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PATENTED SEPT. 12, 1905.

S. F. JONES.
TELEGRAPHY.

APPLICATION FILED APR. 6, 1905.

2 SHEETS—SHEET 1.

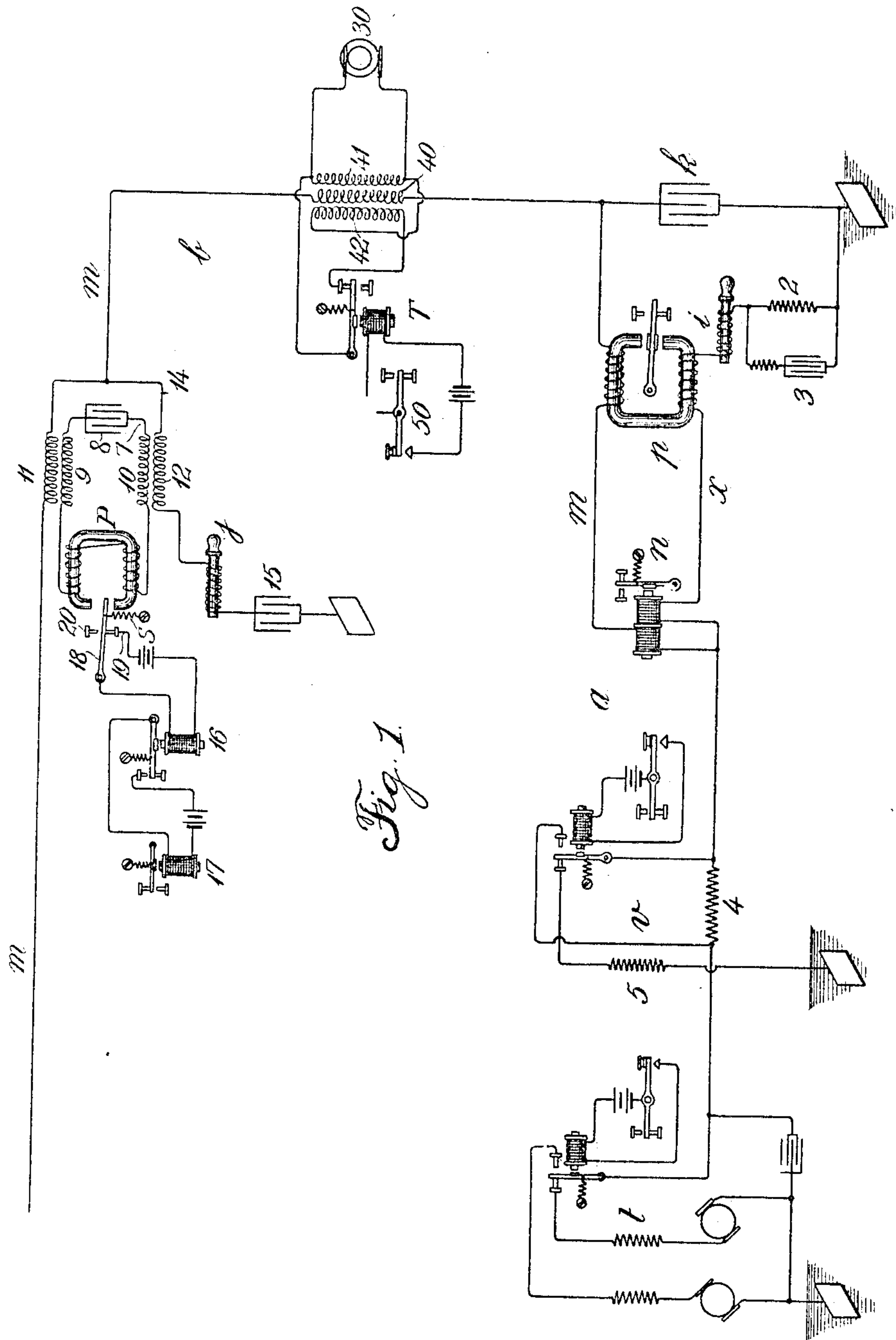


Fig. 1.

Witnesses
A. M. Donlevy.
H. Heichel.

