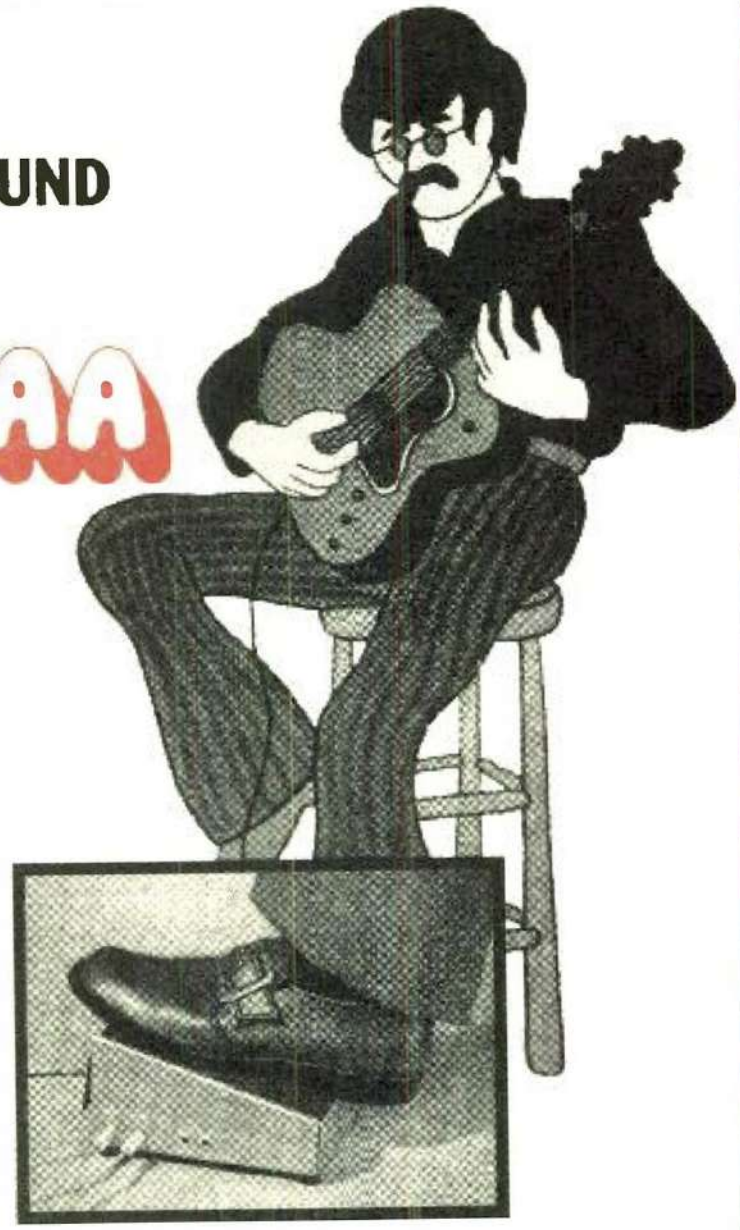
COVER STORY

A REAL BOSS SOUND

THE WAA-WAA

Be first with a new vibration



BY JOHN S. SIMONTON, JR.

IF YOU'RE an avid admirer, and a participant in, the rock music scene, you may have noticed that really "new" sounds are coming out of a few recording studios and even fewer groups. Fuzz, reverb, tremolo, and vibrato are being overworked.

The groups that have something new have been keeping it under wraps; but now the secret is out—it's the "Waa-Waa" sound.

You don't need fancy gear to create your own Waa-Waa sound. This story tells how to build a foot-operated self-contained Waa-Waa unit that is simply plugged into the circuit (using ordinary shielded phone cables) between your guitar and amplifier.

Unless you press the Waa-Waa pedal, the sound from your guitar remains unchanged. Pressing the pedal (and releasing it according to the effect you want to create) introduces a totally new sound experience. It's pretty difficult to describe in print. Some groups think it sounds like a "wow" or "whoop"; others use the Waa-Waa to create an effect as if the music were being modulated by the gentle spring breeze. You can do all sorts of tricks with the Waa-Waa and the difference is that this is practically a musical instrument itself. It's not just an idiot box that you turn on and forget. You actually play the Waa-Waa to add a new dimension to any sound signal that is rich in harmonics.

