W. NOBLE.

ELECTRICAL SIGNALING SYSTEM.

APPLICATION FILED JULY 16, 1909.

1,048,200. Patented Dec. 24, 1912.

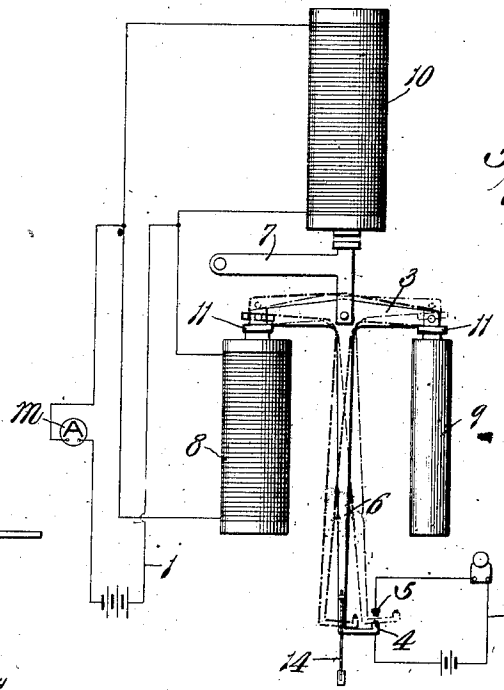

Fig. 1.

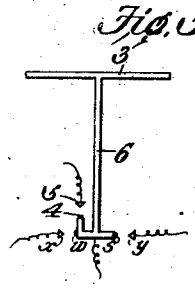

Fig. 5.

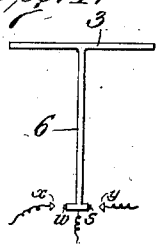

Fig. 4.

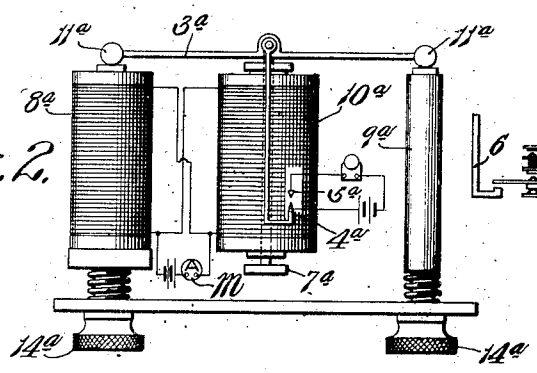

Fig. 2.

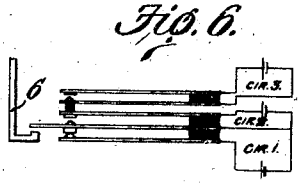

Fig. 6.

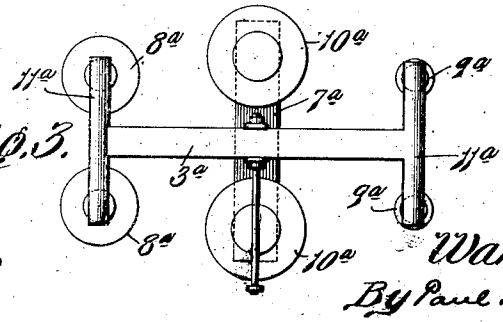

Fig. 3.

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ELECTRICAL SIGNALING SYSTEM.

1,048,200. Specification of Letters Patent. Patented Dec. 24, 1912.

Application filed July 16, 1909. Serial No. 507,938.

To all whom it may concern:

Be it known that I, WARREN NOBLE, a British subject, residing at St. Louis, Missouri, have invented a certain new and useful Improvement in Electrical Signaling Systems, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to electrical signaling systems.

The main object of my invention is to provide a system which is so designed that a circuit subsidiary to a main circuit will be opened, closed or diverted only when a certain current impulse passes in the main circuit and so that a greater or lesser current in the main circuit outside desired limits will have no effect upon the subsidiary circuits.

