Oct. 24, 1944. B. D. WILLIS 2,361,342

TELEGRAPH SYSTEM

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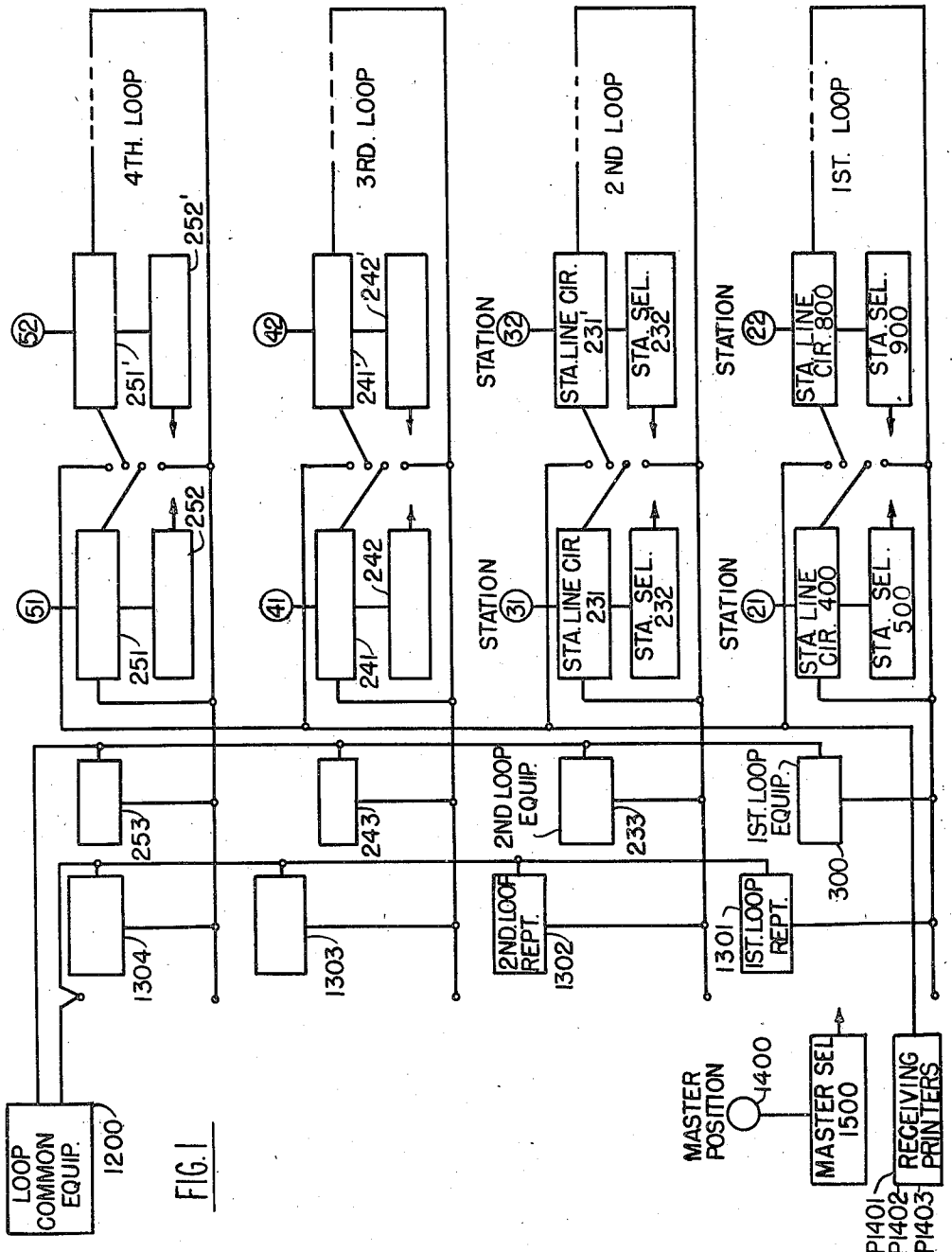


FIG. 1

INVENTOR.
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Wm. WALTER OWEN, Executor
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Davis, Lindsey, Smith & Shontz

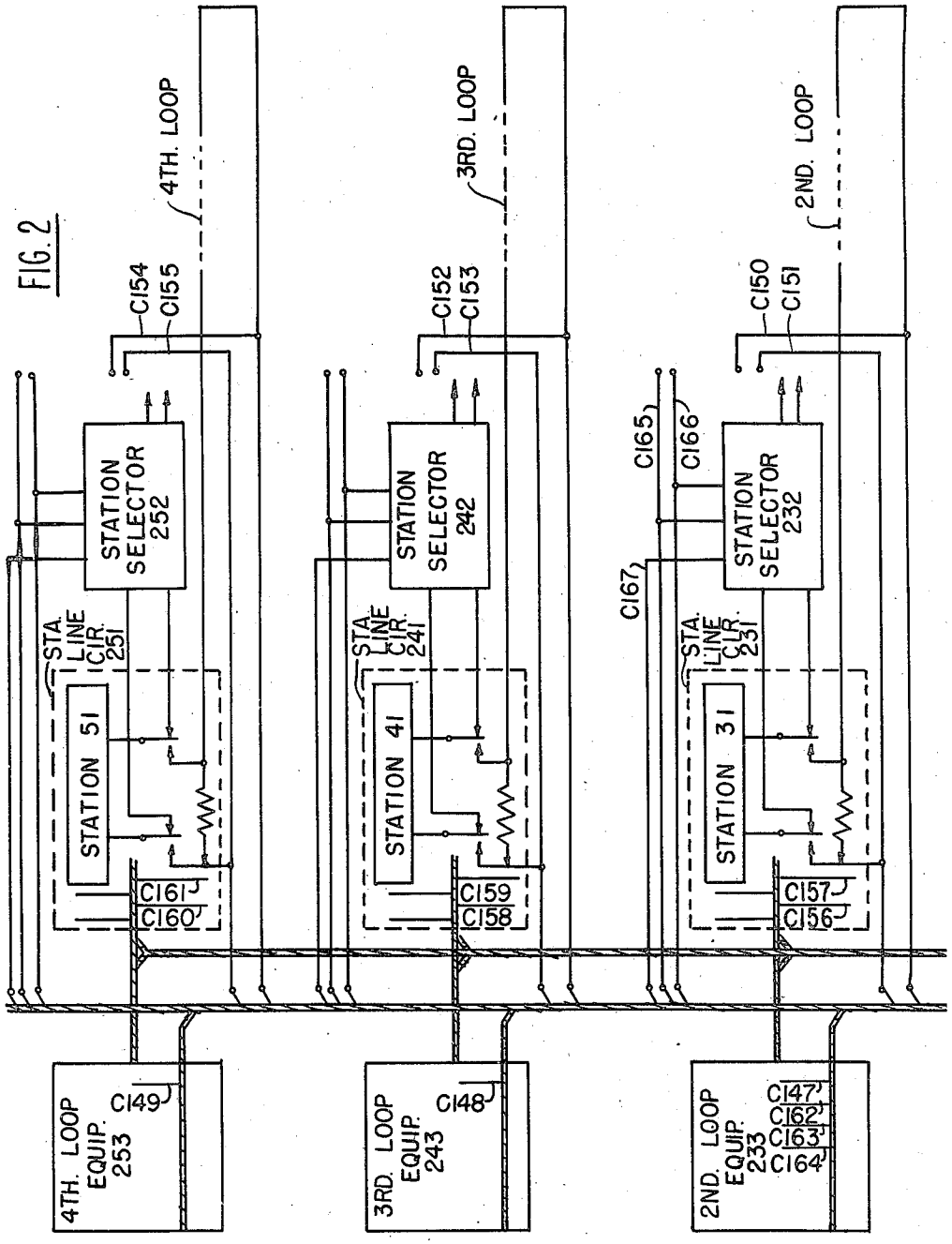
ATTORNEYS

Oct. 24, 1944. B. D. WILLIS 2,361,342

TELEGRAPH SYSTEM

Filed March 6, 1942 17 Sheets-Sheet 2

FIG. 2



INVENTOR.
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Oct. 24, 1944. B. D. WILLIS 2,361,342

TELEGRAPH SYSTEM

Filed March 6, 1942 17 Sheets-Sheet 3

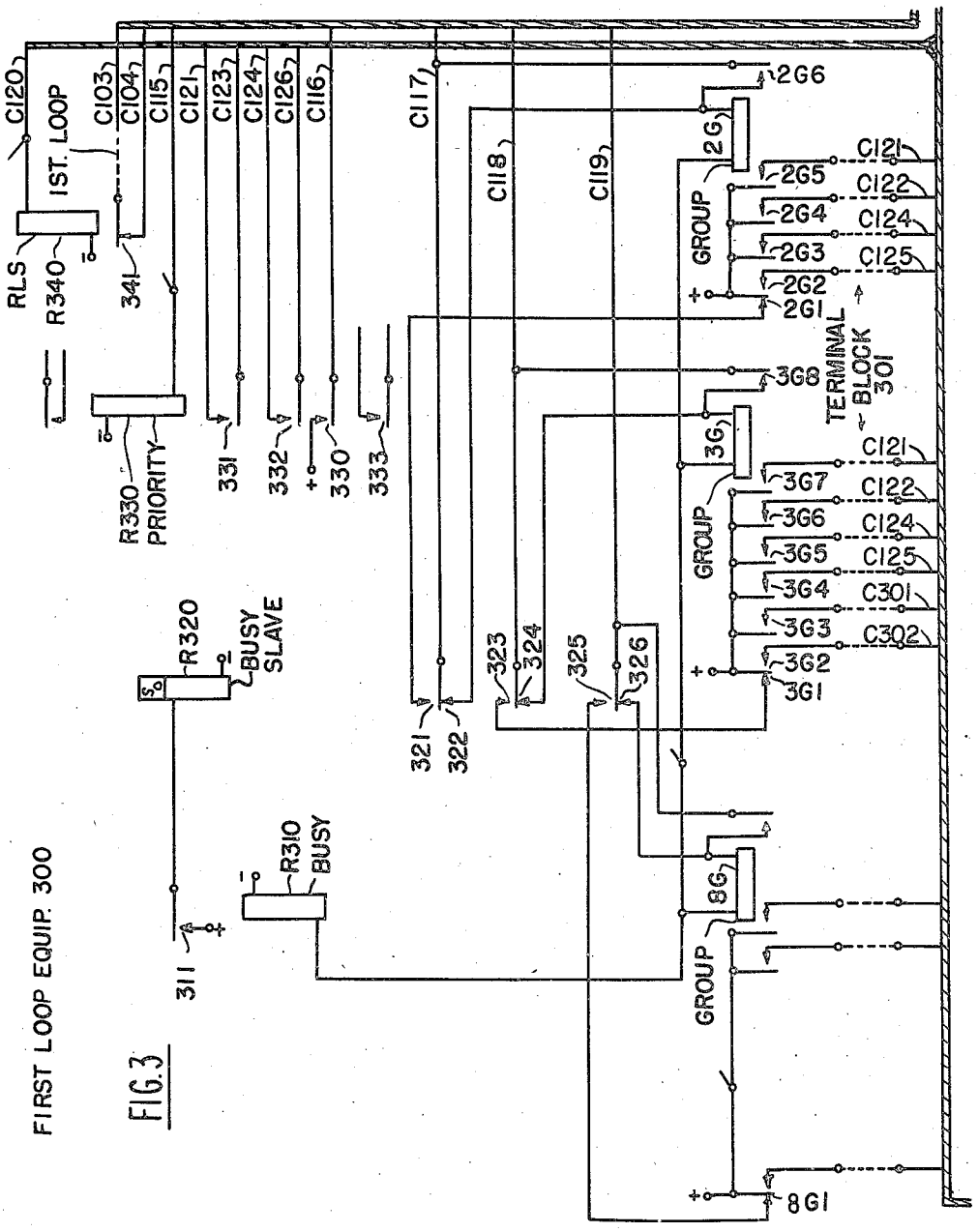


FIG. 3

INVENTOR.
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Oct. 24, 1944. B. D. WILLIS 2,361,342

TELEGRAPH SYSTEM

Filed March 6, 1942 17 Sheets-Sheet 4

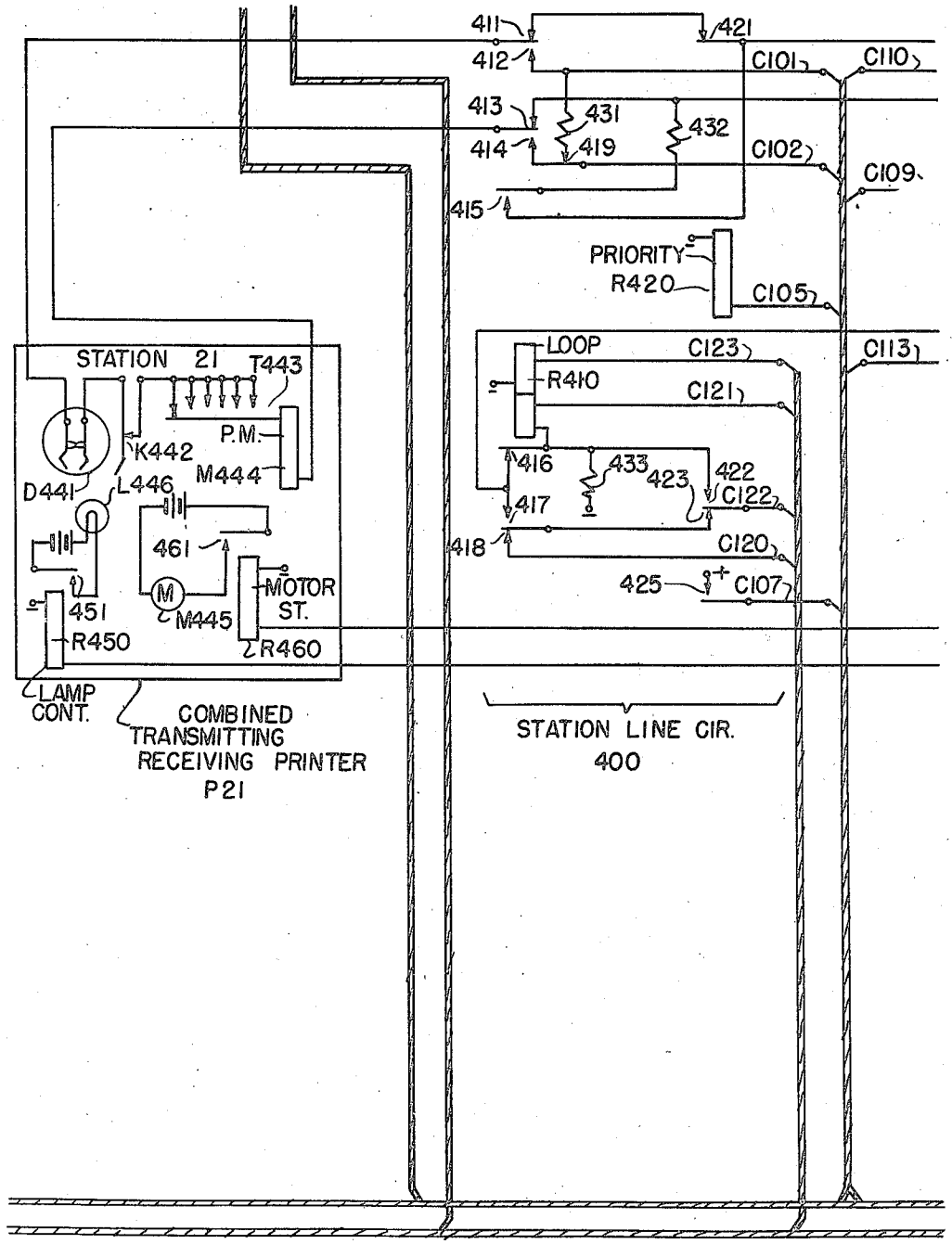


FIG. 4

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Oct. 24, 1944. B. D. WILLIS 2,361,342

TELEGRAPH SYSTEM

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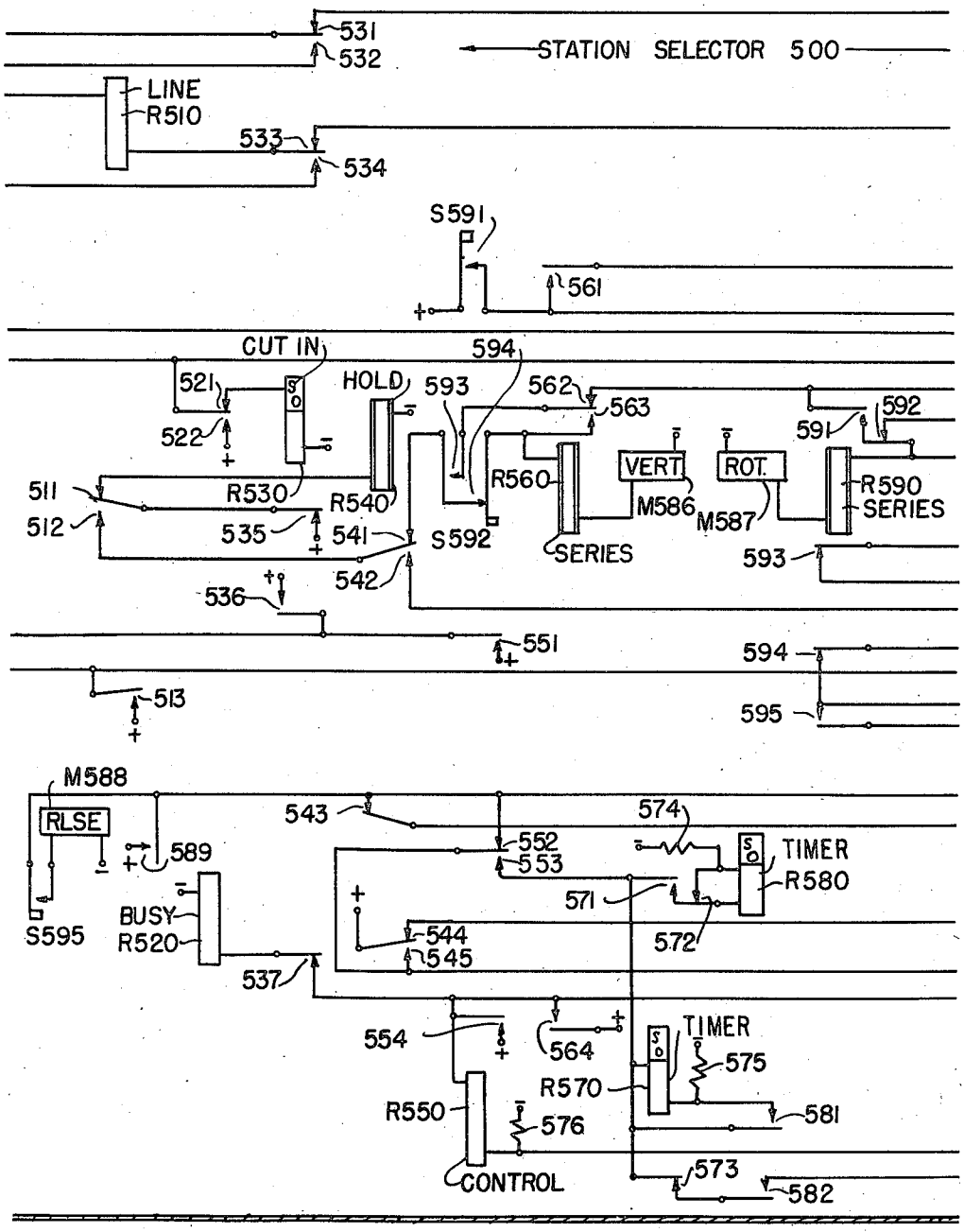


FIG. 5

INVENTOR.
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Oct. 24, 1944. B. D. WILLIS 2,361,342

TELEGRAPH SYSTEM

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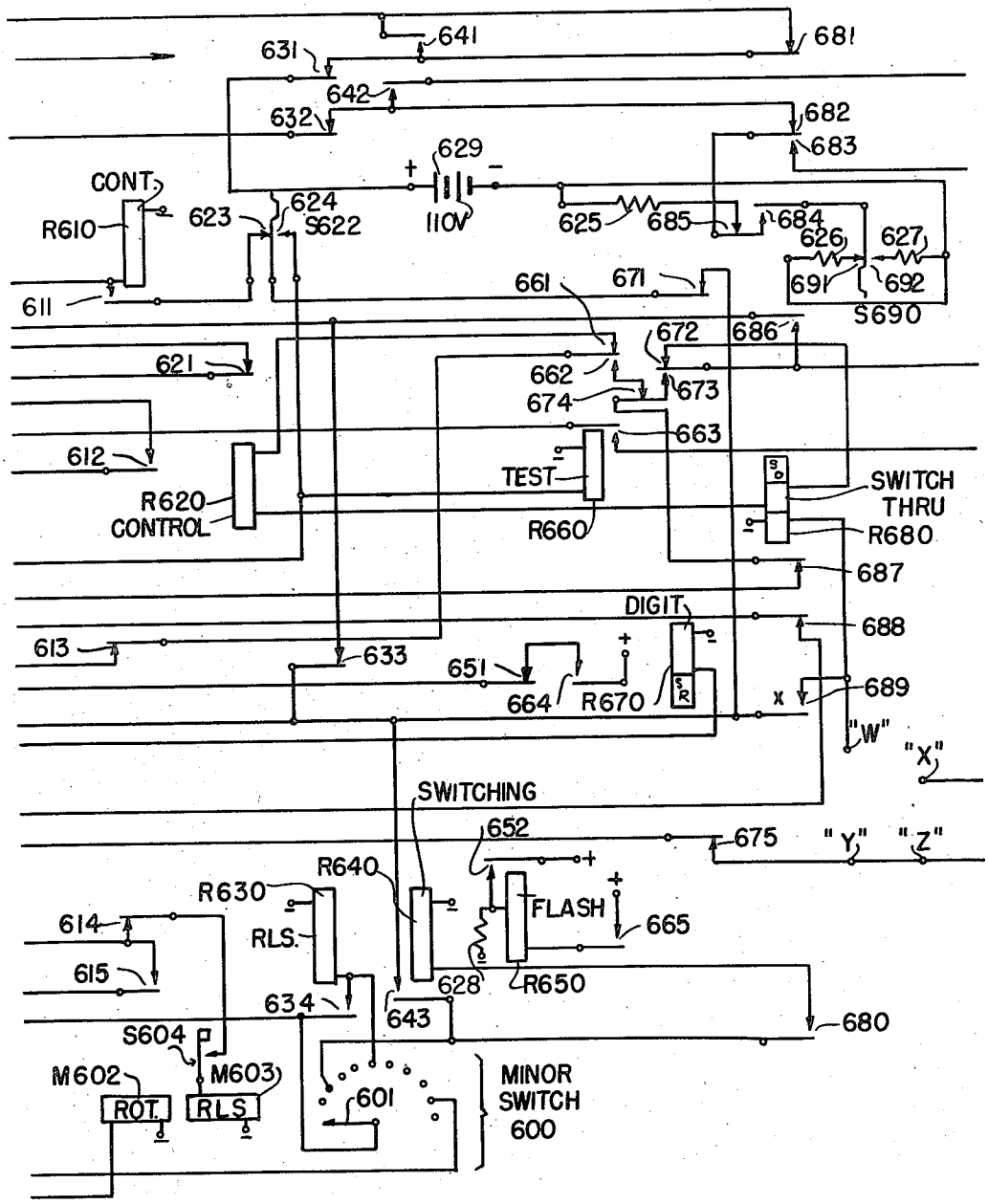


FIG. 6

INVENTOR.
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Oct. 24, 1944. B. D. WILLIS 2,361,342

TELEGRAPH SYSTEM

Filed March 6, 1942 17 Sheets-Sheet 7

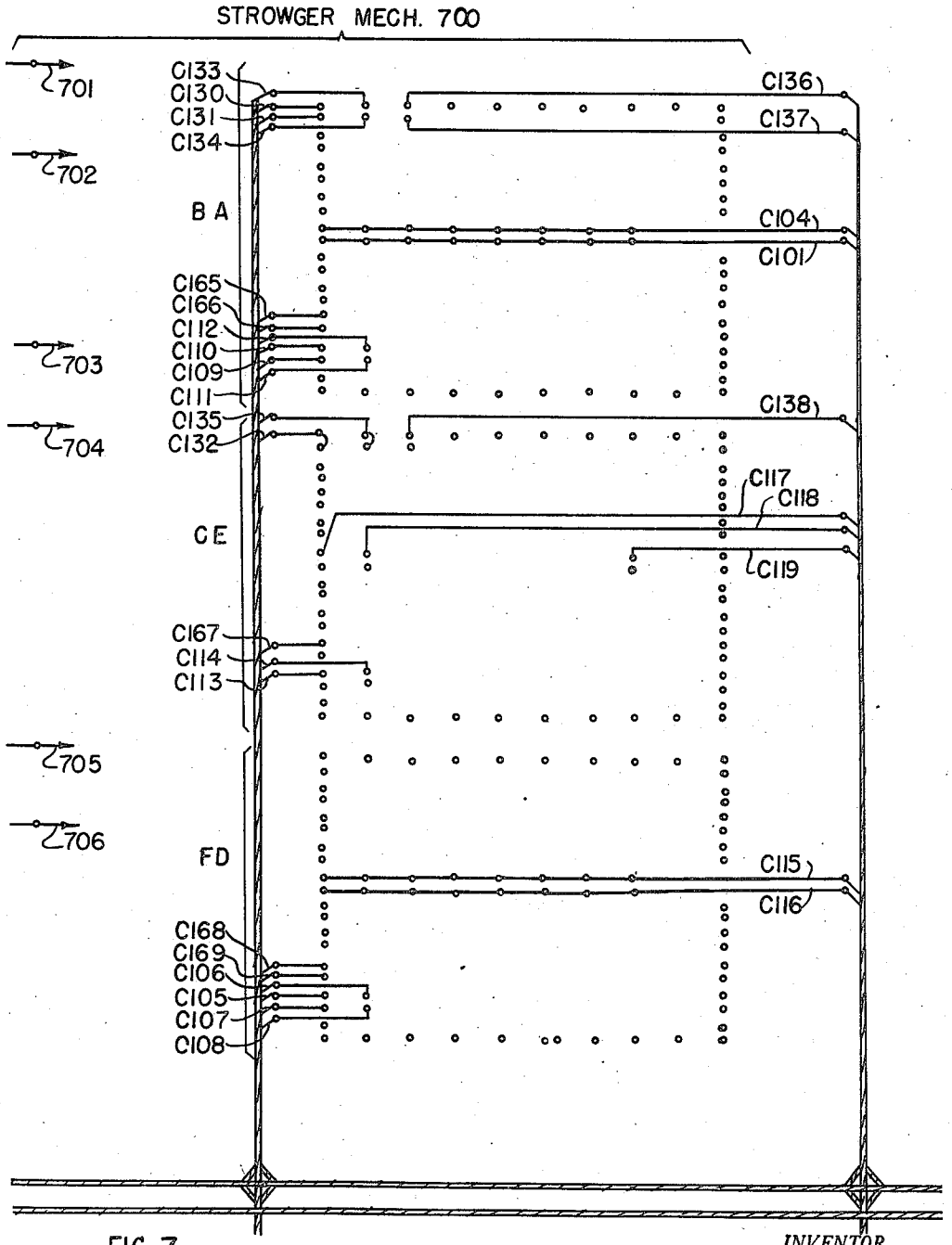


FIG. 7

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Oct. 24, 1944. B. D. WILLIS 2,361,342