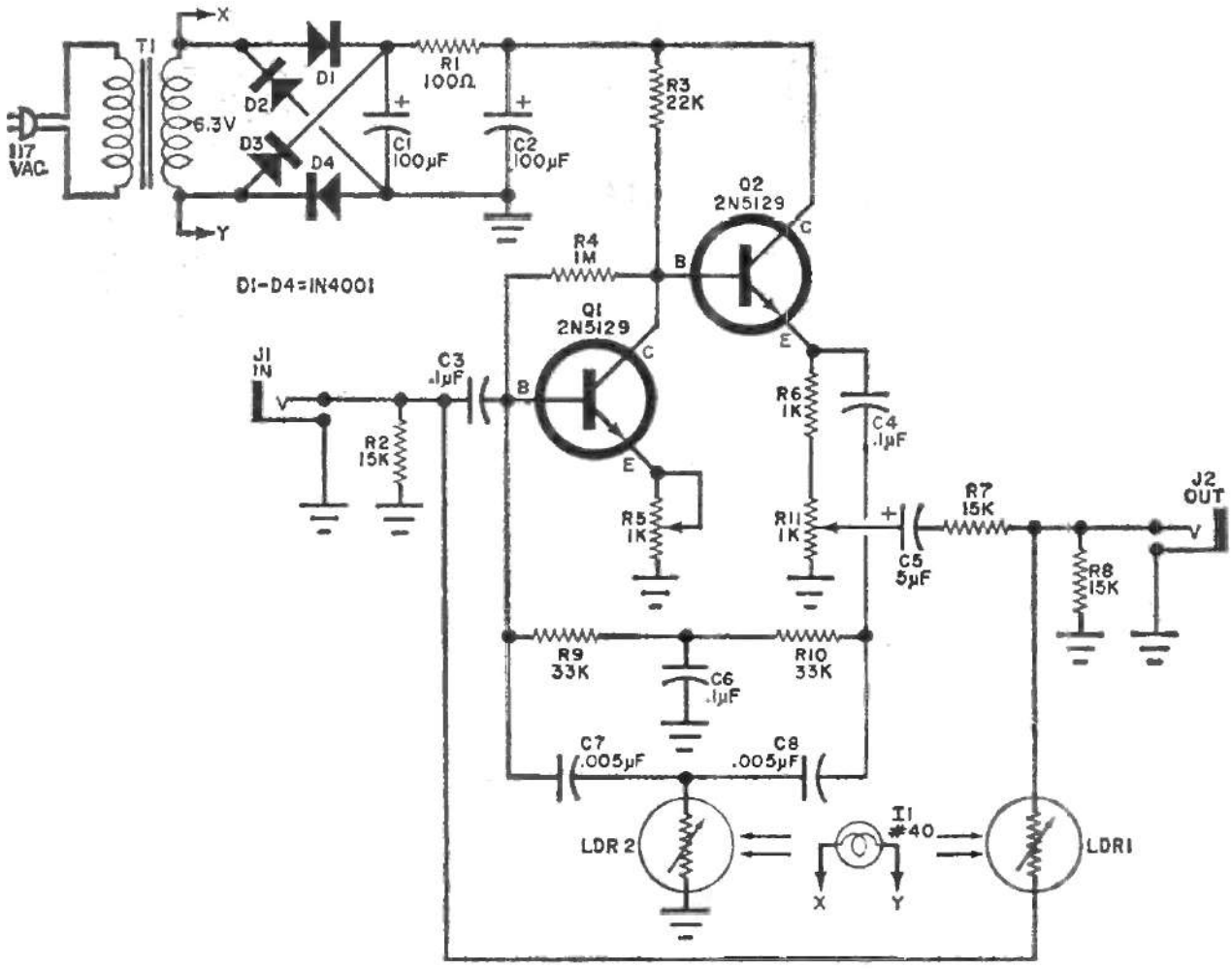


Fig. 1. The circuit is a variable-frequency, narrow-band amplifier whose gain and center frequency are determined by the amount of light on the LDR's.

PARTS LIST

C1,C2—100-μF, 10-volt electrolytic capacitor
C3,C4,C6—0.1-μF disc capacitor
C5—5-μF, 6-volt electrolytic capacitor
C7,C8—0.005-μF disc capacitor
D1-D4—1N4001 diode
I1—#40 pilot lamp
J1, J2—Open-circuit phone jack
LDR1—Light dependent resistor (Clairex 703L)
LDR2—Light dependent resistor (Clairex 703)
Q1,Q2—2N5129 transistor
R1—100-ohm
R2,R7,R8—15,000-ohm
R3—22,000-ohm
R4—1-megohm
R6—1000-ohm
R9,R10—33,000-ohm
All resistors ½-watt
R5,R11—1000-ohm, printed circuit type trimmer potentiometer
T1—Transformer, secondary: 6.3 volts at 300 mA
Misc.—Chassis, wooden foot pedal, mounting bracket for light dependent resistors and light, light mask, spring, dust cover, terminal strips, rubber feet (4), line cord, strain relief, flat black paint, shielded, cable, wire, etc.
Note—The following are available from PAIA Electronics, P.O. Box 14359, Oklahoma City, Oklahoma, 73114: etched and drilled PC board #7690, $3.00, postpaid in continental U.S.; pre-punched case including all brackets, spring, etc., unpainted, #7690C, $5.10, plus postage for 2 pounds; complete kit including case, circuit board, and all parts, #7690K, $18.75, plus postage for 3 pounds. Oklahoma residents, add 3% sales tax.

Construction. The electronic portion of the Waa-Waa is straightforward and follows the schematic shown in Fig. 1. Component layout is not critical and any method of assembly may be used. Use of a printed circuit board lends a professional touch and guarantees correct wiring. You can make your own board using the foil pattern shown in Fig. 2 or you can buy one as described in the Parts List. Install the components as shown in Fig. 3.

