No. 838,545. PATENTED DEC. 18, 1906.

M. HUTIN & M. LEBLANC.

MULTIPLE TELEGRAPHY AND TELEPHONY.

APPLICATION FILED MAY 9, 1894.

4 SHEETS—SHEET 1.

Fig. 1.

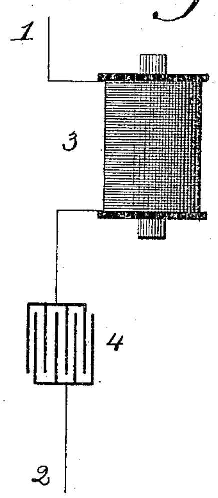
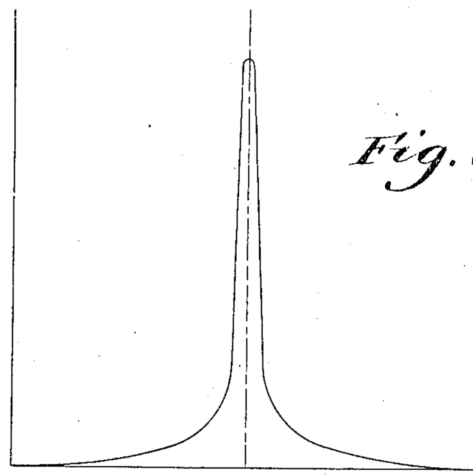


Fig. 2.



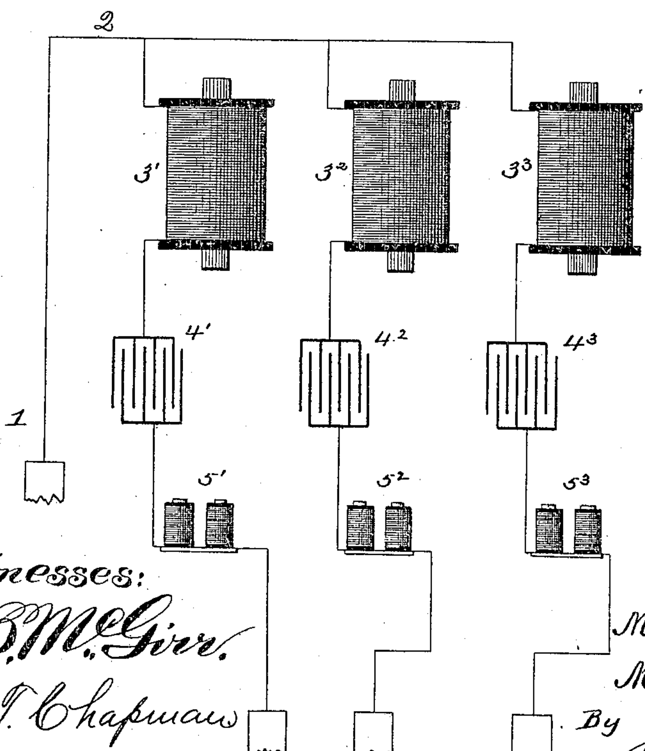


Fig. 3.

Witnesses:

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4 SHEETS—SHEET 2.

Fig. 4.

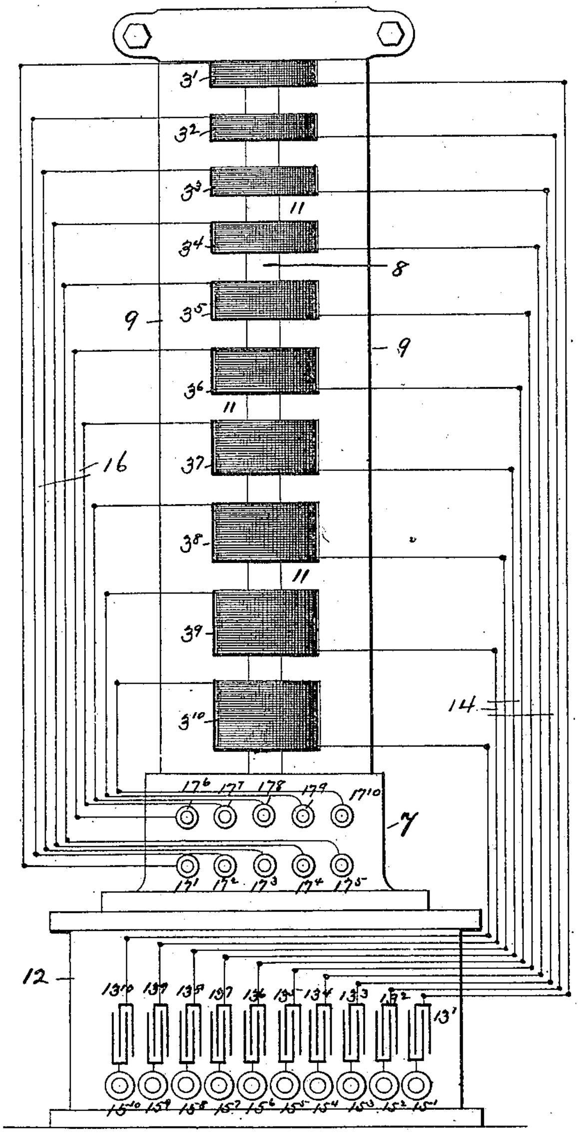
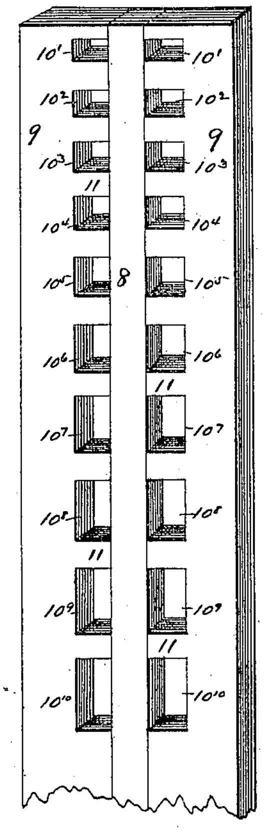


