

## GRAPHICAL DETERMINATION OF INPUT IMPEDANCE OF REPEATING COIL WITH ANY TERMINATING IMPEDANCE 120D COIL

### 1. GENERAL

1.01 This section contains transmission characteristics of 120D repeating coils, and charts for graphically adding the effect of a 120D coil to, or subtracting it from, a given positive impedance. The charts are computed from the equivalent T network impedances and image parameters given for dc currents up to 100 ma.

1.02 The 120D repeating coil has an impedance ratio of 1 to 1.5, which is equivalent to a unity ratio coil plus an ideal 1:1.5 ratio transformer, as shown in Fig. 1. This makes it possible to obtain the input impedance of the 120D coil from charts similar to those for the 1:1 ratio coils. For a general discussion of the method of using the charts, refer to Section 304-200-100.

1.03 The input impedance  $Z_X$  looking into the low side of the 120D coil, as indicated in Fig. 2, is found by entering the appropriate chart with the value of terminating impedance  $Z'_T = 2/3 Z_T$ . The input impedance looking into the high side, as indicated in Fig. 3, is given by  $Z_X = 1.5 Z'_X$ , where  $Z'_X$  is the value of input impedance obtained from the chart for a terminating impedance  $Z_T$ .

1.04 Figs. 1, 2, and 3 show, for computation purposes, the equivalent location of capacitors normally associated with the repeating coil, and for convenience a table of reactances of 1 mf and 4 mf at several frequencies is given below. The average value of Western Electric capacitors is usually 8 to 10% (and may be as much as 25%) higher than the nominal, with proportionately lower values of reactance.

Freq. cps	1 mf Capacitor		4 mf Capacitor	
	Nominal	Avg. 1.1 mf	Nominal	Avg. 4.4 mf
200	-j 796	-j 723	-j 199	-j 181
300	-j 531	-j 482	-j 133	-j 121
500	-j 318	-j 289	-j 80	-j 72
1000	-j 159	-j 145	-j 40	-j 36
2000	-j 80	-j 72	-j 20	-j 18
3000	-j 53	-j 48	-j 13	-j 12

1.05 The following examples illustrate the computations for two conditions. Determine the impedance at 1000 cps looking into (1) the low side of a 120D repeating coil terminated in half section 22-gauge H88 cable, with a 4 mf capacitor on the line side and a 1 mf capacitor on the drop side, and (2) the high side of a 120D coil terminated in  $600\omega + 2$  mf with a 1 mf capacitor on the  $600\omega$  side and a 4 mf capacitor on the drop side.

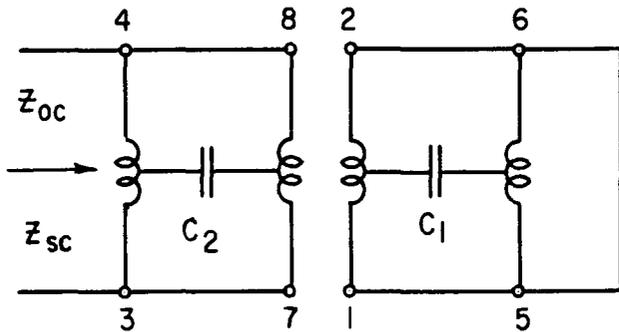
*Example (1):* Looking into low side of 120D coil.  
(See Fig. 2)

Midsection impedance 22H88, $Z_T$	1035-j 177
4 mf capacitor	-j 40
Terminating impedance, $Z_T + \text{cap.}$	<u>1035-j 217</u>
$Z'_T = 2/3 (Z_T + \text{cap.})$	690-j 145
From Chart 4,	N = 1.2
+ 1 unit,	N = 2.2
Input impedance of coil, $Z_X$	735-j 5
1 mf capacitor	-j 159
Required impedance	<u>735-j 164</u>

*Example (2):* Looking into high side of 120D coil.  
(See Fig. 3)

$600\omega + 2$ mf, $Z_T$	600-j 80
1 mf capacitor	-j 159
Terminating impedance, $Z_T + \text{cap.}$	<u>600-j 239</u>
From Chart 4,	N = .2
+ 1 unit,	N = 1.2
Input impedance of coil, $Z'_X$	675-j 135
$Z_X = 1.5 Z'_X$	1013-j 203
4 mf capacitor	-j 40
Required impedance	<u>1013-j 243</u>

2. BASIC IMPEDANCE MEASUREMENTS



$Z_{oc}$  = open circuit impedance

$Z_{sc}$  = short circuit impedance  
 $= 7.0 + j \omega 0.001125$

$C_1 = .0096 \mu f$

$C_2 = .0116 \mu f$

Freq. cps	$Z_{oc}$ (.05 to 3.5 V ac)		
	0-200 ma dc	280 ma dc	360 ma dc
200	10 + j 217	6 + j 195	5 + j 184
300	13 + j 306	9 + j 280	7 + j 259
500	20 + j 495	15 + j 452	12 + j 416
1000	56 + j 974	48 + j 895	43 + j 817
1500	109 + j 1470	90 + j 1380	65 + j 1230
2000	175 + j 1917	145 + j 1740	118 + j 1610
2500	250 + j 2370	200 + j 2160	165 + j 2000
3000	338 + j 2830	255 + j 2570	215 + j 2370

