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J. HERMAN ET AL

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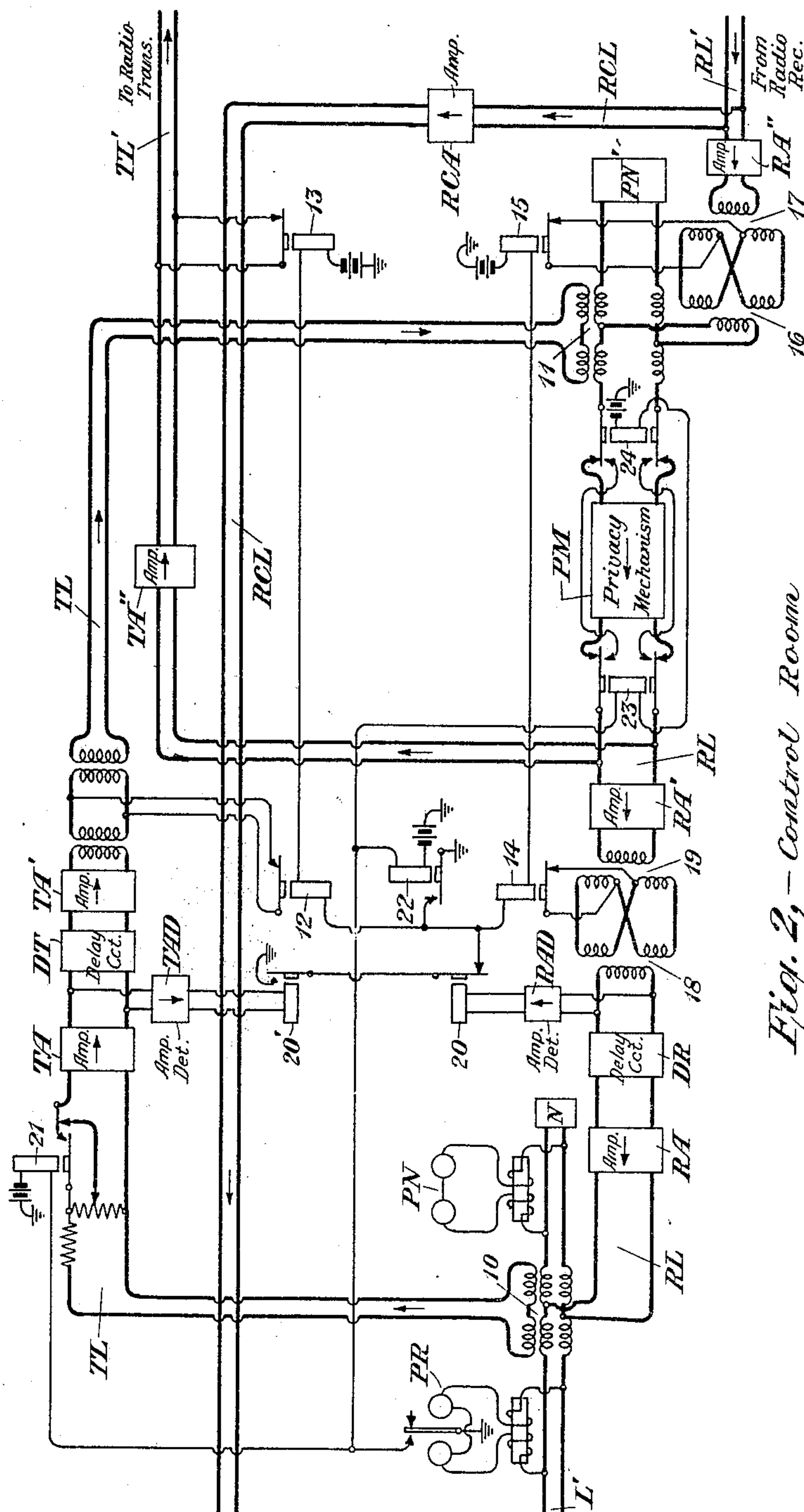


Fig. 2, - Control Room

INVENTORS
J. Herman, E. R. Taylor and
BY *S. B. Wright*
Gordon
ATTORNEY

UNITED STATES PATENT OFFICE

JOSEPH HERMAN, OF WESTFIELD, NEW JERSEY, EDMUND R. TAYLOR, OF NEW YORK, N. Y., AND SUMNER B. WRIGHT, OF SOUTH GRANGE, NEW JERSEY, ASSIGNORS TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK

RADIO TELEPHONE AND TELEGRAPH CIRCUITS

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This invention relates to radio telephone systems, and more particularly to arrangements for sending printing telegraph or other telegraph messages over a radio telephone channel.

In operating a radio telephone circuit such as the transatlantic system between the United States and Great Britain, it is desirable to transmit information for setting up telephone calls by means of printing telegraphy. A printer is also desirable for sending information between technical employees having charge of the maintenance of the circuit. In accordance with the present invention, circuit arrangements are provided whereby printer messages may be transmitted during times that the radio link is not being employed for telephone transmission.

