May 12, 1931. A. ATHERTON 1,805,351

REPEATING APPARATUS FOR CONCENTRATION UNITS

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Fig. 1.

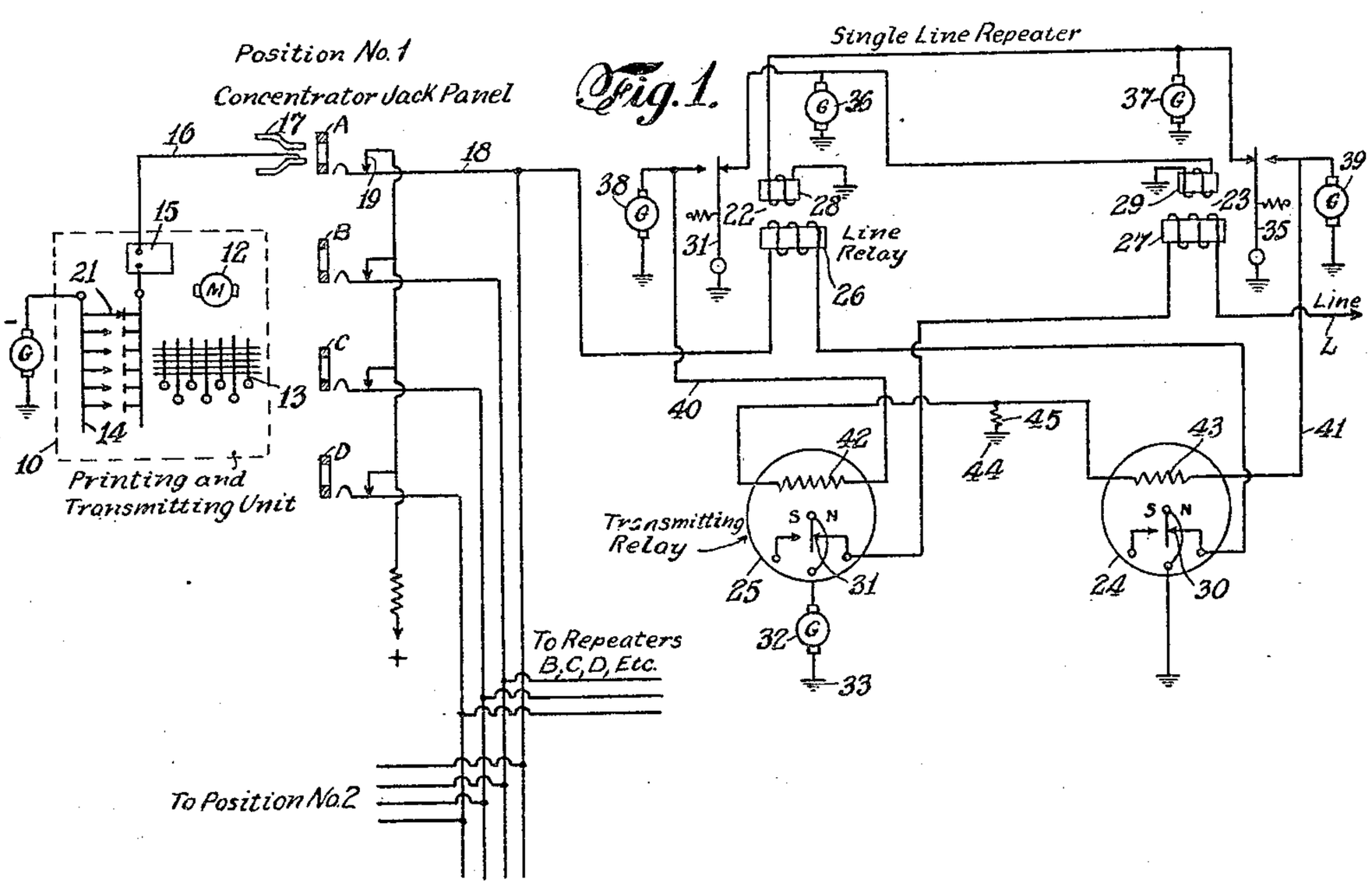
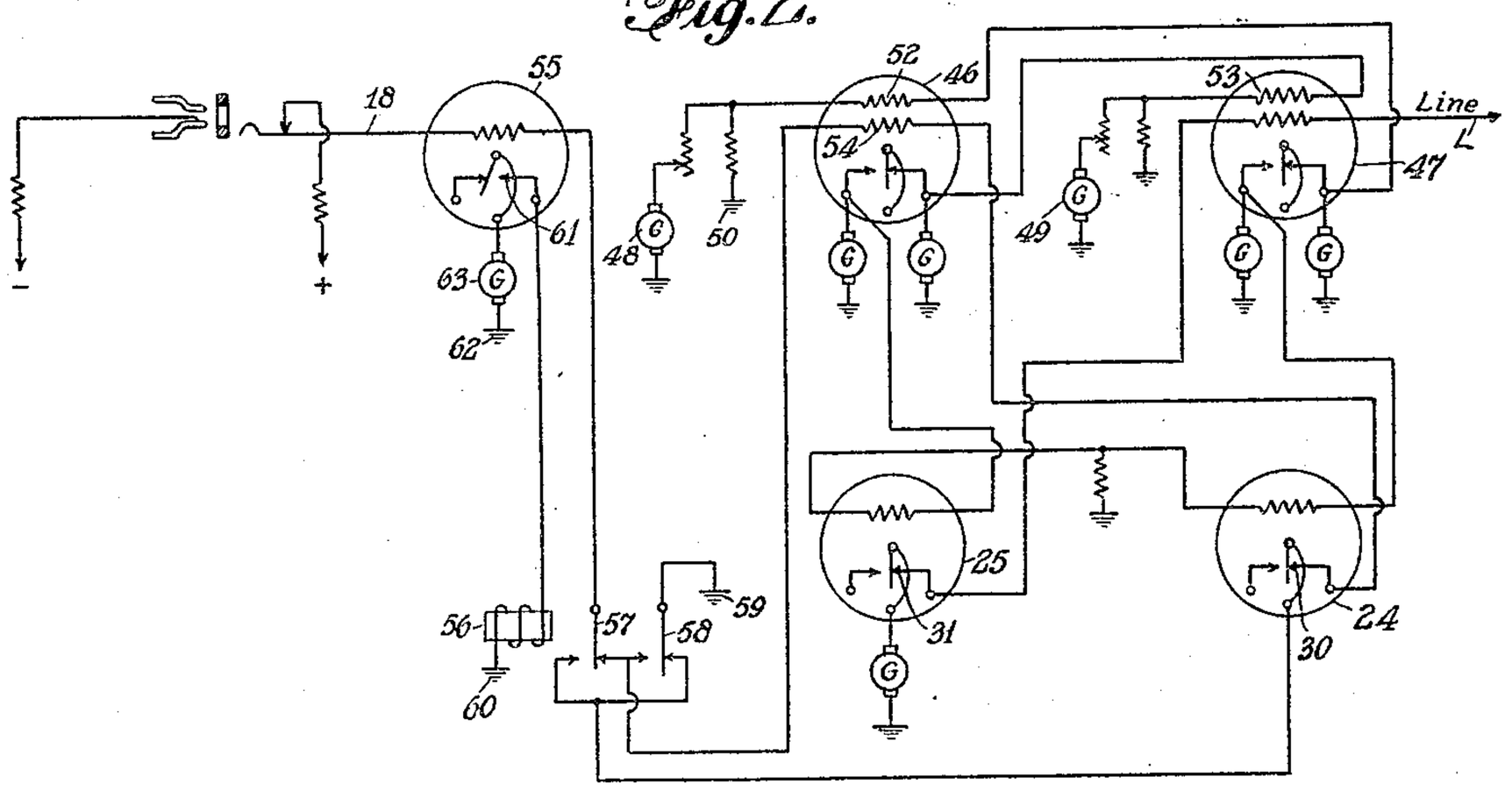


