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AUTOMATIC TELEGRAPH REPEATER

Filed June 30, 1920

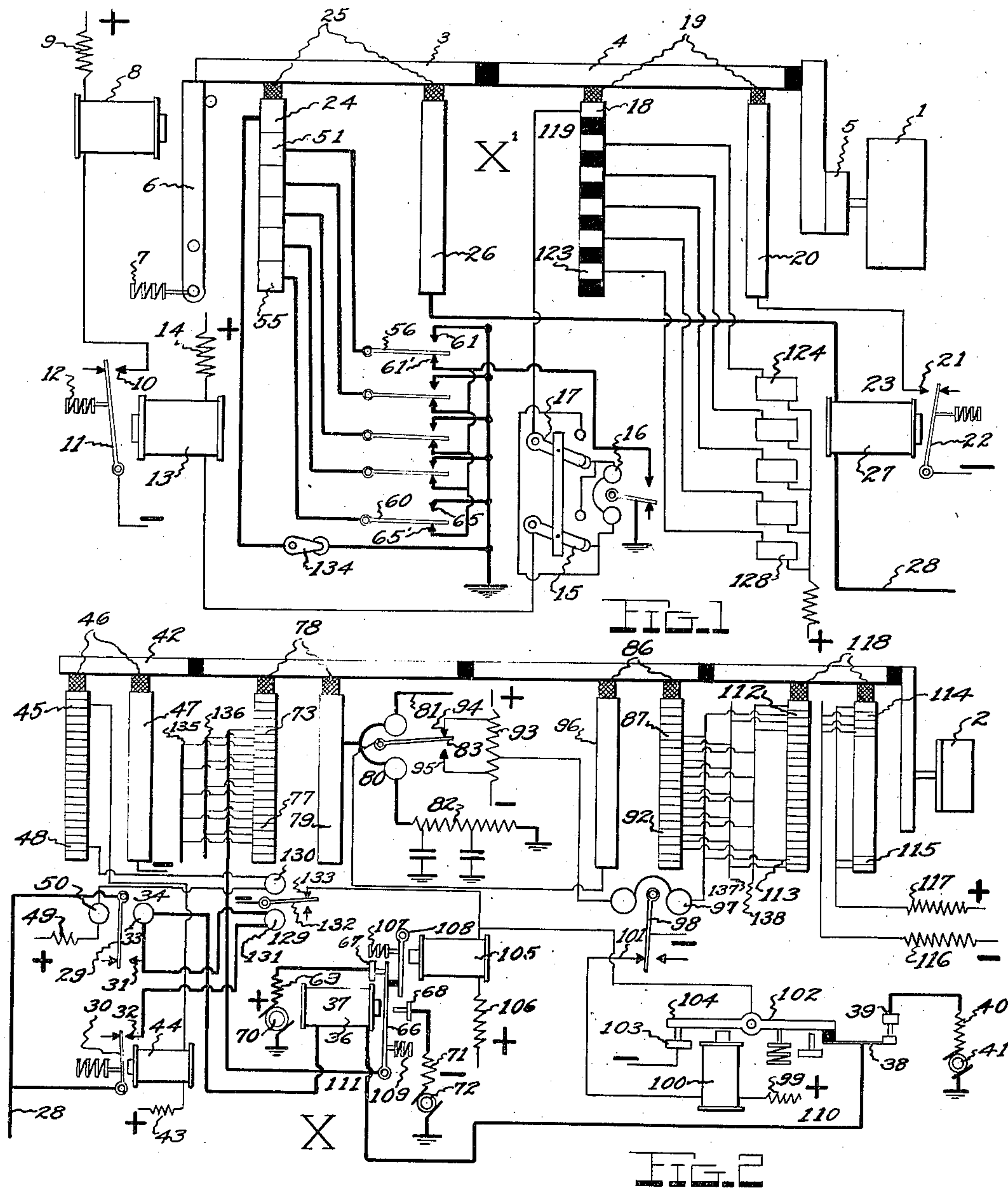


FIG. 1

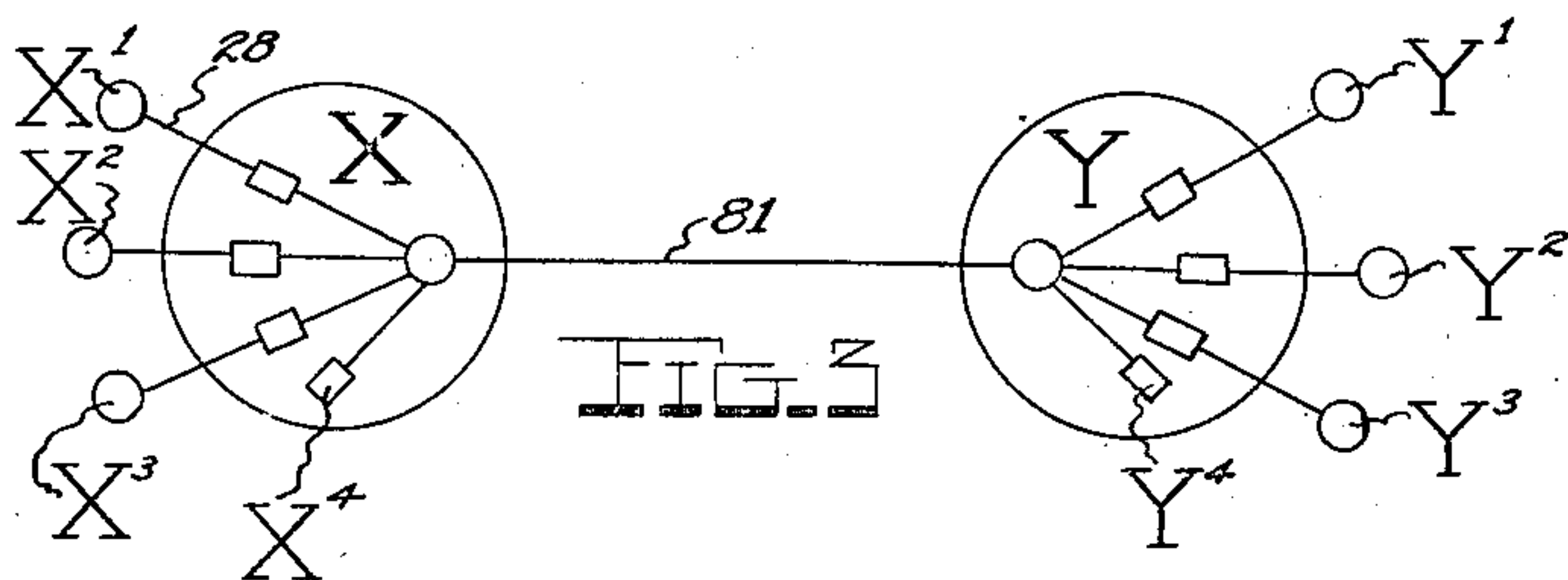


FIG. 2

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UNITED STATES PATENT OFFICE.

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AUTOMATIC TELEGRAPH REPEATER.

Application filed June 30, 1920. Serial No. 392,921.

To all whom it may concern:

Be it known that I, LOUIS M. POTTS, a citizen of the United States of America, residing at Baltimore, State of Maryland, have invented certain new and useful Improvements in Automatic Telegraph Repeaters, of which the following is a specification.

This invention relates to telegraph systems.

10 An object of the invention is to provide a system whereby a plurality of telegraph messages originating at separate stations may be transmitted over a plurality of branch lines or extension circuits to main
15 or central stations where synchronous multiplex apparatus is located, the central stations being connected by a line conductor equipped for duplex operation, and the synchronous multiplex apparatus being provided with means to prevent simultaneous
20 transmission and reception of message impulses over said line conductor.

The invention provides synchronous multiplex apparatus at the central stations with
25 means associated therewith such as a Morse or half repeater for transmitting message impulses over the line conductor in but one direction at a time.