As is well known, a radio transmitter and radio receiver may be connected by means of a four-wire circuit to a two-wire terminal at a switching point where connections are established between the radio channel and various telephone circuits. For example, in the transatlantic radio telephone system above referred to, the radio transmitter is located at Rocky Point, Long Island, and the receiver at Houlton, Maine, while the switching point is in New York City. The four-wire circuit comprises two two-wire lines extending from New York City to Rocky Point and Houlton, respectively. In the office at New York City, a control room is provided whereby a technical operator has control of the terminal amplifiers, voice-operated devices, privacy mechanism and other apparatus associated with the four-wire circuit. The two-wire terminal of the four-wire circuit passes through the control room to an operating room where it terminates upon a jack so that the traffic operator may establish connections to other telephone circuits. In accordance with the invention, printing apparatus is provided both in the control room and in the operating room, so that either the technical operator or the traffic operator, at one end of the system, can communicate with the corresponding operators at the other end.

Since the traffic operator is not ordinarily trained to operate a printer, and moreover,

has duties in connection with the establishment of connections which make it undesirable to burden her with printer operation, the printer in the operating room is operated by a printer operator who is located near the traffic operator, so that information relating to calls may be readily passed by the traffic operator to the printer operator for transmission over the circuit.

The printing equipment in both control and operating rooms consists of two units, one of which is a combined sending and receiving printer, and the other of which is a receiving printer only. The receiving printers in the two rooms are connected serially in a loop, and likewise, the combined sending and receiving printer units of the two rooms are connected in another loop. The receiving printer units are used when the system is operated on a full duplex basis with signals being sent in both directions at the same time. The receiving element of the combined sending and receiving printer, under these conditions, is used as a home recorder for recording the transmitted message. When operating on a half duplex basis, so that signals are transmitted only in one direction at a given time, the receiving printer unit is not used, but the combined sending and receiving unit is used for both sending and receiving in the local loop.

In the control room, the two loops are associated with a voice frequency carrier arrangement so that the printer messages may be sent and received over the four-wire circuit of the radio system by means of an audible tone. The receiving carrier channel is permanently bridged across the receiving path of the four-wire circuit between the radio receiver and the echo suppressor disabling device, so that it is always in condition to receive printer messages without any switching operation. The transmitting channel of the voice frequency carrier apparatus, on the other hand, is arranged to terminate in the operating room in a jack before the switchboard operator in the same manner that telephone lines terminate, so that the sending printer may be connected to the two-

wire terminal of the four-wire system by means of the operator's cord circuit.

Arrangements are provided so that when the sending printer is connected to the two-wire terminal of the four-wire system by the cord circuit, the voice-operated echo suppressor equipment is automatically set to render the transmitting path of the four-wire circuit operative to transmit signals to the radio transmitter. The receiving path is at the same time disabled, but as the carrier telegraph channel is connected thereto between the radio receiver and the point at which the path is disabled, the circuit is in condition to receive telegraph messages. Means are also provided whereby, when the sending printer is connected to the four-wire circuit, the gain of the amplifier in the transmitting path is automatically set at the desired value for printer transmission.

Supervisory signals are provided whereby the printer operator in the control room may signal the traffic operator to set up or take down the printer connection and whereby the traffic operator may signal the printer operator that the connection is set up. Monitoring means are also provided so that the traffic operator may monitor the circuit. The circuit is also so arranged that when the traffic operator desires to use the radio link for telephone purposes, the sending printer may be disconnected and a signal will be given to the printer operator to indicate that fact.

In the control room, the technical operator is provided with means whereby the printer located in that room may be connected to the two-wire terminal of the four-wire circuit independently of the traffic operator, for the purpose of sending technical information. As such information will ordinarily only be sent when the circuit is not used for telephone purposes and for the transmission of information relating to the setting up of telephone connections, the technical operator's printer set is preferably provided with a tape transmitter so that the information which it is desired to send may be punched upon a tape and thus stored up until the circuit is available for printing. A signal is also associated with the technical operator's printer to indicate to the printer operator when the printer is connected to the circuit.

The invention may now be more fully understood from the following description when read in connection with the accompanying drawings, Figures 1 and 2 of which show the circuit arrangement for one terminal of a radio telephone system embodying the invention, and Fig. 3 of which shows a modification of the voice frequency carrier telegraph apparatus employed in connection with the system.

Referring to the drawings, Figs. 1 and 2 show the circuit arrangement of a four-wire terminating arrangement at one end of a ra-

dio telephone system, the radio transmitter and receiver, however, being not illustrated. It will be understood, of course, that the arrangement at the distant terminal of the radio telephone system will be similar to that illustrated. In considering the drawings, it should be noted that the portion of the circuit shown in Fig. 2 is the apparatus associated with the four-wire circuit leading to the radio transmitter and receiver from the two-wire terminal, while the apparatus shown in Fig. 1 comprises printers and associated circuit arrangements for connecting them with the four-wire circuit. It should also be noted that all of the apparatus to the left of the vertical dotted line in Fig. 1 is apparatus located in the operating room where the traffic operator sets up telephone and printer connections with the radio system. The apparatus to the right of the dotted line in Fig. 1 and the apparatus indicated in Fig. 2 will be located in the control room where the technical operator has supervisory control for the purpose of maintaining the apparatus in proper operating condition.

