Aug. 20, 1963 J. P. MAILLE 3,101,390

APPARATUS FOR AUDIO-VOCAL CONDITIONING

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Fig. 1.

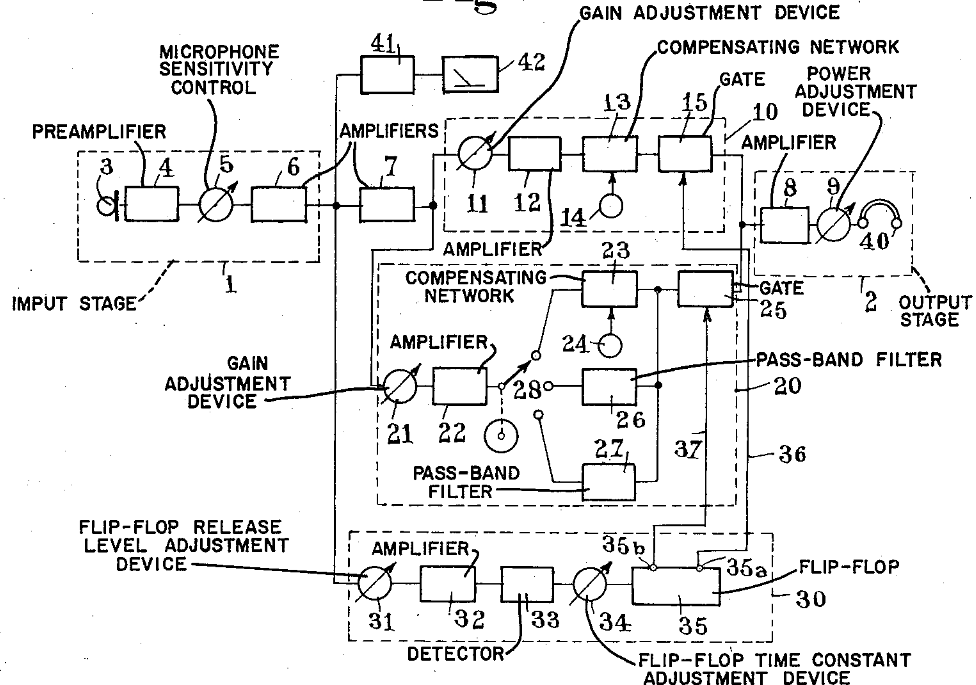
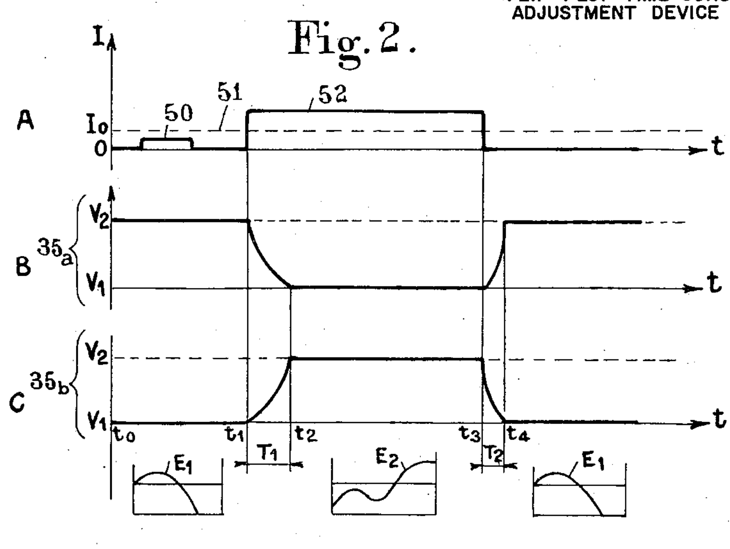


Fig. 2.



