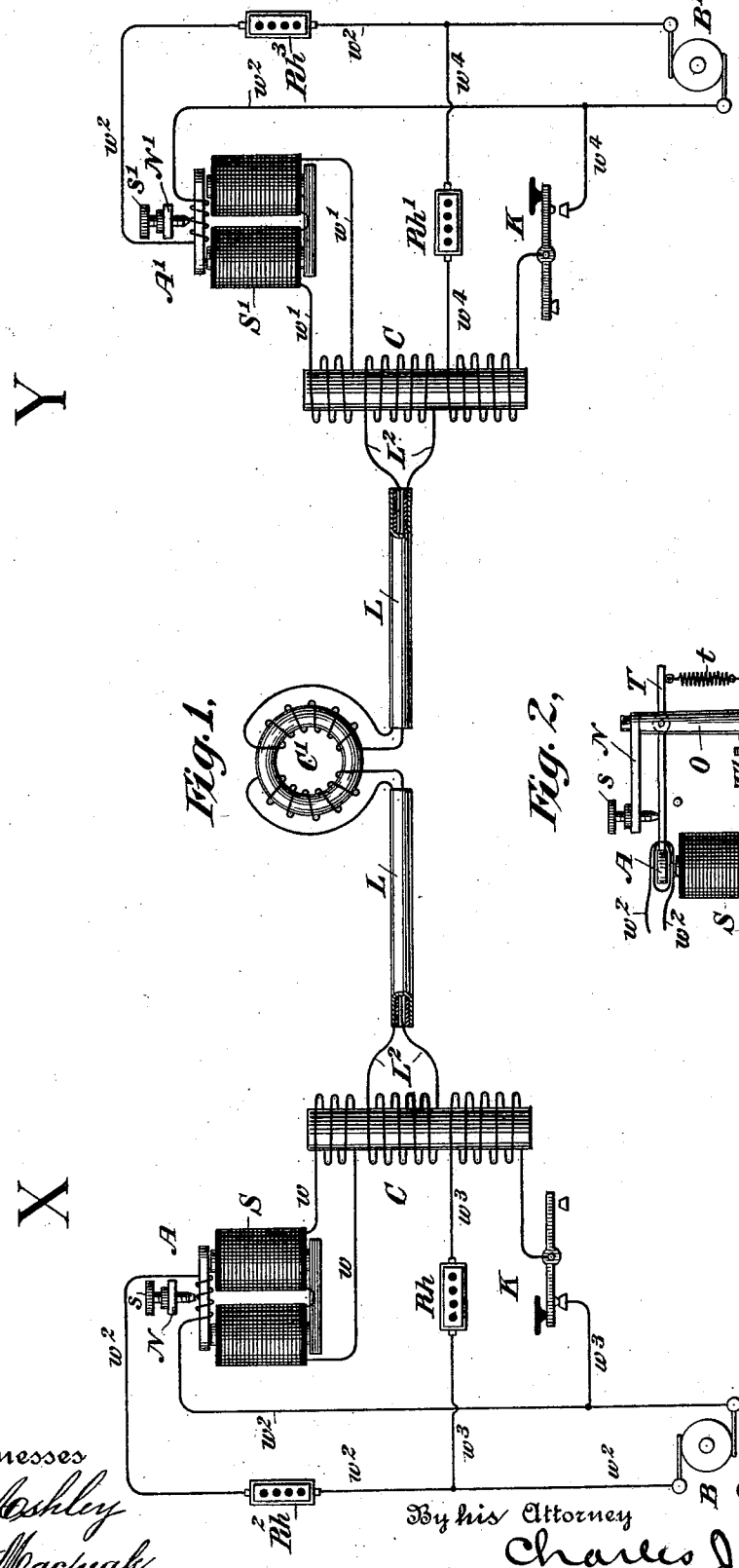
(No Model.) 3 Sheets—Sheet 1.

C. J. REED.

SYSTEM OF TELEGRAPHY

No. 510,612. Patented Dec. 12, 1893.