Referring to Fig. 2, L' designates the two-wire terminal of the four-wire circuit interconnecting the radio transmitter and radio receiver at one end of a radio telephone system. The two-wire terminal L' is connected through a hybrid coil 10 to a transmitting path TL and receiving path RL, the terminal L' being balanced by a suitable network N. The path TL includes amplifiers TA and TA' and a delay circuit DT. Beyond these elements the path TL is associated by means of a hybrid coil 11 with the privacy mechanism PM, of well-known form, which performs the function of rendering speech transmitted therethrough unintelligible. After passing through the privacy mechanism PM, the transmitting path continues over the line TL' including the amplifier TA'' to the distant radio transmitter.

The receiving path RL', incoming from the radio receiver, is connected to the neutral points of the hybrid coil 11. Since the privacy mechanism PM is balanced by a network PN', the connection of the receiving path RL' to the hybrid coil renders such path conjugate with respect to the transmitting path TL. The receiving path, after passing through the privacy mechanism PM, continues over the circuit RL which includes receiving amplifiers RA' and RA, as well as delay circuit DR.

In order that when transmission is taking place over either the transmitting or receiving path, the other path will be disabled, echo suppressor devices are associated with each path. The echo suppressor equipment associated with the transmitter path TL comprises an amplifier-detector unit TAD, of well-known type, bridged across the path TL on the output side of the amplifier TA.

The output of the amplifier-detector unit TAD controls through master relay 20' the relays 12, 13, 14 and 15 for performing the switching operation incident to the blocking or disabling operations whereby telephone transmission is permitted only in one direction at a time. Normally, both sections TL and TL' of the transmitting path are disabled by the back contacts of relays 12 and 13 which short-circuit the conductors. Since these two sections of the transmitting path are interconnected through the privacy mechanism PM, and the two short circuits are applied on opposite sides of the privacy mechanism, transmission from the section TL to the section TL' cannot normally take place through the privacy mechanism. Blocking means, comprising transformer arrangements 16—17 and 18—19, are associated with the receiving path sections RL' and RL, respectively. These disabling means comprise transformer arrangements which are so connected as to be balanced when the contacts of relays 14 and 15 are opened, thereby preventing transmission through the transformer arrangements. When the contacts of relays 14 and 15 are closed, however, the transformer circuits, instead of being balanced, are in effect connected so as to be parallel aiding, thereby permitting transmission to take place readily. Normally, relays 14 and 15 (which are controlled by the amplifier-detector TAD) are deenergized, so that the receiving path is unblocked to permit transmission to take place from the radio receiver through the privacy mechanism to the terminal of the wire circuit L'. An amplifier-detector arrangement RAD is connected across the circuit RL ahead of the delay circuit DR and has in its output a relay 20 which, when operated, opens the control circuit from the amplifier-detector TAD to the switching relays 12, 13, 14 and 15, thereby maintaining the transmitting path blocked and the receiving path unblocked when telephone currents are being received from the radio receiver.

The operation of the apparatus so far described for telephone transmission is as follows: Telephone currents incoming over the two-wire circuit L' pass through the hybrid coil 10 and through the amplifier TA. Some of the energy enters the amplifier-detector unit TAD and causes the relays 12, 13, 14 and 15 to be energized. Relays 12 and 13 remove the short circuits from the transmitting sections TL and TL', while relays 14 and 15, by opening their contacts, cause the transformer arrangements 16—17 and 18—19 to block the receiving path on either side of the privacy mechanism PM. The delay circuit TD, in the meantime, delays the transmission of the telephone currents until these operations have taken place, after which the telephone currents pass through the ampli-

fier TA' through the hybrid coil 11, thence through the privacy mechanism PM and then out through the amplifier TA'' and over the line section TL' to the radio transmitter. The amplifier-detector RAD associated with the receiving path cannot be actuated to disturb the circuit condition now existing, because the receiving path is disabled in the manner already described.

If, in the normal condition of the circuit, telephone signals are received over the line section RL' from the radio receiver, they pass through the amplifier RA'' and the transformer arrangements 16—17 to the midpoints of the hybrid coil 11 and thence through the privacy mechanism PM, through the amplifier RA' and through the transformer arrangements 18—19. Some of the received energy actuates the amplifier-detector RAD to cause the operation of the relay 20 which opens the circuit controlled by the amplifier-detector unit TAD, thereby preventing energization of relays 12, 13, 14 and 15, so that the transmitting path is maintained disabled and the receiving path remains unblocked so long as telephone currents are being received. In the meantime, the telephone currents are delayed in passing through the delay network DR until the foregoing operations take place, after which the telephone currents pass through the receiving amplifier RA to the midpoints of the hybrid coil 10 and thence to the two-wire terminal L'.

