

June 14, 1927.

J. S. JAMMER

1,632,078

SIGNALING SYSTEM

Filed June 20, 1924

2 Sheets-Sheet 1

Fig. 1.

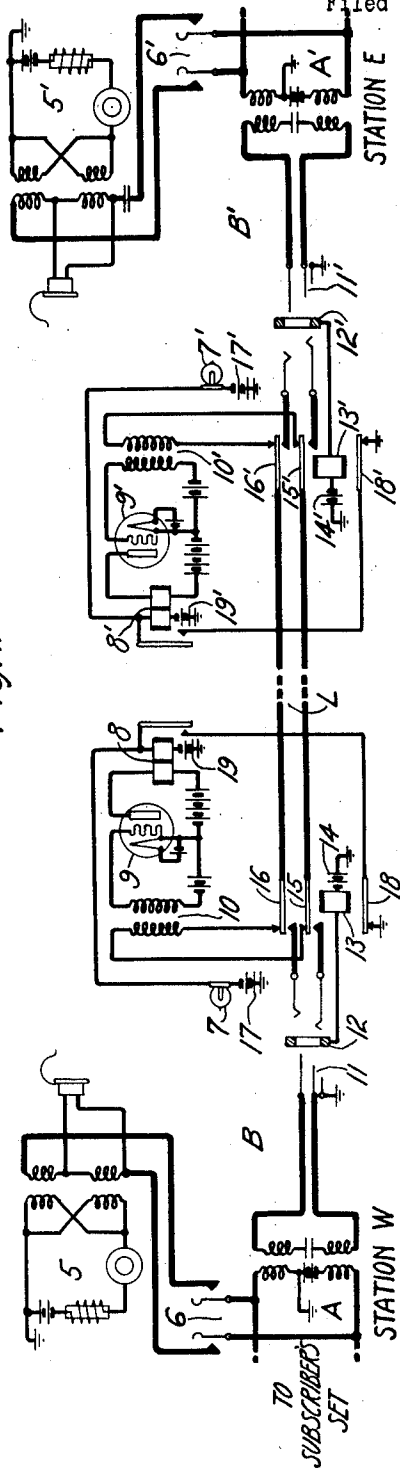
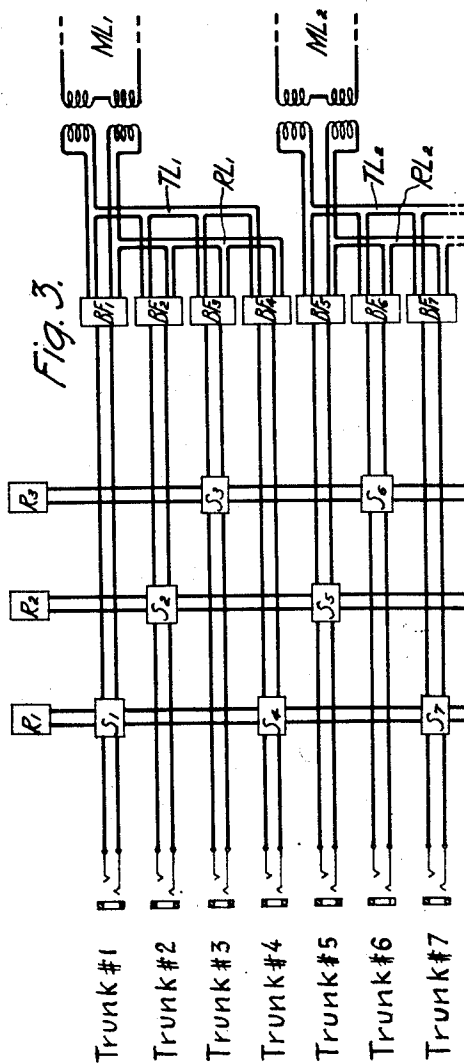


Fig. 3.



Inventor:
Jacob S. Jammer
by E. W. Adams, Att'y.

June 14, 1927.

