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R. K. POTTER

DUPLEX RADIO SIGNALING SET

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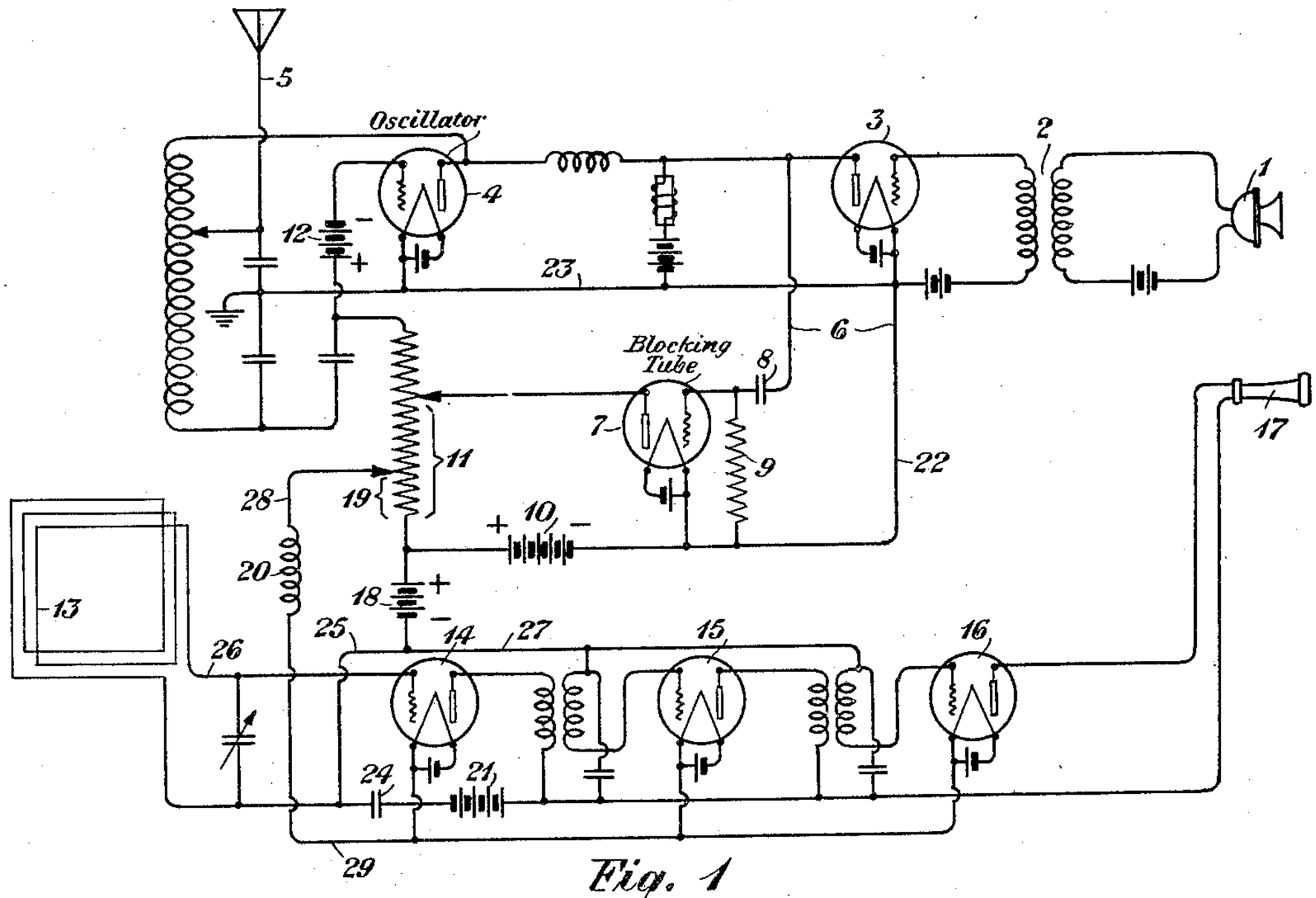

