No. 717,467. Patented Dec. 30, 1902.

J. S. STONE.

METHOD OF ELECTRICAL DISTRIBUTION.

(Application filed Aug. 4, 1902.)

(No Model.) 2 Sheets—Sheet 1.

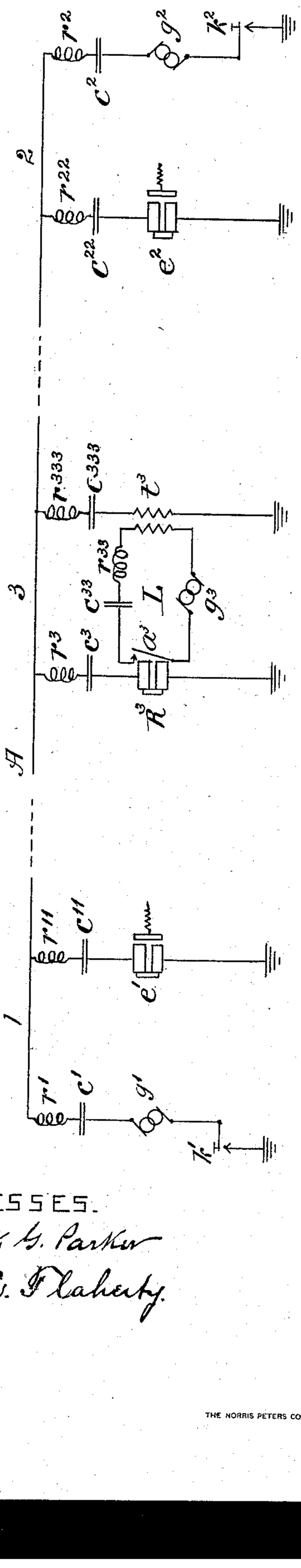

Fig. 1.

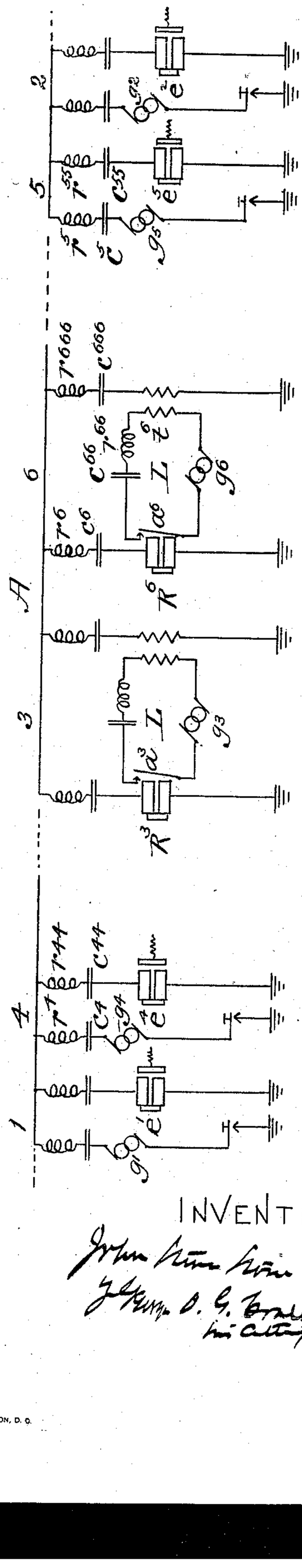

Fig. 2.

WITNESSES.
Frank G. Parker
M. E. Flaherty.

INVENTOR.
John Stone Stone
by Geo. B. Grant
his attorney.

No. 717,467. Patented Dec. 30, 1902.

J. S. STONE.

METHOD OF ELECTRICAL DISTRIBUTION.

(Application filed Aug. 4, 1902.)

(No Model.) 2 Sheets—Sheet 2.

