All About Ballast and Resistor Tubes

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From the number of inquiries which have been I received recently, it is evident that there is considerable uncertainty among members of the radio industry regarding the function, purpose, and application of ballast tubes.

As applied to radio, a ballast tube is intended as a regulator to reduce or smooth out variations in voltage or current applied to the set caused by variations in the power supply, either power lines or batteries.

The term "ballast" is a general term, which has been applied to all types of regulating tubes. The present popular types of ballast tubes should really be divided into three groups according to the type of service for which they are designed.

Fig. A. The type 1A1 Current Regulator type of glass-envelope ballast tube is for use in operating 2-V tubes from a 3-V "A" supply. The type 185R8 Line Ballast tube replaces the resistor cord in AC-DC sets; it is also provided with a tap for two 6-8 V pilot lights.

(1) CURRENT REGULATORS

These are designed to maintain the current to the set (usually filament current) constant when the voltage of the filament supply battery varies during its life.
In battery-operated sets using 2-volt tubes the filaments of all of the tubes are wired in parallel and connected to the filament supply battery. For satisfactory operation of the set and satisfactory tube life the filament current to the tubes must be maintained fairly close to its rated value. During the life of the filament battery its terminal voltage gradually decreases, which means that the current delivered to the tubes in the set also decreases. Many of these sets use 2 drycells in series for a filament supply. When new these have a terminal voltage of about 3.3 volts so that obviously some resistance must be inserted into the set filament circuit so that the tubes will not get more than the rated 2.0 volts. An ordinary resistor would take care of that but as the drycells dropped in voltage during life,

the voltage applied to the tubes would become lower and lower, affecting both the performance of the set and the life of the tubes.

The current regulator tube is intended to replace this resistor and in addition to reducing the battery voltage to the proper value, it has the additional property of automatically changing its resistance so that, in spite of variations in the terminal voltage of the battery, the current supplied to the tubes is held constant.

Since the filaments of the tubes in battery sets are all wired in parallel each different combination of tubes requires a different regulator tube. For example, a set using 1-6C6, 2-34's, 1-32, 1-30, and 1-19 would have a total filament current of O.620-ampere and would use a type 1J1 current regulator (see Table).

To determine the proper current regulator for any set, it is simply necessary to determine the total filament current and use the regulator tube having that rating. The total set current can be determined by noting the number and type of tubes in the set and determining their respective filament currents from published characteristics such as found in the "National Union Handbook."

(2) VOLTAGE REGULATORS

These are designed to maintain the voltage to the set (usually plate and/or screen) constant when the current drawn by the set varies. Tubes of this type are not usually encountered in ordinary broadcast receivers.

The voltage regulator has the property of automatically varying the amount of current, which it draws so that the voltage across its terminals remains constant. If one of these regulators is connected as part of the voltage divider across a power supply, the voltage across the regulator will remain constant regardless of variations in current through the divider or voltage variations from the power supply.

The operation of a voltage regulator may be explained by a simple analogy. Suppose we build a dam across a river. Let the water coming down the river represent our power supply voltage, the dam represents our voltage regulator, and the level of the water above the dam the voltage supplied to the set. No matter how much water comes down the river, the level above the dam will remain approximately constant because all the surplus spills over the dam.

(3) LINE BALLASTS OR RESISTORS

These are designed for use as line dropping resistors in AC-DC sets and are normally connected in series with the filaments of the tubes in the set. In this type of set all of the tube filaments are wired in series. Since the total filament voltage required is normally much less than 110 volts, a resistor or regulator must be connected in series with the filaments to make up the additional voltage drop.

The purpose and function of the line ballast are similar to the action of the current regulator described previously. The ballast tube automatically varies its resistance so that the filament voltage and current are maintained at proper values in spite of variation in line voltage.

Several of the so-called ballast tubes are nothing but resistors and have little or no regulating action. In purchasing be sure to secure true regulators and not just resistors mounted in a metal tube can.

The proper size or type of ballast to use is determined by the filament current drain and the number of tubes in the set. Some of these types are supplied with taps for lighting one or two pilot lights.

There is another type of ballast regulator for AC sets. This type is connected in series with the primary of the power transformer, and is intended to keep the transformer voltage constant regardless of variations in the voltage.

In Table 1 are listed all the glass-envelope tube types shown in Table II and referred-to in basing illustrations A to I (incl.) at the Table II.

Fig. B. These metal-envelope Ballastrons are ingeniously designed to replace over 100 R.M.A.-coded ballasts. The basing arrangement and voltage divider design are shown in Fig. 1, below.

METAL BALLASTRONS

In addition to the previously-described group of glass-envelope ballast and resistor "tubes" there is also a group of metal-envelope resistance units, which the serviceman frequently encounters. One type in this group is National Union Co.'s type known as the Ballastron; it is available in 2 models, designated A and B. These 2 Ballastrons serve as replacements for over 100 R.M.A.-coded ballast tubes and many special radio manufacturers' types.

