

"NEW LOOK" FOR THE EVER-POPULAR UNIT-4

For over five years, since May, 1962, the "Unit Playmaster No. 4" has been a sales leader among kits—a single unit stereo amplifier with excellent performance, full tone control facilities and a power output of about 10 watts per channel. With minor revision to its controls and its input and output facilities, it can take its place alongside the most modern solid-state equivalents.

By Leo Simpson

Two months ago, when we set about presenting the "All-Silicon Playmaster 115," we made no secret of the fact that its specifications were patterned on those which had proved so popular with the original No. 4 Unit Playmaster; sensitivity to operate from good quality ceramic pickups, full control facilities, good performance, a power output of about 10 watts per channel, straightforward construction and a general economy of design. The 115 met these requirements, within the framework of present-day solid-state techniques, with the option of an in-built preamplifier for low-output magnetic pickup cartridges.

But the release of a solid-state amplifier does not, by any means, indicate that valve amplifiers have "had it." For all practical purposes, the performance figures of the basic No. 4 valve design are the same as those for the solid-state version. It can have the same control and input/output facilities, will fit into the same size case and can, if necessary, be provided with a similar preamplifier for magnetic pickup cartridges. To be sure, valves aren't quite as modern as transistors, and they operate at higher temperatures but, against this, many enthusiasts will find this amplifier somewhat easier and cheaper to build than the 115 all-silicon design.

In fact, it is not our purpose to try to "sell" one design or the other. On the contrary, we have quite deliberately arranged for them to be virtually identical in external appearance and performance. Those who are looking for a solid-state design, with its air of modernity, will naturally choose the 115. Others, who may prefer to stay with the techniques they understand better may prefer the new 118, as we have designated the restyled No. 4. The comparative costs will be something for suppliers to work out and advertise, though we expect the valve unit to be the cheaper of the two, at least for the time being.

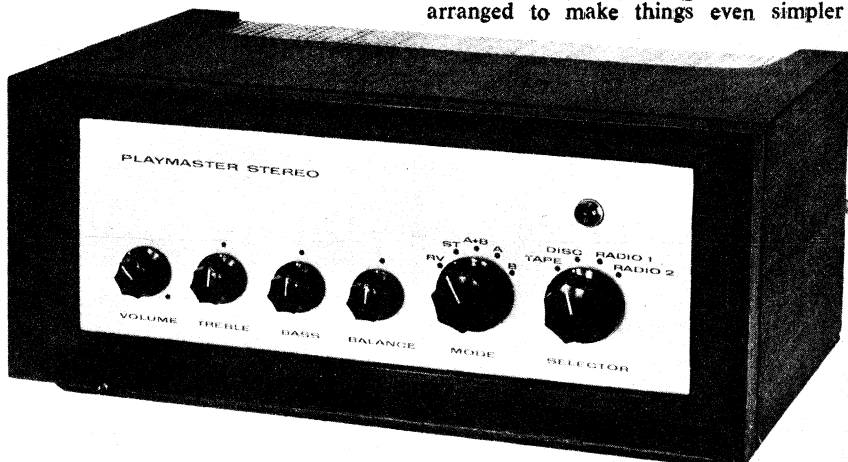
The restyling is largely a matter of physical arrangement. The old "selector" switch, popular a few years ago, has been replaced by two switches, one to select the signal source and the other to select "mode" — a variation largely prompted by the possible use of amplifiers with mono/stereo tape-recorders. This new control facility, requiring an extra knob, obviously calls for a new panel, the layout being the same as for

the 115 and the transistor control unit which preceded it.

