

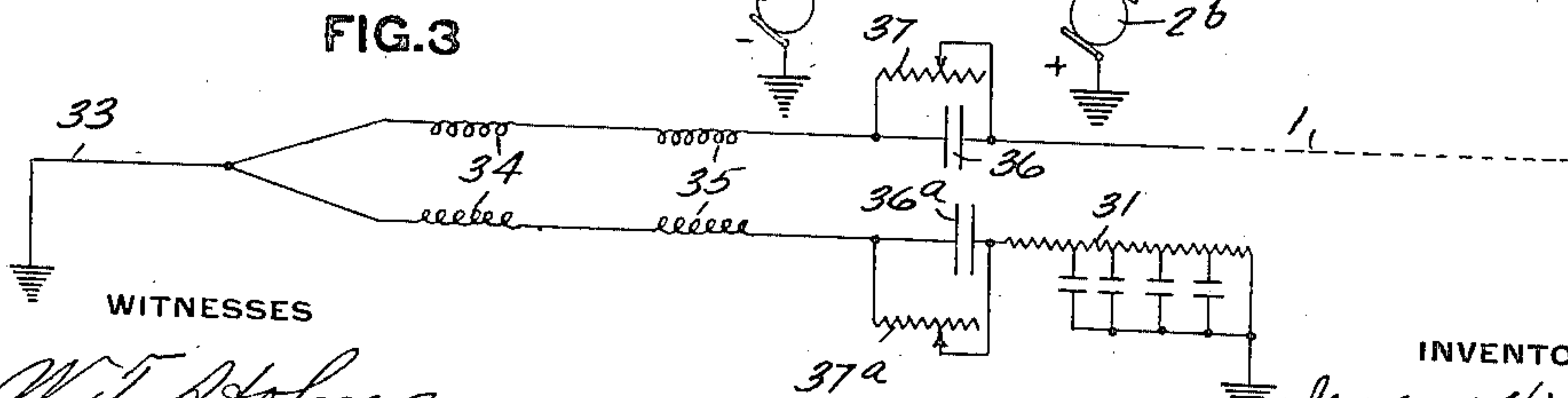
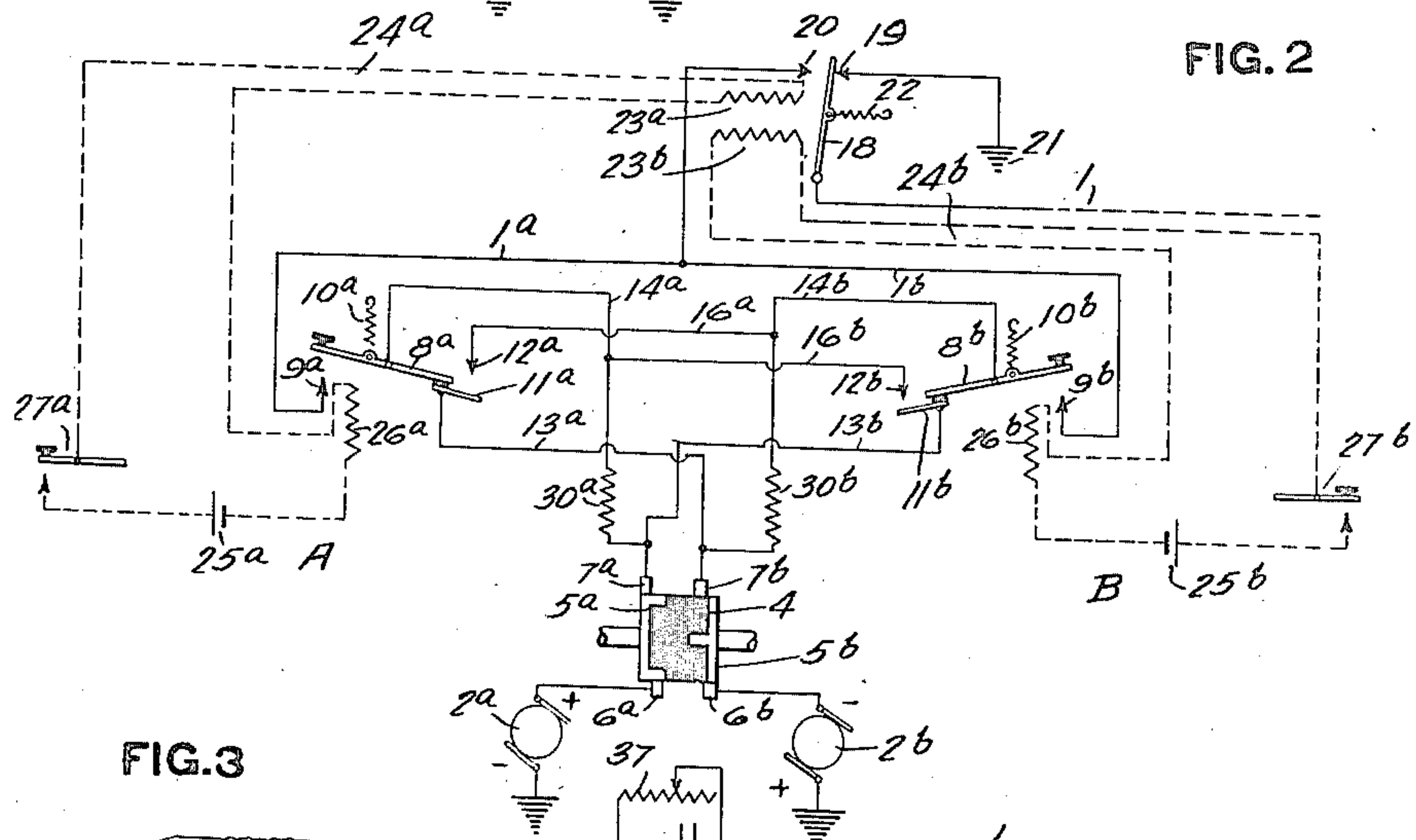
