T. A. EDISON.

TELEGRAPHY.

APPLICATION FILED JUNE 20, 1907.

909,877. Patented Jan. 19, 1909.

2 SHEETS—SHEET 1.

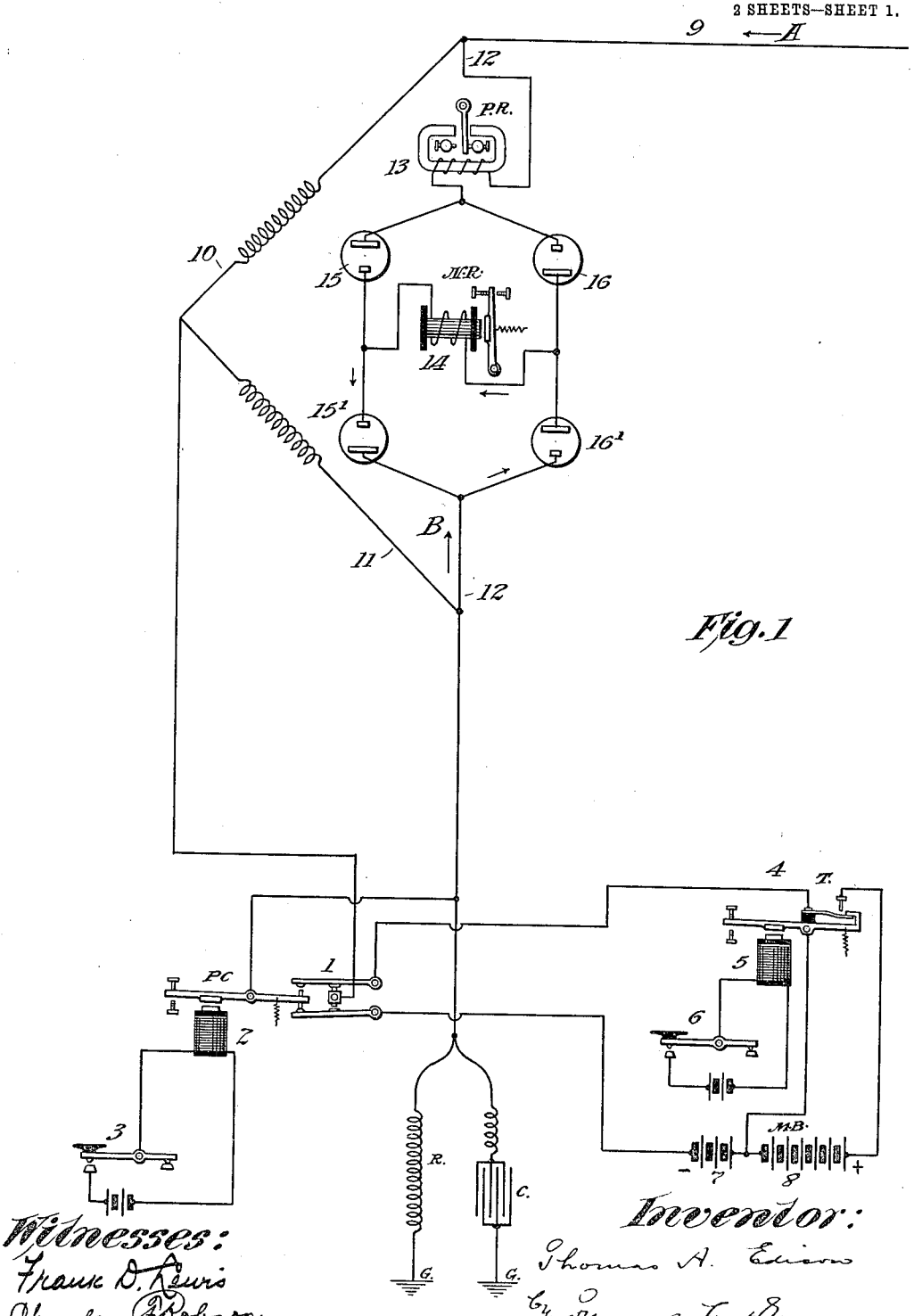

Fig. 1

Witnesses:
Frank D. Lewis
Charles E. Robson.

