

CHAPTER 1-1

PRINCIPLES OF OPERATION OF MICROPHONE AND EARPHONE ELEMENTS

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MOVING COIL TYPE (Fig 1)

1 This type is used where uniform frequency response and wide operating frequency range are required. The basic structure functions either as a microphone or as an earphone. A lightweight diaphragm is attached to a coil wound on a lightweight cylindrical former which is aligned over the central pole of a 'pot' shaped permanent magnet, shown in section in Fig 1. Movement of the diaphragm causes the coil to cut the magnetic flux and a voltage is induced in the coil. Application of an alternating current to the coil causes it to become electro-magnetic and be attracted to or repelled by the permanent magnet, resulting in movement which is transmitted to the diaphragm.

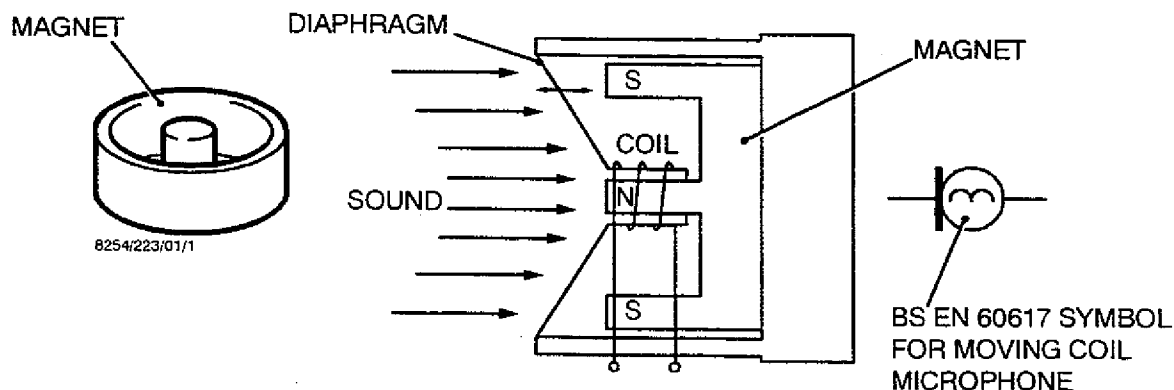


Fig 1 Moving coil type : diagram

MOVING IRON TYPE (Fig 2)

2 This type is used where small size and robust construction are required. The basic structure functions either as a microphone or as an earphone. A diaphragm of magnetic material, usually a lightweight diaphragm with a magnetic alloy disc fixed to its centre, is mounted with a small clearance from the poles of a permanent magnet. A coil is wound on the pole, or poles, of the magnet. Movement of the diaphragm varies the gap between it and the poles of the magnet. This variation of the air gap in the magnetic circuit varies the reluctance and hence the flux density and induces a voltage in the coil. Application of an alternating current to the coil generates a magnetic field which augments or opposes that of the permanent magnet, varying the attractive force on the diaphragm and moving the latter.

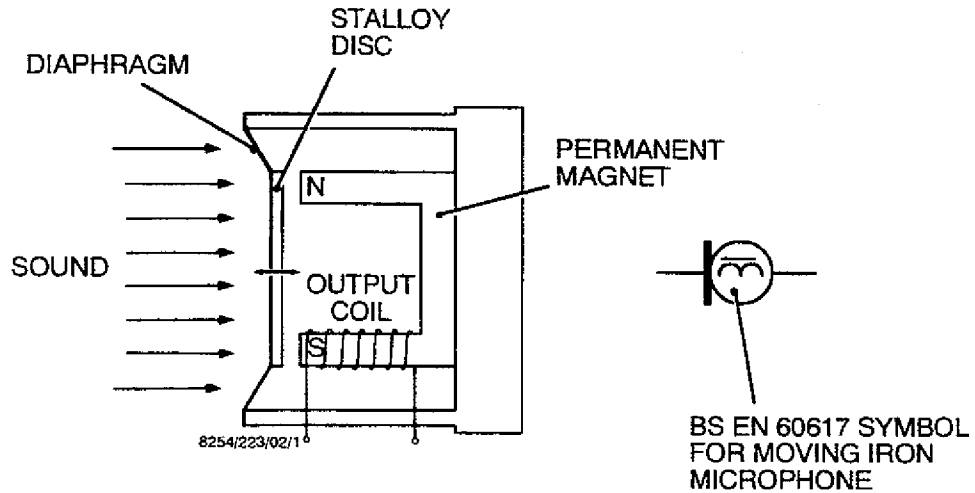


Fig 2 Moving iron type : diagram

ROCKING ARMATURE TYPE (Fig 3)

