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CALLING ARRANGEMENT FOR RADIO SYSTEMS

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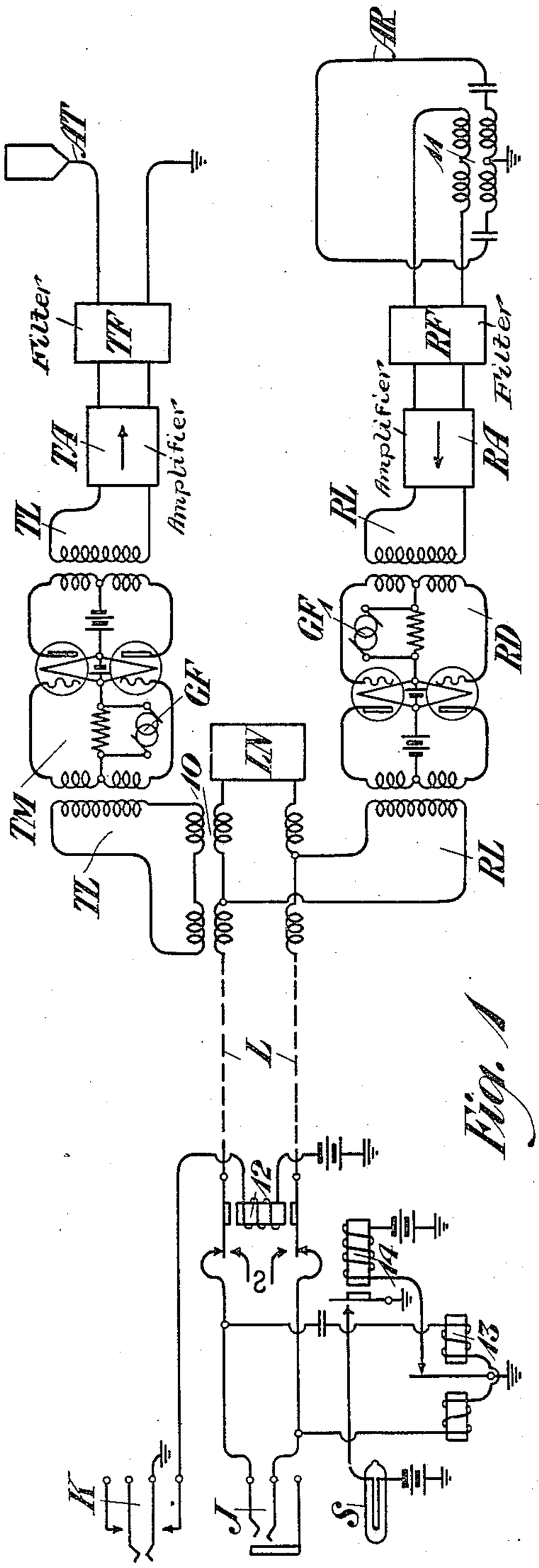

