June 7, 1966 MOTOYOSHI NAKANISHI 3,255,317

STEREO MICROPHONE

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FIG. 1

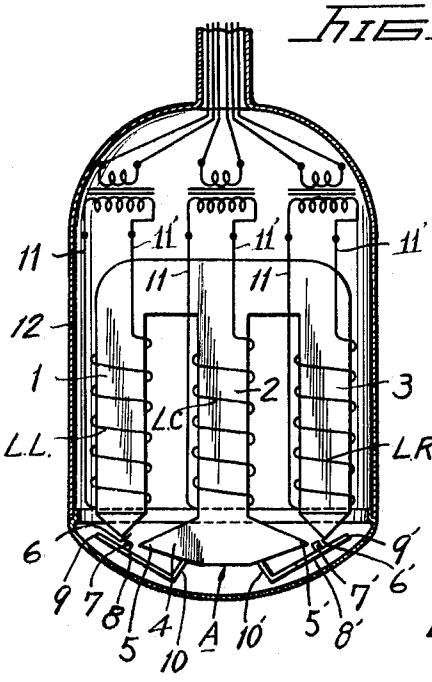


FIG. 2

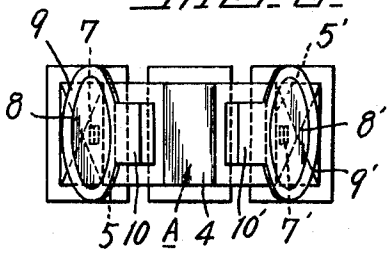


FIG. 3

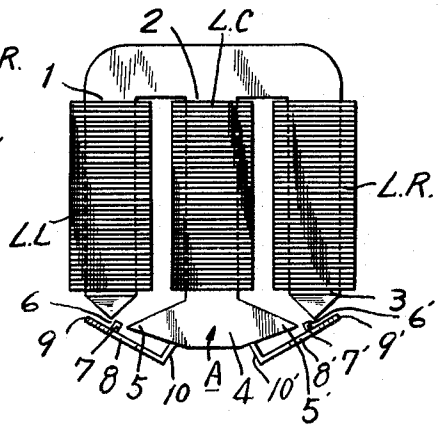
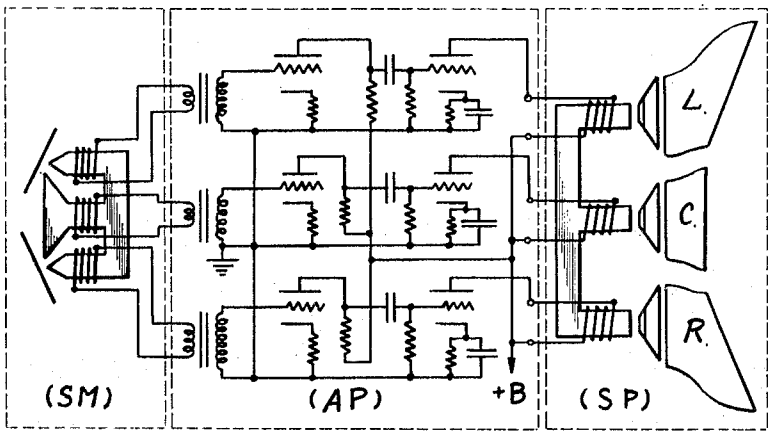


