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CORRECTING DISTURBANCES ON TELEPHONE AND OTHER LIKE WIRES.

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1,114,408. Patented Oct. 20, 1914.

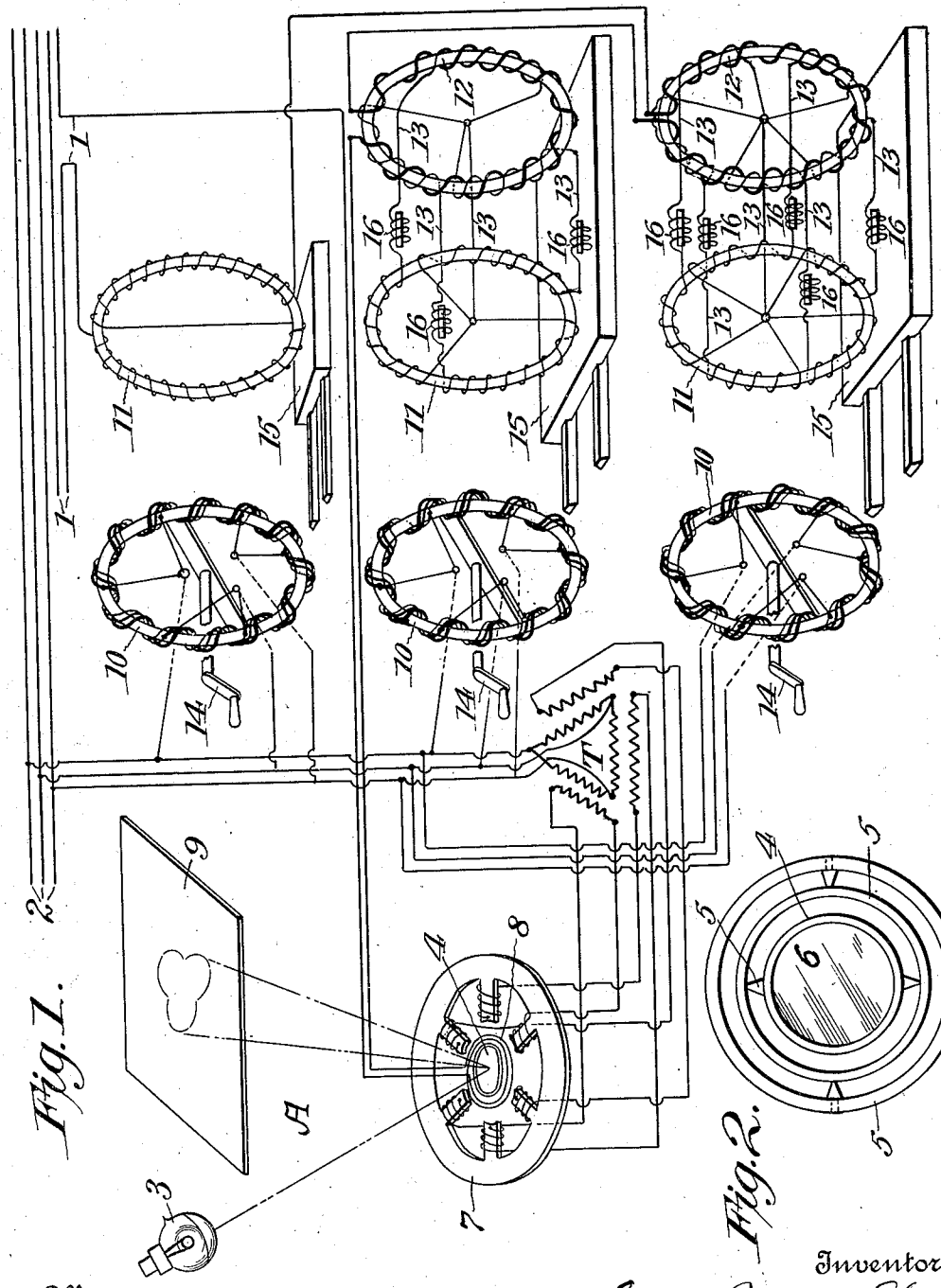

Fig. 1.

Fig. 2.

Witnesses

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CORRECTING DISTURBANCES ON TELEPHONE AND OTHER LIKE WIRES.

1,114,408. Specification of Letters Patent. Patented Oct. 20, 1914.

Continuation of application Serial No. 728,336, filed October 29, 1912. This application filed March 3, 1914, Serial No. 822,128. Renewed September 10, 1914. Serial No. 861,135.

