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M. OSNOS

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TRANSMISSION SYSTEM

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Fig. 1

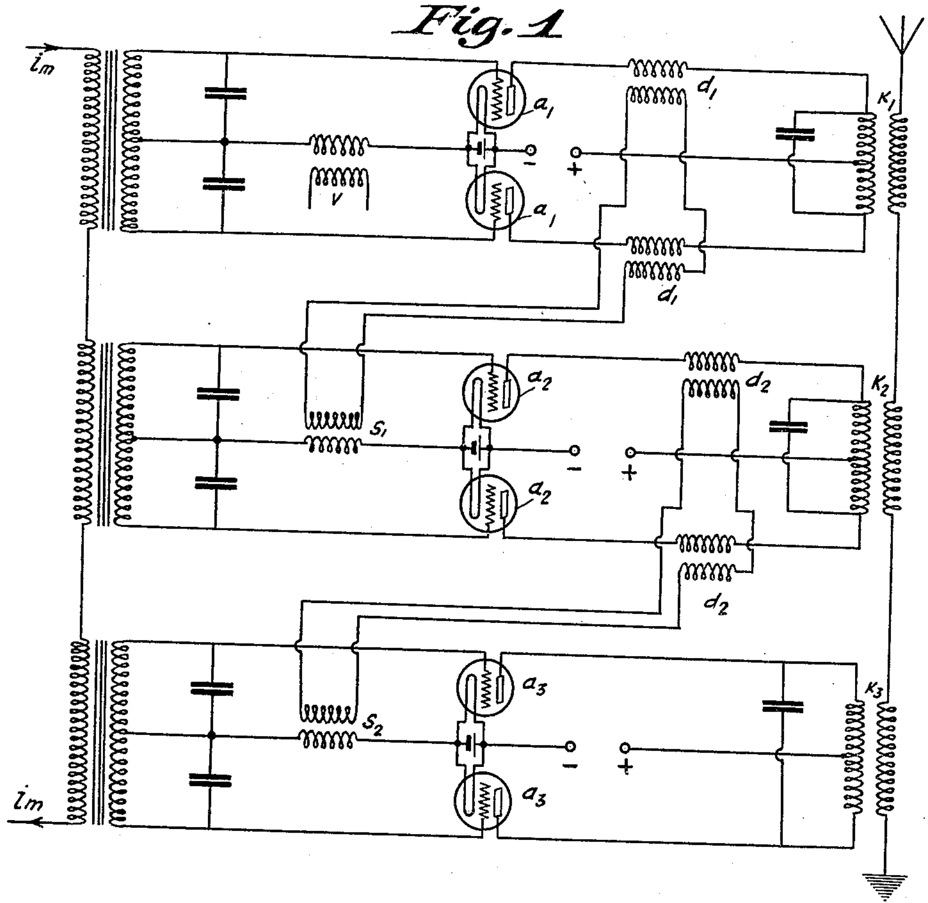
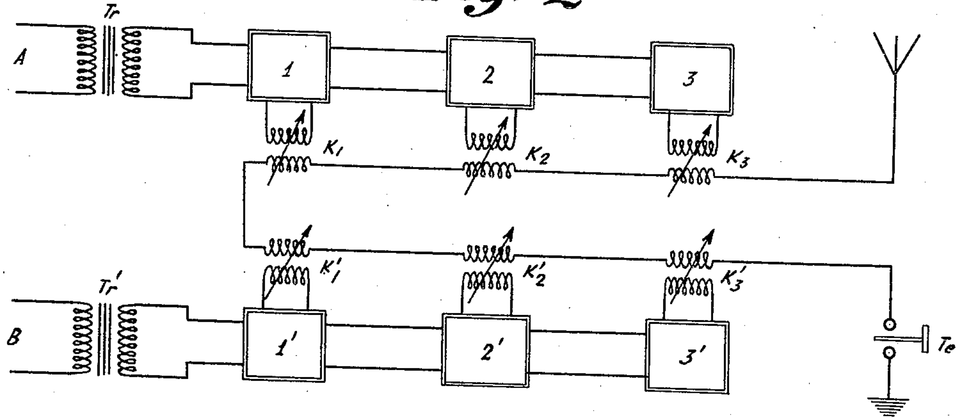


Fig. 2



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UNITED STATES PATENT OFFICE

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TRANSMISSION SYSTEM

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The present invention discloses ways and means adapted to improve telephony work especially in radio transmission on waves customarily used in radio work, including ultra-short waves.