Mechanical construction of the Waa-Waa can be done in one of a number of ways. Basically, what is needed is a U-shaped, sloping top chassis, large enough and strong enough to support the user's foot. A wooden pedal forms the

HOW IT WORKS

The circuit is basically a bandpass amplifier composed of a common-emitter gain stage (*Q1*) and an emitter-follower stage (*Q2*), with feedback through a parallel-T filter (*C6, R9, R10* and *C7, C8, LDR2*). The width and center frequency of the pass band are controlled by the resistance of LDR2, a value proportional to the amount of light falling on the photoresistor's surface.

When the foot pedal is up, *LDR1* is exposed to the light from *I1*. The light striking *LDR1* causes its resistance to be so low that it provides a direct, low-resistance path from the input jack to the output, bypassing the amplifier.

As the foot pedal is depressed, it first blocks the light falling on *LDR1*, thereby raising its resistance so that the signal goes through the amplifier. As the pedal is depressed further, the section of the mask which is in front of *LDR2* gradually begins to expose the surface of this photocell. Its resistance is thus decreased, raising the center frequency of the amplifier's pass band.

Potentiometer *R5* is used to adjust the gain around the feedback loop and is set so that the circuit is held just below the point of oscillation. Potentiometer *R11* is used to adjust the gain at the output and is set so that there is no noticeable change in the volume of the instrument as the Waa-Waa is switched in and out.

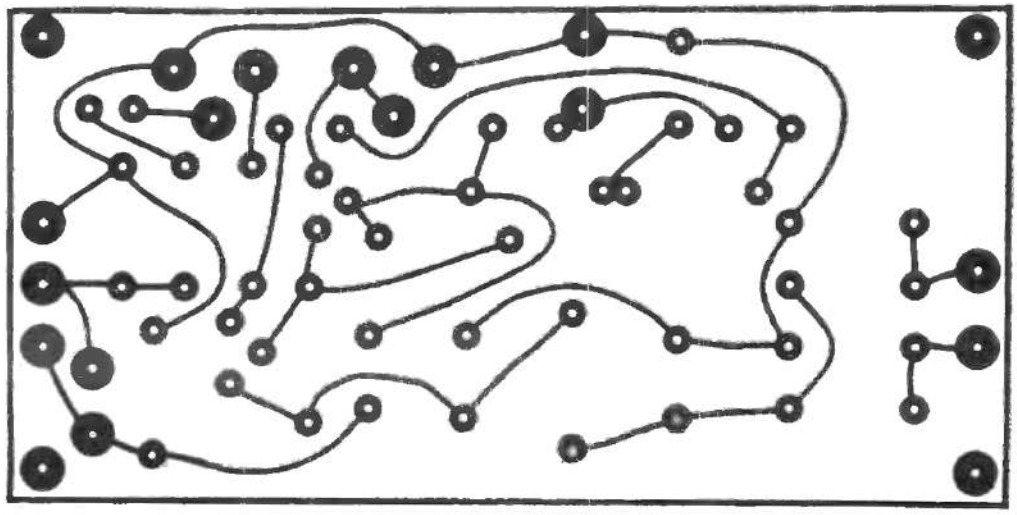


Fig. 2. Actual-size foil pattern can be used to make your own circuit board.