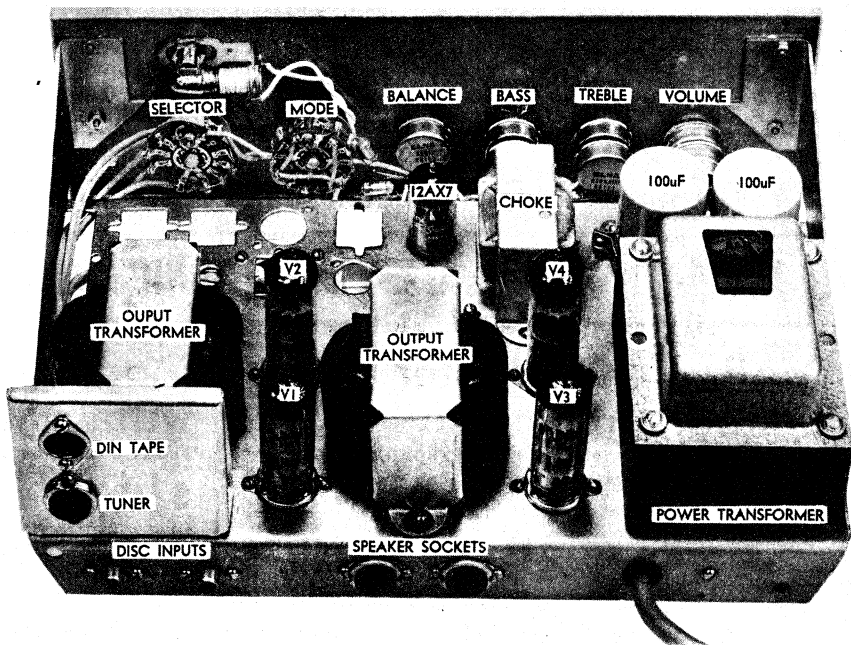
Behind the panel, the components have been laid out on the same chassis as is standard for the 106 Playmaster tuner/amplifier. Use of the same chassis is intended to assist the parts suppliers and the space not used for a tuner is available for a solid-state magnetic pickup preamplifier, should this be required.

At the rear of the chassis, we have rearranged the connection facilities to provide for tape input/output, as well as for pickup and radio tuner.

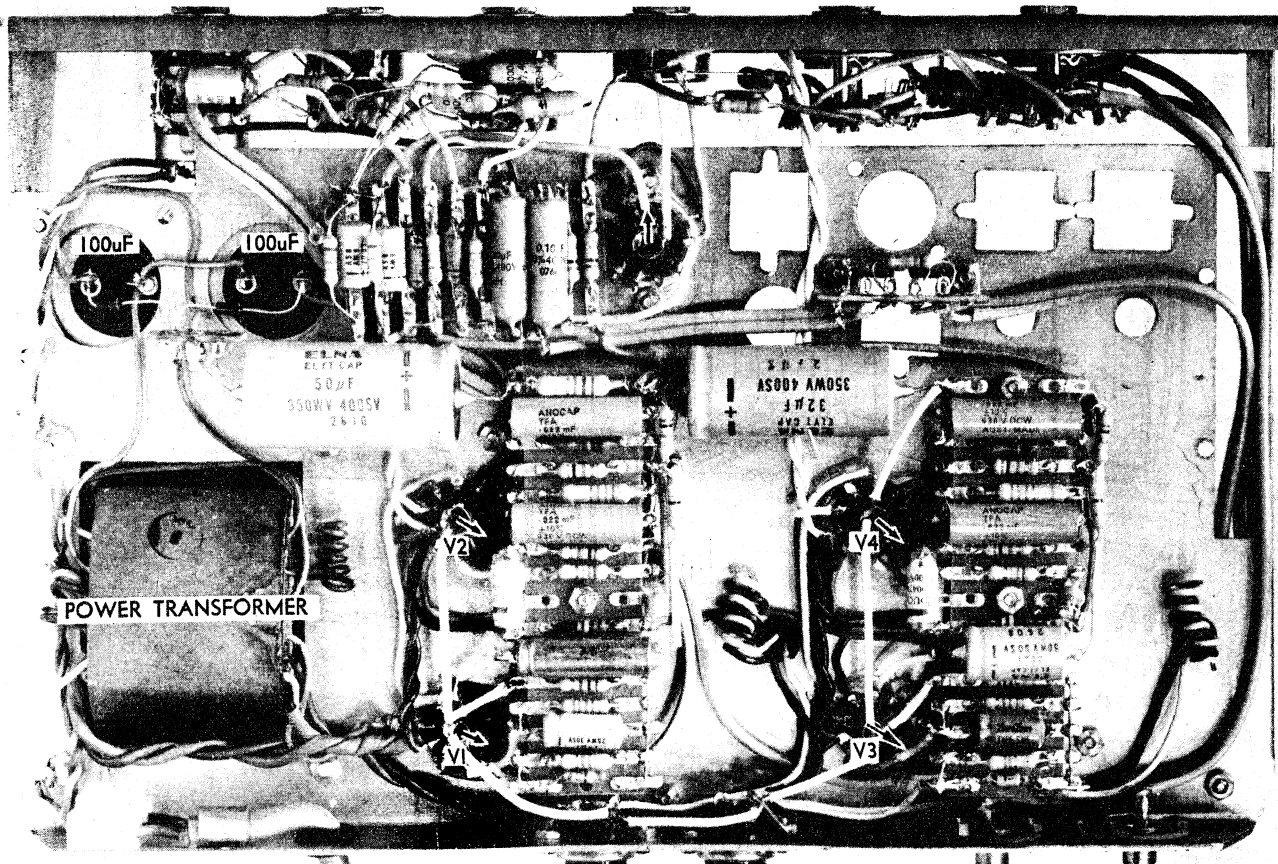
Underneath, the wiring has been rearranged to make things even simpler



