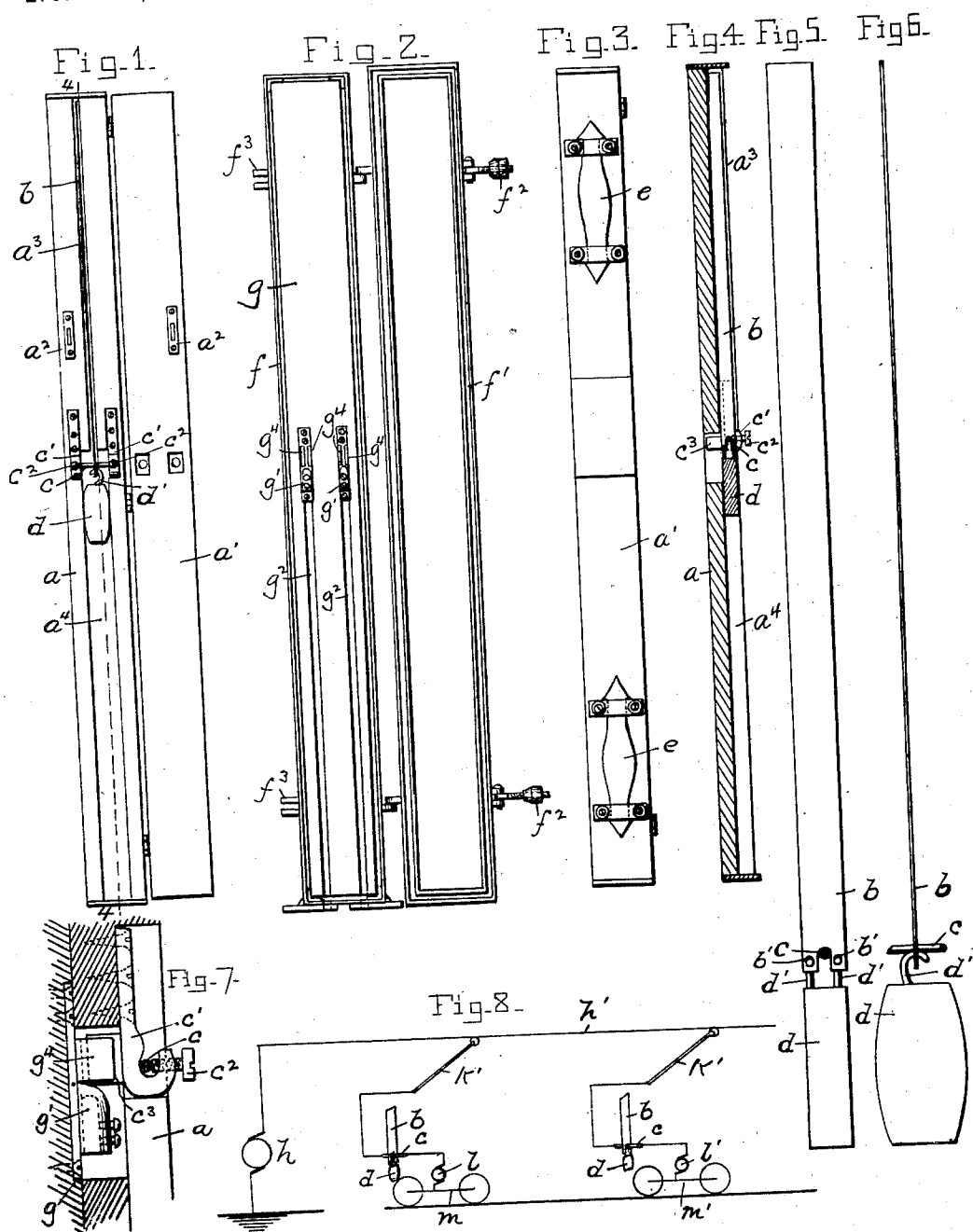


(No Model.)

J. R. CRAVATH.
EXCESSIVE CURRENT RECORDER.

No. 586,723.

Patented July 20, 1897.



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EXCESSIVE-CURRENT RECORDER.

SPECIFICATION forming part of Letters Patent No. 586,723, dated July 20, 1897.

Application filed February 5, 1897. Serial No. 622,105. (No model.)

To all whom it may concern:

Be it known that I, JAMES R. CRAVATH, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Excessive-Current Recorders, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to an excessive-current recorder for affording a comparative record of the excessive currents employed in the operation of several electrical devices, and is particularly applicable to electric-railway systems, where it is desirable to obtain a comparative record of the excessive currents used by the several motormen in the running of their cars or trains, whereby a comparison of the efficiency of the motormen may be obtained.

It is well known among those having the management of electric-railway systems in charge that some motormen are very wasteful and careless in the use of electric current in running their cars, thereby causing undue strain on the power plant and car equipments and a waste of power. It is therefore desirable to have some recording device to enable a manager to determine which of the motormen have been careless in using excessive current.

It is the object of the present invention to provide a recording device which may be used for this purpose and which, while effective in operation, may be constructed and operated at small cost and with little liability for error in common daily use.

