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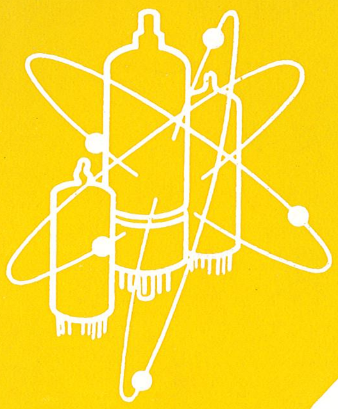
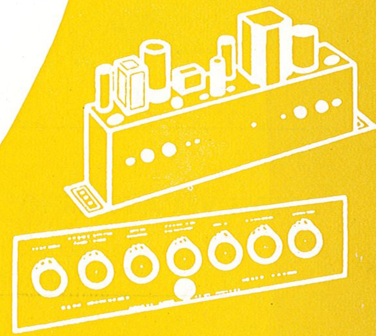


ELECTRONIC VALVES

AUDIO



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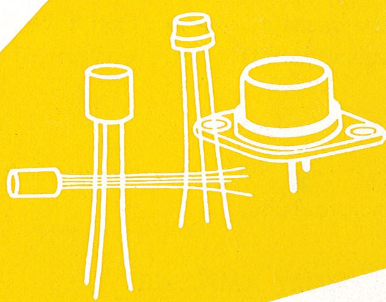
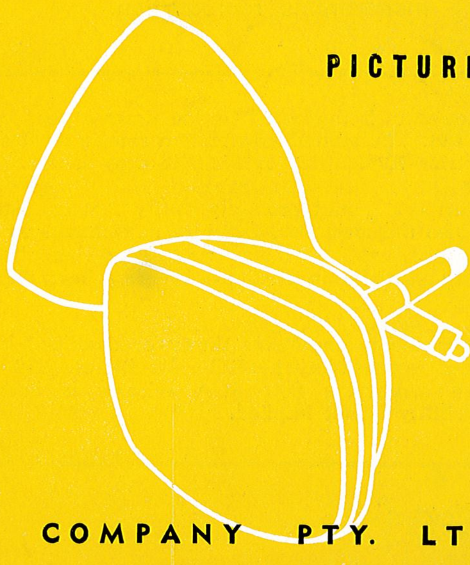
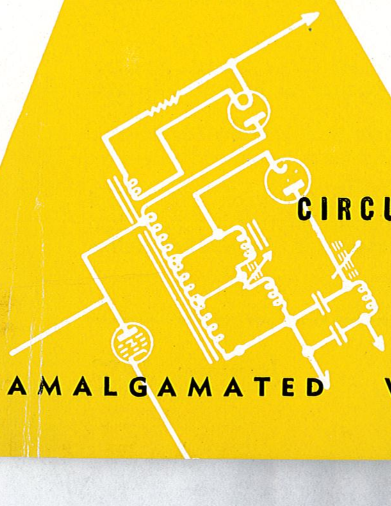


TRANSISTORS

RADIOTRONICS

PICTURE TUBES

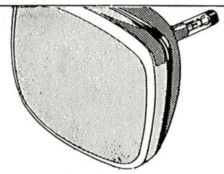


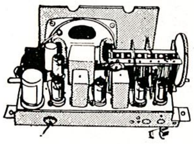


CIRCUITRY

AMALGAMATED WIRELESS VALVE COMPANY PTY. LTD.

IN THIS ISSUE





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TV receiver alignment

The second of two articles by
C. HAMMER
(Test Instrument Section, A.W.A.)

GENERAL

The alignment of a television receiver or other equipment employing wide-band circuits necessitates a visual indication of the circuit band-pass characteristic. The visual alignment method can be used quickly and effectively and when a television calibrator is used with the sweep generator, alignment can be precise.

A recommended test set-up for performing visual alignment of a television receiver is shown in fig. 1.

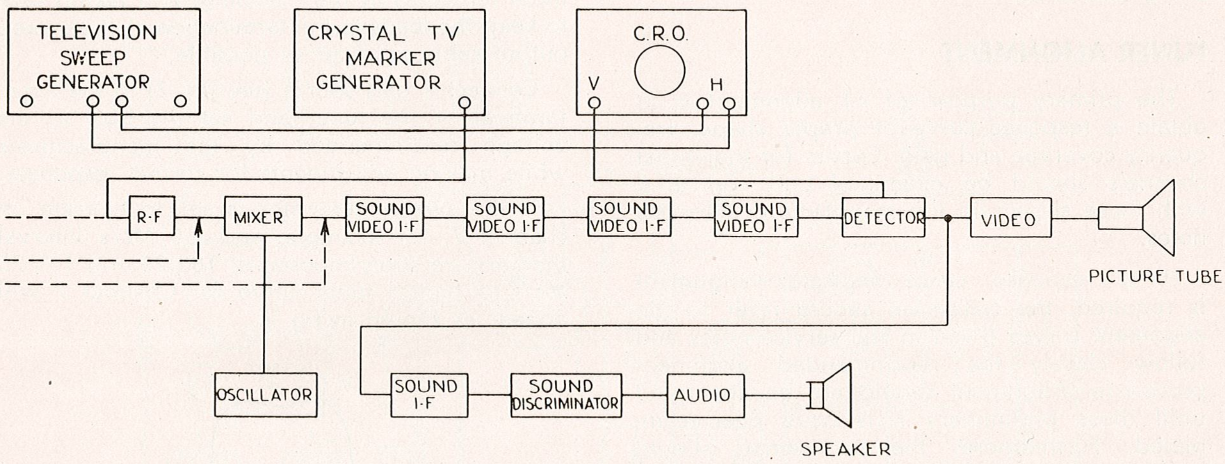


Fig. 1. Recommended Test Set-up.

When the sweep generator is tuned to sweep the band of frequencies normally passed by the wide-band circuits, a trace representing the response characteristic of the circuits will be displayed on the oscilloscope screen. The calibrator can be used to provide calibrated markers along the response curve for checking the frequency setting of traps, for adjustment of capacitors and inductors, and for measuring the overall bandwidth of the receiver.

When the marker signal from the calibrator is coupled into the circuit under test, a vertical "pip" or marker will appear on the curve. (A typical trace with markers is shown in fig. 2). When the calibrator is tuned to a frequency accepted by the receiver, the position of the marker will indicate the frequency on the sweep trace. The circuit components are then adjusted to obtain the desired wave shape, using the different frequency markers as check points.

The order in which various sections of the television receiver should be aligned may differ with receivers produced by different manufacturers. It is not possible therefore to recommend a single alignment procedure which can be applied with equal success to all television receivers.

The test instruments suggested for use in the visual alignment of television receivers are:—

1. Crystal Calibrated Marker Generator.
2. Cathode Ray Oscilloscope.
3. Television Sweep Generator.
4. Voltohmyst.

Fig. 2. Trace with markers.

The technical notes given in the following pages are designed for use with the manufacturer's service notes to aid the serviceman in aligning a receiver correctly and efficiently.

Before the alignment of the receiver can be performed it is necessary to make the operation of the automatic gain control ineffective and provide and artificial bias. Fig. 3 shows a typical bias box used for this purpose.

The use of an efficient earthing system in the alignment and adjustment of a television receiver cannot be overstressed. Every care should be taken to make the earthing lead of test probes as short as possible and confined to the section of the receiver under test. Stray fields present along the receiver chassis can introduce an f-m component on the cathode ray oscilloscope trace and cause interference to the response curve being examined.

TUNER ALIGNMENT

The primary purpose of r-f alignment is to obtain a response curve of proper shape, frequency coverage and gain. Curves for individual channels should be examined and compared with those shown in the manufacturer's service notes.

If a response curve indicates alignment is required, the technician should refer to the alignment curves given in the service notes and follow closely the recommended alignment procedure. Alignment should not be attempted until these preliminary tests have been completed. Furthermore, the serviceman should understand that most tuners are correctly aligned unless they have been tampered with. This knowledge can often prevent misalignment of a good tuner. Most tuners merely require touch up alignment in which relatively few of the adjustments are used.

