C. L. KRUM.

PRINTING TELEGRAPH.

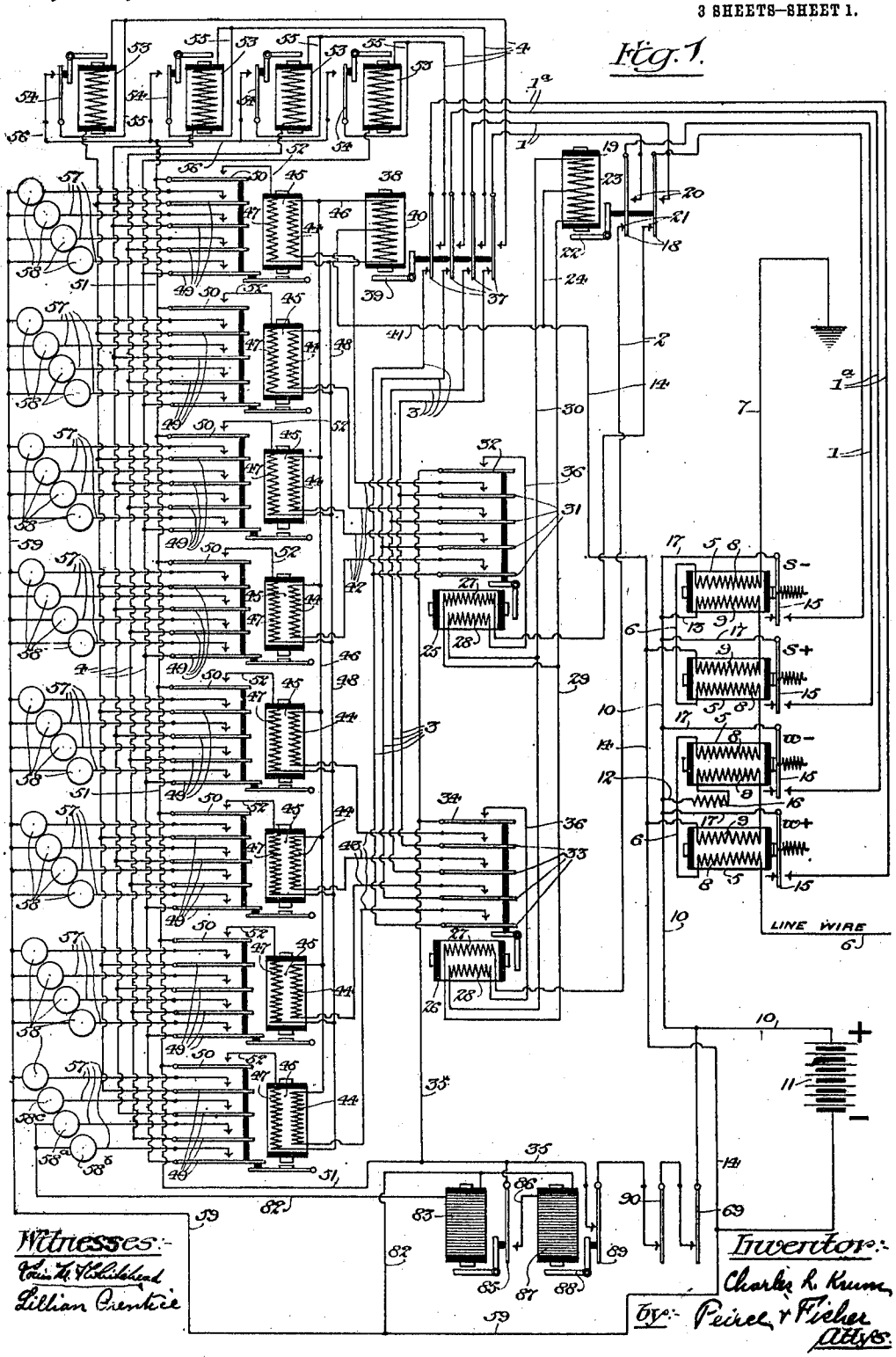
APPLICATION FILED SEPT. 6, 1906.

1,004,038.

Patented Sept. 26, 1911.

3 SHEETS—SHEET 1.

Fig. 1.



Witnesses:-
Louis F. Whitehead
Lillian Prentice

Inventor:-
Charles L. Krum,
by:- Peirce & Fisher
Attys.

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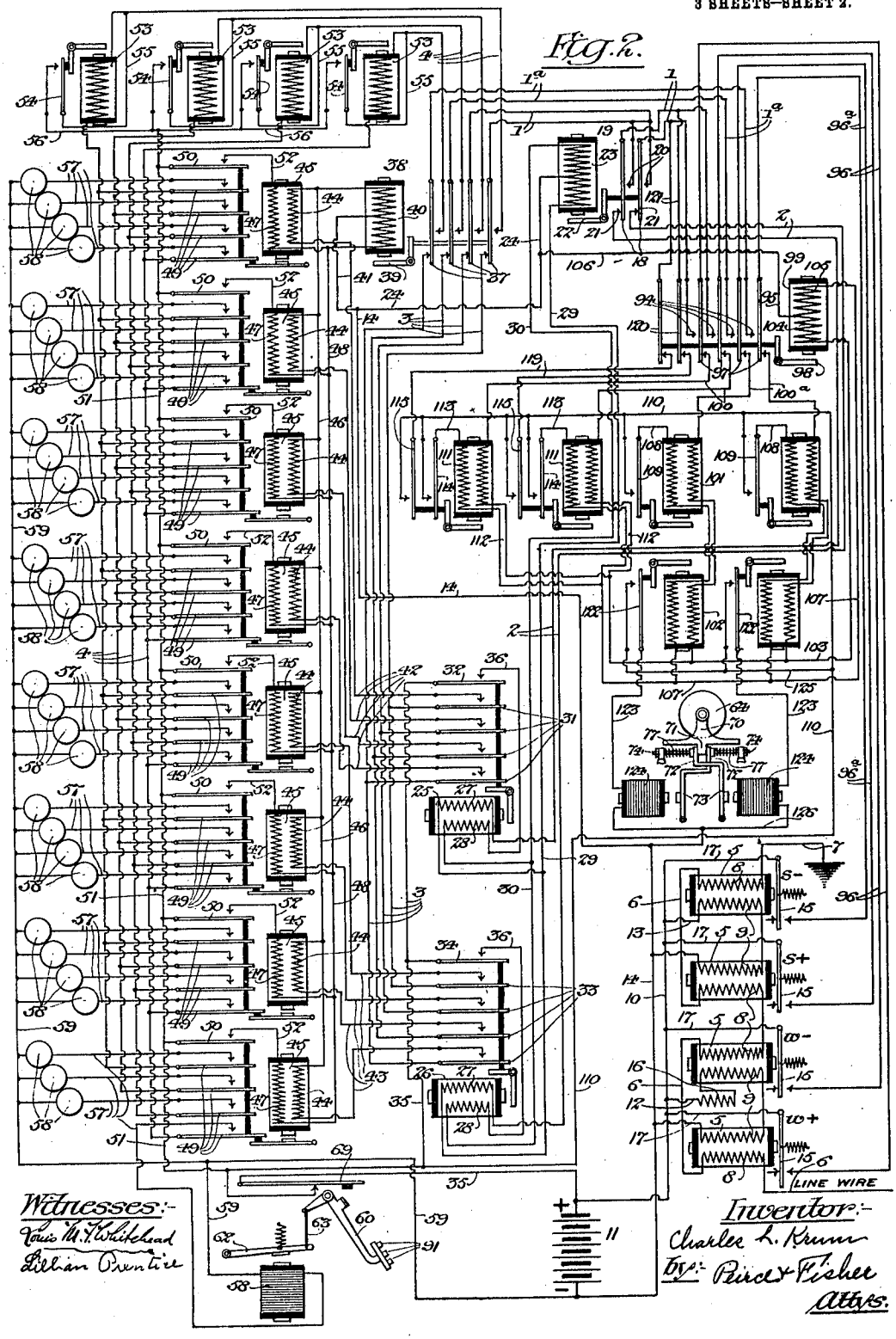
3 SHEETS—SHEET 2.

