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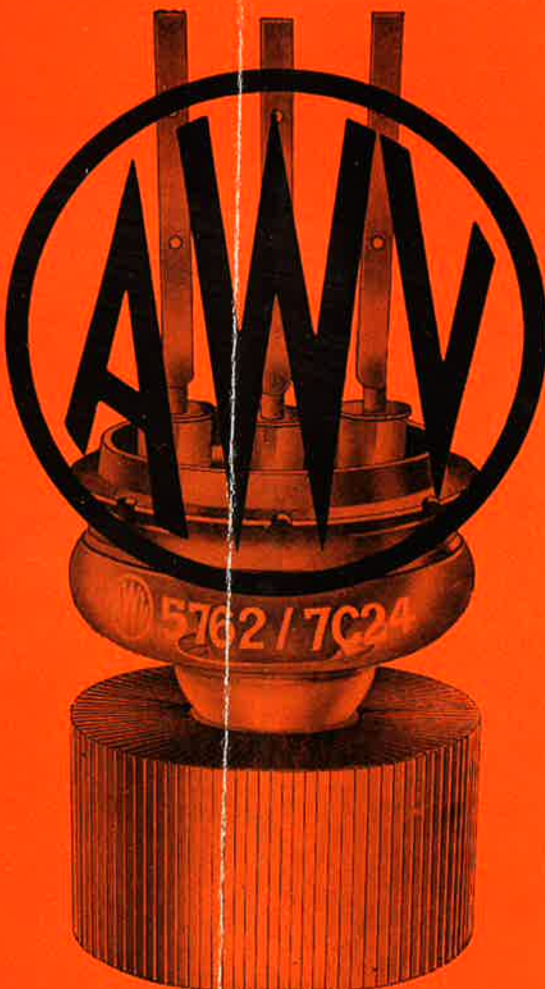

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AMALGAMATED WIRELESS VALVE COMPANY PTY. LTD.

IN THIS ISSUE

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EARLY FOUNDATIONS OF OUR ART

By D. M. SUTHERLAND, B.Sc. (Melb.)

(Works Manager, Amalgamated Wireless Valve Co. Pty. Limited)

If in his darker moments the valve-maker recalls the familiar jest, "Valve making is an Art not a Science"; he yet knows that his industry is saturated with Science, using its methods and tools, and constantly benefiting from the results of the research laboratories.

He knows that his industry had its genesis back in those times when the first discoveries of modern physics and electrical engineering were being made.

BEGINNING OF VACUUM TECHNIQUE.

In searching the past, it is easy to decide that the beginnings of valve-making lay in the early experiments in vacuum physics. Whatever else is done in valve-making, sooner or later it is necessary to produce something like a vacuum. In fact, this is an activity which has appealed to Technical Man for some considerable time. He could go about it in two ways:—following von Guericke (1683) he could use a *solid* piston and finish up with a kind of bicycle pump in reverse, and various other more sophisticated devices; or with Torricelli (1643), he could use the more subtle and (for high vacua) more effective *liquid* piston, plus the low pressure space left by Nature at the top of a barometer. This was the line taken by Geissler (1855), who added a branch tube and stop cock to the top of the mercury barometer to enable a cyclic use of the Torricellian vacuum, with the mercury being alternately raised and lowered. This was most tedious, and encouraged the developments of Topler (1862) and Sprengel (1865) which speeded up the business. The success of Sprengel's mercury jet pump is said to have played a great part in the discharge tube experiments of Crookes and others, and encouraged the development by Swan and Edison of a satisfactory vacuum incandescent electric lamp.

GLOW DISCHARGE EXPERIMENT.

To return to Geissler. It had been known for over a century (e.g., Newton and Hawksbee, 1700) that discharges of electricity near "exhausted glass vessels" produced a glow; and Geissler systematically investigated this, using the Ruhmkorf induction spark coil (1851) — based, of course, on Faraday's laws of induction (1831) — as a convenient high voltage source. He produced the many-coloured Geissler tubes, filled with various gases at low pressure, and excited by a high voltage discharge. Then came a famous series of experiments on discharges through gases, probing deeper and deeper, by Crookes (1875), Hittorf (1869, 1883), Perrin (1895), Lenard (1897), J. J. Thomson (1897) and others.

Why is the discharge tube of such importance in the history of Science? Because the work done with it is squarely in the main stream of modern physics. Glowing with its mysterious light, or luminescing strangely, it turned out to be the magic Aladdin's lamp of Science from which, in the fulness of time, rose an enormous genie, the mushroom cloud of the nuclear bomb!

DISCOVERY OF CATHODE RAYS.

We can quickly describe the main work of the early scientists by imagining an experiment on a tube of glass shaped, shall we say, like a fat cigar connected by means of a side tube with a high vacuum pump, and with the electrodes sealed through the walls at either end. We attach a lead from a high voltage source to the electrodes and start the pump. Soon a streamer discharge occurs between the electrodes; this broadens and fills the tube with a coloured glow characteristic of the gas remaining. This is the Geissler discharge. Then this glow separates from the cathode to give a dark space between it and the cathode, which is now bathed in its own glow — usually of a different hue.

Later this glow itself separates from the cathode to leave a second dark space, which grows larger while the original glowing column attached to the anode break up into flickering segments.

Finally the glows disappear altogether, leaving the glass walls luminescing. This last condition is the interesting one, and the pioneers probed it with success. With no apparent discharge, why should the walls of the vessel luminesce so strangely?

It is due to the impact of "radiant matter" or ***cathode rays***, said Crookes. He and others cast shadows on the walls of the discharge tubes, erecting a cross in the path of the rectilinear rays from the cathode; drove a little paddle wheel along rails with them; bent the rays with a magnet, and, focusing them by means of a concave cathode, made various minerals luminesce brightly. The rays were collected in a cup to produce a negative charge; and were deflected by an electrostatic field. They were shown to act as though they were streams of particles with which could be associated an electric charge and a mass; and they seemed to be the same no matter what metals or gases were used in the experiment. In short, the ***electron*** was discovered. (J. J. Thomson, 1897.)

This in itself was pretty good going. The discharge tube was also responsible for the discovery of X-rays, when Rontgen (1895) found bright luminescence in barium platino-cyanide near a discharge tube wrapped in opaque paper. With, in addition, Becquerel's discovery of radioactivity (1896), the attack on the structure of matter was fairly launched and in the succeeding fifty years made the tremendous strides which are today of such ominous significance.

We shall now go back to describe another line of work which concerns us, but before doing so we can note that Braun (1897) suggested a form of discharge tube in which cathode rays were formed into a beam and directed onto a luminescent screen, external coils being provided so that the beam could be deflected magnetically by an electric current, the variation in time of which it was desired to observe. **This was, of course, the first cathode ray oscillograph and the forerunner of the television picture tube.**

CURRENT FLOW CHARACTERISTICS.

From the origins of the vacuum pump we have been led through the annals of the discharge tube to the dawn of nuclear physics. We shall now review another chain of discoveries which in its fruitful later stages also required the vacuum pump, and which provided more directly the ground work for the development of the principal device of our industry — the amplifying valve — as well as the diode detector.