The term "half duplex" as used herein means, as distinguished from full duplex
30 operation, the transmission of message impulses in only one direction at a time over a line conductor provided for duplex operation.

35 The invention will be described with reference to the following drawings:

Figure 1 shows the wiring of a substation.

Figure 2 shows the wiring at a central station for a single channel of a multiplex.

40 Figure 3 is a schematic diagram showing how a multiplex may be distributed to different users.

Refer to Figure 3, X and Y are central stations connected by a main line 81, which
45 is duplexed and operated by synchronous multiplex apparatus. Branch offices X¹, X² and X³ and Y¹, Y² and Y³ are connected to corresponding centrals by lines operated by a start-stop telegraph in simplex and

communication can take place between corresponding substations at the two ends of the main line in either direction at will. "Half repeaters" are located at each substation for each branch office and the repeating of all elements of the signals for each circuit takes
55 place through the same relay.

At the branch office X¹ Figure 1 there is driving means 1 which includes some sort of speed governing device and at the central station X there is also power means 2, which
60 also includes some sort of speed regulating means. At the other central station Y there would also be power means similar to 2. One or the other of power means 2 would also include some means of synchronizing
65 the devices at the two ends of the line. At the other branch office Y¹ there would be power means with speed regulating means similar to 1. The speed regulation of the power means 1 being so adjusted that the
70 trailer brushes at the substation will pass from the centre of one segment to the centre of the next succeeding segment, while the trailer brushes at the central station are moving from the centre of one segment to the centre
75 of the third following segment. The governing devices 1 and 2 may be of any number of well known types. I have shown one kind in my copending application Serial No. 286,540.

Power means 1 drives brush arms 3 and 4 through a friction clutch 5, brush arms 3 and 4 may be prevented from moving by pivoted arm 6 which is held in the position shown in Figure 1 by spring 7. Arm
85 6 is adapted to be operated by a magnet 8. The circuit of magnet 8 may be traced as follows: positive supply main, resistance 9, magnet 8, contact 10, tongue 11, to negative. Tongue 11 is held away from contact
90 10 by spring 12, but is adapted to make contact with contact 10 when magnet 13 is energized. The circuit of magnet 13 may be traced as follows: positive supply main, resistance 14, magnet 13, switch arm 15, coils
95 16, switch arm 17, segment 18, trailer brushes 19, collecting ring 20, contact 21 and tongue 22 of main line relay 23, to negative. The

circuit of main line relay 23 may be traced as follows: ground, switch 134, segment 24, trailer brushes 25, collecting ring 26, coil 27 of relay 23, branch line 28, tongue 29 or 30, contact 31 or 32 (depending upon conditions later described), coil 33 of polarized relay 34, coil 36 of relay 37, contact 38, contact 39, resistance 40, generator 41, to ground. Power means 2 rotates brush arm 42 continuously and in each revolution of brush arm 42 an impulse will be sent over the following circuit: positive supply main, resistance 43, coil 44, segment 45, brushes 46, collecting ring 47, to negative, contacts 30—32 will be closed momentarily and the branch line circuit 28 will be closed, as above traced, through the coil 33 of polarized relay 34 and contacts 29—31 will be closed and will remain closed even after the trailer brush 46 has passed over segment 45 and will remain closed until trailer brush 46 reaches segment 48 when an impulse will be transmitted over a circuit as follows: positive supply main, resistance 49, coil 50 of polarized relay 34, coil 130 of relay 129, segment 48, trailer brush 46, collecting ring 47, to negative, and contacts 29—31 will again be opened ready for a repetition of the same process for the next signal. Whenever contacts 30—32 are so closed contacts 21—22 are also closed and magnet 13 is energized over a circuit as traced above. Contacts 10—11 are closed, magnet 8 is energized over a circuit as traced above, arm 6 is disengaged from trailer arm 3 and trailer arm 3 is allowed to rotate and an impulse will be transmitted on the branch line 28 as long as trailer brush 25 remains on segment 24. Segments 51 to 55 are connected to movable contacts 56 to 60 which form part of some kind of either automatic or keyboard transmitting mechanism, which is not described here as it forms no part of the present invention. Each of the tongues 56 to 60 are adapted to engage stationary contacts 61 to 65 or 61' to 65', according to the way in which the movable contacts 56 to 60 are set, and successive signals will be transmitted on branch line 28, each signal comprising a starting impulse and five code impulses varying in combinations. At the central station coil 36 will be energized by these impulses and tongue 66 will be vibrated between contacts 67 and 68 according to the impulses transmitted over the branch line 28. Contact 67 is connected through resistance 69 to the positive pole of generator 70 to ground, while contact 68 is connected through resistance 71 to negative pole of generator 72 to ground. Tongue 66 is connected to a group of five segments 73 to 77, consecutive segments being separated by two segments belonging to some other group not concerned with the transmission being described. As brush arm 42 rotates trailer brushes 78

