SHORT COMMUNICATION

New Device

CRYSTAL CARTRIDGE AS FORCE DISPLACEMENT TRANSDUCER FOR ELECTRONIC RECORDING

By

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Force-displacement transducers (Strain gauges) are imported items and are not available in many laboratories. Since the recording of force-displacement is a fundamental procedure in the study of contractile tissue, an easily available substitute is very much desirable. The present paper describes how a crystal cartridge, ordinarily used as a gramophone needle, can be adapted to work as a force-displacement transducer and to provide a matching input for oscillographic recording.

MATERIALS AND METHOD

Many varieties of gramophone needles are available. Some of them are sensitive to bi-directional displacement in one plane while others are steriophonic. These cartridges employ a piezo-electric crystal which acts as a mechano-electric transducer. A needle is placed in contact with the piezo-electric crystal and movements of the needle produce mechanical distortion of the crystal. This physical change in the crystal gives rise to the development of a potential difference (electrical signal) proportional to the degree of distortion, which in turn is proportional to the magnitude of needle displacement. Displacement of needle in the same plane in opposite direction gives signals with identical waveforms but of opposite sign. Thus the direction of contraction and relaxation can be well demarcated. The short needle of the crystal can be made longer to alter the sensitivity response. A long needle will also be desirable for direct insertion in the contracting tissue. A broken hypodermic needle fits nicely over the cyrstal needle (Fig. 1) and the sharp end of the hypodermic needle easily penetrates the tissue.

Since the crystal cartridge terminals form an open circuit, 50 cycle interference is seen in the oscillographic records when the cartridge terminals are connected to recording devices. This 50 cycle interference can easily be abolished by introducing a condenser in parallel with the terminals as shown in Fig. 2.

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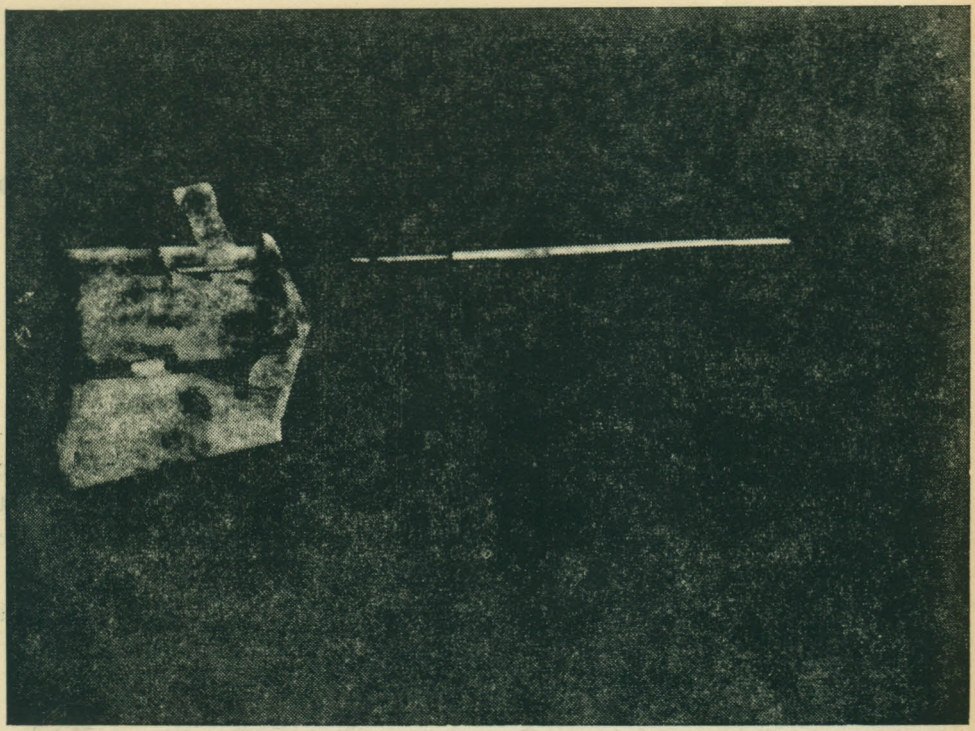

Fig. 1

Crystal cartridge. White points on left are the terminals for wires. A broken hypodermic needle (white) has been fixed firmly over the crystal needle (dark). Vertical movement of the needle produces an electrical impulse.

