

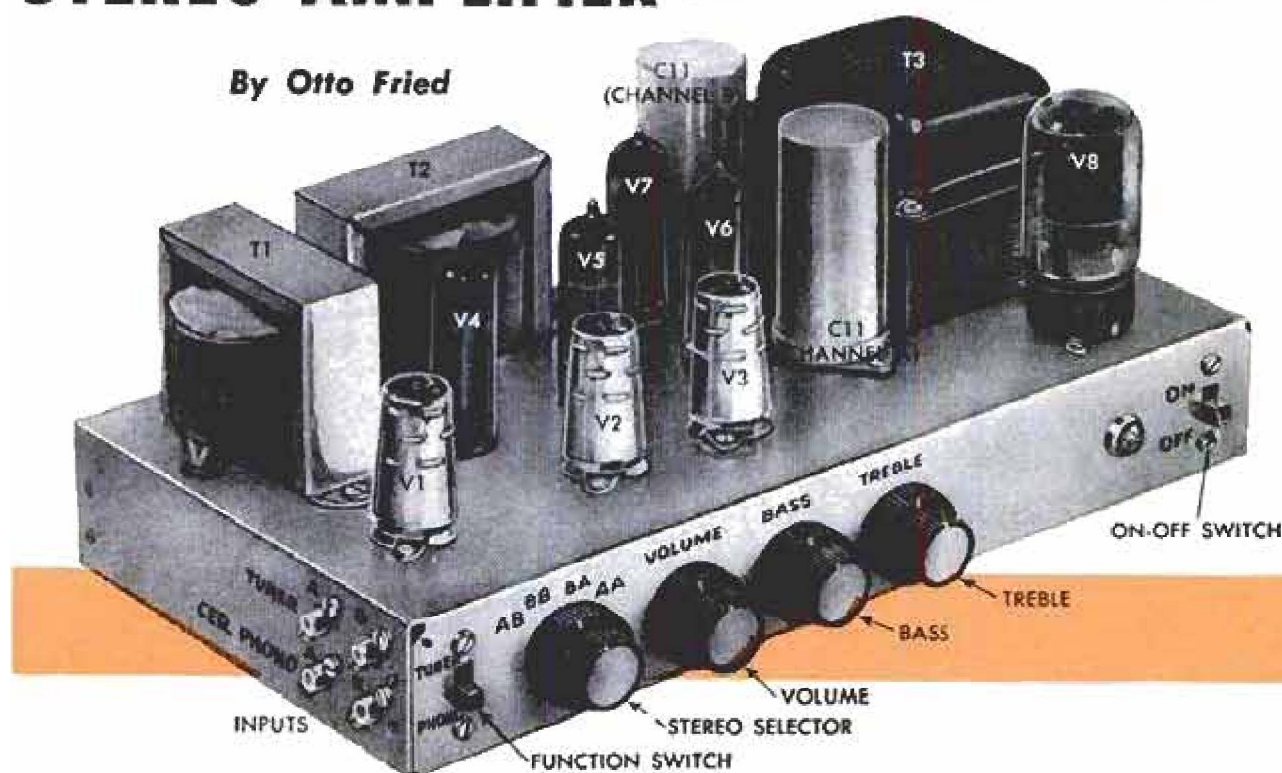
Voltage & Power
Sine Amplifier

*For Hi-Fi Enthusiasts
and Audio Hobbyists*

A HIGH-FIDELITY STEREO AMPLIFIER

Radio Television Electronics

By Otto Fried



IF YOU LIKE MUSIC but have so far resisted the temptation to scrap your present phonograph in favor of high fidelity—don't listen to stereo! But, if you already have exposed yourself to the stereo record, you may as well start planning the location of your two speakers—for, no doubt, you will have succumbed to the spell of three-dimensional sound and, whatever your past resistance to hi-fi, it will have been shattered by the magic of stereo.

