1. Summary

Playmaster 110 stereo power unit chassis and two tape amplifier panels HRSA 1/2023
Circa late 1965.

Tape amplifier chassis #1:
Power supply terminal strip added.
12AX7, EF86, 12AU7A, EF86, 12??? Mullard made in Aust
12-pin interconnect to amp chassis ; 4-pin socket
University Graham level meter W2-18, 500uA
Poor pcb. No Mic transformer.
Bass/treble +/-12dB @ 50Hz and 10kHz.

Tape amplifier chassis #2:
EF86,
12-pin interconnect to amp chassis ; 4-pin socket
University Graham level meter W2-18, 500uA
Poor pcb. No Mic transformer.

Stereo power amp chassis:
Ferguson PF1555FT PT 0,230,240,250V (blk,brn,rd,or); E.S. (gry) 6/65
0,104,114,124V (yel,wh,y/blk,blu) (260,285,310Vdc@150mA)
6V3 CT 3A (yel-blu-yel); 6V3 CT 3A (brn-or-brn)
Ferguson OPM1A 5k,7kΩ SE; 5W; 2,3.7,8,15Ω ; Med Fid 40-30kHz 2dB 10-64 1/65
Red,or,yel ; blk, brn, red, or, yel.
Rola 14/60 CH16 4 Dec 1964
1x 6GW8 ; 2x noval for 6GW8; 1x noval for 12AU7
2x 2-pin to speakers ; 1x 4-pin bias feed
1x 4-pin heater ? ; 2x 12-pin to tape chassis'
OA210 x2
Bias oscillator coil - RCS Radio # 265 - pot core with total clamp on base.

Design is close to Playmaster 108 output stage, and the RTVH Sept 1964 Powered Monitor, and the May 1964 Stereo Amp. Not the same cct as Mullard 3-3.

Amp first stage with step network – starting at 5kHz (220k-150pF), and finishing at 53kHz (20k-150pF).

Tape amplifier panels

Status of one panel: both e-caps bad; one incorrect part; a few changed part values. Modified to function as high gain, guitar input preamp with options for inputs and tone settings, and using the meter for full-time output signal metering and for headphone monitoring.

- Mic input first stage to EF86 V1 and Mic Vol control. Modified to triode mode (screen bypass removed). Added input stopper.
- Playback head second stage EF86 and half 12AX7 with tone control in feedback.
- Then via PU input socket to PU Vol control. External input socket used for independent output of initial stages. PU input socket allows separate input to latter stages.
- Then to half 12AX7 to Bass/Treble controls to Play Vol control.
- Then to half 12AX7 PU input stage to half 12AX7 and half 12AU7 equalisation stage with local feedback.
- Then to half 12AU7 output and meter buffer stage with Mon Vol control to headphone socket. 220k reduced to 47k to raise HF roll off.
- MIC input socket replaced with 6.5mm socket.
- Record indicator used for power on indication.
- Recording Off-On switch is 4-pole and was used for front panel indicator; B+ feed; record head connect; erase head connect. Could use for main power enable.
- Input/Tape switch could bypass from B to input of final buffer stage. Switch appears to have 2 poles, so could separate.
- Mic Vol pot after first stage. PU Vol pot moved to before V5b.
- Play Vol pot could be moved to before V2b instead of V2a.
- All front panel signal sockets insulated from chassis to allow single point grounding.
- Add local grid leak to V2a. Remove 0.1uF coupling to V4 grid.
- V2a loaded with 39k.
- Distortion and effect of meter loading for output signal.
- Heaters wired in parallel for 6V3 supply to tag strip and isolated except for local humdinger to 0V. Heater currents could use 12Vdc supply - 0.2A (EF86 in series) + 0.3+0.3 = 0.8A 12V. V1 and V4 heaters paralleled and can be separately powered by dc and also in series. Pcb limits V2, V3, V4 to only operate with 6V, so V2 and V5 heaters in series for 12V, but V3 needs padder/Zener.
- B+ taken to tag strip with 0V isolated from local chassis. Chassis connected to main amp chassis, and so remote single 0V link to chassis. B+ bleed 470k only on VS3.
- Valve sockets cleaned.
- Voltage ratings of caps at least 400V for B+ testing. May need separate B+ decoupling for V4 and V5a, and for V5b.
- Unused: 2x rear panel RCA sockets; rear panel 4-pin erase head socket;
- Removed: 0.1uF V1 screen (was 0.22uF);
- Replaced 100uF 6V V1, V2a, V3a, V5a, V5b;
- SOT: the parallel caps across V4-V5a feedback.

PCB checked for: 370V B+ across caps; heater elevation to 200V; heater circuit resistance.
To do: connection to amp chassis; grounding heaters / tuned humdinger.

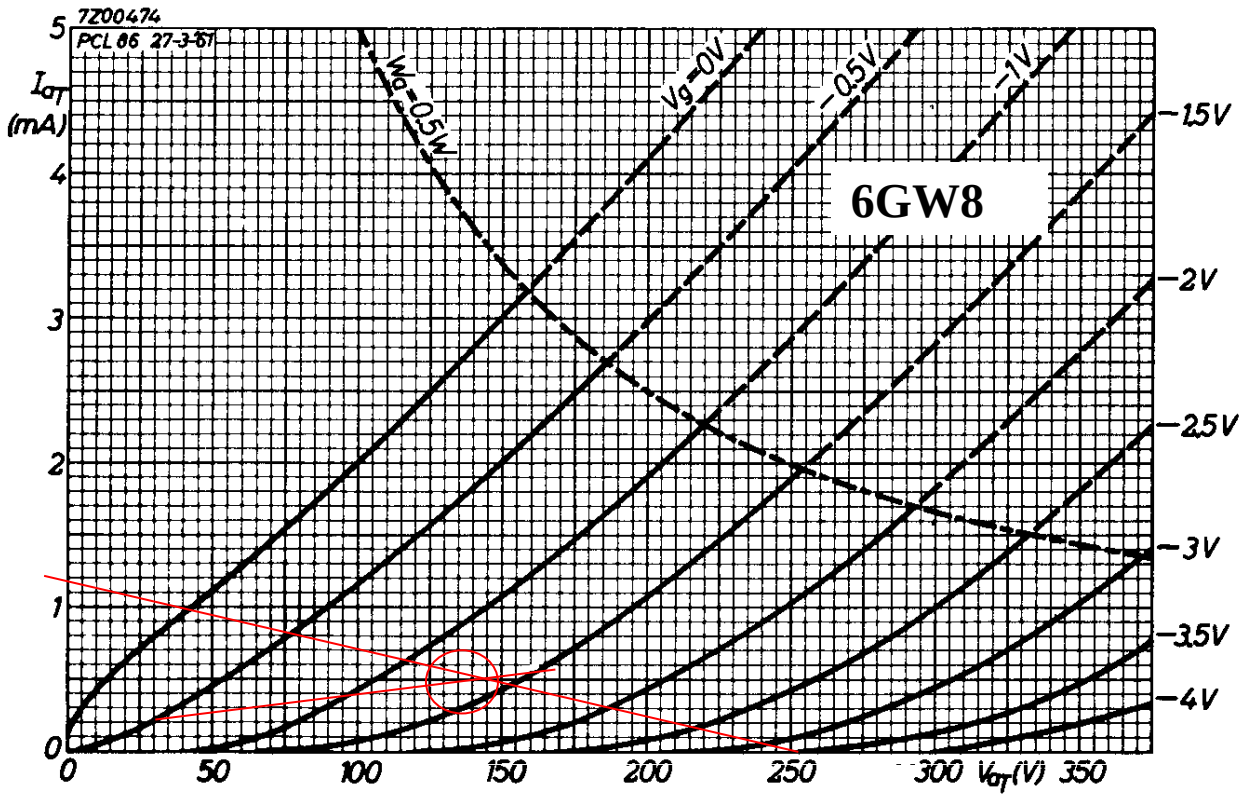
Flying leads: green to tape chassis; blue& yellow twisted to 6V3 heater with humdinger wiper to 0V; red&blk to pcb VS1 and 0V. Perhaps use an octal socket interface.

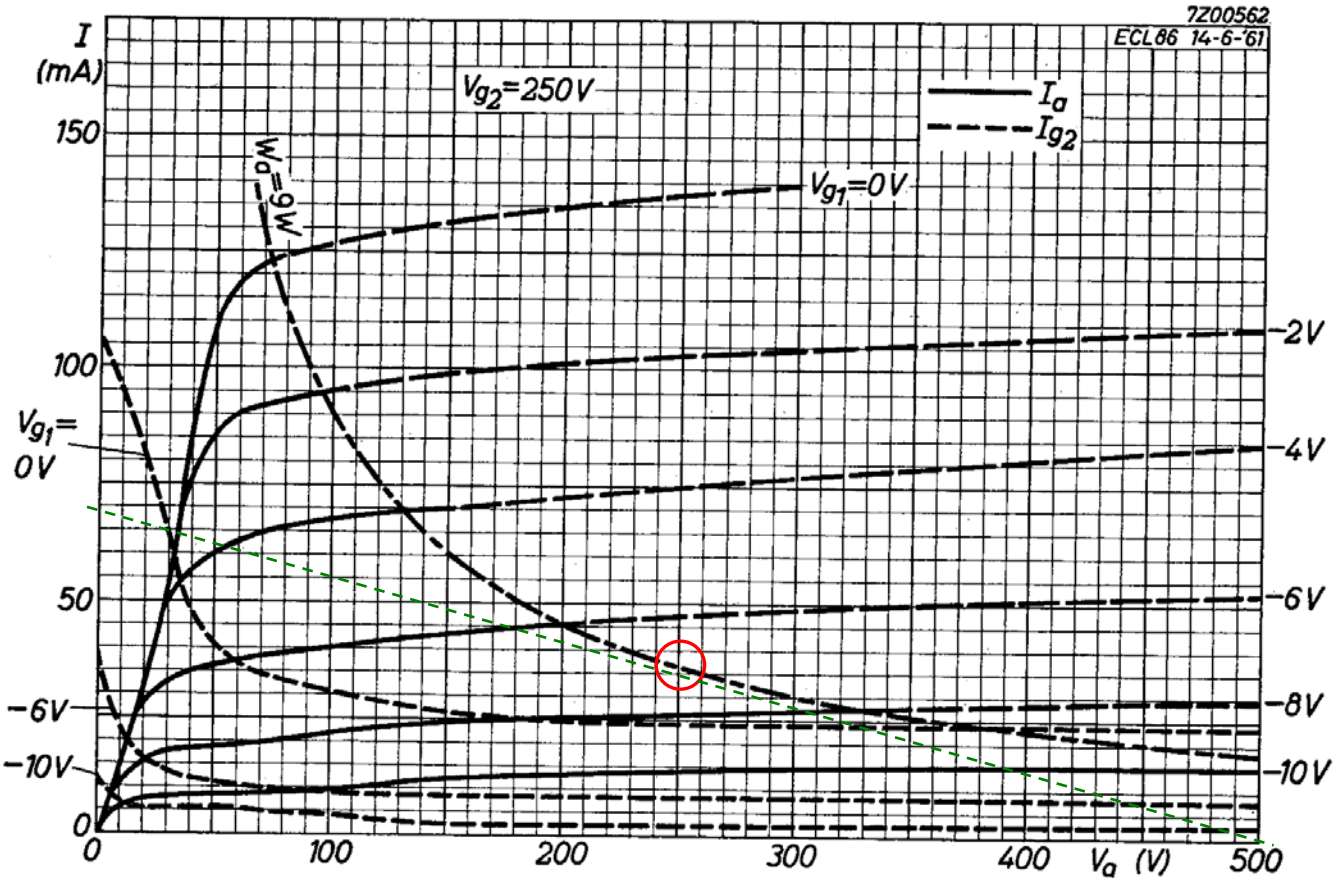
Other panel unrestored.

Stereo power amp chassis

Status: modified for basic dual channel amplifier.

