

1971

POPULAR  
ELECTRONICS

# ELECTRONIC EXPERIMENTER'S HANDBOOK

WINTER EDITION

\$1.50

## Detailed Assembly Plans

- STIMULATING COLOR ORGAN
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- SWL FREQUENCY CHECK
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- TRIAC TRANSFORMER

plus many others

**THE "ORB"**  
Look Out! It's Alive!





# THE ORB



*It Startles!*

*It Fascinates!*

*It Boggles!*

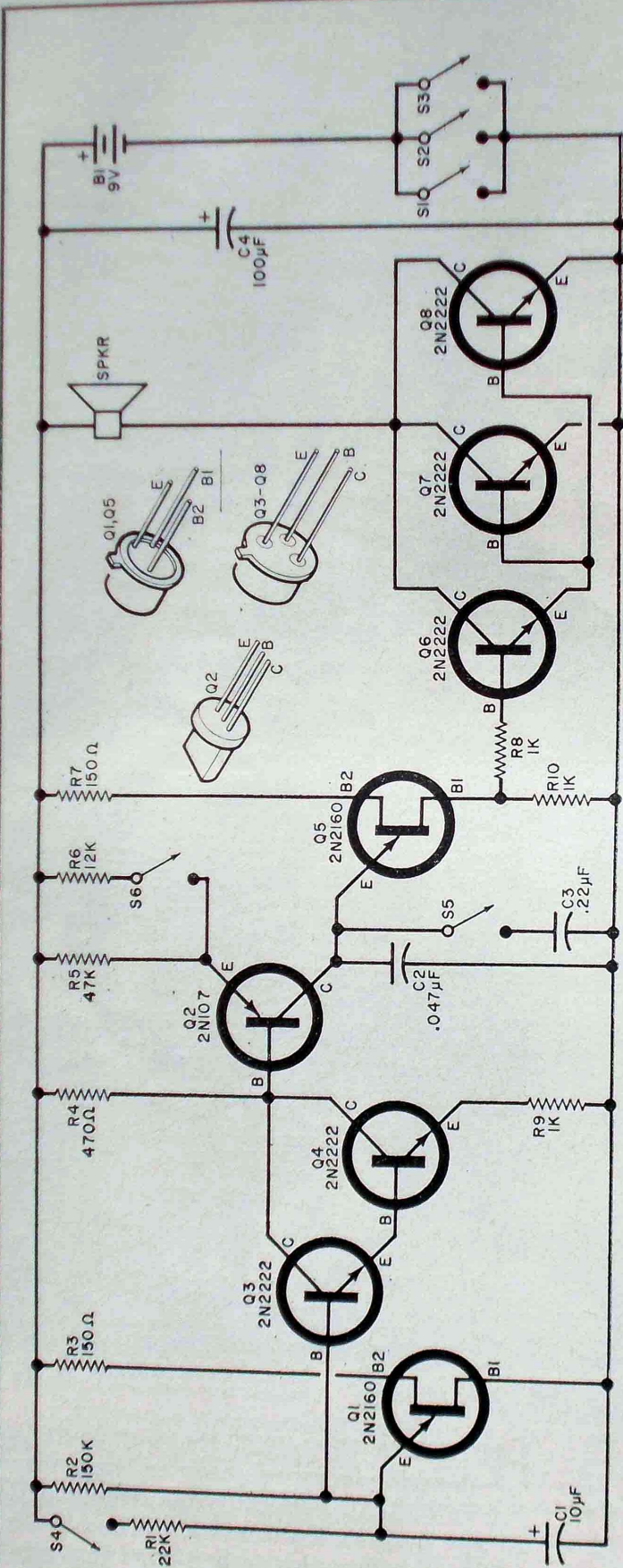
COVER STORY

BY B. FISHER AND R. SHAW

1971 Winter Edition

**H**ERE'S A PROJECT that's difficult to describe but we guarantee that, once you've built it, you and your friends will go ape over it. Quite simply, The Orb is a 12" diameter plastic ball that just sits there quietly doing absolutely nothing. *However*, if it is picked up and rotated, even slightly, it emits a variety of sounds that will liven the dullest party. The sounds range from animal-like grunts to





