

# A PROGRAMMING CIRCUIT FOR SELF-STIMULATION OF THE BRAIN

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Electrical stimulation of the brain as both positive and negative reinforcement is a growing adjunct to the analysis of animal behavior. Olds and Milner (1954) have described the techniques of electrode implantation in the rat, but little has been said about equipment for programming the stimuli. The basic requirements, as determined by experimenters in this area, may be described as follows. For positive reinforcement, the rat receives electrical stimulation for as long as it depresses a bar, but not longer than about 0.5–1 second. The rat must release the bar and depress it a second time to get additional current. When negative reinforcement is used, the stimulus is delivered to the brain unless the rat depresses the lever. Two possible alternatives arise at this point: Either the current is held off until the rat releases the lever, or it is held off for only a short interval, after which the rat must press the bar a second time.

Since the pieces of apparatus usually found around the laboratory do not appear to be ideally suited to the outlined program, the device described here was designed and constructed chiefly for classroom demonstrations. By judicious shopping for parts, the total cost was held to under twenty dollars.

The circuit diagram indicates a double pathway through the relay and switch contacts, so that a signal lamp (or counters and timers) may readily be placed in Circuit B. Because partial-reinforcement schedules are not often used, this feature has not been included; conventional arrangements may easily be wired into the lever circuit. Stimulus currents of various waveforms are introduced through Input A.

Operation is as follows. With Switch 2 in "initiate" (up) position, depression of the bar allows the stimulating current to flow until (a) the bar is released, or (b) the thyatron fires (after a delay determined by C and R<sub>4</sub>), whichever is first. Release of the lever recycles the programmer so it is immediately ready for another sequence. With Switch 2 in "discontinue" (down) posi-

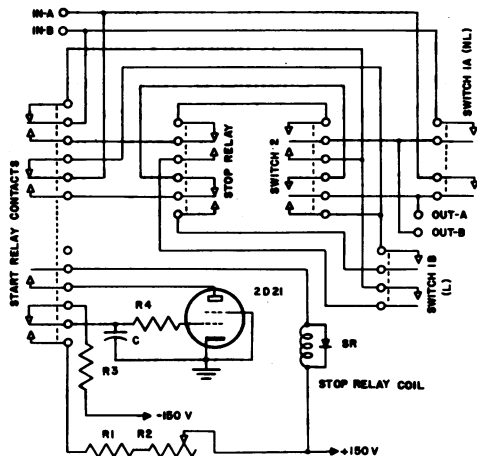


Fig. 1. C: 1-mfd. oil capacitor. R<sub>1</sub>: 470K ohms. R<sub>2</sub>: 750K ohm potentiometer. R<sub>3</sub>: 1000 ohms. R<sub>4</sub>: 1 Meg. All R's are 0.5 watt. Start relay: 4PDT; 24-volt D.C. coil. Stop relay: 2PDT; 1000-ohm coil. SR: silicon diode; 200-PIV; 500 milliamperes. Switch 1: 2-2PDT, center-off. Switch 2: 2PDT, center-off. Power supply is conventional and not shown. Since the operant-conditioning box is usually equipped with a low-voltage supply, the start relay may be selected so as to operate on the existing supply; for this reason, the bar switch and start relay coils are not included in the figure.

tion, the current flows until the bar is depressed. If Switch 1B is now in its closed position, the current is held off for only the thyatron delay interval; the rat must release the bar and press it again to escape. But if Switch 1B is in its open position, the stimulus is avoided so long as the lever is held down. In the non-lock (NL) position, Switch 1A overrides all of the other circuitry and delivers the stimulus irrespective of the condition of the relay-switch tree.