The purposes to which a system of this character may be applied are so numerous that I will not attempt to enumerate all of them but I wish it to be distinctly understood that it is particularly useful in selective telegraph work, railroad despatching apparatus, selective wireless telegraphy, locating fire or burglar-alarms—in fact, for all selective signaling purposes in which more than a single metallic or grounded line is undesirable. It also has features adapting it peculiarly to electrically-controlled coin-collecting apparatus used at telephone pay stations, to voltage regulators, and to many kinds of electrical apparatus now functioning by more complex means.

Moreover, my invention is particularly adapted to a wide variety of purposes since it is operative upon either direct or alternating current, and since unless so designed it is unaffected by a change in current direction.

Briefly described, my invention consists in a system comprising a relay provided with a contact operating member that causes the circuit controlled by the relay to be closed, opened or diverted only when a certain amount of current passes in the main or actuating circuit in which the relay is arranged. When a current passes in this main or actuating circuit in excess of, or less than, the known or certain amount the relay is adjusted or wound to operate upon, the contact-operating member will fail to cause the circuit or circuits controlled by the relay to be opened, closed or diverted. Various means can be employed for controlling or actuating the contact-operating member, such, for example, as a device for moving said member in one direction or in a certain path, and independent means for moving said member at an angle to the path in which the said device moves it, said device and means coöperating with each other to cause the contact which said member controls to engage or fail to engage a coöperating contact. The contact-operating member preferably consists of a beam or pivoted device carrying armatures, lying in the respective fields of an electro-magnet and a permanent magnet so arranged as to affect the balance of the beam carrying the armatures, and a separate electro-magnet for bodily moving or shifting said beam and the attached armatures to cause the contact or contacts which said beam controls to function with regard to other contacts. The balancing electro-magnet; namely, that which coöperates with the permanent magnet in affecting the balance of the beam, may be connected either in series or multiple with the electro-magnet that bodily shifts the beam, and both are connected with the main circuit so that they will be energized when current flows over the main circuit, the shifting electro-magnet being more powerful than the permanent magnet so as to overcome the force which the permanent magnet and the balancing electro-magnet exert jointly on the beam when their respective exerted forces balance. The current which flows over the main circuit bodily shifts the beam but unless the intensity of the magnetic field created at the balancing magnet pole is such as to attract its armature with a force exactly sufficient to balance the attraction of the permanent magnet upon its armature, the beam to which the armatures are attached will move in such a path that the contact or contacts it controls will fail to function with the opposed contact or contacts. If, however, the forces upon the respective armatures are such as to balance the beam it will remain in equilibrium as the shifting magnet bodily moves it, and the stationary contact or contacts being suitably arranged, the circuit or circuits controlled by the relay will be closed, opened or di-

verted as the case may be. If, however, the forces exerted by the magnetic fields of the permanent and balancing magnets, respectively, are such that unequal turning moments about the pivot of the beam are set up the beam will fulcrum about the pole creating the greater moment, with the result that the contact or contact-operating mechanism will be caused to fail to function with the stationary or coöperating contact or contacts of the controlled circuit or circuits.

Figure 1 of the drawings is a diagrammatic view illustrating one form of my invention arranged to control a subsidiary circuit; Fig. 2 is an elevational view of a relay slightly different in construction from that shown in Fig. 1, using bi-polar magnets; Fig. 3 is a top plan view of the relay shown in Fig. 2; Fig. 4 shows a diagram of the relay beam arranged to close two contacts when operated by current impulses above or below predetermined margins and to remain neutral between those margins; Fig. 5 shows a diagram of the relay beam arranged to close three contacts when operated by current impulses above, below or between predetermined margins; and Fig. 6 shows a diagram of the relay arranged to control a series of contacts upon a current impulse between predetermined margins.