**PARTS LIST**

- B1—9-volt battery
  - C1—10- $\mu$ F, 10-volt electrolytic capacitor
  - C2—0.047- $\mu$ F, 10-volt capacitor
  - C3—0.22- $\mu$ F, 10-volt capacitor
  - C4—100- $\mu$ F, 10-volt electrolytic capacitor
  - Q1, Q5—2N2160 transistor or similar
  - Q2—2N107 or HEP253 transistor or similar
  - Q3, Q4, Q6, Q7, Q8—2N2222 or HEP55 transistor or similar
  - R1—22,000-ohm
  - R2—150,000-ohm
  - R3, R7—150-ohm
  - R4—470-ohm
  - R5—47,000-ohm
  - R6—12,000-ohm
  - R8-R10—1000-ohm
- All resistors  
1/2-watt  
10% tolerance

Spkr.—8-16-ohm speaker  
 S1-S6—S.p.s.t. mercury switch  
 Misc.—12" plastic ball, 12" plastic rod, 10" epoxy cement mounting screws, etc.  
 Note—Electronic parts and PC board are available from Super Whoopie Ltd., 523 E. 12th St., New York, NY 10009 for \$18.75. A complete kit, including ball, rod, disc, and stand, is available from the same source for \$30.50. A kit of semiconductors is available from Semiconductors Corp., 265 Canal St., New York, NY 10013 for \$7.50 plus 50¢ postage and handling. Specify kit "Sw." A 12" plastic ball, a rod, and a disc are available for \$7.50 from Engraving and Marking, 336 Canal St., New York, NY 10013. Specify "Electric Ball Kit." The ball alone is \$6.25.

Fig. 1. The circuit consists of one UJT audio oscillator modifying the frequency of another. Each UJT circuit, in turn, has its basic frequency changed by operation of mercury switches which close to introduce new time constants in each oscillator.