- IEC/fuse combo mains input fitted on side panel. 0.4A T IEC fuse added for doubler secondary.
- Replaced doubler diodes with UF4007. Relocated choke to between doubler filter caps and 32u//32u 450V can as bulk output cap (PSUD2 indicates no ringing) – provides better filtering than original 1k to 32u RC. 56k bleeds added across doubler caps, and a 100k:1k voltage divider/sense bleed added across 32u//32u.
- 2x 40u 350V used for pre and driver stage filtering with 10k PRO2 feed.
- OT primary MOV 330Vdc 7mm (2502 GEAQ) protection added.
- new e-caps with 35Vdc rating.
- Replaced front panel 4-pin socket to a stereo input 6.5mm socket, and removed pot. Tip input to RHS and LHS amps.
- Removed 12-pin sockets.
- Replaced side-wall socket with 5-pin monitoring socket (fixed bias connection setup, with VS1/100, VS2/100, CS1, CS2, 0V), and adjusted dividers for 100:1, with added 10R to 0V end of each cathode 180R to provide mA reading – 367mV = 0367 = 36.7mA max.
- Removed tape bias circuitry. Option to use spare Noval socket for stereo input stage – eg. use more feedback and/or extra input stage gain, and choice of triode to allow wide range of input sensitivity - from guitar to cd. May need to shield, and use valve top cover.
- Single 3A heater with local 200Ω humdinger pot for local 0.66+0.66=1.32A, and optional noval socket.
- Single 3A heater with remote 200Ω humdinger pot for 0.2+0.2+0.3+0.3+0.3=1.3A on one tape chassis.
- Fitted 4-pin speaker output socket for each channel and connected Com black, 2Ω brown (for 2Ω Rola 8M speakers in Steanes 976B combo) and 15Ω yellow taps (ie. not 4Ω or 8Ω outputs), with one spare terminal if needed (eg. for 8R).


7Z00474
PCL 86 27-3-61
6GW8
I_{aT} (mA)
V_{aT} (V)
W_g=0,5W
V_g=0V
-0,5V
-1V
-1,5V
-2V
-2,5V
-3V
-3,5V
-4V


7Z00562
ECL86 14-6-61
I (mA)
V_{g_2}=250V
I_a
I_{g_2}
W_a=9W
V_{g_1}=0V
-2V
-4V
-6V
-8V
-10V
V_{g_1}= 0V
-6V
-10V
V_a (V)

200Vpk swing across 7kΩ primary, causes 9.2Vpk across 15Ω secondary, or 6.5Vrms or 2.9W. But pentode input grid appears to start conducting when input voltage rises above 1V, rather than starting to conduct when voltage gets near +6V cathode bias. Same observation with other pentode. This limits the undistorted sinewave output voltage to about 2.4Vpk before apparent clipping starts on one peak.

Options:

- Elevated heater.
- UL output stage.

Measurements

1kV megger test PT primary – gnd >800Meg
1kV megger test primary circuitry including PT ok >600Meg.
Transformer primary blk-or = 14Ω.
Transformer secondary HT (yel-blu) = 7Ω.
1kVdc megger test OT primary ok.

Output transformer primary DC resistance: 392-480Ω ; 15.8H 15.2H 100Hz MCP

- Inductance at idle dc current (6.5V/180Ω = 36mA minus screen current)
- 20.1H 22mAdc 10.7Vac ; 17H 36mAdc 10.7Vac

Choke DCR=497Ω ; 21H 100Hz MCP

C1 100uF 200V : 109uF, 0.12R, <70uA.
C2 100uF 200V : 122uF, 0.34R, <80uA?
C3A 50uF 350V : 57uF, 0.27R, <75uA ; C3B 56uF, 0.21R, <75uA
C4A 32uF 450V : 51uF, 0.28R, < 100uA 375V; C4B 47uF, 0.33R, < 110uA @442V
24uF 350V Nitta :m 29uF 0.36R <30uA 350V

Monitoring: 270V reads as 267; 238V reads as 237.

Pentode dissipation: cathode current 36.7mA; anode voltage 268-392x0.037-7=247; 9.1W.

- 6GW8 max is 9W + 0.5W

Triode cathode = 1.21V, anode 142V, anode current (238-142)/220k = 0.44mA.

180+10=190R cathode. 230V mains: 253V, 37mA. 12dB feedback.

Stable for no load and 10nF, but substantial peak at 105kHz, and unstable for 47nF, and no benefit from comp cap. A 10R-22nF load zobel causes peak at 700kHz.

With 6T inductor, a 10nF load has a 100kHz peak a few dB above mid-band, and a 47nF load has a 55kHz 8-9dB peak, and 100nF is unstable – no benefit from added comp across feedback. 16R load response has 10kHz response with -3dB at 18kHz.

Adding an output zobel had no benefit.

Without step, just stable to 32nF but with 140pF comp. 16R load 1W bandwidth now to 21kHz -3dB.

Both channels the same. 259V, 228V, 39+37mA. Valves 4 and 5.

Sensitivity. Pout versus speaker impedance.

Tube options

6GW8/ECL86 has the highest plate dissipation of 9W for a common 9-pin noval with an accompanying triode. Spare heater current is large (3A plus 3-1.4-0.3=1.3A).

There is room to fit extra preamp/driver valves, which would allow single pentode novals such as 6BQ5/EL84 (12W anode), or 6CW5/EL86 (12W anode).

The OPM1A may notice a higher idle current (and hence peak current) if that is a result of higher plate dissipation.

Pentode/UL option

The 5k tap could be used as a 15.5% turns tap, or 2.4% loading tap (from 7k end, with primary turned around as well as feedback). 20% turns tap was a common tap for 6BQ5/EL84.

Power

PSUD2 simulation based on 124Vac secondary rms into ss diode doubler with VS1 loading of 6.5V/180Ω = 36mA per tube (2x36 = 72mA) for 80mA total load, with hot turn-on. IEC60127-2 0.4A T fuse chosen.

Simulate period in PSUD2	**20ms**	**150ms**	**600ms**	**continuous**
Simulated RMS current	2.4	1.0A	0.6A	0.36A
Multiplier (based on 0.4A fuse rating)	6.0	2.5	1.5	0.9
IEC60127-2 Time-lag T min limit multiplier	10	4	2.75	1

Diode rms is 0.25A, so just ok for UF4007.

Doubler cap bleeds for 180V 0.5W – use 56k Pro2. 32u//32u cap bleed for 300V 0.5W – use 100k Pro2 and 1k + trim. 50u//50u cap bleed for 250V 0.5W – use 100k 2W + 1k + trim.

Choke option for main B+ supply. Rola 14/60 has 495Ω DCR which drops raw B+ from 340Vdc with 16Vpp ripple, to 300Vdc with 50mVpp ripple. Dissipation is 3.2W at 80mA, so not much margin, especially if DCR rises. DCR rose from 500 to 550Ω after 30 mins at 70mA. Step load change with 32uF output filtering shows some ok damped overshoot/undershoot. Adding extra 32uF, or an extra RC (10R/32uF) for each channel, then removes any over/undershoot. So both sections of 2x 32uF 450V connected directly after the choke.

B+ to each OPT and to output stage 6GW8 screens. Internal or socket short-circuit or full conduction of a 6GW8 would be cathode limited by cathode 180Ω and anode limited by OPT 390Ω, to about 280mA (160V on B+ and ~50V on cathode) through OPT primary (~31W) and cathode resistor (~14W), with PT secondary current rising to 1.2A (3x multiplier of 0.4A). Screen conduction only limited by cathode, so up to 380mA and 1.6A from PT primary. Screen terminal #3 is next to heater #4 and cathode #2, so some risk of socket arcing if not kept clean.

The 180Ω 1-2W cathode resistor could see a nominal class A peak current of 2x 36 = 72mA (1Wpk) with an average of 36mA (0.24W). Given a fault of 280mA, the dissipation rises to 14W,

so a modern 0.6W resistor may act like a poor mans fuse. Alternatively, given class A operation, a PTC may be practical but needs a trip current level lower than ~280mA, and a hold current level higher than 40mA. An RXEF005 has a 50mA hold that may be ok if ambient is not onerous; and the 100mA trip exceeds the likely peak nominal current; the hold resistance is likely about 10Ω and could vary by a few ohm. Replaced by 1% MF50.

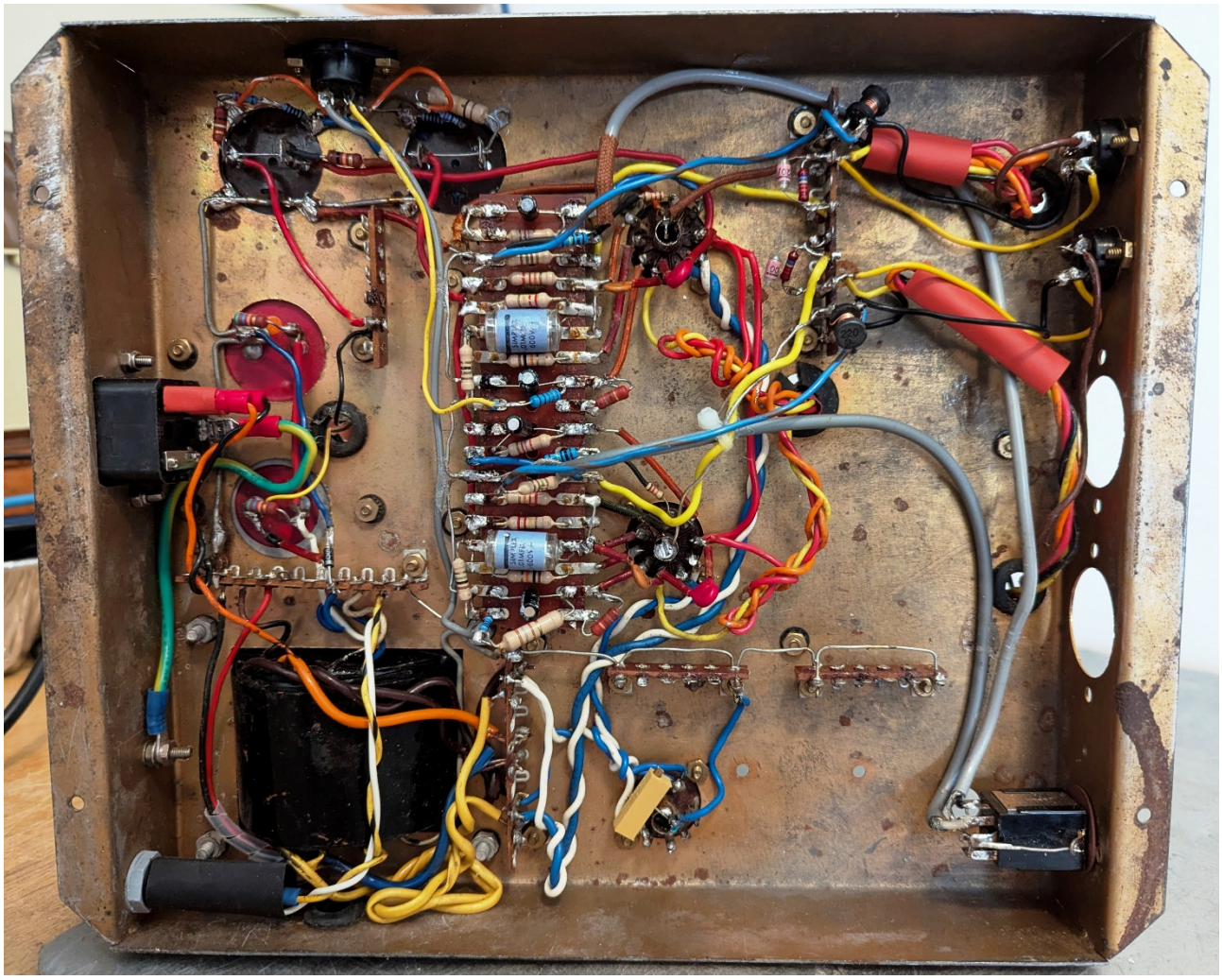
A 0.25W screen stopper acting as a poor man's fuse would likely need to be >22Ω for rapid fail, and is only protecting the PT and choke.

A short from cathode to heater would likely cause full-conduction of both 6GW8 due to low resistance of humdinger. That fault risk could be alleviated by using an elevated heater to say +30V through a high resistance elevation divider which should prevent cathode voltage pulled to ground.

Preamp/drive stages sink up to about 2mA, so 10k distribution would drop up to 20V.

Coupling caps are 600V.