Fig. 2.



INVENTOR
ALBERT ATHERTON
BY
Eugene C. Brown
ATTORNEY

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Fig. 3.

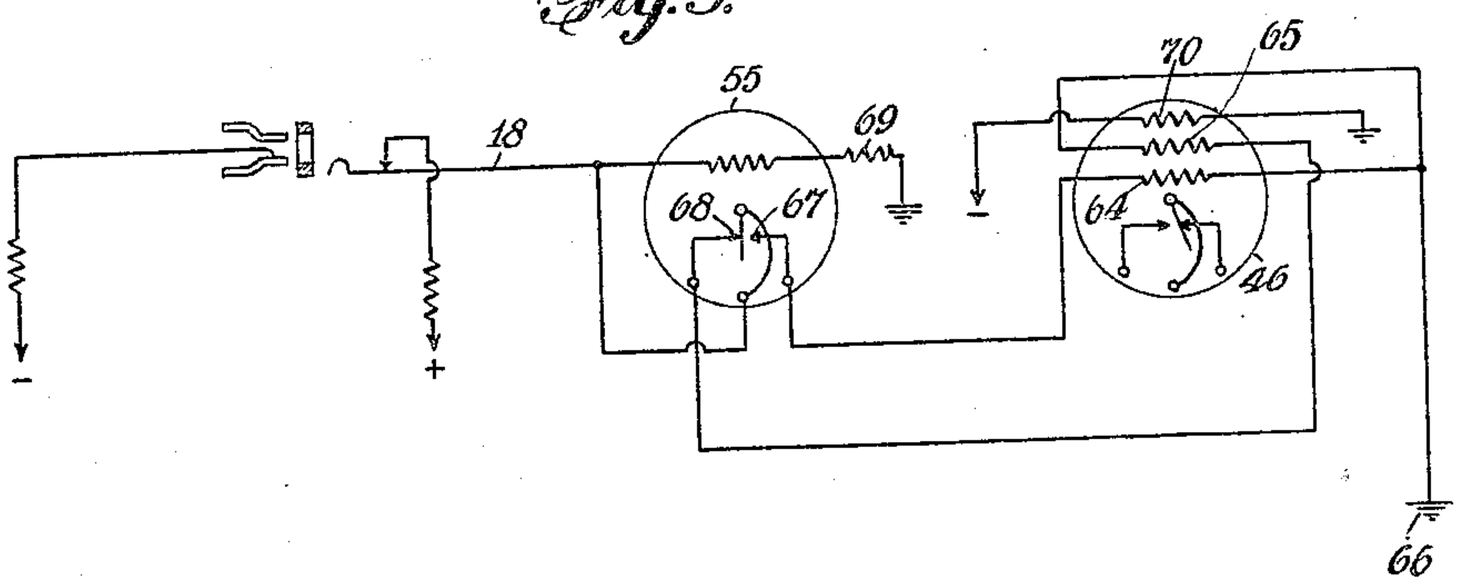
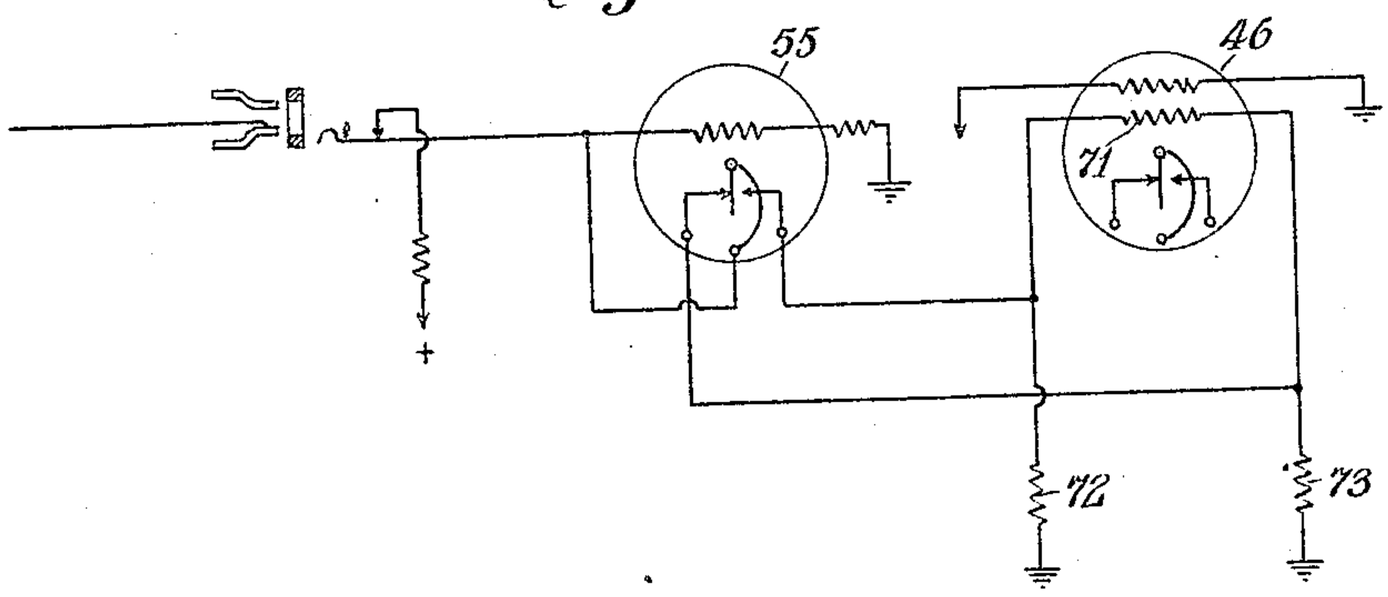


