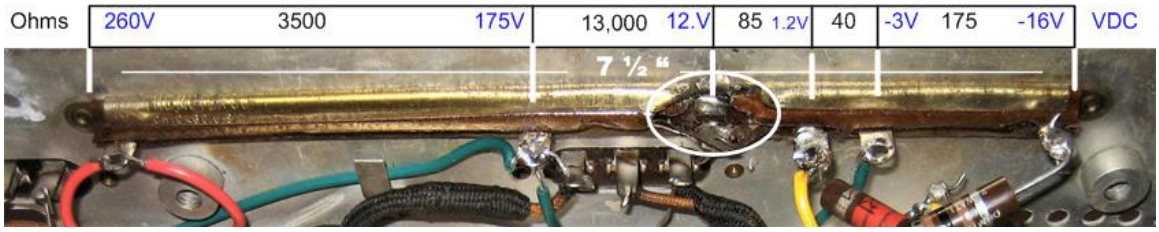
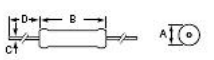
Candohm Resistor Replacement Technique

The Muter company made resistors in Chicago in 1917, they were around in the 1920s. and that is about all I could find. The "power splitting" candohm resistor in the RCA 6K2 was made by them, and it had a defective, open section, basically the 13,000 and 85 ohm sections were disabled. This was compensated for 'somewhat' by a "hobo" incorrect rewiring and some resistors left hanging in space. The yellow on the metal of the Muter indicates it might be cadmium coated and this is pretty toxic, so it should go for that reason alone. These resistors were generally made with a coil of nichrome wire in the center, then some insulating paper, and a metal case. By putting the case against the chassis the heat was dissipated.



Silicon coated wirewound resistors were used to replace the candohm (table below). Since the worst voltage drop was in the 13,000 ohm section (drop of 163 volts) using E^2/R= Watts produced 2.04 watts for the value – 2.5 times that is 5 watts, and you have a nice 1" long form factor. The resistors chosen below can take 1000 volts and 10 times the rated wattage for 5 seconds, so startup spikes are not a concern. While 10 watt resistors would obviously be cooler, they take up about double the space and make the aesthetics more difficult.

Silicone Coated Wirewound Resistors – 1, 3, 5, 10 Watt, 5%



Series	A ±.81mm	B ±.81mm	C	D
ALSR-1	2.79	9.78	.51	38.10
ALSR-3	5.08	13.46	.81	38.10
ALSR-5	7.92	23.80	.81	38.10
ALSR-10	7.92	45.72	.81	38.10

Electrical Specifications:

Series	ALSR-1	ALSR-3	ALSR-5	ALSR-10
Resistance Tolerance	±5%	±5%	±5%	±5%
Power Rating	1 Watts at 25°C	3 Watts at 25°C	5 Watts at 25°C	10 Watts at 25°C
Dielectric Withstanding Voltage	500 VAC	1000 VAC	1000 VAC	1000 VAC
Short Time Overload	5 X rated wattage for 5 seconds		10 X rated wattage for 5 seconds	

RESISTANCE VALUE CHART

.10	2.0	25	75	270	680	1.75K	4.0K	8.5K	20.0K
.13	3.0	27	82	300	700	1.8K	4.5K	9.0K	22.0K
.15	4.0	30	100	330	750	2.0K	4.7K	10.0K	22.5K
.20	5.0	33	120	350	800	2.2K	5.0K	11.0K	25.0K
.25	7.5	35	125	390	820	2.25K	5.6K	12.0K	
.30	10	39	150	400	900	2.5K	6.0K	12.5K	
.33	12	40	180	450	1.0K	2.7K	6.8K	13.5K	
.50	15	47	200	470	1.1K	3.0K	7.0K	15.0K	
.75	18	50	220	500	1.2K	3.3K	7.5K	16.0K	
1.0	20	56	225	560	1.25K	3.5K	8.0K	17.5K	
1.5	22	68	250	600	1.5K	3.9K	8.2K	18.0K	

Resistance Range (Ohms)	Wattage	Digi-Key* Part No.	Price Each 1	10	50	100	Huntington* Part No.
.10-.75	1	ALSR1J-(Value)-ND	1.63	1.45	1.23	.90	ALSR-1-(Value)
1.0-900	1	ALSR1J-(Value)-ND	1.59	1.43	1.21	.89	ALSR-1-(Value)
1.0K-5.6K	1	ALSR1J-(Value)-ND	1.85	1.66	1.40	1.03	ALSR-1-(Value)
6.0K-10.0K	1	ALSR1J-(Value)-ND	1.85	1.66	1.40	1.03	ALSR-1-(Value)
.10-900	3	ALSR3J-(Value)-ND	1.40	1.25	1.06	.78	ALSR-3-(Value)
1.0K-4.7K	3	ALSR3J-(Value)-ND	1.40	1.25	1.06	.78	ALSR-3-(Value)
5.0K-10.0K	3	ALSR3J-(Value)-ND	1.53	1.37	1.16	.85	ALSR-3-(Value)
.10-.75	5	ALSR5J-(Value)-ND	1.56	1.40	1.18	.87	ALSR-5-(Value)
1.0-7.5	5	ALSR5J-(Value)-ND	1.56	1.40	1.18	.87	ALSR-5-(Value)
10-2.7K	5	ALSR5J-(Value)-ND	1.56	1.40	1.18	.87	ALSR-5-(Value)
3.0K-4.7K	5	ALSR5J-(Value)-ND	1.56	1.40	1.18	.87	ALSR-5-(Value)
5.0K-9.0K	5	ALSR5J-(Value)-ND	1.56	1.40	1.18	.87	ALSR-5-(Value)
10.0K-22.5K	5	ALSR5J-(Value)-ND	1.56	1.40	1.18	.87	ALSR-5-(Value)
25.0K	5	ALSR5J-(Value)-ND	1.53	1.37	1.16	.85	ALSR-5-(Value)
.10-.75	10	ALSR10-(Value)-ND	1.98	1.77	1.50	1.10	ALSR-10-(Value)
1.0-680, 750-900	10	ALSR10-(Value)-ND	1.69	1.51	1.28	.94	ALSR-10-(Value)
1.0K-2.7K	10	ALSR10-(Value)-ND	1.82	1.63	1.38	1.01	ALSR-10-(Value)
3.0K-9.0K	10	ALSR10-(Value)-ND	2.11	1.89	1.60	1.17	ALSR-10-(Value)
10.0K-22.5K	10	ALSR10-(Value)-ND	2.31	2.06	1.74	1.28	ALSR-10-(Value)
25.0K	10	ALSR10-(Value)-ND	2.31	2.06	1.74	1.28	ALSR-10-(Value)

