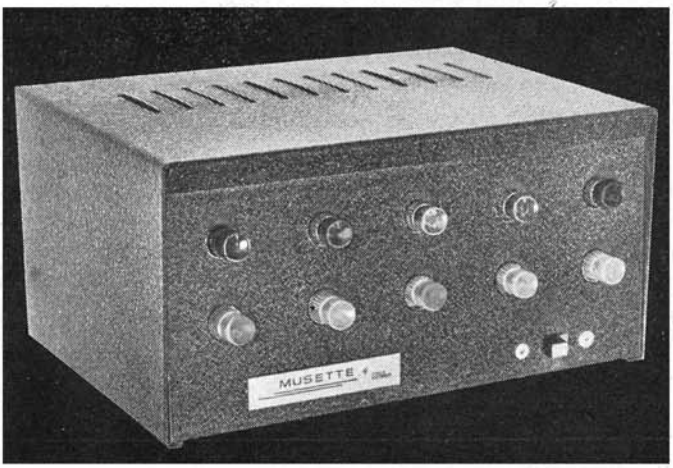


BUILD THE MUSETTE

A true high-fidelity multichannel musical kaleidoscope for home entertainment

By DONALD E. LANCASTER

MORE COLORFUL than a performance of Swan Lake by Disney's spectacular dancing waters . . . more vibrant than any Discotheque party you've seen . . . "Musette," the color organ *par excellence*, swings and sways as it interprets your favorite tunes in delightful kaleidoscopic animation.

Unlike most low-cost, low-power, photocell-operated color organs (see article in POPULAR ELECTRONICS, March, 1965, p. 43), Musette is truly a high-fidelity, high-power instrument. It separates the applied audio from your hi-fi amplifier, AM, FM, or FM stereo receiver into component frequency bands (hereafter called channels). Five such channel separations are provided to cover the full frequency range (see Fig. 1).

The output from each of the five channels can operate up to a 150-watt color purity spotlight to put on a spectacular dancing performance indoors on your wall or ceiling, or outdoors on a special display. For, Musette plays tunes in lights—instead of sounds—by translating the pitch, rhythm, and loudness of speech or music to corresponding variations of color, hue, and brightness.

As a five-channel spotlight control center, Musette can be used for dance hall or patio decoration, as stage lighting for the "Little Playhouse," or as an advertising and sales attraction.

If you are willing—and able—to tackle a really advanced project, and can afford to lay out the 80-odd-bucks for materials alone, the building of Musette should prove to be a rewarding experience. If, on the other hand, you can't swallow

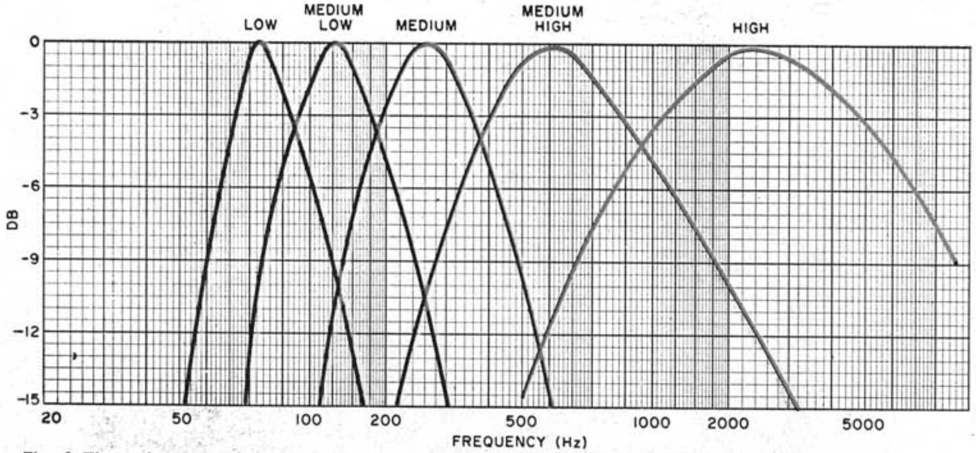
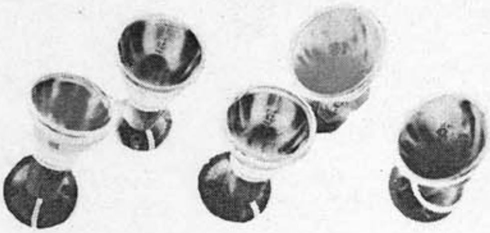


Fig. 1. These frequency response curves show the relative attenuation of each band of frequencies in the audio spectrum. The low channel can be omitted, if desired, with little effect on overall performance.