Generally, complete alignment is required only when an unskilled person with or without proper facilities has worked on the tuner. For a complete alignment of the tuner, it is desirable to follow a specific sequence of adjustments, the sequence depending on the type of tuner.

The complete front end alignment includes alignment of the antenna input circuits and adjustment of the amplifier and r-f oscillator circuits. Adjustments include setting the oscillator frequencies for channels 1 to 10, setting traps to predetermined frequencies and adjustment of tracking with the r-f amplifier.

All these adjustments require that a sweep signal from the sweep generator and marker signal from the crystal calibrated generator be fed into the tuner so that a response curve with markers will be reproduced on the oscilloscope screen.

For complete tuner alignment the tuner should preferably be removed from the receiver. Extension leads for B+, filament and earth connections to the tuner should be made. For final adjustment of oscillator frequencies, the procedure for adjustment may be carried out with covers in position and with the tuner mounted in position.

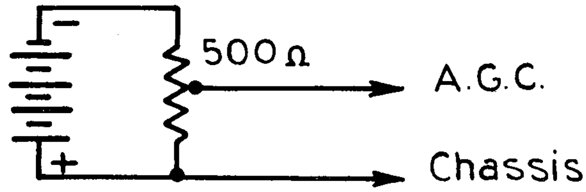


Fig. 3. Bias box.

Connect the sweep generator to the aerial input terminals of the matching, unit taking care to keep the leads to the termination of the sweep output cable as short as possible.

Connect a bias source (see fig. 3) to the a.g.c. terminal of the tuner and set the bias to the voltage recommended by the manufacturers while making adjustments for correct responses.

If the sweep generator is set to operate on channel 7, for example, and 5.5 Mc/s interval markers are superimposed at 182.25 and 185.75 Mc/s, a typical tuner curve for Channel 7 will appear as shown in fig. 4.

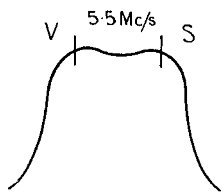


Fig. 4. Typical tuner curve.

The markers on the curve show the separation between the picture and sound carriers. Since the r-f sections of the receiver must pass the full transmitted bandwidth of both sound and picture carrier frequencies, a pass band of approximately 7 Mc/s is required.

The sound and picture carrier frequencies for the Australian Television Channels are shown in the accompanying table.

AUSTRALIAN TELEVISION CHANNELS

Channel No.	Picture Carrier Freq. Mc/s.	Sound Carrier Freq. Mc/s.	Osc. Freq. Mc/s. Receiver R-F
1	50.25	55.75	86.25
2	64.25	69.75	100.25
3	86.25	91.75	122.25
4	133.25	138.75	169.25
5	140.25	145.75	176.25
6	175.25	180.75	211.25
7	182.25	187.75	218.25
8	189.25	194.75	225.25
9	196.25	201.75	232.25
10	210.25	215.75	246.25

The tuner oscillator alignment can readily be adjusted by loosely coupling the oscillator to the calibrated signal generator and beating the two signals.

A typical sequence to practice in the alignment of an incremental inductance type r-f tuner of a television receiver is described below:—

1. Connect a bias source to the a.g.c. terminal of the tuner and set the bias to the desired negative voltage (see fig. 5). The bias source should remain connected while making all adjustments for correct response. Connect the vertical input of the C.R.O. direct to the converter grid test point with a shielded lead. Earth the shield at the tuner.

2. Terminate the i-f coaxial cable with a 47 ohm composition resistor.

3. Switch on the power supply to the receiver and adjust voltages to conform to manufacturer's specifications e.g. 265 volts H.T. 6.3 volts filament and –3 volts bias.

4. Switch to the channel nominated for initial alignment (usually Channel 5 or 6) and turn the fine tuning capacitor to the middle of its range.

5. Loop an insulated wire or probe from the r-f input terminal of the calibrator around the glass envelope of the converter valve. Assuming channel 6 has been nominated the oscillator should be adjusted to beat at 211.25 Mc/s.

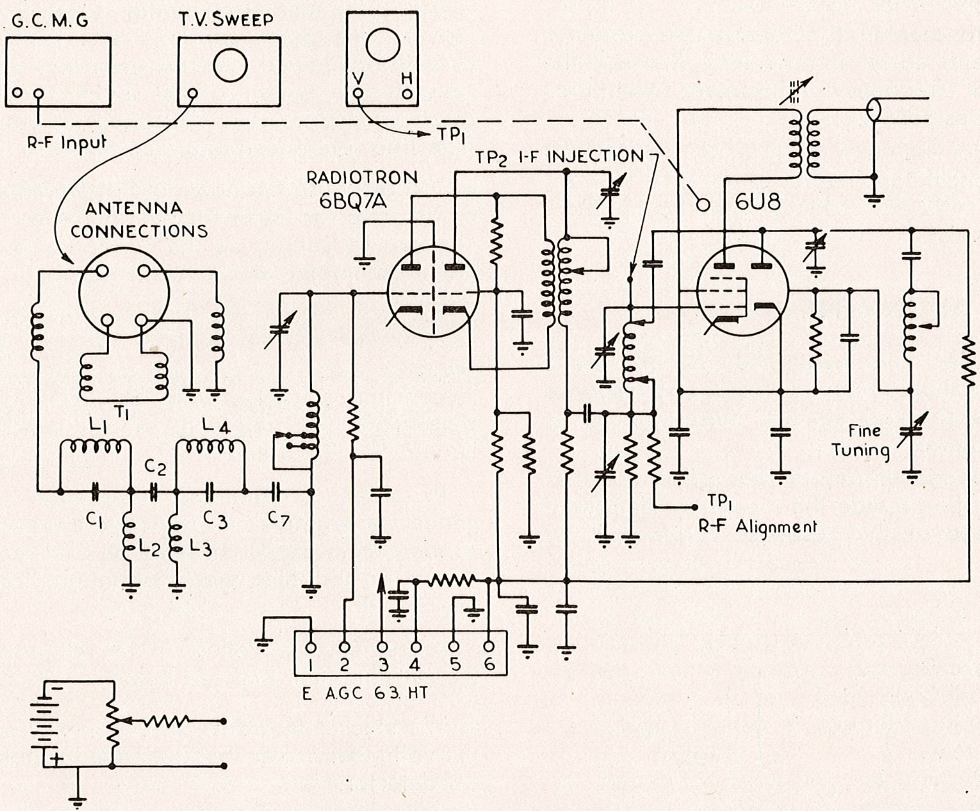


Fig. 5. Front-end adjustments.

6. Switch to channel 10 and adjust the oscillator section inductor to give an oscillator frequency of 246.25 Mc/s.
7. Switch to channel 9 and adjust channel 9 section inductor to give an oscillator frequency of 232.25 Mc/s.
8. Switch to channel 6 again and readjust the circuit capacitor trimmer if necessary for 211.25 Mc/s.
9. Repeat the above procedure until no adjustment is necessary for correct oscillator frequencies on channels 10, 9 and 6 within the desired tolerance. Care should be taken that the presence of the insulated wire loop from the calibrator does not change the frequencies.
10. Switch the tuner and sweep generator to channel 6 and adjust the output to give a response pattern on the C.R.O.
11. Detune the core of the converter i-f transformer when adjusting response curves until no variation of the curve is observed on the C.R.O. Connect 47 ohm resistor at i-f input, if necessary, to remove irregularities in the curve.
12. Switch the tuner and sweep generator to channel 10 and adjust the calibrator to give video and sound markers. Adjust the section inductors for maximum response between video and sound markers.
13. Return to channel 6. Observe the response curves and adjust if necessary. Recheck the oscillator frequency adjustment and then proceed as follows.
14. Switch to channels 5, 4, 3, 2, and 1 and adjust oscillator frequency to give 176.25, 169.25, 122.25, 100.25 and 86.25 Mc/s respectively.

VIDEO I-F ALIGNMENT

As in tuner alignment, the manufacturer's service notes should be read closely and response wave forms checked against those offered as standard patterns.

