FIGURES

9 février 2010

Chapitre 1

Tolérances et états de surface

Méthode d'usinage		Profondeur de rugosité Rt (µm)
Groupe	Désignation	0,1 0,18 0,25 0,4 0,6 1 1,8 2,5 4 >6,3 10 18 25 40 63 100 180 250 400 630 1000
Fonderie	Fonderie au sable	
	Fonderie en coquille	
	Fonderie fine	
Forgeage	Forge libre	
	Estampage	
	Forge de précision	
Laminage	Laminage à chaud	
	Laminage à froid	
Emboutissage	Compression	
	Matriçage	
Galetage	Galetage	
	Roulage	
Rabotage	Dégrossissage	
	Ébauche	
	Finition	
Tournage (extérieur et intérieur)	Tournage dégrossissage	
	Tournage d'ébauche	
	Tournage de finition	
	Tournage de précision avec carbure	
	Tournage de haute précision avec diamant	
Chambrage	Chambrage	
Alésage par alésoir	Alésage normal	
	Alésage de précision	
	Alésage de haute précision	
Fraisage	Fraisage d'ébauche	
	Fraisage de finition	
	Fraisage de précision	
	Fraisage de haute précision	
Brochage	Brochage normal	
	Brochage de précision	
Rectification	Rectification d'ébauche	
	Rectification normale	
	Rectification de précision	
	Rectification de haute précision	
Honing	Honing	
	Honing de précision	
	Honing de haute précision	
Rodage	Rodage d'ébauche	
	Rodage de finition	
	Rodage de haute précision	
	Rodage de très haute précision	

d'après document : CETIM

FIG. 1

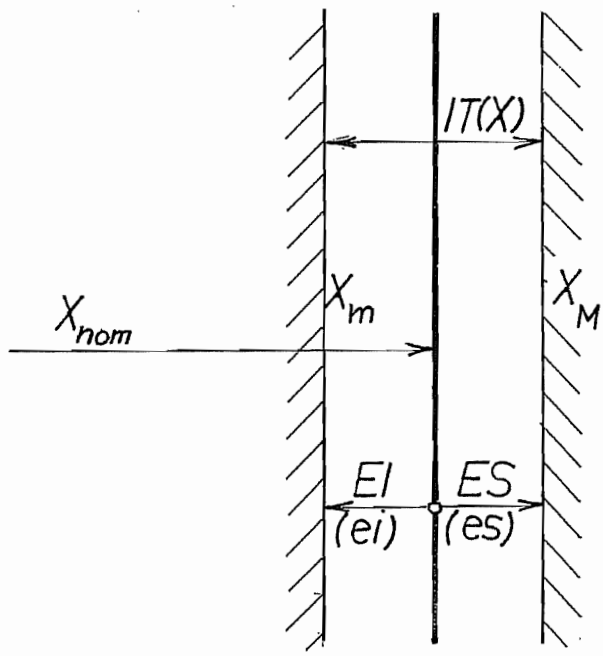


FIG. 2

ÉCARTS DES AJUSTEMENTS LES PLUS COURAMMENT UTILISÉS (NF R 91-011) (1)