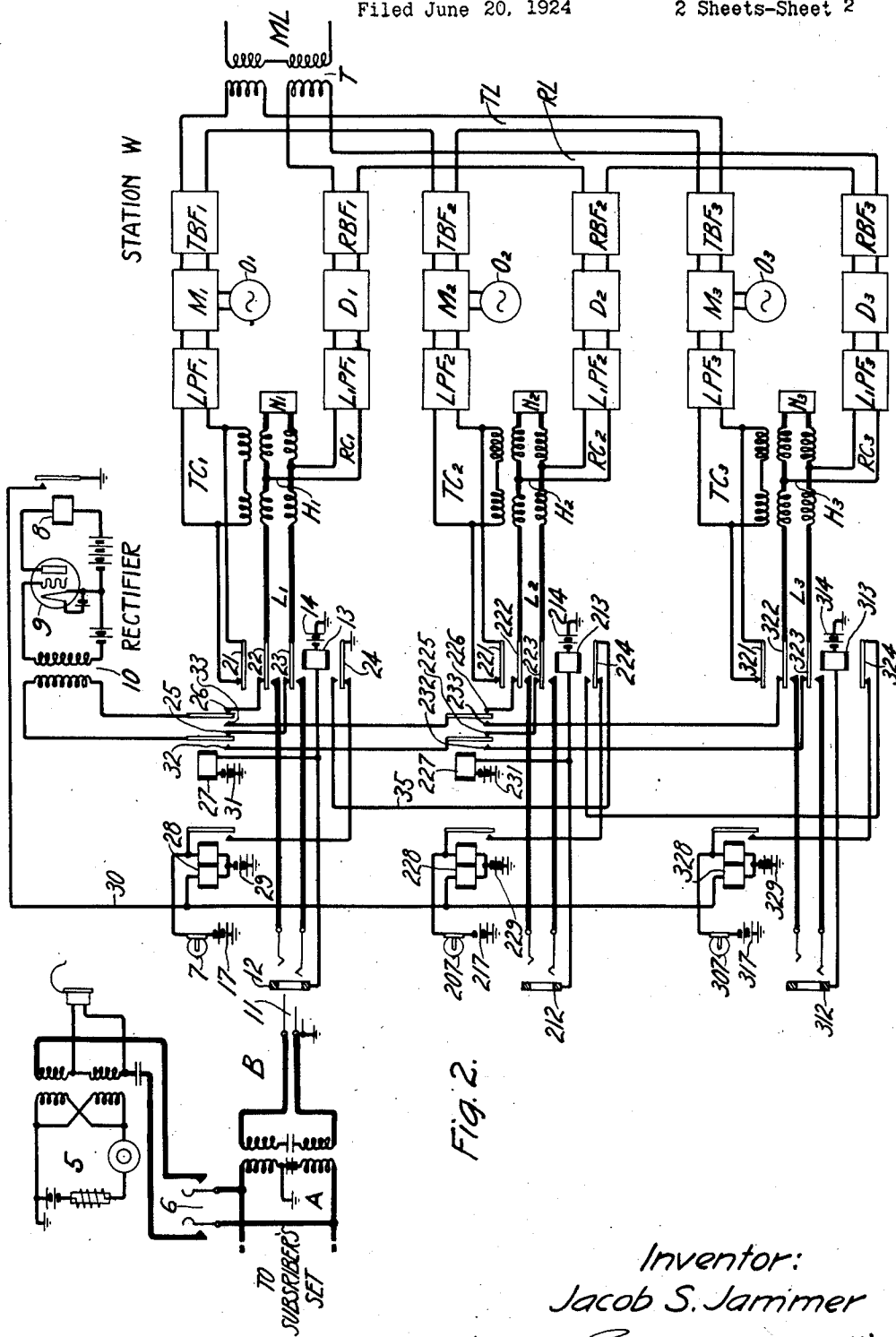
1,632,078

J. S. JAMMER

SIGNALING SYSTEM

Filed June 20, 1924

2 Sheets-Sheet 2



Inventor:
Jacob S. Jammer
by *Edw. Adams* Att'y.

UNITED STATES PATENT OFFICE.

JACOB S. JAMMER, OF NEW YORK, N. Y., ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

SIGNALING SYSTEM.

