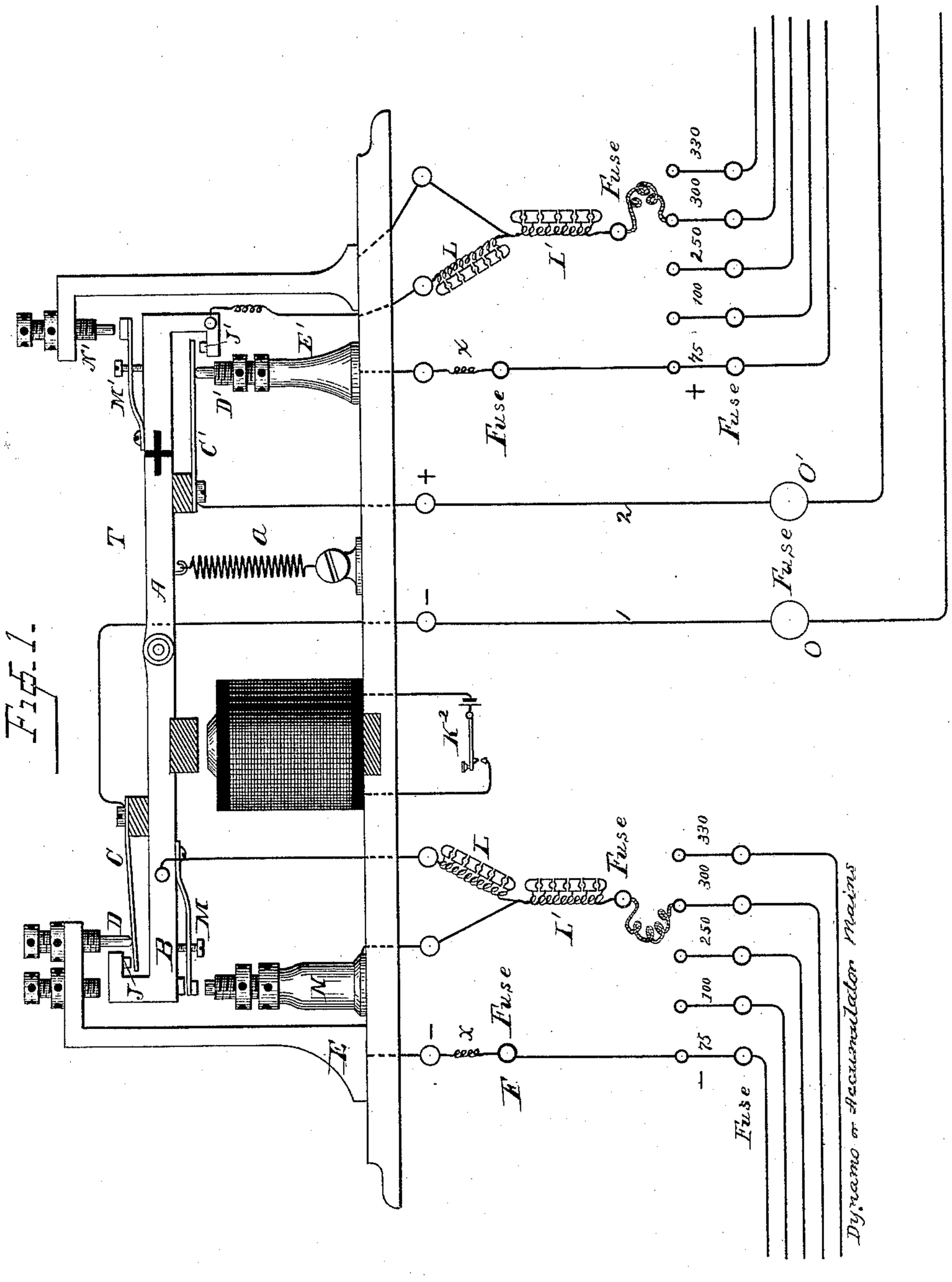
(No Model.) 2 Sheets—Sheet 1.

C. L. HEALY.

QUADRUPLEX TELEGRAPHY.

No. 418,284. Patented Dec. 31, 1889.