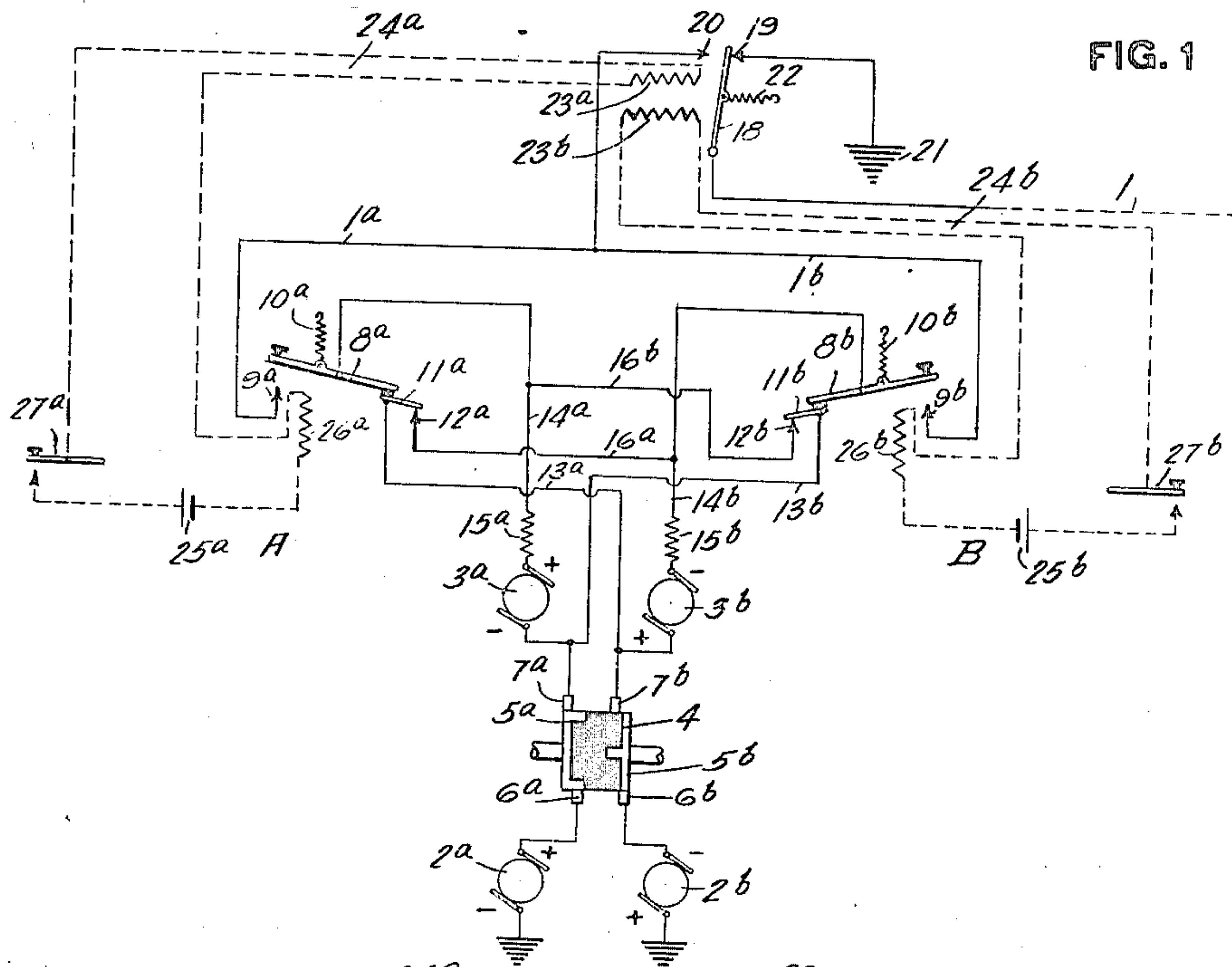
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QUADRUPLIX TELEGRAPHY.