Alésages		H6				H7					H8							H9			H11	
Arbres			h5	js5	k5		g6	h6	m6	p6		e8	f7	h7	s7	u7	x7		e9	h8		d11
Écarts en micromètres (1 µm = 0,001 mm) / Cote nominale en mm	⩽ 3	+ 6 0	0 − 4	+ 2 − 2	+ 4 0	+ 10 0	− 2 − 8	0 − 6	+ 8 + 2	+ 12 + 6	+ 14 0	− 14 − 28	− 6 − 16	0 − 10	+ 24 + 14	+ 28 + 18	+ 30 + 20	+ 25 0	− 14 − 39	0 − 14	+ 60 0	− 20 − 80
	> 3 à 6	+ 8 0	0 − 5	− 2,5 − 2,5	+ 6 + 1	+ 12 0	− 4 − 12	0 − 8	+ 12 + 4	+ 20 + 12	+ 18 0	− 20 − 38	− 10 − 22	0 − 12	+ 31 + 19	+ 35 + 23	+ 40 + 28	+ 30 0	− 20 − 50	0 − 18	+ 75 0	− 30 − 105
	> 6 à 10	+ 9 0	0 − 6	+ 3 − 3	+ 7 + 1	+ 15 0	− 5 − 14	0 − 9	+ 15 + 6	+ 24 + 15	+ 22 0	− 25 − 47	− 13 − 28	0 − 15	+ 38 + 23	+ 43 + 28	+ 49 + 34	+ 36 0	− 25 − 61	0 − 22	+ 90 0	− 40 − 130
	> 10 à 14	+ 11 0	0 − 8	+ 4 − 4	+ 9 + 1	+ 18 0	− 6 − 17	0 − 11	+ 18 + 7	+ 29 + 18	+ 27 0	− 32 − 59	− 16 − 34	0 − 18	+ 46 + 28	+ 51 + 33	+ 58 + 40	+ 43 0	− 32 − 75	0 − 27	+ 110 0	− 50 − 160
	> 14 à 18	+ 11 0	0 − 8	+ 4 − 4	+ 9 + 1	+ 18 0	− 6 − 17	0 − 11	+ 18 + 7	+ 29 + 18	+ 27 0	− 32 − 59	− 16 − 34	0 − 18	+ 46 + 28	+ 51 + 33	+ 63 + 45	+ 43 0	− 32 − 75	0 − 27	+ 110 0	− 50 − 160
	> 18 à 24	+ 13 0	0 − 9	+ 4,5 − 4,5	+ 11 + 2	+ 21 0	− 7 − 20	0 − 13	+ 21 + 8	+ 35 + 22	+ 33 0	− 40 − 73	− 20 − 41	0 − 21	+ 56 + 35	+ 62 + 41	+ 75 + 54	+ 52 0	− 40 − 92	0 − 33	+ 130 0	− 65 − 195
	> 24 à 30	+ 13 0	0 − 9	+ 4,5 − 4,5	+ 11 + 2	+ 21 0	− 7 − 20	0 − 13	+ 21 + 8	+ 35 + 22	+ 33 0	− 40 − 73	− 20 − 41	0 − 21	+ 56 + 35	+ 69 + 48	+ 85 + 64	+ 52 0	− 40 − 92	0 − 33	+ 130 0	− 65 − 195
	> 30 à 40	+ 16 0	0 − 11	+ 5,5 − 5,5	+ 13 + 2	+ 25 0	− 9 − 25	0 − 16	+ 25 + 9	+ 42 + 26	+ 39 0	− 50 − 89	− 25 − 50	0 − 25	+ 68 + 43	+ 85 + 60	+ 105 + 80	+ 62 0	− 50 − 112	0 − 39	+ 160 0	− 80 − 240
	> 40 à 50	+ 16 0	0 − 11	+ 5,5 − 5,5	+ 13 + 2	+ 25 0	− 9 − 25	0 − 16	+ 25 + 9	+ 42 + 26	+ 39 0	− 50 − 89	− 25 − 50	0 − 25	+ 68 + 43	+ 95 + 70	+ 122 + 97	+ 62 0	− 50 − 112	0 − 39	+ 160 0	− 80 − 240
	> 50 à 65	+ 19 0	0 − 13	+ 6,5 − 6,5	+ 15 + 2	+ 30 0	− 10 − 29	0 − 19	+ 30 + 11	+ 51 + 32	+ 46 0	− 60 − 106	− 30 − 60	0 − 30	+ 83 + 53	+ 117 + 87	+ 152 + 122	+ 74 0	− 60 − 134	0 − 46	+ 190 0	− 100 − 290
	> 65 à 80	+ 19 0	0 − 13	+ 6,5 − 6,5	+ 15 + 2	+ 30 0	− 10 − 29	0 − 19	+ 30 + 11	+ 51 + 32	+ 46 0	− 60 − 106	− 30 − 60	0 − 30	+ 89 + 59	+ 132 + 102	+ 176 + 146	+ 74 0	− 60 − 134	0 − 46	+ 190 0	− 100 − 290
	> 80 à 100	+ 22 0	0 − 15	+ 7,5 − 7,5	+ 18 + 3	+ 35 0	− 12 − 34	0 − 22	+ 35 + 13	+ 59 + 37	+ 54 0	− 72 − 126	− 36 − 71	0 − 35	+ 106 + 71	+ 159 + 124	+ 213 + 178	+ 87 0	− 72 − 159	0 − 54	+ 220 0	− 120 − 340
	> 100 à 120	+ 22 0	0 − 15	+ 7,5 − 7,5	+ 18 + 3	+ 35 0	− 12 − 34	0 − 22	+ 35 + 13	+ 59 + 37	+ 54 0	− 72 − 126	− 36 − 71	0 − 35	+ 114 + 79	+ 179 + 144	+ 245 + 210	+ 87 0	− 72 − 159	0 − 54	+ 220 0	− 120 − 340