Fig. 4.



INVENTOR
ALBERT ATHERTON
BY
Eugene C. Brown
ATTORNEY

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UNITED STATES PATENT OFFICE

ALBERT ATHERTON, OF BLOOMFIELD, NEW JERSEY, ASSIGNOR TO THE WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

REPEATING APPARATUS FOR CONCENTRATION UNITS

Application filed September 16, 1929. Serial No. 393,052.

This invention relates to a circuit arrangement for handling the traffic of a number of telegraph lines terminating at a central station and having different characteristics, by means of telegraphic printers, such as the so-called simplex printers or other telegraphic receiving and transmitting apparatus having definite operating characteristics.

It is the practice at the present time in central stations having a large number of lines terminating therein to employ what are known as concentration units in order to reduce the number of operators required to conveniently handle the traffic.

A concentration unit briefly comprises an arrangement whereby a large number of underloaded line circuits are grouped in front of each of a smaller number of operators so that an operator at any position may cut-in her receiving and transmitting apparatus on any line to transact business thereover. A sufficient number of positions are provided to enable the maximum traffic to be handled. As the traffic decreases in volume the surplus operators may be released thus permitting the total volume of traffic on all lines to be operated by from one operator upwards to the maximum number of operators for which there are available positions, depending upon traffic conditions.

It is advantageous in telegraph systems to employ concentration units having a large number of lines terminating at the concentrator with a proportionate number of positions, since the average delay incident to the answering of an incoming call signal on any line decreases as the number of possible positions at which it may be answered, increases. However, as the number of positions increases and the system becomes more complex, certain problems arise in connection with the expeditious handling of the traffic, such as the determination of which operator shall answer the call signal, indications as to which lines are busy, proper distribution of the traffic among the various positions, etc., and the solution of these problems has imposed certain inherent characteristics on the concentration units.

One arrangement which is adaptable to the handling of a large number of lines at each of a large number of positions and to which the present invention particularly relates is fully disclosed in a copending application of H. W. Drake and W. B. Blanton, Serial No. 336,617, filed January 31, 1929. In this arrangement, the circuit connections are such that when a printing and transmitting unit at any position is cut-in on a trunk of a concentrator, battery of negative polarity is applied to the line and when the line is idle, that is, when there is no printer connected to the line the concentrator automatically applies battery of positive polarity to the line. The connection of battery of opposite polarity to the line when a printer is cut-in and when it is cut-out is inherent in the construction of the concentrator and is primarily for the purpose of operating the necessary "busy line test signals" and to prevent a second printer from being operated when cut-in at any position if the line is in use at another position of the concentrator.

Since the printers operate only on make and break signals, reversals of the line polarity do not affect their operation, both polarities serving to hold the line closed at the out station. However, this characterstic of the concentrator of reversing the polarity of the line prevents its direct connection to a line of such length as to require battery at both ends since if it were so connected, the line would stand open or substantially so when the concentrator applied battery of the same polarity as that applied by the out station. In accordance with my invention in order to terminate such long lines in a concentrator I provide a repeater at the central station intermediate the line and the concentrator, for applying battery of the same polarity to the line irrespective of the polarity applied at the concentrator.