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(No Model.)

3 Sheets—Sheet 2.

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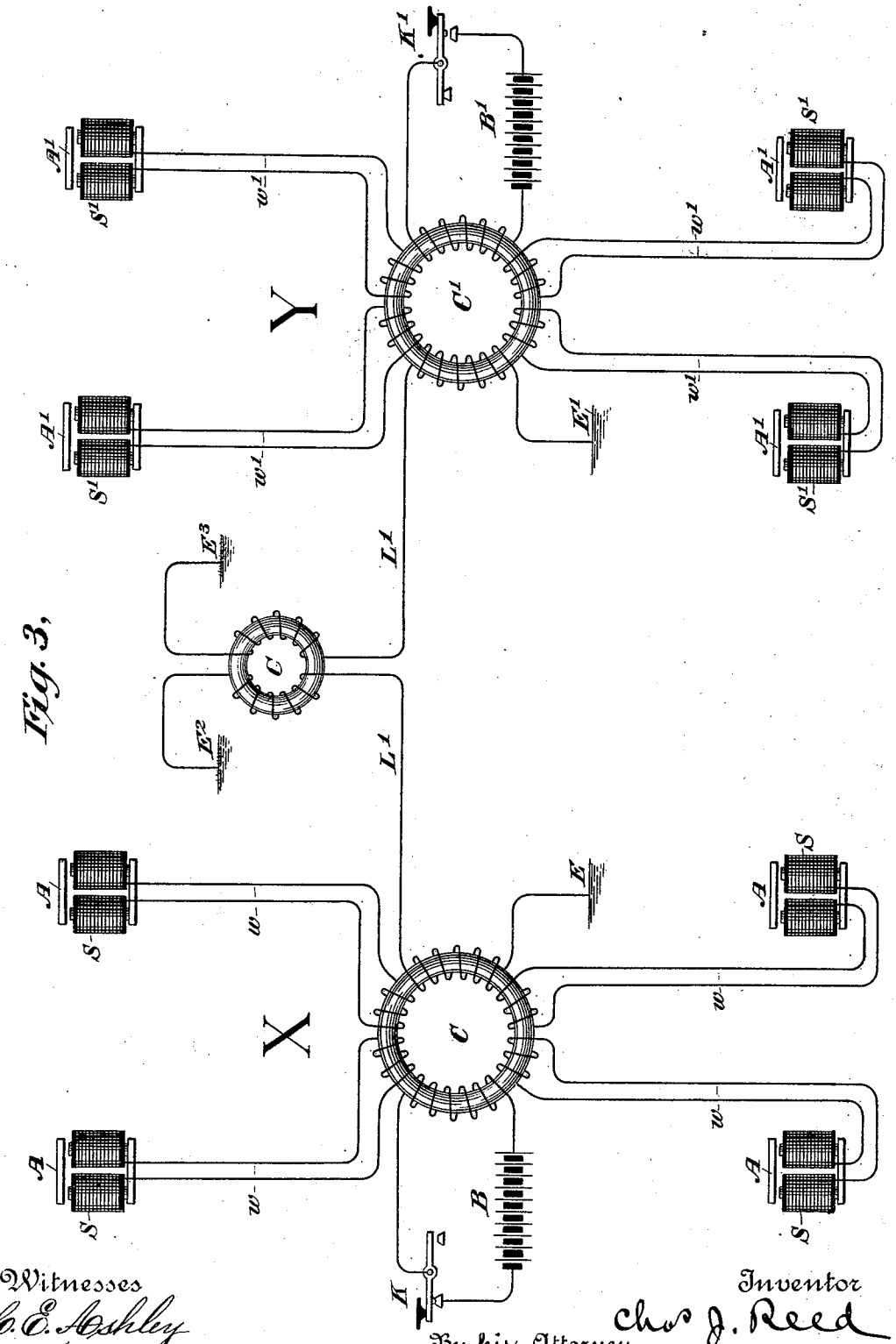

Fig. 3.