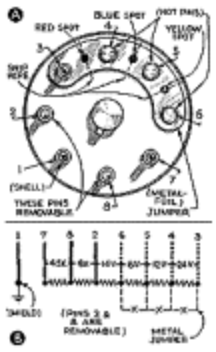


Fig. 1. The types A and B Ballastrons (metal ballast tubes) vary only in the rating of the resistance section between removable terminals 2 and 8. The type A is designed for a pilot light rated at 150ma; the type B is for a 250ma pilot light. The metal jumper may be snipped along the dotted lines that bisect the color-coded dots, as shown at A, to unshort resistor sections inside the tube as shown at B (where X represents the snipping lines shown dotted in A.)

On the base of the Ballastron is an ingeniously arranged metal strip (see Fig. 1A) which short-circuits 3 sections of the resistance unit inside the metal envelope. By snipping or filing this metal shunt all the way through at one or more of the 3 locations, between Prongs 3 and 6, indicated by dots of colored paint, the short circuit between any 2 prongs is thus removed and the respective resistance section cut into circuit.

A second ingenious arrangement is found in base prongs 2 and 8, which may be unscrewed and removed if they are not required. Here is where the difference exists between the type numbers (A and B) of these metal-envelope ballasts: removable terminals 2 and 8 tap onto the internal resistance unit (see Fig. 1B) to provide ballast operation of a pilot light as described in the caption of Fig. 1.

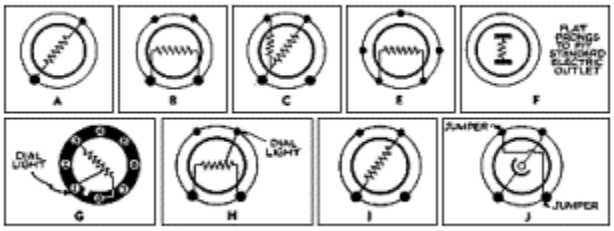
Terminal 1 is the connection ordinarily used on metal tubes to ground the shell. The resistance element of the Ballastrons, which is made by winding helical-wound resistance wire lengthwise on a mica, strip as shown in Fig. B, is tapped-off to terminals 2 to 8 as shown in Fig. 1B. The drops across the various taps of this voltage divider are shown here for the first time in any radio magazine. The drop across the pilot light section of the divider is the same for either current rating (that is, for either the A or B type ballast "tube").

Ballastrons may be "matched" to the requirements of ballast resistors, carrying R.M.A.-code numbers, in accordance with the directions in the chart, Table IV.

NOTE: If a ballast tube has a first letter "B," disregard it (Example: Ballast tube No. BK-55-D is K-55-D on chart). If the first letter is "M," substitute "K" for it (Example: Ballast tube No. M-55-D is K-55-D on chart). To replace an I–C tube, follow directions for a K–C tube but change pilot lamps to 150 ma. (Type No. 40, brown bead.)

This article has been prepared from data supplied by courtesy of National Union Radio Corp

TABLE I



The ballast and resistor-"tube" symbols shown are identified with their respective tubes in Table II as follows:

[A]
1-A-5, 2-A-5, 2H-5, 3-150, 3-220, 3-A-5, 3H-220, 4-220, 4-A-5, 4H-5, 4H-220, 5-16, 5-15O, 5-220, 5-A-5, 5H-5, 5H-220, 6-20, 6-A-5, 7-20, 7-150, 7-A-5, 8-A-5, 9-20, 9-150, 9-A-5, 10-10, 10-A-5, 10V10, 11-10, 11-20, 11-150, 11-A-5, 12-20, 13-10, 13-20, 13-A-5, 14-20, 14-A-5, 15-10, 15-20, 18-10, 20-A-5, 22-10.

[B]
1-1, 1Al, 1B1, 1C1, 1D1, 1E1, 1F1, 1G1, 1J1, LH-1, GM-1, 2, 2H-1, 3, 3-1, 3-40, 3H-1, 4, 4-1, 5, 5-1, 5E1, 5H-1, 6, 6-1, 6AA, 6H-1, D6-1, 7, 7-1, 7H-1, 8, 9, 10AB.

[C]
1A2, 1B2, 1C2, 30, 31, 52.

[E]
46A1, 46B1.

[F]
9V10, 70, 90.

[G]
42A1, 42A2, 42B2, 49A1, 49A2, 49B2, 55A1, 55A2, 55B2.

[H]
140R, 140R4, 140R8, 165R, 165R4, 165R8, 185R, 185R4, 186R8.

[I]
038, 98, 100, 105, 106, 110, 118, 125, 126, 130, l5O, 155, 158, 218, 313, 314, 315, 415, 425, 449, 460, 538, 838.