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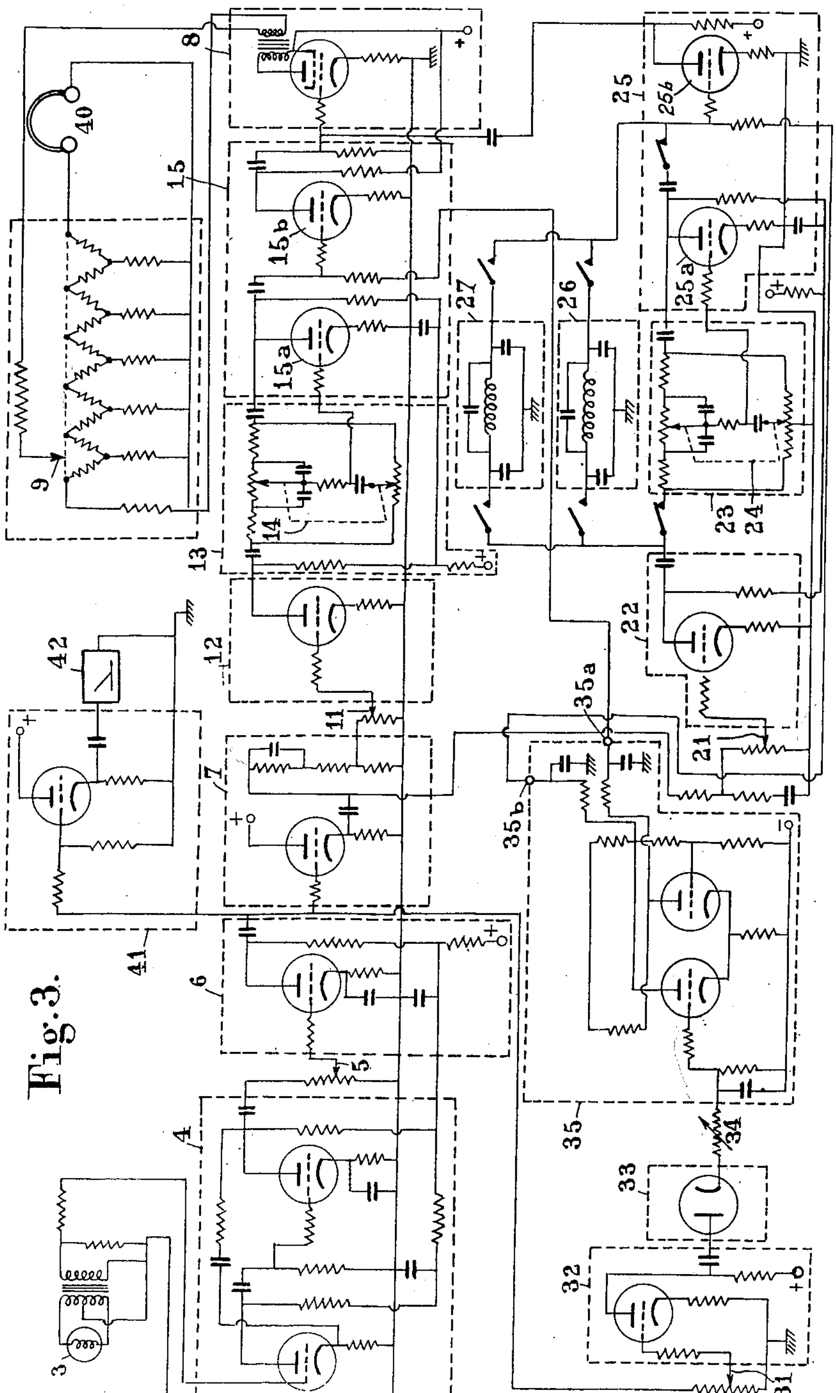

Fig. 3.

