Sept. 21, 1937. A. E. SWICKARD 2,093,664

ACOUSTIC DEVICE

Filed July 30, 1936

FIG. 1

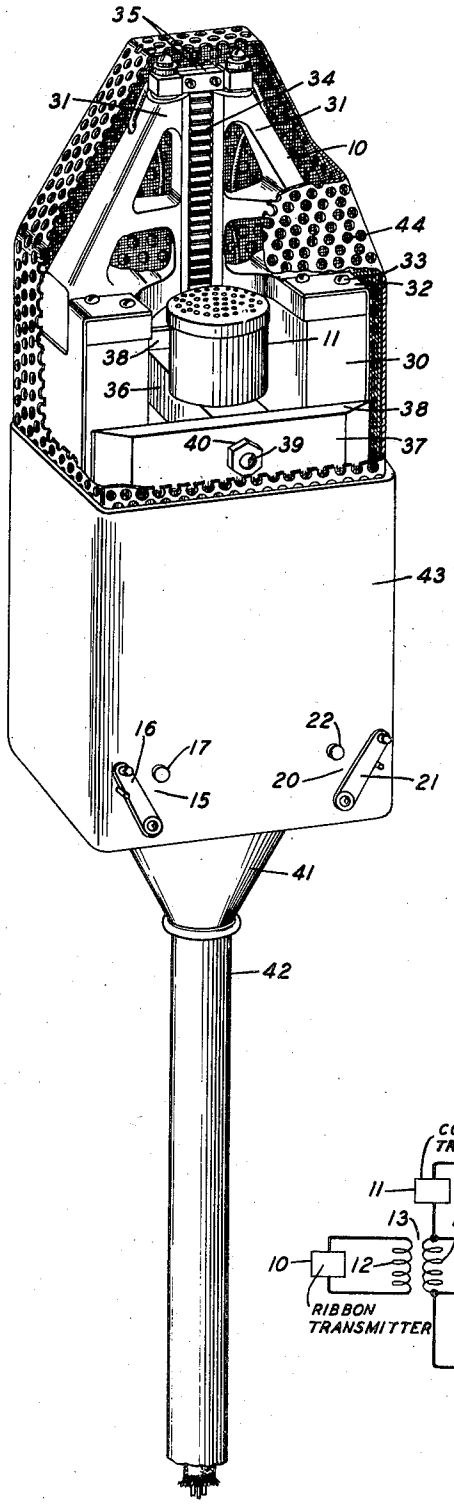
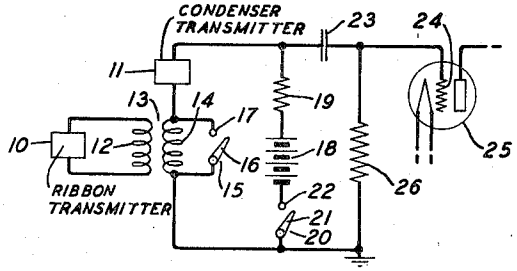


FIG. 2



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ACOUSTIC DEVICE

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7 Claims. (Cl. 179—1)

This invention relates to acoustic devices and, more particularly to a combination of transmitters.

An object of this invention is to translate sound waves with efficiency and fidelity over a desired frequency range.

A feature of the invention comprises the combination of a transmitter having a diaphragm responsive to the velocity component of incident sound waves and of a transmitter having a diaphragm responsive to the pressure component of the sound waves, the latter being a condenser transmitter.

Another feature comprises a combination of a velocity-type transmitter and a pressure-type transmitter, the electrical outputs of the transmitters working into a single amplifier only.

Still another feature comprises such a combination in a circuit containing means for effectively eliminating one or the other transmitter as a sound translating device in the combination.

A further feature comprises a ribbon type velocity transmitter and a condenser type pressure transmitter in close proximity on a common support.

Other and further features will be apparent from the descriptive matter that follows hereinafter.

A more complete understanding of the invention will be obtained from the following detailed description taken in conjunction with the appended drawing, wherein:

Fig. 1 is a perspective view of a transmitter combination or acoustic device in accordance with this invention, partly broken away; and

Fig. 2 is a schematic of the device of Fig. 1 and its associated circuit.

With reference initially to Fig. 2, there is disclosed a circuit or system comprising a transmitter 10, preferably of the type having a vibratile element or diaphragm adapted to respond to the velocity component of incident sound waves, and preferably of the conductive ribbon diaphragm type, and a second transmitter 11, preferably of the type having a vibratile element or diaphragm adapted to respond to the pressure component of the sound waves, and preferably of the electrostatic or condenser type. The output terminals of the transmitter 10 are connected to the ends of the primary winding 12 of transformer 13, the secondary winding 14 of which is connected in series with transmitter 11. A circuit controller or switch 15 is connected in shunt with the winding 14, being normally open with the blade 16 off the contact 17. The condenser transmitter is charged from a suitable source of constant potential, such as the battery 18, a resistor 19 of large resistance, for example, of the order of 50 to 100 megohms, being connected in series with the battery. A circuit controller or switch 20 is provided in series with the battery so that when the blade 21 is off the contact 22, polarizing voltage is removed from the condenser transmitter. The condenser 23 blocks the battery potential from the control electrode or grid 24 of an amplifier 25, for example, a three-electrode electron discharge device. Resistor 26 is a grid leak resistance of the order of 50 to 100 megohms.

