Oct. 23, 1928. 1,688,454

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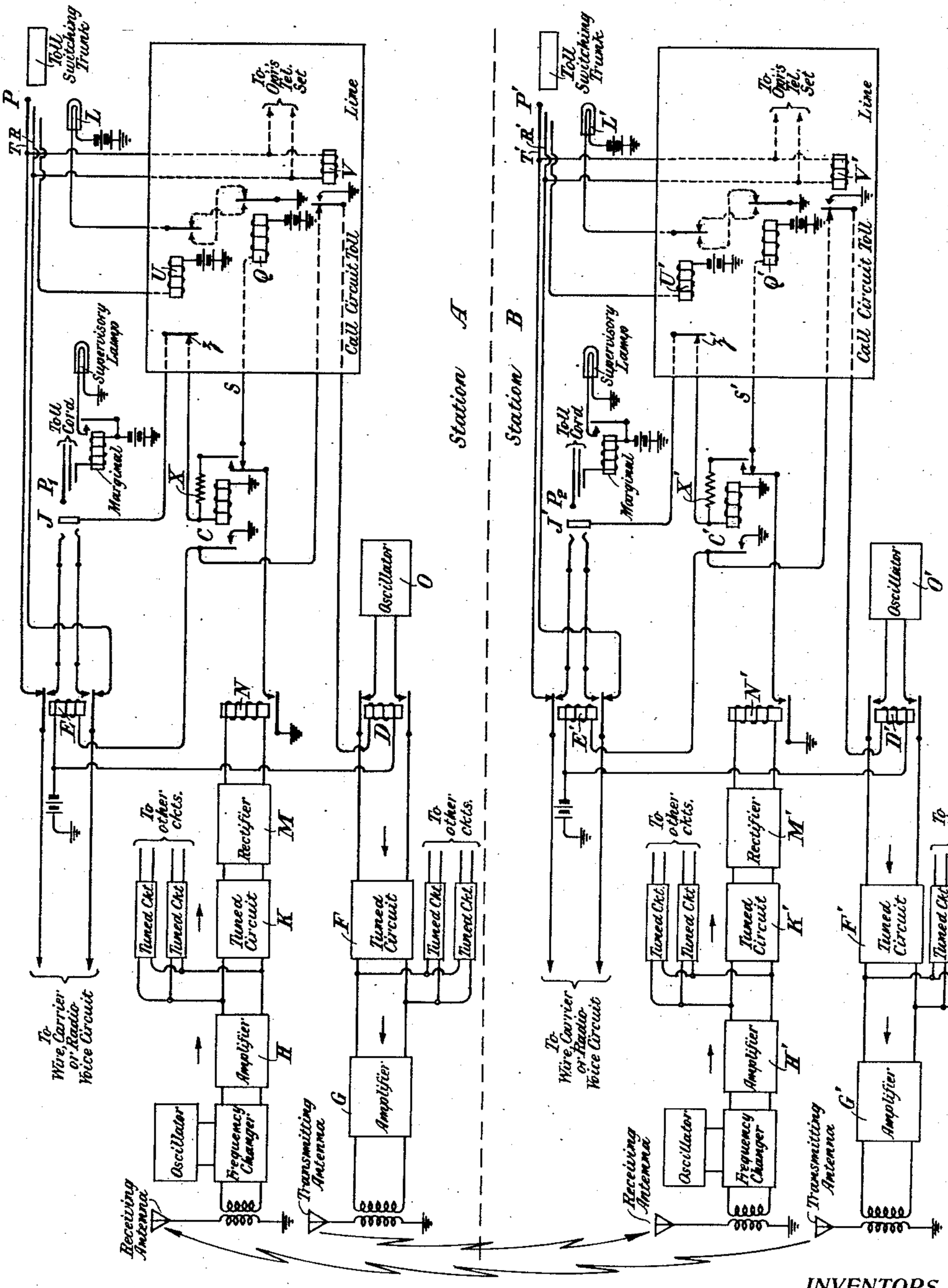
Filed May 19, 1926



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Patented Oct. 23, 1928. 1,688,454.

UNITED STATES PATENT OFFICE.

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TELEPHONE SIGNALING SYSTEM.

Application filed May 19, 1926. Serial No. 110,252.

