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Publisher's version / Version de l'éditeur:
https://doi.org/10.4224/21272346
Report (National Research Council of Canada. Electrical Engineering and Radio Branch. ERA); no. ERA-202, 1951-09

ERA - 202

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NATIONAL RESEARCH COUNCIL OF CANADA

RADIO AND ELECTRICAL ENGINEERING DIVISION

A TWIN-CHANNEL ELECTRONIC SWITCH

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OTTAWA

SEPTEMBER 1951

N.R.C. NO. 2529

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ABSTRACT

A twin-channel electronic switch is described for use with a single-beam oscilloscope. Two transient or steady-state audio frequencies having components up to 20 kilocycles per second can be observed at the same time by switching the sweep vertically at a rate which is variable up to 10^5 times per second and sampling the audio frequencies in turn. In appearance the result is two horizontal sweeps with separate signal inputs to each.

A TWIN-CHANNEL ELECTRONIC SWITCH

Introduction

The conventional electronic switch in general use, with a switching rate of from 30 to 2000 times per second, is quite satisfactory for observing audio frequencies which are being repeated continuously, but for transient audio frequencies the switching rate must be much higher. An example would be in the reception of a meteor Doppler whistle on two similar receivers which may be tuned to transmitters on different frequencies, or on two receivers at different locations with the intelligence being transmitted to one common location and presented simultaneously on one cathode-ray tube. The frequency of a Doppler whistle varies from zero to a value of the order of 800 cycles per second. In order that the instantaneous frequency may be determined at any instant it must be sampled at least three times for each cycle, but a higher rate is more desirable — e.g., five times, or more, per cycle. With the electronic switch described here two transient frequencies as high as 20 kilocycles per second can be observed simultaneously by sampling each frequency at least five times per cycle.

In the oscilloscope used, the vertical deflecting plates must be brought out to terminals on the front panel for best results. The mixed signal from the electronic switch is applied to one vertical deflection plate and the sweep separation voltage is applied to the other plate.

Circuit Description

In Fig.1 V_1 is a multivibrator whose frequency can be varied from approximately twenty to one hundred thousand times per second by the dual potentiometer P_{1a}, P_{1b}. The output from each plate of this tube is further squared in V_2. Since the load resistors of V_2 are very small, a sharp rise and fall time of the voltage of the square wave is obtained. One of the audio signals to be examined is coupled to the control grid of V_4 through potentiometer P_2 and the other signal through P_5 to the control grid of V_5. The square waves from V_2 are connected to the suppressor grids of V_4 and V_5 and these tubes are turned on alternately. Since they have a common plate load, samples of both input signals will appear at the plate in sequence. A type-1N34 crystal is connected from each suppressor to ground to prevent the gating pulse driving the suppressor positive during the instant it is turned on. The gated amplifiers have a voltage gain of approximately 18.

The common output of V_4 and V_5 is connected to the grid of V_6 which is a cathode follower with the grid resistor returned to a tap on the cathode load. This will allow an output voltage of the order of 65 volts, peak-to-peak, to appear at the cathode before the negative part of the signal is clipped off due to the action of the cathode follower.

Sweep separation is obtained by using the square wave which is applied to the suppressor grid of V_4 and coupled through P_3 to an output terminal which can be connected to one of the vertical deflection plates on the oscilloscope. This causes the sweep to be deflected in one direction when V_4 is turned on and in the opposite direction when V_5 is on, thus forming what appear to be two different horizontal sweeps, having an audio signal on one completely independent of the other.

P_4 is a potentiometer in the cathode of V_5 which is adjusted to produce exact balance in the gated amplifiers, V_4 and V_5. The method of adjustment is to apply the output of the switch to one vertical deflecting plate of the oscilloscope with the sweep separation output terminal disconnected, and then adjust P_4 until there is no sweep separation. Once set up it should require no further adjustment during normal operation.

The frequency of the multivibrator, V_1, is not critical and normally requires no adjustment except when observing fairly high audio frequencies that happen to be nearly submultiples of the multivibrator frequency. In this case small breaks appear in the sweep due to switching rate. A slight movement of the frequency control in either direction will cause these breaks to move along the sweep at such a speed that they will no longer be noticeable.

The power supply is of the conventional type and uses a miniature type-6X4 tube as a rectifier. The electronic switch draws about 40 milliamperes at 240 volts, unregulated. Its dimensions are 10 by 6 by 6 inches.

Figs. 2 and 3 are photographs of the electronic switch.

* * *

Mr. H.W. Poapst constructed the models.