In the preferred form of my invention I provide in connection with each of the motors or other devices the excessive currents through which are to be compared a conductor or wire connected in series with the electrical device and adapted to be heated by the passage of the current therethrough. Resting upon the heating-conductor and extending transversely thereto is a thin strip or sheet of alloy or other fusible metal adapted to melt at a comparatively low temperature. Upon the passage of a current in excess of the predetermined maximum the fusible metal is melted by contact with the heating-

conductor and descends, preferably, by the assistance of a weight depending from the lower end thereof, the heating-conductor thus melting its way through the sheet of metal in a longitudinal direction. The distance through which the heating-conductor has melted away the metal affords a comparative measure of the excessive currents which have traversed the circuit when compared with the extent of melting of fusible strips employed upon other similar circuits having heating-conductors of the same dimensions and a fusible metal of the same melting-point and thickness.

The fusible strip, being made of metal which is a conductor of electricity, must be made thin, so that it will not afford a bypath to shunt any considerable portion of the current past the heating-conductor when the current to be recorded is passed directly therethrough. As the metal is also a conductor of heat, the making of the strip of fusible metal thin is further necessitated in order that the metallic strip may not conduct away any considerable portion of the heat of the heating-conductor. In the employment of the fusible metal I have for the above reasons found it essential to make the metal of small thickness where it rests in contact with the heating-conductor.

It is further essential to make the thickness of the metal uniform throughout its entire length and to use metal strips of the same thickness and melting temperature upon circuits which are to be compared, and to subject them to the action of heating-conductors of exactly the same dimensions.

In practice I have thus formed the metal into a thin flat sheet or strip adapted to rest by the end upon the heating-conductor. It is apparent, however, that the thin sheet, instead of being made flat, may assume other forms, provided it has a thin edge or edges resting transversely in heat-conductive contact with the heating-conductor.

The electric current may be passed directly through the heating-conductor or the heat generated by the electrical conductor may be indirectly conveyed to the heating-conductor. The term "heating-conductor" as employed herein refers to the conductor against which

the sheet of fusible metal rests and which conveys the heat to the fusible metal to melt the same, whether it be a part of the electrical circuit or not. Throughout this specification I have employed the term, "fusible metal" as comprehending alloys—that is, mixtures of several metals—also, single metals having a sufficiently low fusing temperature. In all cases the fusing temperature of the heating-conductor should be much above that of the fusible sheet, in order that there may be no danger of melting the heating-conductor by the heat developed.

The fusing temperature of the fusible metal is so adjusted that the fusible metal does not melt to any appreciable extent until the heating-conductor has been subjected to a current above the predetermined value.

As a practical illustration of the application of my invention to electric-railway motors it may be supposed that sixty amperes is the maximum current a motorman should ordinarily use in the operation of a certain type of car. The electrical conductors are then made of such a size that they will begin to melt the fusible strips when sixty amperes flow therethrough. Any currents in excess of sixty amperes will be recorded by the descent of the fusible-metal strips, the extent of the descent of these strips being in a measure proportional to the excessive currents which have passed through the several electrical devices. I am aware that the descent of the fusible metal will not afford an accurate record of the ampere hours of current passing through any circuit over and above sixty amperes, because the movement of the fusible metal will be theoretically proportional to the square of the excessive current flowing. This fact, however, is of practical value in the use of the recorders, since it is desirable that the record of the greatly excessive currents should be magnified and accentuated, because it is these greatly excessive currents that wreck the car equipment and make necessary the running of machinery of greater capacity at the power-station and a correspondingly greater investment in power plant and feeders.

The recorders of the present invention are valuable as affording a comparative measure of the efficiency of the various motormen and not as an absolute record in electrical units. The distance through which the heating-conductor has melted, divided by the number of miles the car has run, gives the excessive current per car-mile, which may be used as the unit of comparison.

I will describe my invention in connection with the accompanying drawings, in which—

Figure 1 is a view of the recorder-box containing the heating-conductor and the strip of fusible metal, the cover of the box being open. Fig. 2 is a view of the metallic casing for the recorder-box. Fig. 3 is a view of the recorder-box closed. Fig. 4 is a sectional view of line 4 4, Fig. 1. Figs. 5 and 6 are

face and edge views of the strip of fusible metal and weight. Fig. 7 is a detail view of the contacts on the recorder-box and on the bottom board of the casing. Fig. 8 is a diagram illustrating the use of the recorders with the motors of an electric-railway system.

Like letters refer to like parts in the several figures.

