R. H. MANSON.

HARMONIC SIGNALING SYSTEM.

APPLICATION FILED FEB. 8, 1906.

942,091.

Patented Dec. 7, 1909.

2 SHEETS—SHEET 1.

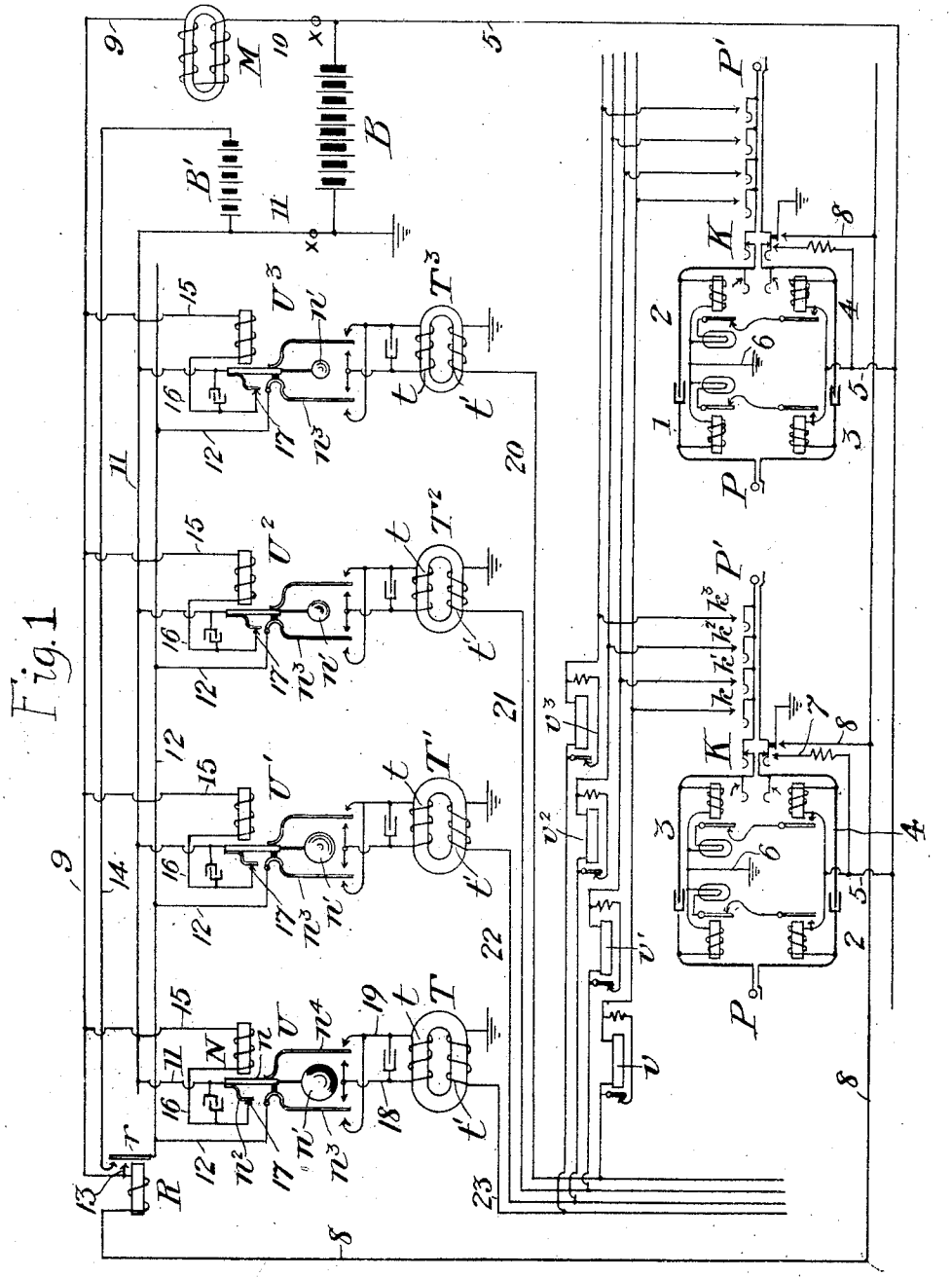

Fig. 1.