Maintenance socket with 0V, cathode 1, cathode 2, VS2+, VS3+



Tape chassis
Input stage EF86 to top of MIC pot:
200mVrms in for 1% THD and 27x gain; 1V in for 5% THD. Flat frequency response (-1dB) from 10Hz to 40kHz. 50Hz hum <-90dB, Noise floor <-110dB

2nd stage EF86 + 12AX7 triode to top of PU pot:
Total gain 7V/0.01 = 700, 2nd stage gain = 700/27 = 26 at 1kHz

PU input to top of Play pot from 12AX7 V5b and 12AX7 V2a:
Total gain = 1.58V/0.01 = 158x for flat FR setting of Treble and Bass pots. About
Max Treble is +13dB from flat at 10kHz.
Max Bass is +17dB from flat at 30Hz.
Min Treble is -16dB from flat at 10kHz.
Min Bass is -8dB from flat at 50Hz.
1% THD at 2.2Vrms top of Play pot. 5% THD at 9.8Vrms.

Meter = 10 at 2.52V at top of Play pot at max (O/P=17.6V). EQ=1 at 1kHz
Meter = 7 for 1.76V. (O/P=12.4V)
Meter = 4 at 1.00V (O/P=7.1V).
Meter = 2 at 0.5V (O/P=3.5V).
Meter = 1 at 0.25V (O/P = 1.76V)

Meter = 10 referred to PU input, with flat Bass/Treble FR and Play Pot at max and 1kHz with EQ=15ips, is 2.52/158 = 16mV.
Referred to MIC input is 16/700 = 0.022mV.

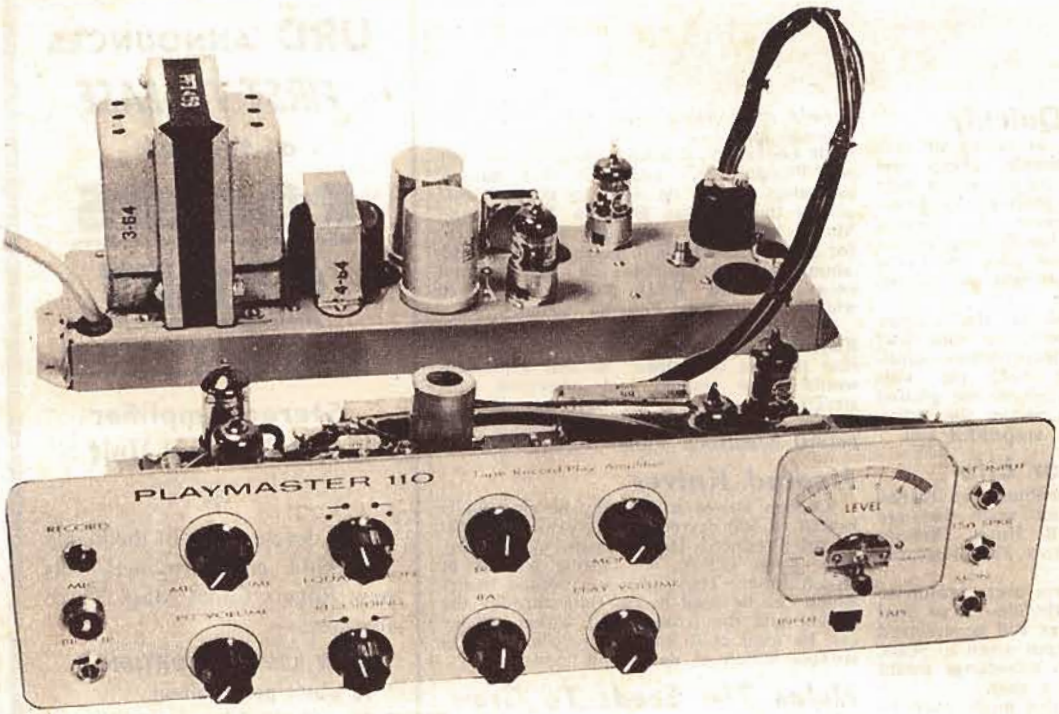
Meter at full scale with 17.6Vrms output, which is 2.5V at top of Play pot and 16mV at PU input for 1kHz with bass/treble set for flat response, and equalisation set for 15ips. Bass pot adjustment has +17/-8dB at 30Hz, and treble has +13/-16dB at 10kHz. Frequency response is with +/-2dB from 50Hz to 20kHz for flat bass/treble and 15ips, but all equalisation settings have a +6dB boost peak down at about 15Hz. Slower tape speed eq setting progressively include a treble peak up to +8dB at about 10-15kHz.

Input EF86 triode mode stage has gain of 27x, and -1dB frequency response from 10Hz to 40kHz, and 5% THD at 1V in.

The following EF86 pentode and 12AX7 triode stage has gain of 26x. The 1.75ips equalisation setting provides a strong bass lift of +12dB pk at 40Hz, and treble lift of +6dB with a 6kHz pk, relative to a 1kHz middle response. The faster tape speeds have the same bass lift, but treble peak is raised in frequency and lowered in lift until the 15ips is basically flat.

Modifications:

- V2b-V3a bass boost suppressed by increasing feedback 0.1uF to 0.27uF and reducing cathode decoupling from 100uF to 6.8uF. LF roll off now below 50Hz, with no peaking.
    - HF response rolls off from 6kHz for 15ips, but 7.5ips has +3dB boost at 10kHz and 1.75ips boost is excessive.
        - 15nF eq replaced by 8n2, 8n2 replaced by 5n6, 5n6 replaced by 2n2F.
- No 100pF across V3a grid.
- 2nd stage equalisation has large constant LF boost and switched HF drop and roll-off
    - Alleviate LF boost by lowering V4-V5a coupling cap from 0.1uF to 10nF and lowering V5a cathode bypass from 100uF to 6u8.
    - Use parallel 220pF for all settings to provide similar HF roll-off.
    - Make 2 settings for LF and 2 settings for HF



At left is the prototype 110 tape amplifier, together with the adapter power unit to be described in the next article. The circuit for the amplifier unit is on the right.

THE 'PLAYMASTER 110' TAPE AMPLIFIER UNIT

Our latest tape amplifier unit combines high quality reproduction, operating flexibility and ease of construction. A single unit is used for mono recording and two units for stereo, in conjunction with matching power units. Employing a printed wiring board to simplify assembly, it operates with either two or three-head decks.

By Jamieson Rowe

THE Playmaster 110 tape amplifier is the result of our efforts to produce a high-quality design which would combine adaptability to a wide range of applications with ease of construction and operating flexibility. We think that it combines these features quite successfully, and are thus confident that it will prove to be our most popular tape design to date.

The unit contains two independent amplifier channels, one for recording and the other for replay. The use of two separate channels simplifies wiring and switching, makes the design more stable, and allows full operating flexibility with three-head tape decks.

With three head mono or stereo decks, it allows the production of "echo" effects, by re-recording from the playback channel during recording. And with stereo decks, it allows the operator to make professional sound-upon-sound superimpositions by means of track-to-track transfer.

The recording amplifier channel uses three valves. It will accept signals from both a microphone and a high-level source such as a pickup, a radio tuner, or other such device, and has separate volume controls for the two inputs to allow mixing of signals. Recording equalisation is provided for the four usual speeds provided on high-quality decks—15, 7.5, 3.75 and 1.875ips. The equalisation is specifically matched to the requirements of the heads used in the "Brenell" deck, but would be suitable for a variety of other heads.

Recording level may be monitored both visually on a meter or aurally by means of earphones or an external amplifier, and may be carried out irrespective of whether recording is actually in progress or whether the tape is moving or stationary. The monitoring system may also be switched to the replay amplifier channel to perform "input/tape" comparisons, and to allow the operator to determine the signal level on previously recorded tapes.

An electrical interlock system prevents accidental erasure by making sure that two separate switches must be moved to the "record" position before the erase/bias oscillator is activated. One switch is the recording control on the front panel of the amplifier (which also turns on a red pilot light, to attract attention), while the other is a switch fitted on the tape deck itself. In the case of the Brenell deck, the latter switch is fitted to the deck as a standard item, and many other decks have similar switch or a provision for one. The Brenell deck also has a mechanical interlock system.

The relay amplifier channel uses two valves. It provides full replay equalisation (substantially C.C.I.R.) for the four speeds, the equalisation being switched at the same time as the recording equalisation. In addition to fixed equalisation the amplifier provides fully variable separate bass and treble adjustments giving the usual 10 - 12dB of maximum boost or cut at 50cps and 10KC.

As mentioned previously, the replay channel signal may be fed to the monitor system. The signal take-off for monitoring is before the tone controls and replay volume control, and the level meter is connected before the monitor volume control, so that the meter may be used to determine the actual level of a recording on the tape.

The replay channel may be used as a control unit for crystal or ceramic pickups, as it is fitted with an "external

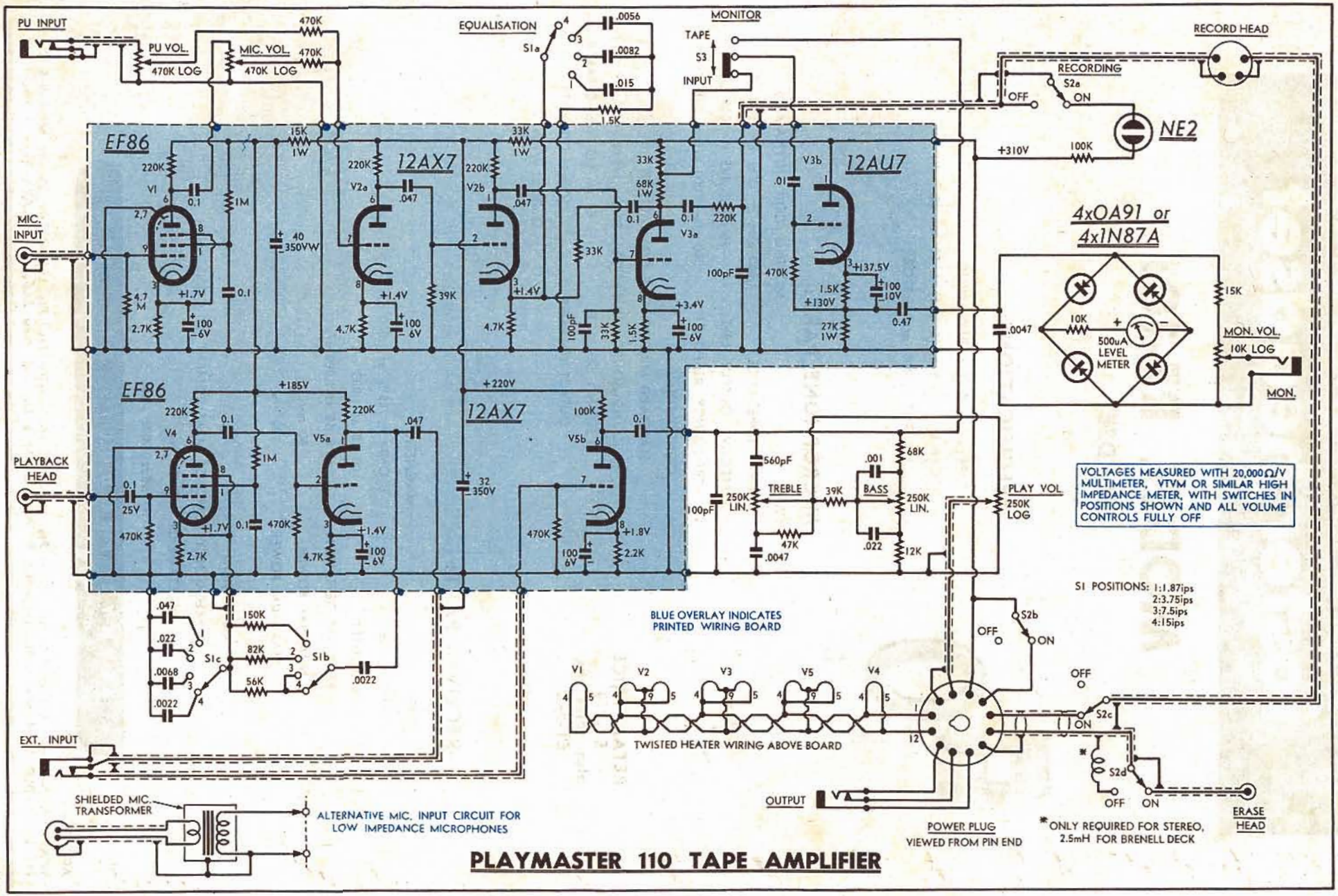
SPECIFICATION

Tape recording/replay amplifier, using two EF86 valves, two 12AX7 valves and one 12AU7 valve. Major proportion of the circuit on a printed wiring board, simplifying assembly. May be used with either two- or three-head tape decks. One unit required for mono, two for stereo. Power units to be described permit either adapters or complete recorders to be made up using the amplifier unit.