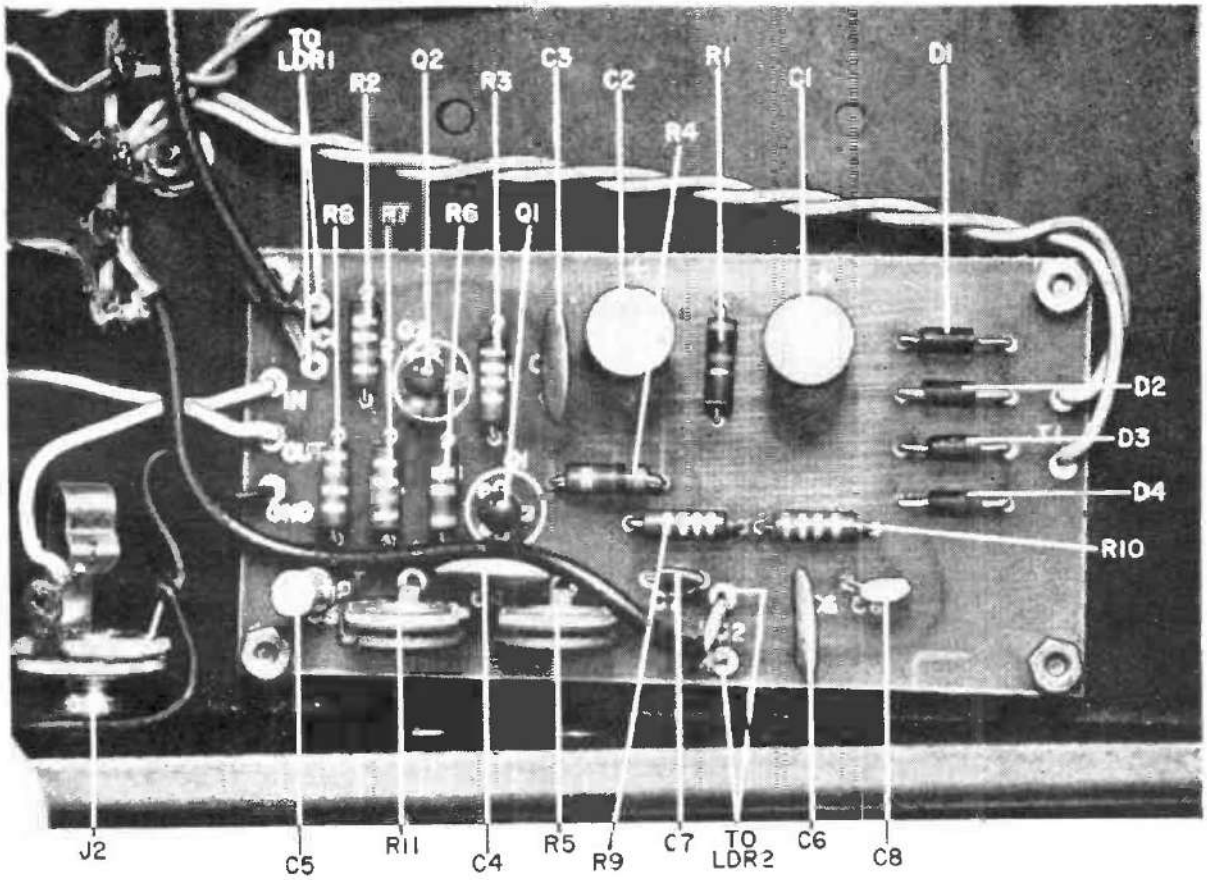


Fig. 3. After installing all components on board, make sure both trimmer potentiometers are accessible through holes drilled in side of chassis. This view also shows connections to other elements.

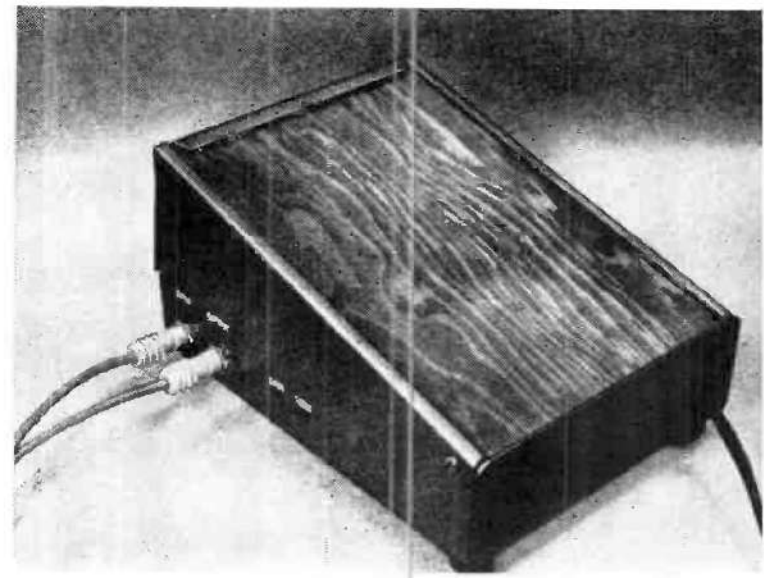
top of the assembly. The pedal is hinged at the heel (lower) end by a pair of long wood screws. A mild-spring steel spring supports the pedal and returns it to the top position when the foot is relaxed or removed.

On the underside of the wooden pedal, is a specially shaped light mask which, as the pedal goes up and down, passes between a light source and a pair of photoresistors or light dependent resistors.

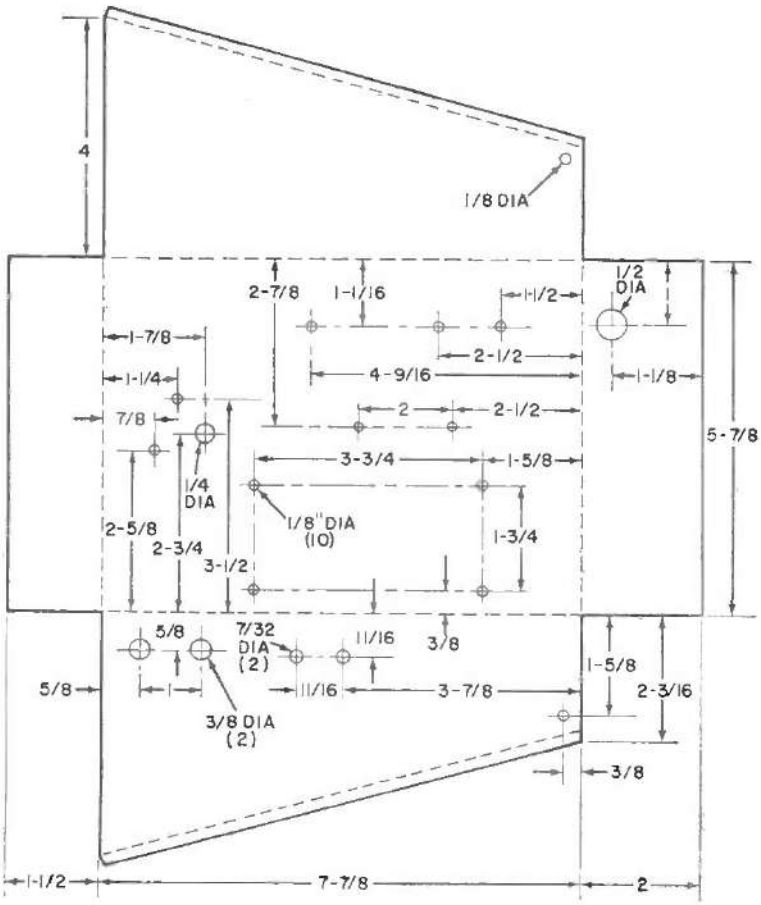
If you have the metalworking facilities, you can duplicate the prototype chassis, using 16-gauge steel or aluminum and following the layout shown in Fig. 4. Once the chassis is made, fabricate the wooden pedal out of ¾" plywood with the dimensions given in Fig. 5. This illustration also shows the spring that is fabricated from 16-gauge mild-spring steel. The dimensions of the support bracket for the photoresistors and the light mask are shown in Fig. 6.