Witnesses

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D. W. Edelin.

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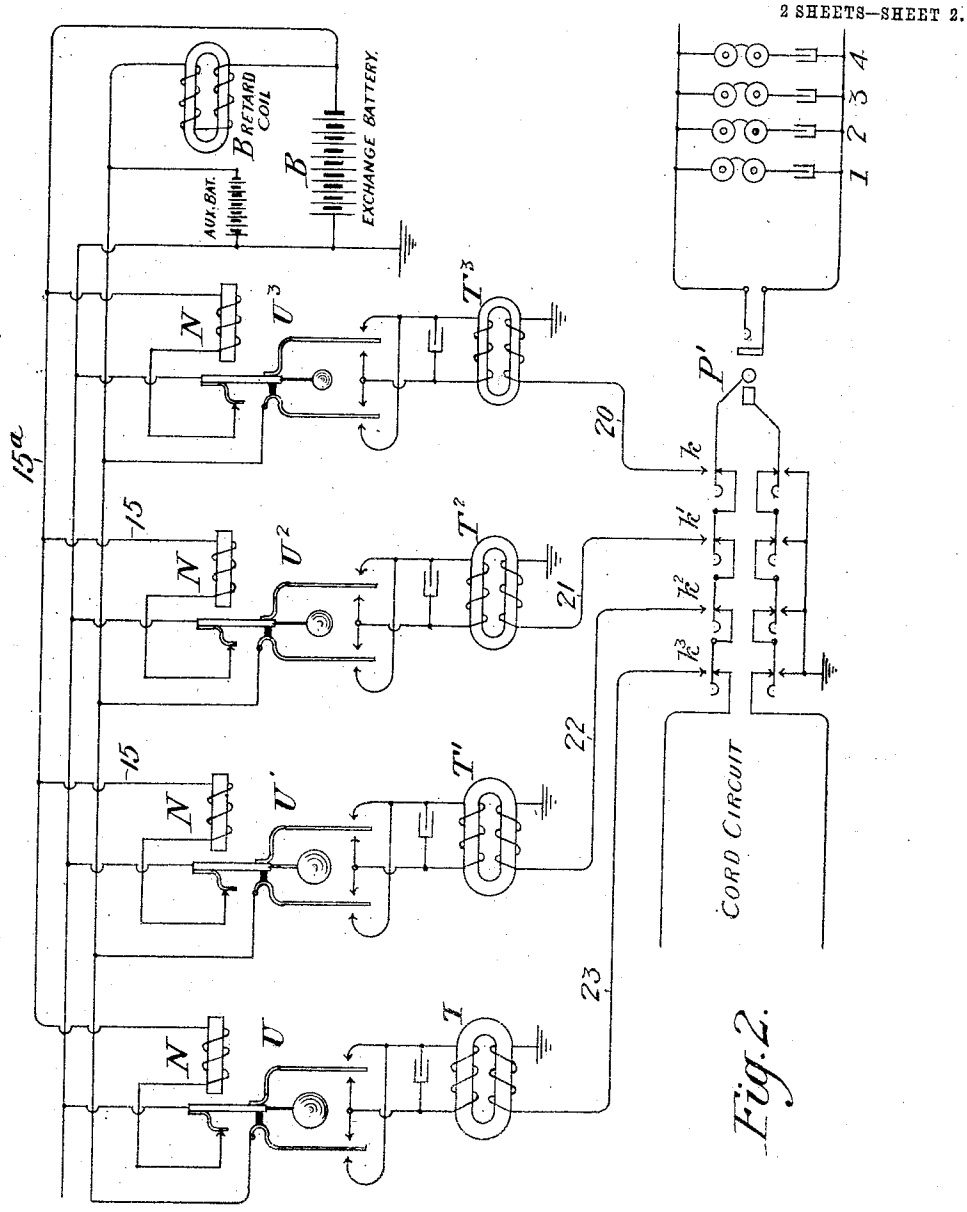

Fig. 2.

Witnesses

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UNITED STATES PATENT OFFICE.