FIG. 5



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FIG. 4

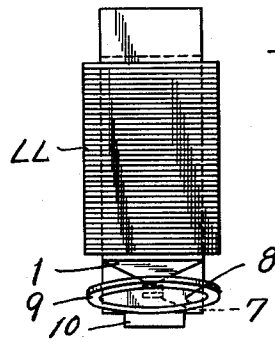


FIG. 6

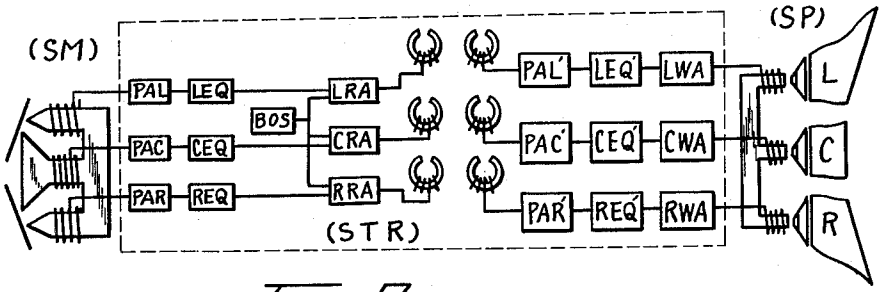


FIG. 7

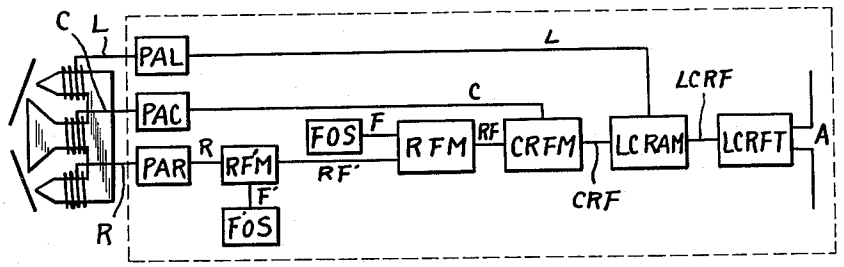
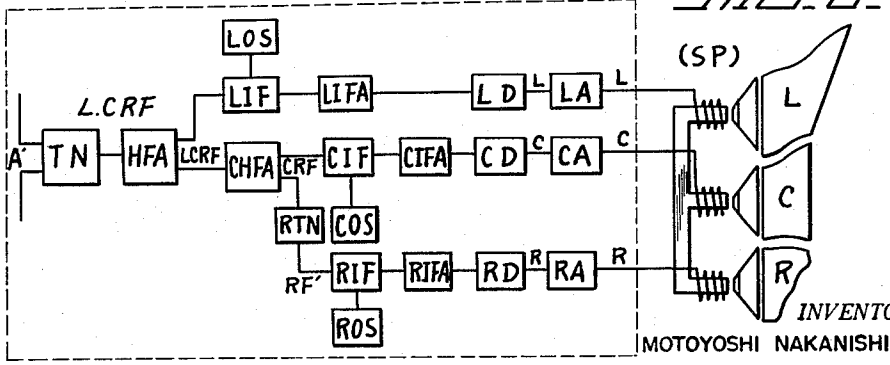


FIG. 8



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STEREO MICROPHONE

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Claims priority, application Japan, Sept. 20, 1961, 36/33,703
4 Claims. (Cl. 179—116)

The present invention relates to a microphone in general, and to a stereo microphone, in particular.

Any conventional microphone is such, that the vibration of the diaphragm operated by the sound, affects directly the electric effect.

It is one object of the present invention to provide a stereo microphone, which is designed such, that the sound is converted into electric signals by way of the magnetic flux that fluctuates in accordance with the vibration of the diaphragm operated by sound.

Up to now in the stereophonic system, the sound is picked up from different vantages, namely at least two microphones positioned at a certain distance, and they feed separately into two recording channels and onto two tracks of the record or they broadcast separately in two channel radio waves.

However, many inconveniences are encountered in the stage preparation and arrangement and also many factors which cause distortion, since a plurality of microphones, circuits and apparatus are required. Further, in the conventional system, the sound is generally picked up from two different vantages and reproduced from two point sources, while the human auditory organ has the capacity of perceiving the sound from the exact front, in spite that it is received by the left and right ear drums. Furthermore, in case a conventional microphone is used, regardless how many microphones are used with the corresponding channels of the apparatus for reproduction, the picked sound performance is obtained as only the electric sum of each monophonic electric effect to give at best spatial illusion. Therefore, the sound reproduction by the conventional microphone and system is substantially far from being called as a stereophonic sound reproduction in the true sense of the word.

