H. Eléctricos

LÁMINAS

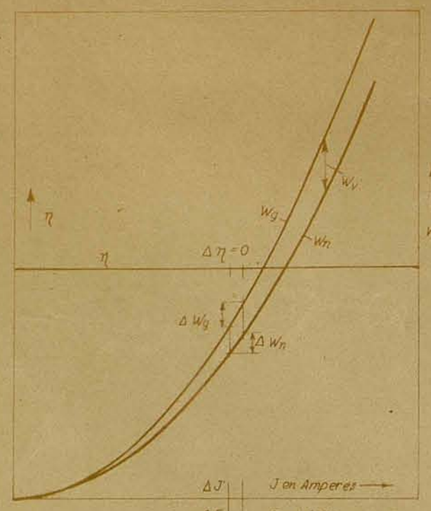


Fig. 1ª.

W_g = Potencia total.
W_n = " util. = $J^2 R_n$
W_v = " perdidas = $J^2 R_v$
$\eta = \frac{W_n}{W_g}$

$W_g = W_n + W_v$

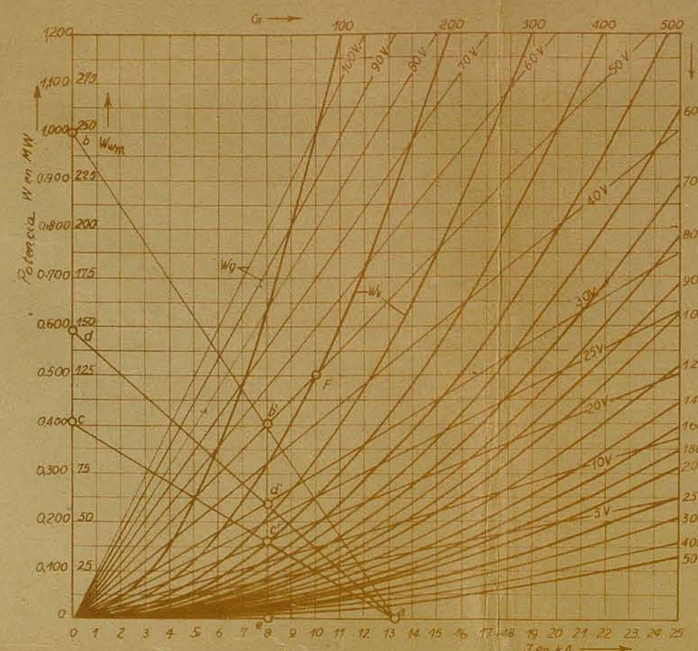


Fig. 3. Grafico de funcionamiento para hornos de c. continua con diferentes clases caracteristicas y tensiones

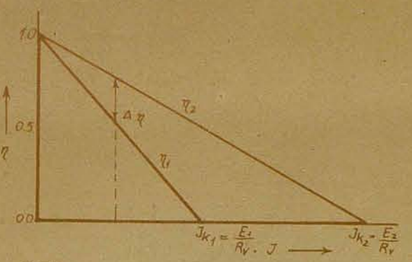


Fig. 5.

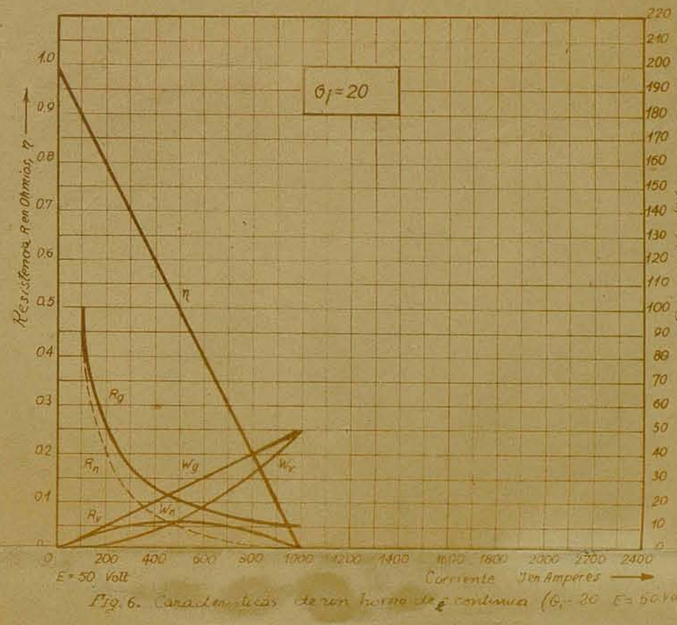


Fig. 6. Caracteristicas de un horno de c. continua (G_i = 20 E = 50 Volt)

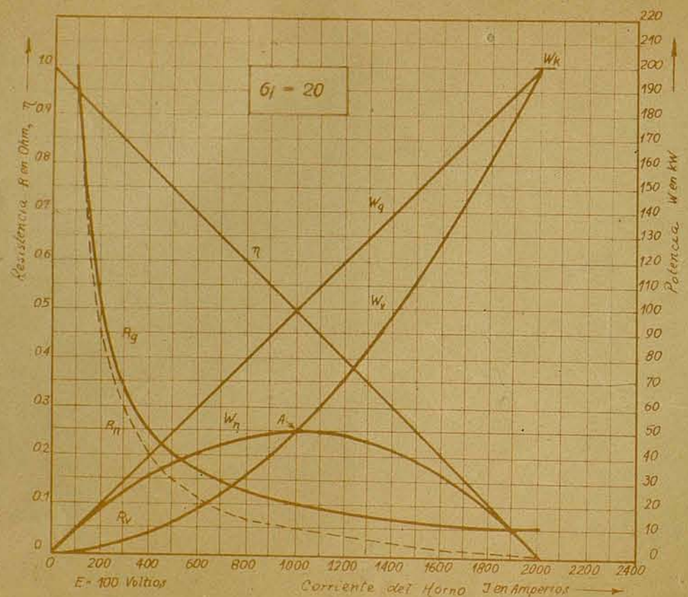


Fig. 2. Lineas caracteristicas de un horno de arco para c. continua

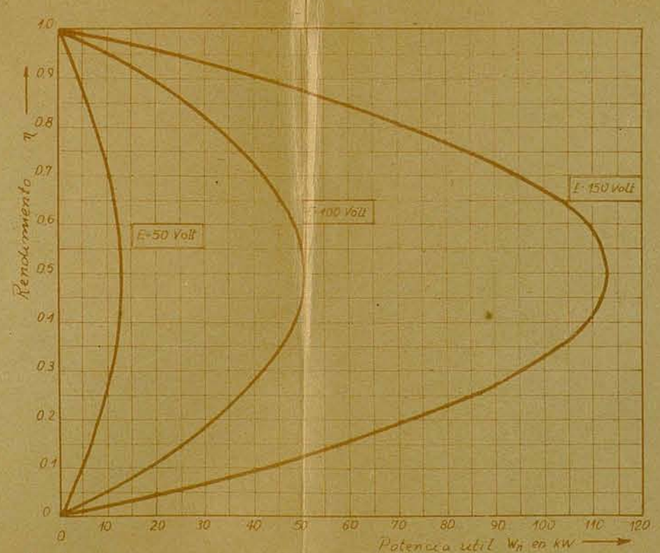


Fig. 4.

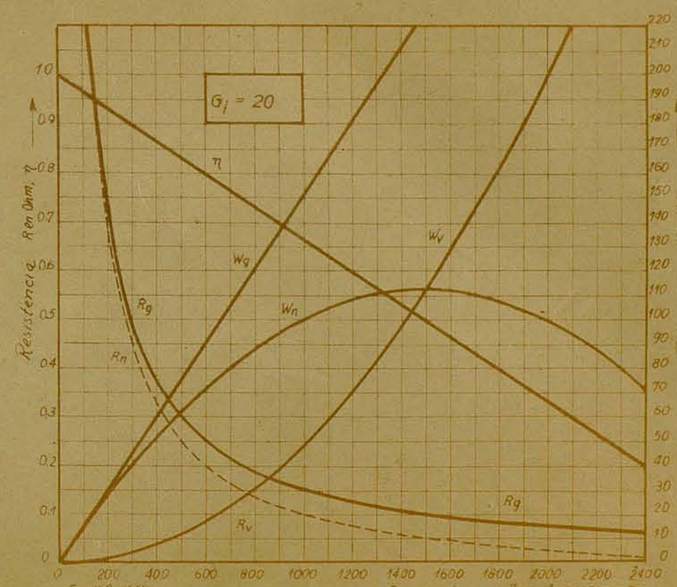


Fig. 7. Caracteristicas de un horno de c. continua (G_i = 20 E = 150 Volt)

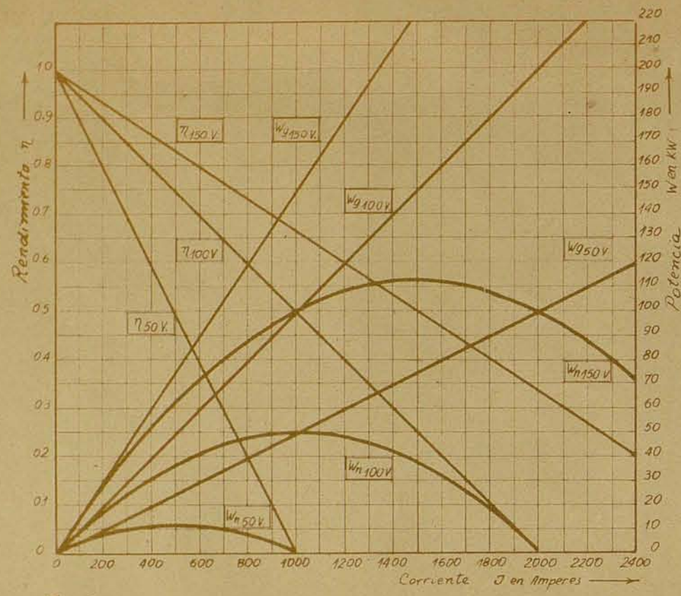


Fig. 8.

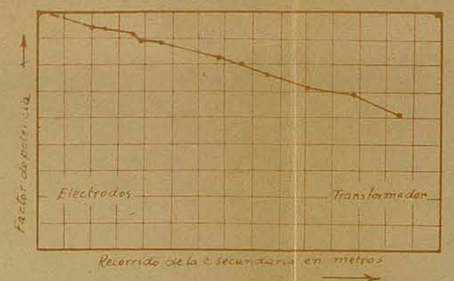


Fig. 10.

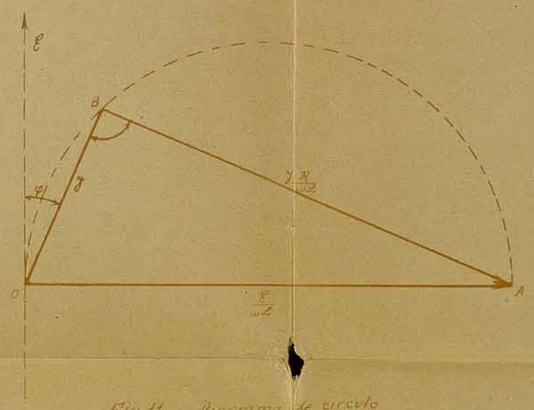


Fig. 11. Diagrama de circulo

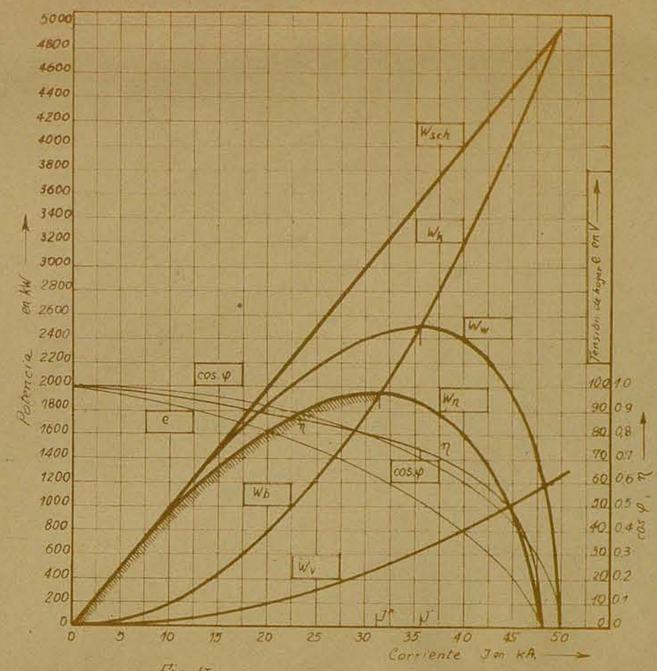


Fig. 13.

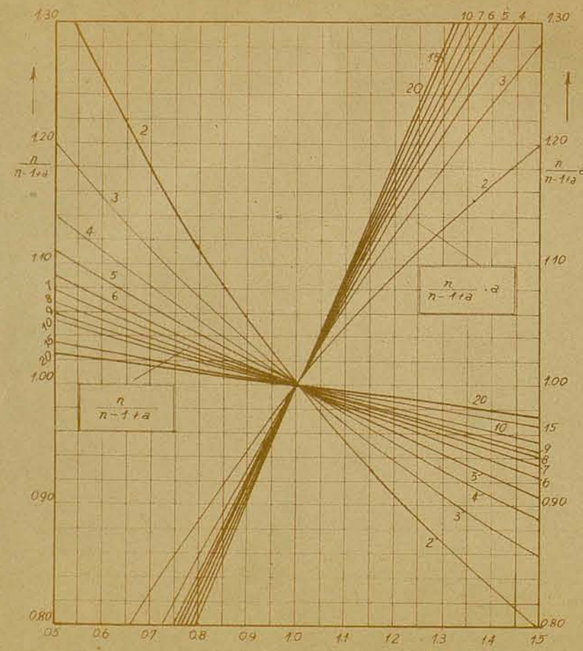


Fig. 9. Grafico para la conexión en serie de varios hornos de c. continua

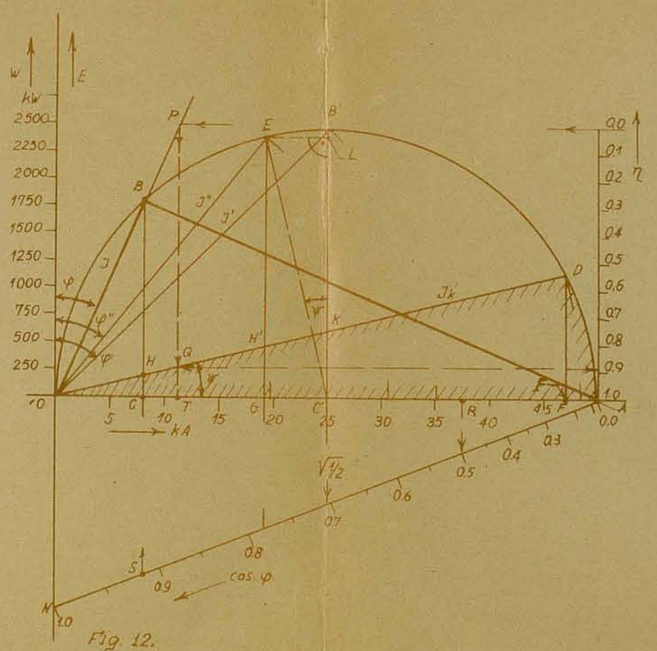


Fig. 12.

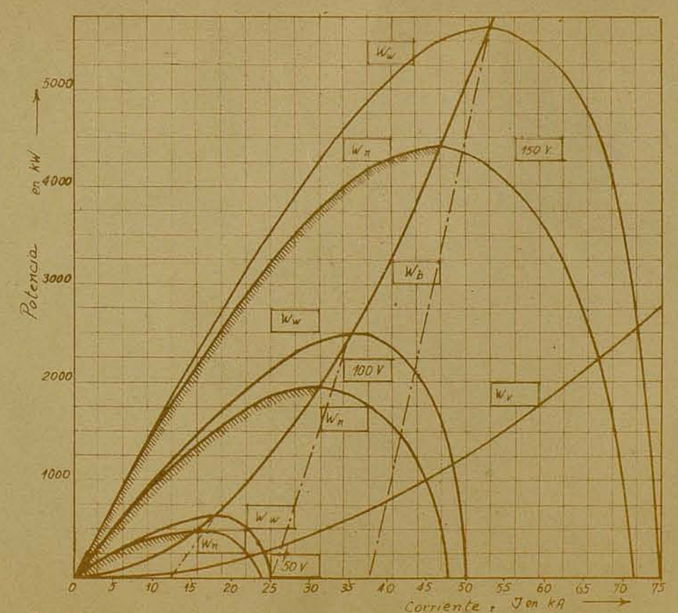


Fig. 14.

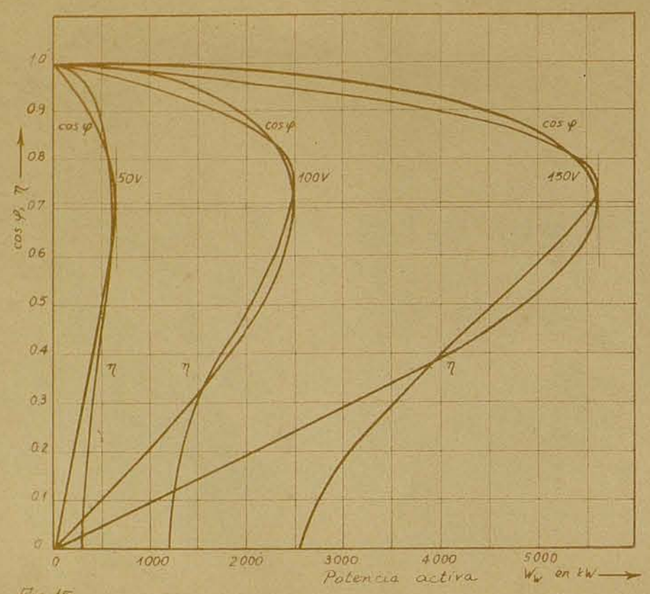


Fig. 15.

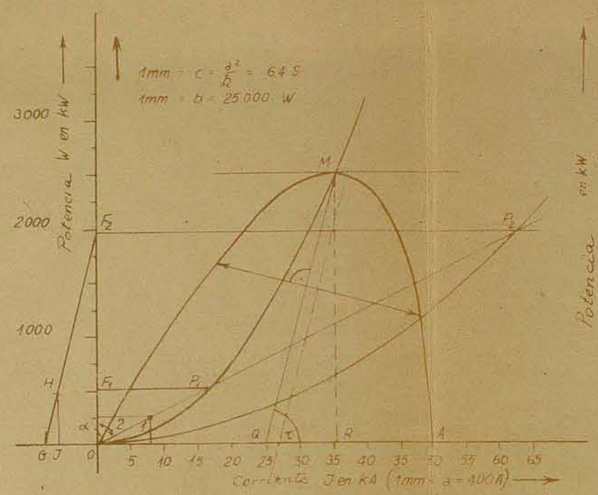


Fig. 17.

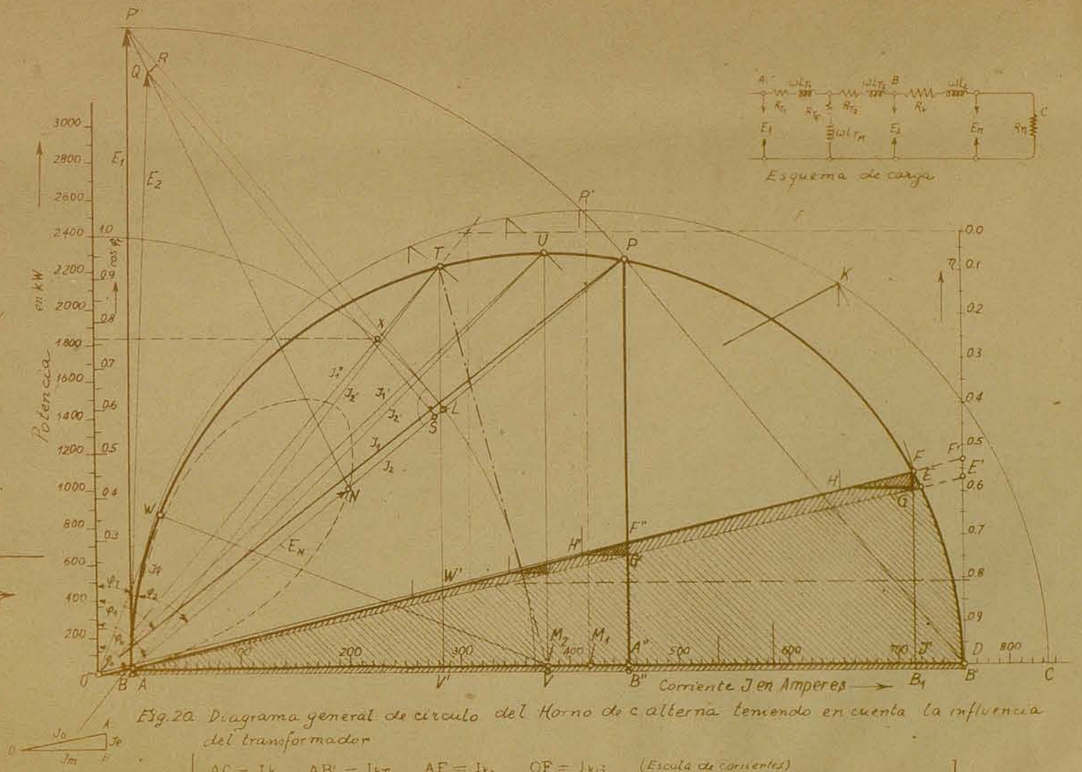


Fig. 20. Diagrama general de circulo del Horno de c alterna teniendo en cuenta la influencia del transformador

$$\left.\begin{array}{l} AC = I_k,\quad AB' = I_{kT},\quad AF = I_{k_2},\quad OF = I_{k_1} \quad \text{(Escala de corrientes)} \\ FG = I_{k_2}^2 \cdot RT,\quad GI' = I_{k_2}^2 \cdot R_L,\quad FI' = I_{k_2}^2 \cdot R_V,\quad OB'' = W_{b_1},\quad AB'' = W_{b_2},\quad UV = W_{w,m} \\ = W_{V_T} \qquad = W_{V_L} \qquad = W_V \qquad I\,B_1 = W_{V_2},\quad FB_1 = W_{V_{ges.}} \end{array}\right\}$$

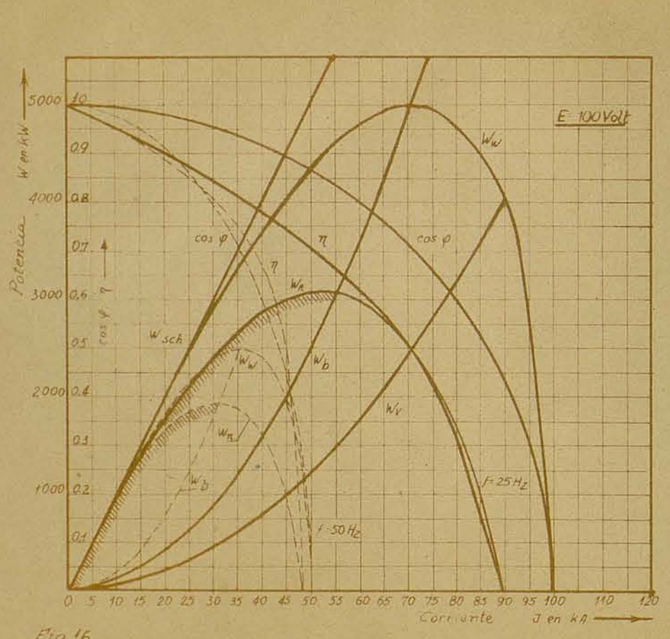


Fig. 16.

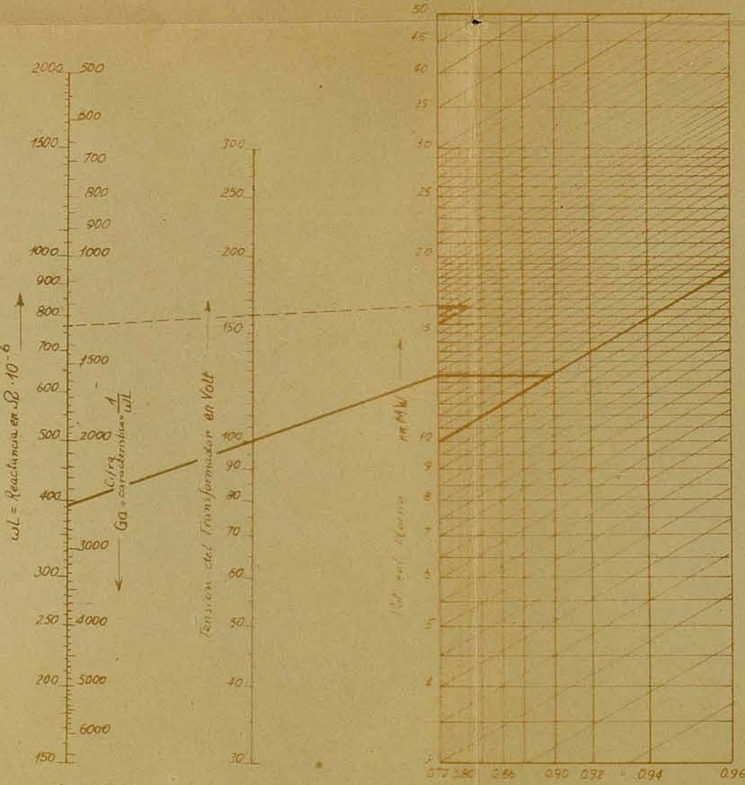


Fig. 19. Abaco para la determinacion de la potencia, partiendo de la cifra caracteristica, la tension del transformador y el factor de potencia.