The sweep generator, marker generator and the oscilloscope provide the means for determining the shape of the response curve and the pass band.

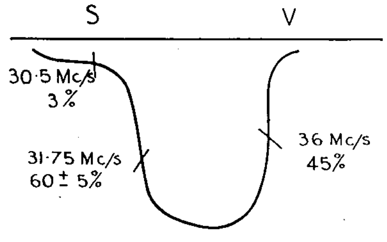


Fig. 6. Marker and generator adjustment.

To obtain an overall picture i-f response curve, connect the direct probe of the oscilloscope across either the diode second detector load resistor or the grid of the first video stage; connect the sweep generator output to the i-f injection test point on the tuner. Adjust the sweep generator to give the required output. Do not overload. Couple the marker generator loosely to the test point via a small capacitor e.g. 25 μμF. See fig. 7.

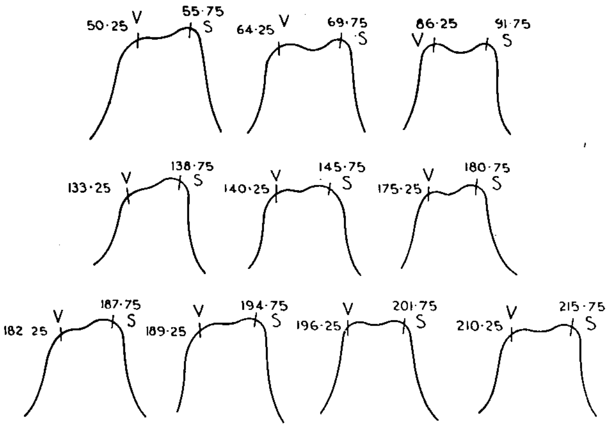


Fig. 7. Typical response curves.

Adjust the marker generator so that the marker moves to a point approximately 50% up the curve slope. Read marker generator dial, then tune the generator so that the marker appears on the opposite curve slope approximately 60% from the reference point. See fig. 6.

The response of individual i-f amplifier stages or of two or more stages together may be checked by setting up the sweep generator and signal generator as shown in fig. 8.

The test equipment line-up is similar to that used for r-f and i-f amplifier circuitry. A sweep response curve is obtained on the oscilloscope screen and a marker from the signal generator determines the frequency at any point on the curves. See fig. 5 and 8.

In order to eliminate the action of a.g.c. connect a negative bias source to a suitable point in the circuit, e.g. point A in the grid decoupling circuit of the first video i-f amplifying valve. See fig. 8.

A sequence to follow in the alignment of a typical amplifier is given below:

1. Connect the probe of a d.c. vacuum tube voltmeter across the diode load of the second detector.

2. Connect the output of the calibrator to the tuner test point of the converter grid circuit

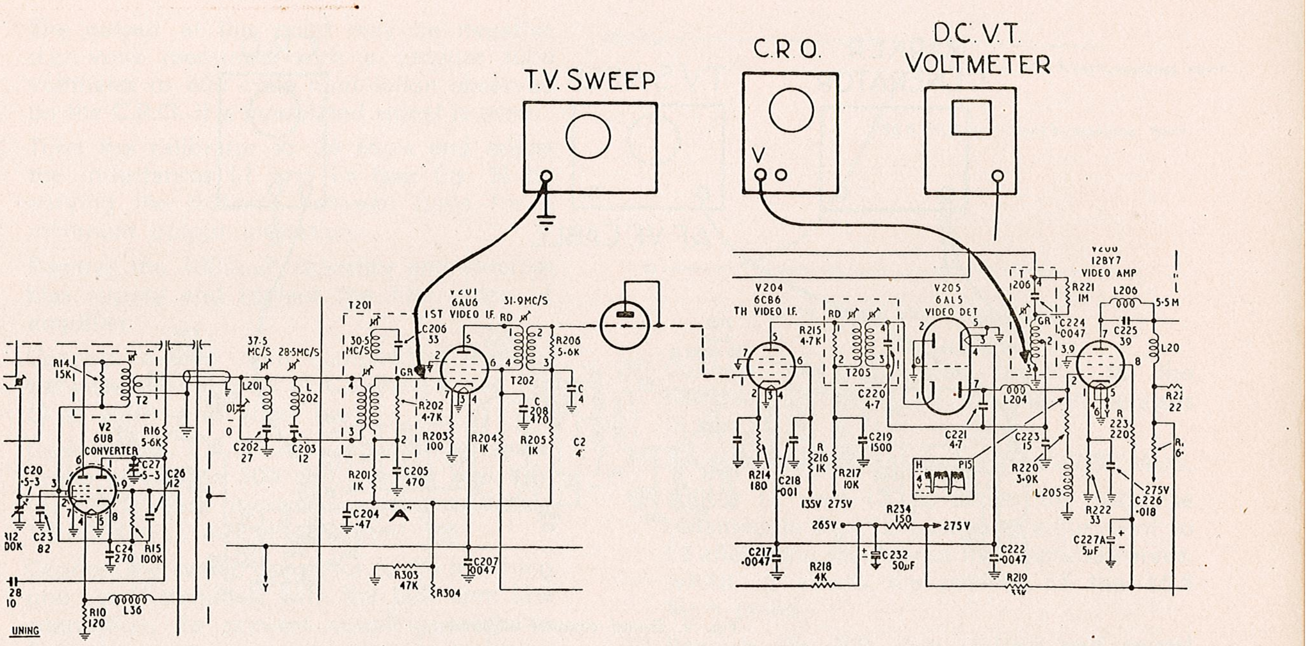


Fig. 8. Checking I.F. response.

through a 1000 $\mu\mu$F capacitor, using short leads. Set the tuner on channel 6. Set the fine tuning control to its mechanical centre and check that the oscillator frequency is 211 Mc/s.

3. Adjust the calibrator to the frequencies recommended by the manufacturer and adjust the transformers in the video i-f amplifier for a peak output, adjusting the input so that the d.c. vacuum tube voltmeter maintains an optimum reading e.g. 3 volts.

Traps are included to attenuate specific frequencies, such as adjacent picture and sound carriers.

The trap circuits included in a television receiver may be located in the r-f unit, picture and sound i-f amplifiers depending on the type of receiver.

Frequencies nominated in the service notes of a particular television receiver manufacturer for the alignment of i-f transformer and trap circuits are listed below:—

33.5 Mc/s	T204
35.3 Mc/s	T203
31.9 Mc/s	T208
28.5 Mc/s	L202
30.5 Mc/s	T201
37.5 Mc/s	L201

Alternatively the trap may be adjusted by connecting the probe of a d.c. vacuum tube voltmeter across the diode load of the video detector and tuning the trap for minimum voltage on the meter. This is the recommended practice in aligning video i-f amplifier circuits. Any mistuning of the traps may be corrected during the amplifier sweep alignment.

SOUND I-F AMPLIFIER AND F-M DETECTORS

The alignment of sound i-f amplifiers in both television and f-m receivers is similar. Australian television receivers employ a sound i-f of 5.5 Mc/s. If a sweep signal with this centre frequency is passed through the sound i-f amplifier the pattern may be observed on an oscilloscope connected across the detector load resistor.

A test set-up for visual alignment of these circuits is shown in fig. 9. This is a typical circuit and employs a ratio detector which receives its signal from the last sound i-f stage.

1. Set the signal frequency of the marker generator to 5.5 Mc/s.
2. Connect the oscilloscope at point A where a demodulated signal appears.
3. Adjust the sweep generator to give a sweep width of approximately 1 Mc/s. An S curve similar to the curve shown in fig. 10 will appear on the oscilloscope screen. The marker pips for determining pass band are shown for positive and negative peaks of the S curve.

