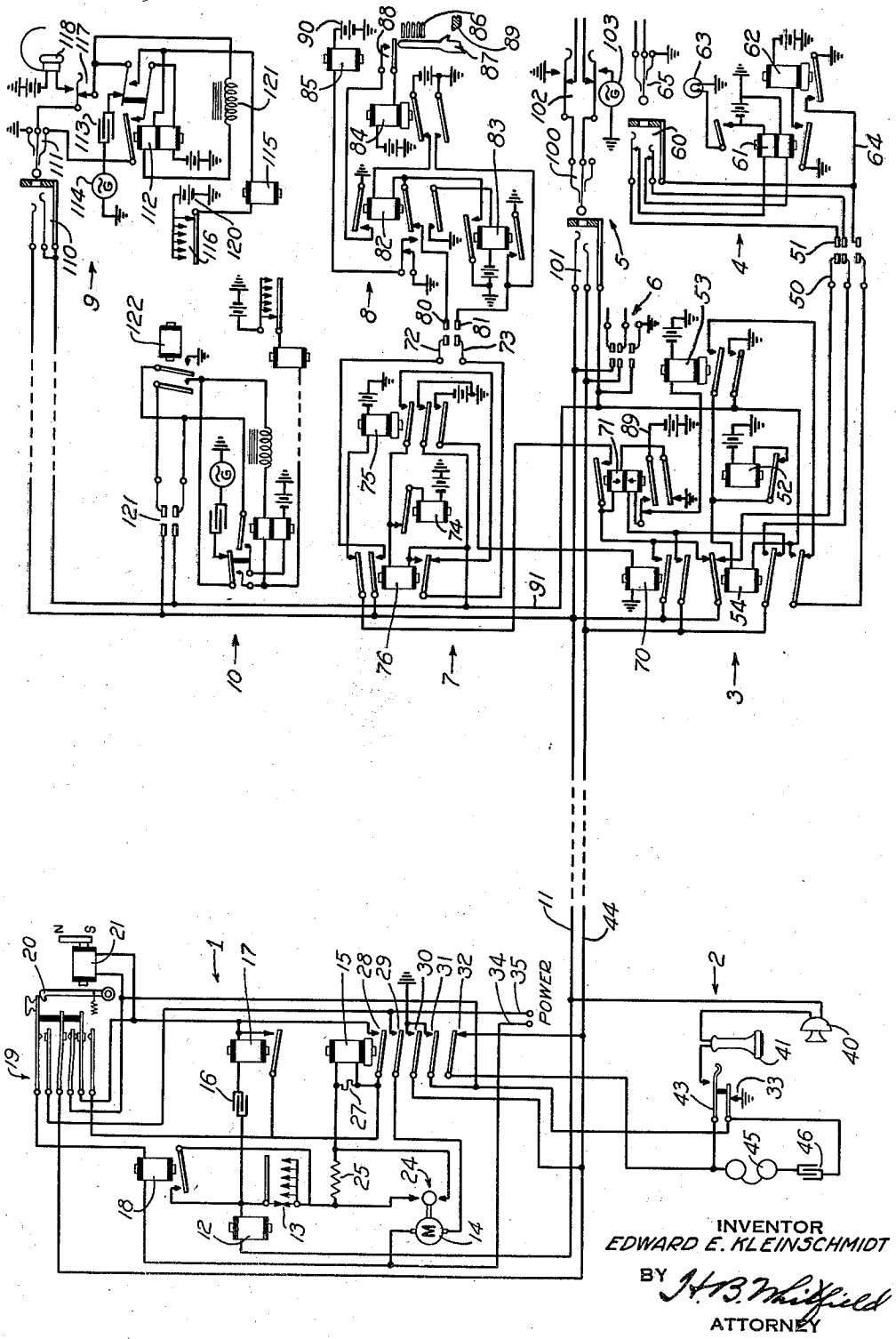
Oct. 12, 1937. E. E. KLEINSCHMIDT 2,095,415

TELEPHONE AND PRINTING TELEGRAPH SIGNALING SYSTEM

Filed April 14, 1934



INVENTOR
EDWARD E. KLEINSCHMIDT
BY J. H. B. Whitfield
ATTORNEY

Patented Oct. 12, 1937 2,095,415

UNITED STATES PATENT OFFICE

2,095,415

TELEPHONE AND PRINTING TELEGRAPH SIGNALING SYSTEM

Edward E. Kleinschmidt, Highland Park, Ill., assignor to Teletype Corporation, Chicago, Ill., a corporation of Delaware

Application April 14, 1934, Serial No. 720,557

23 Claims. (Cl. 179—3)

This invention pertains to combined telegraph and telephone systems and more particularly to a signaling system wherein either telephone or telegraph service over a common signaling channel is selectively available.

