BUILD

Stereo Headphone Control Center

Patch your headphones to your amplifier and adjust blend, balance, bass boost and volume for better listening

By PETER E. SUTHEIM

STEREO HEADPHONES are great—they provide the ultimate in separation and you aren't distracted by room noise. Only trouble is they usually don't match your amplifier output. This stereo headphone control center takes care of the matching; moreover, it gives you full control of volume, bass, blend and balance. And you don't have to disconnect it to use the speakers.

The control center can be used with any stereo headset and any stereo amplifier—unless you have a very unusual headset or an amplifier.

Controls

For controls, it has a three-position selector switch: You can choose speakers only, phones only, or both at the same time. (The third choice may seem a bit strange, but it is much appreciated where one listener is hard of hearing. He can wear the phones and enjoy the music at a suitable volume level. The others can listen at a comfortable volume through the speakers.) The switch is of the shorting (make-before-break) type to reduce switching clicks.

There is, of course, a volume control for the phones, ganged so that both channels are controlled simultaneously. A balance control compensates for uneven tracking between the two sections of the volume control, and for individual differences in hearing sensitivity between the listener's ears.

The blend control corrects for the sometimes excessive stereo separation in headphone listening. At its extreme counterclockwise position, the blend-control resistance is switched out of the circuit, allowing full separation. At the other extreme, the two channels are connected together, producing mono sound.

The bass control provides up to approximately 6 dB of boost at 40 Hz (referred to 1 kHz) to compensate for headsets whose air seal against the sides of the head is not good.

Connections

Leaving aside the convenience this box provides—which may or may not interest you—it might seem that there's a simpler way of connecting phones to an amplifier. The most obvious would be simply to connect the phones across the speaker terminals with a switch in series to turn the speakers on or off. This works, but has a couple of very serious disadvantages. First, earphones require only between

