

# SQUEE, THE ROBOT SQUIRREL — CONSTRUCTION PLANS

by

Edmund C. Berkeley and Jack Koff

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Squee, the Robot Squirrel, is a scientific experimental machine constructed by Robert A. Jensen, William Szabo, Jack Koff, and Edmund C. Berkeley in the period August, 1950 to August, 1951. Squee rolls over the floor and hunts for "nuts"; when he finds one, he picks it up in his "hands" or scoop, takes it over to his nest, there leaves it, and then hunts for more nuts.

Squee has been described in "Newsweek", August 27, 1951, in "Radio Electronics", December, 1951, and February, 1952, and in "Popular Science", July, 1952. His picture in color was on the front cover of December, 1951, "Radio Electronics".

The purpose of Squee is to display in a machine the kind of behavior that people ordinarily think only animals can carry out.

These pages describe the machine as it was on September 15, 1951, and give all the circuits and other information which we used to construct the robot. The cost of materials was about \$195. The machine can be considerably improved. We hope this description will encourage other investigators and experimenters to build it with improvements, and we shall be glad to help anybody to the extent that we can.

## CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
1	Squee, the Robot Squirrel -- General Description	2
2	Views: Left Side View (including key to other views)	3
	View A -- Bottom Looking up	4
	View B -- Looking Down	5
	View C -- Looking Up	6
	View D -- Looking Down	7
	View E -- Looking From Rear	8
	View F -- Steering Column	9
3	Mechanical Parts List	10
4	Electrical Parts List	11
5	Main Circuits Parts List	12
6	Circuits -- A. Drive Motor Control, etc.	13
	B. Scoop Control	14
	C. and D. Amplifiers, Right Eye	15
	E. and F. Amplifiers, Left Eye	16
	G. Steering Motor Control	17
	H. and I. Main Power Switch, and Vest Light	18
7	Operating Instructions	19

## 1. SQUEE, THE ROBOT SQUIRREL -- GENERAL DESCRIPTION

Squee, the Robot Squirrel, is an **electromechanical device** which:

- hunts for "nuts", lighted by a steady light (for example, a tungsten filament lamp lighted by A.C. or D.C. current);
- when it finds one, picks it up in its "hands" or scoop;
- thereupon heads for its "nest", lighted by an oscillating light (for example, a gas-filled lamp lighted by A.C. current, which is dark 120 times a second and light 120 times a second);
- deposits the nut in its nest; and then,
- hunts for more nuts.

The squirrel has three wheels like a tricycle. The front wheel is driven by the "motor drive" attached. The front wheel is mounted within a vertical shaft that can be turned entirely around, and steered by the "steering motor", which is right next to the shaft. The two rear wheels turn freely. Just in front of the rear wheel is a couple of wet batteries in series supplying  $3/4$  ampere at 12 volts for 4 hours, and providing the energy for the squirrel.

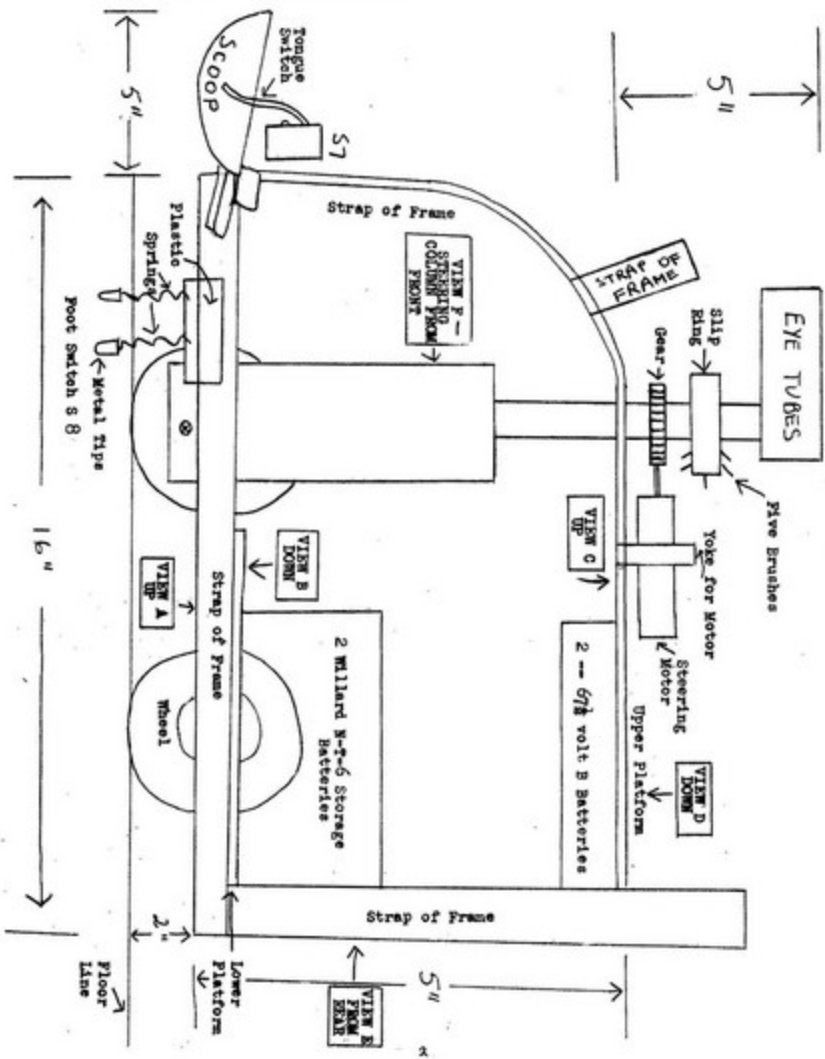
The "nuts" of the squirrel are tennis balls. An assistant holds a flashlight steadily above one of the tennis balls, and the squirrel approaches the light. When a tennis ball gets into the scoop, the ball rolls against a switch (the "tongue" switch), which causes the scoop to close. The squirrel then forgets about the steady light, and hunts for the oscillating light, sees it at the nest, and then homes towards its nest.

