AMPLIFIER DESIGNATIONS

Within a radio and television broadcasting system audio amplifiers are used for many specific purposes. These include:-

a) microphone pre-amplifiers.

b) pick-up pre-amplifiers.

c) line amplifiers.

d) splitting amplifiers.

e) monitoring amplifiers.

A designation system employing amplifier types A, B, C, D, E etc, was used by the N.B.S. studios until approx. 1955. This was then followed by a numbering system employing amplifier types 1, 2, 3, and 4, introduced to rationalise and reduce the number of types in service. The current system (recently introduced) has reverted to the use of letters, A, B, C etc.

The functional use of the various amplifier types are shown in Fig.1.

Old Letter System

The old type amplifiers are not covered in detail in these notes but a summary of their characteristics are listed in Table 1, with typical circuits shown in Figs. 2 to 9.

The W amplifier was employed for the purpose of preventing the overmodulation of transmitters and also to compensate for a level loss due to equalised programme lines. An automatic gain control circuit is provided for limiting the audio output. The limiting or compression may be adjusted to meet local requirements.

Number System

This series provides an adequate range of amplifiers to meet most sound control requirements (see Table 2). Simplified circuits are shown in Figs. 10, 11, 12 and 15, and the Type 4 amplifier is described in detail (see Pages 19,21 and 22).

New Letter Type

A more detailed description is provided for these amplifiers in the section, Audio Amplifiers (New Letter Type) (Pages 26,27,29,31 and 33) and a summary of their characteristics is given in Table 3.

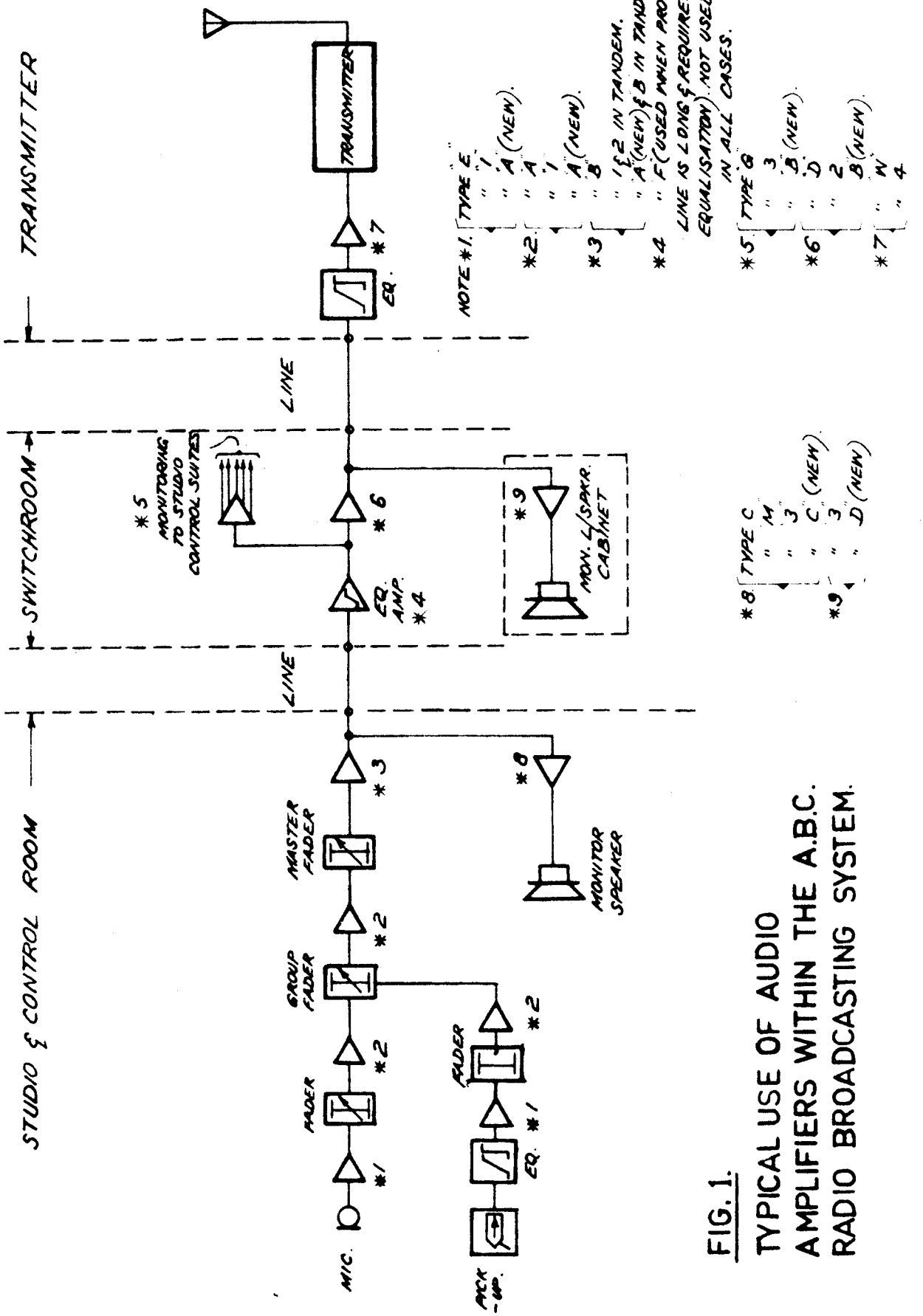

FIG. 1.
TYPICAL USE OF AUDIO AMPLIFIERS WITHIN THE A.B.C. RADIO BROADCASTING SYSTEM.

TABLE 1.

SPECIFICATIONS FOR AUDIO AMPLIFIERS (Old Letter System).

Type	Use	Impedance. Input	Output	Gain	Power Output	Freq.Response	Noise
A (Fig.2)	To amplify signal prior to Master Gain Control	150 or 600 Ω	600 Ω	40dB	10mW	±0.5dB 30Hz-10kHz	86dB below 6mW
B (Fig.3)	Programme Line Amplifier	600 Ω	600 Ω	45dB	250mW	±0.5dB 30Hz-10kHz	68dB below 6mW
C (Fig.4)	Monitoring Amplifier	10k Ω	300 or 600 Ω	25dB	3mW	±1.0dB 30Hz-10kHz	
D (Fig.5)	Distribution Amplifier	100k Ω	600 Ω	5dB	240mW	±0.5dB 30-Hz-10kHz	
E (Fig.6)	Microphone or Pick-up Pre-amplifier	50 Ω	600 Ω	30dB	10mW		
F (Fig.7)	Adjustable Equaliser and Amplifier	600 Ω	600 Ω	15dB	120mW		
G (Fig.8)	Multi-Output Splitting Amplifier	10k Ω	600 Ω	5dB per channel	120mW	±0.5dB 30Hz-10kHz	
M	Monitoring Amplifier	10k Ω	15 Ω 600 Ω	25dB	3mW	±1.0dB 30Hz-10kHz	
W (Fig.9)	Limiting Amplifier	600 Ω	600 Ω	50dB	240mW		

TABLE 2.

SPECIFICATIONS FOR AUDIO AMPLIFIERS (Number System).

Type	Use	Impedance Input	Impedance Output	Gain	Freq. Response	Distortion	Noise
1 (Fig.10)	(1) Microphone or Pick-up Pre-Amp. (2) Amplifier between Individual Source and Group Faders. (3) Amplifier between Group and Master Fader.	150 or 600Ω	600 Ω	40dB	±1.0dB 30Hz-15kHz relative to 1kHz at level of +8dBm	0.5% at 21dBm output 60Hz-7.5kHz 1.0% at 21dBm output 30Hz-15kHz	-82dBm
2 (Fig.11)	Line Amplifier	Greater than 25k Ω	600 Ω	6.5dB adjustable	±1.0dB 30Hz-15kHz relative to 1kHz at +16dBm	Less than 1.0% at 16dBm output 60Hz-7.5kHz Less than 2.0% at 27dBm output 30Hz-15kHz.	-75dBm
3 (Fig.12)	(1) Monitoring Loudspeaker Amplifier (2) Distribution Amplifier	Greater than 25k Ω	3 or 12 Ω	40dB	±0.5dB 20Hz-20kHz ±1.0dB 15Hz-30kHz	Less than 0.25% at 12 Watts output -1kHz 1.0% at 20W output	-80dBm
4 (Fig.15)	Limiting Amplifier	600 Ω	600 Ω	see description	±1.0dB 60Hz-10kHz relative 1kHz ±2.0dB 30Hz-15kHz		-48dBm

TABLE 3.

SPECIFICATIONS FOR AUDIO AMPLIFIERS (New Letter Type).