3. LIST OF CHARTS

	Chart
200 Cycles per Second	1
300 " " "	2
500 " " "	3
1000 " " "	4
2000 " " "	5
3000 " " "	6

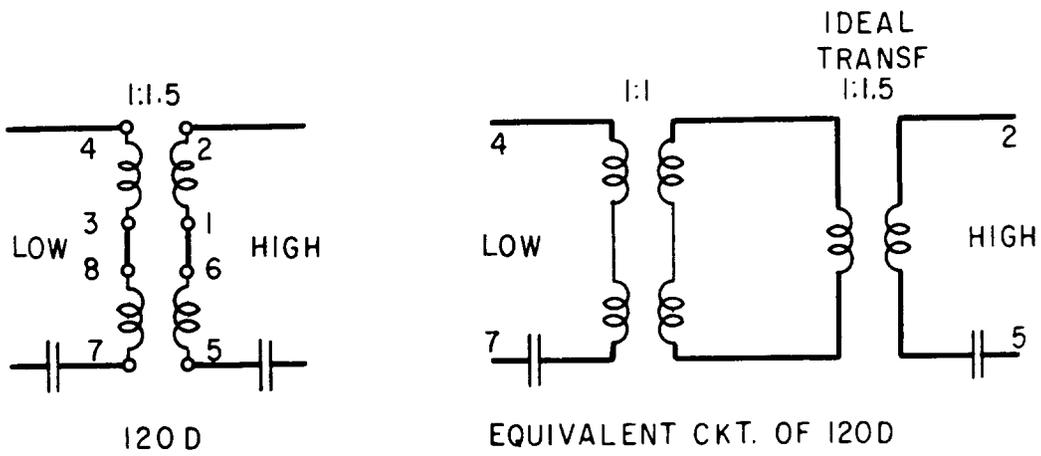


FIG. 1

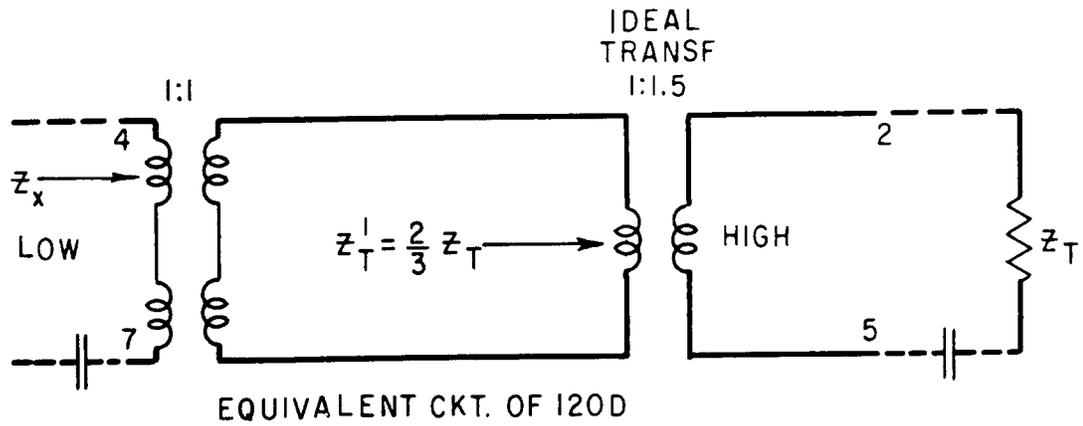


FIG. 2

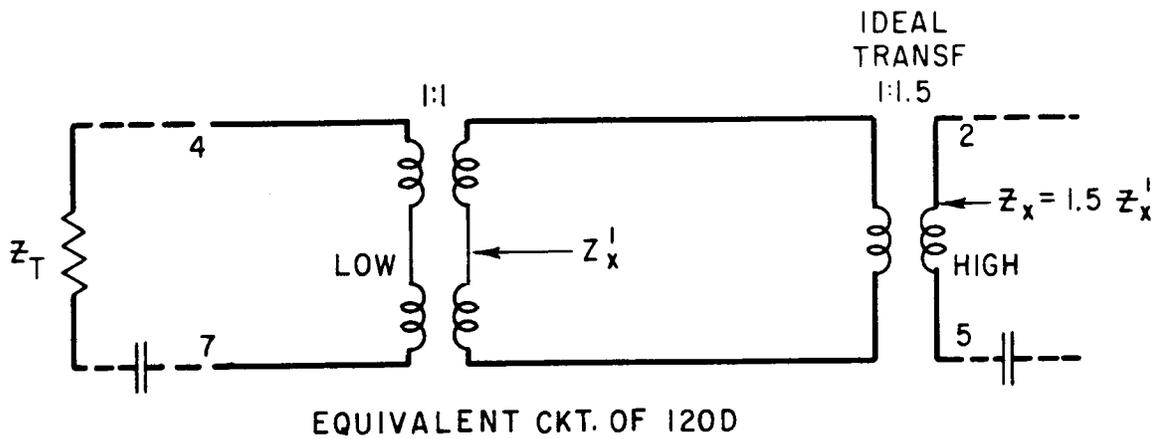


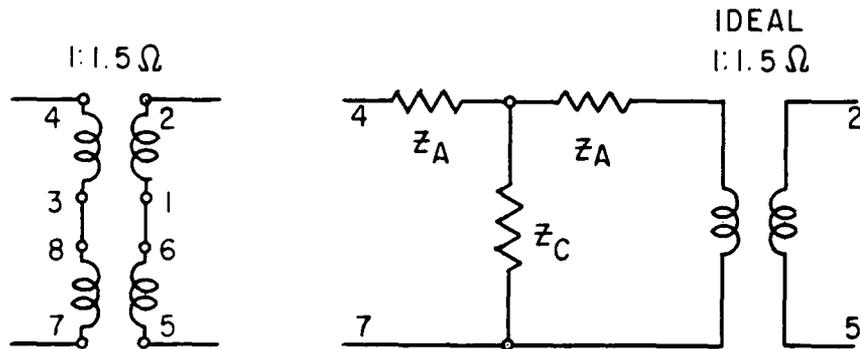
FIG. 3

TRANSMISSION CHARACTERISTICS OF 120D REPEATING COIL

Miscellaneous Data

Inner windings (2-1) and (6-5), parallel wound, each 569 turns #29ES,  $12.7\Omega \pm 15\%$ .  
 Outer windings (4-3) and (8-7), parallel wound, each 465 turns #25ES,  $5.5\Omega \pm 15\%$ .  
 Permalloy core with 8 mil equivalent series air gap.  
 Impedance ratio (4-3) (8-7) to (2-1) (6-5) = 1:1.5 ( $\pm 4\%$ ).  
 Inductance of (4-3) (8-7) at 900 cps, 3V, = 0.55 hen. min., 0.90 hen. max.  
 Effective resistance of (4-3) (8-7) at 900 cps, 3V, = 450 $\Omega$  max.  
 Inductance unbalance: (2-1) and (6-5) = 0.3% max.; (4-3) and (8-7) = 0.3% max.

Equivalent Networks and Parameters



0.1-7V ac, 0-100 ma dc in (4-3) (8-7)