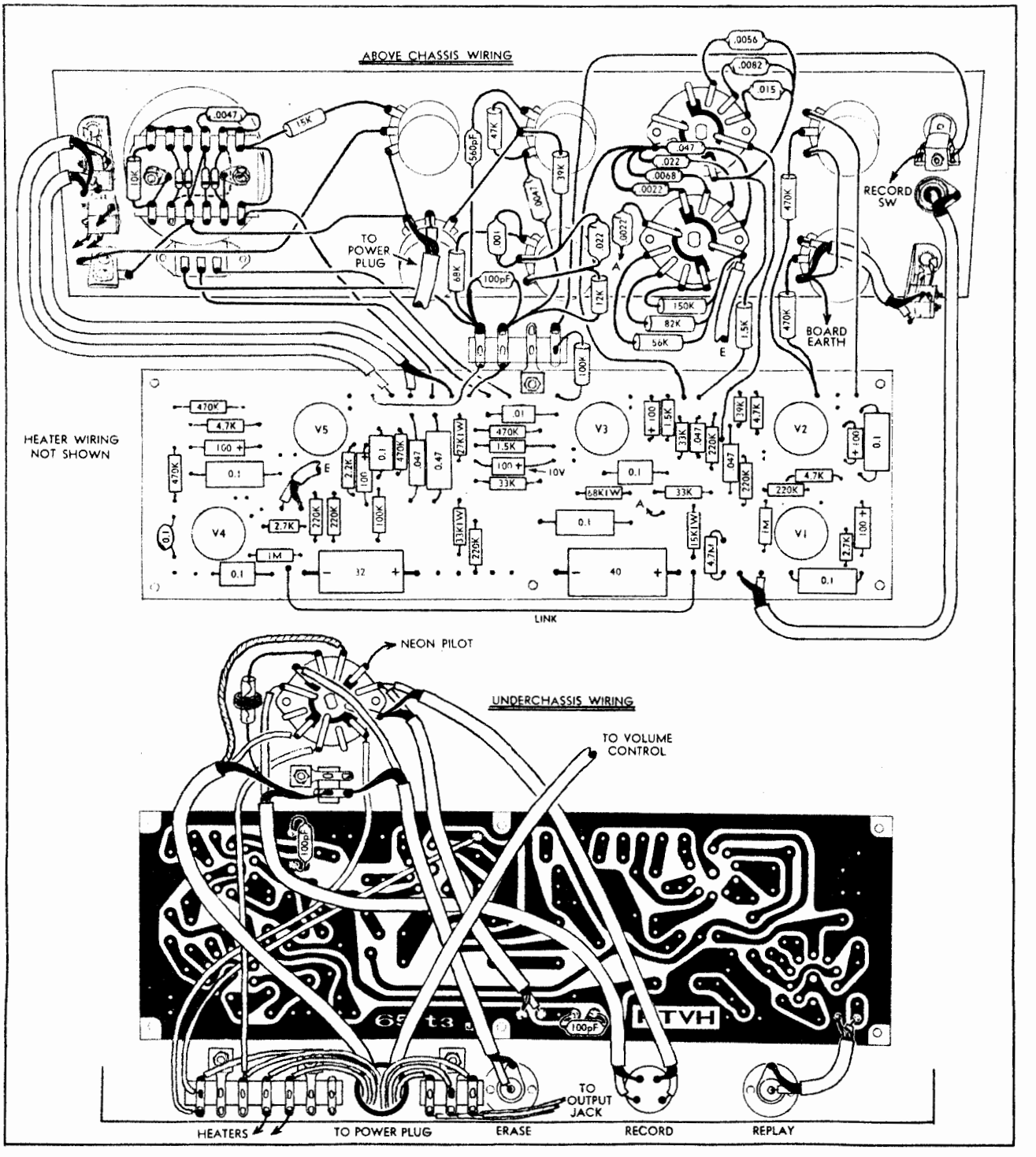
Complete recording amplifier channel accepts signal from two sources, which may be mixed. Microphone input sensitivity 1mV, pickup input sensitivity 100mV. Input impedance 4.7M and 470K respectively. Recording equalisation for 15ips, 7.5ips, 3.75ips and 1.875-ips. Monitoring of recording level on meter and also by phones.

Replay amplifier has medium-impedance output of 300mV, fully equalised for the four above speeds. Output may be fed to the monitor level meter and phone jack for off-the-tape monitoring. Bass and treble controls provided. External input provided for use of tone controls with pickups, etc.

Overall record/play frequency response (plus/minus 3dB) for the various speeds with Brenell heads is: 15ips, 25cps—20KC; 7.5 ips, 20cps—19KC; 3.75ips, 30cps—8.5KC; 1.875ips, 30cps—4KC. Total record/play harmonic distortion approx. 1 per cent. Replay system signal/noise ratio approx. 42dB.



PLAYMASTER 110 TAPE AMPLIFIER



The above wiring diagram should make wiring of the tape amplifier a relatively easy matter. It should be used in conjunction with the schematic circuit and the photographs, as the physical layout has been distorted for clarity.

input" jack which feeds to the stage previous to the bass and treble controls. The gain from this jack to the channel output is approximately unity, and the monitoring system may be used to observe the level of signals.

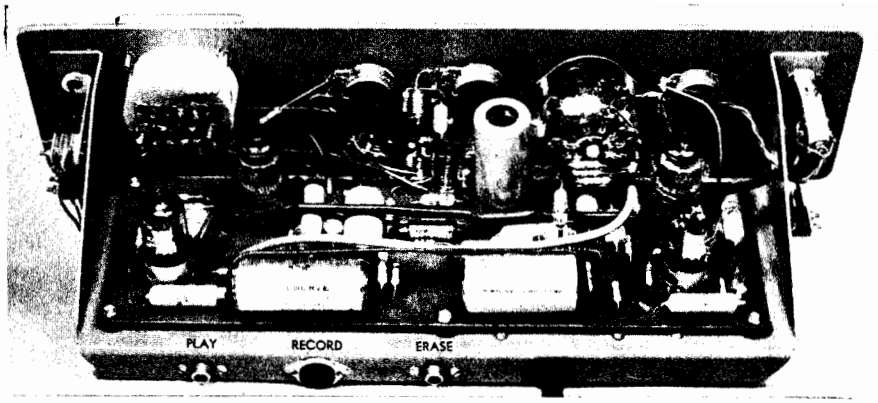
The output of the replay channel is approximately 300mV at an impedance level of 250K. This signal could be fed to an external high-fidelity amplifier system (such as a "Playmaster") direct, but if long leads were used attenuation and treble loss would result due to cable capacitance. Accordingly the adapter power unit shown in the photograph and to be described in the next article provides cathode follower stages to reduce the output impedance to approximately 400 ohms. At this impedance level quite long output cables may be used to connect the unit to the amplifier system.

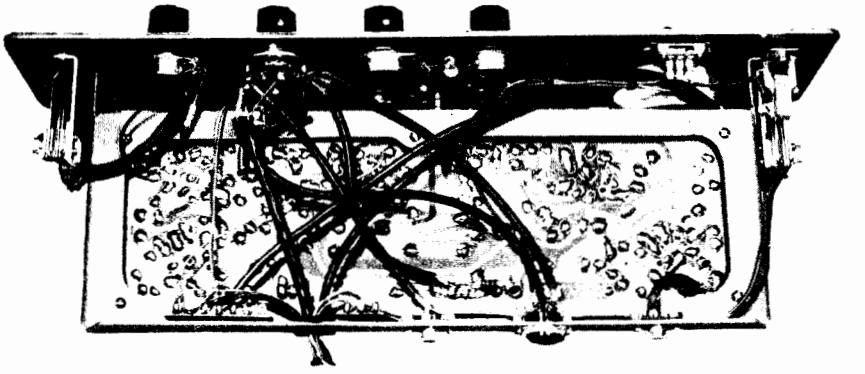
A further power unit to be described will feature complete power output stages and speakers, for those who require a complete replay amplifier system in contrast to the adapter system. The basic 110 amplifier unit may be used with either of the power units, either singly for mono or with a second unit for stereo. The bias/erase oscillator used in each power unit will be identical.

To gain a brief idea of the operation of the amplifier unit, refer to the main circuit diagram. Most of the amplifier circuitry is mounted on a printed wiring board, as the overlay indicates. The use of a printed wiring board simplifies construction and ensures stable operation.

The first stage of the recording channel is a microphone preamp using an EF86/Z729 valve (V1). This stage is quite conventional and as shown will accept signals from either crystal or medium-high impedance dynamic microphones. By fitting a shielded stepup transformer to the grid circuit, however, it can be used with low impedance types. The input level required for peak recording level is approximately 1mV.

Following this stage is the mixing circuit, at which point the high-level signal may be introduced via the "PU"





At left is the rear above view of the amplifier, and below the underneath view. Wiring of the unit should be carried out using the wiring diagram as a guide.

input jack. The signal level required here for peak recording level is approximately 100mV.

From the mixing circuit the signals pass through a three-stage recording amplifier using a 12AX7 and half a 12AU7 (V2a, V2b, V3a). The second and third stages of this amplifier are arranged in a feedback configuration which has switched constants to provide the various recording equalisation curves. The output of the third stage is fed to the recording head via a 220K resistor to produce effectively constant-current recording.

The second half of the 12AU7 (V3b) is used as an isolating cathode follower in the monitoring circuit. Its input is is switched to either the recording amplifier output or the replay amplifier output as required, by the "Tape/Input" switch (S3). The level meter circuit is connected directly across the output of the cathode follower.

The monitor output jack is connected to the cathode follower output via a 15K isolating resistor and a 10K monitor volume control. The maximum open-circuit voltage available at the jack (at peak recording level—"6" on the meter) is approximately 1.5 volts, at 15K impedance level. The isolating resistor is used to prevent possible loading of the level meter due to low-impedance monitor earphones, and should not be reduced in value.

Recording is controlled by the "record On/Off" switch (S2), which controls record head signal, record head bias, bias/erase oscillator HT, and erase head feed. In the "Off" position of the switch both the recording and erase heads are completely isolated from all signals, to prevent spurious effects.

One pole of this switch (marked S2d) switches the erase head. When two 110 amplifier units are to be used together for stereo, it is necessary to fit to this section of the switch a small RF choke to substitute for the erase head in the "Off" position, to preserve correct oscillator loading. As shown on the circuit, however, this choke is not required when only one 110 unit is to be used, for mono recording.

The first stage of the replay channel is a pentode amplifier using another EF86/Z729 (V4). Together with the next stage (V5a, using half a 12AX7) this stage forms a feedback amplifier whose constants are switched to provide the appropriate replay equalisation for the various speeds. Recording and replay equalisation are switched together, each being switched by a section of S1 (S1a for recording, S1b and S1c for replay.)

From the equalisation stages the replay signal passes to the "Ext. input" jack, where it may be replaced by an external signal when using the remainder of the channel as a control unit. The signal from the jack passes to the second half of the 12AX7, (V5b), arranged as a conventional triode amplifier.

From V5b the signal passes to the bass and treble controls and to the monitor switch. The controls are quite conventional bass and treble boost/cut potentionmeters, and their output feeds to the replay volume control. The volume control output connects to the power plug.

When the 110 amplifier is connected to the adapter power unit, the replay signals are fed through a cathode follower and returned at a lower impedance via pin 11 of the power plug. They then connect to the "Output" jack on the amplifier front panel, for connection to an external amplifier system.