It is another object of the present invention, to provide a stereo microphone comprising a pair of magnetic vibrating means, a core unit having three leg portions and a coil around each of the leg portions, and wherein the magnetic vibrating means, which correspond to the left and right ear drums, are set into magnetic vibration as operated by the sound, and the magnetic vibration is transmitted to the core unit by means of a pair of clearances or gaps as the corresponding magnetic flux fluctuation, which is converted into magnetic stereophonic signals of three dimensions in the core unit due to the composition of the magnetic density through the core unit and is derived through the coils as electric stereophonic signals of three dimensions, just as the vibration by both ear drums is compounded in each of the inner ears and carried through the acoustic nerve, so as to be perceived in the brain as stereophonic impulses of three dimensions.

It is yet another object of the present invention to provide a stereo microphone, which is of a considerably small size and quite simple in structure, as well as stable for a long use and yet of low manufacturing costs.

It is still a further object of the present invention to provide a stereophonic broadcasting system in a one channel radio wave and also a radio receiving system for the broadcast.

With these and other objects in view, which will become apparent in the following detailed description, the present

invention will be clearly understood in connection with the accompanying drawings, in which:

FIGURE 1 is an axial section of a stereo microphone according to the present invention;

FIG. 2 is a fragmentary front elevation of the principal part of the microphone;

FIG. 3 is a top plan view of the showing in FIG. 2;

FIG. 4 is an end view of the device shown in FIG. 3;

FIG. 5 is a diagrammatic showing of a stereophonic reproduction system employing a stereo microphone according to the present invention;

FIG. 6 is a diagrammatic showing of a stereophonic recording system employing a stereo microphone according to the present invention;

FIG. 7 is a diagrammatic showing of a stereophonic broadcasting system employing a stereo microphone according to the present invention; and

FIG. 8 is a diagrammatic showing of a radio receiving system for the stereophonic broadcasting system shown in FIG. 7.

Referring now to the drawings, and in particular to FIGS. 1 to 4, the stereo microphone according to the present invention comprises in the generic structure a substantially E-shaped core unit A having a left leg portion **1**, a central leg portion **2** and a right leg portion **3**, each of which has a tapered end, a coil LL, LC and LR, respectively, around each of the leg portions connected with lead wires **11** and **11'**, a pair of magnetic vibrating means, a pair of holding members and a microphone casing **12**.

The central leg portion **2** is provided with an end portion **4** having knife-shaped tapered extensions **5** and **5'**, each extending toward the tapered ends of the left and right leg portions **1** and **3** such, that they define extremely narrow clearances or gaps **6** and **6'** between the tapered extensions **5** and **5'** and the tapered ends of the left and right leg portions **1** and **3**.

Each magnetic vibrating means comprises a diaphragm **8** and **8'** and a magnet **7** and **7'**, each being secured to the center of the rear face of the diaphragm **8** and **8'**, so that the diaphragms and the magnets vibrate as a unit, upon operation by sound.

Each holding member comprises integrally a rim portion **9** and **9'**, to provide the magnetic vibrating means thereon and a base portion **10** and **10'** secured to the extensions **4** of the central leg portion **2** such, that each magnetic vibrating means is supported at either side of the core unit A in a desired angle therebetween in respect to the central leg portion **2** and each defining an extremely narrow clearance or gap **6** and **6'** adjacent to each tapered end of the leg portions **1** and **3**.

The important features of the present invention reside in the tapered extensions of the core unit A, the magnet **7** and **7'** which vibrates with the diaphragm **8** and **8'** as a unit and the extremely narrow clearances or gaps **6** and **6'** between the tapered extensions and the magnet. The end portion **4** with the knife-shaped tapered extensions **5** and **5'** extending on either side is mainly adapted to provide a wider section, so as to improve the magnetic permeability of the core unit. The core unit A, therefore, may take any other form, as long as the form is adequate for the noted purpose, in accordance with structural requirements.

