March 29, 1932. E. E. CLEMENT 1,851,495

RADIO BROADCAST DISTRIBUTION

Filed Aug. 5. 1927 2 Sheets-Sheet 1

Fig. 1.

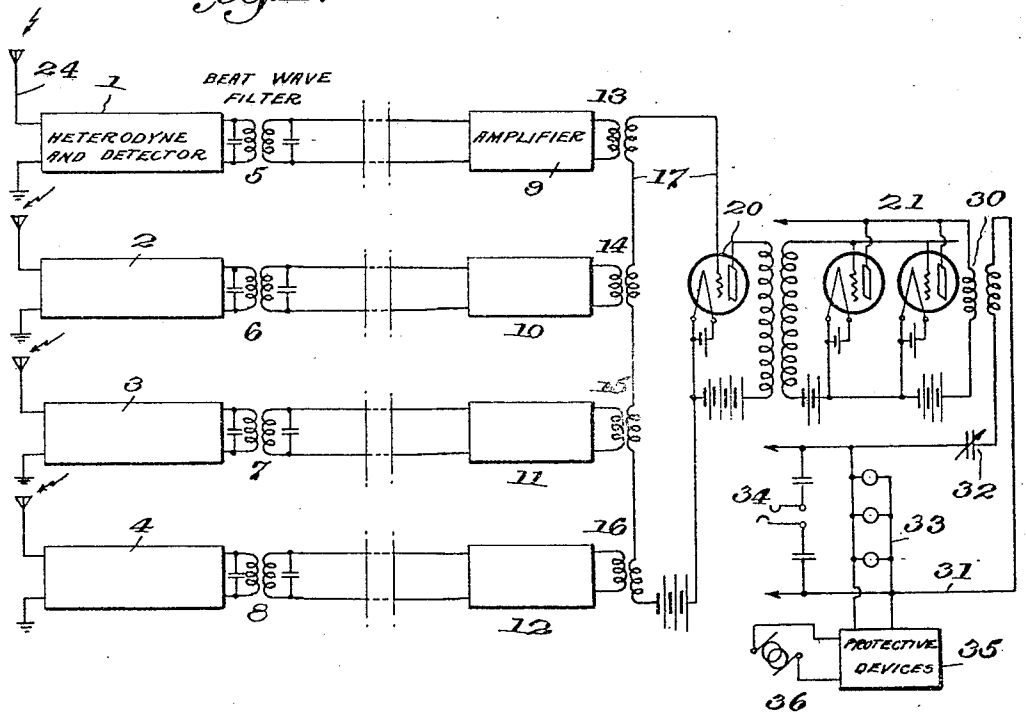
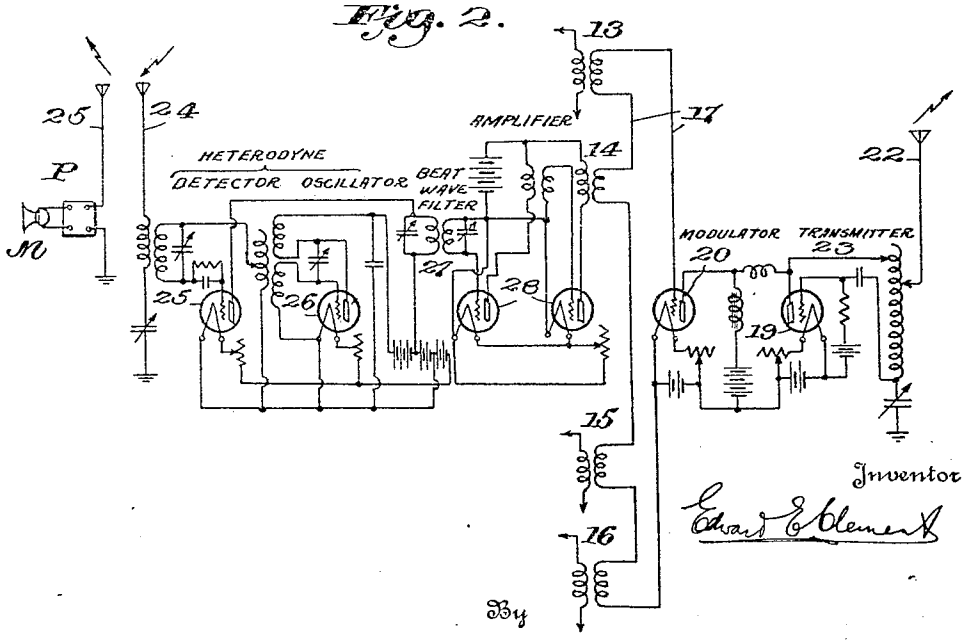


Fig. 2.



