Feb. 8, 1927. 1,616,638

F. M. RYAN

SUPERVISORY SYSTEM FOR CARRIER TELEPHONE SYSTEMS

Filed March 10, 1923 2 Sheets-Sheet 1

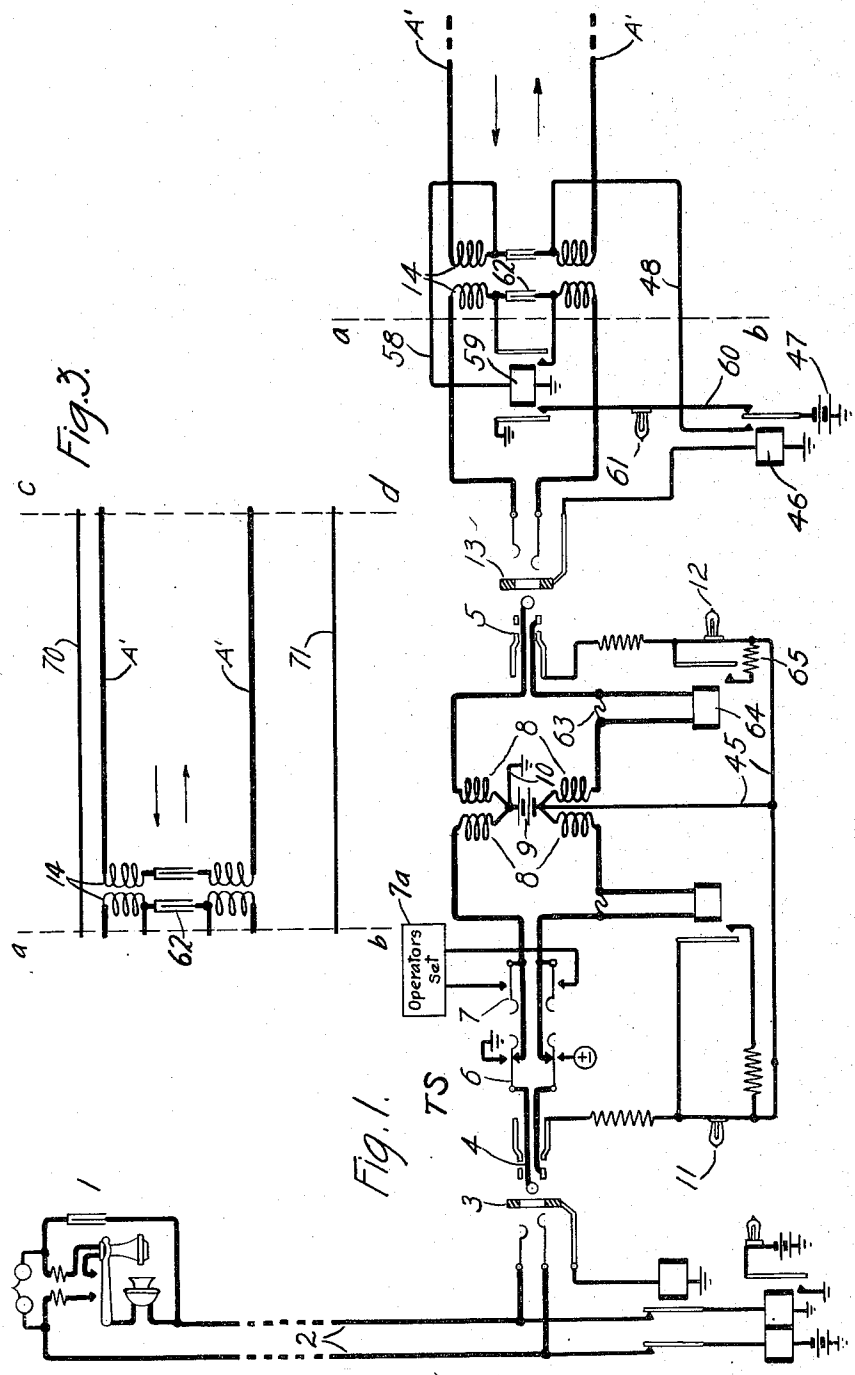



Fig. 3.

Fig. 1.

Inventor:
Francis M. Ryan
by E. W. Griggs Atty.