Type	Use	Impedance. Input	Impedance. Output	Impedance. Load	Voltage gain	Freq. response	Noise	Distortion.
A (Fig.16)	General Purpose low level mic. Amplifier	600Ω	Not to exceed 60 Ω 30Hz-15kHz	540 or 660Ω	60dB ±0.5dB or 40dB ±0.5dB (400Hz)	±0.25dB (or 400Hz response) 30Hz-15kHz	Not less than 110dB below 40mW (40dB gain) or 90dB (60dB gain)	Not less than 54dB up to 40mW or 52dB below 100mW 30Hz-15kHz
B (Fig.17)	Splitting and line sending Amplifier	Greater than 30k Ω (30Hz-15kHz)	100 Ω each outlet (30Hz-15kHz) (5 outputs)	540 to 660Ω (300Ω Resis-tors in each leg)	12dB adjustable	±0.25dB (of 400Hz response) 30Hz-15kHz	Not less than 96dB (each outlet) below 80mW (60dB gain)	Not less than 54dB below 80mW and 52dB below 200mW 30Hz-15kHz
C (Fig.18)	Splitting and Loudspeaker Amplifier	Greater than 30k Ω (30Hz-15kHz)	1.2 Ω approx. (see Specs.)	13.5 to 16.5 Ω	40dB adjustable	±0.25dB (of 400Hz response) 30Hz-15kHz	Not less than 86dB below 6.4mW (20dB gain)	Not less than 54dB below 6.4W and 52dB below 16W 30Hz-15kHz
D (Fig.19)	Monitoring Loudspeaker Amplifier	Greater than 30k Ω (30Hz-15kHz)	1.5 Ω 30Hz-15kHz	13.5 to 16.5 Ω	40dB adjustable	±1.0dB (of 400Hz response) 30Hz-15kHz	80dB below 6.4W (40dB gain)	Not less than 50dB below 6.4W and 48dB below 16W 30Hz-15kHz

AUDIO AMPLIFIERS

Old Letter System

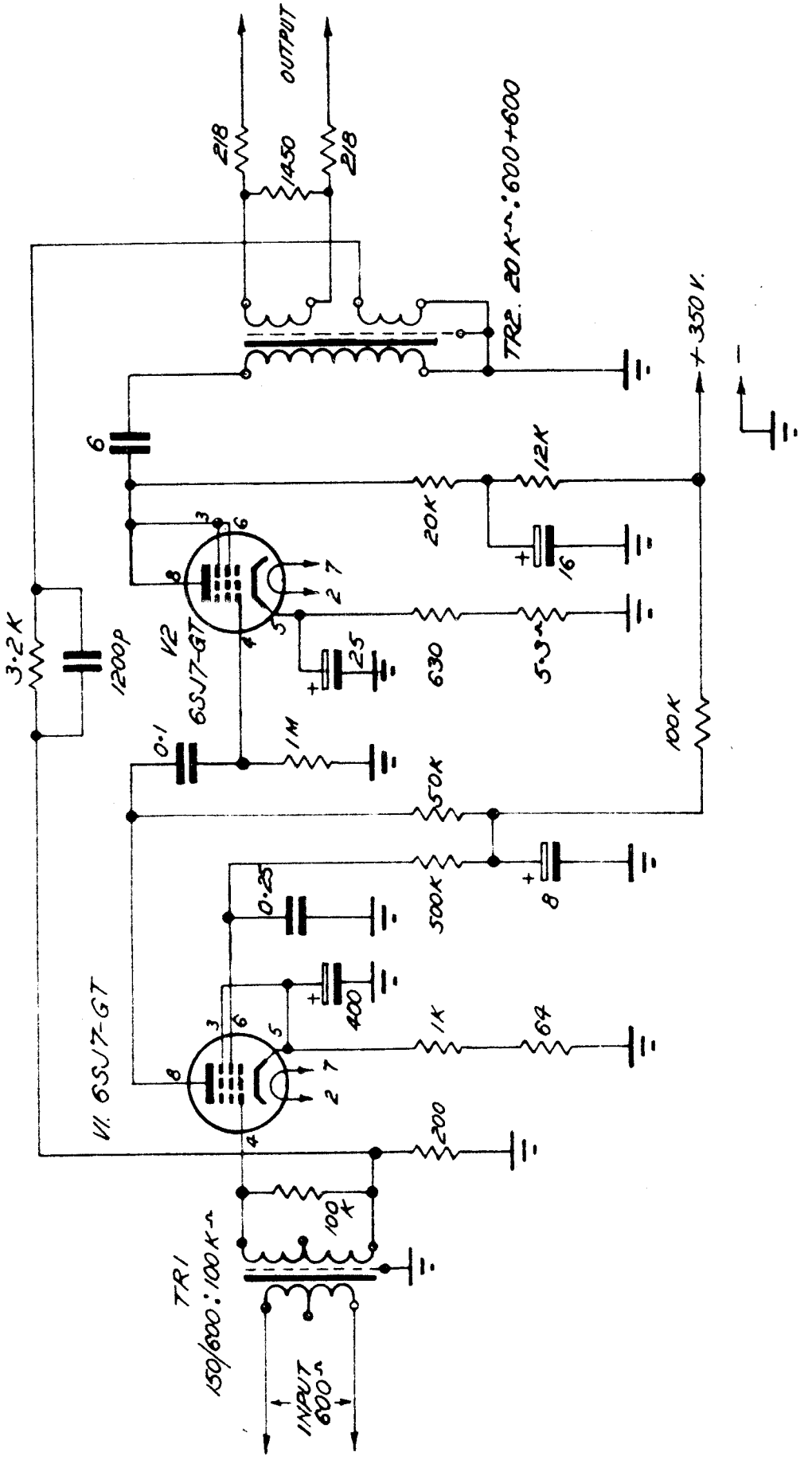

FIG. 2. "A" AMPLIFIER SIMPLIFIED SCHEMATIC (A.W.A.)

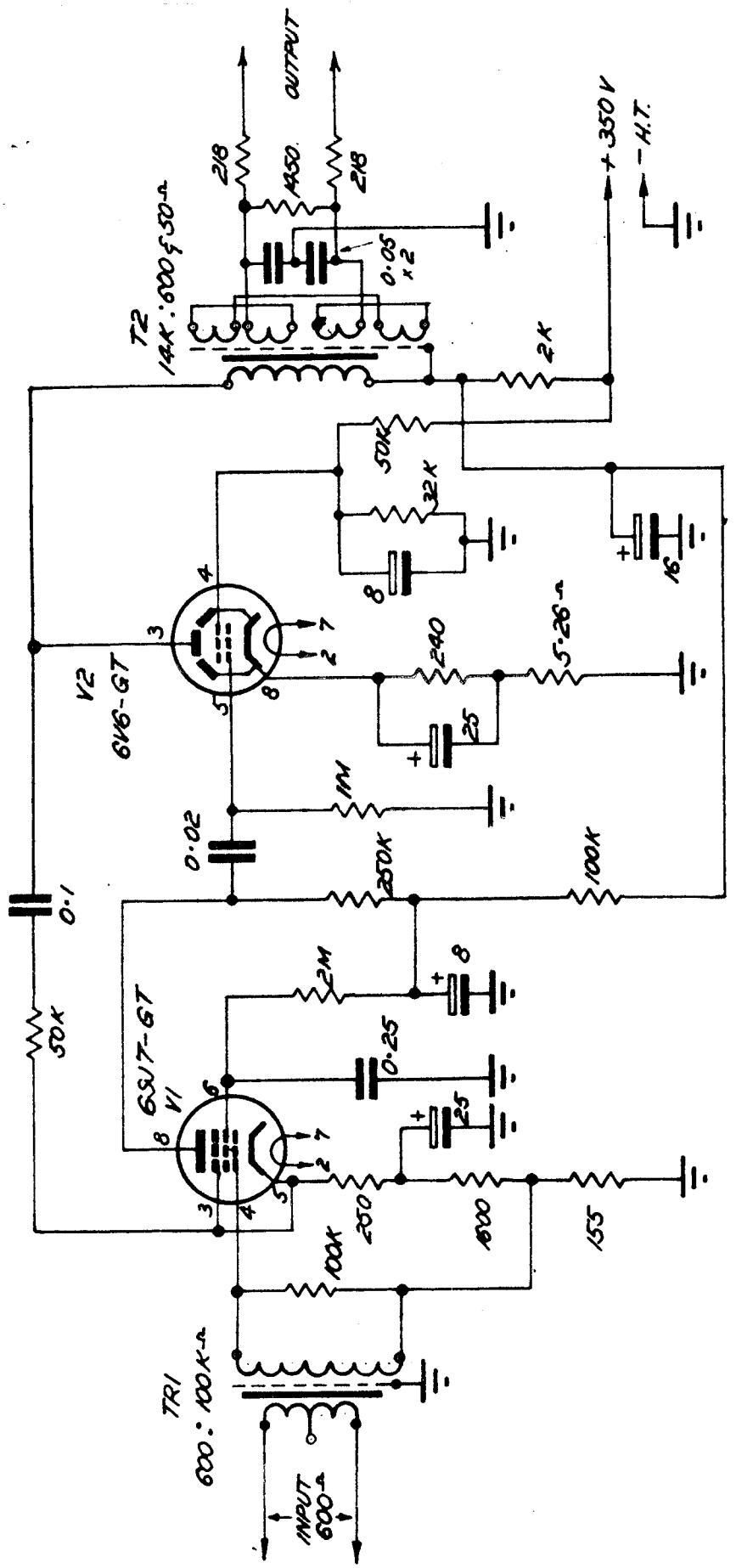

FIG.3. 'B' AMPLIFIER SIMPLIFIED SCHEMATIC (A.B.C.).