Inventor:
Thomas A. Edison
by Frank L. Dyer
Atty.

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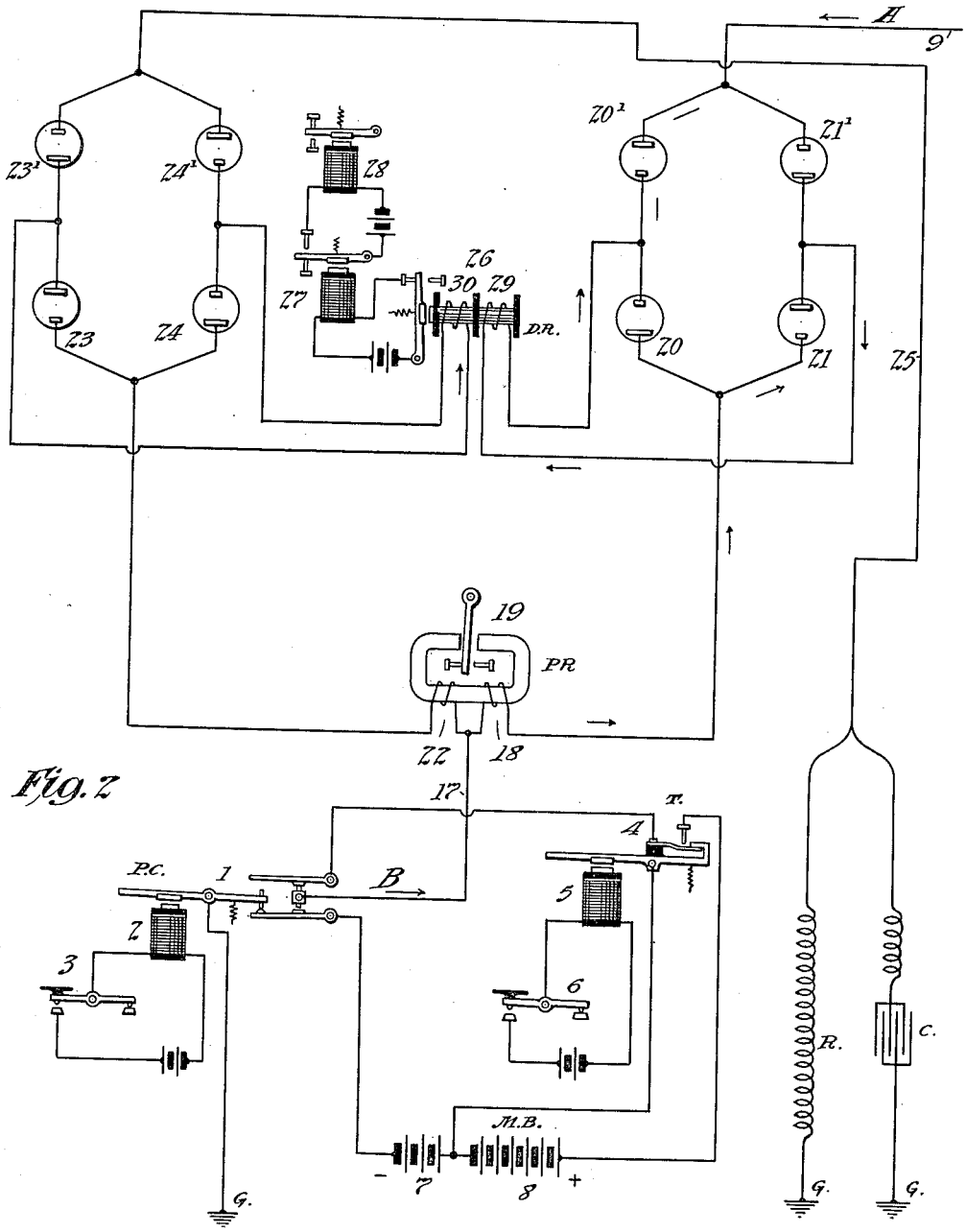

Fig. 7

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UNITED STATES PATENT OFFICE.

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TELEGRAPHY.

