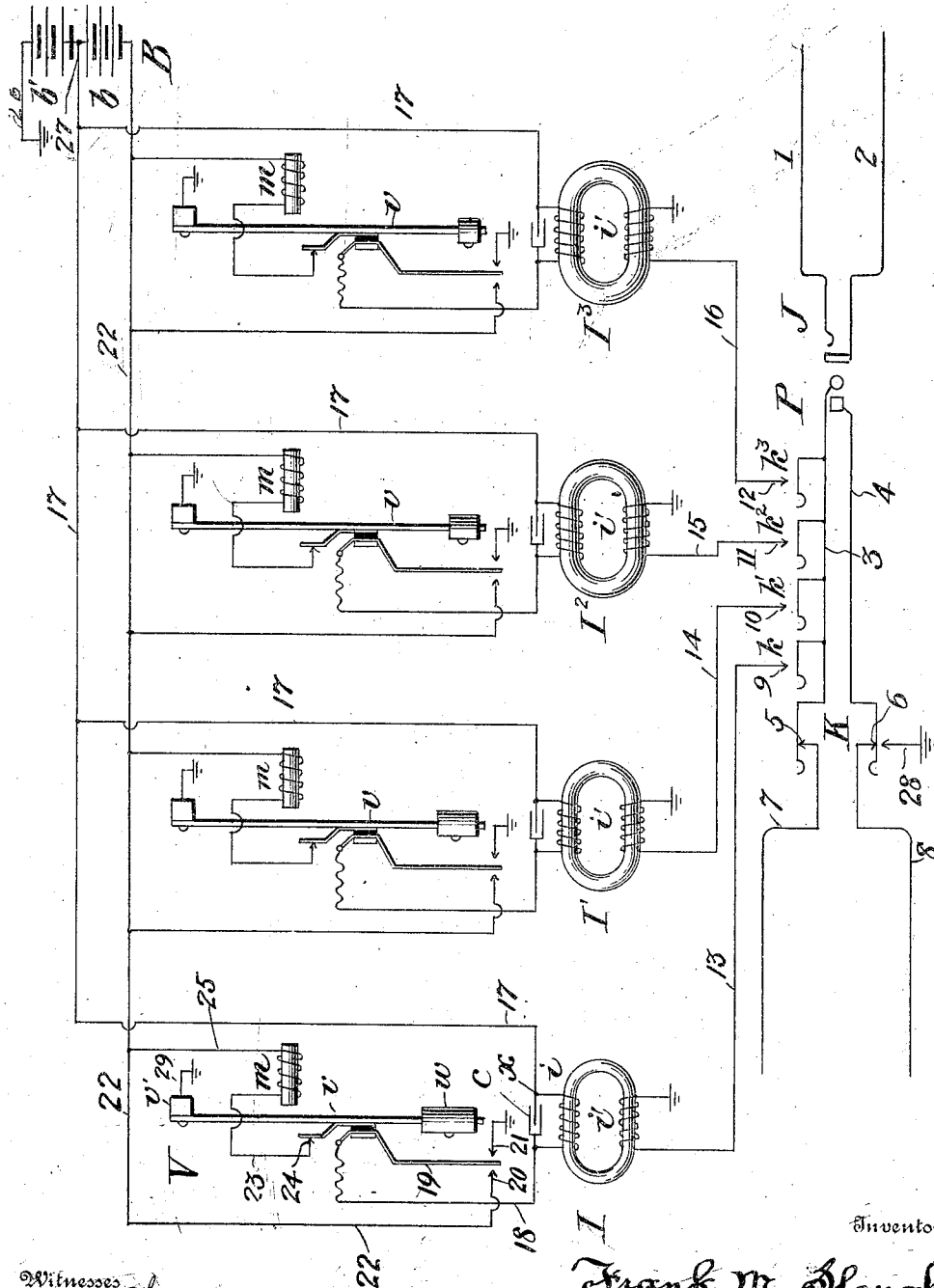


F. M. SLOUGH.
ELECTRICAL SIGNALING SYSTEM.
APPLICATION FILED JUNE 19, 1906.

938,345.

Patented Oct. 26, 1909.