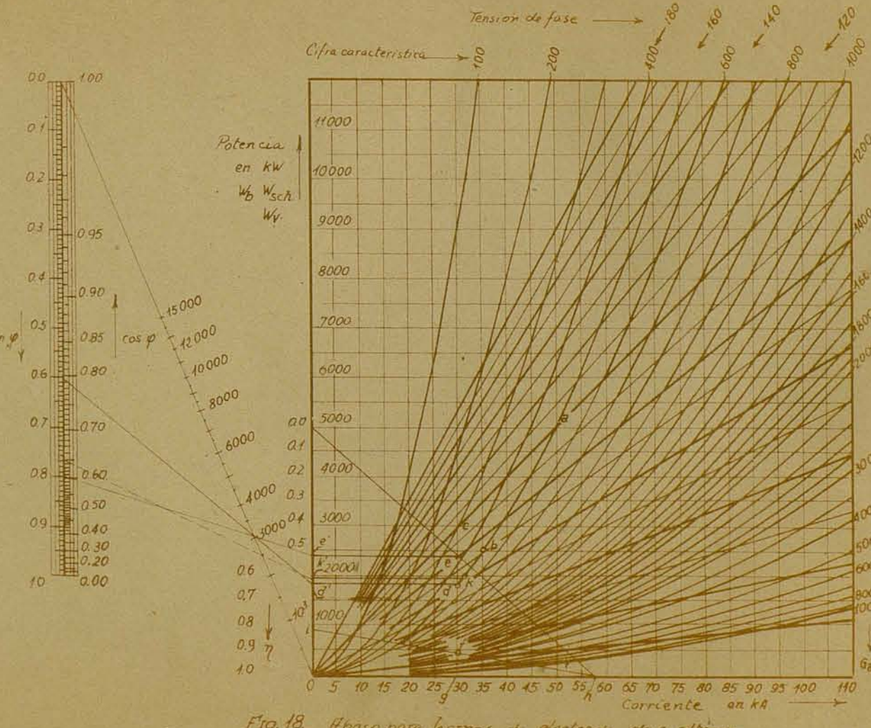


Fig. 18. Abaco para hornos de electrodo de c. alterna

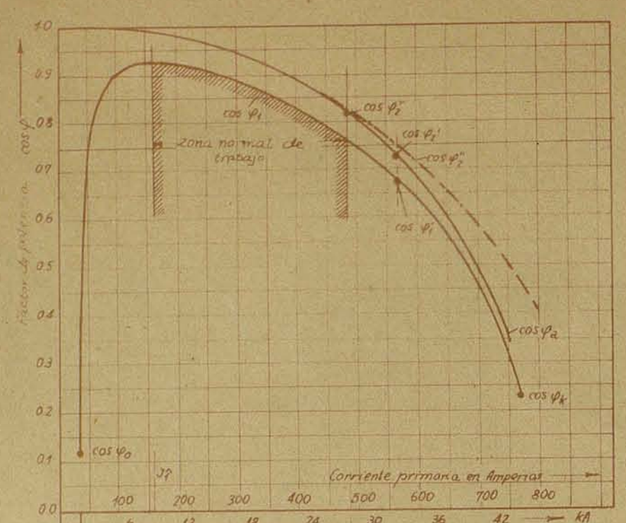


Fig. 21.

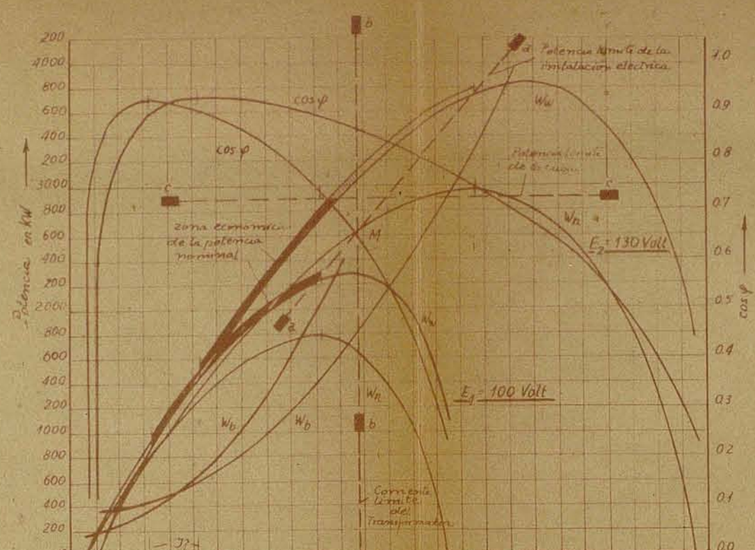


Fig. 25.

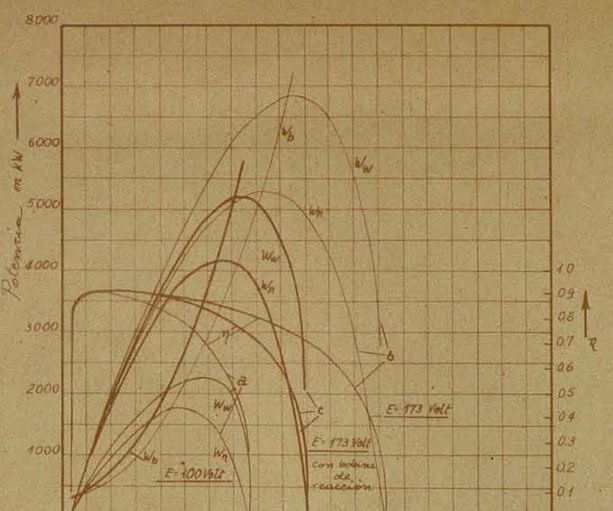


Fig. 26.

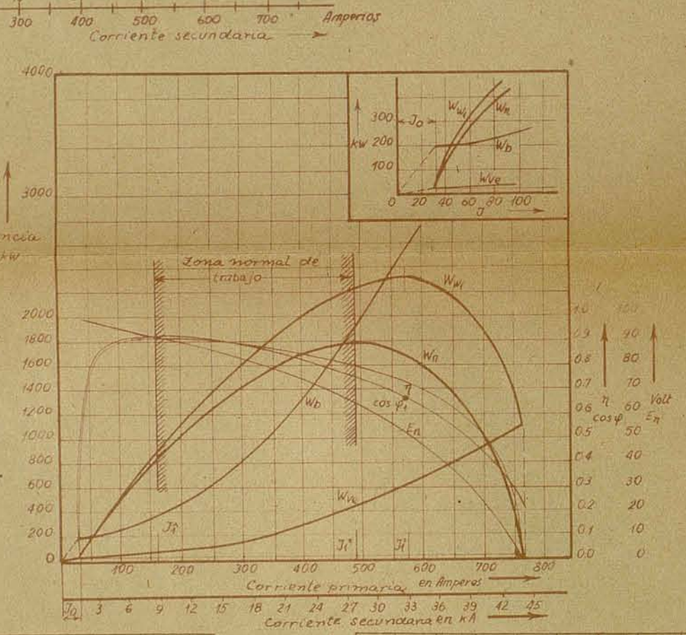


Fig. 22.

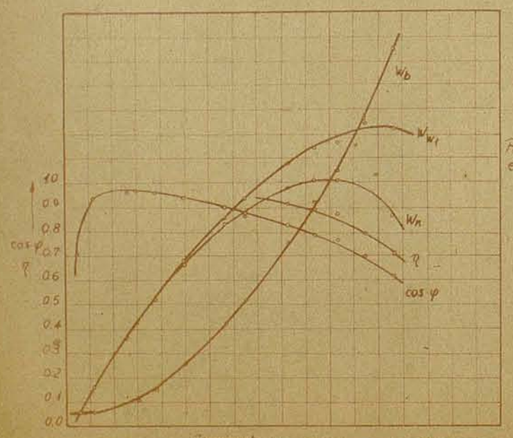


Fig. 23.

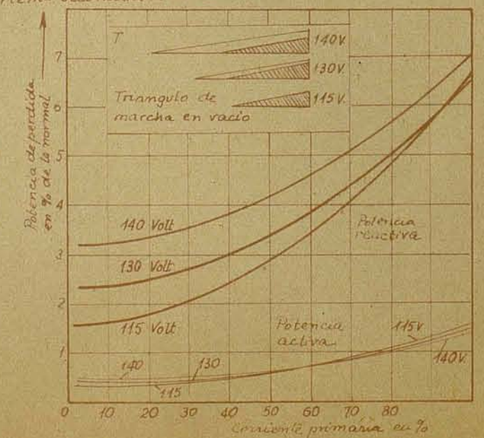


Fig. 24.

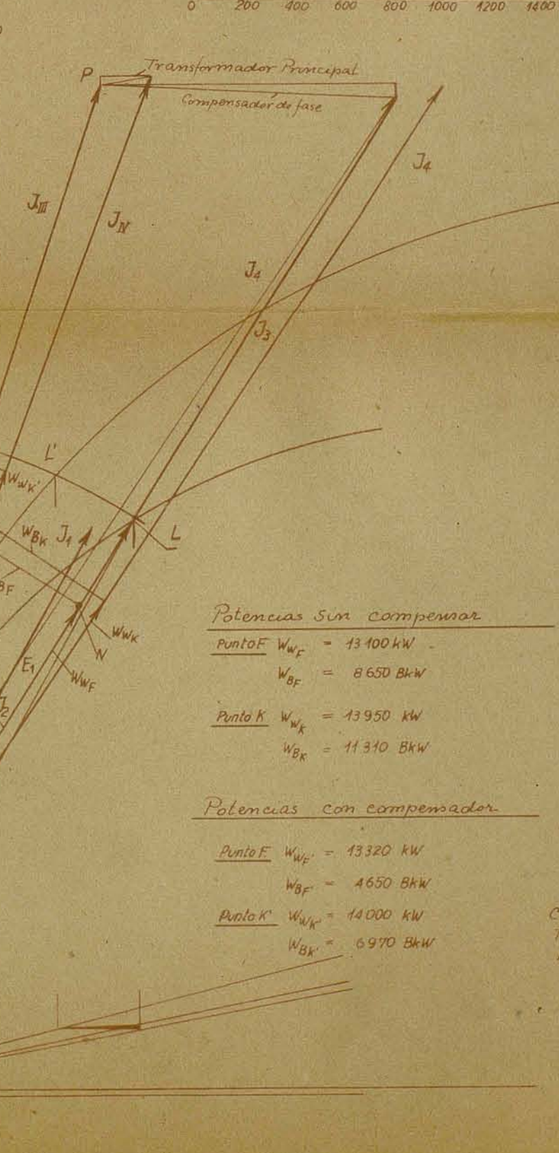


Fig. 27.

Potencias sin compensar

Punto F W_{WF} = 13 100 kW

W_{BF} = 8 650 BkW

Punto K W_{WK} = 13 950 kW

W_{BK} = 11 310 BkW

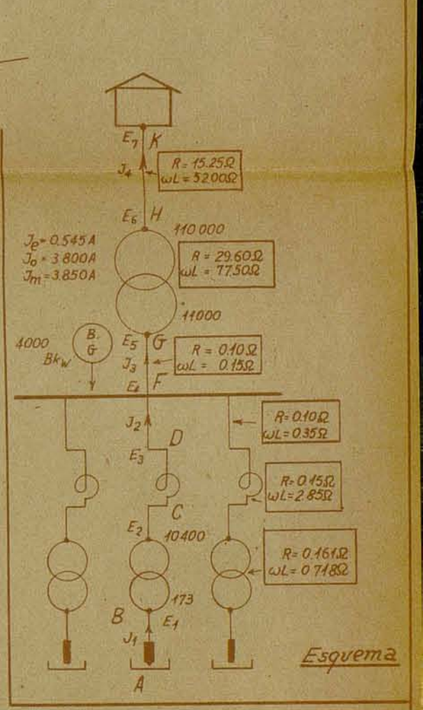
Potencias con compensador

Punto F $W_{WF'}$ = 13 320 kW

$W_{BF'}$ = 4 650 BkW

Punto K' $W_{WK'}$ = 14 000 kW

$W_{BK'}$ = 6 970 BkW



Escalas

Corriente 1mm = 2 Amperios

Tension 1mm = 4.16 Voltios

Potencia $1mm^2$ = 2 x 4.16 = 83.2 Watios

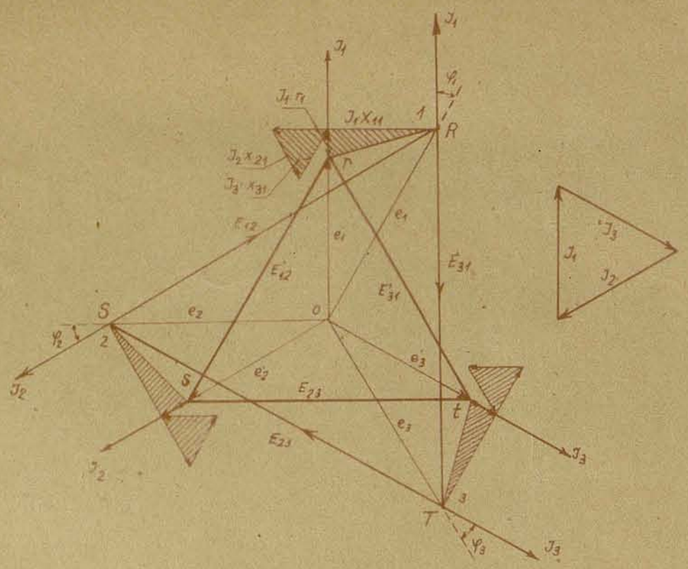


Fig. 28.

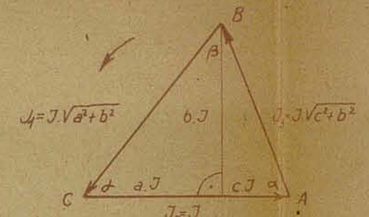


Fig. 29.

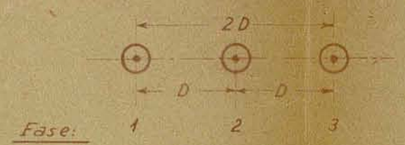


Fig. 30

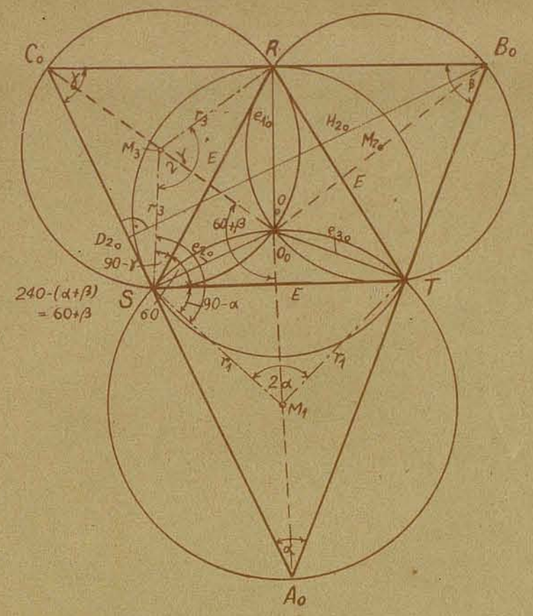


Fig. 33.

Fig. 31.

Triangulo de pot. aparente A'B'C'
" " " activa A B C
" " " reactiva A''B''C''

Fig. 32

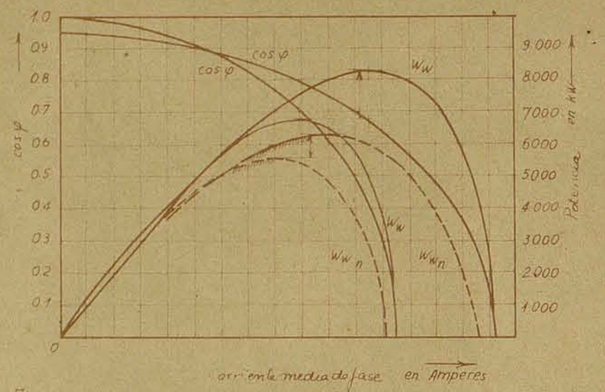
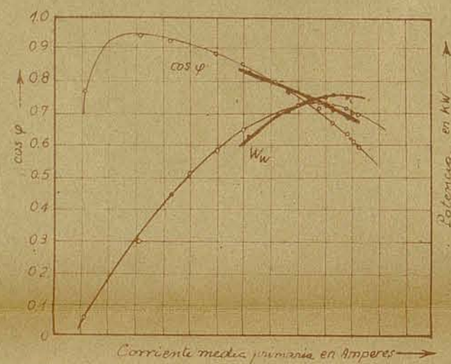


Fig 34



Carga simétrica
» asimetrica

Fig 35.

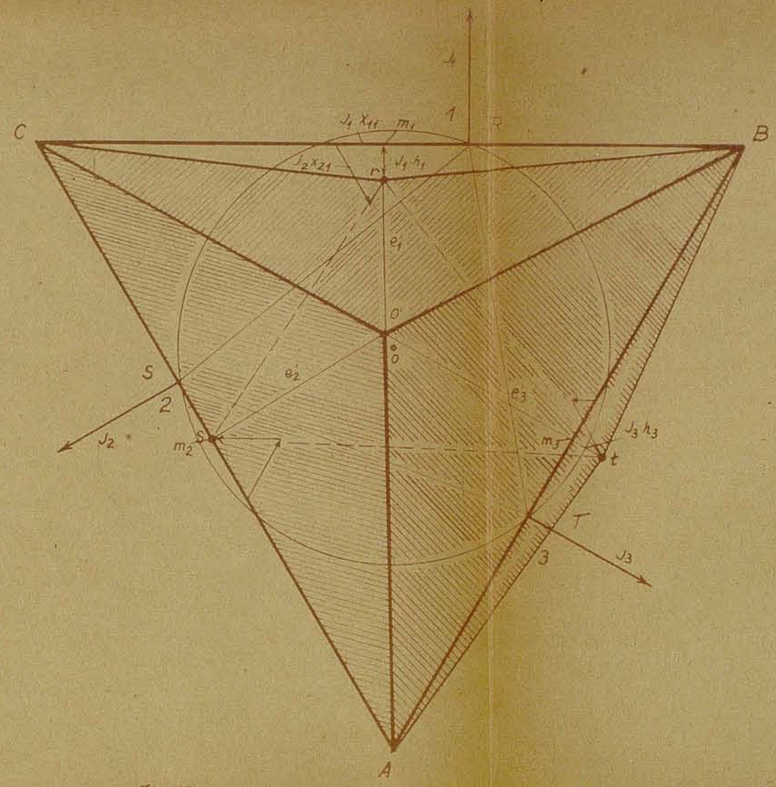


Fig 37.

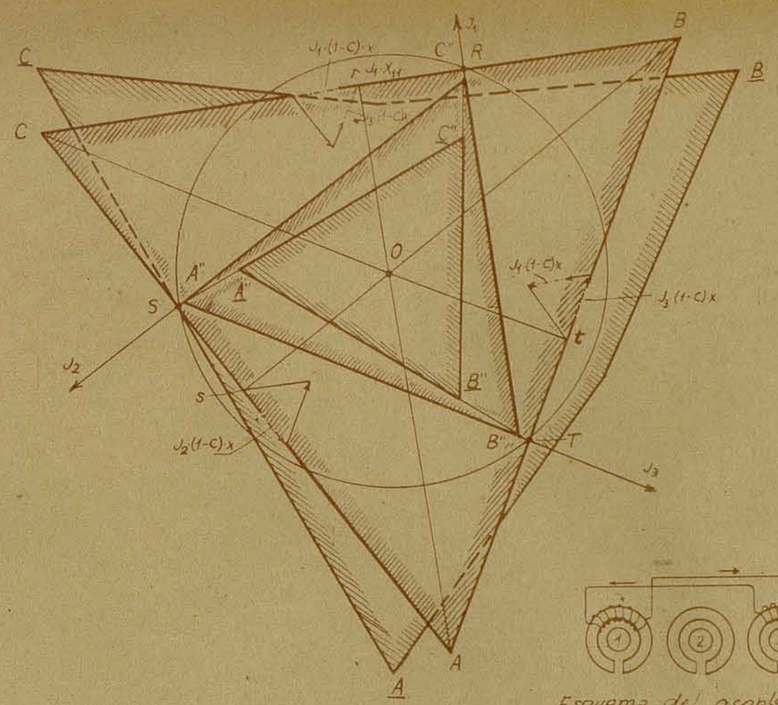
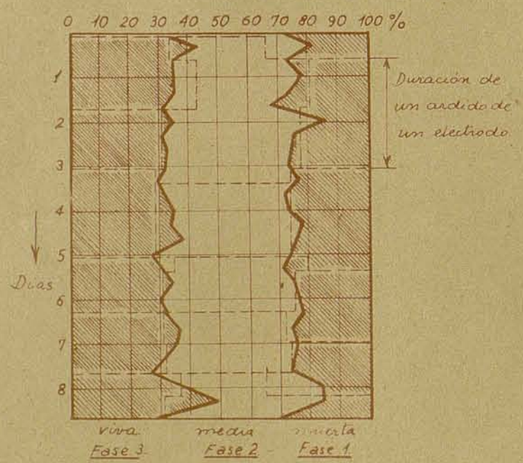


Fig 39.

Esquema del acoplamiento adicional



Potencia de fusión
Consumo de electrodos/hora

Fig 36.

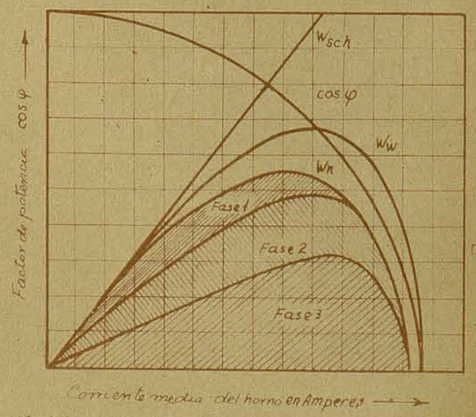


Fig 38.

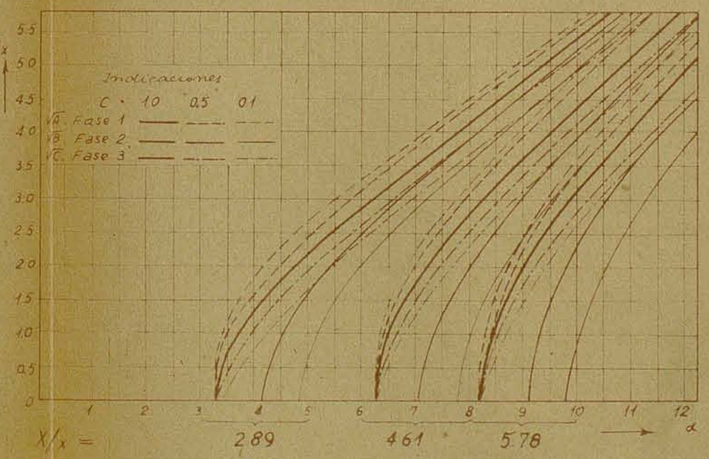


Fig 40

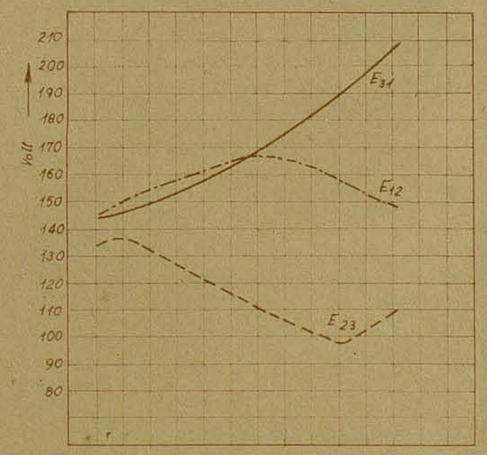


Fig 41

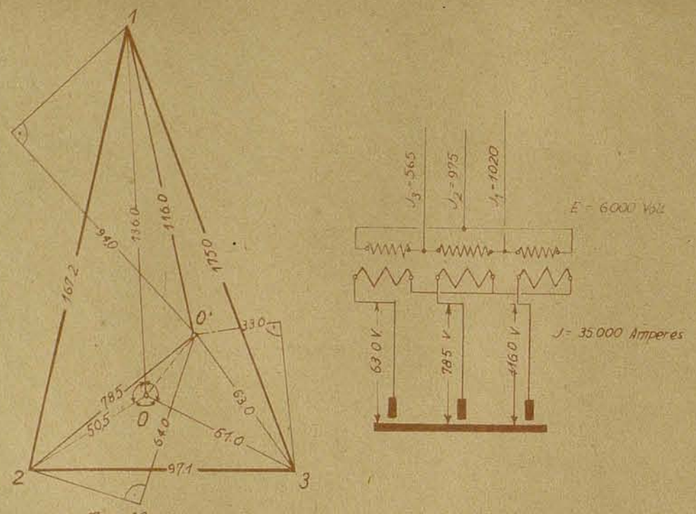


Fig 42.

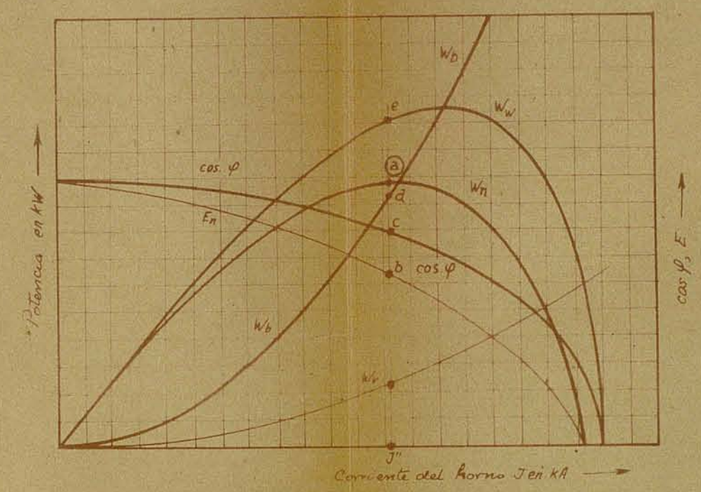


Fig 45.

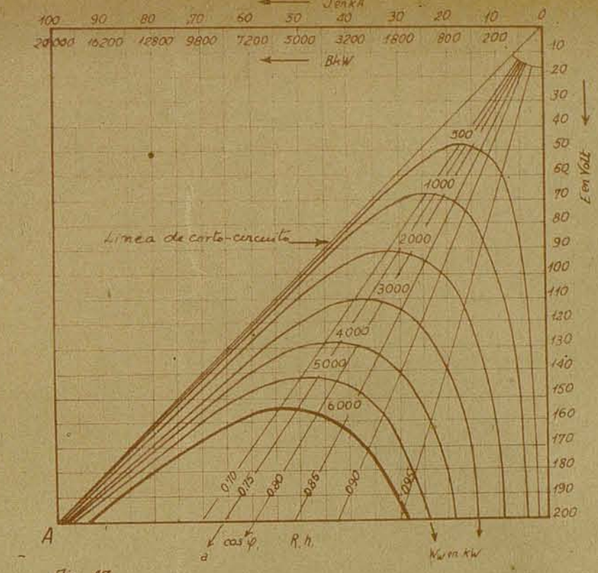


Fig 47.

