struments a lot better than it actually sounds.

Circuit Used

The circuit of Fig. 2 is a very stable 40-watt amplifier (or a 60-watt amplifier with the higher voltage power supply in Fig. 4), using a new transformer made by *Chicago Standard Transformer Corp.*—the BO-15. This transformer was designed for 6550's, EL34's, or KT88's using screen taps plus 11 db of tertiary feedback in the output stage. There is also 12 db of feedback taken around the whole amplifier. Many configurations were tried and discarded for one reason or another before the present design was arrived at.

The first problem which arose was the high signal needed to drive the 6550's when using tertiary feedback. The required signal is 135 volts r.m.s. grid-to-grid. The need for this high signal arises because the voltage must be increased by the feedback factor in the output stage. This ruled out the use of a 6SN7 as a driver. The tube found best suited for this purpose was the 5687, a dual-triode used extensively in electronic computers. It is capable of exceptional output into the low impedance necessary when using fixed bias. When used in the *Mullard* circuit as a phase-splitter/driver, as it is here, it will deliver 180 volts r.m.s. grid-to-grid into a 50,000-ohm load. The outputs from the plates are almost perfectly balanced and the impedance looking back into the tube is the same. This stage is quite degenerative and very little distortion is introduced by it.

The EF86 is a low-noise pentode used as a voltage amplifier. This is direct-coupled to the phase-splitter/driver, thus eliminating some phase shift that would be introduced by a coupling capacitor.

Stability of the amplifier is very good under practically any type of load, as can be seen by the oscillograms of Fig. 1. Over 20 db more of over-all feedback could be added before instability in the form of ringing or motorboating sets in. If the amplifier is to be used