3 This type is used where high sensitivity and stability with temperature and pressure changes are required. It is similar in principle to the moving-iron type, but the inertia of the moving parts is lower and may be designed for optimum frequency response. It is used on an earphone only. A lightweight diaphragm is connected to one end of an iron armature which pivots on one pole of a permanent magnet. The armature becomes an extension of the pole of the magnet. Its ends are aligned over pole pieces attached to the opposite pole, and the magnetic field normally holds it in a balanced position. Coils are wound on the pole pieces, electrically in series and magnetically in opposition. Application of an alternating current to the coils unbalances the magnetic field at the pole pieces and rocks the armature.

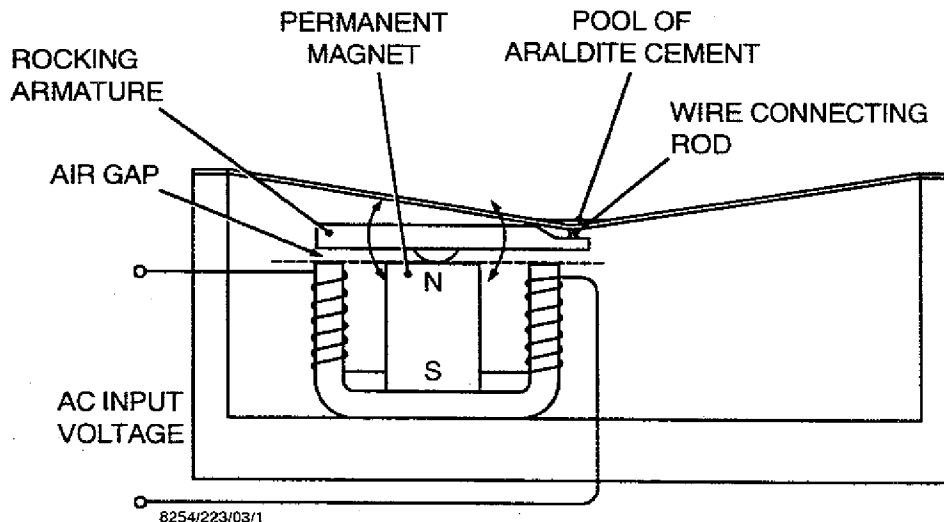


Fig 3 Rocking armature type : diagram

CARBON TYPE (Fig 4)

4 This type is used where high power output and robust construction are required. It is not normally used in airborne applications or in noise-cancelling units because it is inherently electrically noisy, has a poor operating frequency range and requires an external DC power supply. It functions as a microphone only. It comprises a ceramic cup filled with fine granules of carbon and a metal or carbon plunger. A diaphragm is attached to the plunger and spring loaded so that it holds the plunger under pressure against the carbon granules. Movement of the diaphragm varies the pressure on the carbon granules. When the granules are under pressure the resistance across them is low; as pressure is reduced the resistance increases. A direct voltage is applied across the mass of the granules and the sound waves produce a corresponding variation in circuit current, which is transformed into an output signal.

