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G. F. ZIFFER

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HIGH-FREQUENCY COMMUNICATION SYSTEM

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Fig. 1.

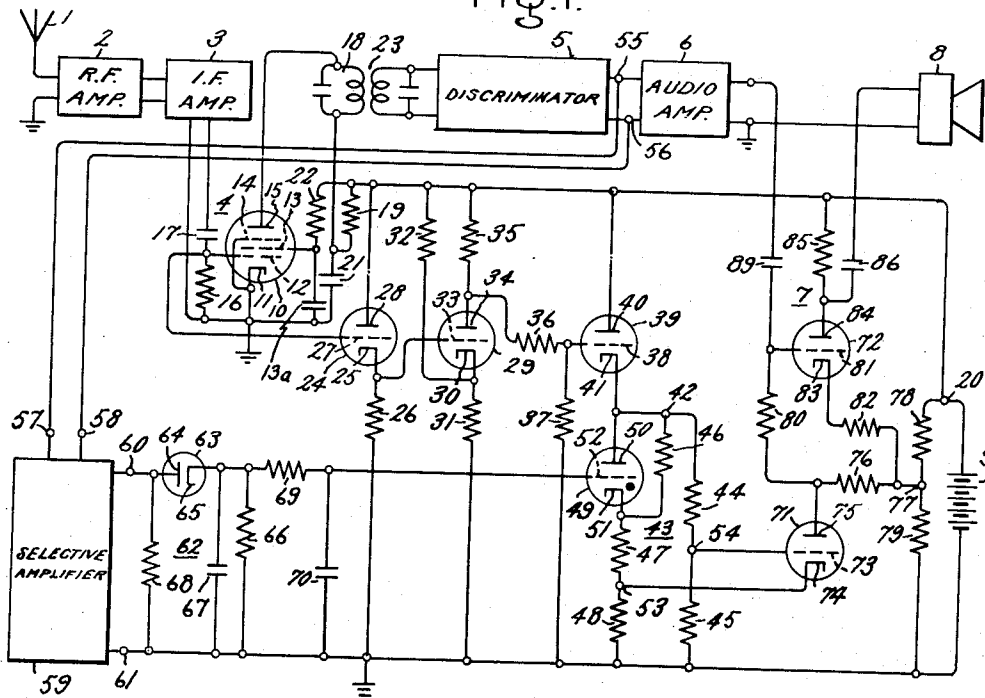
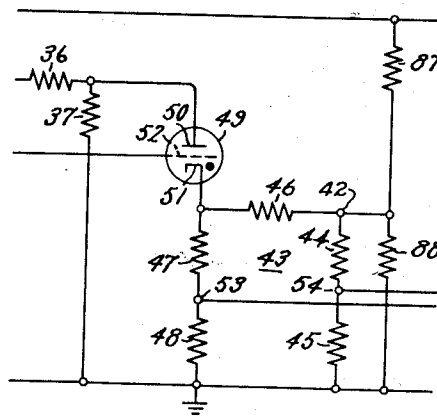


Fig. 2.



Inventor:
Garret F. Ziffer,
by *Merton D. Moore*
His Attorney.

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HIGH-FREQUENCY COMMUNICATION
SYSTEMGarret F. Ziffer, Cambridge, Mass., assignor to
General Electric Company, a corporation of
New York

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2 Claims. (Cl. 250-20)

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The present invention relates to high frequency communication systems and particularly to such systems in which means are employed to select a particular high frequency receiver to the exclusion of other receivers in the system.

An object of my invention is to provide improved means for effecting, from a transmitting station, the selection of a receiver with which that station is to communicate.

A further object of my invention is to provide means, in each of the receiving stations in the system, all of which may operate at the same carrier frequency, to render the respective station operative only in response to reception of the aforementioned carrier wave and a second wave to which only the respective receiving station responds. This second wave may be received as a modulation of the carrier for an instant prior to the desired communication.

A further object of my invention is to provide means to effect such selection and thereafter to maintain the receiver operative during the period when the carrier wave is received even though the second wave is interrupted.

