Aug. 7, 1945. E. W. KENEFAKE 2,381,758

CARRIER CURRENT SYSTEM

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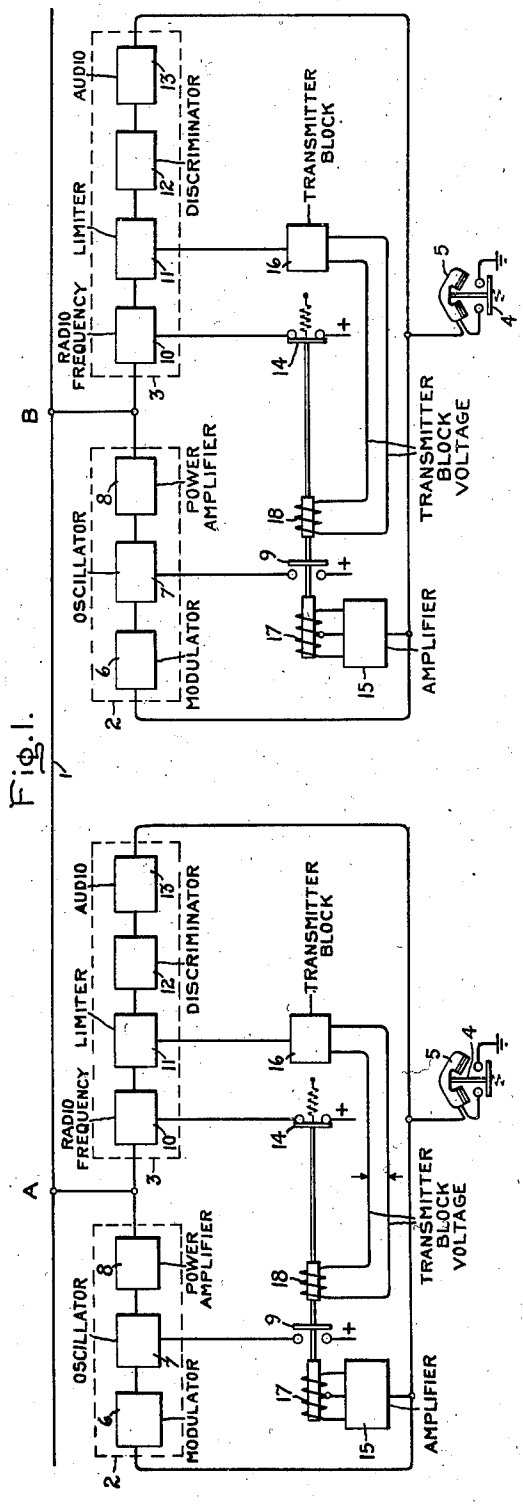


Fig. 1.

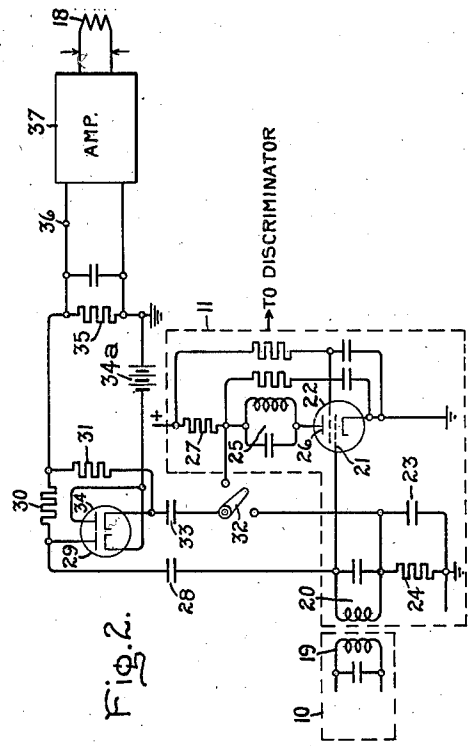


Fig. 2.

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CARRIER CURRENT SYSTEM

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5 Claims. (Cl. 179—15)

The present invention relates to a single frequency duplex carrier communication system in which the transmitter at one station is blocked while a signal is being received from another station to prevent oscillations caused by the transfer of energy from the output of the station receiving to the input of the station transmitter.

Difficulty has been experienced with prior systems of this type under conditions in which noise voltages are of sufficient magnitude to block the transmitter but are of insufficient magnitude to prevent communication.

The object of my invention is to provide an improved system in which transmitter blocking by noise voltages is prevented.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing in which Fig. 1 is a block diagram of a system embodying my invention, and Fig. 2 is a diagram of the transmitter blocking circuit.

Referring to the drawing, there is shown a carrier system connecting stations A and B on a power line 1. At each of the stations is a frequency modulation transmitter 2 and a frequency modulation receiver 3 having the transmitter output and the receiver input coupled through a common circuit to the power line and having the receiver output and the transmitter input connected through a hook switch 4 to a hand set 5. The transmitter is diagrammatically illustrated as comprising a modulator 6, an oscillator 7, and a power amplifier 8 controlled by a switch 9 in the power supply to the oscillator. The receiver is diagrammatically illustrated as comprising R. F. stages 10, a limiter 11, a discriminator 12, and audio output 13 controlled by a switch 14 in the power supply to the R. F. stages. The switches are interlocked to prevent simultaneous operation of the transmitter and receiver. Preferably the receiver is disconnected (or blocked) before the transmitter is connected. The transmitter switch 9 is closed to connect the station transmitter and to disconnect the station receiver by the output of an amplifier 15 connected in parallel with the modulator so as to be energized by the output of the hand set 5. The amplifier output closes the switch 9 after opening the receiver switch 14, disabling the receiver while the transmitter is being used. The receiver switch 14, which is normally closed, is held in the closed position while signals are being received by a transmitter block 16 which prevents use of the transmitter while signals are being received. The control for the switches 9 and 14 is diagrammatically illustrated as effected by opposed relay coils 17 and 18, the relay coil 17 being energized from the output of the amplifier 15 and the relay coil 18 being energized by the output of the transmitter block 16. Normally the relay coil 18 is stronger than the relay coil 17 so that use of the transmitter is prevented while signals are being received. It is possible to design the coils so that an exceptionally loud signal from the hand set will supply sufficient voltage to the coil 17 to overpower the coil 18 and disconnect the receiver (and connect the transmitter) while signals are being received. When the transmitter at one station is in use, the received signals prevent use of the transmitters at other stations. The above described elements are merely illustrative of the well-known duplex carrier system which may comprise a wide variety of elements performing similar or equivalent functions (for example see my Patent 2,330,593).

