MORE ON DENTOPHONICS

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DENTOPHONICS is concerned with the relationship of sound to the mouth, and with practical applications of sound transmission through body tissues. Before giving an outline of various systems, it is as well to give a warning to those interested in practical experiments in this field.

At the present time, the medical profession states that there appears to be some link between high power audio noise levels and cardio-vascular diseases and cancer. Therefore care and advice should be taken regarding experiments involving the direct propagation of high power audio frequencies through body tissue of living subjects.

Furthermore hobbyist experimenters are advised to use transistor battery powered equipment, taking extreme care over electric shock precautions.

Direct transmission of audible sound through solids is relatively inefficient when compared with ultrasonic frequencies. The power required to drive a transmitting transducer in the speech range of 300Hz to 3kHz is much larger than that for 30kHz.

SONIC PROBES

The term "sonic probe" is applied to specialist transducers used for transmitting into, or receiving from, a material and means quite literally sound probe. There are three types of transducer commonly used in this application, piezo-electric, dynamic (moving armature) and variable reluctance. For transmission and reception purposes, the easiest probe for construction by the amateur is of the dynamic type, the basic design being shown in Fig. 1.

One method of making a probe is to obtain an ex-Government oxygen mask assembly and remove the microphone insert. This has a bright soft metal case which is carefully stripped off, the diaphragm assembly then pulls apart easily from the microphone body. The diaphragm alone is then replaced over the pole pieces and secured to the body with rubber impact adhesive.

An insert modified in this fashion may be used as a surface contact probe; an unmodified throat microphone cell may be used for the same purpose. For surface contact usage, as in the case of body tissues, acoustic coupling is improved by using MS4 silicone grease between the skin surface and the probe face (diaphragm).

For localised transmission and reception at a point, the diaphragm may be fitted with some form of socket assembly so that it can accept various types of probe head. In the author's case these were household sewing needles and a bodkin as may be seen in Fig. 2. However, in this case the original brass diaphragm retaining ring from the microphone insert is best refitted and secured with adhesive to add to the robustness of the assembly. Care should be exercised in the choice of material for the probe head, and its length, to prevent the introduction of resonances caused by the natural springiness of the material (modulus of elasticity) when stressed.

These microphone inserts have a nominal impedance of 200 ohms, connections on the plastic base marked 1 and 2 are connected to the coil and the connection marked C goes to the case.

A point contact reception probe can be made by modifying, or replacing, the stylus from a pick-up cartridge. Ceramic cartridges are best suited for this purpose due to their natural robustness and relatively high signal output voltage. Also a reception probe of this type and construction is not susceptible to external ambient noise, as are the types that have a diaphragm as a part of their construction.

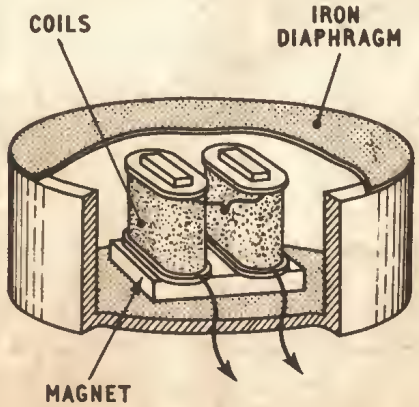

Fig. 1. A dynamic moving-iron transducer, e.g. headphone insert

A modified microphone of the aforementioned type was mounted on a denture (shown in Fig. 3) for experiments regarding a possible design for an artificial larynx (vocal chords). This was also found to be suitable for usage in experiments concerning Dentophonics and the Audio Dental Phenomenon.

THROAT MICROPHONES

These are basically similar in design to normal dynamic microphones, except the diaphragm has a slightly higher compliance (stiffness) and an interface pad of chamois leather covering the external face of the diaphragm. Two cells are used as part of a neck band and are designed to pick up the vibrations of the human vocal chords via the external walls of the cartilagenous structure of the larynx. Thus, these cells are ideally suited for use as sonic probes. The nominal impedance of complete throat microphone assemblies, available on the surplus market, is usually 200 ohms.