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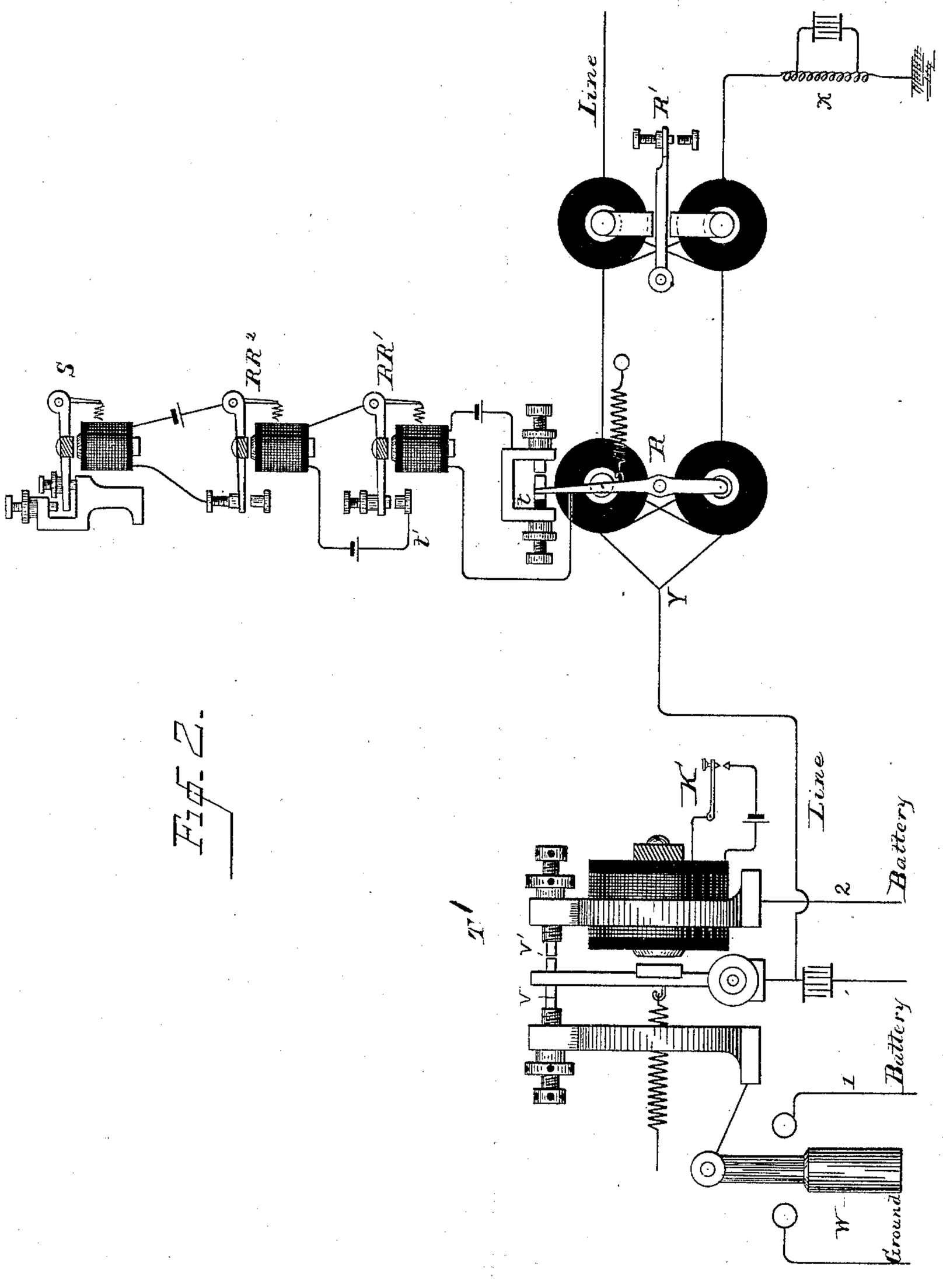

Fig. 2.

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UNITED STATES PATENT OFFICE.

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QUADRUPLEX TELEGRAPHY.

SPECIFICATION forming part of Letters Patent No. 418,284, dated December 31, 1889.

Application filed April 9, 1889. Serial No. 306,636. (No model.)

To all whom it may concern:

Be it known that I, CLARENCE L. HEALY, a citizen of the United States, residing in Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Quadruplex Telegraphy, of which the following is a specification.

My invention relates to the quadruplex system of telegraphy in which four distinct communications—two in either direction—may be simultaneously transmitted over the same line-wire. This system comprises, as is well known, two transmitters at each end of the line, one of which effects the transmission of its signal by increasing and decreasing the current conveyed to the line, while the second or pole-changing transmitter operates by reversing the polarity of the current.