This invention relates to telephone signaling systems, and more particularly to arrangements for transmitting supervisory signals between central office stations.

In the operation of a group of telephone circuits by improved traffic methods, a number of supervisory signals are required. Facilities for the transmission of these supervisory signals are sometimes not available, as in the case of radio speech channels; and, in the case of wire circuits, they cannot always be obtained unless there are sacrificed facilities for the transmission of Morse telegraph signals over the telephone circuits. Furthermore, with the present standard facilities for signaling over voice circuits, certain precautions must be taken in order to guard against interference with the signals by the voice currents, and in order to reduce the interference from other voice circuits and the interference caused in other voice circuits.

It is the object of applicants' invention to transmit supervisory signals in cases in which the facilities cannot be obtained by wire means, as in the case of radio speech channels, and, in the case of wire circuits, to transmit such signals without any sacrifice of Morse telegraph facilities and without any of the types of interference mentioned above.

Applicants accomplish this object by transmitting all the supervisory signals for a group of voice circuits over a common radio channel between the central office stations.

The arrangement described below and illustrated diagrammatically in the accompanying drawing is one suitable for transmitting by applicants' means the signals employed in the so-called "two-way straightforward" method of operation, in which the circuits are used "two-way"—that is, so that a call may be originated at either station—and in which the operators talk on the circuits also used for the subscribers' conversation, instead of using a separate call circuit.

With reference to the accompanying drawing, station A is a telephone central office station connected with a distant central office station B by a plurality of voice channels, which may be ordinary wire circuits, carrier circuits, or radio channels. The system is shown equipped for operation in either direction, that is, for the initiation of a call at either station and the proper signaling and supervision at both stations. The following apparatus at each station, in association with each voice channel, is usually found at central office stations equipped for this method of operation; a cord for outgoing calls, a cord for incoming calls, a jack for outgoing calls, a switching trunk associated with the inward cord, a first annunciator associated with the inward cord, and a second annunciator associated with the outward cord. Applicants provide at each station means for transmitting radio signals and means for receiving radio signals. In addition, there are provided at each station, in association with each of the voice channels, means for producing radio signaling current for transmission, and means for suitably tuning the radio receiver. For each voice channel served, there is required one radio signaling frequency for signaling in each direction, the signaling current producer associated with that channel at each station producing an alternating current of a predetermined frequency, and the receiver at the other station being correspondingly tuned by the circuit associated with that channel. It is to be understood that only the apparatus associated with one voice channel is shown in full, the apparatus peculiarly associated with the other channels being merely indicated and its connection to the radio transmitting and receiving apparatus shown.

The details of the signaling system will be clearly understood from the following description of the operation thereof.

If a subscriber directly connected with the central office station A wishes to communicate with a subscriber connected to station B, the operator at station A inserts the toll cord terminating in plug P_1 into jack J at an outgoing position. Battery from the sleeve of the toll cord causes the operation of relay C. The operation of relay C in turn causes relays D and E to operate. The operation of relay E transfers the connection of the toll line from the plug P which is used for incoming calls to the outward jack J. The operation of relay D connects the oscillator O, which produces a high frequency signaling current, through

the tuned circuit F associated with the voice channel under consideration and the common amplifier G to the transmitting antenna of station A. The radio signal is transmitted to station B, received in the receiving apparatus of that station, and changed in frequency (an oscillator being associated with the frequency changer). The signal is then passed through the common amplifier H', the tuned circuit K' associated with the voice channel under consideration, and the rectifier M' to the relay N', which operates. The operation of relay N' places ground over the lead S' to the standard call circuit toll line, of which the essential parts are here shown symbolically. The ground on lead S' causes relay Q' to operate, which operation closes the circuit including the lamp L' associated with the toll line at the incoming position, causing the lamp to light. The operator at station B is thus informed that a call is waiting on the particular line under consideration.

As is well understood in the art, the call circuit toll line is so arranged that the operator's telephone set is connected automatically to the incoming end of the toll line on which a signal is waiting. When the called subscriber's number has been transmitted over the toll circuit to the operator at station B, the plug P' of the incoming circuit at station B is connected to the toll switching trunk, and the latter in turn is connected to the subscriber's line. The connection of the plug P' and the switching trunk causes the operation of relay U'. The operation of this relay brakes the circuit including the lamp L', extinguishing that lamp, and also opens the contact *z'*.