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HARMONIC SIGNALING SYSTEM.

942,091. Specification of Letters Patent. Patented Dec. 7, 1909.

Application filed February 8, 1906. Serial No. 300,125.

To all whom it may concern:

Be it known that I, RAY H. MANSON, 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 Harmonic Signaling Systems, of which the following is a specification, reference being had therein to the accompanying drawing.

My invention relates to signal systems, and more particularly to what are known as harmonic selective signaling systems, wherein a plurality of stations are served, or a plurality of signals may be actuated over a single circuit.

My invention finds its principal use at present, and I shall therefore illustrate and describe it as embodied, in a party-line telephone system; but it will sufficiently appear from both illustration and description that it is equally applicable to any other class of systems wherein the same kind of current is employed.

It has heretofore been proposed to employ what are known as pole-changers to supply currents of different frequencies for signaling over telephone lines. The source of current supply for these pole-changers is conveniently arranged to be the main storage battery of the exchange equipment. This battery also supplies current for incoming signals, and for the transmitters employed both at the central office and at the subscribers' stations. It is therefore very important to prevent the accession of any rapidly recurring changes in potential which would tend to make lines noisy. The vibrating pole-changers, if connected directly to the main battery busses, have a tendency to produce noise in the subscribers' lines connected to said busses, and this is particularly so where the storage battery is small or is comparatively old; that is where its internal resistance is not of the lowest, or its output of current ample for all purposes. In order to prevent this noise, I propose inserting a choking coil in the supply or feed wire between the battery and the pole-changers; but if this coil be included without any further provision, and if it offer sufficient retardation to currents of the frequencies dealt with in the pole-changers to prevent substantial leakage therefrom into the talking circuits, then the efficiency of the pole-changers is reduced to a marked degree. This is due to the fact that the peaks or crests of the successive waves are smoothed off, and the current curve is very much flattened and reduced below the shape and dimensions which give the best results in ringing. The amount of energy supplied from the main battery is substantially sufficient for the purpose, but it is no longer applied in the most efficient manner. In order to remedy this defect, and according to the present invention, I supply an auxiliary source, which may be a small storage battery or its equivalent, bridged or floated across the main battery wires, between the retardation coil and the pole-changers. Like poles of this battery and the main battery are connected to the same wires, so that the auxiliary is kept constantly charged, and in fact is called upon for no discharge except when the electromotive force due to the main battery is choked down and prevented from producing a peak current, the deficiency being then momentarily supplied for each wave by the auxiliary battery.

It will be observed that the auxiliary source is not necessarily a storage battery, nor indeed a battery at all. A generator may be employed in its place, of any desired and suitable type, and a driven generator may also be employed in place of a battery for the main source. In fact, in applying the invention in its broadest aspect to transmission systems other than such as I describe herein, the character of the source will necessarily be varied according to the character and requirements of the system. The gist of the invention lies in the employment of a source of current with associated parts so constructed as to deliver energy in successive waves or increments, together with means for accentuating the said waves, preferably by boosting the available electromotive force for each recurring wave. Where the main source of current is one like the main battery of a telephone exchange from which current must be taken intermittently for one purpose without interference with a steady and continuous supply for other purposes, the invention serves its end; but it will also serve in the case where the main source itself is not capable of supplying sharp pulsations. Assuming, for example, that an alternator of ordinary design with collector rings be substituted for

the main battery and pole-changer, the auxiliary source may then be associated with the alternator so as to furnish the boosting electromotive forces and current through a commutator or pole-changer running synchronously with the rotor of the alternator. Since the invention may therefore be applied reversely in a sense as to the functions subserved, and since I believe myself to be the first to produce a successful arrangement of this kind, I shall claim the same broadly, intending to cover all the applications of which it is capable, whether described herein or not.

In a number of telephone systems equipped with improved ringing means according to the present invention, I have made the auxiliary battery of ordinary dry cells, which of course are commonly employed only in "open circuit" work. I have found them eminently satisfactory for my purposes, and that they stand up well, because they are normally exposed to a counter e. m. f. which prevents flow as well as an open circuit. In fact, they work better than under ordinary conditions, because the counter e. m. f. tends to depolarize and restore them constantly, thus keeping their voltage up to normal.