To all whom it may concern:

Be it known that I, JAMES BUCKNER SPEED, of the city, county, and State of New York, have invented a certain new and useful Improvement in Correcting Disturbances on Telephone and other like Wires, of which the following is a specification.

Except as to certain details of circuit arrangement in the transformers 11—12, including the impedance coils 16, this application is a continuation of my application 728,336, filed Oct. 29, 1912, and is substituted therefor.

My invention relates to the art of correcting disturbances on telephone and other like wires, occasioned by the proximity of electric power circuits.

It consists, more essentially, in separately correcting the fundamental frequency, and its harmonics, of the disturbing current by the application of independent currents possessing characteristics similar to said components of the disturbing current.

The particular method of procedure which I have chosen to hereinafter describe in detail comprises the steps of producing an observable manifestation of the disturbance on the telephone line; producing a second disturbance on said line synthetically out of alternating currents whose periodicities are those of the fundamental and of the harmonics of the disturbance note; and regulating and adjusting the several parts of said synthetically constructed disturbance by reference to the said observable manifestation until said disturbance is as nearly nullified as desired. These several steps of my method are capable of and subjected to refinements and qualifications which while not changing or affecting the generic idea of my method render the invention of practical moment, and in themselves lend further novelty to the method; as, for example, the best form in which to produce the observable manifestation of the disturbance to be corrected in order that it may be practically followed and serve as a guide in the adjustment and attainment of the similar and opposite neutralizing disturbance; and in the best manufacture, as it were, and control of said neutralizing disturbance in order that it may be rendered practical in the attainment of its object.

In order to fully understand my invention, I illustrate diagrammatically in the accompanying drawings an apparatus by the use of which the method may be carried out.

In these drawings—Figure 1 is a diagram of the apparatus above mentioned. Fig. 2 is a plan view enlarged of the reflecting disk.

1 is a telephone or telegraph line in which by reason of the proximity of an electric power line 2 disturbances or troubles occur.

A indicates, as a whole, an oscilloscope by which the disturbances in the line 1 are made visually manifest. Though this manifestation may be of any suitable observable character, I recommend, in practice, a form of oscilloscope which will give a closed curve or polar type of diagram, in which one revolution, or 360 degrees, of the diagram occupies the period of one cycle of the fundamental of the disturbance. It is, further, best that the visual representation of the disturbance shall be stationary in azimuth, as this is desirable for the correction of disturbances resulting from more than one source of power not operated in parallel with the others.

In general, the oscilloscope A comprises a source of light 3, say a small electric bulb. A minute iron disk 4 is pivoted in gimbals 5, so as to be free to turn in any direction, except in azimuth, said disk carrying a small concave mirror or a reflecting surface 6. This disk is held in the plane of its gimbal rings by a magnetic field produced by the six pole field magnet 7, the axis of said magnetic field being in the plane of the disk, and said magnetic field rotates synchronously with the fundamental of the disturbance, by reason of being energized by three 3-phase circuits, as shown.

A coil of wire 8 is arranged with its axis perpendicular to the plane of rotation of the magnetic field, and this coil of wire is connected in any suitable manner, as, for example, looped in, with the line wire 1, as shown, or a repeating coil may be used in the usual manner, so that said coil is energized by the currents in said line wire. The coil of wire 8 is so disposed with reference to the iron disk 4 and the field magnet 7 that its effect is to displace the plane of the iron disk angularly with respect to the plane of the rotating magnetic field which the field magnet 7 produces.

As will be seen, the field magnet 7 is elec-

trically connected with the power wire 2 through the transformer at T, that is to say, it is energized from the same power system which is the cause of the disturbance on the line wire 1. It will now readily be understood that because said field magnet 7 is energized from the power wire 2, it follows that the movements of the iron disk 4 and its mirror 6 will always occur at the same position in the circular path of the spot of light, and, therefore, the same diagram will be repeated as many times a second as the frequency of the fundamental of the power circuit, and consequently the disturbance. In order to observe this diagram, the beam of light from the bulb 3 is reflected by the mirror 6 to a ground glass screen 9, and on this screen the spot of light will only retraverse that portion of its path which is produced by the same source of disturbance as is operating the rotating field. As this is the case, it follows that the vibrations introduced by the telephone conversation, or, in case of a telegraph wire, by the application of the line battery by the operator's key, while interrupting or adding other vibrations to the disturbance vibrations, will be practically invisible on the screen 9, since they are not repeated over and over again as are those displacements produced by the disturbing current, which as before stated, is operating the field magnet 7. Thus, by means of an oscilloscope, an observable manifestation of all the electrical disturbance on the line is produced, whether caused by electro-magnetic or electrostatic or leakage or atmospheric conduction, said manifestation being a visual one and its diagram being a closed curve as its best type.