Application filed June 20, 1924. Serial No. 721,347.

This invention relates to signaling systems and particularly to telephone signaling systems.

An object of the invention is to utilize voice currents for signaling purposes.

A related object of the invention is to simplify the operation and maintenance of a voice operated signaling system.

Another object of the invention is to employ a single signaling circuit for a plurality of telephone lines.

In a specific embodiment of the invention, according to one feature, a current rectifier is bridged across the line at each terminal station of a telephone system. When the operator at one station speaks, the voice currents incoming at the other station are rectified and caused to operate a relay to pass the signal to the receiving switchboard. When the operator at the receiving end of the circuit inserts the plug in the answering jack the rectifier is removed from the line.

According to another feature of the invention, a single signaling circuit is used for a plurality of telephone lines by providing means for automatically shifting the signaling circuit from a busy line to an idle line and for automatically shifting the signaling circuit back to the first line when such line again becomes idle.

The invention is applicable to both voice frequency and carrier current telephone systems, and, in fact, has wide application to various types of signaling systems where it is desired to utilize voice frequency currents for signaling purposes.

In the drawings, in which similar reference characters designate similar parts,

Fig. 1 is a diagrammatic view of a simplified form of voice frequency telephone system embodying the invention;

Fig. 2 is a diagrammatic view illustrating one terminal of a carrier current telephone system embodying the invention;

Fig. 3 is a diagrammatic view of one terminal of a carrier telephone system including a plurality of trunk lines equipped with signaling circuits in accordance with the invention.

The system shown in Fig. 1 represents a telephone system having a station W and station E interconnected by a transmission line L.

Since the system must be worked in either direction the apparatus at stations W and

E is similar. For the sake of clearness only the apparatus at station W will be described, the apparatus at station E being designated by similar reference characters with primes affixed thereto.

In Fig. 1, a subscriber's line (not shown) may terminate at a switchboard from which a connection may be extended to a cord circuit A and a link circuit B in the usual manner. An operator's telephone set may be connected to the cord circuit A by means of a listening key 6.

A signaling lamp 7 is controlled by a relay 8 in the output of a rectifier 9 which may be of the three-element electron discharge type. The rectifier 9 is coupled to the transmission line L by means of a transformer 10, and accordingly, incoming currents at station W passing into the rectifier 9 are rectified and caused to operate relay 8 to light lamp 7.

The link circuit B includes a plug 11 which when inserted in jack 12 establishes an operating circuit for a relay 13. The operation of relay 13 extinguishes lamp 7, disconnects the line L from the input of rectifier 9, and connects line L to the operator's cord circuit A, in a manner hereinafter to be described.

Assuming that it is desired to transmit a signal from station E to station W, the operator at station E inserts plug 11' into jack 12'. This operates relay 13' over a circuit extending from ground, through plug 11', jack 12', winding of relay 13', battery 14', to ground, relay 13' in operating attracting its armatures 15' and 16' to connect the jack 12' to the transmission line L. The operator then speaks on the circuit and the incoming currents at station W pass into rectifier 9 through the transformer 10. The rectified currents in the output of rectifier 9 operate relay 8 which establishes a circuit for the lamp 7 which may be traced from ground, through battery 17, lamp 7, armature and contact of relay 8, armature 18 and lower contact of relay 13 to ground. The relay 8 is thereupon locked up over a circuit extending from ground, through battery 19, winding of relay 8, armature and contact of relay 8, armature 18 and lower contact of relay 13 to ground.

Upon the illumination of lamp 7, the operator at station W inserts plug 11 into jack 12, thereby operating relay 13 over a circuit

extending from ground, through plug 11, jack 12, winding of relay 13, battery 14 to ground. Relay 13, in operating, attracts its armatures 15, 16 and 18. The attraction of armature 18 opens the locking circuit of relay 8 and extinguishing lamp 7. The attraction of armatures 15 and 16 disconnects line L from the input of rectifier 9 and connects jack 12 to line L. By actuating listening key 6 the operator at station W may converse with the operator at station E, and may make connections with the appropriate subscriber's telephone line in the usual manner.