COMPONENTS

	CONDENSERS		
C1	10mfd	450v	Electrolytic condenser
C2	10mfd	450v	Electrolytic
C3	4.7pfd	500v	Mica
C4	4.7pfd	500v	Mica
C5	.01pfd	400v	Mica
C6	.1pfd	400v	Paper
C7	.01pfd	400v	Mica
C8	.1pfd	400v	Paper
C9	10mfd	450v	Electrolytic
C10	1mfd	200v	Paper
C11	50mfd	25v	Electrolytic
C12	10mfd	450v	Electrolytic
C13	50mfd	25v	Electrolytic
C14	1mfd	200v	Paper
C15	1mfd	200v	Paper
C16	1mfd	200v	Paper
	RESISTORS		
R1	120k	2w	
R2	4.7k	2w	
R3	4.7k	2w	
R4	47Ω	1/2w	
R5	47Ω	1/2w	
R6	470k	1/2w	
R7	470Ω	1w	
R8	470k	1/2w	
R9	470Ω	1/2w	
R10	3.3k	2w	
R11	3.3k	2w	
R12	47Ω	1/2w	
R13	47Ω	1/2w	
R14	2.2M	1/2w	
R15	1k	2w	
R16	1k	2w	
R17	2.2M	1/2w	
R18	470Ω	1/2w	
R19	47k	2w	
R20	4.7k	1w	
R21	22k	1w	
R22	22k	1/2w	
R23	470Ω	1w	
R24	100Ω	1w	
R25	22k	1/2w	
R26	330k	1/2w	
R27	680Ω	2w	
R28	3.9k	2w	
	POTENTIOMETERS		
P1	2M dual pot.		
P2	100k pot.		
P3	25k		
P4	1k		
P5	100k		
	TUBES		
V1	6J6		
V2	12AU7		
V3	6X4		
V4	6AS6		
V5	6AS6		
V6	12AU7		
	MISCELLANEOUS		
Sw.1	S.P.S.T.		
T1	Hammond 270B Transformer		
L1	Hammond 155 Choke		
XL1	IN34 Germanium crystal		
XL2	IN34 Germanium crystal		
IL1	6.3v Pilot light		
Q1	A.C. Chassis connector recessed male G.E.-2711		
	BINDING POSTS		
J1	Superior DF-30 Binding post - female		
J2	Superior DF-30 Binding post - female		
J3	Superior DF-30 Binding post - female		
J4	Superior DF-30 Binding post - female		

