

March 26, 1935.

R. C. CURTIS

1,995,418

WIRED AND SPACE RADIO RECEPTION SYSTEM

Filed Dec. 2, 1932

2 Sheets-Sheet 1

FIG. 1

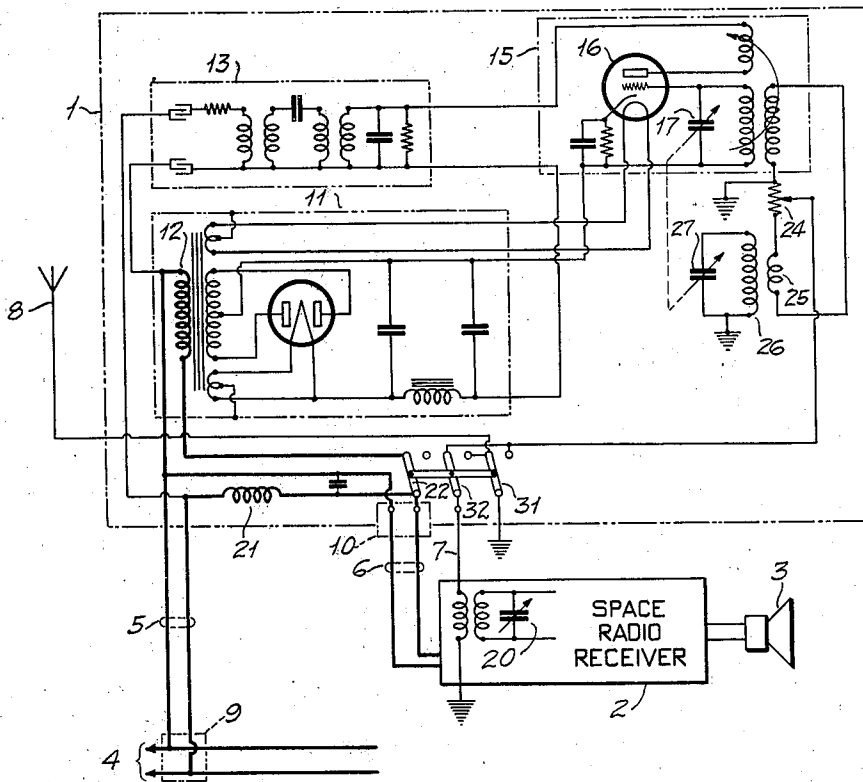
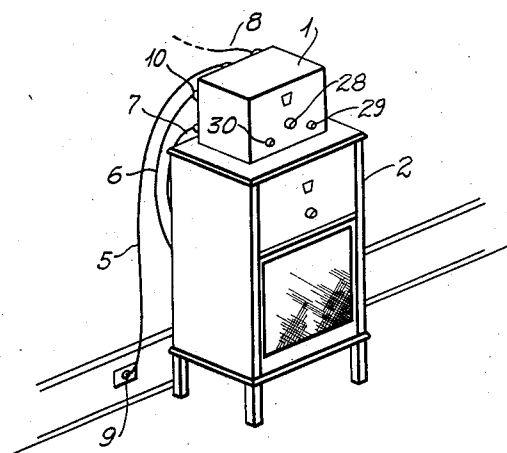


FIG. 2



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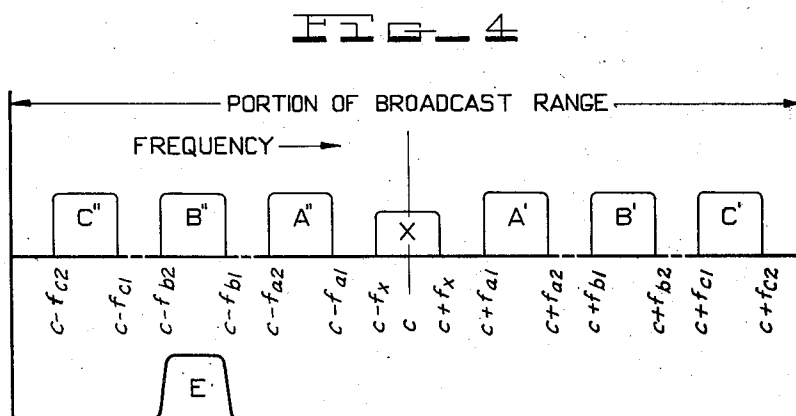
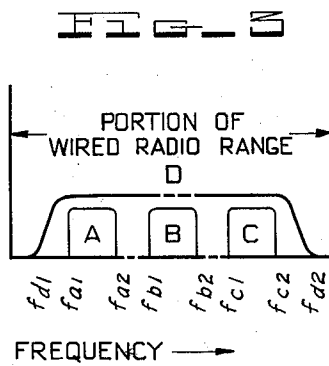
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WIRED AND SPACE RADIO RECEPTION SYSTEM

