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APPARATUS FOR ALTERNATING THE POLARITY OF CURRENT IN ELECTRIC CIRCUITS.

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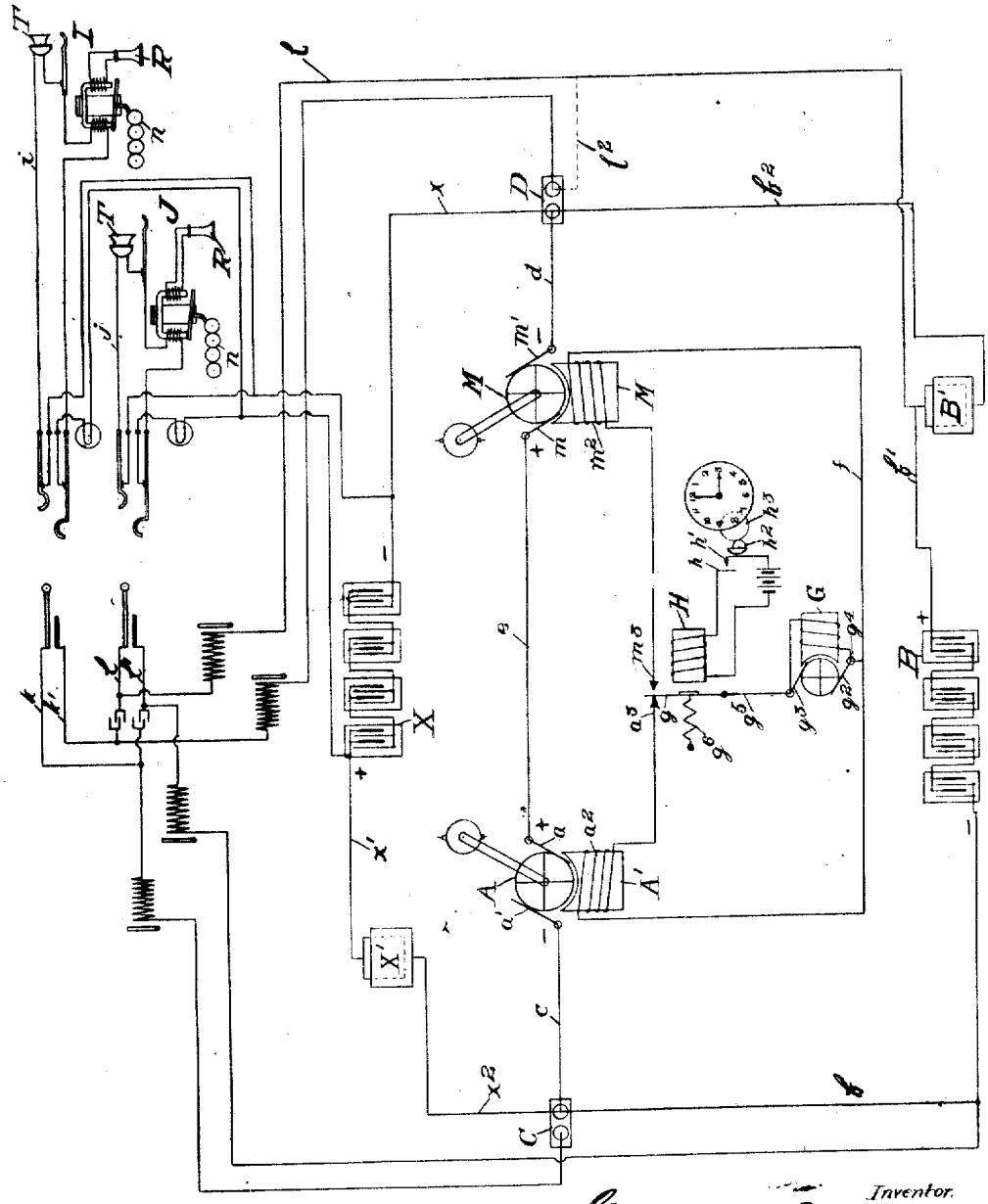

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR ALTERNATING THE POLARITY OF CURRENT IN ELECTRIC CIRCUITS.

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To all whom it may concern:

Be it known that I, GARRISON BABCOCK, of Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Apparatus for Alternating the Polarity of Current in Electric Circuits; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification, and to the reference characters marked thereon.