A front view of the new 118 Playmaster, fitted with a full-size panel and housed in a teak case, both available from one of our advertisers. These could be used for the 115 all-silicon unit featured in the May issue, alternatively, the new 118 can as easily be housed in a metal case, the two being quite interchangeable.



A rear view of the 118 Playmaster, constructed in the chassis originally designed for the popular 106 tuner/amplifier. The vertical bracket in the left foreground carries the DIN plugs for radio tuner and tape input/output. Constructors not requiring these facilities may prefer to omit them for the time being, but we suggest that the adjacent output transformer be moved forward slightly—just in case!



An underneath view of the amplifier, with most of the wiring components neatly arranged on tagboards. These are diagrammed on page 83. The vacant holes used for the tuner in the 106 tuner/amplifier are evident, but this area can very logically be used for a solid-state pre-amplifier board, if it is intended to use a high quality magnetic cartridge.

for the constructor but the circuit itself is virtually unchanged.

As will be apparent from the photograph of the chassis, two "push-in" type shielded sockets are provided on the rear lip for connection to a stereo cartridge. Where it is intended to use a magnetic cartridge, the connectors would be wired to a transistorised preamplifier board to boost and equalise the signal before it is passed on to the valve circuitry proper. Where a ceramic or crystal pick-up is to be used, the preamplifier is unnecessary, the available signal being suitable for direct application to the amplifier in the simple form as pictured. (We plan to describe a suitable preamplifier in our next issue.)

As already mentioned two sockets are mounted on a vertical plate behind one output transformer—a DIN socket for high level tape inputs and outputs and another socket (preferably dissimilar) for possible connection to a Playmaster AM radio tuner.

The various input signals are directed, as desired, by the Selector and Mode switches to the grids of a 12AX7 high-gain twin-triode used as a preamp for both channels. Use of this high-gain valve secures an input sensitivity of 110mV RMS for full output, enabling even low output ceramic cartridges to drive the amplifier to full power.

In specifying a 12AX7 as a first choice, we are assuming that most constructors of an amplifier such as this will, in fact, select one of the better quality ceramics. If a crystal cartridge is used, its higher output could lead to some distortion, since the 12AX7 ap-

proaches overload with input signals greater than about 1.7 volt RMS.

Those who already have a crystal cartridge on hand could reduce the gain by substituting a 12AU7 as a direct plug-in replacement. For best operating conditions, however, the cathode resistors should be increased to 2.2K and the 120pF capacitors in the input balance network reduced to 33pF. With the 12AU7, the sensitivity falls to 360mV for full output, a figure which is ample for crystal cartridges.

Alternatively, the signal output of any piezo cartridge—crystal or ceramic—can be reduced by connecting selected values of capacitor across the respective output leads. This has the added advantage of reducing the effective source reactance, relative to the load resistance and extends the bass response, whilst lowering the output over the rest of the range. A little experiment can establish the desirable conditions where the pickup can just comfortably overload the amplifier with the volume control a little less than full on.

The balance control consists of a single 2-meg linear potentiometer, with each "leg" connected to the triode grid in each channel and with the moving arm connected to earth.

Following the preamp. stage come the tone control networks and the volume control. Putting the controls in this relative position in the circuit makes it necessary to protect the preamplifier valve against overload, as already outlined, but it makes for a much "quieter" amplifier. Any hiss and hum from the preamplifier stage is attenuated by what-

ever amount the volume control is normally retarded, while there is less gain following the controls to amplify "scratching" sounds produced by faulty variable elements.

As can be seen from the tone control response curves, generous bass and treble boost and cut facilities are provided. This suits the amplifier to typical "bookshelf" loudspeaker systems, which usually require moderate bass boost, while still leaving enough bass boost for program correction or low level listening.

