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F. H. HANLEY

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THREE-ELEMENT CARRIER CODE ARRANGEMENT

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FIG. 1

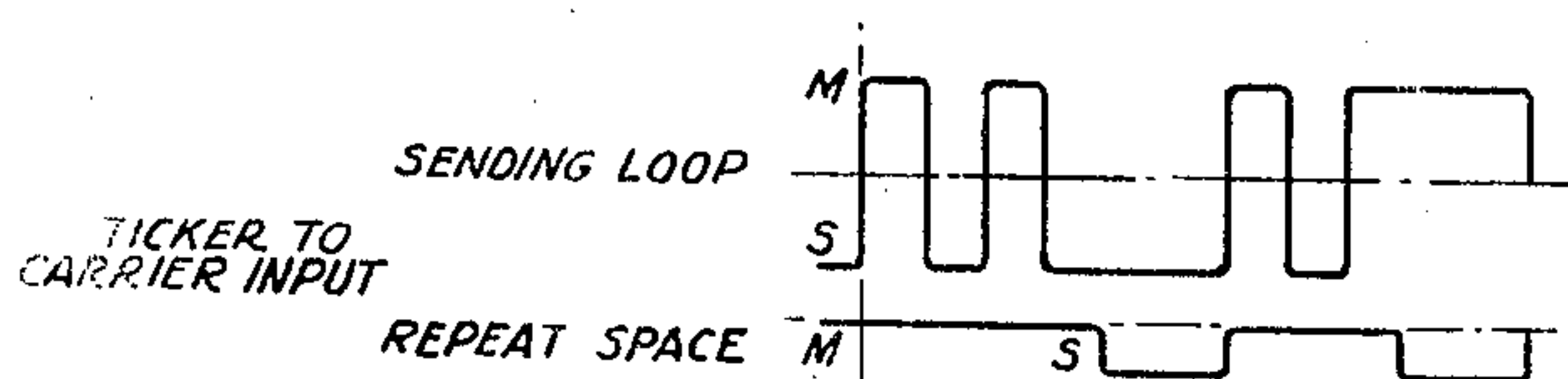
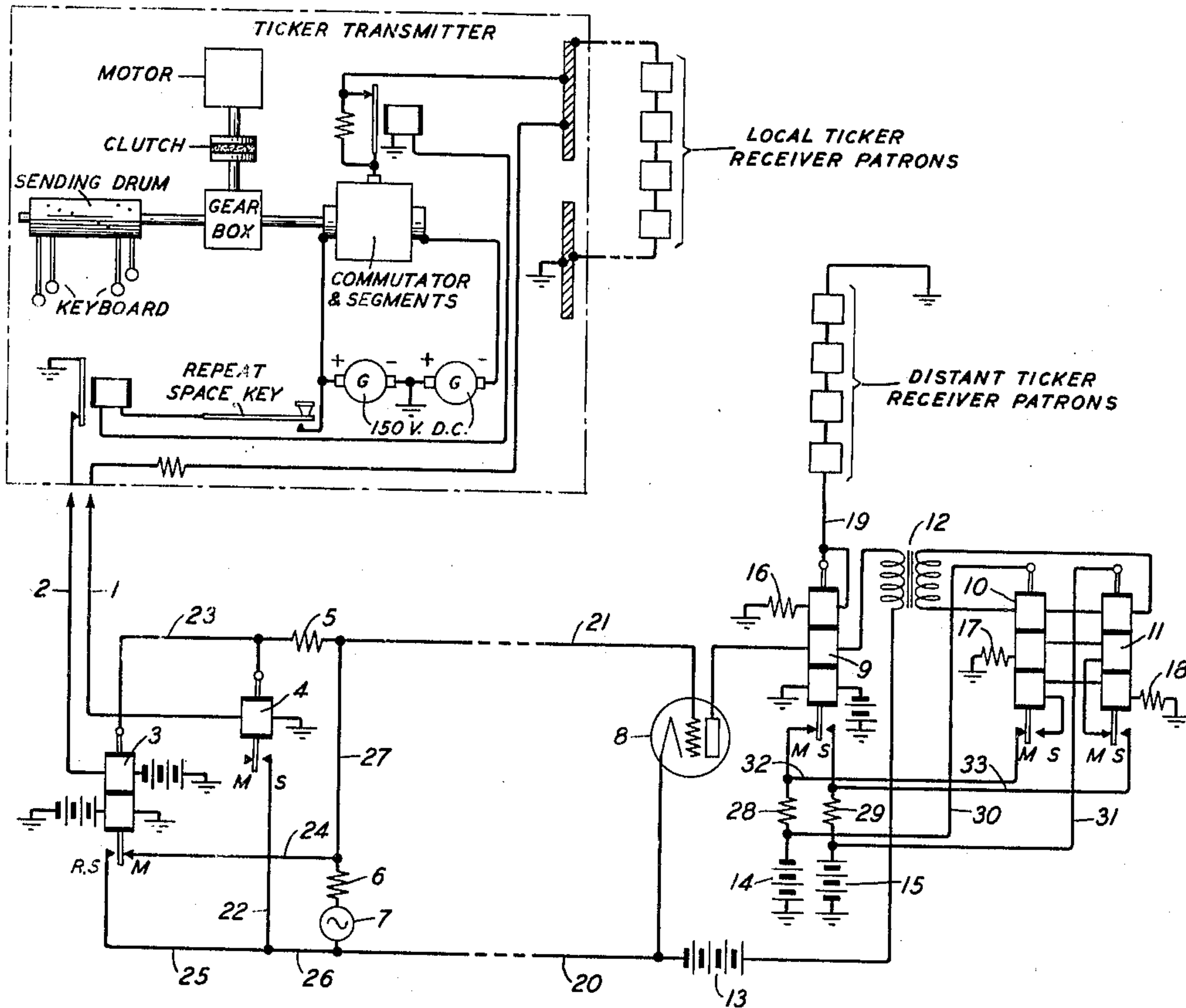
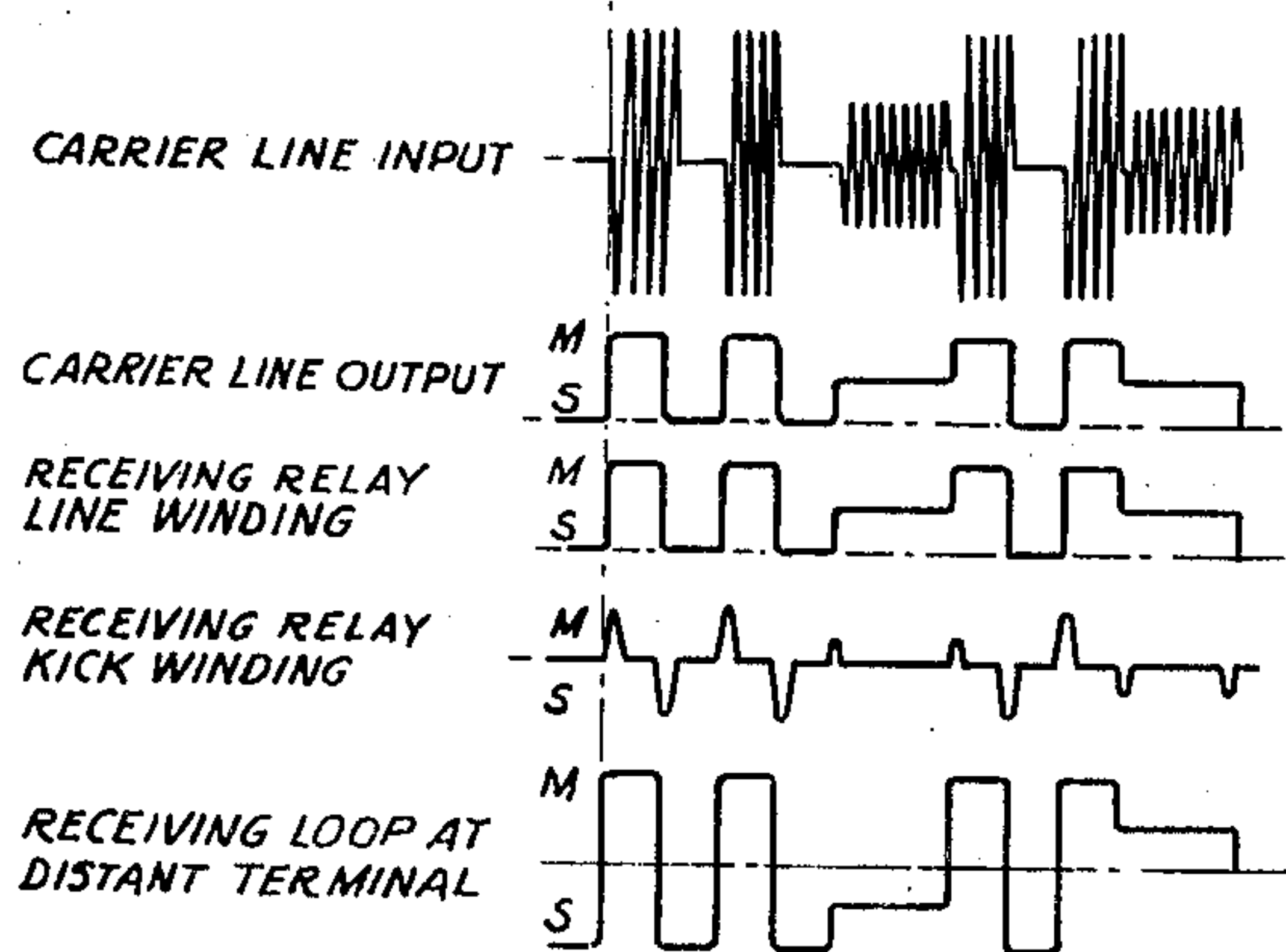


