Oct. 31, 1933. C. B. AIKEN ET AL 1,932,435

TRANSMISSION NETWORK

Filed Dec. 15, 1931 2 Sheets-Sheet 1

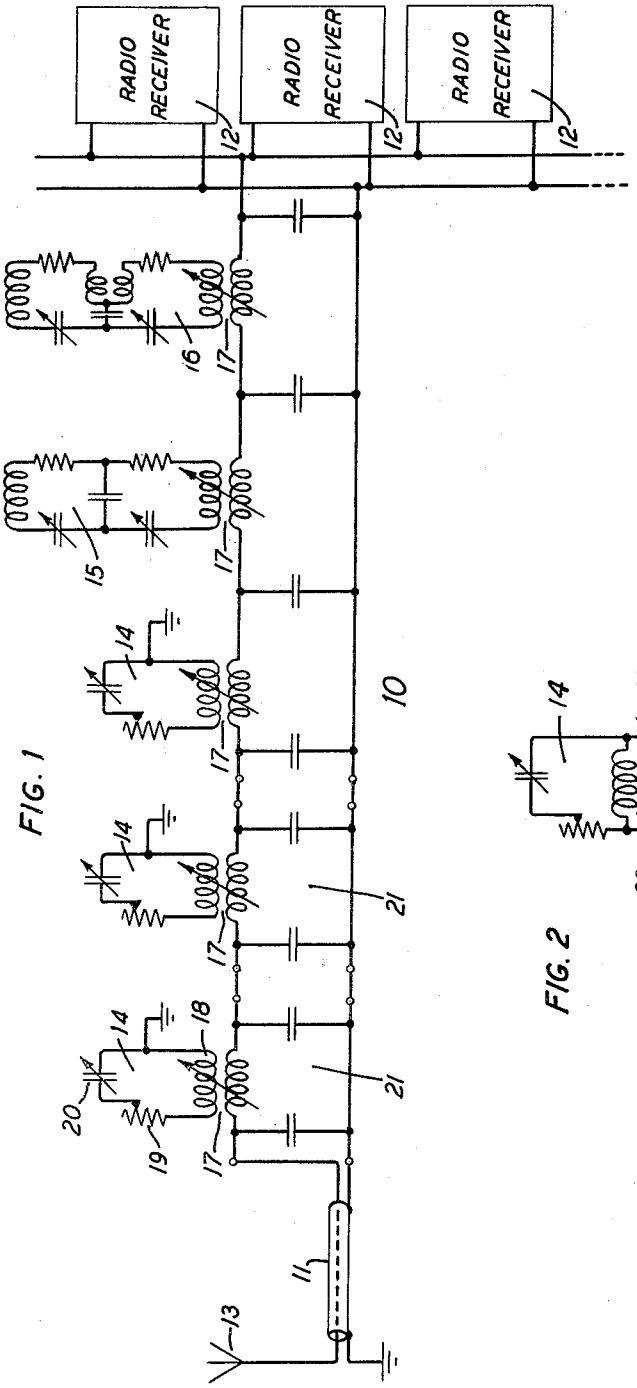

FIG. 1

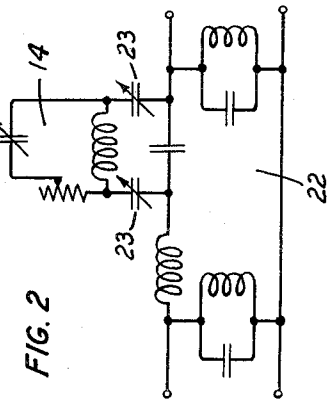

FIG. 2

INVENTORS: C.B.AIKEN
J.E.CORBIN

BY G. H. Stevenson

ATTORNEY

Oct. 31, 1933. C. B. AIKEN ET AL 1,932,435

TRANSMISSION NETWORK

Filed Dec. 15, 1931 2 Sheets-Sheet 2