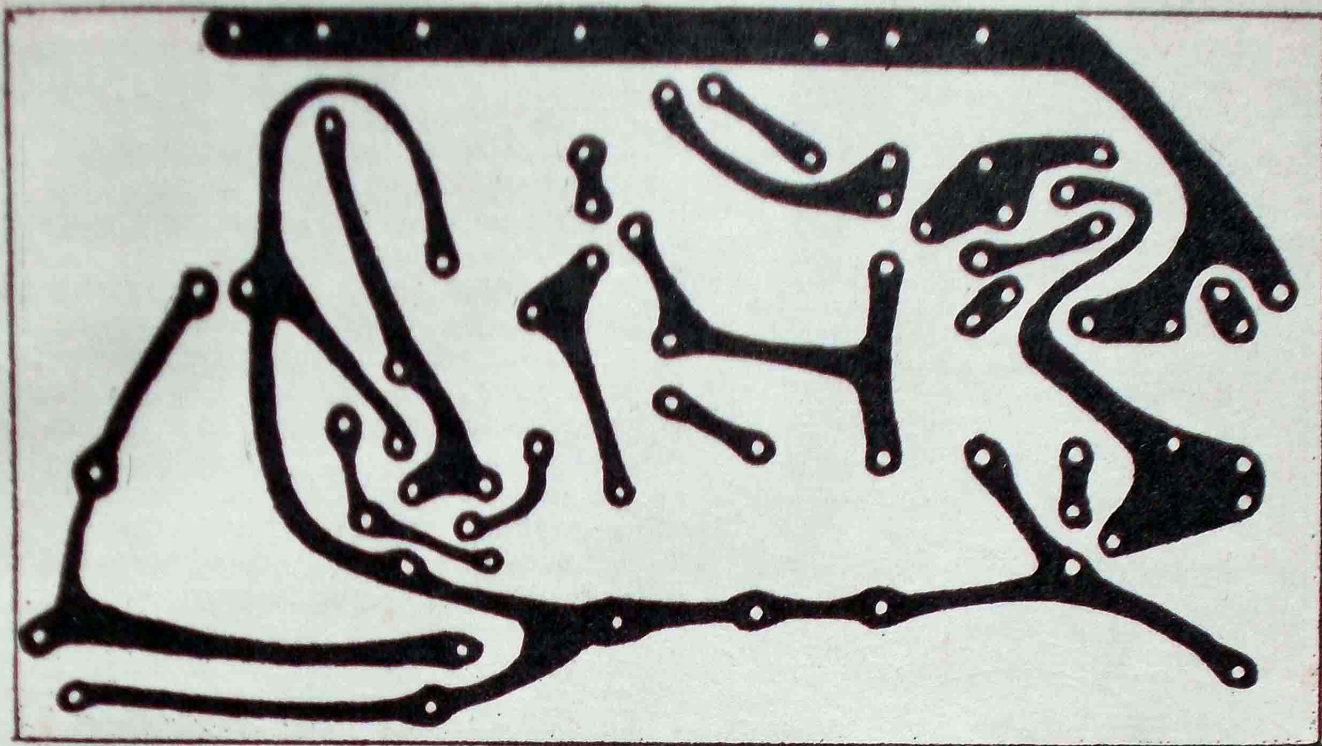
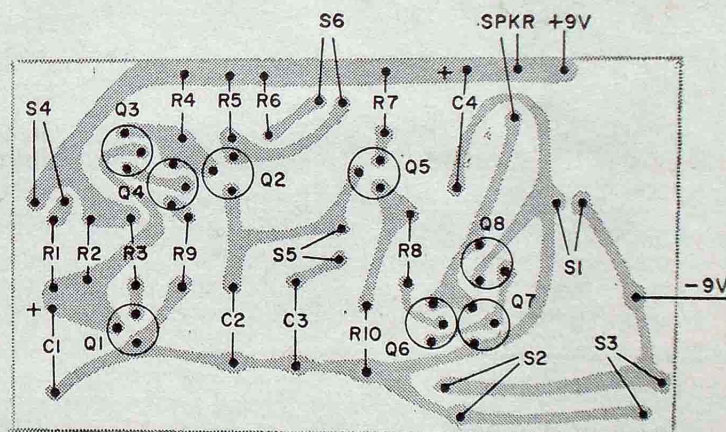


Fig. 2. After making the PC board, shown actual size above, install components as illustrated on the right. It is possible to alter the values of the UJT time constants (in the emitter circuits) so as to create a completely different set of unusual sound effects. Just be sure that there is at least one position of finished sphere where the power switches (S1,S2,S3) are turned off, removing power.



wild whistles, to outer-space screeches—with variations in between. Each sound is dependent on the attitude of The Orb and how it is rotated. The sound continues until the ball is placed in its “off” position—and trying to find this can be a lot of fun too, especially for the uninitiated.

This electronic toy is ideal for parties, as a conversation piece, and as a safe means of entertaining children. Once you start to play with it, it gets to be like potato chips—you just can't put it down.

**About the Circuit.** The noises emitted by The Orb are generated by two unijunction oscillators feeding a common audio amplifier (see Fig. 1). The frequencies of the oscillators are changed by switching components in and out of the circuits. The switching is performed by

mercury switches which go on and off as the ball rotates.

The frequency of the first oscillator (Q1) is determined by R2 and C1. This frequency is changed when mercury switch S4 introduces R1 in parallel with R2. The second oscillator (Q5) uses either C2 or C2 and C3 in parallel and the emitter-collector resistance of Q2 as the frequency-determining factors. The resistance of Q2 is determined by the sawtooth signal generated at Q1 and amplified by the Darlington-connected pair, Q3 and Q4 and is also changed by the action S6.