The squirrel has two photocell "eyes", left and right, which see either steady or oscillating light. While hunting, the squirrel pays no attention to the oscillating (nest) light, only to a steady light illuminating the "nut". When a "nut" is picked up, the squirrel homes towards its nest. The nest is a sheet of metal on the floor. When the squirrel arrives there, two probes on the base of the squirrel (the "foot" switch) close a contact, the scoop opens, the ball rolls out, and the squirrel backs away from the nest. The squirrel then forgets about its nest, and goes back to hunting for another nut.

The squirrel has four sensing organs: the two eyes (which look in directions about thirty degrees apart), the tongue, and the foot. It has three acting organs: the drive motor, the steering motor, and the scoop motor. And it has a brain, consisting essentially of thirteen relays.

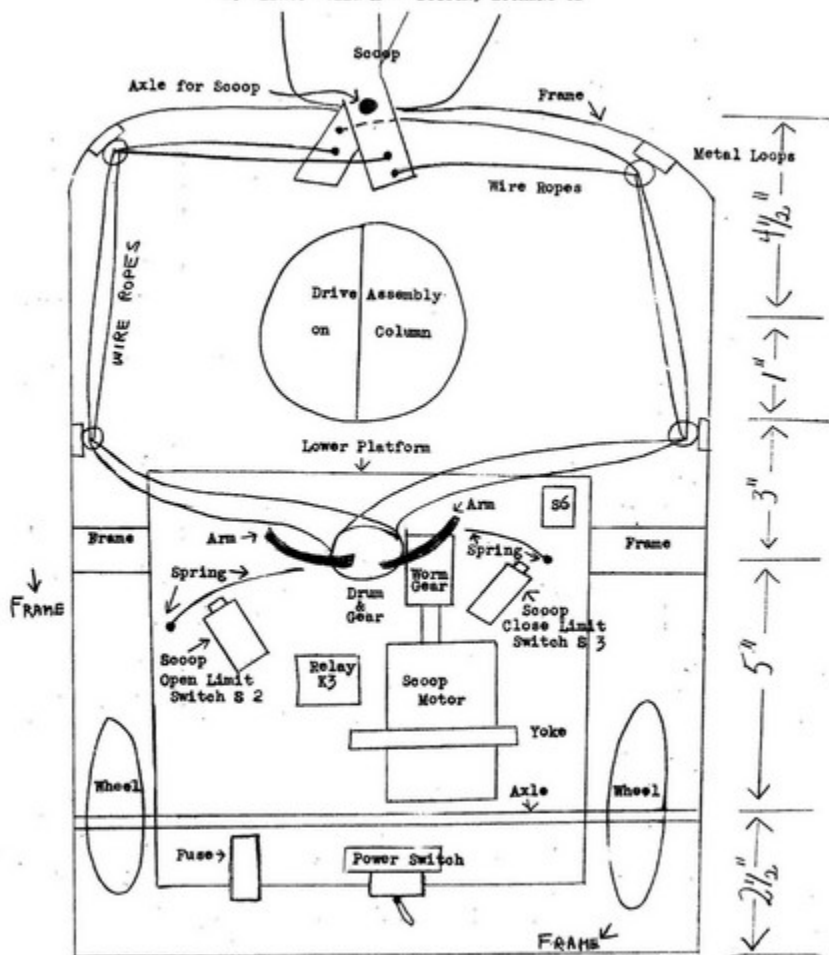
Squee, The Robot Squirrel

2. VIEWS: LEFT SIDE VIEW



Squee, The Robot Squirrel

2. VIEWS: VIEW A -- BOTTOM, LOOKING UP



Squee, the Robot, Squirrel

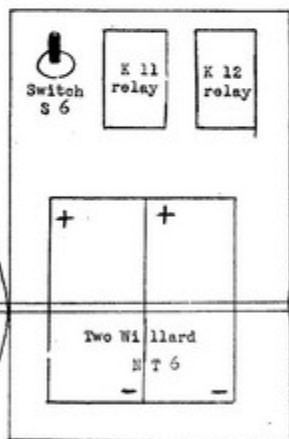
2. VIEWS -- VIEW B,  
LOOKING DOWN

Front

Scoop



4 3/4"