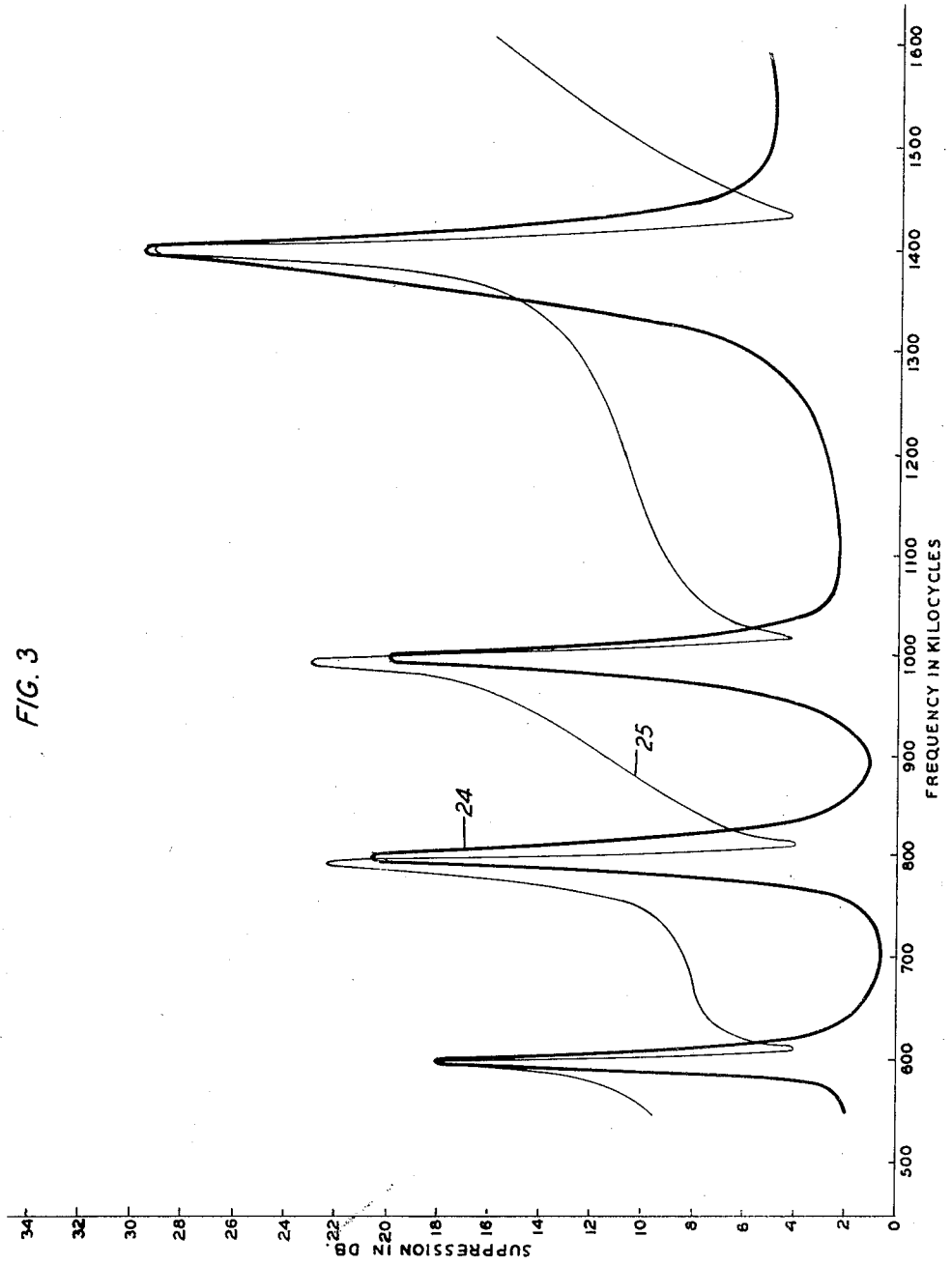

FIG. 3

INVENTORS: C.B. AIKEN
J.E. CORBIN

BY

G. H. Stevenson

ATTORNEY

Patented Oct. 31, 1933 1,932,435

UNITED STATES PATENT OFFICE

1,932,435

TRANSMISSION NETWORK

Charles B. Aiken, New York, and Joseph E. Corbin, Jackson Heights, N. Y., assignors to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application December 15, 1931
Serial No. 581,118

