

C. L. & H. L. KRUM.
PRINTING TELEGRAPH.

APPLICATION FILED JAN. 22, 1908. RENEWED FEB. 14, 1916.

1,199,011.

Patented Sept. 19, 1916.

2 SHEETS—SHEET 1.

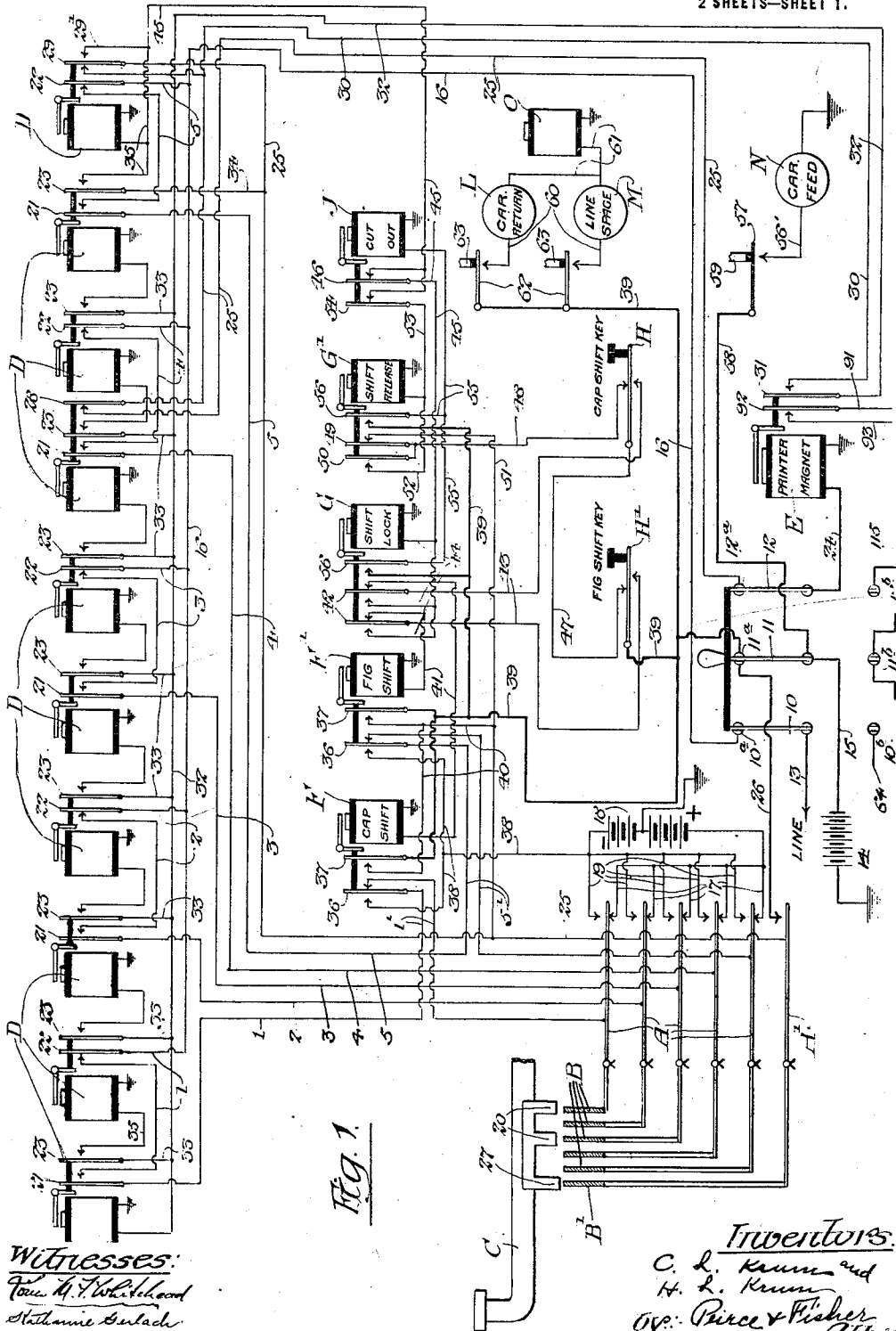


Fig. 1.

Witnesses:
Paul A. Whithead
Stathane Sulech

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Attys.

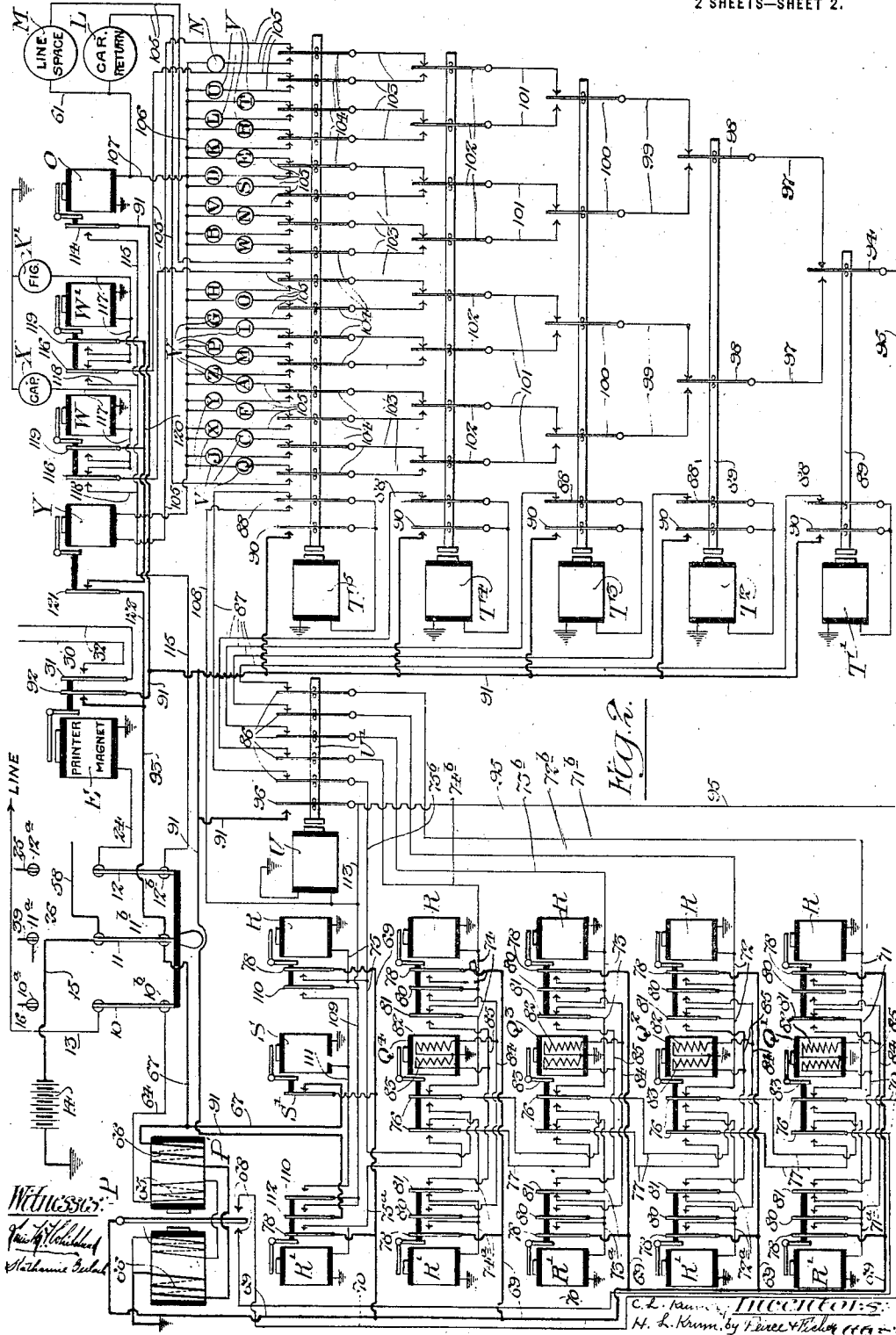
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UNITED STATES PATENT OFFICE.

CHARLES L. KRUM AND HOWARD L. KRUM, OF CHICAGO, ILLINOIS, ASSIGNORS TO
MORSE KRUM COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF MAINE.

PRINTING-TELEGRAPH.

1,199,011.

Specification of Letters Patent.

Patented Sept. 19, 1916.

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To all whom it may concern:

Be it known that we, CHARLES L. KRUM and HOWARD L. KRUM, citizens of the United States, and residents of Chicago, county of Cook and State of Illinois, have invented certain new and useful Improvements in Printing-Telegraphs, of which the following is a specification.

The invention relates to printing telegraphs employing a single wire for the transmission of impulses and in which each character is represented by a series of impulses (preferably five in number) of substantially equal length, and in which the characters are distinguished from one another by varying the polarity of one or more of the impulses of the series, and wherein the different permutations or combinations of impulses act upon suitable selecting mechanism at the receiving station to effect the printing of the several characters.

The object of the present invention is to provide improved selecting means for such a system in which all shifting parts have but a single movement and are operated by positively acting relays and which obviate the necessity of employing variably acting switch mechanism or the like, which readily get out of proper position and which are inaccurate in operation.

The invention also seeks to provide means whereby the printing of one character may be effected at the same time the next succeeding character is selected, so that the transmission of the characters may be effected with great speed.

The transmitter employed comprises a series of finger keys or like devices which control a set of five pole-changers which determine the nature of the permutations representing the different characters which are to be transmitted. The different permutations selected by the movement of the finger keys and pole-changers are transmitted to the line by a set of transmitter switches actuated by a set of magnets which are arranged to automatically and successively operate to transmit the successive impulses of each permutation to the line with precision and regularity.

The line impulses actuate a relay or relays at the receiving station which, in turn, selectively control two local circuits. These local circuits comprise a pair of main conductors and five pairs of branch conductors.

The main conductors are successively connected to the pairs of branch conductors so that the five successive impulses of each permutation may select one or the other of each pair of branch conductors. Instead of connecting the main conductors to the branch conductors by a sunflower or other variably moving switch mechanism, a series of positively acting transfer switch mechanisms are provided which act at the pauses between the successive impulses to disconnect the local main conductors from one pair of branch conductors and connect them to the succeeding pair of branch conductors. The transfer switches are operated by a set of relays and the circuits therethrough are controlled by magnets arranged in the several branch conductors. These magnets are also provided with locking devices so that when a branch conductor is selected the locking switch is shifted to maintain the selected branch circuit in closed condition, independently of the line relay.