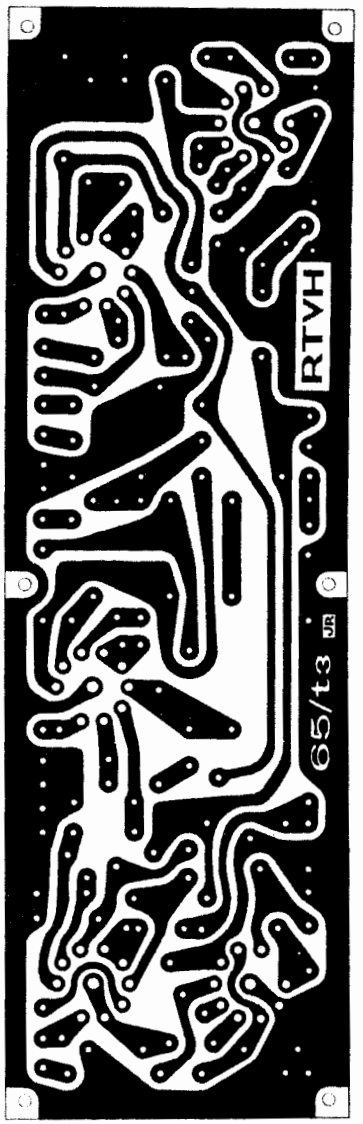
On the other hand, when the amplifier unit is connected to the recorder power unit, the replay signals will pass through power output stages in the power unit, to return to the amplifier unit at 15ohms speaker impedance. The "Output" jack will then become an external speaker jack, while the signals will return to the speakers via pin 10 of the power plug if an external speaker is not used.

Let us now turn to the mechanical aspects of the design. As mentioned earlier, and as visible in the photographs most of the amplifier circuitry is mounted on a printed wiring board, which is in turn supported by a shallow bracket chassis behind the front panel. The chassis and front panel are held to-

gether by the input and output connectors at each end of the panel.

The front panel of the prototype unit is an 18 gauge aluminium plate faced with a photographic print, which was in turn covered with a protective sheet of 1/16in perspex. However, etched panels will no doubt be made available by metalwork suppliers, for those who prefer them. Alternatively, readers may care to silk-screen the panel markings on the rear of a sheet of 1/16in perspex placed in front of a brushed-finish aluminium panel.

For those who wish to follow our own procedure, full-size glossy prints of the front panel are available through the query service.



This reproduction of the printed wiring board pattern is somewhat smaller than half actual size. Full-size prints are available via the query service.

All controls are mounted on the front panel, along with the level meter. The position of the controls is visible in the front panel photograph.

The wiring of the unit should be fairly straightforward, as we have prepared a wiring diagram showing all connections and components. The photographs and schematic circuit should also be of assistance in this regard.

There are one or two points which should be noted when constructing the

unit. The wiring board should be mounted on fibre or plastic washers or spacers, to raise it above the chassis surface by at least 3/16in. This prevents accidental short-circuits, and lets the board clear the heads of bolts securing under-chassis tagstrips.

The equalisation switch (S1) is a 2-section 2-pole 4-position rotary switch with the two sections double spaced (1in apart). If difficulty is experienced in obtaining the switch with double spacing of the wafer sections, a three section switch may be obtained and the centre section removed. The prototype switch was in fact produced in this way.

The recording control switch (S2) is a 4-pole 2-position type, and due to its proximity to the lower edge of the front panel it should be one of the newer miniature rotary switches. Otherwise it may be difficult to fit the finished amplifier unit into a recorder case.

The recording indicator is an NE2 pigtail-type neon bulb mounted behind

PARTS LIST

1 Chassis and front panel. Panel 15½in x 4in, chassis depth 5½in.
1 Printed wiring board, as per diagram, 11½in x 3½in.
1 2 section 2-pole, 4-position rotary switch (see text).
1 Miniature 4-pole, 2-position rotary sw.
1 Single pole, 2-position slider sw.
1 Level meter, 2½in sq., 500uA.
4 Germanium diodes, type OA91, 1N87A or sim.
2 EF86/Z729 valves.
2 12AX7/ECC83.
1 12AU7/ECC82.
1 NE2 neon lamp and bezel assembly (see text).
1 Microphone connector.
1 Open-circuit phone jack.
3 Contact-type phone jacks.
2 Small co-axial sockets.
1 Miniature 4-pin socket.
1 2.5mH RFC (stereo only).

RESISTORS Half watt unless marked

3	1.5K	3	33K	2	100K
1	2.2K	1	33K 1W	1	150K
2	2.7K	2	39K	6	220K
3	4.7K	1	47K	6	470K
1	10K	1	56K	2	1M
1	12K	1	68K	1	4.7M
2	15K	1	68K 1W		
1	27K 1W	1	82K		

POTENTIOMETERS.

1	10K log.	2	250K lin.
1	250K log.	2	470K log.

CAPACITORS Plastic unless marked.

3	100pF	1	.0082uF
1	560pF	1	.01uF
1	.001uF	1	.015uF
2	.0022uF	2	.022uF
2	.0047 uF	4	.047uF 400V
1	.0056uF	7	.1uF 400V
1	.0068uF		
1	.1uF 25V ceramic		
1	.47uF 400V		
1	32uF 350VW electro.		
1	40uF 350VW electro.		
6	100uF 6VW electro.		

MISCELLANEOUS.

5 skirted min. 9-pin valve sockets, printed wiring board type; one shield to suit (for V3); 8 small knobs; 6-tag length of min. resistor strip (meter panel); min. 2-lug tagstrip, 2 min., 3-lug tagstrips, min. 4-lug tagstrip, min. 7-lug tagstrip; 12-pin plug; shielded wire, nuts, bolts, wire

a red bezel. The bezel assembly used in the prototype was one normally fitted with a socket for a miniature Edison-screw bulb, but the socket was removed and replaced by a miniature 3-lug tagstrip to support the neon lamp pigtails.

We understand that ready-made neon bezel assemblies are available, and readers may care to substitute one of these for our arrangement if they feel that this would produce a more professional job.

When soldering small components, particularly small capacitors, half-watt resistors and the meter rectifier diodes, use care to prevent overheating.

It is recommended that the component pigtail wire be held with long-nose pliers or stout tweezers, so that the pliers or tweezers act as a heat sink.

The heater wiring is above the board, as may be seen in the photographs, and is twisted inside 3mm nylex tubing. Keep the wiring at least ¼in above the board to reduce possible hum induction.

Where space permits, components should be mounted close to the board, with their pigtail wires bent no closer than 1/8in from the component body to prevent strain. The only components which should NOT be mounted close to the board are the 220K recording head feed resistor and its 0.1uF series capacitor. These should be raised by about 3/8in on their leads, to reduce induction of recording signal into the replay preamp.

EARTH BRAIDS

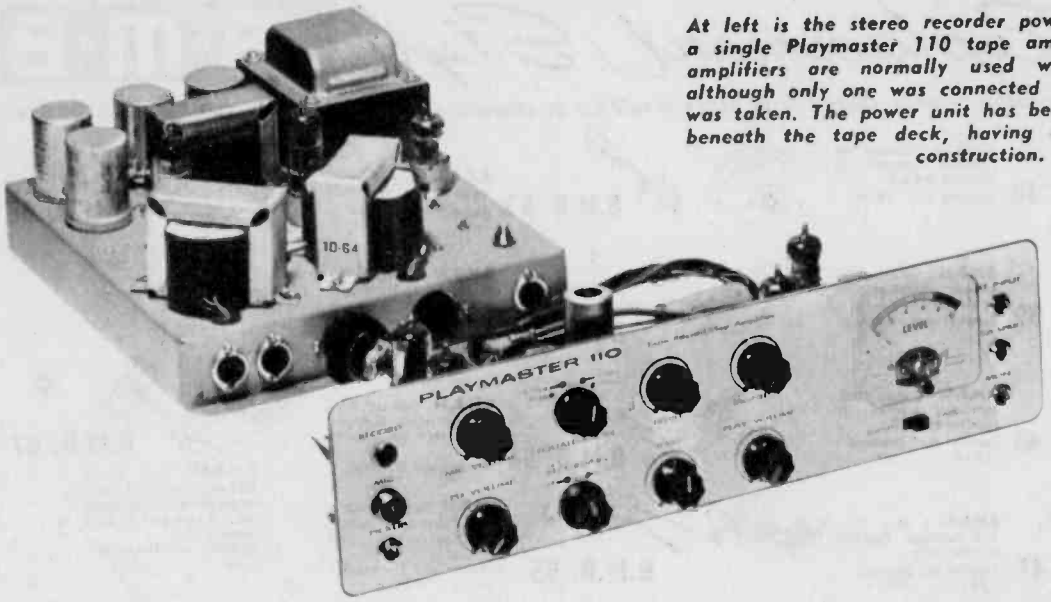
All shielded cable earth braids should be wired as shown in the circuit and the wiring diagram. Otherwise the amplifier may exhibit excessive hum or even instability in extreme cases. The microphone input socket should be insulated from the front panel by the fibre washers supplied with it, the earth connection being made via the shield braid to the board.

The unit may be used with either two—or three-head decks, as mentioned previously. For two-head decks, additional poles are required on the "record/play" switch of the tape deck—the basic 110 amplifier remains unaltered. An auxiliary circuit diagram which will be given in the next article will show all the connections required for the different types of deck.

As supplied, the Brenell deck heads and R/P switch are connected in a different fashion from that required for the 110 amplifier. The existing plugs and switch wiring must be removed and re-wired according to the diagram provided, otherwise the heads may be damaged. Other decks will probably require re-wiring of the head connections also.

Some models of the Brenell deck have the replay head connections brought out to an unshielded tagstrip underneath the deck mechanism. It is necessary to make a small shield cover for this tagstrip, to prevent hum and bias induction. We made a small shield cover out of 20 gauge brass sheet, and soldered it to the existing shield plate over the erase/record head connection strip.

This completes the description of the Playmaster 110 tape amplifier unit. The next article will describe the adapter power unit, which will combine with either one or two 110 amplifiers to form either a mono or stereo tape adapter suitable for use with any high-fidelity amplifier system.



At left is the stereo recorder power unit connected to a single Playmaster 110 tape amplifier. Two of these amplifiers are normally used with the power unit, although only one was connected when this photograph was taken. The power unit has been designed to mount beneath the tape deck, having a chassis of shallow construction.

A COMPLETE STEREO RECORDER USING

THE 'PLAYMASTER 110' TAPE AMPLIFIER UNIT

The second power unit to be described as part of the "Playmaster 110" tape system, the unit described in this article combines with two of the type 110 amplifiers and a suitable high-quality deck to form a complete stereo tape recorder system. Used with suitable microphones and loudspeakers it is capable of very high quality recording and reproduction, yet all components of the system have been designed to facilitate construction.

By Jamieson Rowe

LAST month, you may recall, we described an Adapter Power Unit which combined with either one or two of the "Playmaster 110" tape amplifiers of March to form either a mono or stereo tape adapter system—one requiring the use of an existing high-quality mono or stereo amplifier system for loudspeaker operation on playback. However, as there are applications where complete replay facilities are required in the tape unit itself, we describe this month a power unit which includes power output stages.

This power unit has two single-ended output channels and is intended for use with two type 110 amplifiers to make up a complete stereo tape recorder. A slightly modified version will be described in a following article, having a single push-pull output channel for those wanting to make up a complete high-quality mono recorder. Both versions will employ the same power supply, bias/erase oscillator and chassis.

Before describing the new power unit a correction must be made regarding an erroneous statement made in the April article. It was stated that the Bogen erase heads used on the Brenell deck are low impedence types, requiring less erase voltage than those used in such decks as the Collaro (English Magnavox). In fact, the Bogen erase heads are of relatively high impedence and considerably higher than the other types. It is the Bogen RECORD heads which are of relatively low impedance.

Because of the differing head impedances of the various decks, it is not possible to design an amplifier which will suit all decks without modification. However, the 110 tape system has been arranged to suit without modification decks having a head complement similar to that of the Brenell—high impedance erase, low impedance record, medium impedance replay (where used). With various modifications, it may be used with a number of other decks and head complements, as discussed in the appendix at the end of this article.

Let us now turn to the circuit of the new power unit for a brief discussion of its operation. The circuit may be split for discussion into three basic sections—the output amplifiers, the bias/erase ocillator and the power supply.

The output amplifier channels employ 6GW8 (ECL86) triode-pentode valves, using one valve per channel. The valves are connected in a two-stage feedback amplifier circuit having an output of approximately 3 watts RMS (in the voice coil). The input sensitivity of the channels is approximately 150-mV for full output.

The response of the channels is flat within 1dB from 35 cps to 19KC (approx), the 3dB down points occuring at 25cps and 25KC. Thus whether used for tape or gramophone reproduction the channels will give excellent tonal fidelity.