COLOR ORGAN



the high price tag in one gulp, you can still bite off, build, and use the unit one channel at a time, adding more channels when money and time permit.

For maximum utilization of the organ while building, you should start with the *high* and *medium* frequency channels. These channels cover a relatively wide range of instruments. Then you can tackle the *medium high, medium low,* and *low* channel, in that order.

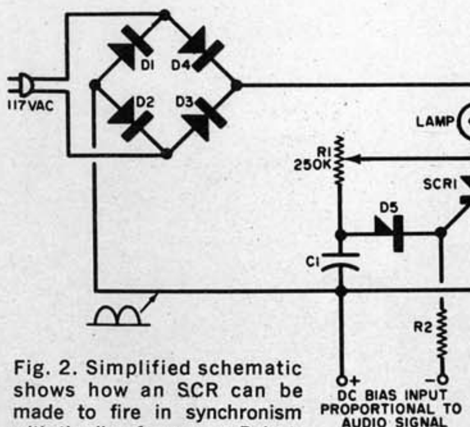


Fig. 2. Simplified schematic shows how an SCR can be made to fire in synchronism with the line frequency. Pulsating d.c. acts as trigger pulses.

Simplified Circuit. To understand the inner workings of Musette, first consider the simplified lamp control circuit of Fig. 2. A lamp in series with a silicon-controlled rectifier (*SCR1*) makes up the load across the output of a full-wave rectifier (*D1* through *D4*).

The SCR that controls the lamp is triggered by a pulsing circuit consisting of avalanche breakdown (trigger) diode *D5*, a capacitor charging circuit (*C1-R1*), and biasing resistor *R2*.

When the charge on *C1* reaches 30 volts, trigger diode *D5*, interposed between the charging capacitor (*C1*) and the SCR gate, switches on, causing the capacitor to discharge and trigger the SCR. The ratio of *on* period to *off* period, and thus the average brightness of the lamp, is determined by the adjustment of *R1*, which establishes the charging time of *C1*. Thus, if *D5* turns on the SCR at the start of each half cycle, the lamp will stay on longer than if the SCR is turned on later in that half cycle.

Now, if a negative voltage is applied to the cathode side of *D5*, the effect will be to pre-bias the diode so that it conducts and triggers the SCR earlier during each half cycle. The greater the negative bias, the earlier the SCR will be turned on, and the longer will be the *on* cycle that applies power through the lamp. Initially, potentiometer *R1* is adjusted to set the lamp at a minimum brightness level. Then, any varying negative voltage across *R2* will produce a corresponding variation in brightness levels.