will successively pass over segments 73 to 77 at a time when tongue 66 is under the control of a corresponding one of the segments 51 to 55 at the substation and each of the segments 73 to 77 will transmit an impulse positive or negative according to the setting of the movable contacts 56 to 60 at the substation. These impulses are transmitted over a circuit which may be traced as follows: generator 70 or 72, resistance 69 or 71, contact 67 or 68, tongue 66, segments 73 to 77, trailer brushes 78, collecting ring 79 and there dividing through the duplex windings of polarized relay 80 to the main line 81 and the artificial line 82 to ground and return. The real line 81 of course being connected at the other central station to apparatus similar to that shown in Figure 2. The signals transmitted over the main line as described above have no effect on the tongue 83 of polarized relay 80, according to the well known polar duplex method.

The transmission of signals from central to the substation will now be described. When receiving at the substation the switch arms 15 and 17 may be thrown to the other position or similar results may be obtained by closing all of the contacts 56 to 60—61 to 65, it being necessary to have the line permanently closed at the substation. The coils of polarized relay 16 are so connected that when it receives the impulse initiated by the closure of contacts 29—31 and switch arms 15 and 17 are down it will receive an impulse pulling it to its back stop, as shown in Figure 1. However, when the switch arms 15 and 17 are moved to the other position the coils of relay 16 are reversed and the tongue of relay 16 will be moved in the opposite direction with the closure of contacts 29—31 and all the back contacts 61—65 will be grounded so that branch line 28 will be grounded through relay coil 27 no matter on what segment brushes 25 may be.

At the distant substation Y¹ there is transmitting apparatus identical with that shown in Fig. 1 and at the distant central Y apparatus similar to that at X. Signals are transmitted from substation Y¹ to central Y and there automatically repeated by a "half repeater" to the main line 81 and control the tongue 83 of main line relay 80 when trailer brush 86 is passing over segments 87—92, and when trailer brush 86 is passing over other segments tongue 83 is under the control of other apparatus not shown.

Segments 87 to 92 are grouped in a manner exactly corresponding to the group of segments 73 to 77 so that positive or negative impulses will be transmitted over a circuit traced as follows: positive or negative supply main, resistance 93, contact 94 or 95, tongue 83, collecting ring 96, trailer brushes 86, segments 87 to 92, coils of polarized relay 97, resistance 93 to negative or