Sound from the left side of the stereo microphone strikes the left vibrating means more strongly, than it does the right vibrating means, and accordingly the left diaphragm **8** and magnet **7** are set as a unit into stronger vibration than that of the right diaphragm **8'** and magnet **7'** as a unit. The flux fluctuation in the magnetic field over the clearance or gap **6** that is stronger than that over the

clearance or gap 6' causes a corresponding flux flow through the left leg portion 1 and the centrol leg portion 2 of the core unit A in a greater density than that of the flux flow through the right leg portion 3 and the central leg portion 2 of the core unit A in proportion to the vibration. Thus, the left component part of the sound is converted into an electric signal generated in the left coil LL.

Sound from the right side of the stereo microphone strikes the right vibrating means more strongly than it does the left vibrating means, and accordingly, the right diaphragm 8' and magnet 7' are set as a whole into stronger vibration than that of the left diaphragm 8 and magnet 7 as a unit. The flux fluctuation in the magnetic field over the clearance or gap 6' that is stronger than that over the clearance or gap 6 causes a corresponding flux flow through the right leg portion 3 and the central leg portion 2 of the core unit A in proportion to the vibration. Thus, the right component part of the sound is converted into an electric signal generated in the right coil LR.

Sound from the front of the stereo microphone strikes evenly the left and right magnetic vibrating means, so as to cause equal flux fluctuation in either magnetic field over the clearances or gaps 6 and 6' and even a flux flow at either side in respect to the central leg portion 2. Thus, the central component part of the sound wave is converted into an electric signal generated in the central coil LC.

In the human aduitory organ, sound waves from the left and right set each ear drum into vibration and are converted into acoustic nerve impulses and carried to the brain as leftward and rightward information sources, and sound waves from the front are perceived in the brain, although received by both ear drums, as a central information source due to the composition in the inner ears of the loudness proportion and phasic difference as if it were by a middle or central ear drum.

The present invention has materialized the principle of the function of the human aduitory organ, and a single stereo microphone according to the present invention functions, as will be understood from the foregoing description concerning its structure and function, the same as the human auditory organ does and can convert the sound into electric signals of three dimensions due to the composition in the core of the flux fluctuation in the magnetic field caused by vibration of diaphragms with magnets, and makes possible to reproduce the picked sound performance in the most realistic form that is to be called as a stereophonic reproduction in the true sense of the word.

It will be clear to those skilled in the art that a very small magnet piece may be employed in a stereo microphone according to the present invention and consequently a very small size of the stereo microphone can be produced, and that the size of the device can be easily varied depending upon the purpose of its use.

Referring now again to the drawings, and in particular to FIG. 5, when the electric signals generated in each of the coils LL, LC and LR of a stereo microphone according to the present invention, SM feeds separately into three channel amplifiers AP, the picked-up sound can be reproduced from a three channel stereophonic loud speaker system SP with an adequate directional adapter L, C and R with a most realistic effect.

An ideal recording system can be provided, when the stereo microphone SM according to the present invention is used in combination with a three channel recorder STR, a diagrammatic representation of which is shown in FIG. 6.

Referring to a stereophonic broadcasting system by a stereo microphone according to the present invention, a diagrammatic representation is shown in FIG. 7, the electric signals derived from a stereo mircophone SM in three channels LCR feed separately into three amplifiers

PAL, PAC and PAR and modulators RFM, CRFM and LCRAM and then into the transmitter LCRFT, and are then broadcast through a radiating antenna A.

FM, local modulation methods are used to broadcast the three channel signals from a stereo microphone according to the present invention in one channel radio wave.

Referring now to FIG. 7, the oscillator FOS generates the radio frequency F. The frequency F', lower than the frequency F, is separately generated by a local oscillator F'OS. The signal from the left amplifier PAL is modulated with the frequency F' by the modulator RF'M into the modulated frequency RF'.