But stereo, particularly high-fidelity stereo, is likely to be expensive. The dual amplifier and speaker requirements for stereophonic sound reproduction are not compatible with low cost, and the price of a really good stereo system is considerably higher than that of a comparable monaural unit. Money-saving short cuts are possible, of course. For little more than the cost of a stereo cartridge, almost any good monaural phono system can be converted to stereo by employing the amplifier and speaker of a suitable radio or TV set as the second channel (see "Stereo Music at Low Cost," *Popular Mechanics*, October 1958). But the inadequacies of such con-

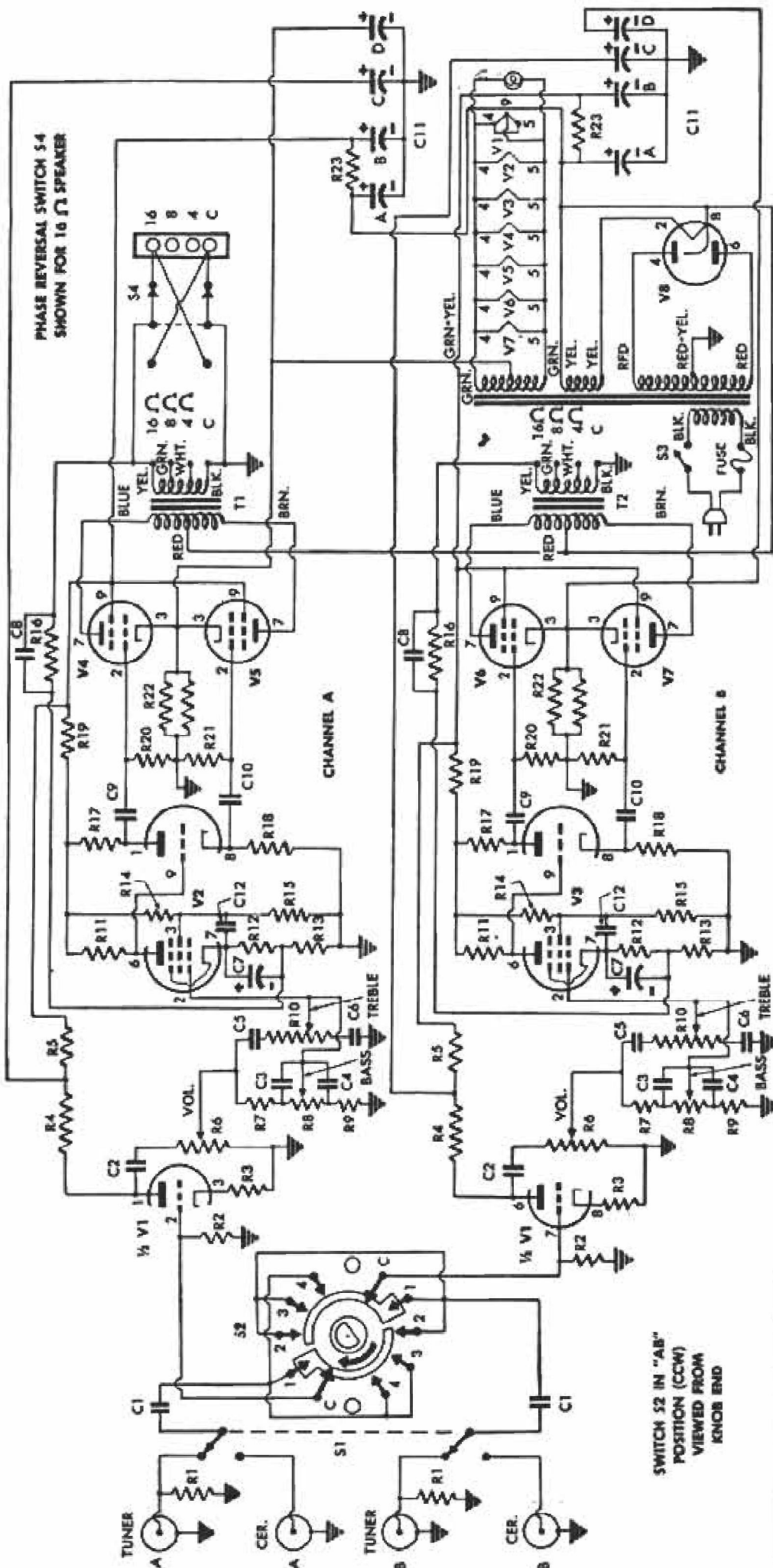
versions, both from a standpoint of fidelity and operating convenience, will soon become apparent. The only uncompromising path to money-saving high-quality stereo is to dust off the tool box and build some of the necessary components yourself.