Fig. 5.



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4 SHEETS—SHEET 3.

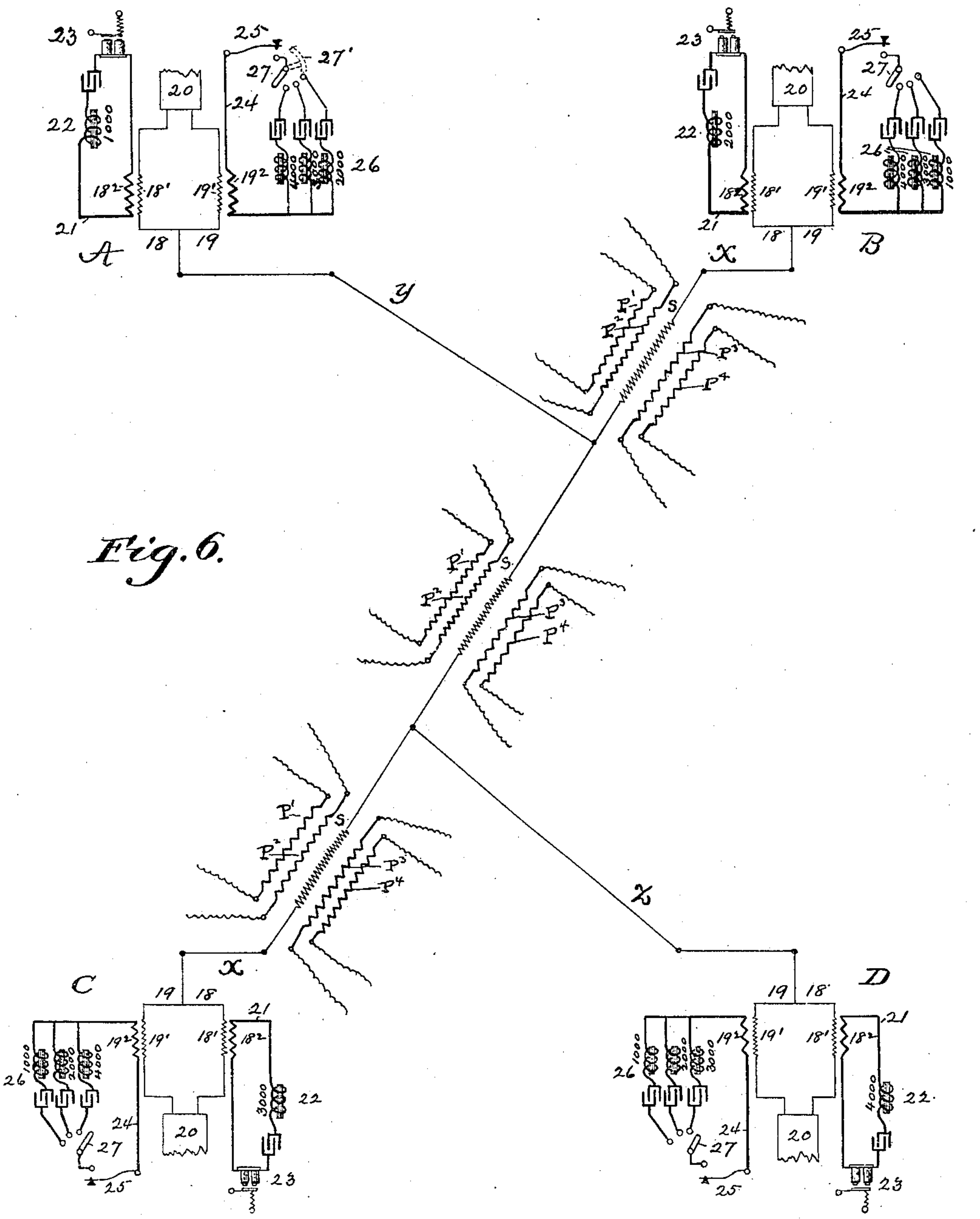

Fig. 6.

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APPLICATION FILED MAY 9, 1894.

