Oct. 17, 1933. K. S. JOHNSON 1,930,898

PROGRAM TRANSMISSION

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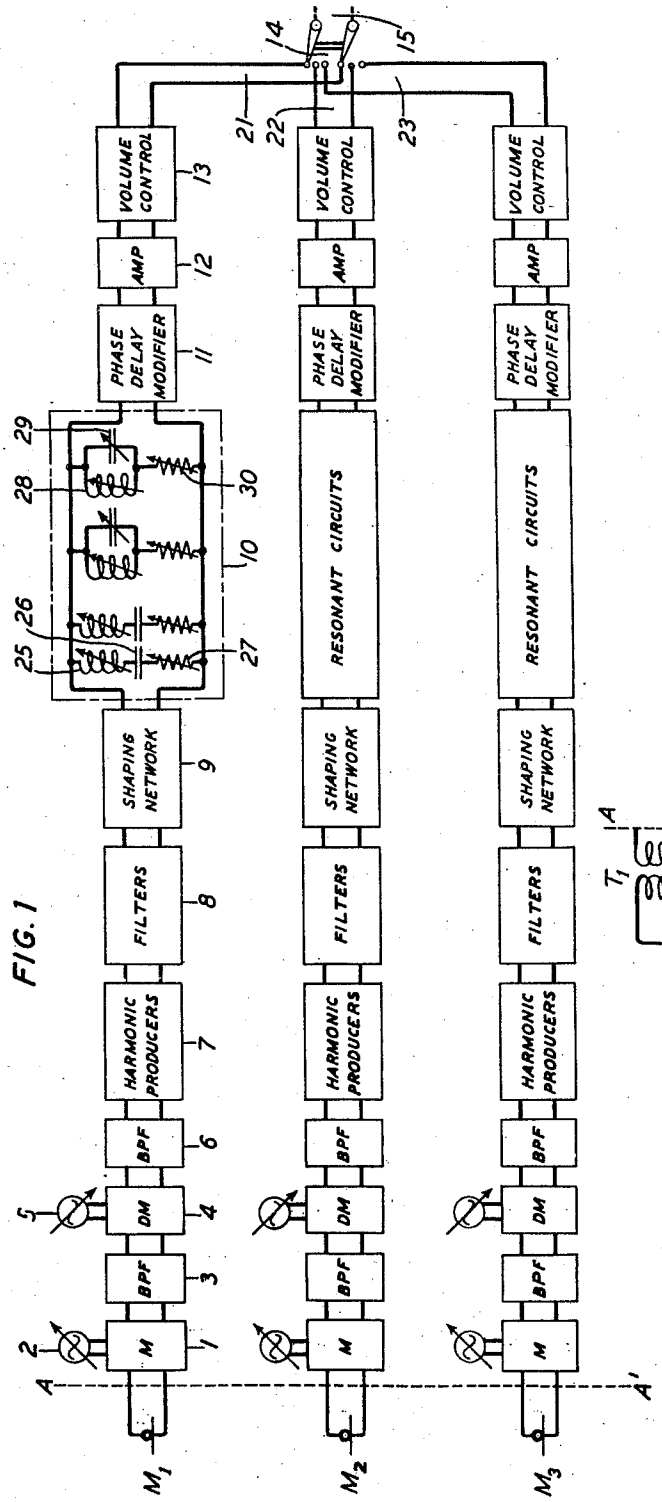

FIG. 1

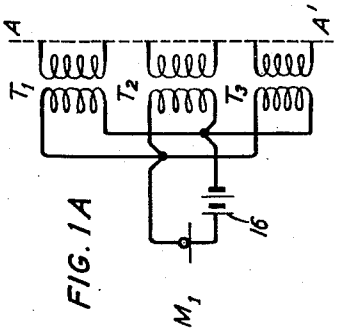

FIG. 1A

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PROGRAM TRANSMISSION

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5 Claims. (Cl. 179—1)

This invention relates to speech transmission circuits and more particularly to apparatus and circuits for altering the characteristics of speech waves.

In the broadcasting of radio programs it is sometimes desirable that one individual be capable of taking the part of several characters. Although the individual can alter his voice for this purpose to a certain extent, it is usually difficult for him to simulate the voices of more than perhaps one or two others, and to distinguish clearly and unerringly the different characters. It is an object of this invention to enable one speaker to impersonate several others.