Referring to Fig. 1, 1 designates a main circuit, and 2 a bell circuit or local circuit. A non-magnetic beam or centrally pivoted device 3 carries armatures 11 lying in the fields of electro-magnet 8 and permanent magnet 9, respectively. Beam 3 controls the movable contact 4 of the local circuit, and stationary contact 5 of said local circuit is arranged in such a position as to be engaged by movable contact 4 only when the beam 3 is bodily shifted while in balance. I have herein shown movable contact 4 as being carried by a leg 6 that depends from beam 3 but it will be obvious that the movable contact could be carried by a member separate and distinct from the beam and having no direct connection thereto or to the arm 6 on the beam. The beam 3 is preferably fulcrumed on or pivoted to a movable member herein shown as lever 7.

The balancing electro-magnet 8 is shown connected in multiple with an electro-magnet 10 which I will hereinafter term the shifting magnet, both being tapped into the main circuit 1 so that they will be energized simultaneously by a current flowing in the main circuit. The support 7 carrying the beam 3 is provided with an armature coöperating with the shifting magnet 10.

Whenever a current passes over the main circuit the support 7 will be moved upwardly and the beam 3 will swing in one direction or the other if the current flowing in the balancing magnet 8 is not such as to produce a magnetic field which will so act upon its armature as to balance the force exerted by the permanent magnet 9 upon its armature. The effect of either too strong or too weak a current impulse will be to cause the beam 3 to fulcrum about the pole having the advantage, thus causing the movable contact 4 to swing to one side or the other and so cause it to miss the stationary contact 5 of the local circuit in moving toward it. If, however, the forces acting on the armatures attached to the beam 3 are such as to maintain its equilibrium as the support 7 is raised by the shifting magnet 10 the movable contact 4 will be brought into contact with stationary contact 5 and the local circuit closed. It will, of course, be understood that with a telephone installation employing relays of this character each subscriber's station would be sensitive to a different current impulse and that the central exchange would be provided with means for grading the current sent over the line so as to call different stations. Such means might be a variable resistance and millimeter M. In such case the operator would first send out a maximum or minimum impulse which would have no effect upon the relay controlled circuits, then adjust the resistance until the desired reading of the millimeter for the particular station is obtained; that is, until the current strength is the same as that at which the subscriber's relay is known to be sensitive, and then operate the ringing key, the function of which would be to first break and then remake the main circuit.

If there be, say, five stations on a line and it be desired to ring No. 3, the stations being sensitive to ascending amounts of current, the relays would arrange themselves diversely on either side of No. 3. Thus, Nos. 1 and 2 would lie with their beams fulcrumed about the balancing magnets, Nos. 4 and 5 with their beams fulcrumed about the permanent magnets. Thus, though the function of the trial of balance would be performed at all the stations, only the calling circuit at No. 3 would be closed.

The point of difference between the relay herein shown and previous constructions lies in its quality of operating only upon a known current impulse within margins that may be determined by constructional features or adjustment.

Marginal relays are in common use which are inoperative with a current below a certain amount but differ from the relay herein shown in that any current above their critical operation current will also cause them to operate.

In order that similar windings may be used throughout a system employing relays of the type herein shown it is desirable that adjustment be provided for the permanent magnet so that the force exerted upon its

armature may be varied by causing the magnet to approach or recede from its armature. By so doing the intensity of field necessary on the part of the balancing magnet to maintain the beam in equilibrium may become greater or less capable of creation only by a greater or less amount of current in the winding of the balancing magnets.

For practical work it is desirable that the relay shall work with a slightly varying amount of current but not with currents beyond the desired variations, margins or limits. This variation may be compensated for by making the dependent portion of the beam more or less ponderous or by an arrangement of springs. However, by increasing the distances of the centers of gravity of the armatures from the axis of the beam any desired sensitiveness may be obtained, such sensitiveness being dependent only upon the effort necessary to disturb the beam sufficiently to cause the movable contact or contacts it controls to miss the stationary contact or contacts.

In Fig. 1 a margin-regulating spring is shown at 14. It will be readily seen that the beam or corresponding device may be arranged vertically or horizontally and that either single pole or bi-polar magnets may be used.