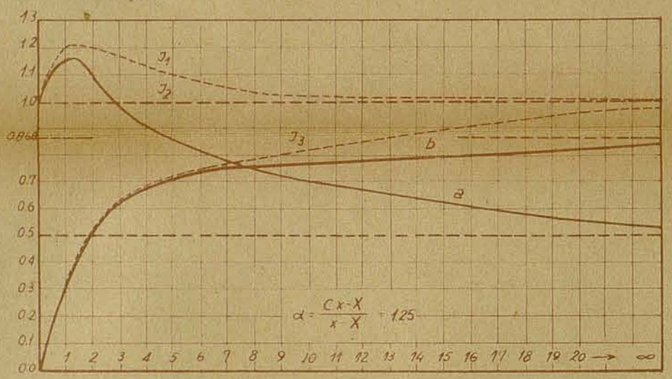


Fig 43.

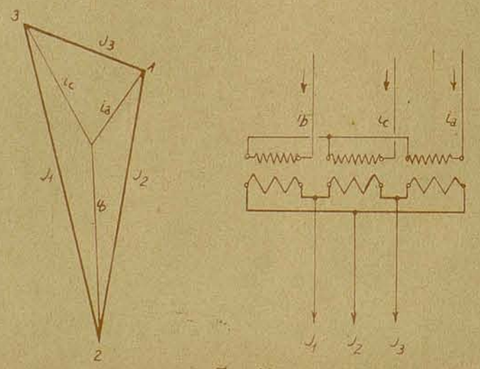


Fig 44.

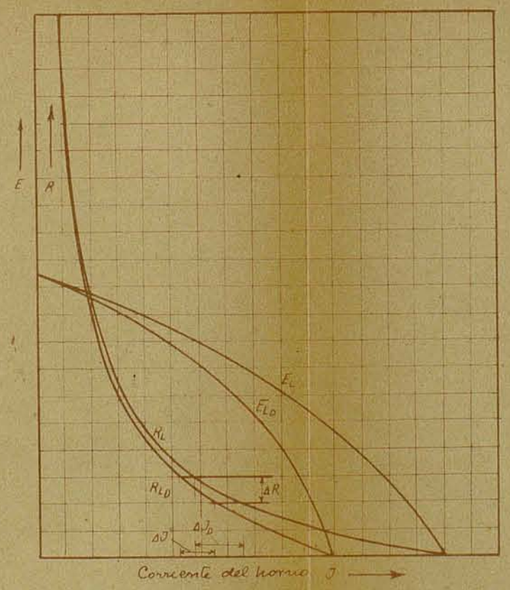


Fig 46a

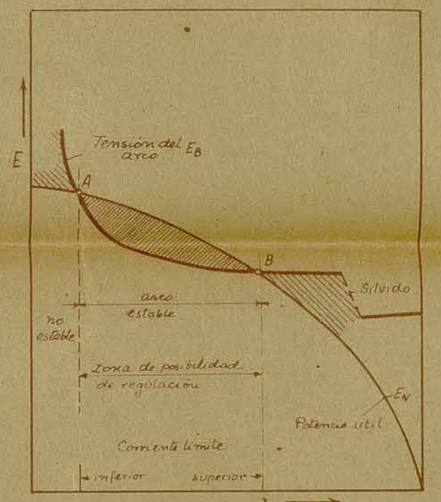


Fig 48.

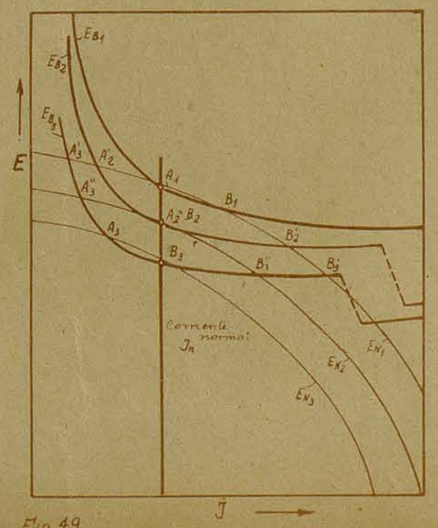


Fig 49

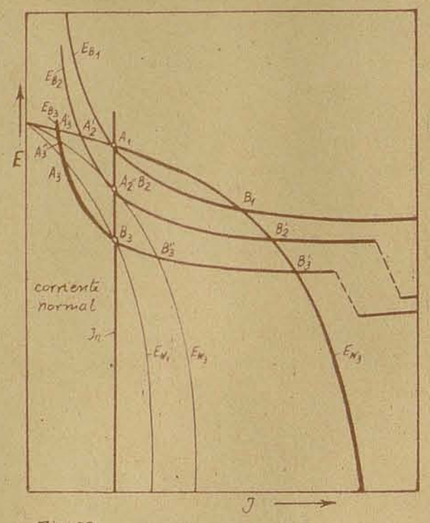


Fig. 50.

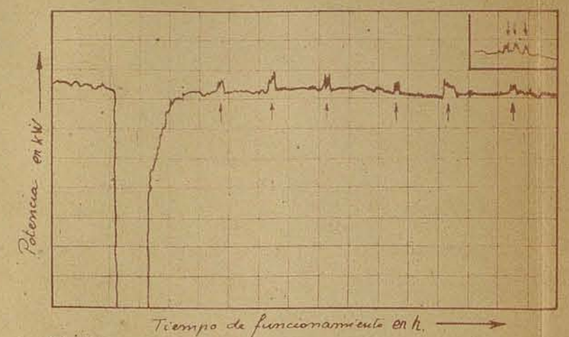
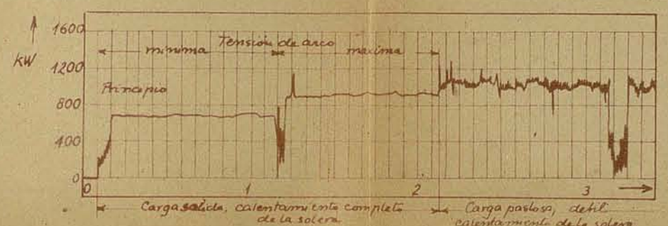


Fig. 55.



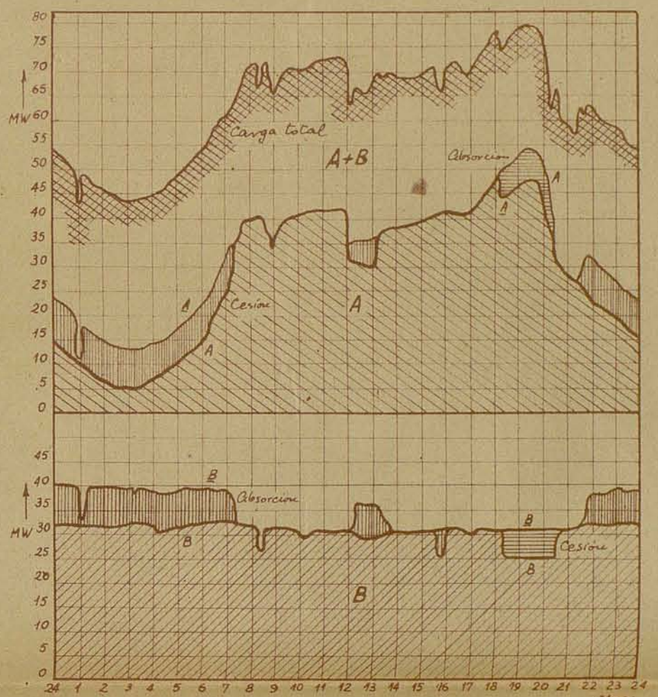


Fig. 58.

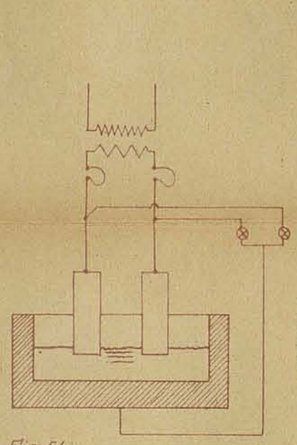


Fig. 51

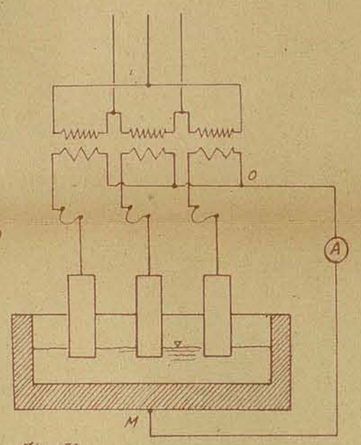


Fig. 52.

Fig. 56.

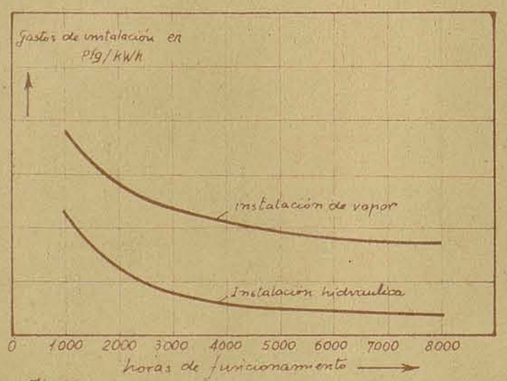


Fig. 53.

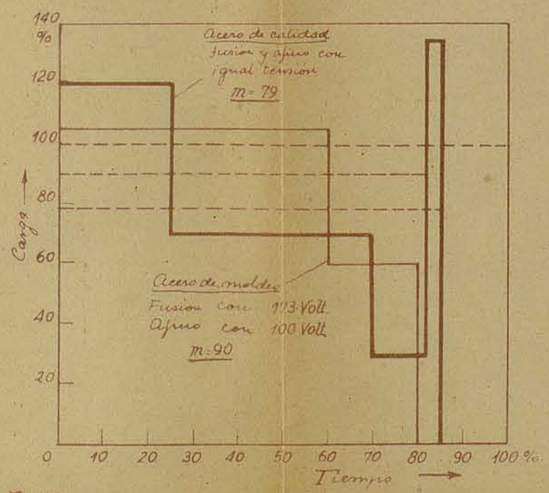


Fig. 57.

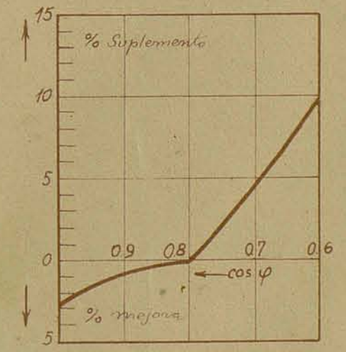


Fig. 59.

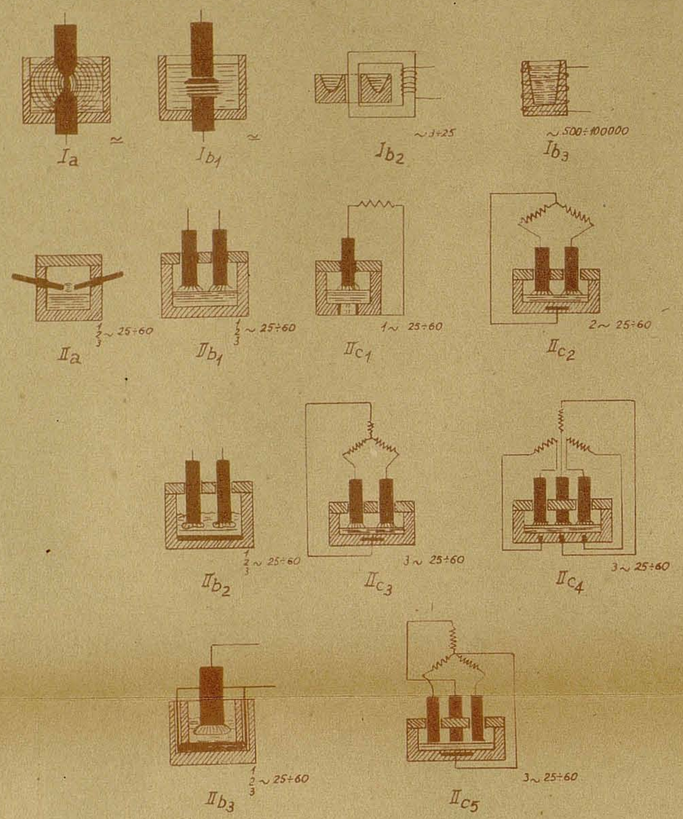
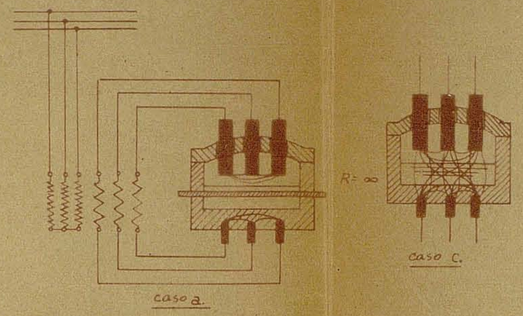


Fig. 60.



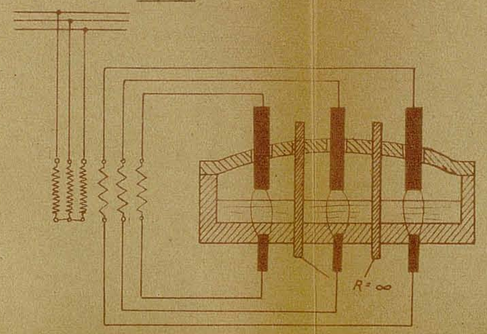


Fig. 62.

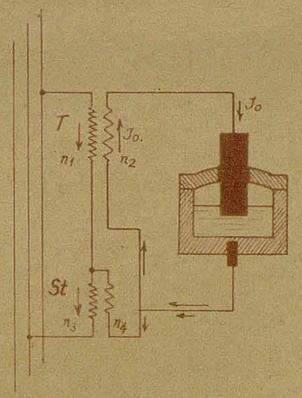


Fig. 64.

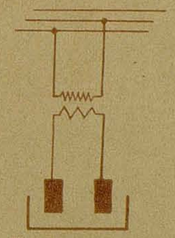


Fig. 66.

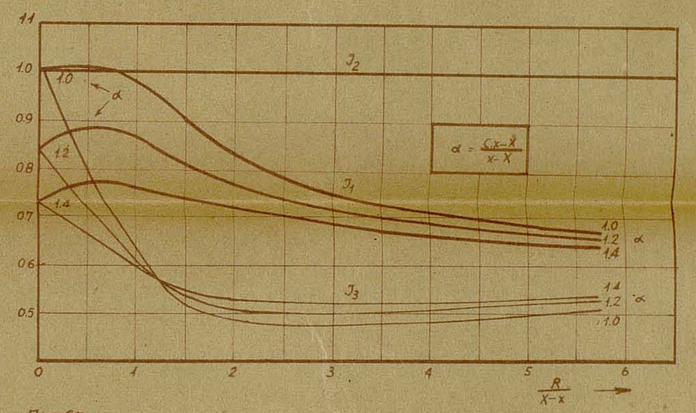


Fig. 65.

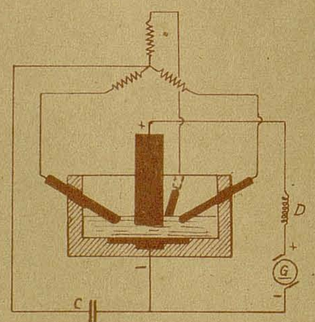


Fig. 61.

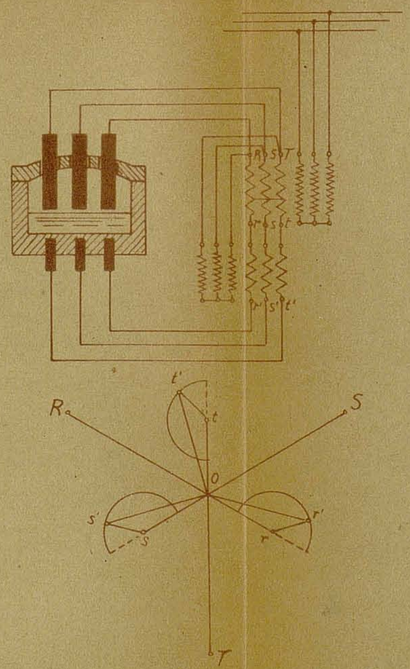


Fig. 63.

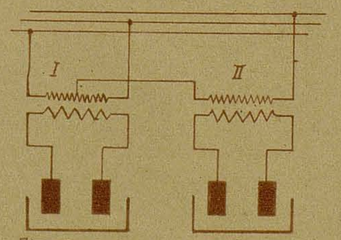


Fig. 67.

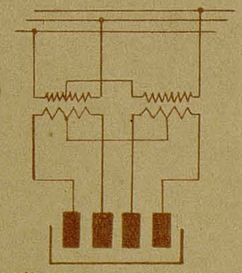


Fig. 68.

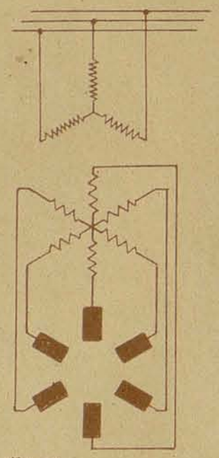


Fig 69.

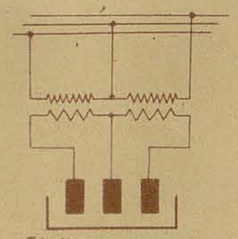


Fig. 70

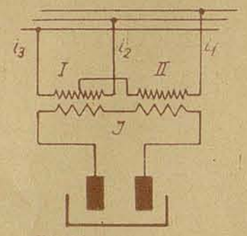


Fig. 71.

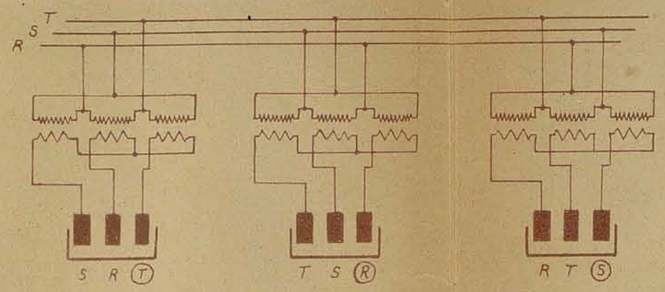


Fig. 74.

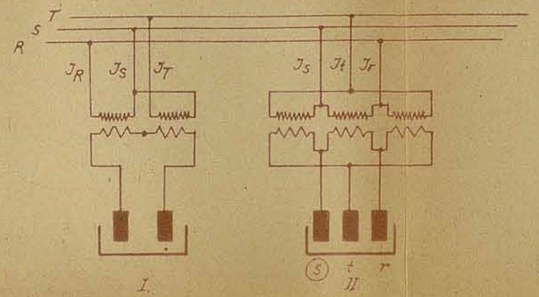


Fig. 75.

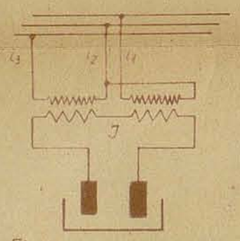


Fig. 72.

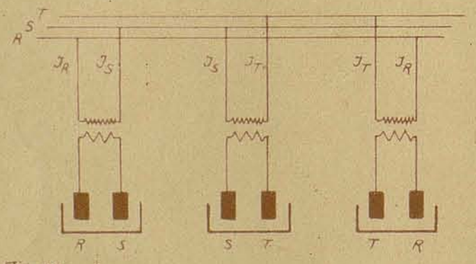


Fig 73.

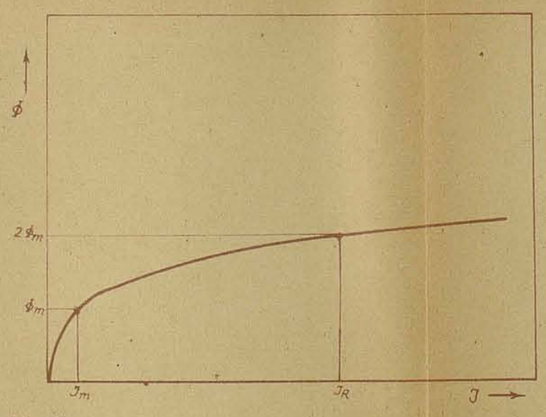


Fig. 76.

Fig. 77.

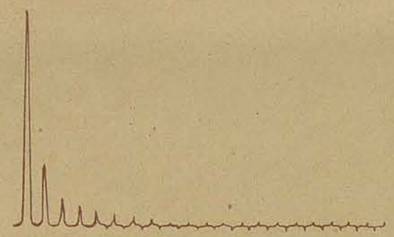


Fig. 78.

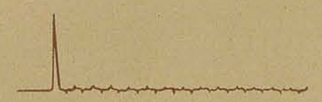


Fig 79.

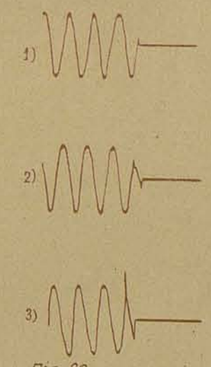


Fig. 80.

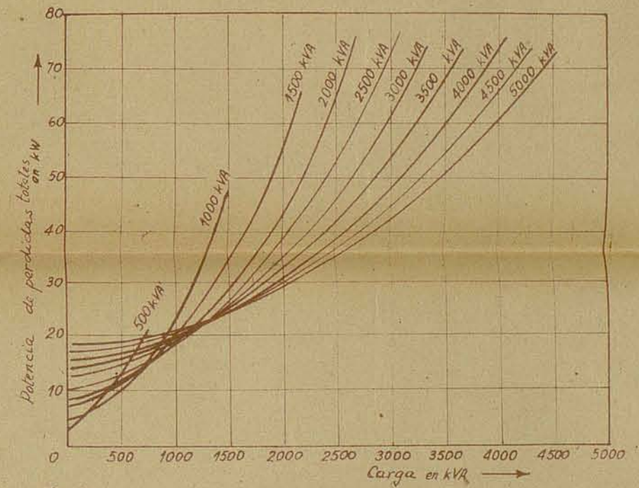


Fig. 81.

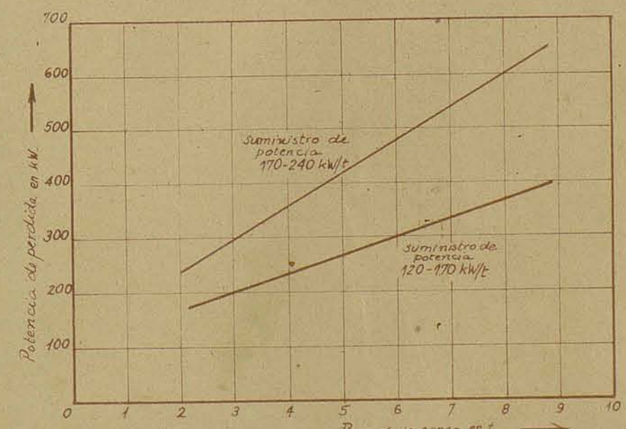


Fig. 82.

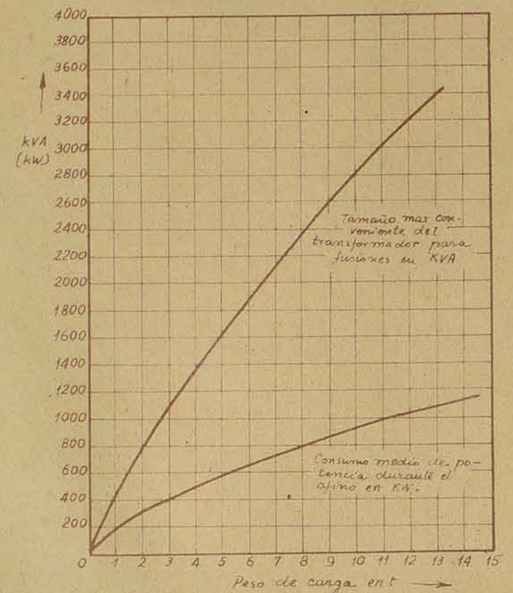


Fig 83

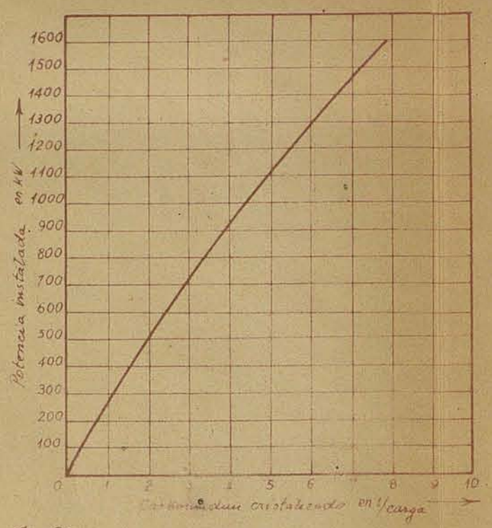


Fig 85.

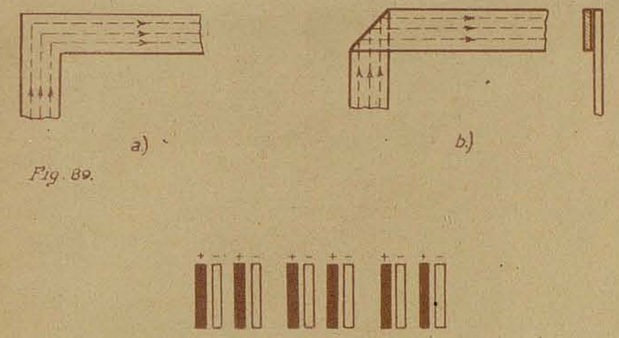


Fig. 89.

Fig 90.