The operating circuits through the several printer magnets or like devices, are controlled by a set of five magnets, the variable operation of which is arranged to close the circuit through one of the printer magnets or like devices to be selected. The circuits through these five controlling magnets are in turn controlled by the flow of current through the pairs of branch conductors, or, preferably, by the flow of current through one conductor of each pair. Each of the controlling magnets is provided with a locking switch so that when the circuit is once closed it will be held in closed position until the selected character has been printed.

Means are provided for separating or breaking the connection between the selecting circuits and the circuits of the controlling and printing magnets as soon as any particular selection has been made, so that the printing of a character or the printing of any particular signal may be accomplished while the proper circuits are being selected for making the next signal or character. In this way characters and signals may be selected or printed very rapidly.

While the invention is particularly designed for printing telegraphs, it is evident that it may be utilized for other purposes where it is desired to select and operate any one of a large number of devices at a distant point.

In the drawings, Figure 1 is a diagrammatic view of the transmitting apparatus and circuits. Fig. 2 is a similar view of the receiving apparatus and circuits. It will be understood that there is a transmitting and receiving apparatus at each station. The diagrammatic view in Fig. 1 represents the apparatus at a station in condition for transmitting, with the parts employed for receiving omitted, and Fig. 2 represents the apparatus at a station in condition for receiving, with the parts employed for transmitting omitted.

A switch is preferably provided at each station, having three blades 10, 11 and 12 which, when the apparatus is used for transmitting, are shifted into engagement with contacts 10^a, 11^a and 12^a, as shown in Fig. 1. When the apparatus is used for receiving, the switch blades are shifted into engagement with the contacts 10^b, 11^b and 12^b. A line wire 13 is connected, as shown, to the pivoted end of the switch blade 10. A local battery 14 is grounded on one side and its other pole is connected by a conductor 15 to the pivoted end of the switch blade 11.

A transmitter line wire 16 is connected to the contact 10^a and a set of five line branches, 1, 2, 3, 4 and 5 are connected to the transmitter line wire 16. These branches lead from a set of five pole-changers A. The normally engaged back contacts of the pole-changers are connected by the conductors 17 to the positive side of a divided line battery 18 and the normally disengaged or front contacts are connected to the negative side of the line battery by the conductors 19. The pole-changers are operated through the medium of a series of bars B from a set of keys. One of these keys C is shown in Fig. 1, and each key is provided with one or more projections for shifting one or more pole-changers of the series of five so that one or more of the pole-changers will transmit a negative impulse, while the pole-changers which have not been shifted will transmit positive impulses. By having each of the keys operate the pole-changers in different combinations, the thirty-two permutations which distinguish the separate characters are obtained.

Instead of connecting the several line branches which lead from the pole-changers to the line by means of a sunflower or like device which is apt to get out of order or operate inaccurately, this is done by means of transmitter switches which are automatically and successively operated by a set of relays. In each of the several branch circuits there is interposed a normally open transmitter switch 21 and a normally closed transmitter switch 22. These switches are operated by a set of transmitter relays or magnets D. Each of these magnets, except the last one of the set, is provided with a

switch 23 which is arranged to close the circuit of the next succeeding magnet, so that by energizing the first magnet they will operate in succession and will successively connect and disconnect the several line branches 1, 2, 3, 4 and 5 to and from the transmitter line wire 16; that is to say, when the first magnet D is energized, its armature will shift the switch 21 in branch 1 to connect the same to the transmitter line wire 16. The second magnet will open the switch 22 in branch 1 to disconnect it from the line wire. The third and fourth magnets will similarly connect and disconnect branch 2 to and from the line wire 16, and so on until the five impulses of the signal, the character of which is determined by the position of the pole-changers A, have been transmitted.

The characters transmitted are printed both at the transmitting and at the receiving stations and a single magnet is preferably employed for furnishing the force necessary to do the work of printing, so that the magnet switch which selects the characters to be printed at the receiving station may be light and quick operating and so that the finger keys which select the characters to be printed at the transmitting station may have a light touch. This large printing magnet E is grounded on one side and its other pole is connected by a conductor 24 to the pivoted end of the switch-blade 12. The contact 12^a, with which the switch-blade 12 engages when the apparatus is used for transmitting, is connected by a conductor 25 to a normally open switch A'. The contact of the switch is connected by a conductor 26 to the contact 11^a and this contact, when the apparatus is used for transmitting, is connected by the switch-blade 11 to the conductor 15 that leads from the local battery 14. Switch A' is operated when any of the keys of the transmitter are operated through the medium of a bar B' and each of the keys of the transmitter is provided with a lug 27 for operating the bar B' and closing the switch A', so that the circuit of the local battery 14 is closed through the heavy printer magnet E whenever one of the transmitter keys is shifted. The lug 27 on the keys is preferably slightly longer than the lugs 20 so that the switch A' will be operated slightly in advance of the movement of the pole-changers A. A pair of normally closed switches 28 and 29 are interposed in the conductor 25 which leads from the switch A' to the large printer magnet E. One of these switches 28 is arranged to be opened by one of the transmitter magnets D, preferably the seventh magnet of the set, as shown, and the other switch 29 is arranged to be opened by the last relay or magnet of the set.

A branch conductor 30 leads from the

portion of the conductor between the switches 28 and 29 to the contact of the normally open switch 31 which is arranged to be closed when the magnet E is energized.

5 A conductor 32 leads from the switch 31 to the first one in the set of transmitter magnets D and is also connected by a set of branch conductors to the several switches 23 by a series of branch conductors 33. The
10 switch 23, however, of the next to the last relay D of the set is connected directly to the conductor 25 by a wire 34.

When any key is operated, one or more of the five pole-changers A are shifted so that
15 one or more of the five line branches are connected to the negative side of the line battery 18, while the others remain connected to the positive side thereof. The switch A' is also shifted to close the operating circuit
20 from the local battery 14. As stated, this switch is shifted by the operation of any character key and slightly in advance of the movement of the pole-changers and to insure the prompt operation of the transmitter magnets and switches actuated thereby.
25 When the switch A' is shifted into engagement with its contact, current flows from local battery 14 through conductor 15, switch-blade 11 and conductor 26 to the switch A', thence by conductor 25 through the closed switches 29 and 28 to the contact 12^a and by switch-blade 12 and conductor 24 to the printer magnet E and back to battery through the ground or through a
30 suitable return wire. The magnet E is then shifted to effect the printing at the sending station and is also preferably arranged to hold the shifted key and the pole-changers moved thereby, in shifted position until
35 the transmission of the signal is completed. It also closes the switch 31 so that current may be then traced from the battery 14, as before, to the switch A' and conductor 25 through the switch 29, conductor 30, switch
40 31 and conductor 32 to the first one of the set of transmitter relays D which, like the other magnets of this set, are either grounded on one side or connected to the local battery 14 by a suitable return wire. The armature of this magnet then closes switch 21 to connect the line branch 1 to the transmitter line wire 16. The first magnet D also closes
45 its switch 23 and current flows from the conductor 32 through the second magnet of the set. The armature of this magnet opens the closed switch 22 in line branch 1 and closes the switch 23 so that the local operating circuit is closed through the third magnet D of the set. The line branch 1 is thus successively connected to and disconnected from
50 the transmitter line wire 16 to send the first impulse of the signal over the line; and, in similar manner, the other relays or magnets D are successively operated to connect and
55 disconnect the line branches 2, 3, 4 and 5

to the line wire 16 to complete the transmission of the signal. The successive operation of the several transmitter magnets D is very rapid, so that any given signal is quickly transmitted, but the operation of the magnets is also very regular, so that the
60 separate impulses of each signal are sent over the line wire with precision and regularity.

The seventh transmitter magnet D not
75 only connects the fourth line branch 4 to the transmitter line conductor 16 and closes the local operating circuit through the eighth magnet, but also, when operated, opens the switch 28 so that the local operating circuit, through the magnet E, is broken. The magnet E is necessarily a heavy, slow operating magnet and it is desirable to open a circuit therethrough before
80 the operation of all of the transmitter magnets is completed, so that the apparatus may be ready, when one signal is transmitted, to quickly transmit the next succeeding signal. Inasmuch as the operation of the magnet E is slow and retarded, the eighth
85 and ninth magnets D of the set will operate, even though the circuit through the magnet E is broken by the seventh magnet D. The circuit through the last transmitter magnet D is closed by the switch 23 of the next to the last magnet of the set directly from the conductor 25 and independently of the switch 31 which is operated by the printer magnet E. That is to say, when the next
90 to the last magnet D operates to close the switch 23, the local operating circuit from battery 14 may be traced, as before, to the switch A', conductor 25 and directly to the switch 23 by the conductor 34 and conductor 35 to the last one of the set of transmitter magnets D. The operation of this magnet shifts its switch 22 to open the last line branch 5 and also moves the switch 29 to open the circuit through the conductor 25 at that point. The set of operating relays D are then all restored to normal position with the exception of the last one which remains energized so long as the finger key is held depressed to hold the switch A' in closed position, since the movement of
95 switch 29 into engagement with its normally disengaged contact closes the circuit through switch A' and conductor 25 by a conductor 29' through the coil of the last magnet D. As soon as the key is released, however, the circuit through the last transmitter magnet is opened and the apparatus is then in condition to at once send the next signal.

Means are provided for sending special signals over the line for effecting the capital or figure shift of the printer mechanism at the receiving station so that the number of characters which may be printed at the receiving station is largely increased. For this purpose a pair of magnets F and F' are
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employed for transmitting special signals, one signal, for example, for effecting the "capital" shift and the other for effecting the "figure" shift mechanism at the receiving station. The armatures of these magnets are each arranged to operate a pole-changing switch 36 and a normally open switch 37. One of the pole-changing switches 36 is interposed in a loop 1' of the line branch 1 and the other in the loop 5' of the line branch 5 and the normally disengaged contacts of the switches 36 are connected to the negative side of the line battery by conductors 38, so that in the special signal transmitted by the magnet F' in the particular arrangement shown, the first one of five impulses will be negative and the others positive, while in the special signal transmitted by the magnet F' the last impulse will be a negative one. It is, of course, obvious that other special signals could be employed for this purpose. The switches 37, operated by the magnets F and F', are connected by a battery wire 39 (shown in heavy lines) which is connected to the contact 11^a and to the local battery 14, when the apparatus is used for transmitting, by the switch-blade 11 and conductor 15. The contacts of the switches 37 are both connected by branch conductors 40 to the conductor 25, so that when either the magnet F or F' is operated, the local operating circuit will be closed through the magnet E and the set of transmitter magnets D in the same way as when one of the character keys C is shifted to operate the switch A'. The circuits through the magnets F, F' are controlled by a pair of magnets G, G', one of which may be termed a locking magnet and the other a releasing magnet, and by a pair of shift keys H and H'. The circuits through the magnets G, G' are controlled by the shift keys H, H' and by the switch 29 that is operated by the last one in the set of transmitter magnets D, and also by a magnet J which may be termed a cut-out magnet.