The entire interior of the Waa-Waa, including the mask and photoresistor bracket, must be finished in flat black to minimize internal reflections from the light. After the photoresistor bracket has dried, mount it on the chassis as shown in the photos. The two photoresistors are glued in place as shown in Fig. 6.

Attach the PC board, temporarily, to



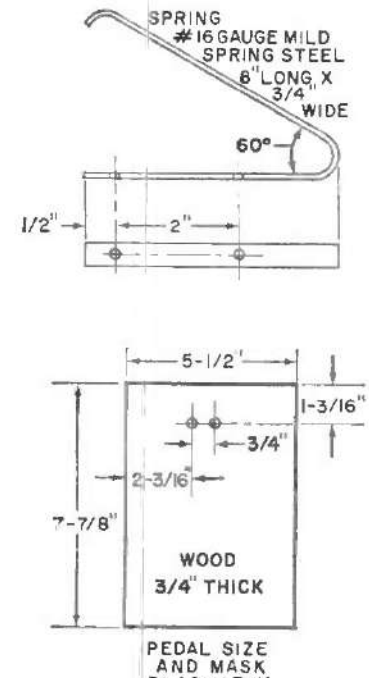
The completed Waa-Waa. Two audio leads, one input and one output, plug into the appropriate jacks. Two holes alongside are for trimmer adjustments.



ALL MEASUREMENTS ARE IN INCHES

Fig. 4. If you want to fabricate chassis similar to the one shown in the photos, follow construction details shown here.

Fig. 5. Fabrication details for the wooden pedal and spring. Two holes in the pedal support the shadow mask. Spring serves to return the pedal to the top of its travel when the foot is removed from the top.