* For complete part number, substitute Digi-Key value (from Resistance Value Chart) for (Value).

Huntington Electric Inc is the manufacturer, bought them from Digi-Key.
http://dkc3.digikey.com/PDF/T053/1158-1160.pdf

The challenge was to make a replacement part that "looked cool and vintage" and fit with the space One could have "hobo'ed sandstone or bathtubs" resistors all over, but that wouldn't have looked cool – so after some thought, the device below was fabricated, which you see installed.

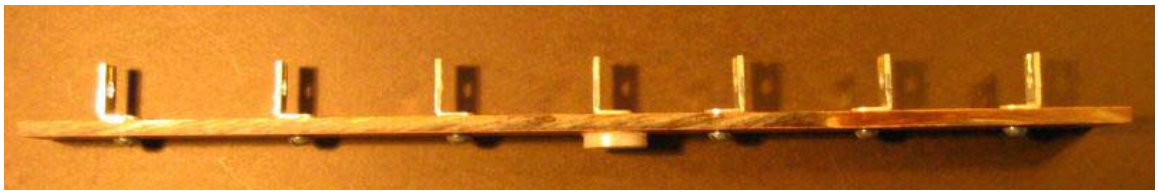
Now this is not the least cost route by far, and the effort and parts has to merit the expense. What constitutes "merit" is an individual decision.

The first challenge was to select the backing, given the vintage requirement phenolic board seemed to be the best choice. It also has good electrical and heat characteristics and is easy to work (carefully) with

standard wood working tools. Symmetrical, smooth cuts are necessary for a good appearance. When drilling, go slow so you don't cause the phenolic board to burn or fuse from heat and back the work.

Phenolic Board from http://www.k-mac-plastics.com/phenolkraft-x-xx-xxx-phenolics.htm - k-mac plastics in 12" by 12" sheets is pretty reasonable. Another good source, is the McMaster-Carr Garolite XX www.mcmaster.com. This assembly used 1/8" thick (.125) for stability over the eight inches. You don't want possible flex to cause the back of a screw to hit the chassis. Finding small amounts of this material is difficult. Several plastic suppliers have large sheets.

The basic board assembled from the side is shown below. The phenolic board was cut to ½ inch by 8 inches on a table saw.



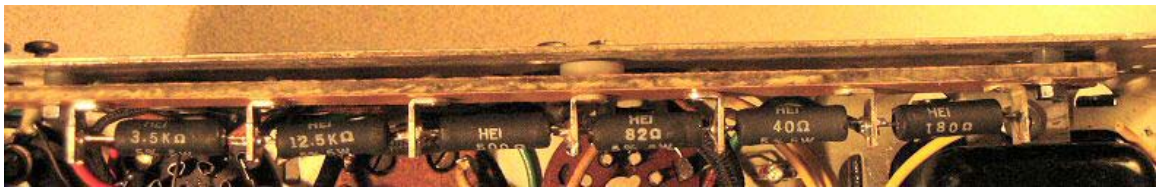
The L threaded brackets were then laid out to get the spacing needed for the number of resistors to be used, taking into account the size of the resistors. The L brackets were secured to the phenolic board with 4-40 screws into the threaded portion of the mounting brackets. One source is Digi-key http://dkc3.digikey.com/PDF/T053/1454.pdf

The overage in the screws (if any) can be cut off with a Dremel or other tool. JR Hobbies has a lot of small screw sizes in small amounts (50 cent bags) and they mail low cost USPS First Class. You can look around and find a pretty close fit there, or a number of other sites..

The back of the screws face the chassis. To avoid a short a standoff washer should be used on the ends of the phenolic board where it is secured to the chassis. It is pretty simple to just match these holes to the rivet holes that held the now removed candohm. A standoff was glued to the center, just in case of a major bump causing a shorting flex of the device.

The threaded brackets were cut on the non-threaded end to make placement of components and wire an easy, efficent task. Again a Dremel was used, but you could do the same with a hack saw. These brackets are available at Digi-Key http://dkc3.digikey.com/PDF/T053/1454.pdf and many other suppliers. This modification made the job of wiring and resistor mounting much easier.

The final device installed looked as photographed below.



This angle clearly show the chassis standoffs on the mounting screws at each end as well as the glued on standoff in the middle to absolutely prevent shorting of the screw heads from flexing against the chassis.

Care given to the positioning of the resistors to show values for the "next guy" looks good and is good practice. Finally in regards to heat dissipation, the L threaded brackets were selected to give plenty of air around the resistors and the brackets themselves serve as very nice heat sinks. Hope you enjoy making your own custom modern "vintage" candohm.