FIG. 1A



PATTERN OF SIGNALS IN PARTS OF CIRCUIT INDICATED

INVENTOR
F. H. HANLEY
BY
William R. Bullard
ATTORNEY

UNITED STATES PATENT OFFICE

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THREE-ELEMENT CARRIER CODE
ARRANGEMENTFrank Harold Hanley, Butler, N. J., assignor to
American Telephone and Telegraph Company,
a corporation of New York

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This invention relates to telegraph systems and more particularly to a telegraph circuit by means of which three-element direct current signals are converted into three-element alternating current signals, transmitted over a single carrier channel, and thereafter reconverted to three-element direct current signals.

Three-element direct current signals are used in certain telegraph systems, notably in well-known stock quotation systems.

There are advantages well known in the telegraph art in the use of direct current signals in the local receiving circuit for the operation of telegraph printers. It is desirable for economic reasons to use a carrier channel in connecting widely separated transmitting and receiving centers.

In cases, as say in said well-known stock quotation service, a single transmitter, say in New York city, is connected to a number of local receivers, as well as to receivers in distant cities. It is desirable to generate direct current signals for transmission to the local stations. For the distant cities it is desirable for the economic use of the long connecting line to convert the direct current signals into alternating current signals for transmission over a carrier channel and then to reproduce the original signals at the distant cities to operate the local printers in these areas.

While it has been possible heretofore to transmit three-element signals over a carrier channel, as far as applicant is aware there are no known facilities for converting three-element direct current signals into three-element alternating current signals and thereafter reproducing signals of the original character.

It is an object of this invention to provide means for translating three-element direct current signals directly into three-element alternating current signals and then reproducing, from these latter, direct current pulses of the original character.

A feature of this invention is the relay arrangement used to translate the three-element direct current signals into three-element alternating current signals at the input of the carrier channel.

A further feature of this invention is the relay arrangement used to reproduce the original signals at the carrier output terminal.

While this invention will be pointed out with particularity in the appended claims, the invention itself both as to its further objects and features will be better understood from the detailed

description hereinafter following when read in connection with the accompanying drawing representing an embodiment of the invention.

Fig. 1 of the accompanying drawing discloses a circuit by means of which three-element direct current signals are converted into three-element alternating current signals. The alternating current signals are transmitted over a carrier channel to a distant receiving station where they are rectified and retranslated into three-element direct current signals of the original character.

Fig. 1A of the accompanying drawing shows in a series of diagrams the character of the signals transmitted over various parts of the circuit per Fig. 1.

The detailed description of the operation of the circuit is as follows:

Conductors Nos. 1 and 2 are connected to a well-known stock quotation ticker transmitter. A train of positive and negative battery pulses are transmitted over conductor 1 from a local transmitter through the winding of polar relay 4 to ground. The armature of relay 4 follows these pulses, being operated alternately to engage its marking contact M, and its spacing contact S. During the operation of relay 4 polar relay 3 is held on its marking contact M. How this is performed will be described hereinafter.