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To all whom it may concern:

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, Orange, county of Essex, and State of New Jersey, have invented certain new and useful Improvements in Telegraphy, of which the following is a description.

My invention relates to improvements in telegraphy and my object is to provide an arrangement by which a neutral relay designed to be operated by variations in current strength, will be unaffected by reversals of current in the circuit in which the relay is included. Such a situation is presented in connection with the well-known quadruplex telegraph operating either on the bridge or differential principle. With such an apparatus at the receiving station and in circuit with the line and with each other are arranged a polarized relay responsive to reversals of current, and a neutral relay responsive to variations in current strength. One of the defects which has always existed in the quadruplex telegraph, or in fact in any other system in which a neutral relay is traversed by a reversed current, is that when the armature of the neutral relay is attracted by the full current strength and a reversal of the current takes place, the armature momentarily falls away from the front stop with the likelihood of producing a "kick" or false signal in the local sounder. Numerous suggestions have been proposed for overcoming this defect, such as arranging the neutral relay to make contact on the back stop, or by arranging an auxiliary magnet which coöperates with the armature of the neutral relay and receives a momentary charge from a condenser when the current by the change of polarity ceases, to thereby serve to bridge over the interval of no magnetism. The suggestions which have been made for overcoming the defect mentioned have not, however, in practice and on lines of considerable length, been entirely satisfactory, since in reversing the current through the neutral relay the magnets thereof when the current ceases, require to be completely discharged before they can be built up by the succeeding impulse of opposite polarity, and during this interval the relay armature being no longer attracted is free to be drawn back to produce a false signal. By my invention, I entirely overcome this defect, since I arrange the neutral relay in such a way that although the current on the line may be reversed, the current passing through the neutral relay will be always of the same polarity. Although the current which thus traverses the neutral relay will be momentarily weakened during the changes of polarity on the line, yet, since the polarity of the magnets of the neutral relay is never changed, there is no interval corresponding to that now encountered when the polarity of such magnets is changed, and furthermore, the residual magnetism will materially aid in maintaining the attraction of the armature during the periods in which the current is momentarily weakened. I find from actual experiments with the apparatus that there appears to be substantially no movement of the armature of the neutral relay under the conditions noted, when the current through the same is reversed, while under the old conditions, when the reversals take place in the relay magnets, the movements of the armature thereof away from the front stop are quite perceptible.

In carrying the invention into effect I combine with the neutral relay a suitable arrangement of rectifiers by which, although the current on the line may be reversed, the polarity of the current influencing the neutral relay will remain unchanged, as I will more fully hereinafter describe and claim. The most satisfactory rectifier for the purpose, both as to economy of installation and certainty of operation, is the so-called aluminum rectifier, employing an aluminum electrode opposed to an electrode of lead or platinum in a suitable electrolyte. Such a rectifier, as is well known, when included in an electric circuit, presents a practically perfect insulation to currents of one polarity without appreciably resisting currents of the opposite polarity. It becomes possible, as I hereinafter point out, to arrange a number of these rectifiers in such a way that currents of reversed polarity will be so commutated as to pass through the neutral relay always in the same direction.

In order that the invention may be better understood, attention is directed to the accompanying drawings, in which—

Figure 1, is a diagram of the well-known form of quadruplex apparatus at one end of the line, operating on the principle of the Wheatstone bridge, and in which I show an arrangement by which the neutral relay thereof although in circuit with the polar-

ized relay will not be subjected to the reversals of current which control the polarized relay, and Fig. 2, a similar view of a corresponding apparatus operating on the differential method in which rectifiers are employed for commutating the reversals of current at the neutral relay.