The apparatus so far described relates to the telephone operation of the circuit. The printing telegraph equipment, and the circuits whereby it is associated with the four-wire telephone circuit leading to the radio transmitter and receiver, will now be described. Referring to Fig. 1, it will be seen that the two-wire terminal of the telephone circuit passes through the control room and terminates in a jack J' in the operating room, whereby it may be connected through a cord circuit CC to jacks, such as TJ, associated with telephone lines, such as L, for completing connections to telephone subscribers. At the switchboard of the traffic operator (which includes the jacks of various telephone lines such as TJ) is a jack TCJ which is connected over a circuit TCL to the transmitting equipment of a voice frequency carrier telegraph apparatus shown within the dotted rectangle at X. The circuit TCL may therefore be connected by the traffic operator through the cord circuit CC to the two-wire terminal L' of the four-wire telephone circuit to connect to the circuit the sending equipment of the printing apparatus hereinafter described.

The printer apparatus located in the operating room for sending and receiving printer messages necessary for the establishment of telephone connections by the traffic operator,

comprises two units, a combined transmitting and receiving unit conventionally indicated at TP, and a unit conventionally indicated at RP, comprising a receiving printer only. Both of these units may be of any well-known type, such, for example, as the Morkrum printer. A lamp 28 is associated with the printing apparatus to indicate to the printer operator that the printer is connected in circuit, and a key RSK is provided whereby the printer operator may signal the traffic operator when a connection to the radio circuit is desired.

Similar printer equipment is located in the control room for the use of the technical operator in sending messages relating to the maintenance and operation of the circuits. This equipment comprises a combined transmitting and receiving unit TP' and a unit RP' which comprises a receiving printer only. The receiver units RP and RP', in the operating and control rooms, respectively, are connected in series in a receiving loop RPL. The sending and receiving halves of the combined printers TP and TP' in the operating and control rooms, respectively, are arranged in series with each other, and the two units are also connected in series in a loop TPL, so that when a sender of the unit TP, for example, is operated, the associated receiving printer of that unit will operate as a home recorder, and also the receiving portion of the unit TP will record the same message in the control room. Likewise, when the sender of the unit TP' is actuated, the receiving elements of both printer units will record the message. A tape transmitter TS may be associated with the set TP' for tape sending.

The voice frequency carrier apparatus at X is shown connected for a full duplex operation so that transmission may take place in both directions simultaneously. This carrier apparatus comprises a transmitting relay TR associated with the transmitting loop TPL and having its armature arranged to short-circuit the output of oscillator O, which generates a tone frequency which will be interrupted in accordance with the transmitted printer signals, and transmitted through the transformer 30 and over the circuit TCL and two-wire terminal L' to the transmitting path of the four-wire circuit. The receiving portion of the voice frequency carrier equipment comprises a receiving relay RR for transmitting the printer code to the loop RPL. The relay RR is controlled by an amplifier-detector unit AD for amplifying and rectifying the received tone from the distant transmitter. The amplifier-detector AD of the voice frequency carrier equipment is permanently associated with the receiving section RL' of the four-wire circuit over a circuit RCL which includes an amplifier RCA having a high impedance input, so that the

connection of the circuit RCL to the receiving path RL' does not introduce any material loss for telephone transmission over the path RL'—RL. A filter RCF for selecting the tone employed in transmitting from the distant station may also be included between the circuit RCL and the amplifier-detector AD.

The printer apparatus in the control room may also include a tape sender TS connected in series with the transmitting keyboard of the transmitting unit TP', so that control room messages may be punched on the tape and allowed to accumulate until the technical operator has an opportunity to obtain control of the radio circuit for printer transmission. The printer apparatus in the control room has associated therewith a signal 29 for indicating when the sending apparatus of the control room printer is connected to the two-wire terminal L'. Such connection may be established independently of the traffic operator by means of an ordinary patching cord PC which will interconnect jacks CBJ and CBJ', the one associated with the sending printer and the other associated with the two-wire terminal L'. When the patching connection is made, the transmitting side of the voice frequency carrier apparatus is disconnected from the circuit TCL leading to the traffic operator's board and is connected to the jack CBJ.

The traffic operator's cord circuit CC for establishing telephone connections or sending printer connections, includes the usual supervisory signal 27, splitting key SK and monitoring and talking key TMK; the latter, when thrown to the left, bridging the operator's receiver OR across the cord, and, when thrown to the right, connecting both the operator's transmitter OT and receiver OR to the cord circuit. By means of a tone key TK, a tone source may be connected to the cord circuit for signaling the traffic operator at the distant end. The traffic operator is also provided with a lamp 25 to indicate signals transmitted by the printer operator's key RSK when the printer operator requests the circuit. The traffic operator is also provided with a key RLK by which she can cause the printer operator's lamp 28 to flash to indicate that the traffic operator wants the circuit for a telephone connection. The traffic operator also has at her board a jack MJ, by means of which she may monitor on the receiving printer circuit RCL, a lamp 27 being provided to indicate to the traffic operator that the printer circuit is set up so that she should monitor.

