Dec. 8, 1931. S. B. WILLIAMS 1,835,737

ELECTRICAL RECORDER

Filed Jan. 29, 1931

FIG. 1

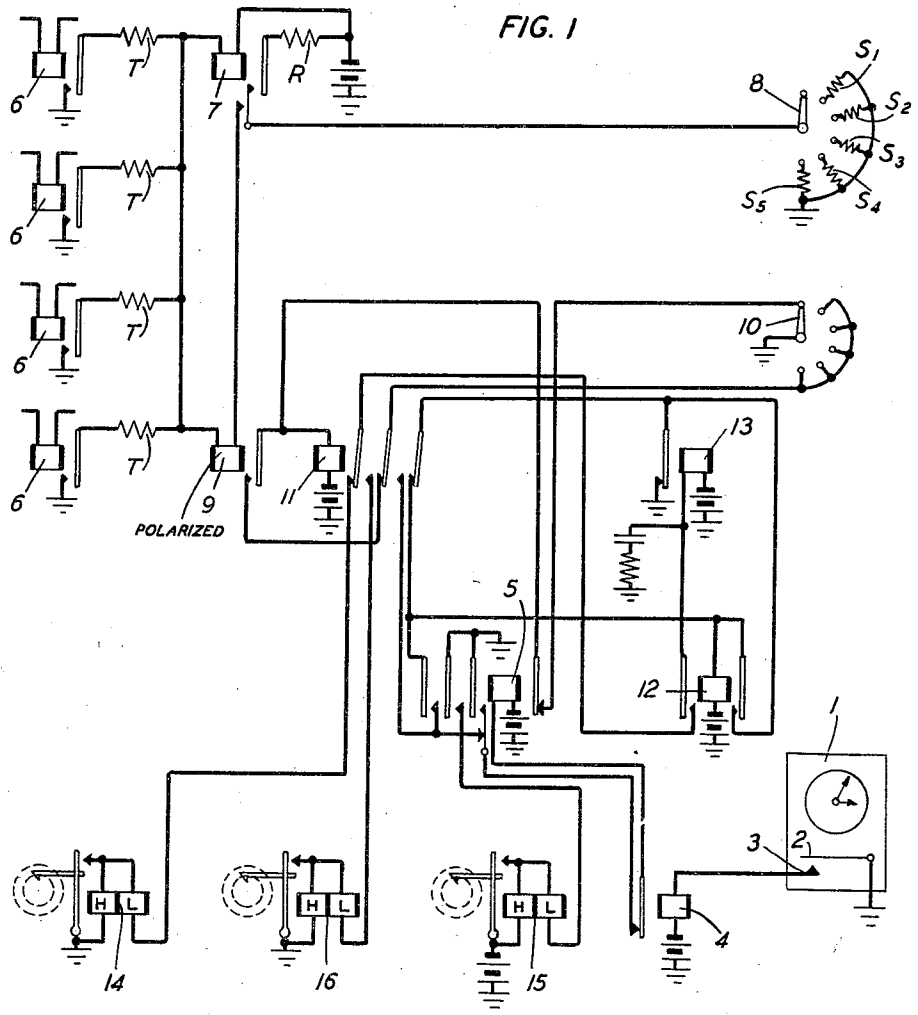
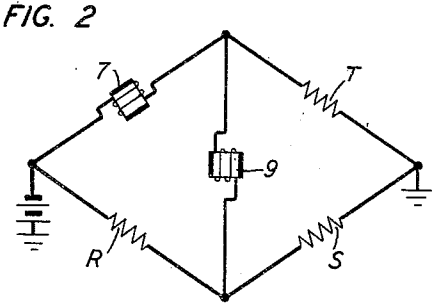


FIG. 2



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Patented Dec. 8, 1931 1,835,737

UNITED STATES PATENT OFFICE

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ELECTRICAL RECORDER

Application filed January 29, 1931. Serial No. 512,034.

This invention relates to electrical counting systems and is particularly adapted for use in a telephone system.

In general, the invention may be described as an integrating timing circuit, since its object is to produce a composite and single record of the number of simultaneous occurrences of a certain event counted at a particular time, the count being repeated at frequent and regular intervals. In the embodiment of the invention disclosed the event is the use of a telephone trunk circuit and is manifested and illustrated by the closing of a contact point. By counting the number of such contacts simultaneously closed at a given time by repeating this operation at frequent and regular intervals, a record of the integrated holding time of a group of trunks may be obtained.

A feature of the invention is a plurality of circuits each having a fixed resistance and a contact point and all terminating in a common connection to form one arm of a Wheatstone bridge which is balanced automatically by the movement of a step-by-step switch and which in turn controls a counting mechanism.

In the drawings:

Fig. 1 is a circuit diagram of one embodiment of the present invention; and

Fig. 2 is a schematic diagram showing how certain elements of the system shown in Fig. 1 constitute a Wheatstone bridge arrangement.

In the operation of this electrical recorder a clock 1 controls a pair of contacts 2 and 3 periodically. Therefore, periodically the relay 4 will be energized for a short interval of time. Upon the energization of relay 4, relay 5 will be released from its operated condition in which it is left each time the recorder operates as will be understood from the following description.

In the present embodiment of this invention it is desired to count the number of trunk circuits which are busy at any particular time and to do this periodically. Each such circuit is represented by a relay 6. When such circuit is busy the relay 6 will be energized and ground will be connected through its front contact and armature through a resistance T to the winding of relay 7. When one or more of relays 6 are energized ground connected through the resistances T in parallel and thence through the winding of relay 7 to battery causes the energization of this relay. Relay 7 in responding connects battery through resistance R to switch arm 8 and in parallel therewith through the winding of polarized relay 9 to the junction between resistances T and the winding of relay 7.