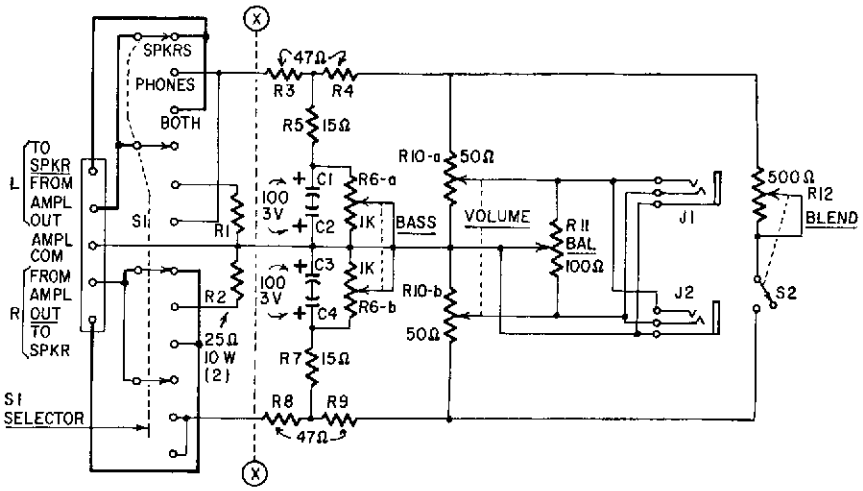
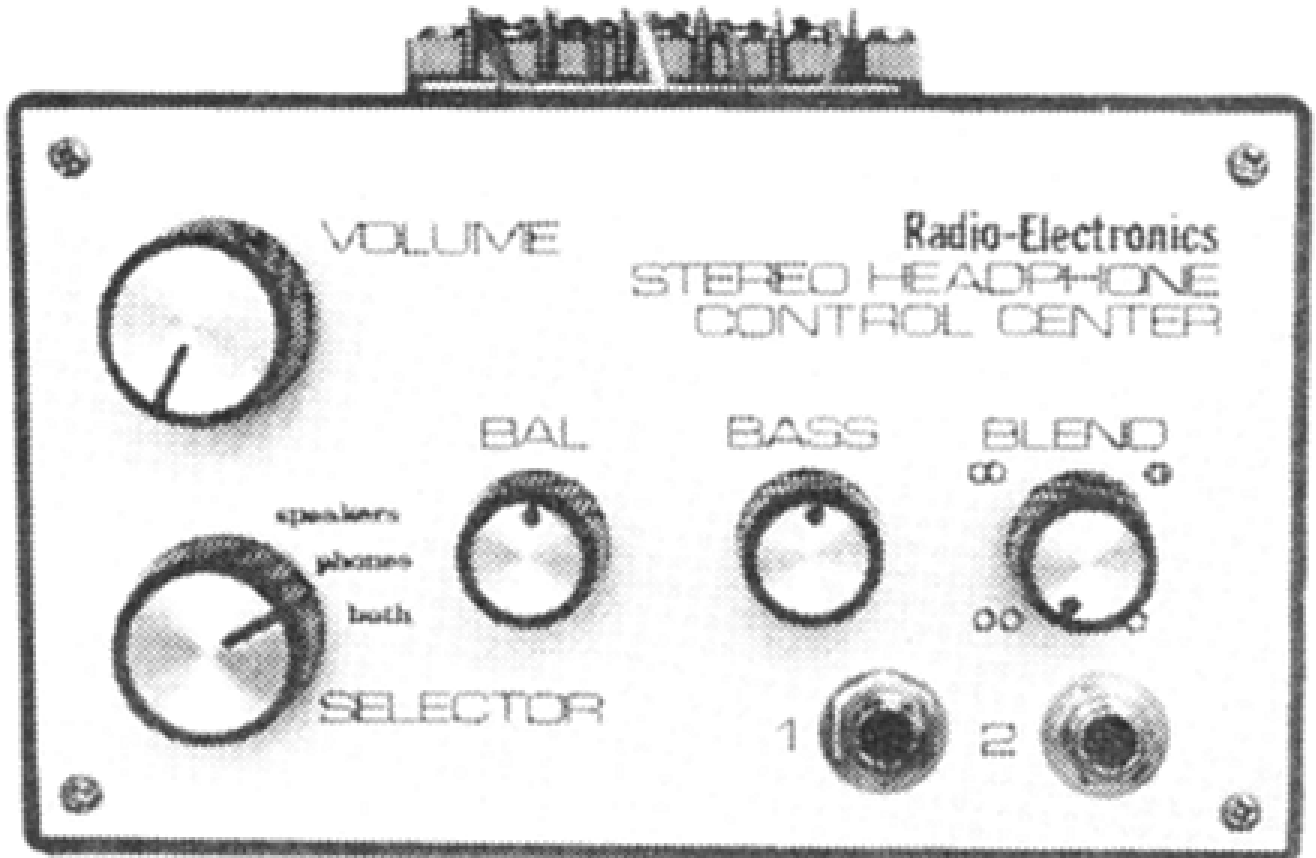


Fig. 1—Unique switching arrangement makes it possible to switch in speaker or phones only, or both. Amplifier is loaded, either by the speakers or R1 and R2.

PARTS LIST

C1, C2, C3, C4—100-μF, 3-volt electrolytic capacitor
J1, J2—Three-contact phone jack
R1, R2—25-ohm, 10-watt wirewound resistor
R3, R4, R8, R9—47-ohm, ½-watt resistor
R5, R7—15-ohm, ½-watt resistor
R6—Dual 1000-ohm potentiometer, log taper (Centralab, F5-1000 & R5-1000)
R10—Dual 50-ohm wirewound potentiometer
R11—100-ohm wirewound potentiometer
R12—500-ohm potentiometer (with S2)
S1—4-pole, 3-position shorting-type (make-before-break) rotary switch
S2—S.p.s.t. switch (on R12)
Misc.—Plastic case with aluminum panel (Lafayette 99 H 6272 or similar); barrier-type terminal strip (5 terminals)


VOLUME
Radio-Electronics
STEREO HEADPHONE
CONTROL CENTER
BAL
BASS
BLEND
speakers
phones
both
SELECTOR
1
2

10 and 100 *milliwatts* for quite loud volume levels. This is in the neighborhood of one-thousandth of the power output capability of typical amplifiers.