Central switching offices for interconnection of telephone lines serving telephone substations are an established feature of telephone service. Central concentration and distributing stations for receiving and forwarding telegraph messages are widely used and further central offices or central switchboards for interconnecting telegraph lines serving telegraph substations are used to serve an increasing volume of telegraphic traffic. To provide for economical use of line wires for the rendering of telegraph and telephone service to substations which do not demand continuous telephone and telegraph service, a single signaling channel may be used for telegraph service and for telephone service selectively.

The principal object of the invention accordingly is to provide a simple, reliable, and inexpensive signaling system wherein either telephone or telegraphic communication may be established on a signaling channel common thereto to the exclusion of the other.

A feature of the invention is the provision of mechanism responsive at both the subscriber's station and the central office upon the selection of the system for one type of service for rendering the system incapable of being used for the other type of service until the system is restored to its normal unactuated condition.

The above and other objects are attained by connecting telephone and telegraph substation equipments to a pair of line wires in such manner that either, when in use, disables the other, and by connecting telephone and telegraph central office equipments to the pair of line wires in such manner that either, when in use, disables the other, the central office telegraphic equipment being solely responsive to the substation telegraphic equipment and the central office telephone equipment being solely responsive to the substation telephone equipment.

The central office telephone equipment provided will respond to a loop circuit formed by the usual hook switch of a substation telephone, the central office telegraphic equipment however will not respond to a loop circuit. Likewise, the central office telegraphic equipment will respond to a circuit formed by a ground contact placed upon a line wire by a calling key at the substation telegraph equipment, but the central office telephone equipment will not respond to the circuit of the ground contact at the substation either because it is unresponsive to such a circuit or because the central office telegraph equipment responds more quickly or interferes with any response by the central office telephone equipment.

At the telephone substation equipment, the hook switch operates in well-known manner to complete a loop circuit upon the line wires and an extra contact operated by the hook switch lever removes a ground connection from a calling key of the telegraph set. At the telegraph substation equipment, a calling key is provided for connecting a ground contact to one of the line wires and in response to the operation of the key a contact in the telephone bridge wiring is opened so that the telephone hook switch is disabled from completing a loop circuit upon the line wires and further in response to the operation of the telegraph calling key a substitute ground contact for the telegraph calling key is provided, thus rendering the telegraph set independent of the ground contact at the telephone set which contact may be operated at any time by the telephone hook lever. Thus, whichever of the two substation equipments is taken into use will disable the other.

At the central office a busy-by-test condition is provided which is standard and well known as a busy-by-test condition for automatic telephone equipment switching; namely, a ground contact upon the private wire of a telephone line equipment. The private wires of the two equipments, telephonic and telegraphic, at the central office are connected together permanently with the result that a busy-by-test ground connection upon either private wire renders the other private wire and its equipment also busy by test. Equipment is provided at the central office to operate in response to the telephone substation loop signal to connect the calling substation to a manual jack and to illuminate a signal lamp to attract the attention of a telephone operator. Equipment is provided to operate in response to the ground contact of the substation telegraph calling key to search and to seize a recording telegraph receiver which then becomes responsive to the telegraph transmitter at the calling station.

A better understanding of the invention may be had from the following description, taken in conjunction with the accompanying drawing, wherein a single figure shows a telegraph and telephone substation interconnected to a central office equipped for both telephonic and tele-

graphic communication. In the drawing, many of the parts or units have been designated by general reference numerals; for example, at the subscriber's station, numeral 1 indicates a telegraph substation equipment, 2 a telephone set, and at the central office, 3 a line switch and its operating and controlling relays, 4 a manual switching unit for responding to set 2 and switch 3, while 5 indicates a manual switching equipment for calling set 2 by a manual operator, and 6 indicates an automatic switch for calling set 2 by control of a remote operator. Likewise, 7 indicates a line switch and its relays and 8 a recording telegraph receiver for responding to set 1 and switch 7, while 9 indicates a manual switching equipment for connecting and transmitting to set 1 by a manual operator and 10 indicates an automatic switch for communicating with set 1 by control of a remote operator.