One terminal of each of the magnets F, F', G, G' and J is grounded or connected to the local battery 14 by a return wire. The other terminals of the magnets F, F' are connected, respectively, by a pair of conductors 41 to the normally engaged or back contacts of a pair of switches 42 which are arranged to be operated by an armature of the locking magnet G. These switches are connected by a pair of conductors 43 to the normally disengaged or front contacts of the switches or shift keys H, H'. The normally disengaged contacts of the switches 42 are connected by conductors 44 to the terminal of the locking magnet G. The terminal of this magnet is also connected by conductors 45 and 29' to the front contact of the switch 29 that is operated by

the last transmitter magnet D and to the conductor 35 that leads from the normally disengaged contact of the switch 23 that is operated by the next to the last transmitter magnet. A switch 46 is interposed in this conductor 45 and is arranged to be opened, as shown, by the armature of the cut-out magnet J. The shift key or switch H' is connected to the battery wire 39 and its back or normally engaged contact is connected by a conductor 47 to the shift key or switch H, so that when either one of the shift keys is depressed, the local operating circuit will be closed through one or the other of the magnets F, F', through the medium of the conductors 43, switches 42 and conductors 41. The normally engaged contact of the switch or shift key H is connected by a conductor 48 to a pair of switches 49 and 50, that are operated by the armature of the releasing magnet G'. The contact of the switch 49 is connected by a conductor 51 to the branch conductor 40. The contact of the switch 50 is connected by a conductor 52 to the terminal of the releasing magnet and this terminal is also connected by a conductor 53 to the conductor 45 through the medium of a switch 54 that is opened by the armature of the cut-out magnet. The terminal of the cut-out magnet J is connected by conductors 55 to a pair of switches 56, one of which is operated by the locking magnet G and the other by the releasing magnet G'. The contacts of the switches 56 are connected to the battery wire 39, so that when either the locking or releasing magnets G or G' is energized, the cut-out magnet J will also be energized.

When the releasing magnet G' is deenergized, switches 50 and 56 are open and switch 49 is closed. But when the apparatus is in condition for transmitting, the operating circuit from local battery 14 is normally closed through the releasing magnet, as follows: from the battery, by conductor 15, switch-blade 11, battery wire 39 to shift key H', thence by conductor 47, shift key H, conductor 48 and switch 50 and conductor 52 through the coil of the releasing magnet G' and back to battery through the ground or through a return wire. Thus, when the apparatus is in condition for transmitting, the switches 56 and 50 are closed and switch 49 is open, and they will remain in this condition as long as both of the shift keys or switches H and H' are in normal position and in engagement with their back contacts. The switch 56 of the releasing magnet also normally closes the local battery circuit from the battery wire 39 and conductor 55 through the coil of the cut-out magnet J, so that the switches 46 and 54 are held open when the apparatus is in condition for transmitting, and so long as both of the

shift keys H and H' are in normal position. It will be noted, however, that if either of the shift keys is depressed the circuit through the releasing magnet G' will be broken, switches 50 and 56 will open and switch 49 will close and the movement of switch 56 will break the circuit through the cut-out magnet so that the switches 46 and 54 will move to closed position. At the same time when one of the shift keys is depressed, the local operating circuit will be closed from the battery wire 39 through one or the other of the conductors 43, switches 42 and conductors 41 to energize one or the other of the magnets F or F'. One or the other of the pole changers 36 will then be operated to change the polarity of either the first or last impulse of the signal and the local circuit will be closed from the battery wire 39 by means of one of the switches 37, branch conductor 40 and conductor 25 through the printer magnet E and the operation of that magnet will effect the successive operation of the transmitting magnets D as before described, to send the special shifting signal to the line.

As the special shifting signal is completed, and the next to the last and last magnets D are operated, the local battery will be closed by switches 23 and 29 from the conductor 25 and conductors 34, 35 and 45 through the closed switch 46 and conductor 44 to the coil of the locking magnet G. The operation of this magnet will shift the switches 42 to open the circuit which was closed either through the magnet F or F' and at the same time will close the local battery through the coil of the locking magnet, as follows: from battery wire 39 to the depressed shift key, thence by one or the other of the conductors 43, switch 42 and conductor 44, so that the locking magnet G will remain energized so long as the shift key is held in depressed position. The movement of the switch 56 of the locking magnet will close the current from the local battery to the cut-out magnet J, as follows: from battery wire 39 to switch 56 and conductor 55, through the coil of the cut-out magnet, so that the switches 46 and 54 will be opened to disconnect the magnets G and G' from the conductor 45 leading from the last transmitter relay D. It should also be noted that the movement of the switch 29 operated by the last one of the set of transmitter magnets D momentarily closes the circuit through the conductor 45, as before, switch 54 and conductor 53 through the coil of the releasing magnet G'. This circuit is, however, broken as soon as the cut-out magnet J is operated and the releasing magnet is then deenergized, since the circuit from the local battery to the releasing magnet is broken by the depression of one or the other of the shift keys.

It will thus be apparent that when the apparatus is in condition for transmitting and the shift keys H and H' are in normal position, the releasing magnet G' and the cut-out magnet J will be energized and the magnets F and F' and G will be deenergized. As one of the special shift signals is being transmitted, the magnets G' and J will be deenergized and one or the other of the magnets F, F' will be operated. At the end of the transmission of a special signal the locking magnet G and the cut-out magnet J will be energized while the magnets F, F' and the releasing magnet G' will be deenergized and the sending relays E and D will be then in condition to transmit signals. This condition persists so long as one of the shift keys is held depressed and the character keys may then be operated to effect the printing of either capitals or figures or like unusual characters at the receiving station; and in this respect the operation of the shifting and character keys is similar to that of the ordinary typewriter.

When it is desired again to transmit ordinary characters, the shift key is released and returns to normal position indicated in the drawings. This breaks the circuit through the locking magnet G so that the switches 56 and 42 are restored to normal position; and this movement of the switch 56 opens the circuit through the cut-out magnet J so that the switches 46 and 54 return to their closed position. At the same time, the local battery circuit is closed from battery wire 39, shift key or switch H', conductor 47 to shift key or switch H, thence by conductor 48 and switch 49 to the conductors 51, 40 and 25, through the coil of the magnet E. The operation of this magnet will effect the automatic operation of the set of transmitter magnets D so that the line branches 1, 2, 3, 4 and 5 are successively connected to the line and, inasmuch as none of the pole changers have been shifted, a special releasing signal, consisting of five positive impulses, will be sent over the line to the receiving station. As the last magnet D is operated, the circuit will be closed to the locking switch 29 and conductor 45 through the switches 46 and 54 and conductor 53 to the coils of the locking and releasing magnets G and G'. The circuit through the releasing magnet will then be locked in closed condition, independently of the transmitting relays, as follows: from battery wire 39 through shift key H', conductor 47, shift key H, conductor 48, switch 50 and conductor 52 through the coil of the releasing magnet; and the movement of the switch 56, effected by the armature of the releasing magnet, will close the circuit from the battery wire 39 and conductor 55 through the coil of the cut-out magnet, so

that switches 54 and 46 are shifted to open position. The movement of the switch 46 will break the circuit through the locking magnet G so that it will then be deenergized. In spite of this shift of the switch 46, the circuit through the releasing magnet G' is held closed, as previously described, by means of the switch 50 and it is held in this condition so long as the shift keys H and H' are in normal position. It should be noted that whenever the switch-blades 10, 11 and 12 are thrown in the position shown in Fig. 1, for the purpose of placing the apparatus in condition for transmitting, the releasing signal is transmitted over the line, to place the apparatus at the receiving station in proper condition and to close the local operating circuit through the releasing and cut-out magnets G' and J. It will be understood that the special shifting signals operate special shifting mechanisms at the receiving station which are held in shifted position until the special releasing signal is transmitted.

A set of three special magnets L, M and N are provided at each station for operating the carriage return, line spacing and carriage feed mechanisms, respectively. The conductor 56', through the coil of the carriage feed magnet, is connected to the contact of the normally open switch 57. This switch is connected by a conductor 58 to the pivoted end of the switch-blade 11 and it is at all times in connection with the local battery, both when the apparatus is in condition for transmitting, or for receiving. The switch 57 is operated by a suitable lug 59 on the universal bar of the apparatus, which is similar to the universal bar of an ordinary typewriter, so that at each operation of the apparatus—whether it is used for transmitting or for receiving—the paper carriage is fed one step.

The conductors 60, through the coils of the carriage return and line spacing magnets, are connected on one side to a conductor 61 leading through the coil of a releasing magnet O. On the other side they are connected respectively to the contacts of a pair of normally open switches 62. These switches are connected to the battery wire 39 which leads to the contact 11^a and is connected to the local battery 14 by the switch-blade 11 only when the apparatus is placed in condition for transmitting. The line space and carriage return keys are provided with suitable lugs 63 for operating the switches 62 to close the circuit either through the carriage return or line space magnets when the apparatus is used for transmitting. When the apparatus is used for receiving, the magnets L and M will be operated by the transmission of special signals over the line.

When the apparatus is used for receiving,

the hand switch is moved to bring the switch blades 10, 11 and 12 into engagement respectively with the contacts 10^b, 11^b and 12^b as shown in Fig. 2. From the contact 10^b the line circuit is completed through a conductor 64 and through oppositely wound coils of a polarized line relay P and thence to the ground. The polarized relay P is also provided with a pair of oppositely wound coils 66 that are preferably arranged upon the same spools and which receive current from the local battery 14 through a conductor 67 which is connected to the contact 11^b and leads through the coils and thence to the ground or to a suitable conductor. The local battery is thus permanently connected to the oppositely wound coils 66 of the line relay P when the apparatus is used for receiving messages. The coils 66 balance one another and take the place of the permanent magnet ordinarily used in a polarized relay. An impulse passing over the line circuit and through the coils 65 will neutralize one of the coils 66 and will strengthen the other so that the armature lever P' of the polarized relay, which is normally held in central position, will be shifted in one or the other direction, in accordance with the polarity of the line impulse into engagement with one or the other of a pair of contacts 68. The local battery is also connected, when the apparatus is used for receiving, through the conductor 67 and through a normally closed, unlocking switch S' to a battery wire 69 which is shown in the diagram in heavy lines and which is provided with a number of branches leading to different parts of the selecting mechanism. One branch of the battery wire 69 leads to the armature P' of the line relay P so that the local battery 14, as each line impulse is received, is connected to one or the other of a pair of conductors 70. The flow of current through the pair of conductors 70 is arranged to selectively control a number of branch conductors that are divided into five pairs or sets, that is to say, the first impulse of any permutation representing the character or signal will connect either one of the conductors 71 or 71^a of the first pair to the local battery; the second impulse of the permutation will connect either one of the second pair of branch conductors 72 or 72^a to the battery; and, the third, fourth and fifth impulses of the signal or permutation will respectively connect one or the other of the second, third, fourth, and fifth pairs of branch conductors 73 or 73^a, 74 or 74^a and 75 or 75^a to the local battery.