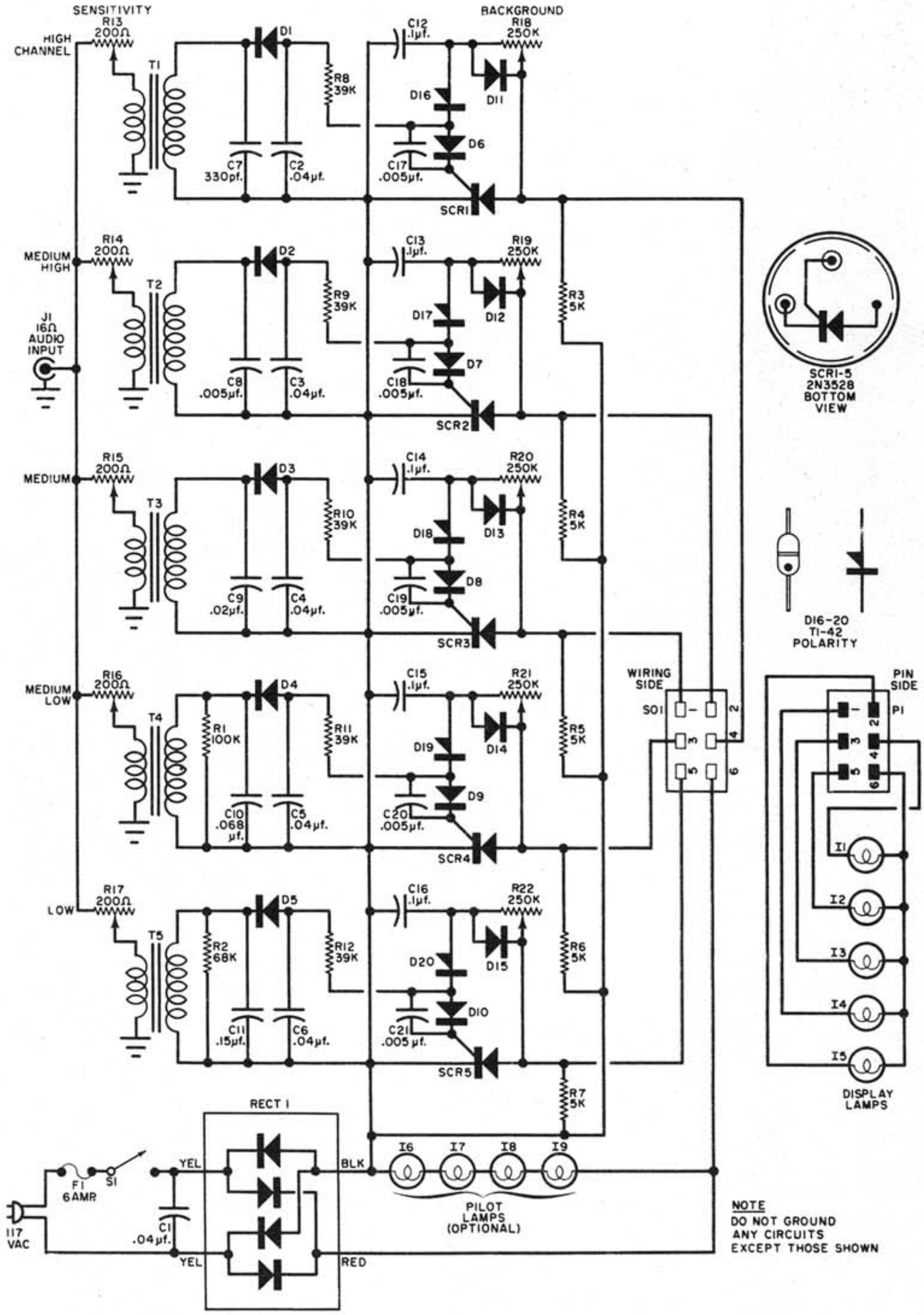


Fig. 3. Overall circuit of five-channel color organ is made up of five basic circuits easily identified by individual input transformers (T1 through T5). Each circuit operates its own display lamp.