4 SHEETS—SHEET 4.

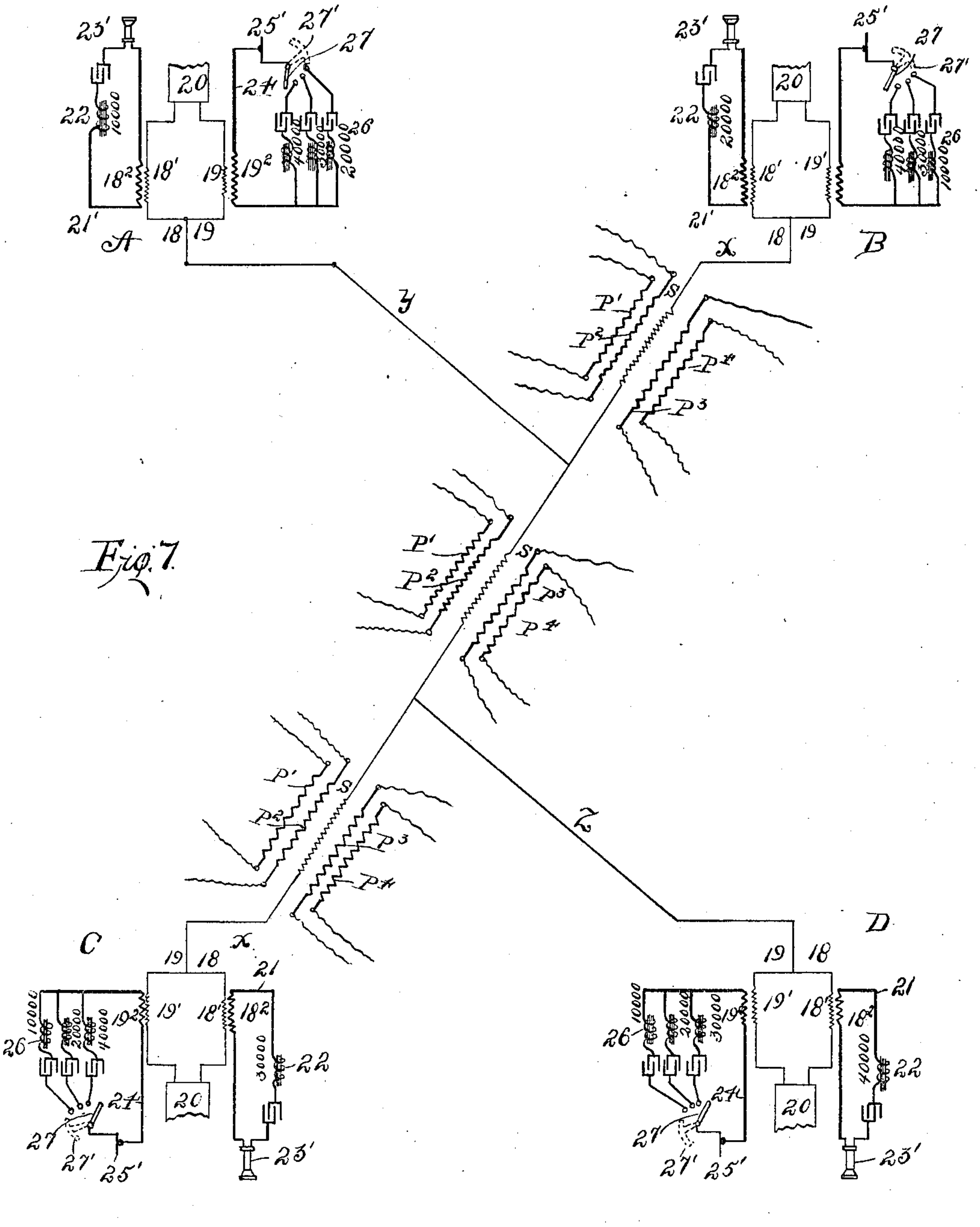

Fig. 7

Witnesses:
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F. T. Chapman

Inventors:
Maurice Hutin and
Maurice Leblanc
By Lyons & Bissing.
Att'ys.

THE NORRIS PETERS CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

MAURICE HUTIN AND MAURICE LEBLANC, OF PARIS, FRANCE, ASSIGNORS, BY MESNE ASSIGNMENTS, TO WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA, OF PITTSBURG, PENNSYLVANIA.

MULTIPLE TELEGRAPHY AND TELEPHONY.

No. 838,545. Specification of Letters Patent. Patented Dec. 18, 1906.

Application filed May 9, 1894. Serial No. 510,658.

To all whom it may concern:

Be it known that we, MAURICE HUTIN and MAURICE LEBLANC, citizens of the Republic of France, and residents of Paris, Department of the Seine, Republic of France, have invented certain new and useful Improvements in Multiple Telegraphy and Telephony, of which the following is a specification.

Our invention has reference to improvements in the art of and apparatus for multiple telegraphy and telephony, its object being to enable a number of stations to communicate with each other simultaneously, telegraphically or telephonically, over a single line without interference with each other.

In its widest application this invention includes the distribution of electrical energy for any purpose.