Feb. 8, 1927. 1,616,638

F. M. RYAN

SUPERVISORY SYSTEM FOR CARRIER TELEPHONE SYSTEMS

Filed March 10, 1923 2 Sheets-Sheet 2

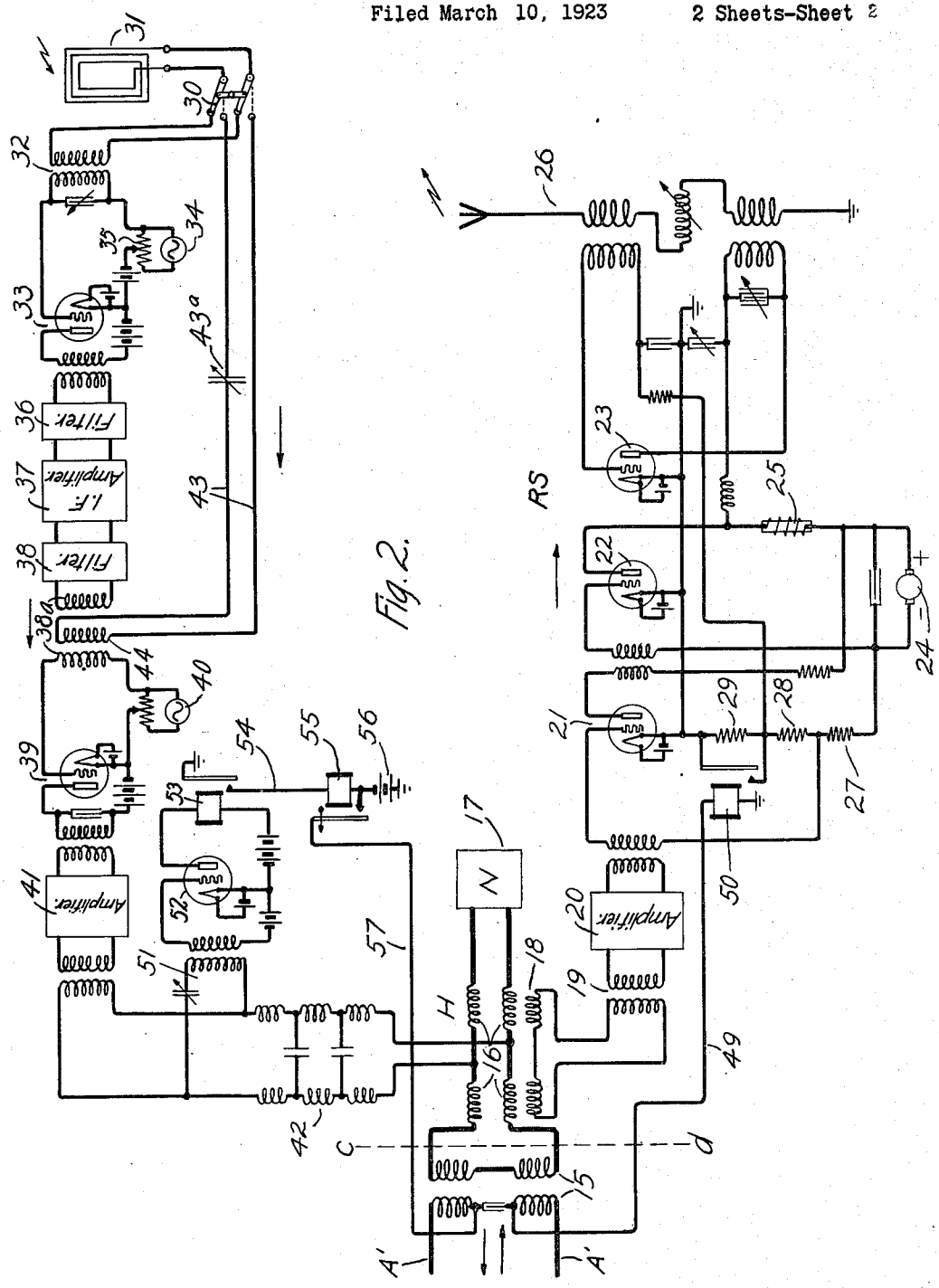



Fig. 2.

Inventor:
Francis M. Ryan
by E. W. Griggs Atty.

Patented Feb. 8, 1927. 1,616,638

# UNITED STATES PATENT OFFICE.

FRANCIS M. RYAN, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

## SUPERVISORY SYSTEM FOR CARRIER TELEPHONE SYSTEMS.

Application filed March 10, 1923. Serial No. 624,071.