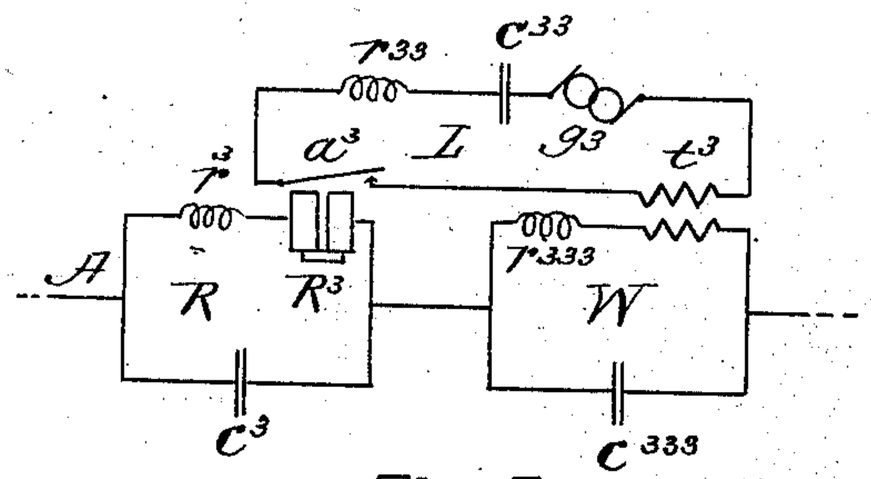

Fig. 3.

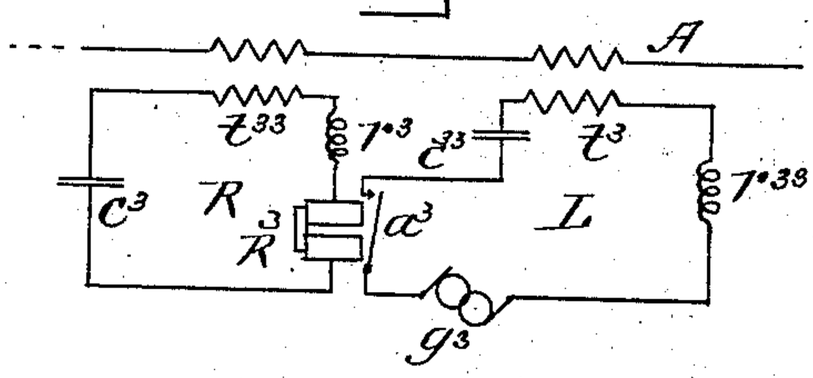

Fig. 4.

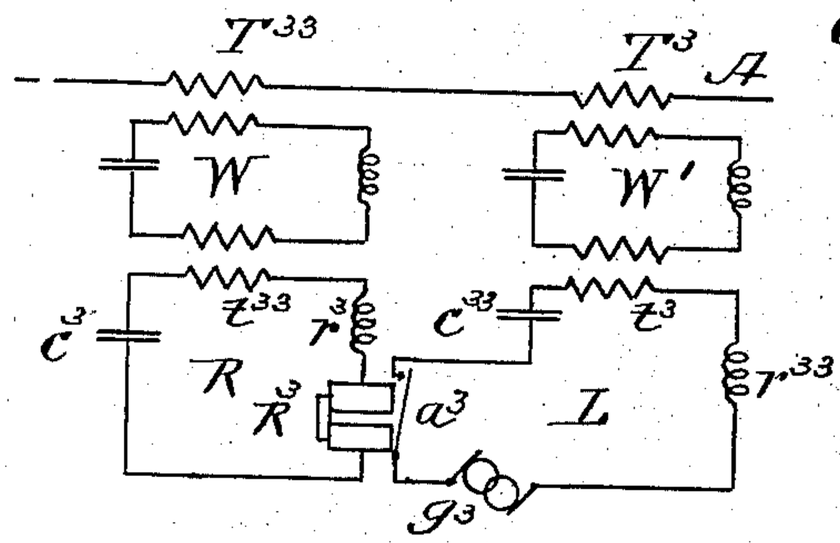

Fig. 5.