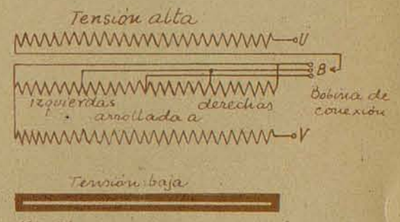


Fig 91.

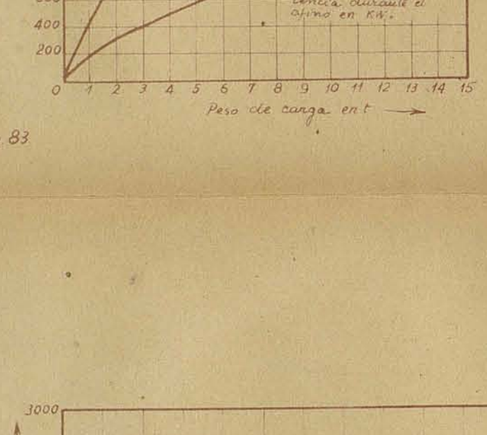


Fig 84.

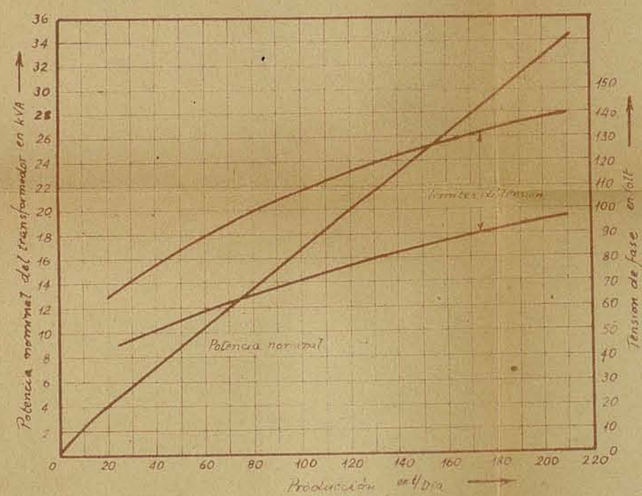


Fig. 86.

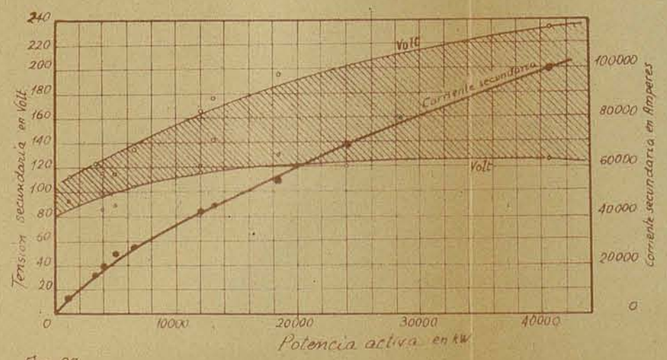


Fig 87.

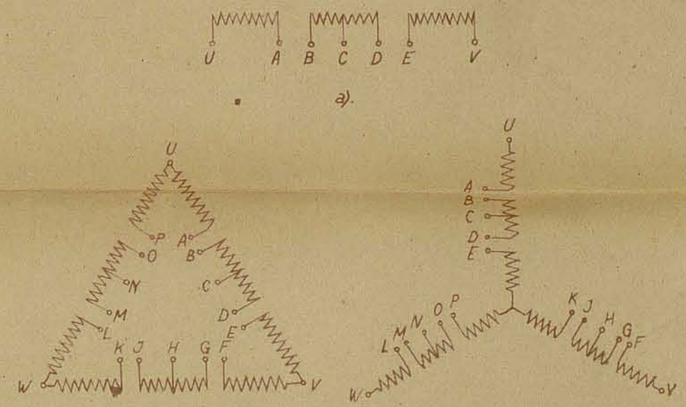


Fig. 92.

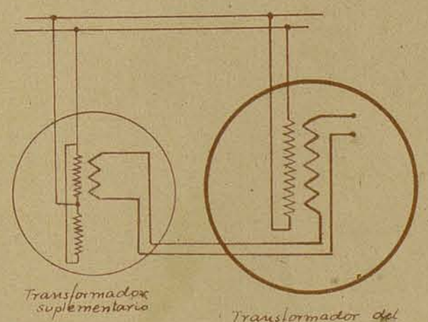


Fig. 93.

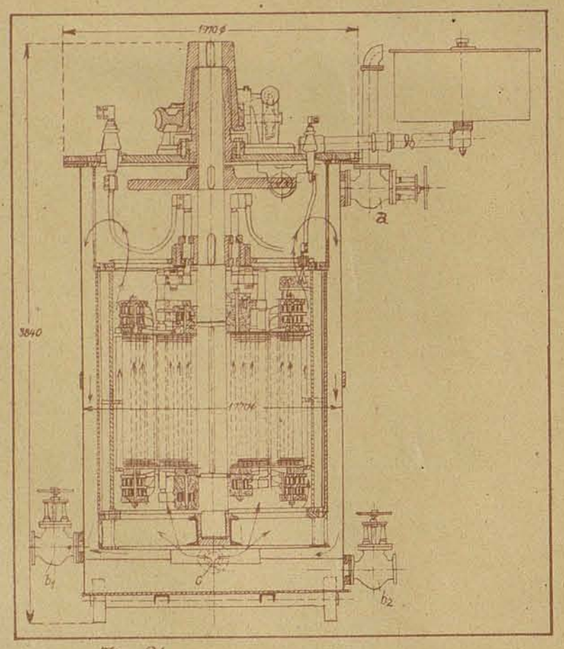


Fig. 94.
Corte de un gran transformador rotatorio

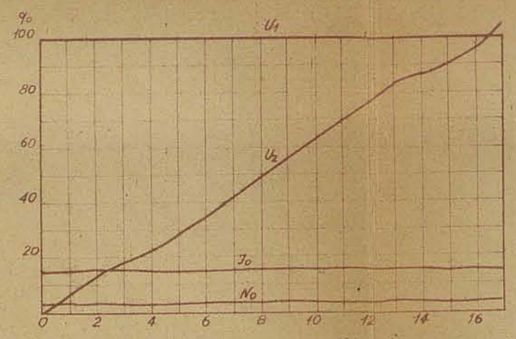


Fig. 96.

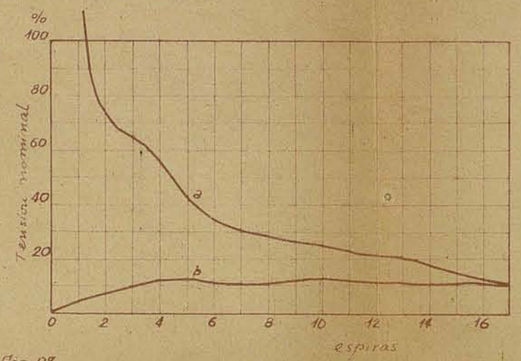


Fig. 98.

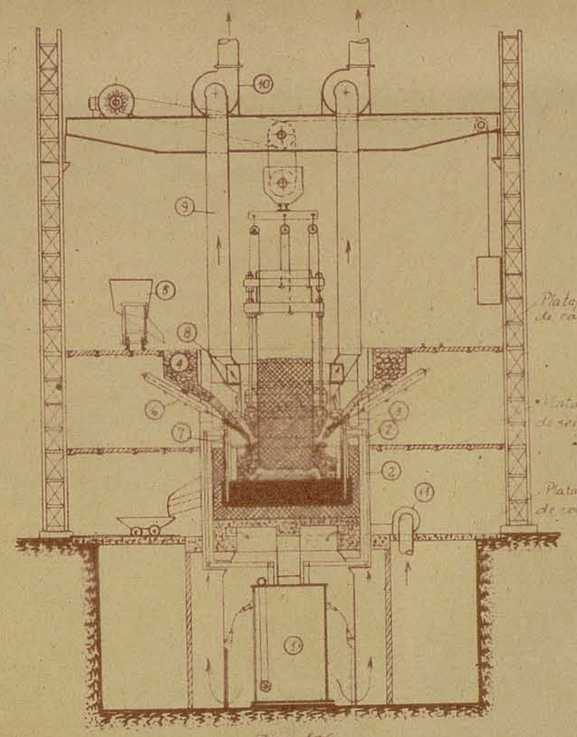


Fig. 106
Corte transversal de un Horno monofasico Miguet
Leyenda 1. Transformador; 2. conductores secundarios 3. Tomas. 4 Tolva de carga. 5 carretilla de carga. 6. Empujador hidraulico 7 Colector de gases refrigerado por agua 8 Canal anular de gases 9 Salida de gases 10 Ventilador 11. Aspirador.

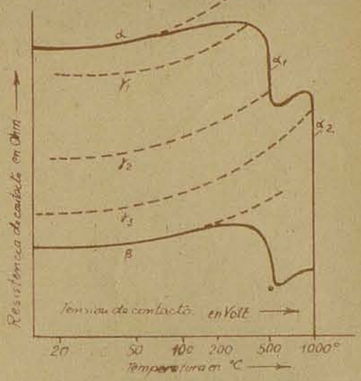


Fig. 107.

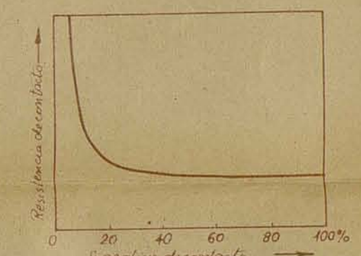


Fig. 108.

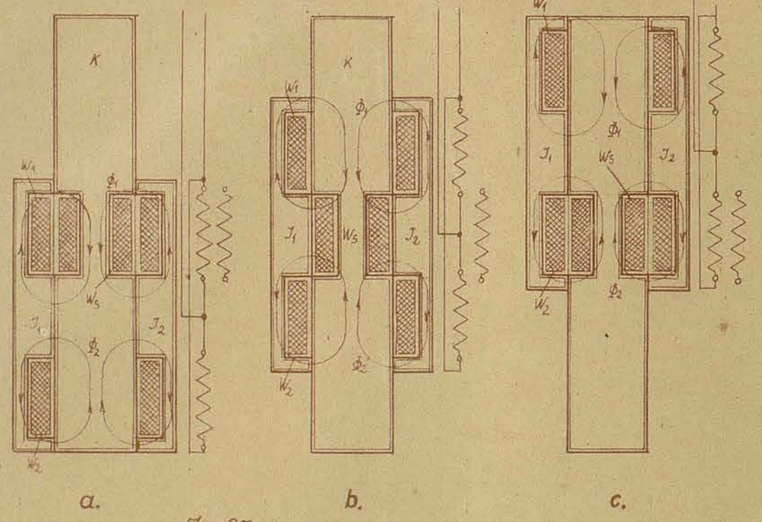


Fig. 95.

Cuadro de conexiones

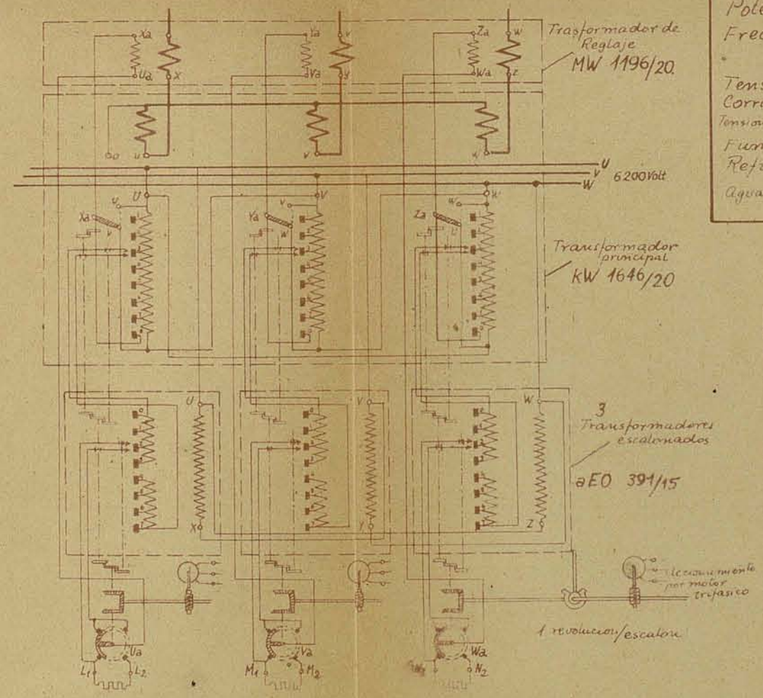


Fig. 105

Esquema de conexiones de un gran transformador de Horno para 40.000 kVA

Potencia nominal	kVA	40.000		
Frecuencia nominal	Hz	50		
		primario	secundario	
Tension nominal	V	Δ 6200	234~~86~~	anillo en vacio / estando
Corriente nominal	A	3720	100000	
Tension nominal de corto-circuito			7.5 %	
Funcionamiento tipo DB				
Refrigeracion tipo OWA				
Agua de refrigeracion 420 l/min.			Temp. de entrada 25°C	
Engrase 8200 l/min.				

Esquema de Regulacion

Alta tension			Baja - tension							
Conexion	Volt	Conexion	Conexion	Volt	Conexiones al inversor			Conexion	Posicion del inversor	Fases	Escalon
Δ	6200	UVW	λ	2333	XU	YW	ZV	UV W	1	1	111
"	"	"	"	2282					1-2	6	106
"	"	"	"	2231					2-3	3	101
"	"	"	"	2192					3	0	96
"	"	"	"	2140					3-4	5	91
"	"	"	"	2089					4	2	86
"	"	"	"	2037					5	7	81
"	"	"	"	1990					5-6	4	76
"	"	"	"	1947					6	1	71
"	"	"	"	1895					6-7	6	66
"	"	"	"	1844					7-8	3	61
"	"	"	"	1805					8	0	56
"	"	"	"	1753	XU	YW	ZV		0-1	5	51
"	"	"	"	1702						2	46
"	"	"	"	1650						7	41
"	"	"	"	1611						3	36
"	"	"	"	1560					1	1	31
"	"	"	"	1508					1-2	6	26
"	"	"	"	1457					1-3	3	21
"	"	"	"	1418					3	0	16
"	"	"	"	1366					3-4	5	11
"	"	"	"	1315					4	2	6
"	"	"	"	1264					5	7	1

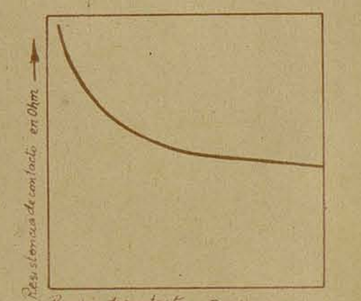


Fig. 109.

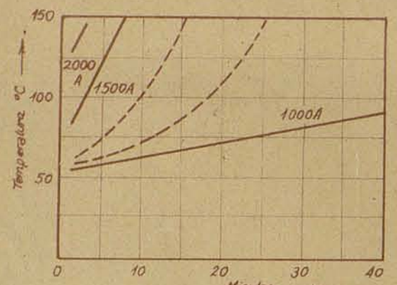


Fig. 110.

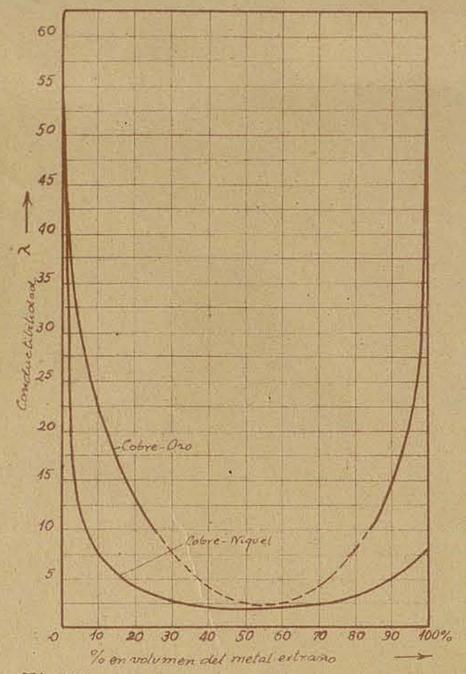


Fig. 113.

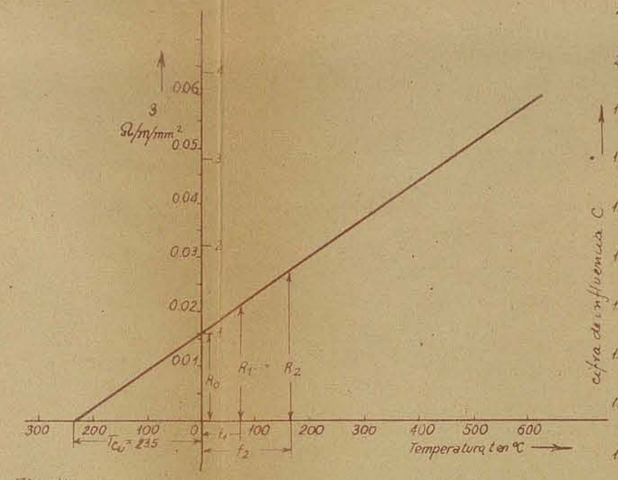


Fig. 114.

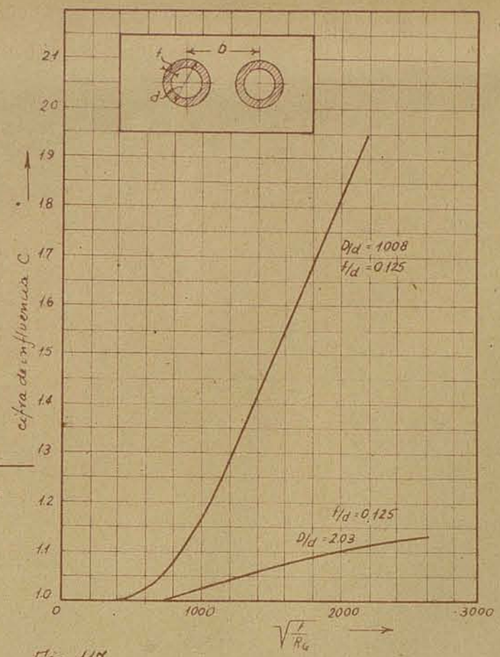


Fig. 117

Fig. 118.

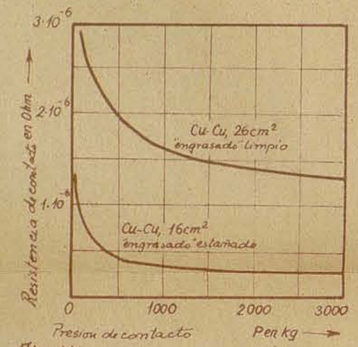


Fig. 111.

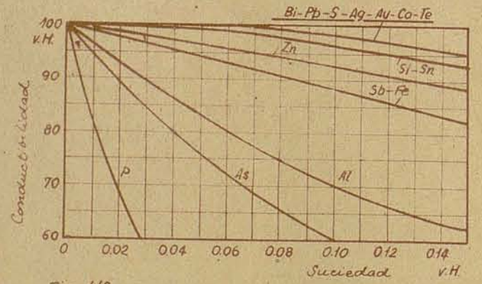


Fig. 112.

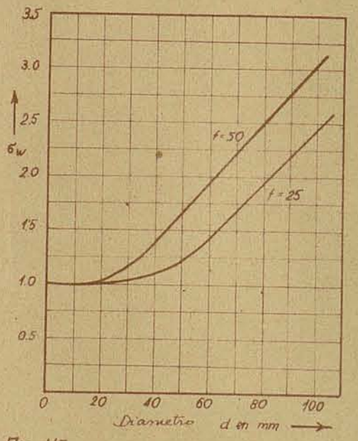


Fig. 115

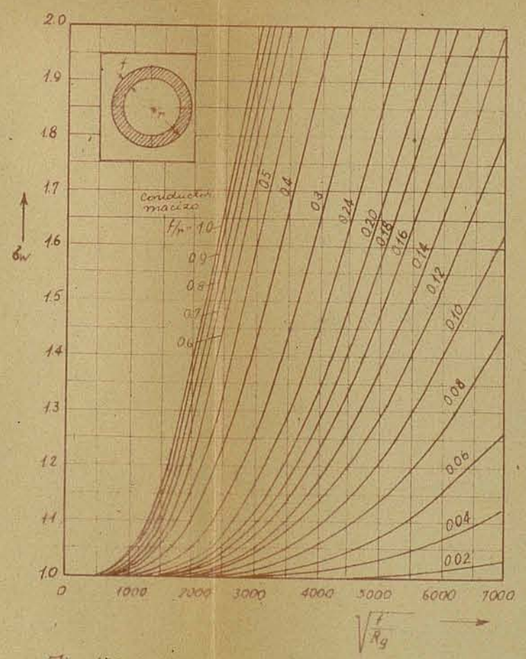


Fig. 116

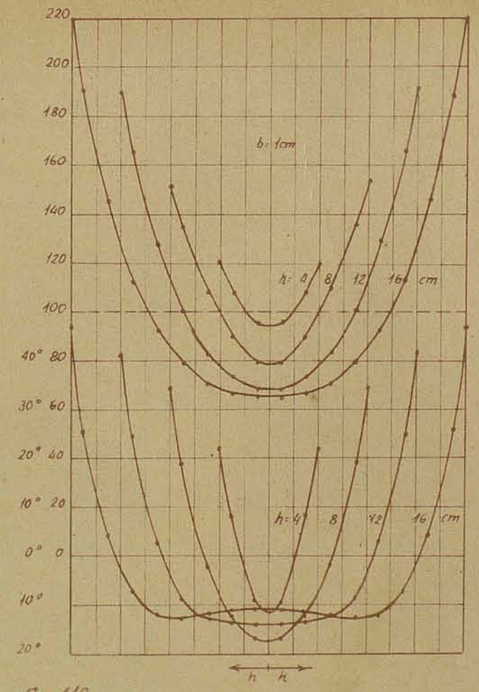


Fig. 119.

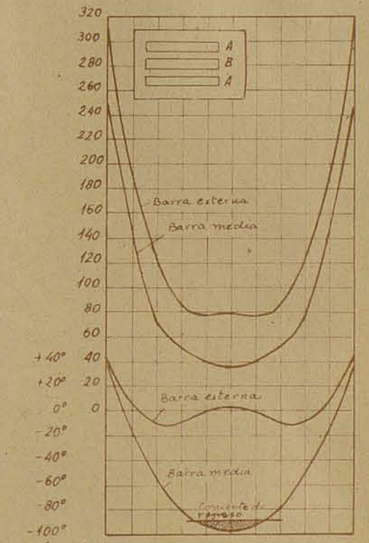


Fig. 120.

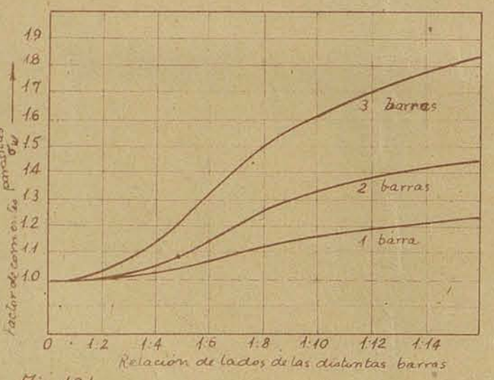


Fig. 121.

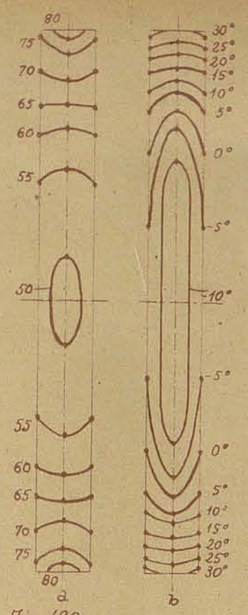


Fig. 122

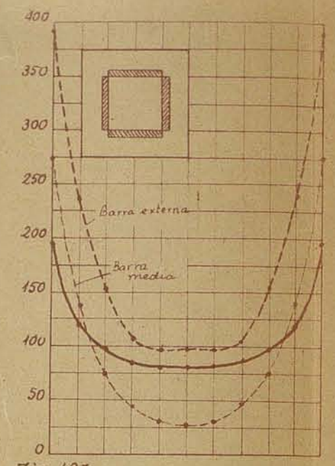


Fig. 123

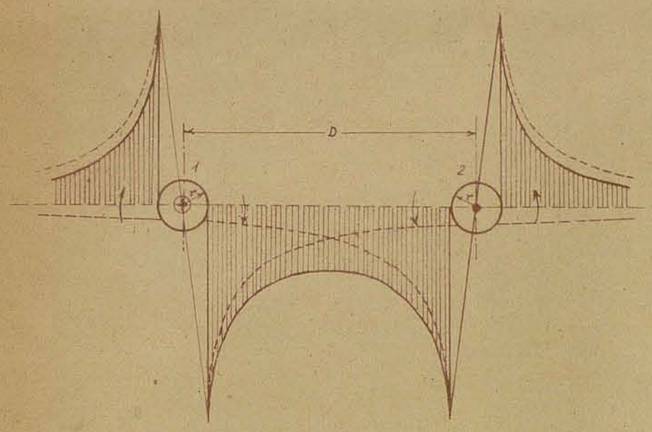


Fig. 135

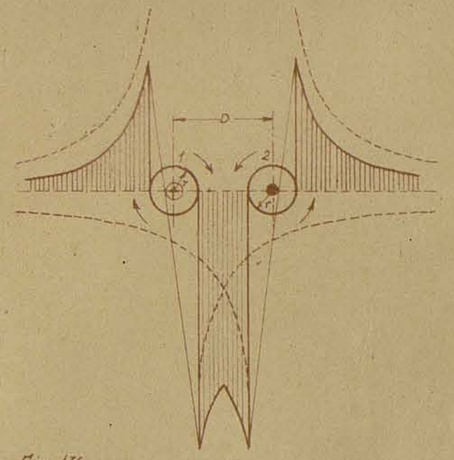


Fig. 136.