The five pairs of branch conductors are successively connected to the pair of main conductors 70, as the signal is received, by a series of transfer switches 76 which are arranged in four pairs and which are operated by a set of transfer relays Q', Q², Q³ and Q⁴.

The two switches 76 operated by the first transfer relay Q' are connected to the main conductors 70. The switches 76 of the second transfer relay Q^2 are connected by a pair of conductors 77 to the front or normally disengaged contacts of the switches 76 of the first relay Q' . In a similar manner the switches of the third and fourth relays are connected to the front or normally disengaged contacts of the switches of the preceding relay in the set by pairs of conductors 77. The first pair of branch conductors 71, 71^a are connected to the back or normally engaged contacts of the switches 76 of the first transfer relay Q' so that the main conductors 70 are normally connected directly to the first pair of branch conductors. The second pair of branch conductors 72, 72^a are similarly connected to the back or normally engaged contacts of the switches 76 of the second line relay Q^2 . In a similar manner the third and fourth pairs of branch conductors 73, 73^a and 74, 74^a are connected to the back contacts of the switches of the third and fourth transfer relays Q^3 and Q^4 , while the fifth pair of branch conductors 75, 75^a are connected to the front or normally disengaged contacts of the switches of the fourth relay Q^4 . With this arrangement the first pair of branch conductors are normally connected to the main conductor 70, but at the operation of the first transfer relay Q' they are disconnected from the main conductors and the latter are connected to the second pair of branch conductors. When the second transfer relay Q^2 is then operated, the second pair of branch conductors will be disconnected from the main conductors 70 and the third pair of branch conductors will be connected thereto. So, also, the successive operation of the transfer relays Q^3 and Q^4 will successively connect the fourth and fifth pairs of branch conductors to the conductor 70 and will insure that only one pair of branch conductors is connected at the time to the main conductors.

The successive operation of the several transfer relays is controlled by the flow of current through the branch conductors as the five impulses of any given combination or permutation are received. For this purpose, a set of locking or selecting magnets R , R' are provided and these magnets are arranged in pairs and are interposed respectively in the pairs of branch conductors as indicated. Each of these magnets R , R' is arranged to operate a normally open, locking switch 78, all of which switches are connected to the battery wire 69 and the contacts of which are connected to the coils of the respective magnets so that when any one of these magnets is energized, the circuit from the local battery 14, through its coil, will be held in closed condition by the operation of the corresponding locking switch 78.

Each of the magnets R , R' in the first four pairs of branch conductors is also arranged to operate a switch 80 and a switch 81 which control a flow of current through the two oppositely wound coils 82 and 83 of the corresponding transfer switch relay. The coils 82 and 83 of each transfer switch relay are oppositely wound, as stated, and are each connected on one side to ground or to the local battery 14 by a suitable return wire. The other end of the coil 82 is connected by a conductor 84 to the normally disengaged contacts of the switches 80 of the corresponding pair of magnets R , R' . The other end of the coil 83 is connected by a conductor 85 to the normally open contacts of the switches 81 of the corresponding pair of magnets R , R' . Each switch 80 is connected to the corresponding branch conductor and each switch 81, together with its normally engaged contact, is interposed in the corresponding branch conductor so that the shift of the switch 81 will open the branch conductor at that point.

The branch conductors 71^a, 72^a, etc., extend through the coils of the magnets R' to the ground or to a suitable return wire leading back to the local battery 14. The branch conductors 71, 72, etc., in a similar manner extend through the coils of the magnets R to the ground or to a return conductor. They are, however, provided with a series of extensions 71^b, 72^b, etc., that lead to a set of five switches 86 and thence to the operating magnets, as hereinafter described.

As stated, each signal or character is represented by a permutation of five impulses of positive and negative polarity. The first line impulse will energize the line relay P and will shift its armature P' in one or the other direction, so that the circuit from the local battery 14 may be traced by the conductor 15, switch blade 11, conductor 67, normally closed unlocking switch S' , battery wire 69 to the armature lever P' and thence by one or the other of the main conductors 70 to one or the other of the switches 76 of the transfer switch relay Q' , and thence to one or the other of the branches 71 or 71^a through the switch 81 therein to the coil of one or the other of the first pair of magnets R , R' . If the first impulse is negative, for example, the circuit through the magnet R will be closed, whereas, if it is positive, the circuit through the magnet R' will be closed. The operation of either one of these magnets will serve to shift the corresponding switches 78, 80 and 81 and the locking circuit, through the switch 78, will be closed through the selected one of the first pair of magnets and will be held in closed position, independently of the operation of the line relay. The movement of the switch 81 will open the local battery circuit

through the line relay, main conductor 70, branch conductor 71 and coil of the corresponding magnet, but will close this circuit through the conductor 85 to the coil 83 of the transfer switch relay Q'. At the same time, the movement of the switch 80 will close the locking circuit direct from the battery wire 69 through the conductor 84 to the other coil 82 of the transfer switch relay and will hold the circuit through the coil 82 in closed position, independently of the armature of the line relay. The circuit from the local battery is thus simultaneously closed through the opposite coils 82 and 83 of the transfer switch relay Q'. The circuit through the coil 83, however, will be closed through the armature P' of the line relay and will only remain closed as long as the first impulse of the permutation persists, while the circuit through the coil 82 is locked in closed condition, independently of the line relay. As stated, the coils 82 and 83 are oppositely wound and balance each other so that the switches 76 of the relay Q' remain in normal condition so long as the first line impulse persists. As soon as it ceases, however, the circuit through the coil 83 is opened and the coil 82 of the transfer switch relay is no longer balanced, so that the relay Q' operates to shift its switches 76 into engagement with its front contacts. The branch conductors 71 and 71^a are thereby disconnected from the main conductors 70 and the second pair of branch conductors 72 and 72^a are connected to the main conductors in readiness for the second impulse of the permutation.

In a similar manner, the second impulse of the signal will select either the branch conductors 72 or the branch conductors 72^a and will close the circuit through the corresponding locking magnet R or R'. Either one of these magnets will serve to close the local battery circuits through the opposite coils 82 and 83 of the relay Q², but as the circuit through both of these coils is simultaneously closed, and as the coils serve to balance each other, the switches 76 of the relay Q² will remain stationary as long as the second line impulse persists, so that one or the other of the branch conductors 72 or 72^a is selected with certainty. At the cessation of the second line impulse, the circuit through the coil 83 of the transfer switch relay Q² is opened and the relay operates to disconnect the second pair of branch conductors 72 and 72^a from the main conductors 70 and to connect the third pair of branch conductors 73 and 73^a thereto. The third line impulse in a similar manner will close the circuit through one or the other of the third pair of branch conductors, that is to say, if the third impulse is negative, the circuit through the branch conductor 73

will be closed and locked in closed position. or, if it is positive, the circuit through the branch conductor 73^a will be closed and held closed, independently of the line relay. At the cessation of the third line impulse, the transfer switch relay Q³ will operate to disconnect the branch conductors 73 and 73^a from the main conductors and to connect the fourth pair of branch conductors 74 and 74^a thereto. The fourth line impulse of the permutation, in a similar manner, will, if negative, select the branch conductor 74, or, if positive, the branch conductor 74^a and, at the cessation of the fourth line impulse, the transfer switch relay Q⁴ will operate to disconnect the fourth pair of branch conductors from the main conductor 70 and to connect the fifth pair of branch conductors 75 and 75^a thereto, so that the fifth or last impulse of the permutation will select either of the branch conductors 75 or 75^a. In this manner, the circuit through one or more of the extensions 71^b, 72^b, etc., will be closed in accordance with the different permutations and will serve to select the signal to be made or character to be printed. The operation of the fifth pair of magnets R, R' will also serve to initiate the making of the signal or the printing of the selected character.

The set of conductors 71^b, 72^b, etc., which are thus selected, extend, as stated, to a set of five switches 86, all of which are connected to and arranged to be operated by the shifting armature U' of a magnet U. These switches are normally closed and the contacts thereof are connected to a set of five conductors 87 which lead respectively to the coils of a set of five operating magnets T', T², T³, T⁴ and T⁵. One terminal of each of these magnets is connected to ground or to a suitable return wire leading back to the local battery 14. In each of the conductors 87 is preferably interposed a normally closed switch 88 and these switches are connected to and arranged to be operated by the armatures 89 of the corresponding operating magnets T', T², etc., so that when any one of these magnets is operated, the circuit from the local battery through the conductor 87 is opened by the shift of the switch 88. The operation of any one of these magnets, however, serves to close a normally open switch 90 that is operated by the armature 89 thereof, and is connected to its coil. These switches are locking switches and serve to close the circuit of the local battery through the corresponding magnet from a conductor 91. This conductor is connected to a normally closed, unlocking switch 92 which is arranged to be opened by the operation of the printer magnet E. The contact of this switch is connected by a conductor 93 to the

contact 11^b and thence, when the apparatus is in condition for receiving, by the switch blade 11 and conductor 15 to the local battery 14.

5 The variable operation of the selecting and locking magnets R, R' at each signal will obviously variably energize the set of five magnets T', T², etc. The variable operation of these magnets may be arranged to select the signal or character to be made or
10 printed in a number of different ways. In the particular form shown, the armature 89 of the operating magnet T' is arranged to shift a switch 94 that is connected by a conductor 95 to a normally open switch 96 operated by the magnet U. This switch 94 has two contacts, with one of which it is normally engaged, and these contacts are connected by a pair of conductors 97 to two
20 switches 98 operated by the armature 89 of the second operating magnet T². Each of these magnets also has two contacts and is normally engaged with one of them and these contacts are connected by conductors 99 to a set of four switches 100 operated by the armature 89 of the magnet T³. In a similar manner, the pairs of contacts of these switches 100 are connected by conductors 101 with a set of eight switches 102
30 operated by the armature of the magnet T⁴ and the pairs of contacts of the switches 102 are connected by the conductors 103 to a set of sixteen switches 104 operated by the magnet T⁵. The pairs of contacts of the switches 104 are connected to a set of thirty-two branch conductors 105 which lead, respectively, through a set of signal making magnets V and thence to a common return conductor 106. This return conductor is
40 connected by a wire 107 to the coil of the magnet O, the opposite terminal of which is connected to the ground or by a suitable return wire to the local battery 14. It is obvious that the variable operation of the magnets T', T², etc., will serve to close the circuit from the conductor 95 to any one of the operating magnets V, and that the circuit of only one of these magnets can be so closed. It is further obvious that the magnets T', T², etc., will respond only to the impulses of one polarity; that is to say, if the negative impulses are used to select the branch conductors 71, 72, etc., and the extensions thereof, 71^b, 72^b, etc., that the operated magnets T', T², etc., will be energized or not, in accordance with the varied permutations of the positive and negative impulses representing the several signals or characters. That is to say, the magnet T',
50 if the first impulse of the signal is negative, will be operated, whereas, if the first impulse is positive, it and the parts controlled thereby will remain in normal position. In a similar manner, the second, third, fourth

and fifth magnets of the set, T², T³, T⁴ and T⁵ will be energized only if the corresponding impulses of the permutation are of negative polarity.