PARTS LIST

C1-C6—0.04-μf., 200-volt Mylar capacitor
C7—330-pf., 600-volt disc capacitor
C8, C17-C21—0.005-μf., 600-volt disc capacitor
C9—0.02-μf., 200-volt Mylar capacitor
C10—0.068-μf., 200-volt Mylar capacitor
C11—0.15-μf., 400-volt Mylar capacitor
C12-C16—0.1-μf., 200-volt Mylar capacitor
D1-D10—1N4001 silicon diode (or equivalent)
D11-D15—1N4003 silicon diode (or equivalent)
D16-D20—Texas Instruments TI-42 pnpn trigger diode, or Motorola MT 30 trigger diode
F1—6-ampere fuse (and fuse holder)
I1-I5—117-volt, 150-watt interference filter spotlight (General Electric PAR38 DICHRO-COLOR in red, orange, yellow, green, and blue, priced at $4.98 each, and available from electrical supply houses—or any combination of incandescent 117-volt lamps not exceeding 200 watts per channel nor less than 10 watts per channel)
I6-I9—28-volt pilot light (GE 313)—optional
J1—Phono jack
P1—6-prong, high-current cable clamp plug (Cinch Jones P-306-CCT)
R1—100,000-ohm, ½-watt resistor
R2—68,000-ohm, ½-watt resistor
R3-R7—5000-ohm, 5-watt wirewound resistor (Ohmite 995-5B-5000 or equivalent)
R8-R12—39,000-ohm, ½-watt resistor
R13-R17—Centralab TT-2 potentiometer, 200-ohm Twist-Tab mount, linear taper
R18-R22—Centralab TT-50 potentiometer, 250,-000-ohm Twist-Tab mount, linear taper
RECT 1—10-ampere, 200-volt, single-phase, full-wave bridge rectifier assembly (Motorola MDA 962-3 at $4.85—no heat sink required)
SCR1-SCR5—2N3528 silicon-controlled rectifier (RCA), 1.6 amperes, 200 volts
SO1—6-prong, high-current socket (Cinch Jones S-306-AB)
S1—S.p.s.t. slide switch, 6 amperes, 100 volts
T1-T5—Thordarson 24S54 audio output transformer: primary, 15-20,000 ohms; secondary, 3.5 ohms, 5 watts (do not substitute)
1—8" x 6" x 4½" cabinet (LMB CB-2, available in grey, brown or black)
*1—Set of Tenite translucent knobs (10 knobs colored red, orange, yellow, green, blue, and milky white)—optional**
*1—6¾" x 2⅜" printed circuit board***
1—7" x 3¼" x 1/32" aluminum sheet (for bracket)
4—Bayonet pilot light sockets (Leecraft 7-11)
Misc.—¼"-high spacers (4), ¾"-high spacers (8), #6 hardware, pop rivets, line cord (minimum 6-amp. rating), Heyco strain relief, wire, solder, display cable (Belden 8467), swivel-type outdoor sockets for display lamps, plywood base and junction box, display materials, reflectors or difusors, 6-terminal strip

*Set of 10 knobs available for $3 postpaid from Musette, c/o Arthur Emerson, 4229½ N. 23rd Ave., Phoenix, Arizona 85015

**Etched and drilled fiberglass circuit board (less parts) available for $3.50 postpaid from DEMCO, Box 16297, San Antonio, Texas 78216

In practice, this negative voltage is obtained from a rectified and filtered audio signal by an action similar to that which produces the a.v.c. voltage in an AM receiver.

Actual Circuit. Now, let's look at the overall schematic of the five-channel color organ (Fig. 3). Each channel is identified by a separate input transformer (*T1* through *T5*).

Except for the fact that each channel responds to a different portion of the audio spectrum, and thus each colored light represents a specific band of frequencies, all the channels operate in the same manner. Therefore, it will suffice to explain how a single channel operates. To make matters easy, let's discuss the channel at the top of Fig. 3. This happens to be the *high* channel.

Potentiometer *R13,* in the primary of input transformer *T1,* is used to adjust the sensitivity of the channel. Capacitor *C7,* together with the inductance provided by the secondary of *T1,* forms a parallel resonant bandpass filter. The audio across *T1* is rectified by *D1* and filtered by *C2* and *R8,* a changing negative voltage that is applied across *R8* to prefire *D16* and vary the brightness of the spotlight in the anode circuit of *SCR1.* Diode *D6* and capacitor *C17* isolate the negative voltage from the SCR's gate. All other components operate as described for Fig. 2.

