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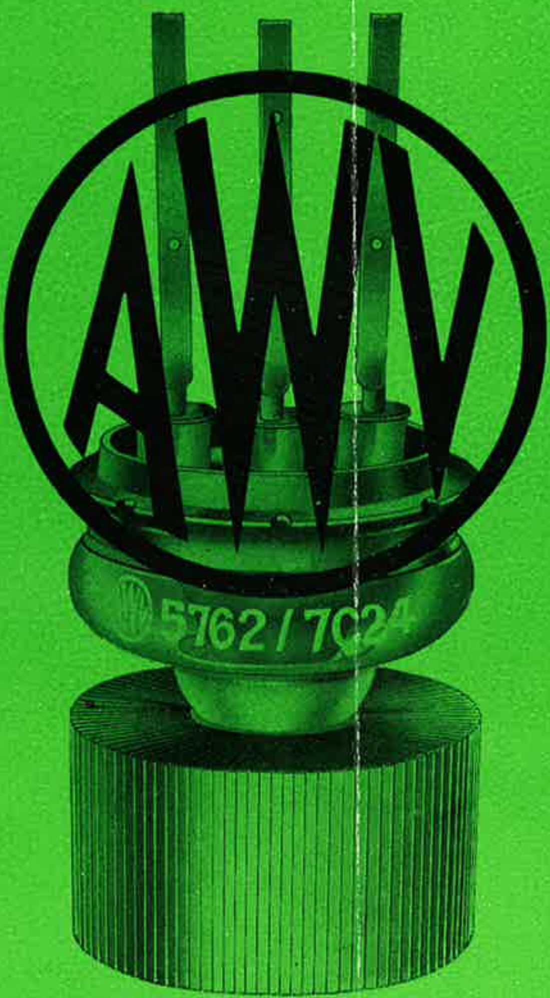

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AMALGAMATED WIRELESS VALVE COMPANY PTY. LTD.

EDITORIAL

Television is "hot news", and we are proud to include a further article by one of our engineers, this time on the subject of Picture Tube Mounting. This is a valuable contribution to an important subject and covers both electro-statically focused tubes and magnetically focused types.

One of the problems facing all would-be users of pre-amplifiers is to decide what sensitivity is required. It is most annoying to find that a particular pickup and pre-amplifier haven't quite enough gain for full volume on all records. It is also annoying to be tied down to the use of a particular pickup and unable to change to a better one because the pre-amplifier has insufficient gain. These problems are all answered in an article by Mr. Langford-Smith.

CONTENTS

In connection with amplifier testing, it has been found that square wave tests with a loudspeaker load give very much less overshoot on the Leak TL/12 main amplifier than those with a resistive load. See the article in this issue.

All subscribers to Radiotronics are supplied with a cover for the current year. If you have not received yours, write to the Applications Department and one will be sent to you.

Arthur J. Gabb.

Editor .. .. A. J. Gabb, B.Sc.

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PICTURE TUBE MOUNTING

*By H. WILSHIRE, A.S.T.C., A.M.I.E., S.M.I.R.E.**

General. The satisfactory holding and fixing of the picture tube is an important requirement in the design of every T.V. receiver. The following are the main factors which should be considered when designing a mounting for an all-glass picture tube:—

(1) The weight of the tube is centred near the face plate and therefore the mounting should be arranged so that the vertical load is taken by supports bearing on the flat section of the face plate moulding (see Fig. 1).

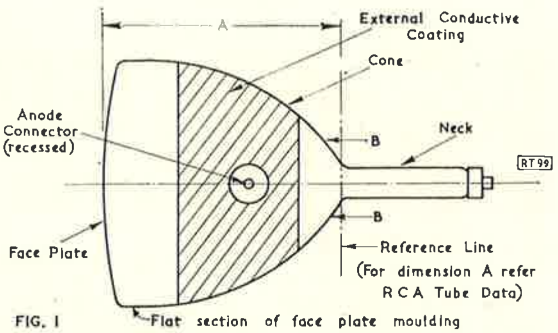

Fig. 1. Diagram illustrating picture tube mounting (RT99).