The switch 88 of the fifth magnet T⁵ is provided with a normally open contact that is connected by a conductor 108 to a coil of the magnet U, one pole of which is connected to the ground or by a suitable return conductor to the local battery 14. The magnet U is also connected by a conductor 109 75 to a pair of normally open switches 110 that are operated, respectively, by the fifth pair of selecting or locking magnets R, R'. The contacts of these switches are connected by a conductor 111 to the coil of the magnet S which serves to open the unlocking switch S'. The coil of this magnet S is grounded on one side or is connected to the local battery by a return wire. The magnet R' is also arranged to operate a normally open switch 112, the contact of which is connected to the conductor 109. The switch 96 of the magnet U is not only connected to the conductor 95, but is also connected to the coil of the magnet U by a conductor 113 and, as its contact is connected to the battery wire 91 which leads from the unlocking switch 92, the switch 96 serves as a locking switch to hold the circuit of the magnet U in closed condition until the unlocking switch 92 is opened. 95

As any signal is received, one or more of the branch conductors 71, 72, 73, 74 and 75 and the corresponding extensions, 71^b, 72^b, etc., thereof will be selected and locked into connection with the local battery by means of the locking switches 78 of the corresponding magnets R. These locking switches connect the selected branch conductors to the local battery through the normally closed, unlocking switch S' so that the selected magnets R remain energized independently of the line relay and until the unlocking switch S' is opened. At the same time, if the magnet U is deenergized, and the switches 86 are engaged with their contacts, the set of magnets T', T², T³, T⁴ and T⁵ will be variably operated and the circuit of any one or more of these magnets which is closed will be locked in closed condition by the operation of the switches 90. These switches, as stated, serve to close the local battery circuit through the magnets T', T², etc., from the conductor 91 which leads from the normally closed, unlocking switch 92, so that when these magnets have been properly operated, they will remain in operative condition independently of the line relay and also independently of the selecting and locking magnets R, R', and until the printer magnet E, which finally makes the signal, is energized. 115 120 125

The fifth impulse of any permutation, as

stated, selects either the branch conductor 75 or the branch conductor 75^a and the magnet T^o is energized if the fifth impulse is negative and selects the branch conductor 75 and the locking magnet R therein. The operation of the magnet T^o will shift its switch 88 so that the circuit from the local battery is closed from the conductor 93 through the switch 92, battery wire 91, switches 90 and 88 to the conductor 108 and through the coil of the magnet U to the ground or by a return wire to the local battery. The operation of the magnet U shifts the switch 96 so that the circuit through the coil of the magnet is locked in closed condition and at the same time the conductor 95 is connected to the battery wire 91 so that the circuit through the selected operating magnet V is closed. If the fifth impulse of the permutation is positive, the magnet R' in the branch conductor 75^a is energized and will close the circuit of the magnet U and to connect the conductor 95 to the battery, since it shifts the switch 112 which connects the battery wire 91 to the conductor 109 leading to the coil of the magnet U.

Whether the fifth impulse be negative or positive, to connect either the conductor 108 or 109 to the battery wire 91 in the manner stated, one or the other of the switches 110 of the fifth pair of selecting magnets R, R' will connect the battery circuit from the conductor 91 through the conductors 108 and 109 to the conductor 111 leading to the coil of the unlocking magnet S. This magnet will then act to open the switch S' and thus disconnect the conductor 69 from the local battery, so that all of the selecting or locking magnets R, R' return to normal condition and are in readiness to receive the next signal. The unlocking switch S' will also return to normal condition, since the circuit through the coil of its relay S is opened when the fifth pair of magnets R, R' are de-energized. The magnet U and the set of operating magnets T', T², etc., will, however, not then return to normal condition, since they are connected to the local battery through the unlocking switch 92. The operation of the magnet U, effected by the fifth impulse of any permutation, shifts the switches 86 and disconnects the selecting branch conductors 71^b, 72^b, etc., from the magnets T', T², etc. It is obvious, therefore, that the apparatus is then in condition to receive a signal at the same time that the preceding character is being printed; that is to say, as soon as the magnets T', T², etc., have been properly selected, and the fifth impulse of any permutation received, the magnet U will be energized to close the circuit through the selected operating magnet V and will also disconnect the selecting circuits entirely from the operating or printing circuits. Moreover, the fifth impulse will

operate the unlocking switch S', so that all the selecting circuits are placed in condition to receive the succeeding signal, whereas, the printing or operating circuits, through the magnet U and the set of magnets T', T², T³, etc., will remain locked until the switch 92 is opened, so that the succeeding signal may be received while the character previous thereto is being printed. Thus the selection of the next succeeding character can be begun and at least the first four impulses of the next succeeding signal may be received to selectively connect the conductors 71^b, 72^b, etc., to the battery, and it is only necessary that the unlocking switch 92 shall be opened to permit the restoration to normal of the magnet U and of the set of magnets T', T², etc., before the fifth and last impulse of the next succeeding signal is received; or, in other words, the next succeeding signal may be built up while the signal just received is being printed. When a character is printed, the switch 92 will be opened and the magnet U and the set of magnets T', T², etc., will be deenergized so that the switches 86 will drop back into engagement with their contacts and the set of magnets T', T², etc., will then be properly operated in accordance with the signal which has been built up by the selecting portion of the apparatus.

As the printing or making of the signal is necessarily effected by heavy magnets that are somewhat slow in operation, this separation of the selecting and operating circuits, by what may be termed the dividing magnet U, greatly increases the speed at which the signals may be received and the corresponding characters recorded.

The switch 92 which disconnects the operating or printing circuits from the local battery might be actuated by any one of the operating magnets V. Preferably, however, these magnets are small and quick acting and merely serve to select the proper character while the actual work required to effect the printing of the character is effected by the magnet E. As stated, the circuit through any one of the magnets V extends to the ground or to a return wire through the coil of the magnet O. This magnet operates a normally open switch 114 which is connected to the battery wire 91. Its contact is connected by a conductor 115 to the switch contact 12^b and the latter in turn, when the apparatus is in condition for receiving, is connected by the switch blade 12 to the conductor 24 that leads to the coil of the printer magnet E, so that the latter operates when any of the selecting magnets V is energized to complete the making of the signal or the printing of the selected character. Two of the branch circuits 105 lead through the special magnets M and L which operate the line space and carriage return magnets, respectively, and the coils of which are con-

5 nected by a conductor 61 through the magnet O and the operation of the latter serves to close the circuit of the printer magnet E and thus opens the unlocking switch 92 to disconnect the operating circuits from the battery. One of the branch conductors also, in similar manner, leads through the special magnet N for effecting the letter space movement of the carriage or the like, so that space
10 may be left between the words of the printed message.

Two of the branch conductors 105 lead to two switches 116 that are respectively operated by two locking magnets W and W'.
15 The normally engaged contacts of the switches 116 are connected respectively by conductors 117 to the coils of the corresponding magnets W and W' and extend, respectively, through the coils of a pair of magnets X, X'. The coils of the magnets W and W' and X and X' are connected to ground or by a suitable return wire to the local battery 14. The magnet X is arranged to effect the shift of the type mechanism or
20 paper carriage to print capitals and the magnet X' is arranged to effect the shift of the proper part to print figures, punctuation marks and the like. The normally disengaged contacts of the switches 116 are connected by conductors 118 to the conductor 115 that leads to the contact 12^b and from thence through the switch blade 12 and conductor 24 to the printer magnet E, so that when either of the pair of magnets W, X, or W', X' is operated, the magnet E will also be energized to open the unlocking switch 92 and the operating circuits leading therefrom. Each of the magnets W and W' is also arranged to operate a locking switch
25 119. These switches are connected by a conductor 120 to the contact of the normally closed switch 121 which is connected directly to the local battery by conductors 122 and 93, switch blade 11 and conductor 15. The unlocking switch 121 is arranged to be operated by an unlocking or releasing magnet Y. It should be noted that the locking circuit, through the switch 121 and conductor 120 to the switches 119 of the magnets W and W' is independent or is bridged around the unlocking switch 92, so that when either of the magnets W or W' has been energized the circuit therethrough will be held in closed condition until the releasing magnet
30 Y is operated to open the unlocking switch 121. The coil of the magnet Y is included in one of the branch operating circuits 105 and connected to the conductor 106 leading to the magnet O, so that when the magnet Y is energized, the printer magnet E will also be operated to open the operating circuit.