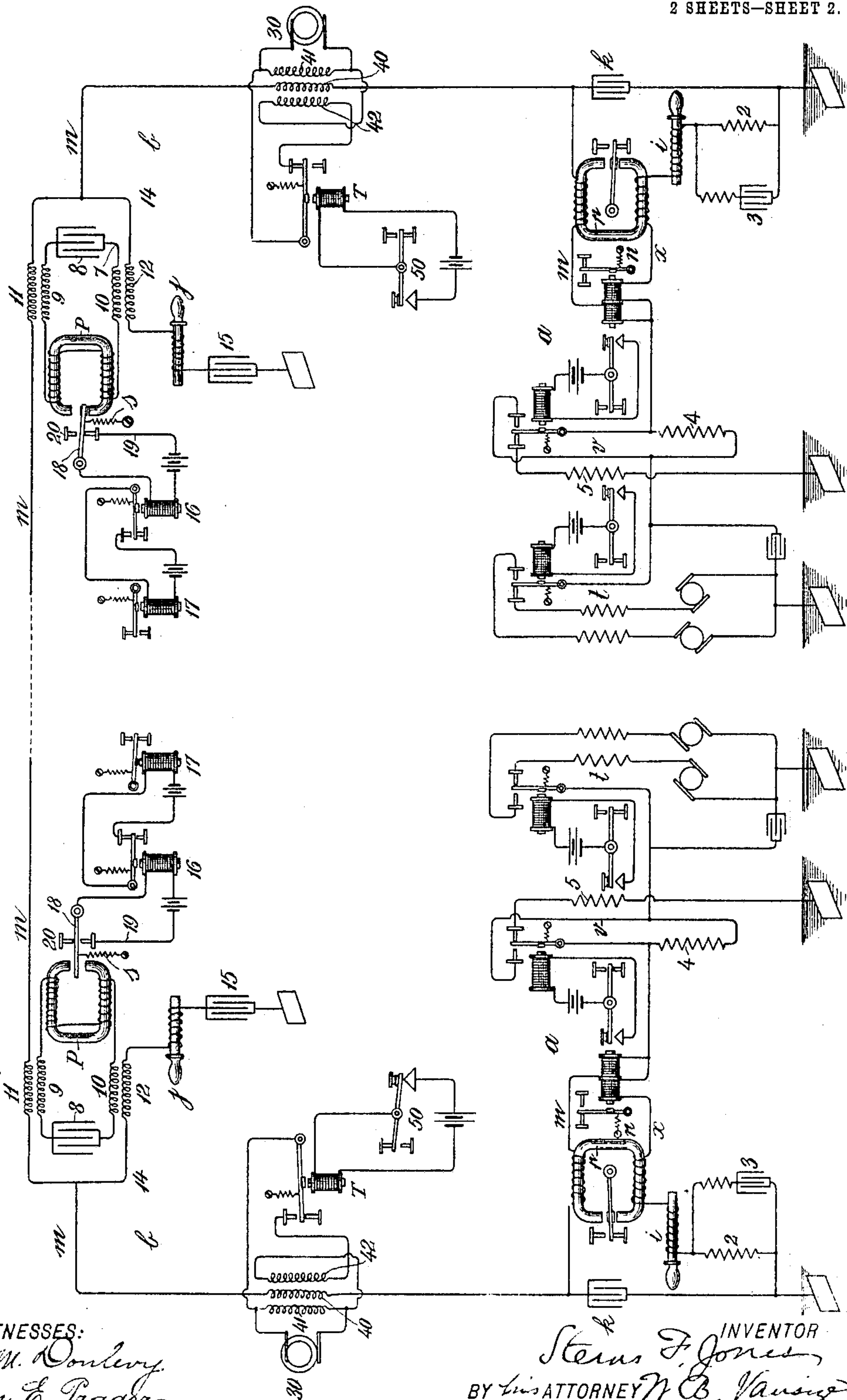
Inventor
S. F. Jones
By his Attorney W. B. Fausz

S. F. JONES.
TELEGRAPHY.

APPLICATION FILED APR. 6, 1905.

2 SHEETS—SHEET 2.

Fig. 2



WITNESSES:
A. M. Donlevy
John E. Trager

INVENTOR
Stearns F. Jones
BY *his ATTORNEY N. B. Vansiger*

UNITED STATES PATENT OFFICE.