(2) The back section of the tube should be supported by pressure applied through a rubber "cushion" to the cone near the points marked "B" in Fig. 1 and preferably should be applied in the direction of the arrows, i.e., along the axis of the tube towards the face plate.

(3) Satisfactory deflection requires the deflection yoke to be held as far as possible towards the cone end of the neck. The coil end of the yolk should rest on and be centred by the glass cone. The terminal end of the yoke is preferably supported by a rubber backed metal plate which, as well as exerting pressure towards the face plate, maintains this end of the yoke concentric with the neck of the tube. The friction required to do this is provided by the rubber pad which also improves the electrical insulation between the yoke terminals and the earthed plate.

(4) For the case of electrostatically focused tubes the centring magnet, which is light in weight, is mounted directly on the neck. For the Radiotron 17HP4B it is located approximately mid-way between the yoke holding plate and the base. It is held in position by spring clips which are sprung apart to allow the magnet assembly to be pushed on to the glass neck (see Fig. 2).

(5) For magnetically focused tubes the weight of the comparatively heavy focus magnet should be supported clear of, and approximately concentric with, the neck.

As the maintenance of accurate focus requires that there be no movement of the focus magnet with respect to the picture tube after the initial adjustment has been made, it is essential to provide a very rigid mounting for the focus magnet in order to support its weight without movement during the vibration and jolting that will be experienced during transport.

The large holes in the mounting lugs attached to the focus magnet assembly allows its position to be adjusted to (a) take care of permissible tolerances in tube dimensions and (b) ensure best focus and proper centring of the raster by means of the variable shuffle plate.

As an aid to centring this assembly and also to prevent the neck being scratched a thin walled sleeve of insulating material is often used between the neck of the tube and the metal cylinder of the magnet (see Fig. 3).

(6) The mounting should locate the centre of the air gap of the focus magnet assembly approximately 3 inches from the reference line (see Fig. 1).

(7) The position of the tube socket should not be restricted in any way. It should be connected to the receiver by means of flexible leads.

(8) On no account should any part of the tube be scratched. The whole mounting should be designed to avoid this occurring during the initial mounting of the tube to the cabinet or chassis, the assembly of the components over the neck or the subsequent adjustment of these components. The need to avoid scratches applies particularly to the cone of the tube.

(9) Provision should be made in the mounting for an earthed connection to the external conductive coating. This is best made by using a piece of spring material say $\frac{1}{2}'' \times 4'' \times 28$ S.W.G. phosphor-bronze, which is fastened to the earthed mount and makes a wiping contact to the external coating.

(10) The ion trap magnet, which like the centring magnet is light in weight, is mounted in a similar way directly on the neck of the tube. When properly adjusted the magnet will be spaced approximately $\frac{1}{4}$ inch from the base of the tube.

* Applications Laboratory, Valve Works, Ashfield.

(11) To avoid damage to the tube from the front and possible injury from flying glass resulting from an implosion it is essential to fit a sheet of "safety" glass or other transparent material to the cabinet in front of the tube. For the aluminised Radiotron 17HP4B with its greater light output the safety glass may be tinted grey to improve contrast and to reduce the effects of reflections from the screen of highlights in the ambient lighting. The type of glass and its mounting should conform with the requirements of the appropriate Safety Code covering television equipment.

(12) It is also desirable, although not absolutely necessary, to have a dust seal between the outside of the cabinet and the face plate.