Prior to the work on high voltage discharges, many early scientists had observed the conduction of electricity in air near hot bodies. O. W. Richardson quotes six names from the 18th century, and further work was done in the 19th century, culminating in the discovery by Guthrie (1873), that a red hot iron ball in air could retain a negative, but not a positive charge, but that at high temperatures electricity of either sign was rapidly lost. A series of experiments on this kind of thing was carried out by Elster and Geitel (1882-9). They used wires of various materials heated by an electric current and examined the potential of a nearby electrode for various atmospheres at various pressures. Their observations could be explained by the flow of both positive and negative ions from the hot body — the positive flow generally taking place at the lower temperatures and the negative at higher temperatures. Further, the negative ion flow seemed to be more permanent than the other.

Meanwhile Edison (1883) made his celebrated discovery while working on the vacuum lamp, that an electrode sealed through the wall of the lamp would pass a current when positive, but not when negative to the filament. Edison was one of the long line of experimenters striving to perfect a high resistance lamp filament, and as did his contemporary, Swan, he decided he must use a high vacuum to prevent his filament being consumed.

Fleming, subsequently the inventor of the thermionic diode detector, visited Edison in 1884 in the course of his commercial duties as a consultant, and obtained first-hand knowledge of the new discovery. He was most interested, and conducted further investigations along the same lines, showing that the effect could be obtained with a platinum filament as well as with a carbon filament. Preece also carried out similar work at this time.

O. W. Richardson, who himself contributed a great deal to the science of thermionics, describes in his book, "The Emission of Electricity from Hot Bodies", how all this early work was drawn together by J. J. Thomson's theory of the electron. The latter, we have noted, was a prominent figure in discharge tube experiments; he was one of the first to measure the ratio e/m for the electron in the discharge tube (1897) and in 1899 he showed in another experiment that the carriers of negative electricity from a hot wire were the electrons with the same properties as those flying from the cold cathode of the discharge tube. The real scientific investigation of thermally produced electrons dates from this time, to the great ultimate benefit of the valve.

OXIDE-COATED CATHODE.

The final step to be mentioned at this stage is due to Wehnelt, who, following Hittorf's earlier observations in 1884 that the high voltage discharge tube would pass currents at comparatively low voltage when the cathode was incandescent, found in 1904 that a speck of lime on heated platinum was an excellent source of negative ions (electrons). He used this cathode first of all to produce an intense beam of electrons in an experiment measuring e/m; and later suggested its use in a Braun oscillograph tube. Its purpose was to reduce greatly the voltage across the tube, thus increasing its deflection sensitivity. The cathode structure proposed had a heated filament covered with lime, with a surrounding cylindrical shield. This was in 1905.

SUBSEQUENT DEVELOPMENT.

Such was the early scientific background to the electronic valve. The two first wireless valves — the thermionic diode, and later, the most important member of the family, the amplifying valve — can now be seen as offshoots from the branches of Physics we have described. Theirs is a story which has often been told. We have noted that Fleming learned of the Edison effect in 1884; but it was not until 20 years later, in 1904, that his association with the young wireless industry led him to apply his knowledge to the detection of wireless signals, and invent the thermionic diode. de Forest invented the triode amplifying valve in 1906 to satisfy another need of wireless in its earliest stages. Both these devices were taken up somewhat tardily, but with the commercial development of wireless, particularly the broadcasting of speech and music, they were eventually pushed along from one improvement to another. But that is another story.

In manufacture the valve owed much to the lamp industry, especially its use of glass bulbs and tubing, glass-metal sealing wire ("dumet"), vacuum pumps, and "gettering". Depending on lamp technology, it was also continually fed by results from the scientific laboratory. Thus it used Langmuir's achievements in his researches on emission and vacuum pumps, and it adapted the Wehnelt cathode — the oxide cathode universally used today. And so on, till it built up its own body of technology, its own applied science and production arts, and its own special materials.

I have said that the amplifying valve was an offshoot from early Physics. It was not the only offshoot of importance to us in the electronic valve industry. It is clear that *the X-ray tube* was a direct and close descendant of the discharge tube we described earlier. The same applies to the *cathode ray tube* now assuming great importance to us with the introduction of television in Australia, but already with a long history of service in peace and war. In addition there is the *photo electric cell,* which arose from the work of many scientists who were interested in the broad field touched on above, including Lenard, and Elster and Geitel (1890), and also Hertz, a famous name in science history. There is also the *voltage regulator tube,* which uses the voltage drop across a gas filled cold cathode discharge tube. That's not a bad harvest.

FIRST ELECTRONIC VALVE.

Finally, we can mention which surely must be the first electron device to be put to practical use; and to do this we must return, not to Fleming who invented the first *wireless* valve to be sure, but to our old friend Edison. It will be recalled that Fleming's idea arose from the demonstration by Edison of current flow to an added electrode in a lamp. Edison noted that the current depended on the temperature of the lamp filament, and so he applied this to the control of the voltage of an electric supply system by connecting the filament across the mains, and using the current variations to the extra electrode to actuate a galvanometer, and thence through a relay to effect control of the generator voltage.

He had, of course, invented the ***thermionic control diode,*** *and applied it in the same way as it is widely used today.*

PICKUP OUTPUT RATINGS

See P.17 for principal article.

TABLE 1 — ALL TYPES OTHER THAN CRYSTAL OR CERAMIC

NAME	MODEL	TYPE	mV/cm/sec.*
Connoisseur†	Mark 1 Std. LP Mark 11 Std. LP	EM EM EM EM	5.1 3.3 4.5 2.5
Fairchild (America)†	215A‡ 215B‡ 215C‡	MC	0.4
	220A 220B 220C	MC	0.8
Ferranti (England)†	with own transformer	ribbon	1
G. E. (America) (variable reluctance)	12-D-1	EM	21.8
R.C.A. (America)†	MI-11874 (Lightweight)	EM	1.8

TABLE 2 — CRYSTAL AND CERAMIC TYPES

NAME	MODEL	TYPE	mV/cm/sec.*
R.C.A. (America)§	RMP128-4	Crystal	91
Ronette§ Std. (load 120K)	T0-284-PX	Crystal	60
LP (load 500K)	T0-284-PX	Crystal	90
Sonotone (America)§	2T	Ceramic	163

† Amendment. * At 1000 c/s. ‡ Addition. § Replacement models.

See Jan. '59 issue, P.12 for more data.

RADIOTRON AV25

DEMONSTRATION TRIODE

By V. ANTHONY, B.Sc. (Syd.), A.M.I.I.T.
(Power Valve Section, A.W.V. Pty. Ltd.)

SUMMARY.

The Radiotron AV25 is an Australian made demonstration triode intended for educational use. Its chief characteristics and operating conditions are given in this article. Both a.c. and d.c. operation are discussed, together with suitable circuits and a showcase for display purposes.

These details supersede any previously published information on this valve type.

GENERAL DATA.