My invention has reference more particularly to the construction and operation of these two transmitters, whereby current having nearly the same potential as the sources of electrical supply may be transmitted directly to the line without loss arising from intermediate artificial resistances, and to a series of repeating-relays, which are used in connection with the neutral relay at the receiving-station to guard against any mutilations of the signals by the slight falling off of the neutral relay during the reversals of the current.

My invention is illustrated in the accompanying drawings, wherein—

Figure 1 is a diagrammatical view showing the supply-leads, the current-changing transmitter, and resistance; and Fig. 2 is a similar view in which the pole-changing transmitter and repeating-relays are represented.

The successful operation of a telegraph-line quadruplex necessitates the use of a high-potential current to work the second or neutral relay, and in wet weather, when the leakage is considerable, the current must be correspondingly increased to allow for the loss due to leakage. It is, furthermore, necessary that any desired increase of current should be sent to the line by the transmitters without any sparking or burning at the contacts.

Heretofore it has been proposed in key systems for dynamo quadruplex telegraphy to have a large resistance permanently in circuit between the dynamo and the transmitters in order to prevent sparking. This permanent resistance proves a great detriment to the successful working of the system by reducing the actual electro-motive force to the joint lines to the percentage that this artificial resistance bears to the joint resistance of the line and artificial line, so that in wet weather and on low-resistance circuits the percentage of the loss is so great as to prevent the operation of the second side.

My means for preventing sparking at the contacts when passing from a lower to a higher potential, or the reverse, consists in cutting in automatically upon the initial movement of the transmitter, a resistance which reduces the current short-circuited at the contacts, and then in immediately cutting out again the resistance when the transmitter reaches the limit of its throw. In this way, also, I am able to put to the joint lines a gradual potential, which prevents bad induction on parallel wires.

T, Fig. 1, is the current-changing transmitter. It consists of the customary vibrating lever A, actuated in one direction by spring *a* and controlled by local sending-key K^2. Upon one end of this lever there are secured two contact-springs C and M, the spring C being upon the upper side of the lever and insulated therefrom in any suitable manner, and the spring M being upon the opposite side of the lever and in electrical connection therewith. These contacts C and M are brought alternately into engagement, respectively, with the fixed terminals D and N by the movement of the lever, and as these terminals are connected, as indicated, by leads or mains with sources of electricity of varying potential, it is apparent that at each vibration of the lever the current passing to the line-wire 1 will be changed from one of higher to one of relatively lower potential or the reverse. Upon the opposite end of the lever A there are two similar spring-contacts C′ and M′, C′ being on the under side of the lever and insulated therefrom, and M′ being upon the upper side and being in electrical connection with the lever, though the two ends of the lever are necessarily insulated from each other, as shown, in order to avoid a short circuit. When the lever is in the position shown,

contact C′ engages the fixed terminal D′ and is connected with a source of low positive potential, and when the lever vibrates to its second position the contact M′ will engage the terminal N′, which is connected to a source of higher positive potential.

At the lower left-hand portion of Fig. 1 there are shown a number of leads connecting with the negative poles of suitable sources of electricity of varying potential, of which the one of least potential is connected to terminal D through a fuse F, the small safety resistance *x*, and standard E, and the others may be connected to terminal N at will through the resistance L′, according to the different strengths of current demanded by the resistance and insulation of the line for the proper working of the neutral relay. The contact J upon lever A, against which the spring C rests except when it is engaged by terminal D, is also connected with the high potential source through an additional resistance L, as shown. Both resistances L and L′ are made adjustable. That of L may be varied when a change is made in the high potential pressure, so that the current short-circuited remains practically the same, and that of L′ is made from three to five per cent. of the joint resistance of the line and artificial line, which consequently gives the corresponding per cent. drop in the initial high potential supplied to the joint lines.

At the lower right-hand portion of Fig. 1 there is shown a corresponding number of mains from the positive poles of sources of electricity similarly varying in potential, that of lowest potential being connected to terminal E′ and the others to terminals N′ and J′ at will. Safety fuses and resistances *x* L L′ are provided and arranged in these connections precisely as before described. The conductors 1 and 2, from the current-changing transmitter, Fig. 1, pass through safety-fuses O O′ and lead to the pole-changing transmitter T′, Fig. 2, whence a plus or minus current is transmitted to the line, according to the position of the said last-named transmitter.