The system described above is exceedingly simple and efficient in operation and has the advantage of simplified maintenance in that tuned relay circuits are entirely eliminated, thereby insuring the operation of the signaling relay 8 under varying transmission conditions.

In the system shown in Fig. 2 a single signaling circuit is employed common to a plurality of telephone lines. This feature of the invention is illustrated in connection with its application to a carrier current telephone system, but it will be obvious as the description proceeds that it is equally applicable to voice frequency telephone systems and to various other systems differing widely from that illustrated.

Fig. 2 represents the west terminal station W of a carrier telephone system connected to a multiplex line ML.

The usual east terminal station, which is identical to terminal station W, is omitted for the sake of clearness. A carrier telephone system of this general type, including both west and east terminal stations, as well as an intermediate repeater station, is illustrated diagrammatically in Fig. 24 of an article entitled "Carrier current telephony and telegraphy" by Messrs. Colpitts and Blackwell, published in the Transactions of the American Institute of Electrical Engineers, Vol. 40, 1921.

The terminal apparatus at station W comprises a plurality of transmitting channels TC_1 , TC_2 and TC_3 connected through a common transmitting circuit TL to the main line ML, and a plurality of receiving channels RC_1 , RC_2 and RC_3 connected through a common receiving circuit RL to the main line ML.

Carrier currents are utilized for transmission over the line ML and are grouped as to their frequencies, the higher frequencies, as a group, being utilized for transmission from west to east and the lower frequencies, as a group, being used for transmission from east to west.

Low frequency telephone lines L_1 , L_2 and L_3 are associated with channels TC_1 — RC_1 , TC_2 — RC_2 and TC_3 — RC_3 , respectively, for simultaneous and independent communica-

tion over line ML with corresponding similar lines at the distant station (not shown).

The low frequency lines are provided with balancing artificial lines or networks N_1 , N_2 and N_3 , respectively, and with differential repeating coils H_1 , H_2 and H_3 , commonly known as hybrid coils, for enabling independent transmission in the two directions between the lines and the high frequency terminal apparatus.

Transmitting channel TC_1 includes a low pass filter LPF_1 , a modulator M_1 and a band filter TBF_1 . Similarly, transmitting channel TC_2 includes a low pass filter LPF_2 , a modulator M_2 and a band filter TBF_2 , while channel TC_3 includes low pass filter LPF_3 , modulator M_3 and band filter TBF_3 .

Receiving channel RC_1 includes a low pass filter L_1PF_1 , a demodulator D_1 and a band filter RBF_1 . Similarly, channel RC_2 includes a low pass filter L_2PF_2 , a demodulator D_2 and band filter RBF_2 , while channel RC_3 includes low pass filter L_3PF_3 , demodulator D_3 and band filter RBF_3 .

The various filters employed throughout the system may be designed in accordance with the principles set forth in the U. S. patent to Campbell, No. 1,227,113, issued May 22, 1917.

The modulators associated with the various transmitting channels throughout the system may be of any well known type, such as that disclosed in the U. S. patent to Van der Bijl, No. 1,350,752, issued August 24, 1920. The various demodulators may be of the well known vacuum tube detector type shown in Fig. 42 of the Colpitts and Blackwell article, supra.

The carrier system outlined above is of the type in which the carrier current is transmitted continuously, as distinguished from the type in which the carrier is suppressed from transmission. A system of this general character is described in connection with Fig. 42 of the Colpitts and Blackwell article, supra.

In this system, carrier currents of the frequency assigned to channel TC_1 are supplied from a source O_1 to the modulator M_1 wherein they are modulated by voice frequency currents from the low frequency line L_1 . Carrier sources O_2 and O_3 are similarly associated with modulators M_2 and M_3 , respectively.

The various low pass filters associated with the terminal transmitting and receiving channels are designed to transmit with substantially negligible attenuation all currents within the voice frequency range and to suppress from transmission currents of all frequencies lying outside such range.