To carry out the second step of my method, namely, the production of another or second disturbance, and to realize the succeeding step, namely, the adjustment of this second disturbance in the light of the first visible diagram, in such manner that it shall nullify the disturbance which it is wished to correct, many ways and divers means may be adopted. Inasmuch as my present application for patent is directed solely to the method of, and not to the means for, correcting the disturbances stated, I have herein illustrated but one way and means for carrying out these steps, and that only in detail sufficient for the purpose of understanding the matter.

10 are field magnets. There is a plurality of these field magnets, and though almost mechanically stationary, they, by the use of 3-phase currents, produce rotating magnetic fields, and these field magnets are made so as to be manually shiftable around their axis of symmetry through a rotational angle less than 360 degrees. Corresponding to each of these field magnets are armatures 11 wound for single, three, five, seven, etc., phase circuits—only the single, three phase and five phase armatures being shown, and these armatures are preferably so arranged that they may be slid or pulled away in the direction of the axis of the field, so as to change the intensity of the poly-phase currents developed in them by the said field.

12 indicates a plurality of small transformers. There are as many of them as there are pairs of fields 10 and armatures 11, except that the field magnets 10 and armatures 11 which are arranged for the production of the fundamental frequency, do not require a transformer 12. The leads 13 from the armatures 11 are carried to these transformers through the choking coils 16 as shown, so that the fundamental frequency of the various members of each polyphase set neutralize each other and nothing is left in the secondary of the transformers except the electromotive force or current which is the same multiple of the fundamental as the number of phases brought into the transformer; for example, from that armature which is wound with three coils for three-phase current, nothing will come out of the transformer into which these armature leads are taken except triple frequency.

I have stated that the field magnets 10 are shiftable around their axis of symmetry, and also that their armatures are movable parallel to themselves in the direction of the said axis. It now follows that by reason of the plurality of fields, it is possible to produce any of the said multiples of the frequency of the fundamental of the power which is operating said fields, and further that by reason of the mechanical rotative shiftability of said field magnet, each of such frequencies may be varied independently as to phase, and, finally, that by reason of the adjustability of the armatures in the direction of the axis of symmetry, each of said currents may be varied independently as to intensity. In the present illustration the means for effecting these variations comprise a crank handle 14 by which the field magnets 10 are rotatively shifted, and sliding bases 15 on which the armatures move to and from the fields. One of these groups of field magnets, armatures and transformers is connected up in that part of the complex generating set which is intended to give the variation of phase and intensity of the fundamental of the correction current to be produced. Thus this group puts in the control of the operator the means of varying the phase and intensity of the fundamental component of the complex correction wave or current to be produced. The other successive groups, of which there may be any required number, vary the phase and intensity of the different multiples of the fundamental. It will now be seen that means are illustrated by the operation of which a second

disturbance may be created on the line and said second disturbance may be manipulated, and so controlled and adjusted as to attain a complexity and character adapting it to neutralize the first disturbance. This final step is effected by the operator through her deliberate selection and manipulation of the several adjusting devices of the groups of field magnets 10 and armatures 11 to the end that in producing the complex correction current, she shall so manufacture it that, as will be indicated by its effect upon the visual diagram of the disturbance to be corrected, it is equal to and opposite at every instant to said disturbance, thereby neutralizing it. This will be better understood by a brief recital of the manner of practically carrying out my method in a telephone exchange.

