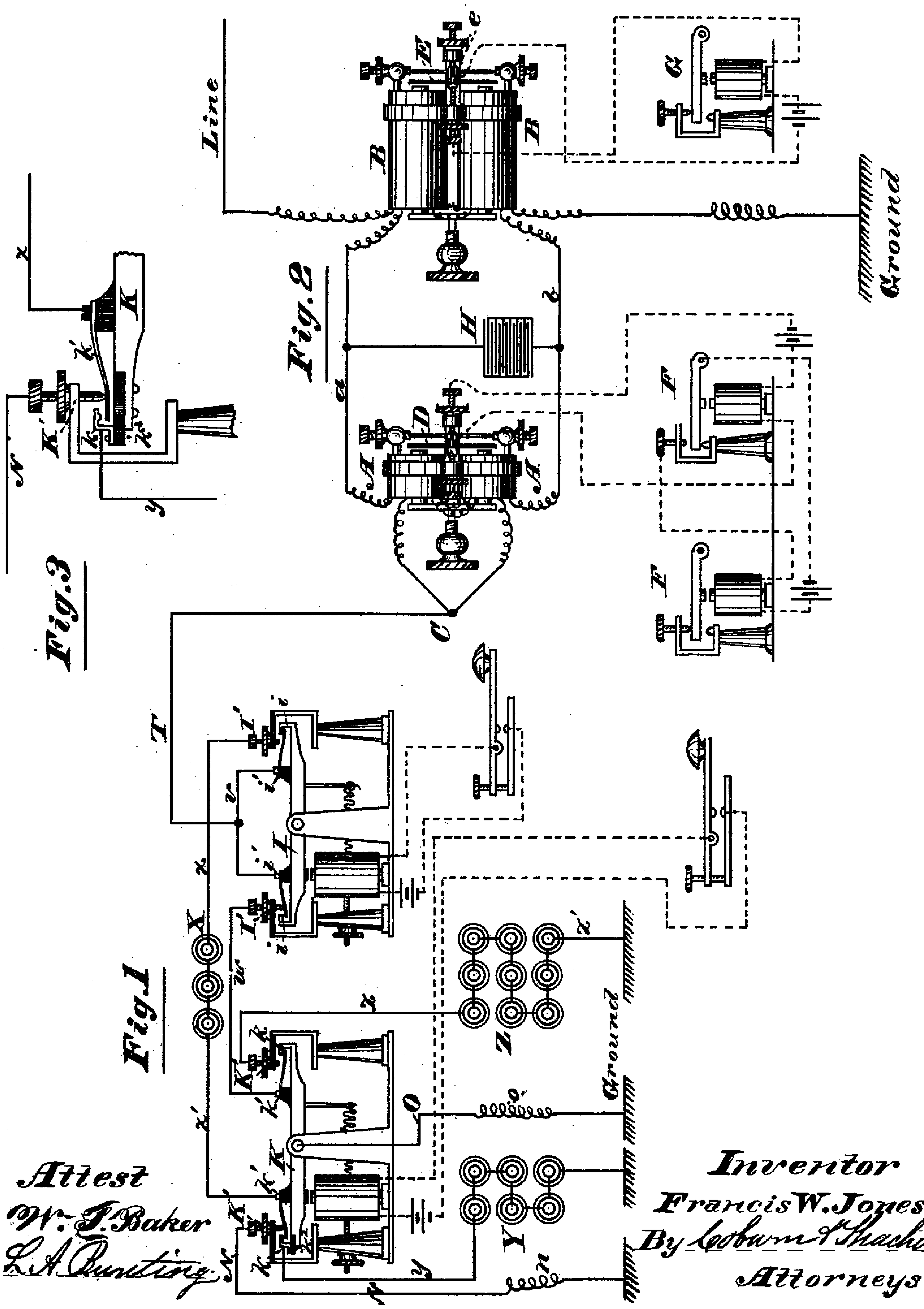
F. W. JONES.

QUADRUPLEX TELEGRAPH.