	> 120 à 140	+ 25 0	0 − 18	+ 9 − 9	+ 21 + 3	+ 40 0	− 14 − 39	0 − 25	+ 40 + 15	+ 68 + 43	+ 63 0	− 85 − 148	− 43 − 83	0 − 40	+ 132 + 92	+ 210 + 170	+ 288 + 248	+ 100 0	− 85 − 185	0 − 63	+ 250 0	− 145 − 395
	> 140 à 160	+ 25 0	0 − 18	+ 9 − 9	+ 21 + 3	+ 40 0	− 14 − 39	0 − 25	+ 40 + 15	+ 68 + 43	+ 63 0	− 85 − 148	− 43 − 83	0 − 40	+ 140 + 100	+ 230 + 190	+ 320 + 280	+ 100 0	− 85 − 185	0 − 63	+ 250 0	− 145 − 395
	> 160 à 180	+ 25 0	0 − 18	+ 9 − 9	+ 21 + 3	+ 40 0	− 14 − 39	0 − 25	+ 40 + 15	+ 68 + 43	+ 63 0	− 85 − 148	− 43 − 83	0 − 40	+ 148 + 108	+ 250 + 210	+ 350 + 310	+ 100 0	− 85 − 185	0 − 63	+ 250 0	− 145 − 395
	> 180 à 200	+ 29 0	0 − 20	+ 10 − 10	+ 24 + 4	+ 46 0	− 15 − 44	0 − 29	+ 46 + 17	+ 79 + 50	+ 72 0	− 100 − 172	− 50 − 96	0 − 46	+ 168 + 122	+ 282 + 236	+ 396 + 350	+ 115 0	− 100 − 215	0 − 72	+ 290 0	− 170 − 460
	> 200 à 225	+ 29 0	0 − 20	+ 10 − 10	+ 24 + 4	+ 46 0	− 15 − 44	0 − 29	+ 46 + 17	+ 79 + 50	+ 72 0	− 100 − 172	− 50 − 96	0 − 46	+ 176 + 130	+ 304 + 258	+ 431 + 385	+ 115 0	− 100 − 215	0 − 72	+ 290 0	− 170 − 460
	> 225 à 250	+ 29 0	0 − 20	+ 10 − 10	+ 24 + 4	+ 46 0	− 15 − 44	0 − 29	+ 46 + 17	+ 79 + 50	+ 72 0	− 100 − 172	− 50 − 96	0 − 46	+ 186 + 140	+ 330 + 284	+ 471 + 425	+ 115 0	− 100 − 215	0 − 72	+ 290 0	− 170 − 460
	> 250 à 280	+ 32 0	0 − 23	+ 11,5 − 11,5	+ 27 + 4	+ 52 0	− 17 − 49	0 − 32	+ 52 + 20	+ 88 + 56	+ 81 0	− 110 − 191	− 56 − 108	0 − 52	+ 210 + 158	+ 367 + 315	+ 527 + 475	+ 130 0	− 110 − 240	0 − 81	+ 320 0	− 190 − 510
	> 280 à 315	+ 32 0	0 − 23	+ 11,5 − 11,5	+ 27 + 4	+ 52 0	− 17 − 49	0 − 32	+ 52 + 20	+ 88 + 56	+ 81 0	− 110 − 191	− 56 − 108	0 − 52	+ 222 + 170	+ 402 + 350	+ 577 + 525	+ 130 0	− 110 − 240	0 − 81	+ 320 0	− 190 − 510
	> 315 à 355	+ 36 0	0 − 25	+ 12,5 − 12,5	+ 29 + 4	+ 57 0	− 18 − 54	0 − 36	+ 57 + 21	+ 98 + 62	+ 89 0	− 125 − 214	− 62 − 119	0 − 57	+ 247 + 190	+ 447 + 390	+ 647 + 590	+ 140 0	− 125 − 265	0 − 89	+ 360 0	− 210 − 570
	> 355 à 400	+ 36 0	0 − 25	+ 12,5 − 12,5	+ 29 + 4	+ 57 0	− 18 − 54	0 − 36	+ 57 + 21	+ 98 + 62	+ 89 0	− 125 − 214	− 62 − 119	0 − 57	+ 265 + 208	+ 492 + 435	+ 717 + 660	+ 140 0	− 125 − 265	0 − 89	+ 360 0	− 210 − 570
	> 400 à 450	+ 40 0	0 − 27	+ 13,5 − 13,5	+ 32 + 5	+ 63 0	− 20 − 60	0 − 40	+ 63 + 23	+ 108 + 68	+ 97 0	− 135 − 232	− 68 − 131	0 − 63	+ 295 + 232	+ 553 + 490	+ 803 + 740	+ 155 0	− 135 − 290	0 − 97	+ 400 0	− 230 − 630
	> 450 à 500	+ 40 0	0 − 27	+ 13,5 + 13,5	+ 32 + 5	+ 63 0	− 20 − 60	0 − 40	+ 63 + 23	+ 108 + 68	+ 97 0	− 135 − 232	− 68 − 131	0 − 63	+ 315 + 252	+ 603 + 540	+ 883 + 820	+ 155 0	− 135 − 290	0 − 97	+ 400 0	− 230 − 630