The operation of the current-changing transmitter will now be described. When the lever A is in the position illustrated with the key K^2 open, the springs C C′ are engaged by terminals D D′, and held away from contacts J J′. If now the transmitter T′ be in one position, a negative current of low potential will be transmitted to the line from the main marked 75 through fuse F, small safety-resistance *x*, standard E, terminal D, spring C, and conductor 1, and if the transmitter T′ be moved to its second position the main 75, at the right hand of the figures, will supply the line with a similar positive current, which will pass through fuse F, resistance *x*, contact D′, spring C′, and conductor 2. Should the key K^2 be closed the lever A is attracted and shifts so that the springs M and M′ engage terminals N and N′, respectively, and the springs C C′ pass away from the contacts D D′ and rest upon contacts J J′. The line-circuit would now be complete from the source of higher potential. The negative current would flow from the main marked 300 through the safety-fuse, resistance L′, terminal N, spring M, contact J, spring C, and conductor 1, and the positive current from the main 300 through the fuse, resistance L′, terminal N′, contact J′, spring C′, and conductor 2.

To avoid the sparking which is liable to occur at the contacts when changing from the higher to the lower potential and vice versa, I have provided the supplemental resistance L, which is placed between lever A and resistance L′, as shown, and it will be seen that this resistance is momentarily cut into circuit upon the initial movement of lever A, and shunted out again upon the completion of the said movement, for the spring-contacts C and M are arranged so that C contacts with J before M does with N; and it will be seen that at the instant when the circuit is changed from the lower to the higher potential the current from the latter source has to pass through the combined resistances L and L′; but that upon the completion of the movement of A a path is completed through N and M, shunting resistance L and leaving L′ alone in circuit.

The arrangement of that resistance L, together with the means for cutting it into and out of circuit, constitutes one of the leading features of my invention, and is of great practical importance. On the one hand sparking of the contacts D and J is prevented, and on the other hand no useless dead-resistance is permanently included in the line-circuit, thereby enabling the use of lower potential currents than have been hitherto proposed. Moreover, as I believe this feature is a novel one, I do not intend to be limited to the exact arrangement shown, but include such other means for arriving at the same result as come fairly within the scope of my invention.

Referring now to Fig. 2, it will be seen that my invention also comprises improvements in the construction of the pole-changing transmitter and in a series of repeating-relays which are interposed between the neutral relay and the sounder. The conductors 1 2, which transmit the plus and minus currents, respectively, from the transmitter T to the pole-changer T′, lead to adjustable contacts *v v′*, between which the line-points are limited. These contacts permit of close and positive adjustment, so that the interruption of the current thereat upon the shifting of the transmitter T′ may be for the smallest fraction of time possible, as the falling off and reduction in the working margin of the neutral relay depends greatly upon the time of no current. In this close adjustment I am greatly aided by being able to use a much lower high potential than heretofore between these points, as I lose by virtue of the arrangement of resistance L only a small per cent. of the initial pressure to the line, and

in regular work I obtain as much current to the line with one hundred and eighty volts initial pressure as I would with three hundred volts with six hundred ohms artificial resistance constantly in circuit as heretofore used. A low potential between these points allows me to put to the joint lines a heavy current when necessary, with a short break and much less liability to arc and short-circuit. On the pole-changer base I have placed the balancing and safety switch W. When the key K′ is open, the armature and line connections rest upon the back contact *v*. It will therefore be seen that by moving the switch W to the left the incoming line-connections will be put to ground to allow a balance to be made at the distant station. By moving W to the right the negative current is sent to line, and by placing it in an intermediate position between the two the battery-current is removed from contact-point *v*. This arrangement of the switch W and the transmitter does away with the extra switches for this purpose, and furnishes a convenient and compact construction.

Safety-fuses O O′ are inserted in the wires 1 and 2, between the two transmitters, to prevent the burning of the contacts should an accidental short-circuit occur at the contact-points of transmitter T′.

The current is sent to the joint lines at Y, where it divides between the main line and artificial line. Here are located the two differentially-wound relays R and R′, R being the neutral relay depending for operation upon the increase and decrease in the current.