In any telephone exchange of moderate size there will be found a chief operator's desk and a trouble clerk's desk, etc., in addition to the numerous panels of the large switchboard which are attended on by the operators. I propose to put in another desk, similar in general appearance to the chief operator's desk, to be called the "Correction desk," with a girl operator in charge. This desk may keep a hundred lines or more corrected. Its operation is similar to the chief operator's desk, in that the main switchboard girls or operators may all speak to the correction desk and plug any one of their noisy lines in connection with the correction desk. The correction operator on receiving a disturbed line from the main switchboard operator, will plug it into a hole of her board, which communicates with one of the correction units, of which there are about a hundred in her desk. This correction unit contains, in some form, all of the apparatus heretofore described, or its equivalents—that is, the oscilloscope and the complex frequency generating groups or sets. As soon as she has plugged the line to the correction unit, there will appear, on the ground glass screen, a clover-leaf-shaped figure, that is, one having three principal lobes and cusps, because usually the principal disturbance on telephone lines is of triple the frequency of the fundamental of the power lines. If, instead of a clover-leaf figure, a heart-shaped figure with one cusp is seen, this will indicate that the trouble is principally of the fundamental frequency. As a matter of fact, neither of these two figures in its simplest form would ever occur, the outline of the figure being decidedly wavy. Suppose, however, the figure contains one principal dent, indicating the presence of some of the fundamental in the disturbance. Thereupon the operator reaches for that group of field magnets 10 and armatures 11 which concerns the production of the fundamental of the correction current, and by moving the field rotatively, she will cause the region of the principal dent in the diagram to be shifted around angularly or in azimuth, while by moving the armature she will change the magnitude of the dent in the diagram as measured radially from its geometrical center. This manipulation will result in the obliteration of any clearly distinguishable onesidedness in the diagram. What remains in the diagram will then be very much more noticeably three-sided or clover-leaf like. She now selects another group of the complex correction current set and by operating either the field or the armature (it makes no difference on which she begins), she will either shift rotationally the three-sided cusps of the oscilloscope figure, or else she will change the magnitude of the three-sided part, as measured radially from the center. Between the two shiftings she then obliterates the three-parted irregularity in her diagram. Frequently, this will be quite enough to bring the diagram of the oscilloscope to indicate practical silence, but in cases where the circuit is of more importance, and greater silence is required, it may be desirable to correct in a similar manner the higher harmonics, a result attained by operating other groups of the correction current set.

I claim:

1. The method of correcting alternating current disturbances on telephone and other like wires which consists in producing an observable manifestation of the disturbance on the line; producing a second disturbance on said line synthetically out of alternating currents whose periodicities are those of the fundamental and of the harmonics of the disturbance note; and regulating and adjusting the several parts of said synthetically constructed disturbance by reference to the said observable manifestation until said disturbance is as nearly nullified as desired.

2. The method of correcting alternating current disturbances on telephone and other like wires which consists in producing an observable manifestation of the disturbance on the line; producing a second disturbance on said line, part by part, of alternating currents of the same periodicities as the fundamental and the harmonics of the said disturbances; and, one by one, regulating and adjusting the said parts individually in phase and intensity, until, part by part, the disturbance has been neutralized, all under the guidance of the said observable manifestation.

3. The method of correcting alternating current disturbances on telephone and other like wires which consists in producing a visible diagram of the disturbance on the line; producing a second disturbance on said line synthetically out of alternating cur-

rents whose periodicities are those of the fundamental and of the harmonics of the disturbance note; and regulating and adjusting the several parts of said synthetically constructed disturbance by reference to the said visible diagram, until said disturbance is as nearly nullified as desired.

4. The method of correcting alternating current disturbances on telephone and other like wires which consists in producing a visible diagram of the disturbance on the line; producing a second disturbance on said line, part by part, of alternating currents of the same periodicities as the fundamental and the harmonics of the said disturbance; and, one by one, regulating and adjusting the said parts individually in phase and intensity, until, part by part, the disturbance has been neutralized, all under the guidance of the said visible diagram.

5. The method of correcting alternating current disturbances on telephone and other like wires which consists in producing a visible diagram of the disturbance current on the line in such a way that the cyclical representation of the current is synchronous with the fundamental frequency of the disturbance, producing a second disturbance on said line synthetically out of a plurality of alternating currents whose periodicities are respectively that of the fundamental and of the several harmonics of the said disturbance; and so regulating and individually adjusting the phases and intensities of the said fundamental and the said harmonics, under the guidance furnished by observation of the visible diagram of the first disturbance, that the second disturbance shall be at every instant equal and opposite to the first disturbance.

6. The method of correcting disturbance heard in a telephone receiver which is connected with a telephone line exposed to the influence of an alternating power circuit, which consists in separately correcting the fundamental of the disturbance note and the several higher harmonics, each individually by the application of other alternating electromotive forces of the same periodicity as the said fundamental and several harmonics, said electromotive forces being independently adjustable in phase and intensity so that the several parts into which the disturbance tone is resolvable are attacked individually and nullified individually, the adjustments being made by the operator under the guidance of an observable manifestation of the amount of disturbance residual in the telephone as the successive steps of the nullification proceed.

7. The method of neutralizing disturbances in a signaling circuit exposed to the influence of an alternating current which consists in separately neutralizing the fundamental frequency, and harmonics, of the disturbing current by the application of independent alternating currents possessing characteristics similar to said components of the disturbing current.

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

JAMES BUCKNER SPEED.

Witnesses:
MARCELLUS BAILEY,
H. B. MARSTON.