Operating power is obtained from the a.c. line, and rectified by the diodes forming the full-wave bridge rectifier. Pilot lamps *I6* through *I9* provide illumination for the special translucent knobs used in the project. The display lamps (*I1* through *I5*) are connected in series with their respective SCR's through plug *P1* and socket *SO1.*

If you are an old pro and can wire directly from a schematic diagram, you may—but need not—use a printed circuit board for component layout. Actually, the only advantage you get from a printed circuit board is the elimination of point-to-point wiring which usually requires more layout space. Since space is not likely to be critical in this instance, you may prefer to lay out and wire the small components on a perforated phenolic board, or even on a metal chassis *if you are careful to isolate the power circuits from the chassis,* and ground only those circuits that are

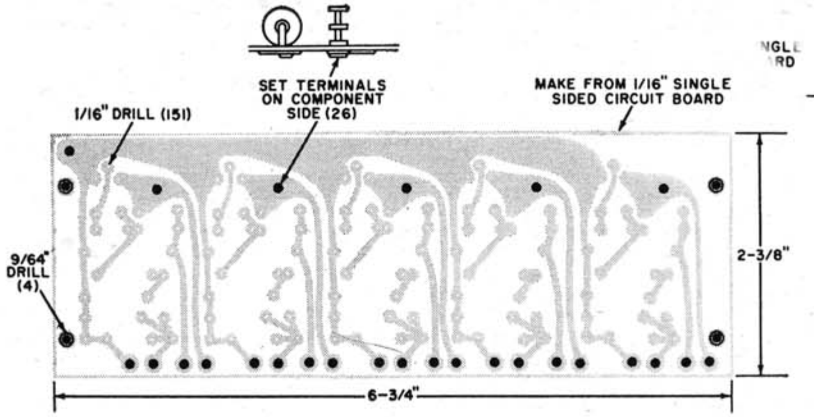


Fig. 4. Prepared circuit board showing overall dimensions and drill sizes for all holes required.

shown grounded in the diagram (Fig. 3).

If the author's design is followed, you will come up with a presentable unit that will work just as well as it looks. But you can vary the packaging, as preferred, without any degradation in the performance of the unit.

Whatever you do, *don't* substitute any other type of input transformer for *T1* through *T5,* and be sure to use the exact value of capacitors specified for *C1* through *C7*. The reason is that each transformer and its corresponding tank capacitor comprise a parallel resonant circuit which determines the frequency bandpass of each channel.

Construction. You can start construction with the circuit board, which should be etched and drilled as shown in Fig. 4. If you prefer, you can buy this PC board (see Parts List). Mount the components on the PC board as shown in the layout guide (Fig. 5), and then put the board aside temporarily.

Cut and form an aluminum mounting bracket for the controls and pilot lamps as shown in Fig. 6. Both the dimensions of the bracket and the spacing for the mounting holes are determined by the chassis enclosure selected.

After mounting the controls and the pilot lamps on the bracket, install the bracket on the chassis, following the spacing shown in Fig. 7. Carefully measure the shaft positions, and drill or punch out the front panel holes to accommodate the potentiometer shafts. If

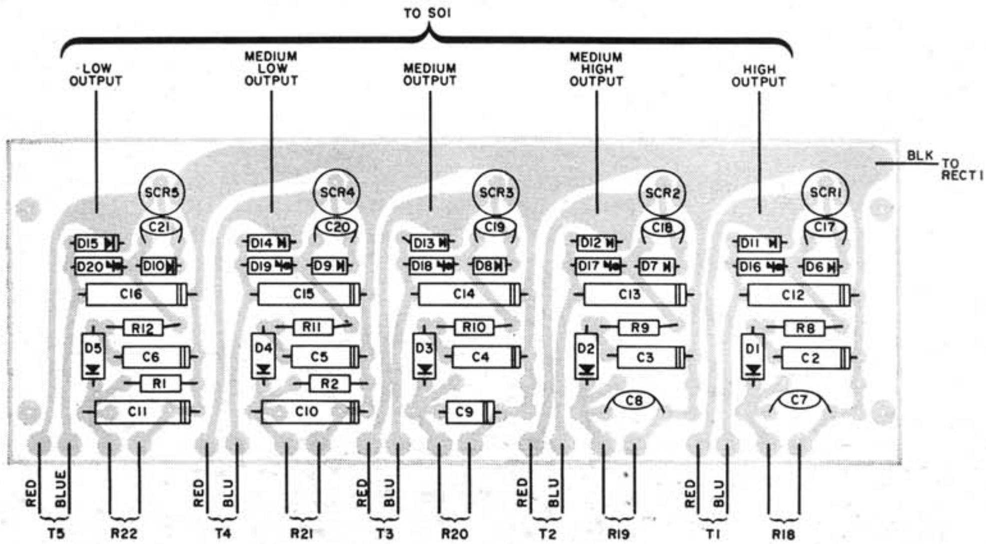


Fig. 5. When mounting parts on the printed circuit board, be sure to position the diodes with the polarity markings as shown. Also, make all input and output connections from terminal pins on the circuit board.