Fig. 2.



Witnesses:-
Louis W. Whitehead
Lillian Orentlicher

Inventor:-
Charles L. Krum
By:- Pierce & Fischer
Attys.

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3 SHEETS—SHEET 3.

Fig. 3.

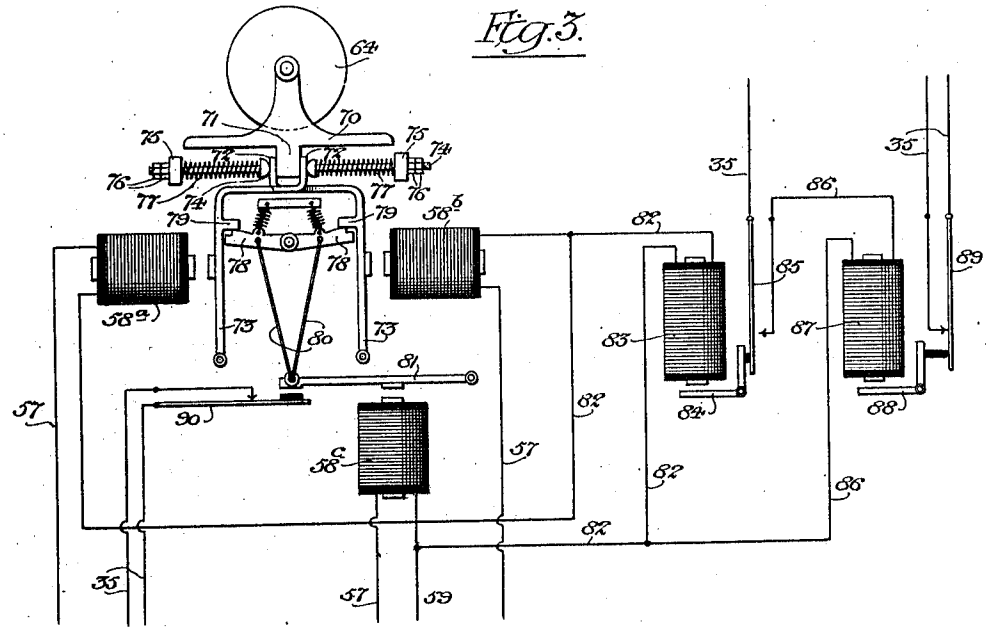
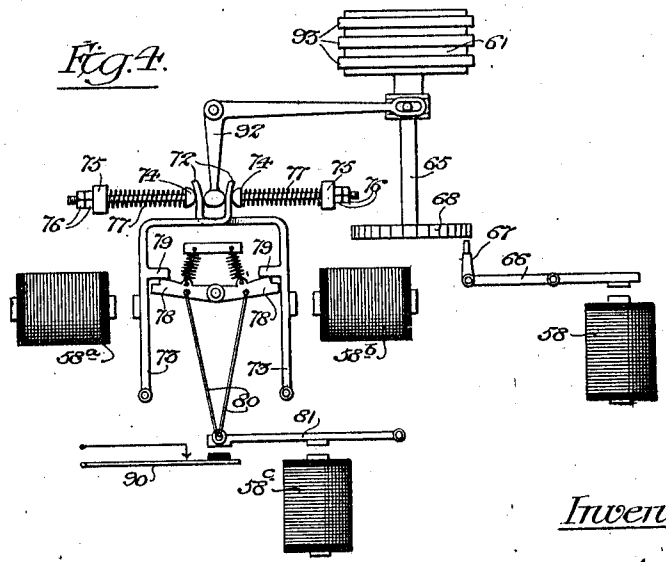


Fig. 4.



Witnesses:-

Louis W. Whitehead

Lillian Prentiss

Inventor:-

Charles L. Krum

by:- Peirce & Fisher

Attys:-

UNITED STATES PATENT OFFICE.

CHARLES L. KRUM, OF CHICAGO, ILLINOIS, ASSIGNOR TO MORKRUM COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF MAINE.

PRINTING-TELEGRAPH.

1,004,038. Specification of Letters Patent. **Patented Sept. 26, 1911.**

Application filed September 6, 1906. Serial No. 333,452.

To all whom it may concern:

Be it known that I, CHARLES L. KRUM, a citizen of the United States, and a resident 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 improvement relates to printing telegraphs and seeks to provide an improved and simplified arrangement of the selecting apparatus in which the number of necessary parts is diminished, and further to provide in connection with the printing devices controlled by the selecting apparatus a shiftable element also controlled by the selecting apparatus and by which the number of possible selections is greatly increased without complicating the arrangement of magnets in the circuits of the selective system.

The invention consists in the combinations and arrangements of parts and circuits hereinafter set forth, illustrated in the accompanying drawings and more particularly pointed out in the appended claims.

In the drawings, Figure 1 is a diagram of the arrangement of parts and circuits in accordance with the present invention. Fig. 2 is a diagram of a modified arrangement. Fig. 3 is a diagrammatic representation of the shifter mechanism employed in connection with the selective system illustrated in Fig. 1. Fig. 4 is a diagrammatic view of a modified form of shifter mechanism.

The operating circuits for the printing devices preferably comprise a set of main conductors and separate sets of branch conductors. Means controlled by the separate branch conductors operate the printing devices. In the arrangement shown in Fig. 1, each signal is made by a combination of three line impulses and four operating circuits are employed and comprise the set of four main conductors 1 and 1ª and the separate sets of branch conductors 2, 3 and 4. Suitable means controlled by the line circuit is arranged to selectively control the flow of current to the main and branch conductors. In the form shown a series of four line relays 5 are interposed in the line circuit 6 leading from a distant station and extending in series through the several relays 5, then by a conductor 7 to the ground or to a suitable return wire. The relays are arranged to respond differently to the modified code impulses transmitted over the line. For example, the first relay may respond to a weak positive impulse, the second to a weak negative impulse and the third and fourth to strong positive and negative impulses respectively. The relays may be arranged to variably respond in this manner in a number of different ways. In the form shown each relay 5 is provided with two coils 8 and 9. The line circuit extends through the coil 8 of the first and third relays in one direction and through the coils 8 of the second and fourth relays in the opposite direction. A conductor 10 leads from the local battery 11 and is provided with a branch 12 extending in opposite directions through the coils 9 of the first and second relays and with a branch wire 13 extending through the coils 9 of the third and fourth relays. The coils 9 are also connected to a return wire 14 leading back to the battery 11. The local circuit from battery 11 is always closed through the coils 9 of the relays 5 so that the armatures 15 of the relays are normally held up against their front contacts. A resistance 16 is interposed in the branch wire 12 so that the current flowing through the coils 9 of the first and second relays is weaker than that flowing through the coils 9 of the third and fourth relays.