The audio amplifier consists of Q6, Q7, and Q8 arranged to drive the low-impedance speaker.

**Construction.** The electronic circuit, shown in Fig. 1, is constructed on the



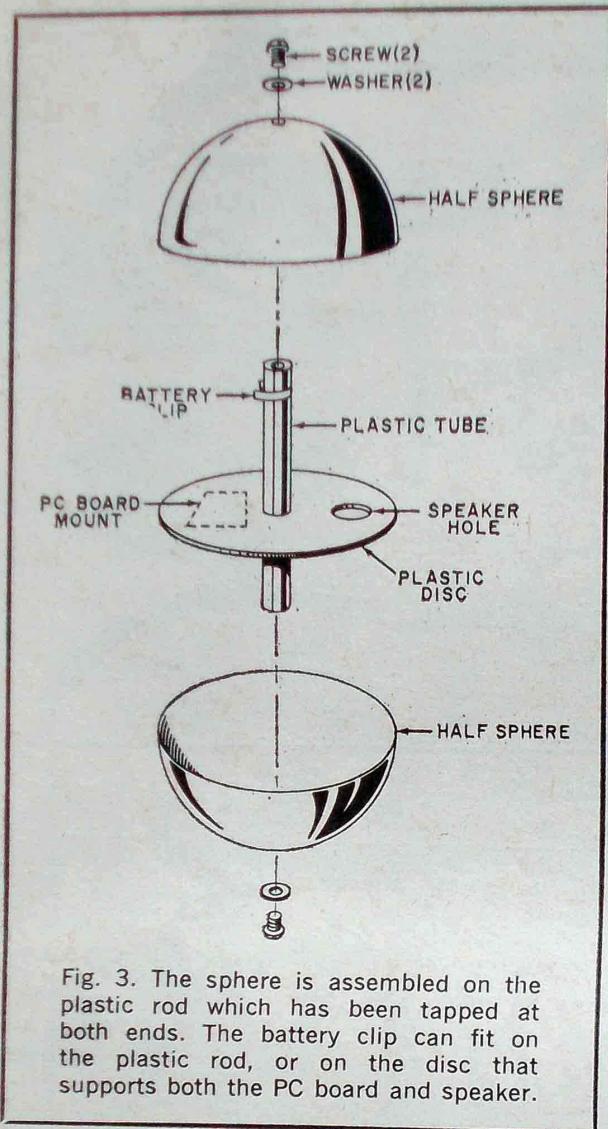


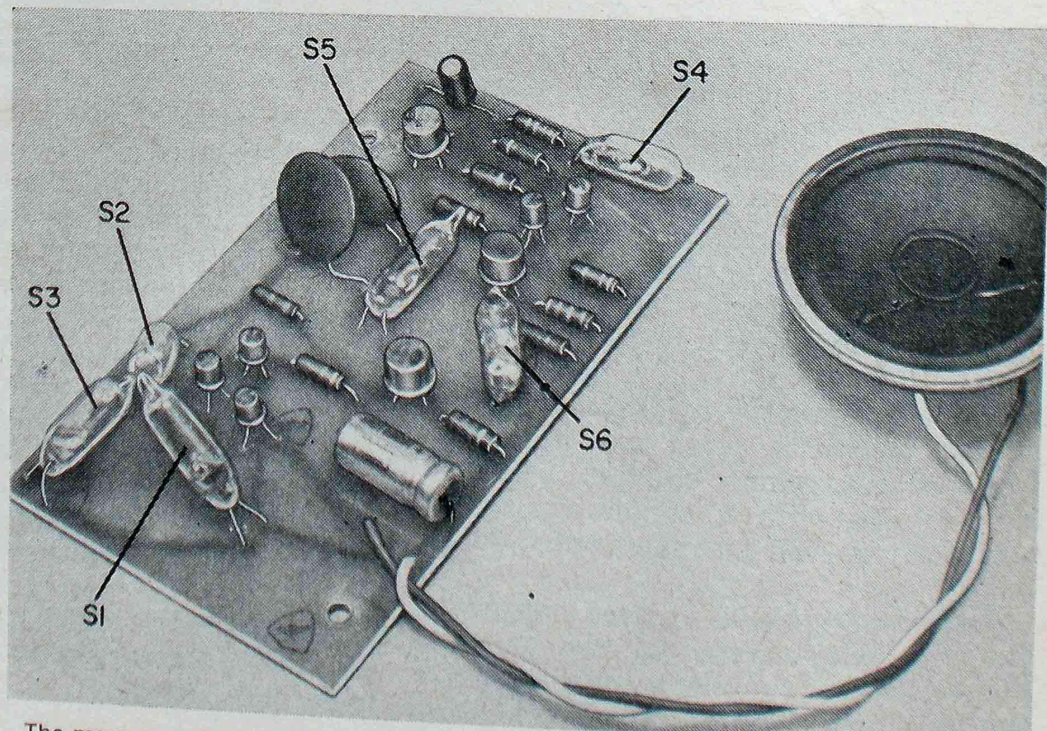
Fig. 3. The sphere is assembled on the plastic rod which has been tapped at both ends. The battery clip can fit on the plastic rod, or on the disc that supports both the PC board and speaker.