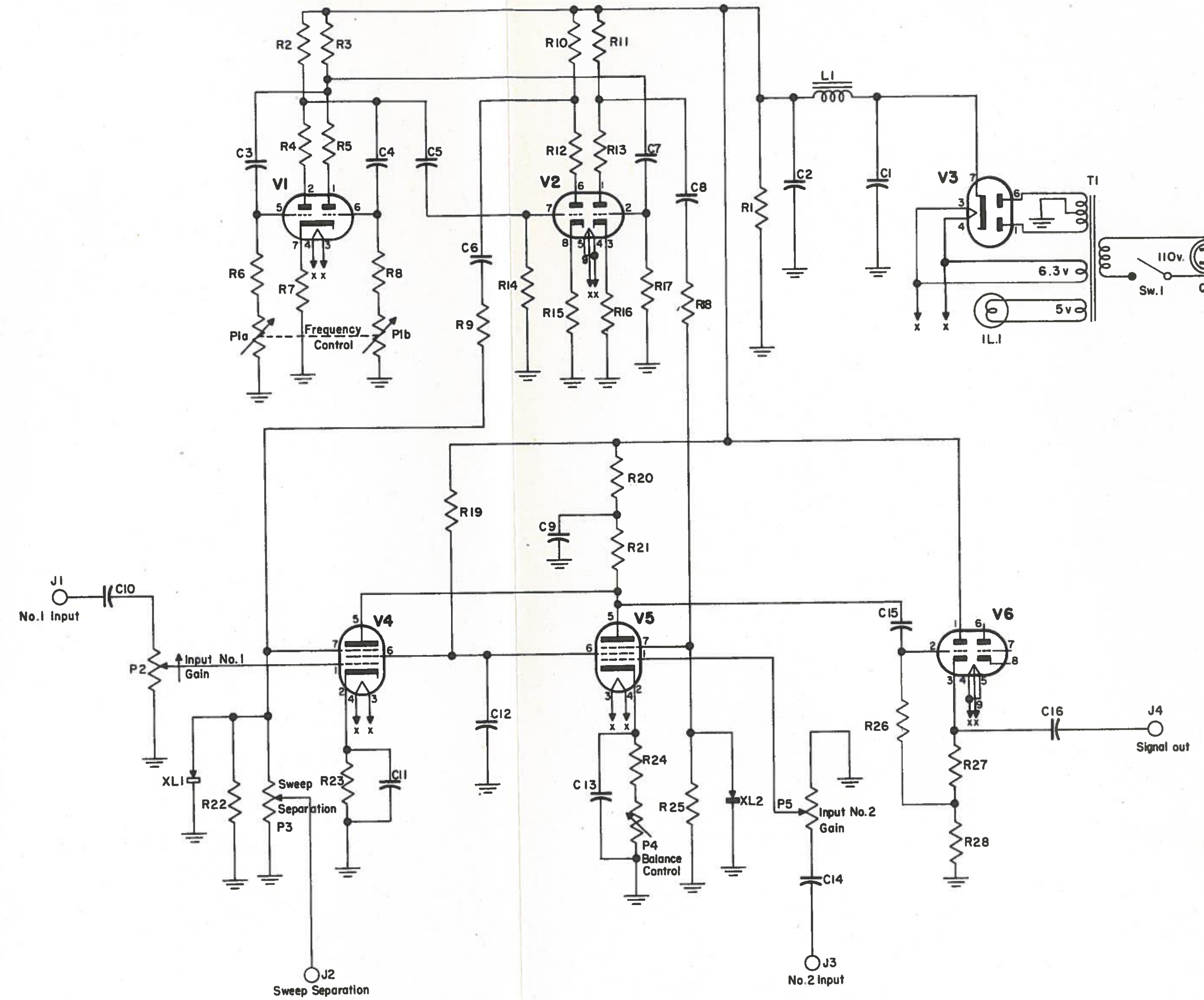

FIG. 1

SCHEMATIC DIAGRAM OF TWIN-CHANNEL ELECTRONIC SWITCH

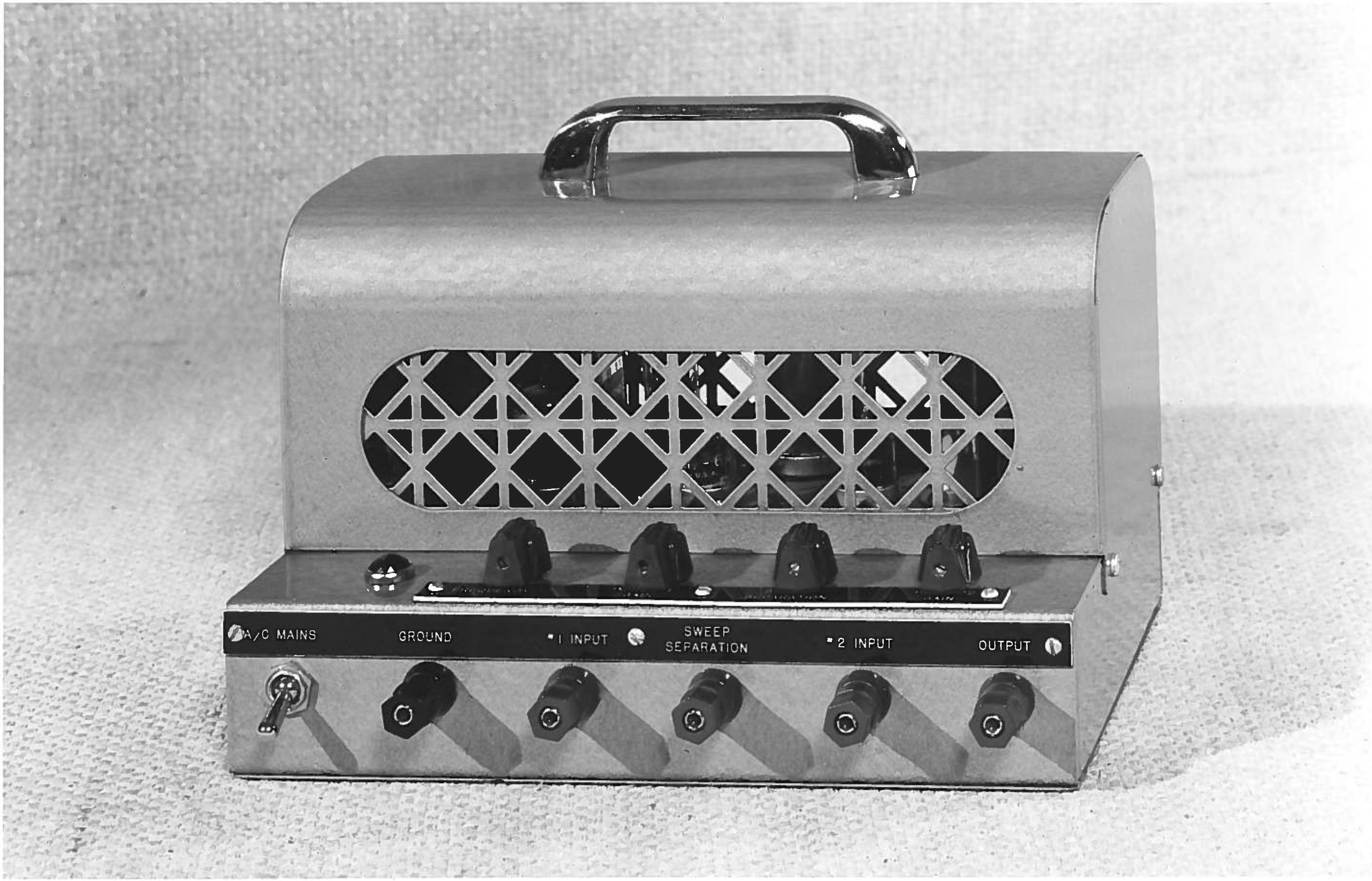