Witnesses
For L. Wright
James A. Marr

By

Frank M. Slough
Edward E. Clement

Attorney

UNITED STATES PATENT OFFICE.

FRANK M. SLOUGH, OF ELYRIA, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE
DEAN ELECTRIC COMPANY, OF ELYRIA, OHIO, A CORPORATION OF OHIO.

ELECTRICAL SIGNALING SYSTEM.

938,345.

Specification of Letters Patent.

Patented Oct. 26, 1909.

Application filed June 19, 1906. Serial No. 322,339.

To all whom it may concern:

Be it known that I, FRANK M. SLOUGH, a citizen of the United States, residing at Elyria, in the county of Lorain and State of Ohio, have invented certain new and useful Improvements in Electrical Signaling Systems, of which the following is a specification, reference being had therein to the accompanying drawing.

My invention relates to electrical signaling systems, and has for its object the improvement and simplification of such systems in the particulars which hereinafter appear.

This invention is particularly applicable to what are known as harmonic signaling systems, wherein current of different frequencies is employed to actuate signals which are tuned so each of them will respond to only one frequency. In such systems it has been found desirable and economical to employ pole changers driven by motor magnets at predetermined speeds or rates of vibration, and supplied with current from a storage battery or generator. With such pole-changers there have been employed transformers properly designed to work on the different frequencies supplied. Current for each pole-changer magnet is controlled by its own contacts, as well as current supply to the corresponding transformer. It is of course this current supply or signal current to the transformer that is of the greatest importance, and one object of the present invention is to render the application of this current more effective and at the same time to avoid interference with the motor currents or current supplied to line circuits, for talking or signaling, otherwise than through the pole-changers.

Briefly stated, my invention contemplates the provision of a battery or other source of current tapped at one or more intermediate points between its end terminals, so as to give two or more sources of electromotive force of approximately equal tension but alternately of opposite sign to the same points. An intermediate point is so connected to one side of the primary winding on each transformer, and the other terminals are so connected to means for alternating them in connection with the other side of the primary, that the several divisional sources

of electromotive force are thus connected to send alternative opposite currents through the primary. In case there are several division points on the source the sections thus produced may be and preferably are connected in pairs to discharge singly and alternately as to each pairs, whereby the aggregate discharge is uniformly distributed and equalized. By this arrangement I am able to secure a positive reversal of current in the primary of each transformer with a sharper and more efficient action than that produced by simply making and breaking the primary circuit, and also to decrease the number of contacts otherwise and now generally necessary in such apparatus.

I shall herein describe my invention as applied to a telephone exchange system wherein the common talking battery furnishes current also for signaling and for ringing.

My invention is illustrated in the accompanying drawing in which the figure is a diagram of a portion of the central office circuits and apparatus in a telephone system showing a group of pole changers with their transformers, and a portion of an operator's cord circuit with keys whereby the same may be applied to a subscriber's line.

In the drawing 1-2 represent a telephone subscriber's line terminating in a spring jack J which is adapted to cooperate with the plug P. This plug has a tip and a sleeve contact, to which are connected the cord conductors 3 and 4 respectively. These conductors pass to normally closed contacts 5 and 6 in the regular ringing key K, and thence through extensions 7 and 8 are connected to the other plug of the pair through associated apparatus which is not illustrated since it is not essential to the present invention.

In addition to the regular ringing key K, I provide the selective keys k , k' , k'' and k''' whose contacts 9, 10, 11 and 12 are normally open. These contacts are connected by wires 13, 14, 15 and 16, to the secondary windings k' of the transformers I, I', I'' and I''', these being adapted to generate in the secondary circuit alternate currents of different frequencies which may conveniently be respectively 16 cycles, 33 cycles, 50 cycles, and 66 cycles, per second. The design of the transformers is such as to secure the highest efficiency in each case with the particular

frequency employed, but as this forms no part of the present invention, the mere mention thereof is sufficient. As regards the primary connectors and associated pole changers, all the transformer sets are alike, so I will describe the first set associated with the transformer I, with the understanding that this applies equally to all the others. The primary winding i is connected on one side by the conductor 17 to an intermediate point on the main battery B. On the other side the transformer is connected through wire 18 to a spring 19 on the vibrator v of the pole changer V. As the vibrator moves back and forth, the spring 19 plays between the contacts 20 and 21, the former of which is connected by wire 22 to the negative side of the main battery B, while the latter contact 21 is connected to ground. The positive pole of the main battery is also grounded.