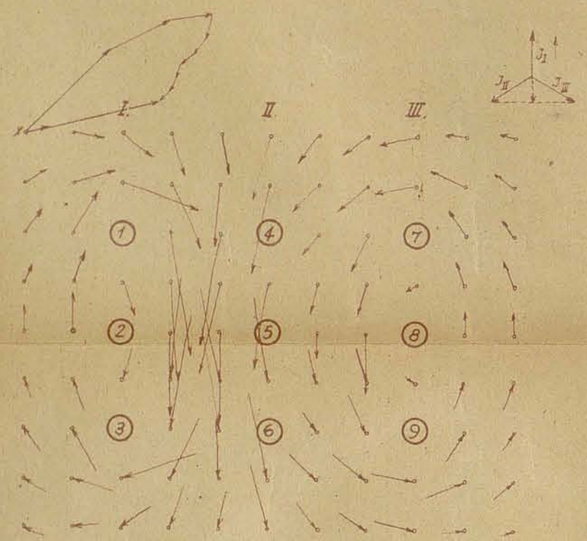


Fig. 124.

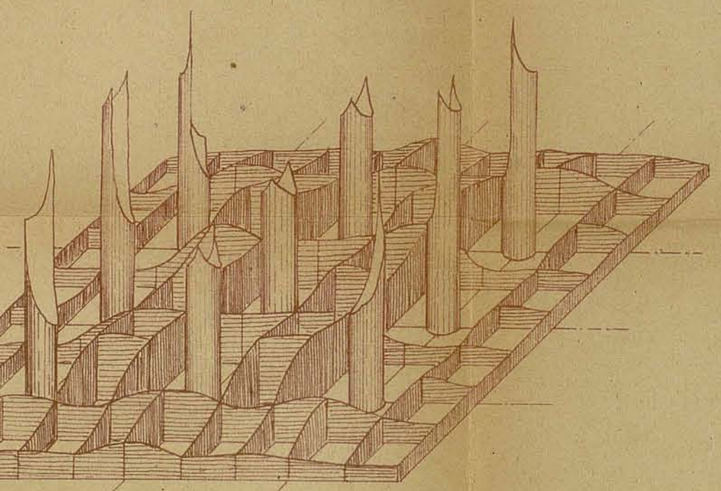


Fig. 126.

Forma del Conductor			L (Henry) %
1.	Circulo d = 1.02 m		100.0
2.	idem partido en dos en angulo recto		99.1
3.	Cuadrado. lado 0.80 m		99.2
4.	idem. dividido en dos en angulo recto		93.6
5.	Rectangulo 0.50 x 1.10 m		94.7
6.	idem dividido en dos en angulo recto		89.3
7.	Rectangulo 0.40 x 1.2 m		88.5
8.	idem partido en tres en angulo recto		81.5
9.	Triangulo equilatero lados de 1.07 m		94.0
10.	idem partido en dos en angulo recto		90.3

Fig. 137

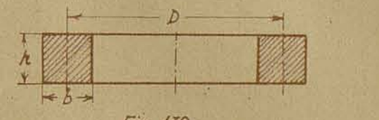


Fig. 139.

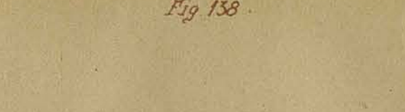


Fig. 138

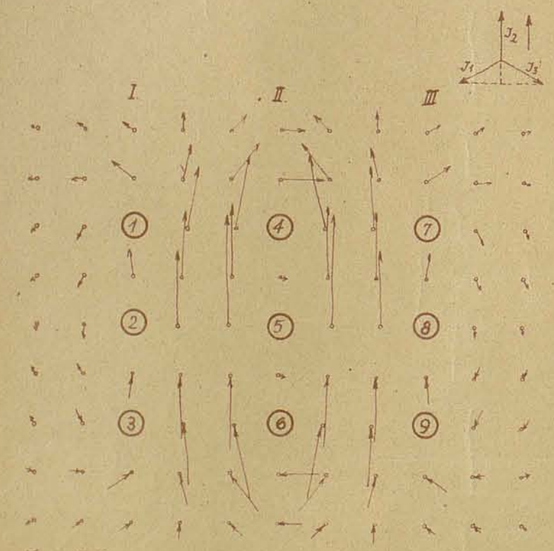


Fig. 125

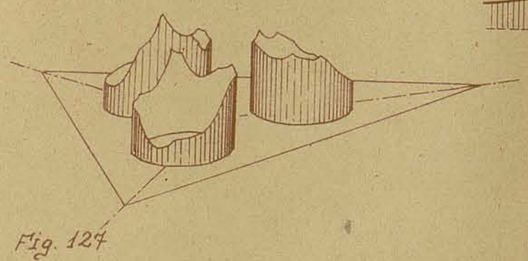


Fig. 127

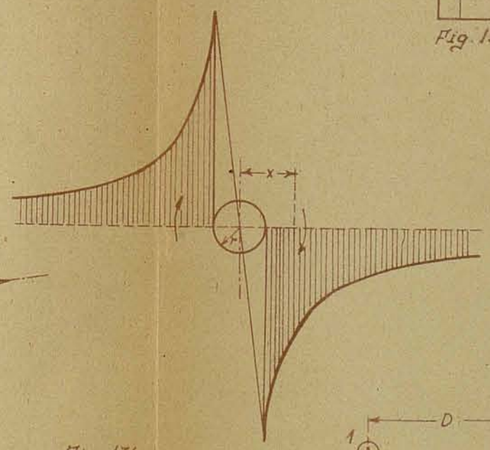


Fig. 134.

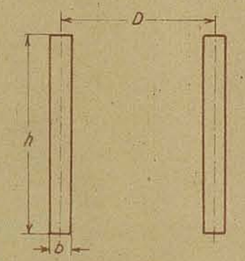


Fig. 140.

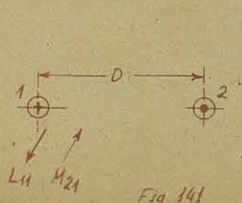


Fig. 141

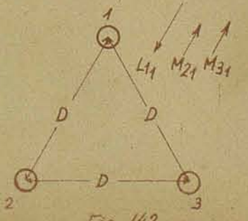


Fig. 142.

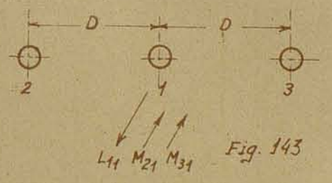


Fig. 143

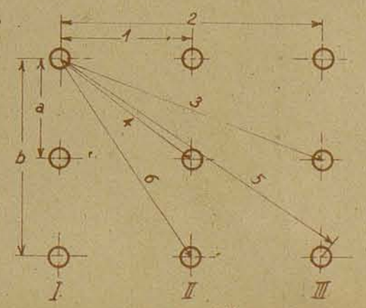
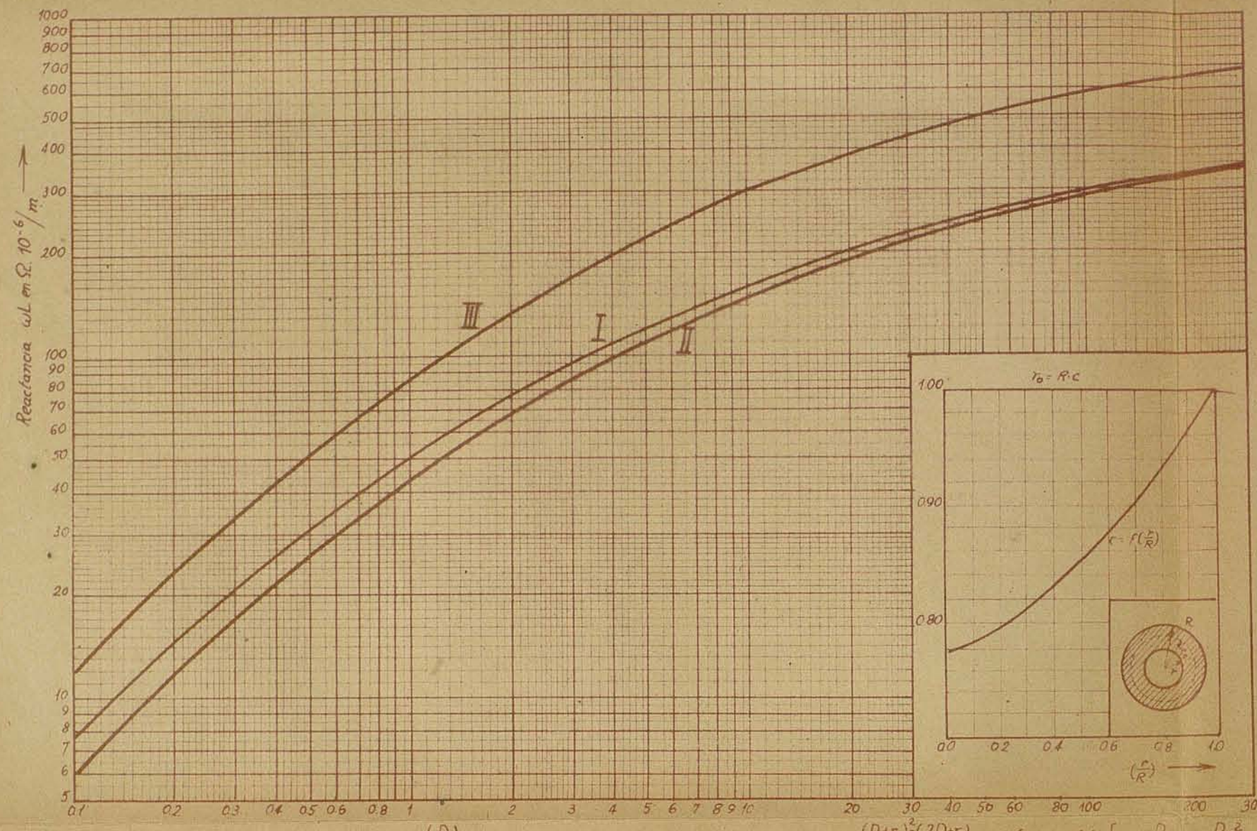


Fig. 144



$\left(\frac{D}{r_0}\right)$ ⟶ I. C. trifasica $\omega L = 48 \cdot l \cdot lg \frac{(D+r_0)^3 \cdot (2D+r_0)}{r_0^3} 10^{-6} = 48 \cdot l \cdot lg \left[1 + 4\left(\frac{D}{r_0}\right) + 5\left(\frac{D}{r_0}\right)^2 + 2\left(\frac{D}{r_0}\right)^3\right] 10^{-6} \Omega$

II C. monofasica (conductor de ida) $\omega L = 144 \cdot l \cdot lg \left(1 + \frac{D}{r_0}\right) \cdot 10^{-6} \Omega$

III C. monofasica (Conductor ida y vuelta) $\omega L = 288 \cdot l \cdot lg \left(1 + \frac{D}{r_0}\right) \cdot 10^{-6} \Omega$

D = Distancia entre conductores en cm
r_0 = Radio mag. equivalente en cm
l = Longitud del conductor en m.

Fig. 145. Tabla para el calculo de la inductividad por el metodo de corte

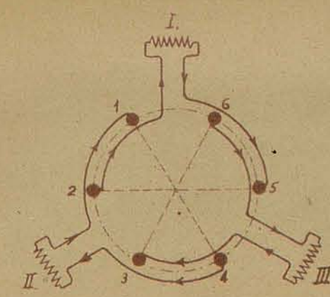


Fig. 146

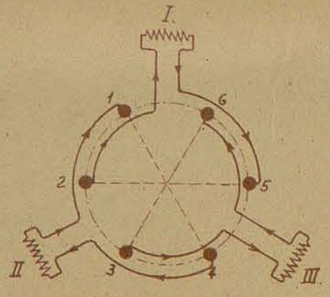


Fig. 147

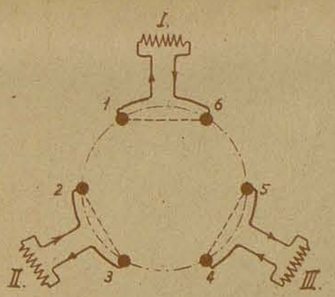


Fig. 148

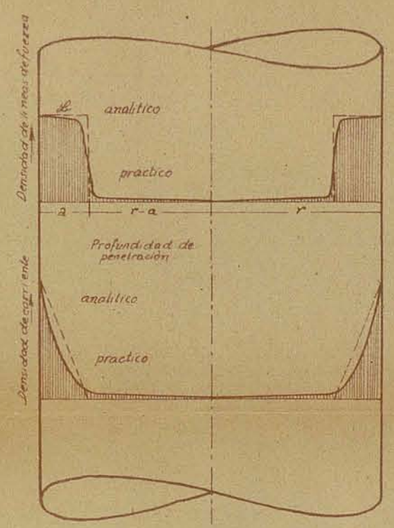


Fig. 151.

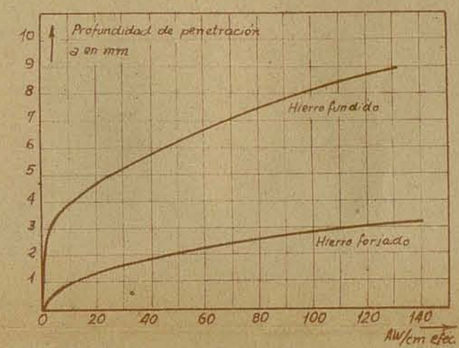


Fig. 152.

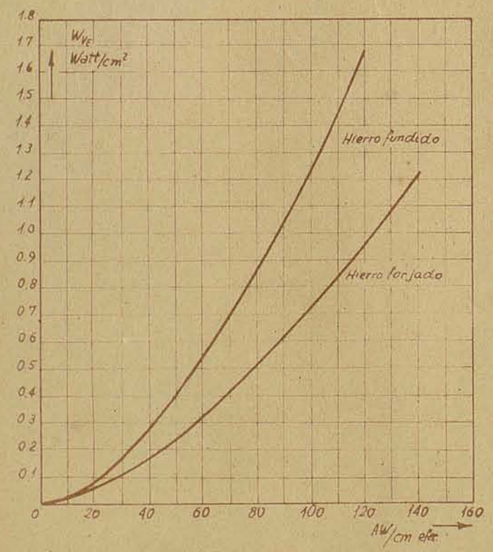


Fig. 153

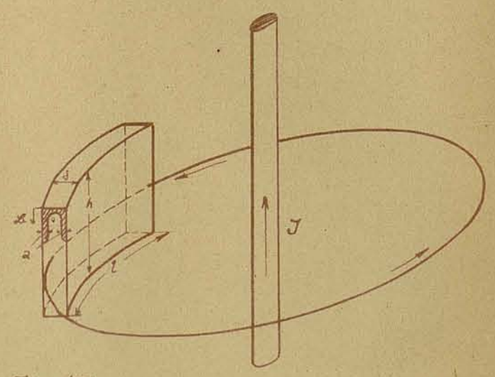


Fig. 154

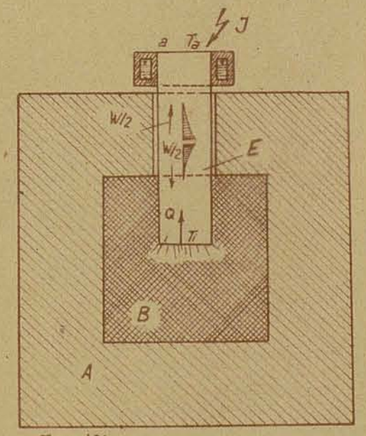


Fig. 159.

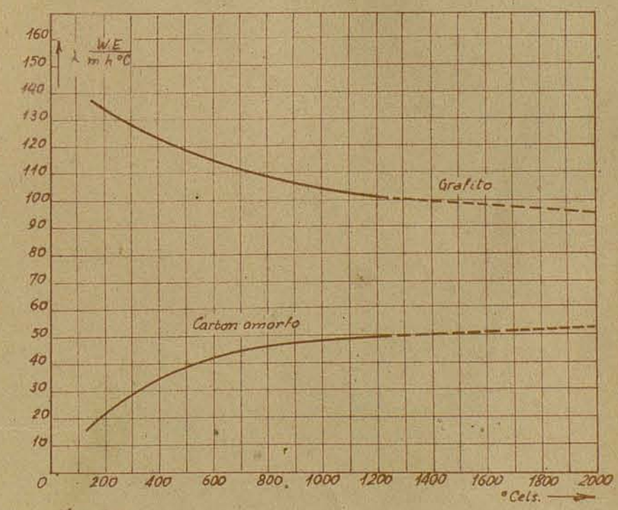


Fig. 160

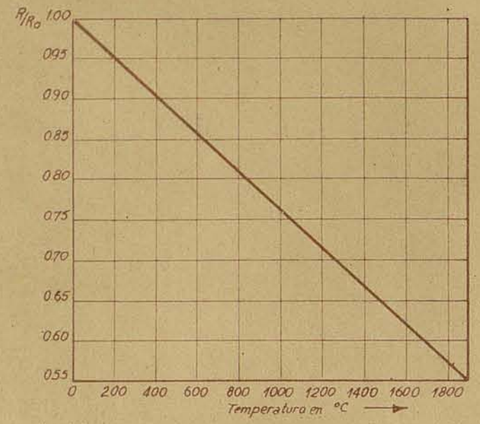


Fig. 161

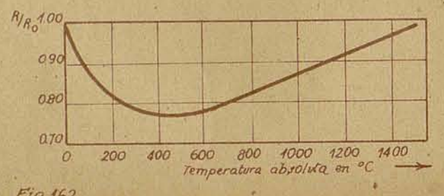
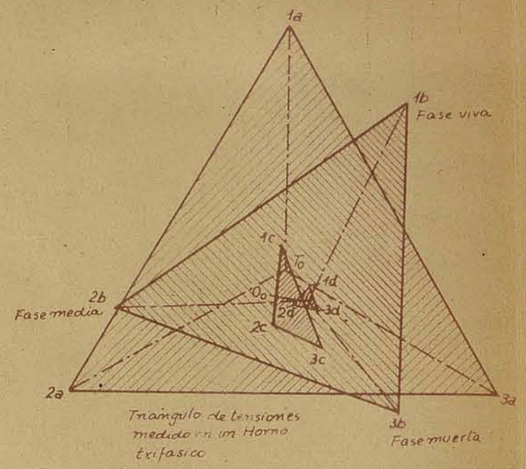


Fig. 162



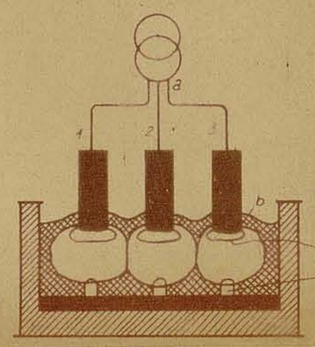


Fig. 164.

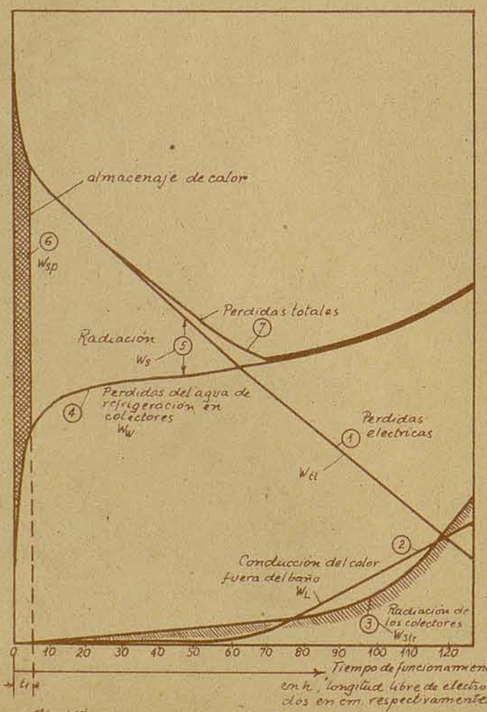


Fig. 163.

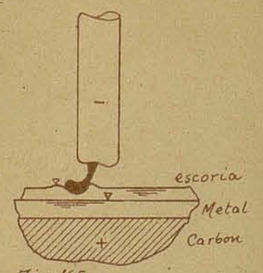


Fig. 165.
Arco normal en un Horno de metal para corriente continua (segun Kelleher)

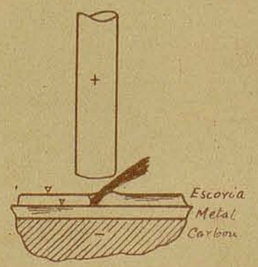


Fig. 166. Arco con polaridad falsa en un Horno como Fig. 165

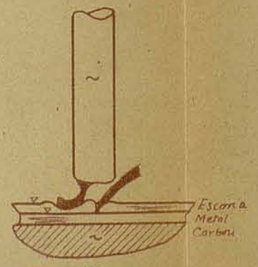


Fig. 167. Arco de c. alterna en debidas condiciones en un Horno de metal (segun Kleiner)

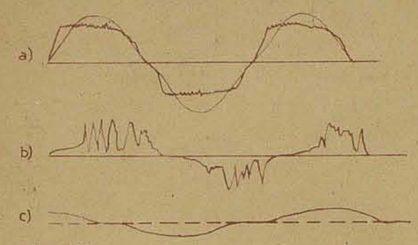


Fig. 168.

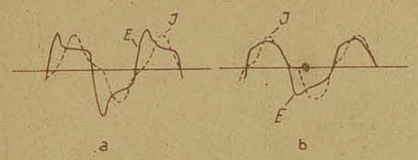


Fig. 169.

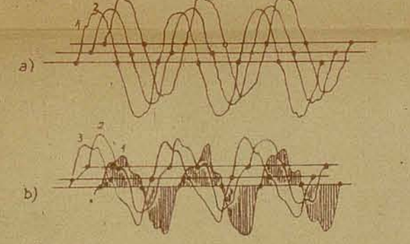


Fig. 170.

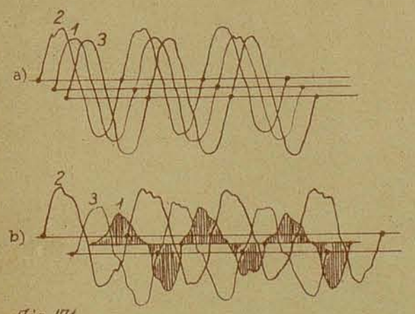


Fig. 171

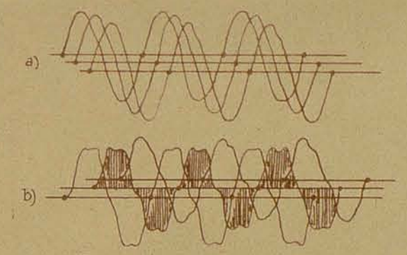


Fig. 172

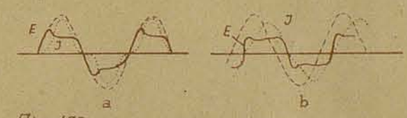


Fig. 173.

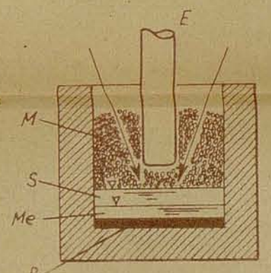


Fig. 174

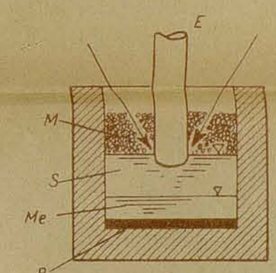


Fig. 175.

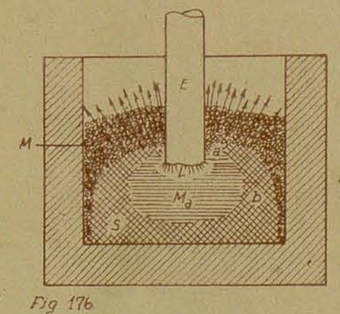


Fig. 176

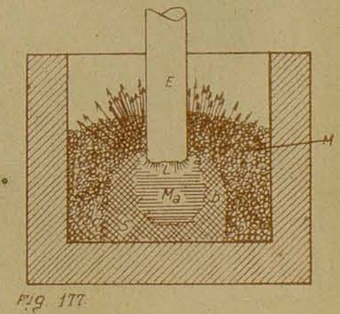


Fig. 177.