STERNS F. JONES, OF NEW YORK, N. Y., ASSIGNOR OF ONE-HALF TO
POSTAL TELEGRAPH-CABLE COMPANY, OF NEW YORK, N. Y., A
CORPORATION OF NEW YORK.

TELEGRAPHY.

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To all whom it may concern:

Be it known that I, STERNS F. JONES, a citizen of the United States, residing in the borough of Brooklyn, in the city of New York, county of Kings, State of New York, have made certain new and useful Improvements in Telegraphy, of which the following is a specification.

My invention relates to that class of apparatus in which two or more sets of signals are simultaneously transmitted on a single main line.

The object of my invention is to increase the capacity of telegraph-circuits and also to improve the effectiveness of the transmitted signals.

I employ a single main line with a suitable return-conductor, which may be the earth. At the terminal stations there are means for transmitting and receiving signals by continuous current impulses. This may be by making and breaking the circuit, by reversing the polarity of the current, or by increasing and decreasing the amperage or current strength, or it may be a combination of the two last-named methods of signaling. At two or more intermediate points or stations I provide two grounded branches with a condenser in each branch, two balanced receiving instruments, one for each point or station, and two sources of short rapid alternating impulses of electricity, such as an alternating-current generator operating at four or five hundred cycles per second. The described receiving instrument is in a local circuit in series with a condenser and is inductively connected with the main line on one side and with the described grounded condenser branch on the other side, so that it is neutral to transmitted impulses from the associated source of alternating current which is located between the grounded branch and the terminal station. I place an inductance in each grounded branch to compensate for the presence of equal and opposite inductive effects in the main line. The associated transmitting apparatus includes at each intermediate station a transformer having three coils. One coil is in the main line. A second coil is connected to the source of alternating current, and the third coil is so connected with a suitable transmitter and said source that it may be made to neutralize the

action of the second coil or not according to the position of the transmitter. By this means I am enabled to throw alternating impulses into the main line without breaking the circuit of the alternating-current generator.

The accompanying drawings illustrate my invention.

Figure 1 shows the apparatus at one terminal and one way station. Fig. 2 shows the apparatus at two terminal stations and two intermediate points or stations electrically united.

The apparatus at one terminal station is a duplicate of that at the other, and the apparatus at one intermediate station is a duplicate of that at the other.

m is the main line or circuit.

a is a terminal station.

b is an intermediate point or station.

At station *a* there is a differentially-wound neutral relay *n* and a differentially-wound polarized relay *p*, each operating the ordinary arrangement of locals and sounders. Relays *n* and *p* have a coil in the main line *m* and a coil in the artificial line *x* with a resistance 2, substantially equivalent to the ohmic resistance of the main line, in connection with which is a capacity in the form of a condenser 3, arranged in a well-known manner.

i is an adjustable inductance to compensate for the effect due to apparatus in the main line at intermediate points or stations to be described.

t is a pole-changing transmitter, and *v* is an ampere-changing transmitter—that is, it changes the current strength by introducing a resistance 4 and connecting a leak branch containing a resistance 5, all as shown and described in a patent issued to Stephen D. Field July 5, 1881, No. 243,698, the arrangement being known as the "Field shunt and leak arrangement of transmitter."

The apparatus described at station *a* provides means for transmitting two signals simultaneously in the same direction and receiving two signals simultaneously from the distant station, each elemental part of a signal being composed of an impulse of current co-terminus with such element. At intermediate stations I provide apparatus for transmitting and receiving by different current impulses,

each elemental part of a signal being composed of groups of alternations.