The tape outlets are supplied from the 0.1μF preamp. coupling capacitors via 56K resistors. Notice that the shielded cable to the DIN socket is earthed at a point adjacent to the 12AX7 socket. The signal to the tape outlets is independent of the setting of volume or tone controls, allowing tape recording to proceed with the amplifier completely silenced, or at any level desired for incidental listening or monitoring.

The rest of the circuit consists of two 6GW8s in each channel, in a well-proven configuration that has been used often in various projects over the years. The pentodes of the two 6GW8s are connected in a push-pull "ultra-linear" mode.

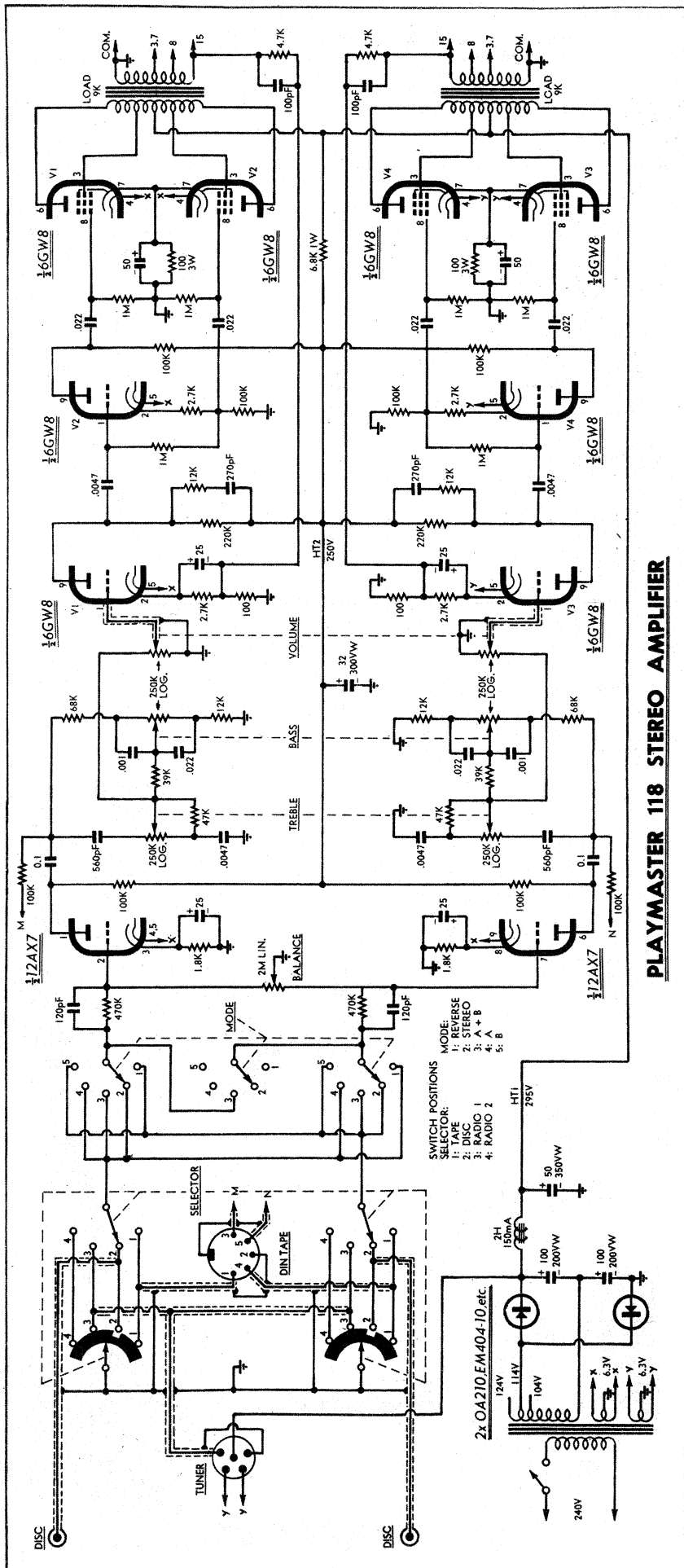
The triodes of the 6GW8s are used as voltage amplifier and phase splitter in each channel. A step circuit is connected in the plate circuit of the voltage amplifier to roll off the frequencies above 20KHz and thus minimise the risk of instability at supersonic frequencies.