A polar relay PR is bridged across the two-wire terminal L'. When operated, this relay performs three functions. It sets the potentiometer of the amplifier TA in the transmitting path. It operates the relays 12, 13, 14 and 15 to disable the receiving path and cut

through the transmitting path of the radio transmitter, and it cut outs the privacy mechanism PM so that the transmitted printer signals need not pass through the privacy mechanism. The polar relay PR is balanced by a similar equipment on the network side, as indicated at PN. The circuit TCL connected to the transmitting side of the voice frequency carrier apparatus has battery connected to its tip side through a coil of transformer 30 in such direction as to cause the operation of the polar relay to perform the operations above described whenever the two-wire terminal L' is connected to the circuit through cord CC. When, however, the two-wire terminal is connected to a toll switching trunk, such as L, for establishing connection to a telephone subscriber, the battery associated with the toll switching trunk is oppositely poled so that the polar relay PR does not operate.

Further details of the apparatus will now be clear from the operation which is as follows: The carrier telegraph receiving apparatus is at all times connected to the receiving path of the four-wire circuit over the circuit RCL and is therefore in condition to receive printer signals at all times, regardless of whether the disabling relays 14 and 15 are operated or not, as the circuit RCL is connected to the path RL' between the disabling means and the radio receiver. Therefore, whenever the distant transmitter is sending printer telegraph messages, the detected tone corresponding thereto comes in over the path RL' and enters the circuit RCL passing through the amplifier RCA and filter RCF to the amplifier-detector AD which detects the interrupted tone to operate the receiving relay RR in accordance with the printer code. The relay RR, responding to the impulses, causes positive or negative battery to be connected to the loop RPL, thereby producing current and no-current intervals therein to operate the receiving printers RP and RP'.

The connection of the transmitting circuit to the four-wire circuit may occur at the traffic switchboard in either of two ways, namely, (1) by and at the initiative of the traffic switchboard operator, and (2) by the traffic switchboard operator at the request of the printer operator.

By and at the initiative of the traffic operator

When the traffic operator desires to use the radio telephone channel for the printer, she inserts the plug P' of the cord circuit CC into the jack J' of the two-wire terminal L' and operates the tone key TK, at the same time throwing her talking and monitoring key TMK to the right. Tone from the tone source S is then transmitted over the make contacts of key TK and key TMK and thence over the cord circuit and two-wire terminal L' to the hybrid coil 10. The tone then passes over the

transmitting path of the four-wire circuit and operates the relays 12, 13, 14 and 15 in the same way as telephone currents to cut through the transmitting path to the radio transmitter where the tone is sent out on a radio wave to the distant station. The distant traffic operator, upon hearing the tone, proceeds to connect the sending printer at that end in the same manner as will presently be described for the circuit illustrated. It will be noted that the printer operator's headset is connected in parallel with the traffic operator's head receiver OR, and the same is true at the distant end, so that the printer operator at the distant end will be advised at the same time as the distant traffic operator that the printer is to be connected.

When arrangements have been made with the distant traffic operator to connect in the sending printer at that end, the traffic operator at the end illustrated inserts the plug P in the jack TCJ which is connected over the circuit TCL to the sending apparatus of the voice frequency carrier equipment. Current now flows from the midpoint of the secondary of the transformer 30, over the tip conductor TCL, tip conductor of cord CC, tip conductor of the two-wire circuit L' to the polar relay PR and thence back over the ring conductor of L', ring conductor of cord CC, ring conductor of TCL and through the winding of relay F, to ground. It will be noted that the supervisory relay U of the cord is bridged across the circuit above traced and consequently, relays F, U and PR are operated. The operation of relay PR causes relay 21 to be actuated, thereby opening the adjustable connection of the input potentiometer of the amplifier TA, at the same time establishing a fixed connection to the potentiometer so that the amplifier will have the desired gain for printer signals. Relay PR also causes the actuation of relay 22, which in turn completes the circuits of relays 12, 13, 14 and 15 independently of the amplifier-detector TAD. Relays 12 to 15, inclusive remove the short circuits from the transmitting path of the four-wire circuit and disable the receiving path in the manner already described, this condition continuing as long as the circuit through the cord circuit CC is established. The relay PR also actuates relays 23 and 24 to cut out the privacy mechanism PM so that the transmitting path from TL to TL' is established over a by-pass about the privacy mechanism.

The operation of relay F connects ground over the outer right-hand back contact of relay E to a common point α from which three circuits are established. One of these circuits extends to the lamp 27 adjacent the monitoring jack at the traffic operator's switchboard to notify the traffic operator that printing is taking place and that she can monitor on the circuit if she so desires by plug-

ging into the jack MJ with another cord circuit, and throwing a monitoring key. Another circuit is established through the relay K which short-circuits the sending apparatus of the control room printing set TP' to prevent the sending of printer signals from this set. A third circuit is established over the back contact of relay H to the lamp 28 associated with the printing apparatus in the operating room. Upon receiving this signal, the printer operator operates the key RSK which closes the circuit of the relay H. Relay H in turn completes a circuit over its lower contact through the relay G, over the outer left-hand back contact of relay E, over the front contact of relay D, and through the winding of relay C to battery.