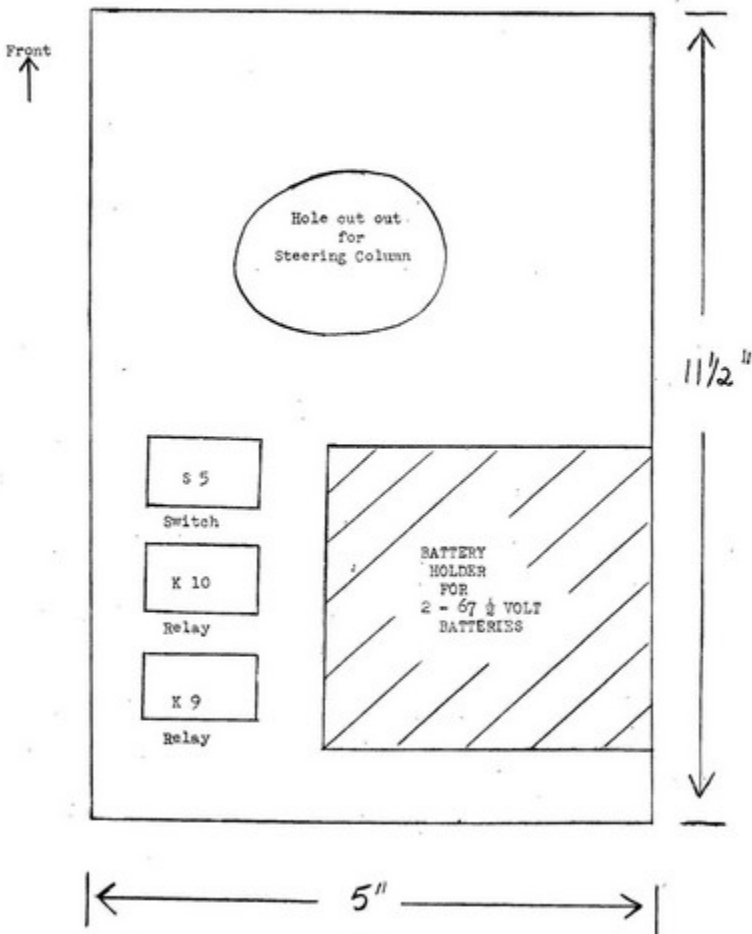


8 1/2"