Negative feedback is applied from the 15-ohm secondary of each output transformers to the cathode of the relevant voltage amplifier triode. The feedback is of the order of 14dB, which seems quite "puny" when compared with the amount used in some transistor amplifiers. However, the ultra-linear connection confers an additional benefit and the performance of the power amplifier as a whole is very good, as will be evident from the distortion figures quoted in the specification panel.

Notice the phase-correction capacitor connected across the feedback resistor. This is used to offset the phase rotation in the output transformers as the frequency increases. It is normally selected using a square wave generator and a CRO, but the value shown should be very close to the mark for the output transformers which constructors are likely to use in this design.

The transformers are supplied with multi-tapped secondaries for loads of 3.7, 8.0 or 15 ohms. We suggest, however, that the transformers be wired with

The complete circuit diagram of the new 118 amplifier, as it would be for those planning to use a ceramic pickup. For a crystal pickup, delivering higher output, it would be wise to substitute a 12AU7 for the 12AX7 input stage, or reduce the output of the crystal cartridge, as explained in the text. For a magnetic cartridge, a preamplifier will need to be added, which will be presented next month. In practical service, the performance of this amplifier should be indistinguishable from the 115 Playmaster, described in the May issue.



the "Common" side of the secondary to chassis and with the feedback taken, as shown, from the 15-ohm tapping. The loudspeakers can be connected across whole or part of the winding, as required.

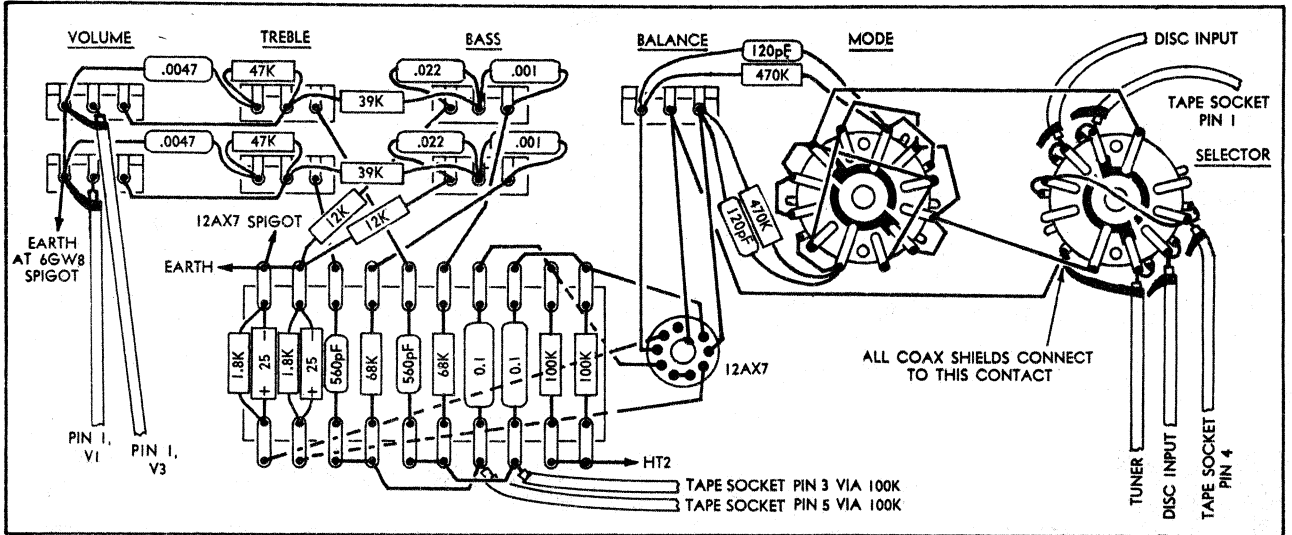
The transformers sold for this and the earlier 106 Playmaster are constructed with "grain-oriented" laminations. They are rated for 12 watts RMS at 40Hz and, as such, are outstanding value for money when compared to the "super-fidelity" types which extend the power response to 20Hz and below — fre-

amplifier chassis which means that the chassis manufacturers can "pension off" the Unit No. 4 chassis. It allows a more compact layout for the valve circuitry, leaving the space normally occupied by a tuner to be utilised for a transistor preamplifier for magnetic cartridges. We intend to describe this in a future article.