The invention is based upon the following facts and considerations: Over a line having a given coefficient of self-induction and a given static capacity alternating currents of only a certain definite frequency can be passed without suffering undue diminution of volume, while currents of all other frequencies are weakened to such extent as to be practically of no value. It is therefore possible to so adjust the coefficient of self-induction and the static capacity of a line that only alternating currents of the desired frequency can be passed over the same for practical purposes. This fact we have published and explained in the scientific journal known as "*La Lumière Electrique,*" published in Paris, France, in the issue of May 2, 1891, in an article entitled "Étude sur les Courants Alternatifs et leur Application au Transport de la Force."

Upon this general principle our invention is based, as will clearly appear from the following detailed description, with reference to the accompanying drawings, in which different embodiments of the invention are illustrated, as follows: Figure 1 shows an electric resonator partly in elevation and partly by conventional signs. Fig. 2 is a diagram illustrating the principle of the electric resonator. Fig. 3 illustrates in diagram a combination of electric resonators constituting an electric-current selector. Fig. 4 is an elevation, partly in diagram, of a preferred form of selector. Fig. 5 is a perspective view of a portion of the same. Fig. 6 is a diagram illustrating a system of multiple telegraphy in accordance with our invention, and Fig. 7 is a diagram showing such system adapted for telephony.

Like letters and numerals of reference indicate like parts.

In Fig. 1, let 1 2 be the terminals of a line with which a source of alternating currents is connected. In this line is inserted a reaction-coil 3 and a condenser 4 in series, as shown. The coefficient of self-induction of the line is practically that of the reaction-coil, and its static capacity is practically that of the condenser. If now we designate L the coefficient of self-induction of the reaction-coil, C the capacity of the condenser, R the resistance of the system, E the effective electromotive force—*i. e.*, the difference of potential between the terminals 1, 2, and $\frac{2}{T}$ the frequency of the alternating currents—the intensity of the currents actually passing over the line is expressed by the formula:

$$I = \frac{E}{\sqrt{R^2 + \frac{4\pi^2}{T^2}\left(L - \frac{T^2}{4\pi^2 C}\right)^2}}.$$

For different frequencies, everything else remaining constant, the intensity of current becomes different, and an examination of the expression shows that its second differential quotient is negative—that is to say, for a certain frequency the intensity I becomes a maximum. This maximum intensity is $I = \frac{E}{R}$, and it occurs when the frequency $\frac{1}{T} = \frac{1}{2\pi\sqrt{LC}}$

These principles and quantitative relations we have fully explained in our aforesaid article in *La Lumière Electrique* for May 2, 1891, and in the continuation of the article in the same journal in its issue for May 9, 1891. More elementary considerations lead to the same results, as follows: In the general expression for the intensity I of the current the denominator

$$\sqrt{R^2 + \frac{4\pi^2}{T^2}\left(L - \frac{T^2}{4\pi^2 C}\right)^2}$$

represents the impedance of the circuit, which is expressed as the square root of the sum of the squares of the resistance R and of the reactance

$$\frac{2\pi}{T}\left(L - \frac{T^2}{4\pi^2 C}\right).$$

It is clear that the current becomes a maximum when the reactance is zero; but when

$$\frac{2\pi}{T}(L - \frac{T^2}{4\pi^2 C} = O$$

there is also

$$L - \frac{T^2}{4\pi^2 C} = O$$

and

$$\frac{1}{T} = \frac{1}{2\pi\sqrt{C L}}.$$

The curve representing the general formula for the intensity has an ascending and a descending branch, and for the purposes of our invention the shape of the curve is of great importance. This curve is indicated in Fig. 2, where the abscissæ represent frequencies and the ordinates the corresponding intensities. A single glance at this curve shows that the intensity of the current is very small for a wide range of frequencies and then approaches its maximum within a very small range of frequencies. Thus, other things being equal, if alternating currents having the frequencies 1,000, 1,001, 1,002–1,999, 2,000 are simultaneously thrown upon the line only the currents having one of these frequencies will attain the maximum value, and only a few other sets of currents having frequencies closely approaching that of the maximum current will approach the maximum value, while the intensities of all other currents will be so small as to have no practical effect upon a translating device in the circuit.

It will be understood at once that if the frequencies of the different sets of currents differ from each other more than in the case above assumed—as, for instance, when the frequencies are 1,000, 1,050, 1,100–1,950, 2,000—only the currents having one of these frequencies will have an appreciable value, and in that case for all practical purposes the property of the circuit may be defined by saying that it will permit to pass through or that it will respond to alternating currents of a certain definite frequency only to the exclusion of all others. A circuit of this kind therefore behaves toward alternating currents very much like a Hemlholtz resonator toward sound vibrations, and on account of this analogy we call these circuits "electric resonators." This analogy between acoustical and electrical resonance we have fully set forth and explained in our articles in *La Lumière Electrique*, above referred to.

From the foregoing it is clear that our electric resonators are circuits in which the real reactance as distinguished from the apparent reactance for a given periodicity of alternating current is made zero, so that the impedance of the circuit is equal to its ohmic resistance.