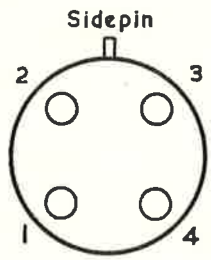
Electrical

Filament Voltage	6.0 volts a.c. or d.c.
Filament Current	1.6 amps
Fluorescent Screen Colour	Green

Mechanical

Mounting Position	Vertical
Maximum Overall Length	$7\frac{7}{8}''$
Maximum Seated Height	$7\frac{1}{2}''$
Maximum Diameter	$2\frac{1}{2}''$
Plate Dimensions	$2\frac{7}{8}'' \times 1\frac{1}{2}''$
Bulb	T18
Base	Medium metal-shell Jumbo 4-pin bayonet.

Bottom View of Base

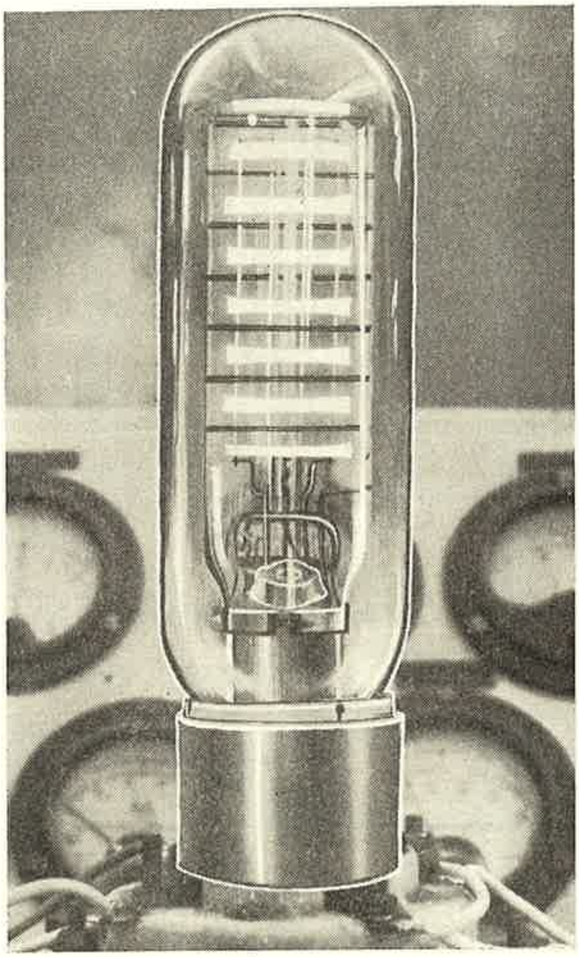


Pin 1 ... Grid
Pin 2 ... Filament
Pin 3 ... Plate
Pin 4 ... Filament

Maximum Ratings	**D.C. Operation**	**A.C. Operation**
Plate Voltage	300 volts	275 volts r.m.s.
Grid Voltage*	± 180 volts	± 150 volts r.m.s.

Typical Operation and Characteristics		
Plate Voltage	250 volts	200 volts r.m.s.
Grid Voltage*		
at Min. Coverage	—110 volts	— 90 volts r.m.s.
at Max. Coverage	± 140 volts	+ 115 volts r.m.s.
Amplification Factor (μ)	3	
Plate Resistance (r_p)	5000 ohms	
Transconductance (g_m)	600 μmhos	
Plate Current (at max. coverage)	110 mA	50 mA r.m.s.

* Phase of the grid voltage with respect to the plate voltage is designated by the ± sign.
Minimum coverage or "cut-off" occurs when the shadows cast by the grid wires just overlap.
Maximum coverage occurs when the same shadows just disappear.



DESCRIPTION.

The AV25 is a simple triode having a filament consisting of four parallel oxide coated wires. These wires are located in a plane parallel to the plate. Between these two electrodes and parallel to them is a ladder-like grid structure, the six "steps" of which are quite widely spaced.

The plate surface facing the other electrodes is coated with a phosphor which fluoresces green under electron bombardment. Thus the pattern of the electron stream striking the plate is made visible. Grid control of the electron stream, even to cut-off, may accordingly be demonstrated. In the photograph the plate fluorescent pattern was obtained with zero grid bias.

D.C. OPERATION.

D.C. operating characteristics of the AV25 are given in Fig. 1 for three different plate voltages.

Operation near maximum plate voltage and maximum coverage is not recommended for extended periods. Fatigue in the fluorescent coating, shown by the appearance of a dark region on the plate, is due to excessive plate dissipation. The resulting loss in definition is only temporary and may be remedied by lowering the plate current and allowing the tube to cool for several minutes.

A suitable circuit is given in Fig. 2. In switch position 1 variation of the grid control gives a positive grid voltage range. In switch position 2 variation of the grid control gives a negative grid voltage range with respect to the filament.

Provision of the ammeter and voltmeters is an optional refinement.

A.C. OPERATION.

The fluorescent intensity is greater at the higher plate voltage, this condition being favourable for operation in brightly illuminated areas.

Fatigue (see reference in d.c. operation) is not so troublesome for a.c. conditions. The low cost of an a.c. power supply also recommends this type of operation.

A simple a.c. type circuit is shown in Fig. 3. An ordinary transformer (secondary H.T. winding rated at 275 volts 80 mA a side) is suitable.

In the centre position of the grid control potentiometer the grid voltage is zero. For positions above the centre, the plate and grid voltage are in phase, and in positions below the centre, they are 180 degrees out of phase. These two positions thus correspond to the positive and negative conditions respectively of the d.c. case.

INSTALLATION AND USE.

The AV25 should be mounted in an upright position. Definition and contrast are considerably improved if stray ambient light is avoided. In Fig. 4 is illustrated a suitable showcase which will both shield the tube from extraneous light and house the power supply.

The effect of fatigue has already been mentioned. Avoidance of this defect is important if optimum definition is to be obtained.

Vibration and shock must be avoided because of the fragile nature of the filament construction.

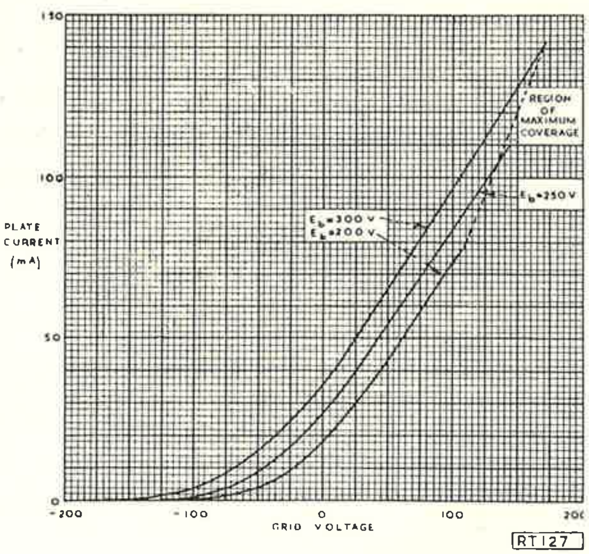


Fig. 1. Plate Characteristics of AV25 operated in a d.c. circuit.