A weak positive line impulse flowing through the coils 8 of the relays will neutralize the current in the coils 9 of the first relay so that the armature of the first relay will be drawn against its back contact. It will not be sufficient to neutralize the coil 9 of the third relay and it will merely serve to strengthen the effect of the coils 9 of the second and fourth relays. A weak negative impulse will neutralize the current in the coil 9 in the second relay but will be insufficient to neutralize the current in coil 9 of the fourth relay and will merely serve to strengthen the effect of the coils 9 in the first and third relays. In a similar manner a strong line impulse, either positive or negative will neutralize the effect of coil 9 in either of the third or fourth relays but will entirely over-balance the current in the coils 9 of the first and second relays. The relay armatures 15 are connected to battery wire 10 by conductors 17 and the main conductors 1 and 1ª of the operating circuits are connected to the back contacts of the line relays 5. In the manner described, the

varied impulses imparted through the line circuit selectively control the flow of current from the local battery 11 to the set of main conductors 1 and 1ª. Other means controlled by the line circuit could be employed, if desired, for selectively connecting the set of main conductors to the battery.

The main conductors 1 are connected to the shifting contacts 18 of a transfer switch 19 and extensions of the main conductors 1 are connected to the back contacts 20 thereof so that the circuit through the main conductors 1 is normally broken at this point. The branch conductors 2 are connected to the front contacts 21 and are thus normally connected with the main circuit conductors 1. At the operation of the transfer switch 19 the connection between the first set of branch conductors 2 and the main conductors 1 is broken and the circuit through the main conductors 1 is closed at this point.

The shifting contacts 18 are operated by the armature 22 of the transfer switch relay 23. This relay is provided with a coil that is divided to form opposed sections or with two coils wound in opposite directions and the opposed coils are connected by a conductor 24 to the battery return wire 14. The first set of branch conductors 2 extend respectively through a pair of selecting magnets 25 and 26. Each of these magnets is provided with two coils 27 and 28 which are wound in the same direction. The coils 27 are included one in each of the branch conductors 2. A common return wire 29 leads from the coils 27 to one of the opposed coils in the transfer switch relay 23. The other opposed coil of the switch relay 23 is connected by a conductor 30 to the coils 28 of the selecting magnets 25 and 26. Magnet 25 is arranged to operate a series of normally open switches 31 and a locking switch 32. Magnet 26 is arranged to operate a series of normally open switches 33 and a locking switch 34. The locking switches 32 and 34 are included in a locking circuit comprising a conductor 35 leading from the battery wire 10 and the branches 36 leading from the contacts of the locking switches 32 and 34 through the coils 28 of the respective magnets 25 and 26.

As stated, each signal comprises a combination of three line impulses. At the first line impulse, which is either a strong positive or a strong negative, the armature of either the third or fourth relay 5, will be operated and the operating circuit may then be traced from battery 11 by wires 10 and 17 to the operated armature 15, thence by one of the main conductors 1 to the corresponding shifting contact 18 of the transfer switch and thence by one of the branch conductors 2 through the coil 27 of either the selecting magnet 25 or the selecting magnet 26. From either of these magnets the current passes by wire 29 through one of the coils of the transfer switch relay 23 and by wires 24 and 14 back to battery 11. This energizes either the magnet 25 or the magnet 26 and shifts one of the two sets of switches 31 and 33 into engagement with their contacts. It also closes either one of the locking switches 32 or 34 so that a current may be traced from battery 11 by wires 10 and 35 to either one of the locking switches and by wire 36 through the coil 28 of the operated selecting magnet and by wire 30 through the opposite coil of the switch relay, thence back as before by wires 24 and 14 to the battery.

The selecting magnets 25 and 26 operate more quickly than the transfer switch relay 23, so that the circuit through both of the opposed coils of the relay is closed before it can operate. As long as the current flows through both coils, the transfer switch remains in normal position, but at the cessation of the line impulse the armature of the selected line relay 5 is restored to its normal position and the circuit through the selected main conductors 1 and corresponding branch conductor 2 and through one of the opposed coils of the relay 23, is broken. The operation however of either of the selecting magnets 25 or 26 operate to close the locking circuit through its coil 28 and through the other coil of the relay 23, and the circuit thus established is held in closed condition, so that the transfer switch relay 23 is then operated to disengage the switches 18 from the circuits 21 and shift them into engagement with the contacts 20. The first line impulse thus serves to select one of the first sets of the branch conductors 2 and its corresponding selecting magnet and locking circuit which, when selected, is held in closed condition. At the cessation of the first line impulse, the transfer switch operates to disconnect the first set of branch conductors 2 from the main conductors 1. The transfer switch, when once operated is of course held in shifted position by the locking circuit which is controlled by the switches 32 and 34 and which extends through one of its coils.

The set of main conductors 1 extend from the transfer switch 19 to two of the shifting switches 37 of the second transfer switch 38. The main conductors 1ª extend directly to the other two shifting switches 37. The second set of branch conductors 3 are connected to the back contacts of the switches 37 and the third set of branch conductors 4 are connected to the front contacts of these switches so that at this point the conductors 3 are normally connected to the main conductors 1 and 1ª and the branches 4 are normally disconnected therefrom. The first line impulse, as stated, serves to shift the connection of the main conductors 1 from

the branches 2 to the branch conductors 3. The switches 37 are operated by the armature 39 of a relay 40 which, when energized serves to shift the connection of the main conductors 1 and 1ª from the set of branch conductors 3 to the set of branch conductors 4. The transfer switch relay 40, like relay 23 is provided with two oppositely wound coils or coil sections which are connected on one side to the battery return wire 14 by a conductor 41. The second set of branch conductors 3 is divided into two sets of sub-branches 42 and 43. The sub-branches 42 are arranged to be connected to the branches 3 by the switch contacts 31 and the sub-branches 43 are connected thereto by the switch contacts 33. The arrangement is such that each of the branch conductors 3 may be connected to one of the sub-branches, either in the set 42 or the set 43. The sub-branches 42 and 43 lead respectively to the coils 44 of a set of selecting magnets 45 and from these coils a common return wire 46 leads to one of the coils of the transfer switch relay 40. Magnets 45 are also provided with coils 47 wound in the same direction as coils 44 and the coils 47 are connected by a common conductor 48 to the opposite coil of the transfer switch relay 40. Each of the selecting magnets 45 is arranged to operate a set of normally open switches 49 and a normally open locking switch 50. Switches 50 control a locking circuit extending from battery by the wires 35 and 51 and including a series of branches 52 leading from the contacts of the locking switches to the coils 47 of the respective magnets 45.