Fig. 1

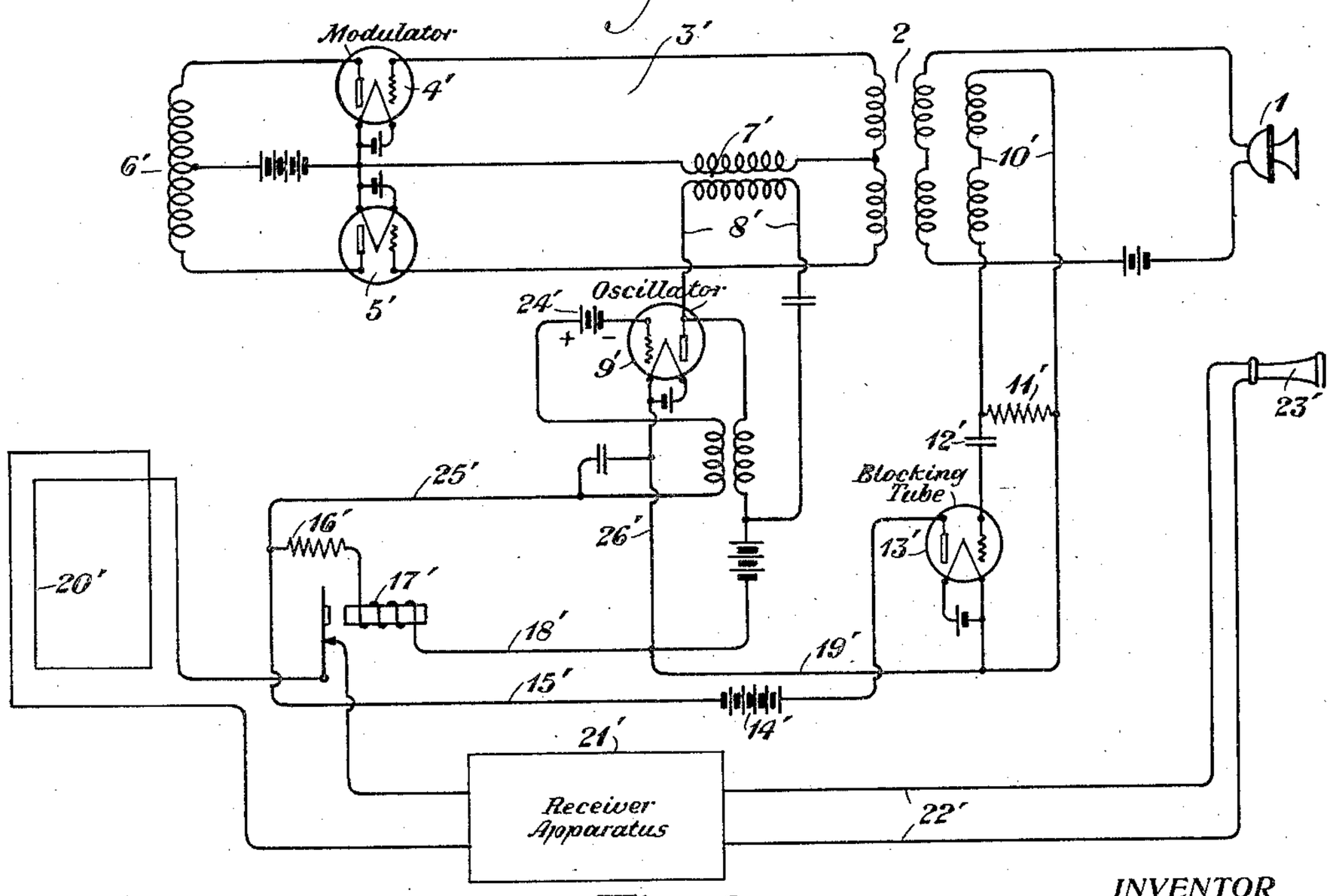

Fig. 2

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DUPLEX RADIO SIGNALING SET.

Application filed October 31, 1925. Serial No. 66,084.

This invention relates to improvements in duplex carrier transmission systems.

The invention provides arrangements whereby in a radio or carrier set the transmitting or receiving apparatus may be rendered operative alternately in response to currents from the microphone of the set. To accomplish this purpose a vacuum tube is provided connected to the transmitter circuit which may be rendered inoperative by the alternating current potentials impressed on its grid from the transmitter circuit. This vacuum tube acts to either block the operation of the oscillator in the transmitter set and render the receiving apparatus operative or vice versa. Other features and objects of the invention will appear more fully from the detailed description thereof hereinafter given.

The invention may be more fully understood from the following description together with the accompanying drawing in the Figures 1 and 2 of which are shown a preferred form of the invention and a modification thereof.