At station *b* P is a polarized relay in a local circuit 7 with a condenser 8. One coil 9 of a transformer is in the circuit 7, the secondary coil 11 of which is in the main line *m*. There is a primary coil 10 of a second transformer in the circuit 7, the secondary coil 12 of which is in a branch 14, connected to the main line *m* and to one plate of the condenser 15, the opposite plate of which is connected to the earth. There is also an inductance *j* in the branch 14 to compensate for inductive effects due to the presence of equal and opposite effects in the main line. The relay P is the ordinary form of polarized relay and is without magnetic bias. I provide a spring or retracting device *s* to maintain the local circuit of the repeating-sounder 16 closed when no alternating impulses are present in the coils of relay P. The repeating-sounder 16 operates a reading-sounder 17 by means of a local circuit in a manner well understood. The armature 18 of the relay P when the relay is subjected to short rapid impulses of electricity takes up a central position between the stops 19 and 20 and is absolutely quiet so far as the emission of a tone or sound is concerned. Heretofore it has been common practice to employ a telephone as a receiving instrument or relay to operate a local circuit through a dancing or vibrating lever circuit-closing point; but the sound emitted by the telephone-diaphragm is extremely objectionable and confusing, and my arrangement of a polarized relay herein shown and described is novel and of great commercial value.

By the employment of the grounded branch 14, as described, impulses coming from the terminal station *a* or stray currents coming onto the line through defective insulation between the branch 14 and station *a* are ineffective in the coils of the relay P, while straight current variations coming from the distant terminal station are ineffective in the coils of relay P, because of the presence of the condensers 8 and 15.

The transmitting apparatus T at station *b*, employed to influence the relay P at the distant station, consists of a source 30 of short rapid alternations of current. This preferably is an alternating-current generator yielding, say, four hundred cycles per second. 40 is the secondary coil of a transformer included in the main line *m*. There are two primary coils 41 and 42, which are exactly equal in their electromagnetic effect upon the coil 40. Coil 41 is connected to the terminals of the generator 30. Coil 42 is connected to the contact-points of a transmitter T and to the terminals of the generator 30 in such a manner that when the transmitter T is operated the circuit of coil 42 is either opened in one position of the transmitter T or is closed and

opposed in its effect to the influence of the coil 41. This latter function is accomplished by reversing the connection of the coil 42 with respect to the coil 41 in establishing connection with the generator 30. When the transmitter T is closed by the operation of the Morse key 50, groups of alternating impulses are thrown into the main line *m* by the inductive action of the transformer and the generator 30. Normally the coils 41 and 42 are opposing each other and no current impulses due to the generator 30 appear in the line *m*. When the key 50 is closed, the circuit of coil 42 is opened and the inductive action of the primary coil 41 is immediately apparent in the secondary coil 40 and in the main line *m*. Groups of impulses of varying length formed according to the Morse code thrown upon the line *m*, as described, divide at the point of connection with the branch 14, and the relay P does not respond. The relay P at the second intermediate point or station, however, responds to incoming signals from the point or station *a*, and the relay P at the point or station *b* responds to signals from the alternating-current generator 30 under control of the key 50 at the distant point or station.

By my arrangement of apparatus two sets of signals or communications may be simultaneously transmitted and received between the terminal stations, while two other and distinct sets of signals or communications may be simultaneously transmitted or received between points or stations intermediate the terminals. The condenser *k* in a branch at station *a* affords a path for the alternating impulses outside the terminal instruments.

What I claim, and desire to secure by Letters Patent, is—

1. The combination of a suitable telegraph line or circuit, means for transmitting signals consisting of a source of short and rapid current alternations and a suitable transmitter for throwing said alternations onto the line in groups of varying length and sequence, and at a receiving-station a suitable relay in a balanced separate circuit and means for inductively connecting said circuit with the main and branch lines.

2. The combination of a suitable telegraph line or circuit, a source of short, rapid, current alternations, a transmitting device and means for connecting said transmitter with the line and source, and at a receiving-station a suitable relay, a separate balanced circuit therefor, a condenser in series in said circuit and means for inductively connecting said circuit with said main line and branch.

3. The combination of a suitable telegraph line or circuit, a source of short, rapid, current alternations, a transmitting device suitably connected with the line and said source, and at a receiving-station a relay, a separate circuit therefor, a condenser in series in said

circuit and two transformers, one coil of each of which is in said separate circuit, the secondary coils being in the main line and branch, respectively.

5 4. The combination of a telegraph line or circuit, a source of short and rapid current alternations, a transmitting device suitably connected with the line and said source, and at a receiving-station a grounded branch, a con-
10 denser in said branch and a relay inductively connected with said main line and branch.