FIG. 2

TWIN-CHANNEL ELECTRONIC SWITCH

COVER IN PLACE

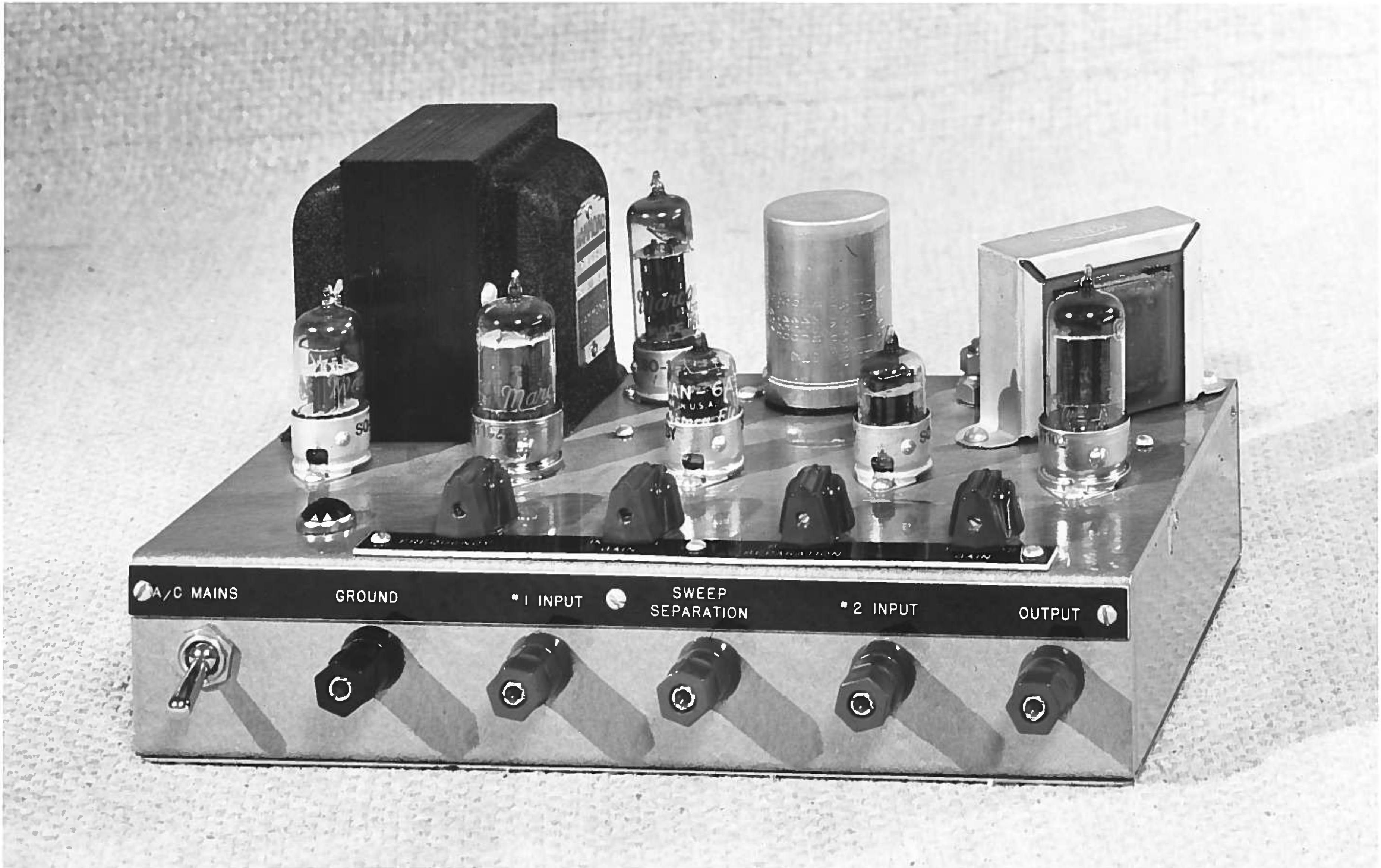

FIG. 3

TWIN-CHANNEL ELECTRONIC SWITCH

COVER REMOVED