My present invention has for its object to provide an electrical apparatus for supplying to a line circuit a direct current which periodically flows in opposite directions for the purpose of operating such devices as may be adapted to be actuated by a change in the polarity or direction of flow of the current in the operating circuit in which they are arranged.

A specific purpose for which my present invention is adapted is that of supplying direct current to the lines of telephone exchanges which is adapted to be used for talking purposes and also actuating service metering devices which may be so constructed as to be capable of operation, during the use of the subscriber's line, by a mere reversal in the direction of flow or change of polarity of the current.

To these and other ends the invention consists in certain improvements and combinations of parts all as will be hereinafter more fully described, the novel features being pointed out in the claims at the end of the specification.

The figure of drawing illustrates diagrammatically one form of apparatus which may be employed for carrying out my invention.

In the illustration I have shown in conjunction with my apparatus a telephone system comprising a central office apparatus and two subscribers' lines, which although they form no part of the present invention, are illustrated to give a clear understanding of the operation and function of the present form of apparatus which I have devised for operating them.

The present apparatus may be employed for supplying current of opposite polarity periodically to a circuit for any purpose for which it may be used but as its more important service is to be found in connection with telephone systems equipped with service metering devices, a type of which is shown in United States Letters Patent No. 912,268, granted February 9, 1909, to Charles M. Beattie, the metering mechanism shown therein has been employed as an example of one form of mechanism for the operation of which my apparatus is well adapted.

In the operation of a metering device arranged on a telephone circuit which is actuated by variations or changes in the direction of the flow of the current on the line, it is desirable that the changes in the current from positive to negative and vice versa be graduated both as the current in one direction diminishes and as it increases in the other direction. In other words, it is essential that the potential change of the current be perfectly regular so that no vibration due to this cause will be imparted to the diaphragm of the receiver of the telephone and no inconvenience will be experienced by the subscriber by reason of the change in the direction of the flow of current occurring during the use of his instrument.

In order to carry out the object as above outlined briefly, I employ two generators of the direct current type which are connected in series in opposite polarity between the two sides of the line circuit their fields being arranged to be alternately excited. The armatures of both generators are in constant rotation and the coils of each alternately operate as a conductor for the current of the other when the field coils of the latter are excited. Associated with these generators are electrolytic devices which are bridged to the terminals of the generators and are employed as a means for absorbing the slight variations of the polarity of the current produced during the operation of the generators due to commutation changes of the current which may be noticeable during the operation of either of the generators. Various forms of devices of this character may be employed but the one I prefer to use, especially when the apparatus is employed in connection with a telephone system, is a storage battery as I propose to use it as a source of current for the operation of part of the central office telephone apparatus and to so associate it with the generators that the battery may be maintained charged to its full capacity by the generators.

In the drawings I have shown two direct current generators A and M each having the brushes a m and a' m' indicated respectively as positive and negative. These brushes are arranged in the line circuit indicated by the bus bars C and D from which lead the respective conductors c and d to the brushes a' m', said circuit being completed by the conductor e which unites the positive brushes a and m of the two generators. The field cores of the latter are indicated by A', M' supporting the field coils a^2 m^2 one end of each of which is connected by the conductor f while their opposite extremities terminate in contacts a^3, m^3 with which coöperates a switch arm g. The current employed for exciting the generators is obtained from a dynamo indicated by G having the brushes g^2, g^3, the former being connected with the conductor f by the tap g^4 while the latter is united to the switch arm g by the wire g^5.

Any suitable means may be employed for actuating the switch arm g but as it is preferable to move it periodically at given graduations of time, I prefer to operate it by an electro-magnet H arranged in a circuit which is opened and closed by contacts actuated by a clock train. In the present instance the circuit of the magnet is shown provided with a local battery and with a pair of contacts h, h', the latter being adapted to be moved to a position to close the circuit by a cam h^2 driven by the clock train h^3 and so arranged that the magnet will be energized to attract the switch arm g and be deënergized to permit it to return to its normal position under the influence of the spring g^6, at given intervals of time which may be expressed in seconds.

The armatures of the generators A and M it will be understood are driven continuously by any suitable form of motor as is also the armature of the dynamo G, or the armature of the exciting machine which it will be understood may be employed in place of the dynamo in the event the exciting current is taken from feed wires. For the sake of clearness, these elements have been separated in the illustration but in practice they may be combined as separate parts of a single machine the several armatures being mounted on a single driving shaft.