TELEGRAPH SYSTEM

Filed March 6, 1942 17 Sheets-Sheet 8

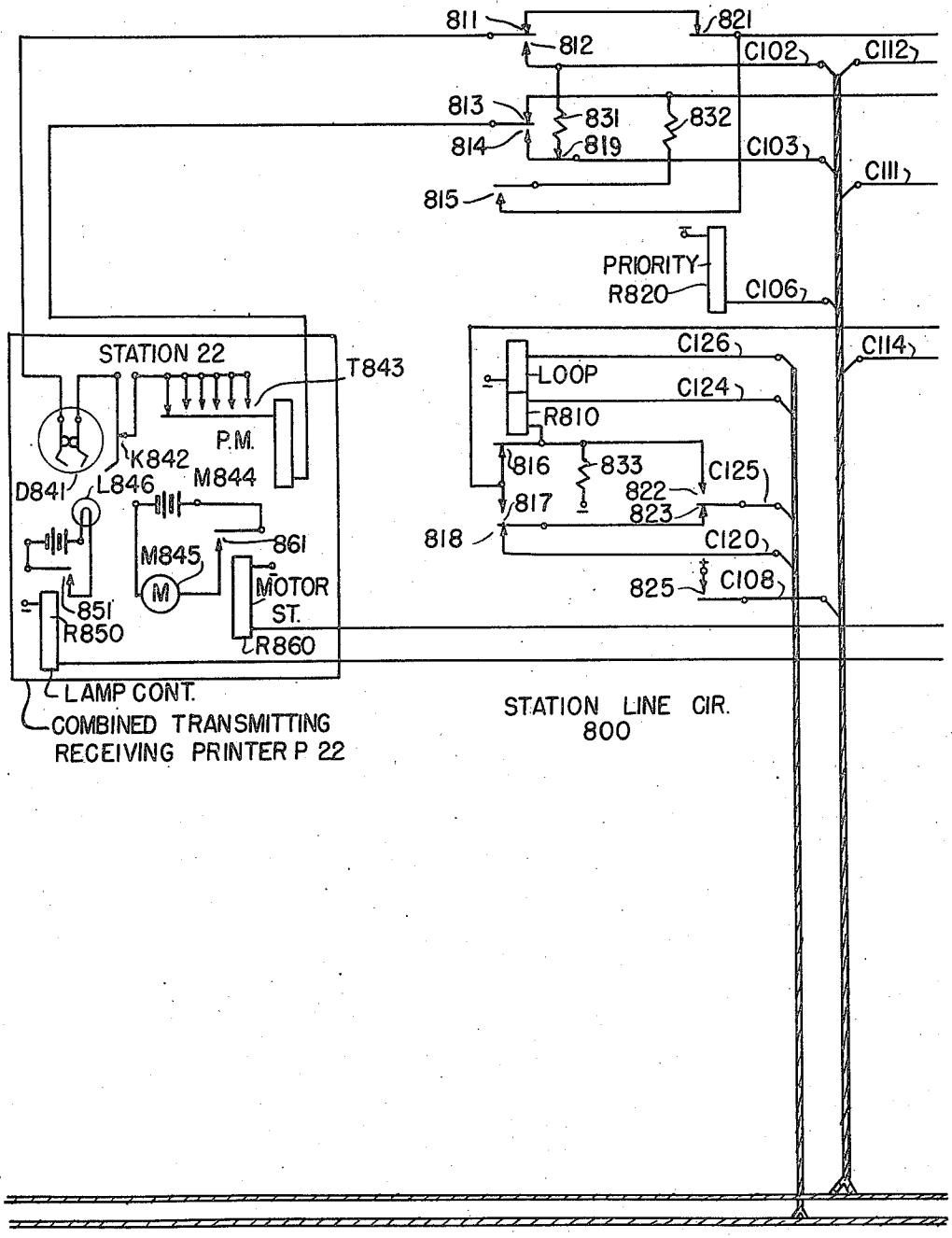


FIG. 8

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TELEGRAPH SYSTEM

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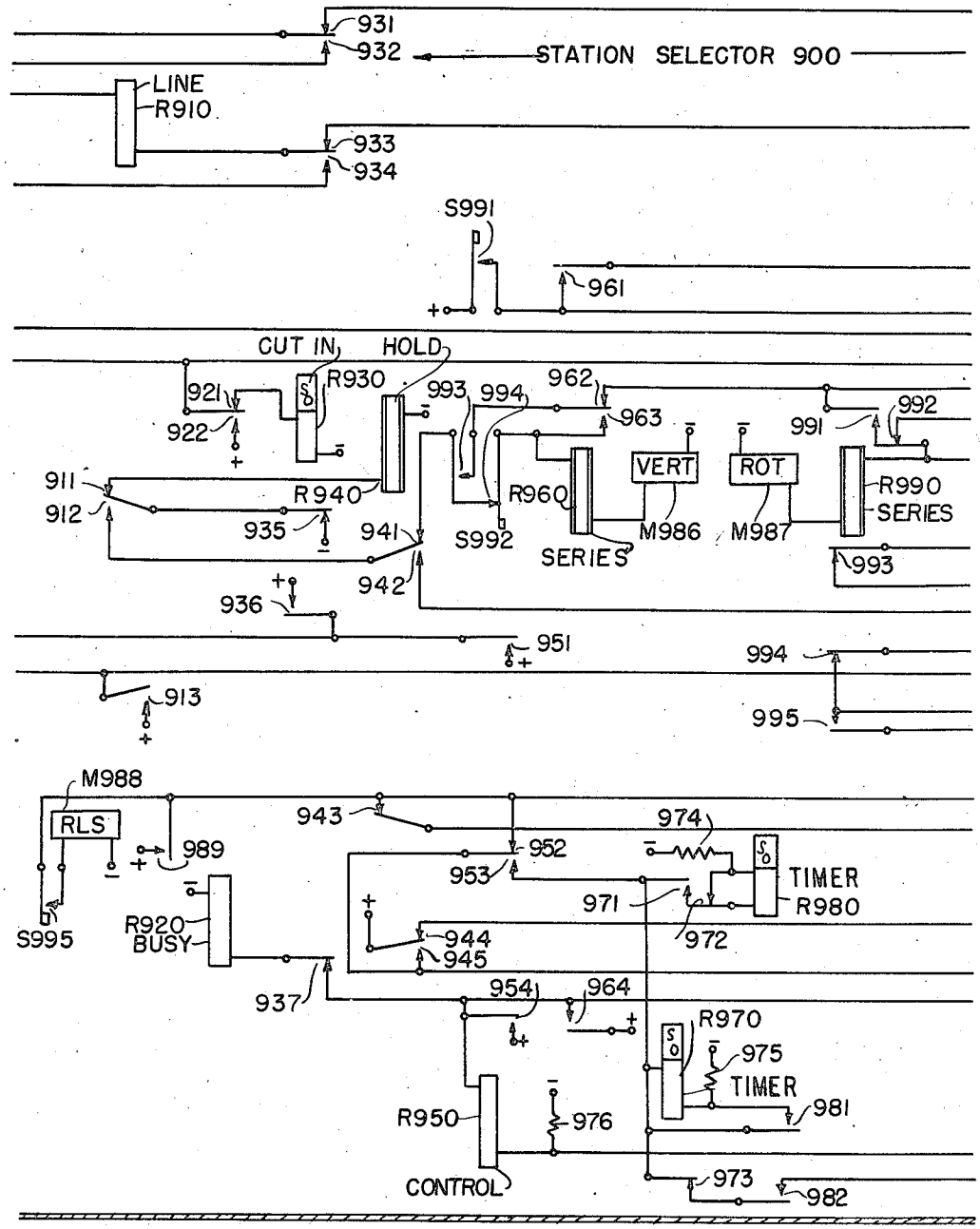


FIG. 9

INVENTOR.
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Oct. 24, 1944. B. D. WILLIS 2,361,342

TELEGRAPH SYSTEM

Filed March 6, 1942 17 Sheets-Sheet 10

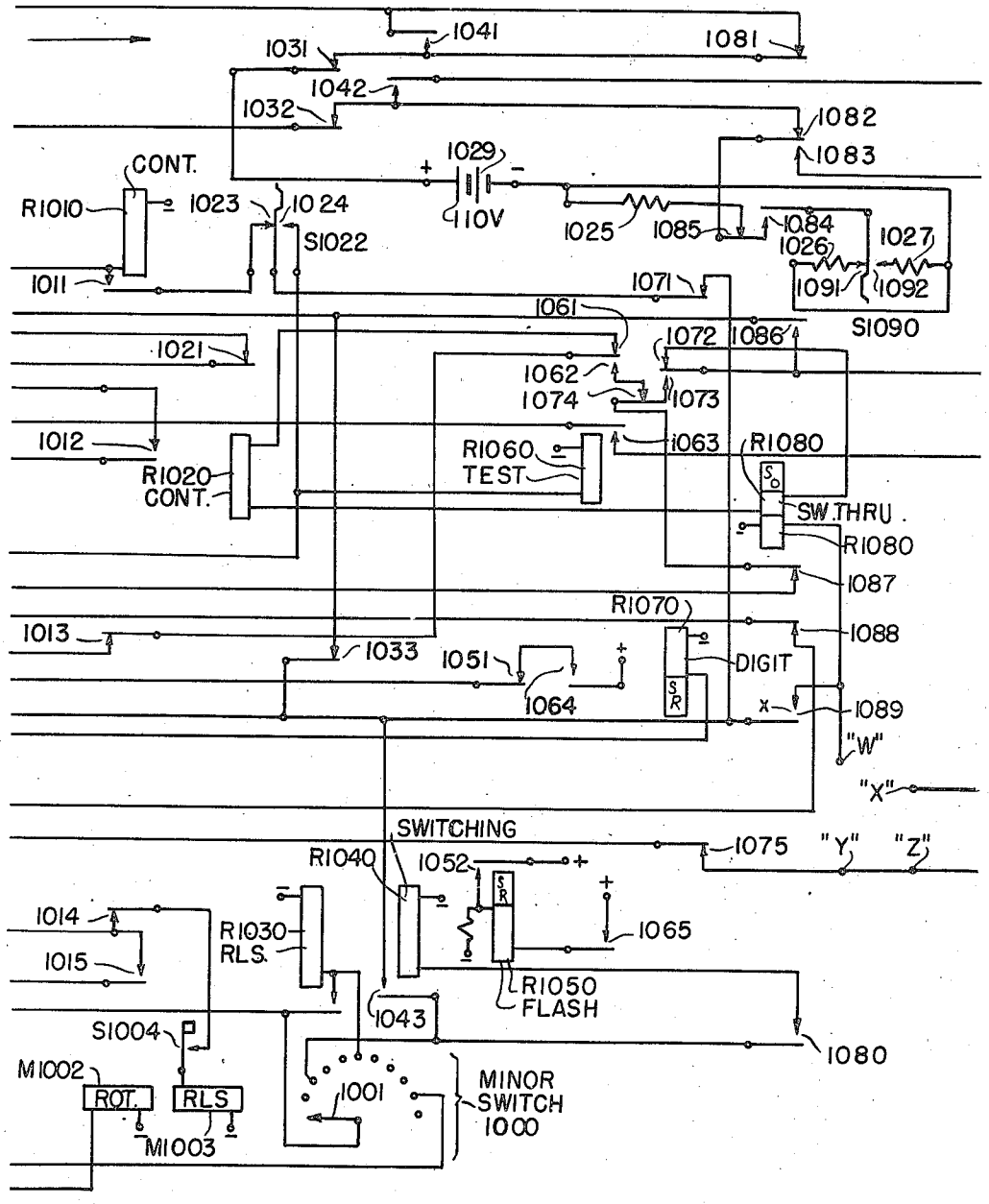


FIG. 10

INVENTOR.
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Oct. 24, 1944. B. D. WILLIS 2,361,342

TELEGRAPH SYSTEM

Filed March 6, 1942 17 Sheets-Sheet 11

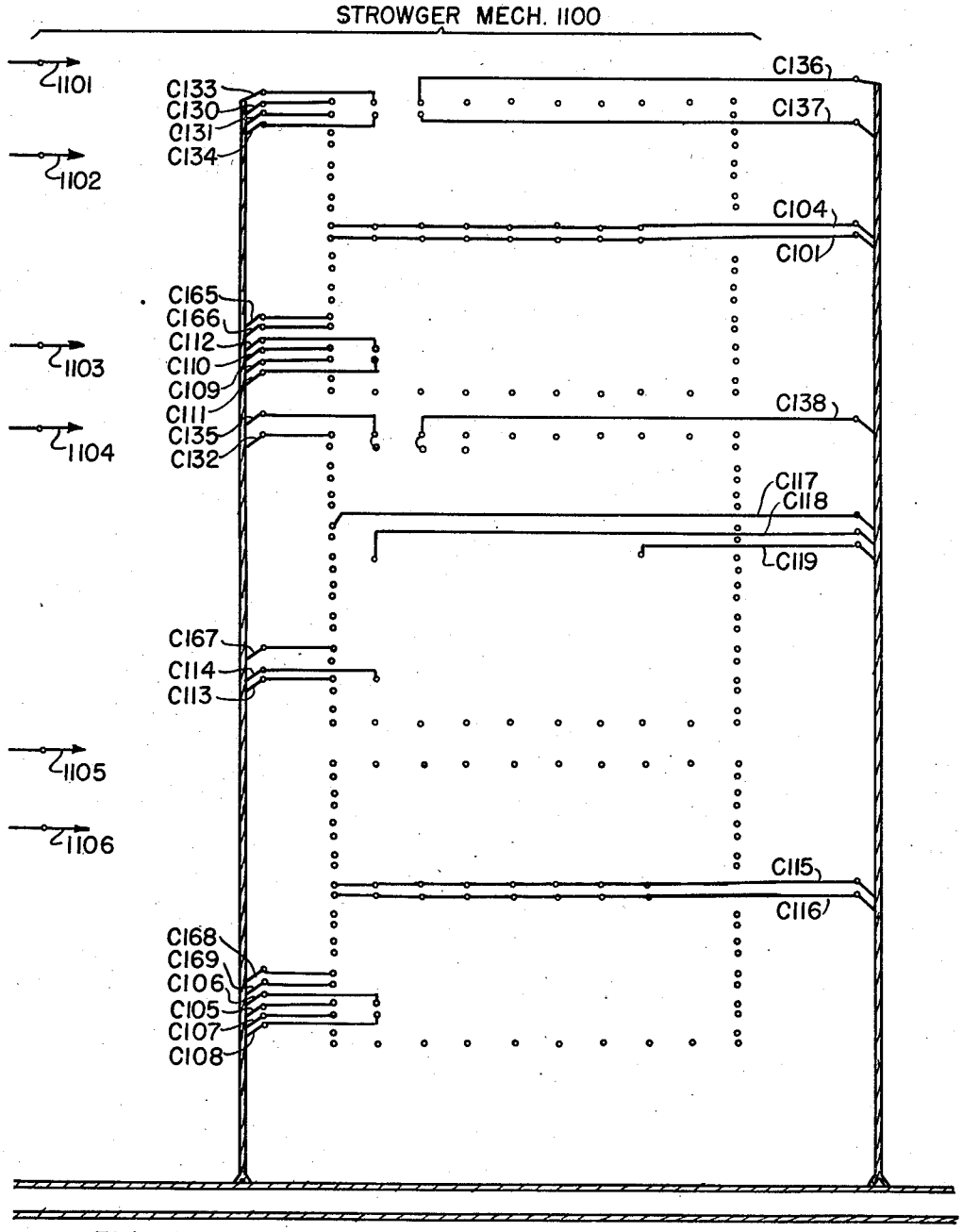


FIG. 11

INVENTOR.
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Oct. 24, 1944. B. D. WILLIS 2,361,342

TELEGRAPH SYSTEM

Filed March 6, 1942 17 Sheets-Sheet 12

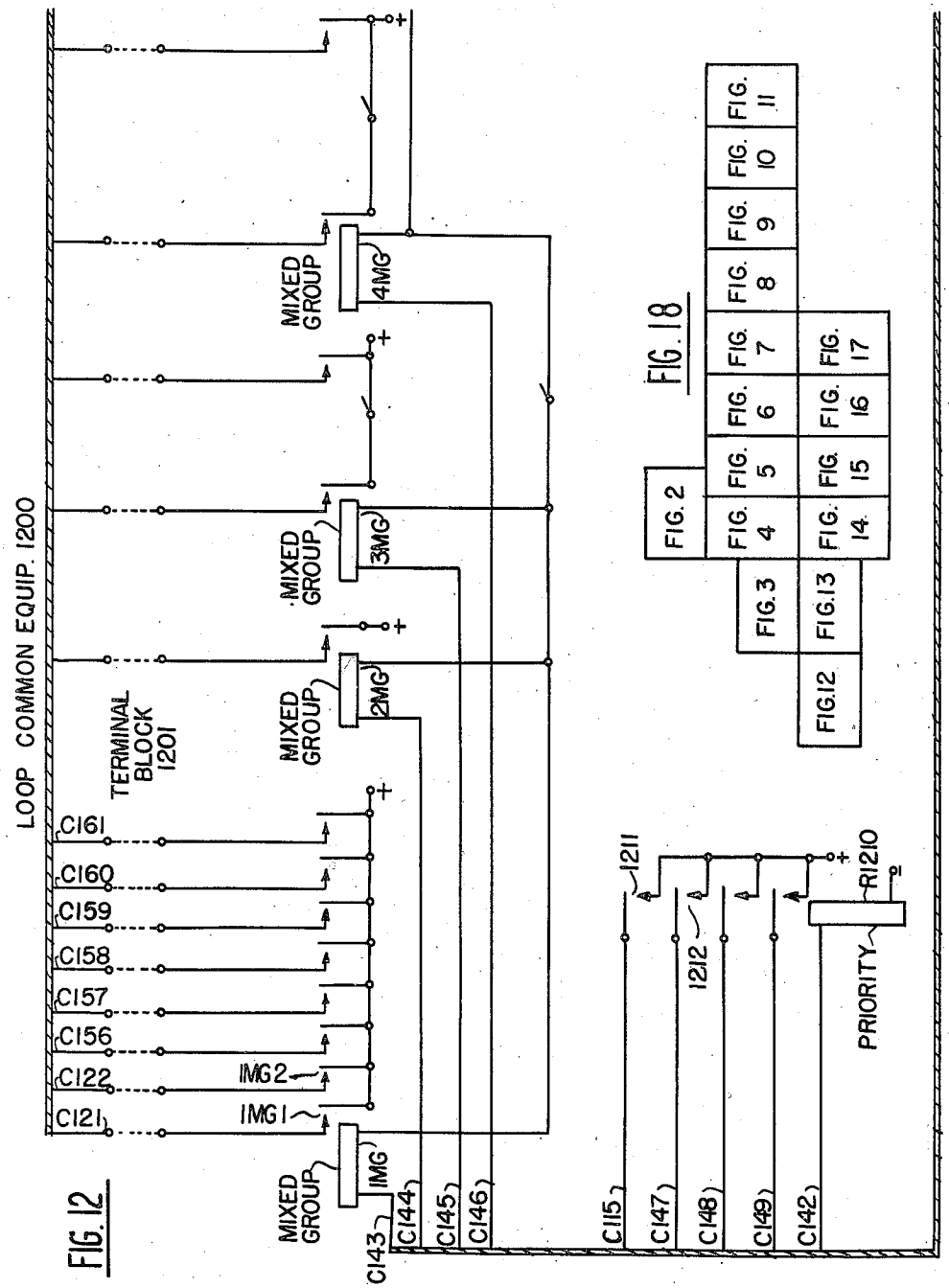


FIG. 12

INVENTOR.
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Oct. 24, 1944. B. D. WILLIS 2,361,342

TELEGRAPH SYSTEM

Filed March 6, 1942 17 Sheets-Sheet 13

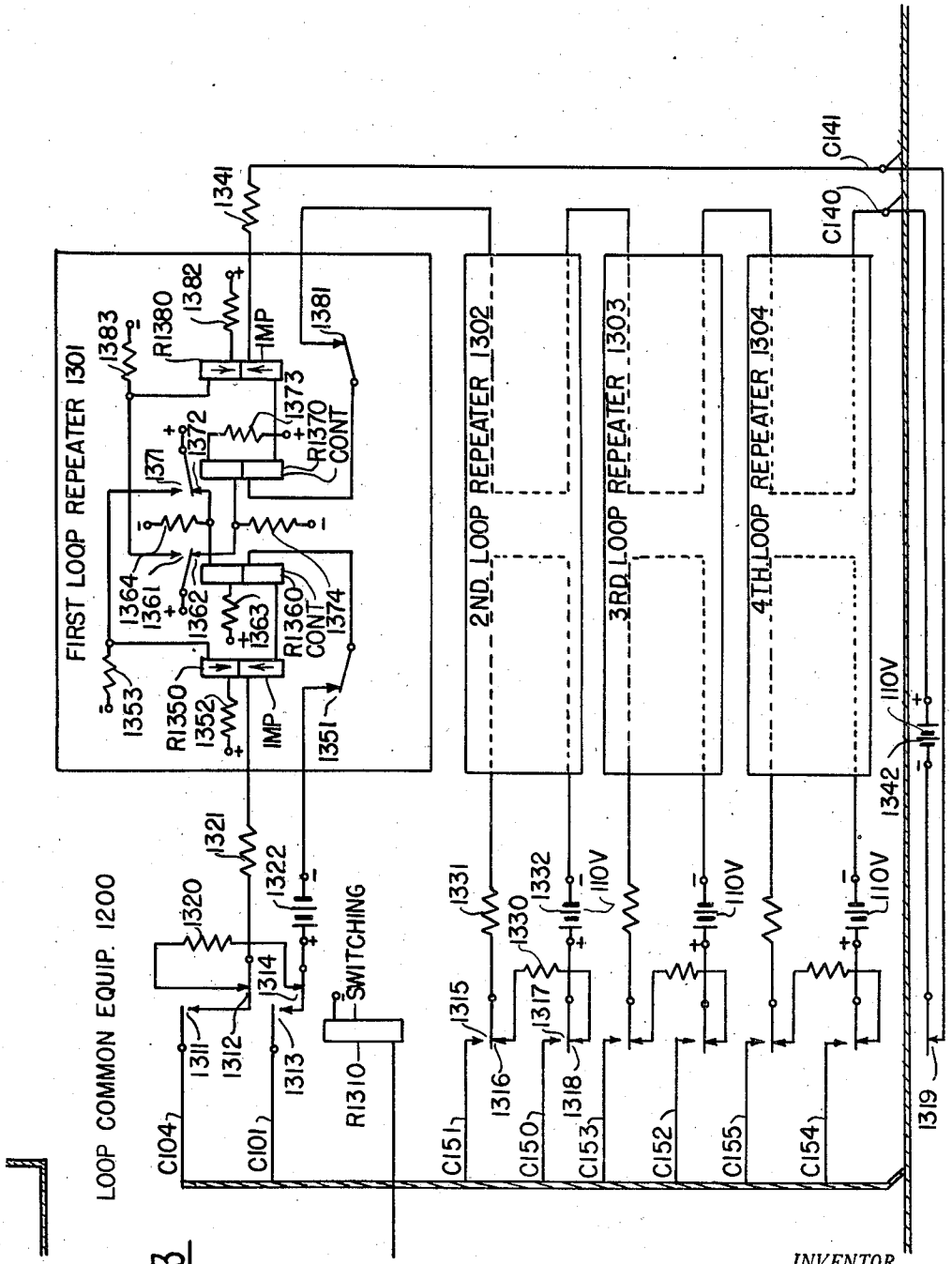


FIG. 13

INVENTOR.
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Oct. 24, 1944. B. D. WILLIS 2,361,342

TELEGRAPH SYSTEM

Filed March 6, 1942 17 Sheets-Sheet 14

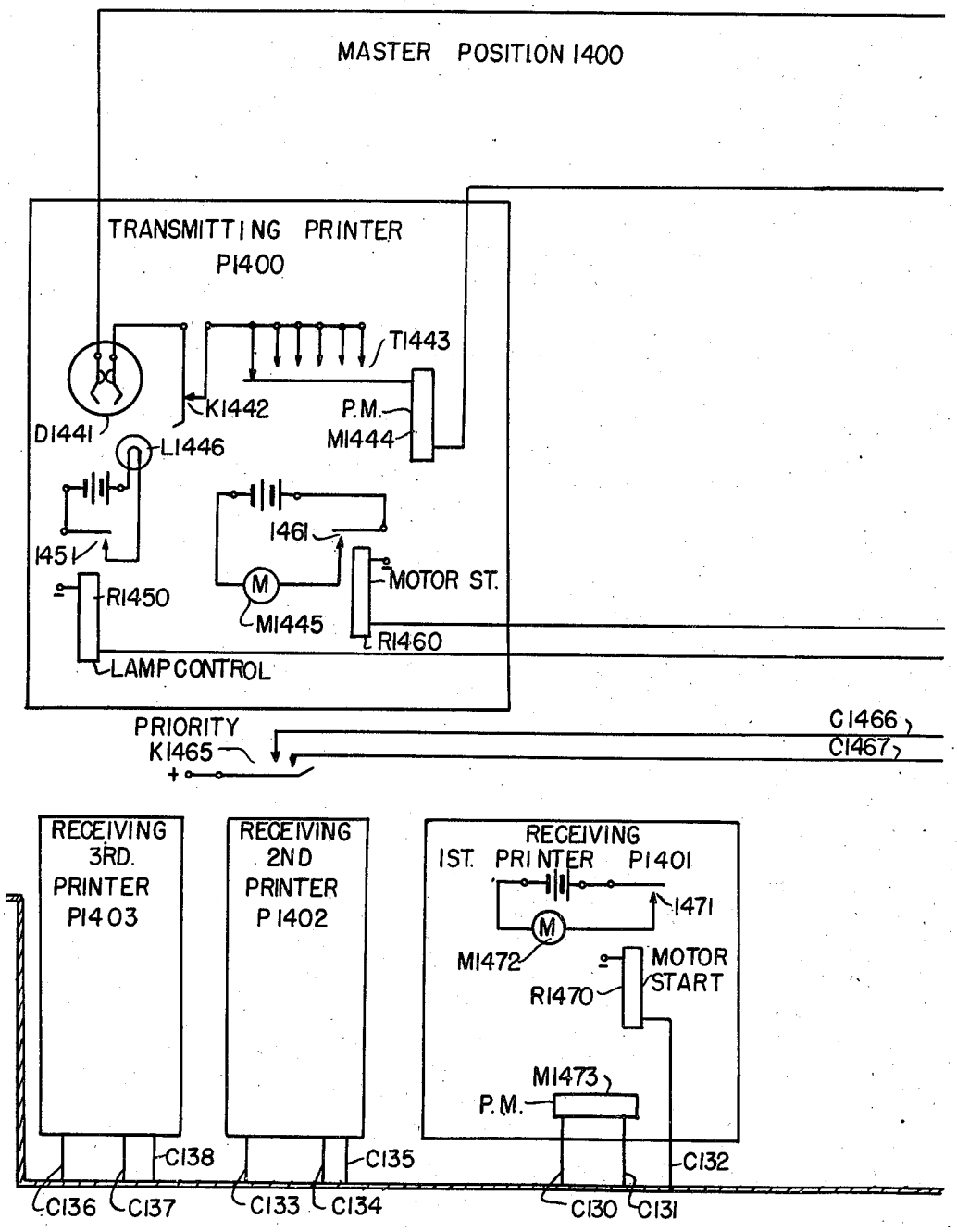


FIG. 14

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TELEGRAPH SYSTEM

Filed March 6, 1942 17 Sheets-Sheet 15

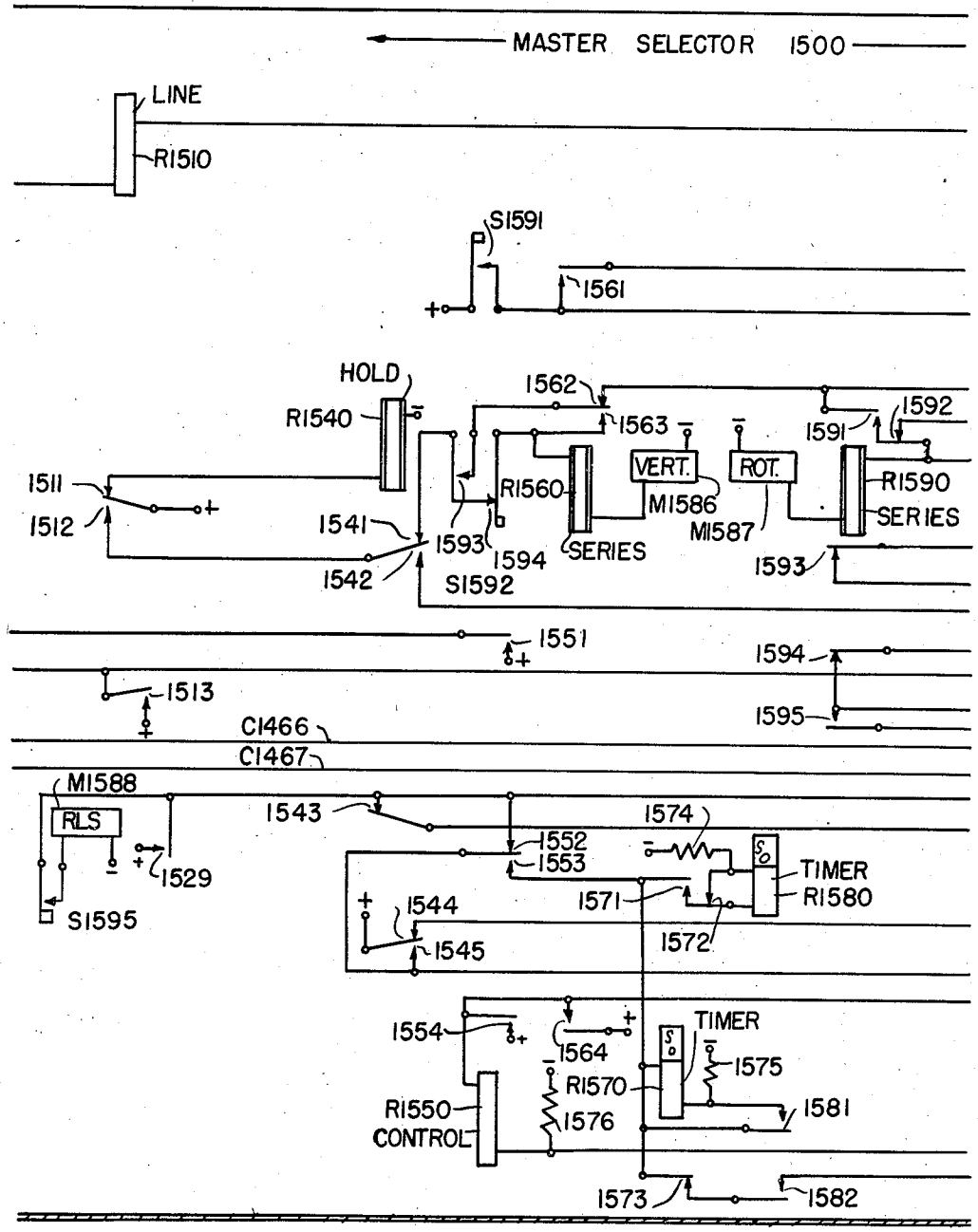


FIG. 15

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Oct. 24, 1944. B. D. WILLIS 2,361,342