Inventor

Edward E. Clement

By

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Filed Aug. 5, 1927 2 Sheets-Sheet 2

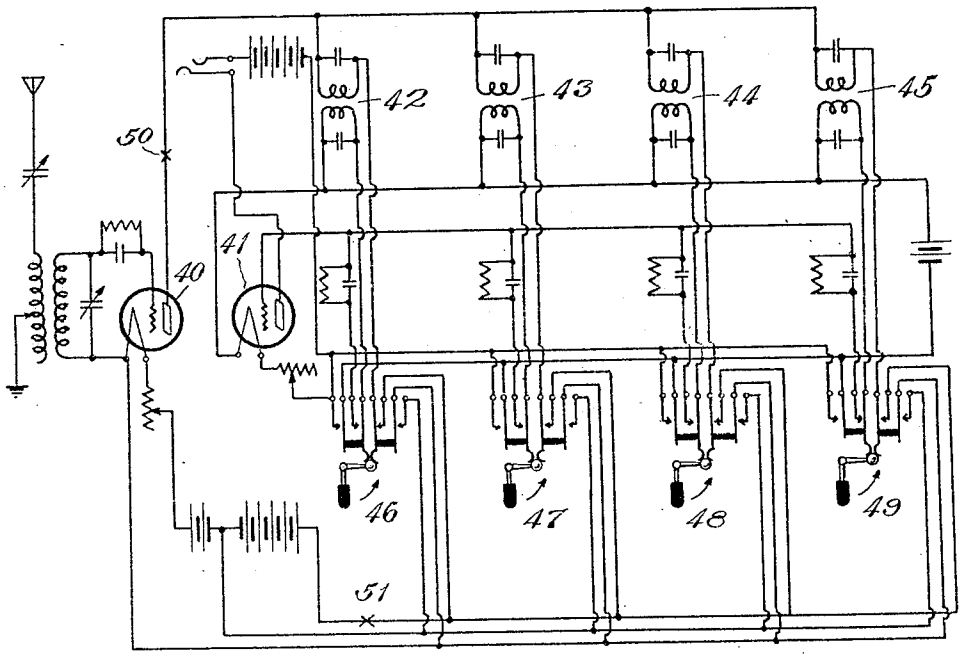

Fig. 3.

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Patented Mar. 29, 1932 1,851,495

UNITED STATES PATENT OFFICE

EDWARD E. CLEMENT, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO EDWARD F. COLLADAY, OF WASHINGTON, DISTRICT OF COLUMBIA

RADIO BROADCAST DISTRIBUTION

Application filed August 5, 1927. Serial No. 210,911.

My invention relates to radio and radio-wire broadcasting, and has for its object the distribution of programs economically and efficiently. The application is in the nature of a continuation in part of each of my two prior copending applications, Serial No. 746,358, filed October 28, 1924, issued as Patent No. 1,672,372, June 5, 1928, and Serial No. 47,546, filed August 1, 1925, isued as Patent No. 1,777,690, October 7, 1930. I attain my object by using certain methods disclosed in said prior applications, combined herein as follows: A central office is equipped to serve a plurality of local stations, by way of receiving and relaying to them the programs from other transmitting stations, a plurality of programs being presented simultaneously for selection. Relaying is effected by means of instruments which change the frequencies of the different carrier waves received from relatively high or radio frequencies to relatively low or intermediate frequencies, which however are super-audio and which are suitable for retransmission to the subscribers, either over wires or as plural modulations on a second high frequency carrier wave. If distributed by wire, the subscriber needs only a single detector, but if radiated on a carrier wave, his instrument must be a double detector, the first detector taking off the long wave and the second detector taking off the audio modulations. In either case the subscriber must have tuned or tunable means for selecting the particular intermediate frequency, and thereby the particular program, he desires.

My invention is illustrated in the accompanying drawings, in which

Fig. 1 is a diagram of a relay station equipped with my invention for receiving and distributing programs on different intermediate or beat wave lengths over wire circuits.

Fig. 2 is a similar diagram showing the circuits of a heterodyne receiver and its connection to modulating and radiating circuits, for plural transmission of collected programs on a single carrier wave.

Fig. 3 is a similar diagram of a subscriber's selective receiver for use in the system of Fig. 2.

Referring to Fig. 1, the numerals 1, 2, 3 and 4 designate four heterodyne receivers, each of the type shown in Fig. 2, and all, as regards their collecting or input circuits 24, tuned to different frequencies and receiving different programs. Each of these sets includes a detector tube 25 with a tunable circuit, (see Fig. 2), an oscillator 26 with a tunable circuit, a filter coupler 27 tuned for a distinctive beat wave, and an amplifier shown as a pair of tubes 28. In Fig. 1, for convenience, the first detector and oscillator units of the respective sets are designated as 1, 2, 3 and 4, the respective filter couplers as 5, 6, 7 and 8, and the amplifiers as 9, 10, 11 and 12. These amplifiers are coupled through coils 13, 14, 15 and 16, to a common circuit 17, which constitutes the input or grid circuit of a collecting or amplifying tube 20, whose plate circuit is coupled to a suitable set of power tubes 21, whose output terminals in turn are coupled at 30 to the wire circuit 31, symbolizing a line or network of electric light or other wires. 32 is a condenser of low capacity in said circuit to keep low frequency current off the radio circuits; and 35 indicates the usual protective devices, fuses, etc. to keep the high frequency waves off the electric light mains and also to afford additional protection from any surging or disturbance in the mains. The power supply is indicated at 36. 34 shows a jack, by means of which the subscriber's receiving set may be connected across the circuit 31, also through low capacity condensers.