The various band filters associated with the terminal transmitting and receiving channels are so designed that they will transmit bands of frequencies including the car-

rier assigned to the respective channels as well as one of the side bands, either the upper or lower as desired, and will suppress from transmission frequencies lying outside such bands.

Voice frequency currents originating, for instance, in the low frequency line L_1 , pass through the associated hybrid coil H_1 through low pass filter LPF_1 into modulator M_1 . There is likewise fed into the modulator the carrier current from the oscillator O_1 as described above. Of the components of modulation appearing in the output circuit of the modulator M_1 the transmitting band filter TBF_1 suppresses all except one side band, for example the upper side band, and the carrier, which it transmits or passes into the common transmitting circuit TL . The currents thus transmitted from channel TC_1 and the other transmitting channels then pass through transformer T to the multiplex line ML . The incoming currents at the distant station (not shown) are picked up by the receiving band filter in the appropriate channel, are demodulated, and are passed on to the associated low frequency apparatus in the usual manner.

The system of Fig. 2 is so arranged that a single rectifier circuit and voice operated relay is utilized to operate lamps or other signaling devices for a plurality of telephone lines. This is accomplished by providing means for automatically shifting the signal controlling mechanisms from a busy to an idle line, and for automatically shifting the signal controlling mechanisms back to the first line when such line again becomes idle.

It will be understood that the operator's telephone set 5 and switching mechanisms associated with the low frequency telephone line L_1 are similar to the operator's set and switching mechanism shown in Fig. 1, and that similar apparatus is also associated with low frequency lines L_2 and L_3 but are omitted from the drawings for the sake of clearness.

When the operator at the distant station plugs in and talks over the transmitting channel which cooperates with receiving channel RC_1 at station W , the currents received at station W , consisting of one side band accompanied by its carrier, are selectively passed through the receiving band filter RBF_1 and are then amplified and demodulated in the demodulator D_1 . The voice frequency currents appearing in the output circuit of the demodulator D_1 are selected from the other components of demodulation by the low pass filter LPF_1 from which point in the circuit they pass through the low frequency hybrid coil H_1 to the voice frequency line L_1 .

The incoming voice currents on line L_1 pass through armatures 22 and 23 and their associated upper contacts of relay 13, arma-

tures and contacts 25 and 26 of relay 27, transformer 10 to the input of rectifier 9. The rectified currents in the output of rectifier 9 operate relay 8 thus completing an energizing circuit for relay 28 which may be traced from ground, through armature and contact of relay 8, conductor 30, winding of relay 28, battery 29, to ground. Relay 28 in operating lights lamp 7 over a circuit extending from ground, through battery 17, lamp 7, armature and contact of relay 28, lower contact and armature 24 of relay 13 to ground. Relay 28 is thereupon locked up over a circuit extending from ground, through battery 29, winding, armature and contact of relay 28, armature 24 and lower contact of relay 13, to ground. Although relays 228 and 328 are likewise operated, the lamps 207 and 307 are not lighted due to the fact that their energizing circuits are open at the upper contact associated with armature 24 of relay 13 and the energizing circuit of lamp 307 is also open at the upper contact associated with armature 224 of relay 213.

When the operator inserts plug 11 into jack 12, relay 13 is operated over a circuit extending from ground, through plug 11, jack 12, winding of relay 13, battery 14, to ground. Relay 13 in attracting its armatures 22 and 23 disconnects the line L_1 from the input of rectifier 9 and connects the jack 12 to the line L_1 . Relay 13 in operating also attracts its armature 21 thereby removing a short circuit across transmitting channel TC_1 and enabling the operator to talk through the hybrid coil H_1 into channel TC_1 . Relay 13 in operating also moves its armature 24 from its lower to its upper contact, thereby opening the locking circuit of relay 28 and extinguishing lamp 7.

An operating circuit for relay 27 is likewise established by the insertion of plug 11 into jack 12, this circuit extending from ground, through plug 11, jack 12, winding of relay 27, battery 31 to ground. Relay 27 in operating attracts its armatures, opening contacts 25 and 26 and closing contacts 32 and 33, thus shifting the rectifier 9 and associated signal controlling mechanisms from line L_1 to line L_2 .