It will be appreciated, since any operator may be called upon to cut-in on any one of a hundred or more lines of different lengths and characteristics and receive thereover with the same apparatus that in order to avoid the necessity of readjusting the apparatus each time a change is made from one line to another, the signals should be trans-

mitted to each printer with substantially equal strength and completeness or attenuation. By the provision of a repeater at the central station for each line terminating at the concentrator, I am able to operate the printers under substantially uniform conditions over all of the lines.

The repeater may be a single line repeater, a duplex half repeater or a terminal duplex repeater.

It is desirable in certain instances to employ polar line relays in these repeaters, responsive to the signals originating at the concentrator and it is necessary that such relays remain on their marking contacts whenever the line is closed, regardless of whether positive or negative battery is applied at the concentrator. This requirement is met, in accordance with one embodiment of my invention, by providing pole changing means associated with such polarized relays, responsive to reversals of polarity at the concentrator, for maintaining the current in the same direction through the operating winding of the relay and hence to hold the movable contact of the polarized relay on its marking contact, when battery of either polarity is applied at the concentrator.

From the foregoing it will be understood that the principal objects of the invention are to permit long lines having battery at each end to be terminated at a concentrator unit at which reversals of current occur; to provide signals of substantially uniform strength at the concentrator for each of a number of lines so that traffic can be handled over any of such lines by the same printing or other receiving apparatus without readjustment thereof and further, where polarized relays are employed in carrying out the above objects, to prevent the improper operation of such polarized relays by reversals in polarity originating at the concentrator.

Other objects and advantages will hereinafter appear.

In order that a full understanding of the invention may be had reference is made to the accompanying drawings in which;

Fig. 1 is a circuit diagram illustrating a single concentrator position with a single line repeater associated with one line terminating at the concentrator.

Fig. 2 is a similar diagram in which polarized line relays are employed in the repeater and provided with means for maintaining the contacts thereof on marking when the concentrator is connected to battery of either polarity and;

Figures 3 and 4 are circuit diagrams showing modified arrangements for maintaining the polarized relays on their marking contacts when the concentrator is connected to the battery of either polarity.

Referring to Figure 1, I have shown one position of a concentrator with the signal circuits, motor operating circuits and other auxiliary circuits omitted. Each position includes, as essential elements, a printing and transmitting unit 10 and a concentrator jack panel 11. The printing and transmitting unit comprises a driving motor 12, the circuit of which is completed by mechanism not shown when the printing and transmitting unit is connected to a line, a keyboard 13, a series of transmitting contacts 14 controlled by said keys and a printing magnet 15. The concentrator jack panel has a plurality of jacks A, B, C, D, etc., one for each line terminating at the concentrator. While only four of such jacks have been illustrated it will be understood that with a hundred wire concentrator there will be one hundred jacks for each position. The printing unit may be selectively connected to any of the line jacks by a cord 16 and plug 17. When the plug 17 is free of any particular jack, battery of positive polarity is applied to the trunk 18 connected to such jack through auxiliary jack contact 19 and when the plug is inserted to cut-in a printer on the line contact 19 is opened and negative potential is applied to the trunk 18 from a generator 20, normally closed transmitter contacts 21 of the distributor 14, printer magnet 15 and cord 16 to the plug 17.

As stated above a repeater is interposed between the trunk 18 and the line L in connection with each line for the purpose of enabling long lines having battery at each end to terminate at the concentrator and to provide uniform operating conditions for the printer over all lines.

The particular arrangement of the single line repeater shown in Figure 1, forms no part of the present invention, aside from the combination thereof with the concentration unit and only a general discription thereof will be given.

The repeater consists of two line relays 22 and 23 and two associated polar transmitting relays 24 and 25. The line relays 22 and 23 each have an operating magnet 26 and 27 respectively and a locking magnet 28 and 29 respectively. The winding of operating magnet 26 is connected to the trunk 18 and to the marking contact 30 of transmitting relay 24. The winding of the operating magnet 27 of line relay 23 is connected from the line L through the marking contact 31 of the transmitting relay 25 and through a generator 32 to the ground 33. Each of the line relays 22 and 23 has a grounded armature 34 and 35 respectively.