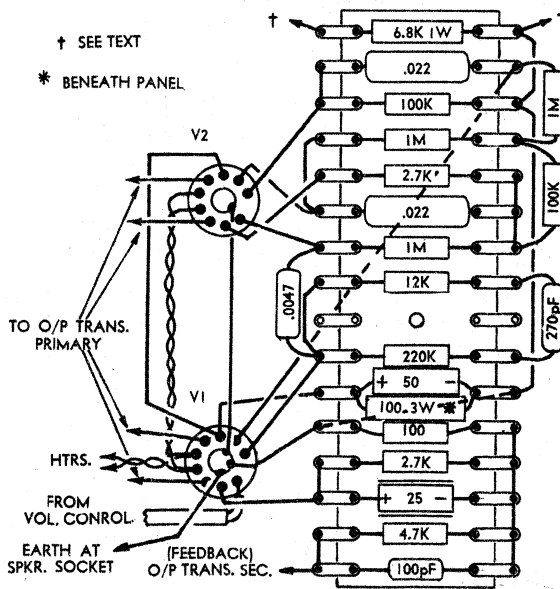
Combined with the chassis is the front panel from the Playmaster 115 transistor amplifier. This accommodates the new control layout, which is now standard on Playmaster stereo ampli-

hardware, such as the power and output transformers, should be mounted first. The power transformer should be mounted on the chassis with spacing nuts, leaving in position the nuts already on the transformer. If it is mounted flush on the chassis, the chassis tends to become part of the transformer core, aggravating any possible eddy-current and hum problems.

Note that the output transformers must be mounted as shown so that their cores are perpendicular to the plane of the power transformer core — this to



These diagrams should assist materially in wiring up the amplifier. Depicted above is the wiring for the preamplifier board and the adjacent tone controls. At the right is the wiring for one power amplifier board, the two being identical except for a pair of lugs used to terminate the HT wiring. It is suggested that the boards be checked for mounting position, then pre-wired before installation.



quencies which occur very seldom in recorded music, anyhow!

Moving now to the power supply, it will be recognised as a conventional "voltage-doubler" full-wave system, with an LC network for effective filtering of the HT supply. The regulation of the power supply is sufficient to enable both channels to give the same power before "clipping," whether they are driven singly or simultaneously.

And now to the construction of the amplifier: Here, the major differences between the Unit No. 4 and the present amplifier will become readily apparent.

We used a Playmaster 106/107 tuner/

fiers. Some of our advertisers supply an anodised aluminium control panel to be used with the Playmaster 115, and this is attached to the front panel with the potentiometer nuts. However, it should not be mounted until the amplifier is complete and ready for installation, otherwise it may be marred by accidental scratches.

Four extra 1/8-inch clearance holes will need to be drilled in the front panel to enable panel and chassis to be screwed together. Use countersunk screws and see that the heads are flush with the surface of the sub-panel.

To begin the assembly, the bulky

PARTS LIST

- 1 Chassis 12½in x 7½in x 1½in (Playmaster 106/107).
- 1 Panel 12½in x 4½in (Playmaster 115).
- 1 Printed label (Playmaster 115).
- 1 Power transformer, voltage doubler type, 114 volts AC, 150mA DC, 2 x 6.3 volts CT-3A.
- 1 Filter choke, 150mA, 2Henries, DC resistance 125 ohms.
- 2 Output transformers, A&R Type OT 4005, Ferguson OP412 or equivalent.
- 5 9-pin valve sockets.
- 1 2-pole 4-position rotary switch with "earthing plate."
- 1 3-pole 5-position rotary switch.
- 1 5-pin DIN socket, 1 5-pin socket for tuner.

VALVES AND DIODES

- 4 6GW8.
- 1 12AX7 or 12AU7.
- 2 Power diodes, OA210, EM404-10, etc.

CAPACITORS

- 2 100uF/200VW Electrolytics, "voltage doubler" type.
- 1 50uF/350VW Electrolytic.
- 1 32uF/300VW Electrolytic.

- 2 50uF/50VW Electrolytic.
- 2 50uF/6VW Electrolytic.
- 2 25uF/10VW Electrolytic.
- 4 .022uF/400VW plastic.
- 2 .01uF/400VW plastic.
- 2 .022uF L.V. (low voltage) plastic.
- 2 .0047uF L.V. plastic.
- 2 .0047uF/125VW plastic.
- 2 100pF L.V. plastic.
- 2 560pF L.V. plastic.
- 2 120pF L.V. plastic.
- 2 270pF L.V. plastic.
- 2 1000pF L.V. plastic.