Telegraphic equipments 7, 8, 9, and 10 are connected over line wire 11 to telegraphic substation 1 where a telegraph receiver magnet 12, transmitter 13, and motor 14 comprise the customary telegraph equipment to which is added a slow-to-release relay 15, a series condenser 16 and ringing relay 17 responsive to alternating current from the central office, a relay 18 responsive to a power source which may be of alternating or direct current, and a calling key 19 having a latch 20 and a polarized magnet 21 whose armature operates the latch 20 against the urge of its retractile spring. Motor 14 has a centrifugal switch 24 shunted by resistor 25, the switch 24 operating to close contacts only during the period when the motor 14 is operating at proper speed for telegraphic transmission. Contacts of relay 18 shunt transmitter contacts 13 to prevent interference by contacts 13 in the progress of setting up a connection. Relay 15, which is included serially in the communication circuit during the operation of the telegraph substation, has its winding shunted by a non-inductive resistor 27 to reduce the inductance of the communication circuit, and has five pairs of armature contacts of which contacts 28 are included in the communication circuit, contacts 29 control the operation of the motor 14, contacts 30 connect ground to line wire 44, contacts 31 connect a substitute ground to provide against interference with telegraphic service by opening of the contact 33 at the telephone hook switch, and contacts 32 open the telephone bridge wires. A source of electrical power is provided upon wires 34 and 35.

In telephone substation 2, a transmitter 40 and a receiver 41 are in series with contacts of hook switch 43 and contacts 32 of relay 15 to provide a telephone bridge upon line wires 11 and 44 when the hook switch is operated into its upward position. A telephone ringer 45 and series condenser 46 are connected from ground through contact 33 and contact 32 to line wire 44.

At the central office, an equipment 3 for receiving a telephone call originating at substation 2 comprises a non-numerical automatic line switch comprising a set of brushes 50 and a plurality of sets of bank contacts 51, the brushes being driven by a motor magnet 52 in cooperation with a line relay 53 and a cut-off relay 54, the relays 53 and 54 having a mechanical interlocking device which permits the cut-off relay to break all back contacts without closing any front contacts if the line relay is found deenergized at the time that the cut-off relay becomes energized, but should the line relay be found energized at the time that the cut-off relay becomes energized, the cut-off relay will move its armature a full stroke. The operation of this non-numerical switch and the relays mentioned is described in "Automatic Telephony" by Smith and Campbell, 2nd edition, 1921, pages 51 and 52.

The bank contacts 51 are connected to jack 60, line relay 61 and local relay 62, the line relay 61 having contacts connected to battery and to signal lamp 63, and local relay 62 having contacts connected to ground and to private wire 64. A manual telephone operator, in response to illumination of lamp 63, may connect with jack 60 by means of plug 65, thereby cutting off relays 61 and 62 and connecting the line wires 11 and 44 to apparatus not shown, but by which telephone service may be given to the substation 2 in response to an originating call.

To the standard equipment of the non-numerical switch just described there are added relays 70 and 71, the relay 70 having its front contacts connected to shunt corresponding back contacts in relay 54 so that circuits may be preserved when both relays 54 and 70 are energized, and relay 71 having its winding differentially connected so that it is not energized in response to a loop circuit upon line wires 11 and 44 but is responsive to a grounded circuit over line wire 11 whereby current flows over line wire 11 without corresponding current flowing over line wire 44.

A line switch equipment forming a part of the telegraphic switching equipment 7 comprises a non-numerical switch such as is shown in the equipment 3, with the exception that only one brush and contact is used in the communication circuit. Communication brush 72 and private brush 73 are driven by motor magnet 74 in cooperation with line relay 75 and cut-off relay 76 which have interlocking features corresponding to relays 53 and 54. Bank contacts 80 and 81 are connected to contacts of connector relay 82, local relay 83 and release relay 84. A telegraphic recorder which may be a printer or a reperforator or both is provided and is indicated by its selector magnet 85 and details are shown further by a set of permutation bars 86, a selector pull bar 87, a power bail 89, and a pair of contacts 88 operable by the pull bar 87 and operating to close a circuit to energize the release relay 84.

The operation of the system in response to calls originating at the substation is as follows.