The output of the amplifier channels is at 15ohms impedance. It is taken to the 12-pin sockets, from which it passes to the 110 amplifier units and their "Output" jacks. This allows external speakers to be connected to the recorder system for high quality reproduction in the home. Any high quality 15ohm speakers in suitable enclosures could be used with the unit in this fashion, the recently described "Playmaster 109 Bookshelf" units (December 1964) being eminently suitable.

If external speakers are not used the output signals return to the power unit from the 110 amplifiers, and are fed to the internal speakers. These would typically take the form of small round or elliptical units mounted at each end of a portable case, or perhaps slightly larger units mounted in the halves of a split and removable case lid.

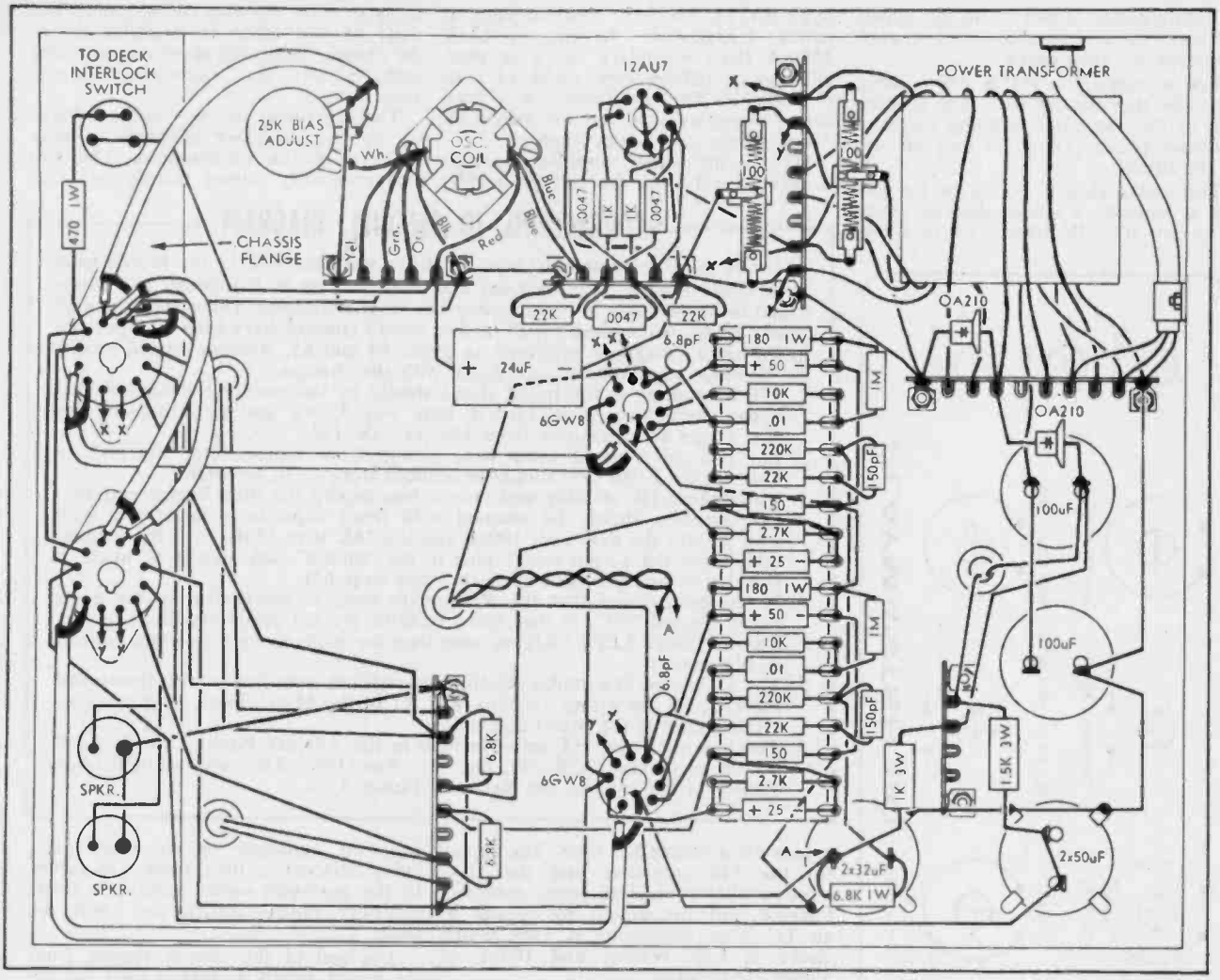
There is no reason why the internal speakers could not be larger, properly

SPECIFICATION

THE power unit described combines with two type 110 tape amplifiers and a high quality deck such as the Brenell Mark 5 Series 2 to form a complete stereo recorder. It contains power supply, erase/bias oscillator and replay power amplifiers.

The power amplifiers are single-ended output channels using 6GW8 valves and have an output of approximately 3W (RMS) maximum. Response is within 3dB from flat over the range 25cps—25KC, and the overall recorder response obtained will be close to that of the 110 amplifiers — 40cps to 19KC at 15ips, 40 cps to 18KC at 7.5ips, 40cps to 8.5KC at 3.75ips and 40cps to 4KC at 1.875ips (these figures refer to 3dB down points).

Using the replay system of the recorder for gramophone record reproduction from a crystal or ceramic pickup the response will be virtually the same as for the 15ips tape speed, and full bass and treble control is retained. For further specifications regarding the 110 amplifiers refer to the March article.



Above is a complete wiring diagram of the stereo recorder power unit, to allow construction by enthusiasts with little previous wiring experience. Below is an underchassis photograph of the unit, showing the actual wiring and placement of parts. These have been distorted in the above diagram where a literal representation would have impaired clarity.

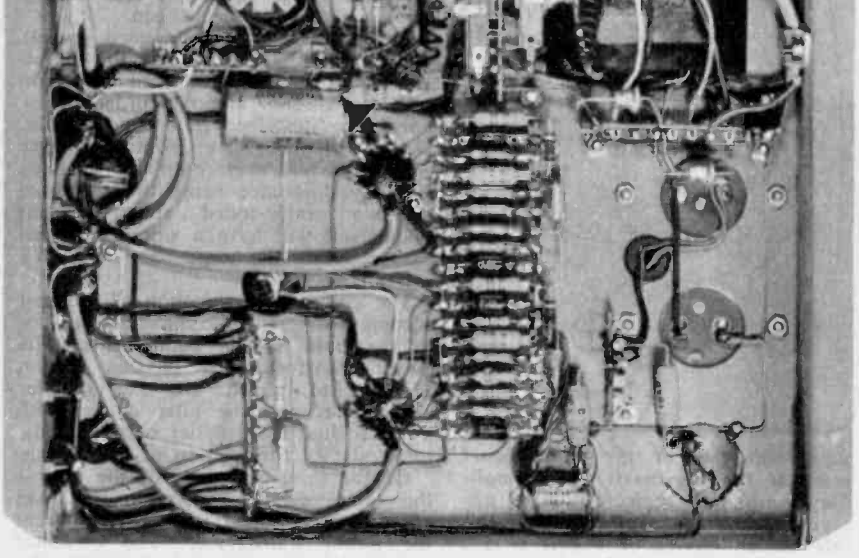
enclosed units, of course, although this would strictly only be possible if the tape recorder were to be made a "non-portable" console unit — perhaps the basis of a complete home stereo system, since it may be used for high-quality gramophone reproduction.

In such a case the unit could well incorporate two enclosures identical to the Bookshelf units placed at opposite ends of a longish console (the longer the better, within reason!), or preferably use two Bookshelf enclosures as "internal" speakers separate from the deck and electronics console.

The bias/erase oscillator is identical with that used in the adapter power unit. It employs a 12AU7 valve in a push-pull Hartley circuit, and delivers a pure waveform to ensure quiet erasure and low recording distortion.

The actual coil used differs from that used in the adapter power unit, as may be seen from the photograph. As mentioned in last month's article, the first coil was an original Brenell unit, but these are not available in this country. Accordingly, arrangements were made for equivalent coils to be manufactured locally, by R.C.S. Radio Pty. Ltd.

The coil used in the new power unit is, in fact, one of the new R.C.S. units. It uses the same colour code as the original Brenell coils to obviate possible confusion if the latter should ever become available. It is electrically equivalent to the Brenell coil but is fitted with additional secondary winding turns which make it also suitable for use with decks having high impedance



recording heads. Later on in the appendix we shall discuss the circuit changes necessary for such decks.

For reference, the R.C.S. coil is designated by the number 265. The connection to the secondary winding extension is colour coded yellow, as may be seen on the circuit.

The power supply section of the new unit is basically a voltage-doubler circuit using two 400 PIV 500mA silicon diodes (type 0A210, 1N1763, 1N2862, etc.). A power transformer having a 124V 150mA (DC) secondary rating is used, although a 125mA type could be used if available. The transformer is a horizontal mounting type and has two 6.3V 3A windings for heater supply.

HT for the power amplifier channels is taken direct from the voltage doubler output via a simple RC filter. The supply for the 110 amplifiers and the bias/erase oscillator receives more extensive filtering and decoupling by means of an LC filter employing a 14H 60mA choke, a 1.5K resistor and 100uF of bypass capacitance.

This degree of decoupling is required to ensure low-frequency stability, as the system possesses considerable gain and the tape replay equalisation is characterised by a substantial amount of bass boost.

Mechanically, the recorder power supply unit is constructed on a shallow rectangular pan-type chassis measuring 11in x 9in x 1¾in overall. The shallow chassis and the use of a horizontal mounting power transformer keep the total height of the unit to approximately 4½in, making it suitable for mounting beneath the deck mechanism.

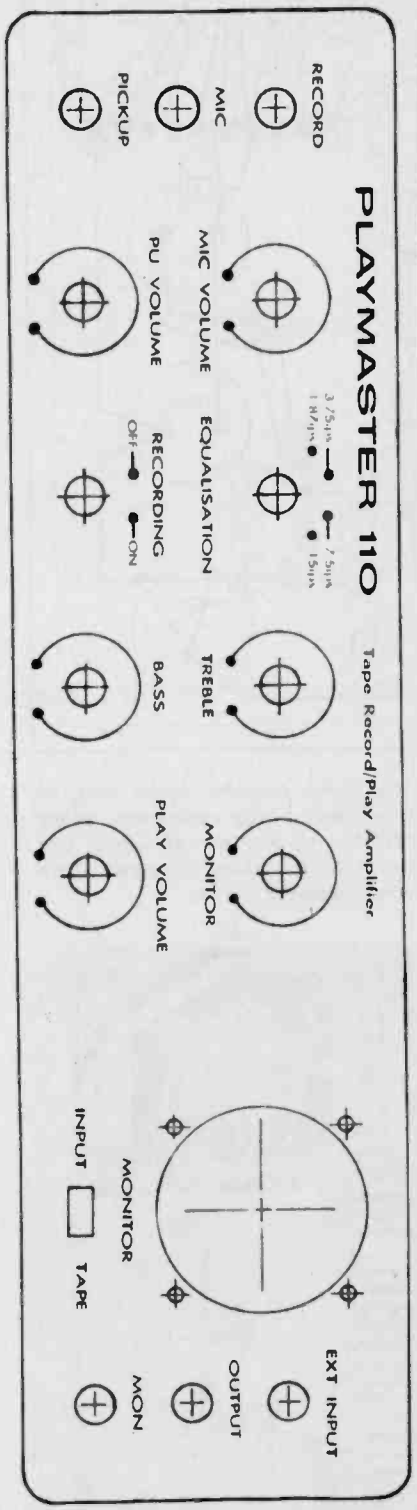
The chassis has been designed so that it may be used either for the stereo recorder power unit described herein or for the push-pull mono recorder power unit to be described in a later article. The latter will have identical power supply and bias/erase oscillator sections, the only difference being that in place of two single-ended stereo output channels it will have a single push-pull channel using the same pair of 6GW8 valves.

The power supply section of the unit occupies almost half the chassis, due to the bulk of its components. The power transformer is in one corner, adjacent to which are the doubler electrolytics and the filter choke, with the two dual electrolytics occupying the remainder of this section of the chassis.