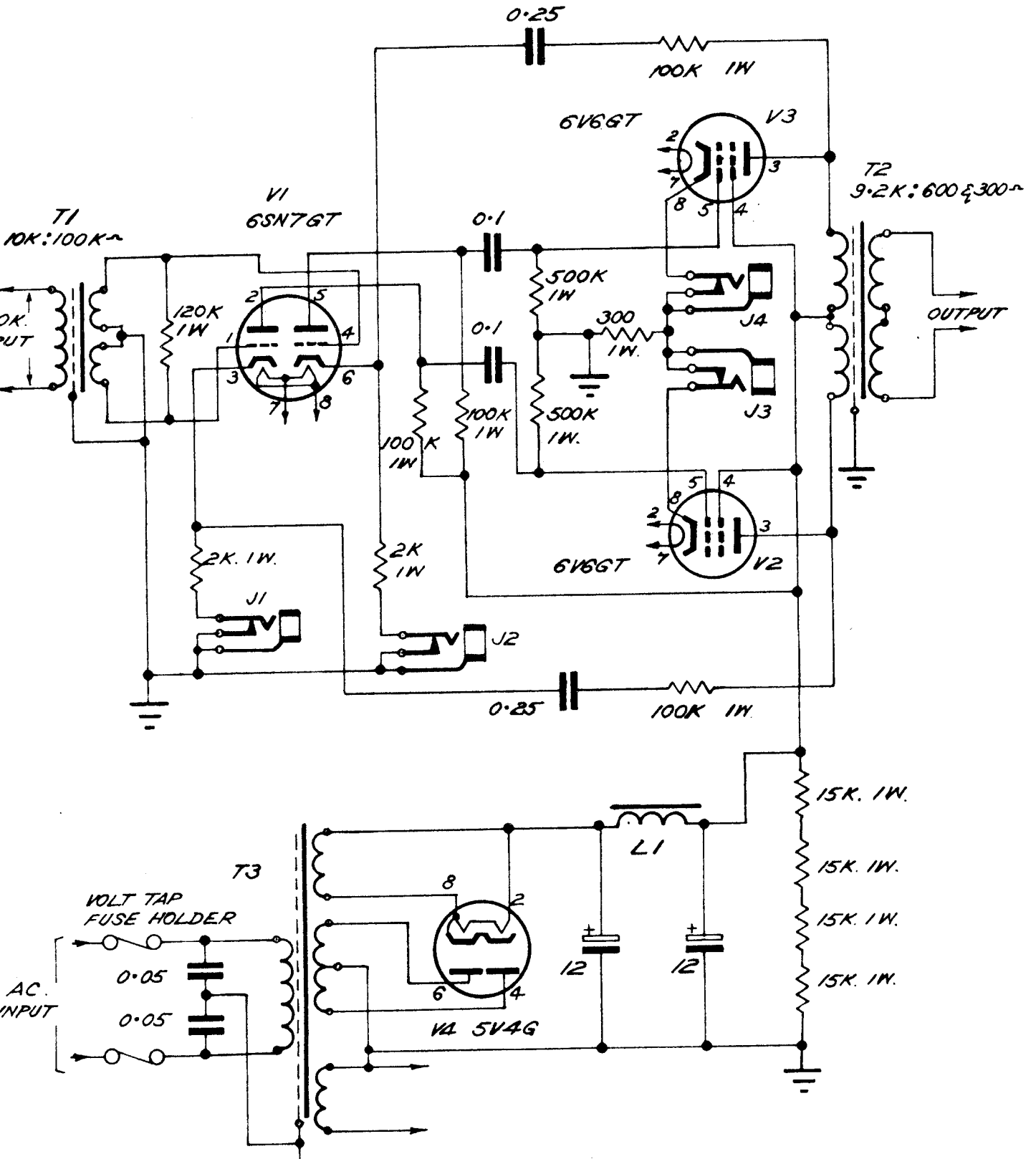

FIG. 4. "C" AMPLIFIER
SIMPLIFIED SCHEMATIC (A.B. A.C.)

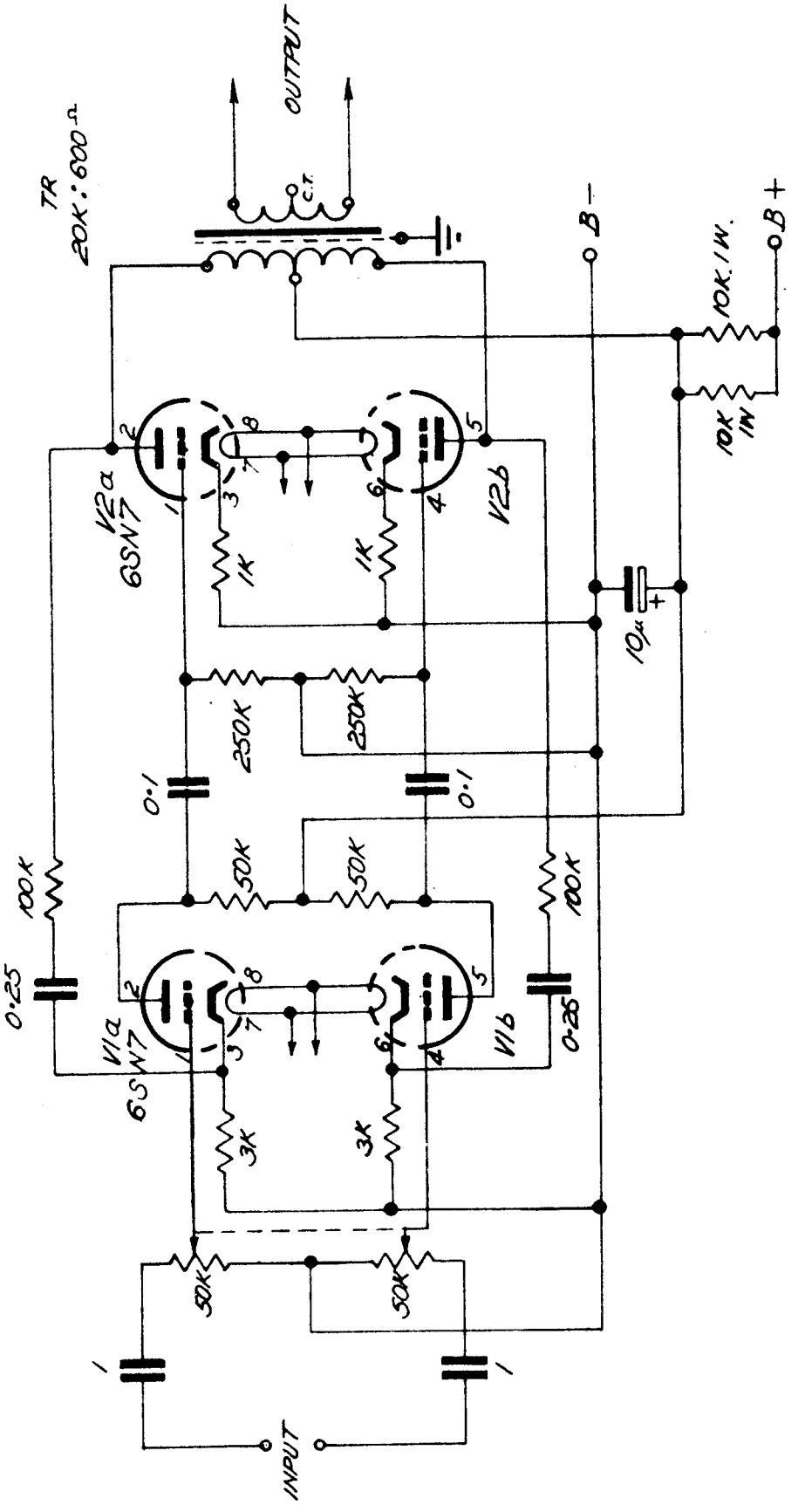

FIG. 5 "D" AMPLIFIER SIMPLIFIED SCHEMATIC.