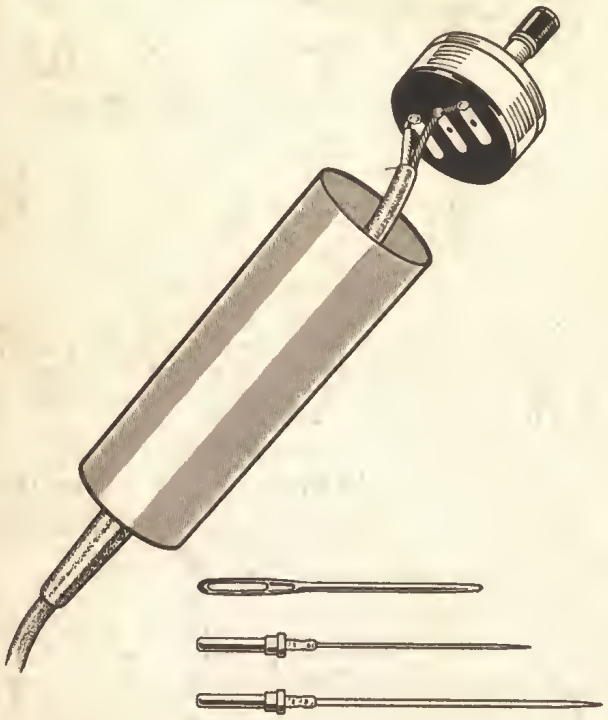

Fig. 2. A sonic probe for localised contact. The microphone diaphragm has been fitted with a socket which will receive various types of probe heads

ANCILLARY EQUIPMENT

Microphone inserts and throat microphone cells will handle continuous sine wave powers of up to 250 milliwatts at audio frequencies when used as transmission probes. Thus low power transistor amplifiers may be used for driving transmission probes and an amplifier having a rating of five watts is more than adequate.

However, the voltage levels obtained from reception probes are usually very small and a pre-amplifier capable of dealing with inputs of the order of 1 millivolt is a necessity. Also care must be taken with earth loops, electrical and acoustic screening to

Fig. 3. An experimental denture-microphone assembly

prevent hum and/or noise pick-up. This also avoids an experiment being marred by minute audio frequency electrical currents travelling through the human body during tissue investigations.

OCCLUSION

In experiments where it is necessary to muffle the human ear to shut out extraneous noises, it is best to use a set of the ear defenders now available. These specialist devices are primarily designed to protect the hearing of individuals working in high ambient noise levels. An example is that of airport personnel working in close proximity to running aero-engines. Ear defenders are worn like a normal headset, in fact some models have inbuilt telephone earpieces.

The ear pads are soft plastics cushions filled with glycerine, or plastic foam, and the streamlined hard plastic case cavity is filled with fine grain plastic foam. As an example of their efficiency a wearer in a quiet room can only just hear a domestic radio running at a normal listening level.

Ear defenders are manufactured by Anticoustic, Amplivox and Denis Ferranti Meters Limited.

CONCLUSION

Professional equipment is available; a variable reluctance bone conduction microphone is manufactured by Spembley Electronics, Enham Arch, Newbury Road, Andover, Hants. This item has a nominal impedance of 300 ohms, delivers 100 microvolts and has a twisted pair lead out. Accessories, such as line amplifiers, are also available from this firm.

Shure Electronics Limited, 84 Blackfriars Road, London, S.E.1, manufacture a high impedance crystal vibration pick-up. The model number is 61CP, and it is designed for research purposes.

Surplus throat microphones, inserts and dynamic telephone earpieces are available from suppliers including those given below.

London Central Radio Stores, 23 Lisle Street, London, W.C.2.

Samsons (Electronics) Limited, 9 & 10 Chapel Street, London, N.W.1.

Job Stocks Limited, St. Mary Road, Walthamstow, London, E.17 (callers only). This firm also has occasional stocks of surplus ear defenders. ★