PEDAL SIZE AND MASK PLACEMENT

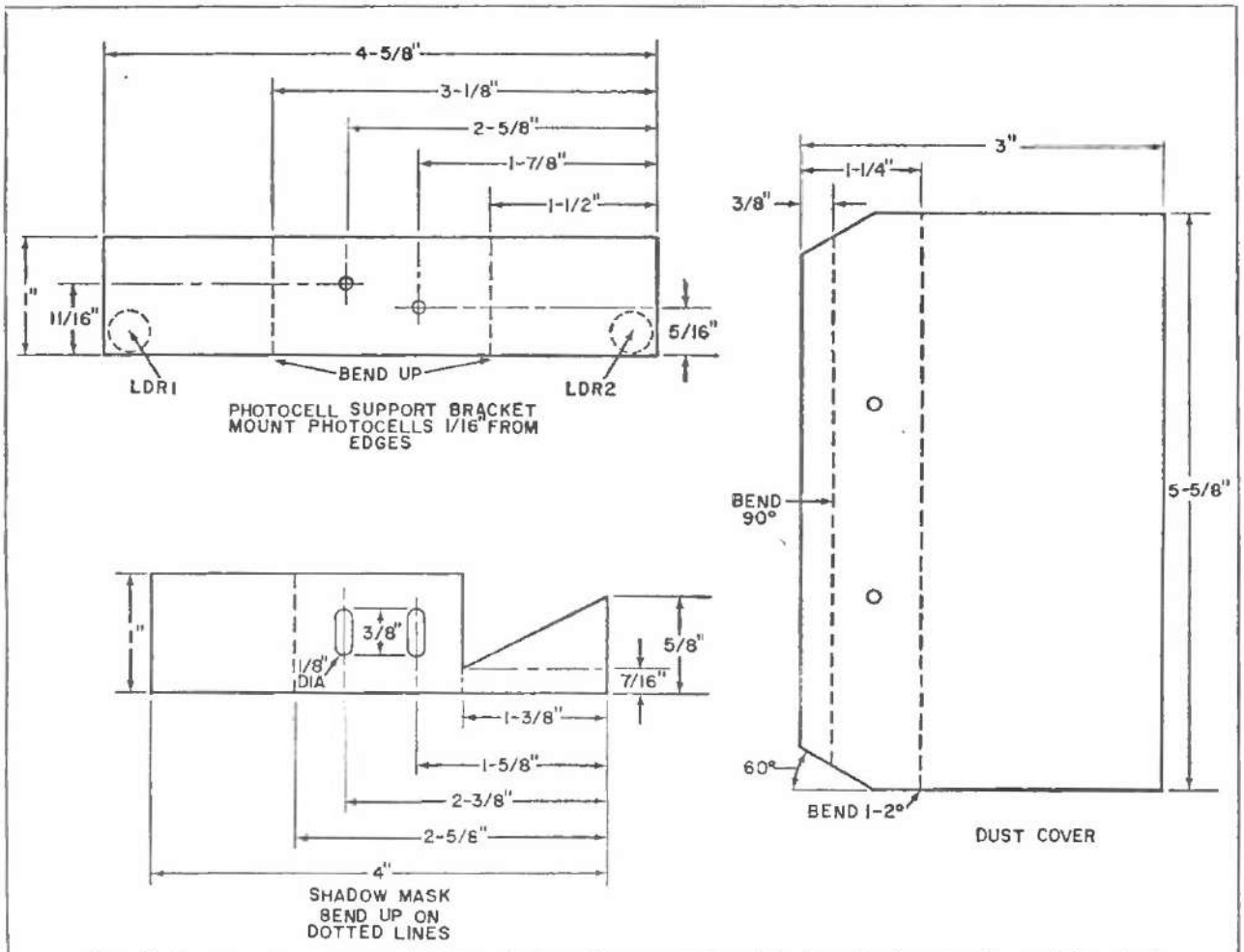
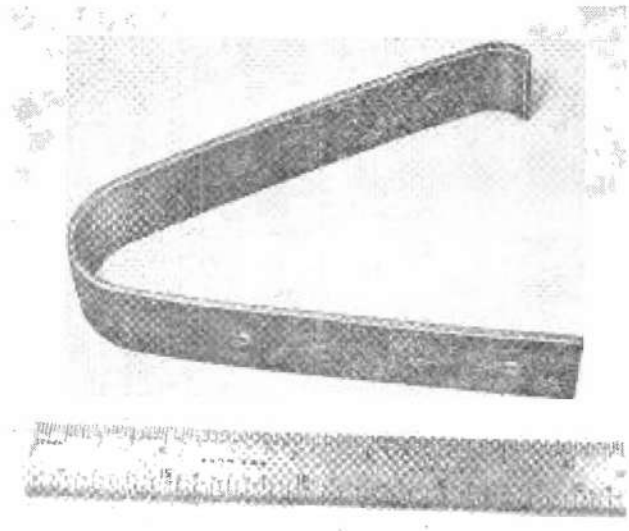


Fig. 6. Construction details for the photocell support bracket, the shadow mask, and the dust cover. These can be made from thin sheet metal and painted flat black to remove reflections.

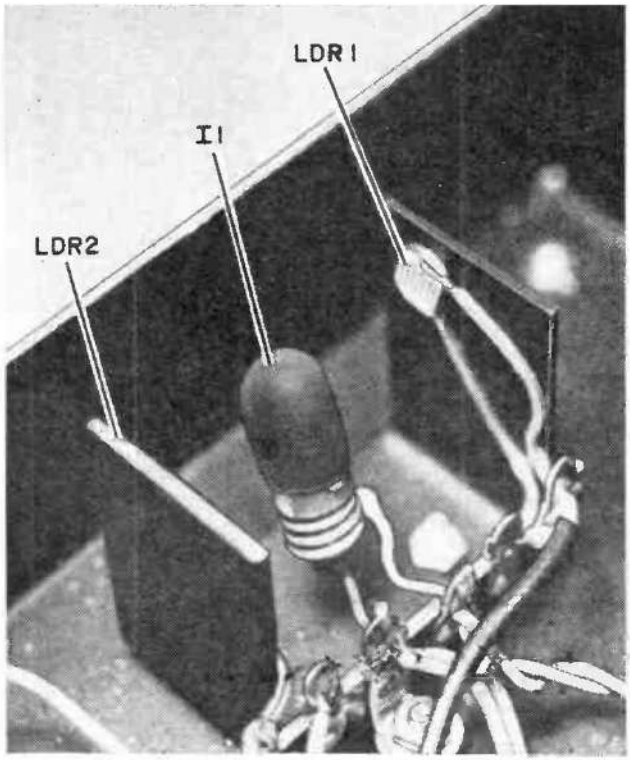
the chassis, using four small standoffs. Note and mark the chassis for both trimmer potentiometers. Remove the PC board and drill holes in the chassis so that the trimmers can be adjusted from outside with a screwdriver.

Using suitable hardware, mount the transformer on the bottom of the chassis. Mount the input and output phone jacks. After soldering appropriately long leads on the PC board terminals, attach the board (on its spacers) to the chassis. Make sure that the two trimmers face the holes for adjustment. Mount a six-lug terminal strip (one lug grounded) close to the photoresistor support as shown in the photos. Lamp *L1* can be installed in a socket or it can be attached to heavy leads soldered to its base connectors. Connect one side of the lamp to the grounded lug on the terminal strip and the other to the adjacent ungrounded lug. Position the lamp midway between the two photoresistors. Coat the lamp with flat black paint. After the paint dries, scratch a small clear spot on each side of the lamp so that, when it is lit, a small beam of light falls on the sensitive face of each photoresistor.