The pole changer may be of any suitable or desired type. I have shown it as comprising essentially a main tongue or vibrator v rigidly secured upon a metallic support v' , which is grounded, and serving itself as an armature for a motor magnet m , which is connected on one side through wire 23 to a contact 24, and on the other side through wire 25 to the battery wire 22. The contact 24 coöperates with a spring carried on and connected directly to the vibrator v which is preferably of spring metal and is grounded since its support v' is grounded. Upon each vibrator is mounted a weight w , these weights being different for the different frequencies and being adjustable upon the vibrators if desired.

The circuit thus described is multiplied in each of the other pole changers producing the complete layout illustrated for four frequencies. While I do not limit myself in the application of the invention to a plurality of frequencies or to a plurality of machines, it will be observed that the arrangement reduces such a plurality to the simplest possible form. The motor magnets m may be driven either from part of the main battery or from the whole, but it has been found that the low voltage is preferable where it can be employed on account of the decrease in sparking at the contacts.

The condensers C are bridged across the primaries i , etc., to cut down the sparking at the primary contacts 20—21, and to assist in the action of the transformer. This arrangement as well as the design of the transformer may, of course, be varied in many ways.

Briefly stated, the operation of the circuit is as follows. Assuming the plug P to have been inserted in the jack J, and the key k^1 to have been closed while the main key K is open, we then have the following conditions: Ground is on the sleeve side

of the line through the key wire 28; the wire 13 is connected to the tip side 1 of the line through the contact 9 and cord conductor 3. Alternating current from the secondary winding i' of the transformer I therefore passes from ground through the following circuit: 13, 9, k , 3, P, J, I, subscriber's station, 2, J, P, 4, 28, and ground. At the same time the motor magnet has been vibrating the arm v continuously by reason of the flow of current in the following circuit: B, 26, ground, to the pole changer V through the ground, wire 29, v' , v , 24, 23, m , 25, 22 and B. At the same time the current flow in the primary winding i of the transformer is being rapidly alternated over the following two paths: (1) B, 26, ground, 21, 19, 18, i , 17, 27, B. This takes current from the section b' of the battery with the terminal a of the primary winding i negative. As the arm v throws the spring 19 away from the contact 21 and against the contact 20, this first circuit is broken and the second one is made as follows: (2) B, 17, i , 18, 19, 20, 22, B. This makes the terminal a of the primary positive and thus it will be observed the direction of current through the primary is alternated continuously while the pole changer is in operation.

I believe it is entirely new with me to split a battery in this manner so as to use a portion of the same to produce current in one direction in a primary winding, and another portion to produce current in an opposite direction in the same primary. It will be observed that the pole changer employed with this method has only two contacts instead of the four which are necessary when the complete battery has to be reversed. Moreover, it has been found that the low voltage pole changers and transformers using a low voltage in the primary, give efficient results, and are easier handled due to less sparking at the contacts. In the case illustrated in my drawing herewith, a 10 cell storage battery of a common battery exchange will give 5 cells, or 10 volts in each half, or a total difference of potential or amplitude of change of 20 volts, with only the sparking due to 10 volts. Where an 11 cell storage battery is used, taps can be brought out so as to give 5 cells on either half of the middle conductor; also where a 20 or 22 cell storage battery is used, taps can be brought out to switches so as to connect the vibrating machines to different sections of the battery so as to equalize the amount of current taken from the same. However, as this current is very small, I do not expect any difficulty even if the switches are not used and current is taken from only 10 of the 20 or more cells of a large storage battery. For small exchanges where dry batteries are used instead of storage bat-

teries, it is a small matter to arrange the cells so as to give the effect shown in the drawing.

It will be understood that I contemplate various non-essential changes and do not limit myself to any of the specific details or connections described.

The gist of the invention lies in the method of connection to the battery, and the corollary features are the simplification of the pole changers and the increase in efficiency in the invention.