The condenser also permits attenuation of signal voltage and control of wave-form. The needle should be properly grounded.

The crystal cartridge so modified now works as a force-displacement transducer and provides a matching input for recording contractile response of muscular tissues electronically with oscilloscope or oscillograph.

RESULTS

Fig. 3 shows the record from an experiment on isolated perfused rabbit heart. The upper tracing is the E.C.G. while the lower tracing shows ventricular contractions recorded with the modified crystal cartridge. It is clear from this record that the modified crystal-cartridge-device is quite suitable for oscilloscopic or oscillographic recording of contractions of

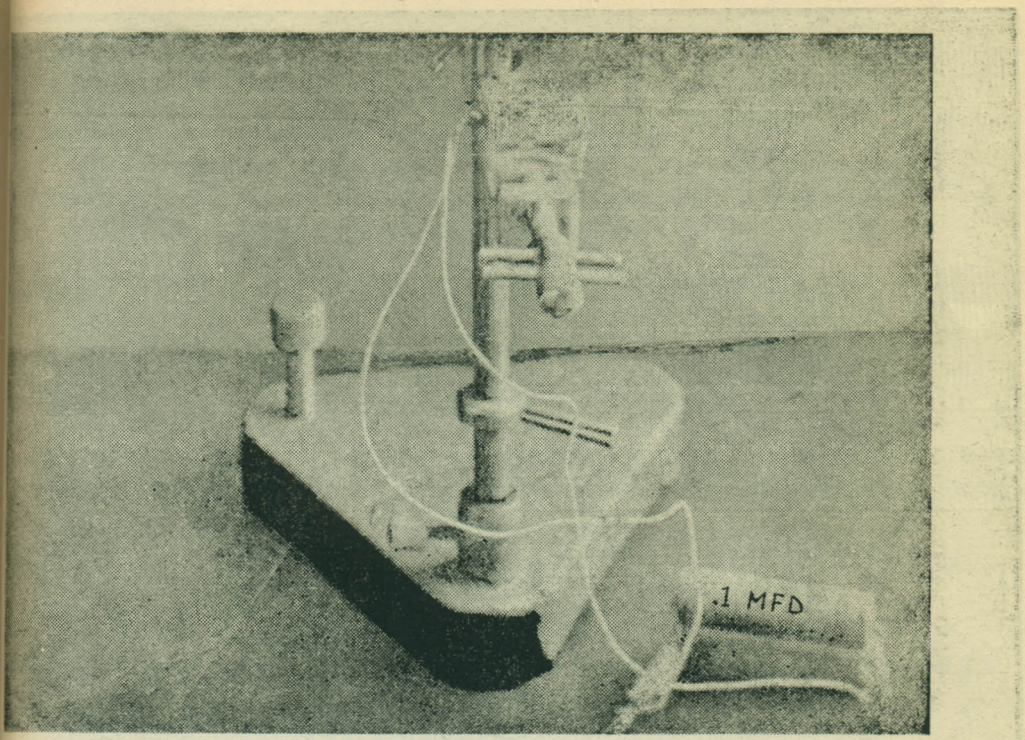

Fig. 2

tal cartridge held in position with a clamp. Note this condenser (**0.1** *mfd*) *placed across the two wires ted to the terminals.*

muscle. With further suitable adjustments it may also be used for recording contrac- of smooth muscle of intestine, uterus and of other contractile tissues.

