

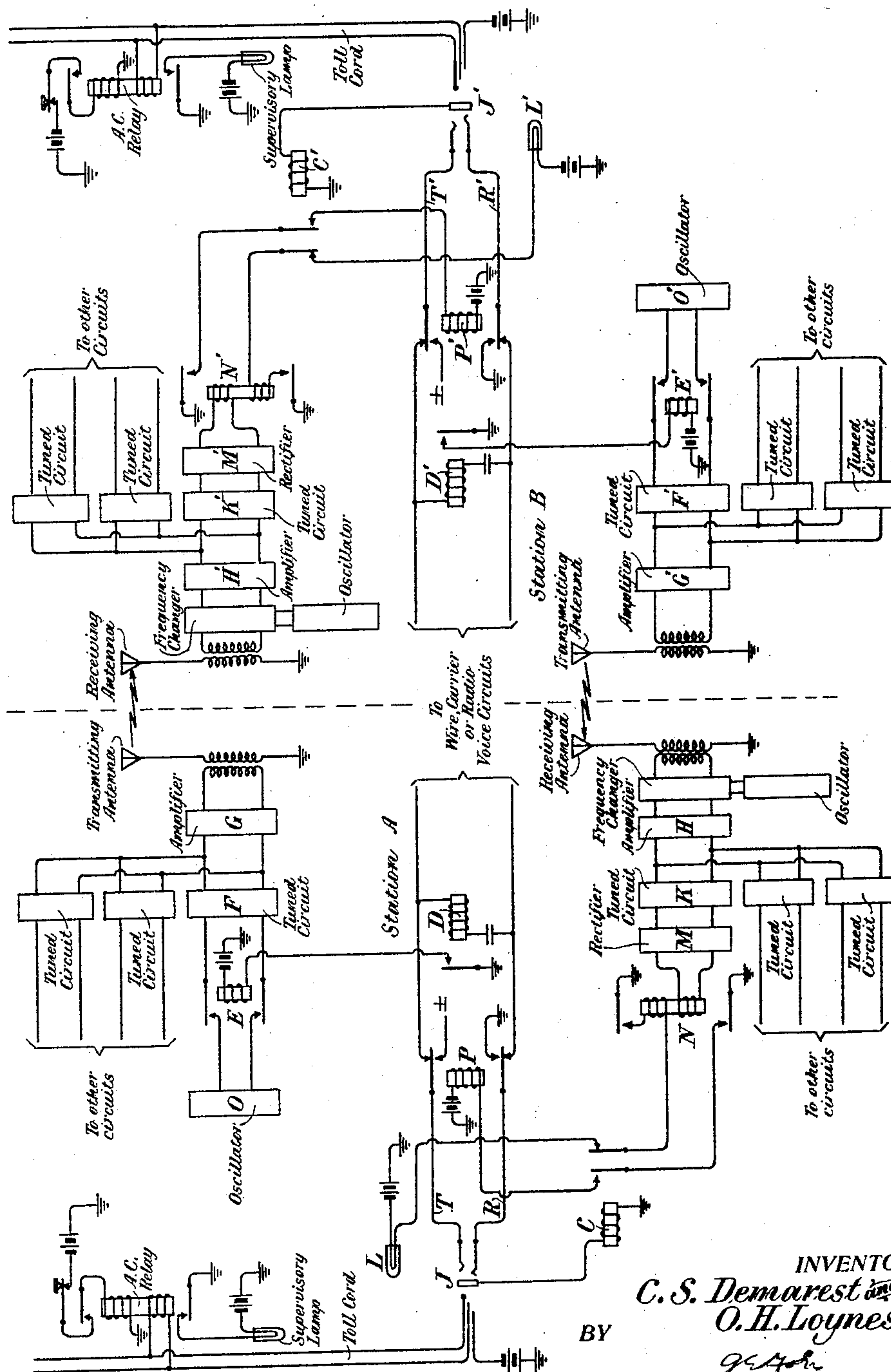
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TELEPHONE SIGNALING SYSTEM

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## UNITED STATES PATENT OFFICE.

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## TELEPHONE SIGNALING SYSTEM.

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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 "ring down" method of operation, in which the central office operators plug into and ring over the circuits also used for the subscribers' conversation.