Back

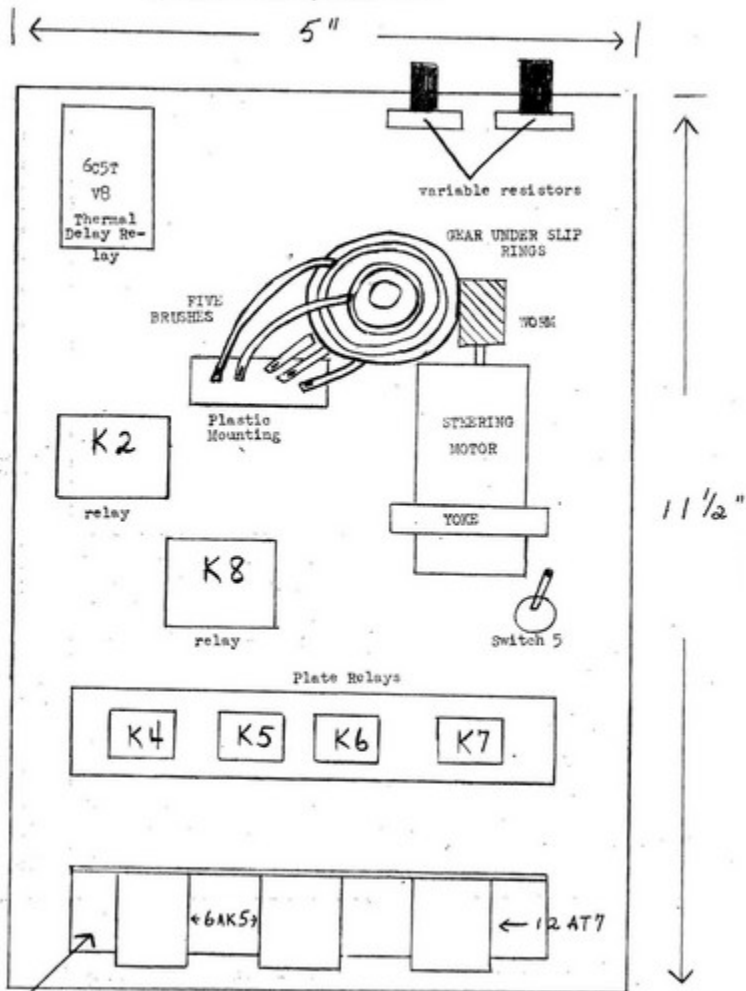
Squee, the Robot Squirrel

2. VIEWS -- VIEW C, LOOKING UP



Squee, the Robot Squirrel

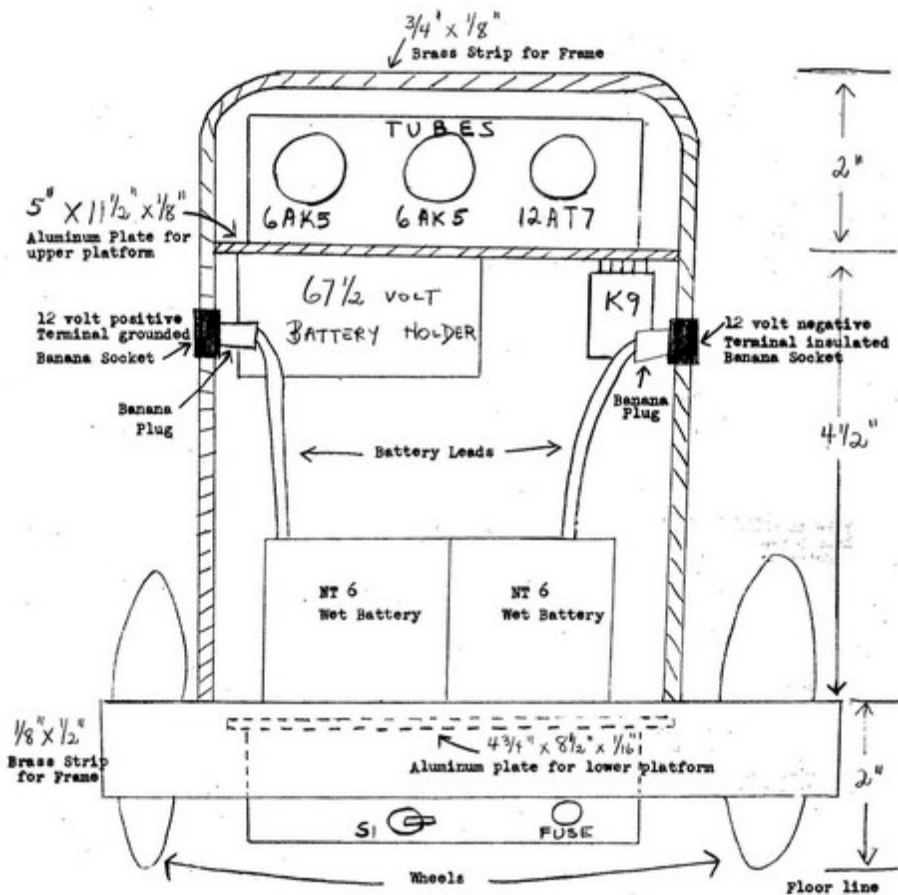
2. VIEWS -- VIEW D, LOOKING DOWN



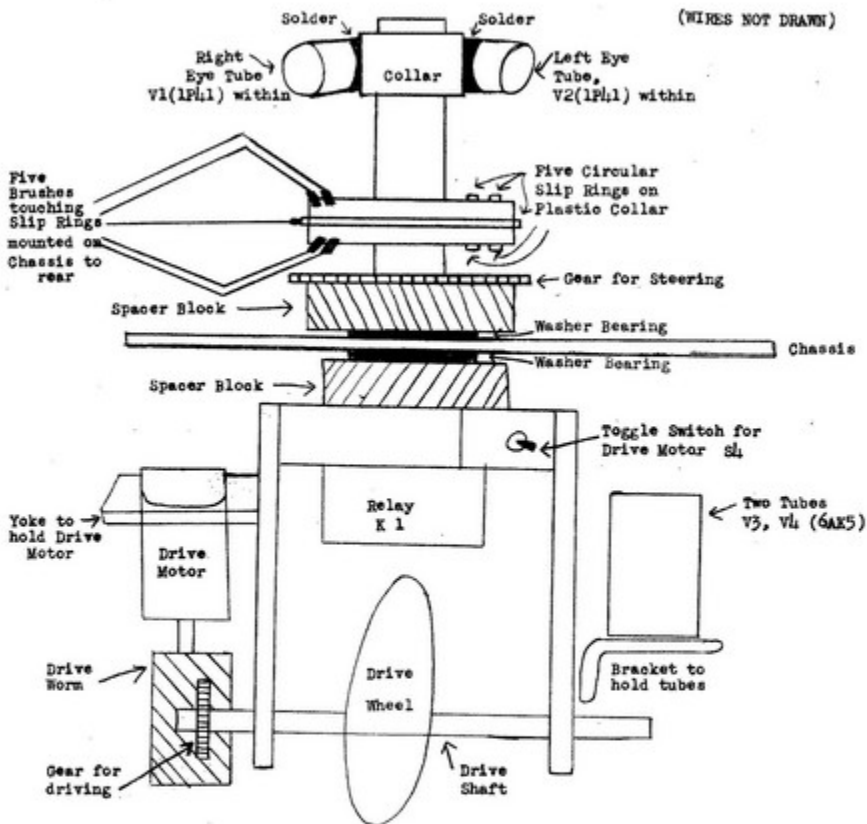
Angle bracket to support tubes



2. VIEWS -- VIEW E, LOOKING FROM REAR



2. VIEWS: VIEW F -- STEERING COLUMN



Squee, The Robot Squirrel

3. MECHANICAL PARTS LIST

A. SQUEE

- 3 Wheels, rubber tired, 4" diameter
- 1 Front drive axle, 3" length
- 1 Hollow metal steering post, 5" long, 3/8" diameter, fastened to a square U of metal to hold axle of drive wheel
- 2 Spacing blocks and washers for bearings
- 2 "Eye tubes" enclosing photocells, 1" diameter, 3" long
- 1 Bottom platform, aluminum sheet, 8 1/2" x 4 1/2" x 1/8" thick
- 1 Top platform, aluminum sheet, 11 1/2" x 5" x 1/8" thick
- 1 "Scoop", in two halves, shaped like two longitudinal quarters of a hollow pear, 4 1/2" long x 4" wide x 1 3/4" deep, with scissor-like handles
- 3 Sprocket gears
- 3 Worm gears
- 1 Rear axle for 2 wheels, idling, 6" long
- 1 Compound slip ring enabling 5 electrical connections between steering post and chassis
- 3 Yokes to hold motors to chassis or column
- Misc. brass strip framing, 1/8" or 1/16" thick, 3/4" or 1/2" wide
- Misc. collars, brushes, pieces of plastic, loops, nuts, bolts, etc.