DISCUSSION

The frequency response of the crystal cartridge covers the audio-frequency range. Very equencies may not be faithfully followed. Further the needle cannot be presumed to from inertia specially after being elongated with a broken hypodermic needle. The nship between the displacement of the needle and piezo-electric effect could be consi- o be linear over a certain range. These factors limit the use of such a device for quantitative analysis in absolute terms and for faithful reproduction of waveforms. er the device is quite suitable for a large number of investigations where mostly relative s are studied *e.g.* action of drugs or other agents on contractile (inotropic) response. combined with E.C.G. recording as in Fig. 3, quite useful information about the mecha- nd electrical activity of the heart or other contractile organs can be recorded.

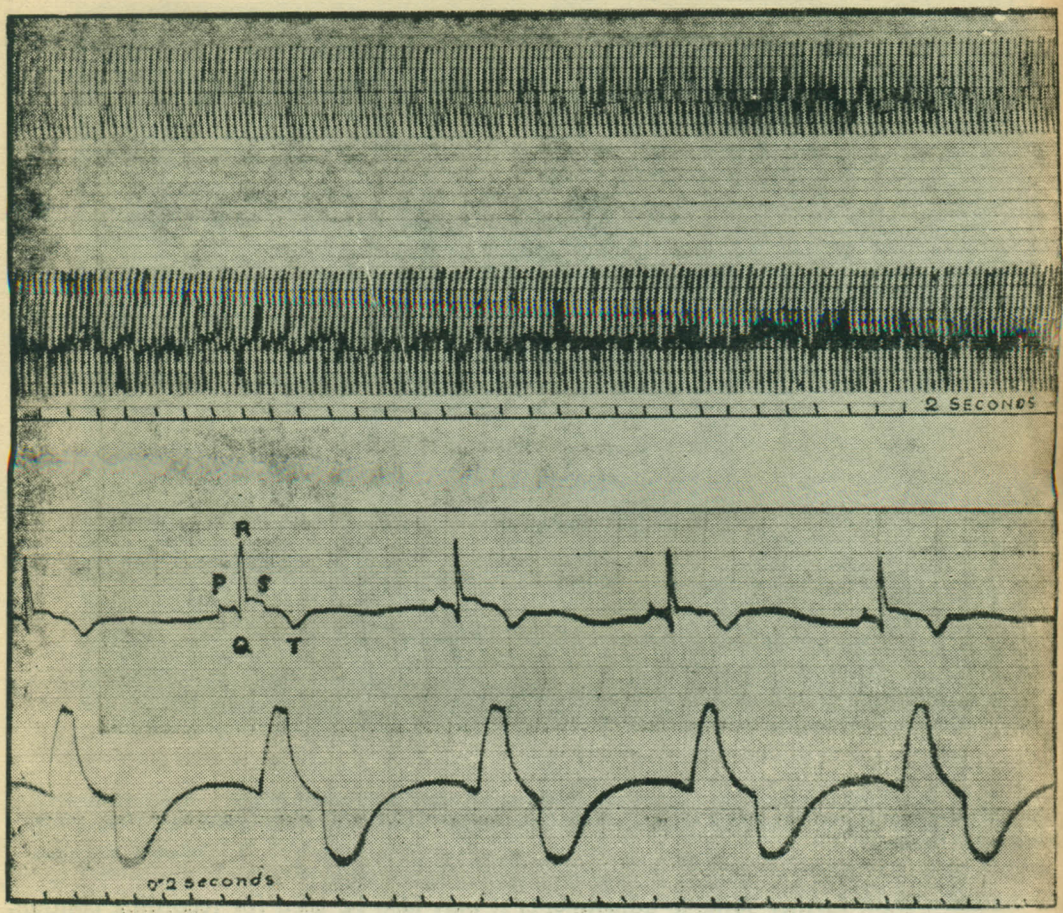

Fig. 3

Isolated rabbit heart. A, slow speed. Upper trace, E. C. G; lower trace, ventricular contractions. B, fast speed. Upstroke of mechanogram following R wave gives the actual contraction height.

SUMMARY

1. The use of crystal cartridge (gramophone needle) as a force-displacement input transducer has been described.

2. The device is quite suitable for recording contractions of heart as well as of other muscular organs.

ACKNOWLEDGEMENT

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