When the subscriber's line has been connected to the circuit at station B, battery over leads T' and R' causes the operation of relay V', which in turn causes relay D' to operate. The operation of relay D' connects the oscillator O', which produces a high frequency signaling current, through the tuned circuit F' associated with the voice channel under consideration and the common amplifier G' to the transmitting antenna of station B. A radio signal is sent to station A, being received in the receiving antenna of that station. This signal is changed in frequency and passed through the common amplifier H, the tuned circuit K associated with the voice channel under consideration, and the rectifier M to the relay N, which operates. Since relay C at station A is already operated, the operation of relay N serves to connect the resistance X to ground in parallel with the winding of relay C. The value of this resistance X is so chosen with relation to the resistance of relay C that the connection to ground of the two resistances in parallel causes the operation of a marginal relay in the sleeve of the toll cord at the outgoing position. This marginal relay controls the supervisory lamp in the toll cord, which now lights.

When the subscriber at station B has answered, relay V' releases, causing the release of relay D' and the removal of the radio signal sent to station A as described above. Consequently, relay N at station A will release, and resistance X will be removed from the circuit including the marginal relay in the sleeve of the toll cord, the result being that the supervisory lamp in the toll cord is extinguished. If the subscriber at station B operates his switch hook, relay V' will follow this operation, that is, the relay will be operated when the hook is down, and released when the hook is up. Relay D' will follow the operation and will transmit radio signaling current pulses to station A where relay N is caused to operate and release, placing resistance X in circuit intermittently. The result is the flashing of the supervisory lamp in the toll cord at the outgoing position.

When the called subscriber at station B hangs up his receiver, the supervisory lamp at station A will be lighted steadily, as will be understood from the operations described above. The operator at station A then removes the plug P_1 at the outgoing position from the jack J, releasing relays C, D and E. The release of relay D causes the radio signal, which was continuously transmitted from oscillator O during the period of connection of the cord and the jack J, to be removed. Accordingly, at station B relay N' will release, this relay having been operated during the same period. The release of relay N' causes the release of relay Q'. Since relay U' remains operated, the release of relay Q' will close the circuit including the lamp L' associated with the incoming position at station B, causing this lamp to light. This indicates to the operator at station B that the plug P' associated with the lamp is to be removed from the toll switching trunk. Upon the removal of the plug, the lamp L' is extinguished.

It is to be understood that only so much of the terminal apparatus at the two stations, which is old and well understood in the art, is shown in the drawing as appears to be necessary to an understanding of applicants' invention.

The operation of applicants' system in connection with a call initiated at station B is similar to the operation in the opposite direction, and will now be traced briefly. The operator at station B inserts plug P_2 into the jack J', causing the operation of relay C', which, in turn, causes relays D' and E' to operate. Upon the operation of relay D', a radio signal is transmitted from the oscillator O' to relay N at station A through tuned circuit F', amplifier G', trans-

mitting antenna of station B, receiving antenna of station A, amplifier H, tuned circuit K and rectifier M. The operation at station A of relay N connects ground to lead S, which results in the operation of relay Q and the lighting of lamp L. When the called subscriber's number has been transmitted over the toll circuit from station B to station A, the operator at station A inserts plug P into the toll switching trunk. Relay U is operated and extinguishes lamp L. Battery over leads T and R causes relay V to operate, this operation resulting in the operation of relay D. Upon the operation of relay D a radio signal is transmitted from oscillator O at station A to relay N′ at station B through tuned circuit F, amplifier G, transmitting antenna of station A, receiving antenna of station B, amplifier H′, tuned circuit K′ and rectifier M′. Since relay C′ at station B remains operated, the operation of relay N′ connects the resistance X′ to ground in parallel with the winding of relay C′, and the marginal relay in the toll cord at the outgoing position is operated, lighting the supervisory lamp associated with the toll cord.