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 apparatus at each station consists essentially of radio transmitting means, radio receiving

means, and the following in association with each of the voice channels; means for producing radio signaling current for transmission, means for suitably tuning the receiving means, the usual annunciator, and means for associating the signaling current producer and the annunciator with the radio transmitting and receiving apparatus, respectively. 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 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 with the distant central office station B, the operator at station A plugs the toll cord into jack J. Battery from the sleeve of the toll cord operates relay C. The operator then rings, the ringing current being applied over the leads T and R to relay D, which operates. The relay D, upon operation, in turn operates relay E. The operation of relay E connects the oscillator O, which produces high frequency signaling current, through the tuned circuit F associated with the voice channel under consideration and through the common amplifier G to the radio transmitting antenna of station A. At the distant station B a radio signal is received in the receiving antenna, is changed in frequency (an oscillator being associated with the frequency changer), and is passed through the common amplifier H', the tuned circuit K' associated with the voice channel under consideration and the rectifier M' to relay N'. This relay N' operates and locks through its lower winding. The locking circuit of the relay includes the lamp L', which is associated with the jack J'.



Therefore, when the locking circuit of the relay is closed, this lamp lights. In response to the operation of the lamp L', the operator at station B plugs the toll cord into the jack J'. Battery from the sleeve of the toll cord operates relay C'. Upon the operation of this relay the locking circuit of relay N' is broken, relay N' is released, and lamp L' is extinguished.

If the operator at station A rerings, the ringing current over leads T and R re-operates relay D, and a second radio signal is transmitted to station B in the manner described above. Relay N' at station B again responds, but, since relay C' remains operated, the lamp L' will not light again, but relay P' will be operated, the circuit to this relay being through the make contact of relay C'. The operation of relay P' connects to the leads T' and R' the current source and ground indicated in the drawing, and consequently ringing current is transmitted over these leads to the toll cord previously inserted in the jack J'. As is well understood in the art this ringing current operates an alternating current relay, which, in turn, lights the supervisory lamp in the toll cord.

Only so much of the toll cord circuit at each station is shown as appears to be necessary to a full understanding of applicants' invention.

The operation of applicants' signaling system will now be described in connection with a call originated at station B. The operator at station B plugs the toll cord into jack J'. Battery from the sleeve of the toll cord operates relay C'. The operator then rings, ringing current being applied over the leads T' and R' to relay D', which operates. The operation of this relay operates, in turn, relay E'. The operation of relay E' connects the oscillator O', which produces high frequency signaling current, through the tuned circuit F' and the common amplifier G' to the radio transmitting antenna of station B. At the distant station A, the radio signal is received in the receiving antenna, is changed in frequency and is passed through a common amplifier H, the tuned circuit K, and the rectifier M to the relay N. Relay N operates and locks through its upper winding. The locking circuit includes the lamp L associated with the jack J. Accordingly, when the locking circuit is completed, this lamp lights, giving the signal to the operator at station A, who responds by plugging the toll cord into jack J. Battery from the sleeve of the toll cord operates relay C, its operation breaking the locking circuit of relay N and extinguishing the lamp L. If the operator at station B rerings, ringing current is again transmitted over the leads T' and R', and relay D' is again operated.

The re-operation of relay D' results in the transmission of a second radio signal to station A, and relay N again responds. Since relay C remains operated, lamp L will not relight, but relay P will be operated, the circuit to this relay being completed at the make contact of relay C. The operation of relay P connects to the leads T and R the current source and ground indicated in the drawing, and ringing current is transmitted over these leads to the toll cord previously inserted in the jack J.

While applicants' invention has been described 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, two central office stations, 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: signal announcing means, means for producing signaling current peculiar in frequency to that station and to the voice channel, means for tuning the radio signal receiving means at that station to the peculiar frequency produced at the other station and corresponding to the voice channel, automatic means, responsive to signaling operations at that station, for connecting the current producing means to the radio signal transmitting means at that station, and automatic means for operating the signal announcing means at that station in response to radio signals received from the other station.

2. In a telephone system including two central office stations and a voice channel connecting said stations, means at each station for generating and transmitting radio signals, means at each station for receiving the radio signals transmitted from the other station, an annunciator at each station, automatic means at each station, responsive to ringing current introduced into the voice channel at that station, for operating the signal generating and transmitting means at that station, automatic means at each station for operating the annunciator at that station in response to an initial radio signal received from the other station, and automatic means at each station for producing ringing current at that station in response to a subsequent radio signal received from the other station.