For telephone service: The user of the telephone set 2 may take control of the line wires 11 and 44 by lifting the receiver 41, thereby operating hook switch 43 which at once disables the telegraphic substation 1 by opening the contact 33, thereby removing from the telegraphic substation 1 the ground connection which is required to enable the substation 1 to initiate control of any central office apparatus. Neither can the operator at the telegraphic apparatus 1 control the relay 15 to open contact 32 to interfere with the telephone circuits about to be described, so that by closing hook switch 43 when the substation equipment 1 is inert, the telephone station 2 has seized the line wires 11 and 44 and has removed any possibility of interruption from the telegraphic equipment connected thereto at the substation. The closing of the hook switch 43 has closed and electrified a circuit beginning at the central office through battery, line relay 53, contacts and lower winding of relay 71, contacts of relay 54, line wire 44, contacts 32, hook

switch 43, receiver 41, transmitter 40, line wire 11, contacts of relay 54, upper winding and contacts of relay 71 to ground. Relay 71 is not energized because of its differential nature. Relay 53 is energized and the resultant operation of the non-numerical switch connects brushes 50 to contacts 51 and operates relay 54 fully, which transfers the line circuit described from relay 53 to relay 61, energizing relay 61 which in turn energizes relay 62 over an obvious circuit. Relay 62 connects ground to private wire 64, thus forming a holding circuit for relay 54, and relay 61 illuminates lamp 63 over an obvious circuit. The manual operator responds by inserting plug 65 in jack 60 thereby completing another holding circuit for relay 54 to ground connection upon the plug 55. Contacts of jack 60 open the circuit of relay 61 which becomes deenergized, and in turn deenergizes relay 62 and lamp 63. Telephone service then is given by the operator in response to the originating call by a suitable apparatus in any known manner.

For telegraph service: The telegraph operator at substation 1 may take the line wire 11 into use for telegraphic purposes when it is not being used for telephonic communication by operating the manual key 19 whose latch 20 retains the contacts of the key in operated position. A telegraph calling circuit is formed beginning at central office battery, through winding of relay 53, contacts and lower winding of relay 71, contacts of relay 54, line wire 44, third and fourth contacts of operated key 19, hook switch contact 33 and ground. Current now flows through but one winding of relay 71 and energization is effected in relay 71 and relay 53 but the operation of relay 71 disconnects the relay 53 and substitutes a circuit from battery over wire 89 and thence through the lower winding of relay 71. Contacts of relay 71 also open the upper winding of relay 71 and a further contact of relay 71 closes a circuit to energize relay 75. The circuit of relay 75 extends from battery, through contacts of relay 76, contacts of relay 71, contacts of deenergized relay 54, line wire 11, selector magnet 12, contacts of energized relay 18, resistor 25, winding of relay 15, lowest two contacts of key 19, winding of magnet 21, and contact 33 to ground. The polar direction of the current is such that it is ineffective upon polar magnet 21. By reason of resistor 25, the volume of current is too small to be effective upon selector 12. Relay 15 at the substation and relay 75 at the central office are operated. In response to relay 75, the non-numerical switch connects brush 72 to contact 80 and brush 73 to contact 81. Operation of relay 15 opens contacts 32 which disables the telephone set 2, closes contact 31, which substitutes a ground connection for the ground connection of contact 33, closes contacts 29 which start the motor 14 into operation, and closes contact 28 which shunts the connection between fifth and sixth contacts of operated key 19 to maintain a communication circuit after release and restoration of key 19. Operation of the non-numerical switch of equipment 7 energizes relay 76 to open its back contacts and transfers the circuit from winding of relay 75 to the winding of connector relay 82, the new circuit extending from battery through contact of deenergized relay 84, winding of relay 82, contact of relay 82, bank contact 80, brush 72, contact of relay 76 and line wire 11. Relay 82 operates and energizes relay 83 over an obvious local circuit. Relay 83 connects ground to private bank contact 81 to form a holding circuit for relay 76, and at the same time connects ground to the winding of relay 82 to form a holding circuit for relay 82. The armature contacts of relay 82 remove the winding of relay 82 from the circuit of the line wire 11 and from the definitive central office communication circuit as follows: from battery 90, through winding of receiver selector magnet 85, contacts of operated relay 82, bank contact 80, brush 72, contacts of relay 76, line wire 11, selector magnet 12 of home recorder of station 1, contacts of energized relay 18, resistor 25, resistor 27, contacts 28 of energized relay 15, winding of polarized magnet 21, and contacts 31 of energized relay 15 to ground. All batteries which have been considered heretofore as supplying current to line wire 11 have been of uniform polarity and of such polarity that polarized magnet 21 has not attracted its armature in response to any current, but battery 90 is of reversed polarity, to which polarized magnet 21 responds, attracting its armature 20, releasing key 19 and deenergizing relay 18 which opens its contacts to remove the shunt from the contacts of transmitter 13. Motor 14 has attained full speed and closes its centrifugal contacts 24, thus shunting resistor 25 and reducing the resistance of the communication circuit to produce in cooperation with battery 90 a proper volume of operating current in the communication circuit. The operator at station 1, noticing the release of his starting key 19, then may operate his transmitter 13 to record upon the selector indicated by magnet 85 at the central office the message which he desires to transmit.