Fig. 1

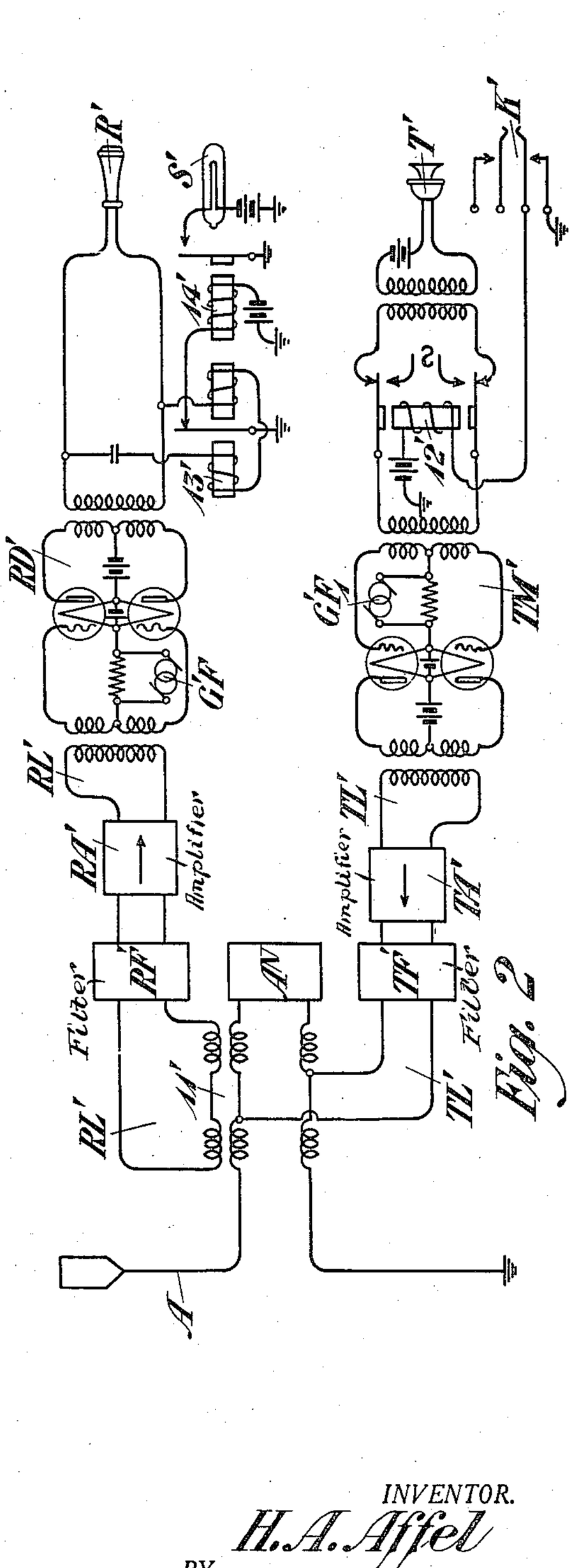

Fig. 2

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CALLING ARRANGEMENT FOR RADIO SYSTEMS.

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To all whom it may concern:

Be it known that I, HERMAN A. AFFEL, residing at Brooklyn, in the county of Kings and State of New York, have invented certain Improvements in Calling Arrangement for Radio Systems, of which the following is a specification.

This invention relates to a radio transmission system and more particularly calling means for enabling radio operators at different stations to establish inter-communication between the stations.

In a radio system it is desirable that some means should be provided whereby an operator at one station may call the attention of an operator at another station. The provision of such means is especially desirable in the case of radio telephony, since the voice signals used in the transmission of messages are not well adapted for calling the attention of a distant operator. One of the features of this invention therefore resides in the provisions of means in a wireless telephone system whereby a ringing or other form of call signal may be transmitted to the distant station. A further feature of the invention resides in the provision of special signal responsive means at the receiving station, to respond to a call signal, so that upon observing the special signal the operator at the receiving station may know that a telephone conversation with his station is desired. Other features of the invention will be clear from the detailed description thereof.

These features are realized in an arrangement whereby a low frequency ringing current, differing substantially in frequency from the frequencies ordinarily employed in ordinary telephone transmission, is translated into high frequency oscillations in a manner similar to that utilized in translating voice currents into high frequency oscillations for radiation to the distant station. At the receiving station means are provided whereby the received oscillations are translated into voice currents or ringing currents, as the case may be, the frequency separation between the ringing currents and the voice currents being utilized to separate them into different circuits in order to actuate corresponding receiving and signaling devices.

The invention may now be fully understood from the following description, when read in connection with the accompanying drawing, Figure 1 of which is a diagram of a circuit arrangement embodying the invention as applied to a land radio station and Fig. 2 of which is a circuit diagram of an embodiment of the invention, particularly adapted for stations at which a limited amount of space is available as is the case with ship stations.

Referring to Fig. 1, L designates an ordinary telephone transmission line terminating at one end in a jack, J, whereby communication may be established with different subscribers. At the opposite end the line L is associated by means of a transmitting channel TL with a transmitting antenna AT and by means of a receiving channel RL with a receiving antenna AR. The channels TL and RL are inter-connected with the line L through a balanced transformer arrangement 10 of well-known construction, and in order that interference between the two channels may be reduced to a minimum the transmitting and the receiving channel are rendered conjugate by balancing the low frequency line L at telephonic frequency through the medium of the artificial line or network LN.