Relay D was previously energized over the sleeve circuit of the cord CC. Relay M, being marginal, was not energized over the sleeve circuit, and hence the supervisory relay U of the cord was permitted to close the circuit of the supervisory lamp 26. As soon as relay C is energized, ground is connected over its upper front contact to short-circuit the resistance r , thereby increasing the current flow over the sleeve circuit through the relay D and the relay M, causing the latter to be energized, thereby opening the circuit of the supervisory relay U and extinguishing the lamp 27 to notify the traffic operator that the printer operator has taken control of the circuit.

The energization of relay H by the locking key RSK, as previously described, opens the circuit previously traced for the printer operator's lamp 28, but this circuit is reestablished at the same time over the front contact of the relay G which is now operated. Consequently, the lamp 28 glows as long as the sending circuit is established for the printer.

When the sending apparatus of the printer unit TP is operated to transmit printer signals, the loop TPL is interrupted to cause current and no-current intervals in accordance with the printer code. The receiving apparatus of the printer units TP and TP' record the message thus transmitted. At the same time, the transmitting relay TR of the voice frequency carrier equipment is energized and deenergized in accordance with the code to cause an interrupted tone from the oscillator O to be transmitted through the transformer 30 and over the circuit TCL, cord circuit CC and two-wire terminal L' to the hybrid coil of the four-wire circuit. From the hybrid coil, the tone is transmitted over the circuit TL through the by-pass about the privacy mechanism PM and over the circuit TL' to the radio transmitter. At the same time, of course, printer signals from the distant station may be received through the amplifier-detector AD and recorded on the receiving printer units RP and RP' in the manner previously described. Consequently,

printing may take place in both directions at the same time.

Operation when the printer operator requests the circuit

If the printer operator desires to use the radio telephone apparatus at a time that it is being used for voice transmission, she operates the request service key RSK, causing the operation of relay H as before. Relay H, at its lower front contact, completes a circuit through the relay G, outer back left-hand contact of relay E, back contact of relay D and through the winding of relay A to battery. The operation of relay A causes the line lamp 25 associated with the jack TCJ to glow, thereby indicating to the traffic operator that the circuit is requested. When the traffic operator establishes connection from the circuit TCL to the two-wire terminal L' by means of the cord circuit CC, the operation of the relay D in the sleeve circuit releases relay A and extinguishes the line lamp. The other relays operate as previously described, except that in this instance the relay C is operated by the relay D as soon as the operator plugs into the jack TCJ, so that the marginal relay M at once operates and prevents the actuation of the signal lamp 27 by the supervisory relay U. Printing now takes place as already described.

Release of the radio telephone circuit

If the traffic operator desires to use the radio telephone circuit for telephone transmission without waiting for the completion of a printer message, she pulls down the cord CC connected to the telegraph circuit TCL. This causes the release of the polar relay PR associated with the two-wire circuit L', thereby restoring the four-wire circuit to normal condition, with the transmitting path disabled and the receiving path in normal talking condition. The relay F associated with the voice frequency carrier equipment is also released at the same time, thereby extinguishing the monitoring lamp 27 and the service lamp 28 at the printer. The printer operator at once knows that the circuit has been taken away and simply waits until the circuit is re-established, which fact will be indicated by the lamp 28 again glowing. If, however, the printer operator no longer desires to use the circuit, the request service key RSK is restored and the circuit returns to normal.

If the traffic operator wishes to use the circuit for telephone transmission but is willing to wait until a telegraph message, then being sent, is completed, she operates the request line key RLK at her position. This connects interrupted ground over the contacts of said key and over the lower front contact of relay C to relay B, causing relay B to alternately operate and release. Each time the relay B operates, it establishes an alternate path for

the relay C over its front contact and opens the circuit previously traced from the relay G. Relay G, therefore, alternately releases and operates to cause flashing of the service lamp 28 as long as the request line key is operated. This informs the printer operator that the circuit should be released as soon as convenient by restoring the request service key RSK.

Accordingly, the printer operator, as soon as the message is completed, restores the key RSK, thereby releasing relays H, G and C. The latter relay removes the short-circuit from the resistance r , thereby causing the marginal relay M to release. Consequently, the supervisory lamp 27 again glows, giving the traffic operator the signal to disconnect the sending printer circuit. The operator accordingly pulls down the cord and restores the circuit to normal.