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

1. In a signaling system, line wires leading from a central station to a subscriber's station, a pole changer at the central station, such pole changer containing a single vibrating arm, a source of electric energy, means for operating such pole changer from such source by a circuit closed through such arm, an electric conductor carried by and insulated from the arm, a transformer having primary and secondary windings, the primary of said transformer being normally connected to said conductor, and circuits from such source adapted to be closed through such conductor as such arm vibrates, whereby currents are directed through such primary winding alternately in opposite directions.

2. In a signaling system, line wires leading from a central station to a subscriber's station, a pole changer at the central station, such pole changer containing a single vibrating arm, a source of electric energy, means for operating such pole changer from such source by a circuit closed through such arm, an electric conductor carried by and insulated from the arm, a transformer having primary and secondary windings, the primary of said transformer being normally connected to said conductor, circuits from such source adapted to be closed through such conductor as such arm vibrates, whereby currents are directed through such primary winding alternately in opposite directions, an operator's cord circuit, means for connecting such cord circuit to the line wires, and a key associated with the cord circuit for making connection from the secondary winding of the transformer to such cord circuit.

3. In a signaling system, line wires leading from a central station to a subscriber's station, a pole changer at the central station, such pole changer containing a single vibrating arm, a source of electric energy, means for operating such pole changer from such source, an insulated member carried by such arm, a transformer having primary and secondary windings, the primary of said transformer being normally connected to

said conductor, and circuits from such source adapted to be closed through such member as such arm vibrates, whereby currents are directed through such primary winding alternately in opposite directions.

4. In a signaling system, line wires leading from a central station to a subscriber's station, a pole changer at the central station, such pole changer containing a single vibrating arm, a source of electric energy, means for operating such pole changer from such source, an insulated member carried by such arm, a transformer having primary and secondary windings, the primary of said transformer being normally connected to said conductor, circuits from such source adapted to be closed through such member as such arm vibrates, whereby currents are directed through such primary winding alternately in opposite directions, an operator's cord circuit, means for connecting such cord circuit to the line wires, and a key associated with the cord circuit for making connection from the secondary winding of the transformer to such cord circuit.

5. In a signaling system, line wires leading from a central station to a subscriber's station, a pole changer at the central station, such pole changer containing a single vibrating arm, a source of electric energy, means for operating such pole changer from such source by a circuit closed through such arm, a transformer having primary and secondary windings, and means normally connected to the transformer operated by such vibrating arm for closing circuits through a single conductor carried by and insulated from such arm from such source to such primary winding, whereby currents are directed through such primary winding alternately in opposite directions.

6. In a signaling system, line wires leading from a central station to a subscriber's station, a pole changer at the central station, such pole changer containing a single vibrating arm, a source of electric energy, means for operating such pole changer from such source by a circuit closed through such arm, a transformer having primary and secondary windings, means normally connected to the transformer operated by such vibrating arm for closing circuits through a single conductor carried by and insulated from such arm from such source to such primary winding, whereby currents are directed through such primary winding alternately in opposite directions, an operator's cord circuit, means for connecting such cord circuit to the line wires, and a key associated with the cord circuit for making connection from the secondary winding of the transformer to such cord circuit.

7. In a harmonic signaling system for telephone lines, line wires leading from a

central station, a plurality of tuned pole changers at the central station, each of such pole changers containing a single vibrating arm, a source of electric energy, means for
 5 operating each of such pole changers from such source by circuits closed through its vibrating arm, an electrical conductor carried by and insulated from the arm, transformers having primary and secondary
 10 windings, said conductor of each corresponding vibrating member being normally connected to said transformer, and circuits from such source adapted to be closed through each of such conductors as the corresponding vibrating arm operates, whereby currents are
 15 directed through such primary windings alternately in opposite directions.

8. In a harmonic signaling system for telephone lines, line wires leading from a
 20 central station, a plurality of tuned pole changers at the central station, each of such pole changers containing a single vibrating arm, a source of electric energy, means for operating each of such pole changers from
 25 such source by circuits closed through its vibrating arm, an electrical conductor carried by and insulated from the arm, transformers having primary and secondary windings, said conductor of each corresponding
 30 vibrating member being normally connected to said transformer, the circuits from such source adapted to be closed through each of such conductors as the corresponding vibrating arm operates, whereby currents
 35 are directed through such primary windings alternately in opposite directions, an operator's cord circuit, means for connecting such cord circuit to the line wires, and keys associated with the cord circuit for making con-
 40 nection from the secondary windings of the transformers to such cord circuit.