Not only is the full amplifier power unnecessary for phones, but it can destroy them in a fraction of a second by burning out the voice coils or rupturing the diaphragms. As a result, the volume control on the amplifier can be only just barely cracked open. There has to be some way of cutting the power fed to the phones.

Furthermore, the high sensitivity of the phones results in a good bit of noise along with the music. The normal amplifier hiss and hum, usually inaudible a few inches from a speaker system, become definitely audible in high-sensitivity headphones pressed close to your ears.

The usual way of solving both problems is simple and quite satisfactory: Stick a resistance in series with each "hot" earphone wire. The value most commonly used is around 300 ohms. It cuts down the power to the phones and, of course, cuts back the noise at the same time. It also reduces the damping factor to nearly zero. But, this seems to have little audible effect on phones, which have very small, low-mass cones or diaphragms with little inertia. They are usually pretty well damped by internal absorbents and by close coupling to the ear chamber.

But a load in the vicinity of 300 ohms is almost an open circuit as far as the amplifier output is concerned. It becomes necessary then to provide a dummy load for the amplifier when the speakers are switched out. The value of the dummy load is not critical. It isn't necessary, or even desirable, to *match* the dummy to the amplifier output.

A considerable upward mismatch (for instance, 8-ohm output loaded by 25-ohm resistor) means much less power wasted in the dummy load as heat, since the amplifier will not usually develop nearly as much power into a 25-ohm load as it will into an 8-ohm load. This headphone box switches in a pair of 25-ohm 10-watt resistors (one for each channel) in the PHONES position of the selector only.

It might be worth while to digress for a moment to explain this matter of protecting amplifiers with a dummy load. In general, the dummy is most important with tube amplifiers, principally because the high inductance of an unloaded output transformer can develop peak voltages during loud signals or instability high enough to break down transformer insulation or cause arcs in tubes or tube sockets. Almost any value of load resistance less than 5 or 10 times the nominal output impedance of the amplifier will load the transformer enough to prevent this type of trouble.

In transistor amplifiers, *shorts* across the output, rather than opens, most often cause trouble. However, it can do no harm to load the output of even a transistor amplifier in the same way. Dummy-loading may even save the output transistors if the amplifier happens to be unstable with no load. Occasionally a defective or poorly designed amplifier will oscillate with no load and damage its output transistors.