Figs. 2 and 3 show a bi-polar arrangement for controlling the beam. In this construction a bi-polar electro-magnet 8^a is arranged on one side of the fulcrum of the beam 3^a, and a bi-polar permanent magnet 9^a is arranged on the opposite side of said fulcrum for controlling the equipoise of the beam, and a bi-polar electro-magnet 10^a is provided for bodily shifting the beam so as to carry the movable contact 4^a into and out of engagement with the stationary contact 5^a of the local circuit. The apparatus shown in Fig. 2 is also provided with devices 14^a for adjusting the magnets 8^a and 9^a relatively to the armatures of the beam but it will, of course, be obvious that various other means could be employed for accomplishing the same result.

The principle of operation of the relay shown in Fig. 2 is exactly the same as that shown in Fig. 1 for when the force exerted by the field of the balancing magnet 8^a on its armature is less than that of the permanent magnet 9^a the beam 3^a will fulcrum on the poles of the permanent magnet and thus cause the movable contact 4^a to swing to one side of the stationary contact 5^a whenever the support 7^a which carries said beam is lifted by the shifting magnet 10^a. When the force exerted by the field of the balancing magnet 8^a on its armature is stronger than that exerted by the permanent magnet on its armature the beam 3^a will fulcrum on the pole of the balancing magnet 8^a and the beam will swing to the opposite side as the support is lifted. If the forces are such that the beam remains in equilibrium as it is lifted the movable contact 4^a will engage the stationary contact 5^a of the controlled circuit.

It will be obvious also that if desired my system may be utilized to close more than one subsidiary circuit. For example, a series of contacts might be mounted above the stationary contact and the lifting of the beam caused to transmit a closing impulse to them in sequence, or a greater or less current than the critical operating current the relay is sensitive to may be caused to operate circuits as the beam rocks to one side or the other.

In the construction illustrated in Fig. 4, x and y designate stationary contacts which are adapted to be closed by contacts w and s on the dependent portion 6 of the beam 3 as the beam is caused to rock from one side to the other. In the construction illustrated in Fig. 5, w, s and 4 represent contacts operated by the beam, and x, y and 5 are stationary contacts. Contacts w and x are brought together beyond one current margin; contacts s and y are brought together beyond the other current margin, and 4 and 5 are brought together by a current impulse between the margins.

In the construction illustrated in Fig. 6 circuit 1 is broken and circuits 2 and 3 are closed when the beam lifts in equilibrium; *i. e.*, when the relay is operated by a current impulse between its set margins, current impulses above or below the determined impulse leaving circuits 1, 2 and 3 unaffected.

While I have herein illustrated several ways of controlling the subsidiary circuit I wish it to be clearly understood that it is immaterial so far as my broad idea is concerned what particular means is used for controlling the subsidiary circuit so long as said means is operated only by a known current impulse in the main circuit.

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

1. In an electrical signaling system, a main circuit, a controlled circuit, and means for opening, closing or diverting said controlled circuit when a certain amount of current passes over the main circuit, said means being so designed that the controlled circuit will remain without change, when a current passes in the main circuit greater or less than said certain amount.

2. In an electrical signaling system, a circuit or circuits, a member for controlling said circuit or circuits, an electrically-operated device for causing said member to move in one direction, and electrically-operated means for causing said member to control the circuit or circuits when a current of certain magnitude actuates said means and to

fail to control said circuit or circuits when a current of different magnitude actuates said means.

3. In an electrical signaling system, a contact-controlling device, and means for causing said contact-controlling device to close, open or divert subsidiary circuits according to the magnitude of the current passed through said means, and so as to close, open or divert a circuit or circuits when a current impulse less than a predetermined minimum current passes, and to close, open or divert another circuit or circuits when a current impulse of greater magnitude than a predetermined maximum passes, said contact-controlling device remaining neutral with regard to said circuits when a current impulse not greater or less than the set maximum or minimum is passed.

In testimony whereof I hereunto affix my signature in the presence of two witnesses, this thirteenth day of July 1909.

WARREN NOBLE.

Witnesses:
WELLS L. CHURCH,
GEORGE BAKEWELL.