1. COTES AVEC INDICATION DE TOLÉRANCE.

Le dessin comporte des cotes avec indication de tolérance : se reporter au tableau figure 1. Le tableau donne les écarts des ajustements les plus couramment utilisés.

2. COTES SANS INDICATION DE TOLÉRANCE.

La tolérance est reportée dans un nota général suivant les directives ci-après de **NF E 02-350** :

1er cas : tolérance JS/js
exemple : JS14/js14

2e cas : tolérance extraite des tableaux de la norme (fig. 2).

DIMENSIONS LINÉAIRES (mm) (2)

Dimensions nominales		0,5 à 3	de 3 à 6	de 6 à 30	de 30 à 120	de 120 à 315	de 315 à 1 000	1 000 à 2 000	2 000 à 4 000
Écarts (mm)	Série fine	± 0,05	± 0,05	± 0,1	± 0,15	± 0,2	-	-	-
	Série moy.	± 0,1	± 0,1	± 0,2	± 0,3	± 0,5	± 0,8	± 1,2	± 2
	Série grossière	-	± 0,2	± 0,5	± 0,8	± 1,2	± 2	± 3	± 4

DIMENSIONS ANGULAIRES

Longueur du plus petit côté de l'angle (mm)		Jusqu'à 10	de 10 à 50	de 50 à 120	de 120 à 400
Écarts	en degrés et minutes	± 1°	± 30′	± 20′	± 10′
	en pourcentage	± 1,8	± 0,9	± 0,6	± 0,3