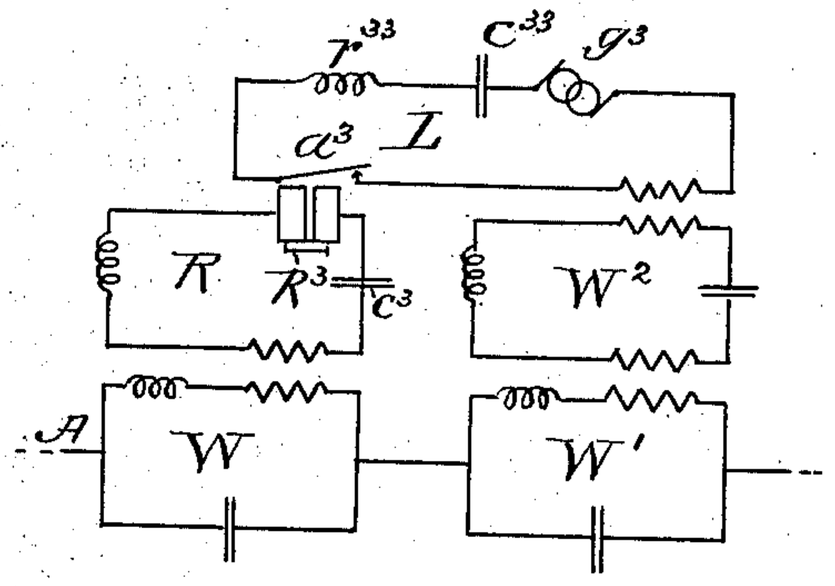

Fig. 6.