5 5. The combination of a telegraph line or circuit, a suitable relay or receiving device and at a transmitting-station a transformer
15 composed of three coils or coil-windings, one of which is located in the main line, a source of short, rapid current alternations electrically connected to the terminals of the second coil, a suitable transmitting device connected to
20 the terminals of the two last-named coils, and means whereby the operation of said transmitter neutralizes the inductive influence of two of said coils with respect to the line-coil.

25 6. The combination of a telegraph line or circuit, a suitable relay or receiving device and at a transmitting-station a transformer composed of three coils or coil-windings, one of which is located in the main line, a source of short, rapid current alternations electrically
30 connected to the terminals of the second coil, a suitable transmitting device connected to the terminals of the two last-named coils and means whereby the operation of said transmitter alternately neutralizes the normal in-
35 ductive influence of one of said coils upon the line-coil.

7. The combination with a telegraph line or circuit at each terminal station, of means for transmitting and receiving signals by continu-
40 ous current impulses and at two or more intermediate points or stations two grounded branches, a condenser in each branch, two balanced receiving instruments one for each point or station suitably connected with said
45 main line and branch, two sources of short and rapid alternations of current, one for each point or station, means for throwing such alternations into the main line at points between each main-line terminal and said condenser
50 branches, respectively, and a grounded condenser branch between said straight-current instruments at the terminal station and said alternating apparatus at the intermediate point or station.

55 8. The combination at each terminal station of a main and artificial line, a balanced neutral receiving instrument and a balanced polarized receiving instrument with a suitable source of continuous current, a pole-changing
60 transmitter and an ampere-varying transmitter in a suitable transmitting branch; and at two intermediate points or stations two grounded branches, a condenser in each branch, two balanced receiving instruments,

one for each station or point, each inductively 65 connected with the main line and a branch, two sources of short, rapid alternations of current one for each point or station with means for throwing such alternations into the main line at points between each terminal and said
70 condenser branches, respectively.

9. The combination with a telegraph-line at each terminal station of means for simultaneously transmitting and receiving two sets of signals and at each of a pair of intermediate 75 points or stations, a grounded branch, a condenser in said branch, a balanced receiving instrument inductively connected with the main line and branch, a source of short, rapid, current alternations and means for throwing 80 such alternations into the line at a point between the main-line terminal and said condenser branch.

10. The combination with a telegraph-circuit at an intermediate point or station of a 85 grounded branch line, a condenser in said line, a receiving instrument in a separate circuit, and two transformers each having a coil in said separate circuit, a coil in the main line and a coil in the grounded branch, with means 90 at a second separate point or station for transmitting signals consisting of a suitable transmitting device and a source of short, rapid, current alternations.

11. The combination with a telegraph-line 95 of means for transmitting signals by short, rapid alternations at one point or station and at a second point or station a grounded branch, a condenser in said branch, a receiving instru- 100 ment in a separate circuit, two transformer-coils in said circuit and two secondary coils therefor located in the main line and grounded branch, respectively.

12. The combination with a telegraph-line of means for transmitting signals by short, 105 rapid alternations at one point or station and at a second point or station a grounded branch, a condenser in said branch, a receiving instrument in a separate circuit, two transformer-coils in said circuit, two secondary coils there- 110 for located in the main line and said branch respectively, and a condenser in said separate circuit.

13. The combination of a telegraph line or circuit, having at separated stations continu- 115 ous-current transmitting and receiving apparatus with a transmitting point or station having a source of short, rapid alternations of current and a receiving-station therefor hav- 120 ing a grounded condenser branch, a relay or receiving instrument inductively connected to said main line and branch and an inductance in series in said condenser branch.

14. The combination with a suitable tele- 125 graph-circuit of a transmitter at one station combined with a source of short, rapid, alternations of electricity, and at a second station a polarized relay inductively connected with

the main line, a local circuit therefor, containing a repeating-sounder, a second circuit containing the repeating-points of said sounder and the coils of a reading-sounder, and means whereby said relay-armature assumes an intermediate position between the stops during the existence of short and rapid

current impulses in its coils and rests upon its circuit-closing point upon the cessation of such impulses.

STERNS F. JONES.

Witnesses:

HENRY G. FRITSCHÉ,
A. M. DONLEVY.