printed circuit board whose foil pattern is shown in Fig. 2, which also gives component layout. When mounting the 6 mercury switches, position *S4* and *S5* close to the board at right angles to each other and *S6* vertical to the board. Switches *S1*, *S2*, and *S3* are arranged so that the tips touch to form a pyramid. Put a spot of cement at the tip junctions to keep them in place. This arrangement of the switches insures that there will be at least one position in which the power is off. The other three switches change the sound as the ball is rotated.

Once the board has been assembled, connect the speaker and the battery connector to it through 6- to 8-inch twisted pairs. Be sure to get the proper polarity on the battery connector. Hold the board upside down, so that the three switches *S1*, *S2*, and *S3* are off when connecting the battery to the connector. There should be no sound from the speaker with the board in this position.

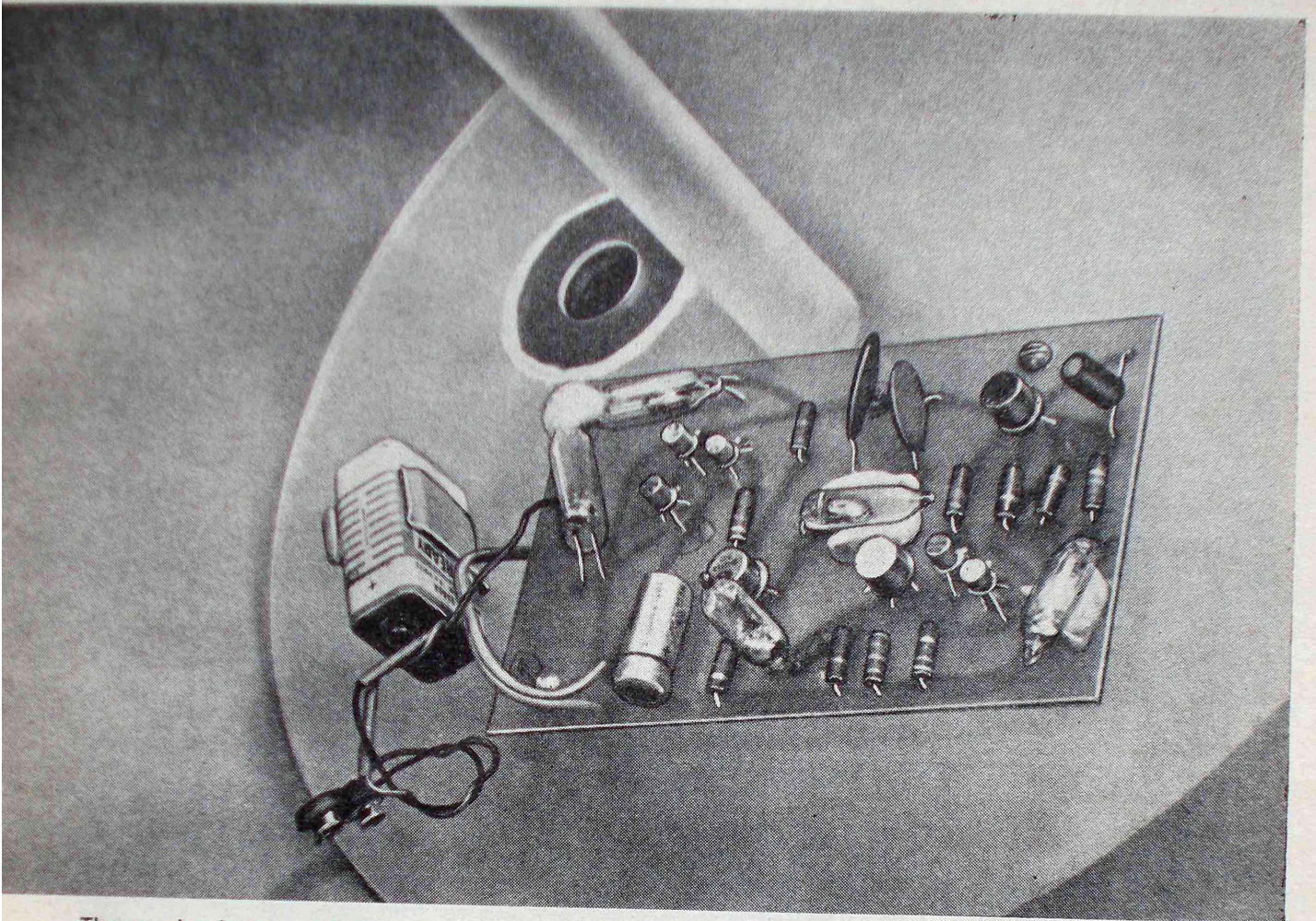
The 12" plastic ball (see Parts List) comes in two pieces which are to be held together by a 12" piece of  $\frac{3}{4}$ " or 1" plastic rod. The latter is drilled and tapped at each end as shown in Fig. 3.

Position the plastic rod in one of the sphere halves and secure it in place using a suitable screw and washer. Make