5 Claims. (Cl. 178—44)

This invention relates to frequency selective transmission networks and more particularly to an arrangement for associating a plurality of wave-traps with a high frequency transmission line.

A problem which is of frequent occurrence in the reception of radio broadcast signals is that of tuning out the very strong signals received from near-by transmitting stations. In many cases there may be several of such stations having frequencies at different points in the broadcast range and for most efficient reception it is desirable that their signal strengths should be diminished effectively to a value more comparable to that of the other stations it is desired to receive. For this purpose selective wave-traps have been used, but when more than one is required, it is found that the signals from other stations may be unduly attenuated by the traps.

In accordance with the present invention, a low-pass filter or a broad-band filter adapted to transmit the whole range of signals to be received is inserted in the high frequency circuit between an antenna and a receiving set and suppression of very strong signals in this range is effected by the use of wave-traps loosely coupled to impedances in each filter section. The degree of suppression is preferably controlled by adjustment of the coupling between the wave-trap and the filter section, but control may also be had by adjustment of a resistance in the trap circuit. The several traps may be tuned to the frequencies of different stations, or two or more may be tuned to the same station depending upon the degree of attenuation desired. The traps may comprise simple, closed tuned circuits or a band suppression effect can be obtained by using coupled circuit arrangements.

The invention is described in detail hereinafter with reference to the drawings in which:

Fig. 1 shows a radio frequency distribution and receiving system embodying the invention;

Fig. 2 shows an alternative form of the network of the invention; and,

Fig. 3 is a graph showing operating results with and without the use of the invention.

In Fig. 1 the network 10 is a low-pass filter of the conventional type comprising a plurality of sections. This network serves to transmit signals between a high frequency transmission line 11 and an antenna 13 and one or more radio receiving sets 12, 12. It is designed to transmit the whole range of signal frequencies to which the receivers can be tuned, for example, frequencies up to 1500 kilocycles including the radio broadcast range. Wave-traps 14, 15 and 16 are coupled to the series inductances of the respective filter sections by variable mutual inductive couplings as at 17, 17. Wave-traps 14, 14 comprise simple, closed tuned circuits each including a fixed inductance 18, a variable resistance 19 and a variable capacity 20. Traps 15 and 16 comprise coupled circuit arrangements having adjustable tuning elements.

Filter section 21 is separable from the remainder of network 10 and in combination with wave-trap 14 constitutes a unitary transmission device. A number of these units may be assembled to form a complete system such as network 10.

In the operation of the system shown in Fig. 1, the wave-traps 14, 14, 15, 16 are tuned in the usual manner to resonate with any incoming signals which it is desirable to attenuate or suppress. The several traps may be tuned to different stations or two or more may be tuned to the same station. Coupled circuit arrangements such as 15, 16 are used in place of the simple circuit 14 when it is necessary to avoid unequal suppression of the carrier and the side-bands. A band suppression effect can also be obtained by slightly staggering the tuning of several simple traps such as 14, 14.

The degree of attenuation or suppression may be controlled by adjustment of the coupling between the trap and the filter section, or by adjustment of the trap circuit resistance. To promote good selectivity the resistance is preferably kept small and the adjustment effected by varying the coupling. Adjustment of the resistance is also effective to modify the shape of the resonant curve of the section. By means of the resistance sharply resonant peaks may be rounded off to effect a more nearly uniform suppression characteristic throughout the region of resonance.