Type of Mounting. The mechanical nature of the mounting will be affected a great deal by whether the tube is mounted to the cabinet or to the chassis. A brief description of some arrangements, which have been successfully used, follows:—

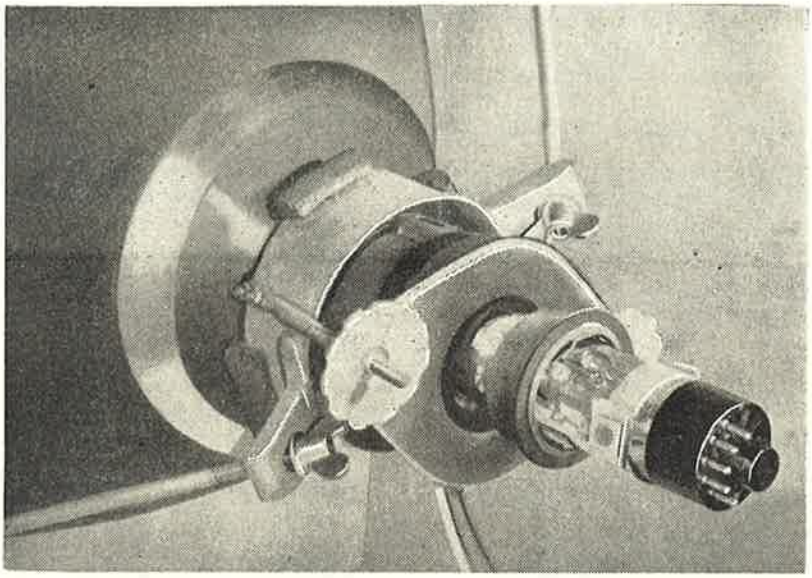

Fig. 2. Photograph illustrating the mounting of Radiotron 17HP4B electrostatically focused tube (RT91).

(1) Cabinet mounting

(a) Magnetically Focused Tube

This type is illustrated in Fig. 3. A metal strip say 1¼ inch wide of 18 S.W.G. material which can be clamped around the flat section of the face plate

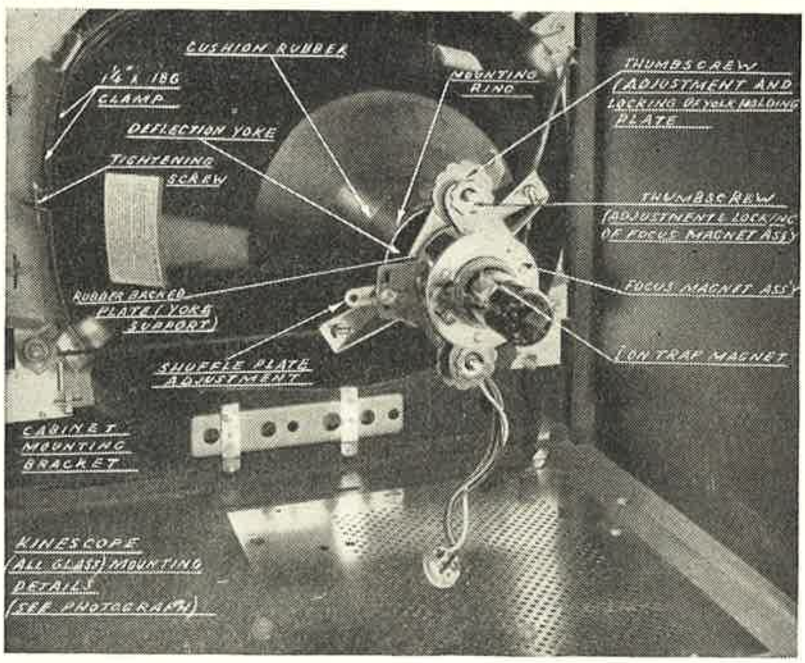

Fig. 3. Photograph illustrating the mounting of a magnetically focused tube (RT100).

moulding is secured by brackets at the corners to the inside front of the cabinet.

A thin strip of insulating material is placed between the encircling metal clamp and the tube to avoid scratching the glass and to provide more friction and hence better holding of the tube. Considerable pressure can be applied when this clamp is tightened but since the tube has great strength in this direction no undue strain is set up. The photograph shows the mounting ring which is a steel cylinder of 16 S.W.G. material, the welded brackets and the two tension rods which pull the cylinder hard up against the ring of cushion rubber and, together with the clamp mentioned above, rigidly mounts the tube to the front of the cabinet.