In the arrangements illustrated in Fig. 1 the sending apparatus comprises the transmitter 1 coupled through a transformer 2 to a vacuum tube 3. The signals from the transmitter 1 will be impressed on the tube 3 and will thence be transmitted to the oscillator tube 4 where they will be superimposed on a carrier frequency and thence transmitted out over an antenna circuit 5 in a manner well known in the art. Bridged across the output circuit of the tube 3 is a circuit 6 leading to the input of a vacuum tube 7, known as the blocking tube. A condenser 8 and a leak resistance are associated with the grid of the blocking tube as shown. When the transmitter 1 is actuated by speech waves an alternating potential will be applied to circuit 6 and to the grid of the blocking tube 7. If this alternating potential is thus impressed on the grid of tube 7 the electrons will accumulate upon the grid during each positive half cycle and will be detained there by the blocking condenser 8, leak resistance 9 determining the maximum value to which the accumulated grid potential will be built up. If this impressed alternating potential is of sufficient magnitude it will tend to force the grid to a sufficient negative potential to block the flow of current from the filament to the plate. In other words, when the transmitter 1 is actuated by speech the grid of the blocking tube will be given a sufficiently great negative potential to prevent the normal current from flowing in the plate circuit of the tube 7. The effect of this action of blocking the current flow in the plate circuit will have a certain effect on the operation of the oscillator tube 4 which will now be explained. The plate circuit of the blocking tube 7 includes a resistance 11 and the battery 10 poled as illustrated. The filament of the oscillator tube 4 is connected by conductors 23 and 22 to the negative pole of battery 10. The grid of oscillator tube 4 is connected to a battery 12 poled as shown. Battery 12 is connected to resistance 11 which in turn is connected to the positive pole of battery 10. Hence the potential of the grid of the oscillator tube 4 with respect to its filament depends upon the cumulating effect of the following factors: namely, the potential applied thereto from battery 12, the potential applied from battery 10, and the effect of the potential drop through resistance 11. The battery 10, as poled, will tend to give the grid of tube 4 a positive potential with respect to its filament. The battery 12, as poled, will oppose the potential of battery 10 and bring the potential of the grid to a point such that it will be sufficiently negative with respect to the filament so that the tube will oscillate satisfactorily. When a current is flowing in the plate circuit of the blocking tube 7, the drop through the resistance 11 will further tend to oppose the effect of battery 10 and will further change the potential of the grid of tube 4 so that it will become so negative with respect to its filament that the tube will fail to function and will not oscillate. It will be seen that the normal state of affairs, when the transmitter 1 is not in use, will be that current will flow normally in the plate circuit of the blocking tube and cause the drop through the resistance 11 to have such an effect on the potential of the oscillator grid that the oscillator will fail to function. However, when the transmitter 1 is actuated, the blocking tube 7, as has been pointed out, reduces or even stops the current flow in its plate circuit and hence the current flow through resistance 11 is reduced or closes. The cessation of current flow through resistance 11 causes this resist-

ance to have no effect on the potential of the grid of the oscillator which will now depend only upon the cumulative effect of the applied potentials of batteries 10 and 12. It has already been pointed out that under these conditions the grid of the oscillator is of a potential proper for the tube to oscillate. Accordingly, the oscillator tube is normally rendered inoperative by the blocking tube, but when the transmitter is actuated by speech the blocking tube is affected thereby to allow the operation of the oscillator.

The receiving circuit comprises the loop antenna 13 connected to the series of vacuum tubes 14, 15 and 16 which comprise the detector amplifier system. The tube 16 has in its output circuit a receiver 17. The condenser 24 and the inductance 20 are provided as shown in the receiver circuit for the purpose of keeping the transmitter oscillations off the receiver grids during the time modulation takes place in the transmitting portion of the apparatus. The receiver grids have potential applied to them from the battery 18. The grid of tube 14 is connected over conductor 26, loop 13, conductor 25, to the negative pole of battery 18. The grids of tubes 15 and 16 are connected over conductor 27 to the negative pole of battery 18. Hence a negative potential from battery 18 is applied to all of the receiver grids. The receiver filaments are connected over conductors 29 and 28, through resistance 19, to the positive pole of battery 18 and hence will have a positive potential applied thereto. As has been pointed out heretofore, when current is flowing in the plate circuit of the blocking tube 7, the drop through the resistance 11 tended to oppose the positive potential effect of battery 10. In like manner, when current is flowing in the plate circuit of the blocking tube 7, the drop through the resistance 19 will tend to oppose in the receiver filament circuits the positive potential effect of battery 18. This will reduce the potential difference between the grids and filaments of the receiver to a point where the tubes will operate satisfactorily. It is pointed out that this is the normal state of affairs when the receiver 1 is not actuated by speech. Accordingly, whenever the transmitter portion of the apparatus is not operating the receiver will be in condition for operation. As has been pointed out heretofore when the transmitter is operated, the current flow in the plate circuit is stopped. This has the effect of cutting out the potential drop through resistance 19 in the filament circuits of the receiver tubes. Accordingly, the normal positive potential of the battery 18, without any reduction due to the drop through resistance 19, will be applied to the receiver filaments. This will result in an increase in the potential drop between the grids and filaments. In other words, the grid potentials will be reduced to a point so negative with respect to the filaments that the receiver tubes will not function. Accordingly, it will be seen that as soon as speech is impressed on the transmitter, the receiver apparatus will be prevented from functioning.