The amplifier described here, actually two amplifiers in one, combines stereo flexibility with true high-fidelity performance. While not "cheap," its construction cost is far below that of commercially assembled units with similar specifications, and its design is such that a more experienced hobbyist should have little difficulty in duplicating the original model.

No tricky circuitry here. No critical adjustments, hard-to-get parts or added frills which increase costs and complicate operation. Just a straightforward circuit of a dual amplifier, using a common power supply, with sufficient power to fill even the largest living room with clean, undistorted sound.

Why a Stereo Amplifier Is Different

The principal difference between a stereo amplifier and a monaural one is the fact that the former has two complete and



RESISTORS: (All resistors are $\frac{1}{2}$ -watt $\pm 10\%$ unless otherwise specified; $K = 1000$ ohms, $M = 1,000,000$ ohms, 2 sets of the following values are required): R1, R15—100K; R2—2.7M; R3—6.8K; R4, R7—220K; R5—470K; R6, R8, R10—1M potentiometer, audio taper (requires dual individually variable controls such as Mallory Concentric Midretrols or equivalent; R9—22K; R11—2.2M; R12, R19—10K; R13—47K; R14—1M; R16—2.7K; R17, R18—270K (1% or matched pair); R20, R21—330K; R22—165.4 watts (2 330-ohm, 2-watt resistors connected in parallel); R23—2.2K, 2 watts.

CAPACITORS: (All are disk ceramics unless other-

wise specified. Values given in mfd. 2 sets of the following values are required): C1—.02; C2, C12—.01, 400-v. tubular; C3—0.001; C4—0.01; C5, C8—0.00047; C6—.0008; C7—50.0, 10-v. electrolytic; C9, C10—0.05, 400-v. tubular; C11—4-section electrolytic, sections A, B, C are 40 mfd./450-v. section D is 40 mfd./25-v.