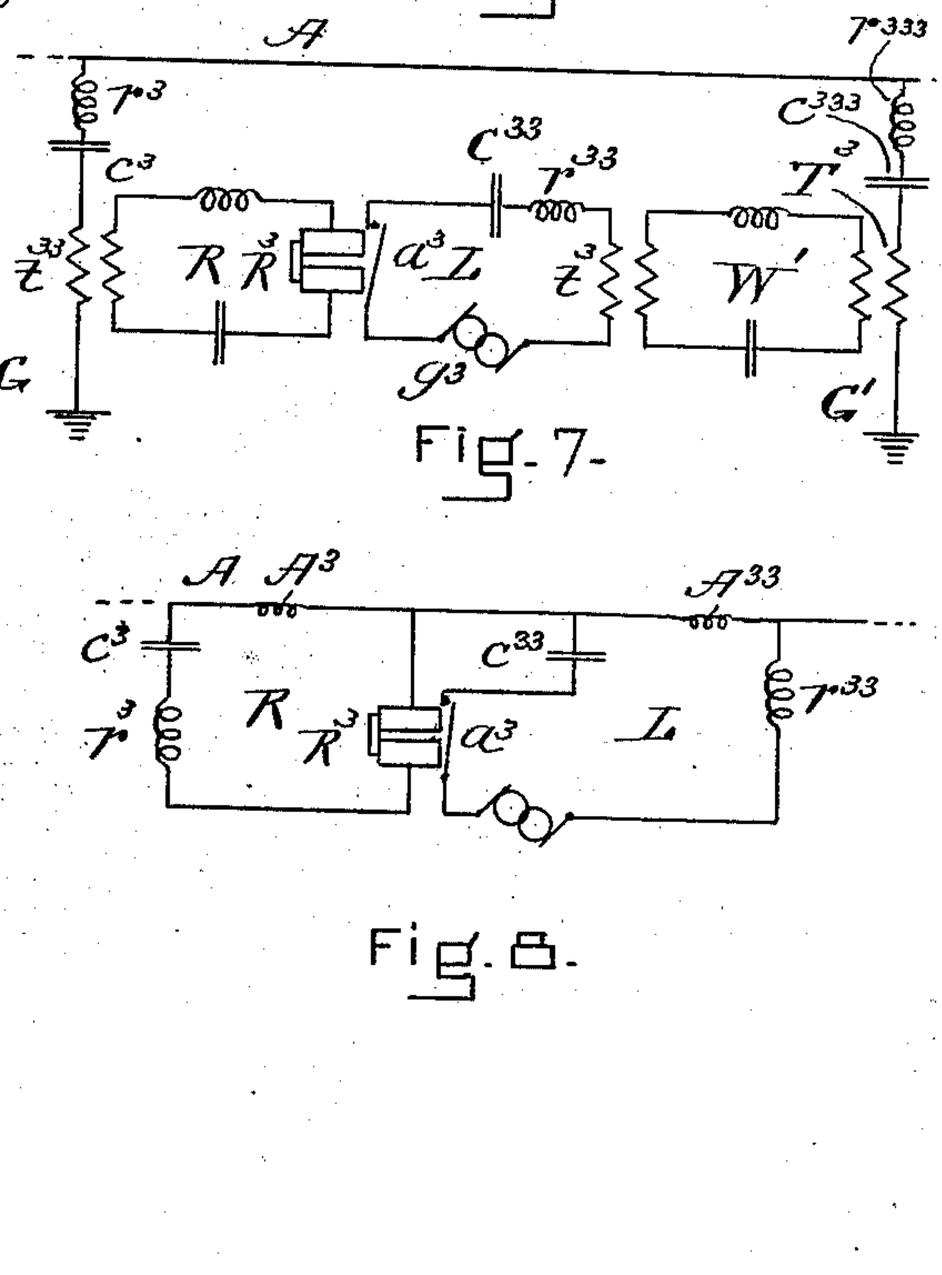

Fig. 7.

Fig. 8.

WITNESSES

Frank G. Parker

M. E. Flaherty.

INVENTOR

John Stone Stone

by Kerr, Page & Cooper

his attorneys

UNITED STATES PATENT OFFICE.

JOHN STONE STONE, OF CAMBRIDGE, MASSACHUSETTS.

METHOD OF ELECTRICAL DISTRIBUTION.

SPECIFICATION forming part of Letters Patent No. 717,467, dated December 30, 1902.

Application filed August 4, 1902. Serial No. 118,210. (No model.)

To all whom it may concern:

Be it known that I, JOHN STONE STONE, of Cambridge, in the county of Middlesex and State of Massachusetts, have invented a new and useful Method of Electrical Distribution, of which the following is a specification.

My improvement relates especially to a method of electrical distribution in which vibrating currents are employed and it is desirable to use automatic relays in the circuit. In relaying such a circuit in which the transmitting-generator and the relay-generator develop currents of the same frequency a practical difficulty arises in that the vibrations transmitted from the signaling-station to the relay on being impressed by the relay-generator upon the main line not only pass to the receiving-station, but also establish the constant operation of the relay for an indefinite period, thus thereafter preventing intelligible signaling. Instead of being effective at the receiving-station only the vibrations thus become constant and serve not only to confuse the operation of the receiving instrument, but also to render constant the transmitting action of the relay. The relay therefore becomes what may be termed a "center of wasted energy" in that it continually signals to itself instead of relaying intelligibly to the receiving-station. The reason for this in the case supposed is that the relay-circuit contains means for generating a vibrating current of the same frequency as that which impresses the line at the signaling-station. The current so generated impresses the main line, and hence not only signals to the receiving instrument, but also continues to actuate the relay-armature through its coils, which are in a branch from the main line. So long, therefore, as the relay-generator can operate it will react upon itself through the relay-coils irrespective of the signals transmitted from the signaling instrument and irrespective of the action of the transmitting-station, and will thus render nugatory any attempt at the transmitting-station to communicate intelligibly with the receiving-station.

My improved method of distribution consists in causing the signals which are to be transmitted to effect the transmission of similar signals by currents of different frequency which shall act upon a properly-attuned receiver by which the signals shall be received. In a circuit containing two terminal stations this method may be carried out by apparatus at each station comprising, in addition to proper receiving instruments, means for producing and impressing upon a main circuit vibrating currents of a given frequency, with the addition at some convenient point of a relay adapted to respond to the impressed vibrating current. The local circuit at the relay-station, however, should contain means for producing and impressing upon the line a vibrating current of different frequency, and the receiving means at each terminal station should be such as will respond only to the vibrating currents originating in the local circuit of the relay. In such a case, while the signals are originated at a given frequency of vibration and excite the relay-armature, which alone is capable of receiving them, the signals of different frequency impressed by the relay-generator have no effect upon the relay-armature, but only cause a response in the receiving means which is made resonant to the frequency of current developed by the relay-generator. It is evident that this method may be elaborated in various ways and that by its use a main line can be utilized for a number of stations each having its own system, comprising a signaling and receiving means differently attuned and a relay the receiving member of which is attuned to the transmitting means of the system, and the transmitting member of which is attuned to the receiving means of the system, the several instruments of each system being differently attuned for the instruments of every other system.