One side of the output from a source of alternating current 7 is connected to 20 which will simulate one side of a carrier channel extending to a distant station. The other side of said output is connected through protective resistance 6 to 21 which will simulate the second side of a carrier channel which also extends to said distant station. With the armatures of both relays 3 and 4 on their marking contacts M, the full output from source 7 is impressed through protective resistance 6 on 20 and 21. When the armature of relay 4 is operated to engage its spacing contact S, a direct shunt is closed around the alternating current source 7 and its protective resistance 6.

This shunt may be traced from the top terminal of resistance 6, through lead 24, the M contact and armature of relay 3, conductor 23, the armature and S contact of relay 4, conductor 22 and through conductor 25 to the bottom terminal of the alternating current source 7. The resistance of the few feet of wire and the contacts in the shunt path is practically negligible as compared with the resistance of the carrier channel 20 and 21 to the distant station. The current in the channel is therefore reduced prac-

tically to zero. Thus we find that we have full output current in the channel when relay 4 is on its M contact and no current when relay 4 is on its S contact.

5 The operation of relay 3 will now be described. Ground is normally connected to lead 2 in the connecting transmitter circuit. Current therefore normally flows through the upper winding of relay 3 from battery connected thereto. This
10 current is in such a direction as to tend to operate the armature to engage its marking contact M. The current in the lower or biasing winding is in such a direction as to tend to operate the armature of relay 3 to engage its con-
15 tact R. S. Under these conditions the effect of the current through the upper winding is stronger than the effect of the current through the lower winding and the armature of relay 3 is operated to its M contact where it remains while
20 relay 4 is reproducing the full positive and negative pulses from the transmitter to impress full current and zero current on the line.

Under certain circumstances it may be desirable to transmit a third current condition.
25 In the case of the well-known stock quotation transmitter, a third condition, which is half of the full line current, either positive or negative, is transmitted to the local receiving tickers as a repeat space condition. This operation is used
30 in ticker printer service principally for tabulation and indentation. In transmitting the signal a resistance is inserted in the transmitter circuit, in series with the transmitter output lead, which serves customers' printers in the area local to
35 the transmitter, to reduce the output current to either half of full positive or negative current. Heretofore, as far as applicant is aware, no circuit has been available to translate such a condition at the input of a carrier in order to trans-
40 mit such signals to distant centers. Applicant's circuit performs this function in the following manner:

When the third current condition is to be transmitted, a relay in the local transmitter circuit,
45 to which lead 2 is connected, is operated to open the connection thus removing ground from conductor 2 at the transmitter. The current in the upper winding of relay 3 thereupon falls to zero. The current in the lower or biasing winding of
50 relay 3 is then effective to operate the armature of relay 3 to engage its contact R. S. R. S. is chosen to designate "repeat space." The invention is not limited, however, to the transmission of a third current condition for this purpose
55 only. The third current condition may be used to perform any of a wide variety of functions. Furthermore, while the invention is shown in connection with a well-known stock quotation transmitter and receiver it is understood that
60 it discloses broadly a method of converting three-element direct current signals into three-element alternating current signals and thereafter reproducing the three-element direct current signals.

When the armature of relay 3 is operated to
65 engage its contact R. S. the alternating current source 7 and its protective resistance 6 are shunted by a circuit which includes resistance 5, to reduce the input into the carrier channel by half. This resistance can be chosen to give
70 any desired input into the carrier channel, however. The armature of relay 4 may be operated to either its M or S contact, in response either to the half-positive or half negative current through the aforementioned resistance in the
75 transmitter output lead in series with conduc-

tor 1 as the armature of relay 3 is operated to engage its R. S. contact. If the armature of relay 4 is on its M contact, the shunt may be traced from the upper terminal of resistance 6,
5 through conductor 27, resistance 5, conductor 23, the armature of relay 3, contact R. S. and conductors 25 and 26 to the lower terminal of 7. If the armature of relay 4 is on its S contact there is a path through the armature and S
10 contact of relay 4 and conductor 22 in parallel with conductor 23, the armature and R. S. contact of relay 3 and conductor 25. Therefore, a "repeat space" signal of half full current may
15 be transmitted regardless of the position of relay 4. Or relay 4 may be arranged so that it does not respond to half current without affecting the operation of the circuit.