A connection is now established from switch arm 10, back contact and right hand armature of relay 5 (assuming that relay 5 has been returned to normal through the action of clock 1) to the winding of relay 11. Relay 11 becomes energized and closes a circuit from battery, the winding of relay 12, the front contact and outer right hand armature of relay 11, armature and back contact of stepping magnet 13 to ground. Relay 12 becomes energized in this circuit and through its right hand armature establishes a by-path from its winding to the armature of stepping magnet 13 independent of the right hand armature of relay 11.

Through its left hand armature, relay 12 establishes a circuit from battery, winding of stepping magnet 13, left hand armature and front contacts of relay 12, innermost right hand armature and front contact of relay 11 through the two windings of register 14 to ground. The register has two windings marked H and L to designate high and low resistances. The resistance of this circuit is too great to allow the energization of stepping magnet 13, but it does cause the energization of register 14. Upon the completion of its step, register 14 short-circuits its high resistance winding and thus reducing the resistance in the circuit just described, causes the energization of stepping magnet 13. When the stepping magnet 13 becomes energized it opens the circuit for relay 12 and this relay returns to normal. The circuit of stepping magnet 13 is now broken and it in turn returns to normal thereby reestablishing the original energizing circuit for relay 12.

Upon the deenergization of stepping magnet 13, the switch arms 8 and 10 are moved

to their first active contacts whereupon the original energizing circuit for relay 11 is opened and a circuit established from switch arm 10 through the contact on which it now rests, the middle right hand armature and front contact of relay 11, the front contact and armature of relay 9, winding of relay 11 to battery so that relay 11 is maintained energized under the control of relay 9. Switch arm 8 now connects resistance S_1 in circuit so that if a corresponding number of relays 6 are energized the Wheatstone bridge will be balanced and polarized relay 9 will be deenergized. If a balance is not achieved at this time then stepping magnet 13 becomes energized again and the switch arm 8 is moved until a proper resistance to balance the number of busy circuits has been found. When the Wheatstone bridge is balanced then relay 9 becomes deenergized, and consequently relay 11 is returned to normal. At this time a circuit is established from switch arm 10 through the contact on which it rests, the middle right hand armature and back contact of relay 11, the normal contact of the inner left hand armature of relay 5, back contact and armature of relay 4, winding of relay 5 to battery. Relay 5 now locks in a circuit from ground, inner left hand armature and front contact of relay 5, back contact and armature of relay 4 to the winding of relay 5.

Through its middle left hand armature, relay 5 causes the actuation of register 15. This register counts the number of times relay 5 operates and thereby checks the operation of the clock 1.

Through its outer left hand armature relay 5 establishes a circuit from the winding of relay 12 and thence through the back contact and middle right hand armature of relay 11 to ground at switch arm 10. Stepping magnet 13 now cooperates with a register 16 and the switch arms 8 and 10 are moved forward to their normal position at which time ground is removed from the middle right hand armature of relay 11. Relay 5, however, is maintained in its operated position until the clock 1 closes contacts 2 and 3 momentarily to cause the momentary operation of relay 4.

Through the operation just described, register 14 counts the number of steps which it takes the switch arm 8 to move in order to check the number of circuits represented by the relays 6 which are operated. The register 16 counts the number of steps which it takes the switch arm 8 to move to return to normal after a balance of the Wheatstone bridge has been achieved. The sum of the readings of the message registers 14 and 16 will therefore be the total number of steps which it takes the switch arm 8 to move through a complete cycle of operation. Only one message register such as 14 is actually needed but the second one 16 may be used as a check.

Over a long period of time the reading of message register 14 divided by the reading of message register 15 will give the average number of circuits busy. Also over a long period of time the reading of message register 14 will give a substantially correct indication of the total time over which the circuits represented by the relay 6 are busy when such reading is properly interpreted in view of the periodicity of the action of relay 4 controlled by the clock 1.

What is claimed is:

1. In an electrical counting system, a plurality of circuits terminating in a common connection, a contact point in each of said circuits, said contact points being in number variably closed at different times and means for counting and recording the number of said circuits closed at any time.

2. In an electrical counting system, a plurality of circuits terminating in a common connection, a fixed resistance and a contact point in each of said circuits, said contact points being in number variably closed at different times, and means including an automatically adjustable Wheatstone bridge for counting and recording the number of said circuits closed at any time.

3. In an electrical counting system, a plurality of circuits terminating in a common connection, a contact point in each of said circuits, said contact points being in number variably closed at different times, means for counting and recording the number of said circuits closed at any one time and means for periodically operating said counting and recording means.

4. In an electrical counting system, a plurality of circuits terminating in a common connection, a contact point in each of said circuits, a fixed and equal resistance in each of said circuits, said contact points being in number variably closed at different times, a variable resistance and a step-by-step switch for controlling said variable resistance, and means including said plurality of circuits, said variable resistance and said step-by-step switch comprising a Wheatstone bridge for automatically counting and recording the number of said circuits closed at any time.

5. In an electrical counting system, a plurality of circuits terminating in a common connection, a contact point in each of said circuits, a fixed resistance in each of said circuits, said contact points being in number variably closed at different times, a variable resistance and a step-by-step switch for controlling said variable resistance, means including said plurality of circuits and said variable resistance comprising a Wheatstone bridge for automatically setting said step-by-step switch in a position corresponding to the number of said circuits closed at any

time, and means controlled by said step-by-step switch for counting and recording the said number of said circuits closed at any time.

In witness whereof, I hereunto subscribe my name, this 28th day of January, 1931.

SAMUEL B. WILLIAMS.