An alternative method for sound i-f alignment may be produced by:—

1. Connect the output of the marker generator to the grid of the last video i-f amplifier.
2. Set the generator to 5.5 Mc/s.
3. Connect a suitable vacuum tube voltmeter to pin 1 of the ratio detector and set the range control to approximately +5 volts d.c. (see fig. 8).
4. Adjust the following transformers for a peak output, reducing the input so that the voltmeter maintains a reading of +5 volts: T102 secondary core, T102 primary core,

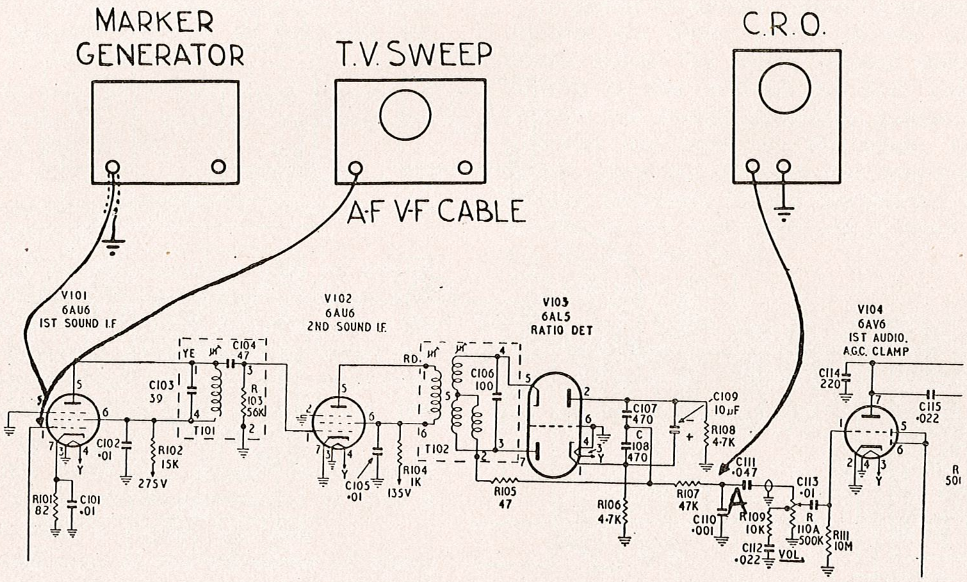


Fig. 9. Sound channel alignment.

T101 core, and T206 core.

5. Disconnect the vacuum tube voltmeter probe from pin 1 and connect it to point A.

6. Readjust T102 secondary core for zero voltage reading on the voltmeter.

ALIGNMENT OF AERIAL MATCHING UNIT

The aerial matching unit is accurately aligned at the factory and no adjustment of the unit should be attempted in the customer's home, since slight re-adjustment may cause serious attenuation of the signal. The r-f unit is aligned with a particular matching unit in place and if for any reason a new matching unit is installed the r-f unit should be re-aligned.

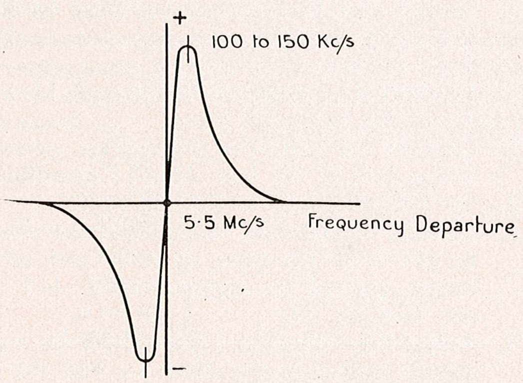


Fig. 10. Detector output.

To align the aerial matching unit:

1. Remove the unit from the r-f tuner and connect the output via a 1000 $\mu\mu$F capacitor to the grid of the second video i-f amplifier (Keep the leads as short as possible).

2. Remove the preceding video i-f valve and connect a variable bias source to eliminate the a.g.c.

3. Connect the marker generator at 46.5 Mc/s to the aerial input socket of the aerial matching unit.

4. Adjust its output until a convenient signal is measured at the grid of the video amplifier.

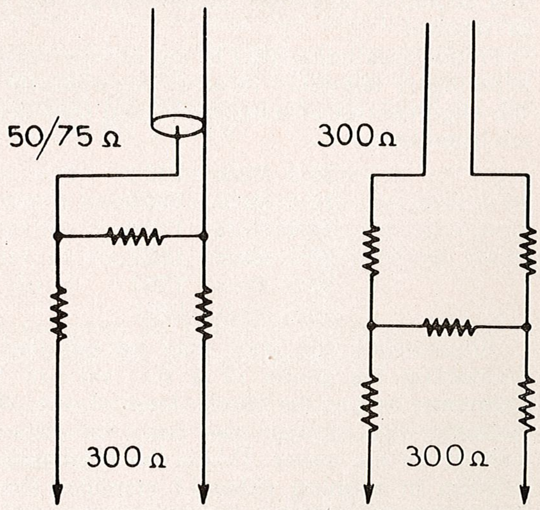


Fig. 11 Resistive pads.

The output at this point may be negative d.c. volts measured with a vacuum tube voltmeter or 400 cycle modulation observed on the C.R.O. if a modulated signal is used.

5. Tune the calibrator to 36 Mc/s and adjust the inductances L1 and L4 (see fig. 5) by varying the distance between turns for a minimum output indication.
6. Remove the 1000$\mu\mu$F capacitor and external bias supply and replace the first video i-f amplifier.
7. Connect a 300 ohm composition resistor between the junction of C3 and L4 (see fig. 5) to earth with short leads.
8. Connect the C.R.O. low capacitance crystal probe across the 300 ohm resistor and turn the C.R.O. gain to maximum (approximately 10 mV r.m.s./inch of deflection).
9. Connect the sweep generator to the matching unit aerial terminals with the 300 ohm line connection. To prevent coupling reactance from the sweep generator into the matching unit, it is advisable to connect a resistance pad (see fig. 11) constructed with short leads to the input terminals.

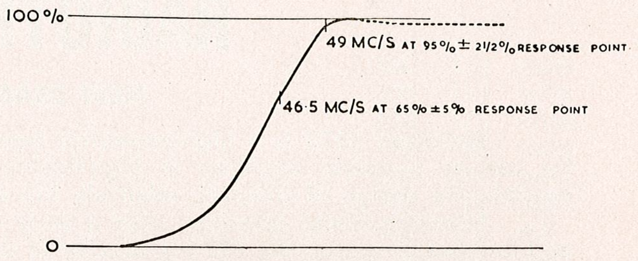


Fig. 12. Aerial coupler response.

10. Connect the calibrator loosely to the matching unit terminals, via one of the pads in fig. 11.
11. Set the generator to sweep from 42-52 Mc/s.
12. Adjust L2 and L3 to obtain the response obtained in fig. 12 (note the adjustment to L3 affects the shoulder of the response curves, whilst L2 affects the position of the 46.5 Mc/s point).
13. Remove the 300 ohm resistor and crystal probe connections. Set L1, L2, L3 and L4 in position and replace covers. Re-connect aerial tuning unit to turret, or r-f tuner.

750-MESH RULING ENGINE DEVELOPED BY R.C.A.

R.C.A. recently developed and put into operation a precision-built machine capable of ruling perpendicular sets of parallel lines which number at least 750 to the linear inch. The ruled surface produced by this machine are used as forms for consistently reproducing the fine-mesh screens required by image orthicons and vidicons. The width of these precision-ruled lines is no thicker than the filament spun by spiders.

The development and construction of a ruling machine is a unique R.C.A. achievement. When R.C.A. attempted to surmount the first problems of design, a careful search revealed no experienced manufacturers. For information, R.C.A. development engineers studied designs of three basic types of ruling machines.

Investigations showed that few ruling engines were ever built alike, verifying the surmise that they are not merely mechanical assemblies, but works of art. The three basic types of ruling engines, mentioned above, were available for study at Johns Hopkins University.

The room housing the R.C.A. ruling engine is temperature controlled. Temperature changes would cause imperfections in the ruled lines, so the room is maintained to within one-half degree of the optimum operating-temperature. Vibration is another critical factor, and the machine, therefore, is mounted on an eight ton, cast-concrete inertia block, which is in turn spring-mounted on top of pilings which rest on bedrock 20 feet below ground level. The base casting for the new R.C.A. ruling engine weighs about two-and-one-half tons. It is supported on the concrete inertia block by three one-inch steel balls.