The transmitting channel TL includes a modulating arrangement TM, which is preferably a duplex vacuum tube arrangement of the type disclosed in the application of B. W. Kendall, Serial No. 125,349, filed October 13, 1916, or in the application of John R. Carson, Serial No. 157,413, filed March 26, 1917, issued as Patent No. 1,343,307, dated June 15, 1920. Carrier oscillations of the frequency assigned to the transmitting channel TL are supplied from a suitable source GF and the circuit of the modulator is normally balanced so that carrier oscillations are not transmitted unless signaling current is applied to the modulator. The function of the modulator is to translate low frequency signaling currents into high frequency oscillations for radiation to distant stations.

The transmitting channel TL also includes an amplifier TA and a broad band filter TF, the latter being located between the amplifier TA and the transmitting antenna AT. The filter TF may be a tuned circuit where the carrier frequency is sufficiently high in proportion to the voice modulating frequency so that a substantially

broad band is provided. The amplifier TA is preferably of the well-known vacuum tube type and the broad band filter TF is preferably of the general type disclosed in U. S. Patents to George A. Campbell, Nos. 1,227,113 and 1,227,114, dated May 22, 1917. The filter is designed in accordance with the principles disclosed in said Campbell patents, to transmit a band of frequencies extending either above or below the carrier frequency assigned to the channel by a range substantially equal to that employed in ordinary telephonic transmission.

The receiving channel RL is provided with a demodulating or detecting arrangement RD for translating received high frequency oscillations into low frequency signaling currents. The demodulating or detecting arrangement is preferably of the balanced duplex vacuum tube type disclosed in the U. S. application of John R. Carson, Serial No. 157,414, filed March 26, 1917, issued as Patent No. 1,343,308, dated June 15, 1920. The duplex detector of said application employs the homodyne method of the receiving and consequently the detector RD is supplied with homodyne oscillations from a source GF_1. The frequency of this source is made equal to that of the unmodulated received carrier frequency and since the low frequency balancing arrangement between channels TL and RL is usually insufficient to completely separate the channels, it is desirable that the frequency of the source GF_1 be somewhat different from that of the source GF employed for transmission. By thus employing sources of different frequencies for transmitting and receiving, frequency separation may be used to supplement the separation due to balance.

The receiving channel RL also includes an amplifier RA and a broad band filter or tuned circuit RF. The amplifier RA is preferably of the same type as amplifier TA in the transmitting channel. The filter RF, like the filter TF, is of the broad band type, disclosed in the Campbell patents, above referred to, but differs from the filter TF as to its frequency range, since it is so designed as to pass a band of frequencies equal to the band employed in ordinary telephonic transmission, said band extending either above or below the basic carrier frequency received, which, as already stated, is the same as the frequency of the source GF_1. The transmitting antenna AT, associated with the transmitting channel TL and the receiving antenna AR associated with the receiving channel RL, are preferably located some distance apart, in order that the effect of the large quantities of energy radiated by the antenna AT may be as small as possible upon the receiving antenna AR. In order to further reduce the effect of sending energy upon the receiving antenna AR the latter is arranged in the form of a closed loop, as indicated in the drawing, the plane of the loop being perpendicular to a radial line extending from the antenna 18. The loop is associated with the receiving channel RL through a balanced transformer arrangement 11, having its windings equally divided between the two halves of the loop, with a ground connection at the mid-point of the primary winding. The plane of the loop AR is arranged in the direction of radiation from the distant transmitting station, so that the received signals produce a maximum effect in the receiving channel RL, while energy coming from the antenna AT is balanced out at high frequency.

In order that a telephone operator at the central station end of the line L may signal the distant radio operator a key K is provided for the purpose of impressing ringing current upon the line L through the medium of a relay 12. In order that a ringing signal from the distant station may be received by the operator at the central station, a ringing responsive relay 13 is bridged across the line L and controls a lamp or other suitable form of signal, S.

The modified arrangement in Fig. 2 differs from that of Fig. 1, in that a single antenna A is employed for both sending and receiving, said antenna being associated with the transmitting channel TL′ and receiving channel RL′, through a balanced transformer arrangement 11′. In order that the receiving and transmitting channels may be balanced against each other at radio frequency, an artificial line or network AN, having characteristics simulating those of the antenna A, is provided. The transmitting channel TL′ includes a modulator TM′, an amplifier TA′ and a filter TF′ similar in general construction to the corresponding arrangements of the station of Fig. 1. Since the transmitting frequency of the station shown in Fig. 2 must correspond to the receiving frequency of the station shown in Fig. 1, the modulator TM′ is supplied with carrier oscillations from a source $G'F_1$, whose frequency is the same as that of the source GF_1. So also the filter TF_1 will be designed to transmit the same range of frequencies as the filter RF.