As stated, when it is desired to transmit figures or capitals, either the shift key H or H' (see Fig. 1) is depressed and held depressed as long as figures or capitals are to
35

be transmitted. The depression of either one of these keys will send a special signal over the line, while the return to normal will send a special releasing signal over the line. The depression of either one of
70 these shift keys will send a proper permutation of impulses to select either of the locking magnets W or W' and the corresponding shifter operating magnets X and X'. Whether the magnet W or the magnet W' is energized, the movement of the corresponding switch 116 will disconnect the circuit of the magnet from the operating circuit and will connect the operating circuit to the conductor 115 which extends by
80 switch blade 12 and conductor 24 to the printer magnet E, so that the switch 92 will be moved to open the operating circuit. The pair of shifter magnets W and X or W' and X' will remain energized since the corresponding switch 119 has served to connect the coils of one or the other of these pairs of magnets directly to the local battery through the conductor 15, switch blade 11, conductors 93 and 122, unlocking
90 switch 121 and conductor 120 and the shifted locking switch 119 and thence to the coils of the corresponding locking and shifting magnets. The receiving apparatus is then in condition to receive and properly print either the capitals or figures and will remain in this condition as long as either one of the shift keys H or H' at the transmitting station is held depressed. As soon as the depressed key is released, a special
100 releasing signal will be transmitted over the line, which will properly select the releasing magnet Y. This serves to open the unlocking switch 121 so that the selected shift magnets X, X' and the corresponding locking magnets W, W' will be deenergized and the parts controlled thereby restored to normal condition. The selection of the magnet Y will also energize magnet O to operate switch 114 to connect the operating circuit from conductor 91 to the conductor 115, switch blade 11 and conductor 24 to the coil of the magnet E, so that the operating circuit will be opened and the entire apparatus restored to normal condition and in readiness to receive and record the ordinary characters.
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It should be noted that both in the receiving and transmitting portions of the apparatus no variably operating switches, such as sunflowers or the like, have been employed. Such variably operating switches are apt to get out of order and require the constant attention of skilled electricians to keep them in working condition. On the contrary, all of the switches are positive in their action, and all—with the single exception of the line relay P—are provided with armatures which have but a single movement. The different permutations of
120
125
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combinations are transmitted to the line by the automatically operating set of relays D with regularity and precision. At the receiving station the selection is quickly and rapidly made by a set of light, quick-acting magnets which variably connect a set of operating circuits to the local battery and hold them in locked condition until the signal is made or the selected character printed. The quick-acting selector magnets and selector circuits are separated or divided by the switches 86 and the divide magnet U, so that a character may be printed while the next succeeding selection is being built up. As soon as the character is printed, the magnet U is deenergized and the switches 86 dropped back to closed condition. The branch circuits which have been locked to the local battery by the operation of the selecting apparatus, then serve to simultaneously operate one or more of the set of magnets T', T², etc., so that the operation thereof is quickly effected. The transmitting and receiving shift mechanism is so arranged that a shift key may be depressed to send a special signal over the line and set the receiving apparatus in condition to receive and record either capitals or figures and, as soon as the shift key has been released, another special signal will be transmitted to restore the receiving apparatus to normal condition.

It is obvious that numerous changes may be made in the arrangements of the circuits and in the details set forth without departure from the essentials of the invention as defined in the claims.

Having described our invention, what we claim as new and desire to secure by Letters Patent, is:—

1. In a telegraph system in which the characters are represented by different permutations of a definite number of impulses of opposite polarity, the combination with a line circuit, of a relay controlled by said line circuit, a number of local branch conductors, a set of selecting relays located in said branch conductors and transfer switch mechanism for successively connecting and disconnecting said branch conductors and said selecting relays to said line controlled relay in invariable, predetermined order as the succeeding impulses of the different permutations are received, substantially as described.

2. In a telegraph system in which the characters are represented by permutations of a definite number of impulses of opposite polarity, the combination with a line circuit, a relay controlled by said line circuit, a number of pairs of local branch conductors, selecting relays located in said branch conductors and transfer switch mechanism for successively connecting and disconnecting said pairs of branch conductors to said line

controlled relay in invariable, predetermined order as the succeeding impulses of the different permutations are received, substantially as described.

3. In a telegraph system, the combination with a transmitter for imparting permutations of impulses of opposite polarity to the line, of a line relay comprising two differentially-wound electromagnets, one of the coils of each magnet being arranged in a local circuit and one in the line circuit, and a centrally-held armature arranged between said magnets, the arrangement being such that the local coils of the relay magnets will normally balance each other while the line impulses will neutralize the magnetism of one or the other of the magnets and increase that of the other magnet, substantially as described.

4. In a telegraph system, the combination with a transmitter arranged to transmit characters by different permutations of a definite number of impulses of opposite polarity, of a line relay comprising two opposed magnets, said magnets having oppositely-wound coils arranged in a local circuit and oppositely-wound coils arranged in the line circuit, a centrally-held armature arranged between said magnets, and a local circuit controlled by said armature, substantially as described.

5. In a telegraph system in which the characters are represented by different permutations of a number of impulses of opposite polarity, the combination with a line circuit, of a pair of local main conductors selectively controlled by said line circuit, a number of pairs of branch conductors corresponding with the number of impulses constituting a character, and transfer switch mechanism for successively connecting said pairs of branch conductors to said main conductors as the character impulses are received, substantially as described.

6. In a telegraph system in which the characters are represented by different permutations of a definite number of impulses of opposite polarity, the combination with a line circuit, of a pair of local main conductors selectively controlled by said line circuit, a number of pairs of local branch conductors, and transfer switch mechanism controlled by the flow of current through said main and branch conductors for successively connecting said pairs of branch conductors to said main conductors as the character impulses are received, substantially as described.

7. In a telegraph system in which the characters are represented by different permutations of five impulses of opposite polarity, the combination with a line circuit and a line relay, of a pair of local main conductors selectively controlled by said line relay, five pairs of branch conductors, transfer

switch mechanism for successively connecting said pairs of branch conductors to said main conductors, means controlled by the flow of current through said main and branch conductors for operating said transfer switch mechanism, and means controlled by said branch conductors for effecting the printing of the selected characters, substantially as described.

8. In a telegraph system in which the characters are represented by different permutations of a definite number of impulses of opposite polarity, the combination with a line circuit, of two local main conductors, a number of pairs of branch conductors corresponding with the number of impulses constituting a character, and transfer switch mechanism controlled by the flow of current through said main and branch conductors and acting at the pauses between the impulses for successively connecting said pairs of branch conductors to said main conductors as the character impulses are received, substantially as described.

9. In a telegraph system in which the characters are represented by different permutations of five impulses of opposite polarity, the combination of a line circuit and line relay, of a pair of local main conductors selectively controlled by said line relay, five pairs of branch conductors, a set of transfer switches for connecting said pairs of branch conductors to said pair of main conductors, and means controlled by the flow of current through said main and branch conductors and acting at the pauses between the impulses for successively operating said transfer switches, substantially as described.

10. In a telegraph system in which the characters are represented by different permutations of a number of impulses of opposite polarity, the combination with a line circuit, of a pair of local main conductors selectively controlled by said line circuit, a number of pairs of branch conductors corresponding with the number of impulses constituting a character, a set of transfer switches for connecting said pairs of branch conductors to said pair of main conductors, and a set of relays controlled by the flow of current through said main and branch conductors for successively operating said transfer switches, substantially as described.

11. In a telegraph system in which the characters are represented by different permutations of a number of impulses of opposite polarity, the combination with a line circuit, of a pair of local main conductors, means operated by said line circuit for selectively controlling said local main conductors, a number of pairs of local branch conductors, a set of transfer switches, a set of relays controlled by the flow of current through said main and branch conductors

and acting at the pauses between the impulses for successively operating said transfer switches to connect said pairs of branch conductors to said pair of main conductors in order, substantially as described.

12. In a telegraph system in which the characters are represented by different permutations of a number of impulses of opposite polarity, the combination with a line circuit and a line relay, of a pair of local main conductors selectively controlled by said line relay, a number of pairs of local branch conductors corresponding with the number of impulses constituting a character, a set of transfer switches for successively connecting said pairs of branch conductors to said pair of main conductors, a set of relays controlled by the flow of current through said main and branch conductors and acting at the pauses between the impulses for successively operating said transfer switches, and means controlled by the selected branch conductors for printing the different characters, substantially as described.

13. In a telegraph system in which the characters are represented by different permutations of a number of impulses of opposite polarity, the combination with the line circuit and line relay, of a pair of local main conductors, a number of pairs of branch conductors, transfer switch mechanism for successively connecting said pairs of branch conductors to said pair of main conductors, differentially-wound relays for operating said transfer switches in order, said relays having oppositely-wound coils, means for maintaining the flow of current through both coils of each relay as long as the line impulse persists and for opening the circuit of one of the coils when the line impulse ceases whereby said transfer switch mechanism will be operated by said relays at the pauses between the impulses, substantially as described.

14. In a telegraph system in which the characters are represented by different permutations of a number of impulses of opposite polarity, the combination with the line circuit and line relay, of a pair of local main conductors selectively controlled by said line relay, a number of pairs of branch conductors, a set of transfer switches for successively connecting said pairs of branch conductors to said pair of main conductors, a set of differentially-wound relays controlling the operation of said set of transfer switches, each of said relays having oppositely-wound coils, means controlled by the flow of current through said main and branch conductors for closing the local circuit through both coils of each relay and for locking the circuit of one of the said coils in closed condition independently of the line relay whereby said relays will operate

said transfer switches at the pauses between the impulses, substantially as described.

15. In a telegraph system in which the characters are represented by different permutations of a number of impulses of opposite polarity, the combination with a line circuit and a line relay, of a pair of local main conductors selectively controlled by said line relay, a number of pairs of local branch conductors, a set of transfer switches for connecting said pairs of branch conductors to said pair of main conductors, a set of relays for operating said transfer switches interposed respectively in said pairs of branch conductors, each of said relays having opposed coils controlled respectively by the flow of current through the selected main and branch conductors, means for holding the selected branch conductors in closed condition independently of the line relay and of said main conductors, and means controlled by the last pair of branch conductors for restoring the circuit to normal condition, substantially as described.

16. In an electric selective system in which the characters are represented by different permutations of a definite number of impulses of opposite polarity, the combination with a line circuit and a line relay, of a pair of local main conductors selectively controlled by said line relay, a number of pairs of local branch conductors, a set of transfer switches for successively connecting said branch conductors to said main conductors as the character impulses are received, locking magnets in said branch conductors for holding the selected conductors in closed condition independently of said line relay, means controlled by said branch conductors for effecting the printing of the selected characters, and means controlled by the last pair of branch conductors for opening the circuit of said locking magnets, substantially as described.

17. In a telegraph system in which the characters are represented by different permutations of a definite number of impulses of opposite polarity, the combination with the line circuit and line relay, of a pair of local main conductors, a number of pairs of branch conductors corresponding with the number of impulses constituting a character, a set of transfer switches for successively connecting said pairs of branch conductors to said pair of main conductors, a set of differential relays interposed in said pairs of branch conductors for operating said transfer switches, means for locking the selected branch conductors and one coil of each of said differential relays in closed condition independently of said line relay, and means controlled by the last pair of branch conductors for restoring the parts to normal condition, substantially as described.

18. In telegraph systems in which the

characters are represented by different permutations of a definite number of impulses of opposite polarity, the combination with a line circuit, a line relay, of two local main branch conductors selectively controlled by said line relay, a number of pairs of branch conductors corresponding with the number of impulses constituting a character, transfer switches for successively connecting said pairs of branch conductors to said pair of main conductors, differential relays controlled by the flow of current through said main and branch conductors for operating said transfer switches in order, locking magnets arranged in said branch conductors for holding the selected branch conductors and one coil of each of said transfer switch relays in closed condition independently of said line relay, means controlled by the last pair of branch conductors for opening the circuit of said locking magnets, and means controlled by the selected branch conductors for printing the different characters, substantially as described.