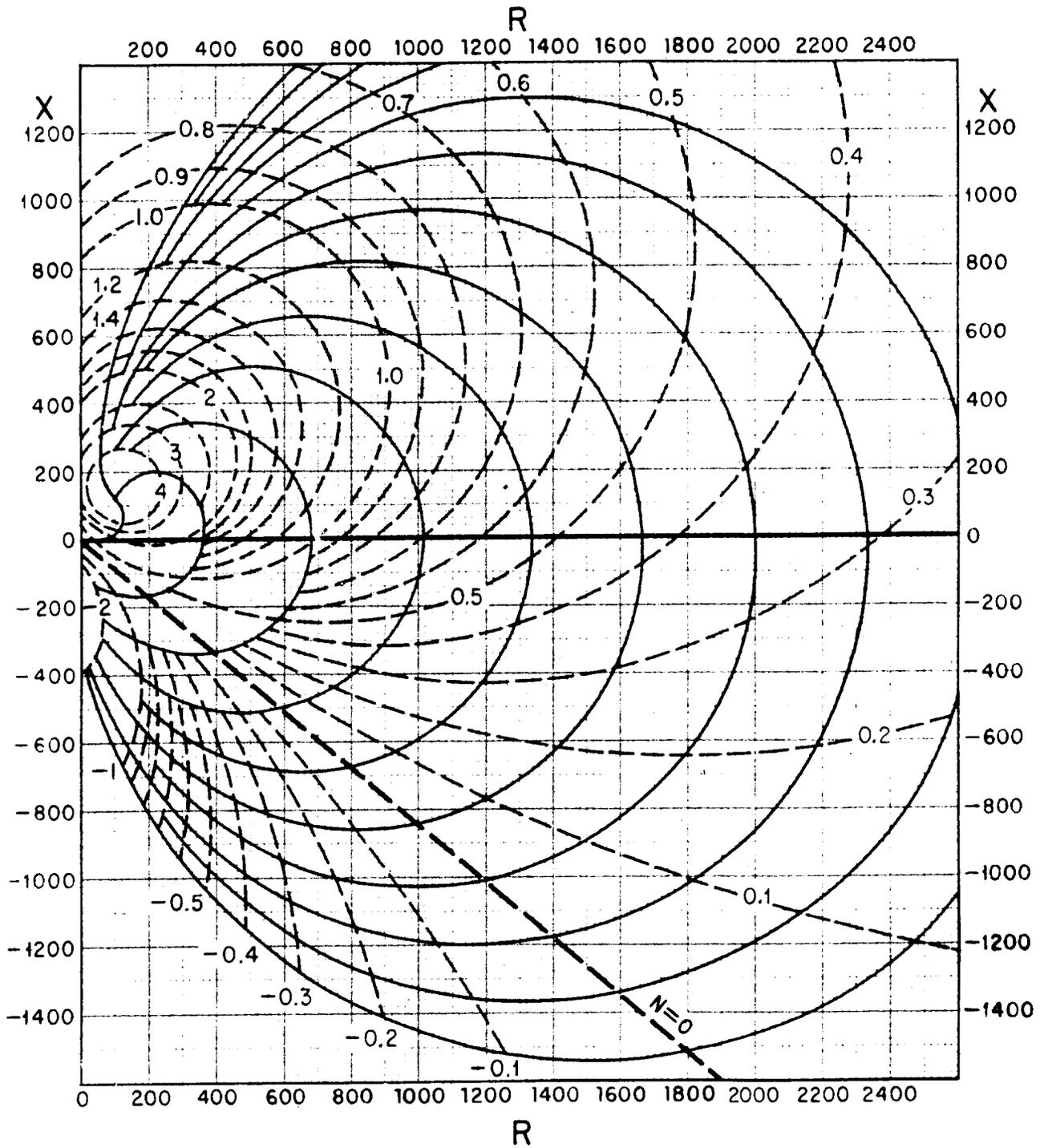
Freq. cps	Equivalent Unity Ratio T Network		Transfer Constant A + j B		Image Parameters	
	Z <sub>A</sub>	Z <sub>C</sub>	Nep.	Rad.	A db	Image Impedance Z <sub>I</sub>
200	14 +j 3	26 +j 871	.143 -j .112		1.24	102 +j 121
300	14 +j 4	39 +j 1240	.124 -j .0902		1.08	118 +j 150
500	14 +j 7	68 +j 2060	.106 -j .0632		0.92	138 +j 214
1000	14 +j 14	298 +j 4610	.0866 -j .0326		0.75	177 +j 390
1500	14 +j 21	1020 +j 9100	.0721 -j .0174		0.63	233 +j 639
2000	14 +j 28	4740 +j 19600	.0554 -j .0063		0.48	386 +j 1056
2500	14 +j 35	87500 +j 19500	.0256 +j .0135		0.22	1980 +j 1685
3000	14 +j 42	7770 -j 26200	.0171 +j .0544		0.15	1556 -j 25

0.1-7V ac, 180 ma dc in (4-3) (8-7)

Freq. cps	Equivalent Unity Ratio T Network		Transfer Constant A + j B		Image Parameters	
	Z <sub>A</sub>	Z <sub>C</sub>	Nep.	Rad.	A db	Image Impedance Z <sub>I</sub>
200	14 +j 3	6 +j 737	.154 -j .123		1.34	92 +j 112
300	14 +j 4	15 +j 1040	.135 -j .0998		1.17	106 +j 138
500	14 +j 7	36 +j 1710	.116 -j .0700		1.01	124 +j 196
1000	14 +j 14	210 +j 3750	.0959 -j .0366		0.83	158 +j 352
1500	14 +j 21	623 +j 6980	.0822 -j .0210		0.71	198 +j 561
2000	14 +j 28	2000 +j 13200	.0676 -j .0106		0.59	277 +j 872
2500	14 +j 35	16600 +j 37000	.0431 +j .0009		0.37	683 +j 1610
3000	14 +j 42	23500 -j 44200	.0166 +j .0387		0.14	2099 +j 176