The first line impulse of the signal, in the manner described, serves to shift either the set of switches 31 or the set of switches 33 to closed position and to lock them in such closed position. It also, as stated, serves to shift the connection of the main conductors 1 from the branch conductors 2 to the second set of branch conductors 3. At the second line impulse, the current may be traced from battery 11 by wires 10 and 17 to the armature 15 of one of the line relays 5 (operated in accordance with the character of the line impulse) thence by one of the main conductors 1 or 1ª to one of the switches 37, thence by one of the branch conductors 3 to one of the switches either in the set 31 or the set 33, since one or the other of these sets have been previously shifted to closed position by the first line impulse of the code signal or combination. Thence, the circuit may be traced by one of the sub-branches 42 or 43 through the coil 44 of one of the selecting magnets 45 and by conductor 46 to one of the coils of the transfer switch relay 40 and thence by wires 41 and 14 back to battery 11. One of the sets of switches 49 and one of the locking switches 50 will then be moved to closed position and the locking circuit may be traced from battery 11 by wires 10, 35, 51, the selective locking switch 50, wire 52, the coil 47 of the corresponding magnet 45 and thence by conductor 48 to the opposite coil of the switch relay and back as before by wires 41 and 14 to battery.

The selecting magnets 45 operate more quickly than the transfer switch relay 40 so that the circuit is closed through both of the opposed coils or sections of the relay before it is energized to operate its armature, and as long as the second line impulse persists the switch members 37 of the transfer switch remain in normal position. At the cessation of the second line impulse however, the armature of the selected line relay 5 returns to normal position and the circuit through the coil 44 of the selected magnet 47 and through one of the coils of the switch relay 40 is broken, but the locking circuit through the coil 47 of the selecting magnet 45 and through the outer coil of the relay 40 remains unbroken so that the transfer switch is then operated to shift the connection of the main conductors 1 and 1ª from the second set of branch conductors 3 to the third set of branch conductors 4. The switches 49 and 50 of the selected magnet 45 and the switches 37 of the transfer switch 40 are of course held in shifted position by the locking circuit after the cessation of the second line impulses.

The third set of branch conductors lead through the coils of a series of locking magnets 53, each of which is arranged to operate a locking switch 54 that is connected by a conductor 55 to the coil of the corresponding magnet. The contacts of these switches are connected to battery by the wires 35, 51 and branch wires 56. Beyond the locking magnets the branch conductors 4 are divided into sets of sub-branches 57. There are four sub-branches in each set and eight sets as shown, and each set of sub-branches 57 is arranged to be connected to the branch conductors 4 by one of the switches 49 which are operated as described by the selecting magnets 45. The arrangement is such that one of the branch conductors 4 may be connected to one of the sub-branches 57 in each of the several sets. The operating magnets 58 are arranged in sets of four as shown, and the coils of these magnets are interposed in the sets of sub-branches 57. These magnets are connected to battery by a common return wire 59.

The second impulse of any given signal serves to shift and lock one of the sets of switches 49 in closed position and also to operate relay 40 to shift the connections of the main conductors from the second set of branches to the third set of branches 4. At the third and final line impulse of any given signal one of the line relays 5 is operated and current may be traced from battery

11 by wires 10 and 17 to the armature 15 of the selected line relay 5, thence by one of the main conductors 1 or 1ª to the switch members 37 of the transfer relay 40 and by one of the branch conductors 4 through the coil of one of the locking magnets 53 and to one of the switches 49 in the previously shifted set, and thence by one of the sub-branches 57 through one of the operating magnets 58 and back by wire 59 to the battery. One of the locking magnets 53 is thus energized and the locking circuit may be traced from battery by wires 10, 35, 51 and 56 to the switch 54 of the selected locking magnet and by wire 55 through the coil of the selected locking magnet, and thence as before by one of the branches 4 through one of the switches 49 and the selected operating magnet 58 to the battery return wire 59, so that the circuit is closed and held closed through the selected operating magnet 58 independently of the continued operation of the selected line relay.

The operating magnets 58 are used to control the operation of any suitable form of printing apparatus. Certain of the operating magnets can be used to control the line space feed and carriage return mechanism of the printing apparatus, while the greater part of the operating magnets will each be arranged to effect the printing of the letter or character corresponding to its particular signal or code combination of impulses. By employing certain of the operating magnets as shifting magnets, each one of the type operating magnets may be employed for printing two or more characters. The type operating magnets 58 may each operate a type-bar 60, as indicated in Fig. 2, or each type operating magnet may be used to control the movement of the type wheel 61, as indicated in Fig. 4. In the arrangement indicated in Fig. 2, the spring-held armature 62 of each type operating magnet is connected by a link 63 to the pivoted type-bar 60 so that when the magnet is energized the type-bar will be shifted to strike upon the paper carried by a platen 64. In the form shown in Fig. 4 type wheel 61 is mounted upon a shaft 65 and the armature 66 of the type-operating magnet 58 is arranged to shift one of a number of stop devices 67 which coöperate with a wheel 68 on the shaft 65 to arrest the movement of the type wheel. Other well known means could be employed by which the operation of the magnet would bring the proper type on the wheel 61 to the printing point.

Whenever one of the operating magnets is energized it is arranged to open the locking circuit through the selecting magnets 25, 26 and 45. For this purpose, the normally closed switch 69 is interposed in the conductor 35 of the locking circuit from the battery 11 and suitable means are provided for opening the switch when any one of the type-operating magnets is energized. For example, as indicated in Fig. 2, each one of the type-bars 60 may be arranged to strike the switch 69 to open the locking circuit so that the magnets 25, 26 and 45 will be de-energized and all parts returned to normal position in readiness to receive the next succeeding signal.

Two of the operating magnets 58ª and 58ᵇ (see Fig. 1) are arranged to operate suitable shift mechanism which may be employed either for shifting the platen or for shifting the type wheel. In the form shown in Fig. 3 the platen 64 is journaled in a suitable frame 70 having a rib 71 on its under side which extends between upwardly projecting lugs 72 on the inwardly bent ends of a pair of shift levers 73. The ends 72 of the shift levers 73 are engaged by the heads of a pair of plungers 74 which extend through fixed abutments 75 and are provided on their outer ends with adjusting and locking nuts 76. Spring 77 coiled about the plunger 74 extends between the heads thereof and fixed abutments 75. By the arrangement described, the shifters and their platen are normally spring-held in central position. One of the shifters 73 is operated by the magnet 58ª to move the platen in one direction while the other shifter is operated by the magnet 58ᵇ to move the platen in the opposite direction.

A pair of spring-held pawls 78 coöperate with lugs 79 on the respective shifters 23 so that when either one of the shifters is operated the adjacent pawl 78 will engage the lug 79 thereon and lock it in shifted position. The pawls 78 are connected by links 80 to a pivoted lever 81 which is actuated by another one of the operating magnets 58ᶜ to move the spring-held pawls and release the shift mechanism.