With this ruling engine, R.C.A. is producing highly satisfactory glass mesh masters for the high-quality 750-mesh screens used in various types of R.C.A. tubes. Called Micro-mesh, the 750-mesh screen eliminated mesh pattern and moire effects, and at the same time improves picture-detail contrast in the R.C.A. 5820 image orthicon for black-and-white and the R.C.A.-6474/1854 Image Orthicon for Colour TV service. It also minimises the beat pattern between the color sub-carrier and the frequency generated by the beam scanning the mesh-screen pattern.

See Jan. '59, P. 16 for 2 high fidelity amplifier circuits.

RADIOTRON 6973

NEW BEAM POWER TUBE

Radiotron 6973 is a high-perveance beam power valve of the 9-pin miniature type designed for use as a power amplifier in high-fidelity audio equipment. Its superior performance makes possible the design of compact, relatively low-cost equipment.

Featuring linear operation over a wide range of power, high power sensitivity, high stability, and low heater power, the 6973 is capable of delivering high power output at low distortion. For example, in push-pull class AB_1 audio service, two 6973's operating with a plate voltage of 350 volts, grid-No. 2 voltage of 280 volts, and fixed grid-No. 1 voltage of -22 volts can deliver a maximum-signal power output of 20 watts with total harmonic distortion of only 1.5%.

In a push-pull class AB_1 circuit with grid-No. 2 feedback connection on the plate winding of the output transformer, it is possible to obtain a substantially lower a.c. output terminal impedance with resultant higher damping factor than can be obtained with conventional pentode operation, and to maintain more constant power output with very low distortion over a wide range of load-impedance variations. For example, in such a circuit, two 6973's operating from a plate supply voltage of 370 volts and with a cathode-bias resistor of 355 ohms can deliver a maximum-signal power output of 15 watts with a total harmonic distortion of only 1.2%.

The design of the 6973 includes double bias-pin connections for both grids No. 1 and No. 2 to provide cool operation of these grids and thus minimize grid emission. Furthermore, cool operation of both grids permits use of high values of grid circuit resistance to reduce driving power.

During manufacture, close controls for dynamic zero-bias plate current, grid-No. 2 current, plate-current cut-off, and grid emission insure dependable performance for the 6973 in high-fidelity audio equipment.

ELECTRICAL DATA

Heater Voltage (a.c. or d.c.)	6.3	volts
Heater Current	0.45	amp

CHARACTERISTICS, CLASS A_1 AMPLIFIER

Plate Voltage	250	volts
Grid-No. 2 (Screen-Grid) Voltage	250	volts
Grid-No. 1 (Control-Grid) Voltage	-15	volts
Plate Resistance (approx.)	73000	ohms
Transconductance	4800	μmhos
Plate Current	46	mA
Grid-No. 2 Current	3.5	mA
Grid-No. 2 Voltage (approx.) for plate current of 100 μa	-40	volts

PUSH-PULL A-F POWER AMPLIFIER — CLASS AB_1

Pentode Connection:

Maximum Ratings, Design-Centre Values:

Plate Voltage	400 max.	volts
Grid-No. 2 (Screen-Grid) Voltage	300 max.	volts
Plate Dissipation	12 max.	watts
Grid-No. 2 Input	2 max.	watts
Peak Heater-Cathode Voltage:		
Heater negative with respect to cathode	200 max.	volts
Heater positive with respect to cathode	§200 max.	volts
Bulb Temperature (At hottest point on bulb surface)	250 max.	°C

Typical Operation with Fixed Bias:

Values are for 2 valves:

Plate Voltage	250	350	400	volts
Grid-No. 2 Voltage	250	280	290	volts
Grid-No. 1 (Control-Grid) Voltage°	-15	-22	-25	volts
Peak A-F Grid-No. 1 to Grid-No. 1 Voltage	30	44	50	volts
Zero-Signal Plate Current	92	58	50	mA
Max. Signal Plate Current	105	106	107	mA
Zero-Signal Grid-No. 2 Current	7	3.5	2.5	mA
Max.-Signal Grid-No. 2 Current	16	14	13.7	mA
Effective Load Resistance (plate to plate)	8000	7500	8000	ohms
Total Harmonic Distortion	2	1.5	2	%
Max. Signal Power Output	12.5	20	24	watts

Typical Operation with Cathode Bias:

Values are for 2 valves:

Plate Supply Voltage	300	310	volts
Grid-No. 2 Supply Voltage	300	310	volts
Cathode-Bias Resistor	230	270	ohms
Peak A-F Grid-No. 1 to Grid-No. 1 Voltage	48	55	volts
Zero-Signal Plate Current	80	77	mA
Max. Signal Plate Current	96	92	mA
Zero-Signal Grid-No. 2 Current	6	5	mA
Max. Signal Grid-No. 2 Current	14	14	mA
Effective Load Resistance (plate to plate)	5500	6000	ohms
Total Harmonic Distortion	2	4	%
Max. Signal Power Output	15	17	watts

Maximum Circuit Values:°

Grid-No. 1-Circuit Resistance:

For fixed-bias operation	0.5 max. megohm
For cathode-bias operation	1 max. megohm

PUSH-PULL A-F AMPLIFIER — CLASS AB_1

Grid No. 2 of each tube connected to tap on Plate Winding of Output Transformer:

Maximum Ratings, Design-Centre Values:

Plate and Grid-No. 2 Supply Voltage	375 max. volts
Plate Dissipation	12 max. watts
Grid-No. 2 Input	1.75 max. watts
Peak Heater-Cathode Voltage:	
Heater negative with respect to cathode	200 max. volts
Heater positive with respect to cathode	§200 max. volts
Bulb Temperature (At hottest point on bulb surface)	250 max. °C

Typical Operation:

Values are for 2 valves:

	Fixed Bias	Cathode Bias	
Plate Supply Voltage	375	370	volts
Grid-No. 2 Supply Voltage	*	**	volts
Grid-No. 1 (Control-Grid) Voltage°	33.5	—	volts
Cathode Bias Resistor	—	355	ohms
Peak A-F Grid-No. 1 to Grid-No. 1 Voltage	67	62	volts
Zero-Signal Cathode Current	62	74	mA
Max. Signal Cathode Current	95	84	mA
Effective Load Resistance (plate to plate)	12500	13000	ohms
Total Harmonic Distortion	1.5	1.2	%
Max. Signal Power Output	18.5	15	watts

Maximum Circuit Values:°

Grid-No. 1 Circuit Resistance:

For fixed-bias operation	0.5 max. megohm
For cathode-bias operation	1 max. megohm

§ The d.c. component must not exceed 100 volts.

° The type of input coupling network used should not introduce too much resistance in the grid-No. 1 circuit. Transformer or impedance-coupling devices are recommended.

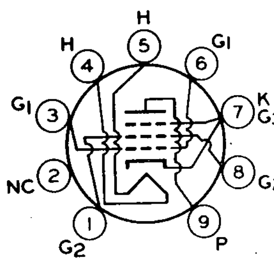
* Obtained from taps on the primary winding of output transformer. The taps are located on each each side of the centre tap (B+) so as to apply 50% of the plate signal voltage to grid No. 2 of each output valve.

** Obtained from taps on the primary winding of the output transformer. The taps are located on each side of the centre tap (B+) so as to supply 43% of the plate signal voltage to grid No. 2 of each output valve.

SOCKET CONNECTIONS

Bottom View

Pin 1: Grid No. 2.
Pin 2: No connection.
Pin 3: Grid No. 1.
Pin 4: Heater.
Pin 5: Heater.
Pin 6: Grid No. 1.
Pin 7: Grid No. 3, Cathode.
Pin 8: Grid No. 2.
Pin 9: Plate.