# INPUT IMPEDANCE OF 120D REPEATING COIL WITH ANY TERMINATION

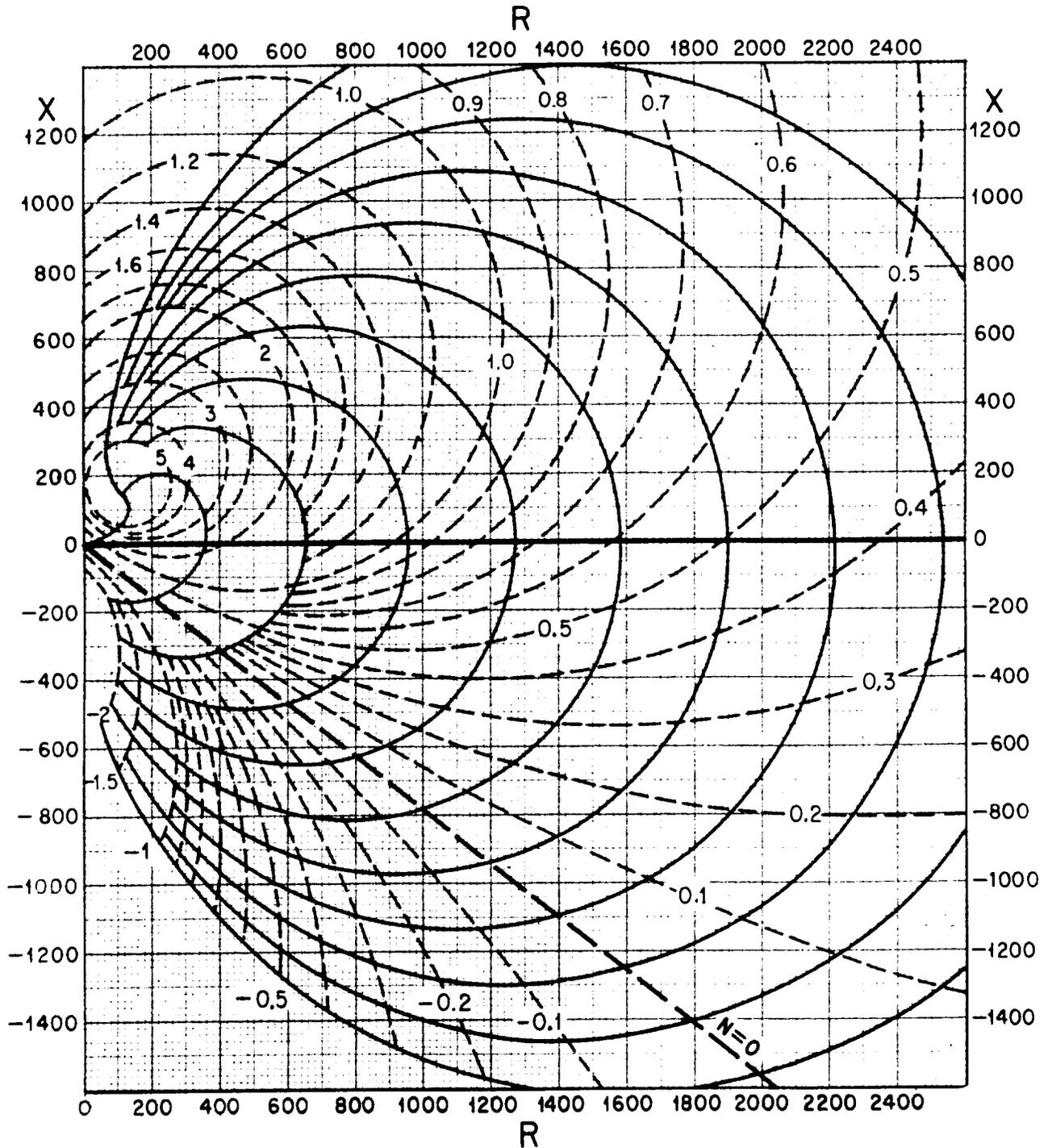
## 200 CPS



FOR EXPLANATION OF USE OF CHARTS SEE SECTION 304-200-100

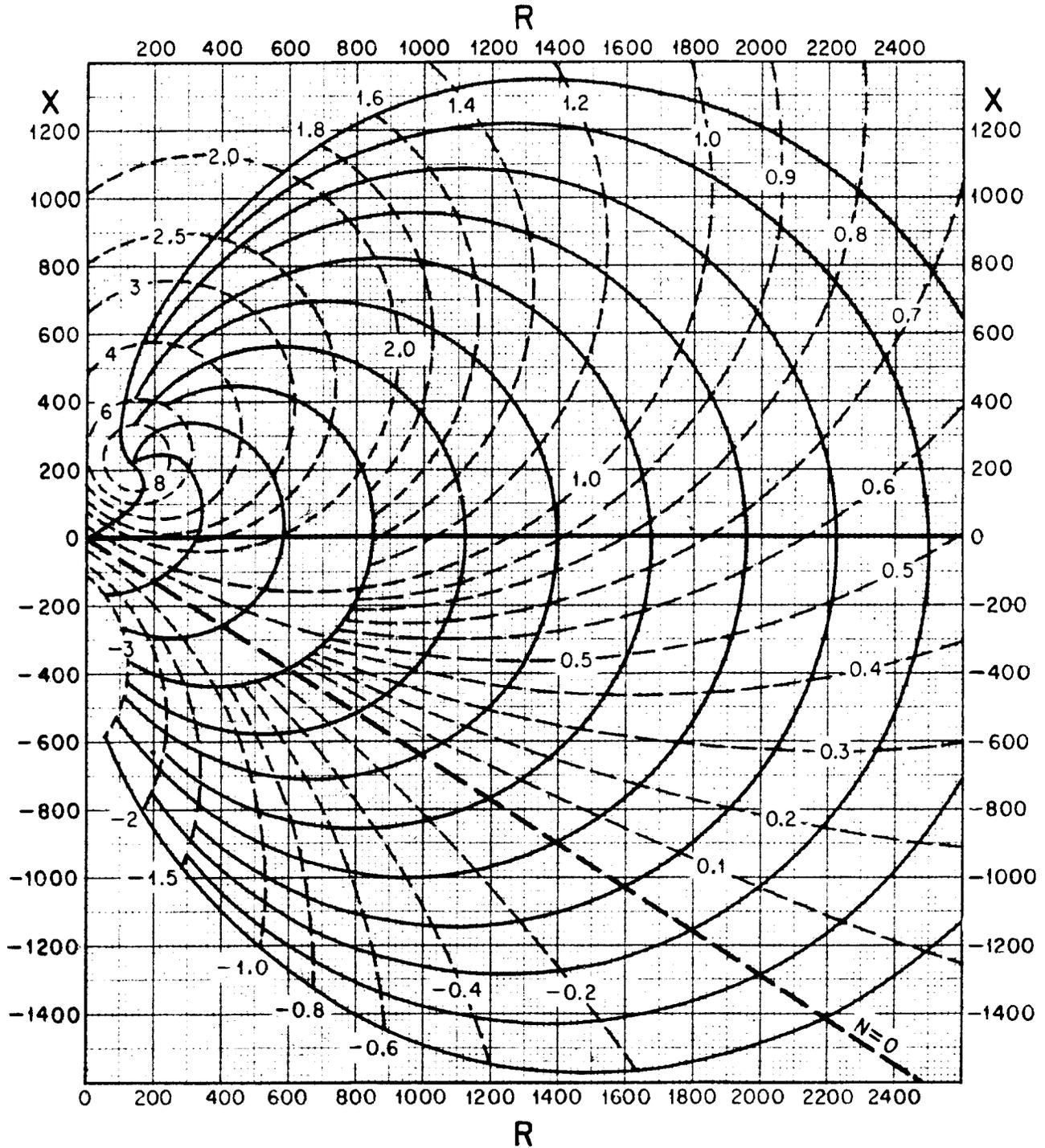