Of the remaining half of the chassis the bias oscillator section occupies approximately one-third, that adjacent the power transformer. The oscillator coil itself is mounted beneath the chassis, as is the bias setting pot. The shaft of the latter is available above the chassis, being cut short and provided with a slot for screwdriver adjustment.

The remainder of the chassis is taken up by the amplifier channels as may be seen in the photographs. The two medium-quality output transformers are mounted obliquely to conserve space, being adjacent to their respective valves. In the push-pull mono version, a single centrally placed transformer will be used.

The end of the chassis remote from the power supply section is used for the interconnection sockets. At the bias oscillator end a small four-pin socket is used as before for connection to the deck interlock switch, while the two 12-pin connectors for the type 110 amplifiers are in the centre. Two polarised two-pin sockets are mounted at the far end for connection to the internal speakers.



A reproduction of the front panel print of the Playmaster 110 amplifier, shown half scale. Full-sized unglazed prints are available from the information service at a cost of 5/, if required.

CORRECTIONS TO CIRCUITS, DIAGRAM

SINCE the Playmaster 110 tape amplifier was described in the March issue a small number of corrections and modifications to the design have been found to be desirable in order to improve its performance. These are explained briefly below, while those which involve circuit changes have been incorporated in the circuit diagrams reprinted on pages 64 and 65. Readers should modify the previous parts lists in accordance with the changes.

1. HT decoupling to the initial stages should be increased by making BOTH bypass capacitors 40uF/350VW (one was 32uF), and by increasing the first stages series resistor from 15K to 33K/1W.
2. For reduced replay preamp hum pickup from motors, etc., the grid resistor of the EF86 (V4) should be reduced from 470K to 220K.
3. To improve HF stability and reduce bias pickup the three replay equalisation resistors should be shunted with small capacitors—the 150K with with 220pF, the 82K with 100pF and the 56K with 33pF. Also the connections from the 12-pin power plug to the "output" jack should be made in shielded twin-conductor cable (see circuit on p. 65).
4. It has been found that the RF chokes used as substitutes for the erase heads (record "off") in the stereo versions are not really required. In fact they are BEST LEFT OUT because they inevitably radiate a certain amount of bias energy.
5. The 150K and 56K replay equalisation resistors were shown with transposed markings in the wiring diagram of p. 31 of the March issue. They are correctly shown in the circuit diagram.
6. The bias oscillator HT series resistor in the Adapter Power Unit of April should be marked 2.2K/3W, not 47[illegible] ohms/1W. The value of 470 ohms applies in the case of the Recorder Power Unit.

WIRING DETAILS

The underchassis wiring is visible in the photograph, and should be made clear by the wiring diagram which we have prepared to aid the lesser-experienced constructor. All minor components are supported on either the resistor panel (miniature type) or on miniature tagstrips. It should be fairly easy to duplicate the original wiring using the photograph, circuit and wiring diagram as a guide.

One or two points should perhaps be mentioned in connection with the wiring. As with all audio equipment, the heater wiring should be carried out in twisted wires to minimise external fields. The wire used should be sufficiently stout to carry two or three amps without undue temperature rise (7-.010 nylex covered is quite satisfactory), and the heater wiring should preferably be done before the rest.

In wiring up the shielded cables for signal and bias/erase connections, follow carefully the wiring diagram concerning the shield braids. Deviations from the connections shown may cause hum, instability or bias injection into

signal circuits, and are not recommended.

When soldering small components to tagstrips or the resistor panel, do not bend their pigtail wires too close to the body of the component or damage may occur. Also do not cut the leads too short (leave at least ¼in), or the component may be damaged during soldering. If possible, use a pair of tweezers or pliers as a "heat sink" during the soldering operation, by using them to grip the wire between the component and the joint.

The output transformers may be provided with additional secondary winding taps, to suit other speaker impedances. If it is desired to use internal and external speakers of other than 15 ohms impedance the wiring to the 12-pin and 2-pin sockets could be taken from the appropriate taps, the 15-ohm taps still being used for the feedback. If transformers having no 15-ohm secondary tap are used (perhaps because these are already possessed by the constructor), the feedback resistors at least will have to be altered accordingly.

The feedback resistor value varies with the square of the impedance ratio, i.e., for a secondary impedance of half the value given (7.5-8 ohms) the resistors would be one quarter the value shown or approximately 1.8K. For a 3.75-ohm secondary the value would be approximately 820 ohms.

POSSIBLE TROUBLE

However, it should be noted that using other transformers may necessitate more modifications than just a simple change of feedback resistors—different transformer phase characteristics may require the use of a feedback phasing capacitor and/or alteration of loop gain by modification of step circuits or feedback ratio.

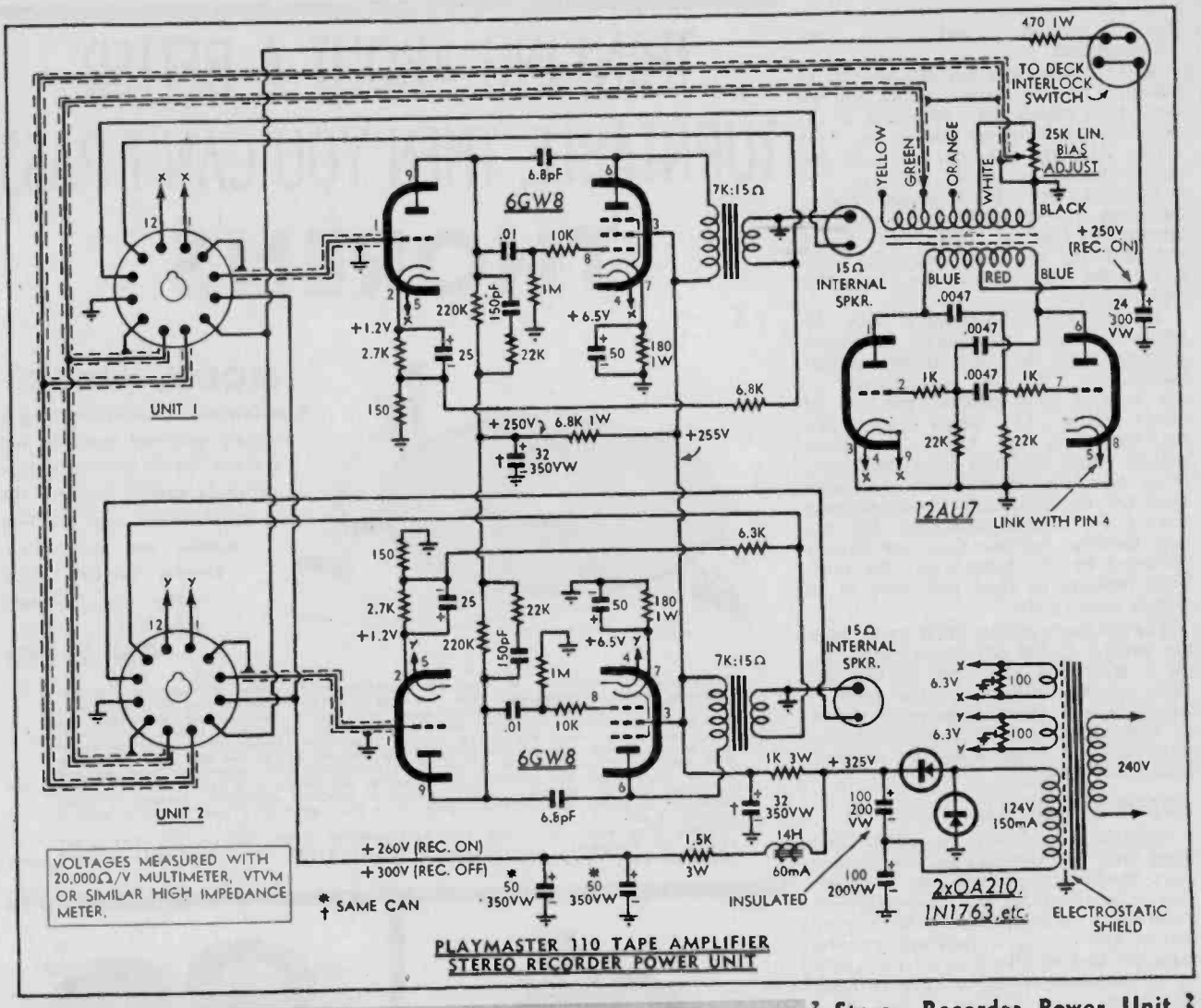
The head connections, both for two-head and three-head decks, were given last month. Particular note should be made of the connection between the deck itself and the amplifier chassis; if this is not done operation will be plagued with instability and hum.

When the wiring is completed, the mains can be connected after the 110 amplifiers and speakers have been plugged in. If you are greeted with a loud scream from one or both channels after warmup, switch off and reverse the output transformer primary connections, as the screaming would indicate that the feedback polarity is positive rather than negative.

Providing the wiring and components are satisfactory, this should be the only possible source of trouble and, if the feedback is correctly polarised, the system should be ready for immediate adjustment and use.

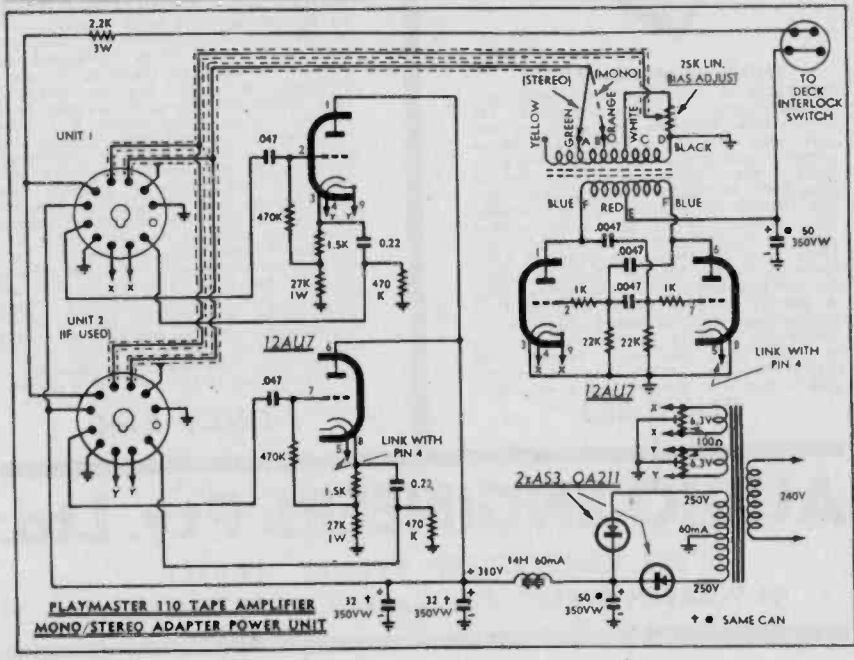
As with the adapter power unit, the heater balancing pots should be set by turning up the replay gain controls and adjusting the pots for minimum hum in the respective channels. Determination of the minimum can be done by listening to the speakers or by connecting a VTVM or millivoltmeter across the speaker leads.

Adjustment of the bias control should be done according to the instructions given in last month's article. Briefly, the idea is to increase the bias to the point where the signal on the tape has peaked and fallen to about 0.8 of its peak value.



PLAYMASTER 110 TAPE AMPLIFIER
STEREO RECORDER POWER UNIT

Above is the circuit diagram of the Stereo Recorder Power Unit, which should be used in conjunction with the wiring diagram and underchassis photograph in constructing the unit. Below and on the facing page are reprinted circuit diagrams for the Adapter Power Unit and the Playmaster 110 amplifier unit, incorporating the modifications mentioned on page 62. All three circuits show typical circuit voltages.