To prevent the falling off of the armature of the neutral relay during the reversals of the current and the consequent mutilations of the signals, induction-coils, condensers, and extra magnets have been used, and also a back contact repeating-relay is well known in connection with the neutral relay, closing on its back contact a repeater which operates the receiving-sounder. The use of induction-coils in the line and of condensers requiring an artificial resistance of several hundred ohms is, however, objectionable, and I have provided as a means of avoiding the difficulties above presented a series of repeating-relays between the neutral relay and sounder, each of which is operated serially by the preceding.

RR′ is a repeater whose circuit is closed by the armature of the neutral relay when in engagement with its back stop *t*. RR² is a second repeater, closed by the armature of RR′ when upon its front stop *t′*, and this second repeater closes the circuit of the working-sounder S on its upstroke. By placing this additional repeater RR′ in the local combination and closing the next repeater on its front stop, I double the time movement necessary to cause any mutilations of the received signals, for if the neutral relay falls off slightly and partially closes the local circuit of the first repeater it will not influence the sounder unless the first repeater be closed long enough to close the second repeater, and this long enough to interrupt the sounder-circuit. The first repeating-relay contacts can be made close or farther apart to meet the conditions of the circuit. In practical work this arrangement has been found to greatly increase the working-margin of the second side.

Having described my invention, I claim—

1. In quadruplex telegraphy, the combination of the current-changing transmitter and sources of varying electrical potential with which said transmitter is brought into circuit for increasing and decreasing the line-current with an artificial resistance automatically cut into circuit by the initial movement of the transmitter, a shunt around said resistance and a contact-maker completing the circuit of said shunt by the final movement of the transmitter and thereby cutting out said resistance, as set forth.

2. In quadruplex telegraphy, the combination of the current-changing transmitter, the terminals, and sources of varying electrical potential connected thereto, with which said transmitter is brought into circuit for increasing and decreasing the line-current with the artificial resistance between the source of higher potential and the transmitter for preventing sparking at the contacts, and a contact-maker automatically cutting out said resistance upon the final movement of the transmitter when shifting from the lower to the higher potential, whereby nearly the entire initial pressure of the source of supply may be put upon the line-circuit.

3. In a system of quadruplex telegraphy, the combination of the current-changing transmitter, the terminals, and the sources of varying electrical potential connected thereto, with which said transmitter is brought into circuit alternately for increasing and decreasing the line-current with the resistance, and a contact-maker operated by the transmitter and cutting said resistance into circuit momentarily while the transmitter is shifting from one source of potential to another, whereby induction on parallel wires is avoided, as set forth.

4. In a key system for quadruplex telegraphy, the combination of the current-changing transmitter, the terminals and a source of low electrical potential connected to one terminal, with the supply-leads connected, respectively, to sources of varying high electrical potential and each adapted to be placed in circuit with the other terminals, with the adjustable safety-resistance L′ between the said last-named terminals and supply-leads, whereby the safety-resistance can be adjusted to correspond with the varying high potential employed and the joint resistance of the line and artificial line.

5. In quadruplex telegraphy, the combination of the current-changing transmitter T

for increasing and decreasing the current upon the line, the terminals in circuit with sources of electricity of relatively high and low potential, and the resistance L for preventing sparking when the transmitter shifts from one source of potential to another, with contact-makers operated by the transmitter and automatically cutting the said resistance into and out of circuit, and means for adjusting the said resistance, whereby its amount may be varied according to the difference between the high and low potentials employed.

6. In a key system for quadruplex telegraphy, the combination of the terminals D and N, in circuit with sources of electricity of relatively high and low potential, and the current-changing transmitter T, with the resistance L, connected to the transmitter, and the contact-makers C and M, whereby the initial movement of the transmitter cuts the resistance into circuit, and the further movement of the transmitter short-circuits the resistance by the contact of M with terminal N, as set forth.

7. In quadruplex telegraphy, the combination of the neutral relay at the receiving-station, the sounder, and the two intermediate repeating-relays, the first of said relays being operated by the neutral relay and the second repeater being operated by the first and actuating the sounder, whereby the mutilations of the signals are prevented.

8. In quadruplex telegraphy, the combination of the neutral relay, the repeater R R′, having its circuit closed on the back stop of the neutral relay, the second repeater R R^2, having its circuit closed on the front stop of R R′, and the sounder S actuated by the second repeater R R^2, substantially as set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

CLARENCE L. HEALY.

Witnesses:
WM. A. ROSENBAUM,
THOMAS K. TRENCHARD.