positive, and relay tongue 98 will receive successive impulses corresponding to the impulses transmitted from a group of segments at the distant substation corresponding to segments 73 to 77. These impulses will be separated by a time interval during which polarized relay 97 will not be under the control of relay tongue 83, but tongue 98 will remain in the position last placed so that it will repeat exactly the movements of a tongue similar to tongue 66 located at the distant central and will transmit, over a circuit traced as follows: positive supply main, resistance 99, coil 100, contact 101, tongue 98 to negative, impulses corresponding to the code impulses transmitted over the distant branch line. The impulses transmitted through coil 100 will be three times as long as those transmitted over main line 81. Magnet 100 will be energized and lever 102 will move accordingly and in so doing will open and close contacts 38—39 in a manner corresponding to the movements of a tongue at the distant central similar to tongue 66 and there will be repeated into branch line 28 impulses exactly like those transmitted over the distant branch line. The signals transmitted by contacts 38—39 also pass through coil 36 the same as signals transmitted from the branch office, but these are not transmitted back into the main line since contacts 103—104 open slightly ahead of contacts 38—39 and open the circuit of the magnet 105, which may be traced as follows: positive supply main, resistance 106, coil 105, contact 104, contact 103, to negative. The deenergization of magnet 105 will allow spring 107 to draw arm 108 against tongue 66 and maintain the contacts 66—67 closed so that no signals will be transmitted over the main line, since spring 107 is stronger than spring 109.

Relays 110 and 111 together with the proper wiring are one form of what is known as a "half repeater." This form has only been used to illustrate the method, but it must be understood that other forms of half repeaters can be connected in a similar manner, and I do not wish to be understood as limiting myself to any particular form of half-repeater.

Attention is called to the fact that relay 97 is controlled only during the interval when the five elements of the code are being transmitted. As far as the connections so far described are concerned relay tongue 98 will stay on whichever side it is placed by the fifth code impulse until it receives the first impulse of the next signal, and the transmission of the start impulse would be interfered with. To control relay 97 during this interval the coils 97 are connected to segments 112 and 113 and segments 114 and 115 are connected through resistances 116 and 117 to — and + respectively. At

each revolution of brushes 118 over segment 115, a positive impulse will be sent through relay coil 97 and contacts 98—101 will be opened in the interval between the transmission of the five code impulse and the start impulse of the next signal. And a negative impulse will be sent to coil 97 when brush 118 passes over segment 114 and contacts 98—101 will be closed and transmit a start impulse on the branch line 28.

The signals transmitted on branch line 28 by contacts 38—39 operate relay 23 at the branch office and contacts 21—22 are closed in a similar manner. The first impulse of the series and controlled by segments 45 and 48 starts arms 3 and 4 into rotation just as described in connection with the transmission from the branch office. As trailer brushes 19 rotate they successively engage segments 119—123 and successively connect coils 124—128 to contact 21 and coils 124—128 will be energized in combinations according to the impulses received by coil 27. Coils 124—128 may be the coils of any suitable recording machine, such as that, for example, described in my U. S. Patent Serial No. 1,309,745.

The device is operative without the relays 34 and 44 as segments 113 and 115 serve to open the branch line between succeeding signals and close it again to send the start impulse for the next signal whether the transmission is from the branch office or from central. Relays 34 and 44 also perform this function and may be omitted, especially if automatic transmission is used from the branch office. The relays 34 and 44 keep the line open for the interval occupied in sending the five code impulses if the branch line is open at another point and when the line is again closed the branch office machine will not start until brush 46 reaches segment 45 and it will then be in the correct phase position. If relays 34 and 44 are omitted the branch line may be closed by contacts 38—39 during the transmission of the five code impulses and the branch office machine would start as soon as the line is closed at another open point and the machine would not be in its correct phase position and several wrong characters would likely be received before the correct phase position would be automatically attained.

A polarized relay 129 is provided to assist in "breaking" the transmission from the distant branch office. The "break" is an important element of single Morse working, by it is meant the ability of an operator by opening the line to stop the distant operator from sending. By this means corrections or enquiries can be made at once. Without relay 129 one substation operator may "break" the distant operator, but the "break" may merely cause errors and not

