TECHNICAL NOTE

*AN INEXPENSIVE DUAL LEAD SLIP-RING FOR USE WITH
TAIL-SHOCK ELECTRODES¹*

Procedures utilizing delivery of shock through tail electrodes have recently been reported with increasing frequency (Caggiula and Eibergen, 1969; Weiss, 1967). The technique of delivering shock to the tail of a single rat subject is especially reliable when using direct current and eliminates the need to use scrambling devices. This technique also allows delivery of shock to one of several animals in the same cage space. For example, in studies of the inhibition of copulation in male rats through shock punishment, it is desirable to deliver shock to the male, but not to the female (Beach, Conovitz, Steinberg, and Goldstein, 1956), which cannot be done with a grid and scramble procedure.

Tail shock has other advantages over foot shock: it is a more reliable unconditioned stimulus because it affords better body contact than usually obtains between floor grid and foot pads. Electrode contact at the tail remains continuous and uniform despite such unconditioned responses as jumping, crouching, and other postural adjustments. In addition, in designs requiring yoked controls, the probability of delivering simultaneous and equivalent shock stimuli to each subject is maximized by connecting the tail electrodes of two or more subjects in series.

One serious mechanical disadvantage associated with this method of shock delivery is that the lead delivering shock to the tail electrodes often becomes twisted, limiting the subject's movement, especially if the animal is very active (as in mating studies). The induced strain on the lead often causes it to break. Commercial "slip-rings" available solve this problem. One of the most reliable types (Lehigh Valley Electronics, Model 1373) uses commutator rings to transfer signals from a rotating connector to stationary contacts. Another type (Laboratory Concepts) uses mercury filled concentric cups swivelling about a central vertical axis. Such devices, however, are best suited to applications requiring low friction and high conductivity of weak current, as in the delivery of electrical brain stimulation through chronically implanted intracranial electrodes. The high precision and expense of these units does not recommend their use for delivering shock via a tail electrode. This note describes a simple,

inexpensive and durable slip-ring, easily assembled from parts costing no more than \$5.50.

Figure 1 shows the major components of the slip-ring: two precision ball bearing assemblies² and two flathead machine screws mounted in a 2.25 in. (5.72 cm) by 1.5 in. (3.81 cm) piece of 1 in. (2.54 cm) thick Polyethylene. The assemblies are held in place by two 1/8 in. (3 mm) thick plastic face pieces fastened to the block with screws.

The bearing assemblies are seated on brass washers. Leads soldered to these washers run through laterally drilled holes to snap-lead studs mounted on each end of the block. The two 0.25 in. (6 mm) flathead machine screws are center-bored and bolted to the ball-bearing assemblies, the excess portion of the screw being cut off. It may be necessary to reduce the size of the nut to provide adequate clearance between the nut and the mounting block. This can be done easily with a drill press and file. A 6 in. (15.3 cm) length of multi-stranded, insulated wire is threaded through and soldered to the head of one of the screws. A second 6 in. (15.3 cm) length of insulated wire and a length of heavy copper Buss wire, to take up strain, are soldered to the second screw.

In the assembled unit, the single insulated wire from the first (or top) assembly passes through the second assembly. The three exiting wires are braided (to distribute strain) and taped. Total time of the construction and assembly should not exceed 2 hr per unit.

This slip-ring has been used without malfunction for several months in our laboratory. Although dc current was used (0.6 mA. at 160 v dc), ac current may be used as well. Electrical resistance is low (6 to 8 ohms) and inherent friction constitutes no apparent impediment to the rat subject. The slip-ring can also be used for delivering shock through a harness.

REFERENCES

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²New Departure No. R4 (open), obtainable from United Delco, 14555 Alondra Blvd., La Mirada, California 90638. An equivalent Fafnir bearing, No. 51K7 (open), is obtainable from Fafnir Bearing Company, 20 Rawlings Road, New Britain, Connecticut 06051. These bearings are also distributed nationally to some hardware stores and industrial suppliers of instrument bearings.

Fig. 1. Dual-lead slip-ring (cross section) for use with tail-shock electrodes. Flathead machine screws are used, since the conical heads are self-centering in the ball-bearing assembly. Either nut may be turned down or filed to permit adequate clearance. Pressure on the protruding ball-bearing from the plastic facing insures good electrical contact with the brass washer.

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