FIG. 3

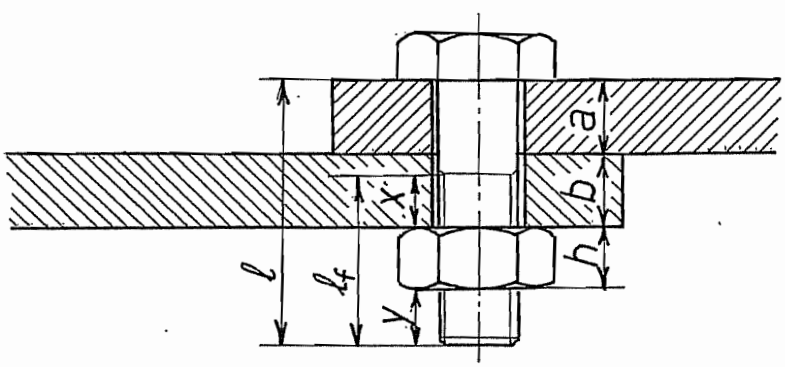


FIG. 4

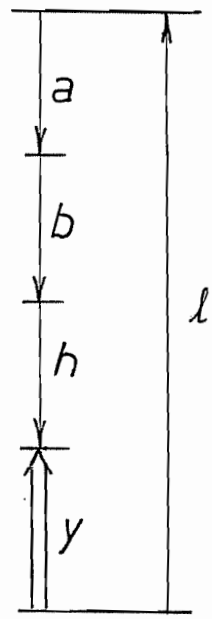


FIG. 5