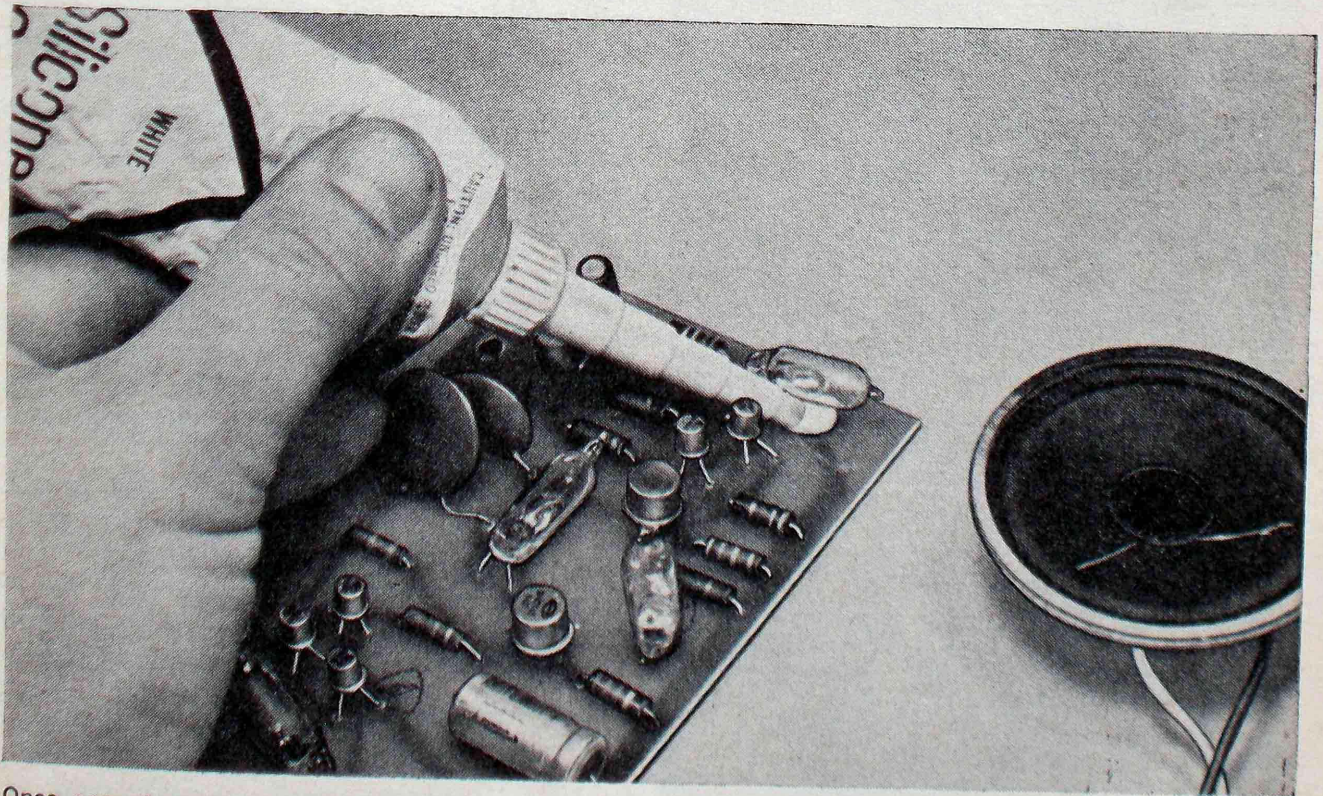


The mercury switches must be positioned as shown here. The pyramid of *S1*, *S2*, and *S3* makes sure that there is at least one position where the battery is switched off. Other switches are at right angles to each other to make finished sphere position sensitive.