TELEGRAPH SYSTEM

Filed March 6, 1942 17 Sheets-Sheet 16

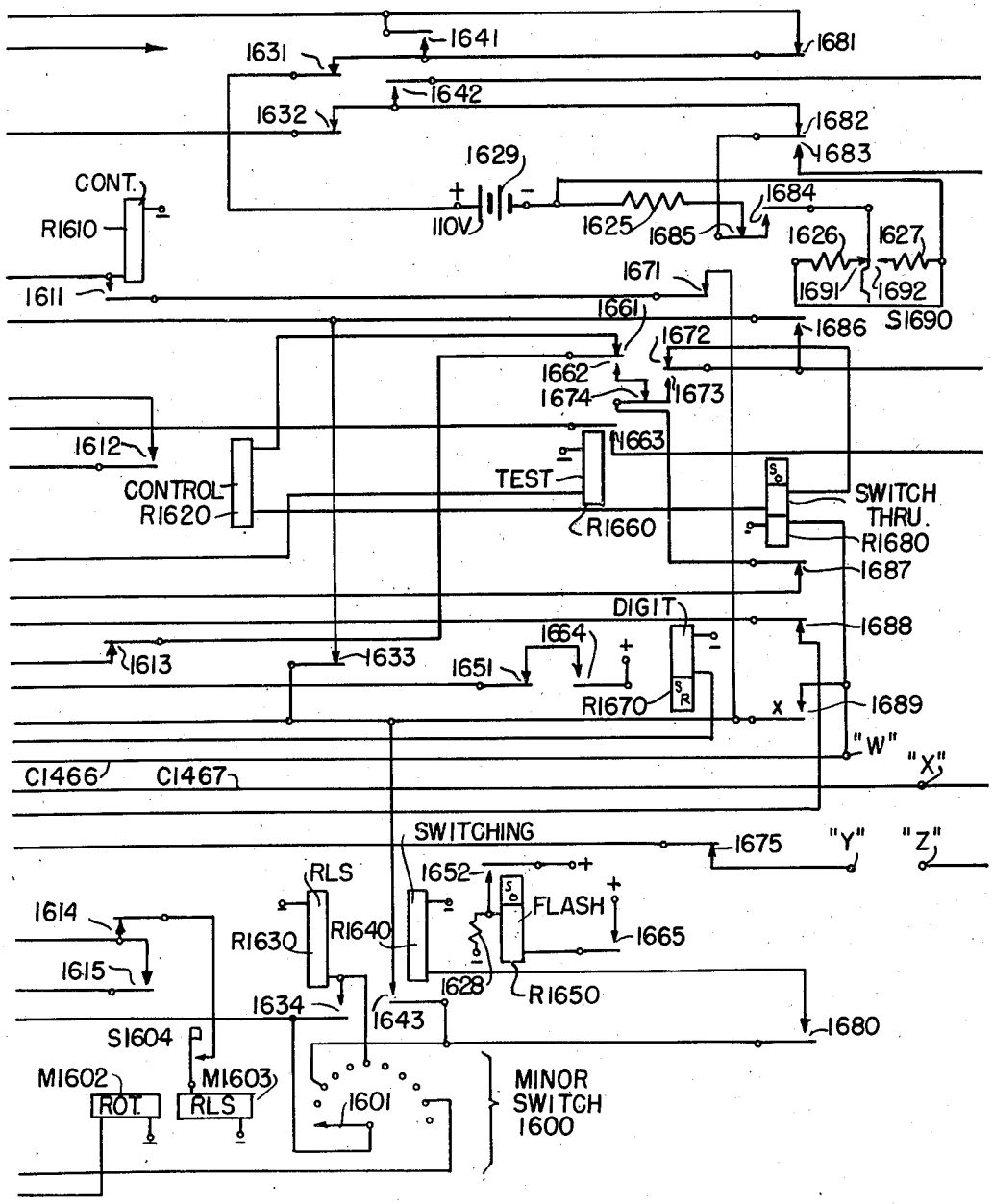


FIG. 16

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TELEGRAPH SYSTEM

Filed March 6, 1942 17 Sheets-Sheet 17

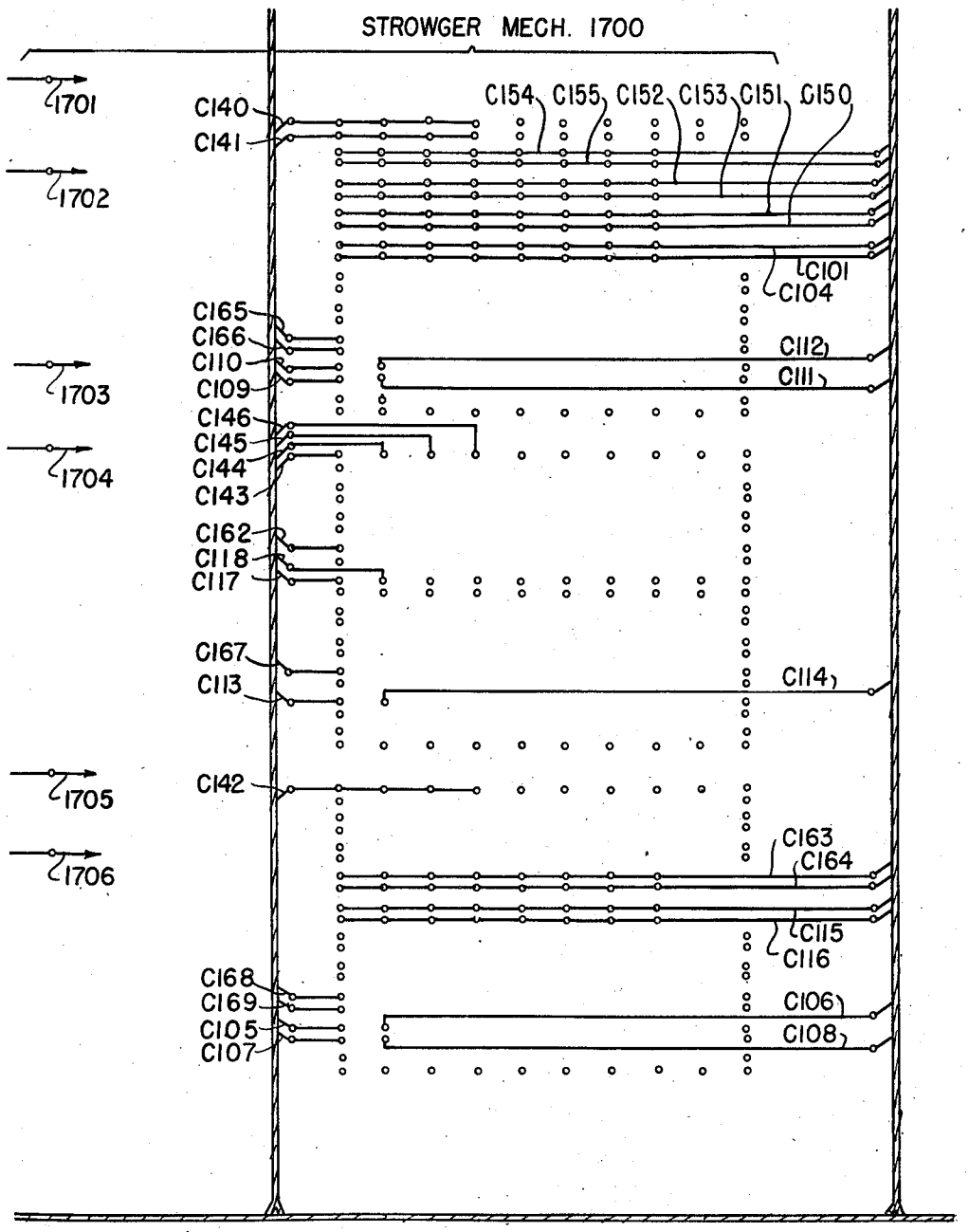


FIG. 17

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Patented Oct. 24, 1944 2,361,342

UNITED STATES PATENT OFFICE

2,361,342

TELEGRAPH SYSTEM

Bernard D. Willis, deceased, late of Oak Park, Ill., by William Walter Owen, executor, Elgin, Ill., assignor to Automatic Electric Laboratories, Inc., a corporation of Delaware

Application March 6, 1942, Serial No. 433,583

28 Claims. (Cl. 178—2)

The present invention relates to signaling systems and more particularly to telegraph switching systems.

Prior automatic telegraph systems may be classified either as series systems or radial systems, depending upon the manner in which connections are set up therein. Each of these types of telegraph systems possesses both certain advantages and disadvantages with respect to the other in setting up the various types of connections. For example, the series type of telegraph system is extremely well suited to the setting up of different conference connections, but is considerably limited in the number of connections which may be set up concurrently; on the other hand, the radial type of telegraph system is extremely well suited to the setting up of a large number of station-to-station connections concurrently, but is considerably limited in the number of different conference connections which may be set up.

Accordingly the principal object of the present invention is to provide a telegraph system of the combined series and radial type, wherein ordinary station-to-station connections are set up on a radial basis and conference connections are set up on a series basis.

Another object of the invention is to provide in a signaling system improved switching apparatus for setting up station-to-station connections on a radial basis.

Another object of the invention is to provide in a signaling system improved switching apparatus for setting up conference connections on a series basis.

A further object of the invention is to provide in a signaling system including a master position, a plurality of groups of stations and a corresponding plurality of loops, improved switching apparatus for setting up different conference connections by way of the individual loops and including different combinations of the stations in the associated groups.

A further object of the invention is to provide in a signaling system including a master position, a plurality of groups of stations and a corresponding plurality of loops, improved switching apparatus for setting up different conference connections by way of all of the loops and including different combinations of the stations in each of the groups.

A still further object of the invention is to provide in a signaling system including switching apparatus selectively controllable to set up station-to-station and conference connections, improved apparatus for overriding and releasing prior connections regardless of the type thereof.

Further features of the invention pertain to the particular arrangement of the circuit elements of the telegraph system, whereby the above-outlined and additional operating features are attained.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following specification taken in connection with the accompanying drawings, in which Figure 1 illustrates the general arrangement of a telegraph system embodying the present invention; Figs. 2 to 17, inclusive, taken together, illustrate the details of a telegraph system having incorporated therein the features briefly outlined above; and Fig. 18 illustrates the mode of combining Figs. 2 to 17, inclusive, to form a unified telegraph system.

Description of the apparatus incorporated in the telegraph system

Referring now more particularly to Fig. 1 of the drawings the telegraph system there illustrated comprises a master position **1400** and a plurality of groups of stations arranged in a corresponding plurality of loops; more specifically, the system comprises a first group of stations (including eight stations **21** to **28**, inclusive) arranged in a first loop, a second group of stations (including eight stations **31** to **38**, inclusive) arranged in a second loop, a third group of stations (including eight stations **41** to **48**, inclusive) arranged in a third loop and a fourth group of stations (including eight stations **51** to **58**, inclusive) arranged in a fourth loop. The master position **1400** is provided with a master selector **1500** individual thereto; while each of the stations is provided with both a station line circuit and a station selector individual thereto. More particularly, the stations **21**, **22**, etc., **31**, **32**, etc., **41**, **42**, etc., and **51**, **52**, etc., are respectively provided with the line circuits **400** 800, etc., **231**, **231'**, etc., **241**, **241'**, etc., and **251**, **251'**, etc., individual thereto, and the station selectors **500**, **900**, etc., **232**, **232'**, etc., **242**, **242'**, etc., and **252**, **252'**, etc., individual thereto.

Also the telegraph system comprises loop common equipment **1200**, loop equipment individual to each loop and a loop repeater individual to each loop; more particularly, the first loop, the second loop, the third loop and the fourth loop are respectively provided with the first loop equipment **300**, the second loop equipment **233**, the third

loop equipment 243 and the fourth loop equipment 253, individual thereto, and the first loop repeater 1301, the second loop repeater 1302, the third loop repeater 1303 and the fourth loop repeater 1304, individual thereto. Finally a plurality of receiving printers P1401, P1402 and P1403 are provided at the master position 1400.

In the telegraph system the master selector 1500 has access to each individual station in each group, to each loop under the control of the individually associated loop equipment and to all of the loops under the control of the associated common loop equipment 1200. Similarly, each individual station in each group has access to each other individual station in the same group, to each individual station in the other groups and to the individually associated loop under the control of the individually associated loop equipment. Further it is noted that, when either the master selector 1500 associated with the master position 1400 or any station selector individually associated with one of the stations seizes any one of the loops under the control of the individually associated loop equipment, the loop equipment may be selectively controlled, whereby any desired combination of two or more of the stations in the seized loop may be cut into the loop for communication purposes. Similarly, when the master selector 1500 associated with the master position 1400 seizes all of the loops under the control of the loop common equipment 1200, the loop common equipment 1200 may be selectively controlled, whereby any combination of one or more stations in each of the loops may be cut into the associated loops for communication purposes.

Considering now the trunking arrangement in greater detail with reference to Figs. 17, 7 and 11, it is pointed out that the master selector 1500 and each of the station selectors 500, 900, etc. have access to the respective stations 21, 22, etc. in the first group by way of the respective first, second, etc. contact sets in the second level in the contact banks of the associated Strowger mechanisms; the selectors mentioned have access to the respective stations 31, 32, etc. in the second group by way of the respective first, second, etc. contact sets in the third level in the contact banks of the associated Strowger mechanisms; the selectors mentioned have access to the respective stations 41, 42, etc. in the third group by way of the respective first, second, etc. contact sets in the fourth level in the contact banks of the associated Strowger mechanisms; and the selectors mentioned have access to the respective stations 51, 52, etc. in the fourth group by way of the respective first, second, etc. contact sets in the fifth level in the contact banks of the associated Strowger mechanisms. Also the master selector 1500 and the station selectors 500, etc., individually associated with the stations in the first group, have access to the terminal line conductors C101 and C104 of the first loop by way of the first eight contact sets in the sixth level in the contact banks of the associated Strowger mechanisms; the master selector 1500 and the station selectors 232, etc., individually associated with the stations in the second group, have access to the terminal line conductors C150 and C151 of the second loop by way of the first eight contact sets in the seventh level in the contact banks of the associated Strowger mechanisms; the master selector 1500 and the station selectors 242, etc., individually associated with the stations in the third group, have access to the terminal line conductors C152 and C153 of the third loop by way of the first eight contact sets in the eighth level in the contact banks of the associated Strowger mechanisms; and the master selector 1500 and the station selectors 252, etc., individually associated with the stations in the fourth group, have access to the terminal line conductors C154 and C155 of the fourth loop by way of the first eight contact sets in the ninth level in the contact banks of the associated Strowger mechanisms. Finally the master selector 1500 has access to the conductors C140 and C141 extending to the primaries of the loop repeaters 1301, etc. by way of the first four contacts in the tenth level in the contact bank of the associated Strowger mechanism 700; while the station selectors 500, etc., 232, etc., 242, etc., and 252, etc., individually associated with the various stations in the first, second, third and fourth groups, have access to the conductors C130, C131 and C133, C134 and C136, C137, respectively extending to the receiving printers P1401, P1402 and P1403 provided at the master position 1400 by way of the first three contact sets in the tenth level in the contact banks of the associated Strowger mechanisms.

The master position 1400 comprises, in addition to the receiving printers P1401, P1402 and P1403, a transmitting printer P1400; while each station comprises a combined transmitting-receiving printer. For example, the stations 21 and 22 respectively comprise the combined transmitting-receiving printers P21 and P22.

Preferably, the transmitting printer P1400 provided at the master position 1400 is of the Morkrum-Kleinschmidt type, comprising, as shown in Fig. 14, a dial D1441, a release key K1442, a transmitter T1443, a printer magnet M1444, an operating motor M1445, a supervisory lamp L1446, a lamp control relay R1450, a motor start relay R1460 and a control network connected and arranged in a manner more fully described hereinafter. Preferably, each of the receiving printers provided at the master position 1400 is identical to the receiving printer P1401, shown in Fig. 14, which is of the Morkrum-Kleinschmidt type comprising a printer magnet M1473, an operating motor M1472, a motor start relay R1470 and a control network connected and arranged in a manner more fully described hereinafter. Further the master position 1400 comprises a priority key K1465 which is utilized in conjunction with the master selector 1500, for a purpose more fully described subsequently.

Preferably, the combined transmitting-receiving printer provided at each station is identical to the combined transmitting-receiving printers P21 and P22 respectively provided at the stations 21 and 22. Preferably, the combined transmitting-receiving printer P21 provided at the station 21 is of the Morkrum-Kleinschmidt type comprising, as shown in Fig. 4, a dial D441, a release key K442, a transmitter T443, a printer magnet M444, an operating motor M445, a supervisory lamp L446, a lamp control relay R450, a motor start relay R460 and a control network connected and arranged in a manner more fully described subsequently. Similarly, the combined transmitting-receiving printer P22 provided at the station 22 is of the Morkrum-Kleinschmidt type comprising, as shown in Fig. 8, a dial D841, a release key K842, a transmitter T843, a printer magnet M844, an operating motor M845, a supervisory lamp L846, a lamp control relay R850, a motor start relay R860 and a control network connected and arranged in a manner more fully described subsequently.

The master selector 1500, shown in Figs. 15 to 17, inclusive, comprises a Strowger mechanism 1700 and a minor switch 1600, the minor switch 1600 constituting a portion of a timing arrangement described in detail hereinafter. The Strowger mechanism 1700 comprises a wiper set, including the wipers 1701 to 1706, inclusive, and an associated contact bank arranged in ten vertical levels, each level including ten circumferentially spaced-apart contact sets. Also the Strowger mechanism 1700 includes a vertical magnet M1586 for moving the wiper set in the vertical direction, a rotary magnet M1587 for moving the wiper set in the rotary direction and a release magnet M1588 for releasing the wiper set and for causing it to be returned to its normal vertical and rotary positions. Also associated with the Strowger mechanism 1700 are a number of sets of switch springs S1591, S1592, S1595 and S1690 which are actuated by the various movements of the wiper set, in a manner more fully described hereinafter. The minor switch 1600 comprises a rotary wiper 1601 provided with an associated contact bank, including ten circumferentially spaced-apart contacts. Also the minor switch 1600 includes a rotary magnet M1602 for rotating the wiper 1601 and a release magnet M1603 for releasing the wiper 1601 and for causing it to be returned to its normal position. Also a set of switch springs S1604 is associated with the minor switch 1600, which is actuated by the rotation of the wiper 1601 in a manner more fully explained hereinafter.

Further the master selector 1500 comprises a relay group, including a line relay R1510, a hold relay R1540, a control relay R1550, two series relays R1560 and R1590, two timer relays R1570 and R1580, two control relays R1610 and R1620, a release relay R1630, a switching relay R1640, a flash relay R1650, a test relay R1660, a digit relay R1670 and a switch-through relay R1680, and a control network connected and arranged in a manner more fully described hereinafter. Also the master selector 1500 comprises a battery 1629 supplying 110 volt potential and four terminals W, X, Y and Z, the terminals W and X being respectively connected to the conductors C1466 and C1467 extending to the priority key K1465 at the master position 1400 and the terminals Y and Z being open-circuited, for a purpose more fully explained hereinafter.

Preferably, the station selector provided at each station is identical to the station selectors 500 and 900 respectively provided at the stations 21 and 22. The station selector 500, shown in Figs. 5 to 7, inclusive, comprises a Strowger mechanism 700 and a minor switch 600, the minor switch 600 constituting a portion of a timing arrangement described in detail hereinafter. The Strowger mechanism 700 comprises a wiper set, including the wipers 701 to 706, inclusive, and an associated contact bank arranged in ten vertical levels, each level including ten circumferentially spaced-apart contact sets. Also the Strowger mechanism 700 includes a vertical magnet M586 for moving the wiper set in the vertical direction, a rotary magnet M587 for moving the wiper set in the rotary direction and a release magnet M588 for releasing the wiper set and for causing it to be returned to its normal vertical and rotary positions. Also associated with the Strowger mechanism 700 are a number of sets of switch springs S591, S592, S595, S622 and S690 which are actuated by the various movements of the wiper set, in a manner more fully described hereinafter. The minor switch 600 comprises a rotary wiper 601 provided with an associated contact bank, including ten circumferentially spaced-apart contacts. Also the minor switch 600 includes a rotary magnet M602 for rotating the wiper 601 and a release magnet M603 for releasing the wiper 601 and for causing it to be returned to its normal position. Also a set of switch springs S604 is associated with the minor switch 600 which is actuated by the rotation of the wiper 601, in a manner more fully explained hereinafter.

Further the station selector 500 comprises a relay group including a line relay R510, a busy relay R520, a cut-in relay R530, a hold relay R540, a control relay R550, two series relays R560 and R590, two timer relays R570 and R580, two control relays R610 and R620, a release relay R630, a switching relay R640, a flash relay R650, a test relay R660, a digit relay R670 and a switch-through relay R680, and a control network connected and arranged in a manner more fully described hereinafter. Also the station selector 500 comprises a battery 629 supplying 110 volt potential and four terminals W, X, Y and Z; the terminals Y and Z being connected together and included in a circuit for energizing the release magnet M588 of the Strowger mechanism 700, and the terminals W and X being open-circuited, for a purpose more fully explained hereinafter.

Similarly the station selector 900, shown in Figs. 9 to 11, inclusive, comprises a Strowger mechanism 1100 and a minor switch 1000, the minor switch 1000 constituting a portion of a timing arrangement described in detail hereinafter. The Strowger mechanism 1100 comprises a wiper set, including the wipers 1101 to 1106, inclusive, and an associated contact bank arranged in ten vertical levels, each level including ten circumferentially spaced-apart contact sets. Also the Strowger mechanism 1100 includes a vertical magnet M986 for moving the wiper set in the vertical direction, a rotary magnet M987 for moving the wiper set in the rotary direction and a release magnet M988 for releasing the wiper set and for causing it to be returned to its normal vertical and rotary positions. Also associated with the Strowger mechanism 1100 are a number of sets of switch springs S991, S992, S995, S1022 and S1090 which are actuated by the various movements of the wiper set, in a manner more fully described hereinafter. The minor switch 1000 comprises a rotary wiper 1001 provided with an associated contact bank, including ten circumferentially spaced-apart contacts. Also the minor switch 1000 includes a rotary magnet M1002 for rotating the wiper 1001 and a release magnet M1003 for releasing the wiper 1001 and for causing it to be returned to its normal position. Also a set of switch springs S1004 is associated with the minor switch 1000 which is actuated by the rotation of the wiper 1001, in a manner more fully explained hereinafter.

Further the station selector 900 comprises a relay group, including a line relay R910, a busy relay R920, a cut-in relay R930, a hold relay R940, a control relay R950, two series relays R960 and R990, two timer relays R970 and R980, two control relays R1010 and R1020, a release relay R1030, a switching relay R1040, a flash relay R1050, a test relay R1060, a digit relay R1070 and a switch-through relay R1080, and a control network connected and arranged in a

manner more fully described hereinafter. Also the station selector 900 comprises a battery 1029 supplying 110 volt potential and four terminals W, X, Y and Z; the terminals Y and Z being connected together and included in a circuit for energizing the release magnet M988 of the Strowger mechanism 1100, and the terminals W and X being open-circuited, for a purpose more fully explained hereinafter.

Preferably, the station line circuit provided at each station is identical to the station line circuits 400 and 800 respectively provided at the stations 21 and 22. The station line circuit 400, shown in Fig. 4, comprises a relay group, including a loop relay R410 and a priority relay R420, and a control network connected and arranged in a manner more fully described hereinafter. Similarly, the station line circuit 800, shown in Fig. 8, comprises a relay group, including a loop relay R810 and a priority relay R820, and a control network connected and arranged in a manner more fully described hereinafter.

Preferably, the loop equipment individually associated with each loop is identical to the first loop equipment 300 individually associated with the first loop which comprises, as shown in Fig. 3, a relay group, including seven group relays 2G, 3G, etc., and 8G, a busy relay R310, a busy slave relay R320, a priority relay R330 and a release relay R340, and a control network connected and arranged in a manner more fully explained hereinafter. At this point it is noted that the group relay 2G is operative to cut the first two stations 21 and 22 into the first loop; the group relay 3G is operative to cut the first three stations 21, 22 and 23 into the first loop; other group relays, not shown, are operative to cut corresponding numbers of the stations 21, 22, etc., into the first loop; while the group relay 8G is operative to cut all eight of the stations 21 to 28, inclusive, into the first loop.

The loop common equipment 1200, shown in Figs. 12 and 13, comprises a relay group, including four mixed group relays 1MG, 2MG, 3MG and 4MG, a priority relay R1210 and a switching relay R1310, and a control network connected and arranged in a manner more fully explained hereinafter. At this point it is noted that the mixed group relay 1MG is operative to cut the first stations 21, 31, 41 and 51 into the respective first, second, third and fourth loops; the mixed group relays 2MG and 3MG are respectively operative to cut other combinations of the stations 21, etc., 31, etc., 41, etc., and 51, etc., respectively into the first, second, third and fourth loops; while the mixed group relay 4MG is operative to cut all of the stations in each of the groups, respectively into the associated loops. Finally the loop common equipment 1200 comprises a number of batteries 1322, 1332, etc., and 1342, each of which is adapted to supply 110 volt potential to the various loop repeaters 1301, etc., in a manner more fully explained hereinafter.

Preferably, each of the loop repeaters is identical to the first loop repeater 1301 which comprises, as shown in Fig. 13, a relay group, including two impulse relays R1350 and R1380 and two control relays R1360 and R1370, and a control network connected and arranged in a manner more fully described hereinafter.

The operation of the telegraph system and the connection and arrangement of the apparatus incorporated therein will best be understood from a consideration of the following description of the idle condition thereof, as well as the operation of the various pieces of apparatus incident to the setting up of the different call connections among the master position and the various stations.

Idle condition of the telegraph system

When the master position 1400 is idle the master selector 1500 occupies its released position shown, at which time a local circuit is completed for energizing the winding of the line relay R1510 in series with the printer magnet M1444, this circuit extending from the positive terminal of the battery 1629 by way of the contacts 1631 and 1681, the dial D1441, the release key K1442, the transmitter T1443, the printer magnet M1444, the winding of R1510, the contacts 1632, 1682 and 1685, and the resistor 1625 to the negative terminal of the battery 1629. Accordingly, the line relay R1510 occupies its operated position, thereby to complete, at the contacts 1511, an obvious circuit for energizing the winding of the hold relay R1540, whereby the latter relay occupies its operated position.

Similarly, when each station is idle the individually associated line circuit and the individually associated station selector occupy their released positions shown. For example, when the station 21 is idle a local circuit is completed for energizing the winding of the line relay R510 in series with the printer magnet M444, this circuit extending from the positive terminal of the battery 629 by way of the contacts 631, 681, 531, 421 and 411, the dial D441, the release key K442, the transmitter T443, the printer magnet M444, the contacts 413, the winding of R510, the contacts 533, 632, 682 and 685, and the resistor 625 to the negative terminal of the battery 629. Accordingly, the line relay R510 occupies its operated position, thereby to complete, at the contacts 511, an obvious circuit, including the contacts 535, for energizing the winding of the hold relay R540, whereby the latter relay occupies its operated position. Also battery potential is applied by way of the winding of the cut-in relay R530 and the contacts 521 to the control conductor C113, thereby to mark the station 21 as idle to the master selector 1500 and to the various station selectors having access thereto.

In a like manner, when the station 22 is idle a local circuit is completed for energizing the winding of the line relay R910 in series with the printer magnet M844, this circuit extending from the positive terminal of the battery 1029 by way of the contacts 1031, 1081, 931, 821 and 811, the dial D841, the release key K842, the transmitter T843, the printer magnet M844, the contacts 813, the winding of R910, the contacts 933, 1032, 1082 and 1085, and the resistor 1025 to the negative terminal of the battery 1029. Accordingly the line relay R910 occupies its operated position, thereby to complete, at the contacts 911, an obvious circuit, including the contacts 935, for energizing the winding of the hold relay R940, whereby the latter relay occupies its operated position. Also battery potential is applied by way of the winding of the cut-in relay R930 and the contacts 921 to the control conductor C114, thereby to mark the station 22 as idle to the master selector 1500 and to the various station selectors having access thereto.

Further it is noted that, when all of the stations in a given group are idle, a chain circuit is completed in the associated loop between the terminal line conductors thereof, which chain circuit includes an impedance element in the station line circuit individually associated with each

station. By way of example it is noted that, when all of the stations 21 to 28, inclusive, in the first group are idle, a chain circuit is completed in the associated first loop between the terminal line conductors C101 and C104 thereof; which chain circuit includes an impedance element in each of the station line circuits 400, 800, etc., respectively associated with the stations 21, 22, etc. More specifically, the chain circuit in the first loop extends from the terminal line conductor C101 thereof by way of the impedance element 431 in the station line circuit 400, the contacts 419, C102, the impedance element 831 in the station line circuit 800, the contacts 819, C103 (the impedance elements in the other station line circuits, not shown), and the contacts 341 to the terminal line conductor C104 thereof. At this point it is noted that the impedance element in each station line circuit which is included in the above-mentioned chain circuit in each loop corresponds to the impedance of the associated station. For example, in the station line circuits 400 and 800, the impedance elements 431 and 831 respectively correspond to the impedances of the stations 21 and 22.

Further it is noted that each station line circuit comprises an additional impedance element corresponding to the impedance of the associated station. By way of example it is noted that the station line circuits 400 and 800, respectively, comprise the impedance elements 432 and 832 which respectively correspond to the impedances of the stations 21 and 22.

When the loop common equipment 1200 occupies its restored position the switching relay R1310 occupies its restored position, whereby there is completed, at the contacts 1312, 1314 and 1316, 1318, etc., circuits for respectively energizing the secondaries of the loop repeaters 1301, 1302, etc. More specifically, at the contacts 1312 and 1314, a circuit is completed for energizing the secondary of the first loop repeater 1301, including the lower windings of the impulse relay R1350 and the control relay R1360; the last-mentioned circuit extends from the positive terminal of the battery 1322 by way of the contacts 1314, the resistor 1320, the contacts 1312, the resistor 1321, the lower windings of R1350 and R1360 and the contacts 1351 to the negative terminal of the battery 1322. Also, at the contacts 1319 of the restored switching relay R1310, there is completed a series circiut for energizing the primaries of the various loop repeaters 1301, etc. The last-mentioned circuit extends from the positive terminal of the battery 1342 by way of C140, the primaries of the loop repeaters 1304, 1303 and 1302, the contacts 1381, the lower windings of the control relay R1370 and the impulse relay R1380, the resistor 1341, C141 and the contacts 1319 to the negative terminal of the battery 1342. Accordingly, in each of the repeaters, both the primary and the secondary thereof are energized; hence, in each repeater, both of the impulse relays and both of the control relays occupy their operated positions.