RESISTORS

(half watt unless specified)

- 6 1M, 8 100K, 2 470K, 2 68K, 2 47K, 2 39K, 4 12K.
- 4 2.7K, 2 4.7K, 2 1.8K, 2 100 ohm, 2 6.8K 1-watt. 2 100 ohm 3-watt.

POTENTIOMETERS

- 3 250K(log) dual ganged, 1-2M(lin).

SUNDRIES

- Miniature tagboard, 2 16-lug, 1 10-lug.
- 2 2-pin speaker plugs and sockets, 2 phono input sockets and plugs.
- 6 knobs as in illustration, dual lamp holder with lamp and bezel, rubber grommets, miniature tagstrips, shielded cable, hook-up wire, etc.

minimise the 50Hz hum induced in the O/P transformers by leakage flux from the power transformer. The 1-inch long countersunk screws for mounting the tagboards should be fitted before mounting the O/P transformers. All holes in the chassis through which wires pass should be fitted with grommets to stop any chafing of the insulation.

Looking at the photograph of the amplifier layout above the chassis it will be noticed that we have moved one O/P transformer forward by a distance of ½in. This is to accommodate the auxiliary panel on which we mounted a DIN socket for tape outlets and inputs and also a socket for a tuner.

We made our panel from a piece of 16-gauge aluminium. The extra input sockets might conceivably have been mounted along the rear of the chassis but we preferred not to do so as they would have been hard against the output valve sockets.

Having mounted the transformers, the rest of the "hardware" can be installed. Due to the different design of the voltage doubler capacitor brackets, we had to drill extra holes to mount them. We re-sited the filter choke for the same reason. Extra holes have also to be drilled to fit another two screws to mount the tag-boards, which are longer than those in the original Playmaster 106.

Valve socket orientation will be readily apparent from the appropriate photograph. The potentiometers were set back by the thickness of one nut, allowing only enough thread to protrude to accommodate a nut and lock washer. This means that the control knobs can be mounted almost flush with the control panel.

Wiring can begin with the power supply and a word of advice to novice constructors is appropriate here. Do not use the same coloured hook-up wire throughout the amplifier. It makes wiring inspection and fault-finding so much

more difficult. For example, red may be used for HT supplies, brown for heater supplies, black for earth returns, yellow for cathode networks.

The power supply is wired using the 114 volt tap on the transformer secondary. Those who intend using a Playmaster tuner are recommended to use the 104 volt tap otherwise the transformer will be overloaded, when the tuner is in use. Since the transformer is supplied with two 3-amp centre-tapped windings it is a good idea to load them equally. Each winding can supply a separate channel and preamp or tuner.

The tuner HT supply can be taken directly from the junction of the "voltage doubler" capacitor and filter choke via a 2Kohm decoupling resistor and a 32uF filter capacitor. This arrangement is least likely to upset the operating potentials in the amplifier. The network can be mounted in the amplifier chassis or tuner chassis; we chose to omit it to avoid crowding.

The power cord should be securely anchored using a metal clamp and insulated terminal block. The mains switch is incorporated with the volume control. This is an optional feature and some readers may prefer to keep all mains wiring away from the control section. Others like the convenience which the combined volume control/switch affords.

All wiring associated with the 6GW8 valves is contained in either of the two 16-lug tagboards. We have provided a wiring diagram of one of these tagboards which are similar except for the following: Notice the tags marked with an asterisk on the diagram; now refer to the under-chassis photograph and it will be seen that these tags are used to mount the HT filtering capacitors and the 6800-ohm dropping resistor.

In general, it is easier to partially wire the tagboards before mounting. For example, all the resistors and smaller capacitors can be inserted, soldered and

tails trimmed. Note that the cathode resistor for the output pentodes is wired beneath the tagboard. Make sure that it is not jammed hard up against the metal chassis as the insulation might fail.