20 Connection to printer circuit at control board

If the attendants in the control room wish to use the radio telephone circuit for printer operation without involving the traffic operator, the technical operator connects the jack CBJ at the control board to the jack CBJ' of the two-wire circuit L' by means of an ordinary three-conductor patching cord PC. Ground is connected over the sleeve of this cord to operate the relay E. Relay E transfers the output connection of the transformer 30 from the circuit TCL to the jack CBJ, thus establishing a direct connection to the two-wire circuit L'. Relay F and polar relay PR are now operated, the latter performing the functions previously described. Relay F, however, connects ground over its front contact and makes contact of the outer right armature of relay E to the service lamp 29 associated with the control room printer, thus giving the printer operator in the control room a signal that the circuit is in condition for use. The opening of the normal outer right-hand contact of the relay E prevents the establishment of the connections previously described from the junction point a . The tape transmitter TS in the control room may now be operated to send printer messages in a manner similar to that described in connection with the operation of the sending equipment of the printer TP, or the keyboard sender of the printer unit TP' may be operated to send messages, if preferred. The short-circuit previously described as being established over the contact of relay K does not now exist. It is, of course, obvious that the sending printer TP might be used for sending signals over the circuit thus established, but the operator of such a printer would not do so, as the lamp 28 would not glow to indicate to such operator that the printer circuit was established.

Half duplex operation

35 The telegraph operations above described were on a full duplex basis, that is, telegraph

messages were transmitted from both directions at the same time. Where the circuit is to be operated on a half duplex basis, so that transmission can take place in both directions, but only in one direction at a time, the voice frequency carrier apparatus will have its circuit modified as shown in Fig. 3. Under these conditions, the receiving loop RCL is disconnected from the voice frequency carrier apparatus, and the armature of the receiving relay RR is connected to the neutral point of the transmitting relay TR. When the receiving relay RR is receiving printer signals, positive and negative batteries are alternately connected to the midpoint of the relay TR, thereby causing current and no-current intervals in the transmitting loop TPL without actuating the transmitting relay TR. Accordingly, the receiving elements of the printer units TP and TP' are operated to record the received message. Under these conditions, the receiving printer units RP and RP' are not used. When it is desired to transmit from the printer unit TP, for example, the sending apparatus is operated to open and close the loop TPL. This causes the receiving elements of the units TP and TP' to record the message transmitted. At the same time, the transmitting relay TR is operated to send an interrupted tone from the oscillator O in the manner previously described for full duplex operation.

It will be obvious that the general principles herein disclosed may be embodied in many other organizations widely different from those illustrated, without departing from the spirit of the invention as defined in the following claims.

What is claimed is:

1. In a radio telegraph system, a four-wire circuit comprising a transmitting path and a receiving path for connecting a radio transmitter and radio receiver, respectively, to a two-wire terminal, a telegraph transmitter and telegraph receiver, means for continuously maintaining said telegraph receiver in connection with said receiving path, and means to connect said telegraph transmitter to said two-wire terminal at will.

2. In a radio telegraph system, a four-wire circuit comprising a transmitting path and a receiving path for connecting a radio transmitter and radio receiver, respectively, to a two-wire terminal, a telegraph transmitter and telegraph receiver, a voice frequency carrier apparatus associated with said telegraph transmitter and receiver, said apparatus comprising means to translate a received tone into telegraph signals for said telegraph receiver and means to transmit a tone varied in accordance with signals from said telegraph transmitter, means to maintain said translating means in continuous connection with said receiving path, and means to connect said tone transmitter to said two-wire terminal at will.

3. In a radio telegraph system, a four-wire circuit comprising a transmitting path and a receiving path for connecting a radio transmitter and a radio receiver, respectively, to a two-wire circuit, an operating room and a control room through which said two-wire circuit passes, a telegraph transmitter and telegraph receiver in said operating room, a telegraph transmitter and telegraph receiver in said control room, means to maintain said telegraph receivers in continuous connection with said receiving path, and means to connect either telegraph transmitter to said two-wire circuit at will.

4. In a radio telephone and telegraph system, a four-wire circuit comprising a transmitting path and a receiving path for connecting a radio transmitter and a radio receiver, respectively, to a two-wire terminal, means to establish telephone connections to said two-wire terminal, voice-operated means associated with said four-wire circuit for disabling one of its paths when telephone transmission takes place over the other, a telegraph transmitter and a telegraph receiver, means to maintain said telegraph receiver continually in connection with said receiving path beyond the point at which it is disabled, means to connect said telegraph transmitter to said two-wire terminal at will, and means responsive to such connection to operate said voice-controlled means independently of vocal transmission to render said transmitting path continuously operative while the connection is established.

5. In a radio telephone and telegraph system, a four-wire circuit comprising a transmitting path and a receiving path for connecting a radio transmitter and a radio receiver, respectively, to a two-wire terminal, means to establish telephone connections to said two-wire terminal, voice-operated means associated with said four-wire circuit for disabling one of its paths when telephone transmission takes place over the other, a telegraph transmitter and a telegraph receiver, a voice frequency carrier apparatus associated with said telegraph transmitter and receiver, said apparatus comprising means to translate a received tone into telegraph signals for said telegraph receiver and means to transmit a tone varied in accordance with signals from said telegraph transmitter, means to maintain said translating means in continuous connection with said receiving path beyond the point at which it is disabled, means to connect said tone transmitter to said two-wire terminal at will, and means responsive to such connection to operate said voice-controlled means independently of vocal transmission to render said transmitting path continuously operative while the connection is established.