3. In a telephone system including two central office stations and a voice channel connecting said stations, means at each station for generating and transmitting radio signals, means at each station for receiving



the radio signals transmitted from the other station, an annunciator at each station, automatic means at each station, responsive to ringing current introduced into the voice channel at that station, for operating the signal generating and transmitting means at that station, automatic means at each station for operating the annunciator at that station in response to an initial radio signal received from the other station, automatic means at each station for producing ringing current at that station in response to a subsequent radio signal received from the other station, and automatic means at each station for preventing the re-operation of the annunciator at that station in response to said subsequent radio signal received from the other station.

4. 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: means for fixing the frequency of the radio signals transmitted from that station at a value peculiar to that station and to that voice channel, means for tuning the signal receiving means at that station to the peculiar frequency of the radio signals transmitted from the other station and corresponding to that voice channel, an annunciator, automatic means, responsive to ringing current introduced into that voice channel at that station, for operating the signal transmitting means at that station, automatic means for operating the annunciator at that station in response to an initial radio signal, of the predetermined frequency, received from the other station, and automatic means for producing ringing current at that station in response to a subsequent radio signal, of the predetermined frequency, received from the other station.

5. 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: means for fixing the frequency of the radio signals transmitted from that station at a value peculiar to that station and to that voice channel, means for tuning the signal receiving means at that station to the peculiar frequency of the radio signals transmitted from the other station and corresponding to that voice channel, an annunciator, automatic means, responsive to ringing current introduced into that voice channel at that station, for operating the signal transmitting means at that station, automatic means for operating the annun-

ator at that station in response to an initial radio signal, of the predetermined frequency, received from the other station, automatic means for producing ringing current at that station in response to a subsequent radio signal, of the predetermined frequency, received from the other station, and automatic means for preventing the re-operation of the annunciator at that station in response to said subsequent radio signal received from the other station.

6. 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: 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, an annunciator, automatic means, responsive to ringing current introduced into that voice channel at that station, for connecting said current producing means to the radio signal transmitting means at that station, automatic means for operating the annunciator at that station in response to an initial radio signal, of the predetermined frequency, received from the other station, and automatic means for producing ringing current at that station in response to a subsequent radio signal, of the predetermined frequency, received from the other station.

7. 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: 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, an annunciator, automatic means, responsive to ringing current introduced into that voice channel at that station, for connecting said current producing means to the radio signal transmitting means at that station, automatic means for operating the annunciator at that station in response to an initial radio signal, of the predetermined frequency, received from the other station, automatic means for producing ringing current at that station in response to a subsequent radio signal, of the predetermined frequency, received from the other station, and automatic means for preventing the re-operation of the annunciator at the station in re-



sponse to said subsequent radio signal received from the other station.

8. In a telephone system, a sending station, a receiving station, a voice channel connecting said stations and including a line circuit and a cord circuit, adapted to be interconnected, at each station and a transmitting medium, a signal annunciator and a line source of ringing current at the receiving station, means at the sending station for generating and transmitting radio signals, means at the receiving station for receiving radio signals means at the sending station for operating the signal generating and transmitting means in response to ringing current from the cord circuit, means at the receiving station for operating the signal annunciator in response to radio signals only when the line and cord circuits at said station are disconnected, and means at said station for operating the line source of ringing current in response to radio signals only when said circuits are interconnected.

9. In a telephone system, including two central office stations and a plurality of voice channels connecting said stations, each of said voice channels including a line circuit and a cord circuit, adapted to be intercon-

nected, at each station and a transmitting medium, 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: means for fixing the frequency of the radio signals at a value peculiar to that station and to that voice channel, means for tuning the signal receiving means at that station to the peculiar frequency of the radio signals transmitted from the other station and corresponding to that voice channel, an annunciator, a line source of ringing current, means responsive to ringing current from the cord circuit for operating the signal transmitting means at that station, means for operating the signal annunciator at that station in response to radio signals only when the line and cord circuits at that station are disconnected, and means for operating the line source of ringing current at that station in response to radio signals only when said circuits are interconnected.

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

CHARLES S. DEMAREST.  
OWEN H. LOYNES.