[J]
874.

Screw
876, 886.

<!--[if !supportEmptyParas]--> <!--[endif]-->

<!--[if !supportEmptyParas]--> <!--[endif]-->

TABLE II

Type No.	Current Rating	Voltage Drop	Normal Use**	Exchange with
1-1	0.120	0.3-1.2	a	
1Al	0.500	0.3-1.2	a	5-1, 5El, 6AA
IA2	(0.120			
	(0.320	0.3-1.2	a	30
1-A-5	0.1	5-25	b	
1B1	0.360	0.3-1.2	a	3H-1
1B2	(0.260			
	(0.360	0.3-1.2	a	31
1C1	O.750	0.3-1.2	a	7H-1
1C2	(0.120			
	(0.250	0.3-1.2	a	52
1D1	0.250	0.3-1.2	a	2H-1
1El	0.480	0.3-1.2	a	
1F1	0.720	0.3-1.2	a	7-1
1G1	0.420	0.3-1.2	a	4-1
1J1	0.620	0.3-1.2	a	6-1
LH-1	0.180	0.3-1.2	a	
GM-1				
2	0.30	9.0	g	
2-A-5	0.20	5-25	b	
2H-1	0.240	0.3-1.2	a	1D1
2H-5	0.250	5-25	b	
3	0.30	128	d	
3-1	0.300	0.3-1.2	a	
3-40	0.30	45-80	c	300*, GOX3*, 5BX3*, 5B*
3-150	0.30	30-60	e	
3-220	0.30	130-1?0	d	
3-A-5	0.30	5-25	b	
3H-1	0.360	0.3-1.2	a	1B1
3H-220	0.35	70-130	f	
4	0.40	115	d	
4-1	0.420	0.3-1.2	a	1G1
4-220	0.40	70-130	f	
4-A-5	0.40	5-25	b	
4H-5	0.45	5-25	b	
4H-220	0.45	70-130	f	
5	0.46	115	d	
5-1	0.500	0.3-1.2	a	1A1, 5E1, 6AA
5-16	0.500	0.3-1.2	g	
5-150	O.5O	30-60	e	
5-220	0.50	70-130	f	
5-A-5	0.50	5-25	b	
5E1	0.500	0.3-1.2	a	1A1, 5-1, 6AA
5H-1	0.550	0.3-1.2	a	10AB, 1K1

5H-5	0.55	5-25	b	
5H-200	0.55	70-130	f	
6	0.695	0.3-1.2	a	
6-1	0.620	0.3-1.2	a	
6-20	0.60	20-40	h3	
6AA	0.500	0.3-1.2	a	1A1, 5-1, 5E1
6-A-5	0.60	5-25	b	
6H-1	0.660	0.3-1.2	a	
D6-1	0.060	0.3-1.2	a	
7	0.30	176	d	
7-1	0.720	0.3-1.2	a	1F1
7-20	0.70	20-40	h3	
7-150	0.70	30-60	e	
7-A-5	0.70	5-25	b	
7 H-1	0.760	0.3-1.2	a	1C1
8	0.30	132	d	
8-A-5	0.80	5-25	b	
9	0.30	80	c	
9-20	0.90	20-40	h3	98, 100, 105, 106
9-150	0.90	30-60	e	
9-A-5	O.9O	5-25	b	
9V10	0.80	5-25	b	
10-10	1.00	10-30	h2	125
10AB	0.550	0.3-1.2	a	5H-1
10-A-5	1.00	5-25	b	
10V10	1.00	10-20	h1	
11-10	1.10	10-30	h2	118-415
11-20	1.10	20-40	h3	110
11-150	1.10	30-60	e	038
11-A-5	1.10	5-25	b	
12-20	1.20	20-40	h3	126
13-10	1.30	10-20	h2	130
13-20	1.30	20-40	h3	313
13-A-5	1.30	5-25	b	
14-20	1.40	20-40	h3	314
14-A-5	1.40	5-25	b	
15-10	1.50	10-30	h2	150
15-20	1.50	20-40	h3	315
18-10	1.80	10-20	h1	
20-A-5	2.00	5-25	b	
22-10	2.20	10-30	h2	
30	(0.120			
	(0-320	0.3-1.2	a	1A2
31	(0.260			
	(0.360	0.3-1.2	a	1B2
038	1.10	38		11-10
42A1	0.30	42.3	m	
42A2	0.30	42.3	m-1	
42B2	0.30	42.3	m-2	
46A1	0.40	30-6O	k	
46B1	0.30	30-6O	k	
49A1	0.30	48.6	m	
49A2	0.30	48.6	m-1	
49B2	0.30	48.6	m-2	
52	(0.120			
	(0.250	0.3-1.2	a	1C2
55A1	0.30	54.9	m	