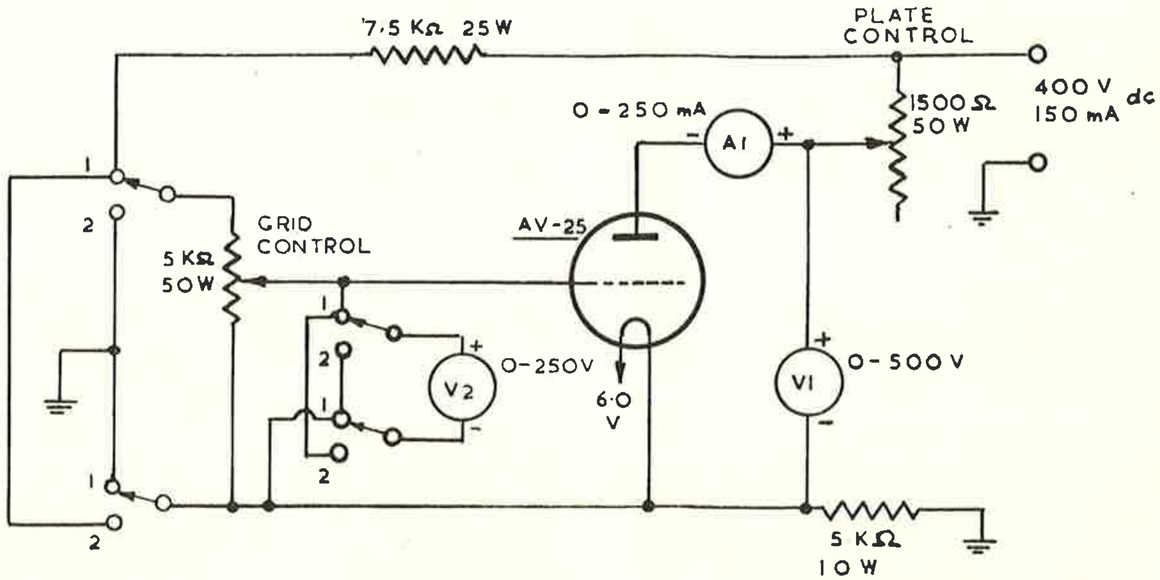


Fig. 2. Typical circuit for demonstrating the Radiotron AV25 using direct supply voltage.

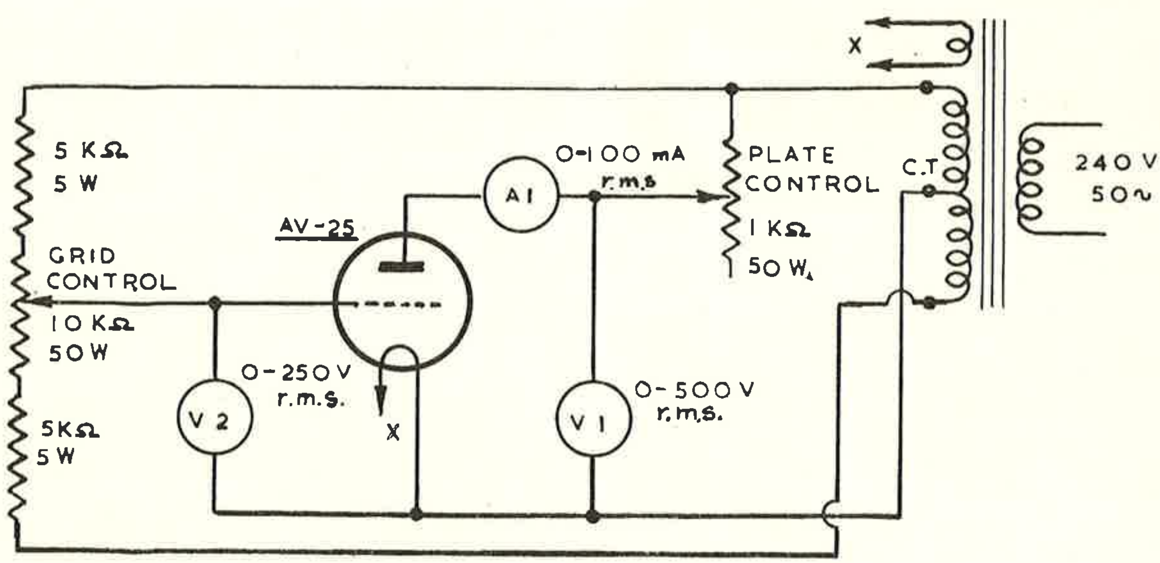
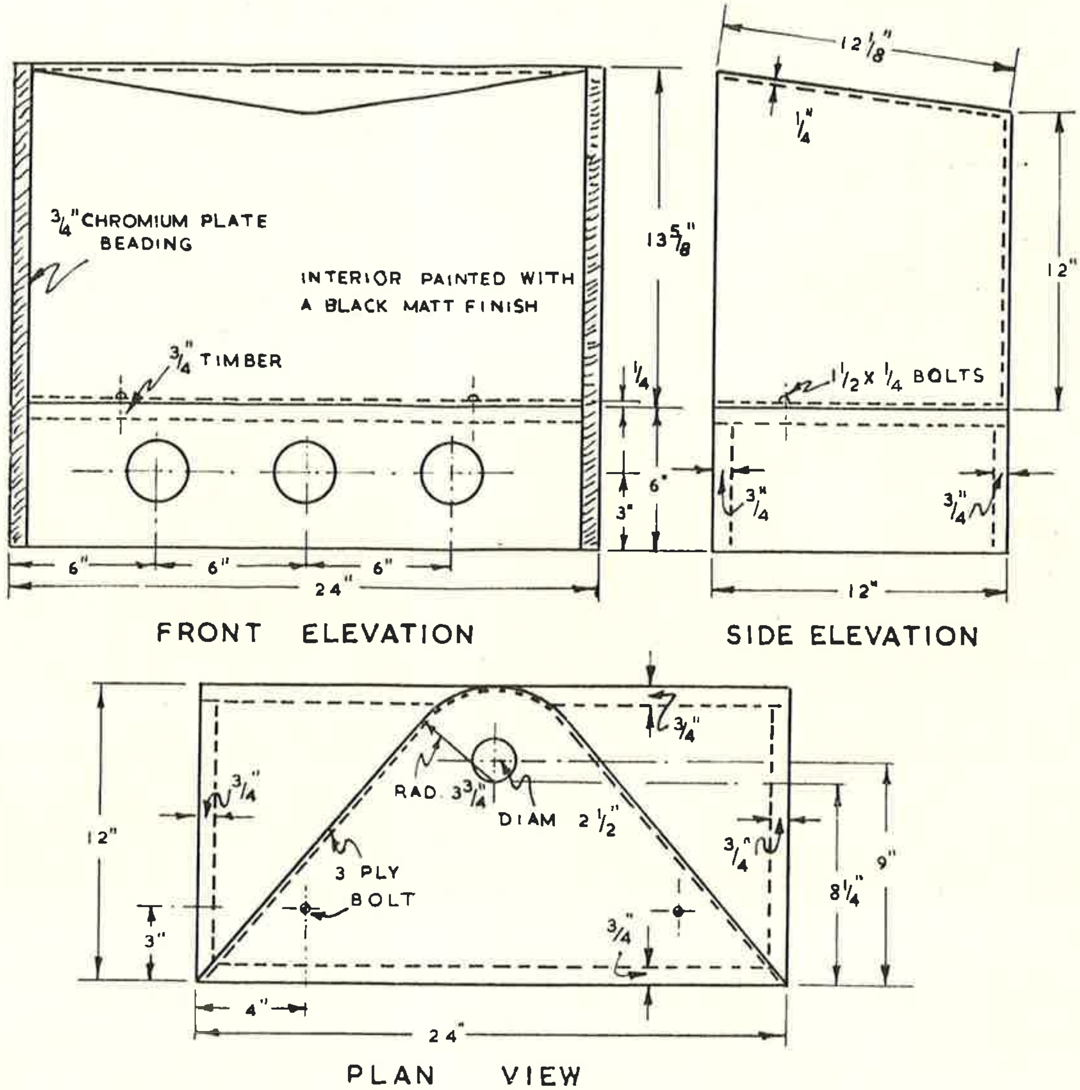
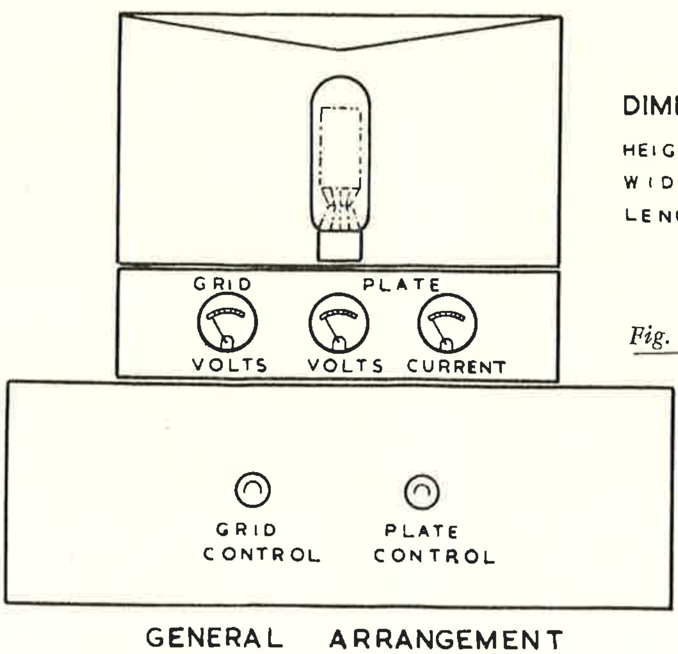