Insulate the leads on the photoresistors and connect them to the outside terminals on the terminal strip. Using shielded cable to minimize hum, connect



The spring has a small curve at the top to slide along the wooden foot pedal as it is depressed.

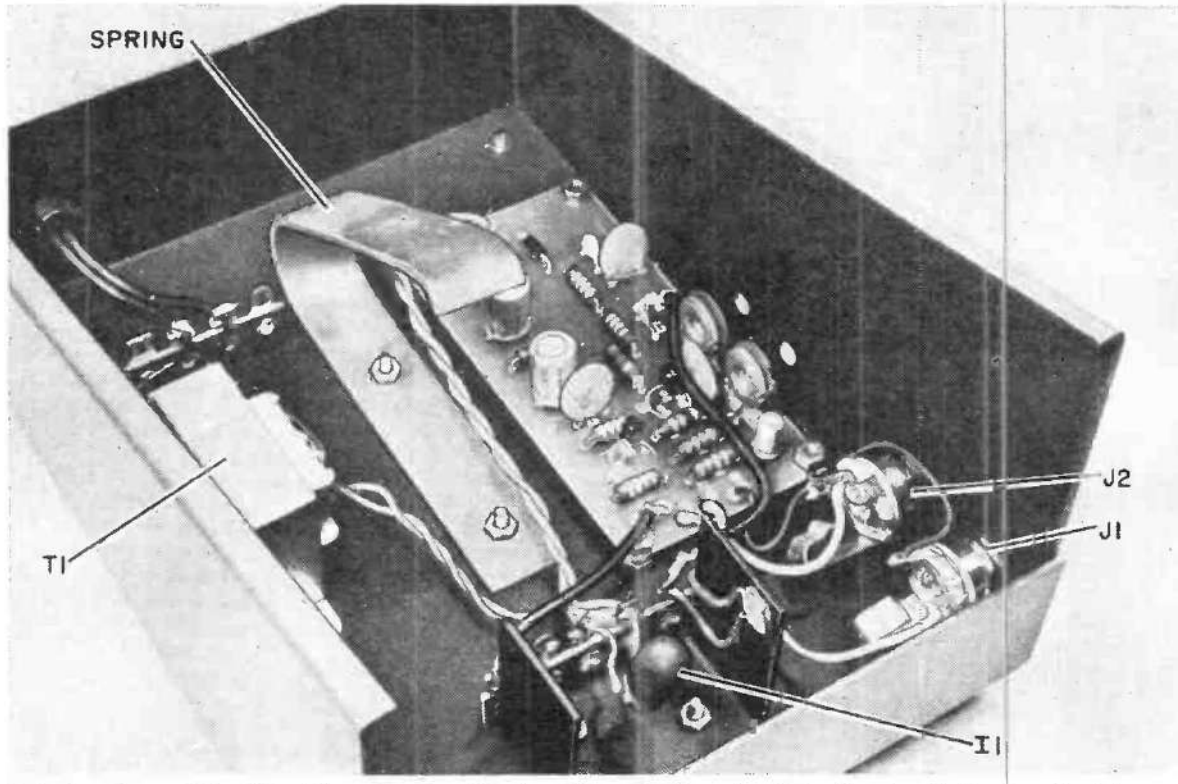


Lamp I1 is painted flat black and small dots of paint are removed on each side to shine on LDR's. Dot where paint was removed appears black here.

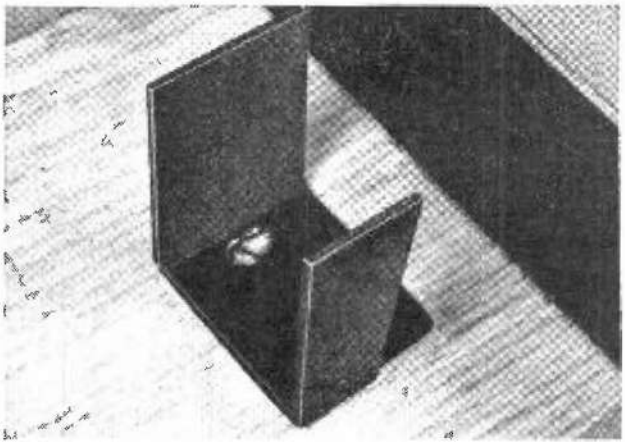
these terminals to the appropriate terminals on the PC board. Use a two-lug (non-grounded) terminal strip to connect the primary leads of the transformer to the line cord. Pass the cord through a hole with a grommet in it in the lower end of the chassis.

Wire the system according to Fig. 1, making sure that the photoresistors are properly installed. Install the wooden foot pedal temporarily, using the hinge screws to hold it. Hold the light mask against the bottom surface of the pedal with the angled portion covering *LDR2*. When the pedal is depressed, the mask must slide cleanly between the lamp and the photoresistors. Put screws through the slotted holes in the light mask to position it laterally but leave it able to move up and down on the pedal.