One difficulty connected with telephony as heretofore practiced, as is well known, consists in the distortion of the timbre of different sounds in music transmissions and the frequent absence of consonants in voice transmission. Both are due to the fact that the overtones or high harmonics which are responsible for the timbre and characteristic for consonants, are wholly or partly lost in the course of transmission.

According to the present invention, between two convenient parts of a sending station equipment or a receiver a transfer element is inserted which, on the one hand, receives the currents influenced by music or the like, and which, on the other hand, supplies currents whereby the part to be supplied is so influenced that the overtones imparting peculiarity and beauty to the voice, music, etc., and which normally are of but feeble value, are amplified, while those originally not existing and those totally lacking are produced or restored.

The basic idea of the invention will be more readily understood from what follows:

Suppose the overtones in a transmission of music which impart to the musical instrument in question its peculiar and typical timbre, have been more or less weakened; the result of course is a natural impairment of the timbre. Now, according to the invention, this fundamental wave or a part thereof can be filtered out in well-known manner and be fed to the transfer element heretofore mentioned and to be described later, while in the latter the weakened overtones, according to the reason underlying their original reduction in volume, can be amplified or reinforced. The overtones thus amplified are then fed into a suitable part of the transmitter or receiver, with the result that perfect timbre of the instrument is restored.

If the overtones of several fundamental waves are weakened, then the identical procedure or treatment is adopted for each one thereof and the corresponding overtones.

Now, the overtones insuring a good timbre are not only capable of being amplified to a certain degree, but they can be reinforced to any desired degree. It is thus feasible not only to produce an acceptable timbre, but to alter the timbre of the instrument at will to suit personal tastes.

However, it is to be distinctly understood that not only are the overtones existing in an instrument able to be amplified or altered in their intensity, but that also new overtones originally absent in these waves can be produced or added thereto with a view to improving the tonal qualities. In this manner the timbre of inherently deficient or defective instruments can be changed to suit personal tastes, or else their peculiarities can be changed into other ones.

For example, the tonal qualities of a musical transmission can be improved by causing the octaves corresponding to all or part of the existing frequencies to sound simultaneously.

Suppose it is possible to derive from an amplifier transformer modulating currents having frequencies $m1, m2, m3, m4 \ldots mk \ldots$ etc., then, according to this invention, it is feasible to generate other currents corresponding thereto and having the following frequencies:

$$2m1, 2m2, 2m3, 2m4 \ldots 2mk$$
$$4m1, 4m2, 4m3, 4m4 \ldots 4mk$$
$$8m1, 8m2, 8m3, 8m4 \ldots 8mk$$

In other words, the second, third, fourth etc. octave of all currents existing in the apparatus, all of these being fed simultaneously either to a single antenna or a single input circuit or else to separate antennae or input circuits. The intensity or amplitude of each octave, according to this invention, can be set at will and in a way independently of one another. Hence, a single voice, e.g., is divided into several parallel voices which render the identical musical piece, though in different keys or pitches.

If desired, it is likewise feasible to preclude one or more octaves from the antenna, including, if desired, the fundamental waves themselves. In this manner, a bass could be changed into a baritone or a tenor.

Tonal quality can be improved according to and within the spirit of this invention by that the frequencies of all of the currents derived from the apparatus are produced in the sequence of the major accord, 4:5:6. If again the frequencies existing in the amplifier are

(I) $m1, m2, m3, m4 \ldots mk \ldots$

then, in conformity with this disclosure all of these frequencies may be raised according to these series:

(II) $4m1, 4m2, 4m3, 4m4 \ldots 4mk \ldots$
(IV) $5m1, 5m2, 5m3, 5m4 \ldots 5mk \ldots$
(V) $6m1, 6m2, 6m3, 6m4 \ldots 6mk \ldots$

and then all of these frequencies are brought to act upon the following circuit or the transmitter antenna. A single voice is thus divided into four voices, one of which the fundamental voice, while the three others are "parallel" voices in major key.

The intensity of each series in turn can be adjusted at will, in the case of radio waves, inter alia, by altering the distance of mobile objects influencing the constants of the circuits either inductively or capacitively, for example, from a suitable tact-striking (metronamic) body or the hand of a conductor. Regulation of volume could be effected also periodically in accordance with any desired law by special means.