Station to station call

Considering now the extension of a call from a station in any group to another station in either the same or a different group, the operator at the calling station first initiates the call by dialing the call number of the called station on the associated dial, thereby selectively to operate the associated station selector. For example, assuming that a call is to be extended from the calling station 21 to the called station 22, the operator at the calling station 21 operates the associated dial D441 in accordance with the call number 22 of the called station 22. Thus the dial D441 is operated twice in accordance with the digit 2, whereby the first digit 2 and then the second digit 2 are sequentially transmitted to the line relay R510 in the associated station selector 500. First, the line relay R510 follows the first digit, restoring each time the previously traced circuit for energizing the winding thereof is interrupted and operating each time the circuit mentioned is recompleted. Each time the line relay R510 restores and then reoperates it interrupts and then recompletes, at the contacts 511, the previously traced circuit for energizing the winding of the hold relay R540. However, the hold relay R540 remains in its operated position during impulsing as it is of the slow-to-release type. Also each time the line relay R510 restores and then reoperates it completes and then interrupts, at the contacts 513, an obvious circuit for energizing the winding of the lamp control relay R450, thereby to cause the latter relay to follow the impulses of the first digit. Each time the lamp control relay R450 operates and then restores it completes and then interrupts, at the contacts 451, an obvious circuit for illuminating the supervisory lamp L446, whereby the supervisory lamp L446 is flashed in accordance with the impulses of the first digit. The first time the line relay R510 restores it completes, at the contacts 512, a circuit, including the contacts 535 and 541 and the contacts 594 of the set of switch springs S592, for energizing the winding of the series relay R560 in series with the vertical magnet M586; whereby the series relay R560 operates and the vertical magnet M586 operates in order to drive the wiper set of the Strowger mechanism 700 one step in the vertical direction. When the wiper set of the Strowger mechanism 700 is driven one step in the vertical direction the sets of switch springs S591, S592 and S595 are actuated. Upon operating, the series relay R560 completes, at the contacts 563, an alternative circuit for energizing the winding thereof in series with the vertical magnet M586. The last-mentioned circuit extends, when completed, from the positive terminal of battery by way of the contacts 535, 512 and 541, the contacts 593 of the set of switch springs S592, the contacts 563, the winding of R560 and the vertical magnet M586 to the negative terminal of battery. The first time the line relay R510 reoperates it interrupts, at the contacts 512, the previously traced alternative circuit for energizing the winding of the series relay R560 in series with the vertical magnet M586, thereby to cause the vertical magnet M586 to restore. However, the series relay R560 does not restore during impulsing as it is of the slow-to-release type.

Also, upon operating, the series relay R560 completes, at the contacts 561, an obvious circuit, including the set of switch springs S591, for energizing the winding of the control relay R610, thereby to cause the latter relay to operate. Upon operating, the control relay R610 completes, at the contacts 611, a holding circuit for energizing the winding thereof, this circuit extending from the positive terminal of battery by way of the set of switch springs S591, the contacts 633 and 671, the contacts 623 of the set of switch springs S622, the contacts 611 and the winding of R610 to the negative terminal of battery. Also

the series relay R560 completes, at the contacts 564, an obvious circuit, including the contacts 537, for energizing the winding of the busy relay R520, thereby to cause the latter relay to operate. Upon operating, the busy relay R520 interrupts, at the contacts 521, the previously traced path for applying negative battery potential by way of the winding of the cut-in relay R530 to the control conductor C113; and completes, at the contacts 522, an obvious path for applying positive battery potential to the control conductor C113, thereby to mark the station 21 as busy to the master selector 1500 and the various station selectors having access thereto. Further the series relay R560 completes, at the contacts 564, an obvious circuit, including the resistor 576, for energizing the winding of the control relay R550, thereby to cause the latter relay to operate. Upon operating, the control relay R550 completes, at the contacts 554, an obvious holding circuit, including the resistor 576, for energizing the winding thereof. Also the control relay R550 completes, at the contacts 551, an obvious circuit for energizing the winding of the motor start relay R460, thereby to cause the latter relay to operate. Upon operating, the motor start relay R460 completes, at the contacts 461, an obvious circuit for energizing the operating motor M445, thereby to cause the latter motor to operate in order to condition the transmitter T443 to transmit the telegraphic signals. Also the control relay R550 completes, at the contacts 553, a circuit for energizing the winding of the timer relay R570, this circuit extending from the positive terminal of battery by way of the contacts 544, 615 and 553, the winding of R570 and the resistor 575 to the negative terminal of battery. Shortly after the timer relay R570 is thus energized, this relay being of the slow-to-operate type, it operates to interrupt, at the contacts 572, a normally completed path for short-circuiting the winding of the timer relay R580; and to complete, at the contacts 571, a circuit for energizing the winding of the timer relay R580. The last-mentioned circuit extends from the positive terminal of battery by way of the contacts 544, 615, 553 and 571, the winding of R580 and the resistor 574 to the negative terminal of battery. Shortly after the timer relay R580 is thus energized, this relay being of the slow-to-operate type, it operates to complete, at the contacts 581, an obvious path for short-circuiting the winding of the timer relay R570, thereby to cause the latter relay to restore shortly thereafter. Upon restoring, the timer relay R570 interrupts, at the contacts 571, the previously traced circuit for energizing the winding of the timer relay R580; and recompletes, at the contacts 572, the previously mentioned path for short-circuiting the winding of the timer relay R580, thereby to cause the latter relay to restore shortly thereafter. Upon restoring, the timer relay R580 interrupts, at the contacts 581, the previously mentioned path for short-circuiting the winding of the timer relay R570, whereby the previously traced circuit for energizing the winding of the timer relay R570 is recompleted in order to cause the latter relay to reoperate shortly thereafter, in the manner previously explained. Accordingly the timer relays R570 and R580 operate and restore in accordance with the cycle described above in order to measure successive time intervals. Each time the timer relay R570 restores, while the timer relay R580 occupies its operated position in the cycle described above, a circuit is completed by the timer relay R570, at the contacts 573, for energizing the rotary magnet M602 of the minor switch 600. The last-mentioned circuit extends from the positive terminal of battery by way of the contacts 544, 615, 553, 573 and 582 and the rotary magnet M602 to battery. Accordingly the rotary magnet M602 is energized intermittently upon each cycle of operation of the timer relays R570 and R580. Each time the rotary magnet M602 is energized it operates to drive the wiper 601 of the minor switch 600 one step in the clockwise direction, for a purpose more fully explained hereinafter.

As previously noted, the line relay R510 follows the first digit 2, whereby the vertical magnet M586 is operated twice in order to cause the wiper set of the Strowger mechanism 700 to be driven two steps in the vertical direction; the line relay R510 then reoperates in order to interrupt, at the contacts 512, the previously traced alternative circuit for energizing in series the winding of the series relay R560 and the vertical magnet M586. Shortly thereafter the series relay R560 restores, this relay being of the slow-to-release type, as previously noted. Upon restoring, the series relay R560 interrupts, at the contacts 561, the previously traced operating circuit for energizing the winding of the control relay R610; however, the latter relay remains in its operated position due to the previously traced holding circuit for energizing the winding thereof. Also the series relay R560 interrupts, at the contacts 564, the previously traced multiple operating circuits for energizing the windings of the busy relay R520 and the control relay R550; however, the latter relays remain in their operated positions due to the completed multiple holding circuits for energizing the windings thereof. Further the series relay R560 interrupts, at the contacts 563, a further point in the previously traced alternative circuit for energizing the winding thereof in series with the vertical magnet M586; and prepares, at the contacts 562, a circuit traced hereinafter for energizing the winding of the series relay R590 in series with the rotary magnet M587.

The line relay R510 then follows the second digit 2, in the manner explained above. The first time the line relay R510 restores it completes, at the contacts 512, the previously mentioned circuit for energizing the winding of the series relay R590 in series with the rotary magnet M587, this circuit extending from the positive terminal of battery by way of the contacts 535, 512 and 541, the contacts 593 of the set of switch springs S592, the contacts 562 and 612, the winding of R590 and the rotary magnet M587 to battery. When thus energized the series relay R590 operates to complete, at the contacts 591, an obvious alternative circuit for energizing the winding thereof in series with the rotary magnet M587. Also the series relay R590 interrupts, at the contacts 593, a point in a circuit traced hereinafter for energizing the winding of the test relay R660; and interrupts, at the contacts 594, a point in a circuit traced hereinafter for energizing the winding of the control relay R620. Further the series relay R590 completes, at the contacts 595, a circuit, including the set of switch springs S591 and the contacts 633, for energizing the winding of the digit relay R670, thereby to cause the latter relay to operate. Upon operating, the digit relay R670 interrupts, at the contacts 671, the previously traced holding circuit for energizing the winding of the control relay R610, thereby to cause the latter relay to restore. Also the digit relay R670 interrupts, at the contacts 672, a further point in a circuit traced here-

inafter for energizing the upper winding of the switch-through relay R680 in series with the winding of the control relay R620; prepares, at the contacts 673, a further point in the previously mentioned circuit for energizing the winding of the test relay R660; and interrupts, at the contacts 674, a point in a holding circuit traced hereinafter for energizing the winding of the test relay R660. Finally, the digit relay R670 interrupts, at the contacts 675, a point in a circuit traced hereinafter for energizing the release magnet M588 of the Strowger mechanism 700.

Upon restoring, the control relay R610 interrupts, at the contacts 611, a further point in the previously traced holding circuit for energizing the winding thereof; and interrupts, at the contacts 612, the previously traced original circuit for energizing the winding of the series relay R590 in series with the rotary magnet M587. Also the control relay R610 prepares, at the contacts 613, a further point in the previously mentioned circuit for energizing the winding of the control relay R620 in series with the upper winding of the switch-through relay R680; and interrupts, at the contacts 615, the previously traced multiple circuits for energizing the rotary magnet M602 of the minor switch 600 and the windings of the timer relays R570 and R580, thereby positively to prevent further operation of the timer relays R570 and R580 and the rotary magnet M602. Finally the control relay R610 completes, at the contacts 614, an obvious circuit, including the contacts 544 and the set of switch springs S604, for energizing the release magnet M603 of the minor switch 600, the set of switch springs S604 being actuated into engagement when the wiper 601 of the minor switch 600 is driven one step in the clockwise direction away from its normal position. When thus energized the release magnet M603 operates, thereby to release the wiper 601 of the minor switch 600 and to cause it to be returned to its normal position.

In view of the foregoing explanation of the mode of operation of the timer relays R570 and R580 under the control of the operated control relay R610 to energize intermittently the rotary magnet M602 of the minor switch 600, it will be understood that the wiper 601 of the minor switch 600 is advanced step by step in the clockwise direction following the first digit while the control relay R610 occupies its operated position. Accordingly, in the event there is a considerable time interval between the dialing of the first digit 2 and the second digit 2 upon the dial D441, the wiper 601 of the minor switch 600 will be driven a number of steps in the clockwise direction away from its normal position before the second digit 2 is dialed in order to effect the restoration of the control relay R610 and the consequent release of the minor switch 600, in the manner previously explained. In this event, when there is a considerable time interval between the dialing of the first digit 2 and the second digit 2, the wiper 601 of the minor switch 600 is driven into engagement with the fifth contact in the associated contact bank, whereby a circuit, including the contacts 554 and the wiper 601 of the minor switch 600 and the engaged fifth contact in the associated contact bank, is completed for energizing the winding of the release relay R630. When thus energized the release relay R630 operates to complete, at the contacts 634, an obvious holding circuit, including the contacts 554, for energizing the winding thereof. Further the release relay R630 interrupts, at the contacts 632, the previously traced local circuit for energizing the winding of the line relay R510, thereby to cause the latter relay to restore. Also the release relay R630 interrupts, at the contacts 633, the previously traced holding circuit for energizing the winding of the control relay R610, thereby to cause the latter relay to restore.

Upon restoring, the line relay R510 interrupts, at the contacts 511, the previously traced circuit for energizing the winding of the hold relay R540, thereby to cause the latter relay to restore shortly thereafter, the latter relay being of the slow-to-release type. Upon restoring, the hold relay R540 interrupts, at the contacts 541, a further point in the previously traced original circuit for energizing the winding of the series relay R590 in series with the rotary magnet M587; and completes, at the contacts 542, a circuit, including the contacts 535, 512 and 688 and the set of switch springs S595, for energizing the release magnet M588 of the Strowger mechanism 700. When thus energized the release magnet M588 operates to complete, at the contacts 589, an obvious holding circuit, including the set of switch springs S595, for energizing the latter magnet and to release the wiper set of the Strowger mechanism 700 and to cause it to be returned to its normal position. When the wiper set of the Strowger mechanism 700 is thus released the sets of switch springs S591, S592 and S595 are actuated. More particularly, the set of switch springs S595 is actuated into disengagement, thereby to interrupt the previously traced holding circuit for energizing the release magnet M588, whereupon the latter magnet restores.

Also, upon restoring, the hold relay R540 completes, at the contacts 545, multiple circuits substantially identical to those previously traced for energizing the windings of the timer relays R570 and R580 and the rotary magnet M602 of the minor switch 600. Accordingly the rotary magnet M602 continues to operate and restore intermittently, thereby to drive the wiper 601 of the minor switch 600 additional steps in the clockwise direction. When the wiper 601 engages the ninth contact in the associated contact bank an obvious path, including the contacts 554 and the resistor 576, is completed for short-circuiting the winding of the control relay R550, thereby to cause the latter relay to restore. Upon restoring, the control relay R550 interrupts, at the contacts 554, the previously mentioned path for short-circuiting the winding thereof and the previously traced multiple holding circuits for energizing the windings of the busy relay R520 and the release relay R630, thereby to cause the latter relays to restore. Upon restoring, the busy relay R520 interrupts, at the contacts 522, the previously traced path for applying positive battery potential to the control conductor C113; and completes, at the contacts 521, the previously traced path for applying negative battery potential by way of the winding of the cut-in relay R530 to the control conductor C113; whereby the station 21 is again marked as idle to the master selector 1500 and the various station selectors having access thereto.

Upon restoring, the release relay R630 recompletes, at the contacts 632, the previously traced local circuit for energizing the winding of the line relay R510, thereby to cause the latter relay to reoperate. Upon reoperating, the line relay R510 recompletes, at the contacts 511, the previously traced circuit for energizing the winding of the hold relay R540, thereby to cause the latter

relay to reoperate. Upon reoperating, the hold relay R540 completes, at the contacts 544, the previously traced circuit, including the contacts 613 and the set of switch springs S604, for energizing the release magnet M603 of the minor switch 600. When thus energized the release magnet M603 operates, thereby to release the wiper 601 of the minor switch 600 and to cause it to be returned to its normal position; whereupon the set of switch springs S604 is actuated in order to interrupt the previously traced circuit for energizing the release magnet M603. At this time the line relay R510 and the hold relay R540 in the station selector 500 occupy their operated positions; while the Strowger mechanism 700 and the minor switch 600 are completely released. Accordingly, at this time, the station selector 500 is completely released and in readiness for further use.

Continuing now with the operation of the station selector and assuming that the second digit 2 is dialed shortly following the first digit 2, in the manner explained above, at the conclusion of the second digit 2, the line relay R510 reoperates and the wiper set of the Strowger mechanism 700 is driven two steps in the rotary direction. Accordingly, at this time, the wiper set of the Strowger mechanism 700 engages the second contact set in the second level in the associated contact bank and, shortly thereafter, the series relay R590 restores; the latter relay being of the slow-to-release type, remains operated during impulsing and a short time interval thereafter, as noted above. Upon restoring, the series relay R590 interrupts, at the contacts 591, a further point in the previously traced alternative circuit for energizing the winding thereof in series with the rotary magnet M587; and interrupts, at the contacts 595, the previously traced circuit for energizing the winding of the digit relay R670; however, the digit relay R670 does not immediately restore as it is of the slow-to-release type. Also the series relay R590 prepares, at the contacts 594, a further point in the previously mentioned circuit for energizing the winding of the control relay R620 in series with the upper winding of the switch-through relay R680; and completes, at the contacts 593, a test circuit between the control wiper 703 of the wiper set of the Strowger mechanism 700 and the winding of the test relay R660. The above-mentioned test circuit extends from the control wiper 703 of the wiper set by way of the contacts 673, 687 and 593 and the winding of the test relay R660 to the negative terminal of battery.

In the event the line extending to the called station 22 is busy at this time, positive battery potential appears upon the control conductor C114 thereof and is applied to the control wiper 703 of the wiper set, thereby to complete a circuit substantially identical to the test circuit traced above for energizing the winding of the test relay R660 in order to cause the latter relay to operate. Upon operating, the test relay R660 completes, at the contacts 664, an obvious circuit, including the contacts 651, for energizing the winding of the lamp control relay R450, thereby to cause the latter relay to operate. Also the test relay R660 completes, at the contacts 665, an obvious circuit, including the resistor 628, for energizing the winding of the flash relay R650, thereby to cause the latter relay to operate shortly thereafter, the flash relay R650 being of the slow-to-operate type. Upon operating, the flash relay R650 completes, at the contacts 652, an obvious path for short-circuiting the winding thereof, whereby the latter relay restores shortly thereafter. Accordingly the flash relay R650 operates and restores intermittently, thereby to interrupt and then to recomplete, at the contacts 651, the previously traced circuit for energizing the winding of the lamp control relay R450. Hence, the lamp control relay R450 operates and restores intermittently, thereby to effect flashing of the supervisory lamp L446, in an obvious manner, in order to indicate to the operator at the calling station 21 that the desired connection to the called station 22 may not be had at this time due to the busy condition of the last-mentioned station.

Shortly following the restoration of the series relay R590 and the operation of the test relay R660, in the manner described above, the digit relay R670 restores, as previously noted. Upon restoring, the digit relay R670 completes, at the contacts 674, a holding circuit for energizing the winding of the test relay R660, this circuit extending from the positive terminal of battery by way of the set of switch springs S591, the contacts 633, 594, 613, 662, 674, 687 and 593 and the winding of R660 to the negative terminal of battery. Also the digit relay R670 interrupts, at the contacts 673, the previously traced test circuit for energizing the winding of the test relay R660; and prepares, at the contacts 672, a further point in the previously mentioned circuit for energizing the upper winding of the switch-through relay R680 in series with the winding of the control relay R620.

When the operator at the calling station 21 observes the flashing of the supervisory lamp L446, indicating the busy condition of the called station 22, he effects the release of the station selector 500 by operating the release key K442. When the release key K442 is thus operated the previously traced circuit for energizing the winding of the line relay R510 is interrupted, thereby to cause the latter relay to restore in order to effect the restoration of the hold relay R540 shortly thereafter, the latter relay being of the slow-to-release type as previously noted. Upon restoring, the hold relay R540 completes, at the contacts 542, the previously traced circuit for energizing the release magnet M588, thereby to cause the latter magnet to operate and complete, at the contacts 589, the previously traced holding circuit for energizing the release magnet M588. Also, upon operating, the release magnet M588 releases the wiper set of the Strowger mechanism 700 and causes it to be returned to its normal vertical and rotary positions, whereupon the sets of switch springs S591, S592 and S595 are actuated, as previously noted. More particularly, the set of switch springs S595 is actuated into disengagement, thereby to interrupt the previously traced holding circuit for energizing the release magnet M588 in order to cause the latter magnet to restore. Also the hold relay R540 completes, at the contacts 545, the previously traced alternative multiple circuits for energizing the windings of the timer relays R570 and R580 and the rotary magnet M602 of the minor switch 600; whereby the timer relays R570 and R580 operate through successive cycles, as previously explained, in order to cause the rotary magnet M602 to operate and restore intermittently, whereby the wiper 601 of the minor switch 600 is advanced step by step in the clockwise direction away from its normal position. When the wiper 601 of the minor switch 600 engages the

fifth contact in the associated contact bank the previously traced circuit for energizing the winding of the release relay R630 is completed, thereby to cause the latter relay to operate, in the manner previously explained. Subsequently, when the wiper 601 of the minor switch 600 engages the ninth contact in the associated contact bank the previously traced path for short-circuiting the winding of the control relay R550 is completed, thereby to cause the latter relay to restore in order to effect the restoration of the busy relay R520, the timer relays R580 and R570 and the release relay R630, in the manner previously explained.

Also the set of switch springs S591 is actuated into disengagement when the wiper set of the Strowger mechanism 700 is released, thereby to interrupt the previously traced holding circuit for energizing the winding of the test relay R660, whereupon the latter relay restores. Upon restoring, the test relay R660 interrupts, at the contacts 664, the previously traced circuit for energizing intermittently the winding of the lamp control relay R450. However, prior to the restoration of the control relay R550 and the consequent restoration of the release relay R630, the line relay R510 occupies its restored position, whereby there is completed, at the contacts 513, the previously traced original operating circuit for energizing the winding of the lamp control relay R450. Accordingly the relay R450 is first operated intermittently; and then after the release of the station selector 500 is initiated the lamp control relay R450 is operated steadily, whereby the flashing of the supervisory lamp L446 is arrested and this supervisory lamp is illuminated steadily. Also the test relay R660 interrupts, at the contacts 665, the previously traced circuit for energizing the winding of the flash relay R650, thereby to arrest further operation of the latter relay.

Upon restoring, the release relay R630 recompletes, at the contacts 632, the previously traced local circuit for energizing the winding of the line relay R510, assuming that the release key K442 at the station 21 occupies its closed position at this time. When thus energized the line relay R510 reoperates in order to effect reoperation of the hold relay R540, in the manner previously explained. Also the line relay R510 interrupts, at the contacts 513, the previously traced circuit for steadily energizing the winding of the lamp control relay R450, thereby to cause the latter relay to restore and extinguish the supervisory lamp L446, in the manner previously explained. Upon reoperating, the hold relay R540 completes, at the contacts 544, the previously traced circuit for energizing the release magnet M603, thereby to cause the latter magnet to operate and release the wiper 601 of the minor switch 600, whereupon the wiper 601 is returned to its normal position. When the minor switch 600 is thus released the set of switch springs S604 is actuated into disengagement, thereby to interrupt the previously traced circuit for energizing the release magnet M603, whereupon the latter magnet restores. Upon restoring, the busy relay R520 interrupts, at the contacts 522, the previously traced path for applying positive battery potential to the control conductor C113; and completes, at the contacts 521, the previously traced path for applying negative battery potential by way of the winding of the cut-in relay R530 to the control conductor C113, whereby the station 21 is marked as idle to the master selector 1500 and the various station selectors having access thereto. At this time the station selector 500 is completely released.

Continuing now with the operation of the station selector 500, and assuming that the called station 22 is idle at this time, when the wiper set of the Strowger mechanism 700 engages the second contact in the second level of the associated contact bank the previously traced test circuit, including the control wiper 703 of the wiper set and the winding of the test relay R660, is completed incident to the restoration of the series relay R530 shortly following the conclusion of the second digit 2, in the manner previously explained. However, in this event, negative battery potential appears upon the control conductor C114 terminated by the control contact engaged by the control wiper 703 of the wiper set of the Strowger mechanism 700 due to the idle condition of the station 22, as noted above. More particularly, negative battery potential is applied by way of the winding of the cut-in relay R930 in the station selector 900, individually associated with the called station 22, and the contacts 921 to the control conductor C114. The application of negative battery potential to the control conductor C114 and consequently to the control wiper 703 of the wiper set of the Strowger mechanism 700 completes a path substantially identical to the previously traced test circuit for short-circuiting the winding of the test relay R660, thereby positively to prevent operation of the latter relay at this time. More particularly, the path for short-circuiting the winding of the test relay R660 extends from the control wiper 703 of the wiper set of the Strowger mechanism 700, having negative battery potential thereon, by way of the contacts 673, 687 and 593, and the winding of R660 to negative battery potential.

Shortly following the second digit 2 the digit relay R670 restores, the latter relay being of the slow-to-release type, as previously noted. Upon restoring, the digit relay R670 interrupts, at the contacts 673, the previously traced path for short-circuiting the winding of the test relay R660; and completes, at the contacts 672, a series circuit for energizing the upper winding of the switch-through relay R680 and the winding of the control relay R620. The above-mentioned series circuit extends from the positive terminal of battery by way of the set of switch springs S591, the contacts 633, 594, 613 and 661, the winding of R620, the upper winding of R680 and the contacts 672 to the control wiper 703 of the wiper set of the Strowger mechanism 700, negative battery potential being connected to the control wiper 703 of the wiper set, as previously noted. When this series circuit is completed the control relay R620 operates immediately and the switch-through relay R680 operates partially shortly thereafter, the switch-through relay R680 being of the slow-to-operate type. Upon operating, the control relay R620 interrupts, at the contacts 621, a previously completed path, including the contacts 522 and 416, for applying positive battery potential to one terminal of the lower winding of the loop relay R410 in the station line circuit 400, individually associated with the calling station 21, for a purpose more fully explained hereinafter.

Upon operating partially, the switch-through relay R680 completes, at the contacts 689, a holding circuit, including the set of switch springs S591 and the contacts 633, for energizing the lower winding thereof. When the above-traced holding circuit for energizing the lower winding

of the switch-through relay R680 is thus completed the latter relay operates fully, the switch-through relay R680 being of the two-step type. Upon operating fully, the switch-through relay R680 interrupts, at the contacts 688, a further point in the previously traced circuit for energizing the release magnet M588 of the Strowger mechanism 700; and interrupts, at the contacts 687, a further point in the previously traced test circuit including the control wiper 703 of the wiper set of the Strowger mechanism 700 and the winding of the test relay R660. Also the switch-through relay R680 completes, at the contacts 686, an obvious path, including the set of switch springs S591, for applying positive battery potential to the control wiper 703 of the wiper set of the Strowger mechanism 700, for a purpose more fully explained hereinafter. Also the switch-through relay R680 completes, at the contacts 686, a path for short-circuiting the upper winding thereof in series with the winding of the control relay R620. The last-mentioned path extends from the contacts 686 by way of the contacts 672, the upper winding of R680, the winding of R620, the contacts 661, 613, 594 and 633 back to the contacts 686. When the above-traced path is completed the control relay R620 restores in order to recomplete, at the contacts 621, the previously traced path for applying positive battery potential to one terminal of the lower winding of the loop relay R410 in the station line circuit 400, individually associated with the calling station 21, for a purpose more fully explained hereinafter.

Further the switch-through relay R680 interrupts, at the contacts 681, 682 and 685, points in the previously traced local circuit for energizing the winding of the line relay R510, thereby to cause the latter relay to restore. Upon restoring, the line relay R510 interrupts, at the contacts 511, the previously traced circuit for energizing the winding of the hold relay R540, thereby to cause the latter relay to restore shortly thereafter, in the manner previously explained. Also, upon restoring, the line relay R510 completes, at the contacts 513, the previously traced circuit for energizing the winding of the lamp control relay R450, thereby to cause the latter relay to operate and complete the previously mentioned circuit for illuminating the supervisory lamp L446. Upon restoring, the hold relay R540 completes, at the contacts 545, the previously traced multiple circuits for energizing the windings of the timer relays R570 and R580 and the rotary magnet M602 of the minor switch 600, whereby the timer relays R570 and R580 operate through succeeding cycles in order to cause intermittent operation of the rotary magnet M602 and the consequent rotation of the wiper 601 of the minor switch 600 step by step in the clockwise direction, all in the manner previously explained. When the wiper 601 of the minor switch 600 engages the second contact in the associated contact bank a circuit, including the contacts 554 and 680, is completed for energizing the winding of the switching relay R640, thereby to cause the latter relay to operate. Upon operating, the switching relay R640 completes, at the contacts 643, a holding circuit, including the set of switch springs S591 and the contacts 633 and 680, for energizing the winding thereof.

At this time the wiper set of the Strowger mechanism 700 engages the second contact set in the second level in the associated contact bank terminating the line conductors C111 and C112 and the control conductor C114 extending to the called station 22; and positive battery potential was applied to the control conductor C703 at the contacts 686 incident to the full operation of the switch-through relay R680, as previously explained. The application of positive battery potential to the control wiper 703 of the wiper set of the Strowger mechanism 700 completes an obvious circuit, including the control conductor C114 and the contacts 921, for energizing the winding of the cut-in relay R930 in the station selector 900 individually associated with the called station 22. Shortly after the cut-in relay R930 is thus energized it operates, the cut-in relay R930 being of the slow-to-operate type. Upon operating, the cut-in relay R930 interrupts, at the contacts 931 and 933, the previously traced local circuit for energizing the winding of the line relay R910, thereby to cause the latter relay to restore. Also, upon operating, the cut-in relay R930 completes, at the contacts 932 and 934, a connection between the called station 22 and the line conductors C111 and C112, this connection extending from the line conductor C111 by way of the contacts 934, the winding of the line relay R910, the contacts 813, the printer magnet M844, the transmitter T843, the release key K842, the dial D841 and the contacts 811, 821 and 932 to the line conductor C112. Also the cut-in relay R930 completes, at the contacts 936, an obvious circuit for energizing the winding of the motor start relay R860, thereby to cause the latter relay to operate and complete, at the contacts 861, an obvious circuit for energizing the operating motor M845, thereby to condition the combined transmitting-receiving printer P22 to receive telegraphic signals. Also, upon restoring, the line relay R910 interrupts, at the contacts 911, the previously traced circuit for energizing the winding of the hold relay R940, thereby to cause the latter relay to restore shortly thereafter. Further the line relay R910 completes, at the contacts 913, an obvious circuit for energizing the winding of the lamp control relay R850, thereby to cause the latter relay to operate and complete, at the contacts 851, an obvious circuit for illuminating the supervisory lamp L846. The illumination of the supervisory lamp L846 indicates to the operator at the called station 22 that this station has been seized and that the combined transmitting-receiving printer P22 will receive a telegraphic message shortly thereafter.

