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TRANSMISSION OF SOUND CURRENTS

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Fig. 1.

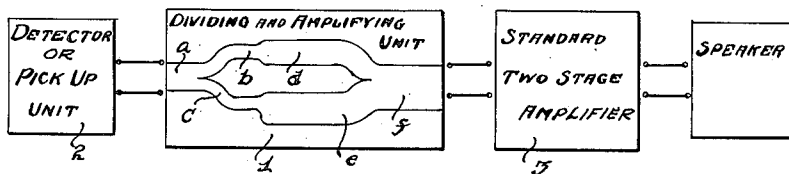


Fig. 2.

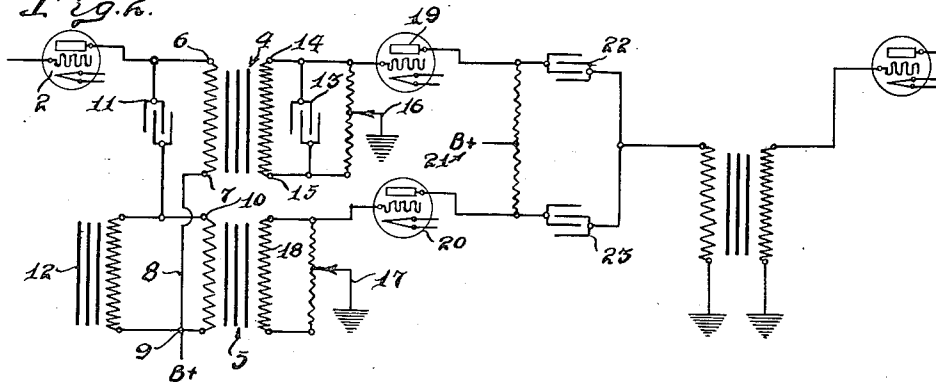
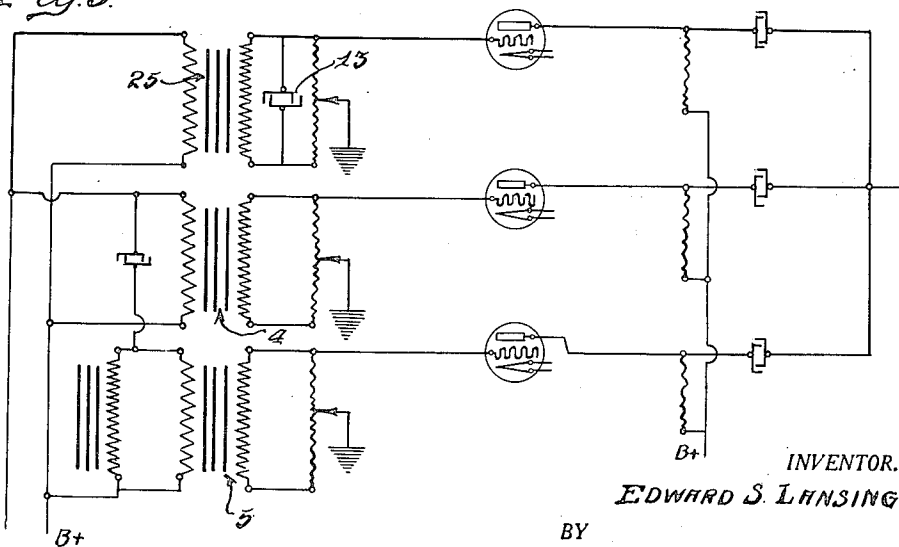


Fig. 3.



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TRANSMISSION OF SOUND CURRENTS

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10 Claims. (Cl. 179—1)

This invention relates to the transmission of sound currents, and has to do particularly with the dividing and amplifying of sound currents in recording and reproducing devices of various types.

Heretofore in the reproduction of sound by radio receiving sets and similar sound reproducing devices a very serious problem has been presented in obtaining a reproduction which in any way simulates the original source of sound. The difficulty of reproducing and amplifying low frequency notes is well recognized and in modern reproducing units wherein the sound waves are transmitted by alternating electric currents attempts have been made to bring out these low frequency notes by providing sufficient power to give greater amplification. However, the power required to properly sound the low notes in dynamic loud speakers and the like is much greater than the power required for sounding the high frequency notes, with the result that the high frequency notes are appreciably distorted.