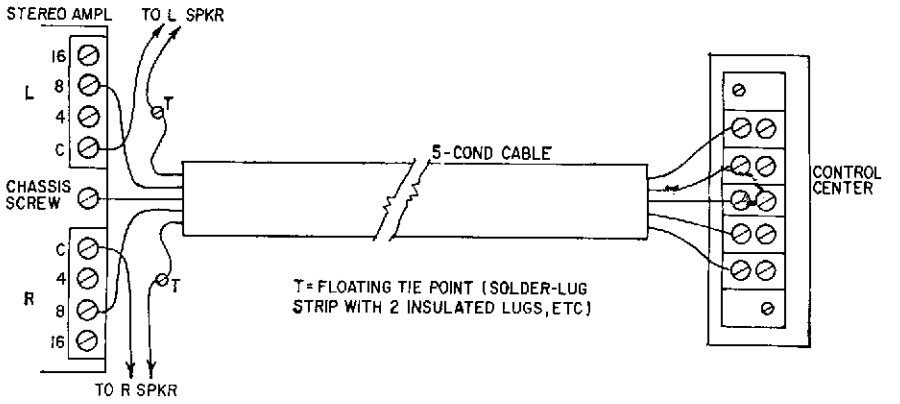
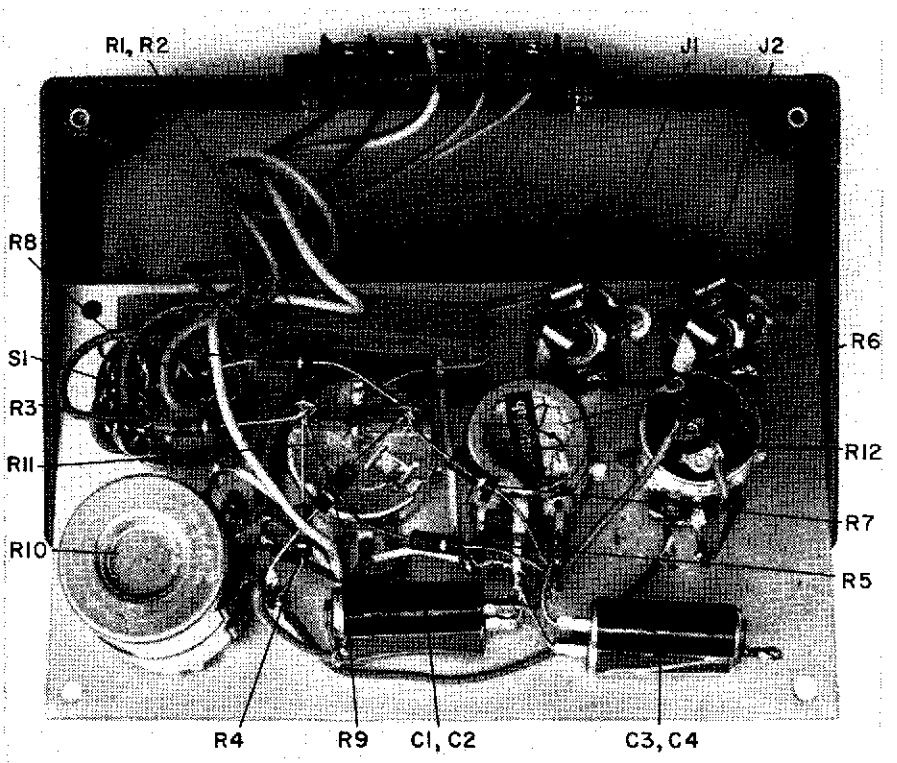


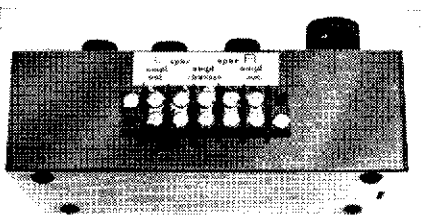
Fig. 2—To avoid undesirable power loss in the speaker wiring, don't use a cable longer than approximately 25 feet. Use impedance taps to match your speakers.



The limiting factor in parts mounting is size of the controls on the front panel. Wire position is not important; the circuit is all low impedance and high level.

Construction

Few things could be simpler or less critical to wire than this switchbox.



Shorted output circuits in a solid-state amplifier can be destructive—use a barrier type terminal strip. Note: speaker and amplifier output terminals are shown in reversed order—follow the schematic.

The low impedances and relatively high signal levels make it unnecessary to observe any precautions about wire length, shielding, routing, and so forth. Be sure, though, to use wire no thinner