During the interval of use of the line wire 11 for telegraphic service, the telephone substation is disabled by the contact 32 and the telephone central office equipment is disabled by a busy-by-test condition placed upon private wire 91 at first by the middle contact of relay 75, later by the lower contact of relay 83, effecting operation to median position of the armatures of relay 54. Wire 91 extends to test contacts of equipments 9 and 10 to prevent access to the line by telegraph operators, extends to the test conductors of equipments 5 and 6 to prevent access to the line by telephone operators, and thus guards the line at the central office to secure to the operator at station 1 the exclusive use of the line for telegraphic purposes on his originating message.

Having completed transmission of a message, the operator at station 1 transmits a predetermined signal such as "blank code" in response to which the code bars 86 permit the pull bar 87 to operate and to be operated to close the electrical contact 88 which energizes release relay 84 over an obvious circuit, the relay 82 being energized at all times throughout the communication period. Relay 84 opens the circuit of the winding of relay 82 and deenergizes relay 82, which opens the circuit of relay 83 and deenergizes relay 83, thus disconnecting bank contact 80 from any and all battery connection during the period of retention of the armatures of relay 84 by reason of its slow-to-release construction. During the delay period of relay 84, its lower armature holds the busy-by-test condition which retains relay 76 fully operated and relay 54 partially operated, and the open condition of the circuit of line wire 11 is continued for a period of time sufficient to effect the release of the slow-to-release relay 15 at substation 1, which opens the circuit of the motor 14 and restores all of the apparatus of substation 1 to its normal inert condition. The final act of the cycle is the release

of the armatures of relay 84, which removes busy-by-test condition from line wire 91, deenergizes relays 54 and 76, and restores battery connection to the winding of relay 62 and thus to bank contact 80, which restores all central office apparatus to normal inert conditions.

Outward service

For telephone service: Telephone service in which the central office calls the telephone substation 2 is effected by inserting the manual plug 100 into the manual jack 101 and ringing with the manual key 102. The insertion of the plug in the jack places ground upon private wire 91 and operates cut-off relays 54 and 76 to middle position of their armatures, thus preventing the operation of equipments 3 and 7. It also places the busy-by-test ground condition upon all manual jacks and automatic switches through which the line wires 11 and 44 might be taken for service. Ringing current from alternating generator 103 through key 102, plug 100, and jack 101 passes over line wire 44 and through contact 32, ringer 45, condenser 46 and contact 33 to ground. During the period from the time of seizing the line by inserting plug 100 in jack 101 to the time of response of the attendant at telephone station 2, the attendant at telephone station 1 may operate the key 19 to initiate a telegraph message, but there will be no response by the telegraph switching equipment 7 since cut-off relay 76 is operated, and the attendant at telegraph station 1 will be unable to proceed with the transmission of a telegraph message because the relay 15 will not be energized and the motor 14 will not start into operation. Since the relay 15 cannot be energized, its contact 32 cannot be opened and the telegraph substation 1 cannot interfere with the response of the telephone substation 2. Telephone operators situated remotely from jack 101 may obtain communication with telephone set 2 through automatic connector switch 6, see Smith and Campbell's book, Fig. 60.

For telegraph service: There is provided at the central office a manual jack 110 connected to the line wire 11 and to the private wire 91, and a manual switching plug 111 having an individual ringing relay 112 and an individual ringing condenser 113 through which it is associated with a common alternating current ringing generator 114, having also a receiver recorder indicated by the selector magnet 115 and individual transmitter 116 and an individual key 117 by which the plug may be associated with a common testing telephone 118.