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1,222,303.

Patented Apr. 10, 1917.



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QUADRUPLIX TELEGRAPHY.

1,222,303.

Specification of Letters Patent.

Patented Apr. 10, 1917.

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To all whom it may concern:

Be it known that I, ISIDOR KITSEE, a resident of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a new and useful Improvement in Quadruplex Telegraphy, of which the following is a specification.

This invention relates to an improvement in quadruplex telegraphy and is specially applicable to a system of quadruplexing in which uni-directional pulses or current of one polarity denote one signal or message, in which uni-directional pulses or current of the opposite polarity denote a second signal or message, and in which pulses alternating in polarity, or an alternating current, denote the simultaneous transmission of two signals or messages.

I have discovered that on lines having considerable capacity, such for instance as copper lines most generally used today in telegraphic work, or lines on which telephone and telegraph are combined, or submarine cables, quadruplexing by means of a system which uses uni-directional pulses or current of one polarity to denote one message, uni-directional pulses or current of the opposite polarity to denote a second message, and alternating current or true reversals to denote two simultaneous messages, the presence of capacity greatly interferes with the proper working of the system, and if this capacity is above three microfarads signaling by means of such system becomes impossible.

I have found that if the capacity of the line exceeds in the neighborhood of three microfarads the absorption or loss with a uni-directional current or uni-directional pulses, is far less than the absorption or loss with alternating current or with pulses of alternating polarity, and that the greater the capacity of the line the greater is the difference between the losses or absorptions of these two currents.

The object of this invention is to obviate this difficulty and to enable the quadruplexing of lines with considerable capacity in systems of the character above specified.

Generally stated, the invention consists in a method of quadruplexing lines with capacity by impressing upon the line uni-directional pulses or current of one polarity

to denote one message, impressing upon the line uni-directional pulses or current of the opposite polarity to denote a second message, and impressing upon the line pulses of alternate polarity, or alternating current, to denote simultaneously two messages, and doing this in a manner so that the difference in absorption or loss of the two kinds of current will not affect the values of these currents at the receiving end, and result in the receipt of currents or pulses of substantially equal value in the receiving systems.

The accompanying drawings show a number of arrangements whereby this new method can be carried into effect, but without attempting to show all arrangements for accomplishing the purpose.

In the drawings Figures 1, 2 and 3 are diagrammatic views of three different arrangements of apparatus for carrying out the method.