No. 191,440. Patented May 29, 1877.



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IMPROVEMENT IN QUADRUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **191,440**, dated May 29, 1877; application filed September 13, 1876.

To all whom it may concern:

Be it known that I, FRANCIS W. JONES, of Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Quadruplex Telegraphs, which is fully set forth in the following specification, reference being had to the accompanying drawings, in which—

Figure 1 represents a side elevation of the transmitting apparatus; Fig. 2, a plan view of the relay system and sounders connected therewith; and Fig. 3 a detail view, on an enlarged scale, showing the construction of one of the transmitting-levers.

My invention relates to an apparatus by means of which four messages may be transmitted simultaneously over a single telegraph line, wire, or cable of ordinary construction; that is, two messages in one direction and two in the other over the same line or circuit.

The invention herein claimed consists in the special construction and combination of transmitters, wires, and batteries, constituting the transmitting apparatus, and also in the combination of this transmitting apparatus with an improved relay system, as will be hereinafter more fully set forth.

The relay system is not herein claimed as a separate and independent device, as it constitutes the subject-matter of another application, and in this is only claimed in combination with the transmitting apparatus. I will proceed to describe it, however, in order that the operation of the entire apparatus may be understood.

In the drawings, A and B represent two ordinary differentially-wound relays, which are employed for the receiving-instruments at one station. The relay A nearest to the transmitting apparatus is constructed with cores and helices considerably shorter than those in the relay B, as shown in the drawings. The core of each relay is surrounded by the convolutions of two wires, so that two separate currents may be made to pass around the core in the same or opposite directions in a well-known way.

The line-wire is brought to the end of one wire of one convolution of the relay B, and to the other end of the same convolution a connection is made through the wire *a* with the end of one convolution of the relay A, the other end of which convolution is connected to a wire running to the transmitting apparatus, and thereby connection is made with the ground through the springs and levers of the transmitters, as will be hereafter described. As thus far described, the position of the relays is precisely similar to that of two electro-magnetic helices or relays in the same line circuit, one of the convolutions of each relay being traversed by the currents arriving from or passing to a distant station. The second convolution of each relay is connected up in an artificial circuit for neutralizing purposes in an artificial manner. At the point C, where the wire running from the transmitting apparatus is joined to one convolution of the relay A, as described above, a connection is also made with one end of the second convolution of this same relay, as shown in Fig. 2 of the drawings, and the other end of this latter convolution is connected through the wire *b* with one end of the second convolution of the relay B, the opposite end of this convolution being connected with a rheostat of sufficient adjustable resistance to answer a purpose similar to that for which it is used in well-k own methods of duplex and quadruplex telegraphy—that is, for the purpose of constituting an artificial circuit from the point C to the ground through one coil of the relays A and B consecutively, which artificial circuit shall be equal or nearly equal in resistance to the circuit from the point C through the other convolutions of each relay out to line, and thence to the instruments of a distant station.

By this arrangement of devices, currents sent by the transmitters to the point C will be caused to divide in such a way that one part passing from C to line through one convolution of each relay will have its magnetizing tendency neutralized by the other part of the current passing from C to the rheostat and ground through the other convolution of each relay, and the soft-iron cores of each relay will therefore remain neutral during the transmission of signals from the home station in the same manner and for the same purpose as in the well-known differential duplex method.

The relay A has moderately short cores, as stated above, and a soft-iron armature, D, to which a suitable spring, *d*, is attached for the purpose of drawing back the armature when released by the magnet. This relay A operates a repeating-sounder by closing a local circuit on the back contact when the armature is released by the magnetism of the cores and is pulled back by a spring. This repeating-sounder operates a recording or repeating instrument by contact in its upstroke in a well-known way. This local circuit and repeating apparatus is shown at F in the drawings, and need not be described more minutely, as it is of ordinary and well-known construction.