In operation when it is desired to send a telegraph message to substation 1, the manual operator inserts plug 111 in jack 110 and thus sets up a combined ringing circuit and battery response circuit as follows: from ground through ringing generator 114 and condenser 113, contacts of relay 112, key 117, plug 111, jack 110, line wire 11, selector magnet 12, condenser 16, relay 17, fifth and fourth contacts of key 19, and hook switch contact 33 to ground. Relay 17 responds and closes its contacts which permit battery current to flow through the battery response circuit, from reversed battery 120, through transmitter 116, selector magnet 115, upper winding of relay 112, choke coil 121, key 117, plug 111, jack 110, line wire 11, selector magnet 12, transmitter 13, resistor 25, winding of relay 15, contact of relay 17, fifth and fourth contacts of key 19, hook switch contact 33 to ground. This current energizes relay 15 which closes its contacts 28 to shunt the contacts of relay 17, its contacts 29 to start motor 14 into operation, its contacts 31 to substitute ground for the ground of hook switch contact 33, and opens its contacts 32 to disable the telephone set. Motor 14 attains operating speed and closes its centrifugal switch 24 which shunts the resistor 25 and increases the current in the circuit last traced to a volume which energizes relay 112 to operate and to form the definitive transmission circuit as follows: reversed battery 120, transmitter 116, selector magnet 115, contact of energized relay 112, key 117, plug 111, jack 110, line wire 11, selector magnet 12, transmitter 13, switch 24, resistor 27, contact 28 of relay 15, fifth and fourth contacts of key 19, contact 31 of relay 15 and ground.

The central office operator then transmits the desired message by means of transmitter 116 and record is made at substation receiver 12. The central office operator is unable to transmit until substation motor 14 has attained operating speed, thereby increasing the current in the communication circuit to operate relay 112. By the insertion of plug 111 in jack 110, the ground upon the plug placed a busy-by-test condition upon private wire 91, operating both relays 54 and 76 to armature mid-position, and guarding the line against intrusion by any central office apparatus of either telephone or telegraph nature. Also, by the insertion of plug 111 in jack 110 and the operation to mid-position of relays 54 and 76, the response of central office switching apparatus to telephone hook switch 43 was rendered impossible and the instantaneous response of relays 17 and then 15 had opened contact 32 to disable the telephone set at once.

Automatic switching for outward service: Operators situated remotely from jack 110 may attain connection with the line wire 11 and telegraph set 1 by manual trunking to similar jacks or by automatic trunking through an automatic connector switch 121 for telegraph service. The connector switch is of the type described on page 59 in Smith and Campbell's book identified above, and the relay 122 in the drawing is the wiper closing relay which is energized following a busy test of the line and which remains closed during the then ensuing connection. Other details of equipment 10 are identical with the details of equipment 9.

It will be seen that the system above described constituting one embodiment of the present invention provides equipment for a single communication line of two conductors such that telegraph messages originating at the substation and extending to the central office or further and conversely, telegraphic messages originating in the central office or more remote parts and terminating in the substation 1 may be served by the telegraph equipment on the line wires 11 and 44 over the line wires 11 and 44 without interference from any possible operation of telephonic apparatus, either substation or central office, after the line wires 11 and 44 have been taken for telegraphic purposes; also that the line wires 11 and 44 may be taken for telephonic service by the substation equipment 2 or by any one of the equipments 3, 5, and 6 to provide telephone service over the line wires 11 and 44 in either direction and without the possibility of interference by any telegraphic equipment associated with the line after the moment when the line wires are taken for telephone service. There is complete independence in the two services given

by the two sets of equipment upon the line wires 11 and 44, with the feature that the line wires may be taken at any point of access for either class of service to the exclusion of all service of either class which may attempt to use the line during the pendency of the service for which the line was seized.

With the great diversity in switching equipments known to any one skilled in the telephone and telegraph switching arts, it is possible to construct widely variant systems to accomplish the results attained in the embodiment here shown. Therefore, although the invention has been described in connection with a specific form thereof, it will be understood that it has further applications and it is not intended to be limited in scope by the embodiment shown herein for illustration.

What is claimed is:

1. In a system for rendering telegraph and telephone service over a single signaling channel, a station having a telegraph set and a telephone set, a distant station, a signaling channel connecting said stations, a relay at said distant station connected to said channel while said channel is idle and responsive to control over said channel by said telegraph set, and neutralizing means in said relay rendering said relay unresponsive to control by said telephone set.

2. In a system for rendering telegraph and telephone service over a single signaling channel, a switching station, a substation having a telegraph set and a telephone set, a signaling channel connecting said stations, a first relay responsive to control over said signaling channel by said telephone set, a further relay responsive to control over said signaling channel by said telegraph set, and means operable by either said first or said further relay for disabling both of said relays.

3. In a system for telegraph and telephone service over a single pair of line wires, a switching station, a substation having telegraph and telephone sets, a line connecting said stations, a first relay at said switching station energizable over said line by one of said sets, and a second relay at said switching station energizable over said line under control of the other of said sets alternatively with the energization of said first relay by its energizing set and operating when energized to disable said first relay.