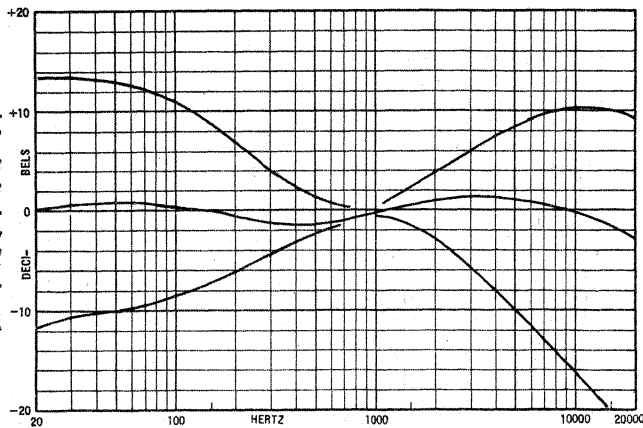
The 100Kohm resistors for the tape outlets were mounted on a separate tagstrip adjacent to the selector switches. These resistors can be omitted if the readers do not require recording facilities.

And here a word about the colour codes to be used when connecting the output transformers. Referring to the wiring diagram of the amplifier tagboard

feedback should be correct. However, if the amplifier breaks into oscillation when it is switched on, the feedback can be reversed by simply swapping the leads to the grids of the two pentodes (pin 8, 6GW8).

All earth returns associated with the 6GW8s are made to points adjacent to speaker sockets. The earth returns associated with the preamp. valve are made to an adjacent point on the chassis, while the shielded cable for the input signal leads should return via the "shorting ring" on the selector switch back to the earthing point for the preamp.

The response curves for the 118 are virtually the same as for the earlier 106 Playmaster. Following what is normal practice for high-fidelity systems, they cross over at 1KHz.



SPECIFICATIONS:

POWER: 8.5 watts rms per channel into 16 ohms, prior to clipping.

DISTORTION: Total harmonic distortion at 2KHz at 1, 3 and 8 watts is 0.26, 0.37 and 0.42 per cent respectively.

CROSS-TALK at 1 KHz: (one channel driven to full power) —38 dB.

SIGNAL to NOISE RATIO: 53dB below full output.

INPUT SENSITIVITY: 110mV for all inputs with input impedance of 1.5M.

FREQUENCY LIMITS (—3dB): 18Hz and 20KHz taken at an output level of 1 watt. Bass control 13dB boost and 10dB cut at 50Hz; Treble, 10dB boost and 20dB cut at 15KHz.

OUTPUT IMPEDANCE: (from 16—ohm secondary) approximately 2 ohms.

DAMPING FACTOR: Appr. 8.

The input shields should not be earthed at the input socket unless this proves later to give a noticeable reduction in residual hum and noise. The shielded cable to the grids of the voltage amplifier triodes is earthed to one of the 6GW8 spigots.

When assembly of the amplifier is complete all wiring should be double-checked against the circuit diagram. Then, if you have an ohmmeter on hand, check the HT line for short-circuits to earth. Touch the positive probe on the positive terminal of the first filter capacitor with the negative terminal connected to the chassis. The pointer should swing over towards zero and then move rapidly up the scale to a value of around 5Kohms, representing initial leakage through the filter capacitors.

The amplifier can now be switched on. Check the feedback as described previously. Then a check can be made on the "no-signal" voltages. If the voltages do not vary by more than about 10 per cent from those specified, the amplifier can be regarded as normal.

The following is a list of voltages obtained from the prototype using the 114 volt tap on the power transformer secondary, with no input signal applied:

HT1	295V
HT2	250V
12AX7 cathodes	1.3V
6GW8 pentode cathodes	7.8V
6GW8 triode (volt. amp.) cathodes	1.2V

Incidentally, the signal to noise ratio on this amplifier was measured with a 470pF capacitor shunting the inputs to simulate a ceramic cartridge. This gave a signal to noise ratio of —53dB relative to full output which improves to about —56dB with "short-circuit" inputs.

Now, you can connect your turntable, put on a record and settle back to enjoy a few hours with your newly constructed stereo amplifier. It can certainly produce some very nice sound and—plenty of it, if need be!

we have nominated the valve close to the rear of the chassis as V1 and the other valve as V2.

When using the A&R OT4005 transformer, the colour code is:

SCREEN 1.....Violet,
SCREEN 2.....Orange,
ANODE 1.....Blue,
ANODE 2.....Green.

The code for the alternative Ferguson OP412 is:

SCREEN 1.....Black,
SCREEN 2.....Yellow,
ANODE 1.....Green,
ANODE 2.....Blue.

With the common terminal of secondary winding earthed, the polarity of the