The transmitter 10 comprises a U- or horseshoe shaped permanent magnet 30, a pair of pole-pieces 31 being secured to its ends by a clamping member 32 and screws 33. The pole-pieces define a magnetic air-gap in which a conductive ribbon diaphragm 34 is supported, the ends of the ribbon being secured between insulating clamping plates 35. The transmitter 11 is of miniature size and rests on the cross-bar 36 of an H-shaped support 37, the uprights 38 and cross-bar of which are secured together and to the magnet by a bolt 39 and screw 40. The common support 41 for the transmitters comprises the pedestal or column 42 having an enlarged, hollow end portion or case 43 enclosing the transformer 13, the amplifier 25, the resistors 19, 26, and the condenser 23, and supporting the switches 15, 20. A multi-aperture extension 44 of the case provides a protective enclosure for the transmitters.

If the electrical outputs of a pressure transmitter such as 11, and a velocity transmitter such as 10, are properly combined, a unidirectional transmitter is obtained. The velocity transmitter discriminates against sound waves coming from the sides, but not from the back or the front of its diaphragm. The pressure device picks up sound waves from all directions without discrimination. When their electrical outputs are combined it is found that a unidirectional characteristic is obtained, since the electrical output of the velocity device is out of phase with that of the pressure device for sound coming from the rear.

Generally, the voltage generated by the transmitter combination should be in phase with the open sound field pressure throughout the entire frequency range. This phase requirement mitigates against the use of transmitters with involved acoustic circuits associated with the diaphragm, since such circuits tend to produce

phase distortion. Since a ribbon velocity transmitter is mass-controlled throughout its entire working frequency range, its electrical output is in phase with the sound field pressure; this is ideal for the velocity transmitter for the unidirectional combination. The voltage generated by a condenser transmitter is in phase with the sound field pressure throughout the frequency range where the mechanical impedance of its diaphragm is substantially that of a stiffness. If the diaphragm resonance is made to occur at a sufficiently high frequency a satisfactory pressure device is obtained for the unidirectional combination. The condenser transmitter, furthermore, should be sufficiently small so that the effects of diffraction therearound are not appreciable in the frequency range over which it is desired that the unidirectional combination be effective.

With the ribbon and the condenser transmitter combination, the terminals of the ribbon transmitter transformer secondary winding are connected between the low impedance terminal of the condenser transmitter and the ground lead of the associated amplifier. The combination operates most satisfactorily when a single amplifier only is used for both transmitters, since the difference in phase shift between two amplifiers, if used, seriously reduces the unidirectional effect of the combination. By associating switching means with the two transmitters, it is possible to utilize one or the other separately as well as the two together. The combination, therefore, may constitute a universal transmitter in that it may serve as a pressure, a velocity or a pressure-velocity device.

Although this invention has been disclosed with reference to a specific embodiment, it will be understood that it is not restricted thereto, but is limited in scope by the appended claims only.

What is claimed is:

1. In combination, a velocity-type transmitter comprising a permanent magnet, pole-pieces supported on said magnet and defining an elongated air-gap, and a conductive ribbon diaphragm in said air-gap, a carrier member secured to said magnet, a condenser transmitter on said carrier member, and a common support for said transmitters.

2. In combination, a velocity-type transmitter comprising a U-shaped permanent magnet, pole-pieces supported on the ends of said magnet and defining an elongated air-gap, and a conductive ribbon diaphragm in said air-gap, a carrier member secured to said magnet, a condenser transmitter on said carrier member at one end of said diaphragm and between the arms of the magnet, and a common support for said transmitters.

3. In combination, a velocity-type transmitter, a pressure-type transmitter, and means for combining the electrical outputs of said transmitters, said means including a transformer having a primary and a secondary winding, said velocity transmitter being connected to said primary winding and said pressure transmitter being connected in series with said secondary winding.

4. In combination, a velocity-type transmitter, a pressure-type transmitter, and means for combining the electrical outputs of said transmitters, said means including a transformer having a primary and a secondary winding, said velocity transmitter being connected to said primary winding and said pressure transmitter being connected in series with said secondary winding, and a single amplifier for said transmitters.

5. In combination, a velocity-type transmitter, a pressure-type transmitter, and means for combining the electrical outputs of said transmitters, said means including a transformer having a primary and a secondary winding, said velocity transmitter being connected to said primary winding and said pressure transmitter being connected in series with said secondary winding, and switching means for cutting out at will either transmitter.

6. In combination, a ribbon-type velocity transmitter, a condenser transmitter, and means for combining the electrical outputs of said transmitters, said means including a transformer having a primary and a secondary winding, said velocity transmitter being connected to said primary winding and said pressure transmitter being connected in series with said secondary winding.

7. In combination, a velocity-type transmitter, a pressure-type transmitter, and means for combining the electrical outputs of said transmitters, said means including a transformer having a primary and a secondary winding, said velocity transmitter being connected to said primary winding and said pressure transmitter being connected in series with said secondary winding, and switching means for cutting out at will either transmitter, one switching means being connected in shunt with the secondary winding of the transformer.

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