B. NEST

- 1 Metal sheet, 20" x 5", for nest, that will trip "foot" switch

C. NUT

- 1 Tennis ball, for scoop, that will trip "tongue" switch

## 4. ELECTRICAL PARTS LIST

A. SQUEE

<u>Kind</u>	<u>No.</u>	<u>Part Identifications</u>	<u>Circuit Identification</u>
Tubes	4	6AK5, miniature pentode	V2, V3, V6, V7
"	1	12AT7, miniature twin triode	V5
"	2	1Ph1, photocells	V1, V2
"	1	6C5T, relay, 5 second thermal delay *1	V8
Tube Sockets	4	7 pin, for 6AK5	
"	2	9 pin, for 12AT7 and 6C5T	
"	2	3 pin, special for photocells	
Resistors	2	5000 ohm, variable	
"	2	100,000 ohm, variable	
"	2	50,000 ohm, $\frac{1}{2}$ watt, carbon	
"	1	0.47 megohm, $\frac{1}{2}$ watt, carbon	
"	5	1 megohm, $\frac{1}{2}$ watt, carbon	
"	2	10 megohm, $\frac{1}{2}$ watt, carbon	
"	2	40 megohm, $\frac{1}{2}$ watt, carbon	
"	1	35 ohm, about 5 watt; a wire wound in series with the 6C5T filament; acting as a voltage dropping resistor for a 6 volt tube in a 12 volt system	
Capacitors	4	0.1 microfarad, 200 volt	
"	2	4 microfarad, 150 volt	
Relays	4	8000 ohm, Sigma type 4F, plate circuit relays, SPDT	K4 to K7
"	2	12 volt coil, DPDT	K11, K12
"	6	12 volt coil, 126 ohm, 4PDT (for example, Clare, A 10851)	K1, K2, K3, K8, K9, K10
Batteries	2	N-T-6, Willard, A battery, 6 volt, wet, sulphuric acid, in series	
"	2	XX45, Burgess, 67 $\frac{1}{2}$ volt, radio B battery, in series	
Switches	1	DPST toggle switch (main power switch; connects both A and B batteries to the circuit simultaneously)	S1
"	3	SPST toggle switch (scoop, drive, and steering motor shut-off switches)	S4, S5, S6
"	3	SPST micro switch, normally open (scoop limit switches and "tongue" switch)	S2, S3, S7
"	1	two metal slugs mounted on springs, dragging on floor	S8
Motors	3	Delco or John Oster, 28 volt motors, series wound, geared head, operated at 12 volts (Delco no. 50696251) *2	

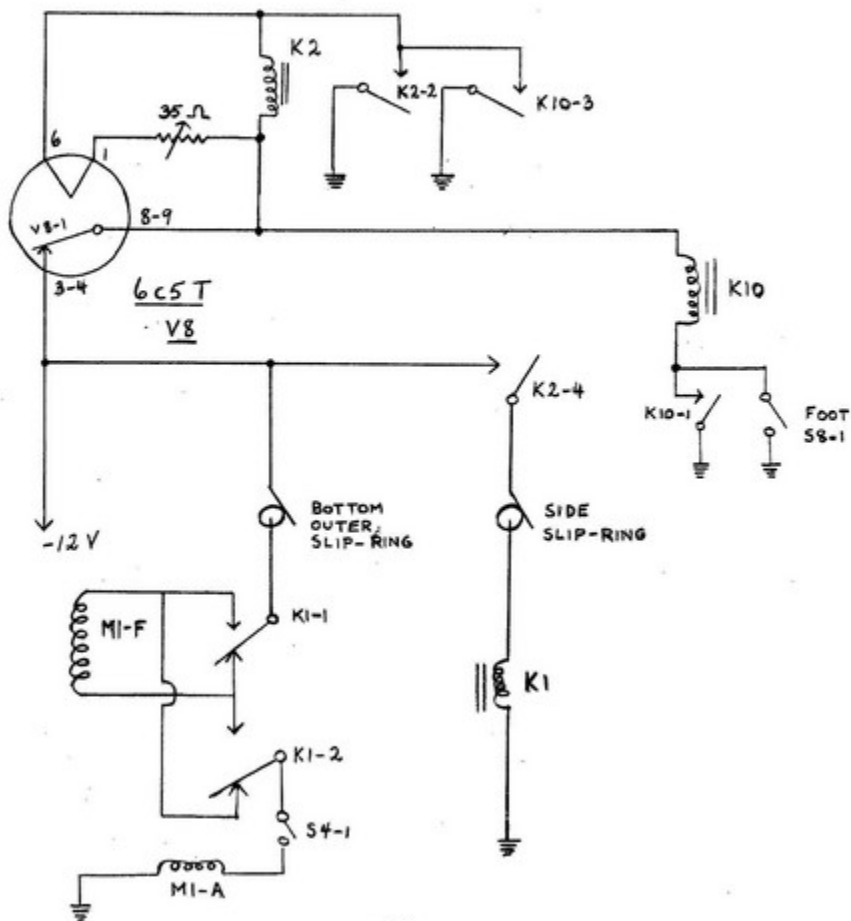
B. NEST & C. MUTS

Lamp	1	glass tube coiled, gas-filled, no persistence of glow
Transformer	1	115 volt AC to 5000 volt AC transformer
Flashlight	1	Flashlight using 2 dry cell, size D batteries