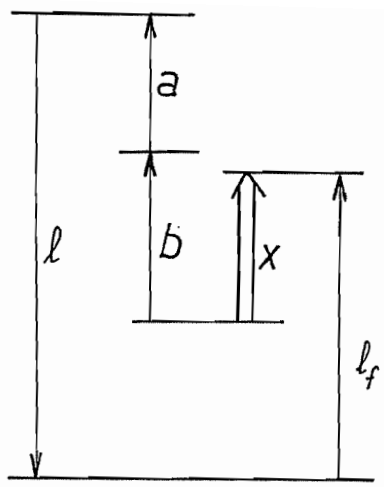


FIG. 6

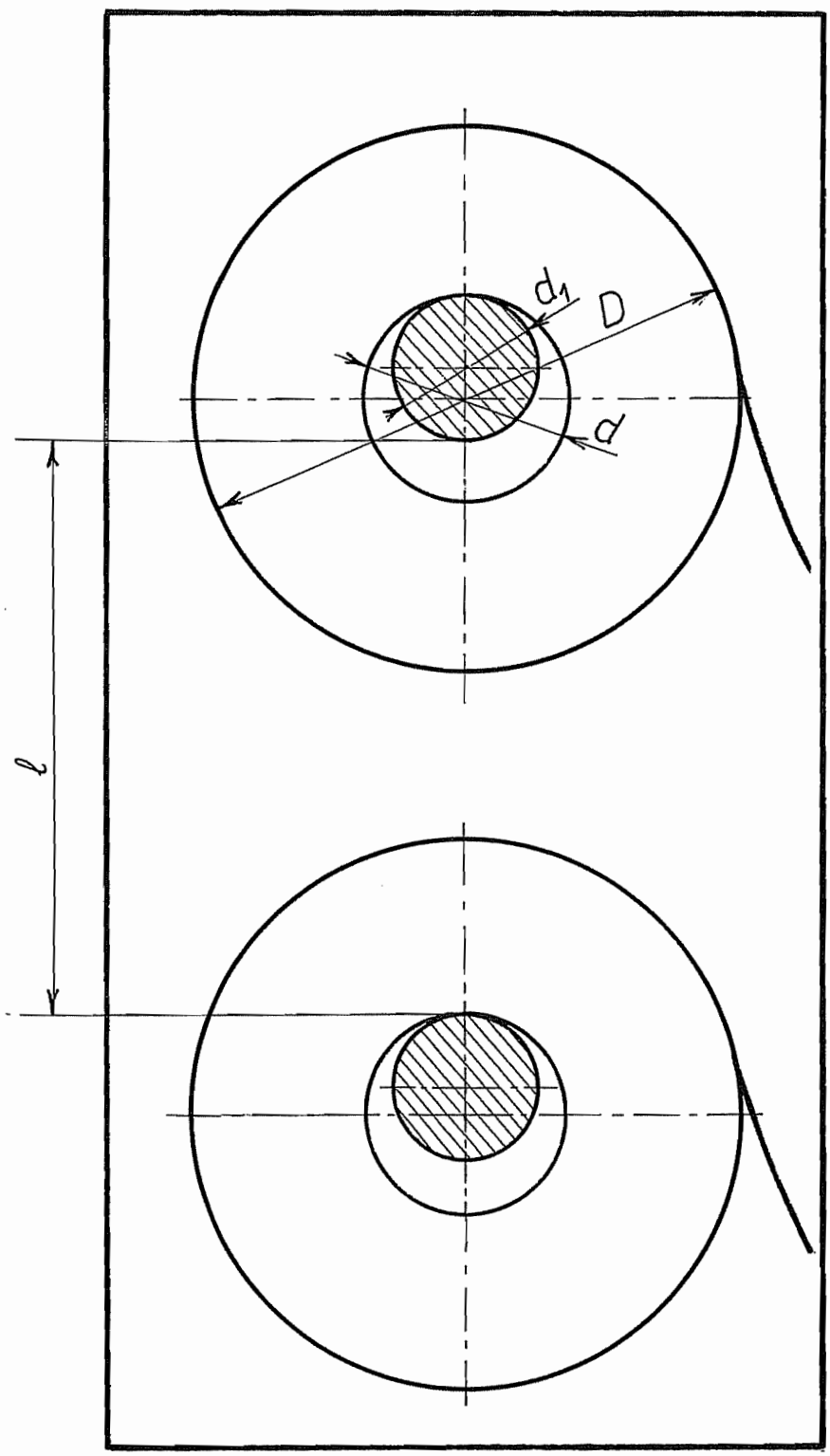


FIG. 7

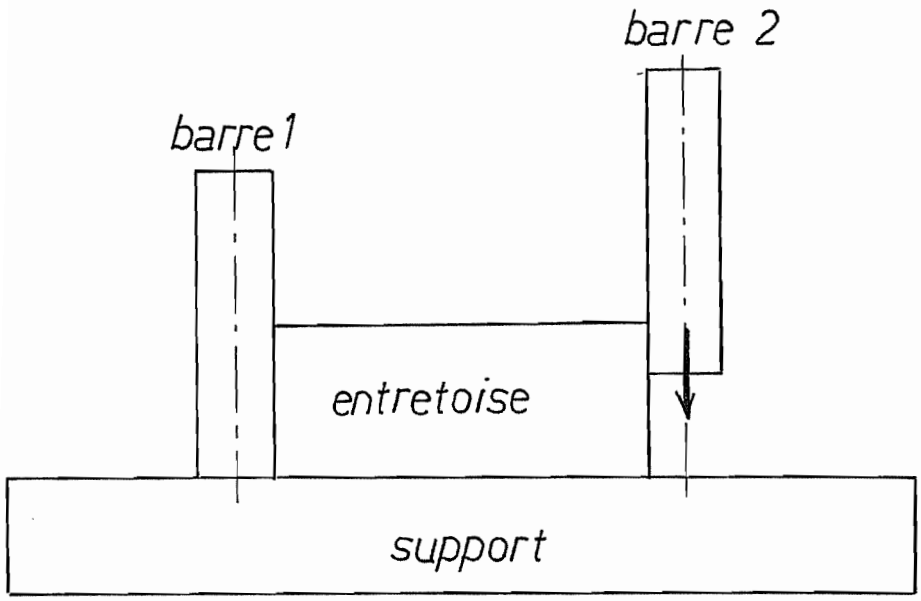


FIG. 8