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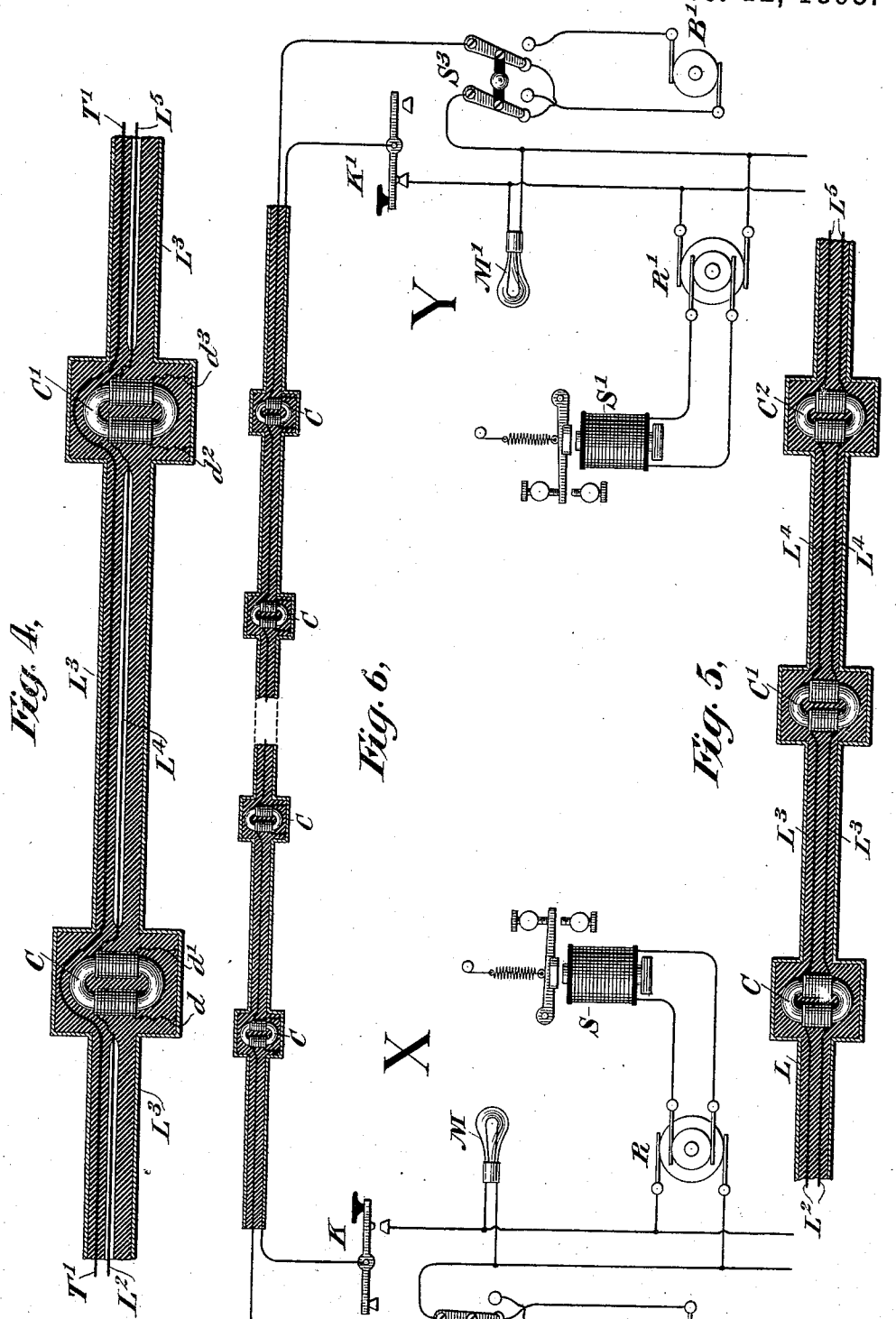

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SYSTEM OF TELEGRAPHY.