My invention is illustrated as to the specific embodiment hereinbefore mentioned, in the accompanying drawing, in which—

Figure 1 is a diagram showing two cord-circuits of a manual telephone switchboard, equipped with selective keys, and supplied with ringing current of four frequencies from main and auxiliary batteries; Fig. 2 is a diagram of a modification.

I do not consider it necessary herein to fully describe the mechanical structures, such as the pole-changers, relays and transformers, of which I make use, since these of themselves form no part of my present invention, and since they are fully described and claimed in a prior application filed by me on the 16th day of January, 1906, Serial No. 296,309.

Referring to Fig. 1, P, P′, represent answering and calling plugs designed to cooperate respectively with the answering and calling or trunk-jacks of a manual switchboard. Each pair of plugs is connected by cord-conductors 1, 2, 3, 4, equipped with the usual or any desired form of supervisory relays and signals controlled thereby. Across each cord the main battery, B, is bridged through the wires 5—6 so as to supply talking and signaling current to the cords and the lines interconnected thereby. Each calling plug, P′, has associated with it a ringing key, K, and a set of selective keys, k, k', k^2, k^3. When the plug, P′, has been inserted in a line-jack, and the operator desires to call one of four parties on that line, she actuates one of the selective keys, k, k', etc., and the master key, K. I preferably combine these so that when any selective key is operated it automatically operates the master key. The latter breaks the cord-circuit, connects the sleeve of the plug to the wire 7 and thence through wire 5 to the main battery, B, and at the same time grounds a wire, 8, which is common to all of the cord-circuit ringing keys and constitutes the controlling wire for the pole-changer set. The sleeve of the plug is connected to battery in order that direct current may be supplied to hold up the cut-off relay of the line, since the cord-circuit is severed at the key, and the flow of battery current would otherwise be interrupted. The ringing current flows out over the tip side of the plug to line, back through the sleeve side of line and plug and to ground through the battery, B.

The wire 8 leads to the common relay, R, which controls ringing current to all of the pole-changing units, U, U′, U², U³. On the other side the relay is connected through the wire 9 to the retardation coil, M, and thence by wire 10 to the main battery. Whenever the wire 8 is grounded, therefore, a circuit will be completed from the main battery through the relay, R, and the latter will pull up.

Each pole-changer has a vibrating magnet, N, whose armature, n, carries a pendulum rod and a weight or pendulum bob, n'. Each armature also carries three contact-springs, n^2, n^3, n^4, the springs, n^3, being insulated and the others connected to the lever, which is itself connected by the wire 11 to ground. The spring, n^3, of every pole-changer is connected through wire 12 to the armature, r, of the relay, R, and when the latter is attracted, to a main battery wire 9 through the branch 13, also to the auxiliary battery wire 14, leading to the auxiliary battery B′.

It will be observed that the circuit of each vibrating magnet, N, is completed as follows: B, 10, M, 9, 15, N, 16, 17, n^2, 11 back to battery. The armatures are kept constantly vibrating, in this simple form of circuit, but may be separately controlled by suitable relays, as specified in my former application. Each pair of contacts, n^2, 17, is bridged by a condenser as usual in this type of apparatus. The pendulum bobs, n', are all of different masses, so that they have different periods of vibration. As each bob vibrates it moves the springs, n^3, n^4, back and forth between fixed contacts so as to reverse the connection of the wires 11, 12 to the wires 18, 19. By this means battery current flowing through these wires is rapidly reversed in the primary winding, t, of each transformer, T, T′, T² or T³. These transformers have their magnetic circuits and their windings properly designed to give maximum efficiency at the several fre-

quencies used, and each has a secondary winding, t', grounded on one side and connected on the other to one of the ringing leads 20, 21, 22, 23. These ringing leads pass through the vibrating compensators or protective devices to the several selective keys, k, k', k^2, k^3. These vibrators, v, v', v^2, v^3 are intended to prevent excessive flow of ringing current due to a short circuit or other trouble on a subscriber's line. Each consists of a magnet having considerable self-induction, and an armature controlling a normally closed shunt containing non-inductive resistance. Any excessive current in a ringing lead will vibrate the corresponding armature to break the shunt and expose the inductive resistance of its electromagnet.