# INPUT IMPEDANCE OF 120D REPEATING COIL WITH ANY TERMINATION

## 300 CPS



FOR EXPLANATION OF USE OF CHARTS SEE SECTION 304-200-100

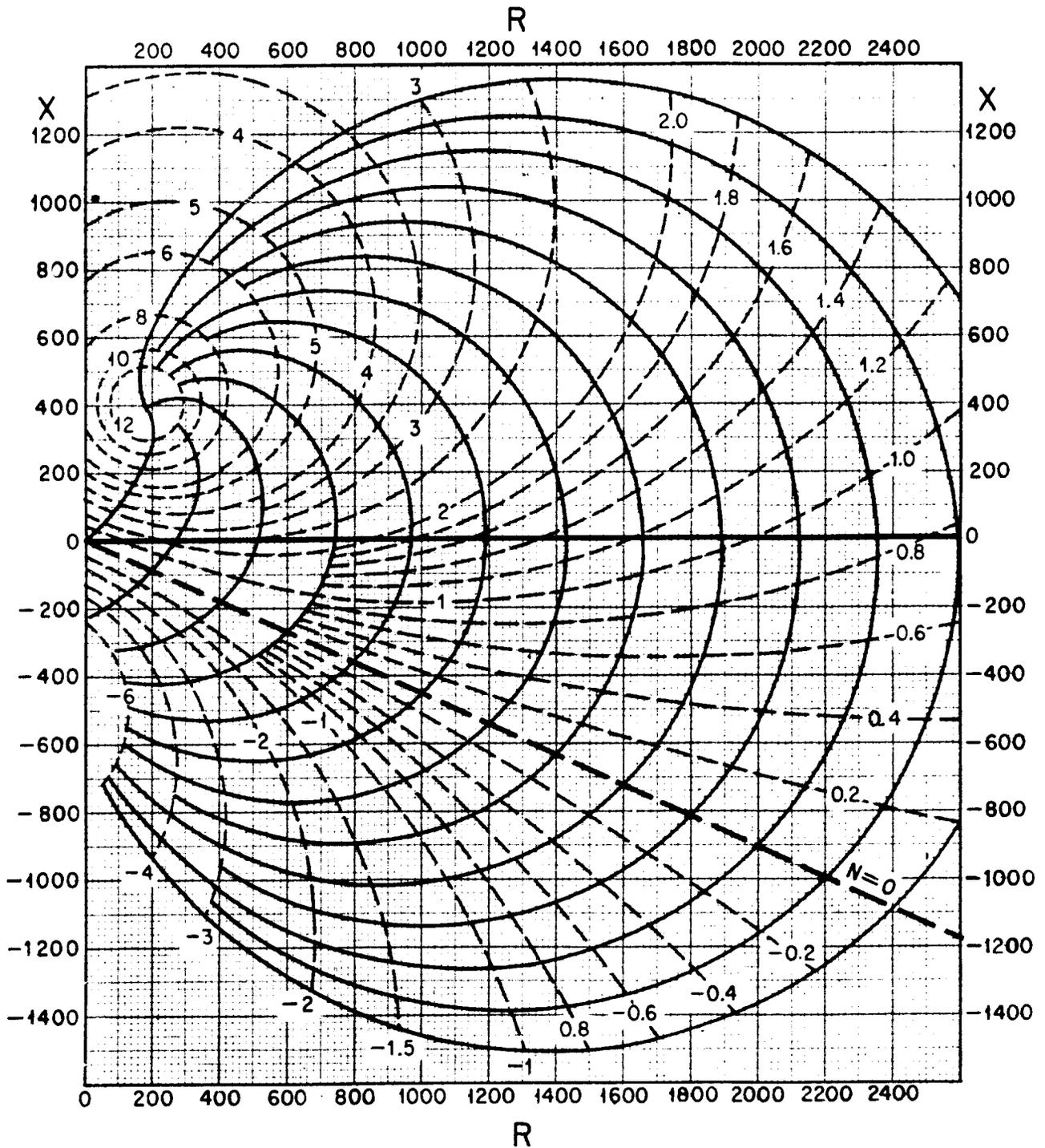
# INPUT IMPEDANCE OF 120D REPEATING COIL WITH ANY TERMINATION 500 CPS



FOR EXPLANATION OF USE OF CHARTS SEE SECTION 304-200-100