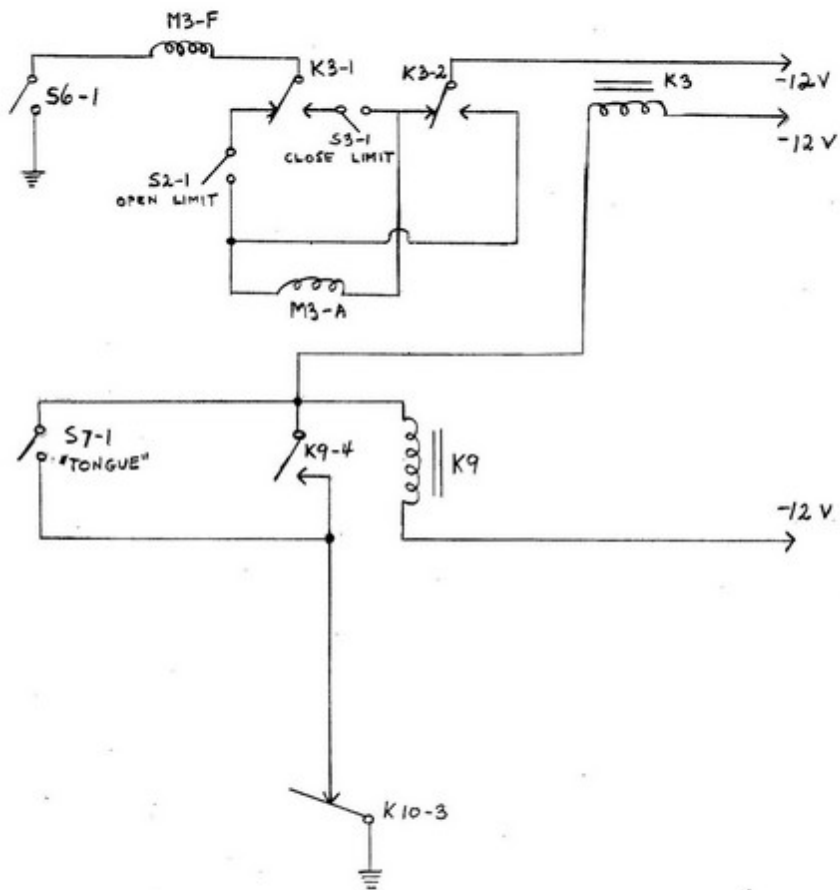
## 5. MAIN CIRCUIT PARTS LIST

<u>Code</u>	<u>Name and Function</u>
K1	Reversing relay for drive motor
K2	Extra K1 contacts
K3	Reversing relay for scoop motor
K4	AC or DC -- right eye
K5	AC or DC -- left eye
K6	AC only -- right eye
K7	AC only -- left eye
K8	Reversing relay for steering motor
K9	"Home-on-nest" program relay
K10	"Arrive-at-nest" relay
K11	DC -- left eye
K12	DC -- right eye
S1	Main power switch
S2	Scoop open-limit switch
S3	Scoop close-limit switch
S4	Drive motor switch
S5	Steering motor switch
S6	Scoop motor switch
S7	"Tongue" switch
S8	"Foot" switch
M1	Drive motor
M3	Scoop motor
M... -A	Motor ..., Armature
M... -F	Motor ..., Field
V1	Right photocell, 1P41
V2	Left photocell, 1P41
V3	Right column amplifier, 6AK5
V4	Left column amplifier, 6AK5
V5	Chassis second amplifier, 12AT7
V6	Right chassis amplifier, 6AK5
V7	Left chassis amplifier, 6AK5
V8	Thermal delay relay, 6C5T
M2	Steering motor

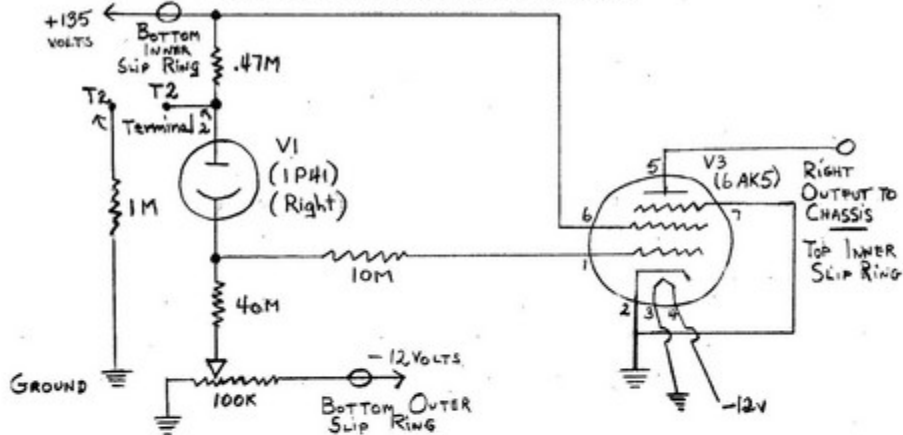
6. CIRCUITS -- A. DRIVE MOTOR, CONTROL, ETC.