It will be observed that whenever a key, k, is operated to ring over a subscriber's line, the relay R pulls up and puts both main and auxiliary batteries on the contact-springs, n^3. The auxiliary battery, B′, I make in practice a primary battery or a storage battery of small ampere capacity, and during operation it is kept constantly charged, since it is floated across the terminals of the main battery and subject to the damping effects of the retardation coil, M, has a constant difference of potential across its terminals. It should be noted particularly that this retardation coil, M, is in the circuit between the main battery and the vibrators, U′, etc., while the connection of the auxiliary battery to the springs, n^3, is direct. The effect of this is as follows: The armature of relay, R, being up, current flows through the primary winding, t, of each transformer from B, 10, M, 9, 13, r, 12, n^3, 18 or 19, t, 19, or 18, n^4, n, 11 and back to battery. As the armature, n, is vibrating back and forth, this circuit is made and broken a number of times per second corresponding to the tuned period of the vibrating parts; and if the retardation coil, M, were not included in the circuit sharp pulsations of current in the primary, t, would be produced. Under such conditions, however, and particularly where the storage battery B is a small one or rather old, I have found that these pulsations react, producing small periodic surgings in other circuits connected to the battery bus 5. This will be understood if it be assumed that the two cord-circuits shown in the drawing are connected to two pairs of lines, and only one of them is being used for ringing. Where the storage battery B has ample capacity, and has a normally low internal resistance, with good terminal connections, no interfering effect would be perceptible; but under the conditions named other circuits connected to the bus 5 may be rendered noisy while ringing is going on over any circuit. It is to obviate this that the retardation coil, M, is introduced. This has a good magnetic circuit, preferably closed as shown, and is wound so as to have a somewhat high coefficient of self-induction. The result is that it chokes out current changes of frequencies within reasonable predetermined limits, but in choking these back from the battery bus 5 it also has a very perceptible damping effect on the current waves in the primary circuit I have traced. The secondary effects produced by the transformers, T, are smoother than those in the primary in any event, and with the retardation coil, M, in the primary circuit the waves become so much flattened and smoothed off as to reduce the efficiency of ringing. The battery, B′, however, remedies this. When the difference of potential between the wires 11 and 9 is at a maximum, the battery B′ supplies practically no current, but when, the circuit having been closed at the contacts, n^2, 17, for an instant so that the electromotive force should be a maximum, but is not owing to the choking effect of the coil, M, then the battery B′ for a very brief interval carries the load, furnishing what I may call the peak of the wave. Although I give this explanation of the action of the battery, B′, it may be stated in other words. The battery may be called an equalizer, since it really takes up and absorbs the noisy back surgings, but I prefer to call it a "peak" battery because it accentuates or boosts the otherwise flattened waves.

With the arrangement thus described, I find that my pole-changing sets may be installed in any exchange, even those of limited size, wherein the batteries have been in use for a long time, without making the lines in the least noisy.

In furnishing equipments embodying this invention, the auxiliary battery, B′, and the coil, M, form a part of the equipment, the main terminals for battery connection in the exchange being as indicated by the letters, x. Suitable binding-posts or other terminals are also provided for the ringing leads and the wires 8, and within these terminals all the circuits and the apparatus herein shown are connected up complete and self-contained. The entire equipment is preferably housed in a cabinet provided with a shelf or other supporting means for the battery, B′.