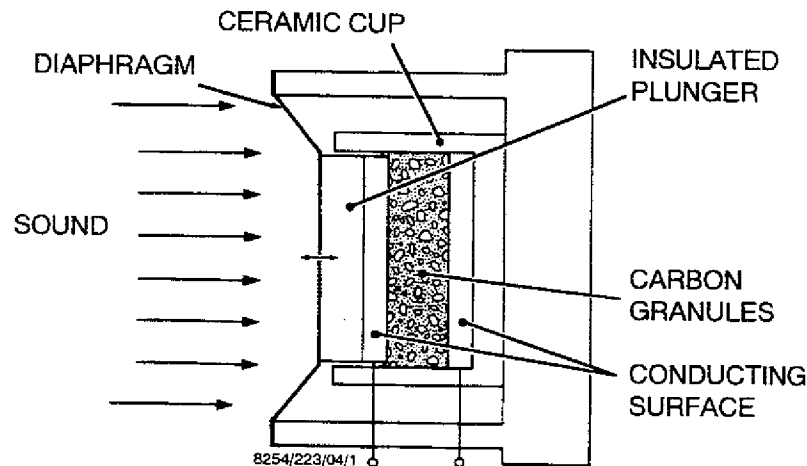


Fig 4 Carbon type : diagram

CAPACITOR TYPE (Fig 5)

5 This type is used where small size and wide operating frequency range are required. It is not normally used in airborne applications because the signal produced is small and it requires an external DC power supply. It functions as a microphone only. It takes the form of an air dielectric capacitor, of which one electrode is fixed and the other attached to a diaphragm. Movement of the diaphragm varies the capacitance. If a direct voltage is applied across it, the charge it carries must vary, resulting in a current in the external circuit. This current is detected and forms the output.

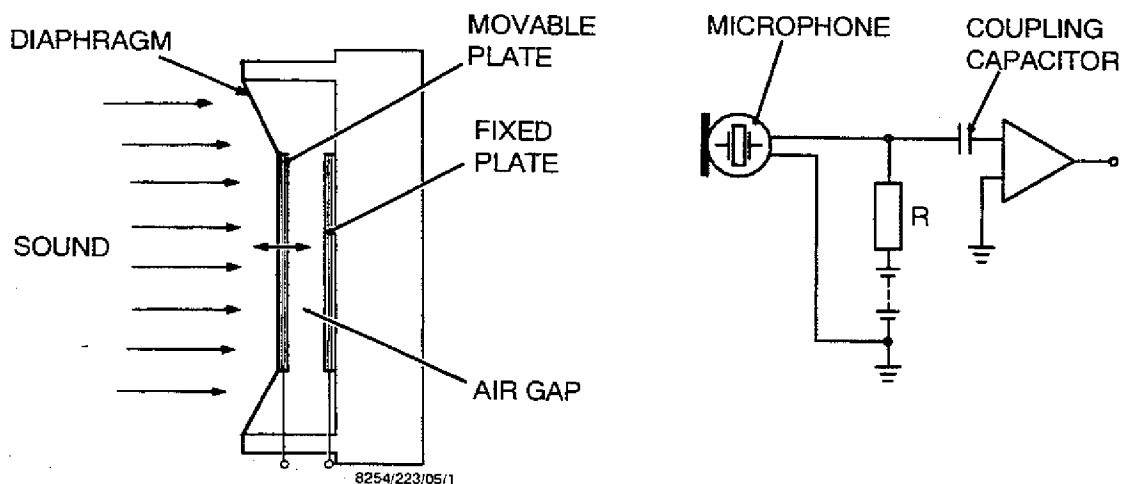


Fig 5 Capacitor type : diagram

RIBBON TYPE (Fig 6)

6 This type is used where uniform frequency response and wide operating frequency range are required. It is particularly suited to noise-cancelling units but is not normally used in airborne or mobile applications because its construction is inherently delicate. It functions as a microphone only. The diaphragm consists of a corrugated metal foil ribbon suspended between the pole pieces of a permanent magnet. Movement of the ribbon causes it to cut the magnetic flux and a voltage is induced in it. The output is at very low impedance and a matching transformer is required. The structure lends itself to construction in a symmetrical layout with equal access for sound waves on both sides of the ribbon.