For the purposes of our invention it is often necessary to connect a number of electric resonators together, so as to form a group. This is shown diagrammatically in Fig. 3. The line 1 2 has in multiple-arc branches the reaction-coils $3'$ 3^2 3^3 and in series with the latter the condensers $4'$ 4^2 4^3, the parts being constructed in accordance with the principles hereinbefore set forth, so as to constitute each branch an electric resonator for a given frequency—say, for the frequencies 1,000, 2,000, and 3,000, respectively. In each resonator branch is a translating device of any suitable kind—such, for instance, as a telegraphic receiver-magnet $5'$ 5^2 5^3. Supposing now that the line, either grounded at each end, as shown, or having a common return-wire, is charged simultaneously with three sets of alternating currents having the frequencies 1,000, 2,000, 3,000, respectively, it will be clear that the resonator-circuit $3'$ $4'$ $5'$ will permit only the current having the frequency of, say, 1,000 to pass through and that the other resonators will only permit the currents having the frequencies 2,000 and 3,000, respectively, to pass through If either of these currents is varied in intensity by any suitable device at any point on the line, these variations will be felt by the translating device in that resonator-circuit only which is adjusted to the frequency of the varied currents. If the variations are in accordance with a well-understood code—say, the Morse code—we can receive at the end of a single main line three different telegraphic messages, and if the resonators and sets of currents are multiplied any number of different messages may be sent and received simultaneously and without interference.

A group of electric resonators connected as shown in Fig. 3 or in any other suitable manner with a single line, either for joined or for independent operation, we call an "electric-current selector," or "current-selector," or "selector" simply. An electric-current selector composed of a number of electric resonators, each adjusted to select one component only of the energy of a multiperiodic current which is thrown upon a line, we have described and its operation explained in our article in *La Lumière Electrique* of May 9, 1891.

For practical work the resonators composing a selector may be mounted on or combined in a single structure, and such structure is shown in Figs. 4 and 5. Upon a wooden base-block 7 is vertically mounted a laminated iron core 8, upon which the coils $3'$ 3^2 3^3–3^{10} are wound with a space between the adjacent coils. While the core 8 is common to all coils, it will presently be seen that only a portion of the common core co-operates with each coil, so that each of the latter becomes an independent reaction-coil. On diametrically opposite sides of this structure are two laminated bars 9 9, each formed with a series of recesses 10′ 10^2, &c., of such width and depth and so spaced that they comfortably fit over the edges of the coils, and the teeth or projections 11 thus formed between the recesses fit into the spaces between the coils and bear upon the core 8. By this construction the circuit of the magnetic lines of force is closed or very nearly closed for each coil separately, so that these reaction-coils do not react upon each other. The lower ends of the toothed bars are either stepped into the block 7 or otherwise secured to the same, and their upper ends are clamped together and to the coils and core, as shown, or in any other suitable manner.

The base-block 7 is mounted upon a wooden box 12, which contains as many condensers 13′ 13^2–13^{10} as there are reaction-coils. Each condenser has one side connected to one terminal of its corresponding reaction-coil by wires 14, and the other side to one of the binding-posts 15′ 15^2–15^{10}, arranged in a row at the front of the box. The other terminals of the reaction-coils are connected by wires 16 with the binding-posts 17′ 17^2–17^{10} on the block 7. Each reaction-coil is thus connected in series with a condenser between the binding-posts, so that in the structure shown there are assembled ten electric resonators constituting an electric-current selector.

From what has been said before it will be understood that each resonator of the selector is constructed, in accordance with the principles hereinbefore set forth, to permit the passage of alternating currents of a certain definite frequency only and that each resonator is constructed for a different frequency. It will also be understood that while in the structure shown in Fig. 4 the resonators are not connected together and with a common line they will when in use be so connected in any suitable manner.