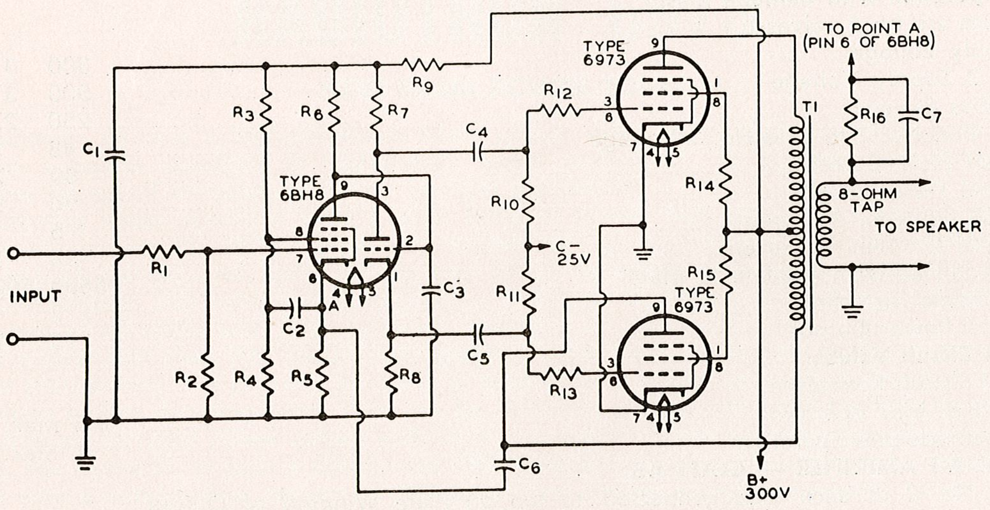


Fig. 1. High Fidelity Amplifier Circuit Utilizing Type 6973.

PARTS LIST FOR AMPLIFIER IN FIG. 1

C1: 40 μF, 450 volts.

C2, C4, C5: 0.25 μF, 400 volts.

C3, C6: 3.3 μμF, 600 volts.

C7: 180 μμF, 400 volts.

R1: 10000 ± 10% ohms, 1/2 watt.

R2: 470000 ± 10% ohms, 1/2 watt.

R3: 1.5 ± 10% megohms, 1/2 watt.

R4: 2.7 ± 10% megohms, 1/2 watt.

R5: 680 ± 10% ohms, 1/2 watt.

R6: 220000 ± 10% ohms, 1/2 watt.

R7, R8: 15000 ± 5% ohms, 2 watts.

R9: 3900 ± 10% ohms, 2 watts.

R10, R11: 100000 ± 10% ohms, 1/2 watt.

R12, R13: 1000 ± 10% ohms, 1/2 watt.

R14, R15: 100 ± 10% ohms, 1/2 watt.

R16: 6800 ± 10% ohms, 1/2 watt.

T1: Output Transformer, matching impedance of voice coil to 6600-ohm plate-to-plate tube load.

Amplifier Performance Specifications:
Sensitivity = 0.98 volt for 15 watts output; Feedback 19.5 db; Hum and Noise = 75 db below 15 watts; Damping Factor = 12.

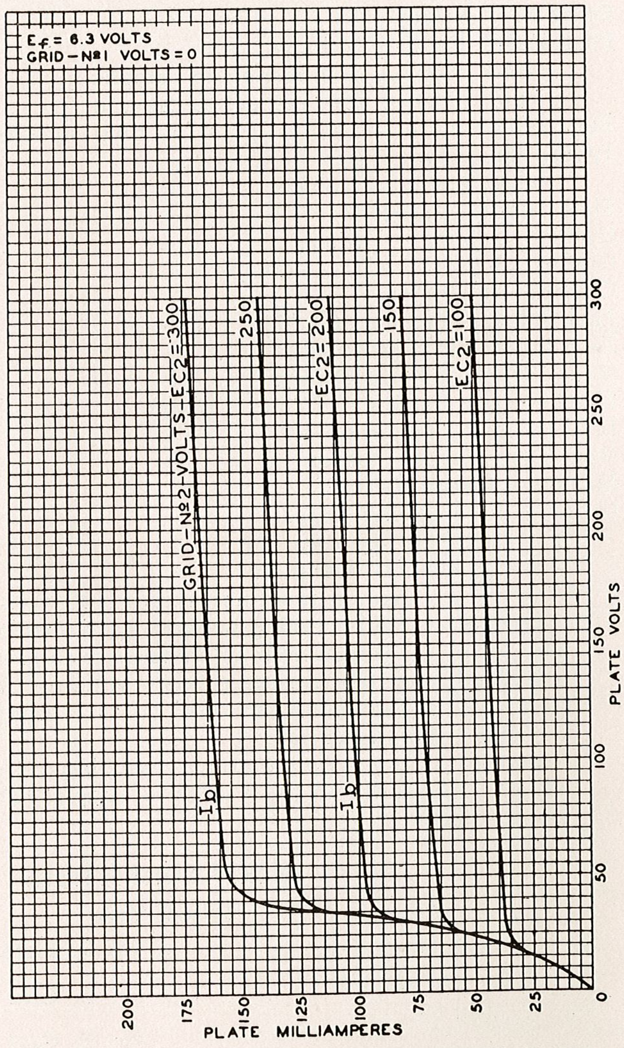


Fig. 2. Average Plate Characteristics of Type 6973.

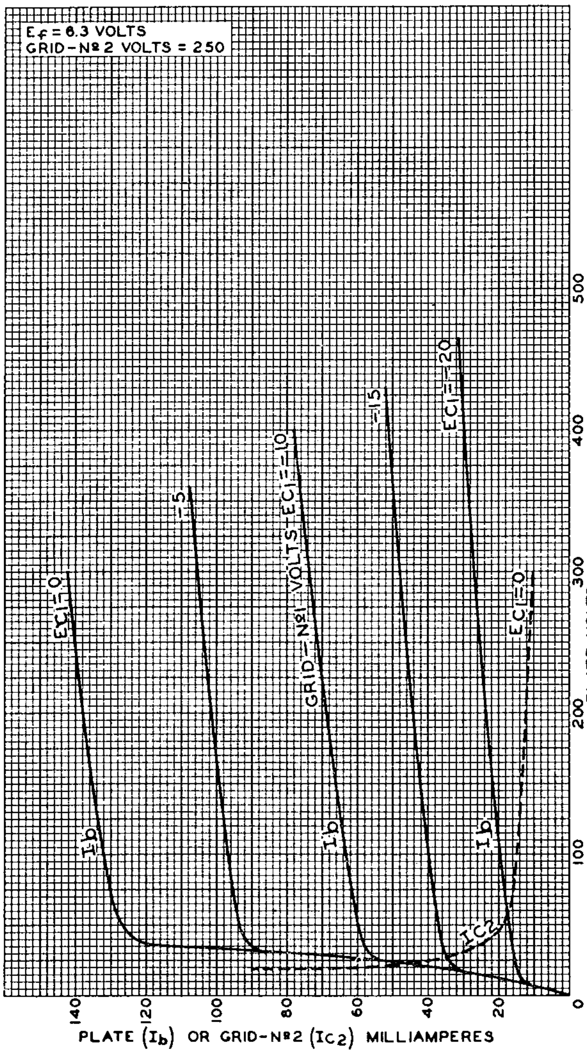


Fig. 3. Average Characteristics of Type 6973.