The receiving channel RL′ includes a filter RF′, amplifier RA′ and demodulator or detector RD′, these elements being likewise similar to the corresponding elements of the receiving channel RL of Fig. 1. The demodulator or detector RD′ is supplied with high frequency oscillations from a homodyne source G′F, whose frequency is the same as that of the source GF of Fig. 1 and the filter RF′ is designed to transmit the same range of frequencies as the filter TF of Fig. 1.

Since, in the case of a ship station such as shown in Fig. 2, it is unnecessary to provide means for associating the wireless system with a transmission line, the channels TL′ and RL′ are not connected upon their low frequency sides and hence no means is provided for low frequency balance between the transmitting and receiving channels. The receiving channel RL′ terminates in a telephone receiver R′ for receiving telephonic signals. For receiving ringing signals a ringing responsive relay 13′ is provided in a bridged circuit tuned to ringing frequency, said ringing responsive relay controlling a lamp or other form of signal S′. The transmitting channel TL′ terminates in telephone transmitter T′ and is provided with a key K′ controlling a relay 12′ for applying ringing current to the modulator TM′.

The operation is as follows:

Assuming that it is desired to inter-connect a subscriber associated with the line L through the jack J with the radio receiving station shown in Fig. 2, the operator at the central office will actuate her key K, thereby energizing the relay 12, so that ringing current is applied over its front contacts and transmitted over the line L to the radio station of Fig. 1. The ringing current is transmitted from the transformer 10 to the transmitting channel TL and is impressed upon the modulator TM. The modulator operates to modulate carrier oscillations of frequency F from the source GF, in accordance with low frequency ringing currents, and the modulated oscillations are then amplified by the amplifier TA and pass through the filter TF to the antenna AT for radiation to the distant station. These oscillations, upon arriving at the station illustrated in Fig. 2, are transmitted from the antenna A through the transformer 11′ to the receiving channel RL′ and are passed through the filter RF′ to the amplifier RA′. After being amplified, the received oscillations are impressed upon the demodulator RD′, where they react with local oscillations of frequency F from the source G′F, so that low frequency currents corresponding to the ringing currents transmitted from the central office appear in the output circuit of the demodulator. The circuit of the relay 13′ is tuned to the ringing frequency, so that the low frequency ringing currents pass through the bridge, including said relay, and cause its actuation. The relay 13′ opens the normally closed circuit of the relay 14′ which in turn causes the actuation of the lamp S′, apprising the radio operator that someone desires to communicate with the station of Fig. 2.

The radio operator now answers the call by speaking in the transmitter T′ so that voice currents are impressed upon the input circuit of the modulator TM′. The modulator TM′ modulates carrier oscillations of frequency F_1 from the source G′F_1, in accordance with voice currents and the modulated oscillations are then amplified by the amplifier TA′ and pass through the filter TF′ to the antenna A, from which point they are radiated to the station of Fig. 1. The receiving loop AR responds to these oscillations and impresses them through the transformer 11 upon the receiving channel RL, where they are passed through the filter RF, amplified by the amplifier RA and then impressed upon the demodulator RD. The modulated oscillations react in the modulator circuit with high frequency oscillations of the same carrier frequency F_1 so that voice currents appear in the output circuit of the modulator and are transmitted over the line L to the distant station.

The party at the distant end of the line L now hears the response of the radio operator at the station of Fig. 2 and speaks into his transmitter, so that voice currents incoming from the telephone set associated with the line L through the jack J are transmitted over said line to the transmitting channel TL and are applied to the modulator TM. By means of the modulator TM high frequency oscillations of frequency F are modulated, by means of the voice currents and the resultant oscillations, are amplified by the amplifier TA and then pass through the filter TF to the antenna AT for radiation to the distant station. Upon arriving at the distant station, for example the station of Fig. 2, the oscillations are transmitted from the antenna A through the transformer 11′ to the receiving channel RL′, where they pass through the filter RF′ to the amplifier RA′. Upon being amplified by said amplifier the oscillations are impressed upon demodulator RD′, where they react with oscillations of the same carrier frequency F from the source G′F, so that low frequency currents corresponding to the original voice currents transmitted over the line L appear in the output circuit of the demodulator. Since the circuit of the relay 13′ is tuned to a ringing frequency lying either above or below the ordinary telephonic range, the voice currents do not affect said relay, but flow to the receiver R′.