It has been found that as long as the mutual couplings at 17, 17 are kept fairly small, the wave-traps have a negligible disturbing effect upon the transmission characteristics of the filter or network 10 except at the suppression frequencies. This result is well illustrated by the curves of Fig. 3, in which the heavy curve 24 is secured with a system comprising four sections of the type of section 21, each tuned to a different frequency in the broadcasting range. The light curve 25 is secured with the same system modified by removing the shunt condensers from the filter 10 leaving the wave-traps coupled to the series inductances. The heavy curve shows a considerable reduction in the transmission loss

between the suppression frequencies. The coupling may be varied within a considerable range of low values thereby correspondingly varying the degree of supression without measurably affecting either the transmission of the filter 10, in the regions between suppression frequencies or disturbing the tuning of the individual traps.

In many receiving locations it is the case that very strong signals are impressed upon the receiving antenna from one or more especially powerful or close-by transmitting stations. A plurality of wave-traps may be required and it may be desirable to attenuate the various signals to different degrees. For this purpose one or more of the wave-traps 14, 15, 16 are particularly useful and are adapted to be associated together without interfering with the reception of signals from other stations. The transmission characteristic of the filter 10 insures a small or negligible attenuation for all signals except those for which one or more traps are tuned. Because of the substantial independence of the filter from the action of the wave-traps, there is no material increase in the attenuation of desired signals due to the presence of wave-traps tuned for other frequencies.

Fig. 2 shows a section 22 of a broad-band filter to which a simple wave-trap 14 is coupled capacitatively by the coupling condensers 23, 23. The section 22 may be substituted for any section such as 21 of filter 10. The broad-band filter is designed to transmit the whole range of signals to be received. The degree of coupling between section 22 and trap 14 can be varied by adjustment of the coupling condensers 23, 23. The entire filter 10 may be replaced by units such as that disclosed in Fig. 2 and the trap 14 may be replaced by any other type of wave-trap circuit including traps 15 and 16 as shown in Fig. 1.

What is claimed is:

1. A transmission network comprising a low-pass filter having a plurality of sections, each containing an inductive series component, a plurality of tuned suppression circuits, inductive coupling means for associating each suppression circuit with one of said inductive series components, and means for independently adjusting a plurality of said coupling means to control the degree of suppression exerted by the suppression circuit associated with the respective coupling means.

2. An input circuit for a radio receiving system comprising a filter having a plurality of sections each including a series reactance and a shunt reactance, the components of said filter being proportioned to provide a broad transmission band, and a plurality of tuned circuits each loosely coupled to a section of said filter to provide suppression of individual frequencies within said band while maintaining the transmission characteristic of the filter otherwise substantially unaffected.

3. An input circuit for a radio receiver comprising a filter having a plurality of sections each including a series reactance and a shunt reactance, said filter being designed to provide a broad transmission band, a plurality of tuned circuits loosely coupled to the respective sections of said filter to provide attenuation of individual frequencies within said band while maintaining the transmission characteristic of the filter otherwise substantially unaffected, and means for varying the coupling of an individual tuned circuit to adjust the degree of attenuation of the corresponding frequency.

4. An input circuit for a radio receiving system comprising a filter having a plurality of sections each including a series reactance and a shunt reactance, the components of said filter being proportioned to provide a broad transmission band, and a plurality of tuned circuits each loosely coupled to a section of said filter and each coupled with a different degree of coupling to provide unequal attenuation of a plurality of individual frequencies within the transmission band while maintaining the transmission characteristic of the filter otherwise substantially unaffected.

5. An input circuit for a radio receiving system comprising a low pass filter having a plurality of sections, each section containing a series inductance and a shunt capacity, said inductances and capacities being proportioned to provide a broad transmission range, and a plurality of tuned circuits each coupled by loose inductive coupling to the series inductance of a section of said filter to provide suppression of individual frequencies within the transmission range of the filter while maintaining the filter characteristic otherwise substantially unaffected.

CHARLES B. AIKEN.
JOSEPH E. CORBIN.