As indicated in Figs. 1 and 3, the shifter magnets 58ª and 58ᵇ are provided with a separate return conductor 82 which extends through the coils of a magnet 83 and thence leads to the common return wire 59 back to battery, so that whenever either of the shifting magnets is selected the magnet 83 will also be energized and its armature 84 operated to close a normally open switch 85. The switch 85 is connected to the battery wire 35 of the locking circuit and its contact is connected to a conductor 86 which extends through the coil of a magnet 87 and back to the return wires 82 and 59, so that the operation of magnet 83 and switch 85 will energize the magnet 87. The armature 88 of this magnet is arranged to operate another normally closed, unlocking switch 89 in the conductor 35 of the locking circuit. The armature lever 81 of the releas-

ing magnet 58c (see Fig. 3) is also arranged to open a normally closed unlocking switch 90 interposed in the conductor 35.

Where the shifter mechanism is arranged to move the platen, each of the type bars 60, as indicated in Fig. 2, will be provided with three type 91, any one of which may be brought to the printing point by the combined operation of the magnets 58a, 58b and the other operating magnets 58. The shifting mechanism may also be employed for moving a type wheel, as indicated in Fig. 4. In this form the lugs 72 on the shifters 73 engage the end of a bell crank lever 92, the other arm of which shifts the type wheel 61 longitudinally upon the shaft 65 to bring any one of the rows of type 93 thereon opposite the printing point. The specific construction of shift mechanism set forth may be widely varied without departure from the essentials of the invention.

The most frequently used characters, that is to say the small letters will require no preliminary operation of the shift mechanism, since at least twenty-seven of the thirty-two operating magnets controlled by the improved selective system, may be employed for operating the type mechanism. By means of the double shift the total number of characters which may be selected is eighty-one. When a capital, figure or punctuation mark is to be printed at the distant station, the proper signal or code combination is transmitted over the line to select either the operating magnet 58a or operating magnet 58b, so that the shifter mechanism will be moved and locked in one or the other of its abnormal positions. At the same time magnets 83 and 87 will be energized to open the switch 89 in the locking circuit and the selecting switches are returned to normal in readiness to receive the succeeding signal which selects one of the type operating magnets. When it is desired to restore the shifter mechanism the code signal necessary to select the operating magnet 58c is transmitted over the line and the lever 81 is shifted to release the locking pawl 78 and permit the return of the shifter mechanism by means of the springs 77 to normal. At the same time switch 90 is shifted by the armature lever 81 to open the locking circuit.

Preferably, the transmitter will be provided with special shift keys which, when depressed, will effect the transmission of the proper code combinations to select the shifter magnets 58a and 58b respectively, and each shift key will be arranged, when released, to transmit a releasing signal or code combination which will select the releasing magnet 58c. In this way the shift keys of the transmitter may be used exactly as are the shift keys of an ordinary typewriter. That is to say, either one may be depressed to effect the movement of the shifting mechanism at the receiving station and held depressed as long as it is desired to print either capitals or numerals. As soon as the depressed shift key is released however, the shifter mechanism at the receiving station will be automatically restored to normal, as in the ordinary typewriter, and the operator need not actuate a special releasing key.

In the modified arrangement of the selecting apparatus shown in Fig. 2, the shift mechanism is not actuated by one of the operating magnets 58 but means are provided whereby the first impulse of certain code combinations is arranged to actuate the shift mechanism. In this modification, the arrangement of the line relays 5, the selecting magnets 25, 26 and 45 and the locking magnet 53 and operating magnets 58 is the same as that shown in Fig. 1 and the transfer switches 19 and 38 are arranged to control the connections of the branch conductors 2, 3 and 4 to the set of conductors 1 and 1a. The conductors 1 and 1a are not however connected directly to the back contacts of the line relays but on the other hand are connected to the front contacts 94 of an additional transfer switch 95. A set of main conductors 96—96a are connected to the back contacts of the armatures 15 of the line relays 5 and to the movable switch contacts 97 which are operated by the armature 98 of the transfer switch relay 99. An additional set of branch conductors 100 and 100a are connected to the normally engaged contacts of switches 97 so that the main conductors 96—96a are normally connected to the branches 100 and 100a. Each of the branch conductors 100a is arranged to control a magnet 101 and a magnet 102. Each of these magnets is provided with two coils and the corresponding branch conductor 100a extends through one coil in each magnet and both branches 100a are connected by a common return wire 103 to one of the opposed coils 104 of the transfer switch relay 99. Both opposed coils 104 and 105 of transfer switch relay 99 are connected by a common conductor 106 to the battery return conductors 24 and 14. The coil 105 of the transfer switch relay is connected by a conductor 107 to the other coils of the magnets 101 and 102 and these coils are connected by conductors 108 with the normally open switches 109 that are controlled respectively by the magnets 101. The contacts of these switches are connected to the battery wire 35 of the locking circuit by a common conductor 110. In a similar manner each of the branch conductors 100 extend through one of the coils of one of the magnets 111 and thence back by the conductors 112 and common conductor 103 to the coil 104 of the transfer switch relay. Conductors 113 extend from the switches 114 of the magnets 111 through the other coil of the re-

spective magnets and back by the common return wire 107 to the opposite coil 105 of the transfer switch relay. The contacts of the switches 114 are connected to the battery wire 35 and 110 of the locking circuit. The magnets 111 also operate additional switches 115 which are connected respectively by conductors 119 to the back contacts of a pair of additional switches 120 operated by the armature 98 of the transfer switch relay 99. The contacts of the switches 115 are connected to the battery wires 110 and 35 of the locking circuit and the additional switches 120 of the transfer switch relay 99 are connected respectively by conductors 121 with the conductors 1. The armatures of the magnets 102 are arranged to operate switches 122 that are connected respectively by conductors 123 to the coils of a pair of magnets 124 which operate the shift mechanism. This shift mechanism in the form shown is similar to that set forth in Fig. 3 except that no means are provided for locking the shift mechanism in its changed position. Other forms of shift mechanism may be provided if desired but it is unnecessary with this arrangement to provide locking means therefor. The contacts of the switches 122 are connected by a conductor 125 to the battery wires 35 and 110 of the locking circuit and the shifter magnets 124 are connected by a conductor 126 to the battery return wire 14.