The relay B is of ordinary dimensions, and is provided with a permanently-magnetized steel armature, E, to which a spring, *e*, is attached, which operates in the same manner as the spring *d* at the other relay. This relay B is also provided with the usual local connections and contact for the operation of a second repeating or recording instrument, G, of ordinary construction, which need not be described more minutely.

In this, as in other systems in which batteries of reversed polarities are used upon a circuit to operate electro-magnets, currents of given polarity, attracting an armature of soft iron against the force of a spring at the remote end of an ordinary line-circuit, cannot by any known device be so quickly withdrawn and a current of opposite polarity sent into the line but that the electro-magnets will for an instant be neutral, and hence the armature will attempt to obey the force of the spring.

This result, constantly recurring, will produce an unsteadiness in the signals which will be detrimental, especially on long circuits of ordinary line. To obviate this difficulty, I place the plates of a condenser, H, between the relays A and B and connect one armature or pole of the condenser to the wire *a*, thereby connecting it to the convolutions of the relays in the line-circuit, and the other armature or pole of the condenser is connected to the wire *b*, and thereby to the convolutions in the artificial or rheostat circuit, as shown in Figs. 1 and 2 of the drawings.

The outgoing currents being equal in the two circuits, and of the same polarity, do not affect the condensers, but an incoming current fills the set of plates connected to the line-circuit, and they attract by induction an equal and opposite charge on the contiguous plates, according to the well-known action of condensers. When the incoming current is withdrawn, the condenser-plates discharge themselves through the relay A, passing through both convolutions of this relay to the point C, and the charge from each side of the condenser produces a momentary magnetic effect on the core of the relay, thereby filling in the neutral gap in the core between the withdrawal of a current of one polarity and the substitution of that of another, so that the signal will be steady and certain.

The transmitting apparatus, by which currents are sent to line to operate the relay system above described at a distant station, must be of somewhat peculiar construction and arrangement. I have made an improvement in the transmitting apparatus, adapting it for use with my improved relay system, although it is not the only apparatus that can be employed in this connection.

Two transmitters, I and K, are mounted on pivotal bearings in the ordinary way, as shown in Fig. 1 of the drawings. These transmitters or levers are of well-known construction in their general features. They are double-pointed—that is, a point, *i* or *k*, is attached to each end of the levers, respectively. The point *k*, on the armature end of the transmitter K, is mounted upon an insulating-block, k^2, as shown in Fig. 3 of the drawings. Contact-springs *i′* and k^1 are also mounted upon the levers I and K, one on each end thereof, respectively, and insulated in the usual way by attaching them to insulating-blocks, as shown in Figs. 1 and 3 of the drawings.

Points I′ and K′ are mounted on insulating-posts and located over the springs on each end, respectively, of the transmitters I and K. These points are of ordinary construction, and will be fully understood without further description.

Three separate batteries are employed, of the proportions of ten, twenty, and thirty, or one, two, and three, which are represented in Fig. 1 of the drawings by X, Y, and Z. The weakest of these batteries, X, is inserted between one of the points I′, at the transmitter I, and the insulated spring k^1 on the armature end of the transmitter K, being connected with such by the wires *x x′*.

The second battery in power, Y, has one pole connected with the insulated point *k* on the armature end of the transmitter K by the wire *y*, and the other pole permanently connected to the ground by the wire *y′*. The batteries X and Y are so arranged that these opposite poles will be placed in connection by means of the insulated connecting-point *k* and spring k^1 on the armature end of the transmitter K, when the latter is closed.

When the transmitter K is in an open position, as shown in Fig. 1 of the drawings, the battery X is put to ground through the spring k^1, point K′, and the wire N, with a small resistance-coil, *n*.

The strongest of the batteries, Z, has one pole connected by the wire *z* to the insulating-point K′ at the outer end of the transmitter K, and the other pole connected permanently to ground by the wire *z′*. The transmitter K is also connected permanently to ground by a wire, O, and small resistance-coil *o*. The point I′ at the armature end of the transmitter I is connected by the wire *w* to the insulated spring k^1 on the outer end of the transmitter K, and the two springs *i′* on the transmitter I are united by the wire *v*, and are connected to the relay system by a wire, T, running to the point C at the junction of the two circuits of said system.