SPECIFICATION forming part of Letters Patent No. 510,612, dated December 12, 1893.

Application filed April 12, 1892. Serial No. 428,852. (No model.)

To all whom it may concern:

Be it known that I, CHARLES J. REED, a citizen of the United States, residing at Orange, in the county of Essex, in the State of New Jersey, have made a new and useful Invention in the Art of Electric Signaling, of which the following is a specification.

My invention is directed particularly to a novel method of and apparatus for transmitting intelligible signals electrically between two or more distant points through the agency of induced currents of electricity and to this end it consists, first, in the novel method of and apparatus, hereinafter described, for utilizing the combined effects of primary or direct currents of electricity with secondary or induced currents in such manner as to render it possible to transmit the Morse or any analogous code of signals in which there is a variation in the length of the characters, through the agency of secondary or induced currents of short or substantially equal duration which pass over the main or signaling line joining the two distant stations; second, in the novel system of inductive repeaters in the nature of converters, hereinafter described, for inductively transferring signals through a line joining two distant stations; third, in the novel method of and apparatus for inductively conveying Morse or analogous signals to a number of independent receivers located in independent lines radiating from two or more main stations joined by a single or main line, and, fourth, in the several details of construction in connection with the complete system of electrical signaling hereinafter described and particularly pointed out in the claims at the end of this specification.

In order that my invention may be fully understood reference is had to the accompanying drawings taken in connection with the following description, in all of which drawings like letters of reference represent like parts wherever used.

Figure 1 is a diagrammatic view illustrating one form of my improved signaling system. Fig. 2 is a side elevational view of my novel form of electro-magnetic receiver. Fig. 3 is a diagrammatic view illustrating my improved apparatus for duplicating or repeating from a main station a message to a series of outlying receivers located in independent lines and also to a distant main station and to corresponding outlying independent receivers. Figs. 4 and 5 are sectional views illustrating my improved cable or conductor made up of successive converters, and circuits, and Fig. 6 is a diagrammatic view illustrating two operating stations and circuit connections with my improved converter system, the cable joining the two stations being shown in sectional view.

In Fig. 1 are shown two main telegraphic stations X and Y joined together by an intervening cable consisting of an internal conductor L^2 insulated from a surrounding conducting tube or shield L, the two portions L and L^2 constituting the direct and return conductors and including in their circuits at the opposite stations the secondary coils of two converters C and C, and the like coils of an intermediate converter C'.

B and B' represent the signaling sources of electrical energy shown in Fig. 1 as two direct current dynamos, in Fig. 3 as batteries, and in Fig. 6 as alternating current dynamos.

K and K' represent the transmitting or signaling keys at the transmitting stations, connected in local circuits with the generators B and B' through the primaries of the converters C and C, rheostats Rh and Rh' and conductors w^3 and w^4.

S and S' are the signal receiving instruments connected through conductors w and w' with additional coils on the converters C and C. The armature levers A and A' of the receiving instruments S and S' may be permanently magnetized, or they may be energized by coils included in permanently closed local circuits w^2 w^2, including rheostats Rh^2, Rh^3, as clearly shown in Fig. 1, the arrangement being such that the influence of the retractile springs t will prevent the armatures A A' from being drawn forward under normal conditions. This adjustment is effected through the agency of an adjusting screw T' sustained on an upright O carried by the base D which supports the magnet. (See Fig. 2). Further adjustment is effected through the

agency of the adjusting screw *s* carried by an arm N at the top of the standard O, and lying in the path of the armature lever T. The receiving instruments S and S′ are illustrated as local sounders although they may be arranged as relays with local circuit connections in a manner well understood.