Figs. 1 and 2 show transmitting systems in which 1 indicates the line, 1^a and 1^b branches thereof respectively for the two transmitting stations A and B. 2^a and 2^b indicate two sources of direct current, associated respectively with the two transmitting stations, and here shown as direct current generators, but, if desired, batteries may be used instead. 3^a and 3^b indicate two supplementary sources of direct current, here also shown as direct current generators. 4 indicates a rotating commutator bearing segmental contacts 5^a and 5^b, with each of which coöperates a set of brushes, viz., brushes 6^a and 7^a coöperating with contact 5^a and of which the former is connected to the positive pole of generator 2^a, and brushes 6^b and 7^b coöperating with contact 5^b and of which the former is connected to the negative pole of generator 2^b. The opposite poles of generators 2^a and 2^b are grounded. 8^a is a key or armature associated with station A, and 8^b is a similar key or armature associated with station B. The key 8^a coöperates with a stop 9^a to which the line branch 1^a is connected and the key 8^b coöperates with a contact 9^b to which the line branch 1^b is connected. Both of these keys are biased, such as by springs 10^a, 10^b, so that they are normally open at the line contacts. Each of these keys carries a tail member, marked 11^a and 11^b, respectively,

which are insulated from the bodies of the keys and normally rest against stops 12^a and 12^b respectively. The tail member 11^a is connected by wire 13^a with the brush 7^b and the tail member 11^b is connected by wire 13^b with the brush 7^a . The positive pole of the supplemental generator 3^a is connected through wire 14^a to the body of key 8^a , and its negative pole to the brush 7^a , while the supplemental generator 3^b has its negative pole connected through wire 14^b to the body of the key 8^b , and its positive pole connected to the brush 7^b . In each of the circuit wires 14^a and 14^b is placed a small resistance coil marked respectively 15^a and 15^b . The stop 12^a is connected through wire 16^a with the wire 14^b , and the stop 12^b is connected through wire 16^b with the wire 14^a .

If now when key 8^b is open, the key 8^a is depressed it makes contact with stop 9^a and breaks contact between its tail piece 11^a and stop 12^a . In this condition the positive pulses from generator 2^a will flow through contact 5^a on the rotating commutator 4 and brushes associated therewith, through supplementary generator 3^a , wire 14^a , key 8^a , stop 9^a , line branch 1^a , to the line. The supplementary generator 3^a is, however, short circuited through wires 14^a , 16^b , stop 12^b , tail piece 11^b , and wire 13^b , so that only the energy from generator 2^a flows to the line. Negative pulses at this time cannot reach the line because the key 8^b is opened at stop 9^b . If while the key 8^a is opened the key 8^b is depressed, so as to contact with the stop 9^b the circuit is as follows: from the negative pole of generator 2^b , through contact 5^b of the commutator 4, through supplementary generator 3^b , wire 14^b , key 8^b , stop 9^b , line branch 1^b to the line. The supplementary generator 3^b is then short circuited through wire 14^b , wire 15^a , stop 12^a , tail piece 11^a and wire 13^a , so that only the energy of generator 2^b is impressed upon the line. Consequently, when sending a message only from station A, pulses of positive polarity are impressed upon the line and of a value equal to the voltage generated by generator 2^a ; while in transmitting a message only from station B, negative pulses alone are impressed upon the line and of a value equal to the voltage generated by generator 2^b . If, however, both keys 8^a and 8^b are simultaneously depressed, the circuits from generators 2^a and 2^b respectively to the line are the same as before described, but the short circuits of supplementary generators 3^a and 3^b are both broken by the lifting of tail pieces 11^a and 11^b respectively from the stops 12^a and 12^b . Consequently, under such conditions pulses of alternate polarity are impressed upon the line, and these pulses will have a value of the voltages generated by the generators 2^a and 2^b respectively plus the voltages generated by the supplementary

generators 3^a and 3^b respectively. Consequently, under this condition the alternating pulses impressed on the line have a higher value than the value of the positive and negative pulses when impressed upon the line. The result is that the greater losses or absorptions due to the capacity of the line when an alternating current or pulses of opposite polarity are impressed on the line is compensated for by the increased value of the alternations impressed upon the line, so that the pulses or currents reaching the receiving instruments at the distant station are substantially equalized with those received at the receiving instruments when pulses of only one polarity are impressed upon the line. In this way lines of very considerable capacity can be practically quadruplexed. The value of the currents generated by supplementary generators 3^a , 3^b will be proportioned to the capacity of the line, in other words, the larger the capacity of the line, the greater must be the power of the supplementary generators.