In this general type of system, it has been noted that under conditions in which the noise level is high, the receiver, which responds to noise as well as to carrier signals, may supply sufficient output to the transmitter block to maintain the station transmitters disconnected and thereby prevent use of the system for communication. One condition during which the noise level is high is during storms when it is desirable that the system be usable since even though the noise level is high, some sort of communication may be possible.

In the present system, transmitter blocking is prevented under conditions of high noise level by a circuit which responds to the difference between the carrier signals and noise and blocks the transmitter only when the signals exceed the noise by a value which permits communication.

In the transmitter blocking arrangement, shown in detail in Fig. 2, the output of the receiver R. F. stages 10 which appears in a tuned circuit 19 is fed to the limiter 11 having a tuned input circuit 20 connected directly to the grid 21 of a device 22 and to ground through a condenser 23 shunted by a resistance 24. The limiter output, which consists of a carrier of constant amplitude modulated in frequency, appears across a tuned circuit 25 connected between the anode 26 of the device 22 and a resistance 27 connected

to the power supply. The carrier signals, which are of constant amplitude, appear across the tuned circuits 20 and 25. Noise voltages, which cause variations in the amplitude of the receiver input, appear across the resistances 24 and 27, the voltage across the resistance 27 differing from the voltage across the resistance 24 by the amplification of the device 22.

The constant amplitude signal voltage is coupled from the tuned circuit 20 through a condenser 28 to a diode 29 poled to short circuit the positive half cycles. The negative half cycles are connected through a resistance 30 to the upper end of a resistance 31 and tend to develop a negative voltage across the resistance. The noise voltages from either of the resistance 24 or 27 are coupled through a switch 32 and a condenser 33 to a diode 34 poled to short circuit the negative half cycles. The positive half cycles of the noise voltages are connected to the lower end of the resistance 31 and tend to develop a positive voltage across the resistance 31. The net voltage across the resistance 31 (the difference between the voltage due to carrier signals and the voltage due to noise) is connected in series with a source of bias voltage 34a to a filter 35 providing a voltage at terminal 36 which is positive if the noise voltages exceed the signal voltages and is negative if the signal voltages exceed the noise voltages. The negative voltage at the terminal 36, which is a measure of the amount the signal voltages exceed the noise voltages, may be amplified in an amplifier 37 having its output connected to the coil 16. With this arrangement the receiving station transmitter will be blocked only if the signal voltages exceed the noise voltages and the equipment is not disabled under high noise level conditions when communication is difficult but may not be impossible.

Except for the transmitter blocking, the operation is the same as the conventional single frequency duplex system. While a signal is being received from a remote station, the transmitter at the receiving station is disabled or blocked. As soon as signals from the remote station cease (or a reasonable time thereafter to take care of gaps in conversation) the transmitter at the receiving station is rendered effective to communicate with the remote station by speaking into the hand set and generating a modulating voltage which disconnects the receiver control switch 14 and closes the transmitter control switch 9 unblocking the transmitter to permit communication.

While I have shown particular embodiments of my invention, it will be understood that many modifications may be made without departing from the spirit thereof, and I contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a duplex carrier system for a plurality of stations each having a transmitter, and a receiver, and means responsive to the difference between carrier signals and noise received at one of the stations for blocking its transmitter.

2. In a duplex frequency modulation carrier system having a station provided with a frequency modulation transmitter and a frequency modulator receiver, said receiver having a circuit element across which the carrier voltages due to signals appear and a circuit element across which noise voltages appear, and means responsive to the excess of said carrier voltage over said noise voltages for blocking the transmitter to prevent operation of the transmitter while signals are being received.

3. In a duplex frequency modulation carrier system having a station provided with a frequency modulation transmitter and a frequency modulation receiver, said receiver having a limiter having a tuned circuit across which the carrier voltages due to signals appear and a resistance across which amplitude modulation of the carrier due to noise voltages appears, and means responsive to the excess of the voltage across the tuned circuit over the voltage across said resistance for blocking the transmitter to prevent operation of the transmitter while carrier signals are being received.

4. A transmitter blocking arrangement for a duplex carrier communication system, comprising means responsive to the received carrier signal voltages, means responsive to the received noise voltages, and means responsive to the excess of the carrier signal voltages over the noise voltages for blocking the transmitter.

5. A transmitter blocking arrangement for a duplex frequency modulation carrier communication system comprising a circuit element across which the constant amplitude component of the received carrier appears, a circuit element across which amplitude modulation of the received carrier due to noise voltage appears, oppositely poled diodes connecting said circuit elements to a resistance whereby the potential at the resistance is a function of the difference between said voltages, and means responsive to said potential for blocking the transmitter.

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