The yoke cannot be clearly seen since it is completely surrounded by the steel cylinder. The rubber padded plate and the large thumbscrews for its adjustment are visible. At the back of this plate the focus magnet assembly can be seen. The mounting lugs are held by smaller thumbscrews to the same studs as hold the yoke mounting plate. These studs are welded to opposite sides of the mounting ring.

(b) Electrostatically Focused Tube

The mounting for this tube is simplified compared with the electromagnetically focused type since no provision need be made for the heavy focus magnet. The face plate end of the tube and the yoke should be held in the same way as for the previous case. Fig. 2 shows a possible arrangement for the neck end of the tube and indicates the relative positions of the centring magnet and the ion trap magnet.

(2) Chassis mounting

(a) Horizontal chassis. A suitable arrangement for the horizontal type of chassis comprises two blocks or a shaped strip of non-metallic material such as fibre or hard rubber fastened to the front top edge of the chassis and a strip of metal which encircles the flat section of the face plate moulding and which, when screwed down to the chassis, firmly holds the front edge of the tube. The rear end of the tube is held in a similar way to that described for cabinet mounting except that the support for the yoke or in the case for the magnetically focused tube, the yoke and the focus magnet is fastened to the chassis. Slotted holes approximately 1 inch long are provided in this fastening so that adjustment both up and down and backwards and forwards can be made to the position of the yoke, or yoke and focus-magnet assembly. The same general considerations such as the need to avoid scratching the glass, the use of a rubber cushion between the cone and the rigid mount and the holding of the yoke as far towards the cone as possible also apply to this type of mounting.

(b) Vertical chassis. The same general requirements as set down for the cabinet mounting apply to this type of construction. The main difference is that since in this case the picture tube is mounted on to a vertical chassis the tube is pulled back against the rubber cushion of the chassis-mounted yoke assembly by, generally, four rods which apply tension between the front clamp and points on the chassis.

Handling Precautions.

(1) Care should be exercised when handling the picture tube to avoid touching the clear area of glass surrounding the recessed anode connection. A high voltage stress exists across this area and leakage can occur if the insulation of the glass surface around the anode button is reduced.

(2) Before the picture tube is touched the anode button should be momentarily connected to the external coating to discharge the capacitance which exists between the anode and the coating. Due to the very good insulating properties of the glass wall of the tube the anode may remain at a very high potential with respect to the external coating for periods up to several days after switching off. If accidental contact is made simultaneously to the anode and the external coating, a shock may be sustained which is severe enough to cause the tube to be dropped or a tool dropped on to the tube.

For further information on this subject reference made be made to the Applications Laboratory of A.W.V.

LEAK TL/12 MAIN AMPLIFIER

SQUARE WAVE TESTS WITH LOUDSPEAKER LOAD

By F. LANGFORD-SMITH

(P.101)

The square wave tests given in the September 1955 issue were on a resistive load. The question was asked what would be the effect on a loudspeaker load.

The loudspeaker used for these tests was M.S.P. (Manufacturers Special Products Pty. Ltd.) Model 12PQ/21568 with 6PU/20766 6 inch tweeter. The square wave tests gave almost identical values with the tweeter connected or disconnected.

The rise time was not appreciably affected (4 instead of 5 microseconds), but the overshoot was reduced from 34% to 1%, quite a remarkable difference. However the ringing time was increased from 50 microseconds to the whole flat top of the square wave, although the ringing was small in amplitude.

The top tilt on 50 c/s square wave was increased from 2-3% to 4.5%, while the bottom tilt was decreased from 2-3% to 1.5%. This does not appear to be significant.

Some further allied tests were also carried out, and in this case the pre-amplifier was connected to make the test as fair as possible. The previous corresponding tests were made without the pre-amplifier.