This invention relates to signal systems and more particularly to a method of and means for controlling call and supervisory signal devices for carrier telephone systems.

In systems of this type it has been heretofore proposed to transmit a modulated carrier wave and to detect the incoming wave at a receiving station to yield the modulating current which is then used to control the signal indicating devices; or an unmodulated carrier wave is transmitted and, at the receiving station, the carrier wave is rectified to produce a current which is utilized to control the signal devices.

One disadvantage of these arrangements is that special circuits including high efficiency amplifiers, separate from those used for amplifying the speech currents are required to produce a current of sufficiently large amplitude to actuate the signal control devices. These circuits are essential, because, as is well known, the amplitude of the detected modulating current or that resulting from rectification of the carrier wave is entirely too small to actuate the signal control devices.

The present invention provides an arrangement in which the unmodulated carrier wave is transmitted from the transmission station, and, at the receiving station, a single circuit arrangement normally employed for producing and amplifying the speech currents is also used to supply a control current for the signal and supervisory lamps or other indicating devices.

According to this invention it is proposed to automatically cause the unmodulated carrier wave to be transmitted when the plug of the cord circuit at the calling station is inserted into the jack associated with the carrier circuits. At the receiving station, the incoming unmodulated carrier wave is combined with locally generated oscillations in the detector used for producing speech currents so that a current of audible frequency and large amplitude results. This current is then amplified by the speech current amplifying system and rectified to supply a current which may be used to actuate an electromagnetic relay.

The present invention therefore decreases the number of detecting and high efficiency amplifying devices used in a carrier telephone system to a minimum and also reduces the time required to make a call, while at the same time the width of the frequency band required for all signaling purposes is not increased beyond that formerly used for carrier telephone communication.

The primary object of this invention is to provide an efficient and economical supervisory and calling arrangement for carrier telephone systems. Another object is to provide an arrangement in which the speech current detecting and amplifying devices may be used to produce call and supervisory signal control currents of large amplitude. Still another object is to provide a call and supervisory arrangement for a carrier telephone system in which an electromagnetic relay may be used to control the signal devices.

Other objects and advantages of this invention will be apparent from the following description taken in conjunction with the appended drawings in which Figs. 1 and 2, taken together, illustrate a radio telephone system embodying the present invention, and Fig. 3 shows a circuit which may be substituted for the portion between the section lines *ab* and *cd* in the arrangement shown in Figs. 1 and 2.

Fig. 2 should be placed at the right of Fig. 1 so that the conductors A coincide with the conductors A'. In the system shown the local telephone station TS is removed some distance, for example, several miles from the radio station RS, these two stations being connected together by the line A'A'. At the transmitting station the radio transmitting and receiving circuits are conjugately associated with the connecting line A'A' by the hybrid coil H. A balanced condition is secured by connecting the line A'A' to one pair of terminals of the line winding of the hybrid coil while the other pair of terminals of this winding are connected to a network N adapted to simulate the impedance of the low frequency circuits, including the connecting line A'A', the circuits of the local exchange and the subscriber's line.

A subscriber's station 1 is connected to the local telephone exchange by a line 2 terminating in a jack 3. As usual, signal lamps and control circuits therefor are associated with the subscriber's line at the exchange switchboard; and a cord circuit,

terminating in plugs 4 and 5, is provided for connecting the telephone line to the radio circuits. The cord circuit includes a ringing key 6, a key 7 for the operator's monitoring and talking set 7ª, a repeating coil 8 and a central station battery 9 having one terminal grounded at 10, as well as supervisory lamps 11 and 12, and control circuits therefor. By inserting the plug 4 in the jack 3 and the plug 5 in the jack 13, the local subscriber's line may be extended to the radio circuits. As is usual, a local subscriber may be called by actuating the ringing key 6 and the operator's set may be connected for monitoring and talking in either direction by means of the key 7.

The spring contacts of the jack 13 are connected through repeating coil 14 to the line A′A′ which terminates in a repeating coil 15 connected to the terminals of the line winding 16 of the hybrid coil H. The other terminal of the line winding 16 is connected to the network 17 adapted to simulate impedances of the low frequency circuits connected to the line side of the winding 16.