Continuing now with the operation of the station selector 500 individually associated with the calling station 21, it is noted that, upon operating, the switching relay R640 completes, at the contacts 641 and 642, an operative connection between the calling station 21 and the called station 22. The above-mentioned connection extends from the positive terminal of the battery 629 by way of the contacts 631, 641, 531, 421 and 411, the dial D441, the release key K442, the transmitter T443, the printer magnet M444, the contacts 413, the winding of the line relay R510, the contacts 533, 632 and 642, the line wiper 701 of the wiper set of the Strowger mechanism 700, the line conductor C112, the contacts 932, 821 and 811, the dial D841, the release key K842, the transmitter T843, the printer magnet M844, the contacts 813, the winding of the line relay R910, the contacts 934, the line conductor C111, the line wiper 702 of the wiper set of the Strowger mechanism 700, the contacts 683 and 684, the contacts 691 of the set of switch springs S690 and the impedance 626 to the negative terminal of the

battery 629. When this series circuit is completed the line relay R510 in the station selector 500 and the line relay R910 in the station selector 900 operate. Upon operating, the line relay R910 interrupts, at the contacts 913, the previously traced circuit for energizing the winding of the lamp control relay R850, thereby to cause the latter relay to restore and extinguish the supervisory lamp L846. When the lamp L846 is thus extinguished it indicates to the operator at the called station 22 that this station has been completely seized and that shortly thereafter the combined transmitting-receiving printer P22 will receive the telegraphic message.

Upon operating, the line relay R510 in the station selector 500 recompletes, at the contacts 511, the previously traced circuit for energizing the winding of the hold relay R540, thereby to cause the latter relay to reoperate. Upon reoperating, the hold relay R540 interrupts, at the contacts 545, the previously traced multiple circuits for energizing the windings of the timer relays R570 and R580 and the winding of the rotary magnet M602 of the minor switch 600, thereby positively to arrest further operation of the timer relays R570 and R580 and the minor switch 600. Also the hold relay R540 completes, at the contacts 544, the previously traced circuit for energizing the release magnet M603, thereby to cause the latter magnet to operate and release the wiper 601 of the minor switch 600, whereupon the wiper 601 is returned to its normal position. When the minor switch 600 is thus released the set of switch springs S604 is actuated, thereby to interrupt the previously traced circuit for energizing the release magnet M603 in order to cause the latter magnet to restore. Also, upon reoperating, the line relay R510 interrupts, at the contacts 513, the previously traced circuit for energizing the winding of the lamp control relay R450, thereby to cause the latter relay to restore and extinguish the supervisory lamp L446. Accordingly the supervisory lamp L446 is first illuminated and then extinguished a short time interval thereafter under the control of the minor switch 600 incident to the switching through of the station selector 500, which control of the supervisory lamp L446 serves as an answer-back signal to the operator at the calling station 21.

At this time an operative connection is completed between the calling station 21 and the called station 22; the calling station 21 is marked as busy to the master selector 1500 and the various station selectors having access thereto by the application of positive battery potential to the control conductor C113; and the called station 22 is marked as busy to the master selector 1500 and the various station selectors having access thereto by the application of positive battery potential to the control conductor C114. At this time the operator at the calling station 21 operates the transmiter T443, whereby the telegraphic signals are transmitted over the above-traced operative connection in order to cause the printer magnet M444 and the printer magnet M844 to follow the telegraphic signals in the usual manner. The printer magnet M444 following the telegraphic signals produces a printed record of the telegraphic message transmitted from the calling station 21; and the printer magnet M844 following the telegraphic signals produces a printed record of the telegraphic message received at the called station 22. Of course, it will be understood that at any time the operator at the called station 22 may operate his transmitter T843 in order to transmit a telegraphic message or answer from the called station 22 back to the calling station 21. In this event the printer magnets M844 and M444 follow the telegraphic signals and respectively produce printed records of the telegraphic message transmitted from the called station 22 and received at the calling station 21.

The established connection between the calling station 21 and the called station 22 may be released under the control of either the operator at the calling station 21 or the operator at the called station 22. More particularly, the operator at the calling station 21 may release the established connection by operating the release key K442; while the operator at the called station 22 may release the established connection by operating the release key K842. When either of the release keys mentioned is operated the previously traced operating connection is interrupted, thereby to effect the restoration of the line relay R510 in the station selector 500 and the line relay R910 in the station selector 900. Upon restoring, the line relay R510 interrupts, at the contacts 511, the previously traced circuit for energizing the winding of the hold relay R540, thereby to cause the latter relay to restore shortly thereafter. Upon restoring, the hold relay R540 completes, at the contacts 545, the previously traced multiple circuits for energizing the windings of the timer relays R570 and R580 and the rotary magnet M602 of the minor switch 600; whereby the timer relays R570 and R580 operate through successive cycles in order to cause intermittent operation of the rotary magnet M602, whereupon the wiper 601 of the minor switch 600 is advanced step by step in the clockwise direction. When the wiper 601 engages the fifth contact in the associated contact bank the previously traced circuit for energizing the winding of the release relay R630 is completed, thereby to cause the latter relay to operate. Upon operating, the release relay R630 completes, at the contacts 634, the previously traced holding circuit for energizing the winding thereof; interrupts, at the contacts 631 and 632, further points in the previously traced operative connection between the calling station 21 and the called station 22; and interrupts, at the contacts 633, the previously traced holding circuit for energizing the winding of the switching relay R640 and the previously traced holding circuit for energizing the lower winding of the switch-through relay R680, thereby to cause the latter relays to restore. Upon restoring, the switch-through relay R680 completes, at the contacts 688, the previously traced circuit for energizing the release magnet M588 of the Strowger mechanism 700, thereby to cause the latter magnet to operate. Upon operating, the release magnet M588 completes, at the contacts 589, the previously traced holding circuit for energizing the last-mentioned magnet and releases the wiper set of the Strowger mechanism 700, whereupon the last-mentioned wiper set is returned to its normal vertical and rotary positions. When the wiper set of the Strowger mechanism 700 is thus released the sets of switch springs S591, S592 and S595 are actuated. More particularly, the set of switch springs S595 is actuated into disengagement, thereby to interrupt the previously traced holding circuit for energizing the release magnet M588, whereupon the latter magnet restores. Subsequently, when the wiper 601 of the minor switch 600 engages the ninth contact in the associated contact bank

the previously traced path for short-circuiting the winding of the control relay R550 is completed, thereby to cause the latter relay to restore. Upon restoring, the control relay R550 interrupts, at the contacts 554, the previously traced multiple holding circuits for energizing the windings of the busy relay R520 and the release relay R630, thereby to cause the latter relays to restore. Further the control relay R550 interrupts, at the contacts 553, the previously traced multiple circuits for energizing the windings of the timer relays R570 and R580 and the rotary magnet M602 of the minor switch 600, thereby to arrest further operation of the timer relays R570 and R580 and the rotary magnet M602 of the minor switch 600.

Upon restoring, the release relay R630 recompletes, at the contacts 631 and 632, the previously traced local circuit for energizing the winding of the line relay R510, thereby to cause the latter relay to reoperate in order to effect reoperation of the hold relay R540, in the manner previously explained. Upon reoperating, the hold relay R540 completes, at the contacts 544, the previously traced circuit for energizing the release magnet M603; thereby to cause the latter magnet to operate and release the wiper 601 of the minor switch 600, whereupon the last-mentioned wiper is returned to its normal position. When the minor switch 600 is thus released the set of switch springs S604 is actuated into disengagement, thereby to interrupt the previously traced circuit for energizing the release magnet M603 in order to cause the latter magnet to restore. Also, upon restoring, the busy relay R520 interrupts, at the contacts 522, the previously traced path for applying positive battery potential to the control conductor C113; and completes, at the contacts 521, the previously traced path for applying negative battery potential by way of the winding of the cut-in relay R530 to the control conductor C113. Also when the control relay R550 restores it interrupts, at the contacts 551, the previously traced circuit for energizing the winding of the motor start relay R460, thereby to cause the latter relay to restore and interrupt the previously traced circuit for energizing the operating motor M445 of the combined transmitting-receiving printer P21. Further, upon reoperating, the line relay R510 interrupts, at the contacts 513, the previously traced circuit for energizing the winding of the lamp control relay R450, thereby to cause the latter relay to restore and interrupt the previously mentioned circuit for illuminating the supervisory lamp L446. When the supervisory lamp L446 is thus extinguished it indicates to the operator at the calling station 21 that the individually associated station selector 500 is completely released. At this time the station selector 500 is completely released and is marked as idle to the master selector 1500 and the various station selectors having access thereto.

When the station selector 500 individually associated with the calling station 21 is released, in the manner explained above, positive battery potential is removed from the control conductor C114, thereby to interrupt the previously traced circuit for energizing the winding of the cut-in relay R930 in the station selector 900, whereupon the latter relay restores. Upon restoring, the cut-in relay R930 interrupts, at the contacts 932 and 934, the previously traced connection between the called station 22 and the line conductors C111 and C112; and recompletes, at the contacts 931 and 933, the previously traced local circuit for energizing the winding of the line relay R910, whereupon the latter relay reoperates. Upon reoperating, the line relay R910 recompletes, at the contacts 911, the previously traced circuit for energizing the winding of the hold relay R940, thereby to cause the latter relay to reoperate. Also, upon restoring, the cut-in relay R930 interrupts, at the contacts 936, the previously traced circuit for energizing the winding of the motor start relay R860, thereby to cause the latter relay to restore and interrupt the previously mentioned circuit for energizing the operating motor M845 of the combined transmitting-receiving printer P22. Also, upon reoperating, the line relay R910 interrupts, at the contacts 913, the previously traced circuit for energizing the winding of the lamp control relay R850, thereby to cause the latter relay to restore and interrupt the previously traced circuit for illuminating the supervisory lamp L846. When the supervisory lamp L846 is thus extinguished it indicates to the operator at the called station 22 that the individually associated station selector 900 is completely released. Also when positive battery potential is removed from the control conductor C114 negative battery potential is again applied by way of the winding of the cut-in relay R930 thereto, whereby the called station 22 is marked as idle to the master selector 1500 and the various station selectors having access thereto.

In the foregoing explanation of the mode of operation of the station selector 500 to extend the connection from the calling station 21 to the called station 22, it was assumed that, incident to the operation of the switching relay R640, the above-traced operative connection was completed between the calling station 21 and the called station 22; whereby the line relay R510 in the station selector 500 was reoperated in order to effect reoperation of the hold relay R540 and the consequent termination of the answer-back signal incident to the switching through of the station selector 500. However, it may occur that this operative connection between the calling station 21 and the called station 22 is not completed incident to the operation of the switching relay R640 in the event the line conductors C111 and C112 are open-circuited, or in the event the apparatus at the called station 22 is in an open-circuit condition. In the last-mentioned event, upon operating, the switching relay R640 only prepares, at the contacts 641 and 642, the previously traced operative connection between the calling station 21 and the called station 22; and the line relay R510 and the hold relay R540 are not reoperated incident to the operation of the switching relay R640, in the manner explained above. Accordingly, in this event, the timer relays R570 and R580 continue to operate, whereby the wiper 601 of the minor switch 600 is advanced additional steps in the clockwise direction, in the manner previously explained, whereupon the wiper 601 ultimately engages the fifth contact in the associated contact bank. When the wiper 601 of the minor switch 600 engages the fifth contact in the associated contact bank the previously traced circuit for energizing the winding of the release relay R630 is completed, thereby to cause the latter relay to operate. Upon operating, the release relay R630 completes, at the contacts 634, the previously traced holding circuit for energizing the winding thereof; interrupts, at the contacts 631 and 632,

additional points in the previously traced operative connection between the calling station 21 and the called station 22; and interrupts, at the contacts 633, the previously traced multiple holding circuits for energizing the winding of the switching relay R640 and the lower winding of the switch-through relay R680, thereby to cause the latter relays to restore. Upon restoring, the switch-through relay R680 completes, at the contacts 688, the previously traced circuit for energizing the release magnet M588 of the Strowger mechanism 700. When thus energized the release magnet M588 operates to effect the release of the wiper set of the Strowger mechanism 700, in the manner previously explained. Subsequently, the wiper 601 of the minor switch 600 engages the ninth contact in the associated contact bank, thereby to effect the restoration of the control relay R550, the busy relay R520, the timer relays R570 and R580 and the release relay R630, in the manner previously explained. Upon restoring, the release relay R630 recompletes, at the contacts 631 and 632, the previously traced local circuit for energizing the winding of the line relay R510, whereby the latter relay reoperates in order to effect reoperation of the hold relay R540, in the manner previously explained. Upon reoperating, the hold relay R540 effects the release of the minor switch 600, in the manner previously explained. At this time, the station selector 500 is completely released and the calling station 21 is marked as idle to the master selector 1500 and the various station selectors having access thereto, all in the manner previously explained.

In view of the foregoing explanation of the mode of operation of the station selector 500, it will be understood that, in the event the wiper set of the Strowger mechanism 700 seizes a line extending to an idle called station, which line is open-circuited, the station selector 500 is automatically released.

Station to associated loop call

Considering now the extension of a connection from a station in any group to a plurality of stations in the same group by way of the associated loop, the operator at the calling station first initiates the call by dialing the group call digit identifying the associated group or loop in conjunction with a combination call digit identifying the particular called combination of stations to which the call is to be extended in the associated group by way of the associated loop. For example, assuming that a call is to be extended from the calling station 21 in the first group to the first three stations 21, 22 and 23 in the first group by way of the associated first loop, the operator at the calling station 21 first initiates the call by dialing the group call digit 6 identifying the associated first group or loop in conjunction with the combination call digit 2 identifying the particular called combination of stations 21, 22 and 23 to which the call is to be extended in the associated first group by way of the associated first loop. At this point it is noted that the calling station 21 happens also to be one of the called stations in the called combination in the first group; however, the operation of the equipment is independent of whether the calling station happens also to be in the called combination in the first group, as is explained more fully hereinafter.

The station selector 500 responds to the group call digit 6 and the combination call digit 2, in the manner previously explained, whereby the wiper set of the Strowger mechanism 700 engages the second contact set in the sixth level in the associated contact bank, in an obvious manner. Also it is noted that, when the wiper set of the Strowger mechanism 700 is moved in the vertical direction to the sixth level in the associated contact bank, the set of switch springs S690 is actuated. More particularly, there is interrupted, at the contacts 691 of the set of switch springs S690, a further point in the previously traced operating circuit including the impedance 626; and there is prepared, at the contacts 692 of the set of switch springs S690, a point in an operating circuit, including the impedance 627. In other words, when the set of switch springs S690 is actuated the impedance 627 is substituted for the impedance 626 when the operating circuit traced hereinafter is ultimately completed. It is noted that the impedance 626 is of relatively high value; while the impedance 627 is of relatively low value. Accordingly the impedance 627 of relatively low value is substituted for the impedance 626 of relatively high value in view of the fact that the ultimate operating circuit to be completed will include the first loop which is of inherently high impedance.

Shortly following the second digit 2 the series relay R590 restores, thereby to complete the previously traced test circuit including the control wiper 703 of the wiper set of the Strowger mechanism 700 and the winding of the test relay R660. At this time positive battery potential appears upon the control conductor C118 in the event the first loop is busy; whereby the test relay R660 is operated in order to cause busy supervision to be returned to the calling station 21, in the manner previously explained. On the other hand, in the event the first loop is idle at this time, negative battery potential appears upon the control conductor C118, whereby the previously traced path for short-circuiting the winding of the test relay R660 is completed. The path for applying negative battery potential to the control conductor C118 is completed in the first loop equipment 300 and extends from the negative terminal of battery by way of the winding of the busy relay R310, the winding of the group relay 3G and the contacts 324 to the control conductor C118.

Accordingly, when the first loop is idle the test relay R660 is not operated and shortly following the second digit 2 the digit relay R670 restores in order to complete, at the contacts 672, the previously traced series circuit for energizing the winding of the control relay R620 and the upper winding of the switch-through relay R680, whereupon the control relay R620 operates and the switch-through relay R680 operates first partially and then fully, all in the manner previously explained. When the switch-through relay R680 fully operates it completes, at the contacts 686, the previously traced path for applying positive battery potential to the control wiper 703 of the wiper set of the Strowger mechanism 700, whereby positive battery potential is applied to the control conductor C118, in an obvious manner, thereby to complete a series circuit substantially identical to that previously traced for energizing the winding of the group relay 3G and the busy relay R310. When the group relay 3G and the busy relay R310 are thus energized they operate. Upon operating, the group relay 3G completes, at the contacts 3G8, an obvious holding circuit substantially identical to that previ-

ously traced for energizing the winding thereof in series with the winding of the busy relay R310. Also the group relay 3G completes, at the contacts 3G7, 3G6, etc., obvious paths, including the terminal block 301, for applying positive battery potential to the conductors C121, C122, C124, C125, C301 and C302. At this point it is noted that the conductors C121 and C122 extend to the station line circuit 400 individually associated with the called station 21; the conductors C124 and C125 extend to the station line circuit 800 individually associated with the called station 22; and, the conductors C301 and C302 extend to the station line circuit, not shown, individually associated with the called station 23, not shown.

The application of positive battery potential to the conductor C121 completes a circuit, including the resistor 433, for energizing the lower winding of the loop relay R410 in the station line circuit 400 individually associated with the calling station 21 in view of the fact that the station 21 is also a called station, as previously noted. It is pointed out that the application of positive battery potential to the conductor C121 completes the above-traced circuit for energizing the lower winding of the loop relay R410 due to the operated position of the control relay R620. More particularly, the operated control relay R620 interrupts, at the contacts 621, the previously traced path for applying positive battery potential by way of the contacts 522 and 416 to one terminal of the lower winding of the loop relay R410. This arrangement permits the lower winding of the loop relay R410 to be energized, whereupon the latter relay operates at this time. Upon operating, the loop relay R410 interrupts, at the contacts 416, a further point in the previously traced path, including the contacts 522, for applying positive battery potential to one terminal of the lower winding thereof. Shortly after the loop relay R410 in the station line circuit 400 operates, in the manner described above, the control relay R620 in the station selector 500 restores; the latter relay being short-circuited in series with the upper winding of the switch-through relay R680 incident to the operation of the switch-through relay R680, in the manner previously explained. Upon restoring, the control relay R620 completes, at the contacts 621, a connection between the conductors C113 and C122; this connection extending from the control conductor C113 by way of the contacts 621, 417 and 423 to the conductor C122. Accordingly the positive battery potential applied to the conductor C122 is connected to the control conductor C113, thereby positively to insure that the called station 21 is marked as busy to the master selector 1500 and the various station selectors having access thereto. Also it is noted that, upon operating, the loop relay R410 in the station line circuit 400 interrupts, at the contacts 418, a point in a circuit, including the conductor C122 and traced hereinafter, for energizing the winding of the release relay R340 in the first loop equipment 300, thereby positively to prevent operation of the release relay R340 in the first loop equipment 300 under the control of the station line circuit 400.

Continuing now with the operation of the first loop equipment 300, upon operating, the busy relay R310 completes, at the contacts 311, an obvious circuit for energizing the winding of the busy slave relay R320, thereby to cause the latter relay to operate shortly thereafter, the busy slave relay R320 being of the slow-to-operate type. Upon operating, the busy slave relay R320 interrupts, at the contacts 322, 324, etc., and 326, the previously traced paths for applying negative battery potential by way of the winding of the busy relay R310 and the windings of the respective group relays 2G, 3G, etc., and 8G to the respective control conductors C117, C118, etc., and C119. Further the busy relay R320 completes, at the contacts 321, etc., and 325, paths for applying positive battery potential to the control conductors C117, etc., and C119. The path for applying positive battery potential to the control conductor C117 includes the contacts 2G1 and 321; while the path for applying positive battery potential to the control conductor C119 includes the contacts 8G1 and 325. Accordingly, at this time, positive battery potential is applied to the control conductor C118 by way of the control wiper 703 of the wiper set of the Strowger mechanism 700 in the station selector 500; and positive battery potential is applied in the first loop equipment 300 to the other control conductors C117, etc., and C119. The application of positive battery potential to the control conductors C117, C118, etc., and C119 positively marks each combination in the first group as busy to the master selector 1500 and the station selectors individually associated with the other stations in the first group.

Also, upon operating, the loop relay R410 in the station line circuit 400 interrupts, at the contacts 419, the connection including the impedance element 431 between the conductors C101 and C102 in the first loop; prepares, at the contacts 415, an alternative circuit, including the impedance 432, for energizing the winding of the line relay R510; and interrupts, at the contacts 411 and 413, further points in the previously traced local circuit for energizing the winding of the line relay R510. Finally the loop relay R410 completes, at the contacts 412 and 414, a connection including the combined transmitting-receiving printer P21 between the conductors C101 and C102 in the first loop. Accordingly, at this time, the conductor C101 in the first loop is connected by way of the contacts 412, the dial D441, the release key K442, the transmitter T443, the printer magnet M444 and the contacts 414 to the conductor C102 in the first loop.

Considering now the operation of the station line circuit 800, individually associated with the called station 22, it is pointed out that the subsequent operation of the apparatus depends upon the idle or busy condition of the called station 22. First assuming that the called station 22 is idle at this time, negative battery potential is applied by way of the winding of the cut-in relay R930 and the contacts 921 to the control conductor C114, which negative battery potential is further connected by the contacts 1021 and 816 to one terminal of the lower winding of the loop relay R810 in the station line circuit 800. Accordingly, in this event, the application of positive battery potential to the conductor C124 completes an obvious circuit, including the resistor 833, for energizing the lower winding of the loop relay R810. When thus energized the loop relay R810 operates to interrupt, at the contacts 818, a circuit, including the conductors C125 and C120 and traced hereinafter, for energizing the winding of the release relay R340 in the first loop equipment 300, thereby positively to prevent operation of the latter relay at this time. Also the loop relay R810 completes, at the contacts 817, a connection including the contacts 823 and 1021 between the control conductor C114 and the conductor C125, whereby the positive battery

potential appearing upon the conductor C125 is applied to the control conductor C114. This application of positive battery potential to the control conductor C114 completes an obvious circuit, including the contacts 921, for energizing the winding of the cut-in relay R930 in the station selector 900; thereby to cause the latter relay to operate shortly thereafter, the cut-in relay R930 being of the slow-to-operate type. Also the application of positive battery potential to the control conductor C114 marks the called station 22 as busy to the master selector 1500 and the various station selectors having access thereto.

Also the loop relay R810 in the station line circuit 800 interrupts, at the contacts 816, the previously traced connection between the control conductor C114 and one terminal of the lower winding of the loop relay R810; interrupts, at the contacts 811 and 813, the previously traced local circuit for energizing the winding of the line relay R910; and completes, at the contacts 815, an alternative local circuit, including the impedance 832, for energizing the winding of the line relay R910. The last-mentioned alternative local circuit for energizing the winding of the line relay R910 extends from the positive terminal of the battery 1029 by way of the contacts 1031, 1081, 931 and 815, the impedance element 832, the winding of R910, the contacts 933, 1032, 1082 and 1085 and the resistor 1025 to the negative terminal of the battery 1029. Further the loop relay R810 interrupts, at the contacts 819, the previously traced connection including the impedance element 831 between the conductors C102 and C103 in the first loop; and completes, at the contacts 812 and 814, a connection including the combined transmitting-receiving printer P22 between the conductors C102 and C103 in the first loop. At this time the conductor C102 in the first loop is connected by way of the contacts 812, the dial D841, the release key K842, the transmitter T843, the printer magnet M844 and the contacts 814 to the conductor C103 in the first loop.

Upon operating, the cut-in relay R930 interrupts, at the contacts 931 and 933, the previously traced alternative local circuit for energizing the winding of the line relay R910, thereby to cause the latter relay to restore. Also the cut-in relay R930 completes, at the contacts 936 the previously traced circuit for energizing the winding of the motor start relay R860, thereby to cause the latter relay to operate and complete, at the contacts 861, the previously mentioned circuit for energizing the operating motor M845 of the combined transmitting-receiving printer P22. Upon restoring, the line relay R910 completes, at the contacts 913, the previously traced circuit for energizing the winding of the lamp control relay R850, thereby to cause the latter relay to operate and complete, at the contacts 851, the previously mentioned circuit for illuminating the supervisory lamp L846. The illumination of the supervisory lamp L846 indicates to the operator at the called station 22 that this station has been seized and that shortly thereafter the combined transmitting-receiving printer P22 will receive a telegraphic message.

Also the subsequent operation of the apparatus depends upon the idle or busy condition of the called station 23, not shown. First assuming that the called station 23 is idle at this time, the station line circuit, not shown, individually associated therewith operates in response to the application of positive battery potential to the conductors C301 and C302, in a manner identical to the operation of the station line circuit 800 individually associated with the called station 22, in response to the application of positive battery potential to the conductors C124 and C125, explained above.

Continuing now with the operation of the station selector 500 individually associated with the calling station 21, it is pointed out that, when the switch-through relay R680 therein operates, the line relay R510 and the hold relay R540 restore in order to effect operation of the minor switch 600, whereby the switching relay R640 is operated shortly thereafter, all in the manner previously explained. Upon operating, the switching relay R640 completes, at the contacts 641 and 642, an operative connection between the station selector 500 and the first loop; this connection extending from the positive terminal of the battery 629 by way of the contacts 631, 641, 531 and 415, the impedance element 432, the winding of the line relay R510, the contacts 533, 632 and 642 to the line wiper 701 of the wiper set of the Strowger mechanism 700, and from the line wiper 702 of the wiper set of the Strowger mechanism 700 by way of the contacts 683 and 684, the contacts 692 of the set of switch springs S690 and the impedance 627 to the negative terminal of the battery 629. The line wipers 701 and 702 of the wiper set of the Strowger mechanism 700 engage the line contacts of the contact set in the associated contact bank terminating the terminal line conductors C104 and C101 of the first loop; and the first loop extends, at this time, from the terminal line conductor C104 thereof by way of the contacts 341 of the restored release relay R340 in the first loop equipment 300, etc., to C103, the connection between C103 and C102 including the called station 22, C102, the connection between C102 and C101 including the called station 21 to the terminal line conductor C101. At this point it is noted that the battery 629 in the station selector 500 individually associated with the calling station 21 supplies 110 volt potential by way of the impedance element 432 and low impedance 627 to the terminal line conductors C101 and C104 of the first loop; that the first loop includes in series the combined transmitting-receiving printer P21 at the called station 21, the combined transmitting-receiving printer P22 at the called station 22, the combined transmitting-receiving printer, not shown, at the called station 23, not shown, and five impedance elements corresponding to the impedance elements 431 and 831 respectively included in the station line circuits 400 and 800. More particularly, the five impedance elements mentioned are included in the respective five station line circuits individually associated with the five stations 24 to 28, inclusive, not shown, included in the first group.

Accordingly, at this time, an operative loop connection is completed, including the calling station 21 and the called stations 22 and 23; and the operator at the calling station 21 proceeds to operate the transmitter T443, whereby telegraphic signals are transmitted over the first loop in order to cause the combined transmitting-receiving printers disposed at the called stations 22 and 23 to operate and print the telegraphic message. Of course, it will be understood that the operator at either of the called stations 22 or 23 may operate the transmitter in the associated combined transmitting-receiving printer in order to cause telegraphic signals to be transmitted over the first loop and received by the combined trans-

mitting-receiving printers at the other stations included therein.

The release of the established connection, including the stations 21, 22 and 23 set up by way of the first loop, is under the control of the operator at any one of the stations mentioned and is effected when the operator at one of these stations operates the associated release key. For example, the operator at the station 21 may release the established connection, including the first loop, by operating the release key K442, whereby the previously traced circuit for energizing the winding of the line relay R510 in the station selector 500 is interrupted in order to cause the latter relay to restore. Upon restoring, the line relay R510 effects the release of the station selector 500, in the manner previously explained. When the Strowger mechanism 700 in the station selector 500 is thus released the previously traced holding circuit for energizing the winding of the group relay 3G and the winding of the busy relay R310 in series in the first loop equipment 300 is interrupted, thereby to cause the latter relay to restore. Upon restoring, the busy relay R310 interrupts, at the contacts 311, the previously mentioned circuit for energizing the winding of the busy slave relay R320, thereby to cause the latter relay to restore. Upon restoring, the busy slave relay R320 interrupts, at the contacts 321, etc., the previously traced paths for applying positive battery potential to the control conductors C117, etc.; and completes, at the contacts 322, etc., the previously traced paths for applying negative battery potential by way of the winding of the busy relay R310 and the various group relays 2G, 3G, etc., to the respective control conductors C117, C118, etc. The application of negative battery potential to the various control conductors C117, C118, etc., marks the various combinations in the first group as idle to the master selector 1500 and the various station selectors individually associated with the stations in the first group.

Upon restoring, the group relay 3G in the first loop equipment 300 interrupts, at the contacts 3G7, 3G6, etc., the previously mentioned paths for applying positive battery potential to the conductors C121, C122, etc. When positive battery potential is removed from the conductor C121 the previously traced circuit for energizing the lower winding of the loop relay R410 in the station line circuit 400 is interrupted, thereby to cause the latter relay to restore. Upon restoring, the loop relay R410 interrupts, at the contacts 412 and 414, the previously traced connection between the conductors C101 and C102 in the first loop and the combined transmitting-receiving printer P21; completes, at the contacts 419, the previously traced connection, including the impedance element 431, between the conductors C101 and C102 in the first loop; interrupts, at the contacts 415, a further point in the previously traced alternative circuit for energizing the winding of the line relay R510; and recompletes, at the contacts 411 and 413, the previously traced local circuit for energizing the winding of the line relay R510. Also the loop relay R410 completes, at the contacts 416, the previously traced connection between the control conductor C113 and one terminal of the lower winding of the loop relay R410; interrupts, at the contacts 417, the previously traced connection between the conductor C122 and the control conductor C113; and completes, at the contacts 418, the previously traced connection between the conductors C122 and C120. At this time the station selector 500 is completely released and the line relay R510 and the hold relay R540 reoperate. Also, at this time, negative battery potential is applied by way of the winding of the cut-in relay R530 and the contacts 521 to the control conductor C113, thereby to mark the station 21 as idle to the master selector 1500 and the various station selectors having access thereto.