Capacitance shunt across 12.5 ohm loudspeaker to cause oscillation

The capacitance was very much less than for the resistive load, 0.006 μF in place of 0.15 μF. This indicates a poorer stability margin with the loudspeaker load. This frequency of oscillation was 190 K/cs instead of 46 Kc/s.

Stability when shock-excited by a 5 Kc/s square wave

1. Load short circuited — stable in both cases.
2. Load open-circuited — stable in both cases.
3. Load shunted by a capacitance — unstable when capacitance of 0.006 μF is shunted across the voice coil, this being the same value as for the test without being shock excited.

Partially capacitive load for further tests

With 0.005 μF shunted across the voice coil, the capacitance to give worst overshoot, the overshoot was 2% in place of 55% for resistive load, while the ringing, at low amplitude, occupied the whole flat top of the square wave.

Comments

The only really significant change brought about by loudspeaker load was an outstanding decrease in the overshoot, from 34% to 1%, the latter being quite negligible. This solitary result calls for further investigation to see whether a similar effect occurs with all amplifiers, and with all loudspeakers.

Future square-wave tests in the Radiotronics Laboratory will be made on amplifiers on both resistive and loudspeaker loads.

PRE-AMPLIFIERS – WHAT SENSITIVITY IS REQUIRED?

Refer to P17

By F. LANGFORD-SMITH

The information required for calculating the output of a pickup has recently been published (Ref. 1). It is there stated that the minimum recorded level in records is 5 centimetres per second. Since all the pickups are rated at so many millivolts per centimetre per second, it is merely necessary to multiply the rating of a particular pickup by 5 to get the output in millivolts when reproducing a recorded level of 5 centimetres per second.

Since we are looking for the maximum sensitivity of the amplifier, that is minimum input, we can confine our attention to LP which gives an output from the pickup either equal to or slightly less than that with 78 r.p.m.

The complete list of pickups in Table 1 of Ref. 1 was carefully considered, and the few exceptionally low outputs were omitted. In most cases the latter are moving coil types which may be used with transformers to step up the output voltage to a typical value. American pickups (except the General Electric variable reluctance) were omitted as not being available locally.

Pickup Output for 5 cm/sec recorded velocity

Decca X/M/S Green	112.5 mV
Leak (old model) with transformer	100
Decca H Black	65
E.M.I. 17 A with transformer	60
M.B.H. High impedance	45
Leak (new model) with transformer	40
E.M.I. 17 with transformer	37.5
Decca X/M/S Silver	33.5
A.W.A. 5000 ohm	27.5
Lowther	21
Connoisseur Mark I	16.5
Decca X/M/S Red	16.5
Goldring 500	16
Connoisseur Mark II	12.5
G.E. variable reluctance (Home)	11
Tannoy Variluctance	11
Decca H Gold	10
Decca X/M/S/ Gold	5

It will be seen that a pre-amplifier with a sensitivity of 50 millivolts will only be sufficient for playing all types of records when used with the top four pickups in the table — those with outputs above 50 millivolts. If such a pre-amplifier is used with pickups having a lower output level, the main amplifier will not be driven to its full power output by all records.

Take, for example, the Goldring 500 which is very widely used. This gives an output of 16 millivolts for 5 cm/sec recorded velocity, which is far short of 50 millivolts. Even making allowance for the fact that only a fairly small percentage of the records used in this country have recorded levels in the vicinity of 5 cm/sec, the limit for this pickup is only 32 millivolts at the widely-used 10 cm/sec level. This is equivalent to a main amplifier output of 4.1 instead of 10 watts.

The ideal input level for the pickups listed here appears to be 10 millivolts, thus including all but one of the pickups, the rejected one being also available as a higher impedance version of the same model and therefore unimportant. Pre-amplifiers with input voltages of 10 millivolts or more are relatively easy to design and construct, even for home constructors, but hum and noise difficulties increase as the input is decreased below 10 millivolts.

The lowest sensitivity to handle the majoriy of pickups on the great majority of records is 20 millivolts. Hence we should aim at a sensitivity from 10 to 20 millivolts, with the former preferred.