With the key at the outer station closed and positive potential applied to the trunk 18 at the concentrator, the operating windings of both line relays 22 and 23 are energized and hold their tongues 34 and 35 against the front contacts. The locking windings

28 and 29 are unenergized at this time due to the grounding of generators 36 and 37 through the relay tongues 34 and 35 respectively. The tongues of the transmitting relays are both held on their marking contacts by current flowing from the ground through generators 38 and 39, conductors 40 and 41 and windings 42 and 43 respectively of the relays 25 and 24, to the ground at 44, through a resistance 45.

If the printer unit is cut-in at the concentrator so as to apply negative battery to the trunk 18 the position of the movable contacts of the transmitting relays is not affected since the line relay 22 is of the non-polarized type.

However, when the distributor contacts 14 are opened to transmit a spacing signal, the tongue 34 of the line relay 22 leaves its front contact, thus permitting the generator 36 to become effective to energize locking magnet 29 to hold the relay tongue 35 on its front contact. Upon contact of the relay tongue 34 with its back contact, generator 38 is grounded through the relay tongue and is no longer effective to hold the tongue of the transmitting relay 25 on its marking contact. At the same time a second path to the ground is provided for current flowing through the winding 43 of relay 24 namely through the winding 42 of relay 25 conductor 40 and tongue 34 of relay 22. The direction of this current is such as to move the tongue of the transmitting relay 25 to its spacing contact thus transmitting a spacing signal to the line L.

When the line relay is again energized by closing of the transmitting contacts of the printer 10 the tongue 34 of the line relay 22 returns to its front contact and marking current is again applied to the line, through the marking contact 31 of relay 25.

It will be noted, due to the presence of the generator 32 in the line circuit, that battery of constant polarity is applied to the line regardless of whether the concentrator is applying positive or negative battery to the trunk 18 and thus this battery may be used to assist the battery applied at the out station. It should be further noted, that incoming line signals repeated by the relay 24 are of uniform strength, as determined by the potential of the battery applied at the concentrator, irrespective of the length of the line. The printer will, therefore, be operated under uniform conditions from each line terminating at the concentrator.

In Figure 2 I have shown a single line repeater similar to that shown in Figure 1 except that polarized line relays 46 and 47 have been employed in place of the single current line relays 22 and 23 of Figure 1. The spacing bias required for each line relay is applied by generators 48 and 49 connected in parallel with the ground connections 50 and 51 of the biasing windings 52 and 53 with which each of the polarized relays is provided. When the tongue of a line relay is on its marking contact, the locking or biasing circuit of the opposite line relay, instead of being deenergized as in the case of the locking magnets 28 and 29, of Figure 1, is energized by current from the generators 48 and 49 in such direction as to give the relay a spacing bias.

The operating winding 54 of the line relay 46 is connected to the trunk line 18 through a pole changing arrangement which responds to reversal of polarity produced at the concentration unit to reverse the terminal connections of the operating winding and thus to maintain the direction of current through the winding the same. The tongue of the polarized relay is thus held on its marking contact when current of either polarity is applied at the concentrator.

The pole changing apparatus comprises a polarized relay 55 and a single current relay 56, the latter having two movable armature tongues 57 and 58, each of which plays between two fixed contacts. The back contact of tongue 57 and the front contact of tongue 58 are connected to one terminal of the operating winding 54 of the polarized relay 46. The front contact of tongue 57 and back contact of tongue 58 are connected to the tongue of the transmitting relay 24. Relay tongue 57 is connected to one terminal of the winding of relay 55, the opposite terminal of which is connected to the trunk 18 and relay tongue 58 is connected to ground at 59.

One side of the winding of relay 56 is connected to the ground at 60 and the other side is connected to the right hand contact 61 of the polarized relay 55. The contact tongue of relay 55 is grounded at 62 through a generator 63.