In order to eliminate line disturbances and to remove from the telephone line noises caused by the slight fluctuations of the current due to the action of commutation, which may be distinguished in a telephone receiver by a humming sound and also to insure a gradual decrease of the potential in one direction and its equal gradual increase in the other direction, I associate with the generators electrolytic devices preferably a storage battery which is divided into two parts as indicated by B and X which are connected across the terminals of both generators each battery section being so disposed as to constitute a charging load upon one of the generators when in operation. When storage batteries are employed the electrolytic devices also include aluminum cells B' and X' containing an electrolyte, said cells being disposed in the circuits of the batteries between the latter and the generators in such position as to prevent their discharging current into the generators, or to short circuit each other, yet permitting them to receive the current from their respective generators. These parts are shown in the illustration as arranged in the following manner: Section B of the electrolytic device is arranged with its negative pole connected by the wire b to the bus bar C, its positive pole being similarly connected to the bus bar D by the wires b', b^2 between which is located the aluminum cell B'. The other section or battery X is similarly connected with the bus bar D by the conductor x and with the bus bar C by conductors x', x^2 between which is arranged the aluminum cell X'. Although the aluminum cells are mentioned specifically, it will be understood that in some instances other devices may be employed with equal effect for preventing outflow of current from the batteries.

In operation the exciting current being applied to the coil a^2 of generator A, when the switch arm g is engaged with contact a^3 said generator produces current of one polarity which is transmitted over the following line circuit: bus bar C, conductor c, brushes a a', conductor e, brushes m' m, wire d, bus bar D, thence over the line circuit returning to bus bar C. When the switch arm g is attracted in engagement with contact m^3, the source of exciting current is then transferred to the coil m^2 of generator M which latter commences to pick up the load and supplies to the aforedescribed circuit the full potential current of the opposite sign. It will be noticed that the building up of the voltage by the generator M occurs while the coil of generator A is deënergizing, or losing its saturation, and there is therefore in fact a practical balance between the two generators. From an observation of the illustration, it will also be seen that during the operation of generator A that when the internal resistance of the electrolytic devices, or battery B, is reached by the voltage on the line that current will traverse the following path: brush a, conductor e, brushes m, m', conductors d, b^2, cell B', wire b', battery B, wires b, c, and brush a, said circuit being completed through the cell B', when the required voltage of the imposed load is reached. Similarly current will be transmitted from the generator M to the battery X when the voltage transmitted to the line by it reaches the given amount as it will

then overcome the resistance in the following circuit: brush m, conductor c, brushes a, a', wires c x^2, cell X', wire x', battery X, conductors x, d and brush m'.

The telephone system illustrated diagrammatically shows two subscribers' telephone instrument circuits, indicated generally by I and J, each of which comprises the usual transmitters T and receivers R, arranged in circuits comprising the line wires i, j, respectively. The usual switch board jacks at the central office comprise the tip and sleeve contact springs with which coöperate the plugs of the answering and calling cord circuits, indicated in the present instance by l, l' and k, k' terminating in the tip and sleeve contacts as shown. The metering device for recording the length of time the instrument circuit of the calling subscriber is in use is located at the subscriber's station and is indicated as a series of dials n. These are operated by electromagnetic devices associated with the instrument circuit and adapted to be actuated by current thereon at given intervals of time by the aforedescribed devices located at the central office which as before described are so arranged as not to interrupt the undulatory voice currents which may be traversing the line and to prevent a disagreeable click or vibration in the diaphragm of the subscriber's closed circuit. This apparatus is arranged to gradually decrease the potential of said current and to subsequently increase it gradually to the maximum voltage.

The conductors of the answering cord are connected with opposite sides of the battery B from which current for talking purposes is supplied to the calling subscriber's line, the connections being made with this battery in the manner shown so that current flowing in but one direction is obtained and the meter of the calling party's line will not be actuated. However, should it be desired in special instances to cause the called party's register to be actuated, the conductor l may be attached to the bus bar D as indicated by the dotted line l^2, in place of the connection, now shown, leading directly to one side of the battery.

The equalization of the current consumption of the batteries B and X may be effected by employing the latter as a source of current for operating the line signals or the supervising mechanism of the switch board. In practice however, it is customary to employ the two batteries for supplying current to an equal number of sets of calling cords as will be understood.