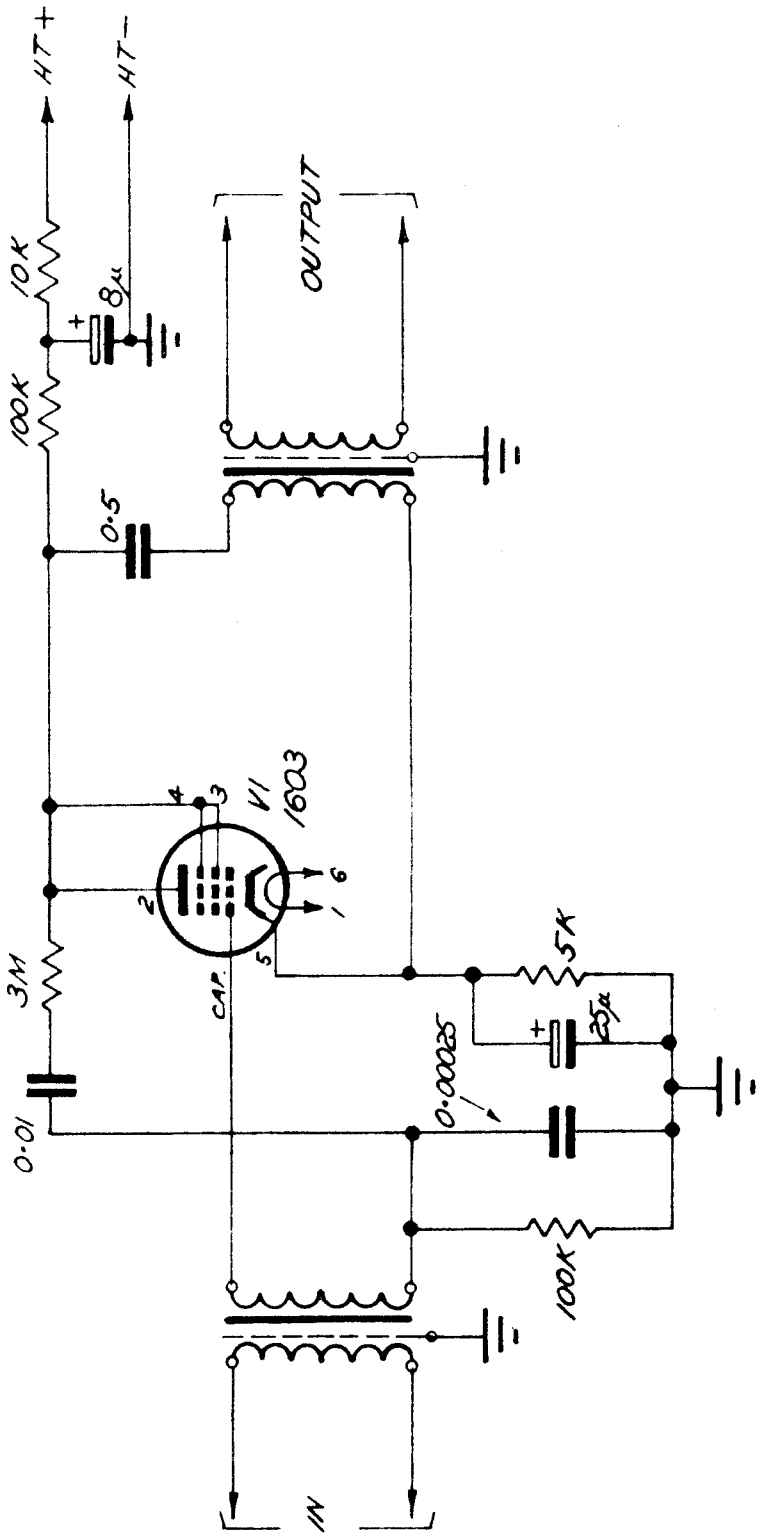

FIG. 6. TYPE 'E' AMPLIFIER, SIMPLIFIED SCHEMATIC. (E.M.ASHWIN)

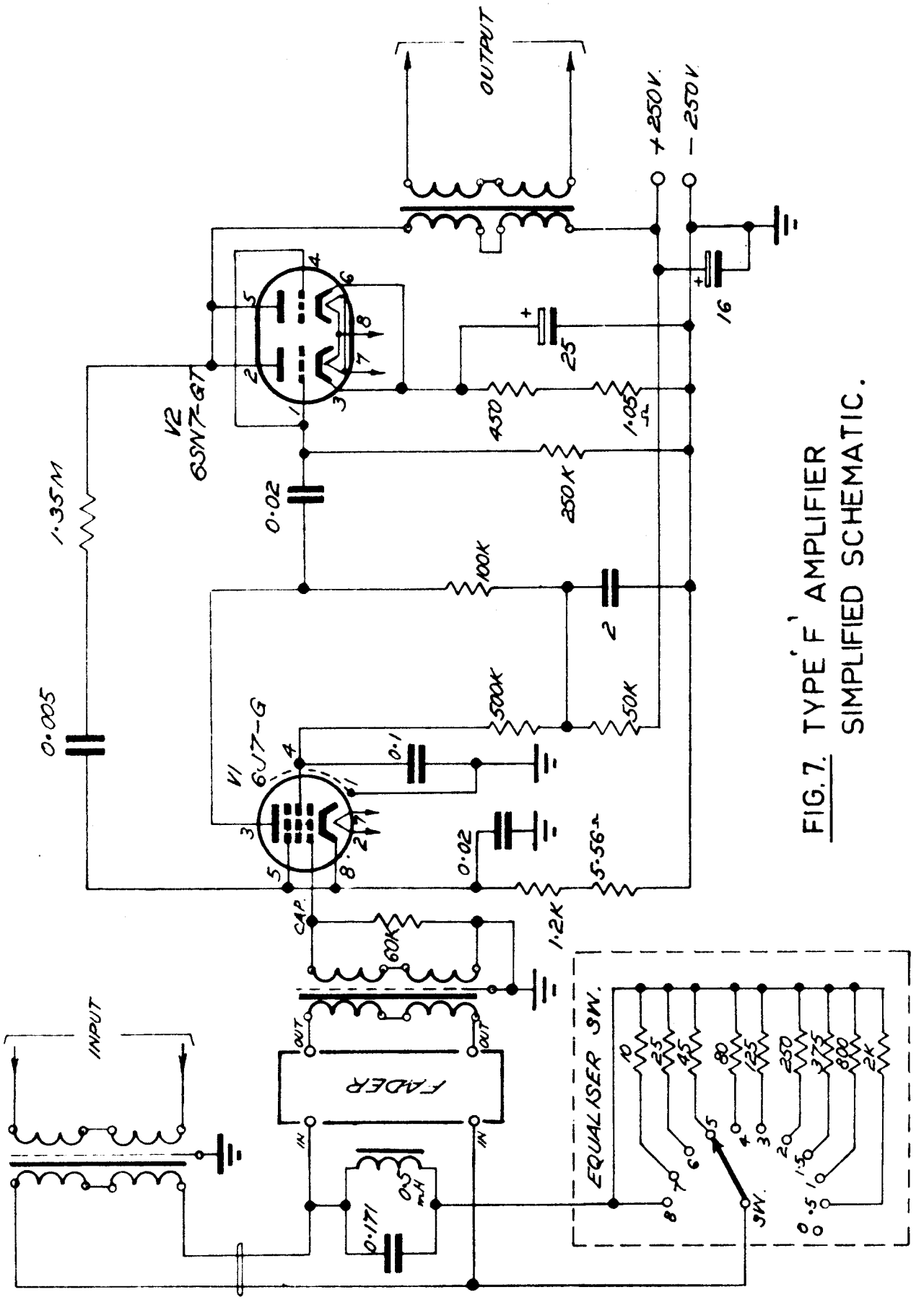

FIG. 7. TYPE 'F' AMPLIFIER SIMPLIFIED SCHEMATIC.