Fig. 3. Typical circuit for demonstrating the Radiotron AV25 using alternating supply voltages.

Mr. V. Anthony graduated as B.Sc. from the University of Sydney in 1949. Since then he has been employed in the Power Valve Section of A.W.V. Co., and has variously engineered power valves (including the 2E26, 5786 and magnetrons), developed new high vacuum techniques and designed several ionigation and thermo-couple gauges.

SHOWCASE FOR DEMONSTRATION TRIODE AV25



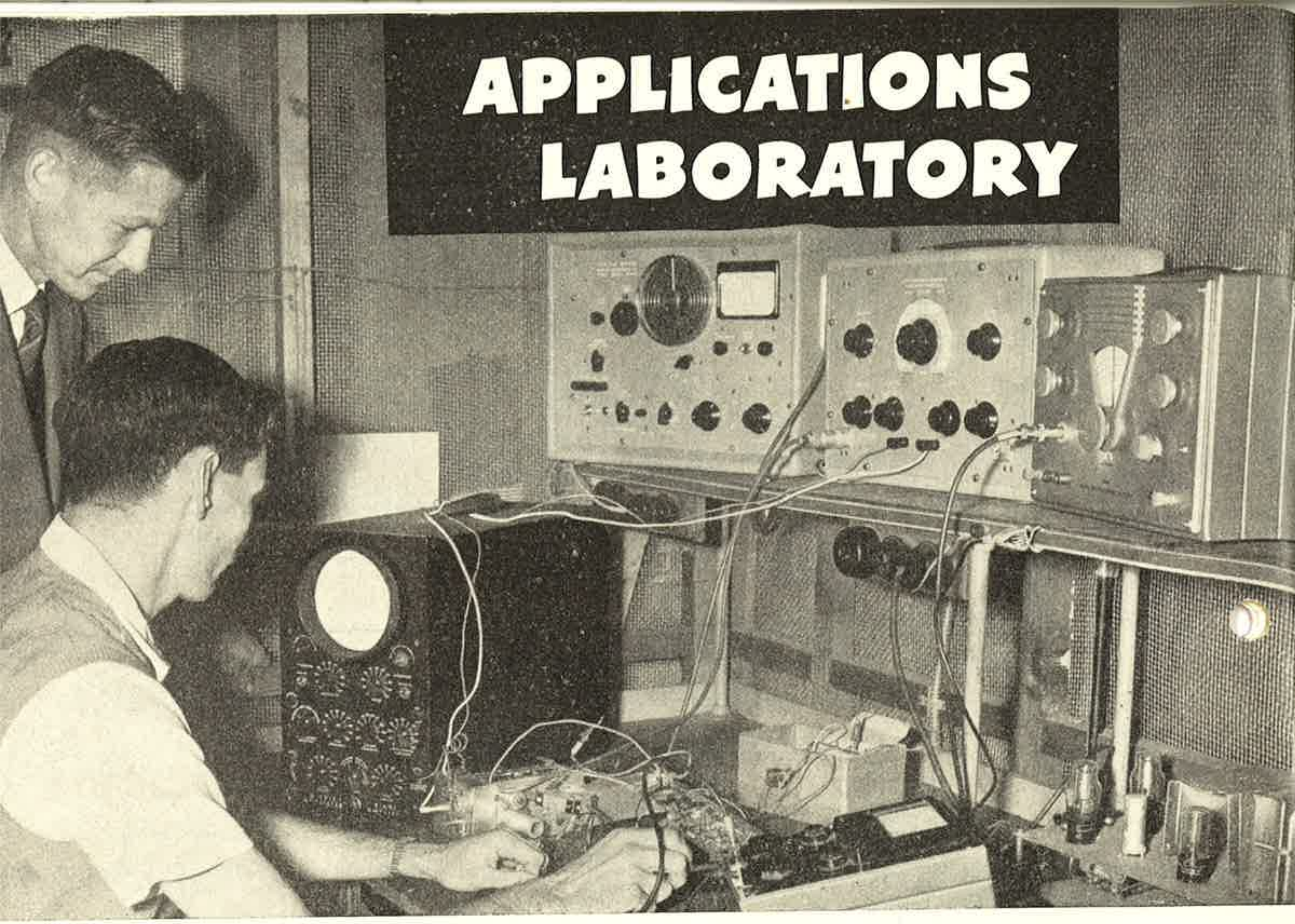


DIMENSIONS OF BOTTOM BOX

HEIGHT = 12"
WIDTH = 24"
LENGTH = 36"

Fig. 5. Showcase for Radiotron AV25.

APPLICATIONS LABORATORY



By H. R. WILSHIRE, A.S.T.C., A.M.I.E. (Aust.), S.M.I.R.E. (Aust.)
(Engineer-in-Charge)

INTRODUCTION.