With the arrangement shown in Fig. 2, the most frequently used characters (that is the small letters) are selected by code combinations or signals of three impulses each when the capitals and figures and other less frequently used characters are selected by code combinations of four impulses each. If a character is transmitted that necessitates the preliminary operation of the shift mechanism, the first line impulse will be of such a nature to select either the third or fourth line relay 5. That is to say, with the arrangement shown, the first line impulse of the signal will be either a strong negative or a strong positive, so that either one of the main conductors 96^a will be selected and the circuit traced from battery 11 by wires 10 to the armature 15 of either the third or fourth relay, thence by one of the conductors 96^a and one of the switches 97 to either one of the branch conductors 100^a, and by the selected branch conductor through either one of the set of magnets 101 and 102 to conductor 103, through the coil 104 of the transfer switch relay 99 and back to battery by wires 106, 24 and 14. In this way one of the switches 109 and one of the switches 122 will be shifted to closed positions and the locking circuit will be closed from battery 11 by conductors 35 and 110 to the shifted switch 109 through the other coils of the selected magnets 101 and 102, by conductor 107 to the other coil 105 of the relay 99 and back as before by conductors 106, 24 and 14 to battery. The magnets 101 operate more quickly than the transfer switch relay 99 so that the battery and locking circuit are closed through the opposed coils 104 and 105 of the switch relay 99 so that its armature remains in normal position so long as the first line impulse of the signal persists. At the same time one of the switches 122 is shifted to closed position as stated, and the locking circuit is closed from battery by conductors 35, 110 and 125 to the selected switch 122, thence by one of the conductors 123 to one of the shifter operating magnets 124 and back to battery by conductors 126 and 14 so that the shift mechanism is moved from normal to one or the other of its changed positions, and it is held in this changed position since the locking circuit is closed through one or the other of the shifter operating magnets 124.

It will be understood that the coils in the magnets 101, 102 and 111 are wound in the same direction so that the flow therethrough of both the battery and locking circuits does not interfere with their operation. The flow of the current however, through the opposed coils 104 and 105 of the switch relay prevents its operation until the cessation of the first line impulse when the circuit through the coil 104 of the switch relay will be broken by the return of the armature 15 of the selected line relay to normal. The locking circuit however is closed through the coil 105 of the switch relay and is held closed so that the armature 98 of the switch relay is operated to shift the switches 97 into engagement with the contacts 94. The connection between the main conductors 96 is thus changed from the branches 100 and 100^a to the set of conductors 1 and 1^a. After this first shifting impulse therefore, the conductors 1 and 1^a are connected directly to the normally disengaged contacts of the line relays. The succeeding three impulses of the signal will then act, as previously described in connection with the arrangement shown in Fig. 1, to select one of the actuating magnets 58.

If the character to be transmitted does not necessitate the preliminary operation of the shift mechanism, the first impulse of the signal will be of proper character to select either the first or second line relay 5, that is to say, in the form shown, either a weak positive or a weak negative impulse. The current may then be traced from battery 11 by conductors 10 and 17 to the armature 15 of either the first or second relay, thence by one of the main conductors 96 to one of the switches 97 and to one of the branch conductors 100, thence through one coil of one of the magnets 111, by conductor 112 and 103 to the coil 104 of the transfer switch relay and to the battery return conductors

106, 24 and 14. One of the magnets 111 is thus energized to shift one of the switches 114 and one of the switches 115. The circuit is thus closed from battery by wires 35 and 110 to the selected switch 114, to the other coil of the corresponding magnet 111, by wire 113 and by conductor 107 through the opposed coil 105 of the transfer switch relay and back as before by conductors 106, 24 and 14 to battery. The magnets 111 operate more quickly than the transfer switch relay so that the circuit is closed through both of the coils 104 and 105 of the relay before it can operate, and its armature is thus held in normal position as long as the first line impulse persists. A circuit is also closed from battery 11 by wires 35 and 110, selected switch 115 to one of the conductors 119, thence by one of the switches 120 to one of the conductors 121 and to either one of the conductors 1, thence by one of the branch conductors 2 to the coil 27 of one of the selecting magnets 25 or 26 and back by the common conductor 29 to one of the opposed coils of the transfer switch relay 23 and back to battery by the conductors 24 and 14. Either magnet 25 or 26 will thus be operated to shift either the set of switches 31 and 32 or the set of switches 33 and 34 to closed position. By the operation of either the magnet 25 or 26 the locking circuit is closed from the battery wire 35 to either the switch 32 or 34, thence by either one of the conductors 36 to the coil 38 of the selected magnet and by the wire 30 to the opposite coil of the transfer switch relay 23 and back as before to the battery by wires 24 and 14. The operation of either the first or second relay by the first line impulse of the signal thus serves to energize either the selecting magnet 25 or the selecting magnet 26 and to close the locking circuit therethrough so that the set of switches operated by either one of these magnets is closed and held in closed position. The first line impulse also acts to close the battery circuit through the opposed coils, both of the transfer switch relay 99 and the transfer switch relay 23 and the armatures of these relays remain in normal position as long as the first line impulse persists. At the cessation of the first line impulse however, the circuit through the coil 104 of the relay 99 is broken by the return of the selected relay armature to normal so that the armature 98 operates to move the switches 97 into engagement with the contacts 94 and change the connection of the main conductors 96 and 96ª from the set of branches 100 and 100ª to the set of conductors 1 and 1ª. At the same time, switches 120 are shifted out of engagement with their contacts so that the circuit through one of the coils of the transfer switch relay 23 is opened while the locking circuit through the other coil remains closed so that the armature of the relay 23 acts to shift the switches 18 to disengage them from the contacts 21 and move them into engagement with the contacts 20. The set of branch conductors 3 are then in connection with the set of main conductors 96 and 96ª and 1 and 1ª, so that the second line impulse will act, as in the manner previously described, to select one of the magnets 45 and close the locking circuit therethrough. At the cessation of the second line impulse as previously described, the transfer switch relay 40 operates to disconnect the branches 3 and connect the branches 4 to the line relays so that the third line impulse will select one of the locking magnets 53 and one of the operating magnets 58, in the manner previously described.

A normally closed unlocking switch in the conductor 35 of the locking circuit is arranged to be opened when any one of the operating magnets 58 is energized. Any suitable arrangement of unlocking switch or switches may be employed. In the form shown, each operating magnet 58 is arranged to shift the type-bar 60 which in turn is arranged to open the unlocking switch 69 so that all parts may return to normal position in readiness to receive the next succeeding signal.

The conductors 96 leading from the first and second line relays may be connected directly to the conductors 1 if desired, thus dispensing with the use of the magnets 111 and switches 120. Other changes may be made without departure from the essentials of the invention.

It will be noted that a set of conductors are employed leading from the line relays and any one of these conductors may be connected to battery by a characteristic line impulse. Several sets of branch conductors are employed, the first set being normally connected to the set of main conductors leading from the selecting relays, so that the first line impulse will serve to close the circuit through one of the first set of branches and operate the selecting magnet therein. At the cessation of the first line impulse the first set of branches are entirely disconnected from the set of main conductors and the second set of branches are connected thereto so that the second line impulse will close the circuit through one of the second sets of branches and operate the selecting magnet therein and close the locking circuit therethrough. Similarly, at the cessation of the second line impulse the transfer switch relay operates to disconnect the second set of branches and connect the third set thereto so that the final selection may be properly effected by closing the circuit through one of the third sets of branches.

By employing the transfer switch mechanism which successively connects and discon-

nects the several sets of branches from the set of main conductors leading from the line relays, impulses of like character may, if desired, follow one another in the same signal or code combination. In this way the number of possible selections is increased over similar selecting systems, or with the same number of selections the arrangement of circuits is simplified and the number of operating magnets required is considerably reduced.