Referring first to Fig. 1, most of the elements are so well-known as to require no more than a very general description. A pole changer 1, is controlled by a magnet 2, from a key 3, in a local circuit. The transmitter 4, is controlled by a magnet 5, operated by a key 6, in a second local circuit. The battery 7, 8, is divided into unequal portions. By reason of the connections shown, the pole changer 1 sends to the line 9, reversals of current from the battery 7, or the two batteries 7, 8, in combination, while the transmitter 4 cuts the battery 8 in or out of line, as may be desired. One of the bridge wires 10 leads to the line, and the other bridge wire 11 to ground, as shown. The circuit 12, which completes the bridge, includes the polarized relay 13, of any usual construction, which controls the ordinary sounder in the usual way, and said circuit also includes a neutral relay 14 of any suitable character, whose armature through a suitable auxiliary relay controls a second sounder. In the circuit 12 is also included four rectifiers 15, 15′ and 16, 16′, arranged as shown, the aluminum electrodes thereof being represented as considerably longer than the lead or platinum electrodes. It will be observed that the circuit after passing the polarized relay 13 branches and leads to the aluminum electrode of the rectifier 15 and to the lead or platinum electrode of the rectifier 16. It will also be observed that the aluminum electrode of the rectifier 15′ and the lead or platinum electrode of the rectifier 16′ are connected with the circuit 12 beyond the neutral relay, while the connections to the neutral relay are between the rectifiers of the two sets. By reason of this construction, it will be seen that if the current flows along the line 9 towards the polarized relay 13, as indicated by the arrow A, it will encounter the aluminum electrode of the rectifier 15, which will act practically as an insulator, so that all the current will pass through the rectifier 16. This current will then encounter the aluminum electrode of the rectifier 16′, which will oppose it, so that all the current passes in the direction of the arrow through the neutral relay and thence through the rectifier 15′ to the line 12. If, however, current passes in the opposite direction, as shown by the arrow B, it will encounter the aluminum electrode of the rectifier 15′ and consequently will pass through the rectifier 16′ and thence through the polarized relay in the same direction as before, thence through the rectifier 15 and polarized relay to the line. Thus, it will be seen that although the current is reversed on the line so as to actuate the polarized relay, yet no reversal of current takes place at the neutral relay. Although during the change of polarity, the current in the neutral relay will manifestly be weakened, this effect is momentarily much shorter than the interval required to discharge and build up the magnetism in the neutral relay if the current were reversed through the same. Furthermore, as I have before pointed out, the residual magnetism of the neutral relay tends materially to hold its armature in an attracted position during the momentary periods in which the weakening of the current takes place.

Referring now to Fig. 2, I here illustrate a quadruplex apparatus operating on the differential principle, most of the parts being so well known as to require only a very general description. Here there is a pole changer 1, operated by a magnet 2, controlled by a key 3, in a local circuit, and a transmitter 4, operated by a magnet 5, controlled by a key 6, in a second local circuit, and a battery 7, 8, as with the arrangement shown in Fig. 1. From the neutral connection of the pole changer 1, a circuit 17, extends to one of the differential coils 18, of the differential polarized relay 19. Thence, the circuit extends through four rectifiers 20, 20′, and 21, 21′, as shown, and thence to the line 9. The circuit 17 also includes the differential coil 22 of the relay 19, and thence extends through four rectifiers 23, 23′ and 24, 24′ arranged as shown, and thence to the artificial line 25. The differential neutral relay 26 is arranged so that its armature on the back stop will control an auxiliary relay 27, which in turn controls a sounder 28 in the usual way. The main line coil 29 of the differential relay is as shown, connected between the rectifiers 20, 20′ and rectifiers 21, 21′, while the artificial line coil 30 is connected between the rectifiers 23, 23′ and 24, 24′. With this arrangement, as with Fig. 1, the aluminum electrodes of the rectifiers are illustrated as considerably longer than the lead or platinum electrodes thereof. In operation, assuming the current from the distant station to be flowing on the line 9, in the direction of the arrow A, it will be opposed by the aluminum electrode of the rectifier 20′, and will therefore enter the rectifier 21′, and being opposed by the aluminum electrode of the rectifier 21, will flow through the main line coil 29, of the neutral relay in the direction of the arrows, passing thence through the rectifier 20 and the main line coil 18 of the polarized relay. Assuming that this current is of the full battery strength, the neutral relay will therefore be operated, while, if of the proper polarity to operate the polarized relay, the armature of