# INPUT IMPEDANCE OF 120D REPEATING COIL WITH ANY TERMINATION

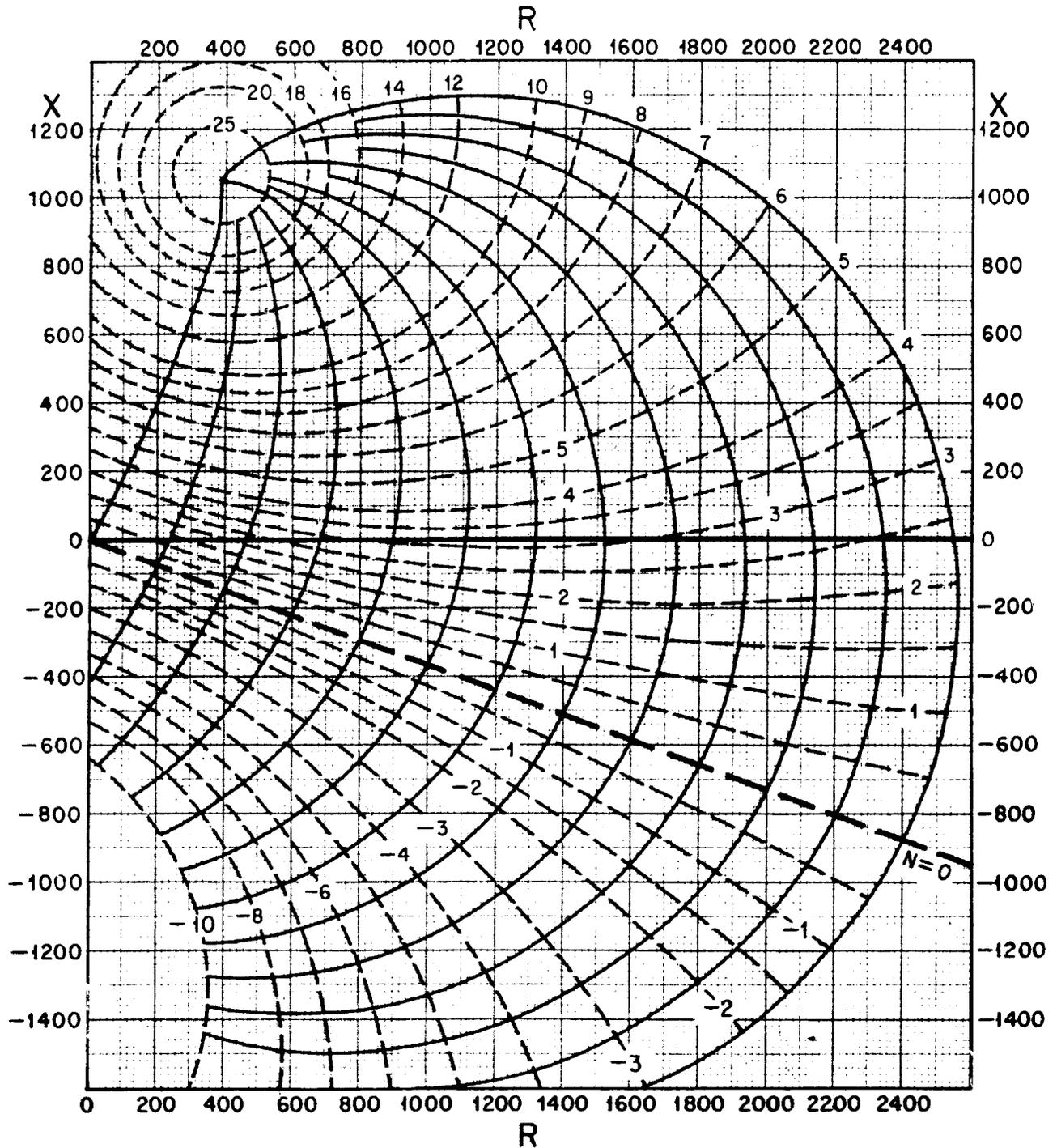
## 1000 CPS



FOR EXPLANATION OF USE OF CHARTS SEE SECTION 304-200-100

# INPUT IMPEDANCE OF 120D REPEATING COIL WITH ANY TERMINATION