The second winding 18 of the hybrid coil, inductively associated with the winding 16, is included in a circuit coupled by a transformer 19 to the input terminals of an amplifier or an amplifying system 20. The output circuit of the system 20 is coupled to the radio transmitter comprising the amplifier 21, and the modulator-oscillator which includes the modulator 22 and oscillator 23. The amplifier, modulator and oscillator are herein illustrated, as three electrode thermionic devices. The output circuits of the modulator and oscillator are connected to a common supply source 24 through a large choke coil 25. The source 24 and choke coil 25 are adapted to provide a constant current source for the plate circuits of the oscillator and modulator, whereby these devices may be operated to produce modulated high frequency waves in accordance with the constant current system described in United States Patent No. 1.442,147, January 16, 1923, to Raymond A. Heising. The input and output circuits of the oscillating tube 23 are coupled to an antenna 26 which serves to determine the frequency of the carrier oscillations generated. The cathodes of the devices 21, 22 and 23 included in the transmitter are connected to the negative terminal of the source 24 through a plurality of resistances 27, 28 and 29, the positive terminal of this source being connected to their anodes.

As shown in Fig. 2, resistances 28 and 29 are also included in the input circuit of the amplifier 21; all three resistances are included in the input circuit of the modulator 22, and the resistance 29 is included in the input circuit of the oscillator 23. The value of the resistance 29 is such that with the plate current flowing therethrough a blocking or paralyzing negative potential will be impressed upon the grids of the thermionic devices i. e. amplifier 21 and oscillator 23 and hence the generation of radio frequency oscillations as well as the supply of modulating current to the modulator 22 will be prevented. However, when the resistance 29 is short-circuited as and for a purpose to be hereinafter described, high frequency oscillations will be generated and radiated from the antenna 26. Under these conditions the resistance 28 serves to determine the grid potential normally impressed upon the amplifier 21, while the resistances 27 and 28 serve to determine the normal grid potential applied to the modulator 22.

On the receiving side two alternatives are shown. With the switch 30 as illustrated the loop antenna 31 is connected through a transformer 32 to the input circuit of a detector or demodulator 33. A source of local oscillations 34, the frequency of which differs from that of the incoming carrier waves by an intermediate carrier frequency, is also connected to the input circuit of the detector 33 by means of the potentiometer 35.

As a result of the combination of the incoming carrier waves and the locally generated oscillations there will be present in the output circuit of the detector 33, an unmodulated current component of the intermediate frequency and components of this frequency modulated in accordance with speech. These components, reinforced in amplitude as a result of combining them with the locally generated oscillations, are selected by a filter 36 adapted to freely pass only the intermediate frequency carrier and its side band or bands, amplified by the amplifier or amplifying system 37, selected by the filter 38 which is similar to filter 36 and are supplied by the repeating coil 38ª to the detector 39. The unmodulated and modulated intermediate carrier wave components are combined in the second detector 39 to produce speech currents which are amplified by the amplifier 41, selected by the filter 42 and impressed across the mid-points of the line windings 16 of the hybrid coil H. The amplified speech currents will be transmitted through the repeating coil 15, line A′A′, repeating coil 14, the connected cord circuit and line 2 to the subscriber's station 1.

Connected to the input circuit of the detector 39 is a second source of local oscillations 40. The frequency of the oscillations supplied by the source 40 is such that when the unmodulated component of the intermediate frequency carrier resulting from the first detection, is combined therewith in the detector 39 there will be present in the output circuit of the detector 39 a current of audible frequency, but above the speech range,

for example, of 6000 cycles. This current will be amplified by the amplifier 41, selected by the resonant circuit 51, which is designed to be of high impedance for speech frequency currents and supplied to a rectifier for a purpose to be hereinafter described.

The filters included in the receiving circuit are adapted to pass with small or negligible attenuations currents of all frequencies lying within a preassigned range and to suppress all frequencies outside the limits of the preassigned range and are designed in accordance with the disclosure in the United States Patent No. 1,227,114, May 22, 1917, to G. A. Campbell. The filters 36 and 38 are adapted to transmit all frequencies falling within the band determined by the intermediate frequency resulting from the first stage of detection plus and minus speech or, if one side frequency is suppressed, by the intermediate frequency carrier plus or minus speech. The filter 42 is designed to pass without appreciable attenuation all frequencies lying within the speech band, namely from 200 to 3000 cycles, and to suppress currents outside this range.