When the line must be automatically grounded at both terminals, that is, when the terminals do not have a straight ground, I connect in the line, at each end, a relay comprising an armature 18 permanently connected to the line and arranged to cooperate with a pair of stops 19 and 20 respectively, the former of which is connected to ground 21 and the latter of which is connected to the line branches 1^a , 1^b . The armature 18 is biased, such as by spring 22, so that normally it is in contact with the ground stop 19. Associated with this armature are a pair of magnet coils 23^a and 23^b , the former of which is in a circuit 24^a , in which is a source of current 25^a , a magnet coil 26^a associated with the key or armature 8^a , and a key 27^a biased so as to normally hold the circuit 24^a open. When key 27^a is closed the magnet 26^a is energized so as to draw key 8^a into contact with stop 9^a , and the magnet 23^a is also energized to draw the line armature 18 into contact with the stop 20. The magnet coil 23^b is likewise in a local circuit 24^b in which is a source of current 25^b , a magnet coil 26^b associated with key 8^b , and a key 27^b , which is biased so that it normally holds the circuit 24^b open. When the key 27^b is closed it results in the energization of magnet 26^b to draw key 8^b into contact with stop 9^b and also energizes magnet 23^b to draw the line armature 18 into contact with stop 20. When this ground connection of the line is used the keys 27^a and 27^b become the operators' keys, and the keys 8^a and 8^b are in effect relay armatures, as will be readily understood.

The arrangement shown in Fig. 2 differs from that shown in Fig. 1 in that instead of increasing the intensity or voltage of the pulses or currents when alternations are im-

pressed upon the line, when both of the keys are simultaneously closed, the same general effect is produced by inserting resistances in the circuits of the primary generators when a single key is depressed, and providing means for automatically shunting such resistance through the depression of both keys, so that in effect the intensity or voltage of the uni-directional pulses is decreased below that of the alternate pulses or current. The circuit arrangements here employed differ from those shown in Fig. 1 only in substituting large resistances 30^a and 30^b in the same connections as the supplementary generators 3^a and 3^b of Fig. 1, and in reversing the relation between the tail pieces 11^a and 11^b of the keys 8^a and 8^b with reference to the stops 12^a and 12^b ; that is to say, normally the circuits between these two tail pieces and stops are open, instead of being closed, as in Fig. 1. The result is that when only a single key is depressed the current from its associated generator 2^a or 2^b can reach the line only by flowing through the resistance 30^a or 30^b , as the case may be, whereas, when both keys are simultaneously depressed both of the resistances 30^a and 30^b are short-circuited. When both keys are depressed the current from generator 2^a passes from brush 7^a through wire 13^b , tail piece 11^b , stop 12^b , wire 16^b , to wire 14^a , and thence through key 8^a , stop 9^a , line branch 1^a to the line, while the pulses from generator 2^b flow from brush 7^b through wire 13^a , tail piece 11^a , stop 12^a , wire 16^a to wire 14^b , and thence through key 8^a , stop 9^a , line branch 1^b to line, as before. This arrangement has the same effect as in Fig. 1, viz., to equalize the values of the received energy in the receiving instruments, so as to compensate for the greater loss or absorption due to the capacity of the line when the alternating current or pulses are impressed on the line.

Fig. 3 shows another arrangement for accomplishing the same result, this showing an arrangement at the receiving station. Here also 1 indicates the main line, 31 indicates the artificial line, and 33 the ground connection of the line. 34 and 35 indicate diagrammatically the relays of the receiving instruments. The remainder of the receiving circuits are not illustrated, as they will be readily understood by those skilled in the art. In the main line is inserted a large capacity, such as condenser 36, and shunted around this is a comparatively small variable resistance 37. In the artificial line is placed a similar capacity 36^a and resistance 37^a for balancing purposes. The capacity 36 may have from 10 to 20 microfarads, more or less, depending upon the capacity of the line, and the resistance 37 may vary from 500 to 1000 ohms, more or less, depending upon the resistance of the line. With this

arrangement when pulses of one polarity only arrive they cannot pass through the condenser 36, but must go through the resistance shunt, and will therefore be reduced in intensity, while when the pulses of alternating polarity, or an alternating current, arrive they pass through the condenser, as is well known, and encounter only slight resistance, so that they are substantially unreduced in intensity. By properly proportioning the value of the resistance 37 the pulses of one polarity can be reduced in intensity so that they will substantially equalize with the value of the pulses of opposite polarity, or alternating current, whose intensity has been reduced due to losses and absorption on the line to a greater extent than have the uni-directional pulses or current.