The modulated frequency RF' is modulated with the radio frequency F by the modulator RFM into the modulated frequency RF.

The signal from the central amplifier PAC is modulated with the frequency RF' by the modulator CRFM into the frequency CRF.

The signal from the right amplifier PAR is modulated (not so deeply) with the frequency CRF' by the modulator LCRAM into the integrated wave LCRF to be broadcast.

The important feature of the described stereophonic broadcasting system employing a stereo microphone according to the present invention is, as will be readily appreciated from the description set forth above, the local modulation method employed there, whereby a novel stereophonic broadcasting in one channel radio wave can be achieved with a radio receiving system, a diagrammatic showing of which is disclosed in FIG. 8.

The radiated wave LCRF received by a receiving antenna A' and tuned by tuner TN is amplified by the amplifier HFA into the high frequency wave LCRF and modulated by the converter LIF with the frequency generated by the local oscillator LIF into the intermediate frequency, which is then amplified by the amplifier LIFA, detected into the left signal L by the detector LD, and amplified by the low frequency amplifier LA to be led to the left portion L of a stereophonic loudspeaker system SP.

The high frequency amplifier CHFA eliminates the component of the left signal L from the high frequency wave LCRF and gains the frequency modulating component CRF which is modulated by the converter CIF with the frequency generated by the local oscillator COS, amplified by the intermediate frequency amplifier CIFA, detected into the central signal C by the detector CD (the FM detection can provide here with ease the central signal component due to the fact that the central signal component is of far lower frequency than that of the radio wave LCRF and also of a substantially lower frequency than of the prior local modulated frequency RF', which is to be referred to later), and amplified by the low frequency amplifier LC to be led to the central portion C of a stereophonic loudspeaker system SP.

The right signal component RF' obtained from the local tuner RTN from the high frequency amplifier CHFA is modulated by the converter RIF with the frequency generated by the local oscillator ROS, amplified by the intermediate frequency amplifier RIFA, detected into the right signal R by the detector RD and amplified by the low frequency amplifier RA to be led to the right portion R of a stereophonic loudspeaker system SP.

Thus, the sound performance picked up in three dimensions by a stereo microphone according to the present invention and broadcast in one channel radio wave can be reproduced with the most realistic effect in accordance with the teachings of the present invention.

It will be appreciated by those skilled in the art that a stereo microphone according to the present invention, although a specific form of apparatus has been disclosed in this specification, provides a new concept in the stereophonic field, and that many changes in detail in structure are possible without departing from the inventive con-

cept of the present invention, the scope of which is only limited in accordance with the following claims.

I claim:

1. A stereo microphone comprising

a substantially E-shaped iron core unit having a left leg portion, a central leg portion and a right leg portion,

each of said leg portions having a tapered cusp,

a coil wound around each of said leg portions,

a pair of magnetic vibrating means secured to said central leg portion,

a pair of holding members projecting from said central leg portion, to constitute means for securing said pair of magnetic vibrating means to said central leg portion, and

a casing receiving and surrounding said iron core unit.

2. The stereo microphone, as set forth in claim 1, wherein

said central leg portion of said iron core unit has an end portion including a pair of knife-shaped tapered extensions,

each of said knife-shaped tapered extensions projecting toward said extensions of said left leg portion and of said right leg portion, in order to define a narrow clearance therebetween.

3. The stereo microphone, as set forth in claim 1, wherein

each of said magnetic vibrating means comprises a diaphragm and a magnet ragidly secured to the center of the rear face of said diaphragm, in order to vibrate with said diaphragm as a unit.

4. The stereo microphone, as set forth in claim 1, wherein

each of said holding members comprises a rim portion to provide said diaphragm thereon, and

a base portion secured to the end portion of said central leg portion in order to support said magnetic vibrating means at both sides of said iron core unit at a desired angle therebetween relative to said central leg portion, and

each of said holding members defining a narrow clearance adjacent each of said cusps of said leg portions.

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