When the conversation is completed on line L_1 and plug 11 is removed from jack 12, relays 13 and 27 are deenergized and, accordingly, the circuit is restored to the original normal condition shown in the drawing. If, however, the operator at the distant station wishes to send through another call to station W while the line L_1 is busy, the operator at the distant station will take up the circuit associated with line L_2 and speak. The incoming currents at station W of the frequency assigned to channel RC_2 are selectively passed through that channel and the voice frequency components

appear in the low frequency line L_2 in the manner described above. These voice currents pass through armatures 222, 223 and their associated upper contacts of relay 213, contacts 225 and 226 and armatures of relay 227, contacts 32, 33 and armatures of relay 27, transformer 10 to the input of rectifier 9. The output currents of rectifier 9 operate relay 8, thereby establishing an operating circuit for relay 228 which extends from ground, through armature and contact of relay 8, conductor 30, winding of relay 228, battery 229 to ground. Relay 228 in attracting its armature lights lamp 207 over a circuit extending from ground, through battery 217, lamp 207, armature and contact of relay 228, armature 224 and lower contact of relay 213, conductor 35, armature 24 and upper contact associated therewith of relay 13 to ground. Relay 228 is thereupon locked up over a circuit extending from ground, through battery 229, winding, armature and contact of relay 228, armature 224 and lower contact of relay 213, conductor 35, armature 24 and upper contact associated therewith of relay 13 to ground. Although relays 28 and 328 are also operated over circuits similar to the energizing circuit of relay 228, lamps 7 and 307 are not lighted due to the fact that the circuit of lamp 7 is open at the lower contact associated with armature 24 of relay 13, and the circuit of lamp 307 is open at the upper contact associated with armature 224 or relay 213.

The operator at the station W. noting that lamp 207 is illuminated, inserts a plug similar to plug 11 into answering jack 212, thus operating relays 213 and 227 over circuits similar to those described above in connection with relays 13 and 27. Relay 213 in attracting its armatures 222 and 223 disconnects line L_2 from the input of rectifier 9 and connects jack 212 to the line L_2 . Armature 221 is also attracted to remove the short circuit across transmitting channel TC_2 , thereby enabling the operator to talk over the circuit. Armature 224 is also moved from its lower to its upper contact, thereby opening the locking circuit of relay 228 and extinguishing lamp 207. Relay 227 in operating attracts its armatures, opening contacts 225 and 226 and closing contacts 232 and 233, thus shifting the rectifier 9 and associated signal controlling mechanisms from line L_2 to line L_3 .

If the conversation on line L_1 is completed and plug 11 is removed from jack 12 while line L_2 is still busy, relays 13 and 27 will be restored to the normal condition shown in the drawing and rectifier 9 and the associated signaling mechanisms will be restored to line L_1 , thereby enabling a signal to be transmitted over this line while line L_2 is still busy. Likewise, when the conversation is completed on line L_2 and the plug is re-

moved from jack 212 the circuits associated with line L_2 are restored to normal, thus enabling another signal to be transmitted over this line if line L_1 is still busy, or if line L_1 has again become busy in the meantime. If, however, lines L_1 and L_2 are both busy, signals may then be transmitted over line L_3 .

In the latter case, the incoming voice currents on line L_3 pass through armatures 322 and 323 of relay 313, contacts 232 and 233 and armatures of relay 227 (since relay 227 is energized), contacts 32 and 33 and armatures of relay 27 (since relay 27 is energized), transformer 10, to the input of rectifier 9, thus operating relay 8. Relay 8 in operating establishes an energizing circuit for relay 328 over an obvious circuit, and relay 328, in operating lights lamp 307 over a circuit extending from ground, through battery 317, lamp 307, armature and contact of relay 328, armature 324 and lower contact of relay 313, armature 224 and upper contact associated therewith of relay 213, conductor 35, armature 24 and upper contact associated therewith of relay 13 to ground. A locking circuit is likewise established for relay 328, thus maintaining lamp 307 illuminated until the operator inserts a plug similar to the plug 11 into jack 312 at which time the relay 313 is operated in the manner described in connection with relays 13 and 213. Relay 313 in attracting its armatures 322 and 323 disconnects line L_3 from the input of rectifier 9 and connects jack 312 to line L_3 . The operation of armature 324 opens the locking circuit of relay 328 and extinguishes lamp 307. The operation of armature 321 removes the short circuit across transmitting channel TC_3 , and enables voice currents originating in line L_3 to pass into transmitting channel TC_3 .