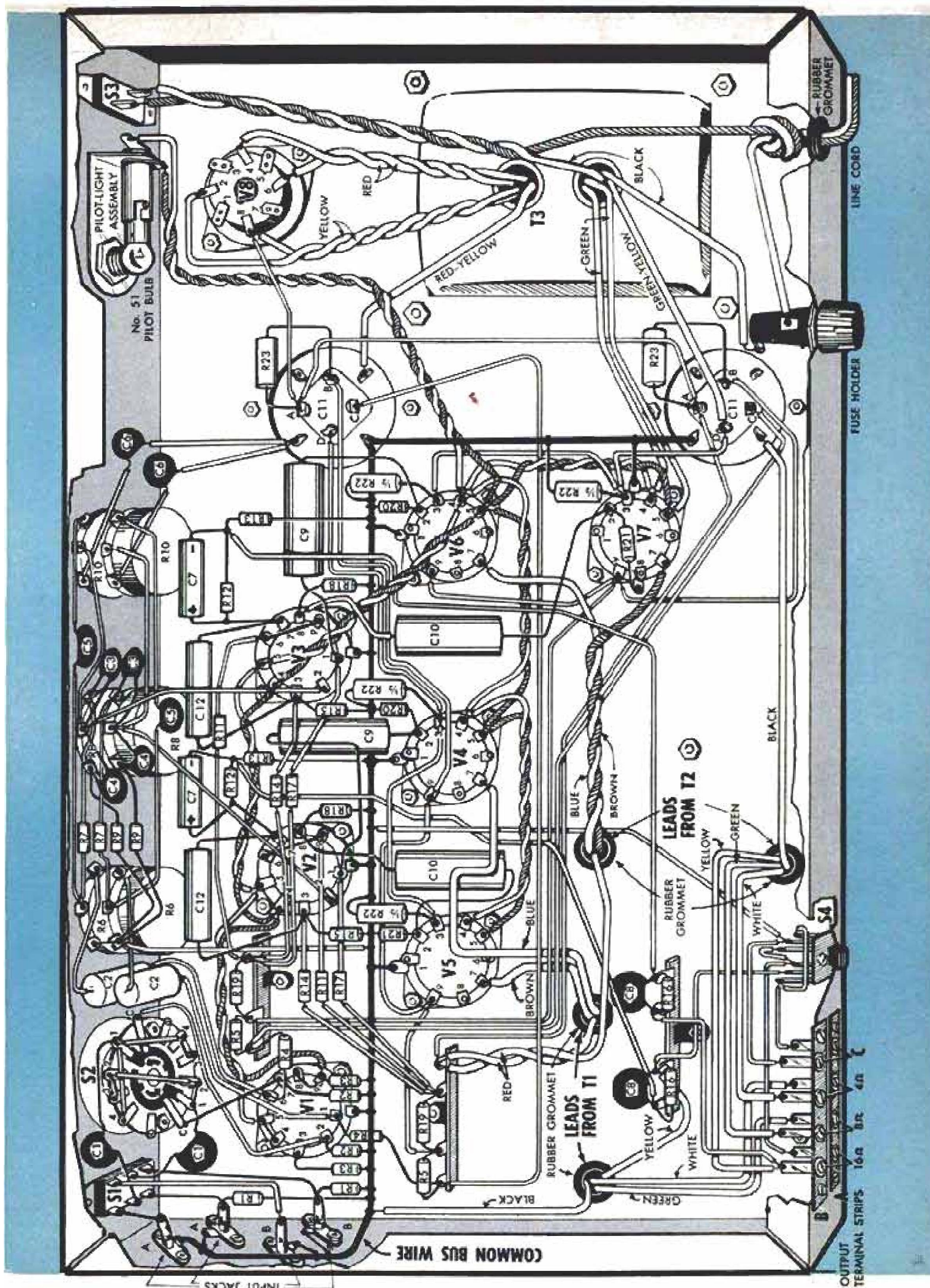
TUBES: V1—12AU7/6X82; V2, V3—6CQ8; V4, V5, V6, V7—7189/6BQ5A; V8—5V4GA.

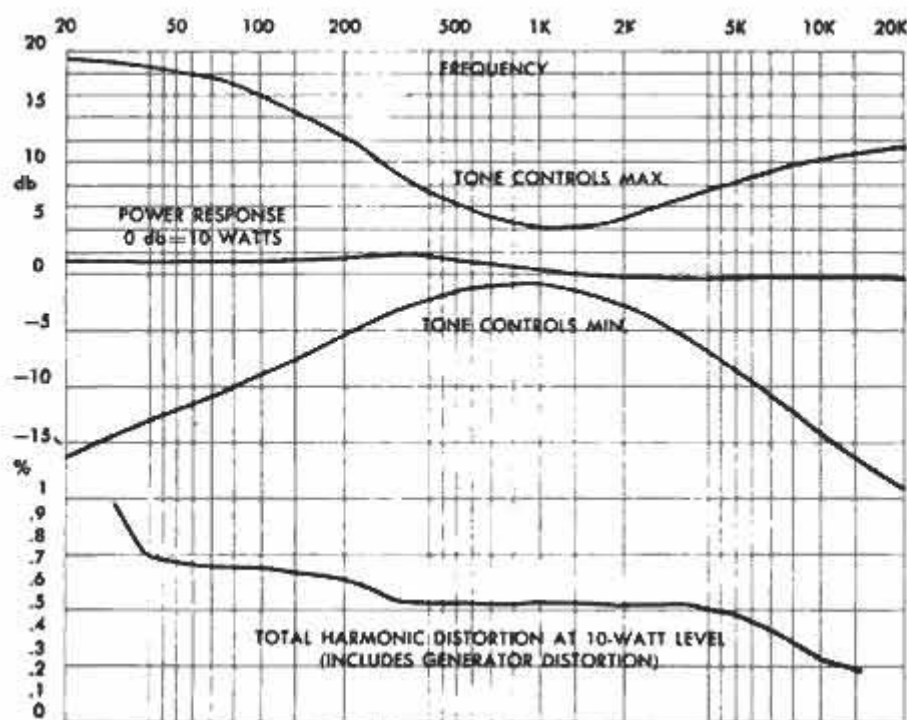
TRANSFORMERS: T1, T2—output, (primary impedance—8000ct. sec.-4, 8 and 16 ohms), Triad type S-31A; T3—power (plate-700vct 200 ma., filaments—5v/3a. and 6.3 vct./6 a.) Thordarson type 22R07.