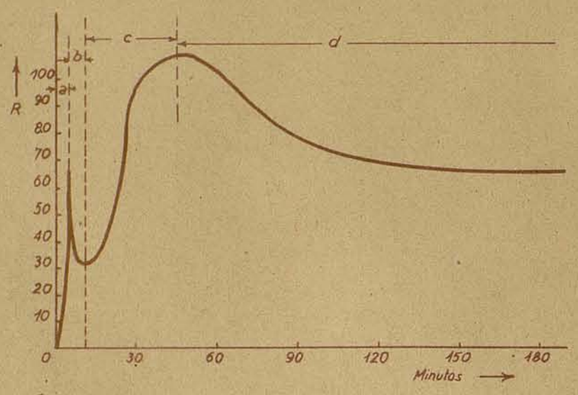


Fig 178

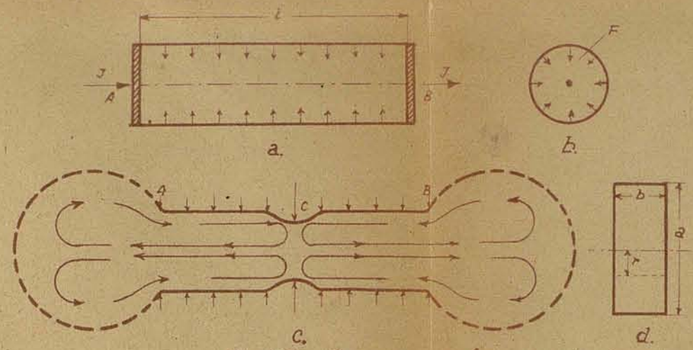


Fig 181. Fenomenos de fuerzas de la corriente

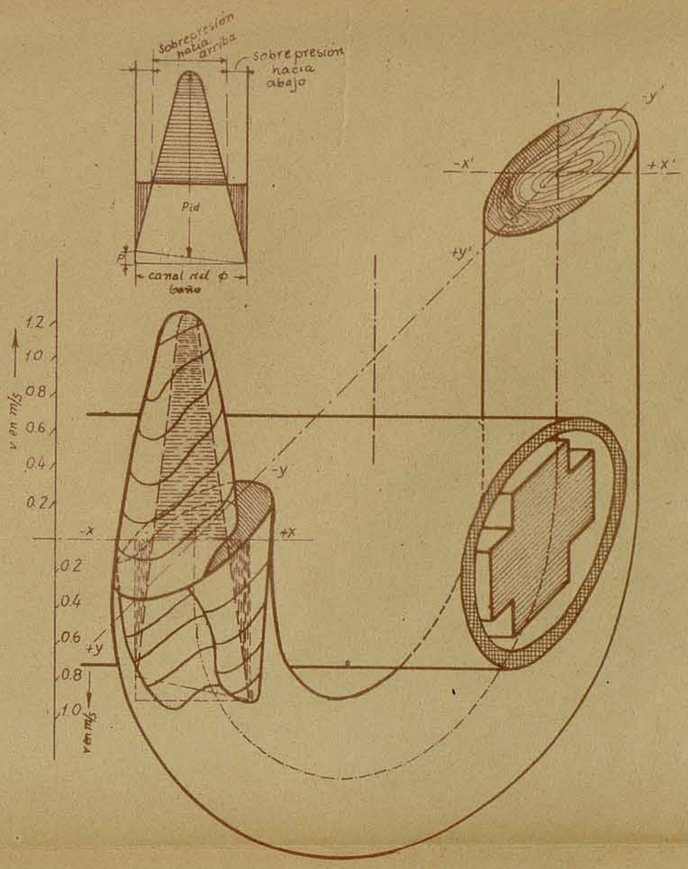


Fig 184. Grafico de corrientes en un Horno de inducción

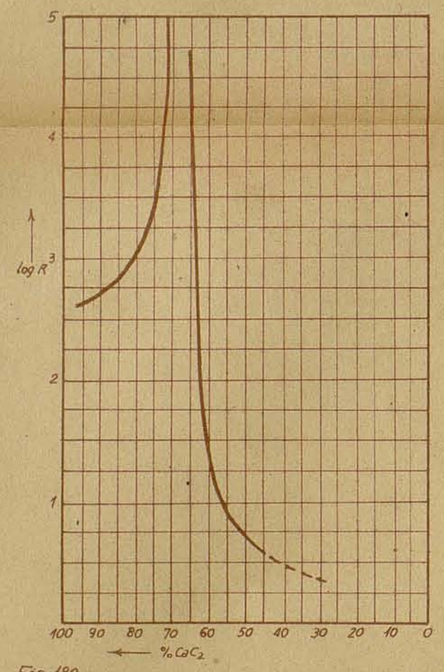


Fig 180

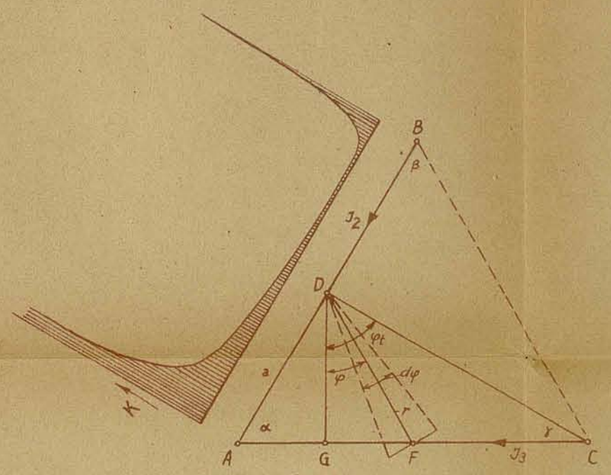


Fig 182

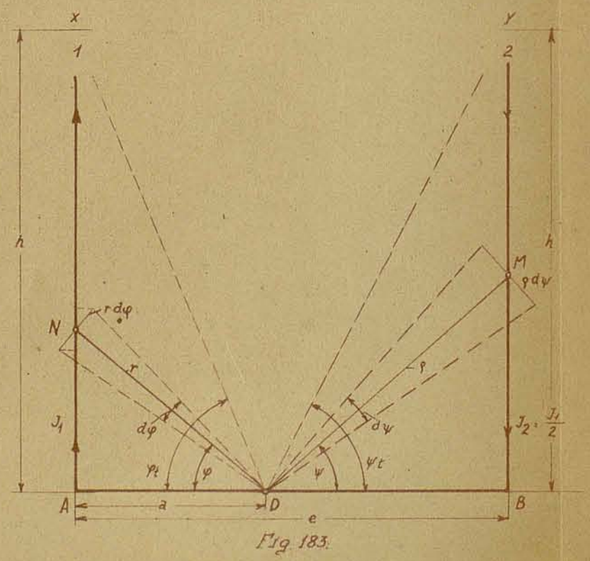


Fig 183

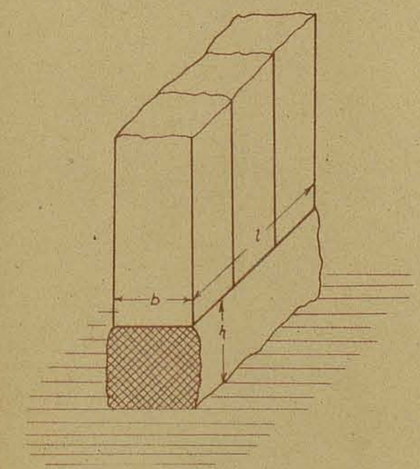


Fig 185. Volumen de baño de un electrodo rectangular.

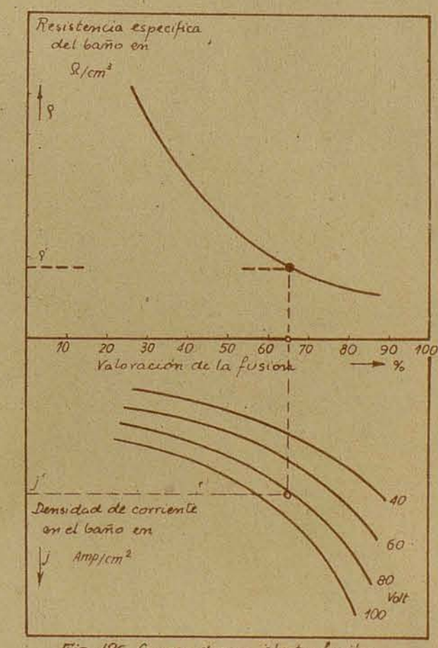
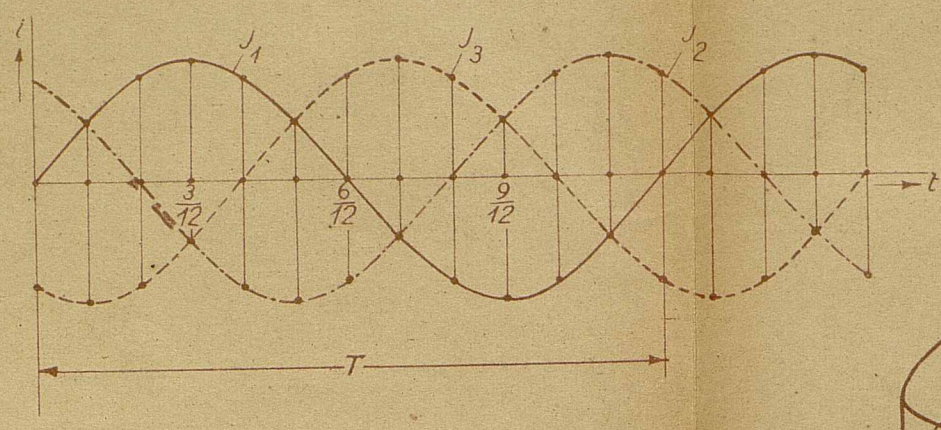
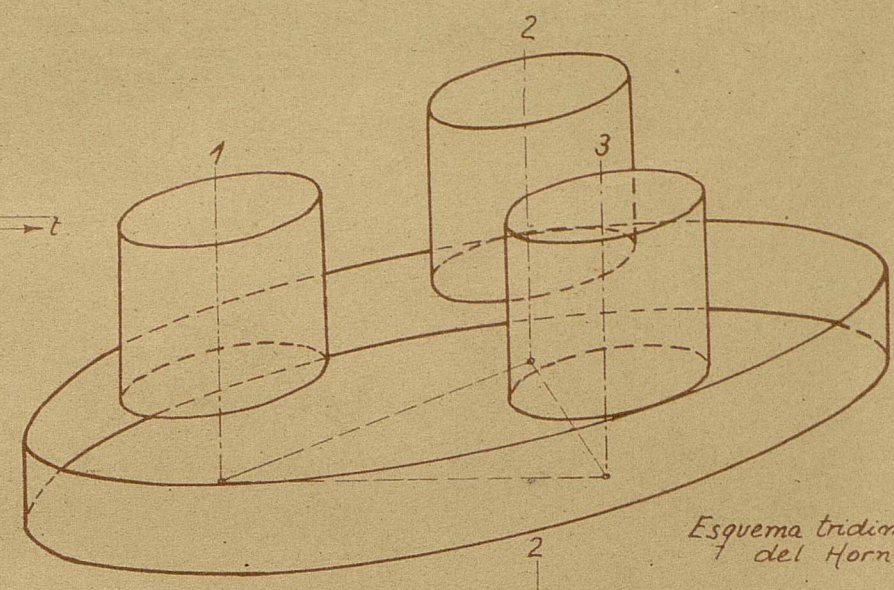
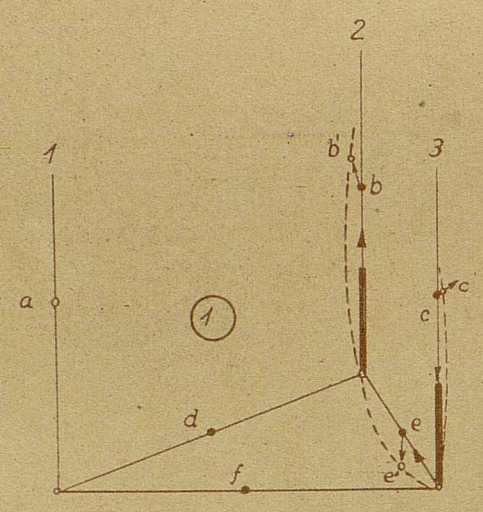


Fig 186. Curvas de una electro fusión

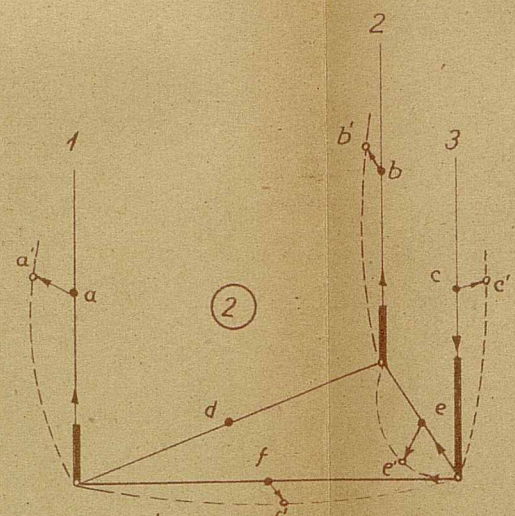




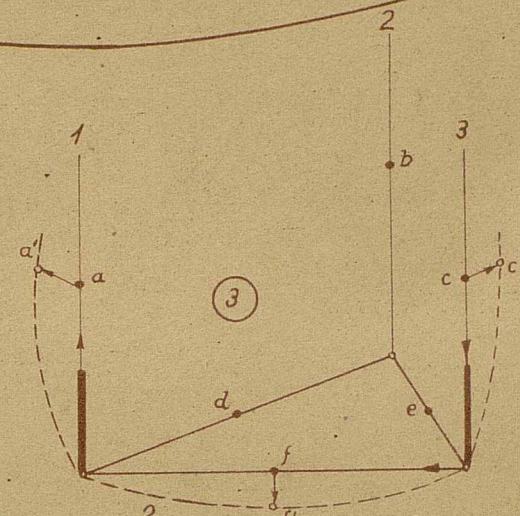
Esquema tridimensional del Horno



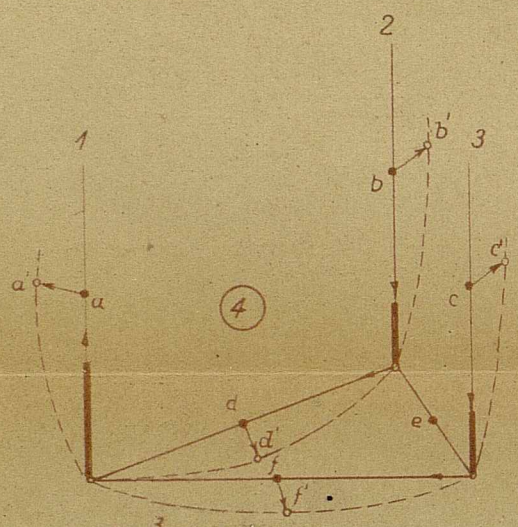
$t = 0$



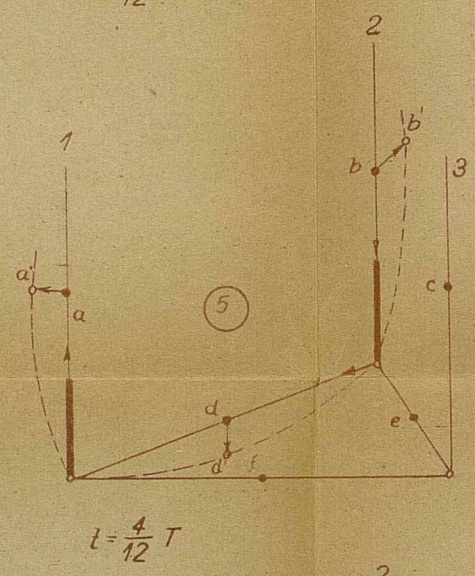
$t = \frac{1}{12} T$



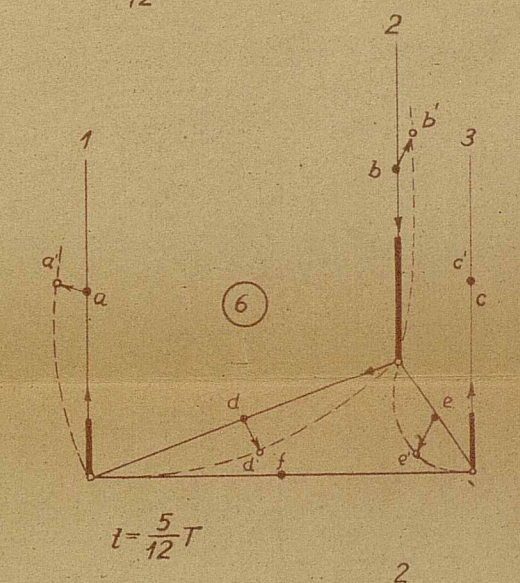
$t = \frac{2}{12} T$



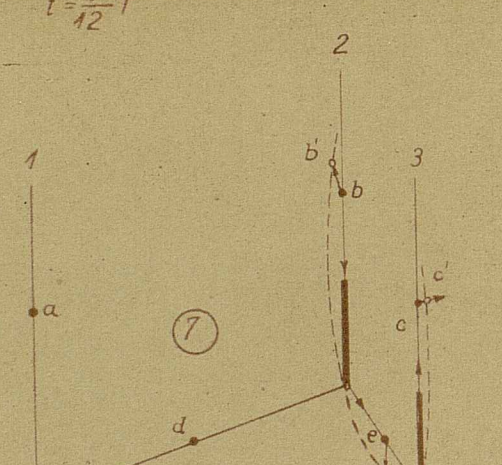
$t = \frac{3}{12} T$



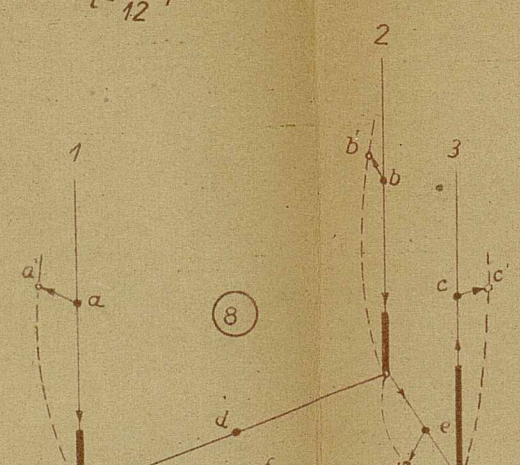
$t = \frac{4}{12} T$



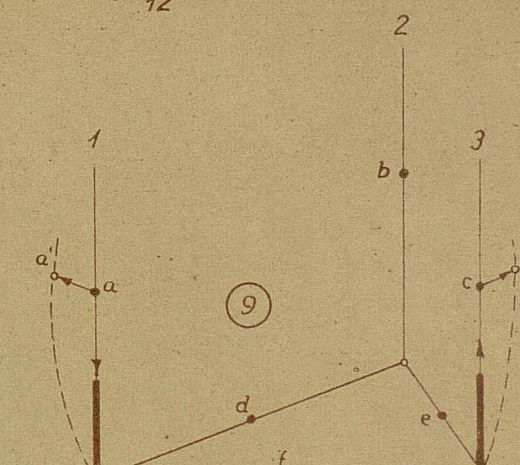
$t = \frac{5}{12} T$



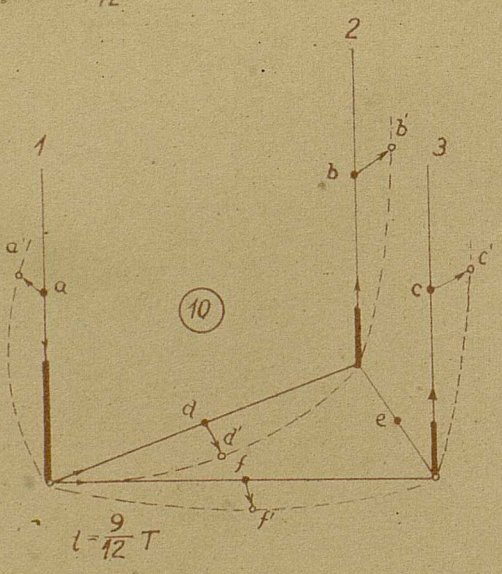
$t = \frac{6}{12} T$



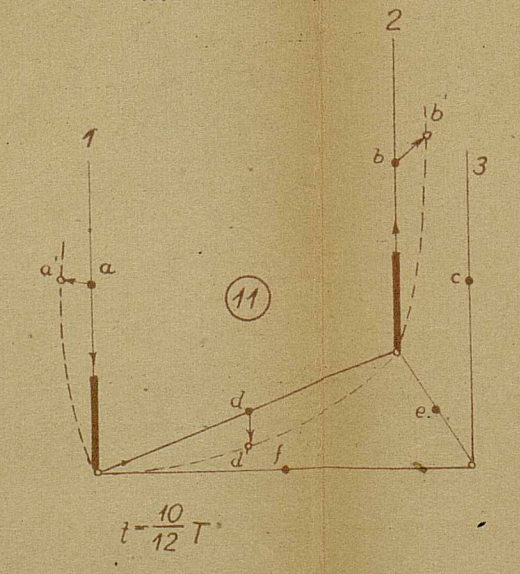
$t = \frac{7}{12} T$



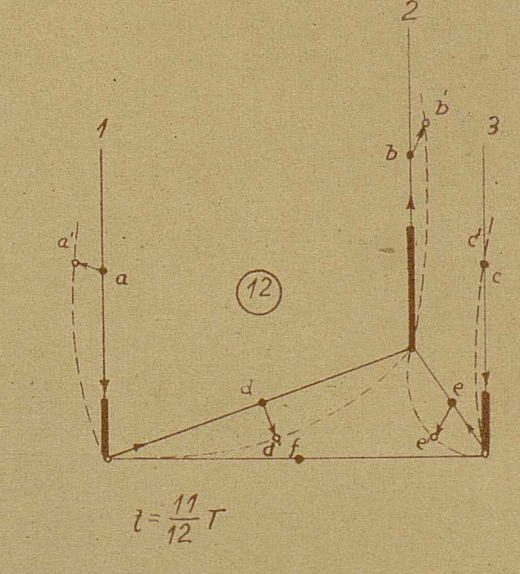
$t = \frac{8}{12} T$



$t = \frac{9}{12} T$



$t = \frac{10}{12} T$



$t = \frac{11}{12} T$

Tabla I. Marcha de corriente en Horno trifasico en las diferentes fases de un periodo.

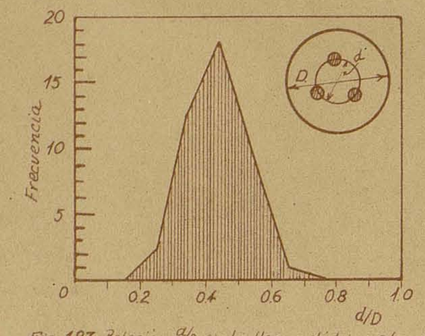


Fig. 187. Relación d/D en los Hornos electricos alemanes

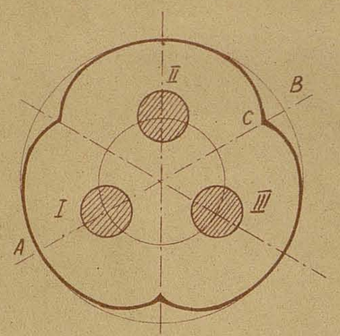


Fig. 190.

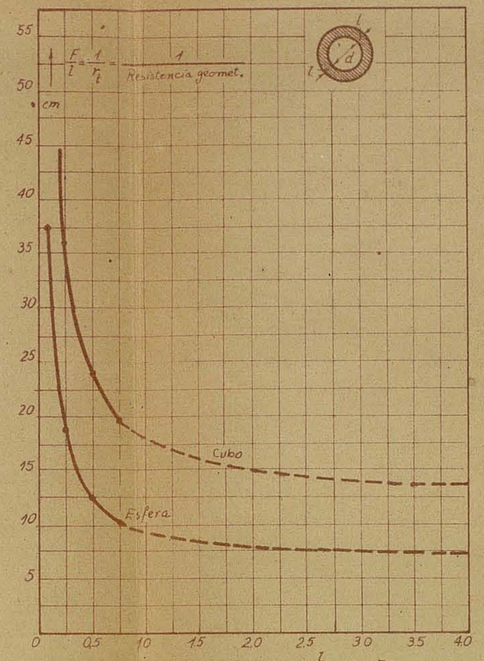


Fig. 195. "Conductibilidad geometrica" ó factor de forma para esferas huecas y cubos

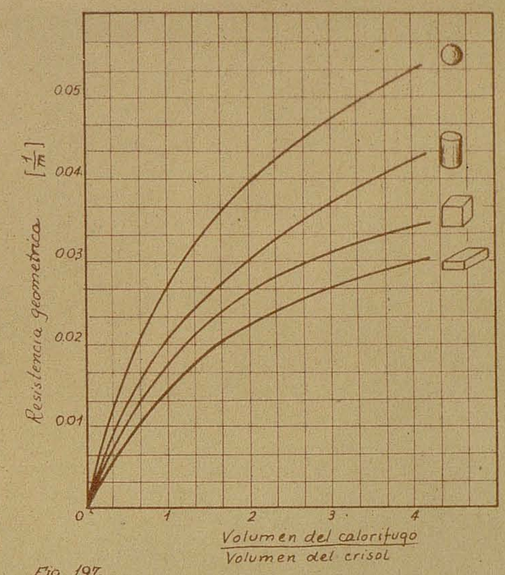


Fig. 197.

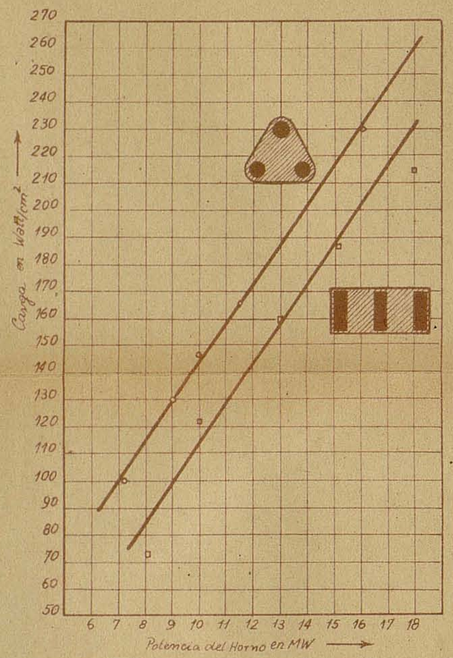


Fig. 188. Carga electrica en los Hornos de Carburo de distintas disposiciones de electrodos.

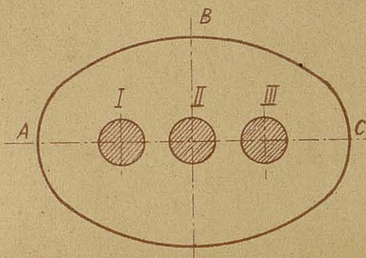


Fig. 191

Cuerpo	Volumen	Superficie
	1.00	4.83
d h	1.00	5.50
b·h·l	1.00	6.00
b·h	2/3a	1.00	6.16
2a 3a	1.00	6.68

Fig. 192
Relacion Superficie a Volumen en crisoles de distintas formas.