More recently attempts have been made to obviate this distortion by attempting to accentuate or emphasize either the bass or treble notes, but the difficulty in all such attempts has been that the characteristics and quality of the original musical sound are changed. In other words, these attempts to emphasize either the bass or treble notes are generally based on the shifting of the pitch.

It is known that a condenser will pass alternating currents of high frequency and bypass a large percentage of the low frequency currents while contrariwise a choke coil will absorb or pass alternating currents of low frequency and shut off or bypass those of high frequency. The above principles have been utilized experimentally in attempting to obtain separation of the low and high frequency notes and attempts have also been made experimentally to amplify some frequencies that have been separated to control the relative intensity given different frequencies. However, so far as I am aware, these latter attempts have not been entirely successful, one reason being apparently because complete clear separation of high and low frequencies was not obtained, and another apparent reason being because very little amplification was given such frequencies as were separated.

It is the object of the present invention to provide means placed ahead of any standard reproducing and/or amplifying device for positively dividing the transmitted musical tones transmitting said positively divided frequencies as true

and clear duplicates of the original source of sound and then positively amplifying the divided and transmitted frequencies so as to obtain any desired individual amplification of the divided high and low frequencies. The invention resides both in the method for obtaining this individual division and amplification and the novel hook-up for making this method possible.

Specific features of my invention reside in the use of a plurality of transformers, preferably of varying ratios, in combination with a novel manner of connecting said transformers in parallel to a condenser. Other features reside in the manner of connecting transformers to eliminate any sound connection therebetween, the manner of arranging a choke coil relative to the high frequency transformer and the manner of connecting the B current supply for the detector so as to eliminate all muddiness in the high frequency transformer. Other features embody the use of a novel electrical balancing network for the transformers to insure positive amplification of approximately one stage and the individual control of each transformer output with a variable resistance center tap connected to ground. Other novel features will be more clearly brought out in the specification and claims.

In the drawing:

Fig. 1 is a schematic layout of one manner of connecting my dividing and amplifying unit in between a standard detector or pick up and a standard amplifier.

Fig. 2 represents a diagrammatic wiring diagram of the preferred arrangement of my novel dividing and amplifying system.

Fig. 3 is a diagrammatic layout similar to Fig. 2 but illustrating a system giving more complete control in that it separates the frequency range into three or more divisions.

In explaining the method of operation of my novel hook-up, the same will be preferably shown and described as embodied in a typical standard radio receiving unit and the relative arrangement of parts is best illustrated in the schematic layout of Fig. 1. Here my unit, which I will call a dividing and amplifying unit, is shown as at 1 connected between the detector or pick up unit 2 and a standard amplifier unit 3. The unit 1 is shown in Fig. 1 in the manner of a flow chart measured in intensity, the sound current being shown entering the unit at *a* with the standard intensity. The high and low frequencies are positively divided as at *b* and *c* and these divided frequencies may then be amplified or regulated to any desired amount; in Fig. 1 the high fre-

quency tones are being only slightly amplified as at *d* while the low frequency tones are amplified to a greater extent as at *e*. The clear and individually amplified high and low frequencies are then joined together in one band as at *f* when they are fed into the standard amplifier 3 correctly modified as to relative intensity and at the same time being a true duplicate as to quality and pitch of the original source of sound.

The method of positively dividing and individually regulating and amplifying the divided sound waves may be best understood by describing the diagram as shown in Fig. 2. For general use I preferably use two transformers 4 and 5, the transformer 4 preferably having a ratio of $3\frac{1}{2}$ to 1 and the transformer 5 having a ratio of $3\frac{1}{2}$ to $\frac{1}{2}$. Any standard detector or pick up device 2 is directly connected to the terminals 6 on the primary of the first transformer 4. The other terminal 7 of the primary is connected by means of the wire 8 to a terminal 9 to which terminal is connected the B supply.