In Fig. 2 is illustrated an alternative form of the invention. A circuit including a transmitter 1 is coupled through a transformer 2 to the circuit 3′ of a duplex vacuum tube modulator which comprises vacuum tubes 4′ and 5′ and an output transformer 6′. Coupled through a transformer 7′ to the modulator circuit is a circuit 8′ leading to an oscillator which includes the vacuum tube 9′. The voice waves impressed on the transmitter will in turn be impressed on the modulator circuit 3′. The oscillator through transformer 7′ will supply a carrier frequency for these voice waves. The arrangement is a conventional showing of a balanced modulator which results in the elimination of the unmodulated carrier. Inductively related to the transmitter circuit is a circuit 10′ leading to the grid of a vacuum tube 13′. This tube is a blocking tube similar to the blocking tube of Fig. 1. The blocking condenser 12′ and the leak resistance 11′ are provided as shown in the circuit 10′.

As has been previously described in connection with Fig. 1, the alternating current potentials impressed on circuit 10′ will operate to stop the normal flow of current in the plate circuit of the blocking tube 13′. The plate circuit of tube 13′ is as follows: plate of tube 13′, battery 14′, conductor 15′, resistance 16′, winding of relay 17′, conductors 18′ and 19′ to the filament of tube 13′. When the transmitter 1 is not being actuated by speech waves, current will normally flow in this plate circuit and will hold the relay 17′ operated. The grid filament circuit of the oscillator tube 9′ is as follows: grid of tube 9′, battery 24′, conductor 25′, resistance 16′, winding of relay 17′, conductors 18′ and 26′ to the filament of tube 9′. The battery 24′ is so poled that the grid of the tube will have a negative potential with respect to its filament. Furthermore, the battery 24′ is of the proper value so that without taking other factors into consideration, the potential drop between filament and grid will be just sufficient so that the tube will operate properly and its circuit will function as an oscillator. However, it will be seen that the resistance 16′ is included both in the plate circuit of the blocking tube and the grid filament circuit of the oscillator tube. When current is flowing in the plate circuit of the blocking tube, the potential drop across the resistance 16′ will augment the effect of battery 24′ and will increase the potential difference between

grid and filament of the oscillator tube to such an extent that the grid will be so negative in potential with respect to the filament that the tube will fail to operate. However, when speech is impressed on the transmitter 1 and the blocking tube ceases to function, there will be no drop through resistance 16′ and the tube 9′ and its associated circuit will function as an oscillator. Under this condition, namely when the current flow in the plate circuit of the blocking tube is cut off by speech, the relay 17′ will release. This will open the circuit from the loop antenna 20′ to the receiver apparatus 21′. The receiver apparatus 21′ is shown schematically as it may be of any desired type. Connected to the receiver apparatus is a circuit 22′ leading to the receiver 23′.

While the arrangements of the invention have been disclosed as embodied in certain specific forms, it is understood that they may be embodied in many and other widely varied forms without departing from the spirit of the invention as defined in the appended claim.

What is claimed is:

A carrier signaling set comprising transmitting apparatus including a high frequency oscillator circuit, a low frequency signaling circuit associated therewith whereby the high frequency oscillations may be modulated by the low frequency signals, a vacuum tube circuit having its grid circuit connected to said low frequency signaling circuit whereby the potential of said grid will be determined by the low frequency signaling currents, means controlled by said grid potential for controlling the current flow in the plate circuit of said tube, a resistance included in the plate circuit of said tube, the potential drop across said resistance being controlled by the current flow in said plate circuit, and means controlled by said potential drop across said resistance for controlling said oscillator circuit.

In testimony whereof, I have signed my name to this specification this 27th day of October, 1925.

RALPH K. POTTER.