When the line is idle and hence when positive battery is being applied at the concentrator, the tongue of relay 55 is held on its left hand contact and the tongues of relay 56 are consequently on their back contacts. The circuit for the operating winding of the line relay 46 is then completed from the trunk line 18 through the winding of the relay 55, back contact of relay tongue 57, operating winding 54 of the line relay, marking contact 30 of transmitting relay 24 and back contact of relay tongue 58 to the ground at 59. The direction of current through the winding 54 is such as to maintain the tongue of the relay on its marking contact. Upon reversal of current at the concentrator the tongue of relay 55 moves to its righthand contact 61, thus energizing relay 56 and moving contact tongues 57 and 58 to their front contacts. This reverses the connections of the operating winding 54 of the line relay so that the direction of current is maintained the same through the winding 57 and hence

so that the tongue of the relay is held on its marking contact. It will be noted, therefore, that reversals of current applied at the concentrator do not affect the operation of the polarized line relay. When a break in the circuit occurs at the concentrator, as in the transmitting of spacing signals, the tongue of polarized relay 46 moves to its spacing contact due to the spacing bias applied by its biasing winding 52.

In Figure 3 I have shown a modified arrangement for maintaining the tongue of the polarized relay on its marking contact when current of either polarity is applied at the concentrator. Two operating windings 64 and 65 are provided for the line relay 46, each having their opposite ends grounded at 66 (as through the transmitting relay 24). The opposite end of winding 64 is connected to the marking contact 67 of the polarized relay 55 and the opposite terminal of the winding 65 is connected to the spacing contact 68 of the relay 55. The tongue of relay 55 is connected to the trunk 18 and the winding of the relay is also connected to the trunk and to the ground through a resistance 69.

The connections of windings 64 and 65, to the contacts of relay 55 are such that current therethrough will always be in a direction to maintain the tongue of the relay on its marking contact regardless of the polarity of the current applied at the concentrator. A biasing winding 70 is provided for moving the tongue to its spacing contact when the circuit is opened.

In Figure 4 a still further modification is shown for rendering the polarized relay unresponsive to changes in polarity applied at the concentrator. The polarized line relay 46 is provided with a single operating winding 71, the opposite ends of which are connected to the spacing and marking contacts of the polarized relay 55 and also to the ground through equal resistances 72 and 73. Reversal of the direction of current produced at the concentrator causes reversals in the connections of the winding 71 so that the direction of current in the winding 71 is maintained the same.

It is obvious that various other means may be provided for maintaining the current in a constant direction through the winding of the polarized relay, as for instance by means of rectifiers and since various other changes may be made in the arrangement shown and described without departing from the invention I do not desire to be limited to the exact details illustrated except in accordance with the appended claims.

What I claim is:

1. The combination with a concentration unit having a telegraph printer associated therewith, of a number of telegraph lines terminating at said concentration unit, repeaters intermediate certain of said lines and said concentration unit, means at the concentration unit for reversing the polarity of current applied to the repeaters and means for supplying current of uniform polarity from said repeaters to the lines when current of either polarity is applied at the concentration unit.

2. The combination with a concentration unit having a telegraph printer, of a number of telegraph lines, having different characteristics, terminating at said concentration unit, a repeater employing a polarized line relay interposed between each of certain of said lines and said concentration unit and means intermediate said concentration unit and repeater for preventing changes in polarity, applied at the concentration unit, from affecting the operation of said polarized relay.

3. The combination with a concentration unit having a telegraph printer, of a number of telegraph lines, having different characteristics, terminating at said concentration unit, a repeater employing a polarized line relay interposed between each of certain of said lines and said concentration unit and means for preventing changes in polarity applied at the concentration unit from affecting the operation of said polarized relay.

4. The combination with a concentration unit, having a receiving and transmitting apparatus associated therewith, of a number of telegraph lines terminating at said concentration unit, repeaters interposed between certain of said lines and said concentration unit, means at the concentration unit for supplying current of either polarity to the repeaters, a polarized line relay for certain of said repeaters having an operating winding responsive to current applied at the concentrator and pole changing means for said polarized relay operable by reversals of polarity applied at the concentration unit for reversing the connection of said winding.

5. The combination with a concentration unit having receiving and transmitting apparatus associated therewith, of a number of telegraph lines terminating at said concentration unit, repeaters interposed between certain of said lines and said concentration unit, means at the concentration unit for supplying current of either polarity to the repeaters, a polarized line relay for certain of said repeaters responsive to current applied at the concentrator and means responsive to changes in direction of the current applied at the concentration unit for maintaining the movable contact of said polarized relay in the same position when current of either polarity is applied at the concentration unit.

In testimony whereof I affix my signature.

ALBERT ATHERTON.