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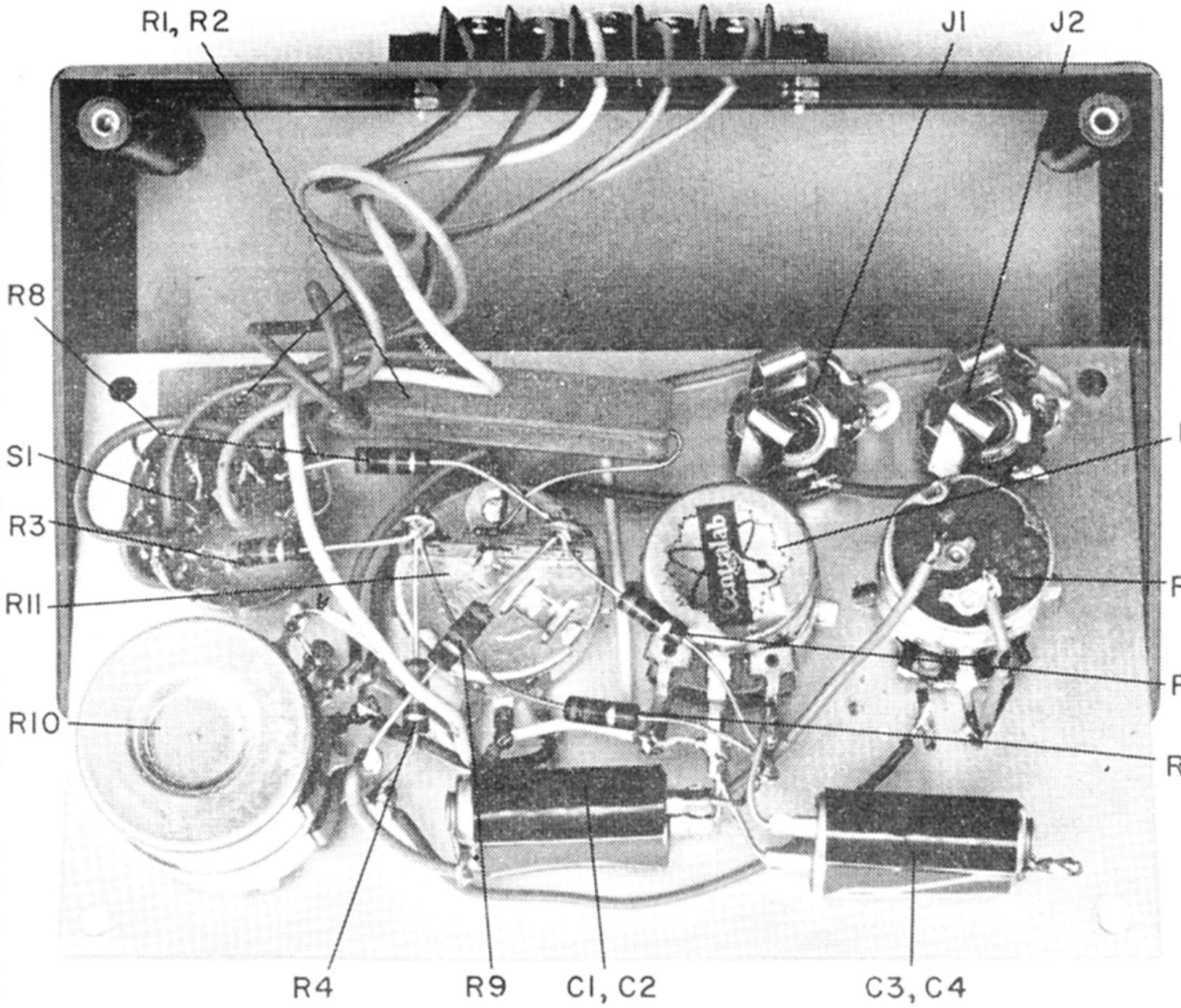