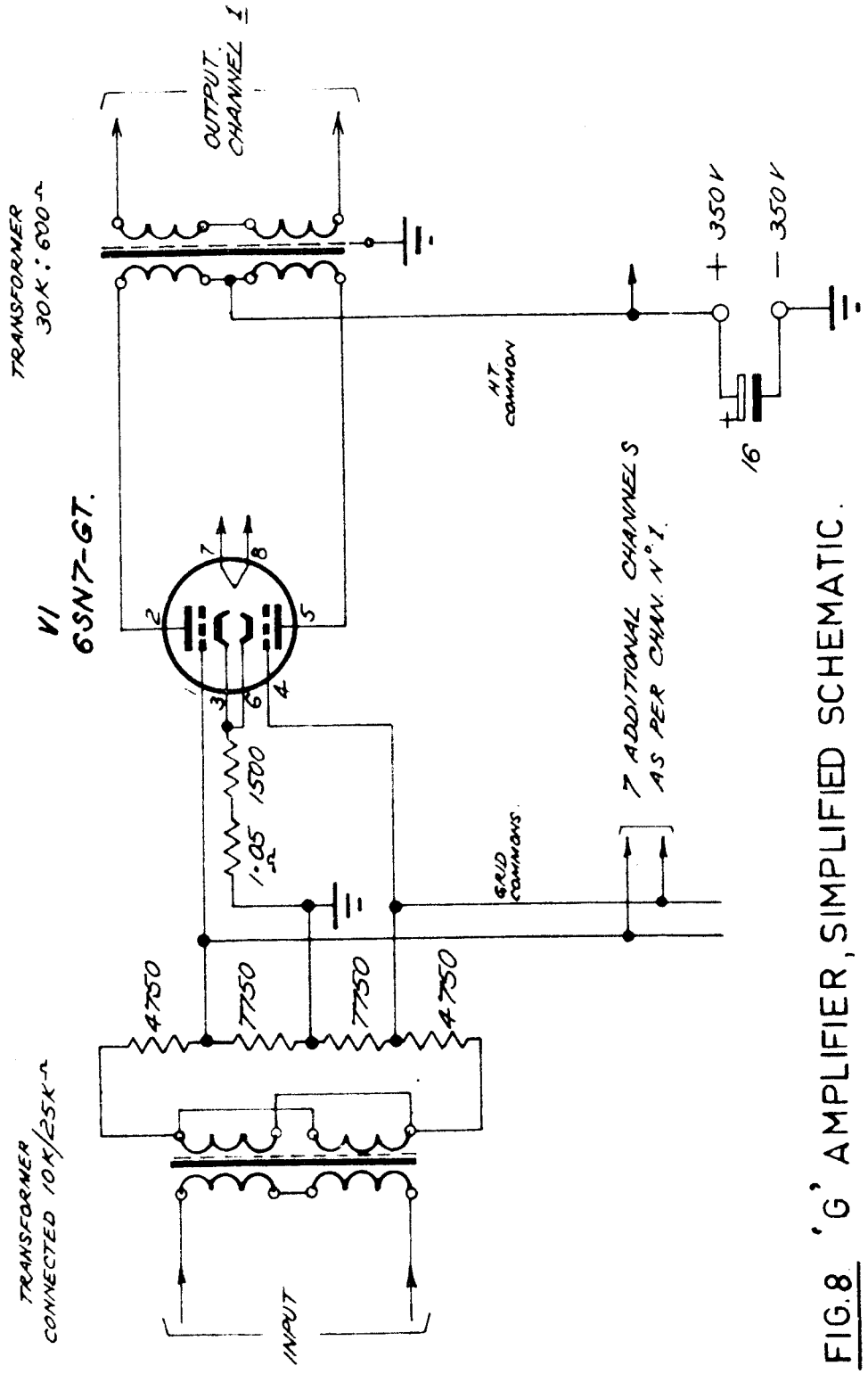

FIG.8 'G' AMPLIFIER, SIMPLIFIED SCHEMATIC.

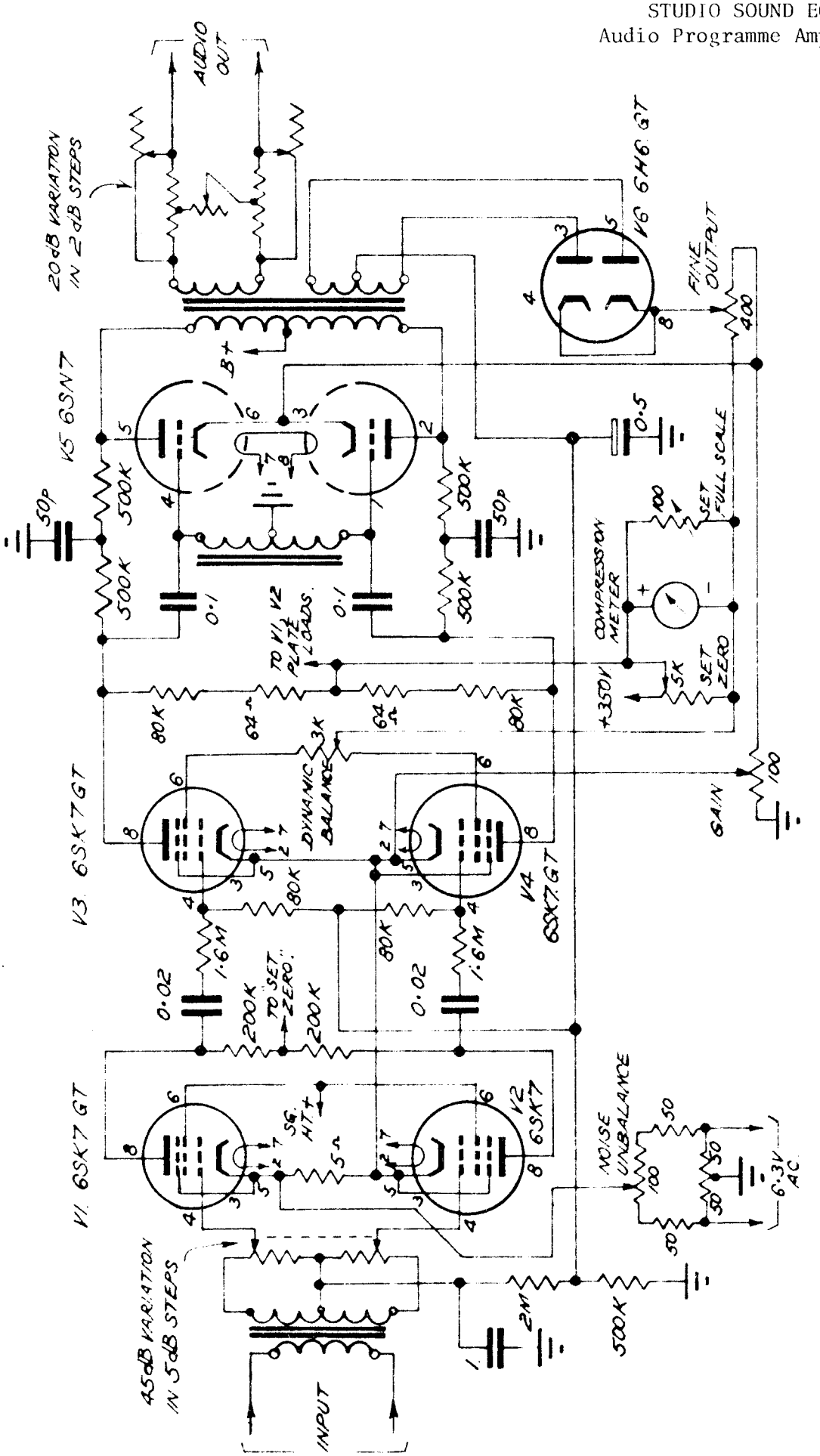

FIG. 9.
'A.W.A.' LIMITING AMPLIFIER, SIMPLIFIED SCHEMATIC.