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APPARATUS FOR AUDIO-VOCAL CONDITIONING

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8 Claims. (Cl. 179—1)

This invention relates to an apparatus permitting the audio-vocal conditioning of a subject, that is, the physical conditioning of the internal ear of a subject, which has a marked effect on its phonation, since it was discovered that the phonation of a subject depended on his audition. Therefore, the term "audio-vocal" is used herein to designate firstly the audition or hearing of a subject, and consequently his phonation.

It is known that speech constitutes one of the most widely used modes of supplying information or news. It utilizes the signals resulting from the transformation of a voluntary cerebral act into a more or less periodical and more or less sustained perturbation of the ambient air in the so-called audible range of frequencies modulating upon the frequency, height, intensity and also the duration and sustaining time of these phenomena. There is an infinite number of possible modulations, such is the elasticity of the surrounding air medium.

On the other hand it is known that the phonation of the subject depends on his or her audition.

The ear operates like a monitoring pickup, for the output modulation, that is, the sounds emitted by the subject, is a function of the cortical pulse modified as a function of the discrepancy detected by the checking instrument constituted by the ear.

It is known to measure and define the inherent characteristic of a give ear by means of the so-called audiometric curve indicating for certain standard frequencies selected from the audible range, the auditory thresholds from which the subject begins to hear the sound at the selected frequency. These thresholds are defined as losses of gains in decibels with respect to a reference level chosen arbitrarily on subjects considered as having a normal hearing.

Thus, the audiometric curve gives an image of the auditory state of a subject and therefore of his phonation.

It is the essential object of the apparatus of this invention to superimpose, at the ear of any subject, a selected audition or way of hearing determined by the desired audiometric curve with a view to produce in this subject a series of reactions identical with those characterizing the owner of the selected audition.

To this end the method of effecting the audio-vocal conditioning of a subject consists firstly in imposing to the subject's ear, in the absence of a signal of an intensity higher than a predetermined threshold, a first auditory state or way of hearing defined by a first audiometric curve, then—immediately as an acoustic signal of an intensity higher than said threshold appears—causing said ear to pass from said first auditory state to another audiory state defined by another audiometric curve, and finally restoring the ear to its first auditory state immediately as said higher-intensity signal disappears.

According to a complementary feature of this method the passage from said first auditory state to said second auditory state is repeated periodically as many times as necessary.

The acoustic signal causing the ear to pass from said first state to said second state may either be emitted from an external source, for example a tape recorder, or consist of the voice of the subject himself or herself.

In the first auditory state the curve of harmonic decomposition of the acoustic signal is modified at will so that the subject is unable to appreciate anything else than the pressure of the acoustic signal, in this case the sound.

When the acoustic signal, sound or noise attains a predetermined level subordinate to the preset threshold, the first auditory state vanishes rapidly and is replaced by the second auditory state in which the selected audiometric curve is superimposed to the ear.

According to a specific application of the method of this invention, a so-called ear-relaxation curve may be superimposed to the ear in the aforesaid first auditory state, this curve being characterized by a maximum intensity in the low-pitch sounds with treble suppression. The second auditory state on the other hand may be defined by an audiometric curve showing a pronounced sag in the low-pitch sound zone with on the contrary a zone very rich in high-pitched sounds.

The second auditory state may of course be defined by any desired audiometric curve. To this end, selective audiometric curves corresponding for example to vowels or musical notes may be imposed to the ear so that the subject will be induced to pronounce a vowel properly or to emit a musical note to perfection.

This invention is also concerned with an apparatus for carrying out the method broadly set forth hereinabove and providing the aforesaid audio-vocal conditioning function.

The time for passing from the first auditory state to the second auditory state may be adjusted at will so that it is also possible to vary the subject's modulation by modifying the emission time and the time lapse during which each emitted syllable is controlled.

The apparatus of this invention may be used in many applications.

Firstly, they are suitable for treating all the troubles of phonation rhythm and tone, and also to correct certain hypoacousia, auditive distortion, etc., affecting the ear.