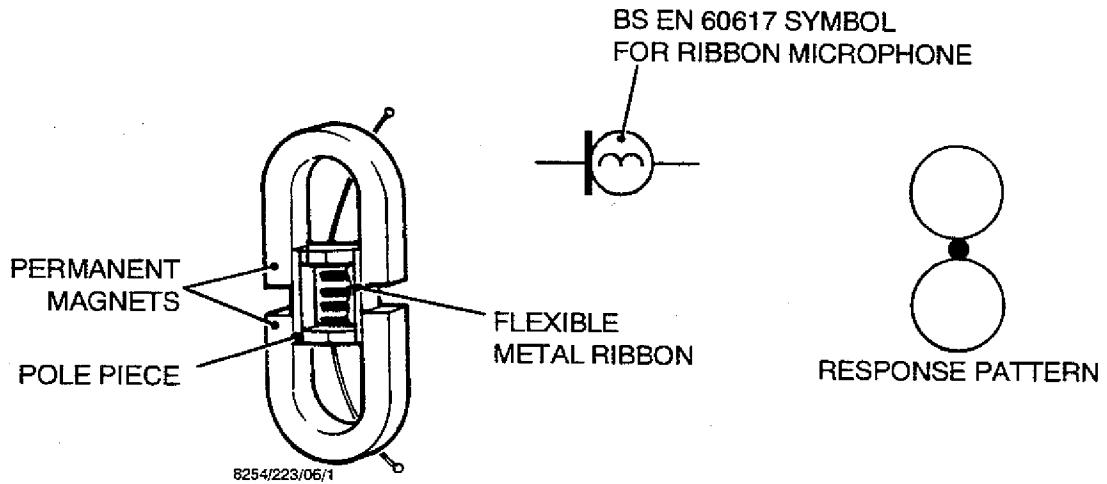


Fig 6 Ribbon type : diagram

CRYSTAL TYPE (Fig 7)

7 This type is used where low cost and robust construction are required. It utilises the piezoelectric effect in certain crystalline materials, ie if the crystal structure is distorted physically it develops a voltage across two of its faces, and vice versa. The basic structure functions either as a microphone or an earphone. The crystal is mounted with one face fixed and the other connected to a diaphragm. Movement of the diaphragm applies varying pressure on the crystal, which produces a corresponding voltage. Application of alternating voltage causes the crystal to vibrate and move the diaphragm. The frequency response is uneven due to resonance effects in the crystal. The output is at very high impedance and a matching transformer is required.

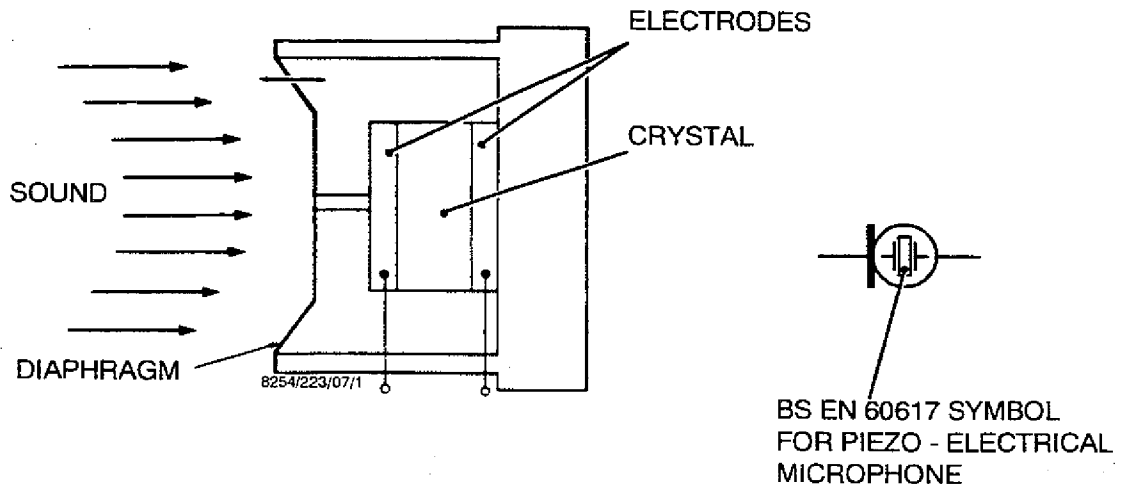


Fig 7 Crystal type : diagram

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