The Application Laboratory, where the bulk of the Amalgamated Wireless Valve Company's electronic circuit engineering is carried out, stands midway in the organisation between the Customer — the valve user; and the Factory — the valve maker; and has the important and challenging task of keeping both happy. The Laboratory must look both ways; it must represent the Customer to the Factory and ensure that the factory supplies the valve types the Cutsomer wants, to the quality the Customer wants; then it must do everything it can to help the Customer use valves properly and obtain the best possible service from them.

Let us review some of the ways in which this task is carried out.

MAIN FUNCTIONS OF THE LABORATORY.

Valve Quality and Receiver Performance.

Modern valves with their collection of electrodes form highly complex structures in which the movement of electrons in a vacuum can be made to perform, at the will of the circuit designer, an almost unlimited number of tasks. To ensure that each valve behaves in the right way when used in any one of the great variety of circuits possible, the materials making up the valve and the processes involved in its manufacture are subjected to a great many rigid controls and tests. These cover a wide range in the fields of chemical, mechanical and electronic engineering.

The final step necessary in the production of a valve before it is passed into the store as a finished article, is to give it a series of tests which are designed to check its main characteristics. These must fall within specified limits before the valve can be considered satisfactory.

Although routine testing is a production procedure, the Laboratory provides guidance as to the nature of the tests and the limits to be used. A major way in which this is done is to conduct operational tests in a great variety of electronic equipment of the type in which the particular valve can be used. For the valves most commonly produced by the Amalgamated Wireless Valve Company these tests may be carried out in one or more of a number of radio receivers each of which uses the valve in a different way.

For example, a valve such as the Radiotron 6BA6 or 6AU6 may need to be tested for performance in both intermediate frequency and radio frequency amplifying circuits, while the Radiotron pentagrid converter 6BE6 must be checked for satisfactory operation in cathode coupled and screen coupled oscillator circuits on both medium and short wave frequencies. The choice of the particular type of oscillator circuit for use with this valve depends on other basic requirements of the receiver, such as the automatic volume control characteristic required and the method of supplying both screen and bias voltages. Since a valve may normally be used in a great variety of circuits and combinations of applied electrode voltages, very thorough testing is necessary. The measurements carried out on valves when operating in equipment assist the design of suitable test methods. In this way factory tests are related to the performance of valves in the user's equipment and the maintenance of a high standard of outgoing quality is assured. In many cases when there is no suitable circuit available special equipment is set up to check the desired application.

The advent of television has greatly increased the number of valve types and the variety of ways in which they can be operated and the Laboratory has a full programme of TV application work. A television receiver uses more types of valves than the ordinary broadcast receiver and, what is more important, uses them in very different and complicated ways. These types are now included in the Radiotron preferred range, and an important part of the work of the Application Laboratory is the checking in television receivers of new types being prepared for production and the continued testing of samples of valves already in production.

Valve Life Testing.

Since the proper assessment of valve quality takes into account changes of characteristics as the valve ages, many measurements are made of the changes in performance of a receiver or other piece of equipment as the valve undergoes its regular life test. As detailed above this performance measurement in equipment serves as a double check on the results obtained by the normal life test measurements. It helps evaluate the ability of the valve to stand up to life and does so in terms of qualities appreciated by the buyer of valves, i.e. the actual performance of his equipment.

Special Valve Test Equipment.

The final part of this "bread and butter" work of the Laboratory is the design and testing of the prototypes of special equipment for the production testing of valves by the factory. Many of the tests carried out on valves by the Valve Co. require equipment which conforms to rigid specifications. To take two examples:—(i) the noise test for an r-f pentode may require a tuned amplifier with an input impedance of 100 KΩ ± 10% and a gain of >100 db and an overall pass band of >4 Kc/s at an attenuation of 3 db and between 9-11 Kc/s at an attenuation of 20 db; (ii) the plate voltage breakdown test for a television horizontal output valve may specify the application of a pulse of say 6000 volts for 10 μS with a repetition frequency of 15 Kc/s. It is the responsibility of the Laboratory to provide a prototype of equipment which meets the particular requirements.

Advice to Valve Users.

A large part of the work carried out in the Application Laboratory consists of advice on valve usage to a variety of outside people, ranging from the home constructor through to the engineering staff of our biggest manufacturers. Grouped with this work is the checking of valve operation in the receivers and equipment of users of Radiotron valves. (Once again at least one of the major manufacturers is included in the list of those who have availed themselves of this service.)

An indication of the work carried out in the past along these lines is given by the following few examples:—(i) a receiver using a Radiotron 6BE6 converter was submitted for comment on the suitability or otherwise of the oscillator coil for this particular valve. Investigation showed that certain adjustments could be made to the coil to provide optimum operation for the 6BE6. These changes were recommended and the final coil then approved. (ii) a sample of a battery portable receiver of another manufacturer was supplied to the Laboratory for criticism of the circuit as far as the voltage across each valve in the series string was concerned. Some modifications to the values of the series and the parallel filament resistors to ensure longer valve life were suggested. (iii) the difficulty of variable performance from valve to valve, experienced by one manufacturer in a particular receiver, was completely removed when, after investigation, the operating conditions on two of the valves were changed.

Designs Using Radiotron Valves.

It has been found that a worthwhile way of assisting designers to make the best use of our valves is to produce a series of complete receivers designed by the Laboratory to be of high performance, in which the valves are operated in the best method. This receiver is made available to designers, not to show them their business, but merely to illustrate in the most practical way ideas on how to obtain optimum performance from a valve most safely. Experience has shown that this is an excellent method of communicating valve application ideas.

Field Investigations.

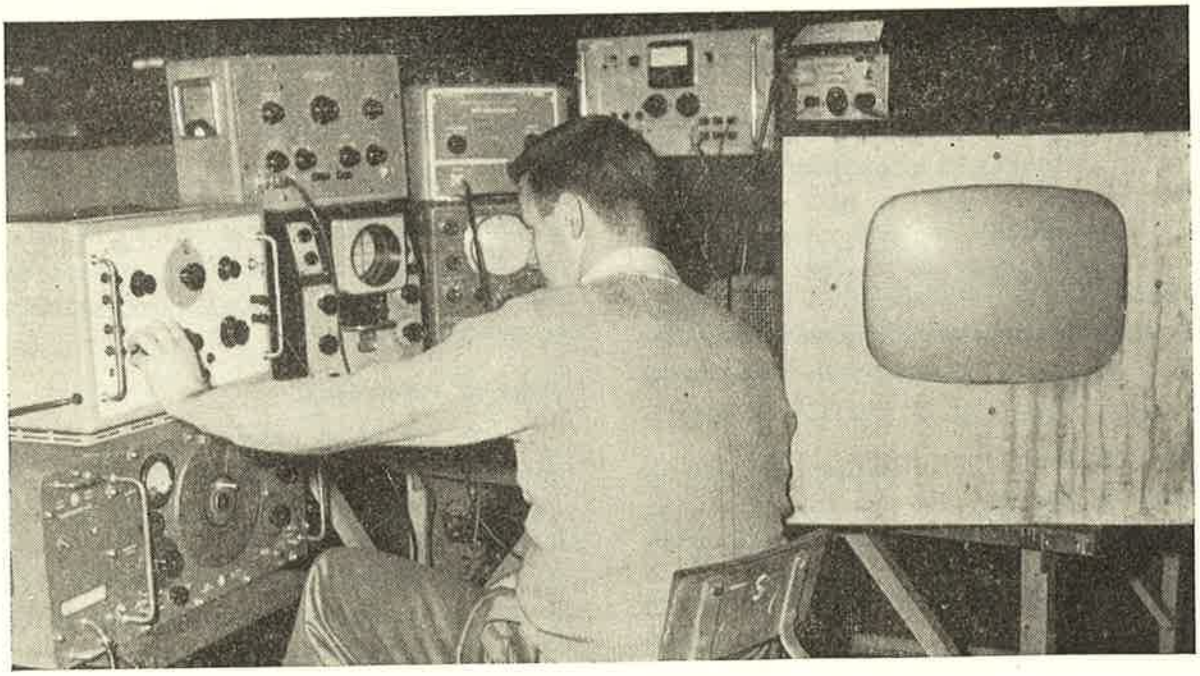
In parallel with this applications advice, runs what might be termed a field investigation service on valve problems. Under this heading come the visits to the factory of a receiver manufacturer where, in conjunction with the engineering personnel of the manufacturers, the particular problem which may involve purely local conditions will be investigated.