Fig. 2 shows a form of circuit and an arrangement of the apparatus which is even simpler than that of Fig. 1. In this case, the wires, 15, instead of being carried to the wire, 9, and so deriving their current supply for the motor magnets, N, through the coil, M, are bunched on to a common return 15^a, which is carried to the bus-wire or live terminal of the main battery, B. The magnets, N, are wound so as to have a very high resistance, and hence they take so little cur-

rent that they have no disturbing effect on the talking circuits. I have found it advisable to make this direct connection to the main battery in some cases, in order to avoid any slowing down of the vibrators when a heavy load is put onto the transformers, *i. e.*, a greater load than the output of the auxiliary battery can conveniently take care of. Under such circumstances, with the arrangement of Fig. 1, the resistance of the coil, M, would limit the flow of current from the main battery, and the lowering of potential would be sufficient to weaken the movements of the vibrators. Of course, this can only occur in cases of extreme load, but I have planned my circuits so that they are adapted to produce the most efficient results even in emergencies. It will also be observed in Fig. 2 that the leads 20, 21, 22 and 23 go directly to the selective ringing keys, k, k', k^2, k^3; and that instead of having a separate master key, K, I ground the sleeve side of the plug through any one of the selective key springs. Any suitable connection of ground or battery can be employed at this point.

The diagram of Fig. 2 may be regarded as showing a very simple embodiment of the invention.

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

1. In an electrical transmission system, translating devices, a circuit therefor, a main source of current for the circuit for supplying energy thereto in quantity, an energy storing or retarding device between said main source and the transmision circuit, whereby a comparatively smooth flow of current is produced, together with a supplemental source connected outside of the energy storing device, and adapted to impress sharply varying periodic waves of electromotive force upon the circuit, so as to accentuate the effects due to the main source.

2. In an electrical transmission system, a circuit and alternating current translating devices therefor, a main source of current for the circuit supplying energy thereto in flattened waves, and a supplemental source adapted to impress synchronous accentuating waves on the circuit.

3. In an electrical transmission system, a circuit, alternating current translating devices thereon, commutating means and a plurality of sources of direct current supply for said commutating means, comprising a main source adapted to supply bulk energy and one or more supplemental sources adapted to directly modify the electromotive force so as to produce accentuated waves.

4. In an electrical transmission system a circuit, alternating current translating devices thereon, a pole-changing device, and a plurality of current sources therefor, adapted to have their electromotive forces and currents combined through said pole-changer to produce resultant effects in the line and translating devices.

5. In an electrical transmission system a circuit, alternating current translating devices thereon, a pole-changer connected therewith, a main source of continuous current connected to said pole-changer through a retardation coil, and a supplemental source connected to the pole-changer direct.

6. In an electrical signaling system a circuit, one or more signal receiving devices thereon, a pole-changer connected therewith, a main battery connected to said pole-changer through a retardation coil, and a supplemental battery connected thereto direct, whereby accentuated waves of current are produced in the circuit without any sharp changes of potential in the main battery connections.

7. In an electrical transmission system, a main source of current supply, a plurality of circuits having both alternating and direct current translating devices thereon, commutating devices for the alternating current circuits, means interposed between the main source and said commutating devices to prevent any abrupt changes on the terminals of said main source, and a supplemental source connected to the commutating devices to furnish accentuated electromotive forces thereto.

8. In an electrical transmission system a main source of current supplying a plurality of circuits having both alternating and direct current translating devices thereon, commutating devices for the alternating current circuits, means interposed between the main source and said commutating devices to prevent any abrupt changes on the terminals of said main source, and a supplemental source comprising a storage battery adapted to be charged by the main source and to discharge through the commutating devices so as to produce accentuated current waves.

9. In a telephone exchange system a plurality of circuits and a main source of current supply therefor for both talking and signaling purposes, a pole-changer associated with said source to furnish modified signaling current, a retardation coil connected between the pole-changer and the source to prevent noise on the talking circuits, and a supplemental source of current connected to the pole-changer between it and the retardation coil, so as to compensate for the loss of sharpness due to the coil.

10. In a telephone exchange system a line-circuit and a plurality of harmonic signaling devices connected thereto, a main battery supplying current for both talking and signaling purposes, a plurality of pole-

changers connected to said main battery to derive current therefrom through a retardation coil, and a supplemental battery connected to the pole-changers direct, so as to sharpen the waves produced.

11. In an electrical transmission system, a source of current, means in circuit with such source for modifying the form of current waves delivered by such source to such circuit and a second source of current adapted to correct such modified current waves.