In carrying out this invention into effect there is provided in each of the receiving stations means for developing a voltage whenever a carrier wave is being transmitted, and another means for developing another voltage during the occurrence of a second wave to which the respective receiving station is responsive. Means are provided responsive to these two voltages to render the low frequency portion of the receiver operative, such means being of such character as to maintain it operative after said second voltage is interrupted, and again to render it inoperative when the first voltage is interrupted. In one form of the invention to be described such means may include a gaseous discharge device to the anode of which the first voltage is applied as an anode operating voltage, and to the grid of which the other voltage is applied as a starting voltage. In response to application of both voltages the device becomes conductive and remains conductive after interruption of the starting voltage and until the anode operating voltage is removed. Current flowing therein may be utilized to render the receiving channel operative so long as it continues.

The novel features which are believed to be characteristic of this invention are set forth with particularity in the appended claims. The invention, itself, however, both as to its organization and method of operation, together with further objects and advantages thereof may best

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be understood by reference to the following description taken in connection with the accompanying drawings in which Fig. 1 is a schematic diagram of circuits embodying this invention; Fig. 2 shows a modification of Fig. 1.

Referring now to Fig. 1, there is shown a schematic representation of an embodiment of this invention as applied to a frequency modulation receiver. The receiver comprises an antenna 1, a radio frequency amplifier 2, an intermediate frequency amplifier 3, a limiter 4, a discriminator 5, audio amplifiers 6 and 7, and a loudspeaker 8 connected together in that order.

Referring particularly to circuits shown in schematic form, signals obtained from the intermediate frequency amplifier 3 are applied to amplitude limiter 4 which comprises electron discharge device 10 having a cathode 11 connected to ground, a control grid 12, a screen grid 13, a suppressor grid 14, and an anode 15. The control grid 12 is connected to cathode 11 through grid leak resistance 16 and is also connected to intermediate frequency amplifier through coupling capacitor 17. The screen grid 13 is connected through voltage dropping resistance 22 to positive terminal 20 of source 9 and also through bypass capacitor 13a to ground. The negative terminal of source 9 is connected to ground. Suppressor grid 14 is connected to cathode 11. The anode 15 is connected through parallel resonant circuit 18 and load resistance 19 to the positive terminal 20. Between the lower potential end of resistance 19 and ground is connected a bypass capacitor 21. The output from limiter 4 appears across tuned circuit 18 and is supplied through transformer 23 to discriminator 5.

As radio frequency signals are applied between the grid 12 and cathode 11 of the limiter, a bias voltage is developed between the grid and the cathode by electrons flowing to the grid and hence charging the capacitor 17 which gradually discharges through the grid leak resistance 16. This bias voltage is dependent upon the amplitude of the carrier waves applied to the grid 12, for example, as the carrier wave increases in amplitude the grid becomes increasingly negative in potential.

This potential appearing at grid 12 is applied to cathode follower 24 which includes a cathode 25 connected through cathode resistance 26 to ground, a grid 27 connected to grid 12 of limiter 4 and an anode 28 connected to positive terminal 20 of unidirectional source 9. The output from cathode follower 24 taken across cathode resist-

ance 26 is applied to electron discharge amplifier 29.

Amplifier 29 includes a cathode 30 connected through resistance 31 to ground and through resistance 32 to positive terminal 20, a grid 33 connected to cathode 25, and an anode 34 connected through resistance 35 to the positive terminal 20. The output across resistance 35 is applied to a voltage divider comprising resistance 36 and resistance 37 connected in series between anode 34 and ground. Grid 38 of electron discharge device 39 is connected to the junction of resistances 36 and 37 and is thus responsive to variations in potential of anode 34. Electron discharge device 39 also includes an anode 40 connected to positive terminal 20 and a cathode 41 connected to terminal 42 of bridge network 43.

The bridge network 43 includes a first pair of resistances 44 and 45 connected in series between terminal 42 and ground. The bridge network 43 also includes a second group of resistances 46, 47 and 48 connected in series between terminal 42 and ground. The anode-cathode discharge path of gaseous discharge device 49 is connected in shunt with resistance 45 with anode 50 of device 49 being connected to terminal 42 and cathode 51 being connected to the junction of resistances 46 and 47.