If desired, relays 13, 27, 213, 227 and 313 may be of the slow-releasing type so that when the circuit of rectifier 9 has been transferred from one line to another, say from line L_1 to line L_2 , the rectifier 9 will remain associated with line L_2 long enough to illuminate lamp 207 if a signal has been sent through on line L_2 at the very instant that conversation on line L_1 is completed and plug 11 is removed from jack 12.

Fig. 3 shows a carrier current telephone system including a plurality of trunk lines equipped with signaling systems of the type shown in Fig. 2. Trunk lines 1 to 4, inclusive, are connected through a common transmitting circuit TL_1 and a common receiving circuit RL_1 to the multiplex line ML_1 . Similarly, trunk lines 5, 6, 7, etc. are connected through a common transmitting circuit TL_2 and a common receiving circuit RL_2 to the multiplex line ML_2 . Additional trunk lines may also be provided and may be associated with either of the lines ML_1 or ML_2 , or may be associated with still another multiplex

line, not shown. Band filters BF_1 , BF_2 , BF_3 , etc., are associated with trunk lines 1, 2, 3, etc. and serve to separate the groups of carrier waves to the respective trunk circuits.

5 These filters may be of the band filter type disclosed in the Campbell patent, supra.

A rectifier circuit R_1 is associated with trunk lines 1, 4 and 7 in a manner identical to that in which rectifier 9 and associated
10 switching mechanisms of Fig. 2 is associated with line L_1 , L_2 and L_3 of Fig. 2. Switching circuits S_1 , S_4 and S_7 similar to the switching circuits associated with lines L_1 , L_2 and L_3 of Fig. 2 are provided for shifting
15 the rectifier circuit R_1 from one trunk line to the other. Similarly, a rectifier circuit R_2 and switching circuits S_2 and S_5 are associated with trunk lines 2 and 5, while rectifier circuit R_3 and switching circuits S_3
20 and S_6 are associated with trunk lines 3 and 6.

In operating the system of Fig. 3, the operators will be instructed to use the circuits in sequence. When a signal has been
25 passed over trunk 1 and answered, rectifier circuit R_1 will be automatically shifted to trunk 4. Likewise, when the signal has been passed over trunk 2 the rectifier circuit R_2 will be shifted to trunk 5, and when a signal
30 has been passed over trunk 3 the rectifier circuit R_3 will be shifted to trunk 6, etc. When trunk 1 becomes idle, rectifier circuit R_1 which has been shifted to trunk 4 is automatically restored to trunk 1, etc.

35 Since many changes may be made in the system herein shown and described without departing from the spirit of the invention, it is to be understood that the invention is not to be limited in any way by the disclosure,
40 except as defined by the scope of the appended claims.

What is claimed is:

1. In a signaling system, a transmission line, a rectifier connected to said line, a
45 relay in the output of said rectifier, a signal controlled by said relay, a telephone set, and switching means for disconnecting said rectifier from said line and for simultaneously connecting said telephone set to said line.
- 50 2. In a signaling system, a transmission line, a rectifier connected to said line, a relay in the output of said rectifier, a signaling circuit controlled by said relay, a telephone set, and switching means for disconnecting
55 said rectifier from said line and connecting said telephone set to said line, and for simultaneously opening said signaling circuit.
3. In a signaling system, a telephone line, a terminal station associated with said line,
60 a cord circuit at said terminal station, a rectifier circuit bridged across said line at said terminal station to rectify incoming voice currents, a relay in the output of said rectifier circuit, a signal controlled by said
65 relay, and switching means to disconnect

said line from said rectifier circuit and to connect said line to said cord circuit.