I have shown in the drawings in diagrammatic views several means by which my method may be carried out.

Figure 1 shows a two-station line; Fig. 2, a four-station line. Figs. 3, 4, 5, 6, 7, and 8 show various means for associating the resonant circuits of the relay with the main line which may be substituted for those shown in Figs. 1 and 2.

In each of the views, A is the main line.

In Fig. 1 I have shown two stations (numbered, respectively, 1 and 2) having between them a relay-station, (numbered 3.) The sta-

tion 1 comprises transmitting or signaling and receiving instruments. The transmitting instruments are primarily a key k' and means for impressing a vibrating current on the line, such as an alternating generator g', the receiving instrument being shown diagrammatically as an electromagnet e'. Each transmitting instrument and each receiving instrument is connected with the main line A by means of a condenser c' c^{11} and an inductance-coil r' r^{11}. The station 2 is arranged in like manner, its key being lettered k^2, its generator g^2, its receiving instrument e^2, its condensers c^2 c^{22}, and its inductance-coils r^2 r^{22}. The relay-station comprises a relay-coil R^3, connected with the main line A through a condenser c^3 and inductance-coil r^3, the other terminal of the relay-coil R^3 being grounded. The local circuit of the relay (marked L) comprises an armature a^3 in the field of the relay R^3, means for developing a vibrating current—for example, an alternating generator g^3, connected with one coil of a transformer t^3, an inductance-coil r^{33}, and a condenser c^{33}. The second coil of the transformer t^3 is connected through a condenser c^{333} and inductance-coil r^{333} with the line A, its other terminal being grounded. When my method is carried out by means of such apparatus, the generators g' and g^2 are capable of developing currents of the same frequency, and each is effective to operate only the armature a^3 of the relay-circuit; but the generator g^3 at the relay-station develops currents of a frequency different from the generators g' and g^2 and is capable of operating the armatures of the receiving instruments e' e^2. Thus suppose a signal to be sent from station 1. The generator g' of that station causes the operation of the circuit-closing armature a^3 at the relay-station, but has no direct effect upon the receiving instrument e^2 at station 2, for the reason that the circuit in which that instrument is included is made resonant to the frequency of the current developed by the relay-generator g^3 and not to the frequency of the generator g'. The closing of the armature a^3, however, causes the effective operation of the generator g^3, which, developing a current to the frequency of which the circuit in which is the receiver e^2 is attuned, causes the receiver e^2 to receive the signal without, however, in any way affecting the continued and intelligible operation of the armature a^3 at the relay-station.

In Fig. 2 there are added to stations 1, 2, and 3, as above described, two other stations 4 and 5, with their relay-station 6, the parts being lettered in like manner, as in Fig. 1; but each element at each station being distinguished by the number of its station, the condensers being lettered c^4, c^{44}, c^5, c^{55}, c^6, c^{66}, and c^{666}, and the inductance-coils r^4, r^{44}, r^5, r^{55}, r^6, r^{66}, and r^{666}. In this case the generators g' and g^2 are capable of developing currents of the same frequency as in the former case, and each is capable of operating the armature a^3 at relay-station 3, while the generator g^3 develops a current of a different frequency capable of operating the armatures of the receiving instruments e' e^2. The generators g^4 g^5 are each capable of developing currents of the same frequency, a frequency, however, different from that developed by any other generators in the circuit, and are capable of operating the armature a^6, and the generator g^6 at the relay-station 6 is capable of developing a current of still a different frequency which operates the armatures of the receiving instruments e^4 e^5. In this case the generators at stations 1 and 2 operate the armature a^3 only, the generators at stations 4 and 5 operate the armature a^6 only, while the generators g^3 and g^6 operate, respectively, the receiving instruments e' e^2 and e^4 e^5. It is evident, therefore, that either station 1 or station 2 may be operated at the same time that either station 4 or station 5 is being operated and that each relay will pick up the signal intended for it and transmit it to the receiver intended to receive it, as above described. My method may be extended in like manner to include a greater number of stations than those shown and described above.