AUDIO AMPLIFIERS

Number System

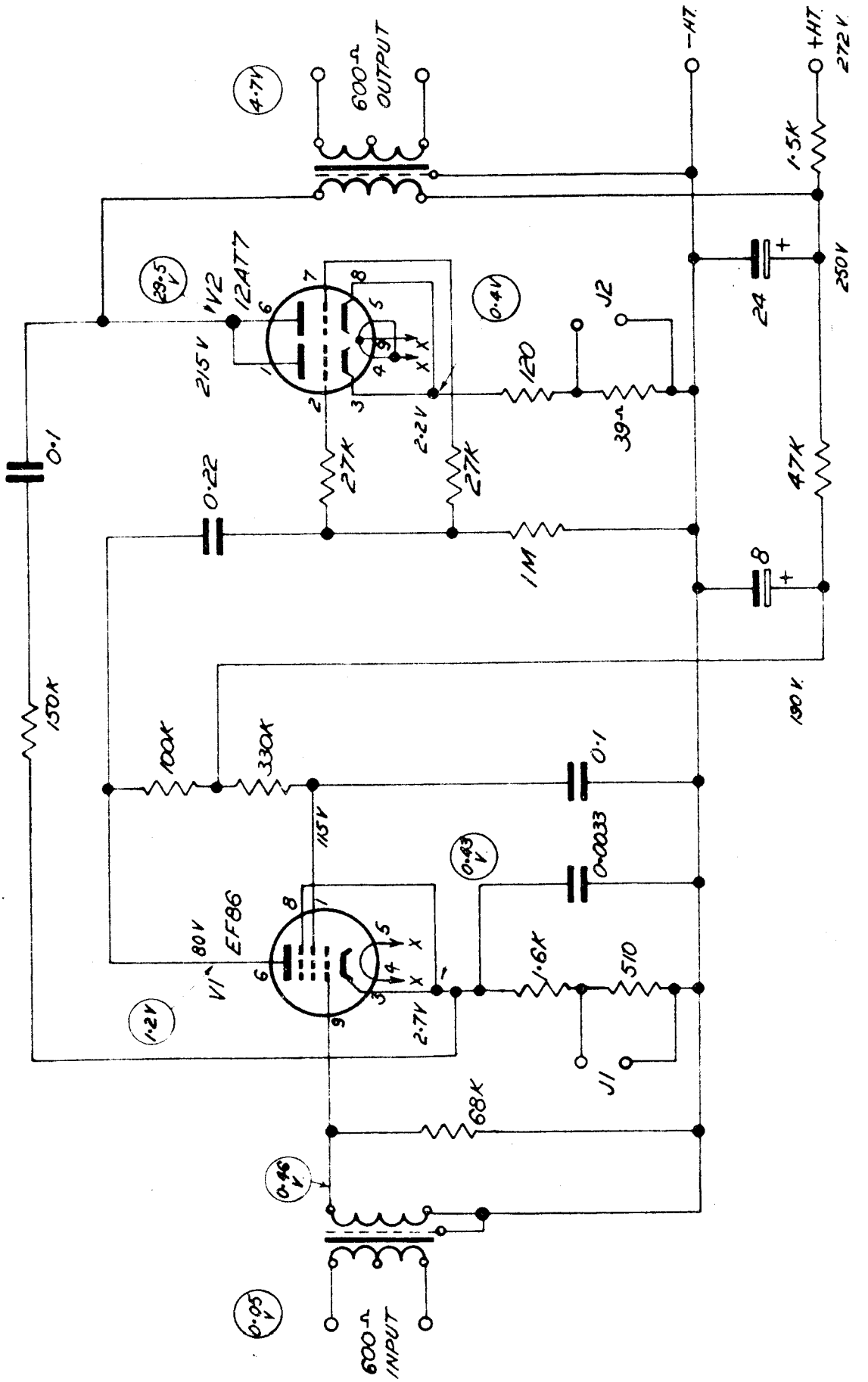

FIG.10. TYPE 1 AMPLIFIER, SIMPLIFIED SCHEMATIC (TRIMAX)

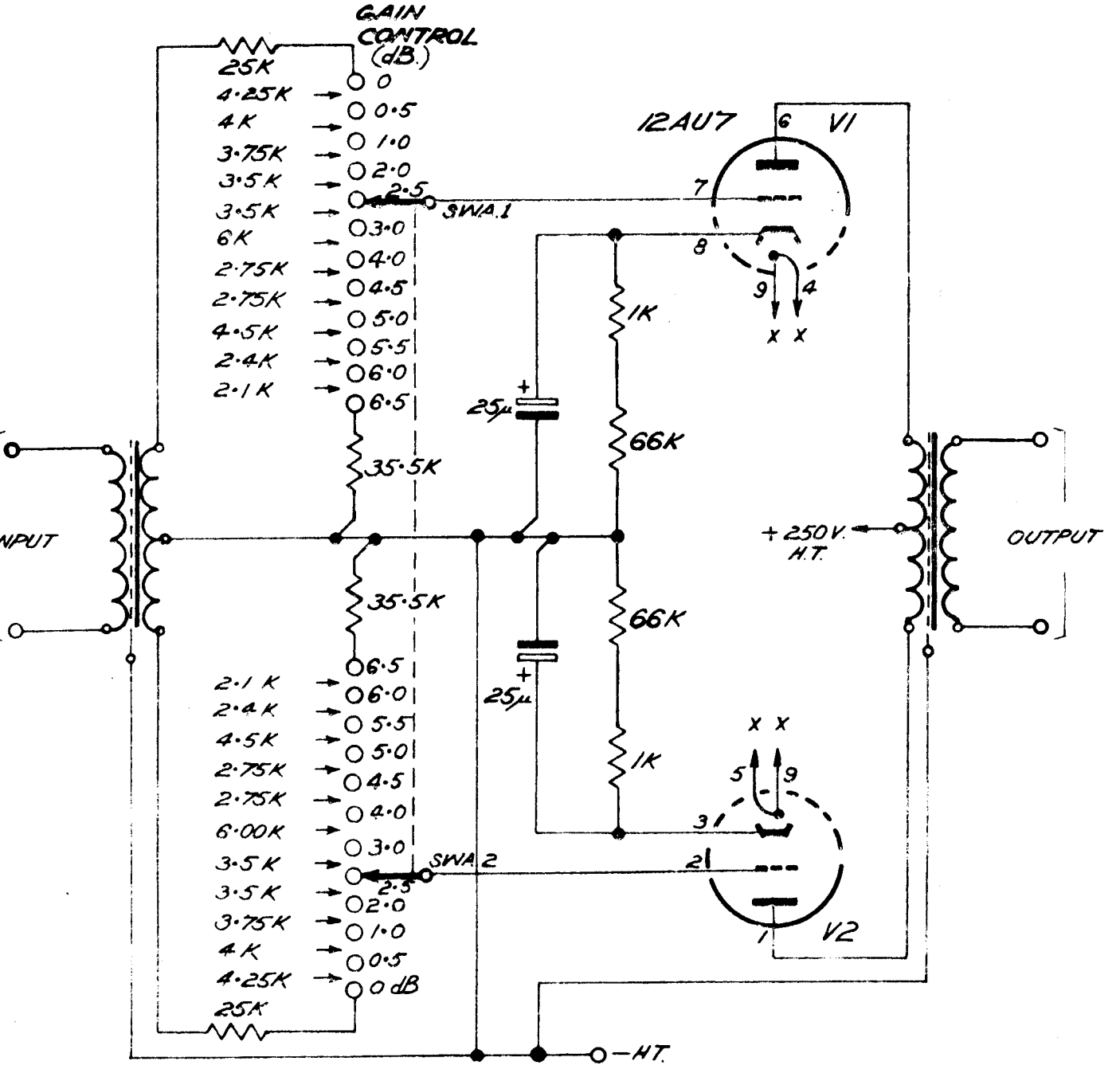

FIG. 11. TYPE 2 AMPLIFIER SIMPLIFIED SCHEMATIC. (TRANSMISSION PRODUCTS).