4. In a signaling system, a telephone line, a terminal station associated with said line, a cord circuit at said terminal station, a
70 rectifier circuit bridged across said line to rectify incoming voice currents, a relay in the output of said rectifier circuit, a signal controlled by said relay, a relay adapted to disconnect said line from said rectifier cir-
75 cuit and to connect said line to said cord circuit, and switching means associated with said cord circuit for operating said last mentioned relay.

5. In a signaling system, a transmitting
80 and a receiving station interconnected by a transmission line, means at said transmitting station to impress voice currents upon said line, a rectifier connected to said line at said
85 receiving station, a relay in the output of said rectifier, a signal controlled by said relay, a telephone set at said receiving station, and switching means for disconnecting said rectifier from said line and for simultaneously connecting said telephone set to
90 said line.

6. In a signaling system, a plurality of transmission lines, a voice operated signal associated with each of said lines and controlled by current received over the respective
95 line, a signal controlling circuit associated with one of said lines for controlling the actuation of the respective signal, and means for disconnecting said signal controlling circuit from said last mentioned line
100 and for connecting it to another of said lines.

7. In a signaling system, a plurality of transmission lines, a signal associated with each of said lines, a voice operated signal controlling circuit associated with one of
105 said lines, and means for disconnecting said signal controlling circuit from one of said lines and for connecting it to another of said lines.

8. In a signaling system, a plurality of
110 transmission lines, a signal associated with each of said lines, a voice operated signal controlling circuit associated with one of said lines, and automatic means operative under predetermined conditions to disconnect
115 said signal controlling circuit from one of said lines and to connect it to another of said lines.

9. In a signaling system, a plurality of transmission lines, a signaling device associated with each of said lines, a rectifier circuit normally connected to one of said lines
120 to rectify voice currents transmitted thereover, means controlled by the current in the output of said rectifier circuit for energizing the associated signaling device, and means
125 for disconnecting said rectifier circuit from one of said lines and connecting it to another of said lines.

10. In a signaling system, a plurality of
130

transmission lines, a signaling device associated with each of said lines, a rectifier connected to one of said lines, means controlled by the current in the output of said rectifier
5 for energizing the associated signaling device, a telephone set, switching means for disconnecting said rectifier from the line to which it is connected and connecting said
10 telephone set to said line, and means controlled by said switching means to connect said rectifier to another of said lines.

11. In a signaling system, a plurality of transmission lines, a signaling circuit associated with each of said lines, a rectifier connected to one of said lines, means controlled
15 by the current in the output of said rectifier for energizing the associated signaling circuit, a telephone set, switching means for disconnecting said rectifier from the line to which it is connected and connecting said
20 telephone set to said line, means controlled by said switching means for opening the signaling circuit of said first line, and means also controlled by said switching means to
25 connect said rectifier to another of said lines.

12. In a carrier wave signaling system, a multiplex carrier line employing carrier waves of different frequencies, a plurality of low frequency lines associated with said multiplex line, a signaling device associated with
30 each of said low frequency lines and controlled by current received over the respective line, a signal controlling circuit, and

means for associating said circuit with any of said low frequency lines under predetermined conditions. 35

13. In a carrier wave signaling system, a multiplex carrier line employing carrier waves of different frequencies, a plurality of incoming channels associated with said multiplex line, a signaling device associated with
40 each of said channels and controlled by current received over the respective channel, a signal receiving circuit connected to one of said channels to control the associated signaling
45 device, and means for disconnecting said signal controlling circuit from said last mentioned channel and for connecting it to another of said channels.

14. In a carrier wave signaling system, a
50 multiplex carrier line employing carrier waves of different frequencies, a low frequency line associated with said multiplex line, a rectifier circuit bridged across said low frequency line to rectify incoming
55 voice currents, a relay in the output of said rectifier circuit, a signaling device energized by said relay, a cord circuit, and switching means to disconnect said low frequency line from said rectifier circuit and
60 to connect it to said cord circuit, and means also controlled by said switching means to deenergize said signaling device.

In witness whereof, I hereunto subscribe my name this 14th day of June A. D., 1924.

JACOB S. JAMMER.