The alternative receiving arrangement illustrated is adapted to employ a single stage of detection. With the switch 30 engaging the lower pair of contacts as indicated by dotted lines, the antenna is connected by the conductors 43 to the winding 44 inductively associated with the coil $39^A$ included in the input circuit of the detector 39. A tuning condenser $43^a$ should preferably be included in the circuit comprising the antenna 31, switch 30, conductors 43 and winding 44. In this arrangement the incoming unmodulated carrier and the modulated waves will be combined to produce the speech frequency currents which as before will be amplified and transmitted through the filter 42, hybrid coil H and associated circuits to the subscribers station 1. However, the frequency of the oscillations supplied by the source 40 will be such that, when combined with the incoming unmodulated carrier wave in the detector 39, they will produce an audible frequency current outside the speech frequency range, for example, of 6000 cycles, which as before will be selected by the circuit 51.

The various features of the signal and supervisory system will be clear from the following description of its operation. An operator, desiring to call a subscriber whose line is associated with a distant radio station of the system, inserts the plug 5 of the toll cord into the jack 13. Current will flow from one terminal of the common battery 9 over the conductor 45, through the supervisory lamp 12, the sleeve contacts of the plug 5 and jack 13, through the winding of the relay 46 to ground, and thence to the grounded terminal 10 of the battery 9. The supervisory lamp 12 will be lighted, and relay 46 will be energized to cause its armature to close at the left hand front contact. Current from one terminal of the battery 47 will flow over the conductor 48, lower half of the repeating coil 14, lower line conductor A′, lower half of the repeating coil 15, conductor 49 and relay 50 to ground, and thence back to the other terminal of the battery 47.

Energization of the relay 50 causes its armature to be pulled up to short circuit the resistance 29, whereby the negative potential impressed upon the grids of the amplifier 21, and oscillator 23 will be that desired for normal operation, and as a result the oscillator will be started to transmit a carrier wave to a distant station.

The carrier wave thus transmitted to the distant station actuates a signal control device at this station similar to the lamp 61 to attract the attention of the operator at this station. The operations taking place at the called station in connection with the lighting of the lamp may be understood from a consideration of similar operations taking place at the calling station. The incoming carrier is combined with the locally generated oscillations to produce a difference current of reinforced amplitude and ultimately of audible frequency, but above the speech range, for example, of 6000 cycles. The current after being amplified by the device 41 and selected by the circuit 51 is rectified by the device 52, the rectified current being used to energize the relay 53 included in the output circuit of the rectifier. The relay 53 pulls up its armature to complete a circuit over the conductor 54 for the relay 55 and battery 56. Upon energization of the relay 55 current will flow from the battery 56 over the conductor 57, the upper portion of the winding of the repeating coil 15, upper line conductor A′, the upper half of the winding of the repeating coil 14, conductor 58 and relay winding 59 to ground. At the called station, the relay 46 is not energized and its armature is in engagement with the right hand back contact. Hence upon closure of the left hand armature of the relay 59 current will flow from battery 47 over the conductor 60 and signal lamp 61 to ground to thereby notify the operator of an incoming call.

In answering, the called operator inserts plug 5 in jack 13 whereby relay 46 will be energized, over the circuit described above with reference to the calling station, to open the circuit through the signal lamp 61 and complete the control circuit for the transmitting oscillator whereby a carrier wave is transmitted to the calling station. At the calling station the incoming carrier wave is demodulated to supply a current to the relay 53 for controlling the relay 59 to short cir-

cuit the condenser 62 by means of its right hand armature. The right hand armature of relay 59 will be closed to connect the signal lamp 61 to ground, but this lamp will not be lighted, because the relay 46 is energized and hence source 47 is disconnected from the lamp circuit. By short circuiting the condenser 62, a circuit for direct current will be completed from the battery 9 through the two cord circuit conductors including the resistance 63. In shunt to the resistance 63 is a relay 64 through which direct current from the source 9 will flow and the armature of the relay 64 will pull up to complete a control circuit including a resistance 65 in shunt to the supervisory lamp, thereby reducing the current flowing through this lamp so that it, in effect, will be extinguished to notify the calling operator that the called operator has answered. The subscribers may then be connected to the radio circuits at the two stations and conversation may proceed. The incoming carrier at the connected stations will serve to maintain the relay 59 energized whereby the supervisory lamps will be in effect extinguished.