The principles of operation and the devices so far described may be employed for multiple telegraphy and multiple telephony in many different ways. One way of employing them is shown diagrammatically in Fig. 6. There are shown four telegraphic stations A, B, C, and D, which may be widely separated and which are connected by the branched main line *x x y z*. The station end of each branch is again split into two local branches 18 19, and the primary coils 18′ 19′, respectively, of local induction-coils are included in these branches, which have a common earth connection 20. On the main line are produced four alternating currents, each having a different frequency from the others. For the sake of convenience let it be assumed that these frequencies are 1,000, 2,000, 3,000, and 4,000. These currents may be thrown and maintained upon the line in any convenient manner—as, for instance, by induction-coils or transformers. In Fig. 6 this is indicated by the secondary coils S S S, which are included in the line, and by four primary coils P′ P^2 P^3 P^4 for each secondary coil in proper inductive relation to the same and each charged with alternating pulsatory or intermittent currents having frequencies, respectively, of 1,000, 2,000, 3,000, and 4,000 from any suitable generators. The latter are omitted in the drawings for the sake of simplicity. Other modes of charging the main line with alternating currents of different frequencies may be employed, and the transformer may be differently located, and a lesser or greater number may be employed. It is, however, preferable to locate a transformer at or about each junction of the main line with one of its main branches, as shown. It is also practicable to use simple transformers, each with a single primary coil, for the generation of the current of each frequency. At each station the secondary coil 18^2 of one local induction-coil is in a constantly-closed local circuit 21, which also includes an electric resonator 22, the reaction-coil and condenser of which are shown conventionally, and a telegraphic receiving instrument 23 of any kind, constructed to operate under the influence of alternating currents. For this purpose the core of the magnet of the receiver must be made of very soft iron and highly laminated, or, still better, instead of the ordinary electromagnet a solenoid with a soft-iron laminated movable core may be used, as is well understood by those skilled in the art. The retractile spring of the armature or of the movable solenoid-core of the receiver is so adjusted that the normal currents which circulate in the local circuit 21 will be insufficient to move the armature or the core of the solenoid, while when the current is intensified, as will presently be seen, the armature or the core will move and cause a signal to be made. The secondary coil 19^2 of another local induction-coil is included in a local circuit 24, which also contains a telegraph-key 25 and a current-selector 26, composed of three electric resonators connected in multiple arc, as shown, and a switch 27, by means of which the local circuit can be broken or closed upon any one of the three resonators composing the selector. Under the assumption that the currents generated upon the line of the frequencies 1,000, 2,000, 3,000, and 4,000, respectively, the resonators in the local receiver-circuits 21 at stations A, B, C, and D will be adjusted to permit currents of these frequencies to pass, respectively, and no other currents—that is to say, station A will have a receiver-resonator for the frequency 1,000, station B for the frequency 2,000, station G for the frequency 3,000, and station D for the frequency 4,000. On the other hand, the current-selectors will be equipped with resonators as follows: station A for frequencies 2,000, 3,000, 4,000; station B for frequencies 1,000, 3,000, 4,000; station C for frequencies 1,000, 2,000, 4,000, station D for frequencies 1,000, 2,000, 3,000. The adjustment of each resonator is obtained in accordance with the principles hereinbefore set forth—namely, by making the real reactance as distinguished from the apparent reactance of the circuit in which it is located zero for the desired frequency of current. Since the currents on the main line are constantly maintained, each receiver-circuit is constantly charged with currents of the frequency to which it is adapted; but these currents are normally too weak to operate the receivers, as hereinbefore stated.

The operation of this system will now be readily understood.

Suppose station C desires to communicate with station B. The operator at station C turns the switch-lever 27 upon the free terminal contact of that resonator of the current-selector which corresponds to the frequency which can be received at B—namely, to the contact of the resonator for the frequency 2,000, and he then operates the key 25 in the ordinary manner. At each closure of the local circuit 24 currents of the frequency 2,000 and of no other frequency are generated in the secondary coil 19^2. The effect of these currents upon the primary coil 19′ in the local branch 19 is the same as if the resistance of this branch, and thereby of the whole line, had been suddenly reduced. In fact, no reduction of resistance takes place; but the counter electromotive force in the primary coil is reduced. The effect, however, is the same. It follows from this that the intensity of the currents having the frequency 2,000 will be suddenly increased everywhere upon the line, and consequently, also, in the local branch 18′ at station B. This in turn increases the current in the local receiver-circuit 21 at station B sufficiently to actuate the receiver 23. Since there is no other receiver-circuit that will admit currents of frequency 2,000, it is clear that the messages sent from station C under these circumstances cannot be received at any other station than at station B. In like manner station C can communicate with stations A or D by placing the switch upon the free terminal contacts of the resonators for the frequency 1,000 or 4,000, respectively, and in like manner each station can communicate with every other station simultaneously without interference, as will now be readily understood. In addition to the switch-lever 27 there may be another switch-lever 27′ with a broad contact-surface (indicated at station A) by means of which any portion of or the whole current-selector may be thrown into the local circuit 24, so that the same message may be sent at the same time to all outlying stations.

From the foregoing description it will be understood that the current-selector at each station must have as many electric resonators in the local circuit 24 as there are outlying stations and that these resonators must be adjusted to frequencies corresponding to those of the resonators in the outlying local receiver-circuits. There is no theoretical limit to the number of stations which may be connected in this system, and the practical limits are exceedingly wide.

In the diagram, Fig. 6, the resonators 22 in the local receiver-circuits are shown as disconnected from the resonators composing the current-selectors in the local transmitter-circuits. In practice, however, the resonator 22 at each station may be and ordinarily will be a portion of the selector represented in Fig. 4, except that its circuit will be entirely distinct, as shown in Fig. 6.

The invention is equally applicable to multiple telephony. For this purpose telephonic transmitters and receivers are substituted for the telegraphic transmitters and receivers, and in addition thereto currents of much higher frequency are required upon the line. Since the line-currents are continuously maintained, and since in consequence thereof each local receiver-circuit is continuously charged by one set of these currents—by induction, as hereinbefore explained—the telephone-receivers will be continuously actuated, and it becomes necessary to suppress the continuous tone which each would emit. This is accomplished by giving to the line-currents such high frequencies that the pitch of the corresponding tones in the telephone-receivers exceeds the upper limit of practical audibility. The tone which in the musical nomenclature is designated by e_6 and which results from ten thousand two hundred and forty vibrations is practically inaudible—that is to say, it is so faint that it requires careful attention to hear it at all, and that it does not interfere with or drown very faint tones of much lower pitch. The highest tones produced by the human voice rarely exceed the pitch corresponding to eight hundred vibrations, and these tones are not at all affected, drowned, or obliterated by a continuous tone produced by about ten thousand vibrations. Therefore to adapt our system to telephony it is sufficient to produce upon the main line alternating currents having the frequencies 10,000, 20,000, 30,000, 40,000, &c. The telephones will then normally be practically silent. If now in the system thus charged microphones of any description are substituted for the keys 25 and telephone-receivers are substituted for the magnets 23 and sounds are uttered against the transmitters, the currents in the local transmitter-circuit in the line and in the corresponding local receiver-circuit will be increased and diminished in accordance with the numbers and amplitudes of the vibrations produced by the voice. The frequencies of these variations or beats of currents affect the telephone-receiver and are there translated into readily-audible sounds, the same as if the line were normally charged by a straight current. Vocal and other sounds, including articulate speech, can thus be transmitted between any number of stations over a single branched line simultaneously in all directions without interference.