19. In a telegraph system, selecting means comprising a set of main conductors and a number of sets of branch conductors, transfer switch mechanism for disconnecting one set of branch conductors from said set of main conductors thereto, a differential relay for operating said switch mechanism and means controlled by the flow of current through said main and branch conductors for simultaneously closing the circuit of both of the coils of said differential relay, the circuit of one of said coils being dependent upon said line relay, whereby the transfer switch will remain in normal condition as long as the line impulse persists but will be shifted at the pause between the impulses, substantially as described.

20. In a telegraph system, selecting means comprising a line relay, a set of main conductors and separate sets of branch conductors, a set of transfer switches for successively disconnecting one set of branch conductors and connecting the next succeeding set of branch conductors thereto, a set of differential relays for operating said transfer switches, means controlled by the flow of current through said main and each set of branch conductors for simultaneously closing the circuit through both coils of the corresponding differential relays and means for holding the circuit of one coil of each relay in closed condition independently of the line relay, substantially as described.

21. In telegraph systems, a selecting means comprising a line relay, a set of main conductors, a number of sets of branch conductors, a set of transfer switches for successively disconnecting one set of branch conductors from said set of main conductors and connecting the next succeeding set of branch conductors thereto, a set of differen-

5 tial relays for operating said transfer switches, locking magnets in each set of branch conductors for simultaneously closing the circuit through both coils of the corresponding differential relay and for holding one of the coils in closed condition independently of said line relay, and means controlled by the last set of branch conductors for restoring the parts to normal condition substantially as described.

10 22. In telegraph systems, selecting means comprising a line relay, a set of main conductors, and a number of sets of branch conductors, a set of transfer switches for successively connecting said sets of branch conductors to said set of main conductors, a set of differential relays for operating said transfer switches in order, locking magnets in each set of branch conductors for holding the selected branch conductors in closed condition and for simultaneously closing the circuit through both coils of the corresponding differential relay and for holding the circuit of one of said coils in closed condition independently of the line relay, whereby said differential relays will operate at the pauses between impulses, means controlled by the selected branch conductors for completing the signals, and means controlled by the last set of branch conductors for opening the circuits of said locking magnets, substantially as described.

23. In a telegraph system in which the characters are represented by different permutations of a number of impulses of opposite polarity, selecting means comprising a line relay, a pair of main conductors selectively controlled by said line relay, a number of pairs of branch conductors, a set of transfer switches for successively connecting and disconnecting said pairs of branch conductors and said pair of main conductors, a set of relays for operating said transfer switches, each of said relays having opposed coils, means controlled by the flow of current through said main and each pair of branch conductors for simultaneously closing the circuit through both coils of the corresponding differential relay and for holding one of said coils in closed condition independently of said line relay, whereby the corresponding transfer switch will be operated at the cessation of the impulse, and means controlled by the last pair of branch conductors for restoring the selecting means to normal condition, substantially as described.

24. In a telegraph system, the combination with a line circuit and a line relay, of selecting means comprising a set of main conductors and a number of sets of local branch conductors, a set of transfer switches for successively connecting said sets of branch conductors to said set of main conductors, a set of differential relays for op-

erating said transfer switches, locking magnets interposed in each set of branch conductors for simultaneously closing the circuits of both coils of the corresponding differential relay and for holding the circuit of one of the coils of the corresponding transfer switch relay and the selected branch in closed condition independently of said line relay, means controlled by the selected branch conductors for printing the different characters, and means controlled by the last set of branch conductors for restoring the selecting means to normal condition, substantially as described.

25. In telegraph systems in which the characters are represented by different permutations of a definite number of impulses of opposite polarity, the combination with a line circuit, and a line relay, of a pair of local main conductors, a number of pairs of local branch conductors corresponding with the number of impulses constituting a character, a set of transfer switches for successively connecting and disconnecting said pairs of branch conductors to said pair of main conductors, a set of differential relays for operating said transfer switches, locking magnets in each pair of branch conductors for simultaneously closing the circuit of both coils of the corresponding differential relay and for holding the circuit of one of said coils and the selected branch in closed condition independently of said line relay, whereby said transfer switches will be operated at the pauses between the impulses, means controlled by the selected branch conductors for printing the different characters, and means controlled by the last pair of branch conductors for opening the circuit of said locking magnets, substantially as described.

26. In a telegraph system in which the characters are represented by different permutations of five impulses of opposite polarity, the combination with a line circuit and a line relay, of a pair of local main conductors selectively controlled by said line relay, five pairs of local branch conductors, a set of transfer switches for successively connecting and disconnecting said pairs of branch conductors and said pair of main conductors, a set of differential relays for operating said transfer switches, locking magnets in each pair of branch conductors for simultaneously closing the circuit through both coils of the corresponding differential relay and for holding the circuit of one of said coils and the selected branch in closed condition independently of said line relay, means controlled by the selected branch conductors for printing the different characters, and means controlled by the last pair of branch conductors for opening the circuit of said locking magnets, substantially as described.

27. In a printing telegraph, a receiver comprising a selecting part arranged to effect all selections of the characters of a message, printing means responsive to said selecting part, and means whereby said selecting part can be freed for the selection of a character before the printing of the preceding character selected thereby, is completed.
28. In a telegraph system, the combination with a line circuit, of a selector controlled by said line circuit for effecting all selections of the characters of a message, operating devices controlled by said selector for making all of the signals, and means for connecting and disconnecting said selector and said operating devices, all arranged to permit the simultaneous making of one signal and the selection of the next succeeding signal, substantially as described.
29. In a telegraph system, the combination with a line circuit, of a selector controlled by said line circuit for effecting the selection of all of the characters of a message, operating devices for effecting the printing of all of the characters, and means for disconnecting said operating devices from said selector at the end of each selection of a character and for connecting the same thereto after a character has been printed, the parts being so organized that while one character is being printed the selection of the next succeeding character may be initiated, substantially as described.
30. In a telegraph system, the combination with a line circuit, of a receiver comprising a selecting apparatus controlled by said line circuit for effecting the selection of all of the characters or signals of a message, operating devices controlled by said selecting apparatus and arranged to effect the printing of all of the characters, means for holding said selecting apparatus in changed condition independently of said line circuit, means acting at the end of each selection of a character for restoring said selecting apparatus to normal condition and for disconnecting the same from said operating devices, means for holding said operating devices in condition to effect the printing of a character independently of said selecting apparatus, and means for restoring said operating devices to normal condition and for connecting the same to said selecting apparatus, said means acting after the printing of a character, the parts being so organized that the printing of one character may be effected and the next succeeding character simultaneously selected, substantially as described.
31. In a telegraph system in which the characters are represented by different permutations of a number of impulses of opposite polarity, the combination with a line circuit, of a receiver comprising a selecting part controlled by said line circuit and arranged to effect the selection of all of the characters of a message, an operating part controlled by said selecting part and arranged to control the printing of all of the characters, means for disconnecting the selecting part from the operating part at the end of a selection and for restoring the selecting part to normal condition at the end of a selection and means acting at the end of the printing of a character for restoring said printing part to normal condition and connecting the same to said selecting part, whereby the printing of a character and the selection of the next succeeding character may be simultaneously effected, substantially as described.
32. In a telegraph system, a receiver comprising a set of circuits for effecting all selections of the characters of a message, a set of circuits for controlling all printing of characters, and means for connecting and disconnecting said selecting and printing circuits and for simultaneously controlling the printing of one character and the selection of a succeeding character, substantially as described.
33. In a telegraph system, the combination with a line circuit, of a receiver having a set of selecting circuits and a set of circuits for controlling the printing of the characters, and means acting at the end of the selection of a character for disconnecting said selecting and said printing circuits and at the end of the printing of a character for connecting the same, substantially as described.
34. In a telegraph system, the combination with the line circuit and line relay, of a set of selecting circuits controlled by said line relay and arranged to effect the selection of all of the characters of a message, a set of operating circuits controlled by said selecting circuits and arranged to effect the printing of all of the characters, means for holding the selecting circuits in changed condition independently of said line relay, means for holding said operating circuits in changed condition independently of said selecting circuits, and means acting at the end of a selection for disconnecting said printing circuits from said selecting circuits and for restoring said selecting circuit to normal condition, and means acting at the end of the printing of a character for restoring said printing circuits to normal condition and connecting the same to said selecting circuits, the parts being so organized that the printing of a character may be controlled while the selection of the next succeeding character is being effected, substantially as described.
35. In a telegraph system, the combination of a line circuit and a line relay, of a set of selecting circuits controlled by said

line relay for effecting the selection of all of the characters of a message, a set of operating circuits controlling the printing of all of the characters, said operating circuits being controlled in turn by said selecting circuits, switch mechanism for connecting and disconnecting said operating and said selecting circuits, means acting at the end of the selection of a character for restoring said selecting circuits to normal condition and for actuating said switch mechanism to disconnect the selecting and operating circuits, and means acting at the end of the printing of a character for restoring said operating circuits to normal condition and for actuating said switch mechanism to connect said operating and said selecting circuits, substantially as described.

36. In a telegraph system, the combination with a line relay, of a set of selecting circuits controlled by said line relay, a set of operating circuits controlled by said selecting circuits for effecting the printing of the characters, dividing switch mechanism for connecting and disconnecting said selecting and said operating circuits, locking switch mechanism for holding said selecting circuits in changed condition independently of said line relay, locking switch mechanism for holding said operating circuits in changed condition independently of said selecting circuits, means acting at the end of the selection of a character for restoring said selecting circuits to normal condition and for actuating said dividing switch mechanism to disconnect the selecting circuits from said printing circuits, and means acting at the end of the printing of a character for restoring said operating circuits to normal condition and for actuating said dividing switch mechanism to connect said operating circuits to said selecting circuits, substantially as described.

37. In a telegraph system, the combination with a line circuit and line relay, of a set of selecting circuits controlled by said line relay and arranged to effect the selection of all of the characters of a message, a set of operating circuits controlled by said selecting circuits and arranged to effect the printing of all of the characters, a dividing switch mechanism for connecting and disconnecting said selecting and operating circuits, a set of normally open locking switches controlled by said selecting circuits for holding the latter in changed condition independently of said line relay, a normally closed unlocking switch for said selecting circuits, means acting at the end of the selection of a character for opening said unlocking switch and for actuating said dividing switch mechanism to disconnect said selecting circuits from said operating circuits, normally open locking switches controlled by said operating circuits for holding the

latter in changed condition independently of said selecting circuits, a normally closed unlocking switch for said operating circuits, and means controlled by the printing of any character for opening said unlocking switch and for effecting the operation of said dividing switch mechanism to connect said operating circuits to said selecting circuits, substantially as described.