The individuality of a person's voice is determined by several characteristics. The fundamental or lowest frequency of vibration of the speech waves is a primary factor; this determines the pitch of the voice and is probably the principal factor differentiating the characteristic male and female voices. Another important factor is the distribution and relative intensities of the various component frequencies. The timbre of a person's voice is determined by this factor. The rapidity of utterance and the intensity of accent are still other factors that distinguish the voice of one person from that of another.

In accordance with the present invention means are provided for modifying at will certain of the characteristics of speech waves so that a person speaking into a microphone in his normal voice may take the part of any other particular person or character. It is obvious, of course, that the individual who is broadcasting may himself control certain characteristics of his speech, the rapidity of utterance, for example, tc augment the effect of the wave modifying apparatus. A plurality of microphone circuits may be employed each including apparatus adjusted to the voice of the person at the microphone and to the particular character to be represented. By speaking into first one microphone and then another, one individual may take the part of several different characters.

The nature of applicant's invention will more fully appear in the following detailed description of a preferred embodiment of it, reference being made to the accompanying drawing.

In Fig. 1 of the drawing are schematically represented three microphone circuits adapted to be alternatively connected to the speech input terminals of a radio transmitter or other apparatus. In each circuit are provided frequency translating means for altering the pitch of the waves received from the microphone, a distorting device for increasing the harmonic content of the waves, passive networks of several types for controlling the amplitudes of the various frequency components and a phase delay modifier. An amplifier and potentiometer permit the volume to be regulated. With the great number of variable factors intricately involved in determining the individuality of a person's voice, it is impossible to predict what adjustment of the foregoing elements will be required in any particular case. The circuit is flexible, however, and the desired effect can readily be obtained by experiment.

The change in pitch is effected by first applying the speech signals to a relatively high frequency carrier wave, then combining one of the resulting sidebands with a second carrier wave the frequency of which is greater or less than that of the first by the amount the pitch is to be raised or lowered, and then selecting one of the sidebands resulting from this last step. Thus, in the first of the three microphone circuits shown, as in each of the others, speech signals from a microphone M_1 are combined in modulator 1 with carrier wave supplied by generator 2. The frequency of the carrier wave is such that the sidebands can readily be separated by the succeeding filter 3. The latter is preferably adapted to select the lower sideband and may, therefore, be of the low-pass type or, as illustrated, of the band-pass type. The selected sideband is then combined in demodulator 4 with a wave supplied by generator 5, the frequency of this wave being greater than that supplied by generator 2 if the pitch is to be raised, and less if the pitch is to be lowered. Band-pass filter 6 is designed to pass no frequencies above the translated speech band. Alternatively, a low-pass filter may be used at this point. Modulator 1 and demodulator 4 are preferably of the balanced type in which the carrier is suppressed, such for example, as described in J. R. Carson Patent 1,343,306, June 15, 1920.

Where the speaker's normal voice and the voice it is desired to simulate are of the same pitch, the frequency translating apparatus may be removed from the circuit. So also where the speaker is able to control the pitch of his voice effectively, this apparatus may be dispensed with.

As stated above, speech waves, in general, are comprised of a fundamental frequency and harmonics thereof, the relative amplitudes of the harmonics determining the timbre of the individual's voice. To insure that all harmonics of the fundamental wave issuing from the frequency translating apparatus are present and of such

amplitude that they are not lost in the succeeding filtering circuits, a harmonic producer 7 is employed. Any suitable device having a non-linear input amplitude vs. output amplitude characteristic may be used. A space discharge device operated at overload will prove satisfactory.

Some voices are characterized by an almost complete absence of waves in particular frequency ranges; others by a concentration of waves in certain ranges. Filters 8 may therefore be of types adapted to eliminate or exclusively pass bands of frequencies. High pass and low pass filters also may be used for certain types of voices. In general, filters of the types described in United States Patent 1,227,113, issued May 22, 1917, to G. A. Campbell are satisfactory. A higher degree of discrimination may be obtained, however, with filters using piezo-electric crystals, such as described for example, in an application of W. P. Mason bearing Serial No. 489,268 filed October 17, 1930.