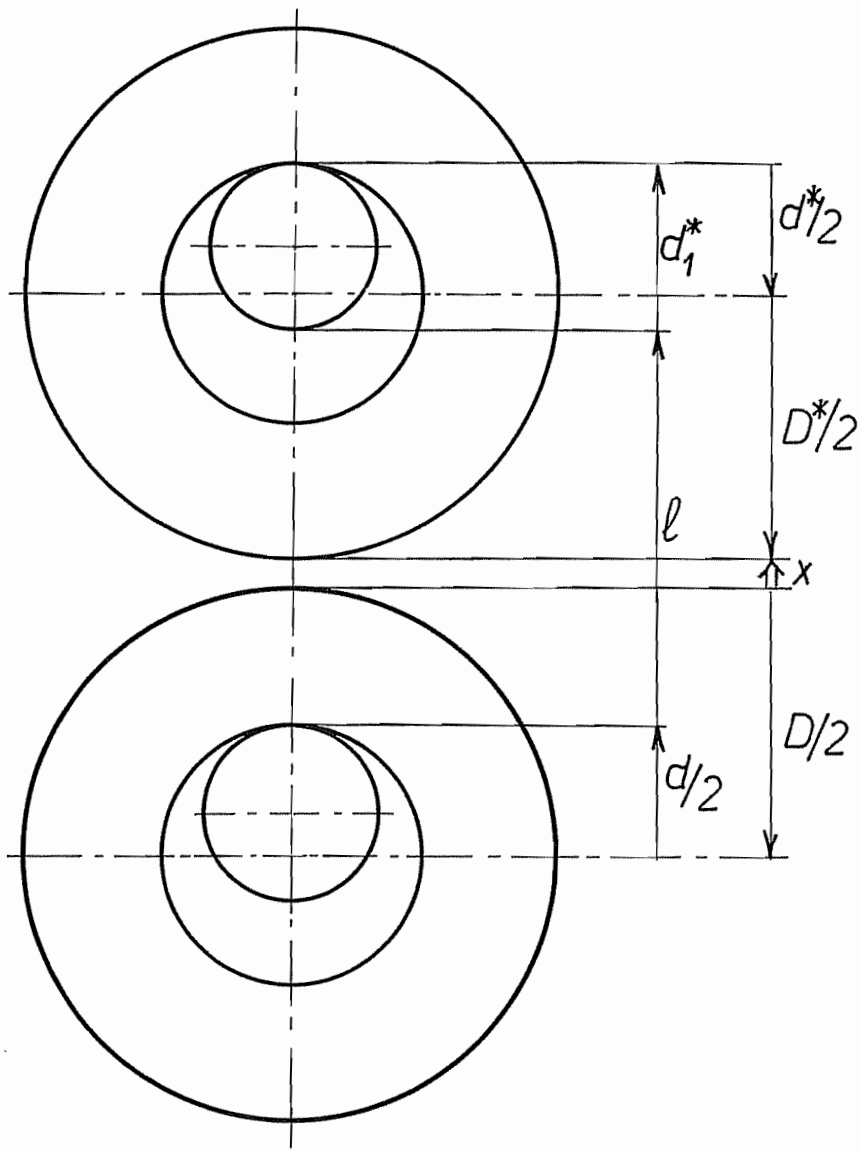


FIG. 9

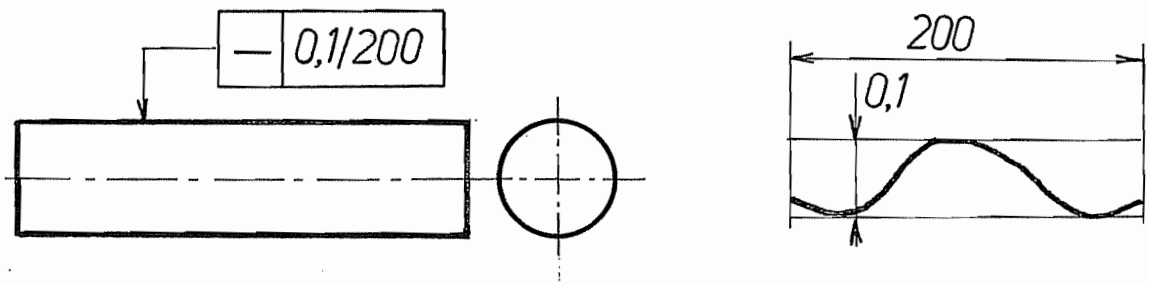


FIG. 10

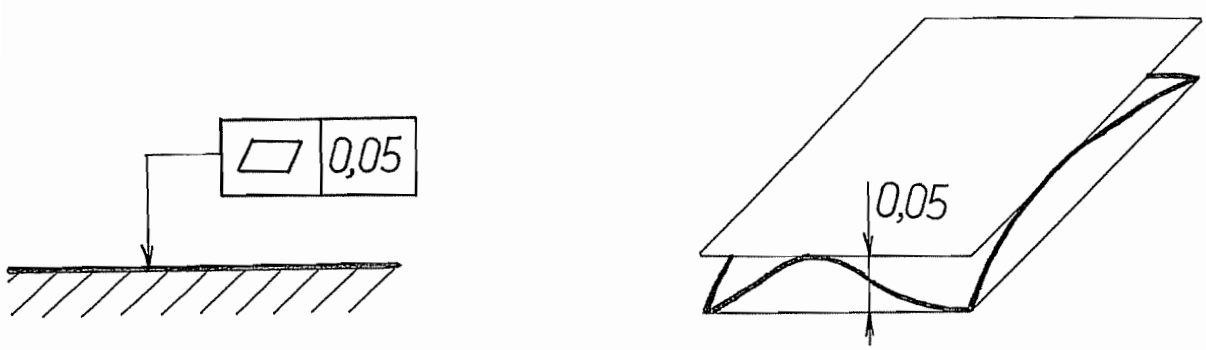