Reference

1. Langford-Smith, F. "Pickup output ratings and recording levels with comments on their effect on pre-amplifiers" Radiotronics 21.2 (February 1956) 17.

See also P.97 re types OC3 & OD3.

VOLTAGE REGULATOR TUBES

By WALTER R. JONES

Panel on Electron Tubes, Research and Development Board, New York, N.Y.

Use of voltage regulator tubes in military equipment is increasing. As the many uses for these tubes increase, difficulties encountered in their applications will likewise increase. Certain fundamental characteristics of a voltage-regulator tube must be considered if reliability and satisfactory performance are to be obtained.

Voltage regulator tubes are usually recommended for use under various conditions of current drain from 5 milliamperes to 30 or 40 milliamperes as shown in Table I.

Essentially, voltage-regulator tubes of the glow-discharge variety contain a cathode, usually cylindrical in shape, of relatively large area, and a relatively small anode. Upon the cathode is deposited a thin film of some material that serves as an activator. The electrodes are sealed in a bulb containing an inert gas — argon, helium, neon, krypton or a mixture of gases at pressures that may be as low as a few millimetres to more than a centimetre of mercury, depending upon the operating conditions under which regulation is desired. Figure 1 indicates the basic structure of a glow-type regulator tube.

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Table I shows that the minimum plate current for these tubes is 5 milliamperes while the maximum varies from 30 to 40 milliamperes depending upon the tube type. Frequently a voltage regulator tube is employed as a reference tube where the drain is less than 5 milliamperes. Erratic performance is obtained under these conditions owing to the fact that only a small amount of the cathode surface is covered by the glow.

In applications of this sort the use of a voltage-reference tube is required if reliable operation is to be obtained. In instances where a reference tube is not employed, the current drain must be increased to at least 5 milliamperes if satisfactory operation is to be obtained with a voltage-regulator tube.

The second part of Table I shows the characteristics of two voltage-reference tubes that are currently available.

It is a characteristic of glow-regulator tubes that the current density remains constant so that the

Table I—Voltage Regulator and Reference Tubes

Tube type	Minimum current in ma	Maximum current in ma	Maximum breakdown D-C volts	D-C operating volts	Minimum breakdown in darkness D-C volts**
OA2*	5	30	185	150	225
OA3* / VR75	5	40	105	75	160
OB2*	5	30	133	108	210
OB3	5	30	130	90	175
OC3 / VR105	5	40	133	105	210
VR150 (OD-3)	5	40	185	150	225
5644*	5	25	130	95	***
5787	5	30	141	100	***
6073	5	30	185	150	***
6074	5	30	133	108	***
Voltage Reference Tubes					
5651*	1.5	3.5	115	87	160
5783	1.5	3.5	125	87	***

* Armed Services Preferred List.

** This is the minimum value if tube is held in dark for 24 hours before testing and tested in total darkness.

*** These values for the darkness test are currently being determined.

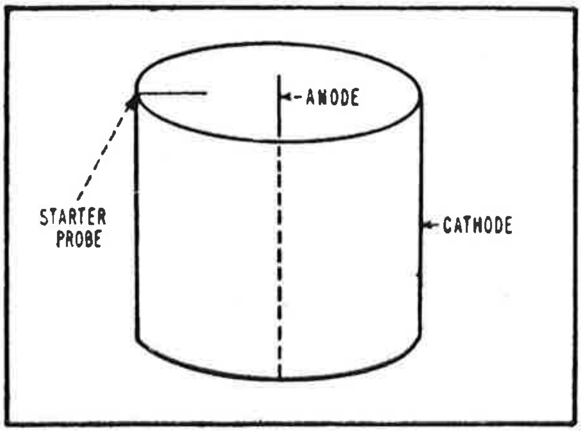

FIG. 1—Voltage-regulator tube structure

cross-sectional area over which current flows varies instead. Thus when the current is small, the glow does not cover the whole of the cathode surface but concentrates on a part of it. As the current is increased, the area of the cathode covered by the glow increases linearly with the total current.