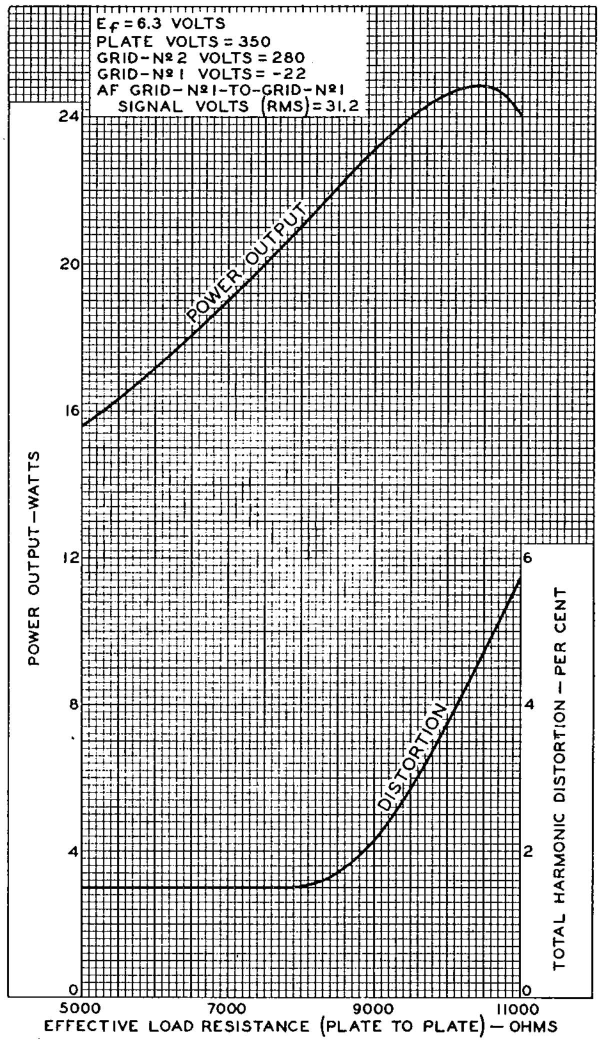


Fig. 4. Operation Characteristics of Type 6973 for Push-Pull CLASS AB1 Pentode Connection.

NEW RCA RELEASE

RADIOTRON — 24AHP4

The 24AHP4 is a rectangular glass picture tube having 24" diagonal, and an overall length of 15-7/8". In comparison with 24" types having 90° deflection, the 24AHP4 has an overall length approximately 5-1/4" shorter and a weight 7 pounds lighter.

In addition to its wide deflection angle and very short length, the 24AHP4 features a neck diameter of only1-1/8". This small neck diameter not only makes possible the use of a deflecting yoke having high deflection sensitivity, but also permits deflection of the beam through the wide deflection angle with only slightly more power than is required to scan a tube with 90° deflection angle.

Another design feature of the 24AHP4 is its electron gun of the "straight" type designed to minimize deflection distortion and to eliminate the need for an ion-trap magnet.

The 24AHP4 is of the low-voltage electrostatic-focus and magnetic-deflection type. It has a spherical Filterglass faceplate, an aluminized screen 21-7/16" x 16-7/8" with slightly curved sides and rounded corners and a minimum projected screen area of 332 square inches. In addition, the 24AHP4 has an external conductive bulb coating which provides a capacitance value ranging between 2000 and 2500 $\mu\mu$F, and utilizes an integral glass-button base.

Low Distortion Laboratory Amplifier

by F. Langford-Smith, B.Sc., B.E.

It is often desired to measure the distortion of an amplifier or pre-amplifier with a high impedance output. This cannot be done directly with a Total Distortion and Noise Meter (usually 100,000 ohms), or a Marconi Wave Analyser (100,000 ohms), or the General Radio Type 736A Wave Analyser while using the input potentiometer (100,000 ohms). Although it can be done directly with the G.R. Type 736A Wave Analyser without the potentiometer input, this is rather an undesirable arrangement, as the potentiometer input is a great convenience.

In addition, it is most convenient to be able to measure the distortion of an amplifier stage by stage, in an attempt to reduce the overall distortion. This calls for a high impedance input, of the order of 1 megohm.

A low output impedance is desirable when a filter is to be fitted between this amplifier and a Wave Analyser, as described in the article "Harmonic Measurement using Wave Analyser" (Ref. 1). A cathode follower output is the ideal. A cathode follower is essential for use with the Altec-Lansing Intermodulation Tester which has 600 ohms input impedance with an input level of –20 dbm, equivalent to 0.077 V across 600 ohms.

The output voltage required on the high impedance output is:

0.3 V for Wave Analyser

1 V for Total Distortion and Noise Meter.

The circuit shown meets all these requirements, together with very low distortion. The amplifying portion incorporates only two valves, one twin triode (Radiotron 12AT7) and a cathode follower output (Radiotron 6BQ5/N709).

The power supply was originally built for a larger amplifier and has been loaded by a 10,000 ohms resistor to reduce the supply voltage. Any power pack capable of supplying 21 mA at 250 volts, with equivalent filtering, would be satisfactory.

The method of testing this amplifier for harmonic distortion was described in the article in the March issue mentioned above.

SPECIFICATION

Voltage gain*: 20 times (26dbv).

Frequency response 30 c/s to 20,000 c/s:

High impedance output:	+0, –0.1 db
600 ohm output:	+0, –0.5 db

Current drain: 21 mA at 250 V (amplifier only)

Harmonic distortion expressed as percentage*:

Second harmonic:	0.008%	at 1 volt output
Third harmonic:	<0.001%	at 1 volt output
Second harmonic:	0.13 %	at 16 volts output
Third harmonic:	<0.15%	at 16 volts output

Harmonic distortion expressed in decibels:*

Second harmonic:	–82 db	at 1 volt output
Third harmonic:	–100 db	at 1 volt output
Second harmonic:	–58 db	at 16 volts output
Third harmonic:	–76 db	at 16 volts output

Hum*: –72 db below 1 volt output
–96 db below 16 volts output

COMMENTS ON DESIGN

V1A and V1B are conventional R.C. triodes with unbypassed cathode resistors. V2 is a cathode follower with fixed grid bias from the 1 and 0.5 megohm potential divider; this arrangement gives the full theoretical input impedance of the cathode follower (Ref. 2). The load resistor for V2 (5600 ohms), is a compromise between optimum values for a high impedance load and 600 ohms.

The feedback loop is purposely taken from the cathode of V2 to the cathode of V1A for good stability. The input coupling capacitor and each of the output coupling capacitors are outside the feedback loop and have been designed accordingly. The 600 ohm output demanded a capacitance

* for high impedance output (100,000 ohms).

too high for paper capacitors, and an electrolytic capacitor has been used here with apparently excellent results. When in use with the Altec-Lansing Intermodulation Tester, there is conduction between the output terminals and the small leakage current through the capacitor is not harmful.

REFERENCES

(1) F. Langford-Smith, "Harmonic measurement using Wave Analyser", Radiotronics 21.3 (March, 1956).

(2) Radiotron Designer's Handbook, 4th ed., pages 322 and 323.