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## UNITED STATES PATENT OFFICE

1,995,418

WIRED AND SPACE RADIO RECEPTION  
SYSTEMRichard C. Curtis, East Orange, N. J., assignor  
to Wired Radio, Inc., New York, N. Y., a cor-  
poration of Delaware

Application December 2, 1932, Serial No. 645,401

6 Claims. (Cl. 179-2.5)

My invention pertains in general to radio receiving systems and specifically relates to such systems for the selective reception of either wired radio or space radio programs.

5 In wired radio broadcasting, in which carrier signals are transmitted over commercial power distribution networks, the carrier frequencies employed are usually within a range of 25 to 100 kilocycles. On the other hand, the transmission frequency range employed in space radio broadcasting begins at around 500 kilocycles. It is quite evident, therefore, that there is considerable difference in the frequency ranges employed in wired radio broadcasting and space radio broadcasting. It follows that apparatus especially designed for the reception of space radio signals is unsuited for the efficient reception of wired radio signals, and vice versa. My invention contemplates providing a system whereby a normal space radio receiver can be conveniently adapted for use in the efficient reception of wired radio signals in frequency ranges to which space radio receivers are not normally responsive.

One of the objects of my invention consists in providing a convertor for use in conjunction with an existing radio receiving system for rendering the same operative for the efficient reception of programs transmitted within frequency ranges to which the receiver is normally unresponsive.

Another object consists in producing a system for program reception in which a plurality of discrete program carriers are utilized to simultaneously modulate a locally generated carrier from which the desired program is selected by tuning.

These and other objects will be apparent from the following, reference being had to the accompanying drawings in which:

Fig. 1 is a diagrammatic representation of one embodiment of the system of my invention;

Fig. 2 illustrates a typical installation of the system of my invention showing a unitary convertor mounted upon an existing space radio receiver for rendering the same responsive to wired radio programs;

Fig. 3 is a graphical representation of various frequencies employed in wired radio broadcasting; and

Fig. 4 is a graphical representation of frequencies employed in accordance with the principles of my invention.

In carrying out my invention I provide a unitary convertor which can be conveniently placed upon or associated with an existing radio receiving organization whereby the latter may be rendered responsive to signals or programs transmitted

by carrier frequencies to which the receiving organization is normally unresponsive. To accomplish this, I provide, within the unitary convertor, a local generator of carrier frequency oscillations of a frequency suitable for the existing receiving organization. However, this frequency may be adjusted to be a desired value. Wired radio programs, which are transmitted over a power network at a plurality of discrete carrier frequencies are utilized to modulate the locally generated carrier frequency. The locally generated frequency then appears as a carrier with a plurality of upper and lower side bands, there being an upper and lower side band for each of the wired radio program channels. In accordance with the method of my invention, the selection circuits in either the convertor or the existing receiving organization, are tuned to one of the side bands whereby the wired radio program is reproduced over the existing radio receiving organization.