It will thus be obvious that the transformers 4 and 5 are connected in parallel and there is no sound connection between the terminal 7 of the transformer 4 and the terminal 10 of the primary of transformer 5. It will also be obvious that the B current will be fed through the wire 8 so as to be completely bypassed around the transformer 5 with the result that the B current can be fed only through the primary of the transformer 4 and then to the detector. This latter feature is very important as will be presently pointed out. The transformers 4 and 5 are connected in parallel with one another through a .1 mfd. condenser. The high frequency sound currents from the detector 2 will readily pass through the condenser 11, and the majority of the low frequency sound waves will be deflected so they will pass through the primary of the transformer 4, this transformer becoming a low frequency transformer.

In the preferred arrangement all of the frequencies are divided approximately in the center with the result that practically all of the sound waves having a frequency which places them below the center of the musical scale will be transmitted to the primary of the transformer 4. As the terminal 7 of the primary does not have a sound connection with the second transformer 5, it will be obvious that there will be no strays transmitted from the primary of the transformer 4 to the primary of the transformer 5. Thus the division of the low frequency tones is complete.

The notes of high frequency will pass through the condenser 11 and what few low frequency currents should pass through the condenser will be absorbed by a choke coil 12. Thus by the use of a parallel connected condenser, a choke coil 12 and the bypassing of the wire 8 around the high frequency transformer, it will be obvious that only the true undistorted high frequency currents will be passed through the primary of the transformer 5.

I believe that the reason for obtaining my markedly better results with transformers of different ratios is because the low frequency notes require greater amplification. Possibly there may be other reasons for this result but the fact remains that better results are obtained by using transformers of a different ratio and preferably of the ratio indicated. I find that because of the three means utilized for keeping the low frequency currents out of the trans-

former 5 and because of the by-passing of the B current that all muddiness in the high frequency transformer 5 is eliminated. Because I have eliminated any sound connection between the transformers better low frequency quality is obtained because I have eliminated the possibility of any high frequency currents or electrical strays breaking back into the low frequency transformer.

A .01 mfd. condenser 13 is connected across the terminals 14 and 15 of the secondary of the transformer 4 to filter out any possible high frequency notes that may pass through the secondary and any such bypassed high frequency notes are conducted to the ground of the variable resistance 16. Not only does this variable resistance 16 control the amplifying of the low frequency notes but the connecting of the same with the ground is found to give very good results. A similar variable resistance center tap 17 is connected across the terminals of the secondary 18 of the high frequency transformer to obtain adjustable amplification of the high frequency notes. I consider that this adjustment of the high frequency tones is one of the most important elements in the present system and contributes materially in the final results obtained. It will thus be seen that any combination of the high frequency and low frequency tones may be obtained by varying the power intensity or amplification of each individual transformer.

In transmitting and combining the separately controlled high and low frequencies the secondary of the transformer 4 is connected directly to the grid of a 27 or 201—A tube 19, and the secondary 18 of the high frequency transformer 5 connected directly to the grid of a similar tube 20. If the plates of these tubes were tied together at this point it will be obvious that there is no appreciable gain. I have discovered that if the plates are each connected to a B supply 21 through a 100,000 ohm fixed resistance and then connected together thereto to separate condensers 22 and 23, of preferably 1 mfd. capacity, I get a gain of substantially one stage. The properly amplified individual sound currents are thus combined in the proper phased balance and from this point may be fed into a standard audio amplifier to be amplified for use in the loud speaker. It will be obvious that because of the inherent amplification in my novel dividing and amplifying unit that the amplifying efficiency of the standard amplifier may be materially increased, thus permitting in many cases the discontinuance of the standard first stage of audio entirely.

In Fig. 3, I have illustrated a modification of my system as adapted especially for theatres and providing accurate acoustical balance therefor. The wiring diagram as roughly illustrated in Fig. 3 is substantially identical with that shown in Fig. 2 with the exception that an additional transformer 25 is added for the very low frequency currents and the transformer 4 becomes an intermediate transformer, the high frequency bypass condenser 13 being connected across the secondary of the transformer 25.

What I claim is:

1. The method of dividing and amplifying sound currents transmitted through a single channel without changing their original tonal characteristics as broadcast or recorded, which comprises transmitting sound currents of all the created frequencies from a common source through a single channel, substantially complete-

ly separating the combined sound currents into a plurality of component parts maintaining said division and amplifying said parts individually through a variable range and reproducing the sound currents through a single channel amplifier and single speaker with their component parts of unequal frequency ranges.