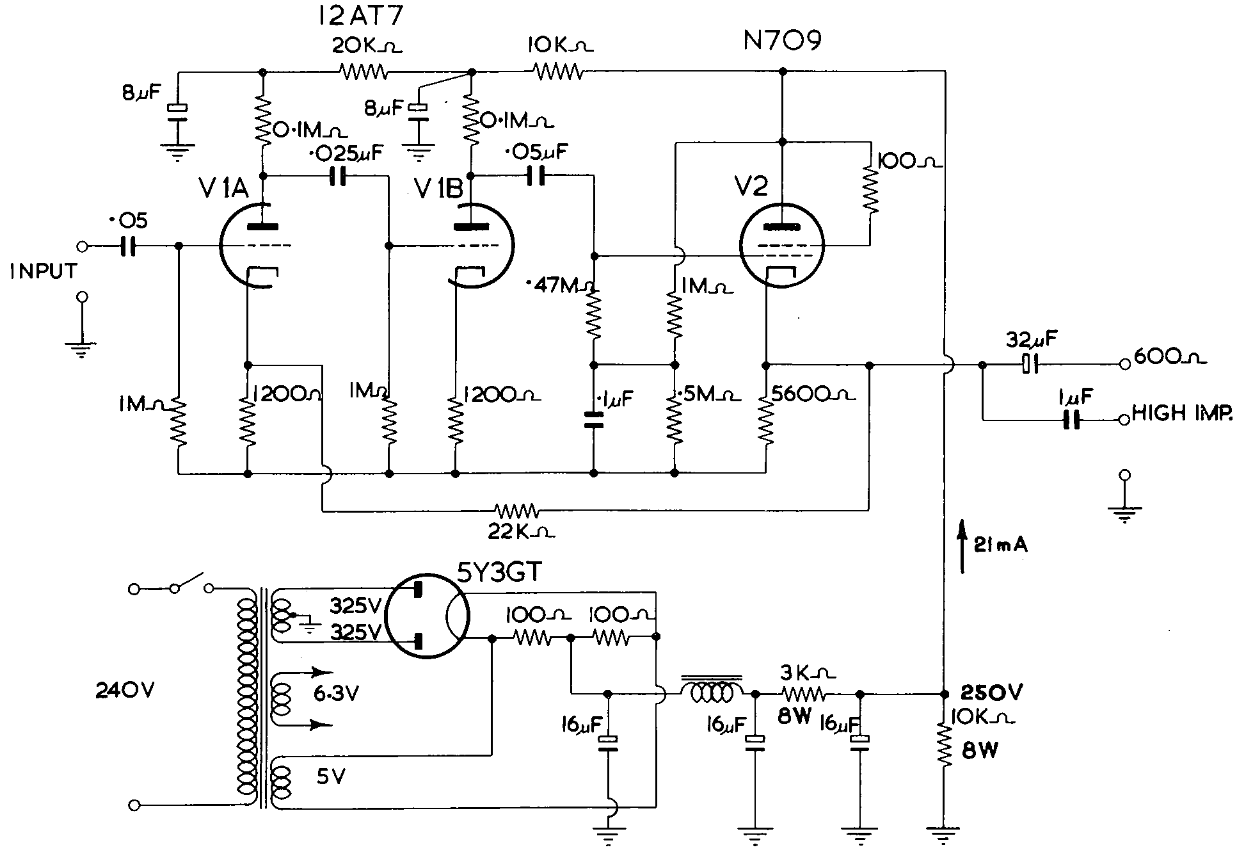


Fig.1. Low distortion laboratory amplifier designed by the Radiotronics Laboratory. The amplifier portion may be used with any power supply delivering 21 mA at 250 V.

COLOUR PICTURE TUBES

RADIOTRON 21CYP22

Radiotron 21CYP22 is a directly viewed, round, glass picture tube for use in color television receivers. It is capable of producing either a full-color or a black-and-white picture measuring 19¼" x 15½" with rounded sides and having a projected area of 261 square inches.

Design features of the 21CYP22 include an all-glass envelope which reduces the high-voltage insulation requirements and an external conductive bulb coating which with a portion of the internal conductive coating forms a supplementary filter capacitor.

The 21CYP22 utilizes three electrostatic-focus guns spaced 120° apart with axes tilted toward the tube axis to facilitate convergence of the three beams at the shadow mask; individual convergence control of each beam radially by internal magnetic poles and supplemental control of the three beams horizontally by internal magnetic poles; and an assembly consisting of a spherical metal shadow mask and an aluminized, tricolor, phosphor-dot screen on the inner surface of the spherical Filterglass faceplate.

The tricolor, phosphor-dot screen is composed of an orderly array of small, closely spaced, phosphor

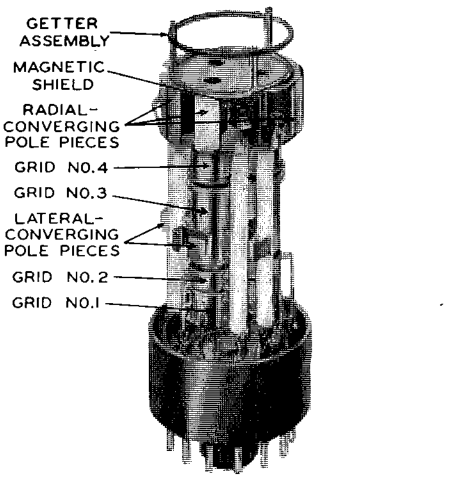


Fig. 1. Electron-Gun Assembly Utilized in the 21CYP22.

dots arranged in triangular groups (trios). Each trio consists of a green-emitting dot, a red-emitting dot, and a blue-emitting dot, and is aligned with a corresponding hole in the shadow mask.

OPERATING PRINCIPLES.

Each of the electrostatic-focus guns has an indirectly heated cathode,a grid No. 1, a grid No. 2 (accelerating electrode), a grid No. 3 (focusing electrode), a grid No. 4 (ultor), and a pair of radial-converging pole pieces. In addition, a pair of pole pieces is provided for lateral converging of the beams.

The axes of the beams from the three guns must be made to converge at the hole in the spherical mask corresponding to the phosphor-dot trio being scanned at any moment. Convergence is accomplished by the action of magnetic fields coupled into the radial-converging pole pieces by external magnets mounted on the neck of the tube, as shown in Fig. 2. The magnetic flux provided by the external magnets is coupled through the glass neck of the tube to their associated pairs of internal pole pieces. The two pole pieces comprising each pair, together with the internal shield, shape and confine the magnetic flux between them so as to affect primarily only the associated beam. Adjusting the strength of the magnetic flux between the pole pieces associated with each of the three beams changes the convergence angle of each beam.

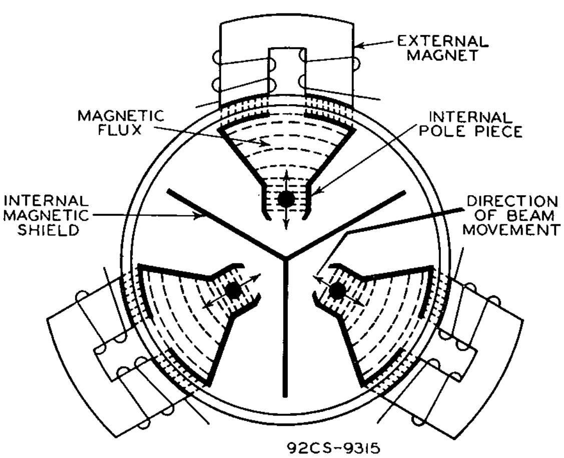


Fig. 2. Schematic of Radial-Converging Pole Pieces.

To supplement the action of the three pairs of pole pieces in radially converging the three beams, another pair of pole pieces activated by an external magnet mounted on the neck of the tube is provided. These pole pieces permit lateral shift in position of the blue beam in opposition to the lateral shift of the green and red beams as shown in Fig. 3.

The different angles at which the beams from the three guns reach the shadow mask determine the particular color phosphor-dot which is energized by each beam. Thus, one gun is associated with each of the primary colors so that control of the beam current from that gun controls the amount of that primary color developed. The shadow mask is oriented so that electrons from one of the three beams can strike phosphor dots of only a single color no matter which part of the phosphor-dot screen is being scanned. Thus, three color signals controlling the three beams produce independent pictures in the primary colors. These primary colors from the three phosphor dots comprising a picture element (trio) appear to the eye to blend because of the close spacing of the dots and as a result the eye sees a full-color picture.

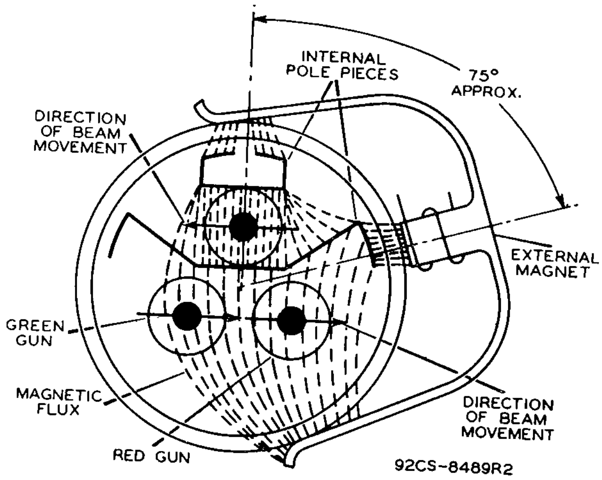


Fig. 3. Schematic of Lateral Converging Pole Pieces.

Focusing of the three beams is accomplished electrostatically by adjustment of the voltage applied to the three No. 3 grids which are inter-connected within the tube and have a common base-pin terminal.

A deflecting yoke, consisting of four electromagnetic coils, is required for deflecting the electron beams simultaneously after they pass between the respective radial-converging pole pieces. The coils are used in pairs; the coils for each pair are located diametrically opposite each other. The axes of the fields produced by these pairs of coils should intersect at right angles to each other and to the tube axis.