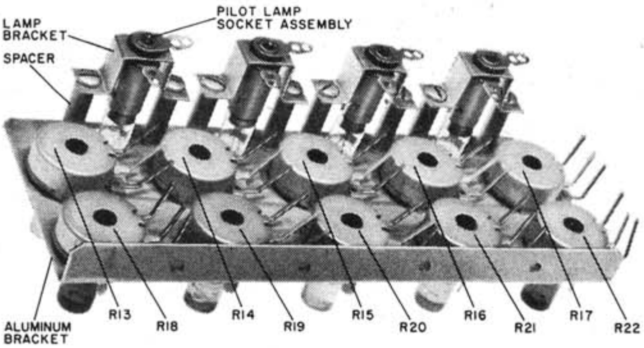


Fig. 6. The pilot lamps and controls are first preassembled on the aluminum bracket which is then mounted 5/16" behind the front panel.

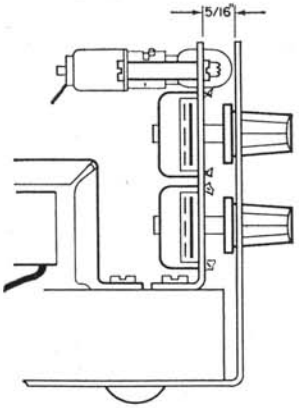


Fig. 7. Be sure to allow indicated spacing between aluminum bracket and instrument's front panel, to clear the pilot lamps.

you plan to use the recommended Tenite translucent knobs, bear in mind that each hole should be slightly larger than the knob diameter.

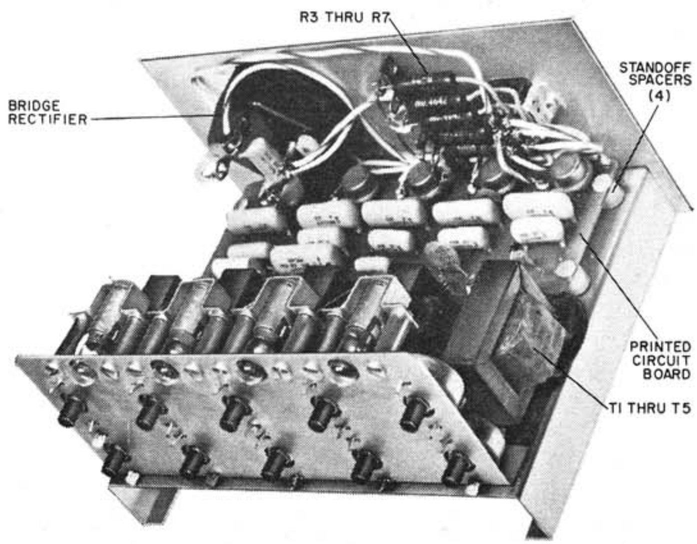
To avoid costly errors when drilling the front panel holes, make a cardboard template to use as a drill guide once you have verified all the dimensions. If you decide not to use the special knobs, make the front panel holes just large enough for the shafts. (In this case, the pilot lamps may be unnecessary.)

Finally, drill the mounting holes for the power switch in the front panel. If you don't have a rectangular punch, you can make the rectangular switch cutout by first drilling a large enough hole, and then filing the hole into a rectangular shape as required.

Now turn to the rear panel and determine a suitable layout for the input and output connectors (*J1* and *SO1*), the fuse holder, and the line cord strain relief. From Figs. 8 and 9 you can determine the best place to mount the full-wave bridge rectifier, as well as resistors *R3* through *R7* which are installed on the inside of the rear panel. Observe the mounting position of the terminal strip.