Finally, in the fields of psychology and psychotherapeutics the apparatus of this invention permit on the one hand a psychological adaptation of the ear for example in the case of vocational guidance, and on the other hand a re-tuning of the ear when the latter has become out of tune as a consequence of periods of internal mutation of the individual, this re-tuning involving a psychological recovery of the individual.

With the foregoing and other objects in view, the invention resides in the novel arrangement and combination of parts, and in the details of construction and embodiment hereinafter described and claimed, it being understood that changes in the precise embodiments of the invetnion herein disclosed may be made within the scope of what is claimed without departing from the spirit of the invention. Other objects and advantages will become apparent from the following description taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a diagram showing the principle of the apparatus of this invention;

FIGURES 2(A) to 2(C) are diagrams illustrating the method of this invention; and

FIGURE 3 is a wiring diagram of a typical form of embodiment of the invention.

The various component elements of the apparatus of this invention are shown in block form in FIG. 1, these blocks being also shown in the detailed diagram of FIG. 3 in which they are designated by the same reference numerals.

In FIG. 1 the apparatus is shown as comprising essentially an input stage 1, an output stage 2, a first channel 10 and another channel 20 connected in parallel between said input and output stages 1 and 2, and finally an auxiliary channel 30. Each one of these main elements is enclosed in dotted rectangles.

The input stage 1 comprises a microphone 3 receiving the acoustic signals, sound or noise, emitted from an external source or from the subject himself or herself. This microphone is connected to a preamplifier 4 connected in turn to a general amplifier 6 through a device 5 for adjusting the sensitivity of the microphone.

The output of amplifier 6 is connected to an impedance-matching amplifier 7 having its output connected in parallel to the inputs of channels 10 and 20.

The first channel 10 comprises in succession a device 11 for adjusting the gain of this channel, an amplifier 12, a filter or compensating network 13 of which the response curve is adjustable by means of a knob 14, and finally a gate 15. Similarly, the other channel 20 comprises a gain adjustment device 21, an amplifier 22, a filter or compensating network 23 of which the response curve is adjustable by means of a knob 24, and a gate 25. In the specific form of embodiment illustrated in FIGS. 1 and 3 of the drawings there are provided, in parallel to the filter 23, a pair of selective pass-band filters 26 and 27 adapted to be inserted at will in the circuit by means of a switch 28.

The outputs of gates 15 and 25 of channels 10 and 20 are connected together to the input side of the output stage 2 comprising in succession a power amplifier 8, a power adjustment device 9 and earphones 40.

The auxiliary channel 30 has its input connected to the output of the general amplifier 6 of input stage 1. This auxiliary channel 30 comprises in succession a device 31 for adjusting the flip-flop release level, an impedance adapting amplifier 32, a detector 33 and a device 34 for adjusting the time constant of the flip-flop 35 controlling the channels 10 and 20. The flip-flop 35 may be of any known type and this specific application consists of a monostable multivibrator of which the two outputs 35*a* and 35*b* are connected through conductors 36 and 37 respectively to the control inputs of gates 15 and 25 of channels 10 and 20.

Finally, the apparatus comprises accessorily a measuring circuit connected to the output of the general amplifier 6, this circuit comprising an adaptor amplifier 41 and a reference VU meter 42.

The operation of the apparatus of this invention will now be described with specific reference to FIGS. 2(A) to 2(C).

Assuming that in the initial state, that is, at time t_0, the acoustic intensity of the input signal received by the microphone 3 is not sufficient to release the monostable multivibrator 35. In this case, the subject's ear is conditioned in a first auditory state, as emphasized hereinafter, this first way of hearing remaining from time t_0 to time t_1. FIG. 2(A) shows an acoustic signal 50 of rectangular shape, to indicate the noise or sound of which the intensity I is lower than the threshold I_0 necessary for releasing the monostable multivibrator, this threshold being shown in the form of a dotted line at 51. The threshold of release of the monostable multivibrator 35 is determined by the device 31 for adjusting the level of the monostable multivibrator in combination with the detector 33. Therefore, by acting upon the device 31 it is possible to shift the threshold for which the multvibrator is released.