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

1. In printing telegraphs, the combination with the set of main conductors and the sets of branch conductors as described, transfer switches for successively connecting said sets of branch conductors to said set of main conductors, signal operating magnets in the last set of branch conductors, switch operating magnets in each of the other sets of branch conductors and switch contacts in each set controlled by the magnets in the preceding set, substantially as described.

2. In printing telegraphs, the combination with the set of main conductors and the sets of branch conductors as described, transfer switches automatically acting at the cessation of the impulse or change in the condition of the current to successively connect said sets of said branch conductors to said set of main conductors, signal operating magnets in the last set of the series, switch operating magnets in each of the other sets of branches and switch contacts in each set controlled by the magnets of the preceding sets, substantially as described.

3. In printing telegraphs, the combination with the set of main conductors and the sets of branch conductors as described, transfer switches controlled by the flow of current through said conductors and automatically acting at the cessation of the impulse therethrough or change of current therein to successively connect said sets of branch conductors to said set of main conductors, signal operating magnets in the last set of the series, switch operating magnets in each of the other sets of branches and switch contacts in each set controlled by the magnets in the preceding set, substantially as described.

4. In printing telegraphs, the combination with the set of main conductors and the separate sets of branch conductors as described, transfer switches for successively connecting said sets of branch conductors to said set of main conductors, operating relays for said transfer switches having opposed coils included in said conductors and automatically actuating said transfer switches at the cessation of the impulses through said conductors, signal operating magnets in the last set of branch conductors, switch operating magnets in each of the other sets of branches and switch contacts in each set controlled by the magnets in the preceding set, substantially as described.

5. In printing telegraphs, the combination with the set of main conductors, the sets of branch conductors and means for selectively controlling the flow of current therethrough, of signal operating magnets in the last set of branch conductors, switch operating magnets in each of the other sets of branches and switch contacts in each set controlled by the magnets of the preceding set, substantially as described.

6. In printing telegraphs, the combination with the set of main conductors and the sets of branch conductors as described, of a line circuit, means operated thereby for selectively controlling the flow of current through said main and branch conductors, signal operating magnets in the last set of branch conductors, switch operating magnets in each of the other sets of branches and switch contacts in each set controlled by the magnets in the preceding set, substantially as described.

7. In printing telegraphs, the combination with the set of main conductors and separate sets of branch conductors, of a line circuit, relays operated thereby for selectively controlling the flow of current through said main conductors, transfer switches automatically actuated by the flow of current through the main and branch conductors for successively connecting said sets of branch conductors to said sets of main conductors, signal operating magnets in the last set of branch conductors, switch operating magnets in each of the other sets of branches and switch contacts in each set controlled by the magnets in the preceding set, substantially as described.

8. In printing telegraphs, the combination with the set of local main conductors and the separate sets of local branch conductors as described, of a line circuit, means actuated thereby for selectively controlling the flow of current through said local main and branch conductors, signal operating magnets in the last set of the series, switch operating magnets in each of the other sets of branches, switch contacts in each set controlled by the magnets in the preceding set and a locking switch controlled by each of said magnets for maintaining its circuit in closed condition independently of said main conductors, substantially as described.

9. In printing telegraphs, the combination with the set of local main conductors and the separate sets of local branch conductors as described, of a line circuit, means actuated thereby for selectively controlling the flow of current through the local main and branch conductors, signal operating magnets in the last set of the series, switch operating magnets in each of the other sets of

branches, switch contacts in each set controlled by the magnets in the preceding set, a locking switch controlled by each of said magnets for maintaining its circuit in closed condition independently of the flow of current through said main conductors and a set of locking magnets in the last set of branch conductors for maintaining the flow of current therethrough independently of said main conductors, substantially as described.

10. In printing telegraphs, the combination with the set of local main conductors and the separate sets of local branch conductors as described, of a line circuit, means actuated thereby for selectively controlling the flow of current through said local main and branch conductors, signal operating magnets in the last set of the series, switch operating magnets in each of the other sets of branches, switch contacts in each set controlled by the magnets in the preceding set, a locking switch controlled by each of said magnets and a set of locking magnets in the last set of branch conductors for maintaining the flow of current independently of said main conductors and means controlled by each of said signal operating magnets for opening the circuit of said switch operating magnets and of said locking magnets, substantially as described.

11. In printing telegraphs, the combination with the set of main conductors and the three sets of branch conductors, of transfer switch mechanism for successively connecting said sets of branch conductors to said sets of main conductors, signal operating magnets in the third set of branch conductors, switch operating magnets in the first and second sets of branch conductors and switch contacts in each set controlled by the magnets in the preceding set, substantially as described.

12. In printing telegraphs, the combination with the set of local main conductors and the three sets of local branch conductors, of a line circuit, means operated thereby for selectively controlling the flow of current through said local main and branch conductors, signal operating magnets in the third set of branch conductors, switch operating magnets in the first and second sets of branch conductors and switch contacts in each set controlled by the magnets in the preceding set, substantially as described.

13. In printing telegraphs, the combination with the set of local main conductors and the three sets of local branch conductors, of a line circuit, means operated thereby for selectively controlling the flow of current through said main conductors, transfer switch mechanism automatically controlled by the flow of current through said local main and branch conductors for successively connecting said sets of branch conductors to said sets of main conductors, signal operating magnets in the third set of the series, switch operating magnets in the first and second sets of branches and switch contacts in the second and third sets of branches controlled by the magnets in the preceding sets, substantially as described.

14. In printing telegraphs, the combination with the set of local main conductors and the three sets of local branch conductors, of a line circuit, means operated thereby for selectively controlling the flow of current through said main and branch conductors, signal operating magnets in the third set of branch conductors, switch operating magnets in the first and second sets of branch conductors, switch contacts in the second and third sets controlled respectively by the magnets in the first and second sets and a locking switch controlled by each of said magnets for maintaining the flow of current therethrough independently of said main conductors, substantially as described.

15. In printing telegraphs, the combination with the set of local main conductors and the three sets of local branch conductors, of a line circuit, means operated thereby for selectively controlling the flow of current through said main and branch conductors, signal operating magnets in the third set of branch conductors, switch operating magnets in the first and second sets of branch conductors, switch contacts in the second and third sets controlled respectively by the magnets in the first and second sets, a locking switch controlled by each of said magnets for maintaining the flow of current therethrough independently of said main conductors, a locking magnet in each branch conductor of the third set for maintaining the flow of current therethrough independently of said main conductors and means controlled by each of said signal operating magnets for opening the circuit through said branch conductors, substantially as described.

16. In printing telegraphs, the combination with the set of main conductors and the separate sets of branch conductors, of transfer switch mechanism for automatically and successively connecting said sets of branch conductors to said set of main conductors, type controlling magnets in the last set of branch conductors, magnets in the other sets of branch conductors, controlling switch contacts in the succeeding branches and printing mechanism including a shiftable element operated by certain of said magnets, substantially as described.

17. In a printing telegraph, the combination with the set of main conductors and separate sets of branch conductors, of transfer switch mechanism controlled by the flow of current through said conductors for automatically and successively connecting said

separate sets of branch conductors to said set of main conductors, a line circuit, means operated thereby for selectively controlling said main and branch conductors, type operating magnets in the last set of branch conductors, selecting magnets in the other sets of branches each controlling switch contacts in the succeeding sets and printing mechanism including a shiftable element actuated by certain of said magnets, substantially as described.