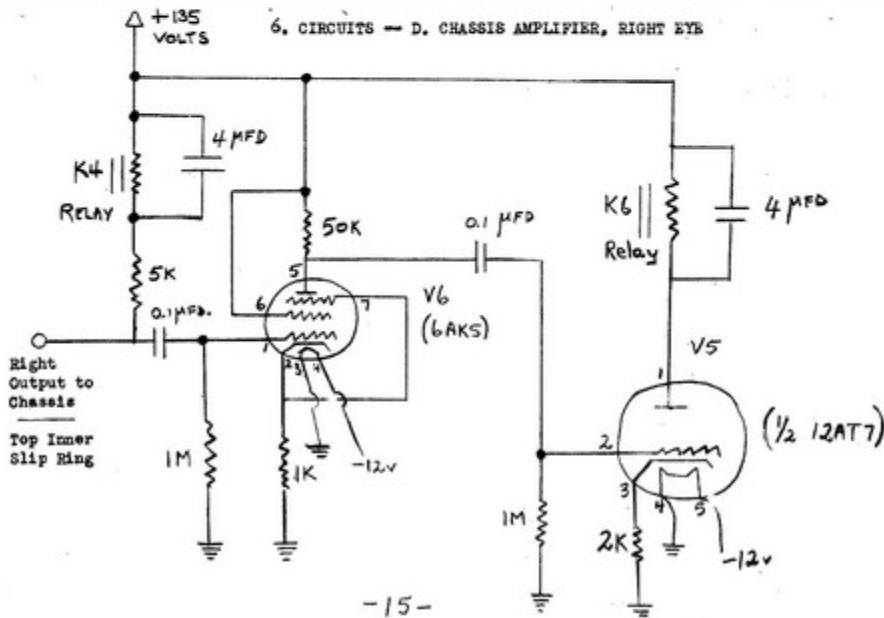
## 6. CIRCUITS -- B. SCOOP CONTROL



## 6. CIRCUITS -- C. COLUMN AMPLIFIER, RIGHT EYE

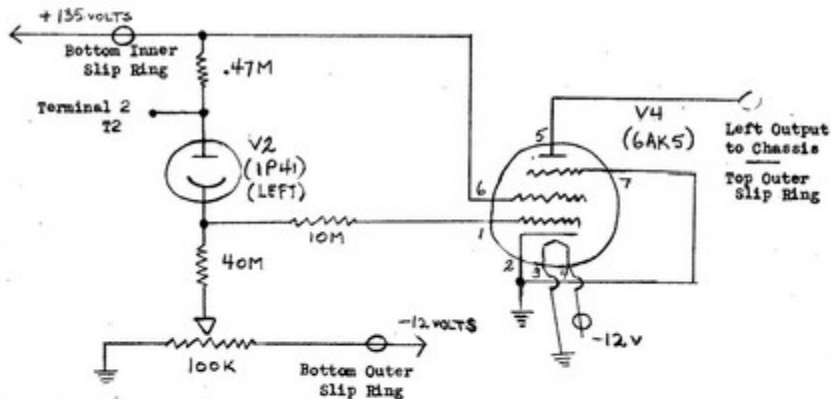


## 6. CIRCUITS -- D. CHASSIS AMPLIFIER, RIGHT EYE

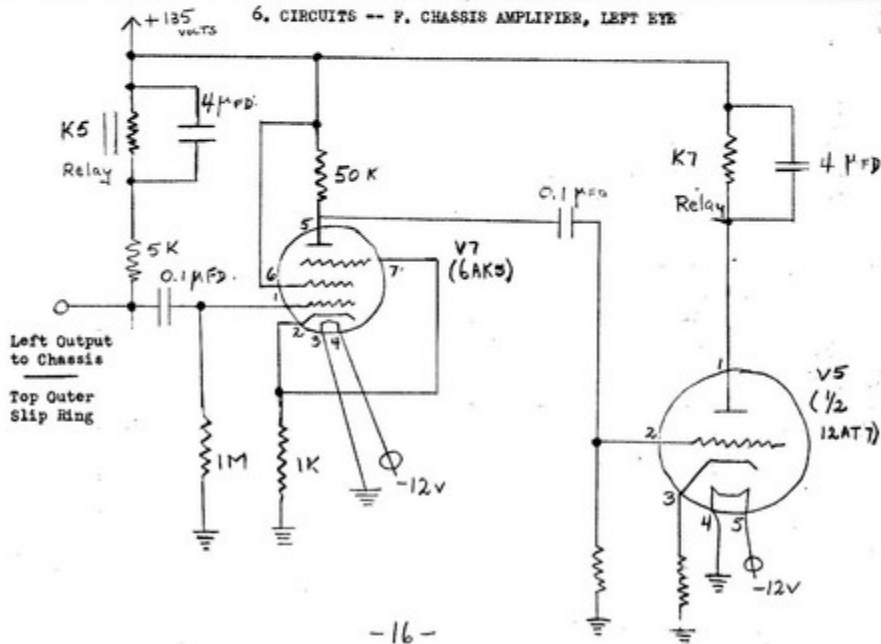




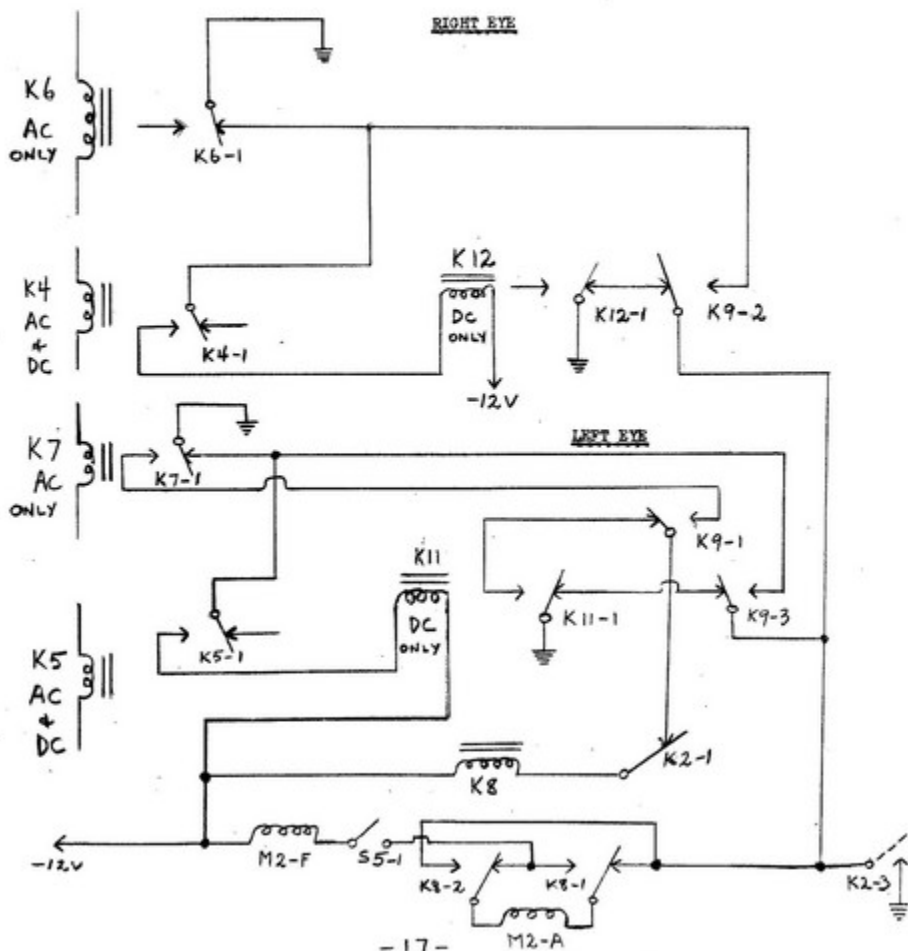
## 6. CIRCUITS -- E. COLUMN AMPLIFIER, LEFT EYE



## 6. CIRCUITS -- P. CHASSIS AMPLIFIER, LEFT EYE

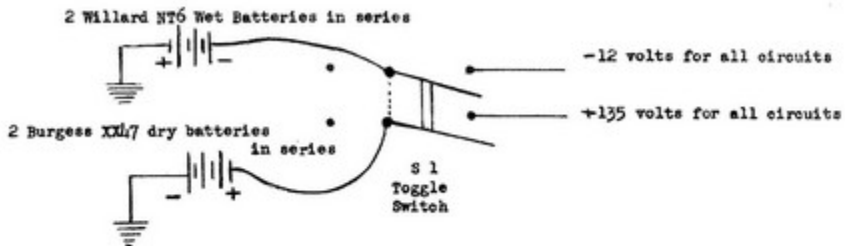


## 5. CIRCUITS -- 9. STEERING MOTOR CONTROL

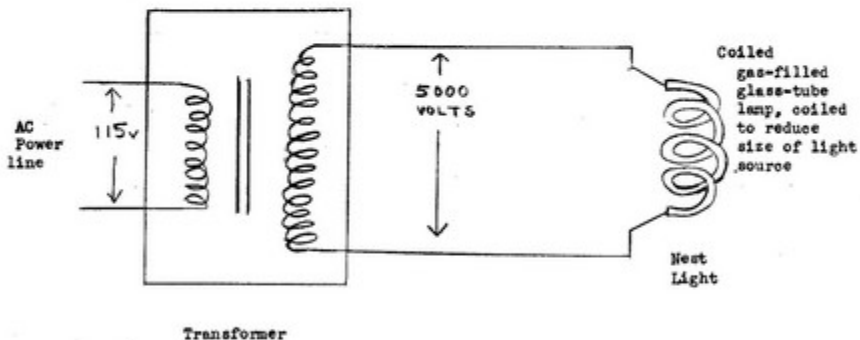


Squee, The Robot Squirrel

6. CIRCUITS -- H. MAIN POWER SWITCH



6. CIRCUITS -- I. CIRCUIT FOR NEST LIGHT



7. OPERATING INSTRUCTIONS

1. Make the room rather dark, with no bright sources or reflections of light. Place the nest light and transformer in a convenient place, and put the nest metal plate in front of the nest light; turn on the nest light. Place a tennis ball on the floor, in a convenient place, and get assistance from the audience to hold the flashlight above it, ready to shine the light on Squee's photocells.
2. Make sure that the three motor switches of Squee, S4, S5, S6, are off.
3. Turn on the main power switch S1, and wait for the tubes to warm up.
4. Turn the column variable resistors and the chassis variable resistors until the plate relays respond properly to the nest and nut light sources, taking into account the level of light in the room. \*3
5. Turn on the three motor switches, in the sequence: scoop motor, drive motor, steering motor.
6. If the scoop is closed, connect the foot switch probes so that the scoop will open, and Squee will be conditioned to hunt first for nuts.

NOTES

Page 11, note \*1: Bought from Amperite Co., 561 Broadway, New York

Page 11, note \*2: Bought from Instrument Associates, Great Neck, L.I., N.Y.

Page 19, note \*3: In this process of adjustment, the following summary of information will be useful:

<u>Variable Resistor</u>	<u>Affects Plate Relay</u>	<u>Which Represents Response to</u>
Column, right eye	K4	AC and DC light, right eye
Column, left eye	K5	AC and DC light, left eye
Chassis, right eye	K6	AC light only, right eye
Chassis, left eye	K7	AC light only, left eye

Turn the variable resistor clockwise to make the plate relay energise.