4. In a system for rendering telephone service and telegraph service over a single pair of line wires, a switching station, a substation having a telegraph set and a telephone set, a line connecting said stations, a telephone line relay at said switching station and responsive to control over said line by said telephone set or said telegraph set, and a fast to operate line relay at said switching station responsive to control over said line by said telegraph set for disabling said telephone line relay.

5. In a system for rendering telephone service and telegraph service over a single pair of line wires, a switching station, apparatus sets for telegraph and telephone respectively, a line connecting said stations, a first line relay at said switching station and connected to said line when idle and responsive to control over said line by one of said sets, and a second line relay at said switching station and connected to said line when idle and responsive to control over said line by the other of said sets, said relays operable alternatively when said line is idle.

6. In a system for rendering telephone service and telegraph service, a signaling channel, a telephone substation connected to said channel, a telegraph substation connected to said channel, a central office line switch connected to said channel responsive to said telegraph substation, a further central office line switch connected to said channel responsive to said telephone substation, and switching means at the central office for connecting with said channel and for signaling either of said substations and when connected rendering both of said central office line switches inoperative.

7. In a system for rendering telephone service and telegraph service, a line, a telephone substation connected to said line, a telegraph substation connected to said line, a central office line switch and cut-off relay connected to said line responsive to said telegraph substation, a further central office line switch and cut-off relay connected to said line responsive to said telephone substation, and switching means at the central office for connecting with said line and for signaling one of said substations and when connected energizing both of said cut-off relays and rendering both of said line switches inoperative.

8. In a system for rendering telephone service and telegraph service, a line, a telephone substation connected to said line, a telegraph substation connected to said line, first means at a central office responsive to said telegraph substation to initiate a switching operation and to render said line busy by test, second means at said central office and responsive to said telephone substation to initiate a switching operation and to render said line busy by test, and further means at said central office operable when said line is not busy by test for connecting with said line and for signaling one of said substations and when connected rendering both of said first means and second means inoperative and for rendering said line busy by test.

9. In a system for the combined working of telephone and telegraph apparatus, a telegraph substation equipment, a telephone substation equipment, a telegraph central office switching equipment, a telephone central office switching equipment, a line connecting said telegraph substation equipment, said telephone substation equipment, said telegraph central office switching equipment, and said telephone central office switching equipment, a ground-return circuit through said telegraph central office switching equipment, said telegraph substation equipment and said line when idle over which said telegraph central office switching equipment is responsive to control by said telegraph substation equipment, and a loop circuit through said telephone central office switching equipment, said line when idle and said telephone substation equipment over which said telephone central office switching equipment is responsive to control by said telephone substation equipment.

10. In a system of combined telephone and telegraph apparatus, a telegraph substation equipment, a telephone substation equipment, means in said telephone substation equipment for disabling said telegraph substation equipment when said telephone substation equipment is taken for service, means in said telegraph substation equipment for disabling said telephone substation equipment when said telegraph substation equipment is taken for service, a line

common to said telephone substation equipment and said telegraph substation equipment, a central office telegraph line switch connected to said line and responsive to control by said telegraph substation equipment, a central office telephone line switch connected to said line and responsive to control by said telephone substation equipment, means in said central office telegraph line switch for disabling said central office telephone line switch when said central office telegraph line switch is taken for service, and means in said central office telephone line switch for disabling said central office telegraph line switch when said central office telephone line switch is taken for service, said two means comprising in part two cut-off relays, a test wire for busy-by-test condition and common to both of said cut-off relays.

11. In a system of combined telephone and telegraph apparatus, a telegraph substation equipment, a telephone substation equipment, means in said telephone substation equipment for disabling said telegraph substation equipment when said telephone substation equipment is taken for service, means in said telegraph substation equipment for disabling said telephone substation equipment when said telegraph substation equipment is taken for service, a line common to said telephone substation equipment and said telegraph substation equipment, a central office line switch responsive to control over said line by said telegraph substation equipment, and a further central office line switch responsive to control over said line by said telephone substation equipment, both said line switch and said further line switch connected to said line at all times when said line is not in use.

12. In a system of combined telephone and telegraph apparatus, a telegraph substation equipment, a telephone substation equipment, means in said telephone substation equipment for disabling said telegraph substation equipment when said telephone substation equipment is taken for service, means in said telegraph substation equipment for disabling said telephone substation equipment when said telegraph substation equipment is taken for service, a line common to said telephone substation equipment and said telegraph substation equipment, central office apparatus responsive to control of said telegraph substation equipment, and alternative central office apparatus responsive to control by said telephone substation equipment, both said line switch and said further line switch connected to said line at all times when said line is not in use.