38. In a telegraph system in which the characters are represented by different permutations of a number of impulses of opposite polarity, the combination with a line circuit and a line relay, of a receiver controlled by said line relay and comprising a selective part for controlling the selection of all of the characters of a message and an operating part for controlling the printing of all of the characters, means acting at the end of any selection for restoring said selecting part and disconnecting the same from said operating part, and means acting at the end of printing of any character for restoring said printing part to normal condition and for connecting the same to said selecting part, substantially as described.

39. In a telegraph system in which the characters are represented by different permutations of a definite number of impulses of opposite polarity, the combination with a line circuit and a line relay, of a receiver controlled by said line relay comprising a set of selecting circuits controlling the selection of all of the characters of a message, a set of operating circuits controlled by said selecting circuits and arranged to effect the printing of all of the characters, dividing switch mechanism for connecting and disconnecting said operating and said selecting circuits, means controlled by said selecting circuits and acting at the end of any selection for restoring said selecting circuit to normal condition and for actuating said dividing switch mechanism to disconnect the operating circuits from the selecting circuits, and means controlled by said operating circuit and acting at the end of the printing of any character for restoring said operating circuits to normal condition and for actuating said dividing switch mechanism to connect said operating circuits to said selecting circuits, substantially as described.

40. In a printing telegraph, the combination with a line circuit, a receiver comprising a set of selecting devices variably controlled by said line circuit to effect all selections of the characters of a message, a corresponding set of operating devices normally responsive to said selecting devices, printing means controlled by said operating devices, and means acting at the end of each selection for placing said selecting devices in condition for the succeeding operation and for rendering said operating devices and printing means non-responsive thereto,

and means acting after the printing of a character for restoring said operating devices and said printing means to normal, the parts being so organized that said selecting devices can be placed in condition for the selection of a character before the printing of the preceding character selected thereby, is completed.

41. A telegraph system in which the characters are represented by different permutations of a definite number of impulses of opposite polarity, of a receiver comprising a set of selecting devices responsive to the impulses of each permutation for effecting all selections of the characters of a message, a corresponding set of operating devices normally responsive to the operation of said set of selecting devices, means acting at the end of each selection for freeing said set of selecting devices for the succeeding operation and for rendering said set of operating devices non-responsive thereto; and means acting after the printing of a character for restoring said operating devices to normal.

42. In a telegraph system, a receiver comprising a set of selecting magnets, a corresponding set of operating magnets normally responsive to the operation of said set of selecting magnets, printing means controlled by said set of operating magnets, the parts being arranged to maintain said printing means in condition to complete the printing of a character independently of said selecting magnets, means acting at the end of each selection for restoring said set of selecting magnets to normal and for rendering said set of operating magnets non-responsive thereto, and means acting after the printing of a character for restoring said operating magnets to normal condition, the parts being so organized that said set of selecting magnets can be freed to build up a character before the printing of a preceding character is completed.

43. A telegraph system in which the characters are represented by different permutations of a definite number of impulses of opposite polarity, the combination with a line relay, a set of selecting and locking magnets, means for successively connecting said set of selecting and locking magnets to said line relay as the impulses of the permutations are received to thereby variably operate the same, said locking magnets being arranged to be maintained in changed condition independently of said line relay and said connecting means, a corresponding set of operating magnets normally responsive to the operation of said selecting and locking magnets, printing mechanism controlled by said operating magnets, said printing mechanism being arranged to be maintained in condition to complete the printing of a character independently of

said selecting and locking magnets, means acting at the end of each selection for restoring said selecting and locking magnets to normal and means acting after the printing of a character for restoring said operating magnets and said printing mechanism to normal.

44. In a telegraph system in which the characters are represented by different permutations of a definite number of impulses of opposite polarity, the combination with a line circuit and a line relay, of a pair of local main conductors selectively controlled by said line relay, a number of pairs of branch conductors, transfer switch mechanism for successively connecting said pairs of branch conductors to said main conductors as the impulses of a permutation are received, means for holding the selected branch conductors in changed condition independently of said line relay, a set of operating magnets controlled by said branch conductors, a number of sets of switches controlled by said magnets, each switch having a normally engaged and a normally disengaged contact and the contacts of each switch in one set being connected to two switches in the next set, the arrangement being such that the operation of said magnets and said switches will close one of a number of branches of a printing circuit and means acting at the end of the printing of any character for restoring the selecting branch conductors and said printing circuit to normal condition, substantially as described.

45. In a telegraph system in which the characters are represented by different permutations of five impulses of opposite polarity, the combination with a line circuit and a line relay, of a pair of local main conductors selectively controlled by said line relay, five pairs of branch conductors, transfer switch mechanism for successively connecting said pairs of branch conductors to said pair of main conductors as the impulses of a permutation are received, a set of five operating magnets selectively controlled by said branch conductors, a printing circuit, five sets of switches arranged in said printing circuit and controlled by said magnets, each switch having a normally engaged and a normally disengaged contact and the two contacts of each switch in one set being connected to two different switches in the next set, the arrangement being such that operation of said set of magnets will close one branch of the printing circuit, means for holding the selective branch conductors and the printing circuit in changed condition independently of the line relay, and means acting at the end of the printing of any character for restoring the conductors and printing circuit to normal condition, substantially as described.

46. In a telegraph system in which the

characters are represented by different permutations of five impulses of opposite polarity, the combination with a line circuit and a line relay, of a pair of local main conductors selectively controlled by said line relay, five pairs of branch conductors, transfer switch mechanism for successively connecting said pairs of branch conductors to said main conductors as the impulses of a permutation are received, a set of locking magnets interposed in said branch conductors, means controlled thereby for holding the selected branch conductors in changed condition independently of said line relay, a set of operating magnets controlled by said branch conductors, a printing circuit selectively controlled by said operating magnets, means for holding the selected operating magnets in changed condition independently of said branch conductors, a set of dividing switches for connecting and disconnecting said branch conductors and the circuits of said operating magnets, an operating magnet for said dividing switches, means acting at the end of any selection for restoring said branch conductors to normal condition to effect the next selection and to actuate said dividing magnet to disconnect said branch conductors from said operating magnets, and means acting at the end of the printing of any character for restoring said printing circuit to normal condition and to actuate said dividing switch magnet to connect said operating magnets to said branch conductors, substantially as described.

47. In a telegraph system in which the characters are represented by different permutations of a definite number of impulses of opposite polarity, the combination with a line circuit, of a transmitter having a set of pole changers, a set of automatically operating magnets for successively connecting said pole changers to the line to impart the permutations thereto, a line relay for receiving the permutations, a pair of local main conductors selectively controlled by said line relay, a number of pairs of branch conductors, a set of transfer switches for successively connecting said pairs of branch conductors to said pair of main conductors, locking switches for holding the selected branch conductors in closed condition independently of the line relay, a set of operating magnets selectively controlled by the flow of current through said branch conductors, locking switches for holding the circuits of the selected operating magnets in closed condition, a number of sets of switches operated respectively by said magnets, a printing circuit having a number of branches controlled by said sets of switches, the arrangement being such that one of the branches of the printing circuit will be closed at each operation of the set of magnets, and

means for opening the circuit through said branch conductors and through said operating magnets, substantially as described.

48. In a telegraph system, the combination with a line circuit and selective means controlled by said line circuit, of a printing circuit having a number of branches controlled by said selective means, means for restoring said printing circuit to normal condition, a special shift magnet arranged in one of the branches of said printing circuit and arranged to be selected by the transmission of a special signal over the line, and means independent of said first-mentioned means for restoring the circuit of said special magnet to normal condition substantially as described.

49. In a telegraph system, the combination with a line circuit and a selecting apparatus controlled thereby, of a printing circuit having a number of branches one of which is closed at each operation of said selecting device, means acting at the printing of any character for opening the printing circuit, a special shift magnet in one of the branches of said printing circuit and responding to the transmission of a special signal over the line, and means independent of said first mentioned restoring means and acting in response to the transmission of another signal over the line for opening the circuit of said special magnet, substantially as described.

50. In a telegraph system, the combination with a line circuit and a selecting apparatus controlled thereby, of a printing circuit having a number of branches one of which is closed at each operation of the selecting apparatus, two special shift magnets interposed in two of the branches of said printing circuit and responding to the transmission of special signals over the line, a releasing magnet interposed in another branch of the printing circuit for opening the circuits through said special shift magnets, and independent means acting at the end of the printing of any character for opening any other of the branches of the printing circuit, substantially as described.

51. In a selective telegraph system, in which the characters are represented by different combinations of impulses of opposite polarity, the combination with a line circuit, a polarized relay controlled by said line circuit, a number of local branch conductors controlled by said line relay, a set of relays located in said branch conductors, means operated by said relays for successively connecting and disconnecting said branch conductors to said line relay in invariable, predetermined order as the succeeding impulses of the different code combinations are received and a number of selectively operated relays located in said branch conductors, substantially as described.

52. In a selective telegraph system in which the characters are represented by different combinations of impulses of opposite polarity, the combination of a line circuit and polarized line relay controlled thereby, of a number of local branch conductors controlled by the armature of said line relay, a set of relays located in said branch conductors and arranged to successively operate in invariable, predetermined order as the succeeding impulses of the different code combinations are received to successively connect said branch conductors to the contacts of said line relay, and a set of selectively operated relays located in said branch conductors, substantially as described.

53. In a selective telegraph system in which the characters are represented by different permutations of a number of impulses of opposite polarity, the combination with a line circuit, of a pair of local main conductors selectively controlled by said line circuit, a number of local branch conductors corresponding to the number of impulses constituting a character signal and transfer switch mechanism for successively connecting said branch conductors in invariable order to one of said main conductors as the succeeding impulses of the different permutations are received.

54. In a selective telegraph system in which the characters are represented by different permutations of a different number of impulses of opposite polarity, the combination

with a line circuit, of a pair of local main conductors selectively controlled by said line circuit, a number of local branch conductors corresponding with the number of impulses constituting a code signal, a set of transfer switches for connecting said branch conductors to one of said main conductors, and a set of relays controlled by the flow of current through said main and branch conductors and arranged to successively operate said transfer switches in invariable, predetermined order as the succeeding impulses of the different code permutations are received.

55. In a selective telegraph system in which the characters are represented by permutations of a different number of impulses of opposite polarity, the combination with a line circuit and a polarized relay controlled thereby, of a pair of local main conductors controlled by said line relay, a set of local branch conductors, a set of relays arranged to successively operate in invariable, predetermined order as the impulses of the different code permutations are received to successively connect said local branch conductors with one of said main conductors, and a number of selectively operated relays in said local branch conductors.

CHARLES L. KRUM.
HOWARD L. KRUM.

Witnesses:

HARRY L. CLAPP,
KATHARINE GERLACH.