The generation of overtones could be insured, for instance, in the following manner. The acoustic frequencies $m1, m2, m3 \ldots$ of the voice or musical currents derived from an apparatus (for instance, telephone transformer, amplifier or the like), by the aid of a radio frequency N as is well known, result in radio frequencies

(I) $N\pm m1, N\pm m2, N\pm m3 \ldots$ etc.

By the aid of these radio frequencies, the said acoustic currents produce in the same manner as before a new series of radio frequencies, viz.:

(II) $N\pm 2m1,\ N\pm 2m2,\ N\pm 2m3$ etc.

From this series and the acoustic currents in an identical manner these radio frequencies may successively be obtained, to wit:

(III) $N\pm 3m1, N\pm 3m2, N\pm 3m3 \ldots$ etc.
(IV) $N\pm 4m1, N\pm 4m2, N\pm 4m3 \ldots$ etc.
(V) $N\pm 5m1, N\pm 5m2, N\pm 5m3 \ldots$ etc.
(VI) $N\pm 6m1, N\pm 6m2, N\pm 6m3 \ldots$ etc.

to be more precise, each of these series separately in a distinct circuit.

Now, the point is what overtones are to be generated. If the first and second octave of all acoustic frequencies shall be produced, then only those circuits are coupled with the antenna or the input circuit thereof in which the radio frequency series (II) and (IV) are produced.

If, on the contrary, the third, fourth and sixth overtones of all existing frequencies shall be generated, then III, IV, VI, etc. are coupled with the antenna or the input circuit.

The ensuing new frequency series are received in well-known manner in receiver apparatus whereby also according to known practice, the overtones:

$2m1, 2m2, 2m3 \ldots$ etc.
$4m1, 4m2, 4m3 \ldots$ etc.

and

$3m1, 3m2, 3m3 \ldots$ etc.
$4m1, 4m2, 4m3 \ldots$ etc.
$6m1, 6m2, 6m3 \ldots$ etc.

are made audible.

Other features and advantages of the invention will appear from the consideration of the following description taken in connection with the accompanying drawing, in which:—

Figure 1 diagrammatically illustrates a preferred embodiment of my invention; and,

Figure 2 illustrates a circuit adapted to perform a certain musical effect.

The first stage to produce frequencies $N\pm m^1,\ N\pm m2,\ N\pm m3 \ldots$ etc. consists most suitably of the well-known Carson scheme, which comprises two thermionic tubes a_1, a_1 the output circuits of which are in differential coupling relationship with the following circuit (antenna, input circuit of amplifiers, or the like), while their grid circuits are fed both with a radio frequency wave N as well as with a modulating frequency m which act upon the grids differentially relative to each other, for instance, in such a way that the grids are always acted upon by radio frequency N in the same sense and by the modulating frequency in opposite sense. The modulating currents influenced by voice, music or the like, im, contain at a given instant certain acoustic frequencies $m1, m2, m3 \ldots$ etc. which in known manner constitute the first serial stage of frequencies $N\pm m1, N\pm m2, N\pm m3 \ldots$ etc. Now, these frequencies can be transferred in known manner by coupling k_1 to the next circuit, say, the aerial. According to this invention, these series of frequencies are fed through coupler circuits d_1, s_1 to a second stage a_2, a_2 which is connected in a similar way as the first, and which is modulated by the same modulating currents im. In the output circuit of this second stage therefore arise these new frequencies $N\pm 2m1,\ N\pm 2m2,\ N\pm 2m3 \ldots$ etc. capable of resulting in a number of octaves to the original fundament waves, and which again through a coupler circuit d_2, s_2, could be fed to an additional similarly arranged stage a_3, a_3, where they produce in the output circuit these new frequency series $N \pm 3m1$, $N \pm 3m2$, $N \pm 3m3$ etc. The number of stages can be chosen at will, and the couplings k_1, k_2, k_3 . . . can be adjusted ad lib, or, if desired, some of them may be disconnected.

The arrangement hereinbefore described may be inserted not only between two parts of a transmitter, but also between two parts of a receiver set.

In Figure 2 I have illustrated a circuit in which two musically adapted though otherwise totally different melodies result in a fugue.