I have shown in Figs. 3 to 8, inclusive, various ways of associating a relay with a circuit of the character described for the purpose of carrying out my method of distribution, each way having certain advantages which will not only be apparent to those skilled in the art, but will indicate the breadth of the application of my invention. In order to prevent unnecessary repetition in the description of these views, I have lettered what I term the "local" circuit of the relay—viz., that circuit which contains the generator and the armature—with the letter L, the parts in that circuit when necessary being lettered, as in Fig. 1—viz., the generator g^3, the condenser c^{33}, the inductance-coil r^{33}, the armature a^3, and the transformer t^3—and I have lettered the circuit of the relay-coil R. In Fig. 3 the relay-coil R^3 is in a loop-circuit R of the main line A, which loop-circuit contains an inductance-coil r^3 and a condenser c^3. The local circuit L contains one element of the transformer t^3, the other element of which is in the loop W of the main line A, which loop also contains the inductance-coil r^{333} and condenser c^{333}. In Fig. 4 instead of making a direct connection with the main line A, I have inserted in the main line A one element of the transformer t^3, the other element of which is in the local circuit L, and I have shown the relay-circuit R as containing also one element of another transformer t^{33} of similar character, the other element of which being also in the main line A. In Fig. 5 the arrangement is similar, except that between the relay-circuit R and the main line A, I have introduced a weeding-out circuit W, comprising an element of each of two transformers, one, the transformer T^{33}, the other element of which is in the circuit R, the other,

the transformer T^{33}, the other element of which is in the main line A, and in the same way the local circuit L affects the main line through a weeding-out circuit W', similar in all respects to the weeding-out circuit W, but acted upon by the transformer t^3 and acting through a transformer T^3 upon the main line. In Fig. 6 there is a further modification in which the weeding-out circuits W and W' form loops in the main line A, the local circuit being lettered L, as before, and a third weeding-out circuit W^2 being effective to communicate the impulses by means of suitable transferences from the local circuit L to the weeding-out circuit W', looped into the main line. In Fig. 7 there is still another modification, in which instead of weeding-out loops, as shown in Fig. 6, grounding branches G and G' are provided, each carrying one element of the transformers t^{33} T^3, respectively, a condenser c^3 c^{333}, an inductance-coil r^3 r^{333}, the relay-circuit R, also containing one element of the transformer t^{33}, and the local circuit L, also carrying one element t^3 of the transformer, which acts upon the branch G' through the weeding-out circuit W'. Still another modification is shown in Fig. 8, where the relay-circuit R is in a loop-circuit of the main line A, having a coil A^3 of small inductance as compared with the inductance-coil r^3 of the relay-circuit, the local circuit L being also a loop of the main line A and having a coil A^{33} of small inductance compared with the inductance-coil r^{33}. In this modification the coils A^3 A^{33} serve to direct the energy of the current into the local resonant circuit containing the relay. From this it will be seen that my method herein described may be carried out by means of any one of a number of combinations and modifications, many of which, as well as many others, will suggest themselves to one skilled in the art when it is understood that the purpose of my invention is to provide a method of relaying by means of resonant circuits which consists in causing the signals which are transmitted by one or more generators transmitting waves of different frequencies each to its own relay, from which the signals are retransmitted by generators capable of transmitting waves of other frequencies to receivers of corresponding frequency.

I have described my method as carried out by placing such apparatus as needs to be selective in its operation in resonant circuits attuned to the frequency to which it is to respond; but I do not wish it to be understood that this is the only means by which my method of relaying may be carried out, as its novelty depends upon the use of one frequency for transmitting and another frequency for receiving and not upon the means employed for imparting the selectivity to the mechanism.

What I claim as my invention is—

1. The method of relaying signals received by a tuned receiver of an alternating-current telegraph system which consists in causing such signals to effect the sending of similar signals by currents of a different frequency.

2. The method of absorbing the energy of currents of one frequency traversing a main line to the exclusion of the energy of currents of other frequencies traversing said line, which consists in diverting the energy of the current of said frequency by means of an inductance-coil included in said main line into a local resonant circuit containing a tuning-coil of inductance very large compared to the inductance of said coil included in the main line.

In testimony whereof I hereunto set my name this 29th day of July, 1902.

JOHN STONE STONE.

Witnesses:
GEORGE O. G. COALE,
M. E. FLAHERTY.