In this preliminary state corresponding to the first auditory state or way of hearing the multivibrator 35 is in its inoperative position. In this position the output 35*a* connected to wire 36 has for example a positive voltage V_2 (see FIG. 2(B)) which opens the gate 15, the other gate being closed by the voltage V_1, inferior to V_2 (see FIG. 2(C)), at which the output 35*b* connected to wire 37 has been brought.

Under these conditions, the first channel 10 is released whereas on the contrary the other channel 20 is locked. The subject perceives the acoustic signals such as 50 of an intensity inferior to intensity I_0 releasing the multivibrator 35, these signals being transmitted through the first channel 10 to the earphones 40. As a result, in this first auditive state the subject's audition is modified as a consequence of the inherent response curve of the

filter 13 which corresponds to a first predetermined spectrum defining a first way of hearing. The lower portion of FIG. 2 shows diagrammatically a typical example of audiometric curve E_1 which may be taken as a response curve for the filter 13, this curve being superimposed to the subject's ear in the first auditory state. The curve given herein by way of example corresponds to the curve representing the state of rest which is the most desirable for the ear, this state of rest being obtained by suppressing completely the high-pitched sounds, and corresponding to a complete release of the tympanum.

The superimposition of the audiometric curve E_1 to the subject' ear is maintained up to the time t_1 where an acoustic signal 52 appears which is shown in the form of a rectangular signal the intensity of which exceeds the threshold of release I_0 of the monostable multivibrator 36. The signal may for example be emitted by the subject in the microphone 3. At the time t_1, the detector 33 of the auxiliary channel 30 permits the passage of a launching signal transmitted (through the device 34 for adjusting the time constant) to the multivibrator 35. The latter is thus triggered and moves to its operative state after a time T_1 determined by the device 34 for adjusting the time constant. As a result, the control voltages applied to conductors 36 and 37 vary as indicated by the relevant curves of FIGS. 2(B) and 2(C). Therefore, it will be seen that after a time lapse T_1 the gate 25 is fully open due to the voltage V_1 applied to the input thereof, whilst on the contrary the gate 15 is fully closed due to the voltage V_1. From this moment on the second channel 20 is released whereas the first channel is locked.

Under these conditions the appearance of the acoustic signal 52 causes on the one hand the first channel 10 to fade out rapidly and during the same time the insertion of the other channel 20 into the circuit. From the time t_2 at which the switching is completed the other channel 20 alone is operative and the signals transmitted through the impedance adapter amplifier 7 are modified by the filter 23 according to its inherent response curve, which corresponds to a second predetermined spectrum defining a second way of hearing, before being retransmitted through the gate 25 to the output stage 2. Thus, from the time t_2 on, another auditive state or way of hearing defined by an audiometric curve such as E_2 of FIG. 2 is superimposed to the subject's ear. This curve E_2 may comprise a portion rich in high-pitched sounds with a partial vanishing of the fundamental sound so as to permit the harmonic decomposition. Thus, the release of the tympanum caused by the first state E_1 is followed by a state of osteomuscular tension caused by the state E_2.

Of course, any other desired and suitable audiometric curve than this specific curve E_2 may be superimposed, notably selective individualized curves such as those corresponding to the vowels and musical notes. For instance in the example considered herein the filter 26 which may be inserted in the circuit in lieu of the filter 23 by means of switch 28 may have a response curve corresponding to a given vowel so as to teach the pronunciation of this vowel to the subject. Similarly, the filter 27 may have a response curve corresponding to a musical note so that in this case the apparatus is suitable for causing the subject to properly utter this note. Of course, an apparatus comprising as many filters as there are vowels or musical notes may be provided, if desired.