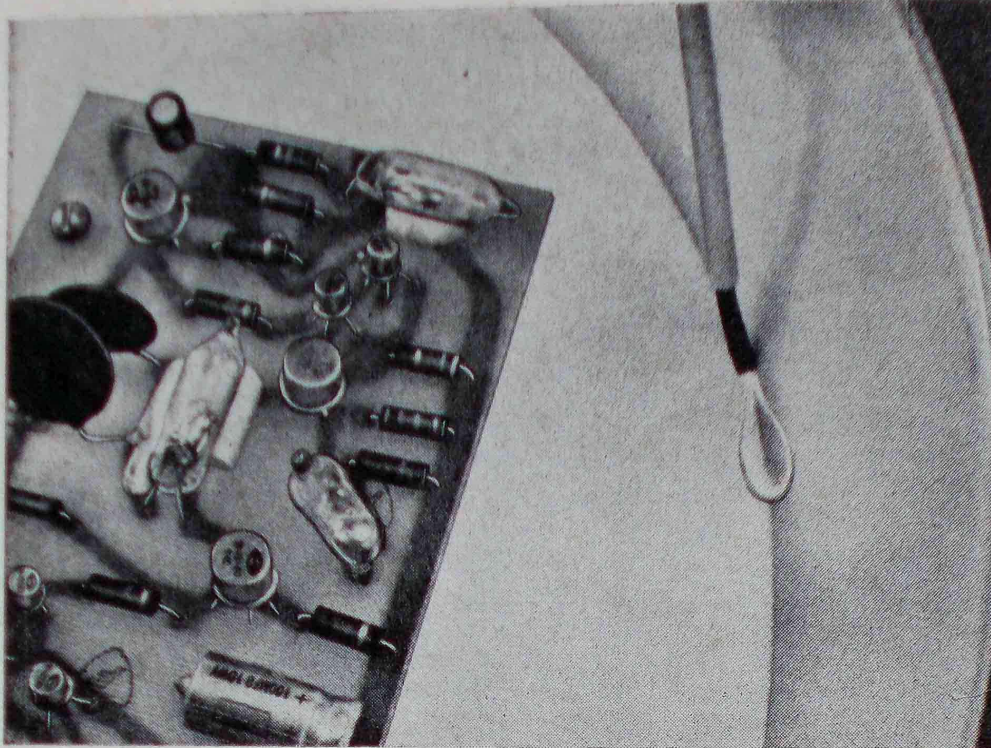


The speaker is mounted directly on large plastic disc that acts as a sounding board, thus increasing volume. The board and battery clip are secured with mounting hardware.

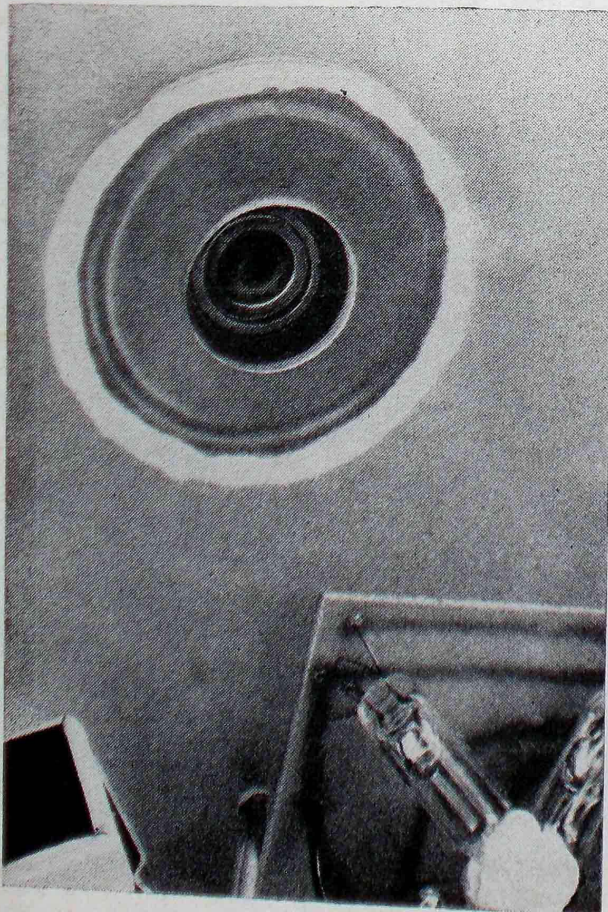


Once correct positioning of mercury switches has been made, they are cemented to prevent movement. Switches S4 and S5 are affixed to board, switches S1, S2, and S3 form a pyramid with their tips cemented together, while S6 is tight to chassis and vertical.





The plastic disc is secured to the sphere wall by applying several cement joints around the circle.



The rim of the speaker is coated with cement and concentrically fixed to its hole in plastic disc.

up a plastic disc having a diameter of approximately 10" and drill a hole in the center just wide enough to accommodate the rod. Make another hole in the disc for the speaker. This hole should be just slightly smaller than the speaker rim so that the speaker can be cemented in place. On the other side of the disc make holes for mounting the PC board and secure it in place using suitable hardware. Make sure that both the speaker and battery connector are still wired to the board.

Lower the disc onto the plastic rod until the disc rim touches the plastic half sphere. Cement the disc in place all around its rim. Insert the battery in its clip and install the battery connector. The ball (rather half ball) is now active and will start up if moved from the stable position.

Carefully mate the other half of the ball with the first half and secure it to the rod using suitable hardware. The complete ball is now ready for use—either plain white as it comes, or you can paint it or add psychedelic stickers, as we did for the cover photo. Make sure that you know where the off position is so that you can "stop the music" when you want to. You will probably want to fashion some sort of base ring to hold the ball when not in use.