Trends in Valve Types.

The information gained from the contacts with the users of valves and from a wide reading of the world's technical literature enables an estimate to be made of the trends in valve types and the likely demand for them. Analyses of valve usage in overseas receiver designs are maintained up to date in the Laboratory to assist in the collection of the required data. The information so gained is passed on to the production and sales engineers and helps in decisions regarding new types to be added to the Radiotron range.

Technical Writing for Radiotronics.

The supply of material to the A.W.V. publication "Radiotronics" is an important call on the activities of this Laboratory and there is an ever-present demand for articles from members of the Application Laboratory staff.



The two figures in this article illustrate the diverse array of equipment used by the Applications Laboratory in checking TV circuitry.

Special Investigations.

The development of circuitry around many different types of valves, the design of broadcast receivers and associated equipment and the thorough analysis of the operation of valves in television circuits continually present problems, phenomena and odd effects, which must be understood. In the firm belief that every effect must have a cause and that "odd" effects unless explained might cloak a "nigger in the woodpile" it has been established as a cardinal rule for the conduct of any job in the Laboratory that every effect noted must agree with theoretical predictions. This code of behaviour often opens up special investigations. One such was the work on the understanding of the operation and the application to circuits of the pentagrid converter valves 6BE6 and 1R5. The results of this work which was shared by a number of the Laboratory staff were written up and presented as a paper to the 1955 I.R.E. Convention*. Other special investigations which have been carried out include the series filament operation of 1.4 volt miniature valves when supplied from the mains, playthrough problems in reflex receivers, methods of testing for, and the evaluations of microphony in battery miniatures, effects of battery recharging circuits on valve life, the development of special methods for the measurement of valve operating conditions in the pulsed circuits of television receivers, e.g. the measurement of the filament voltage of the 1B3GT e.h.t. rectifier, and many others.

MEASURING EQUIPMENT.

To properly carry out the work outlined above a considerable amount of electronic test equipment is required and the Laboratory has at its disposal a large variety of apparatus.

Currents and voltages, both direct and alternating, can be measured with instruments of sub-standard accuracy and a range of high quality thermocouple meters is available for the measurement of audio and radio frequency currents and powers.

Television has brought with it the need to generate and measure voltages and currents with complicated waveforms and covering wide ranges in frequency and amplitude. Apart from the normal audio and medium frequency signal generators the equipment includes those with a range of 500 Mc/s and capable of being frequency modulated to a deviation of 75 Kc/s by signals over the audio frequency band and amplitude modulated by square wave, pulse and video signals. A source of square wave and pulse voltages up to a frequency of 250 Kc/s is often used in the checking of audio and video frequency amplifiers. The mark/space ratio of the square waves produced by this particular generator can be varied over a 9:1 ratio and lengths of the pulses from 0.05 μS to 0.3 μS with a rise time of 0.02 μS.

Video signals of broadcast standard and suitable for checking the linearity of television deflection circuits and the operation of video amplifier and synchronising circuits are piped to the Laboratory through coaxial line from a Marconi Monoscope and synchronising signal generator which is installed in the picture tube section of the Valve Works.

In addition to a number of cathode ray oscilloscopes used to perform the multifarious tasks that fall to the lot of these general purpose instruments, a very high quality 5in. cathode ray oscilloscope is used for the observation of complex circuit operations. The passband of the vertical amplifier of this c.r.o. extends from d.c. to 30 Mc/s with a rise time of 0.012 μS. At maximum sensitivity it produces a deflection of 1 cm for 50 mV. The sweep circuit can be adjusted to sweep horizontally at the minimum rate of 1 cm every 12 seconds and at the maximum rate of 1 cm every 0.02 μS. The quality of the triggering facilities is of an equally high order and can be arranged to provide a variable delay on the start of the sweep so that a particular pulse occurring at a predetermined time after the triggering pulse can be centred and enlarged on the screen. The above features, together with an inbuilt voltage calibrator and the ability to focus the trace to a very fine line, make this instrument a very satisfying one to handle.

The adjustment of the wide band circuits used in television receivers require the use of sweep frequency generators. Two are in use by the Laboratory and provide a 10 Mc/s wide sweep on the video, intermediate and radio frequencies used in television. Many other types of measuring equipment including Q meter, marker generator, noise generator, and accurate resistance and capacitance decade boxes and measuring bridges are available for use by the staff.

A summary could be made of the above by saying that the Laboratory has sufficient electronic test equipment for almost any valve or circuit measurement and that generally for all work carried out the accent is on quality and accuracy and proper understanding of every effect investigated. A note should be made of the work carried out on that "mighty midget", the transistor. This electronic device, the latest product of the electronic scientist, is fast becoming highly important in an expanding list of electronic equipments. Some elementary work on its characteristics and uses has been carried out in the Laboratory and it is expected that the next few years will see a much larger investigation of its somewhat striking features.

CONCLUSION.

This general description of the activities of the Application Laboratory indicates the nature of its position as the link between the valve user and the production function.

It is clear that as television and transistor equipment come into wider use, the activities of this Laboratory will increase considerably and it is our opinion that close co-operation between the equipment manufacturer and the valve manufacturer is most important. It is the intention of the Laboratory that this should be developed to a maximum.

* This paper was printed in "Radiotronics" (August, 1956).