Under many' conditions of 'operation if the voltage-regulator tube is observed it will be noticed that the active glow area within the tube shifts considerably. This shifting that occurs within the tube accounts for small variations in the regulated voltage developed across the tube itself. This effect is sometimes referred to as jitters.

During the long-time life of the tube the voltage regulation may change and the regulated voltage will increase. This results from partial cleaning up of the activator during life.

If the regulator tube is subjected to very high starting currents, the regulated voltage may require as long as 20 to 30 minutes to drop to its normal operating voltage. The regulation is affected by changes in current within the operating range. Thus, if a tube that has been operating for a long time at low current is suddenly changed to higher current the regulated voltage value may be somewhat different from the value obtained after a long period of time at the higher current value. If a voltage-regulator tube is not used for a while the regulated voltage will likewise require considerable time before it becomes stabilized.

The minimum d-c voltage required for breakdown of various voltage regulator tubes is shown in Table I. Voltages somewhat in excess of the values shown must be available to be certain that the tube will completely ionize so the proper d-c regulated voltages will be obtained. These values are also shown in Table I.

Ionization of these tubes is accomplished from three sources: photoelectric effects on the cathode from external light sources, radio-active effects from radiation and finally the field owing to voltage applied between the cathode and anode of the tube. The sum of these effects establishes the value of minimum breakdown voltage shown in Table I. If now the tube is operated under conditions of total darkness, then more voltage, perhaps as much as 50 or 60 volts, will be required for breakdown since the contribution from photoelectric radiation has been removed. Likewise, if the tube is mounted where radioactive radiation is completely removed, the breakdown voltage will also be increased.

It is important to determine whether the published ratings cover operation in the dark or in lighted areas. The conditions are specified on the rating sheets and these values will not be realized in service unless the operating conditions duplicate those under which the production tests are conducted.

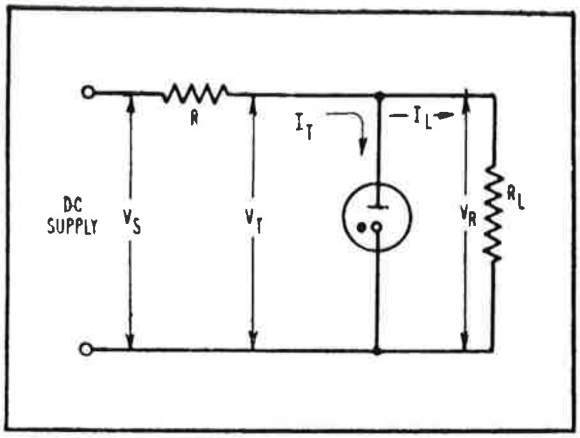

FIG. 2—Parameters for proper operation explained in text

Often it is desirable to shunt the voltage-regulator tube with a capacitor. It is necessary to keep the value of capacitance at or below 0.1 μf. If this value is exceeded instability and oscillations may occur.

In this discussion it has been assumed that the proper circuit design has already been completed. If the voltage regulator tube is to operate within its rated conditions there are three conditions that must be satisfied. These limiting conditions are given in Table I for several types of voltage regulator tubes.

Referring to Fig. 2 these conditions are:

(1) The voltage V_T supplied to the tube before firing is equal to or exceeds the minimum breakdown voltage specified in Table I. Thus the d-c supply voltage V_S must equal V_T plus the voltage drop across R when the only current flowing is that due to the load R_L.

(2) The current I_T flowing through the tube after breakdown is held above the minimum permissible value shown in Table I.

(3) The current I_T flowing through the tube after breakdown will not exceed the maximum value shown in Table I even if the load current should be reduced nearly to zero.

Biography

R. C. Miles, How to Design VR Tube Circuits, *Electronics*, p. 135, Oct. 1952.

In Table I, tube types designated VR75, VR105, and VR150 now have the commercial designations OA3, OC3, and OD3, respectively.