SWITCHES: S1, S4—d.p.d.t. slide switch; S2—2 pole, 5 position rotary switch, shorting type (5th position lug not used); S3—s.p.s.t. slide switch.

MISCELLANEOUS: Chassis, 2 x 7 x 13-in. steel or heavy-gauge aluminum; 9-pin min. tube sockets, (4); 9-pin min. tube sockets with shields, (3); (all min. sockets are saddle type), octal tube socket; pilot-light assembly; No. 51 bulb; line cord with a.c. plug; phonograph input jacks, (4); type 3AG, 2-amp. fuse and fuse holder; 4-term. output terminal strips, (2); No. 14 tinned bus wire; 4-lug terminal strips, (2); rubber grommets, (5); dual knobs for controls, (3); matching knob for switch.

LIST OF MATERIALS





SPECIFICATIONS

RATED POWER—

10 watts per section

FREQUENCY RESPONSE—

20-20,000 c.p.s. ± 1 db

HUM AND NOISE—

68 db below rated power

TOTAL HARMONIC DISTORTION—

See curve

SENSITIVITY—

0.3 volt

independent amplifier channels. There are, however, other differences which contribute to operating convenience and stereo flexibility. These are associated with the input switching arrangement and can readily be seen from the schematic diagram on page 158.

Note that the amplifier has four input jacks. Two of these, labeled TUNER and CER. PHONO, are associated with the A amplifier channel while their counterparts are associated with channel B. The TUNER jacks are intended to receive the output plugs from separate AM and FM tuners, and the CER. PHONO jacks receive the two separate output cables from a ceramic phono cartridge.

With switches S1 and S2 in the positions shown, one TUNER input jack is connected to amplifier channel A and the other to channel B. This permits the reception of stereophonic broadcasts which are available in many sections of the country on a limited but regular basis. With S1 in the CER. (down) position, the two elements of a stereo phono cartridge are connected to separate amplifier channels for the reproduction of stereo records. This same position gives excellent results when playing monaural records with the stereo cartridge. While monaural records cannot produce true stereo sound, the use of two amplifiers and speakers adds a pseudo-stereo effect which can be surprisingly realistic.

The stereo selector switch, S2, has four positions. Its function in the first or AB position has just been described. In the second position, labeled BB on the front panel, the switch applies the signal from the B TUNER jack to both amplifier sections simultaneously. This inserts the pseudo-

stereo effect to the program of whatever tuner is connected to this jack. The pseudo-stereo effect can be further enhanced by unbalancing the separately variable tone controls, thus applying a predominance of bass tones to one speaker and accentuated "highs" to the other.

Position BA is often called "stereo reverse." For stereo material, this position effectively reverses the two halves of the orchestra, either to place them in their proper perspective, or purely for demonstration purposes.

Finally, the AA position of the switch applies the signal from tuner A to both amplifier sections to give monophonic reproduction from tuner A.

Other stereo requirements included in the amplifier are separate volume controls for each channel and independently variable bass and treble controls. These permit balancing of the two stereo signals and compensating for possible variations in the response of the two speakers.