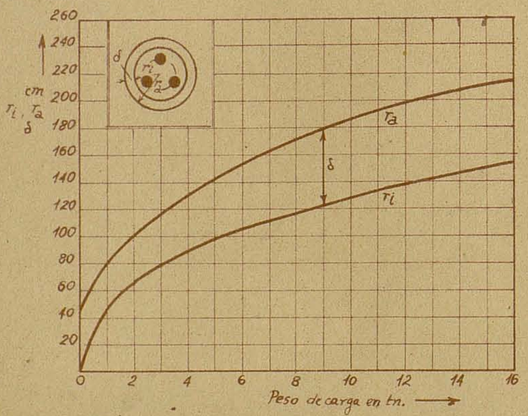


Fig. 189. Radios interno, externo y espesor de paredes

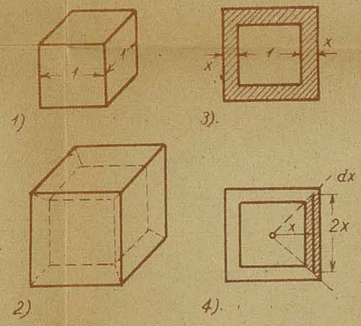


Fig 196. Determinacion de la resistencia geometrica

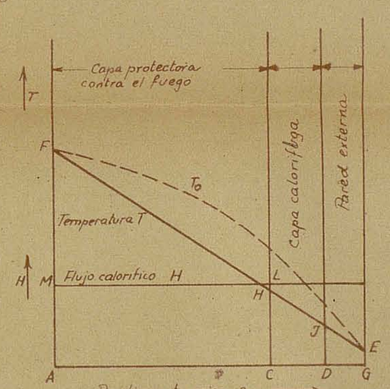


Fig 199. Esquema de la potencia termica de un Horno electrico (Kawasakiya)

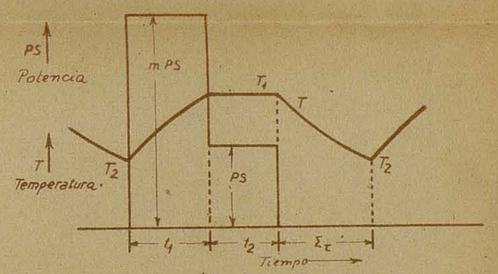


Fig. 200. Esquema termico

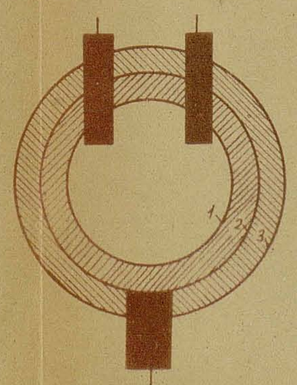


Fig 198. Crisol con paso parcial de corriente a traves del aislante termico al electrodo de solera.

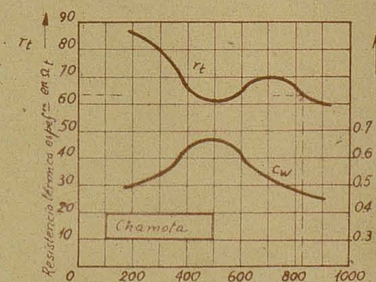


Fig. 204. Caracteristica para la chamota (Ejemplo de Kawasakiya)

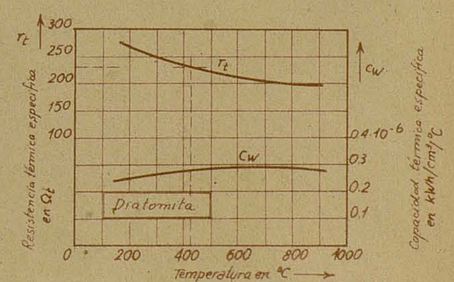


Fig. 205. Caracteristica para la diatomita (Referente al ejemplo de Kawasakiya)

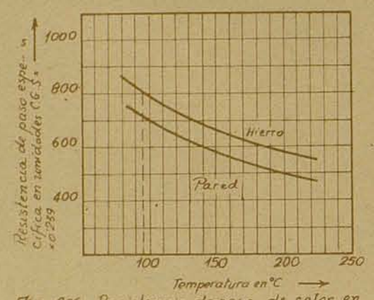


Fig. 206. Resistencia de paso de calor en superficies, según Kawasakiya

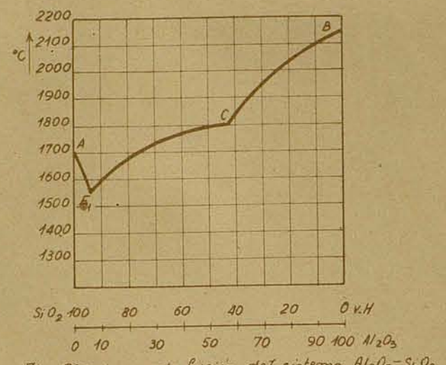


Fig. 209. Línea de fusión del sistema Al_2O_3–SiO_2

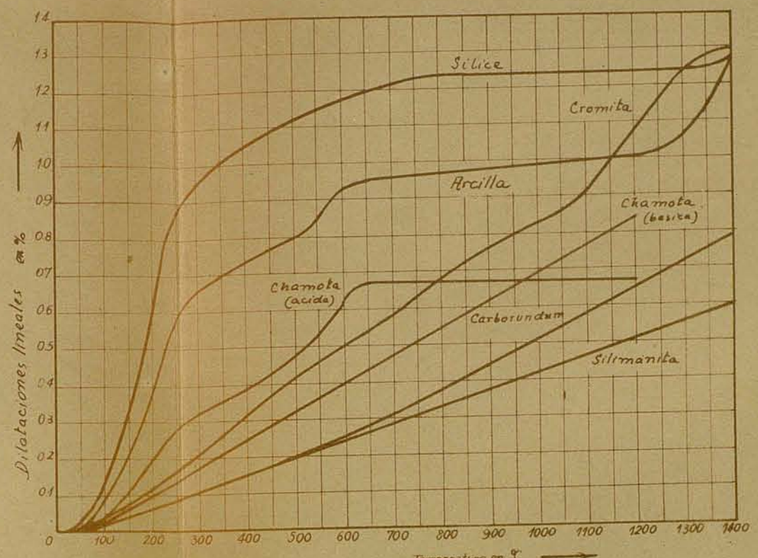


Fig 210. Dilatación térmica de los refractarios

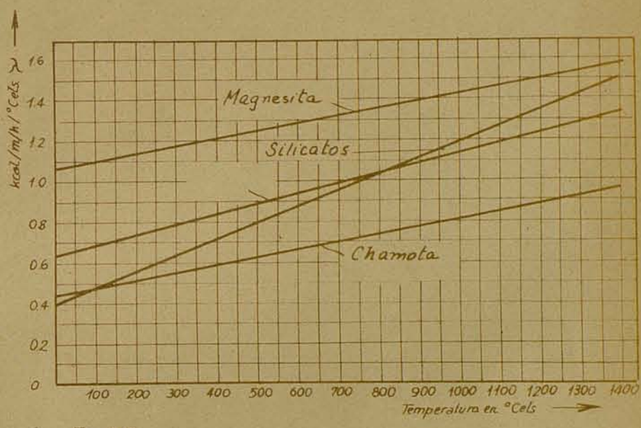


Fig. 212.

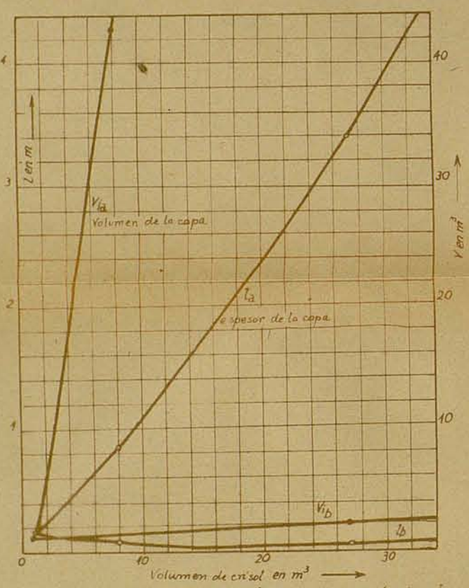


Fig. 207. Volumen V_l y espesor l de la capa aislante al variar el volumen de crisol cúbico
a) Pérdidas constante absolutas de calor
b) » » por m³ de volumen de crisol

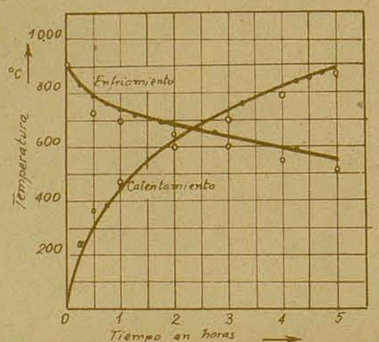


Fig. 208. Calentamiento y enfriamiento de un horno según valores teóricos y experimentales

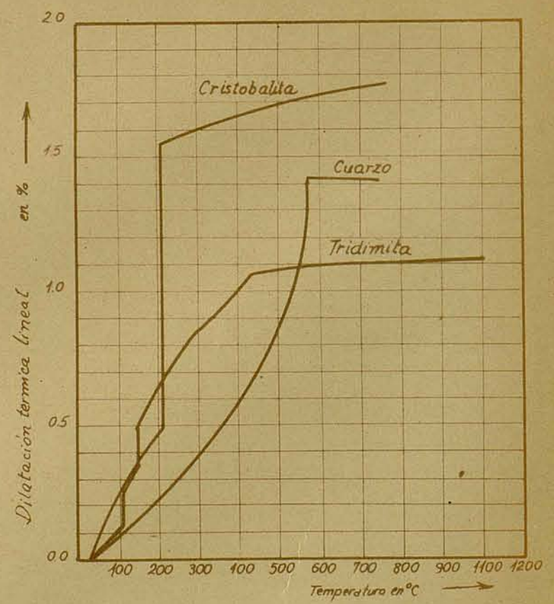


Fig. 211.

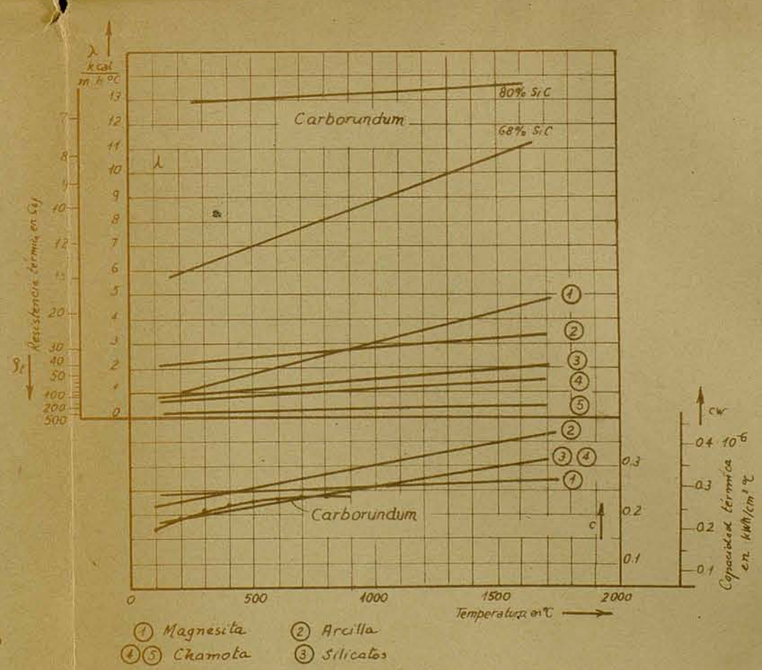


Fig. 213 Cifras características de refractarios.

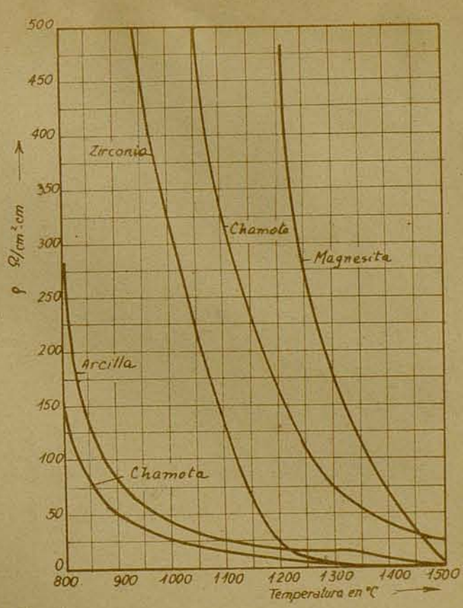


Fig. 215

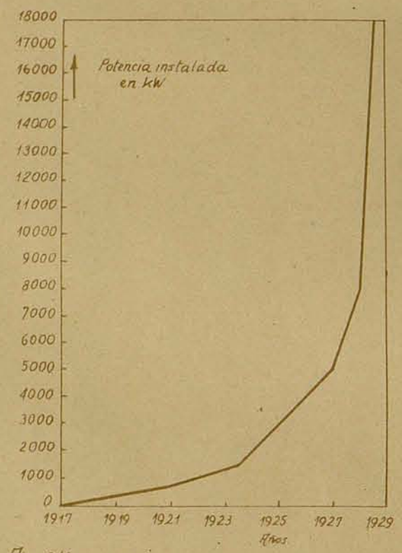


Fig. 216.

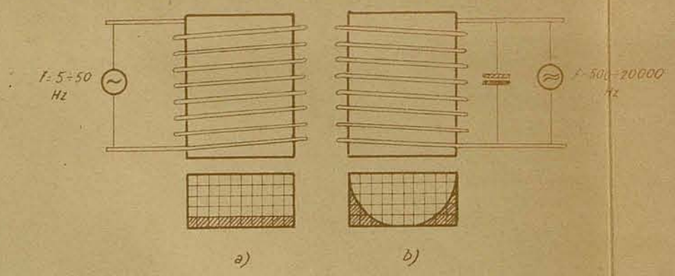


Fig. 220.

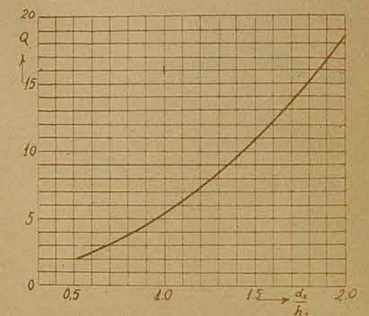


Fig. 222.

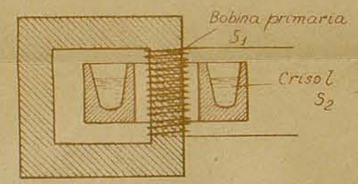


Fig. 217.

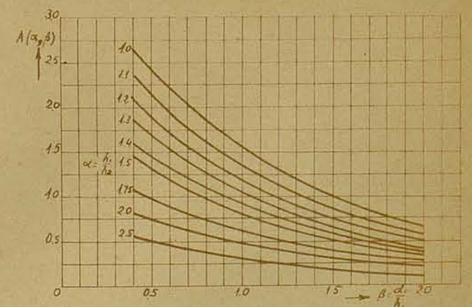


Fig. 223.

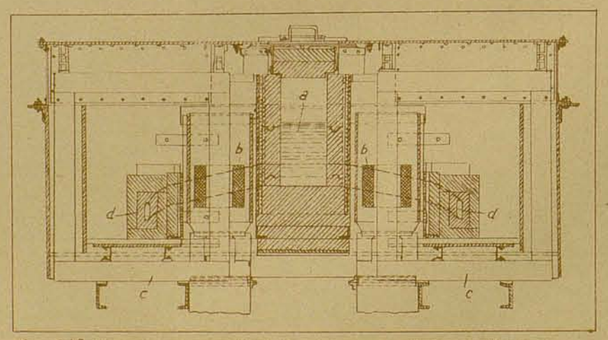


Fig. 218. Horno de inducción de baja frecuencia para refusión de aleaciones
a = crisol central b = bobina primaria C = nucleo de hierro d = anillo secundario

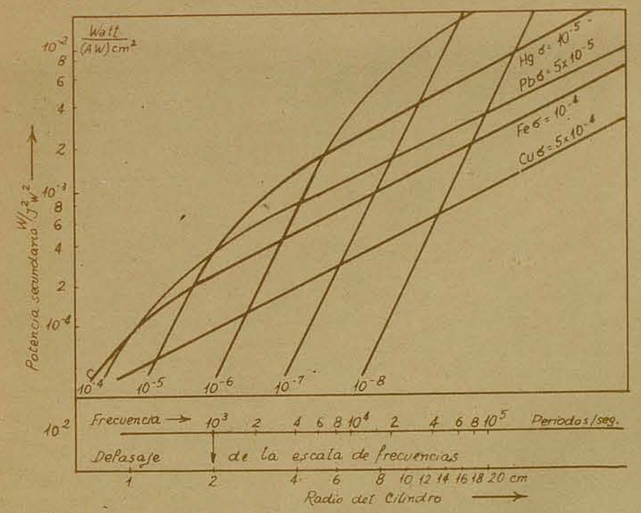


Fig. 224.

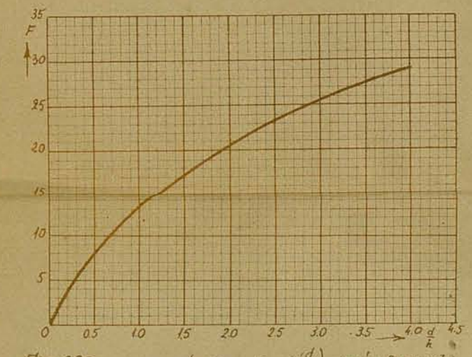


Fig. 225. Función $F = f\left(\frac{d}{h}\right)$. (Según Esmarch.)

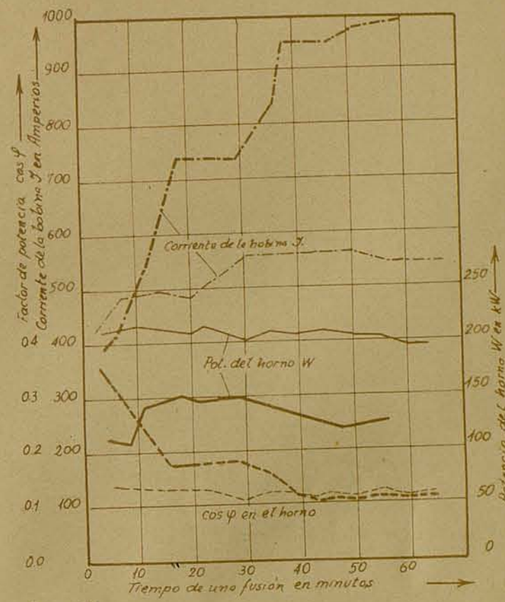


Fig. 227.

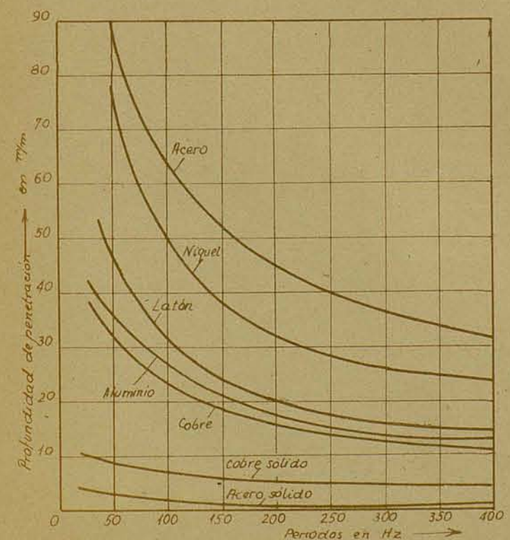


Fig. 226

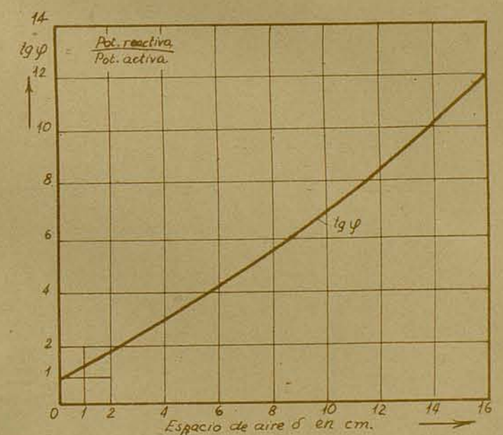


Fig. 228.

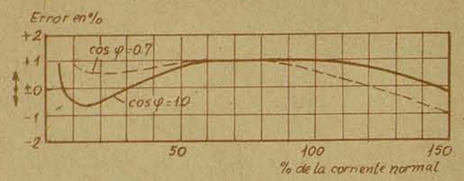


Fig. 229.

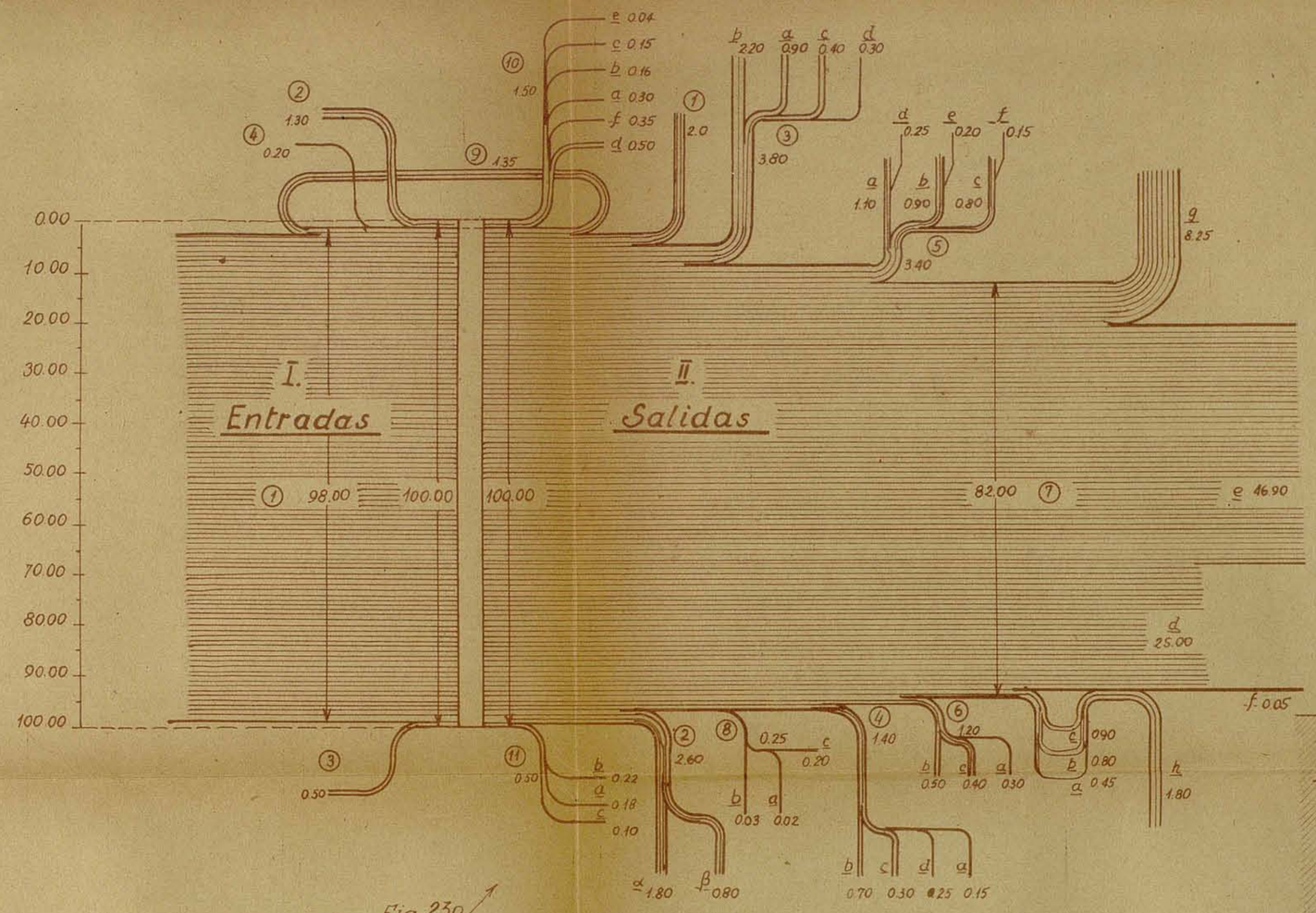


Fig. 230

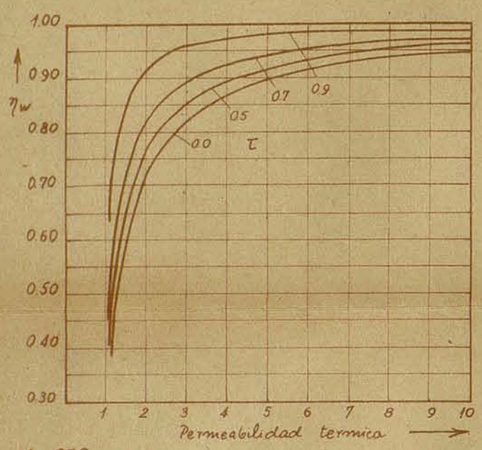


Fig. 232

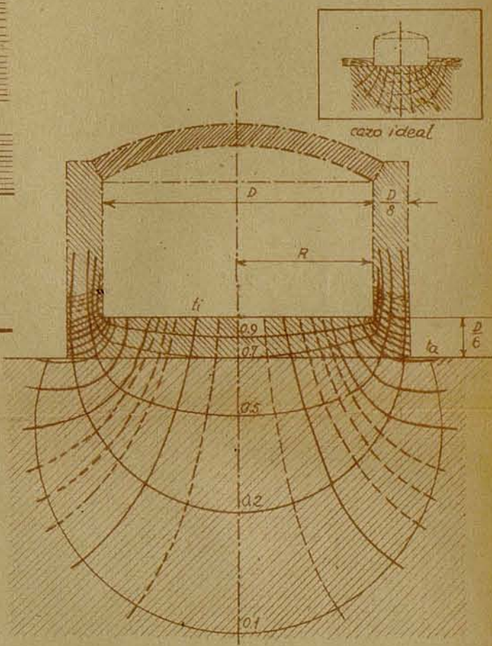


Fig. 234.

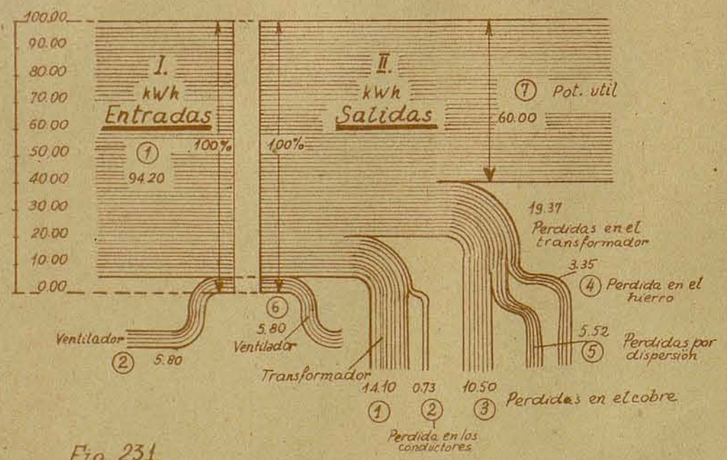


Fig. 231.