The operation of my invention is as follows:

As explained above, an outgoing current does not affect the relay system at the transmitting or home station, on account of the neutralizing effect of the artificial circuit. If, however, a similar receiving apparatus is placed at a distant station in a position agreeable to the relay system at the home station, it will be affected by the currents flowing to line from the batteries at the home station.

Now, it is evident that there are four conditions in which the transmitting apparatus above described may be placed, to wit: first, both transmitters I and K open; second, transmitter I closed and K open; third, transmitter K closed and I open; fourth, both transmitters I and K closed.

In the first condition, the batteries are all grounded and no current is sent to line. In the second condition, contact is made between the spring i' and point I′, at the outer end of the transmitter I, and broken between the corresponding spring and point at the armature end of the same transmitter. A current will, therefore, flow to line from battery X alone.

In the third condition, contact is made between the spring k^1 and the point K′ at the outer end of transmitter K, and battery Z is sent to line; and in the fourth condition battery Z is cut out, battery X is sent to line, re-enforced by battery Y, connection being established between the batteries X and Y through the point k and spring k^1 on the armature end of the transmitter K.

The three batteries are disposed so that a positive current will flow from battery X to line, a negative current from battery Z, and the opposite poles of batteries X and Y being connected, the current flowing from the two united will be positive. It therefore follows that, while in the first condition of the transmitters, as stated above, the batteries are all cut out of the line; in the second condition a current is sent to line, which may be represented by 1 +; in the third condition one which may be represented by 3 —; and in the fourth condition a current that may be represented by 3 +, owing to the relative power of the batteries being in the ratio of one, two, and three, as heretofore stated.

Under the second condition, when the current 1 + arrives at the distant station it closes the relay B, its armature being agreeably polarized, but the retracting-spring of the armature of relay A is so adjusted as to resist the effect of all currents not greater in quantity than 1, and therefore the armature of relay A will not respond under the second condition.

Under the third condition, the current being of greater quantity than 1, the armature of relay A will be closed, and at the same time the armature of relay B, being polarized, will be repelled and held open, the retracting-spring acting in conjunction therewith. In the fourth condition the current being represented by 3 +, the armature of relay B will be closed, and also that of relay A, the current being stronger than 1. Signals are therefore received by the sounders at the distant station, in the first instance by the sounder operated by B; in the second instance by the one operated by A; and in the third instance by both. At the same time, currents arriving from the distant station will produce simultaneously like effects in the relays A and B of the home station; and it makes no difference whether the currents coming in from the distant station agree with or are opposite to the currents sent out from the home station.

It will be noticed that with my improved transmitting apparatus the line is always placed in connection with the ground when the transmitters are open. The system can also be used as a duplex system at one station in connection with an ordinary duplex system at some other station on the same line without change of wires, the relay A being used as a receiver, and the transmitter K as the sending-key.

I have described the main batteries X, Y, and Z as being in the proportion of ten, twenty, and thirty, or one, two, three; but it is evident that this ratio may be considerably varied in either direction without departing from the principle of my arrangement—that is, without changing the operation of the batteries, as set forth in the description above.

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

1. The transmitter K, consisting of the centrally-pivoted lever having a contact-spring at each end mounted thereon, but insulated therefrom, and a contact-point, k, at one end, insulated from the lever, in combination with suitably-insulated contacts k^1, the lever being arranged to play beneath and form connection with said contacts, substantially as and for the purpose set forth.

2. The transmitter K, constructed as described, and transmitter I, in combination with the batteries X, Y, and Z, of the proportion of one, two, and three, or nearly so, connected to the transmitters, so that the batteries may be sent to line, substantially as described.

3. The batteries X, Y, and Z, and double transmitters I and K, in combination with a relay system consisting of the two differential relays A and B, armatures D and E, condenser H, and equaling rheostat, constructed and operating substantially as and for the purpose set forth.

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Witnesses:

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