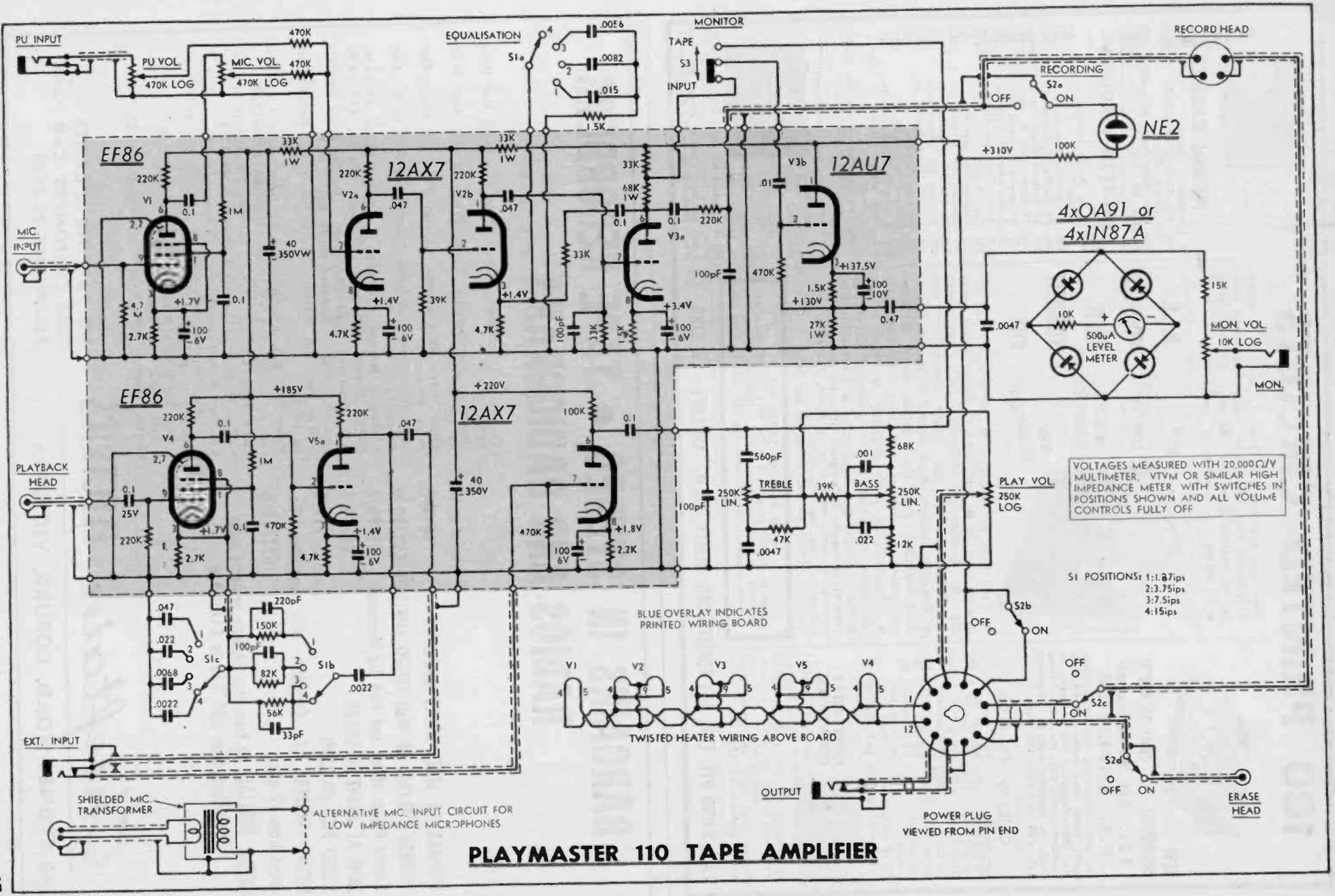
Stereo Recorder Power Unit
PARTS LIST

1 Chassis, 11in x 9in x 1¾in.
1 Power transformer, 124V at 150mA, 2 x 6.3V at 3A, flat mtg.
2 Output transformers, med. quality, 7000 ohms SE to 15 ohms.
1 Filter choke, 14H at 60mA.
2 6GW8 valves, 1 12AU7 valve.
1 Bias osc. coil (see text).
2 Silicon pwr diodes type OA210 or similar.

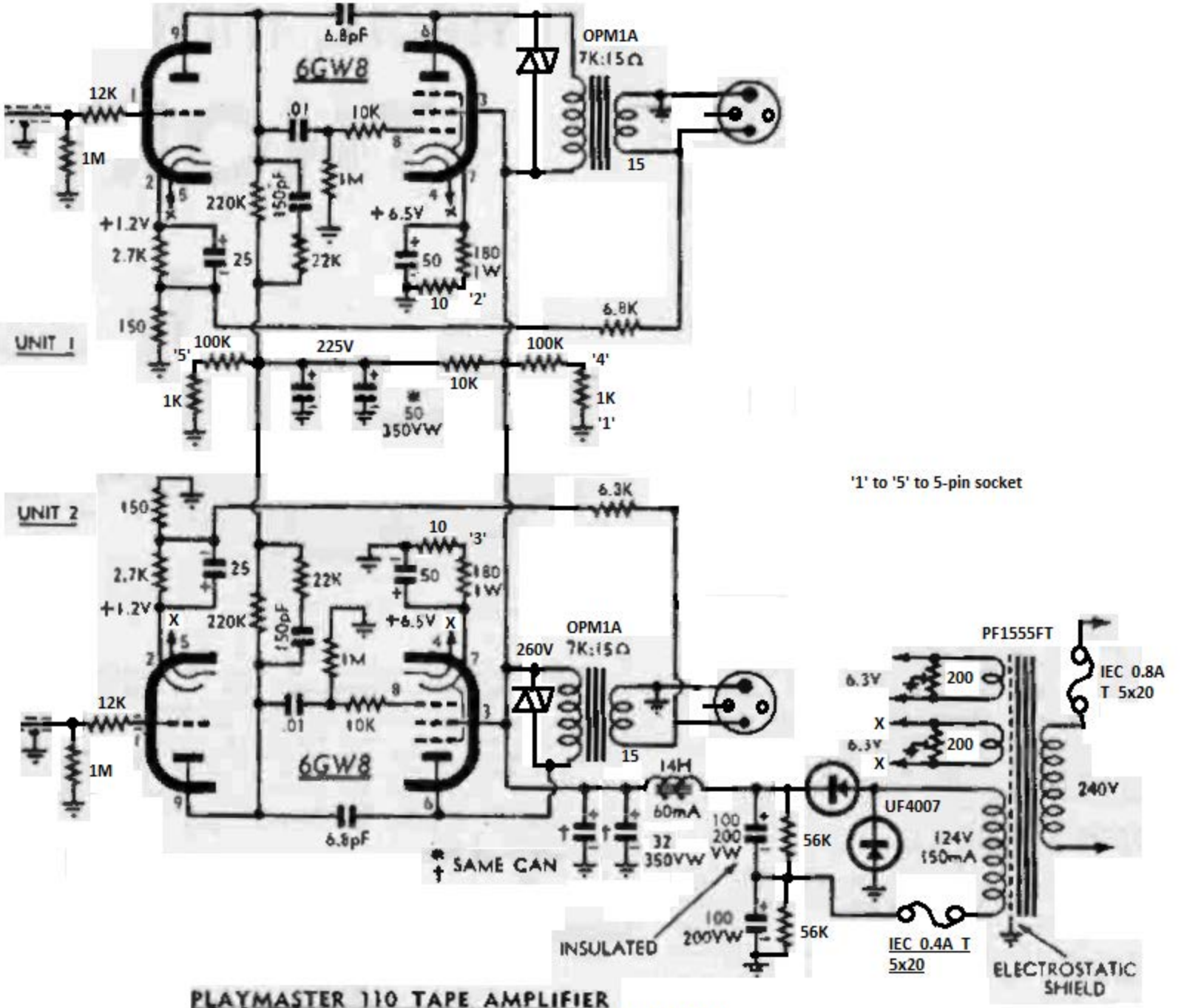
RESISTORS (½ watt unless marked).
2 x 150, 2 x 180/1W, 1 x 470/1W 2 x 1K, 1 x 1K/3W, 1 x 1.5K/-3W, 2 x 2.7K, 2 x 6.8K, 1 x 6.8K/1W, 2 x 10K, 4 x 22K, 2 x 220K, 2 x 1M, 2 x 100 ohm slider pots, 1 x 25K LIN pot.

CAPACITORS
2 x 6.8pF, 2 x 150pF, 3 x .0047uF/-600V, 2 x .01uF, 1 x 24uF/350VW electro, 2 x 25uF/3VW electro, 1 x 32-32uF/350VW electro, 1 x 50-50uF/350VW electro, 2 x 50uF/-10VW electro, 2 x 100uF/200VW electro, one insulated.

MISCELLANEOUS
3 x miniature 9-pin valve sockets; 2 x 12-pin sockets, 2 x polarised 2-pin spkr. sockets and plugs, 1 x min. 4-pin socket and plug; 18-lug length of miniature resistor panel; 3 x 10-lug, 3 x 6-lug min. tagstrips; power cord and plug; nuts, bolts, grommets, etc.



PLAYMASTER 110 TAPE AMPLIFIER



PLAYMASTER 110 TAPE AMPLIFIER
STEREO RECORDER POWER UNIT **MODIFIED**

PLAYMASTER 110 TAPE AMPLIFIER MODIFIED

EQUALISATION
MIC. VOL
470K LOG
A
B
2N2
5N6
8N2
1.5K
MONITOR
TAPE
S3
INPUT
RECORDING
S2a
OFF
ON
S2b
OFF
ON
EF86
100K
0.1u
V1
10K
1M
2K2
100 6V
+1.7V
470k
VS3
47K 1W
47u 350VW
12AX7
220K
V2a
.047
PLAY
VOL
250K LOG
+1.4V
4.7K
6u8
VS2
33K 1W
220K
V2b
.047
+1.4V
4.7K
33K
33K 68K 1W
0.27
0.1
V3a
10K
3.4V
6u8
VS1
V3b
12AU7
47u
470K
+137.5V
1.5K
+120V
100 10V
0.47
27K 1W
.0047
4xOA91 or
4x1N87A
2K2
500uA
LEVEL
METER
OUTPUT
15K
MON. VOL
10K LOG
MON.
MIC. INPUT
EF86
100K
4N7
V4
2.7
1M
3N3
470K
220K
2.7K
+1.7V
220K
.047
V5a
4.7K
100 6V
+1.4V
12AX7
47u 350V
100K
0.1
470K
100 6V
+1.8V
2.2K
560pF
B
100pF
250K LIN.
TREBLE
39K
.001
68K
BASS
250K LIN.
47K
.0047
.022
12K
OFF
S2c
ON
S2d
OFF
ON
A
.047
150K
S1c
S1b
330K
.0022
.047
EXT INPUT
PU INPUT
PU VOL.
470K LOG
BLUE OVERLAY INDICATES
PRINTED WIRING BOARD
S1 POSITIONS: 1:1.87ips
2:3.75ips
3:7.5ips
4:15ips
V1
V2
V3
V5
V4

FERGUSON

OUTPUT TRANSFORMER — OPM1A

MEDIUM FIDELITY 40-12000 cps — FEBRUARY 1962

TYPE OPM1A

Ferguson Type OPM1A Output Transformer is a medium fidelity type designed to couple a single-ended output stage to a wide range of speaker voice coil impedances.

RATING

NOMINAL POWER RATING .....5 Watts

FREQUENCY RESPONSE.....40-30000 cps ± 2db

PRIMARY IMPEDANCES .....7000, 5000 ohms S.E.

SECONDARY IMPEDANCES:-

Nominal ... 15 8 3.7 2 ohms

NOTE: Use secondary tap nearest speaker voice coil impedance.

PRIMARY D.C. RESISTANCE .....513 ohms (7000 ohm tap)
420 ohms (5000 ohm tap)

MAX. PRIM. D.C. .....50 mA

MAX. PRIM. D.C. (For specified response) 35 mA (7000 ohm tap)
45 mA (5000 ohm tap)

MOUNTING

Wrap-over bracket, cadium plated, firmly crimped to the core with heavy core-locking tabs and slotted mounting feet.

Primary and Secondary leads 10/.010 PVC insulated.

DIMENSIONS

HEIGHT	2-5/16 inches
WIDTH (Over Coils)	2-1/2 inches
LENGTH	2-3/4 inches
OVERALL LENGTH (Inc. Mtg. Feet)	3-3/4 inches
MOUNTING CENTRES (NOMINAL)	3-1/8 inches
MOUNTING SLOTS	3/16 inch wide
APPROXIMATE WEIGHT	1-3/4 lbs.

COLOUR CODE

PRIMARY .....7000 ohms - Yellow, 5000 ohms - Orange, H.T. - Red.

SECONDARY .....15 ohms - Yellow, 8 Ohms - Orange, 3.7 ohms - Red

2 ohms - Brown, Common - Black