Upon completion of the conversation, one of the operators having been notified by the lighting of the supervisory lamp associated with telephone line 2, as is usual in telephone practice when the subscriber hangs up, will remove the plug 5 from the jack 13, thereby deenergizing the relay 46 and in turn relay 50 to stop the transmission of carrier waves from his station. When this occurs, the relay 53, and in turn the relays 55 and 59 at the distant station will be deenergized. Direct current flow from the central station battery through the conductors of the cord circuit will be prevented by the inclusion of the condenser 62 between the two halves of the right hand winding of the repeating coil 14. Relay 64 will be deenergized and the shunt circuit around the supervisory lamp 12 at this station will be opened, whereby the latter will be lighted to notify the operator that the connection should be taken down.

During the time two subscribers are in communication over the radio link, direct current, in addition to speech currents, will flow through both of the windings of the repeating coil 14 and both portions of the left hand winding of the repeating coil 15, therefore the repeating coils should be designed to handle these currents without becoming saturated.

If the local telephone exchange and the radio station are adjacent to one another the circuit shown in Fig. 3 may be substituted for that shown between the section lines *a*—*b* and *c*—*d* in the preceding figures. In this case the conductor 57 will be connected to the conductor 58 by the conductor 70 to complete the circuit of relay 59, conductor 71 will connect conductor 48 with conductor 49 to provide a circuit for the relay 50 and conductors A′A′ will connect the right hand winding of the repeating coil 14 to the line winding 16 of the hybrid coil H. Upon energization of the relay 55, current will flow from the battery 56 over the conductors 57, 70 and 58 to actuate the relay 59 to control the signal and supervisory lamps. When relay 46 is energized, current will flow over the conductors 48, 71 and 49 to actuate the relay 50 to short circuit the resistance 29 and start the transmitting oscillator. In other respects the system will operate as described with reference to Figs. 1 and 2.

While the transmitter described above is adapted to supply the carrier wave and both side bands to the antenna circuit for radiation, it is to be understood that a system in which but one side band and the carrier wave is transmitted may be used. Again each of the amplifiers schematically indicated in the circuits of this system may include any number of stages, and any well known form of amplifier may be used.

Obviously the arrangement described above could be used in carrier wave systems in which the carrier waves are guided by conductors connecting the distant communicating stations.

While in this description, for convenience of illustration, we have shown separate batteries for the relay circuit, it is to be understood that in practice direct current for the several relays will be derived from the common battery 9.

It is, therefore, to be understood that, while certain circuits and specific details have been described for the purpose of completely and clearly disclosing the nature of this invention, the invention is not to be limited thereby; but only by the scope of the appended claims.

What is claimed is:

1. In a carrier wave signaling system including common amplifying means for currents within the audible range, a method of controlling call and supervisory signal devices therefor which comprises transmitting a carrier wave having a modulated wave component and an unmodulated wave component, receiving said carrier wave components, utilizing said wave components to produce speech currents, utilizing the unmodulated carrier component to control the production of other currents of audio-frequency but outside the speech range, simultaneously using the amplifying system to amplify the speech currents and other audible currents, and controlling the production of call and supervisory signal indications by the other audible currents.

2. In a carrier wave signaling system including a common amplifying means for currents of audio-frequency, a method of

controlling call and supervisory signal devices which comprises transmitting a carrier wave including a component modulated in accordance with speech and an unmodulated carrier component, combining the incoming wave with locally generated oscillations to produce a carrier wave of super-audible-frequency having a speech modulated component and an unmodulated component, selecting said super-audible-frequency wave combining the selected components to produce speech currents, combining the unmodulated super-audible-frequency component with other locally generated oscillations to produce oscillations of audible-frequency outside the speech frequency range, simultaneously using the amplifying system to amplify the speech currents and audible-frequency oscillations, and controlling the production of signal indications by the audible-frequency oscillations.

3. In a carrier wave signaling system including a common amplifying means for currents of audible-frequency, a method of controlling call and supervisory signal devices which comprises transmitting a carrier wave comprising a component modulated in accordance with speech and an unmodulated carrier component, combining the incoming waves with locally generated oscillations to produce a carrier wave of super-audible-frequency having a speech modulated component and an unmodulated component, selecting said super-audible-frequency wave, combining the selected components to produce speech currents, combining the unmodulated super-audible-frequency component with other locally generated oscillations to produce oscillations of audible-frequency outside the speech frequency range, using the amplifying system to amplify the speech currents and audible-frequency oscillations, separating the speech currents and audible-frequency oscillations, rectifying the audible-frequency oscillations, and controlling the indication of signals by the rectified current.