completely stop the operator from sending, while by the use of relay 129 the "break" is instantly effective. Coil 130 of relay 129 is connected in series with coil 50 and receives an impulse pulling its tongue to its back stop each time trailer brush 46 passes over segment 48. Coil 131 is connected in series with front contact 32 so that each time trailer brush 46 passes over segment 45 tongue 132 will be pulled to its back contact, provided branch line 28 is closed. If branch line 28 is open tongue 132 will remain permanently against its front contact 133. Tongue 132 is connected to — and contact 133 connected to one terminal of coil 105 the other terminal of which connects through resistance 106 to +. When tongue 132 is against contact 133 coil 105 will receive current and arm 108 will be attracted and tongue 66 will move to its back contact 68, since line 28 is open whenever tongue 132 touches contact 133. When the operator at X^1 desires to "break" the operator at Y^1 , operator at X^1 opens switch 134, which in turn closes contacts 132—133 as above described, allows contacts 66—68 to close and transmit on the main line impulses which will cause the relay corresponding to 97 to open its contacts which will in turn open the distant branch line at contacts corresponding to contacts 38—39. Operator at Y^1 will then throw his switch arm corresponding to 15 and 17 to receiving position and operator at X^1 will then close his switch 13 and can then transmit to Y^1 .

The groups of segments 135, 136, 137 and 138 may be used in a manner similar to groups 73—77 and 87—92 for communication to branches X^2 and X^3 . The remaining segments not included in any of these groups may be used for any purpose desired.

What I claim is:

1. In a telegraph system, in combination a main line, a branch line, selective telegraph apparatus started into operation at the beginning of each signal and automatically stopped at the end of each signal operable over said branch line, synchronous multiplex telegraph apparatus operable over said main line, and a single line Morse repeater adapted to repeat automatically from said branch line to one channel of said multiplex or from one channel of said multiplex to said branch line.

2. In a telegraph system, in combination a main line, a branch line, selective telegraph apparatus started into operation at the beginning of each signal and automatically stopped at the end of each signal operable over said branch line, synchronous multiplex telegraph apparatus operable over said main line, and a single line Morse repeater adapted to repeat automatically from said branch line to one channel of said multiplex or from one channel of said mul-

tiplex to said branch line, and means to cause said branch line selective apparatus to start into operation with a definite time relation to said synchronous apparatus.

3. In a telegraph system, a plurality of stations, synchronous multiplex apparatus located at two of said stations, a line conductor equipped for duplex operation connecting said stations, a start-stop system extending from one of said stations to a distant station, transmitting and receiving means associated with said start-stop system, and means separate and distinct from said synchronous multiplex apparatus but individual thereto for preventing the simultaneous reception and transmission of code combinations of signaling impulses over said line conductor.

4. In combination, a plurality of stations, synchronous multiplex apparatus located at two of said stations, a line conductor equipped for duplex operation connecting said apparatus, a start-stop system extending from one of said stations to a distant station, transmitting and receiving means associated with said start-stop system, and means associated with said synchronous multiplex apparatus for permitting of only half duplex service between the stations at which said synchronous apparatus is located.

5. In combination, a plurality of stations, synchronous multiplex apparatus located at two of said stations, a line conductor equipped for duplex operation connecting said second mentioned stations, a start-stop system extending from one of said stations to a distant station, transmitting and receiving means associated with said start-stop system, and repeating means individual to said synchronous multiplex apparatus for providing half duplex service between the stations at which said synchronous apparatus is located.

6. In a telegraph system, a main line, synchronous multiplex telegraph apparatus operable in duplex over said main line, a branch line, telegraph apparatus operable in simplex over said branch line, means to repeat from the simplex apparatus on the branch line to one channel of the multiplex, means to repeat from another channel of the multiplex to the simplex apparatus on the branch line, and means controlled by the direction of transmission of impulse for preventing the operation of the first repeating means when signals are being repeated into the branch line by the second repeating means.

7. In a telegraph system, a main line, synchronous multiplex telegraph apparatus operable in duplex over said main line, a branch line, telegraph apparatus operable in simplex over said branch line, means to repeat from the simplex apparatus on the

branch line to one channel of the multiplex, means to repeat from another channel of the multiplex to the simplex apparatus on the branch line, and means to prevent the operation of the first repeating means when signals are being repeated into the branch line by the second repeating means, and means operable at will located at the distant end of the branch line to disable the third mentioned means. 10

In testimony whereof I affix my signature.

LOUIS M. POTTS.