When positive battery potential is removed from the conductor C124 incident to the restoration of the group relay 3G in the first loop equipment 300, the previously traced circuit for energizing the lower winding of the loop relay R810 in the station line circuit 800 is interrupted, thereby to cause the latter relay to restore. Upon restoring, the loop relay R810 interrupts, at the contacts 812 and 814, the previously traced connection between the conductors C102 and C103 in the first loop and the combined transmitting-receiving printer P22; completes, at the contacts 819, the previously traced connection, including the impedance element 831 between the conductors C102 and C103 in the first loop; interrupts, at the contacts 815, a further point in the previously traced alternative local circuit for energizing the winding of the line relay R910; and recompletes, at the contacts 811 and 813, the previously traced local circuit for energizing the winding of the line relay R910. Also the loop relay R810 completes, at the contacts 816, the previously traced connection between the control conductor C114 and one terminal of the lower winding of the loop relay R810; interrupts, at the contacts 817, the previously traced connection between the conductor C125 and the control conductor C114; and completes, at the contacts 818, the previously traced connection between the conductors C125 and C120. At this time the station selector 900 is completely released and the line relay R910 and the hold relay R940 reoperate. Also, at this time, negative battery potential is applied by way of the winding of the cut-in relay R930 and the contacts 921 to the control conductor C114, thereby to mark the station 22 as idle to the master selector 1500 and the various station selectors having access thereto.

Finally when positive battery potential is removed from the conductor C301, incident to the restoration of the group relay 3G in the first loop equipment 300, the loop relay in the station line circuit, not shown, individually associated with the called station 23, not shown, is restored; whereby the called station 23 is marked as idle to the master selector 1500 and the various station selectors having access thereto, in a manner identical to that explained above in conjunction with the station line circuits 400 and 800, respectively individually associated with the stations 21 and 22.

In the foregoing explanation of the mode of operation of the apparatus, incident to the extension of the connection from the calling station 21 to the called stations 21, 22 and 23, all in the first group by way of the first loop, it was assumed that the first loop and both of the called stations 22 and 23 were idle at this time. However, it may occur that, even though the first loop is idle at this time, one or both of the called stations 22 and 23 are busy at this time. Now assuming that the first loop is idle, but that the called station 22 is busy at this time, the station selector 500 individually associated with the calling station 21 operates; whereby the

test relay R660 is not operated and the switch-through relay R680 is operated, in the manner previously explained. Upon operating, the switch-through relay R680 interrupts, at the contacts 681, 682 and 685, the previously traced local circuit for energizing the winding of the line relay R510, thereby to effect restoration of the latter relay and the hold relay R540; whereby the timing operation of the minor switch 600 is initiated, all in the manner previously explained. Also, upon operating, the switch-through relay R680 completes, at the contacts 686, the previously traced path for applying positive battery potential to the control wiper 703 of the wiper set of the Strowger mechanism 700; whereby the previously traced circuit for energizing the winding of the group relay 3G and the busy relay R310 in the first loop equipment 300 is completed in order to cause the latter relays to operate; in the manner previously explained. Upon operating, the busy relay R310 effects operation of the busy slave relay R320, whereby the various combinations in the first group are marked as busy to the master selector 1500 and the station selectors individually associated with the various stations in the first group, all in the manner previously explained. Upon operating, the group relay 3G completes, at the contacts 3G7, 3G6, etc., the previously traced paths for applying positive battery potential to the conductors C121, C122, etc. The application of positive battery potential to the conductor C121 effects operation of the loop relay R410 in the station line circuit 400, whereby the combined transmitting-receiving printer P21 at the calling station 21 is connected to the conductors C101 and C102 in the first loop, in the manner previously explained.

However, in the present example, it is assumed that the called station 22 is busy at this time; accordingly, positive battery potential is applied to the control conductor C114 and is conducted by way of the contacts 1021 and 816 to one terminal of the lower winding of the loop relay R810 in the station line circuit 800 individually associated with the called station 22. Hence, when the group relay 3G in the first loop equipment 300 operates to apply positive battery potential to the conductor C124 an obvious path for short-circuiting the lower winding of the loop relay R810 in the station line circuit 800 is completed. Hence the loop relay R810 in the station line circuit 800 is not operated and the previously traced operative connection between the conductors C125 and C120 is retained. Hence, the application of positive battery potential to the conductor C125 completes the previously traced path for applying positive battery potential to the conductor C120, whereby an obvious circuit for energizing the winding of the release relay R340 in the first loop equipment 300 is completed. When thus energized the release relay R340 operates to interrupt, at the contacts 341, the normally completed connection between the conductors C103 and C104 in the first loop. In other words, the release relay R340 in the first loop equipment 300 positively prevents completion of the first loop.

Continuing now with the operation of the station selector 500, when the wiper 601 of the minor switch 600 engages the second contact in the associated contact bank the switching relay R640 operates, in the manner previously explained. However, in the present example, upon operating, the switching relay R640 only prepares, at the contacts, 641 and 642, the previously traced operative connection, including the first loop, for energizing the winding of the line relay R510; this connection cannot be completed at this time due to the operated position of the release relay R340 in the first loop equipment 300, as previously explained. Accordingly the line relay R510 and the hold relay R540 remain in their restored positions subsequent to the operation of the switching relay R640, whereby further operation of the minor switch 600 is continued. When the wiper 601 of the minor switch 600 engages the fifth contact in the associated contact bank the previously traced circuit for energizing the winding of the release relay R630 is completed, thereby to cause the latter relay to operate. Upon operating, the release relay R630 effects the release of the station selector 500, whereby the first loop equipment 300 is released in order to effect the release of the various station line circuits 400, 800, etc., individually associated with the stations 21, 22, etc., all in the manner previously explained. In this connection it is pointed out that, when the group relay 3G in the first loop equipment 300 restores it interrupts, at the contacts 3G4, the previously traced circuit for energizing the winding of the release relay R340, thereby to cause the latter relay to restore.

In view of the foregoing explanation of the mode of operation of the apparatus, it will be understood that, even though the first loop is idle when the call is initiated from the calling station 21 to the called stations 22 and 23, the station selector 500 individually associated with the calling station 21 will switch through to complete the established connection only in the event that both of the called stations 22 and 23 are idle at this time; and that the station selector 500 will be automatically released in the event either of the called stations 22 and 23 is busy at this time.

In view of the foregoing explanation of the mode of operation of the apparatus to extend a call from the calling station 21 in the first group to the called stations 21, 22 and 23 in the first group, it will be understood that the call may be extended from the calling station 21 or any other calling station in the first group to the same or other combinations of stations in the first group from the calling station therein by dialing the group call digit 6 in conjunction with the appropriate combination call digits 1 to 8, inclusive. In other words, any calling station in the first group may set up a connection by way of the first loop, including the first and second stations 21 and 22 in the first group, by dialing the call number 61; any calling station in the first group may set up a connection by way of the first loop, including the first three stations 21, 22 and 23 in the first group, by dialing the call number 62; etc.; and finally any calling station in the first group may set up a connection by way of the first loop, including all eight of the stations in the first group, by dialing the call number 68.

As previously pointed out, a calling station in a given group may not set up a connection to a called combination of stations in another group. For example, the calling station 21 in the first group may not set up a connection to a called combination of stations in the second group; and should the operator at the calling station 21 attempt to set up a connection to a called combination of stations in the second group, the individually associated station selector 500 is operated

automatically to return the busy signal. More specifically, should the operator at the calling station 21 dial any one of the group call numbers 7, 8 or 9, respectively corresponding to the second, third and fourth groups, the wiper set of the Strowger mechanism 700 would be moved to the corresponding seventh, eighth or ninth level in the associated contact bank. When the wiper set of the Strowger mechanism 700 is operated to its seventh, eighth or ninth level in the associated contact bank the set of switch springs S622 is actuated. More particularly, the set of switch springs S622 is actuated, thereby to complete, at the contacts 624 thereof, a circuit for energizing the winding of the test relay R660 following the conclusion of the first digit 7, 8 or 9. The circuit for energizing the winding of the test relay R660 extends from the positive terminal of battery by way of the set of switch springs S591, the contacts 633, 671, the contacts 624 of the set of switch springs S622 and the winding of R660 to the negative terminal of battery. When thus energized the test relay R660 operates, thereby to effect intermittent operation of the flash relay R650, whereby the lamp control relay R450 is operated intermittently in order to cause flashing of the supervisory lamp L446, all in the manner previously explained. Also when the set of switch springs S622 is thus actuated there is interrupted, at the contacts 623 thereof, the previously traced holding circuit for energizing the winding of the control relay R610, thereby to cause the latter relay to restore. Upon restoring, the control relay R610 interrupts, at the contacts 612, a further point in the previously traced original circuit for energizing the winding of the series relay R590 in series with the rotary magnet M587, thereby positively to prevent operation of the Strowger mechanism 700 in the event the operator at the calling station 21 proceeds to dial a second digit. Accordingly the operator at the calling station 21 may not operate the station selector 500 further and, upon receiving the busy supervision, operates the release key K442 in order to effect the release of the station selector 500, all in the manner previously explained.

In view of the foregoing explanation of the mode of operation of the apparatus to extend a call from a calling station in the first group to any called combination of stations in the second group by way of the first loop, it will be understood that the corresponding apparatus is operative, in a substantially identical manner, to extend a call from a calling station in the respective second, third or fourth groups to any called combination of stations in the associated group by way of the respective second, third or fourth loop. As previously noted, the group call digits for the second, third and fourth loops are respectively 7, 8 and 9; while the combination call digits for the loops mentioned are 1 to 8, inclusive, as explained above.

Further, in view of the explanation of the mode of operation of the station selector 500 to block the extension of a group call from the station 21 in the first group by way of other than the first loop, it will be understood that the other selectors individually associated with the other stations in the various groups are operative, in a similar manner, to block the extension of a group call from the associated station by way of other than the associated loop.

Station to master position call

Considering now the extension of a call from a station in any group to an idle one of the receiving printers at the master position 1400, the operator at the calling station first initiates the call by dialing the call number 01. For example, assuming that a call is to be extended from the calling station 21 to one of the receiving printers at the master position 1400, the operator at the calling station 21 operates the associated dial D441, whereby the digits 0 and 1 are successively transmitted to the individually associated station selector 500. The station selector 500 responds to the digits 0 and 1, whereby the wiper set of the Strowger mechanism 700 is operated to engage the first contact set in the tenth level in the associated contact bank, in the manner previously explained. Shortly following the conclusion of the second digit 1 the series relay R590 restores, thereby to complete the previously traced test circuit, including the control wiper 703 of the wiper set of the Strowger mechanism 700 and the winding of the test relay R660. In the event the first receiving printer P1401 at the master position 1400 is busy, positive battery potential appears upon the control conductor C132 extending thereto and is applied to the control wiper 703 of the wiper set of the Strowger mechanism 700, thereby to complete the previously traced circuit for energizing the winding of the test relay R660 in order to cause the latter relay to operate. Upon operating, the test relay R660 completes, at the contacts 663, an alternative circuit for energizing in series the winding of the series relay R590 and the rotary magnet M587 of the Strowger mechanism 700, in the present example. The above-mentioned circuit includes the control conductor C132 extending to the first receiving printer P1401 having positive battery potential thereon, the connection between the control contacts respectively engaged by the wipers 703 and 704 of the wiper set of the Strowger mechanism 700, the control wiper 704, the contacts 663 and 592, the winding of R590 and the rotary magnet M587 to negative battery potential. When this series circuit is completed the series relay R590 operates, thereby to interrupt, at the contacts 593, the previously traced circuit for energizing the winding of the test relay R660 in order to cause the latter relay to restore. Also the series relay R590 recompletes, at the contacts 595, the previously traced circuit for energizing the winding of the digit relay R670, thereby to prevent restoration of the latter relay at this time. Upon restoring, the test relay R660 interrupts, at the contacts 663, the above-traced series circuit for energizing the winding of the series relay R590 and the rotary magnet M587; however, the series relay R590 does not immediately restore as it is of the slow-to-release type. When thus energized the rotary magnet M587 operates, thereby to drive the wiper set of the Strowger mechanism 700 an additional step in the rotary direction, whereupon the wiper set engages the second contact set in the tenth level in the associated contact bank terminating the conductors extending to the second receiving printer P1402. At this time the idle or busy condition of the second receiving printer P1402 is tested, whereupon the wiper set of the Strowger mechanism 700 is operated an additional step in the rotary direction in the event the second receiving printer P1402 is busy, in the manner explained above. In the last-mentioned event, the idle or busy condition of the third receiving printer P1403 is then tested and, in the event the last-mentioned receiving printer is busy, the test relay R660 reoperates. However,

in this case, no further operations of the series relay R590 and the rotary magnet M587 are effected due to the fact that the control contacts respectively engaged by the control wipers 703 and 704 of the wiper set of the Strowger mechanism 700 are not connected together in the third contact set in the tenth level in the associated contact bank. In this event the test relay R660 reoperates in order to cause the busy signal to be transmitted to the calling station 21, in the manner previously explained.

In the event any one of the receiving printers is idle at this time, the previously traced path for short-circuiting the winding of the test relay R660 is completed; and shortly following the second digit 1 the digit relay R670 restores in order to effect operation of the switch-through relay R680, all in the manner previously explained. Assuming that the first receiving printer P1401 is idle at this time, when the switch-through relay R680 operates an operating circuit is completed between the calling station 21 and the first receiving printer P1401. The above-mentioned circuit extends from the positive terminal of the battery 629 by way of the contacts 631, 641, 531, 421 and 411, the dial D441, the release key K442, the transmitter T443, the printer magnet M444, the contacts 413, the winding of the line relay R510, the contacts 533, 632 and 642, the line wiper 701 of the wiper set of the Strowger mechanism 700, C130, the printer magnet M1473 of the first receiving printer P1401, C131, the line wiper 702 of the wiper set of the Strowger mechanism 700, the contacts 683 and 684, the contacts 691 of the set of switch springs S690 and the impedance 626 to the negative terminal of the battery 629. Also the switch-through relay R680 completes, at the contacts 686, the previously mentioned path for applying positive battery potential to the control wiper 703 of the wiper set of the Strowger mechanism 700, thereby to complete an obvious circuit, including the control conductor C132, for energizing the winding of the motor start relay R1470. When thus energized the motor start relay R1470 operates to complete, at the contacts 1471, an obvious circuit for energizing the operating motor M1472 of the first receiving printer P1401.

At this time an operative connection is completed between the calling station 21 and the first receiving printer P1401 at the master position 1400. Also the application of positive battery potential to the control conductor C132 marks the first receiving printer P1401 as busy to the various station selectors having access thereto. The operator at the calling station 21 then proceeds to operate the transmitter T443, whereby the telegraphic message is transmitted over the above-traced operative connection. The printer magnet M444 operates in order to cause the combined transmitting-receiving printer P21 to produce a printed record of the telegraphic message transmitted from the calling station 21; while the printer magnet M1473 operates in order to cause the first receiving printer P1401 to produce a printed record of the telegraphic message received at the master position 1400.

The release of the established connection is under the control of the operator at the calling station 21 and is effected when the release key K442 thereat is operated, whereupon the station selector 500 is released in the manner previously explained. When the Strowger mechanism 700 in the station selector 500 is thus released the previously traced circuit for energizing the winding of the motor start relay R1470 is interrupted in order to cause the latter relay to restore and interrupt, at the contacts 1471, the previously mentioned circuit for energizing the operating motor M1472 of the first receiving printer P1401. At this time, negative battery potential is applied by way of the motor start relay R1470 to the control conductor C132, thereby to mark the first receiving printer P1401 as idle to the various station selectors having access thereto.

Master position to station call

Considering now the extension of a call from the master position 1400 to a called station in any one of the groups, the operator at the master position 1400 initiates the call by dialing the call number of the called station. For example, assuming that the call is to be extended from the master position 1400 to the called station 21 in the first group, the operator at the master position 1400 initiates the call by dialing the digits 2 and 1 upon the dial D1441 into the associated master selector 1500. The master selector 1500 responds to the digits 2 and 1, whereby the wiper set of the Strowger mechanism 1700 engages the first contact set in the second level in the associated contact bank. The mode of operation of the master selector 1500 is substantially identical to that of the station selector 500 individually associated with the station 21 and, in the interest of brevity, the detailed operations of the elements in the master selector 1500 are not repeated.

When the wiper set of the Strowger mechanism 1700 engages the first contact set in the second level of the associated contact bank terminating the line conductors C109 and C110 and the control conductor C113 extending to the called station 21, the master selector 1500 operates to test the idle or busy condition of the called station 21, in the manner previously explained. In the event the called station 21 is idle at this time, the master selector 1500 switches through, whereupon an operative connection between the master position 1400 and the called station 21 is completed. The last-mentioned operative connection extends from the positive terminal of the battery 1629 by way of the contacts 1631 and 1641, the dial D1441, the release key K1442, the transmitter T1443, the printer magnet M1444, the winding of the line relay R1510, the contacts 1632 and 1642, the line wiper 1701 of the wiper set of the Strowger mechanism 1700, the line conductor C110, the contacts 532, 421 and 411, the dial D441, the release key K442, the transmitter T443, the printer magnet M444, the contacts 413, the winding of the line relay R510, the contacts 534, the line conductor C109, the line wiper 1702 of the wiper set of the Strowger mechanism 1700, the contacts 1683 and 1684, the contacts 1691 of the set of switch springs S1690 and the impedance 1626 to the negative terminal of the battery 1629. At this time the operator at the master position 1400 operates the transmitter T1443, whereby the telegraphic message is transmitted over the above-traced operative connection in order to cause operation of the transmitting printer P1400 at the master position 1400 and the combined transmitting-receiving printer P21 at the called station 21, in the manner previously explained.

In the foregoing explanation of the mode of operation of the master selector 1500 to set up an operative connection between the master position 1400 and the called station 21, it was assumed that the called station 21 was idle at this time. However, it may occur that the called sta-

tion 21 is busy at this time. More particularly, the called station 21 may be busy either as the calling station or the called station in a station-to-station call of the type previously described, or as either the calling station or the called station in a group call by way of the first loop of the type previously described. In the event the called station 21 is busy as the calling station in a station-to-station call of the type previously described, positive battery potential is applied by way of the contacts 522 to the control conductor C113; and in the event the called station 21 is busy as the called station in a station-to-station call of the type previously described, positive battery potential is applied directly to the control conductor C113 in the contact bank associated with the Strowger mechanism of the station selector individually associated with the calling station in the last-mentioned connection. On the other hand, in the event the called station 21 is busy either as the calling station or as the called station in a group call by way of the first loop of the type previously described, positive battery potential is applied by way of the conductor C122, the contacts 423, 417 and 621 to the control conductor C113. The application of positive battery potential to the control conductor C113 causes operation of the master selector 1500, whereby the test relay R1660 is operated and the switch-through relay R1680 is not operated, in the manner previously explained. The operated test relay R1660 causes intermittent operation of the flash relay R1650, whereby the supervisory lamp L1446 is flashed at the master position 1400, in the manner previously explained, in order to indicate to the operator thereat that the called station 21 is busy at this time.

At this time the operator at the master position 1400 may either operate the release key K1442 in order to release the master selector 1500, in the manner previously explained, or he may exercise his priority authority by operating the priority key K1465. In the event the release key K1442 is operated the release of the master selector 1500 is the same as that previously explained. However, in the event the priority key K1465 is operated, positive battery potential is applied to the conductors C1466 and C1467. The application of positive battery potential to the conductor C1466 completes an obvious circuit for energizing the lower winding of the switch-through relay R1680, thereby to cause the latter relay to operate and force the master selector 1500 to switch through upon the line conductors C109 and C110 extending to the busy called station 21. Upon operating, the switch-through relay R1680 interrupts, at the contacts 1687, the previously completed holding circuit for energizing the winding of the test relay R1660, thereby to cause the latter relay to restore and effect the restoration of the flash relay R1650, whereby the lamp control relay R1450 is restored in order to extinguish the supervisory lamp L1446. Also the switch-through relay R1680 completes, at the contacts 1689, a holding circuit, including the contacts 1633 and the set of switch springs S1591, for energizing the lower winding thereof. The application of positive battery potential to the conductor C1467 completes a circuit, including the control wiper 1705 of the wiper set of the Strowger mechanism 1700 and the control conductor C105, for energizing the winding of the priority relay R420 in the station line circuit 400 individually associated with the called station 21, thereby to cause the latter relay to operate.

First assuming that the station 21 is busy as the calling station in a station-to-station call of the type previously described, involving the called station 22, upon operating, the priority relay R420 interrupts, at the contacts 421, the completed operative connection between the calling station 21 and the called station 22, thereby to effect the release of the station selector 500 individually associated with the calling station 21 and the station selector 900 individually associated with the called station 22, in the manner previously explained. When the station selector 500 is thus released the busy relay R520 restores, thereby to complete, at the contacts 521, a circuit for energizing the winding of the cut-in relay R530. The last-mentioned circuit extends from positive battery potential by way of the set of switch springs S1591, the contacts 1686, the control wiper 1703 of the wiper set of the Strowger mechanism 1700, the control conductor C113, the contacts 521 and the winding of R530 to the negative terminal of battery. When thus energized the cut-in relay R530 operates to prepare, at the contacts 532 and 534, points in the previously traced operative connection between the master position 1400 and the called station 21. The operator at the master position 1400 operates the priority key K1465 only during a short time interval; and when the last-mentioned key is restored positive battery potential is removed from the conductors C1466 and C1467. The removal of positive battery potential from the conductor C1466 is without effect in view of the fact that the operated switch-through relay R1680 has completed, at the contacts 1689, the previously traced holding circuit for energizing the lower winding thereof. The removal of positive battery potential from the conductor C1467 interrupts the previously traced circuit for energizing the winding of the priority relay R420 in the station line circuit 400 individually associated with the called station 21, whereby the latter relay restores. Upon restoring, the priority relay R420 completes, at the contacts 421, the previously traced operative connection between the master station 1400 and the called station 21. At this time, the operator at the master position 1400 may proceed to transmit the telegraphic message, in the manner previously explained.

Now assuming that the station 21 is busy as the called station in a station-to-station call of the type previously described, involving the calling station 22, upon operating, the priority relay R420 interrupts, at the contacts 421, the completed operative connection between the called station 21 and the calling station 22; and completes, at the contacts 425, an obvious path for applying positive battery potential to the control conductor C107. The application of positive battery potential to the control conductor C107 forces the release of the station selector 900 individually associated with the calling station 22. More particularly, the application of positive battery potential to the control conductor C107 completes a circuit, including the control wiper 1106 of the Strowger mechanism 1100 of the station selector 900, the contacts 1075 and 943 and the set of switch springs S995, for energizing the release magnet M988; whereby the latter magnet operates in order to effect the release of the Strowger mechanism 1100 and the consequent release of the station selector 900, in the manner previously explained. When the switch-through

relay R1680 in the master selector 1500 operates it completes, at the contacts 1686, an alternative holding circuit, including the set of switch springs S1591, the control wiper 1703 of the wiper set of the Strowger mechanism 1700, the control conductor C113 and the contacts 521, for energizing the winding of the cut-in relay R530 in the station selector 500 individually associated with the called station 21, whereby the cut-in relay R530 is retained in its operated position. The operator at the master position 1400 operates the priority key K1465 only during a short time interval; and when the last-mentioned key is restored positive battery potential is removed from the conductors C1466 and C1467. The removal of positive battery potential from the conductor C1466 is without effect in view of the fact that the operated switch-through relay R1680 has completed, at the contacts 1689, the previously traced holding circuit for energizing the lower winding thereof. The removal of positive battery potential from the conductor C1467 interrupts the previously traced circuit for energizing the winding of the priority relay R420 in the station line circuit 400 individually associated with the called station 21, whereby the latter relay restores. Upon restoring, the priority relay R420 completes, at the contacts 421, the previously traced operative connection between the master station 1400 and the called station 21. At this time the operator at the master position 1400 may proceed to transmit the telegraphic message, in the manner previously explained.

Now assuming that the station 21 is busy as the calling station in a group call by way of the first loop of the type previously described, involving the called stations 22 and 23, upon operating, the priority relay R420 completes, at the contacts 422, an obvious path including the conductors C121 and C122, for short-circuiting the lower winding of the loop relay R410; positive battery potential being applied to both of the conductors C121 and C122 due to the operating condition of the group relay 3G in the first loop equipment 300. When the lower winding of the loop relay R410 is thus short-circuited the latter relay restores. Upon restoring, the loop relay R410 interrupts, at the contacts 412 and 414, the completed connection between the combined transmitting-receiving printer P21 and the conductors C101 and C102 in the first loop; completes, at the contacts 419, the previously traced connection including the impedance 431 between the conductors C101 and C102 in the first loop; and prepares, at the contacts 411 and 413, further points in the previously traced connection between the combined transmitting-receiving printer P21 and the line conductors C109 and C110 extending to the called station 21. Also the loop relay R410 interrupts, at the contacts 415, the operative connection including the impedance element 432, the battery 629 in the station selector 500 and the first loop; whereby the station selector 500 is released in order to effect the release of the first loop common equipment 300, all in the manner previously explained. When the first loop common equipment 300 is thus released the station line circuit, individually associated with each called station in the group call included in the first loop, is released, whereby each called station included in the group call by way of the first loop is rendered idle. More particularly, in the present example, the station line circuit 800 and the line circuit, not shown, respectively individually associated with the called stations 22 and 23, are released, whereby the called stations 22 and 23 are rendered idle.

When the station selector 500 is thus released the busy relay R520 restores, thereby to complete, at the contacts 521, a circuit for energizing the winding of the cut-in relay R530. The last-mentioned circuit extends from positive battery potential by way of the set of switch springs S1591, the contacts 1686, the control wiper 1703 of the wiper set of the Strowger mechanism 1700, the control conductor C113, the contacts 521 and the winding of R530 to the negative terminal of battery. When thus energized the cut-in relay R530 operates to prepare, at the contacts 532 and 534, points in the previously traced operative connection between the master position 1400 and the called station 21. The operator at the master position 1400 operates the priority key K1465 only during a short time interval; and when the last-mentioned key is restored positive battery potential is removed from the conductors C1466 and C1467. The removal of positive battery potential from the conductor C1466 is without effect in view of the fact that the operated switch-through relay R1680 has completed, at the contacts 1689, the previously traced holding circuit for energizing the lower winding thereof. The removal of positive battery potential from the conductor C1467 interrupts the previously traced circuit for energizing the winding of the priority relay R420 in the station line circuit 400 individually associated with the called station 21, whereby the latter relay restores. Upon restoring, the priority relay R420 completes, at the contacts 421, the previously traced operative connection between the master position 1400 and the called station 21. At this time the operator at the master position 1400 may proceed to transmit the telegraphic message, in the manner previously explained.

Also, upon restoring, the priority relay R420 completes, at the contacts 423, an obvious connection including the contacts 418 between the conductors C122 and C120; whereby an obvious circuit is completed for energizing the winding of the release relay R340 in the first loop equipment 300, in the event the last-mentioned equipment has not been completely released at this time, due to the presence of positive battery potential upon the conductor C122 as a result of the operated position of the group relay 3G in the first loop equipment 300. In the event the last-mentioned circuit is completed, the release relay R340 operates to interrupt, at the contacts 341, a common point in the first loop, thereby positively insuring the complete release of the station selector 500 individually associated with the station 21, in the manner previously explained. Upon restoring, the station selector 500 effects the release of the station selector 900 and the station selector, not shown, respectively individually associated with the stations 22 and 23, and the release of the first loop equipment 300, in the manner previously explained.

Finally assuming that the station 21 is busy as the called station in a group call by way of the first loop of the type previously described, involving the calling station 22 and the called station 23, upon operating, the priority relay R420 completes, at the contacts 422, an obvious path, including the conductors C121 and C122, for short-circuiting the lower winding of the loop relay R410; positive battery potential being applied to both of the conductors C121 and C122 due to the operated position of the group relay 3G in the first loop equipment 300. When the lower wind-

ing of the loop relay R410 is thus short-circuited the latter relay restores. Upon restoring, the loop relay R410 interrupts, at the contacts 412 and 414, the completed connection between the combined transmitting-receiving printer P21 and the conductors C101 and C102 in the first loop; completes, at the contacts 419, the previously traced connection including the impedance 431 between the conductors C101 and C102 in the first loop; and prepares, at the contacts 411 and 413, further points in the previously traced connection between the combined transmitting-receiving printer P21 and the line conductors C109 and C110 extending to the called station 21. When the switch-through relay R1680 in the master selector 1500 operates it completes, at the contacts 1686, an alternative holding circuit, including the set of switch springs S1591, the control wiper 1703 of the wiper set of the Strowger mechanism 1700, the control conductor C113 and the contacts 521, for energizing the winding of the cut-in relay R530 in the station selector 500 individually associated with the called station 21; whereby the cut-in relay R530 is retained in its operated position.

Also the loop relay R410 interrupts, at the contacts 415, a point in the previously completed path for connecting the impedance element 432 between one terminal of the line relay R410 and the contacts 532 of the operated cut-in relay R530. However, in the present example, the interruption of the above-mentioned path is without effect in view of the fact that the source of potential for supplying current to the first loop comprises the battery 1029 in the station selector 900 individually associated with the calling station 22. Accordingly, at this time, the station selector 900 and the station selector, not shown, respectively individually associated with the calling station 22 and the called station 23 are not released; the first loop is retained completed between the calling station 22 and the called station 23; and the impedance element 431 is substituted for the combined transmitting-receiving printer P21 between the conductors C101 and C102 in the first loop. Also it is pointed out that the positive battery potential applied to the control conductor C113 in the master selector 1500 completes an alternative path, including the contacts 621 and 416 and the conductor C121, for short-circuiting the loop relay R410, thereby positively to prevent reoperation of the last-mentioned relay incident to the subsequent restoration of the priority relay R420.

The operator at the master position 1400 operates the priority key K1465 only during a short time interval; and when the last-mentioned key is restored positive battery potential is removed from the conductors C1466 and C1467. The removal of positive battery potential from the conductor C1466 is without effect in view of the fact that the operated switch-through relay R1680 has completed, at the contacts 1689, the previously traced holding circuit for energizing the lower winding thereof. The removal of positive battery potential from the conductor C1467 interrupts the previously traced circuit for energizing the winding of the priority relay R420 in the station line circuit 400 individually associated with the called station 21, whereby the latter relay restores. Upon restoring, the priority relay R420 completes, at the contacts 421, the previously traced operative connection between the master position 1400 and the called station 21. At this time the operator at the master position 1400 may proceed to transmit the telegraphic message, in the manner previously explained.