4. In a carrier wave signaling system, the combination of means for transmitting a carrier wave modulated in accordance with signals of audio-frequency, means for transmitting the unmodulated component of said carrier wave for supervisory purposes, a source of local oscillations, and means using said local oscillations for converting said unmodulated carrier component into difference frequency oscillations, falling within the audio-frequency range, which are used to control signal devices.

5. In a carrier telephone system, the combination of means for receiving an unmodulated component of a carrier wave modulated by speech, a signal device, a local source of oscillations, means to combine the local oscillations with said unmodulated component to produce difference frequency oscillations, an amplifier for amplifying said difference frequency oscillations, and means for actuating said signal device under the control of said difference frequency oscillations.

6. In a carrier system, the combination of means for receiving a wave comprising a signal modulated component and an unmodulated component, a supervisory signal, a local source of oscillations, means for detecting the carrier wave whereby speech frequency currents may be produced and for combining local oscillations with said unmodulated component, whereby difference frequency oscillations are produced, a common amplifier for said speech currents and difference frequency oscillations, and means for utilizing said difference frequency oscillations to control said supervisory signal.

7. In a carrier wave signaling system, means for transmitting a carrier wave comprising at least one component modulated in accordance with signals of audio-frequency, and an unmodulated component for supervisory purposes, means for producing the audio-frequency signal currents, means for supplying local oscillations to convert said unmodulated component into difference frequency oscillations falling within the audio-frequency range, a common amplifier for said audio-frequency signal currents and difference frequency oscillations, and means for utilizing said difference frequency oscillations to actuate said supervisory signal.

8. In a carrier wave signaling system, the combination of means for transmitting a carrier wave modulated in accordance with signals of audio-frequency, means for transmitting said carrier wave unmodulated for supervisory purposes, means for producing audio-signal currents, a source of local oscillations, means including said source for converting said unmodulated carrier wave into difference frequency oscillations falling within the audio-frequency range, a common amplifier for said audio-frequency signals and difference frequency oscillations, means for selecting the difference frequency oscillations, means for rectifying the selected oscillations, and means actuated by the current resulting from said rectification to control said supervisory signal.

9. In a carrier telephone system, the combination of means for receiving a carrier wave comprising at least one component modulated in accordance with speech and an unmodulated component, a signaling device, means for detecting said modulated wave to produce speech currents, a local source of oscillations, means including said source for converting said unmodulated component into oscillations falling within the audio-frequency range, a common amplifier for said speech currents and audio-frequency oscil-

lations, and means for utilizing said audio-frequency oscillations to actuate said signaling device.

10. In a carrier telephone system, the combination of means for receiving a carrier wave modulated in accordance with speech and an unmodulated carrier wave, a signaling device, means for detecting said modulated wave to produce speech currents, a local source of oscillations, means including said source for converting the unmodulated carrier into oscillations within the audible range, a common amplifier for said speech currents and said audio-frequency oscillations, means for separating said speech currents and audio-frequency oscillations, and means for utilizing said audio-frequency oscillations to actuate said signaling device.

11. In a carrier telephone system, the combination of means for receiving a carrier wave modulated in accordance with speech and an unmodulated carrier wave, a signaling device, means for detecting said modulated wave to produce speech currents, a local source of oscillations, means including said source for converting the unmodulated carrier into oscillations within the audible range, a common amplifier for said speech currents and said audible-frequency oscillations, means for separating said speech currents and said audio-oscillations, means for rectifying said audible-oscillations, and means actuated by said rectified currents to control said signal device.

12. In a carrier telephone system, the combination of means for receiving an unmodulated carrier wave, and a carrier wave modulated in accordance with speech, a signaling device, means for detecting said modulated wave to produce speech currents, a local source of oscillations, means including said source for converting the unmodulated carrier wave into oscillations within the audible range, a common amplifier for said speech currents and said audible-frequency oscillations, means for separating said speech currents and said audio oscillations, means for rectifying said audible-oscillations, and a mechanical relay actuated by said rectified currents to control said signal device.

13. In a carrier wave signaling system, the combination of means for transmitting a carrier wave comprising a component modulated in accordance with signals of audible-frequency and an unmodulated component, a source of local oscillations, means for combining said local oscillations with said modulated and unmodulated wave components to produce an inaudible frequency modulated wave component and an inaudible unmodulated wave component, means for detecting the modulated inaudible frequency wave component to produce the audible signal currents, a second source of oscillations, means for combining oscillations of said second source with the unmodulated inaudible frequency wave component to produce oscillations falling within the audible-frequency range but outside the speech frequency range, and a common amplifier for said speech currents and said audible-frequency oscillations, and a supervisory signal adapted to be controlled by said audible frequency oscillations.