At the output end of the carrier channel, the alternating current impulses are rectified by
20 rectifier 8. Thereafter the three original current conditions, namely, full positive current, full negative current, and half current, either positive or negative are reproduced in the system of relays 9, 10 and 11 together with their
25 associated apparatus and connections in the following manner:

Relays 9, 10 and 11 are polar relays. Each has three windings. The top winding of relay 9 is a holding winding. The middle is a
30 line winding. The bottom is a biasing winding. The top windings of relays 10 and 11 are known in the art as "kick" windings. The middle and bottom windings of each are holding wind-
35 ings. The relays are arranged so that all armatures are operated to their marking contacts M on full line current and to their spacing contact S on no line current. Relays 10 and 11 only respond to the half line current condition. The holding windings of all relays are poled so
40 that the armature of each relay tends to be held on the contact to which it was last operated. The holding winding on relay 9 neutralizes some of the effect of relay 9 biasing wind-
45 ing when the relay armature is in its marking contact and adds to the effect of the biasing winding when the armature is on spacing. This makes the armature of relay 9 responsive only
50 to full increase or decrease in line current. Relays 10 and 11 are connected to the rectifier output through a kick circuit comprising the secondary of transformer 12. The relays are
55 arranged so that their armatures will operate to their marking contacts M on either a half or full increase in current and will operate to their spacing contacts S on either a half or full decrease in current.

The operation of these relays and their associated connections will now be described in detail.

Let it be assumed first that the armatures of all
60 relays are on their marking contacts M. Let us assume also that the line current then falls to zero from full current. There is therefore no current flowing through the middle winding of relay 9. The current through the biasing or
65 bottom winding of relay 9 tends to operate the armature to engage its S contact. While the armature of all the relays are still on M, a circuit may be traced from ground through resistance 16,
70 through the top or holding winding of relay 9, the armature and M contact of relay 9, conductor 32, M contact and armature of relay 10, conductor 30 to negative battery 14. The effect of this holding winding is to oppose the
75 effect of the biasing current, which latter effect

is stronger, however, and the armature of relay 9 operates to its S contact.

When the armatures of relays 10 and 11 are on their marking contacts M, there is a circuit from ground through resistance 17, the middle windings of relays 10 and 11, the M contact and armature of relay 11, through conductor 31 to positive battery 15. The effect of current through the middle windings of each of these relays is to tend to hold their armatures on their M contacts. The circuit through the bottom windings of relays 10 and 11 is open at the S contact of relay 10, when relay 10 is on its M contact, so that the bottom windings on relays 10 and 11 are without effect for this condition.

As the rectifier output drops from full current to zero current there is a sudden decrease in current in the primary of transformer 12. This sudden change induces an electromotive force in the secondary of transformer 12 and a flow of current through the top windings of relays 10 and 11. The effect of this current is to tend to operate the armatures of relays 10 and 11 to their spacing contacts S. The effect is great enough to overcome that of the middle or holding windings tending to hold the armatures on their marking contacts M and the armatures of both relays are operated to engage their S contacts. All three relays therefore, 9, 10 and 11, are operated to S by a decrease in current from full current to zero current.

When all three relays 9, 10 and 11 are on their S contacts, a path may be traced from positive battery 15 through conductor 31, the armature and S contact of relay 11, conductor 33, the S contact and armature of relay 9 to conductor 19. Thus we have full positive current supplied to any connecting circuit by conductor 19 for this condition.

When the armatures of the three relays 9, 10 and 11 are operated to engage their S contacts the conditions of some of their various windings are changed. In the case of relay 9, there is no current in the line or middle winding. The bottom or biasing winding is not, of course, affected by the transfer and still operates with the same magnitude to hold the relay armature on its S contact. The direction of current flow through the top winding of relay 9 has been changed as it is now terminated in positive battery 15 instead of in negative battery 14. Since, when the armature was on M the direction of current flow through the top winding was such that the effect of the winding was to hold the armature against the M contact, when the polarity of the battery is reversed by the armature transfer the effect of the winding will be to hold the relay on S. Thus when the armature of relay 9 is on S the effect of the holding winding is to augment the effect of the biasing winding.