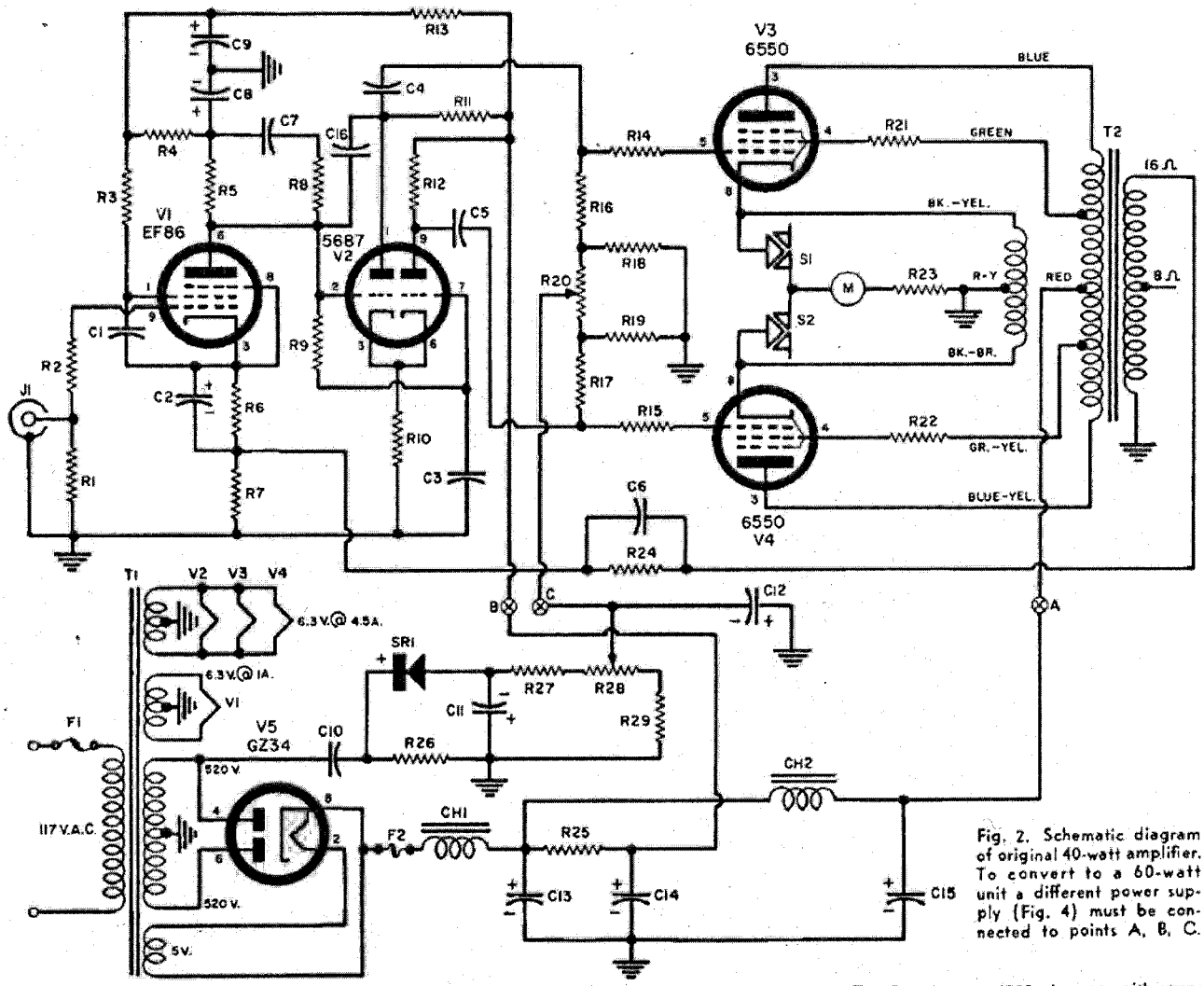

Fig. 2. Schematic diagram of original 40-watt amplifier. To convert to a 60-watt unit a different power supply (Fig. 4) must be connected to points A, B, C.

R_1, R_5—1 megohm, ½ w. res.
R_2—3300 ohm, 1 w. res.
R_3—330,000 ohm, 1 w. res.
R_4, R_7, R_{16}, R_{17}—47,000 ohm, 1 w. res.
R_6—1800 ohm, 1 w. res.
R_8—510 ohm, 1 w. res.
R_9—4700 ohm, 1 w. res.
R_{10}—8000 ohm, 4 w. carbon res. (see text)
R_{11}—25,000 ohm, 4 w. carbon res. (see text)
R_{12}—30,000 ohm, 4 w. carbon res. (see text)
R_{13}—180,000 ohm, 1 w. res.
R_{14}, R_{15}, R_{21}—1000 ohm, ½ w. res.
R_{18}, R_{19}—100,000 ohm, 1 w. res.
R_{20}, R_{22}—10,000 ohm pot
R_{23}—680 ohm, ½ w. res. (see text)
R_{24}—2200 ohm, 1 w. res.
R_{25}—600 ohm, 2 w. res.

R_{26}—25,000 ohm, 10 w. wirewound res.
R_{27}—360 ohm, 1 w. res.
R_{28}—27,000 ohm, 1 w. res.
C_1—.05 μf., 400 v. capacitor
C_2—50 μf., 25 v. elec. capacitor
C_3—.25 μf., 400 v. capacitor
C_4, C_5—.5 μf., 600 v. capacitor
C_6, C_7—50 μμf. ceramic capacitor
C_8, C_9—40 μf., 350 v. elec. capacitor
C_{10}—.04 μf., 1000 v. capacitor
C_{11}, C_{12}—50 μf., 150 v. elec. capacitor
C_{13}, C_{14}, C_{15}—40 μf., 300 v. elec. capacitor
C_{16}—25 μμf. ceramic capacitor
T_1—Power trans. 520-0-520 v. @ 200 ma.; 6.3 v. @ 4.5 amps.; 6.3 v. @ 1 amp.; 5 v. @ 3 amps. (Chicago Standard PCR-200 or equiv.)

T_2—Output trans. 4300 ohms c.t., with screen taps and cathode feedback winding; 8, 16 ohms sec.; 65 watts (Chicago Standard BO-15 or equiv.)
CH_1—8 hy., 200 ma. filter choke (Chicago Standard RC8200 or equiv.)
CH_2—2 hy., 200 ma., 60 ohms d.c. or less filter choke (Stancor C-2325 or equiv.)
SR_1—20 ma., 130 v. selenium rectifier
F_1—2 amp. fuse
F_2—225 ma. fuse
S_1, S_2—S.p.s.t. push-button switch, normally open
M—1 ma. d.c. meter
J_1—Phono jack
V_1—EF86 tube
V_2—5687 tube
V_3, V_4—6550 tube *V_5—GZ34 tube*