Directing attention now to the operation of the circuits just described, upon application of radio frequency carrier waves to the receiver, the potential at the grid 12 of the limiter 4 falls because of the grid leak detector action explained above. This drop in potential is applied through cathode follower 24 to grid 33 of device 29 to produce a rise in potential at anode 34. This rise in potential produces a rise in potential at grid 38 of discharge device 39 thereby rendering the latter device conductive. When device 39 conducts current flows through resistance 45 and causes a potential difference to appear between the anode 50 and cathode 51 of gaseous discharge device 49. If simultaneously with the application of carrier waves to the receiver, there is applied momentarily a sufficiently positive potential between grid 52 and cathode 51 of gaseous discharge device 49, developed from the wave modulating the carrier waves in a manner to be hereinafter described, the device 49 will become conductive and stay conductive as long as the aforementioned potential difference exists between anode and cathode thereof, thereby causing resistance 46 to be shunted out of circuit and causing the current flowing through resistances 47 and 48 to be increased.

Thus, as long as carrier waves are applied to the receiver and after the momentary modulating wave disappears, a substantial potential difference is developed between terminals 53 and 54 at the junctions of resistances 47 and 48, and resistances 44 and 45, respectively. In order to realize a large change in potential between these terminals, resistance 46 is preferably made quite large. Also, in general, it has been found quite satisfactory to make the ratio of resistances 46 and 47 to 48 equal to substantially the ratio of resistance 44 to resistance 45. The change in potential difference between terminals 53 and 54 is utilized as will hereinafter be described to activate or render operative the audio channel of the receiver.

The potential applied to the grid of gaseous discharge device 49 to render it conductive is obtained from an audio voltage of momentary du-

ration, one-half of a second, for example, modulating the radio frequency carrier waves. This voltage is obtained from the output terminals 55 and 56 of discriminator 5 and is applied between terminals 57 and 58 of selective amplifier 59 which may be the kind described in U. S. Patent 2,173,426, for example. The selective amplifier 59 in a particular receiver is tuned to pass a particular audio frequency corresponding to the call tone or frequency of that receiver. This audio signal appears at output terminals 60 and 61 of the selective amplifier 59.

The output from selective amplifier is rectified by rectifier 62 comprising a unilaterally conducting device 63 having an anode 64 connected to terminal 60 and a cathode 65 connected through load resistance 66 shunted by filter capacitor 67 to ground. Resistance 68, connected between anode 64 and ground, provides a current return path for the unilaterally conducting device 63. The rectified momentary pulse of audio voltage appearing across resistance 66 is applied to resistance 69 and integrating capacitor 70 which are connected in series between the ends of the resistance 66. Accordingly, there is developed across capacitor 70 a voltage that increases with time and reaches a magnitude dependent upon the duration of the audio waves of momentary duration. Capacitor 70 is connected between grid 52 and ground, and accordingly, the voltage appearing across this capacitor is applied to gaseous discharge device 49 to render the latter conductive in the manner explained above.

Thus, it is seen that in the absence of a carrier wave in the carrier channel of the receiver, the terminals 53 and 54 are at substantially the same potential. As soon as a carrier wave momentarily modulated by an audio tone is applied to the receiver, the potential of point 53 rises with respect to the potential of point 54 and remains at this higher potential as long as carrier waves are being received by the receiver. When the carrier wave disappears from the receiver, the potential of point 53 again falls to the potential of point 54 since the potential between the anode and cathode of gaseous discharge device falls to a value which will not support conduction through the device. The change in potential between terminals 53 and 54 is utilized to render operative or inoperative, respectively, the audio channel of the receiver.

Electron discharge device 71, including a grid 73, cathode 74, and an anode 75, and electron discharge device 72 including a grid 81, a cathode 83 and an anode 84, perform these latter functions. The grid 73 is connected to terminal 54 and cathode 74 is connected to terminal 53. The anode 75 is connected through anode resistance 76 to the junction 77 of resistances 78 and 79, the latter resistances being connected in series across the source of operating voltage 9. Thus, in the absence of a carrier wave modulated momentarily by the particular audio tone to which the receiver is responsive, a large bias voltage is developed across resistance 76 since the potentials of points 53 and 54 are substantially the same. This bias voltage renders electron discharge device 72 inoperative since the negative end of resistance 76 is connected through resistance 80 to grid 81, and the positive end of resistance 76 is connected through resistance 82 to cathode 83. Accordingly, audio voltages from audio amplifier 6 applied to grid 81

through coupling capacitor 89 do not pass through the device 72 to the loudspeaker 8.