Also, upon restoring, the priority relay R420 interrupts, at the contacts 422, the previously traced original path for short-circuiting the lower winding of the loop relay R410. However, the latter relay remains in its restored position due to the previously traced completed alternative path for short-circuiting the lower winding thereof. Further the priority relay R420 completes, at the contacts 423, an obvious connection, including the contacts 418 between the conductors C122 and C120, whereby an obvious circuit for energizing the winding of the release relay R340 in the first loop equipment 300 is completed; the conductor C122 having positive battery potential thereon due to the operated position of the group relay 3G in the first loop equipment 300, as previously noted. When the release relay R340 is thus energized, it operates to interrupt, at the contacts 341, a common point in the first loop, thereby to effect the release of the station selector 900 and the station selector, not shown, respectively individually associated with the calling station 22 and the called station 23, in the manner previously explained. When the station selector 900 individually associated with the calling station 22 is thus released the first loop equipment 300 is released, whereby positive battery potential is removed from the conductors C121 and C122, in the manner previously explained.

Master position to individual loop call

Considering now the extension of a call from the master position 1400 to any combination of stations in any one of the four groups by way of the individually associated loop, the operator at the master position 1400 initiates the call by dialing the group call digit identifying the particular called group in conjunction with the combination digit identifying the particular called combination of stations in the called group. For example, assuming that the individual loop call is to be extended from the master position 1400 to the called stations 21, 22 and 23 in the first group, the operator at the master position 1400 dials upon the dial D1441 the group call digit 6 identifying the first group in conjunction with the combination call digit 2 identifying the called combination of stations 21, 22 and 23 in the first group. The master selector 1500 responds to the digits 6 and 2, whereby the wiper set of the Strowger mechanism 1700 engages the second contact set in the sixth level in the associated contact bank. The mode of operation of the master selector 1500 is substantially identical to that of the station selector 500 individually associated with the station 21 and, in the interest of brevity, the detailed operation of the elements in the master selector 1500 are not repeated.

When the wiper set of the Strowger mechanism 1700 engages the second contact set in the sixth level of the associated contact bank terminating the terminal line conductors C101 and C104 of the first loop and the control conductor C118 extending to the first loop equipment 300, the master selector 1500 operates to test the idle or busy condition of the first loop, in the manner previously explained. In the event the called first loop is idle at this time, negative battery potential appears upon the control conductor C118, whereby the master selector 1500 switches through in order to complete an operative connection between the master position 1400 and the first loop. More particularly, at this time, positive battery potential appearing upon

the control wiper 1703 of the Strowger mechanism 1700 of the master selector 1500 is applied to the control conductor C118, thereby to complete the previously traced series circuit for energizing the winding of the group relay 3G and the winding of the busy relay R310 in the first loop equipment 300, whereby the relays mentioned operate. Upon operating, the busy relay R310 effects operation of the busy slave relay R320, whereupon the latter relay completes, at the contacts 321, 325, etc., the previously traced paths for applying positive battery potential to the control conductors C117, C119, etc. At this time, positive battery potential is applied to each of the control conductors C117, C118, etc., thereby to mark each combination of stations in the first group and consequently the first loop as busy to the station selectors individually associated with the various stations in the first group. Upon operating, the group relay 3G completes, at the contacts 3G7, 3G6, etc., the previously mentioned paths for applying positive battery potential to the conductors C121, C122, etc. The subsequent operation of the apparatus depends upon the idle or busy condition of the various stations 21, 22 and 23 in the called combination in the first group.

First assuming that each of the stations 21, 22 and 23 in the called combination in the first group is idle, the application of positive battery potential to the conductor C121 effects operation of the loop relay R410 in the station line circuit 400 individually associated with the called station 21, whereby the combined transmitting-receiving printer P21 at the called station 21 is operatively connected to the conductors C101 and C102 in the first loop. Also the application of positive battery potential to the conductor C122 marks the station 21 as busy to the various station selectors having access thereto, in the manner previously explained. Similarly, the application of positive battery potential to the conductors C124, C125 and C301, C302 causes the combined transmitting-receiving printers at the called stations 22 and 23 to be connected into the first loop and the called stations 22 and 23 to be marked as busy to the various station selectors having access thereto. Shortly following this operation of the first loop equipment 300 and the station line circuits 400, etc., individually associated with the called stations 21, 22 and 23, the switching relay R1640 in the master selector 1500 operates, thereby to complete an operative connection between the master position 1400 and the first loop including the called stations 21, 22 and 23. The above-mentioned operative connection extends from the positive terminal of the battery 1629 by way of the contacts 1631, 1641, the dial D1441, the release key K1442, the transmitter T1443, the printer magnet M1444, the winding of the line relay R1510, the contacts 1632 and 1642 to the line wiper 1701 of the wiper set of the Strowger mechanism 1700; and from the negative terminal of the battery 1629 by way of the impedance 1627, the contacts 1692 of the set of switch springs S1690, and the contacts 1684 and 1683 to the line wiper 1702 of the wiper set of the Strowger mechanism 1700; the line wipers 1701 and 1702 of the wiper set of the Strowger mechanism 1700 are respectively connected to the terminal line conductors C104 and C101 of the first loop; which first loop includes the combined transmitting-receiving printers at the called stations 21, 22 and 23 and the impedance elements in the station line circuits individually associated with the other stations in the first group, as previously explained. Accordingly, at this time, the operator at the master position 1400 proceeds to transmit the telegraphic message, in the manner previously explained.

Now assume that the station 21 in the called combination in the first group is busy when the first loop equipment 300 is operated, in the manner described above. In this event, the operation of the group relay 3G in the first loop equipment 300, to apply positive battery potential to the conductor C121, is effective to short-circuit the lower winding of the loop relay R410 in the station line circuit 400 individually associated with the called station 21. The lower winding of the loop relay R410 is thus short-circuited due to the fact that the station 21 is busy at this time either as the calling station or the called station in a station-to-station call of the type previously described, whereby positive battery potential also appears upon the control conductor C113 and is connected by way of the contacts 621 and 416 to one terminal of the lower winding of the loop relay R410. Hence, when the called station 21 is busy at this time, the application of positive battery potential to the conductor C122 completes the previously traced circuit for energizing the winding of the release relay R340 in the first loop equipment 300. When thus energized the release relay R340 operates to interrupt, at the contacts 341, the previously mentioned common point in the first loop.

Subsequently, when the switching relay R1640 in the master selector 1500 operates it only prepares, at the contacts 1641 and 1642, the previously traced operative connection between the master position 1400 and the first loop; the above-traced connection cannot be completed at this time due to the operated position of the release relay R340, interrupting, at the contacts 341, the common point previously mentioned in the first loop. Accordingly, the line relay R1510 in the master selector 1500 does not immediately operate and continued timing operation of the minor switch 1600 proceeds, in the manner previously explained.

When the line relay R1510 restored, incident to the operation of the switch-through relay R1680, an obvious circuit was completed, at the contacts 1513, for energizing the winding of the lamp control relay R1450; whereupon the latter relay operated to complete, at the contacts 1451, an obvious circuit for illuminating the supervisory lamp L1446. This illumination of the supervisory lamp L1446 serves as an answer-back signal to the operator at the master position 1400. In the event the line relay R1510 is not reoperated shortly thereafter to cause the restoration of the lamp control relay R1450 and the consequent termination of the answer-back signal by extinguishing the supervisory lamp L1446, it indicates to the operator at the master position 1400 that, although the master selector 1500 has switched through on the first loop and that the first loop is idle, one or more stations in the called combination is busy.

At this time the operator may either permit the automatic release of the master selector 1500 which will occur a short time interval later, or exercise his priority authority by operating the priority key K1465. First assuming that the operator at the master position 1400 does not operate the priority key K1465, operation of the minor switch 1600 in the master selector 1500 continues,

in the manner previously explained. When the wiper 1601 of the minor switch 1600 engages the fifth contact in the associated contact bank the release relay R1630 is operated in order to effect the release of the master selector 1500, whereby the first loop equipment 300 and the station line circuits 400, etc., individually associated with the stations 21, 22 and 23 in the called combination in the first group, are released, all in the manner previously explained.

Now assuming that the operator at the master position 1400 operates the priority key K1465, upon observing that the answer-back signal has not been terminated promptly by extinguishing the supervisory lamp L1446, when the priority key K1465 is thus operated positive battery potential is applied to the conductors C1466 and C1467. The application of positive battery potential to the conductor C1466 is without effect, in the present example, in view of the fact that the switch-through relay R1680 already occupies its operated position. The application of positive battery potential to the conductor C1467 completes a circuit, including the control wiper 1705 of the wiper set of the Strowger mechanism 1700 and the control conductor C115 extending to the first loop equipment 300, for energizing the winding of the priority relay R330 therein. When thus energized the priority relay R330 operates to complete, at the contacts 331, 332, etc., obvious connections between the conductors C121, C123 and C124, C126, etc. When the conductor C124 is thus connected to the conductor C126 an obvious circuit is completed for energizing the upper winding of the loop relay R810 in the station line circuit 800 individually associated with the called station 22; however, the completion of this circuit is without effect in view of the fact that the loop relay R810 already occupies its operated position, the called station 22 being idle at this time. On the other hand, when the conductor C121 is thus connected to the conductor C123 an obvious circuit is completed for energizing the upper winding of the loop relay R410 in the station line circuit 400 individually associated with the called station 21; when the upper winding of the loop relay R410 is thus energized this relay operates in view of the fact that the loop relay R410 was not previously operated, the called station 21 being busy at this time.

Upon operating, the loop relay R410 interrupts, at the contacts 411 and 413, points in the previously completed connection between the station 21 and the other station involved in the previously mentioned station-to-station call; completes, at the contacts 412 and 414, the previously traced connection between the combined transmitting-receiving printer P21 and the conductors C101 and C102 in the first loop; and interrupts, at the contacts 419, the connection including the impedance 431 between the conductors C101 and C102 in the first loop. Also the loop relay R410 interrupts, at the contacts 416, the previously traced path for short-circuiting the lower winding thereof; whereby the lower winding of the loop relay R410 is energized by way of the previously traced circuit, including the conductor C121 having positive battery potential thereon, and the resistor 433. Further the loop relay R410 interrupts, at the contacts 418, the previously traced connection between the conductors C122 and C120, thereby to interrupt the previously traced circuit for energizing the winding of the release relay R340 in the first loop equipment 300 in order to cause the latter relay to restore. Upon restoring, the release relay R340 completes, at the contacts 341, the previously traced operative connection between the master position 1400 and the first loop including the called stations 21, 22 and 23. When the above-mentioned operative connection is thus completed the line relay R1510 in the master selector 1500 reoperates in order to effect the release of the minor switch 1600, in the manner previously explained. The operator at the master position 1400 only operates the priority key K1465 for a short time interval; and when the last-mentioned key is restored the previously traced circuit for energizing the winding of the priority relay R330 in the first loop equipment 300 is interrupted, thereby to cause the latter relay to restore. Upon restoring, the priority relay R330 interrupts, at the contacts 331, 332, etc., the previously traced circuits for energizing the upper windings of the loop relays R410, R810, etc., in the line circuits individually associated with the stations 21, 22 and 23 in the called combination in the first loop; however, the last-mentioned relays remain in their operated positions due to the previously traced completed circuits for energizing the lower windings thereof. At this time, an operative connection is completed between the master position 1400 and the stations 21, 22 and 23 in the called combination in the first group by way of the first loop, as previously noted; and the operator at the master position 1400 may proceed to transmit the telegraphic message.

In the foregoing explanation of the mode of operation of the master selector 1500 in response to the digits 6 and 2, it was assumed that, when the wiper set of the Strowger mechanism 1700 engaged the second contact set in the sixth level of the associated contact bank, the first loop was idle, and that negative battery potential appeared upon the control conductor C118 causing operation of the switch-through relay R1680, in the manner described above. However, it may occur that the first loop is busy at this time and that positive battery potential appears upon the control conductor C118 extending from the first loop equipment 300, whereby the previously traced circuit for energizing the winding of the test relay R1660 in the master selector 1500 is completed in order to cause operation of the latter relay. Upon operating, the test relay R1660 effects intermittent operation of the flash relay R1650, whereby the lamp control relay R1450 is operated intermittently in order to effect flashing of the supervisory lamp L1446, in the manner previously explained. The flashing of the supervisory lamp L1446 indicates to the operator at the master position 1400 that the first loop is busy at this time. The operator, upon receiving the busy signal as noted above, may either release the master selector 1500 by operating the release key K1442 or he may exercise his priority authority by operating the priority key K1465. In the event the key K1442 is operated, the master selector 1500 is released, in the manner previously explained.

On the other hand, in the event the priority key K1465 is operated, positive battery potential is applied to the conductors C1466 and C1467. The application of positive battery potential to the conductor C1466 completes the previously traced circuit for energizing the lower winding of the switch-through relay R1680, thereby to cause the latter relay to operate. Upon operating, the switch-through relay R1680 completes, at the contacts 1689, the previously traced hold-

ing circuit for energizing the lower winding thereof; and effects the restoration of the test relay R1660, in the manner previously explained. The application of positive battery potential to the conductor C1467 completes the previously traced circuit for energizing the winding of the priority relay R330 in the first loop equipment 300, whereby the latter relay operates. Upon operating, the priority relay R330 completes, at the contacts 330, an obvious path for applying positive battery potential to the control conductor C116. The application of positive battery potential to the control conductor C116 effects the release of the station selector individually associated with the calling station involved in the completed group call by way of the first loop. Assuming that a group call has been previously completed from the calling station 21 to the called station 22 in the called combination in the first group by way of the first loop, the station selector 500 individually associated with the calling station 21 occupies its operated position. In accordance with the above assumption, the application of positive battery potential to the control conductor C116 completes a circuit, including the control wiper 706 of the wiper set of the Strowger mechanism 700 in the station selector 500, the contacts 675 and 543 and the set of switch springs S595, for energizing the release magnet M588 of the Strowger mechanism 700 in the station selector 500, thereby to cause the latter magnet to operate and effect the release of the Strowger mechanism 700 and consequently the release of the station selector 500, all in the manner previously explained. When the station selector 500 individually associated with the calling station 21 is thus released the station selector 900 individually associated with the called station 22 is released, whereby the calling station 21 and the called station 22 are rendered idle. Also when the station selector 500 individually associated with the calling station 21 is thus released the group relay 2G, the busy relay R310 and the busy slave relay R320 in the first loop equipment 300 restore. Upon restoring, the busy slave relay R320 completes, at the contacts 324, the previously traced circuit, including the control conductor C118, for energizing the winding of the group relay 3G in series with the winding of the busy relay R310, whereby the relays mentioned reoperate. Upon reoperating, the busy relay R310 effects reoperation of the busy slave relay R320 shortly thereafter, the busy slave relay R320 being of the slow-to-operate type. Upon reoperating, the busy slave relay R320 completes, at the contacts 321, 325, etc., the previously mentioned paths for applying positive battery potential to the control conductors C117, C119, etc., thereby to mark the various combinations of stations in the first group as busy to the station selectors individually associated with the various stations in the first group. Upon operating, the group relay 3G effects the operation of the loop relays R410 and R810 in the station line circuits 400 and 800 individually associated with the stations 21 and 22 in the called combination in the first group, the stations 21 and 22 being idle at this time. Also the group relay 3G effects operation of the loop relay in the station line circuit, not shown, individually associated with the station 23 in the called combination in the first group in the event the station 23 is idle at this time, in the manner previously explained. On the other hand, in the event the station 23 in the called combination in the first group is busy at this time, operation of the loop relay in the individually associated line circuit, not shown, is effected due to the operated position of the priority relay R330, in the manner previously explained. Accordingly, the combined transmitting-receiving printers at the stations 21, 22 and 23 in the called combination are operatively connected to the first loop; and when the switching relay R1640 in the master selector 1500 operates under the control of the minor switch 1600, in the manner previously explained, the previously traced connection between the master position 1400 and the stations 21, 22 and 23 in the called combination in the first group by way of the first loop is completed. When the above-mentioned operative connection is completed the line relay R1510 in the master selector 1500 reoperates in order to effect the release of the minor switch 1600, in the manner previously explained. At this time the operator at the master position 1400 may proceed to transmit the telegraphic message.

The release of the established connection between the master position 1400 and the stations 21, 22 and 23 in the called combination in the first group by way of the first loop is under the control of the operator at the master position 1400 or the operator at any one of the stations mentioned; and is effected by operating the associated release key, in the manner previously explained.

Master position to all-loops call

Considering now the extension of a call from the master position 1400 to a combination of stations in each of the four groups by way of all of the four loops, the operator at the master position 1400 initiates the call by dialing the all-groups call digit 0 in conjunction with the combination call digit identifying the stations in the called combination in all of the groups. For example, assuming that the all-loops call is to be extended to the first station in each loop, that is, the first stations 21, 31, 41 and 51 in the respective first, second, third and fourth loops, the operator at the master position 1400 dials upon the dial D1441 the all-groups call digit 0 in conjunction with the combination call digit 1 identifying the called stations 21, 31, 41 and 51 in the respective first, second, third and fourth groups. The master selector 1500 responds to the digits 0 and 1, whereby the wiper set of the Strowger mechanism 1700 engages the first contact set in the tenth level in the associated contact bank. The mode of operation of the master selector 1500 is substantially identical to that of the station selector 500 individually associated with the station 21 and, in the interest of brevity, the detailed operation of the elements in the master selector 1500 is not repeated.

When the wiper set of the Strowger mechanism 1700 engages the first contact set in the tenth level in the associated contact bank terminating the line conductors C140 and C141 extending to the repeaters 1301 to 1304, inclusive, and the control conductor C143 extending to the loop common equipment 1200, the switch-through relay R1680 in the master selector 1500 operates, in the manner previously explained, in order to complete, at the contacts 1686, a circuit for energizing in series the winding of the mixed group relay 1MG and the switching relay R1310 in the loop common equipment 1200. The above-mentioned circuit extends from the positive terminal of battery by way of the set of switch springs S1591,

the contacts 1686, the control wiper 1703 of the wiper set of the Strowger mechanism 1700, C143, the winding of 1MG and the winding of R1310 to the negative terminal of battery. When thus energized the mixed group relay 1MG and the switching relay R1310 operate. Upon operating, the switching relay R1310 interrupts, at the contacts 1319, the previously traced local circuit, including the battery 1342, for energizing the primaries of the loop repeaters 1301 to 1304, inclusive; and interrupts, at the contacts 1312, 1314 and 1316, 1318, etc., the previously traced local circuits for respectively energizing the secondaries of the loop repeaters 1301 to 1304, inclusive. Also the switching relay R1310 completes, at the contacts 1311, 1313 and 1315, 1317, etc., connections between the respective secondaries of the loop repeaters 1301 to 1304, inclusive, and the line terminal conductors C101, C104 and C150, C151, etc., of the respective first, second, third and fourth loops.

Upon operating, the mixed group relay 1MG completes, at the contacts 1MG1, 1MG2, etc., obvious paths for applying positive battery potential to the conductors C121, C122, etc., by way of the terminal block 1201. The application of positive battery potential to the conductor C121 completes the previously traced circuit for energizing the lower winding of the loop relay R410 or the previously traced path for short-circuiting the lower winding of the loop relay R410 in the station line circuit 400 individually associated with the called station 21, respectively depending upon the idle or busy condition of the station 21, in the manner previously explained. In the event the lower winding of the loop relay R410 is energized, this relay operates operatively to connect the called station 21 to the conductors C101 and C102 in the first loop. On the other hand, in the event the lower winding of the loop relay R410 is short-circuited, the previously traced circuit, including the conductors C122 and C120, is completed for energizing the winding of the release relay R340 in the first loop equipment 300 in order to cause the latter relay to operate, in the manner previously explained. Similarly, the application of positive battery potential to the pairs of conductors C156, C157 and C158, C159 and C160, C161 either effects operation of the respective station line circuits 231, 241 and 251, respectively individually associated with the called stations 31, 41 and 51; or operation of the respective second loop equipment 233, the third loop equipment 243 or the fourth loop equipment 253, depending respectively upon the idle or busy condition of the respective called stations 31, 41 and 51, all in the manner previously explained.

In view of the foregoing explanation of the mode of operation of the station line circuit 400 in conjunction with the first loop equipment 300, it will be understood that, in the event the called station 21 is idle, it is operatively connected to the first loop; on the other hand, in the event the called station 21 is busy, the release relay R340 in the first loop equipment 300 is operated. Hence, it will be understood that the first loop is either prepared between the terminal conductors C101 and C104 thereof or is interrupted between the terminal conductors mentioned, due to the operated position of the release relay R340 in the first loop equipment 300 at this time. Similarly, the second loop, the third loop and the fourth loop will be completed between the respective line terminal conductors C150, C151, etc., thereof, or interrupted due to the operation of the release relays in the respective second loop equipment 233, the third loop equipment 243 and the fourth loop equipment 253.

More particularly, in the event the called station 21 is idle at this time, the first loop is completed by way of the secondary of the first loop repeater 1301; on the other hand, in the event the called station 21 is busy, the first loop is interrupted at this time. Similarly, the second, third and fourth loops are either respectively completed by way of the secondaries of the second loop repeater 1302 and the third loop repeater 1303 and the fourth loop repeater 1304 or interrupted, depending upon the idle or busy condition of the respective called stations 31, 41 and 51.

First assuming that each of the called stations 21, 31, 41 and 51 is idle, each of the four loops mentioned is completed to the secondary of the respective loop repeater. More particularly, the circuit including the first loop extends from the positive terminal of the battery 1322 by way of the contacts 1313, C101, the contacts 412, the dial D441, the release key K442, the transmitter T443, the printer magnet M444, the contacts 414, C102, station 22, the impedance 831, the contacts 819, C103, etc., the contacts 341, C104, the contacts 1311, the impedance 1321, the lower winding of the impulse relay R1350, the lower winding of the control relay R1360 and the contacts 1351 to the negative terminal of the battery 1322. Accordingly the impulse relay R1350 and the control relay R1360 in the secondary of the first loop repeater 1301 occupy their operated positions, thereby to effect operation of the impulse relay R1380 and the control relay R1370 in the primary of the first loop repeater 1301 when the loop between the master position 1400 and the primaries of the loop repeaters 1301 to 1304, inclusive, is completed. Similarly, the second, third and fourth loops are completed, whereby the loop circuit extending from the master position 1400 will be completed by way of the primaries of the loop repeaters 1301 to 1304, inclusive, when the switching relay R1640 in the master selector 1500 operates under the control of the minor switch 1600.

When the switching relay R1640 in the master selector 1500 operates, the previously mentioned loop circuit extending from the master position 1400 to the primaries of the loop repeaters 1301 to 1304, inclusive, is completed, as noted above; and extends from the positive terminal of the battery 1629 by way of the contacts 1631 and 1641, the dial D1441, the release key K1442, the transmitter T1443, the printer magnet M1444, the winding of the line relay R1510, the contacts 1632 and 1642, the line wiper 1701 of the wiper set of the Strowger mechanism 1700, C140, the primary of the fourth loop repeater 1304, the primary of the third loop repeater 1303, the primary of the second loop repeater 1302, the contacts 1381, the lower winding of the control relay R1370, the lower winding of the impulse relay R1380, the impedance 1341, C141, the line wiper 1702 of the wiper set of the Strowger mechanism 1700, the contacts 1683 and 1684, the contacts 1692 of the set of switch springs S1690 and the impedance 1627 to the negative terminal of the battery 1629. When the above-traced loop circuit is completed the line relay R1510 in the master selector 1500 operates in order to effect the release of the minor switch 1600, in the manner previously explained; and the impulse relay R1380 and the control relay R1370 in the first loop re-

peater 1301 operate in order to insure that the impulse relay R1350 and the control relay R1360 therein are operated, whereby the first loop is closed to the called station 21. Similarly, when the primaries of the other repeaters 1302, etc. are closed the secondaries of these repeaters are closed, thereby insuring closure of the second loop circuit, etc. to the respective called stations 31, etc. At this time, an operative connection is completed between the master position 1400 and the primaries of the loop repeaters 1301 to 1304, inclusive, and between the secondaries of the loop repeaters 1301 to 1304, inclusive, and the respective called stations 21, 31, 41 and 51. At this time, the operator at the master position 1400 may proceed to transmit the telegraphic message over the associated loop circuit to the primaries of the loop repeaters 1301 to 1304, inclusive, whereby the loop repeaters 1301 to 1304, inclusive, respectively repeat the telegraphic message by way of the secondaries thereof to the first, second, third and fourth loops and, consequently, to the called stations 21, 31, 41 and 51. The exact mode of operation of the various loop repeaters 1301, etc. is described in detail subsequently.

In the foregoing explanation of the mode of operation of the apparatus it was assumed that each of the called stations 21, 31, 41 and 51 was idle when the all-loops call was initiated at the master position 1400; however, it may occur that one or more of the called stations 21, 31, 41 and 51 are busy at this time, as previously explained. In this event, the corresponding loop circuit is retained interrupted due to the operated position of the release relay in the associated loop equipment, whereby the secondary of the associated loop repeater is retained interrupted in order to effect the interruption of the primary thereof, in the manner previously explained. Accordingly, in this event, when the switching relay R1640 in the master selector 1500 operates it only prepares, at the contacts 1641 and 1642, the previously traced loop circuit extending between the master position 1400 and the primaries of the loop repeaters 1301 to 1304, inclusive, as previously explained. Hence, in this event, the line relay R1510 is not promptly operated in order to effect the restoration of the lamp control relay R1450 and the consequent termination of the answer-back signal by extinguishing the supervisory lamp L1446. When the supervisory lamp L1446 is not promptly extinguished, terminating the answer-back signal, it indicates to the operator at the master position 1400 that one or more of the called stations 21, 31, 41 and 51 are busy at this time. In this event, the operator at the master position 1400 may either permit the master selector 1500 to be automatically released, in the manner previously explained, or he may exercise his priority authority by operating the priority key K1465. In the event the operator at the master position 1400 permits the master selector 1500 to be released automatically, the release thereof is the same as that previously described.

On the other hand, in the event the priority key K1465 is operated, positive battery potential is applied to the conductors C1466 and C1467, as previously noted. The application of positive battery potential to the conductor C1466 is without effect in view of the fact that the switch-through relay R1680 already occupies its operated position. The application of positive battery potential to the conductor C1467 completes a circuit, including the control wiper 1705 of the wiper set of the Strowger mechanism 1700 and the control conductor C142, for energizing the winding of the priority relay R1210 in the loop common equipment 1200. When thus energized the priority relay R1210 operates to complete, at the contacts 1211, 1212, etc., obvious multiple circuits respectively including the control conductors C115, C147, etc. for energizing the windings of the priority relays R330, etc. in the respective first loop equipment 300, the second loop equipment 233, the third loop equipment 243 and the fourth loop equipment 253. Upon operating, the priority relay R330 in the first loop equipment 300 effects the release of the called station in the first group which is busy at this time, in the manner previously explained. Similarly, the operation of the priority relays in the second loop equipment 233, etc. effects the release of the called station in each of the respective second, third, etc. groups which are busy at this time. The operator at the master position 1400 operates the priority key K1465 only during a short time interval; and when the last-mentioned key is restored the previously traced circuit for energizing the winding of the priority relay R1210 in the loop common equipment 1200 is interrupted, thereby to cause the latter relay to restore. Upon restoring, the priority relay R1210 effects the restoration of the priority relays R330, etc. in the respective first loop equipment 300, the second loop equipment 233, etc. in an obvious manner. At this time, each of the loop circuits is completed to the secondary of the associated loop repeater, thereby to cause the primaries of the loop repeaters 1301 to 1304, inclusive, to be completed in the previously traced loop circuit extending to the master position 1400. At this time, the previously traced operative connection between the master position 1400 and the primaries of the loop repeaters 1301 to 1304, inclusive, is completed; and the operative connections between the secondaries of the respective loop repeaters 1301 to 1304, inclusive, and the called stations in the respective first, second, third and fourth groups by way of the respective first, second, third and fourth loops are completed. Accordingly, the operator at the master position 1400 may proceed to transmit the telegraphic message. At this point it is noted that each of the loop repeaters 1301, etc. is of the two-way type, whereby a telegraphic message may be transmitted from any one of the called stations in any one of the groups by way of the associated loop to the associated loop repeater and repeated from the secondary thereof to the primary thereof over the loop to the master position 1400. Also it is noted that the telegraphic message repeated over the loop extending to the master position 1400 will be repeated by the primaries of the other loop repeaters over the secondaries thereof and consequently over the other loops to the called stations in the other group. The release of the established connection is under the control of the operator at the master position 1400 or the operator at any called station in any one of the groups, and is effected when the operator at the master position 1400 or the operator at any one of the called stations mentioned operates the associated release key, all in the manner previously explained.

In view of the foregoing explanation of the mode of operation of the apparatus in order to extend an all-loops call from the master position 1400 to the particular combination, including the first station in each group, by way of the respective loops, it will be understood that the operator at the master position 1400 may selectively extend

an all-loops call to other combinations of the stations in the groups by way of the respective loops, in a similar manner. In the illustrated embodiment of the trunking arrangement the Strowger mechanism 1700 of the master selector 1500 and the loop common equipment 1200 are arranged for setting up four particular combinations of called stations in the four groups by way of the four loops. More particularly, in accordance with the trunking arrangement, the all-groups call numbers are 01, 02, 03 and 04. Specifically, when the operator at the master position 1400 dials the all-groups call number 04 into the master selector 1500, the apparatus operates in order to set up a connection from the master position 1400 by way of the loop repeaters 1301 to 1304, inclusive, and the four loops including each of the eight called stations in each of the four groups.