55A2	0.30	54.0	m-1	
55B2	0.30	54.9	m-2	
70	O.9O	30-60	k1	
90	1.40	30-60	k1	
98	0.98	30	h3	9-20
100	1.0	30		
105	1.05	30		9-20
106	1.06	30		9-20
110	1.10	30		11-20
118				11-10
125				10-10
126				12-20
130	1.3	20		13-10
140R	0.30	42.3	m	
140-R4	0.30	42.3	m-1	
140R8	0.30	42.3	m-2	
150	1.5	20 1		5-10
155				
158				
165R	0.30	48.6	m	
165R4	0.30	48.6	m-1	
165R8	0.30	48.6	m-2	
185R	0.30	54.9	m	
185R4	0.30	54.9	m-1	
185R8	0.30	54.9	m-2	
218				
313	1.3	30		13-20
314	1.4	30		14-20
315	1.5	30		16-20
415				11-10
425				
449				
460				
538	1.05	38		
838				
874	0.01-0.05		90	n
876	0.70	40-60	h4	
886	2.05	40-60	h	

*Line Resistor, not a tube.
**See notes for explanation

<!--[if !supportEmptyParas]--> <!--[endif]-->

<!--[if !supportEmptyParas]--> <!--[endif]-->TABLE III

R.M.A. Tube No.	Ballastron Equivalent	Cut Strip at Colors R=Red B=Blue, Y=Yellow	rew Pins and Clip Off Screws
85-A	Type B	R-B-Y	No. 2 and 8
79-A	Type B	R-B	No. 2 and 8
73-A	Type B	R-Y	No. 2 and 8
67-A	Type A	R-B-Y	No. 2 and 8
61-A	Type A	R-B	No. 2 and 8
55-A	Type A	R-Y	No. 2 and 8
49-A	Type A	R	No. 2 and 8
42-A	Type A	B-Y	No. 2 and 8

36-A	Type A	B	No. 2 and 8
30-A	Type A	Y	No. 2 and 8
24-A	Type A		No. 2 and 8
<!--[if !supportEmptyParas]--> <!--[endif]-->			
K-67-B	Type A	R-B-Y	No. 2
K-61-B	Type A	R-B	No. 2
K-55-B	Type A	R-Y	No. 2
K-49-B	Type A	R	No. 2
K-42-B	Type A	B-Y	No. 2
K-36-B	Type A	B	No. 2
K-30-B	Type A	Y	No. 2
K-24-B	Type A		No. 2
<!--[if !supportEmptyParas]--> <!--[endif]-->			
L-73-B	Type B	R-B-Y	No. 2
L-67-B	Type B	R-B	No. 2
L-61-B	Type B	R-Y	No. 2
L-55-B	Type B	R	No. 2
L-49-B	Type B	B-Y	No. 2
L-42-B	Type B	B	No. 2
L-36-B	Type B	Y	No. 2
L-30-B	Type B		No. 2
<!--[if !supportEmptyParas]--> <!--[endif]-->			
K-79-C	Type B	R-B-Y	No. 2
K-73-C	Type B	R-B	No. 2
K-67-C	Type B	R-Y	No. 2
K-61-C	Type B	R	No. 2
K-55-C	Type B	B-Y	No. 2
K-49-C	Type B	B	No. 2
K-42-C	Type B	Y	No. 2
K-36-C	Type B		No. 2
<!--[if !supportEmptyParas]--> <!--[endif]-->			
K-67-D	Type A	R-B-Y	None
K-61-D	Type A	R-B	None
K-55-D	Type A	R-Y	None
K-49-D	Type A	R	None
K-42-D	Type A	B-Y	None
K-36-D	Type A	B	None
K-30-D	Type A	Y	None
K-24-D	Type A		None
<!--[if !supportEmptyParas]--> <!--[endif]-->			
L-67-D	Type B	R-B-Y	None
L-61-D	Type B	R-B	None
L-55-D	Type B	R-Y	None
L-49-D	Type B	R	None
L-42-D	Type B	B-Y	None
L-36-D	Type B	B	None
L-30-D	Type B	Y	None
L-24-D	Type B		None

<!--[if !supportEmptyParas]--> <!--[endif]-->

<!--[if !supportEmptyParas]--> <!--[endif]-->TABLE IV

Maker of Set	Part No.	Choose Tube	Remove Pins	Cut Strip
Emerson	2UR224	B	2	R-Y

Emerson	2UR215	B	2	R
Emerson	3CR241	B	None	R
Crosley	W43357	A	2	R
RCA	RC294 or 135K1	A	2	R
RCA	RC300 or 95K2	B	2	Y
RCA	RC345 or 190K1	A	2 and 8	R-Y
DeWald	8598	B	2	R
Fada	115.4	A	2 and 8	R