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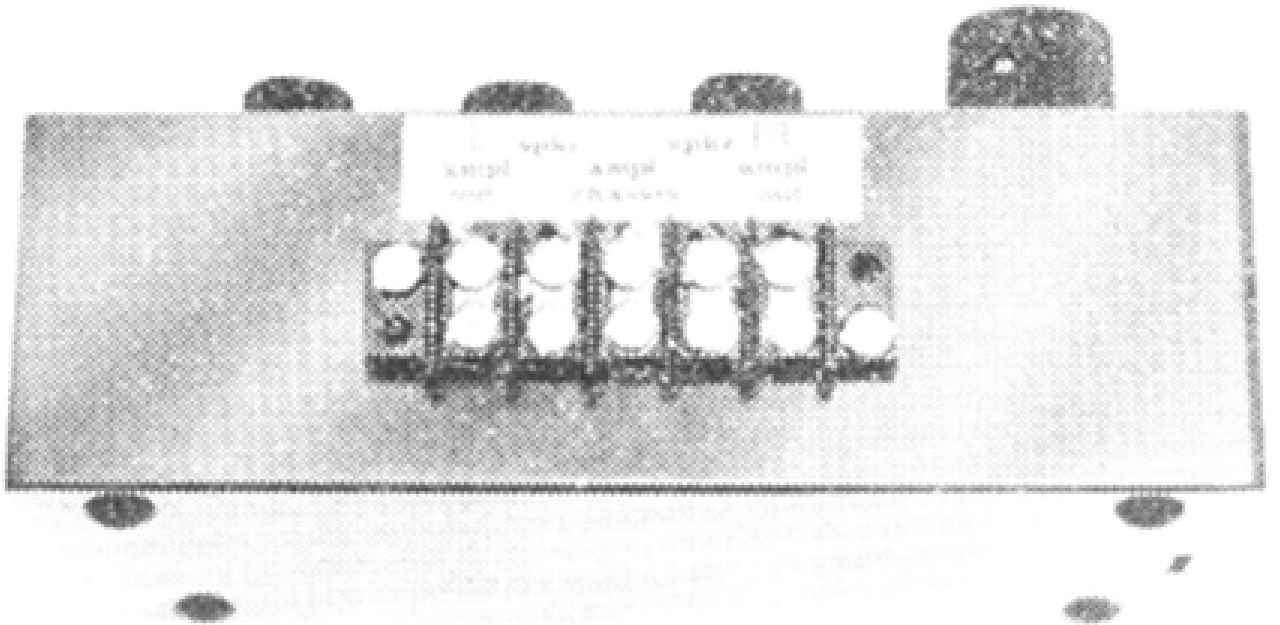

Stereo Headphone Control

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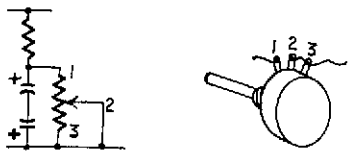
than No. 22 for the leads that will carry the full speaker current (heavy lines drawn on the schematic).

The photos show all the details for wiring the control center. The solder-lug strip mounting is soldered to the back of the balance control.



The Stereo Headphone Control Center works as described. It is important to try to obtain log-taper (audio taper) controls for R6, otherwise the change from flat response to full boost occurs all in the first few degrees of rotation from the counter-clockwise stop.

Be sure to wire the control exactly as shown. If you don't, the taper is in effect reversed and the rate of change will be even more extreme than with a linear-taper control.

If the electrolytic capacitors have uninsulated metal cases, as the ones in this model did, insulate them with tape to prevent their touching the panel. The panel must be electrically common to the common side of the circuit unless you want to provide insulating bushings for the phone jacks.

Modifications

Of course you can provide only one jack if you wish, or three or more. Volume will diminish as you parallel more sets of phones. If you like, you can provide a separate volume control for each headset. You can, in fact, duplicate the portion of the circuit after the switching (to the right of the dashed line X–X on the schematic) so that each headset has full, separate control facilities.

If you like your headphone music extremely loud, you may have to forgo the bass-boost circuit (R5, R6 and R7 and C1, C2, C3 and C4). To provide 6 dB of bass boost, the circuit must introduce 6 dB of loss everywhere else in the spectrum, except at the low frequencies. In a passive equalizer, there is no way around this fact of life. So if you need loudness, disconnect or omit the bass boost circuit.

Connecting the thing

Fig. 2 shows how the control center is to be connected to an amplifier. Note that the common terminal on the control center goes to the amplifier *chassis*, not to either of the speaker

terminals often labeled "common" or "C". The reason is that in many amplifiers the so-called "common" terminals are *not* common to each other or to the chassis, and cannot be connected together without disrupting some circuit function.

This connection is for headphone operation only. The normal connection to the speakers is in no way affected by the addition of the box if you follow the scheme given here. The speakers can be turned off or on by the selector switch in the control center, but this is done by interrupting the *high* (4-, 8- or 16-ohm) side of the wiring, not by disturbing the connection to the amplifier's low side.

Flat, five-conductor antenna-rotator cable is handy for making the connections between control center and amplifier because it can be slipped under a rug or run alongside of baseboard molding.

The wire should be No. 22 or heavier. Avoid running more than about 50 feet to prevent a sizable portion of your expensive amplifier power to be dissipated in the wiring. **R-E**