14. In a carrier telephone system, the combination of means for receiving a carrier wave modulated by signals and having an unmodulated component, a signal device, a local source of oscillations, means to combine the local oscillations with said unmodulated component to produce a wave of inaudible frequency different from the first-mentioned carrier wave, means for selecting said inaudible frequency wave, a second source of oscillations, and means for combining the oscillations of said second source with the inaudible frequency wave to produce oscillations of audio-frequency, an amplifier for said audio-frequency oscillations, and means for actuating said signal device under the control of said audio-frequency oscillations.

15. In a carrier telephone system, the combination of means for receiving a carrier wave modulated by signals including an unmodulated component, a signal device, a local source of oscillations, means to combine the local oscillations with the unmodulated component to produce a wave of inaudible frequency different from the first-mentioned carrier wave, means for selecting said inaudible frequency wave, means for amplifying said inaudible frequency wave, a second source of oscillations, and means for combining the oscillations of said second source with the inaudible frequency wave to produce oscillations of audio-frequency, an amplifier for said audio-frequency oscillations, and means for actuating said signal device under the control of said audio-frequency oscillations.

16. In a carrier telephone system, the combination of means for receiving a carrier wave modulated in accordance with speed frequency currents and an unmodulated carrier wave, a local source of oscillations, means for combining the oscillations of the local source with the modulated and unmodulated wave components to produce a wave modulated in accordance with speech currents and an unmodulated carrier wave both of frequencies different from the first-mentioned carrier wave but above audibility, means for selecting the inaudible frequency carrier wave components, means for detecting the modulated inaudible frequency component to produce speech currents, a signal device, a second source of local oscillations, means for combining oscillations from said second source with the unmodulated inaudi-

ble frequency carrier wave to produce other oscillations of audio-frequency, a common amplifier for the speech currents and the other oscillations of audio-frequency, means for separating the speech currents and other audio-oscillations, and means for utilizing the other audio-oscillations to control said signaling device.

17. In a carrier telephone system, the combination of means for receiving a carrier wave modulated in accordance with speech frequency currents and an unmodulated carrier wave, a local source of oscillations, means for combining the oscillations of the local source with the modulated and unmodulated wave components to produce a wave modulated in accordance with speech currents and an unmodulated carrier wave both of frequencies different from the first-mentioned carrier wave but above audibility, means for selecting the inaudible frequency carrier wave components, means for detecting the modulated inaudible frequency component to produce speech currents, a signal device, a second source of local oscillations, means for combining oscillations from said second source with the unmodulated inaudible frequency carrier wave to produce other oscillations of audio-frequency, a common amplifier for the speech currents and the other oscillations of audio-frequency, means for separating the speech currents and other audio-oscillations, means for rectifying the other audio-frequency oscillations, and means actuated by the rectified current to control said signal device.

18. In a carrier telephone system, the combination of means for receiving a carrier wave modulated in accordance with speech frequency currents and an unmodulated carrier wave, a local source of oscillations, means for combining the oscillations of the local source with the modulated and unmodulated wave components to produce a wave modulated in accordance with speech currents and an unmodulated carrier wave both of frequencies different from the first-mentioned carrier wave but above audibility, means for selecting the inaudible frequency carrier wave components, means for detecting the modulated inaudible frequency component to produce speech currents, a signal device, a second source of local oscillations, means for combining oscillations from said second source with the unmodulated inaudible frequency carrier wave to produce other oscillations of audio-frequency, a common amplifier for the speech currents and the other oscillations of audio-frequency, means for separating the speech currents and other audio-oscillations, means for rectifying the other audio-frequency oscillations, and a mechanical relay actuated by the rectified current to control said signal device.

19. A carrier signaling system comprising means for transmitting a carrier wave modulated in accordance with audio-frequency signal currents and an unmodulated carrier wave, means for receiving said waves including a source of local oscillations and a single means for combining the modulated and unmodulated waves to produce signal currents and in which the unmodulated component and local oscillations are combined to produce other currents of audible frequency outside the speech range for controlling signal indications.

In witness whereof, I hereunto subscribe my name this 9th day of March A. D., 1923.

FRANCIS M. RYAN.