6. In a radio telephone and telegraph system, a four-wire circuit comprising a transmitting path and a receiving path for con-

necting a radio transmitter and a radio receiver, respectively, to a two-wire terminal, means to establish telephone connections to said two-wire terminal, voice-operated means associated with said four-wire circuit for disabling one of its paths when telephone transmission takes place over the other, an operating room in which the telephone connections to said two-wire terminal are made, a control room through which said two-wire terminal passes, a telegraph transmitter and telegraph receiver in said operating room, a telegraph transmitter and telegraph receiver in said control room, means to maintain said telegraph receivers continuously connected to said receiving path beyond the point at which it is disabled, means to connect either telegraph transmitter to said two-wire circuit at will, and means responsive to such connection to operate said voice-controlled means independently of vocal transmission to render said transmitting path continuously operative while the connection is established.

7. In a signaling system, a transmission circuit adapted to transmit either telephone or telegraph signals and terminating at a switching position, a telegraph instrument having a circuit terminating at said switching position, a telephone line terminating at said switching position, means at said switching position whereby a traffic operator may connect said telegraph instrument or said telephone line to said transmission circuit at will, and means operative when the telegraph instrument is disconnected from the transmission circuit whereby the telegraph operator may indicate to the traffic operator that a connection is desired.

8. In a signaling system, a transmission circuit adapted to transmit either telephone or telegraph signals and terminating at a switching position, a telegraph instrument having a circuit terminating at said switching position, a telephone line terminating at said switching position, means at said switching position whereby a traffic operator may connect said telegraph instrument or said telephone line to said transmission circuit at will, and means independent of the operator's telegraph instrument to indicate to the telegraph operator that the telegraph instrument has been connected at the switching position.

9. In a signaling system, a transmission circuit adapted to transmit either telephone or telegraph signals and terminating at a switching position, a telegraph instrument having a circuit terminating at said switching position, a telephone line terminating at said switching position, a link circuit at said switching position whereby a traffic operator may connect said telegraph instrument or said telephone line to said transmission circuit at will, and means associated with said

link circuit to indicate to the traffic operator that the telegraph operator desires the connection between the telegraph instrument and the transmission circuit taken down.

5 10. In a signaling system, a transmission circuit adapted to transmit either telephone or telegraph signals and terminating at a switching position, a telegraph instrument having a circuit terminating at said switch-
 10 ing position, a telephone line terminating at said switching position, means at said switch-
 15 ing position whereby a traffic operator may connect said telegraph instrument or said telephone line to said transmission circuit at will, means operative when the telegraph in-
 20 strument is disconnected from the transmis-
 25 sion circuit whereby the telegraph operator may indicate to the traffic operator that a con-
 nection is desired, means independent of the operator's telegraph instrument to indicate to the telegraph operator that the telegraph instrument has been connected at the switch-
 ing position, and means at the switching posi-
 tion to indicate to the traffic operator that the telegraph operator desires the connections taken down.

11. In a signaling system, a transmission circuit adapted to transmit either telephone or telegraph signals and terminating at a
 30 switching position, a telegraph instrument having a circuit terminating at said switching position, a telephone line terminating at said switching position, means at said switching position whereby a traffic operator may con-
 35 nect said telegraph instrument or said tele-
 phone line to said transmission circuit at will, and means independent of the operator's tele-
 graph instrument to indicate to the telegraph operator during the continuance of an estab-
 40 lished connection from the telegraph instru-
 ment to the transmission circuit that the traffic operator desires to take down the con-
 nection.

12. In a radio telephone and telegraph sys-
 45 tem, a four-wire circuit comprising a trans-
 mitting path and a receiving path for con-
 necting a radio transmitter and a radio re-
 ceiver, respectively, to a two-wire terminal, means to establish telephone connections to
 50 said two-wire terminal, voice-operated means
 associated with said four-wire circuit for dis-
 abling one of its paths when telephone trans-
 mission takes place over the other, an ampli-
 fier in said transmission path, a privacy
 55 mechanism associated with said four-wire
 circuit for rendering speech unintelligible, a
 telegraph transmitter and a telegraph re-
 ceiver, means to maintain said telegraph re-
 ceiver continuously in connection with said
 60 receiving path beyond the point at which it
 is disabled, means to connect said telegraph
 transmitter to said two-wire terminal at will,
 means responsive to such connection to set
 the gain of said amplifier at a predetermined
 65 level, to cut out said privacy mechanism, and

to operate said voice-controlled means inde-
 pendently of vocal transmission to render
 said transmitting path continuously opera-
 tive while the connection is established.

In testimony whereof, we have signed our 70
 names to this specification this 4th day of
 February, 1929.

JOSEPH HERMAN.

EDMUND R. TAYLOR.

SUMNER B. WRIGHT. 75

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