18. In printing telegraphs, the combination with the set of main conductors and separate sets of branch conductors, of means selectively controlling the flow of current through said conductors, type operating magnets in the last set of branch conductors, selecting magnets in the other sets of branch conductors each controlling switch contacts in the succeeding sets, a locking circuit controlled by said magnets, printing mechanism including a shiftable element controlled by certain of said magnets and means controlled by said type operating magnets and said shifter operating magnets for opening said locking circuit, substantially as described.

19. In printing telegraphs, the combination with the set of main conductors, separate sets of branch conductors and means for selectively controlling the flow of current therethrough, of type operating magnets in the last set of branch conductors, selecting magnets in the other sets controlling the flow of current through said type operating magnets, printing mechanism including a shiftable element controlled by certain of said magnets, a locking circuit controlled by each of said selecting magnets for maintaining the flow of current independent of said main conductors and means operated by said type operating magnets for opening said locking circuit substantially as described.

20. In printing telegraphs, the combination with the set of main conductors, separate sets of branch conductors and means for selectively controlling the flow of current therethrough, of type operating magnets in the last set of branch conductors, selecting magnets in the other sets controlling the flow of current through said type operating magnets, printing mechanism including a movable element spring-held in central position, shifter mechanism controlled by certain of said magnets for moving said element in opposite direction from normal, a locking circuit controlled by said selecting magnets and means controlled by said type operating magnets for opening said locking circuit, substantially as described.

21. In printing telegraphs, the combination with the set of main conductors, separate sets of branch conductors and means for selectively controlling the flow of current therethrough, of type operating magnets in the last set of branch conductors, selecting magnets in the other sets controlling the flow of current through said type operating magnets, printing mechanism including a movable element, shifters operated by certain of said operating magnets for moving said element to different positions from normal, means for locking said element in any one of its shifted positions and devices controlled by certain other of said operating magnets for releasing said locking means, substantially as described.

22. In printing telegraphs, the combination with the set of main conductors, separate sets of branch conductors and means for selectively controlling the flow of current therethrough, of type operating magnets in the last set of branch conductors, selecting magnets in the other sets controlling the flow of current through said type operating magnets, printing mechanism including a shiftable element spring-held in central position, shifter mechanism controlled by certain of said operating magnets for moving said element in opposite direction from normal, means for locking said element in shifted position, means operated by certain other of said operating magnets for releasing said locking means, a locking circuit controlled by said selecting magnets and means operated by said type operating, and said locking releasing magnets for opening said locking circuit, substantially as described.

23. In printing telegraphs, the combination with a selective apparatus acting in response to the varied code combinations or signals, of shifter mechanism movable to different positions from normal and acting in response to special signals or code combinations, means for automatically locking said mechanism in any one of its shifted positions and means acting in response to another special signal for releasing said locking means, substantially as described.

24. In printing telegraphs, the combination with the selectively controlled printing devices acting in response to the varied code combinations or signals, of shifter mechanism coöperating with said printing devices, said shifter mechanism being yieldingly spring-held in central position and movable in opposite direction from normal, means acting in response to special signals or code combinations for operating said shifter mechanism, means for automatically locking said mechanism in either of its shifted positions and means acting in response to another special signal for releasing said locking means, substantially as described.

25. In printing telegraphs, the combination with the set of main conductors and the three sets of branch conductors, means for selectively controlling the flow of current through said conductors, switch mechanism

for successively connecting said sets of branch conductors to said set of main conductors, operating magnets in the last set of branch conductors, selecting magnets in the other sets of branch conductors controlling the flow of current through said operating magnets, printing devices controlled by certain of said operating magnets and a shiftable element coöperating with said printing devices and controlled by certain other of said operating magnets, substantially as described.

26. In printing telegraphs, the combination with the set of main conductors and the three sets of branch conductors, means for selectively controlling the flow of current through said conductors, switch mechanism for successively connecting said sets of branch conductors to said set of main conductors, operating magnets in the last set of branch conductors, selecting magnets in the other sets of branch conductors controlling the flow of current through said operating magnets, printing devices controlled by certain of said operating magnets, a shiftable element coöperating with said printing devices and means controlled by two of said operating magnets for moving said shiftable element to different positions from normal, substantially as described.

27. In printing telegraphs, the combination with the set of main conductors and the three sets of branch conductors, a line circuit, means controlled by said line circuit for selectively controlling the flow of current through said conductors, switch mechanism for successively connecting said sets of branch conductors to said set of main conductors, operating magnets in the last set of branch conductors, selecting magnets in the other sets of branch conductors controlling the flow of current through said operating magnets, printing devices controlled by certain of said operating magnets, a shiftable element coöperating with said printing devices and controlled by certain other of said operating magnets, means for operating said element in shifted position and means controlled by another of said operating magnets for releasing said lock, substantially as described.

28. In printing telegraphs, the combination with the set of main conductors and the three sets of branch conductors, a line circuit, means controlled by said line circuit for selectively controlling the flow of current through said conductors, switch mechanism for successively connecting said sets of branch conductors to said set of main conductors, operating magnets in the last set of branch conductors, selecting magnets in the other sets of branch conductors controlling the flow of current through said operating magnets, printing devices controlled by certain of said operating magnets, a shiftable element coöperating with said printing devices and controlled by certain of said operating magnets, a locking circuit controlled by said selecting magnets and means controlled by each of said operating magnets for opening said locking circuit, substantially as described.

29. In printing telegraphs, the combination with the set of main conductors and the three sets of branch conductors, a line circuit, means controlled by said line circuit for selectively controlling the flow of current through said conductors, switch mechanism for successively connecting said sets of branch conductors to said set of main conductors, operating magnets in the last set of branch conductors, selecting magnets in the other sets of branch conductors controlling the flow of current through said operating magnets, printing devices controlled by certain of said operating magnets, a shiftable element coöperating with said printing devices and controlled by certain of said operating magnets, means for automatically locking said element in shifted position, means controlled by another of said operating magnets for releasing said lock, a locking circuit controlled by said selecting magnets and means controlled by each of said operating magnets for opening said locking circuit, substantially as described.

30. In printing telegraphs, the combination with the set of main conductors and the three sets of branch conductors, a line circuit, means controlled by said line circuit for selectively controlling the flow of current through said conductors, switch mechanism for successively connecting said sets of branch conductors to said set of main conductors, operating magnets in the last set of branch conductors, selecting magnets in the other sets of branch conductors controlling the flow of current through said operating magnets, printing devices controlled by certain of said operating magnets, a shiftable element coöperating with said printing devices and spring-held in central position, said element being movable in opposite direction from normal by two of said operating magnets, means for automatically locking said element in shifted position, means actuated by another of said operating magnets for releasing said lock, a locking circuit controlled by said selecting magnets and means controlled by each of said operating magnets for opening said locking circuit, substantially as described.

CHARLES L. KRUM.

Witnesses:
LILLIAN PRENTICE,
KATHERINE GERLACH.