WS No. 19 Mark III

ATTENUATION PADS
DESIGN DATA

COMPUTATION OF RESISTANCE ELEMENTS

1. To compute the values in ohms of resistance elements of a pad shown in Fig. 1, multiply the factors in Table 1 by the characteristic resistance of the pad. Functions for determining the elements of hybrid pads are shown in Fig. 2.

2. In the table :—

$$a = \frac{1}{C} - \frac{1}{A}$$

$$b = \frac{1}{A}$$

$A = $ Sinh θ

$B = $ Cosh θ

$C = $ Tanh θ

Where $\theta = $ Loss in nepers, i.e., $\dfrac{\text{loss in db.}}{8.686}$ and $\dfrac{Z_1}{Z_2}$ or $\dfrac{Z_2}{Z_1} = B^2$

3. Example :—

To design a 20 db. 500/200 Ω unbalanced π pad :—

$Z_1 = 500\,\Omega$ $\qquad Z_2 = 200\,\Omega$

From Table 1, A = 4.9522 $\quad$ B = 5.052

Then series and shunt elements are :—

$$\frac{Z_1 Z_2 A}{Z_2 B - \sqrt{Z_1 Z_2}} = 713\,\Omega$$

$$A \sqrt{Z_1 Z_2} = 1{,}567\,\Omega$$

$$\frac{Z_1 Z_2 A}{Z_1 B - \sqrt{Z_1 Z_2}} = 225\,\Omega$$

Loss in db.	A	B	C	a	b	$\dfrac{1}{a}$	$\dfrac{1}{2b}$	Max. Ratio $\dfrac{Z_1}{Z_2}$ or $\dfrac{Z_2}{Z_1}$
1	0.1154	1.007	0.1150	0.0575	8.664	17.39	0.0577	1.014
2	0.2323	1.027	0.2263	0.1146	4.305	8.724	0.1161	1.055
3	0.3523	1.060	0.3325	0.1710	2.838	5.848	0.1761	1.124
4	0.4770	1.108	0.4305	0.2263	2.097	4.419	0.2385	1.228
5	0.6084	1.170	0.5192	0.2801	1.645	3.570	0.3042	1.369
6	0.7472	1.248	0.5986	0.3323	1.339	3.009	0.3736	1.557
7	0.8960	1.343	0.6673	0.3825	1.116	2.615	0.4480	1.804
8	1.0570	1.455	0.7264	0.4305	0.9462	2.323	0.5285	2.117
9	1.2320	1.586	0.7763	0.4762	0.8118	2.100	0.6160	2.515
10	1.4218	1.738	0.8181	0.5195	0.7027	1.925	0.7109	3.018
11	1.6324	1.914	0.8527	0.5601	0.6127	1.785	0.8162	3.663
12	1.8659	2.117	0.8814	0.5986	0.5359	1.670	0.9329	4.482
13	2.1223	2.346	0.9046	0.6343	0.4712	1.576	1.0611	5.504
14	2.4067	2.605	0.9235	0.6672	0.4155	1.498	1.2033	6.786
15	2.7230	2.901	0.9387	0.6981	0.3672	1.432	1.3615	8.415
20	4.9522	5.052	0.9802	0.8182	0.2020	1.222	2.4761	25.52

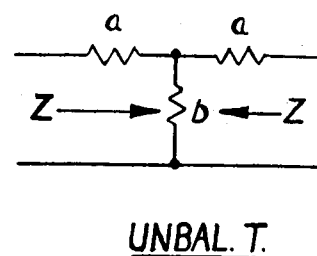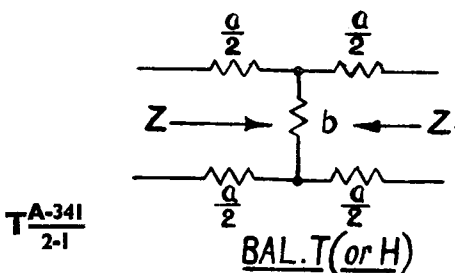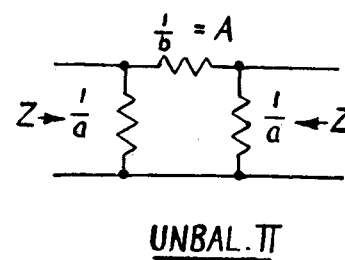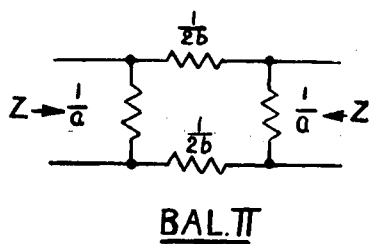Table 1—Factors for the determination of resistance values in attenuation pads
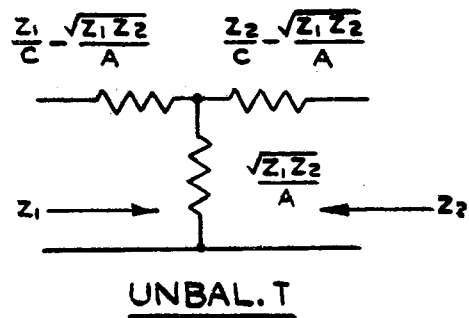
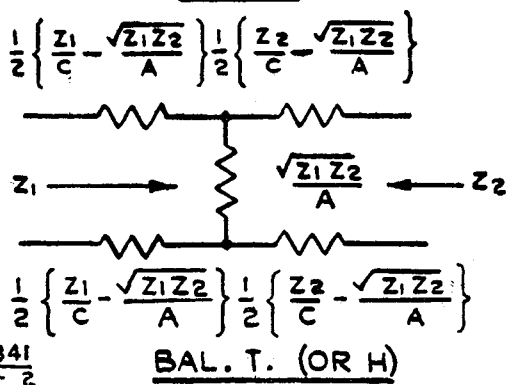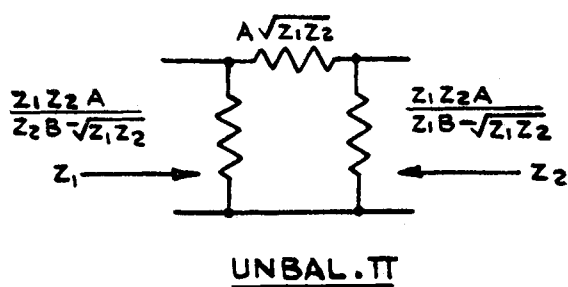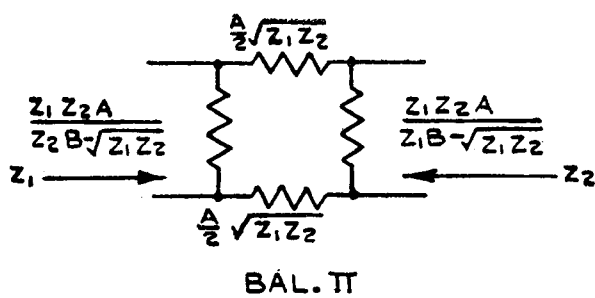Fig. 1—Pads of equal input and output impedances

Fig. 2—Pads of unequal input and output impedances

END

This issue replaces Issue 1, dated 27 July 1943
Amendments are included in para. 3 and Fig. 2.