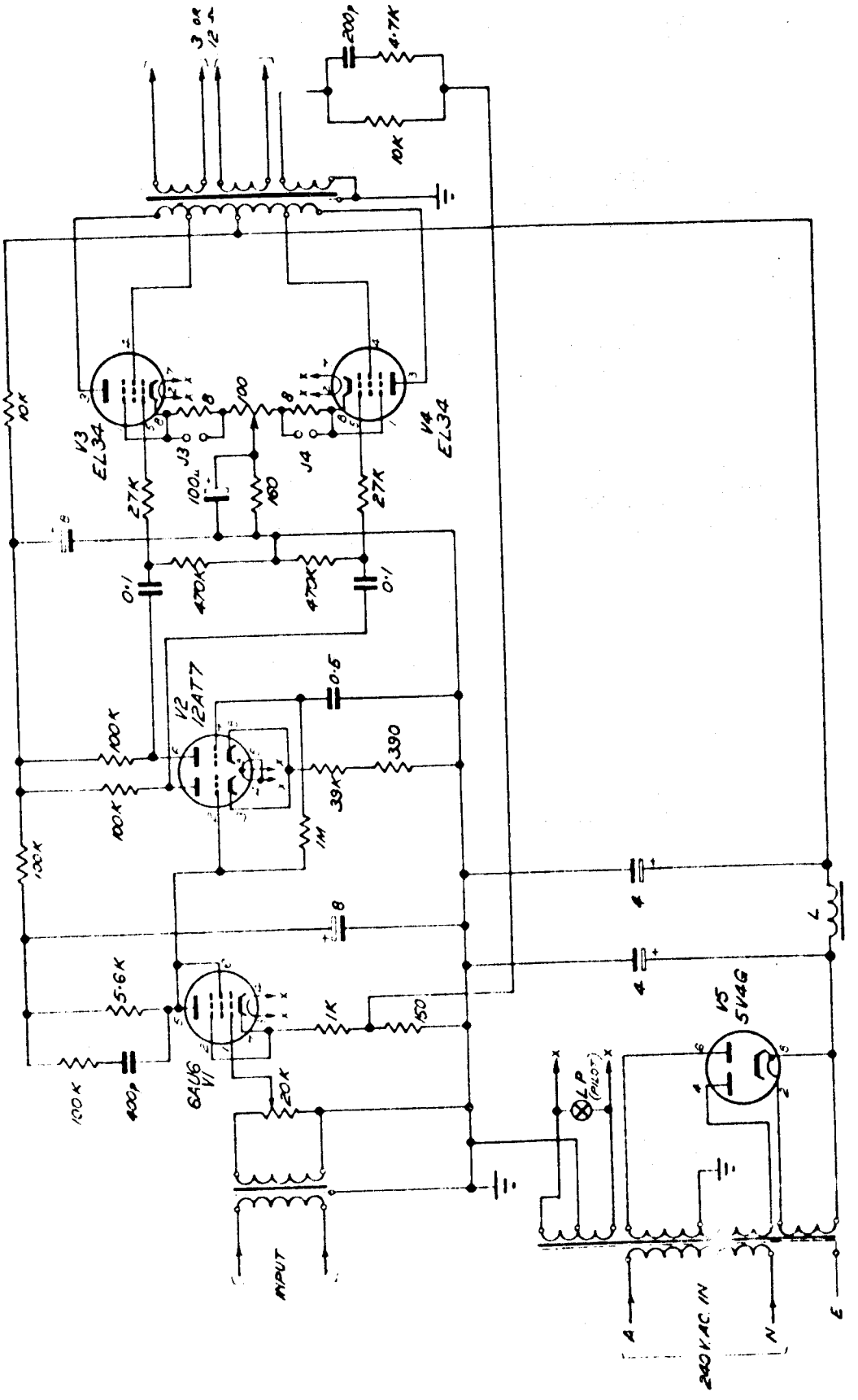

FIG 12 TYPE 3 AMPLIFIER, SIMPLIFIED SCHEMATIC (TRIMAX A54)

TYPE 4 LIMITER AMPLIFIER

A limiter amplifier is designed to limit the output level when signals applied to its input exceed a predetermined amplitude. The level at which limiting commences is referred to as the THRESHOLD point. For the Type 4 amplifier the gain is 40dB for signals below the threshold point which corresponds to an input signal of -21dBm as shown in Fig. 13. The gain of the amplifier is reduced for input levels above threshold so that the amplitude of the output signal tends to remain constant.

The amount of limiting present for any signal which exceeds the threshold level is the difference between the input and threshold levels and is expressed in dB.

The limiting action of a limiter amplifier should be such that it responds quickly to excessive signal peaks. This will prevent the peaks from reaching the output of the amplifier and being passed on to the following equipment within the transmission chain. The time taken for the limiter to respond to a signal peak above threshold is termed the ATTACK TIME and for the Type 4 amplifier this is less than 1 millisecond.

It is undesirable for a limiter amplifier to revert to the full gain condition too quickly after an excessive signal peak has passed. If the recovery time is too short then the limiting action will become apparent to the listener and the programme quality is adversely affected.

The Type 4 amplifier recovery time may be set to 0.5, 1.0 or 2.0 seconds and the circuit design is such that the recovery time is slightly prolonged after signal peaks of longer duration.

When the programme level is varying above threshold level a surge may be generated within the limiter amplifier. This surge is termed THUMP. The signal to thump ratio for the Type 4 amplifier is greater than 40dB for all input levels up to that which will produce 20dB of limiting.

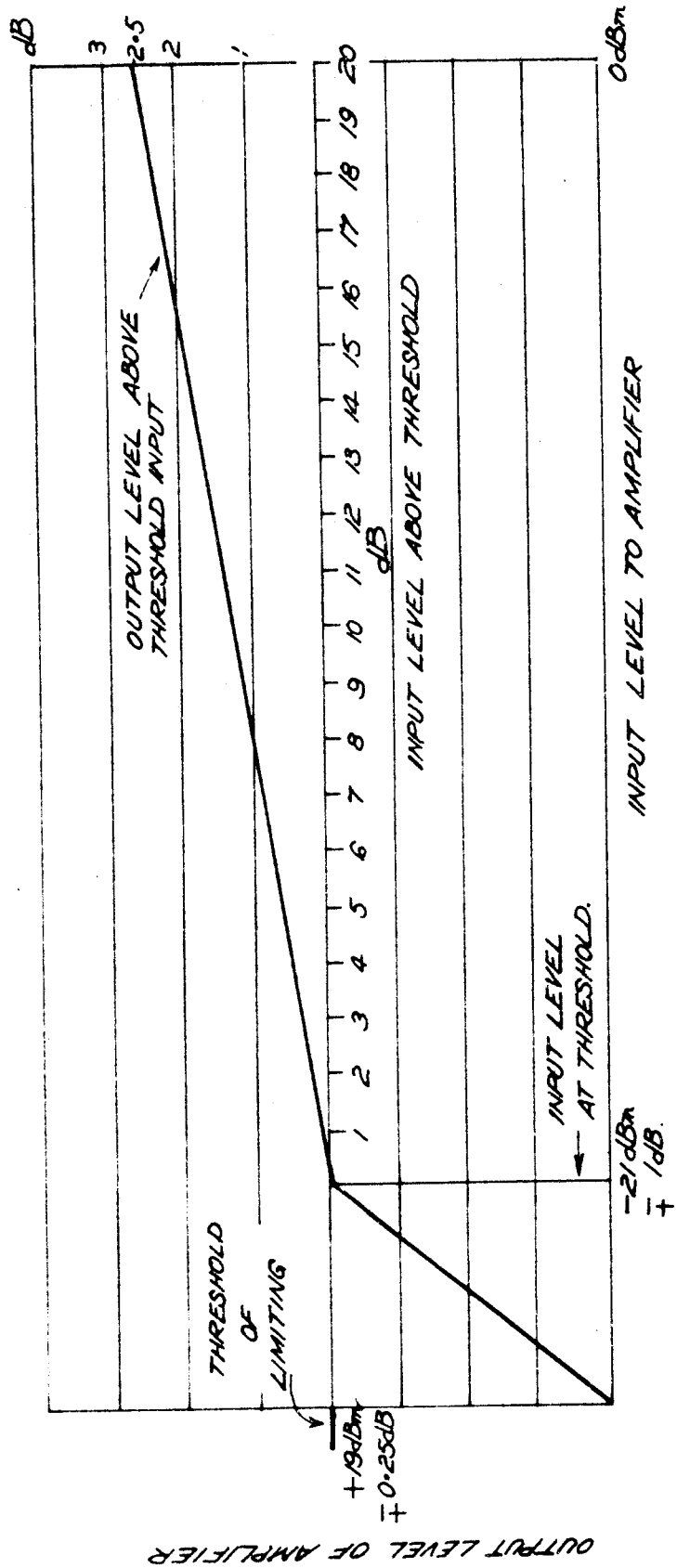

FIG. 13. LIMITING CHARACTERISTIC OF TYPE 4 AMPLIFIER.

TRANSMISSION PRODUCTS LIMITING AMPLIFIER TYPE 216 (FIG. 14 & 15)

Technical Description

The audio input signal passes through a low pass filter. This attenuates any radio frequency interference that may be present on the incoming programme sound line. The signal is then applied to the grids of V2 and V3, a pair of push pull pentode amplifiers. V2 and V3 are resistance capacity coupled to the half wave balanced modulator.

Oscillator

V1 is a crystal oscillator operating at a frequency of 455kHz. This is the carrier signal and it is applied between the centre point of TR2 and ground.

Modulator

The modulator comprises the two diodes G1 and G2, a resistive balancing network R20 - R21 and R19 and the balanced transformer TR2. C10 is provided to balance out any stray capacities that may be present. R19 and C10 are adjusted to balance out the carrier. The modulator output consists of a double sideband suppressed carrier signal.

The output winding of TR2 is tuned by C11 and C12. R25 loads the circuit to provide the required bandwidth.

Intermediate Frequency Amplifier

V5 is a buffer amplifier and it isolates the critically balanced modulator from the input circuit of the control valve V6.

V6 is a variable mu valve amplifier the gain of which is varied by the application of a d.c.voltage to its control grid.

The screen potentials of V5 and V6 are stabilised.

Demodulator

V6 drives the demodulator, the circuit of which is similar to that of the modulator stage. The 455kHz reinserted carrier signal is also obtained from V1 the crystal oscillator. The double sideband suppressed carrier signal ensures that no apparent thump is present in the audio output when changes occur in the control voltage (i.e. no d.c.change is present in the demodulated output).