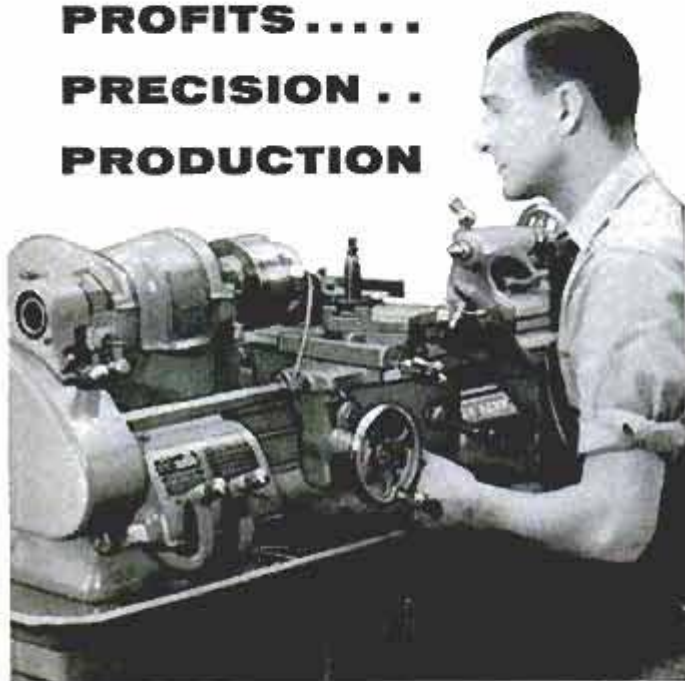
A phase-reversal switch, S4, is included to permit instantaneous reversal of one of the speaker voice coils. With any multiple-speaker system it is essential that all speaker cones vibrate exactly in step with each other. If a given signal were to cause one cone to move forward and the other backward, cancellation of the signal would occur in some parts of the room. Switch S4 provides a quick, convenient means for phasing the two speakers. A slow trip around the room while listening to a monaural signal source will leave little doubt as to which is the correct switch setting.

The performance of any amplifier can

(Continued to page 240)

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High-Fidelity Stereo Amplifier

(Continued from page 160)

be evaluated from its electrical characteristics and, within the scope of its intended operation, this amplifier leaves little to be desired.

The performance curves and specifications table tell the story at a glance. At its rated power output of 10 watts, each amplifier section has *less than 1% total harmonic distortion over a range from 30 to 14,000 c.p.s.* This assures 20 watts of virtually undistorted power—more than enough for practically any application around the home.

A flat frequency response (within ± 1 db) over the entire audio spectrum, sufficient sensitivity for full power output with any ceramic or crystal stereo cartridge or radio tuner, and an inherent hum and noise level below normal audibility round out the details.

Construction

A 7 x 13 x 2-in. chassis, either steel or heavy-gauge aluminum, will conveniently house all the parts for this stereo amplifier. Placement of chassis-mounted components is shown in the title photograph and in the pictorial diagram. The parts themselves can be used as templates to determine the exact dimensions and positions of the necessary cutouts.

After installing the chassis-mounted parts, solder the heavy bus wire in place. This is grounded to the chassis at the input jacks and terminated at the upright electrolytic capacitors. These should be insulated from the chassis by means of their fiber wafers.

The rest of the wiring, although somewhat crowded in the vicinity of the controls, should present no problems. Start at the input jacks and work toward the power supply, making sure that each wire and part is well soldered to its proper connecting point. Follow the pictorial wiring diagram and use the schematic diagram to check your work after all wiring is finished.

Resistor R22 consists of two separate resistors connected in parallel. In the pictorial, the individual resistors of each parallel combination are labeled "½ R22," to avoid confusion.

A metal bottom plate should be used to cover the bottom of the chassis after all wiring has been completed and thoroughly checked. The bottom plate reduces hum pickup and prevents contact with dangerously high voltages appearing inside the chassis when the amplifier is turned on.

(Continued to page 242)



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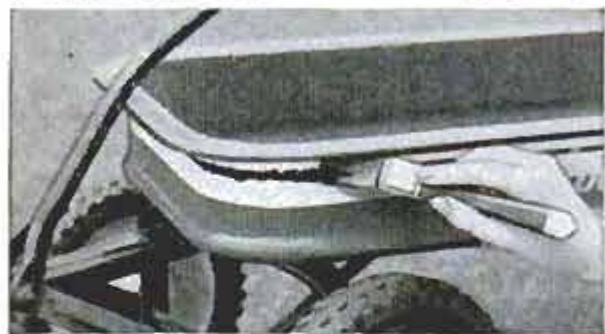
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The amplifier should be turned on only after your loudspeakers have been connected to the terminal strips. Either 4, 8 or 16-ohm speakers may be used, but the phase reversal switch, S4, is wired, as shown, for a 16-ohm speaker. For an 8-ohm speaker, the wire from the junction of R16, C8 and the 16-ohm lead of T1 is connected directly to the 16-ohm terminal rather than S4 and the wire from S4 to the 16-ohm terminal is run, instead, to the 8-ohm terminal. The 8-ohm transformer lead is then soldered to the open lug of S4. Corresponding wiring changes must be made if a 4-ohm speaker is to be used.