I claim as my invention.

1. An apparatus of the character described, comprising two generators arranged in series and connected so as to be of opposite polarity and having fields, means for alternately exciting said fields, and means associated with the generators for absorbing the varying current of each polarity produced during the operation of one or the other of said generators.

2. An apparatus of the character described, comprising two direct current generators arranged in series but polarly opposed and having fields, means for alternately exciting said fields and an electrolytic device in circuit with said generators and adapted to absorb the variations of the current produced during the operation of the generators.

3. An apparatus of the character described comprising two current generators connected in series but arranged in opposition to each other, means for alternately exciting said generators to produce current of opposite polarity and means associated with said generators for absorbing the variations of current so produced due to commutation changes occurring therein.

4. In an apparatus of the character described, comprising a line circuit for electrical operating purposes, two generators arranged to supply current of opposite polarity to said circuit, means for alternately exciting them and electrolytic means connected across the terminals of both generators for preventing transmission to the line circuit polar and commutator variations of the generated current.

5. In an apparatus of the character described, comprising two generators arranged to supply current of opposite polarity to a line circuit, means for alternately exciting said generators, separate batteries connected across the terminals of each generator and means interposed in the battery circuits for preventing the flow of current therefrom to the line but adapted to permit current to flow from the generators to said batteries.

6. An apparatus of the character described, comprising two direct current generators each comprising the usual armature and field windings, commutators and brushes, a line circuit for electrical operating purposes leading through the brushes and so connecting them in series that the generators when operated will supply said line circuit with current of opposite polarity, a source of current for exciting the generators and switching devices for alternately connecting said source with the fields of the respective generators and devices associated with the generators for imposing a sufficient electrical load on each of them to effect a gradual reduction of the current of one polarity on the line circuit produced by one generator, and a gradual increase of the current of the other polarity on said circuit produced by the other generator, upon each alternation of the operation of said generators.

7. An apparatus of the character described comprising two generators arranged in series

and polarly opposed between the two sides of a line circuit for electrical operating purposes, for the purpose of supplying said line at different times with current of opposite polarity, the armatures of said generators being rotated continuously, means for alternately exciting said generators, batteries connected across the terminals of said generators and electrolytic cells interposed in said connections between each battery and its respective generator.

8. The combination with a plurality of subscribers' telephone instrument circuits, and a central office equipment comprising answering and calling cord circuits for interconnecting said circuits, of two current generators of opposite polarity arranged in series and connected to the answering cord circuits and adapted to alternately supply calling subscribers' lines with current of opposite polarity, batteries associated with the generators and cord circuits and arranged to supply current for the called subscribers' lines and for absorbing variations of the generated current produced during the operation of the generators and means for alternately exciting the latter.

9. An apparatus of the character described, comprising two direct current generating machines each comprising the usual commutators, brushes, and armature and field windings, said generators being arranged to produce current of opposite polarity, a line circuit for electrical operating purposes leading through said brushes, a source of current for exciting the fields of the generators, switching devices for disconnecting said source with the field of one generator and connecting it with the field of the other generator, and electrolytic devices arranged in circuit with the generators for absorbing variations of the current produced during the operation of the generators.

10. An apparatus of the character described, comprising two direct current generating machines each comprising the usual commutators, brushes, and armature and field windings, a line circuit leading through the brushes, said circuit and generators being disposed so as to produce current of opposite polarity in the circuit at alternate intervals of time, a source of current for exciting the generators terminating in a switch arm, terminals of the field windings of the generators forming contacts with which said arm alternately coöperates, devices for periodically shifting the arm from one contact to the other and separate means associated with each generator for absorbing variations of the generated current due to commutation changes.

11. The combination with a plurality of subscribers' telephone instrument circuits and a central office equipment comprising answering and calling cord circuits and service supervising mechanism, of two current generators of opposite polarity connected in series and arranged to supply continuous current of opposite polarity to the answering cord circuit, means for alternately and periodically exciting said generators, batteries in circuit with the generators, calling cord circuits, and supervising mechanism, devices interposed in the battery circuits between the latter and the generators for preventing the flow of current from the batteries but permitting it to flow to them from the generators and devices arranged in the instrument circuits adapted to be actuated by the reversal in the direction of flow of current thereover.

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