The operation of this apparatus is as follows: The operator at station X is supposed to be transmitting, and the instant that he closes the key K an inductive impulse will be set up in the local circuit w^3 of the converter C, which impulse sets up two individual secondary impulses, one in the main line $L\ L^2$ running to the distant station Y and the other in the receiving instrument S, the magnetic effect of which is such as to momentarily increase the pull on the armature A sufficiently to enable the armature lever T to overcome the influence of the spring *t* and draw it into the forward position shown. In like manner the impulse sent to the distant station sets up in the secondary of the converter C′ an impulse which, acting through the coils C, secondary circuit *w′* and coils of S′ causes the armature A′ to be drawn into its lower position as shown. Both armatures will therefore remain in their lower position by virtue of their own magnetism after these impulses caused them to be brought down until the key K is opened, at which time like impulses in a reverse direction would cause both armatures to be repelled; so that it is apparent that for simple inductive impulses signals may be transmitted such as the Morse code in which the elements of the characters are of varying lengths.

For the purpose of adapting this inductive impulse principle to the transmission of signals of the character named to numerous outlying stations (see Fig. 3), I utilize preferably ring converters C C at two or more stations X and Y, and join them by a single main line or conductor L′ earthed at E station X, and at E′ station Y, the main line L′ being connected to the coils of the converters C C and C′ as shown, and the transmitting keys K K′ being included in circuit with batteries B B′ and the primary coils of the converters, while the receiving instruments S S, S′ S′ located at various outlying stations are included in additional secondary circuits *w w*, *w′ w′*, the circuit connections for the coils of the armatures A and A′ being made through local generators at those stations, or these armatures are permanently magnetized and the adjustment effected in either instance in the same manner as described in connection with Figs. 1 and 2. It will be appreciated therefore, that on closing the key K at station X all the receiving instruments situated in circuits *w w* running to distant radiating stations will respond at the same time and in the same manner as does the home receiver for the main station and that in like manner the main receiver at station Y and all receivers located at radiating stations and connected through circuits *w′ w′* will respond to the same signal and that the duration of the response will depend upon the length of time that the key K is held down. When the number of main stations X and Y is more than two, the primaries of the several converters will of course be located directly in series with each other in the main line L′ so that messages may be sent to various intermediate points and to outlying individual instruments located in the secondary circuits thereof.

It will be readily appreciated by those skilled in the art that there must be such relation between the several converters used that there shall be produced induced currents of like phase in the receivers at all stations simultaneously. In other words, the induced current phase in receiver S at station X due to an impulse from battery B at that station must set up an induced current of like phase in receiver S′ at station Y due to the action of intermediate coils.

In Fig. 4 I have illustrated a novel apparatus for use in cable telegraphy or on long land lines, which apparatus consists of a series of converters C, C′ located in the body of a cable, the outer surface thereof being of metal constituting a common return circuit for the primaries of all the converters C C′, &c., the first primary circuit L^2 being connected through one leg of the converter to the outer casing at *d* while the secondary coil is similarly connected at *d′* and constitutes the primary conductor L^4 and is connected to the next succeeding converter C′, the primary coil of which is connected as before to the casing L^3 at d^2. The secondary coil of this converter C′ is connected to the casing at d^3 and through the internal conductor L^5 to the distant station, the station connections being as shown in Fig. 6, in which K is the key at station X, and K′ at station Y.

S^2 and S^3, Fig. 6, are switches for connecting the generators B and B′ into the sending circuit and throwing them out of the receiving circuit at will, and vice versa, and R and R′ are current rectifiers of any preferred form which convey direct currents to the receiving instruments S and S′.

M and M′ are incandescent electric lamps connected in multiple circuit with the rectifiers R R′ and the receivers S S′ and designed for visual signaling.

In the form of apparatus shown in Fig. 6, I prefer to use the incandescent lamps M M′ as the receiving apparatus although for more delicate signaling I would use the receivers S S′ with the current rectifiers R R′, the necessary care in adjustment of the apparatus having been effected for the synchronous rotation of the generating dynamos and the current rectifiers and any of the well known methods of effecting this having been utilized.

In Fig. 4, T′ represents a test line embedded in the cable for ascertaining any break in the

cable. Should such a break occur the end of this test line would be earthed through the water and the usual methods of locating the break could be utilized.