Install the circuit board on the chassis (see Fig. 8) using four spacers. The transformers are secured to the top surface of the chassis, between the front

Fig. 8. This fully assembled unit shows printed circuit board mounted on four standoff spacers. Run all point-to-point wiring to the controls and pilot lamps before installing the transformers.



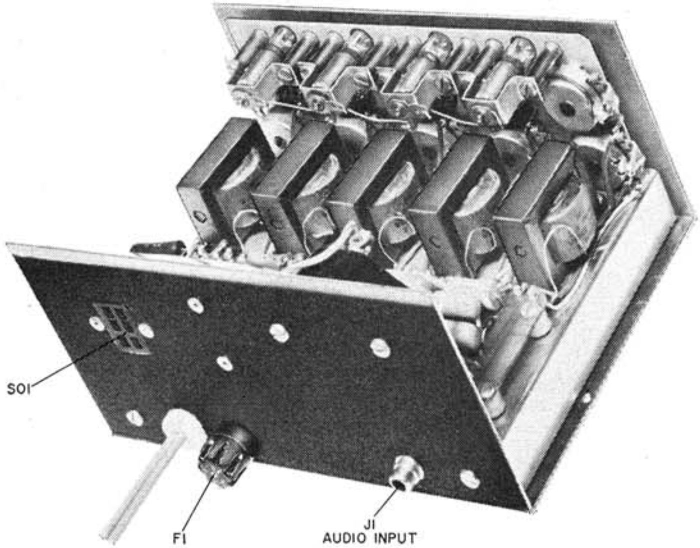


Fig. 9. Rear view of color organ with cover removed shows fuse holder F1, input jack J1, and color lamp receptacle SO1.

panel and the circuit board, with #6 hardware.

After all the parts are installed, you can begin the point-to-point wiring. Start with the power circuit by completing the connections on the rear panel. Then wire up the four pilot lamps in series as shown in Fig. 3. Wire the transformer and potentiometer leads next. After you have made all connections shown in the schematic, start testing out the instrument.

Testing. With the power switch set to the *off* position, connect an audio line from the output of your amplifier (across the speaker voice coil or the 16-ohm speaker terminals) to the input jack (*J1*) on the rear panel.

Measure the voltage, in turn, across capacitors *C2* through *C6*. Depending on the input voltage from the audio amplifier, and the setting of the respective *SENSITIVITY* potentiometers (*R13* through *R17*), the voltage across each capacitor should be somewhere in the range between −1 and −16 volts.

Best operation is usually obtained with the sensitivity control set approximately 1/8 of the way up from minimum resistance. In any case, avoid turning any of the pots all the way up as this will only overdrive the channel.

After testing and adjusting the sensitivity of each channel, disconnect the audio input. Finally, connect a 25-watt incandescent test lamp from the *hot* lead going from output receptacle *SO2* to the anode of one of the SCR's. Apply input power and vary the corresponding *BACKGROUND* potentiometer (*R18* through *R22*) to check the operation of the channel under test. The lamp should glow smoothly from minimum brightness to full brightness. Then set the potentiometer for minimum brightness. Check each of the remaining channels in the same manner.

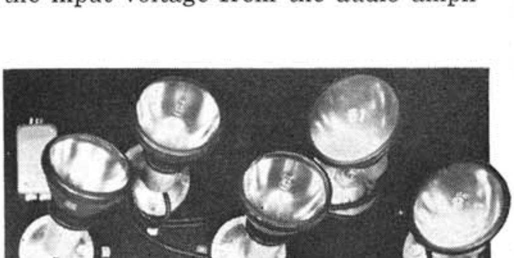


Fig. 10. The individual color spotlights which make up the display can be arranged on a common baseboard as shown for reflected or diffused projection.

Preparing a Display. A typical display arrangement is shown in Fig. 10. It is made up of five swivel-type outdoor spotlights mounted on a sheet of 13″ x 27″ x 3/4″-thick plywood. The size of the board can be varied to suit specific applications. If the lamps are to perform inside a display, you can use either diffused

(*Continued on page* 98)

ly. This distance is best determined by trial.