The magnitude of the effect of these two windings on relay 9 is such that it requires the effect of full line current in the middle or line winding to overcome it. The relay armature is therefore not responsive to a change from zero line current to half line current but does respond by operating to M, whenever full line current flows in the line.

When the armature of relay 9 is on M and the line current is reduced from full current to half current, the effect of the half line current will be to tend to hold the armature on M. The cumulative effect of this winding together with that of the top or holding winding is adequate

to prevent the effect of the biasing winding from operating the armature of relay 9 to S.

When relay 9 line current changes from half current to zero current the resulting relay winding conditions are the same as for the change from full line current to zero line current described above and the relay armature is operated to S. From this description it should be apparent that the armature of relay 9 engages its marking contact M on full line circuit, its spacing current S on zero line current, that it does not respond to a change from full or zero current to half current and that it is operated to the marking contact M and to the spacing contact S on a change from half to full line current and from half to zero line current respectively.

When the armatures of relays 10 and 11 are on their S contacts, the circuit through their middle windings heretofore traced is broken at the M contact of relay 11. A new circuit is established through the bottom windings of these relays, however, from ground through resistance 13, the bottom windings of relays 11 and 10, the S contact and armature of relay 10, through conductor 30 to negative battery 14. The effect of the current through these bottom windings of relays 10 and 11 is to tend to hold the armature of each relay against its S contact. The magnitude of the effect of each of the holding windings, whether for the marking or spacing condition, is not large however. It is just great enough to insure contact while the armatures engage either contact. Relays 10 and 11 armatures are therefore responsive to the effect produced in their "kick" windings by small changes in line current. Therefore if the armatures of relays 10 and 11 are engaging their S contacts for the zero line current condition, a change to half current will produce an effect in the kick winding sufficient to operate the armatures of each relay to its M contact. A further increase in line current from the half to the full current condition, of course, can produce no further effect, because the effect in the kick windings will be in a direction to operate the armatures toward the M contacts which they are already engaging.

A decrease in the line current from full current to half current will operate the armatures of relays 10 and 11 to their S contacts. A further decrease from half line current to zero line current can have no effect.

Thus it should be apparent that the armatures of relays 10 and 11 will engage their M contacts on any increase in current or on full line current and that they will engage their S contacts on any decrease in current or on zero line current. When the armatures of all relays 9, 10 and 11 engage their M contacts, a path may be traced from negative battery 14, through conductor 30, the armature and M contact of relay 10, conductor 32, the M contact and armature of relay 9 to conductor 19 supplying full negative current to any connecting circuit. When the armature of relay 9 engages its M contact and the armatures of relays 10 and 11 have been operated to engage their S contacts as a result of a decrease in current, a path may be traced from negative battery 14, through resistance 28, the M contact and armature of relay 9 to conductor 19 furnishing reduced negative current to any connecting circuit. When the armature of relay 9 is on its S contact and the armatures of relays 10 and 11 have been operated to engage their M

contacts as a result of an increase in current, a path may be traced from positive battery 15 through resistance 29 and the S contact and armature of relay 9 to conductor 19 supplying reduced positive current to any connecting circuit. The resistances 28 and 29 may be of any value to give any reduction in current. When the invention is used in connection with a Dow-Jones ticker receiver, the resistances are chosen so as to give the reduction in current required for the repeat space condition which is a reduction to half current.

Mention has been made that the half current signals may be either positive or negative. The well-known stock quotation transmitter is arranged so that alternate positive and negative battery pulses are transmitted from positive and negative battery sources through a commutator. In order to save operating time which would otherwise be lost if the half current pulse used for repeat space had to be of a particular polarity, this condition is produced by inserting a resistance in series with the lead from the commutator and thereupon stopping the commutator so that a single repeat space pulse or a series of repeat space signals may be either positive or negative. We have seen that, at the input to the carrier channel, the half current pulses will be translated into alternating half current pulses. At the output of the carrier channel if all relays are on M for the full current condition and a change to half current is made the armature of relay 9 remains on its M contact while the armature of relays 10 and 11 are operated to their S contacts. The result is reduced negative current from source 14 through resistance 28. If the armatures of all relays are on their S contacts for the zero current condition and a change to half current is made the armature of relay 9 remains on its S contact while the armatures of relays 10 and 11 are operated to their M contacts and the result is reduced positive current through resistance 29.