The method described is applicable not only to systems such as illustrated and described, that is, in which uni-directional pulses or current are impressed upon the line to indicate one message only, and pulses of opposite polarity, or alternating current impressed upon the line to indicate the transmission of two messages simultaneously, but also to systems in which pulses of opposite polarity, or alternating current, are normally impressed on the line when no messages are being received, and the absence of all pulses on the line indicates the presence of two messages simultaneously, such as illustrated and described in my application, Serial No. 766,085, filed May 7, 1913.

The essential of the new method is the equalization of the values of the received pulses so as to compensate for the greater losses or absorptions on the line, due to the capacity of the latter, when alternations are being transmitted than when uni-directional pulses or current are transmitted. This, as will be noted, can be done either by inserting resistances at the sending station for decreasing the intensity or voltage of the uni-directional pulses or current and which resistances are automatically shunted when both keys are depressed to impress alternations on the line, as in Fig. 2, or by placing such a resistance in the line at the receiving end, shunted by a condenser so that the uni-directional pulses or current must flow through the resistance while the alternations pass through the condenser, as shown in Fig. 3, or by an arrangement for increasing the intensity or voltage of the alternations impressed upon the line when both keys are depressed, as shown in Fig. 1. In lieu of having booster or supplementary generators for securing this increase or intensity of voltage when both keys are depressed, as shown in Fig. 1, a step-up transformer can be substituted therefor, with the circuits so arranged that when only a single key is depressed the transformer is short-circuited, but when both keys are depressed, the trans-

former is put into the line circuit so as to increase the intensity or voltage flowing to the line.

Many other arrangements for securing the same results will readily suggest themselves to those skilled in the art.

What I claim is:—

1. The method of quadruplexing a line with capacity, which consists in impressing on the line uni-directional pulses or current to denote the transmission of a single message, impressing upon the line alternations to denote two simultaneous messages, and equalizing the values of the received pulses or current to compensate for the greater losses due to the line capacity when transmitting alternations.

2. The method of quadruplexing a line with capacity, which consists in impressing on the line at one time uni-directional pulses or current and at other times impressing on the line true alternations, and equalizing the intensity of the received pulses or current to compensate for the greater line losses when alternations are impressed on the line.

3. The method of quadruplexing a line with capacity, which consists in at one time impressing upon the line uni-directional pulses or current and at other times impressing upon the line true alternations, and decreasing the intensity of the uni-directional pulses or current below the intensity of the alternations in order to equalize their values at the receiving station.

4. The method of quadruplexing a line with capacity, which consists in impressing upon the line at one time uni-directional pulses or current and at other times true alternations, the alternations being of a

higher value than the uni-directional pulses or current in order to equalize their value at the receiving station.

5. The method of quadruplexing a line with capacity, which consists in impressing upon the line uni-directional pulses of predetermined value to denote a single message, and impressing upon the line alternations of a higher value than the value of the uni-directional pulses to denote two simultaneous messages.

6. The method of quadruplexing a line with capacity, which consists in impressing upon the line pulses of one polarity and of predetermined value to denote one message, impressing upon the line pulses of opposite polarity and substantially the same predetermined value to denote a second message, and impressing upon the line alternations of a higher value than the value of pulses of single polarity to denote two simultaneous messages.

7. The method of quadruplexing a line with capacity, which consists in impressing upon the line pulses of one polarity to denote one message, impressing upon the line pulses of opposite polarity to denote a second message, impressing upon the line alternations to denote two simultaneous messages, and decreasing the intensity of the pulses of a single polarity below the intensity of the alternations in order to equalize their values at the receiving station.

In testimony whereof, I have hereunto set my hand.

ISIDOR KITSEE.

Witnesses:

GLENN H. LERESCHE,
EMMA K. CUNNINGHAM.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."