The probes are constructed of ⅛"-diameter brass welding rods spaced approximately ¼" apart. Length is not critical, but it should not exceed 12 inches.

Installing the Alarm. Although the accompanying photographs show the alarm installed at the pool, it is preferable to install the unit at some other location. Select a convenient spot that will provide a good listening post most of the time.

Mount the probes close together on a piece of board, allowing the probe tips to extend a few inches beyond the edge of the board. Before mounting the probes, waterproof the board with several coats of oil-base paint and allow it to dry. The probes can be connected to the alarm via ordinary bell wire.

After installing the probes on the swimming pool wall about an eighth of an inch above the surface of the water, flip the switch on for a few "dry" runs. It may be necessary to adjust the spacing between the probes, as well as the height of the probes above the water, for optimum performance —30—

MUSETTE COLOR ORGAN

(*Continued from page* 62)

rear projection through a plastic or glass screen, or reflected projection from a crumpled aluminum foil surface.

For best results, use *red, orange, yellow, green,* and *blue* spotlights to obtain a full spectrum of colors. It has been found that spotlights with built-in optical interference filters perform best, yielding the deepest colors, the coolest operation, and providing the best overall effect. These lamps readily produce all hues, and varying degrees of saturation.

The choice of a display, as well as the arrangement or sequence of colors for the various channels, is yours to make. One logical scheme is to drive the low-frequency color lamp—the color red—with low-frequency audio, and so on up the spectrum to blue.

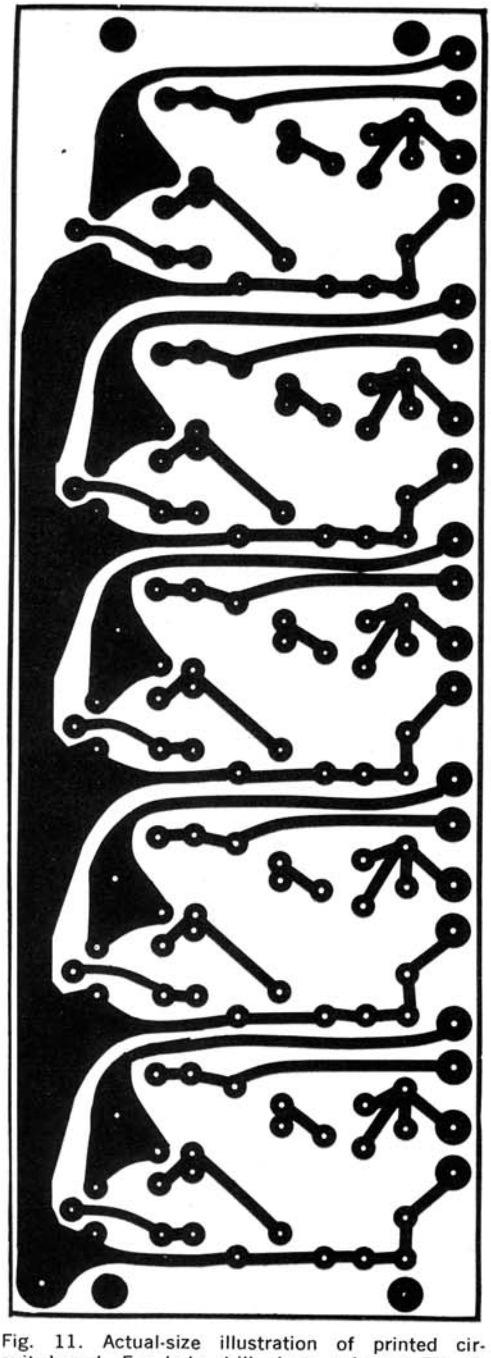


Fig. 11. Actual-size illustration of printed circuit board. For hole drill sizes, refer to Fig. 4.

Regardless of your final arrangement, we believe you will have the best color organ available, in terms of sensitivity, power output, and performance. Enjoy it. —30—