Signals identical in character with those transmitted by the well-known stock quotation transmitter to the receiving tickers in the same local area with the transmitter are thus reproduced at the distant end of a carrier channel for operating receiving tickers at said distant point.

The character of the signals in the various parts of the circuit per Fig. 1 is illustrated in Fig. 1A to elaborate the description of the operation of Fig. 1, as a further aid to a ready understanding of the invention.

What is claimed is:

1. In a telegraph system, a direct current telegraph circuit connected to the input terminal of an alternating current telegraph circuit, means in said direct current circuit for transmitting a three-element direct current telegraph signaling code to said input terminal, means at said input terminal for impressing an alternating voltage of a single frequency only on said input, switching means and lumped impedance means both connected to said alternating circuit at said input terminal, and means for operating said switching means in accordance with said direct current code to vary the amount of said impedance effectively in said alternating current circuit so as to translate said three-element direct current code into a three-element alternating code.

2. In a telegraph system comprising a carrier channel, an input terminal and an output ter-

minal, a first relay and a second relay connected to said input terminal, means connected to said channel for impressing a single alternating voltage only thereon, variable impedance means connected to said channel, means connected to said first and second relays for operating said relays in accordance with a three-element direct current telegraph code, means connected to said first relay for varying said impedance in accordance with two elements in said code, and means connected to said second relay for varying said impedance in accordance with the third element of said code so as to translate three-element direct current signals into three-element alternating current signals.

3. In a telegraph system, a single carrier channel, means for establishing a single frequency alternating current in said channel for a first telegraph signal element, means for modulating the amplitude of said current only in two steps for a second and third telegraph signal element, an output terminal connected to said channel, translating means comprising a rectifier and three polar relays for translating said three-element alternating current signals received from said channel into three-element direct current signals.

4. A single carrier channel telegraph output terminal comprising a first, second and third polar relay, means for receiving three current conditions from said carrier channel means connected to said first relay for operating said relay in response to two of said conditions only, and means connected to said second and said third relays for operating said second and third relays in response to all of said conditions.

5. The method of transmitting three-element direct current signals long distances, said three elements including two elements of a first polarity of current, said two elements differing in magnitude and the third element being of a second polarity, which comprises in the order named translating said three-element signals into signal elements of a single frequency alternating current, transmitting said alternating current from a transmitting to a receiving station, thereafter rectifying said alternating current, retranslating said rectified current into three-element signals of the original character and retransmitting said retranslated signals.

6. A method of telegraph communication comprising generating a plurality of direct current signal elements of opposite polarities and including currents of different magnitudes and of the same polarity, translating said direct current elements into signal elements of a single frequency alternating current in an operation comprising a first relay switching operation, transmitting said alternating current from a transmitting to a receiving station, thereafter rectifying said alternating current, retranslating said rectified current in a second relay switching operation into direct current signals of the original character and retransmitting said retranslated signals.

7. In a telegraph system, means for generating three-element direct current signals including signals of opposite polarity and different magnitudes, means for translating said signals into signals of a single frequency alternating current of different magnitudes, means for retranslating said alternating current into three-element direct current signals of the original character and means for retransmitting said retranslated signals.

8. In a telegraph system, a telegraph input terminal, a telegraph output terminal, means for establishing a single frequency alternating current in the path between said terminals, means
5 at said input terminal for varying the amplitude of and short-circuiting said current in accordance with a three-element telegraph signaling code and relay means at said output terminal for translating said varied and short-circuited current
10 into direct current pulses of a first and second polarity and a first and second amplitude.

9. In a telegraph system, an output circuit for a telegraph carrier channel comprising a
15 rectifier, an output circuit for said rectifier com-

prising a series circuit including a winding on a polar relay and a primary winding on a transformer.

10. In a telegraph system in combination a rectifier, a transformer having a primary and
5 secondary winding and a first, second and third polar relay, a winding on each of said relays, an output circuit for said rectifier including a series connection through said winding on said
10 first polar relay and said primary winding and a series connection including said secondary and said windings on said second and third polar relays.

FRANK HAROLD HANLEY. 15