9. In a harmonic signaling system for telephone lines, line wires leading from a
 45 central station, a plurality of tuned pole changers at the central station, each of such pole changers containing a single vibrating arm, a source of electric energy, means for operating each of such pole changers from
 50 such source, an insulated member carried by such arm, transformers having primary and secondary windings, said member of each corresponding pole changer being normally connected to the transformer, and cir-
 55 cuits from such source adapted to be closed through each of such members as the corresponding vibrating arm operates, whereby currents are directed through such primary windings alternately in opposite directions.

10. In a harmonic signaling system for
 60 telephone lines, line wires leading from a central station, a plurality of tuned pole changers at the central station, each of such pole changers containing a single vibrating arm, a source of electric energy, means for

operating each of such pole changers from
 65 such source, an insulated member carried by such arm, transformers having primary and secondary windings, said member of each corresponding pole changer being normally connected to the transformer, circuits
 70 from such source adapted to be closed through each of such members as the corresponding vibrating arm operates, whereby currents are directed through such primary windings alternately in opposite directions,
 75 an operator's cord circuit, means for connecting such cord circuit to the line wires, and keys associated with the cord circuit for making connection from the secondary windings of the transformers to such cord circuit.
 80

11. In a harmonic signaling system for telephone lines, line wires leading from a central station to a subscriber's station, a plurality of tuned pole changers at the central station, each of such pole changers con-
 35 taining a single vibrating arm, a source of electric energy, means for operating each of such pole changers from such source by a circuit closed through its vibrating arm, transformers having primary and secondary
 90 windings, and means normally connected to said transformer operated by each vibrating arm for closing circuits through a single conductor carried by and insulated from
 95 such arm from such source to the primary winding of the transformer, corresponding to such vibrating arm, whereby currents are directed through the primary windings alternately in opposite directions.

12. In a harmonic signaling system for
 100 telephone lines, line wires leading from a central station to a subscriber's station, a plurality of tuned pole changers at the central station, each of such pole changers containing a single vibrating arm, a source of
 105 electric energy, means for operating each of such pole changers from such source by a circuit closed through its vibrating arm, transformers having primary and secondary windings, means normally connected to said
 110 transformer operated by each vibrating arm for closing circuits through a single conductor carried by and insulated from such arm from such source to the primary wind-
 115 ing of the transformer corresponding to such vibrating arm, whereby currents are directed through the primary windings alternately in opposite directions, an operator's cord circuit, means for connecting such cord circuit to the line wires, and keys associated
 120 with the cord circuit for making connection from the secondary windings of the transformers to such cord circuit.

13. In a signaling system, line wires lead-
 125 ing from a central station to a subscriber's station, a pole changer at the central station, a source of electric energy, a transformer having primary and secondary windings, the

vibrating arm of the pole changer consisting of two members insulated from each other, one of such members normally connected with the primary winding and adapted as the arm is vibrated to alternately close circuits through itself to such source such that current from such source is caused to flow alternately through the primary winding in opposite directions.

14. In a signaling system, line wires leading from a central station to a subscriber's station, a pole changer at the central station, a transformer having primary and secondary windings, the vibrating arm of the pole changer consisting of two members insulated from each other, each member adapted to form part of a circuit controlled thereby, the contacts carried by such members being in electrical connection therewith, a common source of current for supplying the two circuits, one circuit controlling the operation of the pole changer and the other an independent circuit through the primary of the

transformer, whereby current from such source is caused to flow alternately through the primary winding in opposite directions.

15. In a signaling system, line wires leading from a central station to a subscriber's station, a pole changer at the central station, a source of electric energy, a transformer having primary and secondary windings, such pole changer containing a single vibrating arm, an insulated member carried by the arm, such member consisting in a single electrical conductor adapted to close circuits through itself from such source as the arm is vibrated for causing current to flow through the primary winding alternately in opposite directions.

In testimony whereof I affix my signature in presence of two witnesses.

FRANK M. SLOUGH.

Witnesses:

WM. W. DEAN,
A. A. HATHAWAY.