

substance precipitated in the present experiments is creatinine potassium picrate. A direct study of the precipitate will be reported later.

7855 P

Amplified Heart Sounds. Use of the Crystal Microphone.*

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The object of this paper is to describe a practical method of amplifying heart sounds that may be used to teach students abnormalities of these sounds, to distinguish murmurs and to elucidate cardiac arrhythmias. This procedure is particularly useful in teaching auscultation to students.

Many amplifiers† have been described both in the United States and abroad. These usually have been bulky and not portable and many require the use of batteries. We have designed a high-gain 3-stage amplifier that is portable, inexpensive, operates on alternating current and does not require the use of batteries. The essential features consist of a type 57 tube of high amplification value, which is resistance coupled to another 57 tube in the second stage; and this in turn is resistance coupled in a 2A5 tube in the third stage. The power supply is the customary circuit and is heavily filtered using 30 henry chokes and 28 microfarads of condenser. A 2-ampere fuse was installed to prevent burning out the transformer in the event the amplifier is plugged into direct current by mistake. A 12-inch permanent magnet speaker was selected because of a better tone response than the magnetic speaker, and because it is lighter in weight than the dynamic speaker. An output transformer, while not required, was found to improve the tone response. It is possible with certain modifications to use this amplifier with direct current.

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† The crystal type of microphone has been used by Dr. H. B. Weiss at the Cincinnati General Hospital and a crystal microphone was used in the apparatus developed and demonstrated by Mr. M. L. Lockhart at the meetings of the American Heart Association and the American Medical Association. The advantage of the arrangement described in this report is its inexpensiveness.

The choice of a suitable microphone presented the greatest problem in our work. The aim of a portable and inexpensive outfit ruled out the condenser microphone as it is bulky and requires a separate power supply. The same is true of the ribbon and dynamic types of microphones. The carbon microphone is noisy and the inability to use it in any position, due to shifting of the carbon granules, proved it to be unsatisfactory. Theoretical and practical work demonstrated that the piezo crystal microphone was well adapted for our work. It is light, portable, inexpensive, does not require the use of any special transformer or batteries, and will operate in any position without any background noise or hiss. It is sensitive to the frequency level of heart sounds (50 to 160 vibrations per sec.).

Clinical tests with this amplifier have shown it capable of picking up the normal heart sounds and the usual murmurs in most individuals, unless these sounds are distant, and reproduces them through the loud speaker in sufficient volume to be audible in a room of moderate size, without any distracting hum. Further work is in progress with increased stages of amplification which are necessary to reproduce faint heart sounds.

7856 P

Acoustic Function in Pouch Young of the Opossum.

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Pouch young of the opossum were tested for reflex responses to acoustic stimuli, using a litter captured with the mother when they had attained an estimated age of 29 days (40 mm. C. R. length). The tests were begun when the litter was estimated 43 days old (63-64 mm. C. R.). Preliminary tests for vestibular reflexes show that these appear in pouch young of about 41 days (61-62 mm. C. R.), in general agreement with Langworthy.¹ The experiments on acoustic reflexes were begun on 5 young in the brood pouch and attached to the nipples in the normal manner. The pouch was opened only enough to permit observation of the young, the mother being held quietly on her back. Other factors than the acoustic stimuli were eliminated. During the course of the experiment 2 of the young were killed for neuro-histological study of the labyrinth and

¹ Langworthy, Orthello, *J. Comp. Neur.*, 1928, **46**, 201.