The recorder-box comprises a base-board a , to which is hinged a door a' , which may be secured in a closed position by a lock $a^2 a^2$, controlled by a key. A longitudinal slot a^3 is provided in the upper end of the base, in which rests edgewise the strip or sheet b of fusible metal, which rests at the lower end in contact with the heating-conductor c , held at the ends in binding-posts $c' c'$, secured to the base a and provided with binding-screws $c^2 c^2$. The binding-posts are arranged so that the heating-conductor may be removed by lifting the same laterally out of the channels provided in the binding-posts. Below the heating-conductor a channel a^4 is provided in the base-board a , in which moves the weight d , which is adapted to be attached to the lower end of the strip of fusible metal. Upon the upper end of the weight are provided hooks $d' d'$, which fit in holes $b' b'$, provided in the lower end of the strip of fusible metal. In order that the weight may be rocked slightly laterally to permit the passage of the ends of the hooks $d' d'$ through the holes $b' b'$, the sides of the weight are made rounded. Upon the face of the door or cover a' are provided handles or straps $e e$ to facilitate the handling of the recorder-box.

When in position, the recorder-box rests within the metallic casing f , which is secured in position at some convenient location on the car, preferably at the side of the controller-box. A hinged door f' is provided for the casing, which may be secured in a closed position by the nuts $f^2 f^2$, screwing against the lugs $f^3 f^3$. In the bottom of the casing is provided a base-board g , of wood or other insulating material, upon which are mounted contact-posts $g' g'$, to which the circuit-wires are connected, the circuit-wires passing downward in the grooves or channels $g^2 g^2$ and to the exterior of the casing through holes $g^3 g^3$, provided in the lower end thereof. The contact-posts $g' g'$ are provided with blades $g^4 g^4$, between which pass the blades $c^3 c^3$, provided upon the rear of the binding-posts $c' c'$, the blades $c^3 c^3$ being extended through openings provided in the base-board a of the recorder-box. When the recorder-box is placed in the casing, the blades $c^3 c^3$ of the binding-posts on the recorder-box engage, respectively, the blades of the contact-posts $g' g'$, carried in the casing, thus closing the circuit through the heating-conductor, and by the removal of the recorder-box from the casing the circuit is opened.

The recorder-boxes may be under the control of an employee whose duty it is to prepare the boxes by properly placing the strips

of fusible metal therein, and these boxes already locked may be handed each day to the several motormen, who place them in the casings on their respective cars. As the motor-circuit is open until the recorder-box is placed in position the motorman must place his recorder-box in position before he can start his car. Any attempt to operate the car in the absence of the recorder-box by short-circuiting the contact-posts would be readily detected by the inspector. The casings and recorder-boxes are all made alike, so that the recorder-boxes are interchangeable and can be placed in any of the casings. At the end of the day the recorder-boxes may be returned by the motormen. In this manner the motormen have no control over the recorders for the purpose of tampering with the operation thereof or the records made thereby, while the labor of keeping the records is reduced to a minimum.

The recorder-box is constructed to snugly fit the casing, and the door of the casing cannot be closed until the recorder-box is thrust completely into position. The bottom of the recorder-box fits tightly against the base-board in the back of the casing, so that when the recorder-box is in position and the casing-door closed there is not room for the placing of any body, as a wire or conductor, between the back of the recorder-box and the back of the casing, and if such a conductor be placed in position for the purpose of short-circuiting the contact-posts on the casing the recorder-box cannot be placed in position and the door of the casing closed, and such attempt to short-circuit the recorder-box would be frustrated.

In Fig. 8 I have illustrated in diagram the application of the excessive-current recorders to the several cars of an electric-railway system. The generator *h* supplies current to the trolley-wire *h'*, with which the trolley-arms *k' k'* make contact and convey current through the motors *l l'*, mounted on the cars *m m'*. In series with each of the motors is included the heating-conductor *c*, upon which rests the strip *b* of fusible metal. The extent of melting of the several strips of fusible metal divided by the number of miles the respective cars have run affords a comparative indication of the relative efficiency with which the several cars have been operated.

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

1. The combination with a thin sheet of fusible metal, of a heating-conductor extending transversely thereto and heated by an electric current to cause said conductor to melt its way through said sheet of fusible metal, substantially as described.

2. The combination with a recorder-box, of a heating-conductor and a body of fusible material contained therein, a casing for the reception of said recorder-box, contacts provided upon said casing and connected with the working circuit, contacts upon said recorder-box connected with the heating-conductor and arranged to engage the contacts in the casing when the recorder-box is placed therein to complete the circuit through the heating-conductor and to break contact therewith upon the removal of the recorder-box to open the working circuit, substantially as described.

3. The combination with a casing provided with a cover or door and carrying contacts connected with the working circuit, of a recorder-box carrying the heating-conductor and the fusible material, and provided with contacts for engaging the contacts of said casing, said recorder-box being constructed to snugly fit said casing and to rest against the bottom thereof and preventing the closing of the door of the casing until the recorder-box is placed completely in position, substantially as described.

4. The combination with the recorder-box provided with a pair of contact-terminals, of a transverse electrical conductor within said box connected in circuit between said terminals, a narrow slot above said conductor and a thin sheet of fusible metal therein and resting upon said conductor, the plane of said slot being perpendicular to said conductor, a channel beneath said conductor and a weight moving therein, substantially as described.

In witness whereof I have hereunto subscribed my name in the presence of two witnesses.

JAMES R. CRAVATH.

Witnesses:

W. CLYDE JONES,
M. R. ROCHFORD.