13. In a signaling system, a plurality of stations, telegraph and telephone units at each station, a signaling channel connecting the stations and connected to the telegraph and telephone units, seizing means at each unit for seizing said channel for service, means responsive to the seizure of the signaling channel by the said seizing means of either unit at any station for rendering the said seizing means of the other unit at the same station non-effective, and means operative upon the seizure of the signaling channel for either type of service for establishing a communicative relationship with the corresponding type of apparatus at a distant station.

14. In a combined telegraph and telephone system, circuits and apparatus for the dual operation of a telegraph set and a telephone set over the same line circuit connecting a subscriber station with a central office, comprising a switching system connected to said line circuit and responsive to the telephone set, a further switching system connected to said line circuit and responsive to the telegraph set, line circuit seizing means in each set, means to disable the line circuit seizing means of the telephone set when the telegraph set is in use, means to disable the line circuit seizing means of the telegraph set when the telephone set is in use, and means located at the central office to place a busy-by-test condition on both switching systems when either the telephone set or the telegraph set is in use.

15. Circuits and apparatus for rendering telegraph and telephone service over a single signaling channel comprising a subscriber station having a telegraph set and a telephone set, a central station, a signaling channel connecting said stations, and a relay at said central station having a single winding normally in circuit with both the telegraph and the telephone sets and responsive to control over said channel by said telegraph set and having windings differentially connected in series with said telephone set.

16. Circuits and apparatus for rendering telegraph and telephone service over a single signaling channel, a central switching station, a subscriber's substation having a telegraph set and a telephone set, a signaling channel connecting said stations, a differential relay at said switching station responsively connected to control over said signaling channel by said telegraph set and differentially connected to control by said telephone set, and a further relay responsive to control over said line by said telephone set.

17. Circuits and apparatus for rendering telegraph and telephone service over a single signaling channel, comprising a central switching station, a subscriber's substation having a telegraph set and a telephone set, a line connecting said stations, a first relay in said switching station energizable over said line by said sets, and a comparatively faster energizing relay at said switching station and responsive over said line under control of one of said sets, to disable said first relay.

18. Circuits and apparatus for rendering telephone service and telegraph service comprising a switching station, a substation having a telegraph set and a telephone set, a line connecting said stations, a telephone line relay at said switching station responsive to control over said line by said telephone set, and another relay at said switching station responsive to control over said line by said telegraph set to energize simultaneously with said telephone line relay and adapted to disable said telephone line relay.

19. Circuits and apparatus for rendering telephone and telegraph service, comprising a central station equipped with two individual sets of switching apparatus, one for the telegraph and one for the telephone, apparatus sets for telegraph and telephone, located at a subscriber's station, a line circuit connecting said stations, a line relay at said central station controlled over said line by either of said telegraph or telephone sets, and a second line relay responsive to control over said line by one of said sets, one of said relays having operating precedence when both are simultaneously energized.

20. Circuits and apparatus for carrying out the dual operation of telephone and telegraph over a two wire and ground extension from a subscriber station to a central station, characterized in that the telephone message circuit is over a metallic loop and the telegraph message

circuit is over one of the two wires to ground, and means for rendering the telephone and telegraph inoperative when the other is in use, comprising a switch in the telephone circuit located at subscriber's station which is automatically operated when the telegraph is in use to disable the telephone, and a further switch in the telegraph circuit located at the subscriber station which is automatically operated when the telephone is in use to disable the telegraph.

21. Circuits and apparatus for carrying out the dual operation of telephone and telegraph over a two wire and ground extension from a central to a subscriber station characterized in that the telephone calling circuit is over a metallic loop and the telegraph is over a grounded loop, and a system of relays is included in both calling circuits and located at the central station to select the telephone switching apparatus and render the telegraph inoperative, selectively in response to closing the telephone calling circuit.

22. In a system for the alternative working of telephone and telegraph apparatus, a substation, a central office, a connecting signaling line, substation equipment of two classes including means for producing calling signals of two different electrical natures over said line, and central office call responsive means comprising two automatic switches and a system of relays connected to said line when said line is in condition of readiness for seizure for service and responsive to a signal received over said line to select one of said automatic switches according to the nature of the received signal.

23. In a system for the combined operation of telephone and telegraph apparatus, a substation, two preselectors, for telegraph and telephone communication respectively, a line connecting said substation and said preselectors, and means at said substation for causing selectively a response of either of said preselectors by control over said line.

EDWARD E. KLEINSCHMIDT.