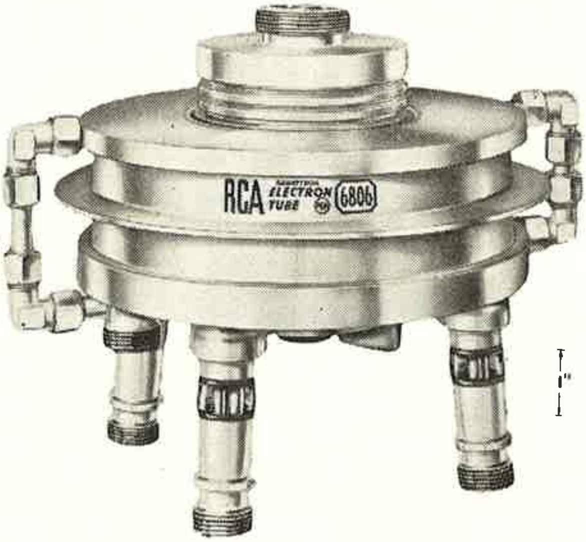
NEW RCA RELEASES

RADIOTRON 6806

SUPER-POWER UHF BEAM POWER VALVE

The 6806 is a water-cooled beam power valve of unique design intended for operation as a grid-driven power amplifier at frequencies up to 1000 Mc/s. It has a maximum plate-dissipation rating of 35 kilowatts.

In colour or black-and-white television service, the 6806 is capable of delivering a synchronizing-level power output of 28 kilowatts at 550 Mc/s or 17 kilowatts at 750 Mc/s. As a cw amplifier in class C telegraphy service, the 6806 is capable of giving a useful power output of 35 kilowatts at 400 Mc/s or 13.5 kilowatts at 900 Mc/s. The 6806 is also well-suited for use in single-sideband service. For example, as a class AB power amplifier, it is capable of delivering a maximum-signal power output of 15 kilowatts at 550 Mc/s.



Unique in design, the 6806 features a coaxial electrode structure in which the centrally located plate is surrounded by a symmetrical array of unit electron-optical systems. These embody a structural design which permits not only close spacing but also unusually accurate alignment of the electrodes. Furthermore, effective bypassing of grid No. 2 cathode is provided by built-in capacitors. Ducts for water cooling the plate, the grid No. 2 block, the grid No. 1 block, the r-f cathode terminals, and the filament section blocks, are built in.

Other features of the 6806 include low-inductance, large-area, r-f electrode terminals insulated from each other by low-loss ceramic bushings; relatively low output capacitance; very low feedback capacitance; and a multistrand thoriated-tungsten filament for economical operation, high emission capability, and long life.

RADIOTRON 6903

MULTIPLIER PHOTOTUBE — WITH ULTRAVIOLET RESPONSE

Radiotron 6903 is a head-on type of multiplier phototube intended especially for the detection and measurement of ultra-violet radiation, and in other applications involving low-level radiation sources.

Featuring S-13 response, the 6903 is constructed with a fused-silica faceplate which transmits radiant energy in the ultra-violet region down to and below 2000 angstroms. At 2000 angstroms, the spectral sensitivity is more than 50% of the maximum response. The spectral response of the 6903 covers the range from about 2000 to 6500 angstroms. Maximum response occurs at approximately 4400 angstroms.

Other design features of the 6903 include a semi-transparent cathode having a minimum diameter of $1\frac{5}{8}$ inches, ten electrostatically focused multiplying (dynode) stages, a focusing electrode with external connection and the capability of multiplying feeble photelectric current produced at the cathode by a median value of 400,000 times.

RADIOTRON 5725

"PREMIUM" SHARP-CUTOFF PENTODE

RCA is pleased to announce to equipment manufactures the 5725—a "premium" sharp-cutoff pentode of the 7-pin miniature type intended particularly for use in gated amplifier circuits, delay circuits, gain-controlled amplifiers, and mixer circuits. Constructed to give dependable performance under conditions of shock and vibration, this premium tube, which is similar to the 6AS6, is especially suited for use in critical industrial applications and in mobile and aircraft equipment.

The 5725 included separate base-pin terminals for grids No. 1 and No. 3. Each of these grids has a sharp-cutoff characteristic and can be used independently as a control electrode.

Featured in the design of the 5725 is a compact structure in which special attention has been given to features which improve its strength for both shock and vibration, and a pure tungsten heater having high mechanical strength to give long life under conditions of frequent "on-off" switching.

The 5725 is manufactured under rigid controls and undergoes rigorous tests to insure its "premium" quality as follows: (1) factory controls and design tests on typical plate-current-cutoff conditions in gated amplifier circuits, (2) test readings at the end of 1 hour, 100 hours, and 500 hours to insure that valves fall within the established tight characteristics limits and that early failures are held to a low percentage, and (3) life tests made with a minimum bulb temperature of 165°C.

RADIOTRON 8DP4

ELECTROSTATIC-FOCUS PICTURE TUBE

Radiotron 8DP4 is a rectangular, glass picture tube of the low-voltage electrostatic-focus and magnetic-deflection type. It has a spherical Filterglass faceplate, a screen $7\frac{3}{16}$ inches by $5\frac{3}{4}$ inches with slightly curved sides and rounded corners and a minimum projected screen area of 35.5 square inches.

Employing a wide-angle (90°) deflection, the 8DP4 has a maximum overall length of only $10\frac{3}{4}$ inches and weighs less than three pounds. Other design features include a specially designed precision electron gun requiring an external, single-field ion-trap magnet; and an external conductive bulb coating which, with the internal conductive coating, forms a supplementary filter capacitor.

Several manufacturers have designed compact portable TV receivers built around the 8DP4 and they are or soon will be placed on the American market. These newly designed receivers — only slightly larger than a table model radio — will be ideal for use anywhere in the home or office and will be an excellent choice for a "second set".

TECHNICAL LIBRARY

"TELEVISION ENGINEERING PRINCIPLES & PRACTICE"

VOLUME II

By S. W. AMOS and D. C. BIRKINSHAW.

This is the second volume of a textbook of TV engineering written by members of the B.B.C. Engineering Division. The work is intended to provide a comprehensive survey of television principles and practice.

Volume 1: Fundamental principles, camera tubes television optics and electron optics.
Volume 2: Video-frequency amplification.
Volume 3: Waveform generation (in preparation).
Volume 4: Circuit techniques (in preparation).

This volume describes the fundamental principles of video-frequency amplifiers and examines the factors which limit their performance at the extremes of the pass-band. The treatment is very detailed and consequently becomes rather more mathematical than Volume 1. It is divided into five parts:

PART 1: Fundamental Principles of Video-Frequency Amplification.
PART 2: Video-Frequency Amplification; High Frequency Considerations.
PART 3: Video-Frequency Amplification; Low Frequency Considerations.
PART 4: Feedback in Video-Frequency Amplifications.
PART 5: Noise in video frequency amplifiers.

"Television Engineering" is published by arrangement with the B.B.C. for "Wireless World" by Iliffe and Sons Limited.

"ABACS OR NOMOGRAMS"

By A. GIET

(Translated from the French by H. D. Phippon and J. W. Head)

Most engineers have made use of nomograms at some time, and are fully aware of the convenience offered when the same formula has to be solved repeatedly for several sets of variables. The few existing books on this subject are very mathematical and unsuited to a practical engineer. This book is essentially practical and demonstrates the many and varied applications of the nomogram and shows how charts may be readily constructed.

PART 1: Relations between two variables.
PART 2: Cartesian abacs.
PART 3: Aligment Charts.
PART 4: Alignment charts not based on parallel co-ordinating.
PART 5: Relations between variables.

This book is published by Iliffe and Sons Limited.

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