2. The method of dividing and amplifying sound currents transmitted through a single channel, which comprises transmitting sound currents of all the created frequencies from a common source through a single channel, separating the combined sound currents into a plurality of component parts, one of said parts being composed of currents of relatively low frequencies and another of relatively high frequencies, changing the volume of one frequency relative to the other, maintaining the relatively high frequency component at its fixed volume and maintaining the relatively low frequency component at its fixed volume, amplifying and then reproducing said sound currents through a single channel amplifier and single speaker at their relatively fixed values.

3. The method of dividing and amplifying alternating current sound frequencies transmitted through a single channel which consists in transmitting sound currents of all the created frequencies from a common source through a single channel, separating the combined frequencies into a plurality of components, changing the relative volume of said components, individually controlling the frequency range of the separated components, individually maintaining controlled range of each component, combining the components in phase with each other, and then amplifying before reproduction.

4. In a sound frequency dividing and amplifying system of the class described the combination of high and low frequency transformers of different ratios having their primaries connected together in parallel through a condenser of a value adapted to pass substantially all of the high frequency currents, a choke in parallel with the primary of the high frequency transformer, the low frequency transformer having a condenser bypass across the secondary, frequency range control means connected in parallel across the secondaries of each transformer, and valves for maintaining the separated frequency ranges before combining, and means for amplifying the combined frequencies before reproduction.

5. In a sound frequency dividing and amplifying system of the class described the combination of high and low frequency transformers having their primaries connected together in parallel through a condenser of a value adapted to pass substantially all of the high frequency currents, a choke in parallel with the primary of the high frequency transformer, the low frequency transformer having a grounded variable center tap condenser bypass across the secondary, and a resistance connected in parallel with said condenser and said secondary, the secondaries of said transformers being completely separated, and a fixed resistance and condensers combining the separate leads from the secondaries.

6. In a sound frequency dividing and amplifying system of the class described, the combination of high and low frequency transformers having their primaries connected together in parallel through a condenser of a value adapted to pass

substantially all of the high frequency currents, a choke in parallel with the primary of the high frequency transformer, the low frequency transformer having a condenser bypass across the secondary, resistances for controlling the individual frequency ranges connected in parallel across each transformer and having a grounded variable center tap, the secondaries of said transformers being completely separated, and a fixed resistance and condensers combining the separate leads from the secondaries.

7. A device for controlling the amplification of individual frequency currents comprising a plurality of transformers of different ratios, means for separating and feeding currents of different frequencies to transformers of predetermined value, means for supplying B current to one transformer only, means for variably and individually controlling the range of the sound frequencies transmitted by each transformer, valves separately connected to the secondaries of each transformer for maintaining each frequency range, a resistance coupling for combining the separate maintained frequencies, and means for amplifying the combined frequencies before reproduction.

8. A device for controlling the amplification of individual frequency currents comprising a plurality of transformers of different ratios, means including a condenser in parallel with one secondary, a choke in parallel with one primary for separating and feeding currents of different frequencies to predetermined transformers, means for variably controlling the range of the sound frequencies transmitted by each transformer, the secondaries of said transformers being completely separated, and a fixed resistance and condensers combining the separate leads from the secondaries.

9. A device for controlling the amplification of individual frequency currents comprising a plurality of parallel connected transformers of different ratios, means including a condenser in parallel with one secondary, a choke in parallel with one primary for separating and feeding currents of different frequencies to predetermined transformers, means for variably and individually controlling the range of the sound frequencies by each transformer, valves separately connected to the secondaries of each transformer for maintaining each frequency range, a resistance coupling for combining the separate maintained frequencies, and means for amplifying the combined frequencies before reproduction.

10. In a sound frequency dividing and amplifying system of the class described, the combination of high and low frequency transformers connected together in parallel to permit passing of sound currents, the low frequency transformer having a condenser by-pass across the secondary, a variable resistance connected in parallel with said condenser and low frequency transformer and a separate resistance connected in parallel with said high frequency transformer for variably controlling the range of sound frequencies transmitted by each transformer, reproducing means, means combining said frequency ranges, and amplifying means between the combining and reproducing means.