The practicability of superimposing vibrations of low frequency upon vibrations of high frequency and rendering the former audible while the latter are inaudible will appear from the following considerations. Diaphragms although responding with tolerable ease to vibrations of numerous different frequencies have still a fundamental note which is far below ten thousand vibrations per second. If, however, it should be found that the diaphragm responds more than it should to currents of the frequency 10,000, then currents of a higher frequency will be used. The receiver will therefore be practically silent, as hereinbefore stated. Now owing to the high frequency of the currents maintained on the line the diaphragm, which is attracted when the alternating currents pass through a certain phase, cannot at the same rate complete its return movement, owing to its inertia. The diaphragm will therefore be normally in a slightly-attracted position. If now sounds are uttered against the transmitter-diaphragm, the local circuit in which it is placed will have its resistance varied at the rate of and in a manner proportionate to the amplitudes of the vibrations of the diaphragm. The consequence of this is that the local circuit reacts by induction upon the line to increase and diminish the prevailing currents on the same at the rate of and in accordance with the amplitudes of the transmitter-diaphragm; but the vibrations of the transmitter-diaphragms under the influence of speech or other sounds uttered against the same have a far less frequency than the alternating currents upon the line, so that the diaphragm of the receiver will now be acted upon at these reduced frequencies—that is to say, the receiver-diaphragm while still receiving impulses at the rate of the line-currents now receives these impulses at one time with increasing force and at another time with decreasing force, the times and amplitudes of increase and decrease being controlled by the vibrations of the transmitter-diaphragm. While the receiver-diaphragm can never complete its vibration, especially its return movements, at the rate of the line-currents, it can and does complete vibrations at the rate at which the successive currents are increased and diminished by the action of the transmitter-diaphragm. The vibrations of the receiver-diaphragm will therefore generally be represented by a curve similar to that which represents the sound-waves uttered against the transmitter, but will be slightly-modified by superimposed sinusoidal waves which are so slight as not to prevent the recognition of the original sounds. All this is fully explained in our United States Patent No. 596,017, dated December 21, 1897.

The conversion of the system from telegraphy to telephony is effected, as hereinbefore stated, by substituting telephonic transmitters for the keys 25 in the local circuits 24 and telephone-receivers for the electromagnets 23 in the local circuits 21. This substitution is indicated in Fig. 7. The telephone-transmitters there shown are marked 25′, and the telephone-receivers are marked 23′. The frequencies to which the resonators are adjusted may now be 10,000, 20,000, 30,000, and 40,000, respectively, as indicated.

It will be seen that in this system of electrical transmission when used for telegraphy or for telephony the currents normally maintained upon the line or the corresponding currents in the resonant receiving-circuits are not adapted to actuate the translating devices in the receiver-circuits either by reason of their initial weakness or by reason of their high frequency, and the character of these currents must be selectively modified in order that they be effective to operate either telegraphic or telephonic receivers. The modification required in telegraphy is the strengthening of the current in accordance with any code, and in telephony it is the strengthening and weakening of the current in accordance with sound-vibrations, which means a change of the form of the current-wave from instant to instant. In both cases, therefore, the character of the current must be modified in order to make it operative.

We desire it to be understood that we are not limited to the details of construction and arrangement herein described, since these may be variously changed without departing from the principles of our invention. Thus the reaction-coil and condenser, constituting a resonator, may be connected in derived circuits instead of in series, and, again, either the reaction-coil or the condenser may be omitted when the line, together with the apparatus included therein, has the required self-induction or the required static capacity, although as a rule a condenser will be found indispensable.

The system of distribution of alternating currents exemplified in this case as applied to the transmission of messages (telegraphy and telephony) may be used for many other purposes, and in either case the equipment of the stations may be changed without departing from our invention. Numerous other changes, additions, or modifications will readily suggest themselves to those skilled in the art.

We claim and desire to secure by Letters Patent—

1. The method of distributing electrical energy, which consists in generating a number of alternating currents of different frequencies and diverting the several energies of these currents each selectively to a circuit whose real reactance is zero for the current it is to receive, substantially as described.

2. The method of distributing electrical energy, which consists in generating simultaneously a number of alternating currents of different frequencies and diverting the several energies of these currents each selectively to a circuit whose real reactance is zero for the current it is to receive, substantially as described.