Referring to the drawings in detail the convertor 1 is provided with a cable 5 having a service plug 9 for connection with any ordinary service outlet of the consumer's power distribution system forming part of the commercial power distribution network. Wired radio programs are broadcast over this power distribution network, schematically indicated by the power lines 4 in Fig. 1. The wired radio programs consist of several different program modulation channels each having different carrier frequencies. The relationship of these frequencies along the frequency spectrum is indicated in Fig. 3. Referring to Fig. 3, curves "A", "B" and "C" correspond to three different programs of the wired radio channels, although there may be other channels if desired. Each of the modulation frequencies within any one of these channels is impressed upon a particular carrier frequency. Means are provided, according to systems well known in the art, for transmitting but one side band of modulation frequencies. For example, the curve "A" extends from frequency  $f_{a1}$  to  $f_{a2}$ . The carrier frequency is substantially  $f_{a1}$ , the modulation extending in the upper side band represented by those frequencies falling within the range  $f_{a2}-f_{a1}$ . Similar conditions prevail for channels "B" and "C", it being apparent that the three carrier frequencies which are substantially  $f_{b1}$ ,  $f_{c1}$ , and  $f_{a1}$ , are all separated from each other sufficiently to avoid interference within the wired radio range.

Referring back to Fig. 1, the cable 5 conveys both commercial power, such as 60 cycle alter-

nating current, and the several wired radio carrier frequency program channels to the convertor. Connections are provided from the cable 5 to a filter 13. The filter 13 is provided with condensers which permit the carrier frequencies to pass therethrough but which prevent the passage of the low frequency commercial alternating current. The filter 13 is of the band pass type broadly responsive to the several wired radio program channels and has a responsive curve substantially in accordance with curve "D" in Fig. 3 having lower and upper cut-offs at  $f_{d1}$  and  $f_{d2}$ , respectively. It will be seen that all of the wired radio channels A, B and C will therefore pass through the filter 13. The output circuit of the filter 13 is connected with an oscillator 15. Oscillator 15 includes an electron tube 16 and a tunable oscillation circuit including the adjustable condenser 17 for producing controlled high frequency oscillations. The oscillation circuit including the adjustable condenser 17 is broadly responsive to the several wired radio frequency channels.

Space radio receiver 2 is indicative of an existing radio receiving organization normally unresponsive to the wired radio frequencies. The radio receiver 2 comprises means well known in the art for the reception of space radio signals and includes a tunable circuit including the adjustable condenser 20 and also electron tubes as well as a loud speaker 3.

The power supply for the electron tubes within the receiver 2 is derived from a cable 6 usually found with such receivers. In the operation of the space radio receiver 2, however, in accordance with the principles of my invention, the cable 6 having a service plug thereon, is connected within a service outlet or attachment 10 provided within the convertor 1 as shown in Fig. 2. This connection is made instead of directly to the consumer's power service outlet as is usually the case. Such an arrangement for connecting the power supply is provided in order to benefit from an inductive impedance 21 provided in the power supply circuit in the convertor 1. The inductive impedance 21 prevents the absorption and modulation of carrier frequency energy by the commercial power consuming elements of either the convertor 1 or the receiver 2. The power circuit within the convertor 1 includes the primary winding of a transformer 12 in a power-pack 11. A switch blade 22 controls the power circuit from cable 5 and through impedance 21 to both the transformer 12 and the space radio receiver 2. The power pack 11 includes a rectifier tube and suitable filtering means for smoothing the rectified current supply which is delivered to the space discharge tube 16 at suitable operating voltages.

The output circuit of oscillator 15 includes a potentiometer 24 and inductance 25. The inductance 25 is coupled with an inductance 26 which is connected with an adjustable condenser 27 to form a "trap" circuit, the use of which will be more apparent hereinafter. The condensers 17 and 27 are mechanically coupled together so that the control thereof may be exercised from a single knob 28 as shown in Fig. 2. The knob 29 controls the potentiometer 24.