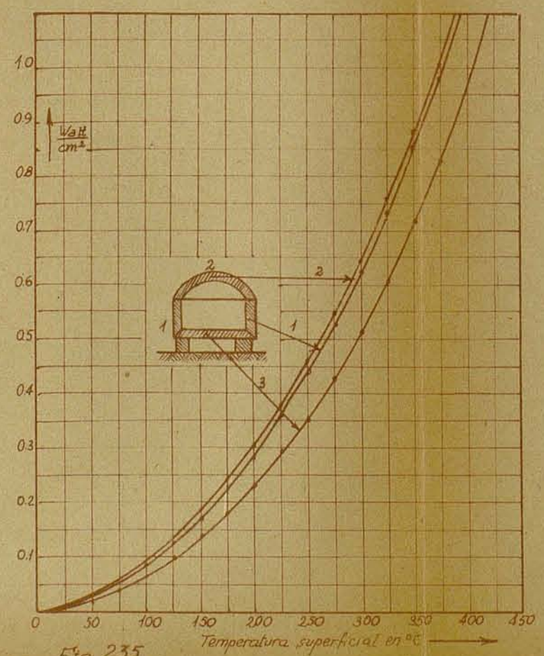


Fig. 235

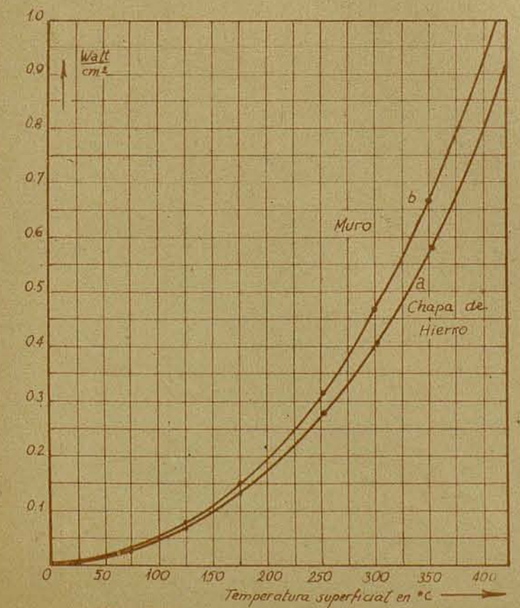


Fig. 236

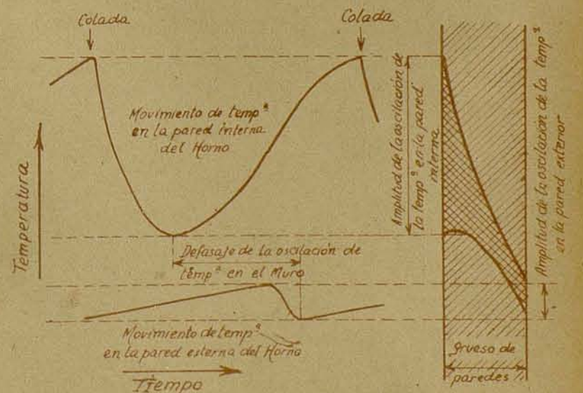


Fig. 233.

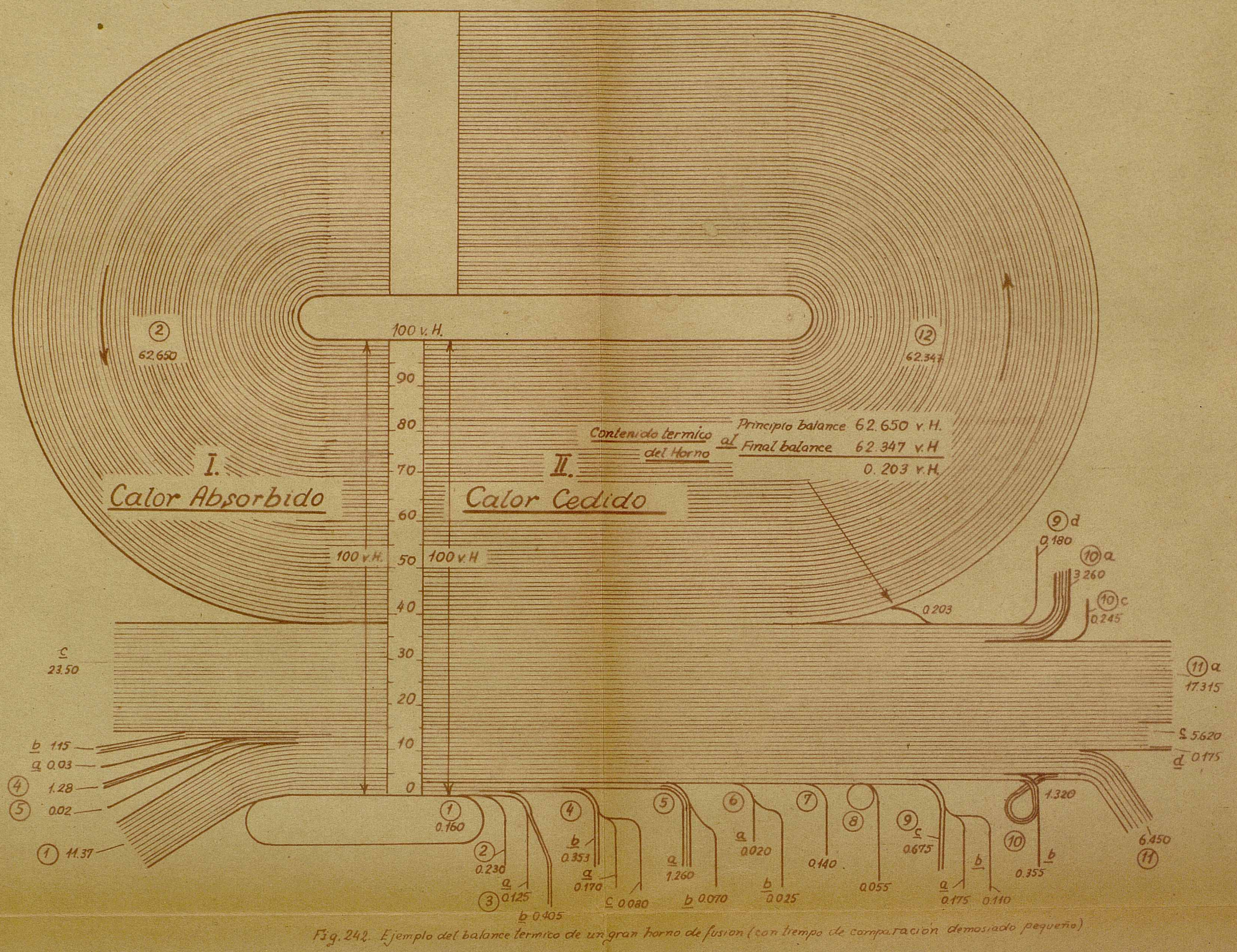


Fig. 242. Ejemplo del balance termico de un gran horno de fusion (con trempo de comparacion demasiado pequeño)

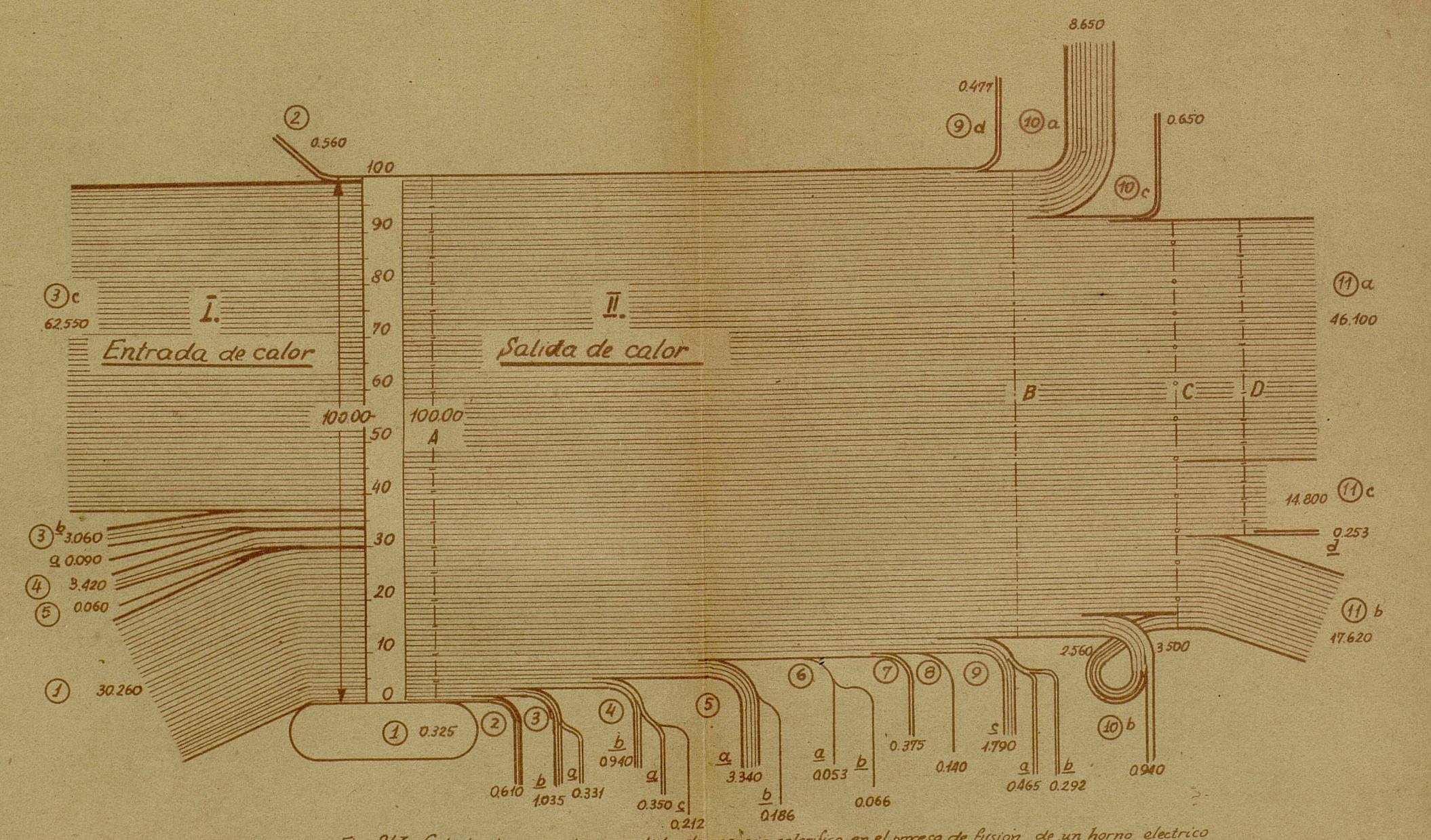


Fig. 243. Calculo de ganancia y perdida de energia calorifica en el proceso de fusion de un horno electrico

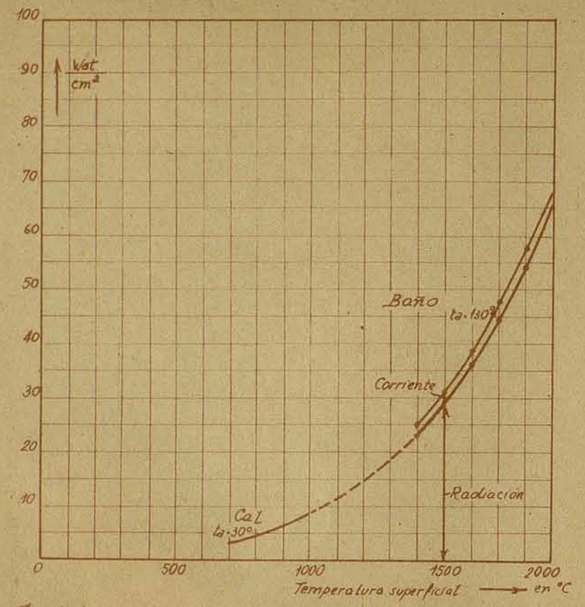


Fig. 237.

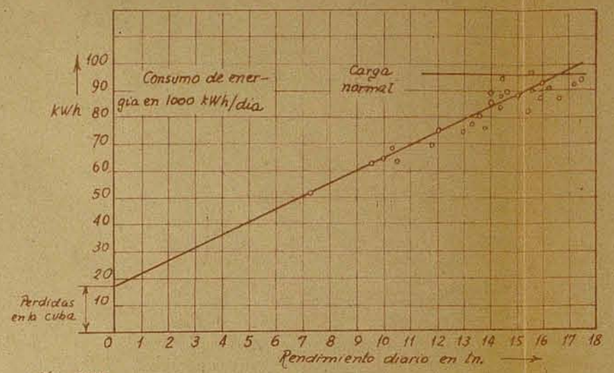


Fig. 239.

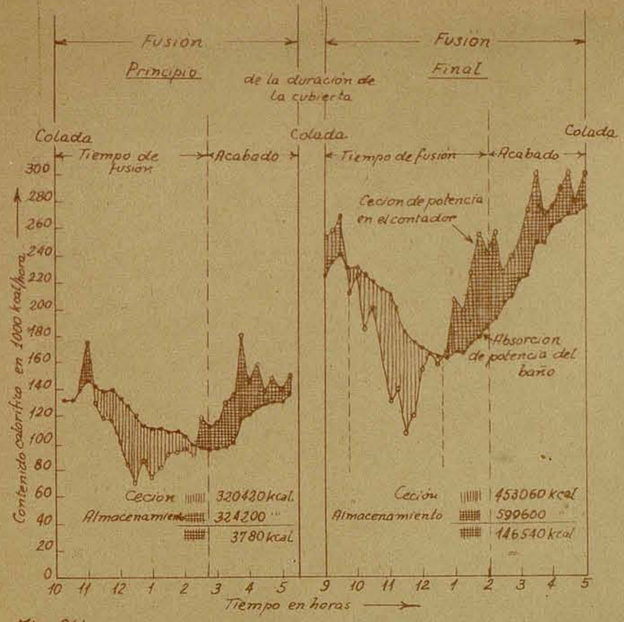


Fig 241.

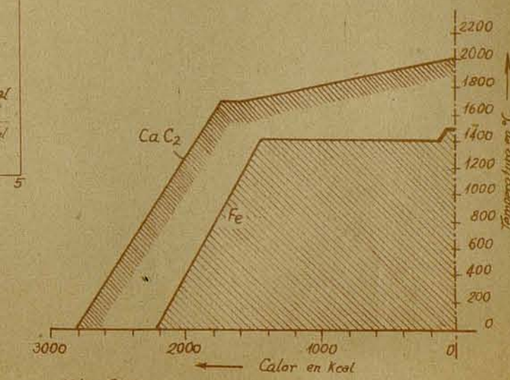


Fig. 245.

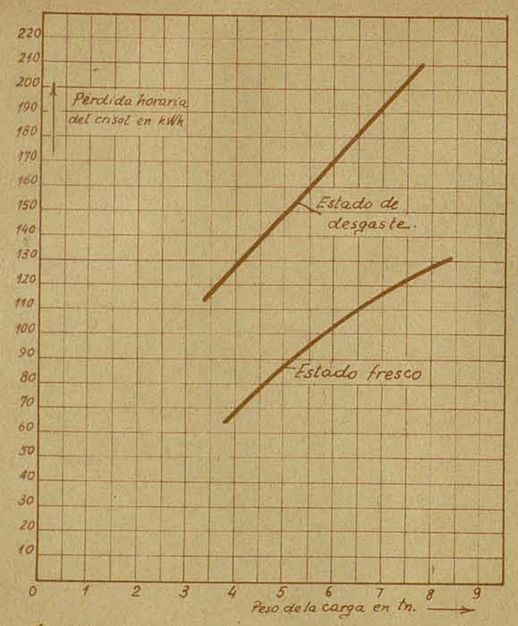


Fig. 238.

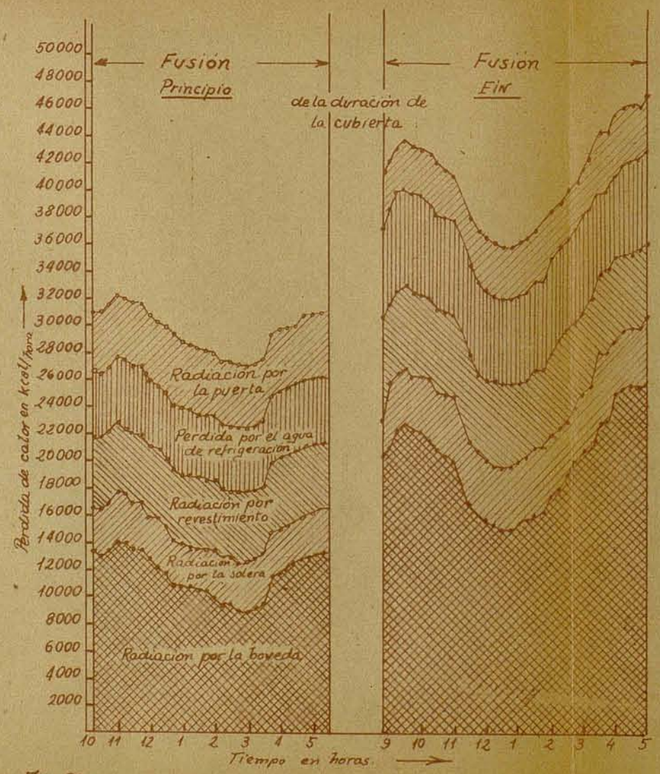


Fig. 240

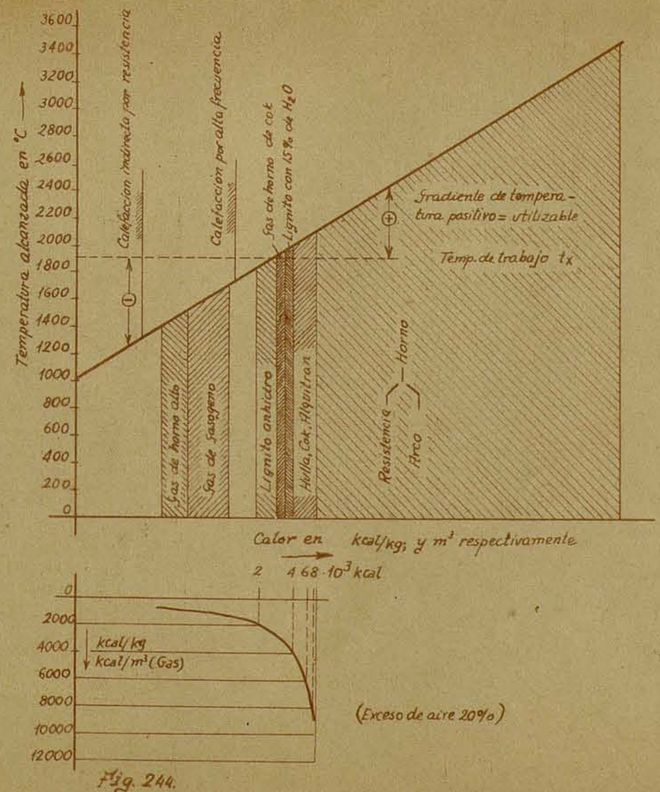


Fig. 244.

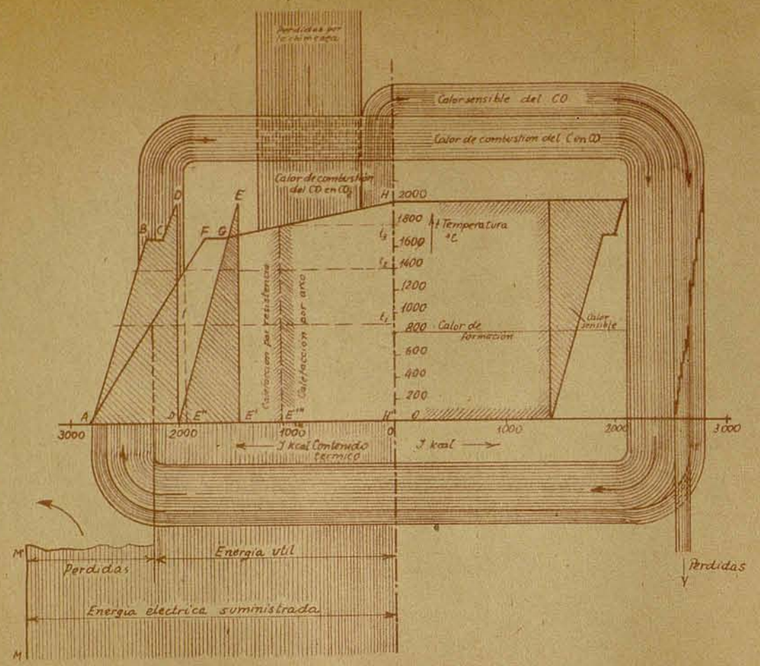


Fig. 246.

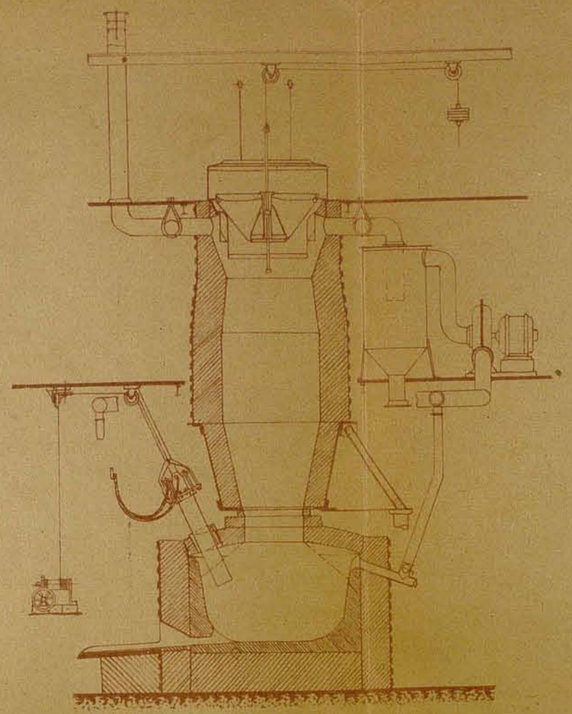


Fig. 247 Horno alto electrico (corte longitudinal)

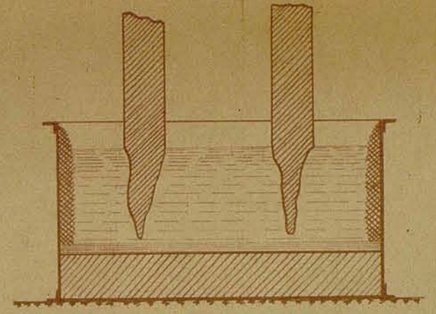


Fig. 251 Exesiva penetracion en el baño

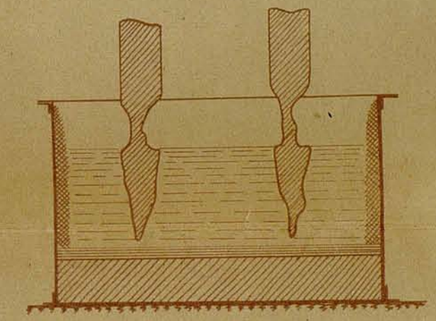


Fig. 252 Desgaste con cuba demasiado alta y exesiva Immersion.

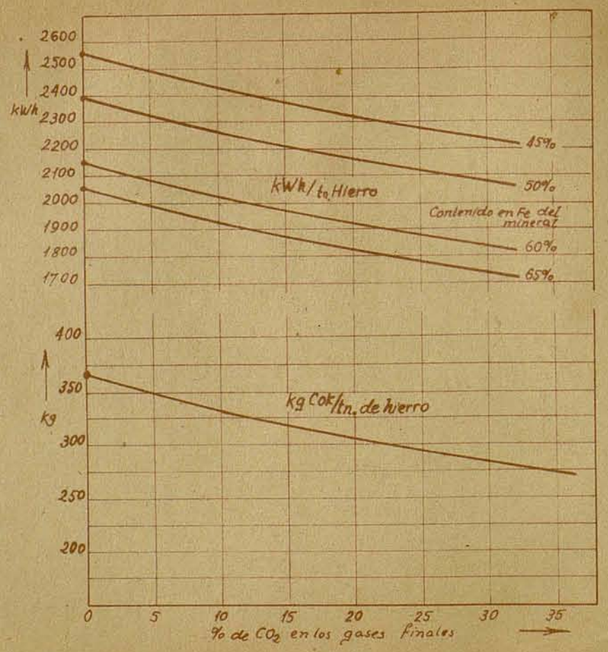


Fig. 248.

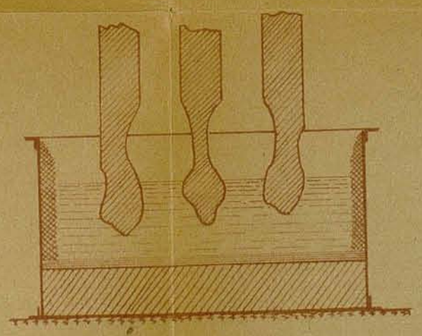


Fig. 249 Quemado de electrodos con distancia demasiado pequeña

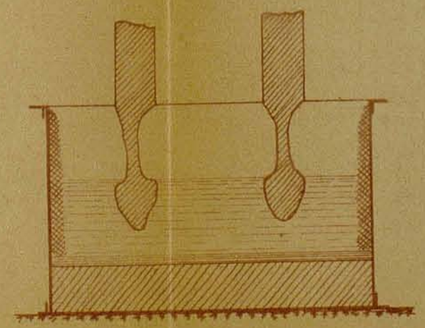


Fig 250. Cuba demasiado alta

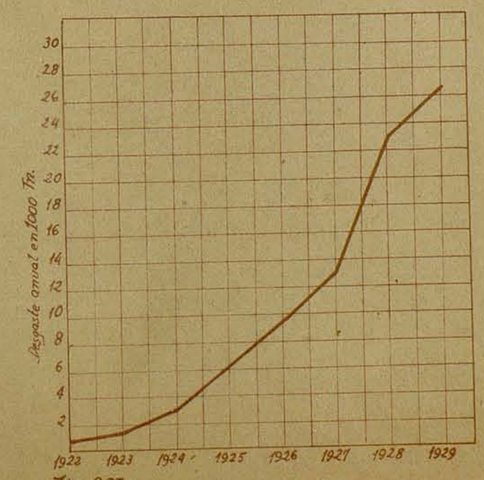


Fig 253.