Two orchestras acoustically isolated and insulated from each other are playing in approximately the same pitch two melodies, say, one of them plays melody A and the other one melody B. In a manner known from the prior art, melody A is transferred to amplifier transformer T*r* and melody B to amplifier transformer T*r'*. Each of the transformers furthermore is associated, say, with a three-stage transfer means diagrammatically shown in Fig. 1 which in turn is associated with the sending antennæ through variable couplings k_1, k_2, k_3, and k_1, k_2, k_3, In order that each of these orchestras may be in proper contact with the respective other orchestra, telephone connection is established with each musician from the other room or hall. In a third room there is the conductor who, by the aid of a receiver apparatus T*e* (monitor device) is able to hear all of the notes acting upon the antenna, and who is able to influence at will the couplings k_1, k_2, k_3, and k_1', k_2', k_3', respectively either by the agency of a rhythm-maker or by his hand. The conductor is thus enabled to change ad libitum melody A and melody B from one pitch to another thus resulting in any desired fugue.

If he renders, for instance, the couplings k_2, k_3 corresponding to the higher pitches and couplers $k_{1'}$, $k_{2'}$ for the lower ones inoperative, then melody A will be fed to the aerial in its lower key, and melody B in its upper key (third octave). But if he does the same thing with couplings k_1, k_2, k_2', k_3', then conditions are reversed, i.e., melody will be transmitted in its upper key (third octave) and melody B in its lower key.

The idea underlying this invention is analogously applicable to a greater number of melodies and also to another number of stages.

The scheme shown in Figure 2 may be used at the receiving end instead of at the sending station.

At the sending end in this instance there are, as before, two orchestras playing acoustically separated and different melodies. The different melodies are transmitted to a distant point, say, by radio waves of different wave-length so that they may be received also at the receiving end separately in well known manner in different receiver and amplifier apparatus. At the receiving end, melody A is fed to the amplifier transformer T*r* and melody B to the amplifier transformer T*r'*, as previously described for the case where the method here disclosed is carried into practice at the sending end. Instead of the antenna, one has to conceive then the provision of a tuned receiver, and the listener instead of the conductor.

I claim:

1. The method of improving the tone and timbre in sound signals to be transmitted over a carrier frequency, which includes the steps of modulating said carrier frequency at signal frequency, selecting components of said modulating frequency and said carrier frequency having a frequency equal to the frequency of the carrier frequency plus the signal frequency, and modulating said components at signal frequency.

2. The method of increasing the range of modulating frequencies for improving the tone and timbre in sound transmitted by means of a plurality of transfer elements inserted between the sound source and a load circuit which includes, the steps of producing a carrier frequency, modulating said carrier frequency at signal frequency, impressing said modulated carrier frequency on one of said transfer elements, impressing the modulated carrier frequency only from said transfer element to said load circuit, selecting a side band produced by the carrier and the signal, combining said side band with the signal frequency, impressing the combined frequencies on a second transfer element, and impressing the resulting frequency components on the load circuit.

3. The method of increasing the range of modulating frequencies for improving the tone and timbre in the transmission of sound signals on a carrier frequency which includes the steps of, modulating said carrier frequency at signal frequency, selecting side bands from said resultant energy, modulating said side bands at signal frequency, and utilizing the resultant energy.

4. The method of increasing the range of modulating frequencies for improving the tone and timbre of sound to be transmitted which includes the steps of, producing a carrier frequency, modulating said carrier frequency with a wide range of acoustic frequencies, selecting from said modulated frequency a series of side bands, modulating said side bands at signal frequency, selecting from the resulting energy a second series of side bands, modulating said side bands at signal frequency and utilizing the energy obtained from the several combinations of high frequency energy with signal energy.

5. In an arrangement for producing signal modulated frequencies, a source of carrier frequency, a source of signal frequency, a plurality of thermionic relays, each having input and output circuits, means for impressing signal frequency on the input circuit of each of said relays, means for impressing carrier frequency on the input circuit of one of said relays, means for selecting the first side band only from the output circuit of said last named relay, means for impressing said side band on the input circuit of another of said relays, and a load circuit connected with the output circuit of each of said relays.

6. An arrangement for producing signal modulated frequencies in which all of the overtones may be maintained or reenforced including, a source of carrier frequency, a source of signal frequency, a plurality of thermionic relays, each comprising a pair of thermionic tubes having symmetrical input and output circuits, means for impressing signal frequency on the input circuit of each of said relays, means for impressing carrier frequency on the input circuit of the first of said relays, and means for selecting from the output circuit of each of said relays a progressive series of side bands means for impressing the side band selected from the output circuits of each of said relays on the input circuit of the following relay, and a load circuit connected with the output circuit of each of said relays.

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