At the time t_3, when the acoustic signal 52 disappears, the multivibrator 35 resumes its inoperative state in a time lapse T_2 which is definitely shorter than T_1. This switching in the reverse direction involves another release of channel 10 attended by a locking of channel 20, so that the subject's ear is restored to the first auditory state in which the audiometric curve E_1 is superimposed thereto.

The passage from curve E_1 to curve E_2 takes place when the subject speaks, periodically, each time a vowel is pronounced.

By properly setting the device **34** for adjusting the time constant of the monostable multivibrator **35** it is possible to vary the time T_1 necessary for the multivibrator **35** to pass from its inoperative state to its operative state. Thus, the emission time and the control duration of each syllable emitted by the subject is modified in order to cause his or her modulation.

It will be readily understood that the form of embodiment of the invention which has been described hereinabove with reference to the attached drawing is given by way of example only and should not be construed as limiting the invention since many modifications may be brought thereto without departing from the spirit and scope of the invention as set forth in the appended claims.

Thus, for example, the gates **15** and **25** provided for opening and closing the channels **10** and **20** may be located at another place in these channels, notably before the filters **13** and **23**. The various amplifying devices may be disposed in a different manner, and the two gates **15** and **25** arranged in the form of two amplifiers connected in series, as shown by way of example in the diagram of FIG. 3, that is, a first amplifier such as **15*a*** and **25*a*** and another amplifier such as **15*b*** and **25*b*** wherein the gain is controlled as a function of the output voltages available in conductors **36** and **37**. These amplifiers may incorporate tubes, transistors or any other suitable and known arrangement.

According to a modified embodiment of this apparatus, means such as an inverter controlled either manually by the operator or by the subject himself or herself may be substituted for the channel controlling automatically the actuation of the monostable multivibrator, for causing the latter to switch from one state to another and thus control the change in the auditory state.

What I claim is:

1. An apparatus permitting the audio-vocal conditioning of a subject by subjecting the subject's auditory system to an exercise which comprises an input stage for converting the acoustic signals into electric signals, an output stage for converting the electric signals into acoustic signals applied to the subject's ear, a first channel and another channel connected in parallel between said input stage and said output stage, said first channel comprising a compensating network of which the response curve over the audio frequency spectrum corresponds to a first predetermined spectrum defining a first way of hearing, and a gate controlling the opening and closing of said first channel, said other channel comprising a compensating network of which the response curve over the audio frequency spectrum corresponds to a second predetermined spectrum which defines a second way of hearing, and another gate controlling the opening and closing of said other channel, said apparatus comprising an auxiliary channel connected to the output of said input stage, said auxiliary channel comprising a monostable multivibrator generating a first and a second control voltage applied to the gates of said first and other channels respectively, each of said control voltages having either a first value at which it opens the gate responsive thereto, or another value at which it closes said gate, said first and second control voltages having respectively the first and second values in the inoperative condition of said multivibrator whereby the first channel is released and the second channel is blocked, said auxiliary channel also comprising means for defining a predetermined threshold beyond which signals appearing at the output of said input stage are applied to the multivibrator, whereby when a signal having an amplitude greater than said threshold is applied to said multivibrator the latter becomes operative so that the first and second control voltages assume respectively said first and second values, thus blocking the first channel and releasing said second channel.

2. An apparatus as set forth in claim 1, comprising means for modifying the response curves of said compensating networks.

3. An apparatus as set forth in claim 1, comprising means for varying the change-over time of said multivibrator.

4. An apparatus as set forth in claim 1, comprising means for adjusting the level at which the multivibrator is released.

5. An apparatus as set forth in claim 1, comprising means for varying separately the gain in each channel.

6. An apparatus as set forth in claim 1, comprising a microphone in said input stage and means for adjusting the sensitivity of said microphone.

7. An apparatus as set forth in claim 1, comprising indicator means for measuring the level of the input signals.

8. An apparatus as set forth in claim 1, comprising manual control means for switching said multivibrator from its inoperative state to its operative state and vice-versa.

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