In the form of cable shown in Fig. 5 the primary and secondary circuits are embedded entirely within the cable, the circuit L^2 constituting the primary of the converter C and the secondary of each converter constituting the primary of the next succeeding converter.

The relative number of ampère turns of the primary and secondary coils of the several converters wherever used in connection with any of the modified forms of my improved apparatus will of course be made in accordance with the necessities of each case and in a manner well understood by skilled electricians.

I am aware that it is not broadly new with me to utilize induction coils or converters for the transmission of intelligible signals by electricity, but I am not aware that any one has heretofore been enabled to transmit through the agency of induction coils impulses of varying length such as are utilized with direct currents in transmitting the Morse code, nor am I aware that any one has heretofore been enabled to repeat or duplicate messages of the Morse type to a number of outlying stations from a single station inductively, and my claims are generic in this particular. I believe it is also broadly new with me to construct an ocean cable with a series of converters so connected together that the secondary of each converter constitutes the primary of the next converter in the series and my claims are also generic upon this feature. I believe it is also broadly new with me to use as a telegraphic conductor a cable having the interior insulated wire and the external conducting casing permanently electrically connected at a point or at numerous points between the sending and the receiving stations.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. The described method of transmitting Morse or analogous characters having elements of varying length consisting in setting up two sets of secondary impulses one at each station and in combining the effects of these secondary impulses with local direct current effects at said stations.

2. The described method of signaling electrically consisting in setting up simultaneously two secondary or induced impulses at a transmitting station and in utilizing one induced impulse at the home station jointly with a direct current and the other at a receiving station with a corresponding direct current.

3. The described method of transmitting a Morse or analogous code having elements of varying lengths, consisting in setting up over a main line joining two or more stations two secondary or induced impulses of different phase for each element or signal transmitted and in maintaining the effect of the first impulse for a length of time corresponding to the closure of the circuit at the transmitting station.

4. The described method of transmitting Morse or analogous signals electrically consisting in setting up induced or secondary impulses over a main line; causing said impulses to act in conjunction with local magnetic effects at the distant or receiving station the durations of which are made dependent upon the subsequent transmission of additional secondary impulses of a different phase.

5. The described method of repeating or duplicating Morse or analogous characters telegraphically consisting in transmitting a single induced or secondary electrical impulse to independent receivers located in independent circuits and in maintaining the effects of the single impulse for a length of time corresponding to the closure of the circuit at the transmitting station.

6. The described method of telegraphically transmitting Morse or analogous characters, consisting in setting up in a main line joining several stations, a single secondary or induced impulse and in combining the effects of this impulse with local magnetic influences for a length of time corresponding to the closure of the circuit at the transmitting station.

7. The described method of signaling electrically, consisting in transmitting induced currents over a main line and in combining the resultant effect thereof with magnetic influences at a receiving station until additional secondary impulses are transmitted of different phase.

8. The described method of operating a Morse receiver which consists in combining induced and direct current effects to produce mechanical motion in one direction and subsequently combining induced and direct current effects to produce mechanical motion in the opposite direction.

9. In a system of telegraphy a main line joining two or more main line stations and including in its circuit a secondary coil of a converter at each station; a generator of electricity and a transmitter for each station included in circuit with the primary or inducing coil of the converter at that station, one or more additional secondary coils for each converter included in circuit with the coils of corresponding electro-magnetic receivers; local coils included in circuit with local generators at each station and adapted to magnetize the armatures of the receivers and adjustable means for regulating the pull on the several armature levers, all substantially as described.

10. In a system of telegraphy an electromagnetic receiver having its energizing coils in circuit with the secondary coil of a con-

verter and a second coil permanently in circuit with a battery or generator of electricity operatively connected through a key or transmitter with the primary coil of the converter with means for varying the pull of the armature lever, all substantially as described.

11. A cable or electrical conductor having two interior insulated wires or conductors, an external metallic casing and a permanent metallic connection at one or more points between the external casing and one of the interior wires, the other wire being insulated throughout the cable.

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