The output circuit in the oscillator 15 taken across the potentiometer 24, includes a connection to a contact adapted to be engaged by a switch blade 32. The same circuit also includes a connection to another contact adapted to be engaged by the switch blade 31. An antenna

8, which might ordinarily be used with the radio receiver 2, is connected to the convertor 1 and extends to a pair of contacts one of which is positioned for engagement with switch blade 32 and the other of which is positioned for engagement with switch blade 31. The three switch blades 22, 32, and 31 are mechanically interconnected and controlled by knob 30 on the convertor. (See Fig. 2). In the position shown in Fig. 1, the switch blade 22 connects the transformer 12 of power pack 11 to the power lines 4 through cable 5. Switch blade 32 connects the output of the oscillator 15 through a wire 7 to the space radio receiver 2. Switch blade 31 connects the antenna 8 to ground. In this condition the space radio receiver 2 is in a condition for reception of selected programs in the wired radio frequency range. The operation of the system of my invention for such reception will now be described:

It is, of course, to be understood that the frequencies in the wired radio range, such as represented in Fig. 3, are of a low order, while the frequencies to which the receiver 2 are normally responsive are of a much higher order. For example, the frequencies depicted in Fig. 3 may all be within a range below 100 kilocycles while the range to which receiver 2 is responsive may begin at around 500 kilocycles.

In the operation of my system, the entire wired radio range which may include any number of discrete program modulated carrier frequency channels, is passed through filter 13 and made to modulate the sustained high frequency oscillations produced by oscillator 16. The frequency of the oscillator 16 is sufficiently high so that the attendant modulation frequencies will fall within the range to which the receiver 2 is normally responsive. This frequency may be in the neighborhood of 600 kilocycles or more. This carrier produced by electron tube 16 is represented in Fig. 4 as the line "C". The carrier frequency channels will now appear as upper and lower side bands, as shown in Fig. 4. The channels A, B, and C will have upper side bands as represented by the curves A', B', and C', while the same channels will have lower side bands represented by the curves A'', B'', and C''. For example, the frequency range or the upper side band of curve A' is the range

$$(c+f_{a2}) - (c+f_{a1})$$

while, on the other hand, the range represented by the lower side band A'' is

$$(c-f_{a1}) - (c-f_{a2})$$

Corresponding conditions prevail for the other side bands shown in Fig. 4. The frequency range immediately adjacent the carrier c and represented by the range

$$(c+f_x) - (c-f_x)$$

represents the extraneous modulation side bands produced by power supply ripple and other causes. In the operation of my system, the circuit 26—27 is tuned to the frequency range of extraneous modulation represented by the curve X in Fig. 4 and serves as a trap circuit for rejecting the energy within this frequency range.

The frequency range including the upper and lower side bands are directed through the circuit including switch blade 32 to the space radio receiver 2. The parameters of the reception circuit including the condenser 20 are proportioned to substantially produce a band pass character-

istic having comparative frequency band width such as represented by the curve E in Fig. 4. The width of the curve E is of the same order as any one of the side band curves. It will be understood that the frequency range between the side bands, such as by the side band A'' and side band B'', is actually greater than the width of the curve E although the drawings are in condensed form for simplicity of representation. Adjustment of condenser 20 in the space radio receiver 2 serves to shift the range represented by curve E along the frequency spectrum so that the receiver 2 is responsive to any selected one of the side bands A', B', C', A'', B'', or C''. However, according to the method of my invention, the curve E may be maintained stationary with respect to the frequency range, that is, the condenser 20 may not be adjusted, while adjustment of condenser 17 serves to shift the carrier c, together with its modulation side bands, along the frequency spectrum with respect to the curve E so that a desired one of either the upper or lower side bands falls within the range of the curve E. It will be seen therefore that single side band reception, with its attendant advantages, is provided by this system.

The chief advantages to be derived from my invention reside in that a simple and compact arrangement is provided for adapting an existing radio receiving organization for the reception of frequency within ranges to which it is normally unresponsive. A further advantage consists in that tuning is accomplished by simple means and that hum and extraneous modulation are considerably reduced by the various arrangements inherent in the system of my invention.

When it is desired to operate the receiver 2 solely as a space radio receiver, the switch bands 22, 32, and 31 may be moved by knob 30 so that the power circuit to the power pack 11 is interrupted, the output circuit from oscillator 15 is grounded by switch blade 31, and switch blade 32 connects the space radio receiver 2 to the antenna 8 for reception of space radio signals. Although I have described a particular embodiment of my system it will of course be obvious that many changes can be made without departing from the intended scope of my invention. I do not therefore desire to limit myself to the foregoing except as may be pointed out in the appended claims.