the latter would be attracted. If, however, the current from the distant station is reversed and flows in the direction of the arrow B, it will be opposed by the aluminum electrode of the rectifier 20, and hence will enter the rectifier 21, so as to traverse the main line coil 29, of the neutral relay in the same direction as before, and will pass to the line 9, through the rectifier 20′. Hence, the reversals of the current on the main line will not affect the main line coil 29 of the neutral relay, which, therefore, will never be reversed as to its polarity. A current from the home station flowing in the direction of the arrow B, will flow equally through the main line coil 18, and the artificial line coil 22 of the polarized relay, so that said coils will oppose one another, in the usual way. The current from the main line coil 18 in passing to the main line 9, will take the same direction as before in passing through the main line coil 29 of the neutral relay. That part of the current which traverses the artificial line coil 22 of the polarized relay will enter the rectifier 23 and proceed thence to the artificial line coil 30 of the neutral relay, thereby opposing the coil 29 so as not to affect the neutral relay, and thence through the rectifier 24′ to the artificial line 25. Although the current at the home station is reversed, yet, by reason of the rectifiers arranged as shown no reversal takes place at the neutral relay, and consequently, the objection now encountered of the armature being withdrawn when the current is reversed on the main line, will be overcome. It will be understood, of course, that the arrangements I have above described are merely illustrative of my invention, and that suitable modifications thereof will be made in applying the invention in other connections and in other arts.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is as follows:—

1. The combination with a circuit, and means for impressing thereon currents of varying strength and of reversed polarity, of a neutral relay and a series of rectifiers between the said relay and said circuit and so disposed as to commutate said currents, whereby all of said currents will pass through the relay in the same direction, substantially as and for the purposes set forth.

2. The combination with a circuit, and means for impressing thereon currents of varying strength and of reversed polarity, of a neutral relay and a series of aluminum rectifiers between the said relay and said circuit and so disposed as to commutate said currents, whereby all of said currents will pass through the relay in the same direction, substantially as and for the purposes set forth.

3. The combination with a neutral relay arranged to make contact on its back stop, of a series of rectifiers in circuit therewith and so arranged as to commutate currents of reversed polarity, whereby all of the currents will pass through the relay always in the same direction, a source of current and a polarized relay in circuit with said neutral relay, said polarized relay being located between said source and said series of rectifiers, substantially as set forth.

4. The combination with a neutral relay, arranged to make contact on its back stop, of a series of aluminum rectifiers in circuit therewith and so arranged as to commutate currents of reversed polarity, whereby all such currents will pass through the relay always in the same direction, a source of current and a polarized relay in circuit with said neutral relay, said polarized relay being located between said source and said series of rectifiers, substantially as set forth.

5. The combination with a line, a polarized relay and a neutral relay at a receiving station in circuit with the line and with each other, means for reversing the polarity of current on the line to operate the polarized relay, and means interposed between the polarized relay and the neutral relay to commutate said reversed currents, so that all of the currents will pass through the neutral relay always in the same direction, substantially as set forth.

6. In a telegraph apparatus, the combination with the main line, a polarized relay, a neutral relay, and means for impressing upon the main line currents of varying strength and of reversed polarity, of means for commutating the currents at the neutral relay, whereby the current will always influence said relay in the same direction, substantially as and for the purpose set forth.

7. In a telegraph apparatus, the combination with the main line, a polarized relay, a neutral relay and means for impressing upon the main line currents of varying strengths and of reversed polarity, of a series of rectifiers coöperating with the neutral relay and so arranged that any currents influencing the same will always flow in the same direction through the neutral relay irrespective of their direction on the main line, substantially as and for the purposes set forth.

8. In a quadruplex telegraph system, the combination with the main line, a bridge and means for impressing upon the main line currents of varying strength and reversed polarity, of a polarized relay connected across the bridge, four rectifiers in said connection arranged in two sets, and a neutral relay having connections between each set of rectifiers, substantially as and for the purposes set forth.

9. In a quadruplex telegraph system, the combination with the main line, a bridge and means for impressing upon the main line

currents of varying strength and reversed polarity, of a polarized relay connected across the bridge, four aluminum rectifiers in said connection arranged in two sets, and a neutral relay having connections between each set of rectifiers, substantially as and for the purposes set forth.

This specification signed and witnessed this 18th day of June 1907.

THOMAS A. EDISON.

Witnesses:
FRANK L. DYER,
ANNA R. KLEHM.