Output Audio Amplifier

The output audio amplifier is a balanced two stage amplifier consisting of V9, V10 and V12. It is driven from a low pass filter which attenuates any remaining I.F. components of the demodulated output. V9 and V10 are in push pull and resistance-capacity coupled to V12A and V12B.

Control Circuit

The cathodes of the control rectifier V11 are driven in push pull. The d.c.

negative voltage obtained by rectification is applied via the control line, to the grid of V6. By this means the gain of V6 is varied. The output level at which limiting commences is determined by the positive bias applied to the cathodes of V11. This is adjusted by the Limited Level Adjust Control, R66.

The attack time depends on the charging time constant of C16 and the total source impedance. The recovery time depends upon the discharge time constant in the grid circuit of V6. Three values of recovery time may be selected by the Recovery Time switch which selects combinations of R32, R33 and R37. When the limiting peaks are of a short duration and they occur only occasionally the recovery time is governed by the time constant of C16 and R37. If the peaks occur more frequently C17 also receives a charge via R36 and the recovery time is extended. The control line voltage is monitored by M1 which is driven from the cathode of V6. M1 is calibrated in dB of limiting. R46 provides a zero adjustment for M1.

Balance Test

As a routine check a thump balance test is provided. This applies a 50Hz signal to the control line to simulate a limiting signal of a varying level. If the amplifier is unbalanced to such an extent that a thump would occur, then a 50Hz signal will appear at the amplifier output.

To perform a routine balance alignment the audio input signal is removed and the Recovery Time switch is rotated to the BALANCE position. This applies the 50Hz signal to the control line. A noise and distortion meter is connected to the output and R19 is adjusted until the output level falls to a minimum. The resulting output level should be a least -25dB below 1 milliwatt.

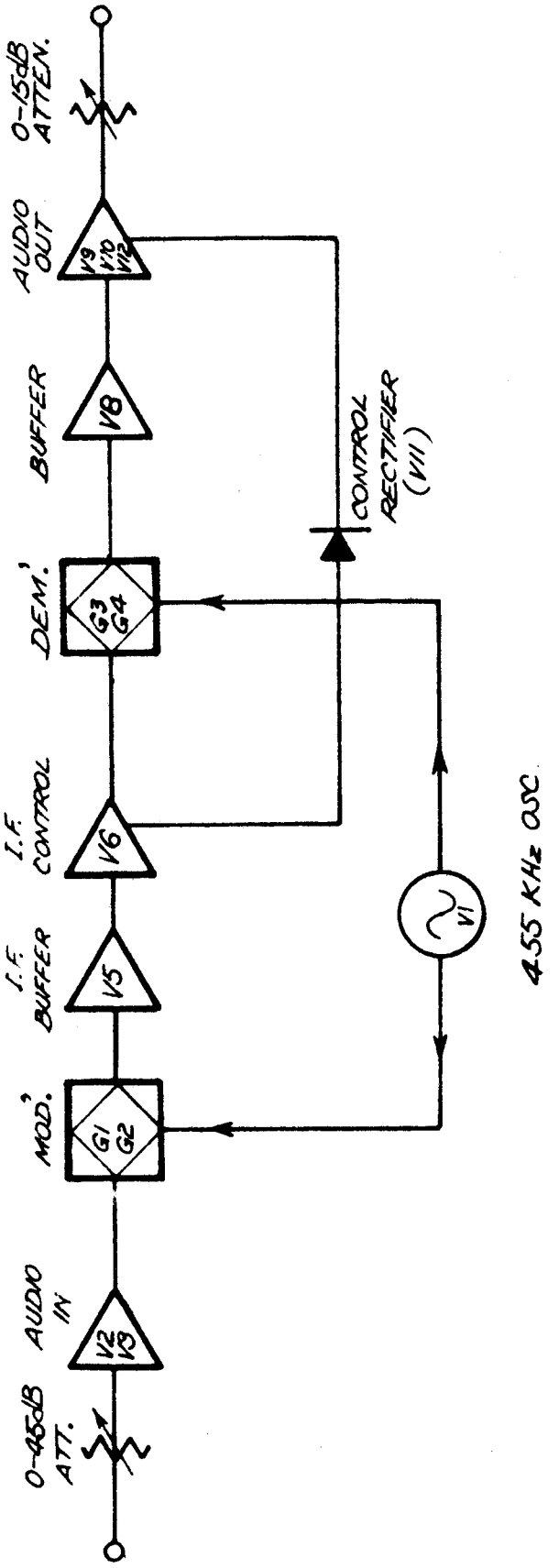

FIG. 14. BLOCK DIAGRAM OF TYPE 4 ('TRANSMISSION PRODUCTS' 216) AMPLIFIER.

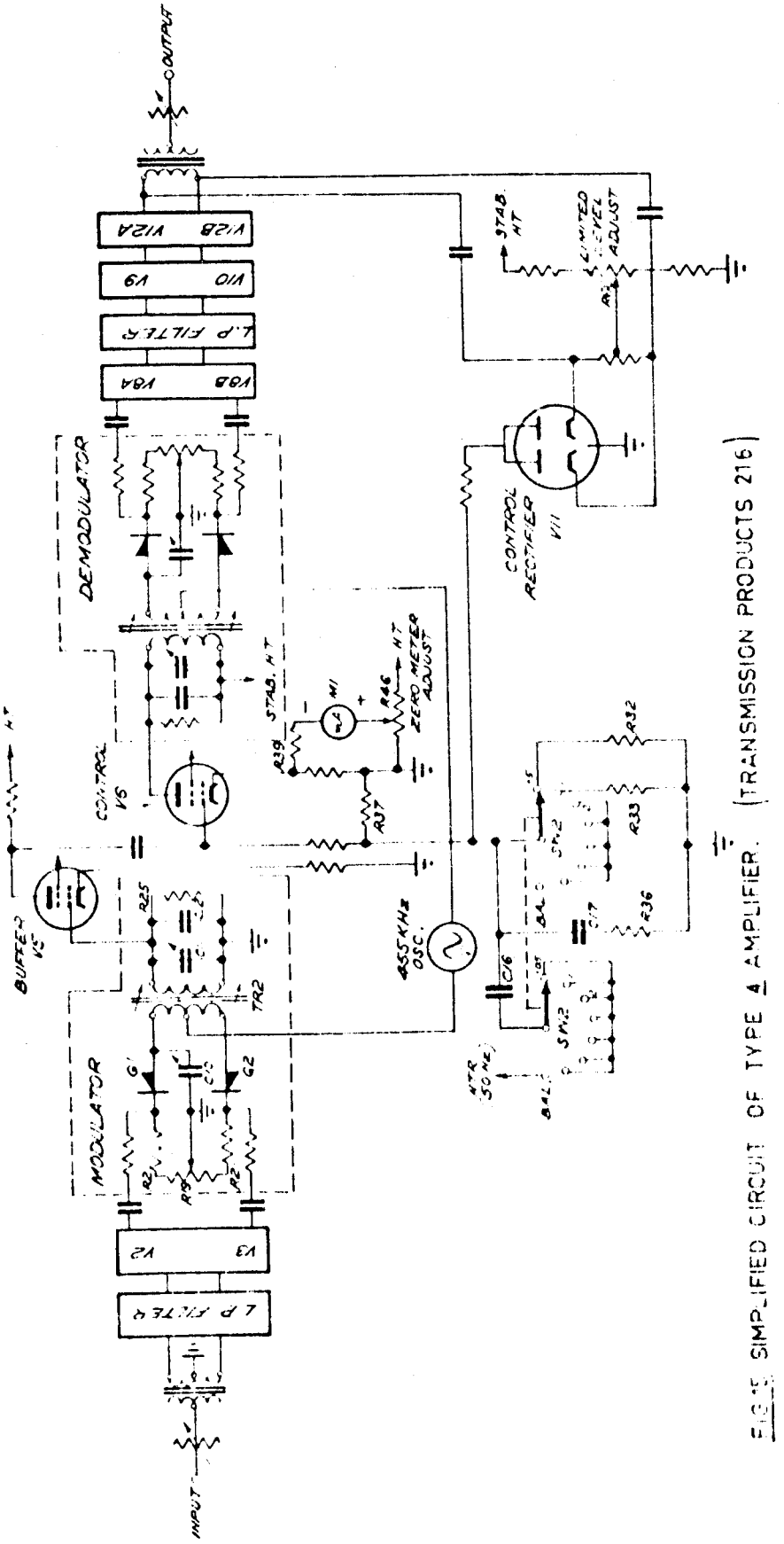

FIG. 15 SIMPLIFIED CIRCUIT OF TYPE 4 AMPLIFIER. (TRANSMISSION PRODUCTS 216)