Possible Modifications

As it stands, this amplifier was designed to handle the requirements of two radio tuners and a crystal or ceramic stereo phono cartridge. With the function switch, S1, in the CER. PHONO position, the input resistance to both channels is 2.7 megohms, the value of R2. While this value will generally provide good results with all cartridges of this type, manufacturers of some cartridges may specify other resistance values, or even a simple R-C network, for optimum performance. In such cases, R2 should be changed to conform with the manufacturer's recommendations.

Many high-fidelity enthusiasts prefer magnetic phono cartridges to crystal or ceramic units. This amplifier has neither the required gain nor the equalization needed for these low-output cartridges. It is a simple matter, however, to add a stereo preamplifier, or two inexpensive monaural units between the magnetic cartridge outputs and the CER. PHONO inputs of the amplifier. If this is done, the value of R2 should be changed to approximately 1 megohm. The preamplifiers need have no volume or tone controls because these functions are available in the main amplifier.

Now, if you already have a monaural hi-fi system but are planning to convert to stereo, the idea of retiring a perfectly good monaural amplifier in favor of a stereo unit just doesn't make sense. Furthermore, it isn't necessary. What you need is another single-channel amplifier, plus the switching provisions for stereo flexibility. In such a case, you can still build this amplifier, but you can save almost 50% of its construction cost.

Obviously, the B channel of the amplifier will not be needed and you can immediately omit V3, V6 and V7, plus all the associated circuit parts. V1 will still be needed, but no connections need be made to the second triode elements. In addition, the recommended power trans-

(Continued to page 244)

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former can be replaced with one having a 120-ma. high-voltage rating for a further, substantial cost reduction.

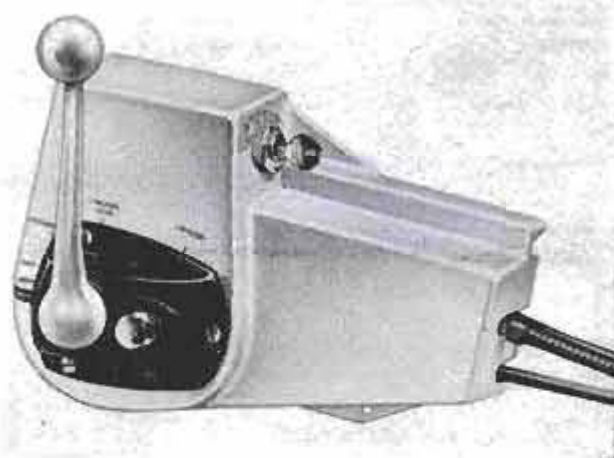
The inputs and the switching circuits, however, should be retained. The wire lead from lug C of S2, normally connected to pin 7 of V1, should, instead, be connected to another phono jack which must be mounted somewhere on the chassis. A shielded cable, terminated on both ends with phono plugs, can then be connected from this jack to the high-impedance input jack of your present amplifier. This arrangement permits both amplifiers to be in use for stereo or monaural applications.

NOTE: Because of the relatively high power supplied by this amplifier, the chassis-mounted parts, as well as the chassis itself, will become quite warm after prolonged operation. This is no cause for alarm, but it does suggest the need for adequate ventilation when the amplifier is mounted behind a panel or in a cabinet.

A table of tube-socket voltage and resistance readings for this amplifier can be obtained by sending a stamped, self-addressed envelope to *Popular Mechanics'* Radio, TV and Electronics Dept. ★ ★ ★

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