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

1. In a system for the reception of programs comprising, a filter circuit for the simultaneous reception of a plurality of programs each consisting of a carrier frequency and modulation frequencies, means for locally producing a high frequency carrier modulated by said programs to produce a plurality of side bands corresponding to said programs but removed in the frequency spectrum from the vicinity of the range of extraneous or noise modulation, and a selection circuit having parameters designed for the reception of frequencies within a range substantially the extent of one of said side bands, and a rejection circuit responsive to the range of extraneous modulation frequencies, the method of selecting a desired program including, simultaneously shifting said high frequency carrier and the frequency response of said rejection circuit along the frequency spectrum maintaining the same relationship therebetween whereby said side bands of said high frequency carrier are shifted along the frequency spectrum so that one of said side bands falls with-

in the range to which said reception circuit is responsive and said rejection circuit continuously rejects said extraneous modulation frequencies.

2. A radio reception system comprising, a filter circuit for the simultaneous reception of a plurality of program channels each comprising a carrier frequency and modulation frequencies, means connecting said filter circuit to commercial power lines for deriving said program frequencies therefrom, an oscillator coupled to said filter and including an oscillation circuit broadly responsive to said program channels whereby a high frequency carrier is produced having modulation side bands corresponding to said program channels, a space radio reception circuit coupled to said oscillator and responsive to frequencies within a range substantially equal to one of said side bands, and means for relatively shifting said high frequency carrier and the response of said space radio reception circuit along the frequency spectrum whereby a selected one of said side bands is made to coincide with the range to which said space radio reception circuit is responsive whereby a desired program is received.

3. A convertor for adapting a radio receiving organization for the reception of programs within ranges to which it is not normally responsive comprising, a unitary housing, a filter within said housing and designed to simultaneously receive a plurality of program channels each comprising carrier and modulation frequencies, a space discharge tube and oscillation circuit for producing a high frequency carrier within the range to which said space radio receiver is responsive, said oscillation circuit being broadly responsive to all of said program channels, a power pack within said convertor and including a transformer and rectifier device, a cable having an attachment for insertion in a consumer's power outlet for supplying both commercial power to said transformer and carrier frequency energy to said filter, said power pack serving to supply operating voltages to said space discharge tube, an attachment in said convertor for connection with a power supply cable of said receiver, a switch for controlling a circuit from said first mentioned cable to said attachment and to said transformer, an inductive impedance in said convertor for restricting the passage of carrier frequency energy from said first mentioned cable to said transformer and to said attachment, a circuit within said convertor for connection with an antenna, a potentiometer coupled with the output of said oscillation circuit, and a switch for connecting said radio receiver with said antenna circuit or with said potentiometer.

4. A convertor in accordance with claim 3 including an adjustable condenser in said oscillation circuit, and a rejection circuit including an adjustable condenser responsive to extraneous or modulation frequencies, common mechanical means for actuating said condensers, and common mechanical means for actuating said switches.

5. A convertor for adapting a radio receiving organization for the reception of programs within ranges at which it is not normally responsive comprising, a unitary housing, frequency changing means within said housing including circuits and electron discharge tube means, a cable connected with said unitary housing and having an attachment for insertion in a consumer's power outlet for supplying carrier frequency program energy to said frequency changing means, as well as commercial power for operating said discharge

tube means, a switch for controlling said supply of commercial power for operating said space discharge tube means, an output connection for said convertor for delivering said carrier frequency to said radio receiver at a converted frequency, an antenna circuit, and means carried by said convertor for operably connecting said radio receiver with said antenna circuit or with said output connection for reproduction of programs.

6. A convertor in accordance with claim 5

carrying an attachment for connection with the power supply cable of said receiver and including a circuit to said convertor power supply cable, said circuit including an impedance for restricting the passage of carrier frequency energy from said power supply cable to said attachment for preventing transfer of carrier frequency energy between said convertor power supply cable and said radio receiver.

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