In operation, the system of Fig. 1 works as follows: The collector circuits 24 are tuned to receive from four different stations, which may be near or far. The four filter couplers 5, 6, 7 and 8 are fixedly tuned to the four beat frequencies to be employed. By tuning the oscillating circuits to heterodyne with the incoming carrier waves, the four modulated beat waves pass to the amplifiers 9, 10, 11 and 12, and so to the tube 20 and the power tubes 21, from which all four sets of modulated waves are transmitted through coupler 30 to the circuit 31.

The subscriber, using a tunable detector set of ordinary type, plugged into jack 34, may select the particular frequency, and thereby

the particular program he desires, and may detect off and hear the same. A suitable type of instrument for this purpose is indicated in Fig. 3*g* of Letters Patent 1,635,153 granted to me July 5, 1927.

The system of Fig. 2 works as follows: each heterodyne receiver collects the carrier waves from the primary stations, reduces the frequency of the same by heterodyning to produce a modulated beat wave of the proper frequency to pass through the filter coupler 27. This modulated beat wave is then amplified in the tubes 28 and passed to the circuit 17 through the coupler 14. Other signals from other primary stations are received on other heterodyne instruments, similar in every respect to the one illustrated in Fig. 2, but having their filter couplers 27 tuned to different frequencies therefrom. These other instruments are connected through the couplings 13, 15 and 16 to the circuit 17, the arrangement up to this point being similar in every respect to that shown in Fig. 1. In Fig. 2 however, it is intended to reradiate the signal modulated carriers received, as plural modulations on another single carrier wave. Hence the circuit 17 is connected to the input or grid and filament terminals of the modulator tube 20 whose plate circuit is connected up in a well known manner to the circuits of the oscillator tube 19, forming part of the transmission circuit 23 connected to the radiator 22. Any other desired and suitable modulator and transmitter circuit may be substituted without departing from the invention. The beat waves from the four heterodyne instruments, each modulated with its own program, from its own station, are thus all imposed by plural modulation through the tube 20 on the carrier wave produced by the tube 19 and radiated from the circuit 22. For selecting and receiving these signals the subscriber must be provided with a first and second detector, with means to tune the first detector circuit to the frequency of the carrier wave radiated from antenna 22 in Fig. 2; and means to tune the second detector circuit at will to anyone of the four frequencies of the beat waves modulated on said carrier. By thus tuning anyone of the beat waves can be selected, and the second detector will then take off the audio signal waves which can be rendered audible in a suitable telephonic instrument. As an alternative and in order to avoid tuning of the secondary or second selector circuits, I may make use of the receiving circuits illustrated and described in my prior copending application Serial No. 31,928. In Fig. 3 of this application, I have shown the first detector and its tunable input circuit connected to the antenna and its plate circuit extending to four tuned filter couplers each adapted to receive one of the four intermediate or beat wave frequencies transmitted from the apparatus of Fig. 2. A second detector tube has its input circuit also extending to all four of the couplers on secondary sides thereof, and four switching keys are provided for the purpose of connecting any desired one of said filter couplers, both with the plate circuit of the first detector and with the grid circuit of the second detector. It may be noted that in the figure referred to, a separate grid leak and condenser is provided with each filter coupler to be used in connection with the second detector. This apparatus while simple is very effective, and enables the subscriber to receive selectively by double demodulation anyone of the four original signals or programs relayed from the station in Fig. 2, by merely throwing a switch. In Fig. 3, the first detector is indicated at 40, the second detector at 41, the filter couplers at 42, 43, 44 and 45, and the switches for selecting programs at 46, 47, 48 and 49. It should be noted that by simply omitting the first detector 40, the key set becomes suitable for use in receiving the signals sent by wire from the relay of Fig. 1. In such case the wire ends 50, 51 in Fig. 3 at points *xx* would be connected across the circuit 31 of Fig. 1 in place of jack 34; or the wires 50—51 may terminate in a plug to fit jack 34.

What I claim is:

1. Apparatus for multiplex relaying of radio signals comprising a plurality of separate frequency changing receivers, each including a separate tuned collector circuit, an oscillator and a tuned first detector circuit, the frequency of said oscillator being adjustable to produce a constant frequency beat from high frequency waves received a common collecting circuit, a separate filter coupler tuned to the beat frequency of its own receiver, and connecting each receiver with said collecting circuit, a high frequency generating, modulating and radiating apparatus connected with said collecting circuit, whereby a plurality of separately received signals may be relayed as multiple modulations upon a single carrier wave.

2. Apparatus for multiplex relaying of radio signals which comprises a plurality of heterodyning receiving units each having a tuned collector circuit a first detector tube in a separately tuned circuit and an oscillator tube in a separately tuned circuit and a filter coupler permanently tuned to the beat frequency of its own receiver, a collecting circuit common to all of said receivers, transmitting links connecting the several filter couplers to said collecting circuit, a modulator tube having its input circuit connected to said collecting circuit and its output or plate circuit connected to a suitable transmitter and radiator, together with suitable sources of current supply.

In testimony whereof I hereunto affix my signature.

EDWARD E. CLEMENT.