When the subscriber answers at station A, relays V and D release, removing the radio signal which was transmitted to station B. Relay N′ at station B releases in response, and resistance X′ is removed from the sleeve circuit of the toll cord, the result being that the supervisory lamp is extinguished. If the subscriber at station A operates his switch hook, the result, as described above, is the flashing of the supervisory lamp in the toll cord at the outgoing position of station B. When the called subscriber at station A hangs up his receiver, the supervisory lamp at the outgoing position of station B remains steadily lighted. The operator at station B then removes the plug P^2, thereby releasing relays C′, D′ and E′. The release of relay D′ results in the removal of the radio signal to station A, the release of relays N and Q at station A, and the lighting of lamp L associated with plug P at station A. This gives the indication to the operator at station A that plug P is to be removed. The removal of this plug extinguishes lamp L.

While applicants' invention has been disclosed in one specific embodiment which is deemed desirable, it is to be understood that it is capable of embodiment in many other and different forms without a departure from the scope of the invention as defined in the appended claims.

What is claimed is:

1. In a telephone system including two central office stations and a vcice channel connecting said stations, a cord at each station for outgoing calls, a cord at each station for incoming calls, a jack at each station for outgoing calls, a switching trunk associated with the inward cord at each station, a first annunciator associated with said inward cord at each station, a second annunciator associated with the outward cord at each station, means at each station for generating and transmitting radio signals, means at each station for receiving radio signals transmitted from the other station, automatic means at each station, responsive to the connection of the outward cord and the outward jack, for connecting the voice channel to the outward jack and simultaneously therewith operating the radio signal generating and transmitting means at that station to send an initial radio signal to the other station, automatic means at each station for operating the first annunciator at that station in response to said initial radio signal received from the other station, automatic means at each station for terminating the operation of said first annunciator in response to the connection at that station of the inward cord and the switching trunk, automatic means at each station, responsive to the flow of direct current over the switching trunk at that station, for operating the radio signal generating and transmitting means at that station to send a responsive radio signal to the other station, automatic means at each station for operating the second annunciator at that station upon the reception of said responsive radio signal from the other station, automatic means at each station, responsive to the cessation and resumption of the flow of direct current over the switching trunk at that station, for terminating the operation of and re-operating, respectively, the radio signal generating and transmitting means at that station and the responsive second annunciator at the other station, automatic means at each station, responsive to the disconnection of the outward cord and the outward jack, for terminating the transmission of the initial radio signal from that station, and automatic means at each station for re-operating the first annunciator at that station in response to the termination of the initial radio signal received from the other station.

2. In a telephone system including two central office stations and a plurality of voice channels connecting said stations, means at each station for transmitting radio signals, means at each station for receiving radio signals, and at each station in association with each voice channel the following: a cord for outgoing calls, a cord for incoming calls, a jack for outgoing calls, a switching trunk associated with the inward cord, a first annunciator associated with said inward cord, a second annunciator associated with the outward cord, means for producing signaling current of a frequency peculiar to that station and to that voice channel, means

for tuning the signal receiving means at that station to the peculiar frequency produced at the other station and corresponding to that voice channel, automatic means, responsive to the connection of the outward cord and the outward jack, for connecting the voice channel to the outward jack and simultaneously therewith connecting the current producing means to the radio signal transmitting means at that station, causing said transmitting means to send an initial radio signal, of the peculiar frequency, to the other station, automatic means for operating the first annunciator at that station in response to said initial radio signal, of the predetermined frequency, received from the other station, automatic means for terminating the operation of said first annunciator in response to the connection at that station of the inward cord and the switching trunk, automatic means, responsive to the flow of direct current over the switching trunk at that station, for connecting the current producing means to the radio signal transmitting means at that station, causing said transmitting means to send a responsive radio signal, of the peculiar frequency, to the other station, automatic means for operating the second annunciator at that station upon the reception of said responsive radio signal, of the predetermined frequency, from the other station, automatic means, responsive to to the cessation and resumption of the flow of direct current over the switching trunk at that station, for disconnceting the current producing means from the radio signal transmitting means at that station and reconnecting the same, respectively, and terminating the operation of and re-operating respectively, the responsive second annunciator at the other station, automatic means, responsive to the disconnection of the outward cord and the outward jack, for terminating the transmission of the initial radio signal, of the peculiar frequency, from that station, and automatic means for reoperating the first annunciator at that station in response to the termination of the initial radio signal, of the predetermined frequency, received from the other station.

In testimony whereof, we have signed our names to this specification this 18th day of May, 1926.

CHARLES S. DEMAREST.
OWEN H. LOYNES.