When a carrier wave modulated by a particular calling tone is applied to the receiver, the potential of point 53 rises with respect to the potential of point 54 since gaseous discharge device 49 shorts out resistance 46, thereby rendering the device 71 non-conductive. When device 71 becomes nonconductive the voltage developed across resistance 76 disappears, thereby rendering device 72 operative. Thus, audio voltages are developed across anode load resistance 85 connected between anode 84 and terminal 20. These voltages are applied through coupling capacitor 86 to loudspeaker 8.

Referring now to Fig. 2, there is shown a modification of the circuit of Fig. 1. Elements of Fig. 2 corresponding to the elements of Fig. 1 have the same reference numerals. In Fig. 2, the anode-cathode discharge path of gaseous discharge device 49 is connected in shunt with resistance 37 so that a voltage, corresponding to the presence of carrier waves in the receiver, appearing across resistance 37 is applied to the anode-cathode discharge path of the gaseous discharge device 49 directly. As in Fig. 1, a voltage developed by the calling tone to which the receiver is responsive is applied between grid 52 and ground. The upper terminal 42 of the bridge network 43 is connected to the junction of resistances 87 and 88 connected in series across the unidirectional source 9 of operating voltage, rather than being connected to anode 50 of gaseous discharge device 49 as in Fig. 1.

When carrier waves modulated by a momentary calling tone are received, a voltage occurring during the presence of carrier waves in the receiver is applied between the anode and cathode of the gaseous discharge device 49, and a voltage produced by the demodulated calling tone is applied between the grid 52 and cathode 51, thereby causing conduction in the device 49. By this action, a rise in the potential of point 53 with respect to the point 54 is produced. This latter condition exists after the momentary signal disappears so that communication may be had with the receiver as explained in connection with Fig. 1.

When the carrier waves from the transmitter are interrupted, the potential across the anode-cathode path of the gaseous discharge device 49 becomes sufficiently reduced in magnitude to cause this device to become nonconductive. Point 53 returns to the same potential as point 54, thereby rendering quiescent the audio channel of the receiver.

Thus, circuits are provided which not only enable communication to be selectively had with particular receivers, but which also maintain the receivers free from annoying noises in the absence of communication directed to the receivers.

While I have shown particular embodiments of this invention, it will, of course, be understood that I do not wish to be limited thereto since many modifications, both in circuit arrangement and in the instrumentalities em-

ployed, may be made and I, therefore, contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of this invention.

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

1. The combination, in a selective system for a high frequency receiver having a normally operative high frequency portion and a normally inoperative low frequency portion, a gaseous discharge device having an anode, a cathode and a control electrode, means responsive to a carrier wave in said high frequency portion to apply operating potential between said anode and cathode, means responsive to a second wave in said receiver to apply voltage to said grid to render said device conductive, said device being adapted to remain conductive upon termination of said last voltage so long as said operating voltage is applied between said anode and cathode, a pair of resistances, means for applying operating potential in shunt with each of said resistances, a portion of one of said resistances being connected in shunt with said device, means responsive to a change in potential between predetermined points on said resistances due to current in said device to render said low frequency portion operative whereby said low frequency portion remains operative during reception of said carrier wave and becomes inoperative upon interruption of said carrier wave.

2. The combination, in a selective system for a high frequency receiver having a normally operative high frequency portion and a normally inoperative low frequency portion, a gaseous discharge device having an anode, a cathode and a control electrode, means responsive to a carrier wave in said high frequency portion to apply operating potential between said anode and cathode, means responsive to a second wave in said receiver to apply voltage to said grid to render said device conductive, said device being adapted to remain conductive upon termination of said last voltage so long as said operating voltage is applied between said anode and cathode, a pair of resistances, means for applying operating potential in shunt with each of said resistances, a portion of one of said resistances being connected in series with the electron discharge path of said device, means responsive to a change in potential between predetermined points on said resistances due to current in said device to render said low frequency portion operative, whereby said low frequency portion remains operative during reception of said carrier wave and becomes inoperative upon interruption of said carrier wave.

GARRET F. ZIFFER.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,531,416	Ferrar	Nov. 28, 1950
2,591,937	Herrick	Apr. 8, 1952
2,610,293	Hanchett, Jr.	Sept. 9, 1952