12. In an electrical transmission system, a source of current, means in circuit with such source for flattening the current waves delivered by such source to such circuit and a second source of current adapted to correct such flattened current waves.

13. In an electrical transmission system, a source of current, means in circuit with such source for modifying the form of current waves delivered by such source to such circuit and a battery adapted to supplement such modified current waves, such battery adapted to be automatically charged from such source of current.

14. In an electrical transmission system, a source of electric energy, means in circuit with such source for retarding the flow of periodic currents therefrom, translating means in such circuit adapted to be operated by periodic currents and a second source of electric energy adapted to supply current periodically to such circuit, such currents thus supplied to such circuit adapted to combine to effectively operate such translating means.

15. In an electrical transmission system, a source of electric energy, means in circuit with such source for retarding the flow of periodic currents therefrom, translating means in such circuit adapted to be operated by periodic currents and a battery adapted to supply current periodically to such circuit, such currents thus supplied to such circuit adapted to combine to effectively operate such translating means, such battery adapted to be automatically charged from such source of current.

16. In an electrical transmission system, a circuit containing translating means adapted to be operated by periodic currents, two sources of electric energy adapted to deliver current to such circuit in periodic waves and means located between such sources of electric energy for modifying current waves delivered from one of such sources to such circuit, the resultant of such combined current waves adapted to effectively operate such translating means.

17. In an electrical transmission system, a source of current, a circuit for delivering current from such source in waves, modifying means in the circuit for causing the waves delivered therethrough to the circuit to have a form different than such waves would assume in the absence of such modifying means, and a second source of current connected to such circuit adapted to effect further changes in the form of waves delivered therefrom.

18. In an electrical transmission system, a source of current, a circuit for delivering current from such source in waves, modifying means electrically connected in the circuit for causing the waves delivered therethrough to the circuit to have a form different than such waves would assume in the absence of such modifying means, and a second source of current electrically connected to such circuit adapted to effect further changes in the form of the waves delivered therefrom.

19. In an electrical transmission system, a source of current, conductors extending therefrom, means electrically connected with the conductors for modifying the form of current waves delivered from such source to the conductors, and a second source of current electrically connected to the conductors for supplementing such current waves.

20. In an electrical transmission system, a source of current of practically constant potential, means in circuit with such source for sending current in waves through the circuit, means in the circuit for modifying the form of the current waves thus produced, and a second source of current adapted to correct such modified waves.

21. In an electrical transmission system, a source of current of practically constant potential, means in circuit with such source for sending current in waves through the circuit, means in the circuit for modifying the form of the current waves thus produced, and a second source of current electrically connected to the circuit and adapted to supplement such modified waves.

22. In an electrical transmission system, a source of current, a circuit extending therefrom, means for delivering current from such source through the circuit in waves, retardation mechanism associated with the circuit to modify the form of the current waves delivered to the circuit, and a second source of current adapted to correct the modified current waves.

23. In an electrical transmission system, a source of current, a circuit extending therefrom, means for delivering current from such source through the circuit in waves, retardation mechanism electrically connected with the circuit to modify the form of the current waves delivered to the circuit, and a second source of current electrically connected to the circuit and adapted to supplement the modified current waves.

24. In an electrical transmission system, a direct current battery, a circuit extending therefrom, means in the circuit for causing current to flow from such battery in waves,

retardation means associated with the circuit to modify the form of such current waves, and a second direct current battery adapted to correct such current waves.

25. In an electrical transmission system, a direct current battery, a circuit extending therefrom, means in the circuit for causing current to flow from such battery in waves, retardation means electrically connected with the circuit to modify the form of such current waves, and a second direct current battery electrically connected to the circuit and adapted to correct such modified waves.

26. In an electrical transmission system, a source of current, a current converter adapted to convert continuous to alternating currents in circuit with said source, a choking device adapted to eliminate battery disturbing effects in circuit with said source, and a second source of current floated across the terminals of the first source adapted to correct the current waves modified by the choking device.

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

RAY H. MANSON.

Witnesses:
A. J. ROBERTS,
C. A. GARSSON.