Considering now the operation of the first loop repeater 1301 and assuming that the primaries of the repeaters 1301, etc. are closed between the line conductors C140 and C141, and that the secondaries of each of these repeaters are respectively closed between the line conductors C101, C104 and C150, C151, etc., it is noted that the impulse relay and the control relay in the primary and in the secondary of each loop repeater occupy their operated positions. Referring now to the first loop repeater 1301, it is pointed out that the impulse relay R1350 and the control relay R1360 in the secondary thereof, and the control relay R1370 and the impulse relay R1380 in the primary thereof, occupy their operated positions. At this time, in the event a telegraphic signal is transmitted over the line conductors C140 and C141, the circuit for energizing the lower winding of the impulse relay R1380 in series with the lower winding of the control relay R1370 is alternately interrupted and recompleted. When the circuit for energizing the lower winding of the impulse relay R1380 and the control relay R1370 is interrupted, the impulse relay R1380 is retained in its operated position due to the previously traced completed circuit, including the resistors 1382 and 1383, for energizing the upper winding thereof at this time; however, the control relay R1370 restores due to the previously traced completed path, including the resistor 1373 and the contacts 1362, for short-circuiting the upper winding thereof at this time. Upon restoring, the control relay R1370 interrupts, at the contacts 1372, the previously traced path, including the resistor 1363, for short-circuiting the upper winding of the control relay A1360, whereby the previously traced circuit, including the resistors 1363 and 1364, is made effective for energizing the upper winding of the last-mentioned relay. Also, upon restoring, the control relay R1370 completes, at the contacts 1371, an obvious path, including the resistor 1352, for short-circuiting the upper winding of the impulse relay R1350; thereby to cause the latter relay to restore exceedingly fast, the impulse relay R1350 being of the differential type. Upon restoring, the impulse relay R1350 interrupts, at the contacts 1351, the previously traced operative circuit including the first loop. When the previously traced circuit for energizing the lower winding of the impulse relay R1380 in series with the lower winding of the control relay R1370 is recompleted, the control relay R1370 reoperates. Upon reoperating, the control relay R1370 interrupts, at the contacts 1371, the previously traced path, including the resistor 1352, for short-circuiting the upper winding of the impulse relay R1350, whereby the previously traced circuit, including the resistors 1352 and 1353, is again made effective for energizing the upper winding of the last-mentioned relay, whereupon the impulse relay R1350 reoperates. Also the control relay R1370 recompletes, at the contacts 1372, the previously traced path, including the resistor 1363, for short-circuiting the upper winding of the control relay R1360. Upon reoperating, the impulse relay R1350 recompletes, at the contacts 1351, the previously traced operative circuit including the first loop, whereby the lower winding of the impulse relay R1350 is again energized in series with the lower winding of the control relay R1360. Accordingly the control relay R1360 is retained in its operated position due to the completed circuit for energizing the lower winding thereof, even though the previously traced path, including the resistor 1363 and the contacts 1372, for short-circuiting the upper winding thereof is completed. Moreover, the impulse relay R1350 remains in its operated position due to the fact that the magnetic flux produced, when the upper winding thereof is energized, predominates over the magnetic flux produced when the lower winding thereof is also energized. Accordingly the first loop repeater 1301 has responded to the opening and closing of the circuit extending to the primary thereof to effect opening and closing of the circuit extending from the secondary thereof. Of course, it will be understood that the second loop repeater 1302, the third loop repeater 1303 and the fourth loop repeater 1304 respond to the impulse transmitted over the conductors C140 and C144 to repeat the impulse over the second, third and fourth loops, in the manner explained above.

In the event a telegraphic signal is transmitted over any one of the loops, such, for example, as the first loop, the circuit for energizing the lower winding of the impulse relay R1350 in series with the lower winding of the control relay R1360 is alternately interrupted and recompleted. When the circuit for energizing the lower winding of the impulse relay R1350 and the control relay R1360 is interrupted the impulse relay R1350 is retained in its operated position due to the previously traced completed circuit, including the resistors 1352 and 1353, for energizing the upper winding thereof at this time; however, the control relay R1360 restores due to the previously traced completed path, including the resistor 1363 and the contacts 1372, for short-circuiting the upper winding thereof at this time. Upon restoring, the control relay R1360 interrupts, at the contacts 1362, the previously traced path, including the resistor 1373, for short-circuiting the upper winding of the control relay R1370, whereby the previously traced circuit, including the resistors 1373 and 1374, becomes effective for energizing the upper winding of the last-mentioned relay. Also, upon restoring, the control relay R1350 completes, at the contacts 1361, an obvious path, including the resistor 1382, for short-circuiting the upper winding of the impulse relay R1380, thereby to cause the latter relay to restore exceedingly fast, the impulse relay R1380 being of the differential type. Upon restoring, the impulse relay R1380 interrupts, at the contacts 1381, the previously traced operative circuit including the conductors C140 and C141. When the previously traced circuit for energizing the lower winding of the impulse relay R1350 in series with the lower winding of the control relay R1360 is recompleted, the control relay R1360 reoperates.

Upon reoperating, the control relay R1360 interrupts, at the contacts 1361, the previously traced path, including the resistor 1382, for short-circuiting the upper winding of the impulse relay R1380; whereby the previously traced circuit, including the resistors 1382 and 1383, is again made effective for energizing the upper winding of the last-mentioned relay, whereupon the impulse relay R1380 reoperates. Also the control relay R1360 recompletes, at the contacts 1362, the previously traced path, including the resistor 1373, for short-circuiting the upper winding of the control relay R1370. Upon reoperating, the impulse relay R1380 recompletes, at the contacts 1381, the previously traced operative circuit, including the conductors C140 and C141, whereby the lower winding of the impulse relay R1380 is again energized in series with the lower winding of the control relay R1370. Accordingly the control relay R1370 is retained in its operated position due to the completed circuit for energizing the lower winding thereof, even though the previously traced path, including the resistor 1373 and the contacts 1362, for short-circuiting the upper winding thereof is completed. Moreover, the impulse relay R1380 remains in its operated position due to the fact that the magnetic flux, produced when the upper winding thereof is energized, predominates over the magnetic flux produced when the lower winding thereof is also energized. Accordingly the first loop repeater 1301 has responded to the opening and closing of the circuit extending to the secondary thereof to effect operating and closing of the circuit extending from the primary thereof. Of course, it will be understood that the impulse transmitted from the primary of the first loop repeater 1301 over the primaries of the second loop repeaters 1302, etc. will cause operation of the second loop repeater 1302, etc. to repeat the impulse over the secondaries thereof. Hence, the telegraphic message received over any one of the loops will be repeated by the associated loop repeater over the loop extending to the master position 1400 and also over the other loops.

Conclusions

From the foregoing it is apparent that a telegraph system is provided, which comprises improved automatic switching apparatus for setting up individual station calls and different loop calls involving different combinations of stations in the associated groups and all-loops calls involving different combinations of stations in all of the groups, and priority equipment, whereby the operator at the master position may override ordinary calls.

While one embodiment of the invention has been disclosed, it will be understood that various modifications may be made therein which are within the true spirit and scope of the invention.

What is claimed is:

1. In a signaling system, a plurality of stations, a plurality of selectors individual to said stations, a loop, a plurality of loop relays individual to said stations and normally individually disconnecting said stations from said loop, a plurality of group relays individually corresponding to different combinations of said stations, each of said selectors having a plurality of different settings having access to said loop and individually corresponding to said group relays, means controllable from any calling station for selectively operating the selector individual thereto to any one of its settings, thereby to connect said calling station serially in said loop and to control a corresponding one of said group relays, means responsive to the control of said one group relay for controlling the loop relays individual to the corresponding combination of said stations, and means responsive to the control of the loop relay individual to any station for connecting said last-mentioned station serially in said loop, thereby to complete a signaling connection from said calling station by way of said loop to said last-mentioned called combination of stations.

2. In a signaling system, a plurality of stations, a plurality of selectors individual to said stations, a loop, a plurality of normally restored loop relays individual to said stations, means controlled when the loop relay individual to any station is restored for disconnecting said last-mentioned station from said loop and controlled when said last-mentioned loop relay is operated for connecting said last-mentioned station serially in said loop, a plurality of group relays individually corresponding to different combinations of said stations, each of said selectors having a plurality of different settings having access to said loop and individually corresponding to said group relays, means controllable from any calling station for selectively operating the selector individual thereto to any one of its settings, thereby to connect said calling station serially in said loop and to control a corresponding one of said group relays, and means responsive to the control of said one group relay for operating the loop relays individual to the corresponding combination of said stations, thereby to complete a signaling connection from said calling station by way of said loop to said last-mentioned called combination of stations.

3. In a telegraph system, a plurality of stations each of said stations including a call transmitter and a signal transmitter-receiver, a loop normally excluding said stations and including a plurality of serially connected impedance elements individually corresponding to the impedance of the corresponding said stations, station selection means selectively controllable to different positions and effective in each position to disconnect a different plurality of said impedance elements from said loop and to connect a corresponding different plurality of said stations serially in said loop, and means controllable from the call transmitter at any calling station for connecting said last-mentioned station serially in said loop and for selectively controlling said station selection means to any of its positions, thereby to complete a two-way signaling connection from said calling station by way of said loop to different called stations.

4. In a telegraph system, a plurality of stations, a switching center, a plurality of lines individually extending between said stations and said switching center, a loop at said switching center normally excluding said lines and including a plurality of serially connected impedance elements individually corresponding to said lines, station selection means at said switching center selectively controllable to different positions and effective to disconnect different groups of said impedance elements from said loop and to connect corresponding different groups of said lines serially in said loop in place thereof, and means controllable from any calling station for connecting the line individually extending thereto serially in said loop and for selectively controlling said station selection means to any of its positions, thereby to complete a signaling connection

from said calling station by way of said loop to different called stations.

5. In a signaling system, a plurality of stations, a loop, a plurality of impedance elements individually corresponding to said stations, a plurality of relays individual to said stations and normally individually disconnecting said stations from said loop and individually connecting said impedance elements serially in said loop, and means controllable from any calling stations for connecting said last-mentioned stations serially in said loop and for selectively controlling said relays to disconnect different ones of said impedance elements from said loop and to connect corresponding different ones of said stations serially in said loop, thereby to complete a signaling connection from said calling station by way of said loop to different called stations while maintaining the impedance of said loop constant.

6. In a signaling system, a plurality of stations, a loop normally excluding said stations and including a plurality of serially connected impedance elements individually corresponding to said stations, station selection means selectively controllable to disconnect different ones of said impedance elements from said loop and to connect the corresponding ones of said stations serially in said loop in place of their associated impedances, means controllable from any calling station for testing the idle or busy condition of said loop, and means governed in the event said loop is tested as busy for returning a busy signal to said calling station and governed in the event said loop is tested as idle for connecting said calling station serially in said loop and for selectively controlling said station selection means, thereby to complete a signaling connection from said calling station by way of said loop to the different called stations which have been connected in said loop in place of their associated impedances.

7. In a signaling system, a plurality of stations, a plurality of selectors individual to said stations and normally individually connected thereto, a loop normally excluding said stations and having terminals accessible to said selectors, station selection means selectively controllable to seize different ones of said terminals to disconnect different groups of said stations from the ones of said selectors individual thereto and to connect said last-mentioned stations in said loop, means controllable from any calling station for operating the connected selector individual thereto to select said loop, means for testing the idle or busy condition of said loop, and means governed in the event said loop is tested as busy for returning a busy signal to said calling station and governed in the event said loop is tested as idle for selectively controlling said station selection means, thereby to seize a set of said terminals to complete a signaling connection from said calling station by way of said loop to different groups of called stations depending upon the terminal seized.

8. In a signaling system, a plurality of stations, a selector individual to each station, a loop associated with but normally excluding said stations, each of said selectors having a plurality of first settings individually coresponding to said stations and a plurality of second settings commonly corresponding to said loop and individually corresponding to different combinations of the stations associated therewith, means controllable from any calling station for selectively operating the selector individual thereto to any one of its settings, means responsive to the operation of said last-mentioned selector to any one of its first settings for completing a signaling connection from said calling station to the called station individually corresponding to said one first setting, and means responsive to the operation of said last-mentioned selector to different ones of its second settings for serially including said calling station in said loop and for serially including any combination of said stations in said loop corresponding to the selected second setting, thereby to complete a signaling connection from said calling station to any of said combinations of said stations.

9. In a signaling system, a plurality of stations, a plurality of selectors individual to said stations, a conference trunk, station selection apparatus selectively controllable in accordance with different combinations of said stations, each of said stations and said conference trunk being accessible to each of said selectors, means controllable from any calling station for selectively operating the selector individual thereto, means responsive to the operation of said last-mentioned selector to select any called station for testing the idle or busy condition of said called station, means governed in the event said called station is tested as busy for returning a busy signal to said calling station and governed in the event said called station is tested as idle for completing a signal connection from said calling station to said called station, means responsive to the operation of said last-mentioned selector to select said conference trunk for testing the idle or busy condition thereof, means governed in the event said conference trunk is tested as busy for returning a busy signal to said calling station and governed in the event said conference trunk is tested as idle for selectively controlling said station selection apparatus in accordance with a particular called combination of said stations, means responsive to the control of said station selection apparatus in accordance with said last-mentioned called combination for testing the idle or busy condition of each station therein, and means governed in the event one or more stations in said last-mentioned called combination are tested as busy for returning a busy signal to said calling station and governed in the event each station in said last-mentioned called combination is tested as idle for completing a signal connection from said calling station by way of said conference trunk to said last-mentioned called combination of stations.

10. In a signaling system, a plurality of stations, a plurality of selectors individual to said stations, each of said selectors being selectively operative to select different ones of said stations and different combinations of said stations, means controllable from any calling station for selectively operating the selector individual thereto, means responsive to the operation of said last-mentioned selector for rendering busy said calling station, additional means responsive to the operation of said last-mentioned selector to select any called station for testing the idle or busy condition thereof, means governed in the event said called station is tested as busy for returning a busy signal to said calling station and governed in the event said called station is tested as idle for completing a signal connection between said calling station and said called station, whereby said called station is rendered busy, further means responsive to the operation of said last-mentioned selector to select any called com-

bination of said stations for testing the idle or busy condition of each station therein, and means governed in the event one or more stations in said called combination are tested as busy for returning a busy signal to said calling station and governed in the event each station in said called combination is tested as idle for completing a signal connection between said calling station and said called combination of stations, whereby each station in said called combination is rendered busy.

11. In a signaling system, a plurality of stations, a plurality of selectors individual to said stations, each of said selectors being selectively operative to select different ones of said stations and different combinations of said stations, means controllable from any calling station for selectively operating the selector individual thereto, means responsive to the operation of said last-mentioned selector for rendering busy said calling station, additional means responsive to the operation of said last-mentioned selector to select any called station for testing the idle or busy condition thereof, means governed in the event said called station is tested as busy for returning a busy signal to said calling station and governed in the event said called station is tested as idle for completing a signal connection between said calling station and said called station, whereby said called station is rendered busy, further means responsive to the operation of said last-mentioned selector to select any called combination of said stations for testing the idle or busy condition of each station therein, means governed in the event one or more stations in said called combination are tested as busy for returning a busy signal to said calling station and governed in the event each station in said called combination is tested as idle for completing a signal connection between said calling station and said called combination of stations, whereby each station in said called combination is rendered busy, and means for preventing said further means from testing said calling station as busy in the event said called combination of stations includes said calling station.

12. In a signaling system, a plurality of stations, a plurality of selectors individual to said stations, a loop normally excluding said stations, each of said selectors having a plurality of first settings individually corresponding to said stations and a plurality of second settings commonly corresponding to said loop and individually corresponding to different combinations of said stations, a network of variable impedance, means controllable from any calling station for selectively operating the selector individual thereto to any one of its settings, means responsive to the operation of said last-mentioned selector to any one of its first settings for completing a signaling connection from said calling station by way of said network to the called station individually corresponding to said one first setting and for setting the impedance of said network to a relatively high value, and means responsive to the operation of said last-mentioned selector to any one of its second settings for serially including in said loop said network and both said calling station and the combination of said stations corresponding to said one second setting and for setting the impedance of said network to a relatively low value, thereby to complete a signaling circuit from said calling station to said last-mentioned called combination of stations.

13. In a signaling system, a plurality of stations, a plurality of selectors individual to said stations, a conference trunk, station selection apparatus selectively controllable in accordance with different combinations of said stations, each of said selectors having a plurality of settings commonly corresponding to said conference trunk and individually corresponding to the different combinations of said stations, means controllable from any calling station for selectively operating the selector individual thereto to any one of its settings, means responsive to the operation of said last-mentioned selector to its one setting for testing the idle or busy condition of said conference trunk, means governed in the event said conference trunk is tested as busy for returning a busy signal to said calling station and governed in the event said conference trunk is tested as idle for selectively controlling said station selection apparatus in accordance with the particular called combination of said stations corresponding to said one setting of said last-mentioned selector, means responsive to the control of said station selection apparatus in accordance with said last-mentioned called combination for testing the idle or busy condition of each station therein, and means governed in the event one or more stations in said last-mentioned called combination are tested as busy for returning a busy signal to said calling station and governed in the event each station in said last-mentioned called combination is tested as idle for completing a signal connection from said calling station by way of said conference trunk to said last-mentioned called combination of stations.

14. In a signaling system, a plurality of stations, a plurality of selectors individual to said stations, a conference trunk, station selection apparatus selectively controllable in accordance with different combinations of said stations, each of said selectors having a plurality of settings commonly corresponding to said conference trunk and individually corresponding to the different combinations of said stations, means controllable from any calling station for selectively operating the selector individual thereto to any one of its settings, means responsive to the operation of said last-mentioned selector to its one setting for testing the idle or busy condition of said conference trunk, means governed in the event said conference trunk is tested as busy for returning a busy signal to said calling station and governed in the event said conference trunk is tested as idle for selectively controlling said station selection apparatus in accordance with the particular called combination of said stations corresponding to said one setting of said last-mentioned selector, means responsive to the control of said station selection apparatus in accordance with said last-mentioned called combination for testing the idle or busy condition of each station therein, and means governed in the event one or more stations in said last-mentioned called combination are tested as busy for releasing said last-mentioned selector and governed in the event each station in said last-mentioned called combination is tested as idle for completing a signal connection from said calling station by way of said conference trunk to said last-mentioned called combination of stations.

15. In a signaling system, a plurality of stations, a plurality of selectors individual to said stations, a loop, a plurality of normally restored loop relays individual to said stations, means controlled when the loop relay individual to any station is restored for disconnecting said last-

mentioned station from said loop and controlled when said last-mentioned loop relay is operated for connecting said last-mentioned station serially in said loop, a plurality of group relays individually corresponding to different combinations of said stations, each of said selectors having a plurality of different settings having access to said loop and individually corresponding to said group relays, means controllable from any calling station for selectively operating the selector individual thereto to any one of its settings, means responsive to the operation of said last-mentioned selector to its one setting for testing the idle or busy condition of said loop, means governed in the event said loop is tested as busy for returning a busy signal to said calling station and governed in the event said loop is tested as idle for connecting said calling station serially in said loop and for controlling the one of said group relays corresponding to said one setting of said last-mentioned selector, a release relay operative to interrupt a common point in said loop, and means responsive to the control of said one group relay for operating the loop relays individual to idle stations in the corresponding combinations of said stations and for operating said release relay in the event there is one or more busy stations in said last-mentioned combination of said stations, whereby a signal connection is completed from said calling station by way of said loop to said last-mentioned called combination of said stations only in the event that each station in said last-mentioned called combination of said stations is idle.

16. In a signaling system, a plurality of stations, a plurality of line circuits individually associated with said stations, each of said line circuits including first and second impedance elements, a plurality of selectors individual to said stations, a loop normally excluding said stations and said second impedance elements and serially including said first impedance elements, station selection means selectively controllable to govern the line circuits individually associated with different combinations of said stations, and means controllable from any calling station for operating the selector individual thereto to seize said loop and selectively to control said station selection means in accordance with any called combination of said stations, whereby the line circuit individual to each station in said called combination is governed; the line circuit individually associated with said calling station not being governed in the event said called combination excludes said calling station, whereby said calling station is serially included in said loop by said last-mentioned selector and the first and second impedance elements in said last-mentioned line circuit are respectively included in and excluded from said loop; the line circuit individually associated with said calling station being governed in the event said called combination includes said calling station, whereby said calling station and the second impedance element in said last-mentioned line circuit are serially included in said loop and the first impedance in said last-mentioned line circuit is excluded from said loop, the line circuit individually associated with each other station included in said called combination being governed, whereby said other station is serially included in said loop and the first impedance element and the second impedance element in said last-mentioned line circuit are excluded from said loop.

17. In a telegraph system, a master position including a signal transmitter-receiver, a selector associated with said master position, a plurality of stations accessible to said selector, each of said stations including a signal transmitter-receiver, means for setting up both station-to-station signal connections between said stations and conference signal connections involving different combinations of said stations, means controllable from said master position for selectively operating said selector to select any called one of said stations, means responsive to the selection of said called station for testing the idle or busy condition thereof, means governed in the event said called station is tested as busy for returning a busy signal to said master position and governed in the event said called station is tested as idle for completing a two-way signal connection between said master position and said called station, and additional means controllable from said master position for forcing the release of a prior signal connection involving said called station regardless of the type thereof and for completing said two-way signal connection between said master position and said called station.

18. In a telegraph system, a master position including a signal transmitter-receiver, a selector associated with said master position, a plurality of stations accessible to said selector, each of said stations including a signal transmitter-receiver, means for setting up signal connections between said stations, means controllable from said master position for selectively operating said selector to select any called one of a plurality of different combinations of said stations, means responsive to the selection of said called combination of stations for testing the idle or busy condition of each station in said called combination, means governed in the event one or more of the stations in said called combination are tested as busy for returning a busy signal to said master position and governed in the event each station in said called combination is tested as idle for completing a two-way conference signal connection between said master position and each station in said called combination, and additional means controllable from said master position for forcing the release of each prior signal connection involving a station in said called combination and for completing said two-way conference signal connection between said master position and each station in said called combination.

19. In a telegraph system, a master position including a signal transmitter-receiver, a selector associated with said master position, a plurality of stations accessible to said selector, each of said stations including a signal transmitter-receiver, means for setting up both station-to-station signal connections between said stations and conference signal connections involving different combinations of said stations, means controllable from said master position for selectively operating said selector to select any called one of a plurality of different combinations of said stations, means responsive to the selection of said called combination of stations for testing the idle or busy condition of each station in said called combination, means governed in the event one or more of the stations in said called combination are tested as busy for returning a busy signal to said master position and governed in the event each station in said called combination is tested as idle for completing a two-way conference signal connection between said master position and each station in said called combination, and ad-

ditional means controllable from said master position for forcing the release of each prior signal connection involving a station in said called combination regardless of the type thereof and for completing said two-way conference signal connection between said master position and each station in said called combination.

20. In a signaling system, a master position, a selector associated with said master position, a plurality of stations, a loop normally excluding said stations, means for setting up both station-to-station signal connections directly between said stations and conference signal connections by way of said loop involving different combinations of said stations, station selection means adapted to be controlled in accordance with different combinations of said stations, means controllable from said master position for operating said selector to select said loop and to condition said selector to control said station selection means in accordance with any called combination of said stations, means responsive to the selection of said loop for testing the idle or busy condition thereof, means governed in the event said loop is tested as busy for returning a busy signal to said master position and governed in the event said loop is tested as idle for causing said selector to control said station selection means, means responsive to the control of said station selection means in accordance with said called combination for testing the idle or busy condition of each station therein, and means governed in the event one or more stations in said called combination is tested as busy for returning a busy signal to said master position and governed in the event each station in said called combination is tested as idle for including the stations in said called combination in said loop, thereby to set up a conference signaling connection from said master position by way of said loop to the stations in said called combination.

21. In a signaling system, a master position, a selector associated with said master position, a plurality of stations, a loop normally excluding said stations, means for setting up both station-to-station signal connections directly between said stations and conference signal connections by way of said loop involving different combinations of said stations, station selection means adapted to be controlled in accordance with different combinations of said stations, means controllable from said master position for operating said selector to select said loop and to condition said selector to control said station selection means in accordance with any called combination of said stations, means responsive to the selection of said loop for testing the idle or busy condition thereof, means governed in the event said loop is tested as busy for returning a busy signal to said master position and governed in the event said loop is tested as idle for causing said selector to control said station selection means, means responsive to the control of said station selection means in accordance with said called combination for testing the idle or busy condition of each station therein, means governed in the event one or more stations in said called combination is tested as busy for returning a busy signal to said master position and governed in the event each station in said called combination is tested as idle for including the stations in said called combination in said loop, thereby to set up a conference signaling connection from said master position by way of said loop to the stations in said called combination, and additional means controllable from said master position for forcing the release of a prior conference signal connection set up by way of said loop and each prior signal connection involving a station in said called combination regardless of the type thereof.

22. In a signaling system, a master position, a selector associated with said master position, a plurality of stations, a loop normally excluding said stations, means for setting up both station-to-station signal connections directly between said stations and conference signal connections by way of said loop involving different combinations of said stations, station selection means adapted to be controlled in accordance with different combinations of said stations, means controllable from said master position for operating said selector to select said loop and to condition said selector to control said station selection means in accordance with any called combination of said stations, means responsive to the selection of said loop for testing the idle or busy condition thereof, means governed in the event said loop is tested as busy for returning a busy signal to said master position and governed in the event said loop is tested as idle for returning an answer-back signal to said master position and for causing said selector to control said station selection means, means responsive to the control of said station selection means in accordance with said called combination for testing the idle or busy condition of each station therein, means governed in the event each station in said called combination is tested as idle for arresting the return of said answer-back signal to said master position and for including the stations in said called combination in said loop, thereby to set up a conference signaling connection from said master position by way of said loop to the stations in said called combination, and means governed in the event said answer-back signal is returned to said master position a predetermined time interval for releasing said selector.

23. In a signaling system, a master position, a selector associated with said master position, a plurality of stations, a loop normally excluding said stations, means for setting up both station-to-station signal connections directly between said stations and conference signal connections by way of said loop involving different combinations of said stations, station selection means adapted to be controlled in accordance with different combinations of said stations, means controllable from said master position for operating said selector to select said loop and to condition said selector to control said station selection means in accordance with any called combination of said stations, means responsive to the selection of said loop for testing the idle or busy condition thereof, means governed in the event said loop is tested as busy for returning a busy signal to said master position and governed in the event said loop is tested as idle for returning an answer-back signal to said master position and for causing said selector to control said station selection means, means responsive to the control of said station selection means in accordance with said called combination for testing the idle or busy condition of each station therein, means governed in the event each station in said called combination is tested as idle for arresting the return of said answer-back signal to said master position and for including the station in said called combination in said loop, thereby to set up a conference signaling connection from said

master position by way of said loop to the stations in said called combination, means governed in the event said answer-back signal is returned to said master position a predetermined time interval for releasing said selector, and additional means controllable from said master position for forcing the release of a prior conference signal connection set up by way of said loop and each prior signal connection involving a station in said called combination regardless of the type thereof.

24. In a signalling system, a plurality of stations arranged in a first loop, a plurality of stations arranged in a second loop, a master station, a plurality of repeaters, a selector for each station, a terminal in the master station selector for each loop and for each station thereon, another terminal in the master station selector connected to the repeaters and to a common loop equipment, means controlled from the master station for operating its selector to seize any of said first terminals to thereby seize any particular station or any particular loop of stations, and for operating its selector to seize said other terminal to thereby extend a connection from the master station through said plurality of repeaters and by means of said common loop equipment to a plurality of the stations in a plurality of loops.

25. In a printing telegraph system, a master station, a plurality of other stations, a selector individual to said master station and a selector individual to each other station, a loop circuit for one group of said other stations, a loop circuit for another group of said other stations, a loop equipment for each loop and a common loop equipment, terminals for the loop equipment of each loop accessible only to the selectors of the stations of that loop and to the main station selector, terminals for the common loop equipment accessible only to the master station selector, means for operating the master station selector to seize one of the terminals of a loop equipment to seize one or a plurality of the stations on that loop and connect them with the master station via that loop or for operating the master station selector to seize a terminal of the common loop equipment to thereby seize a group of the stations on all loops and connect them with the master station via said common loop equipment, and means for operating the selectors of the other stations to seize a group of the stations only on the same loop.

26. In a telegraph system, a plurality of stations, a loop circuit in which all of said stations may be included, said loop normally including a plurality of impedances, one for each station in place of the station itself, a selecting switch, a set of terminals in said switch for each station, a plurality of sets of terminals in the switch connected to the loop, means for operating said switch to seize one of said first sets of terminals to thereby extend a connection to a particular station independent of said loop, or for operating said switch to seize one of said other sets of terminals connected to the loop, each of said other sets having means associated therewith for substituting a different plurality of said stations in the loop in place of the impedances corresponding thereto, the number of stations included depending on the particular terminal seized.

27. In a signalling system, a master station, a selector therefor, a first and second group of stations, a trunk for each group, a plurality of terminals in said selector for each trunk, another plurality of terminals in said selector connected to a repeater network, means associated with each of said first plurality of terminals for connecting a different plurality of said stations to the associated trunk, means associated with each of said other plurality of terminals for connecting a different plurality of said stations to said repeater network, and means at the master station for operating said selector to seize any of said terminals and operate the means associated therewith to thereby extend connections to any plurality of the stations of a loop via said first plurality of terminals, or to any plurality of stations of all groups via said other terminals and said network.

28. In a signalling system, a calling station, a plurality of called stations arranged in groups, a repeater, a selector, a series of terminals in said selector for each group of stations, a relay individual to each terminal, each relay having means for connecting a different group of the called stations to the calling station when its associated terminal is seized by the selector, a series of terminals in said selector for said repeater, a relay individual to each repeater terminal, each of said last relays having means for connecting a different plurality of said called stations through said repeater to the calling station when the associated terminal is seized by said selector, and means controlled from the calling station for operating said selector to seize any of said terminals to operate the associated relay.

WM. WALTER OWEN,
Executor of the Estate of Bernard D. Willis, Deceased.