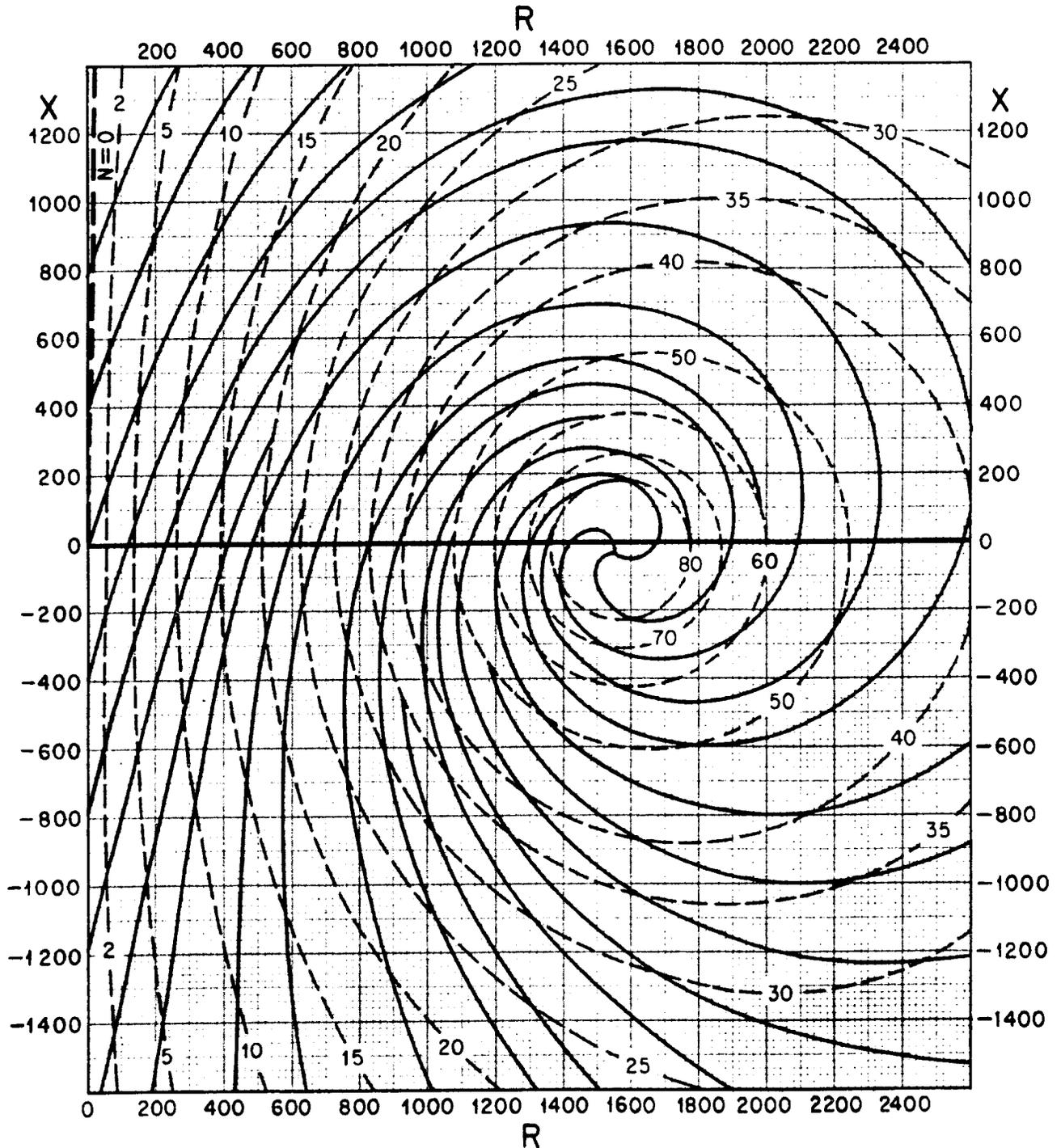
## 2000 CPS



FOR EXPLANATION OF USE OF CHARTS SEE SECTION 304-200-100

# INPUT IMPEDANCE OF 120D REPEATING COIL WITH ANY TERMINATION

## 3000 CPS



FOR EXPLANATION OF USE OF CHARTS SEE SECTION 304-200-100