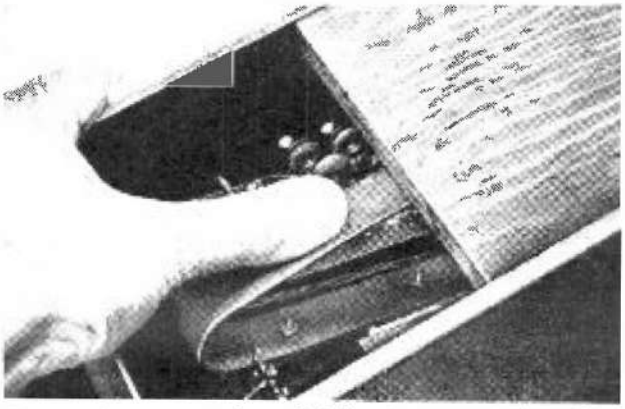
Remove the wood pedal. Attach the spring, using suitable hardware, so that the top of the spring is slightly higher than the chassis walls. Re-install the pedal and secure it with the hinge screws. Check that, as the pedal is depressed, the light mask slides clean. With the pedal all the way up, the uppermost surface of *LDR1* may be in shadow but the majority of its surface must be fully lit by the beam from *I1*. Adjust the final position of the mask so that both photoresistors are completely in shadow when the foot pedal is lightly depressed and *LDR2* is fully lit when the pedal is pressed all the way down. Provide some form of mechanical stop to arrest the pedal at the bottom of its travel. (In the phototype, this stop is provided by the



Interior view of the Waa-Waa showing the location of all parts. Note the two holes for the trimmer potentiometers. The lips on the chassis top limit the wooden foot pedal at the top of its travel.



Shadow mask is secured to underside of foot pedal. The flat black paint removes all reflections.



The spring must be slightly depressed to allow foot pedal to slide under the chassis upper lips.

hitting of the mask against the frame that holds the photoresistors).

Fabricate the light and dust cover as shown in Fig. 6 and mount it on the top end of the foot pedal. The inside of this cover must be painted flat black.

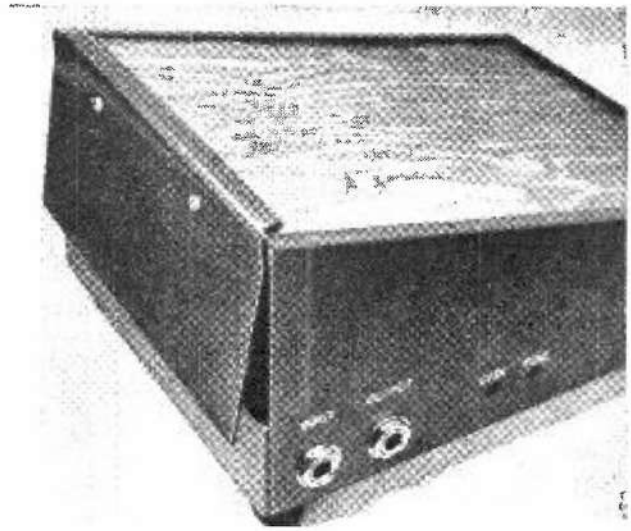
Operation and Use. Plug the output from the instrument you are going to use into the input jack, *J1*, of the Waa-Waa and run an audio cable from the output jack, *J2*, to the amplifier. Supply power to the Waa-Waa, set the amplifier volume to a reasonable level, and use a small screwdriver to turn the potentiometers, *R5* and *R11*, fully clockwise. At this point, a squeal may be heard from the amplifier as the Waa-Waa breaks into oscillation. Adjust *R5* until there is no oscillation at any setting of the foot pedal.

Now strike a chord on the instrument and press the pedal. The effect of the Waa-Waa should be obvious; however, there will also be a noticeable increase in volume as the pedal is depressed. Adjust *R11* so that the volume change is minimized.

As you learn to use the Waa-Waa, you may feel that only a slight motion of the pedal produces too great a change in the tone of the instrument. This can be changed by reducing the size of the hole in the paint on the side of *I1* which illuminates *LDR2*. You may eventually find that just a pinhole produces the proper results.

There may be an annoying squeak as the pedal rubs against the sides of the case and the spring. This can be eliminated by coating the offending areas with one of the silicone lubricants.

For maximum effect, the Waa-Waa should be used with instruments producing a tone rich in harmonics, such as a guitar or harmonica. The effect on a guitar is most noticeable when the strings are plucked next to the bridge but this is really a gimmick on top of a gimmick. In general the effect of the Waa-Waa is less noticeable on bass instruments (unless they generate good harmonics as does a bass harmonica). The pedal may be pressed and released rapidly to get a distinctive "wow" or it may be moved slowly to produce a weird "wind in the willows" effect.



Dust cover keeps the ambient room light from affecting LDR's. A pair of long wood screws form a hinge at the heel (lower) end of wood foot pedal.

The thing to do is experiment. The effect is so unusual that a beginner is as expert as anyone else so no one can say you're doing it wrong.

One word, however! A little Waa-Waa goes a long way. The listener should get the impression of having heard something new, but he shouldn't be able to say exactly what it was. -30-