3. The method of tuning electric circuits which are in inductive relation to a line upon which alternating currents of different frequencies are simultaneously forcibly impressed, which consists in rendering zero the real reactance of each circuit for the current which it is to receive, substantially as described.

4. The improvement in the art of distributing electrical energy, which consists in throwing upon a single line simultaneously a number of normally ineffective alternating currents having different frequencies, conveying the several energies of these currents each selectively to a separate electrical translating device or devices, and selectively modifying the character of these energies so as to operate the said translating devices, substantially as described.

5. The improvement in the art of multiple electrical transmission of messages, which consists in maintaining upon a line normally ineffective alternating electric currents of as many different frequencies as there are message-receiving instruments to be controlled, conveying the energies of these currents each to a separate receiver, and selectively varying the intensity of each current in accordance with the message to be conveyed by the same, substantially as described.

6. The improvement in the art of multiple telephony which consists in producing and maintaining simultaneously a number of alternating currents of different and such high frequencies that the pitch of the tones resulting therefrom in telephones exceed the limits of practical audibility; exciting the telephones to be controlled each by one of the different currents, and selectively varying the intensity of two or more of these currents by and in accordance with sound-vibrations, substantially as described.

7. The herein-described method of multiple telephony, which consists in producing two or more vibratory currents, each of high but different initial frequency, selectively receiving these currents in associated resonant circuits, each attuned to one of said initial frequencies, and selectively modifying the amplitudes of two or more of said currents by and in accordance with sound-waves, substantially as described.

8. The improvement in the art of multiple telephony which consists in maintaining upon a line simultaneously a number of vibrating currents of different and such frequencies as to be practically inaudible in the receivers, selectively receiving the currents each in a separate receiving branch, and varying the intensity of one or each current by and in accordance with sound-vibrations, substantially as described.

9. A system for distributing electrical energy consisting of a main line, means for imposing upon the same a number of alternating currents of different frequencies; a number of circuits associated with the main line, each having its static capacity and inductance so related as to render its real reactance zero each for a different one of the frequencies of alternating currents imposed upon the main line, and a translating device in each associated circuit, substantially as described.

10. A system for distributing electrical energy consisting of a main line, means for imposing upon the same simultaneously a number of alternating currents of different frequencies; a number of circuits associated with the main line, each having its static capacity and inductance so related as to render its real reactance zero each for a different one of the frequencies of alternating currents imposed upon the main line, and a translating device in each associated circuit, substantially as described.

11. In a system of distribution of electrical energy, the combination of a main line, two or more electric resonator-circuits each tuned to a different frequency of alternating current and each containing a translating device, with means for charging the line simultaneously with alternating currents to which the resonator-circuits are permeable but inadapted to operate the translating devices, and means for selectively adapting the said currents for operating the said translating devices, substantially as described.

12. In a system of distribution of electrical energy the combination of a main line, two or more electric resonator-circuits each having its self-induction and static capacity so related as to be permeable to alternating currents of different frequency than the others. means for selectively increasing the intensity

of these currents, and a translating device for each resonator-circuit, substantially as described.

13. A system of multiple electrical transmission of messages, comprising a line terminating at two or more stations and charged with alternating currents having as many different frequencies as there are message-receiving instruments to be controlled by the line, electric resonators, one for each receiver, each consisting of a reaction-coil and a condenser in series and each adapted to a different frequency of current, and means for selectively varying the intensity of each current in accordance with the message to be conveyed by the same, substantially as described.

14. A system of multiple electrical transmission of messages, comprising a line terminating at two or more stations and having maintained upon it alternating currents of as many different frequencies as there are message-receiving instruments to be controlled by the line, message transmitters and receivers, an electric resonator for each receiver, each consisting of a reaction-coil and a condenser in series, and each adapted to a different frequency, and a current-selector for each transmitter, having as many different electric resonators as there are outlying receivers, substantially as described.

15. In a system of multiple electric transmission of messages, the combination of a main line terminating in two local branches at each of two or more stations and having maintained upon it alternating currents of as many frequencies as there are stations; local receiver-circuits one at each station, in inductive relation to one of the local branches and each containing an electric resonator for a different frequency, and local transmitter-circuits, one for each station, in inductive relation to the second local branches and containing each an electric current-selector for the frequencies of the outlying receiver-resonators, substantially as described.

16. The combination with a main telephone-circuit, of a generator of a vibratory current whose initial frequency is greater than the pitch of the human voice, a telephone-transmitter adapted to vary the amplitude of said vibrating current, and an associated resonant-circuit attuned to the frequency of said vibratory current and provided with a receiving-telephone, substantially as described.

17. The combination with a main telephone-line, means for maintaining thereon vibrating currents of different frequencies and of such frequencies as to be practically inaudible in the receivers, telephone-transmitters adapted to vary the amplitude of the vibratory currents, and associated resonant-circuits each attuned to the frequency of one of the vibrating currents and each provided with a receiving-telephone.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

MAURICE HUTIN.
MAURICE LEBLANC.

Witnesses:
CLYDE SHROPSHIN,
JULES ARMENGAUD, Jeune.