Should the operator at the station of Fig. 2 desire to establish connection with some subscriber connected with the central office at which the line L terminates, a calling signal may be transmitted by operating the key K, thereby actuating the relay 12′ to apply ringing current to the modulator TM′. High frequency oscillations are then modulated in accordance with the ringing current, amplified by the amplifier TA′ and pass through the filter TF′ to the antenna

A for radiation to the distant station. Upon arriving at the station of Fig. 1, the antenna loop AR responds and transmits the oscillations through the filter RF and amplifier RA to the demodulator RD. After being demodulated ringing current appears in the output circuit of the demodulator and is transmitted over the line L and through the tuned bridge including the relay 13, to actuate said relay. Relay 13 upon being actuated opens a normally closed circuit of relay 14, thereby actuating the signal lamp S. The operator, upon observing the signal lamp glow, answers the call verbially. The transmission of voice currents between the two operators will now take place, as described heretofore. The operator at the central station, upon ascertaining the party to whom the connection is to be extended, will complete the connection between such party and the line L, in the usual manner, so that the operator at the radio station of Fig. 2 may now converse with the desired party.

By means of the arrangement above described any wire transmission line may be connected by radio with a distant station where the connection may be extended over another wire line, if desired, it being understood, of course, that the arrangement of Fig. 1 may be duplicated at a distant station. So, also, telephonic communication may take place between two ships at sea, each being provided with apparatus such as shown in Fig. 2. The arrangements of the invention also provide means whereby radio operators or central office telephone operators connected with radio stations may transmit calling signals to distant radio stations.

It will also 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 wireless signaling system, a radiating antenna, a vacuum tube modulator associated therewith, means to supply high frequency oscillations to said modulator, means to impress voice currents upon said modulator whereby said high frequency oscillations may be modulated in accordance with said voice currents for radiation by said antenna, and means for impressing alternating ringing currents upon said modulator whereby said high frequency oscillations may be modulated in accordance with said ringing currents for radiation by said antenna.

2. In a wireless signaling system, a radiating antenna, means to impress high frequency oscillations modulated in accordance with voice signals upon said antenna, means to generate alternating ringing current, and vacuum tube means to translate said ringing current into high frequency oscillations, said high frequency oscillations being radiated by said antenna.

3. In a wireless signaling system, a transmitting station adapted to transmit high frequency oscillations within a definite frequency range, a receiving station adapted to receive within said range, a vacuum tube modulating means at the transmitting station supplied with high frequency oscillations within said range, means to impress voice currents upon said modulating means whereby said high frequency oscillations may be modulated in accordance with voice currents, means to impress alternating ringing currents upon said oscillations whereby said oscillations are modulated in accordance with ringing currents, means to radiate the modulated oscillations to the receiving station, means at the receiving station to translate received modulated oscillations into the voice or ringing currents in accordance with which they were modulated, means at the receiving station responsive to voice currents, and means responsive to ringing currents only whereby a special call signal may be given at the receiving station.

4. In a radio signaling system, means to generate a continuous undamped carrier wave of radio frequency, means to modulate said wave in accordance with voice waves, means to modulate said wave in accordance with alternating ringing signals, means for receiving said radio frequency modulated either in accordance with voice currents or in accordance with an alternating ringing signal, a demodulator for detecting the voice currents and the alternating ringing signal, a circuit leading to a telephone receiving instrument for receiving the voice signals, a vibrating alternating current relay tuned to the frequency of the alternating ringing signal and responsive thereto, and signal indicating means controlled by said relay.

5. In a radio signaling system, means to produce a continuous undamped carrier wave of radio frequency, means to modulate said wave in accordance with alternating ringing current, means for receiving said radio frequency modulated in accordance with an alternating ringing signal, a detector, a vibrating alternating current relay associated with the output of said detector, said relay being tuned to the frequency of the alternating ringing signal, and signal indicating means controlled by said relay.

In testimony whereof, I have signed my name to this specification this 23rd day of September, 1919.

HERMAN A. AFFEL.