After the major alterations, effected in the filters, are completed the speech signals are passed through a shaping network 9, which may be of the same general nature as a telephone equalizer circuit, to adjust the relative amplitudes of the upper, the lower and the middle speech frequency groups. As an added refinement the resonant and anti-resonant circuits in apparatus 10 may be used to operate on particular frequencies which in the voice it is desired to simulate are conspicuous by their predominance or by their absence. Each of the resonant circuits, of which two are shown, comprises an inductor 25, a variable condenser 26 and a variable resistance 27 connected in series across the line. The anti-resonant circuits, of which two also are shown across the line, each comprises an inductor 28 and a variable condenser 29 connected in parallel with each other and in series with a variable resistance 30.

The phase delay modifier 11 may be of the same general nature as phase delay equalizers, well known in the telephone art. It permits the relative phase position of a particular frequency or band of frequencies to be altered. Alternatively, it may be used merely as an equalizer to correct for the phase delay distortion occurring in the preceding apparatus, or it may be omitted entirely. Signals from the phase delay modifier 11 are passed through an amplifier 12 and through a volume controlling device 13, such as a potentiometer, to terminal leads 21 of switch 14.

Signals from the corresponding apparatus associated with microphones M_2 and M_3 are similarly applied to terminal leads 22 and 23, respectively, of switch 14. By operation of the switch, then, any one of the microphone circuits may be connected to the leads 15, which may be part of the speech input circuit of a radio broadcasting transmitter or other apparatus.

As stated hereinbefore, the adjustment of the circuit is largely a matter of experiment. The pitch of the speech waves is adjusted by varying the frequency of the generator 5. The quality or timbre of the waves is controlled by the harmonic producer, the filters, shaping network, resonant circuits, and phase delay modifier, while the loudness is adjusted by means of the volume control.

As indicated in Fig. 1A, the microphones to the left of section line AA' in Fig. 1 may be replaced by a single microphone suitably connected, as by transformers T_1, T_2 and T_3, to the respective modulators of the several speech-modifying circuits. Switch 14 enables the speaker to connect any desired modifying circuit to the transmitting apparatus. Alternatively, the selective means may be directly associated with the microphones.

Although three separate microphone circuits have been shown for purpose of illustration, it is apparent that the duplication of apparatus involved may be avoided, at least to a certain extent, by providing suitable switching means. It will probably not be necessary in every instance to employ all the speech-modifying apparatus shown, and various modifications of the specific embodiment shown may be adopted without departing from the invention as defined in the appended claims.

What is claimed is:

1. In combination at a transmitting station, a source of speech waves, a plurality of paths for the transmission of electrical waves equivalent thereto, means in each of said paths altering the frequency-energy composition of speech-frequency waves traversing said respective paths for purposely differently and effectively changing the individuality of said speech waves transmitted through said respective paths from that of the speaker to that of another whom it is desired to simulate, and means at said station for rendering one of said paths transmissive to the exclusion of the remainder of said paths, and an output circuit common to said plurality of paths.

2. In combination, a plurality of microphone circuits, frequency translating means for altering the pitch of speech waves traversing said circuits, selective means for substantially altering the harmonic composition of said waves whereby the character of the speaker's voice is effectively changed, a common output circuit, and selecting means for connecting said microphone circuits individually to said output circuit.

3. In a program transmission system a plurality of microphones, means associated with each of said microphones to alter differentially the pitch and timbre of speech waves received by said microphones, an output circuit, and selective means for connecting said microphones individually to said output circuit.

4. A combination for enabling an individual to simulate the voices of a plurality of different characters, which comprises a plurality of microphones into which the individual may successively speak, electrical means associated with each of said microphones for purposely altering the frequency composition of waves applied to it in accordance with the individuality of speech of a respective one of said characters, means in common to said plurality of microphones for transmitting the modified speech waves, and means for reproducing said transmitted waves in their modified form.

5. A method for enabling a performer to take the vocal parts of a plurality of different characters, which comprises converting his speech waves into electrical waves, purposely distorting the electrical waves in effect to alter the individuality of the speaker's voice, and varying at will the nature of the distortion in accordance with the speech characteristics of the individuals it is desired successively to simulate.

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