FIG. 11

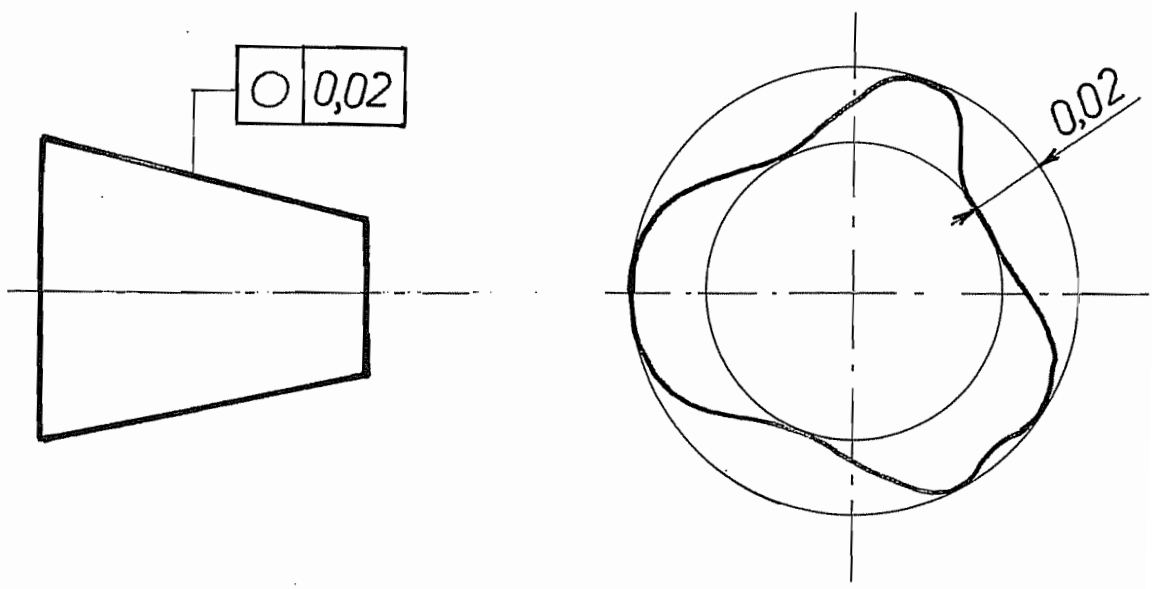


FIG. 12

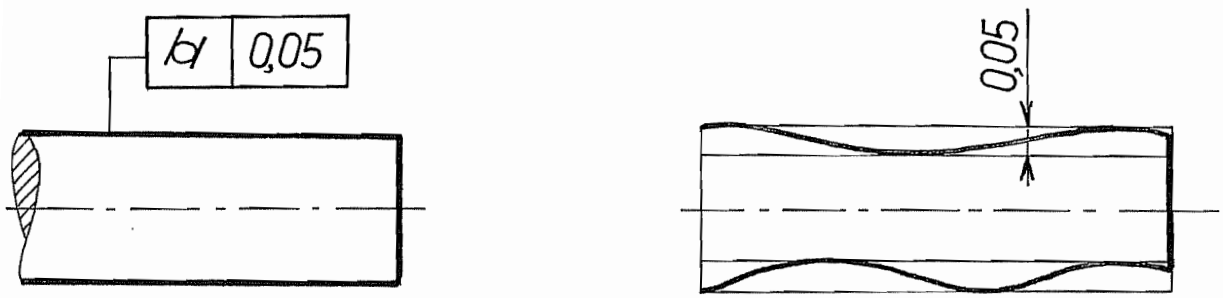


FIG. 13

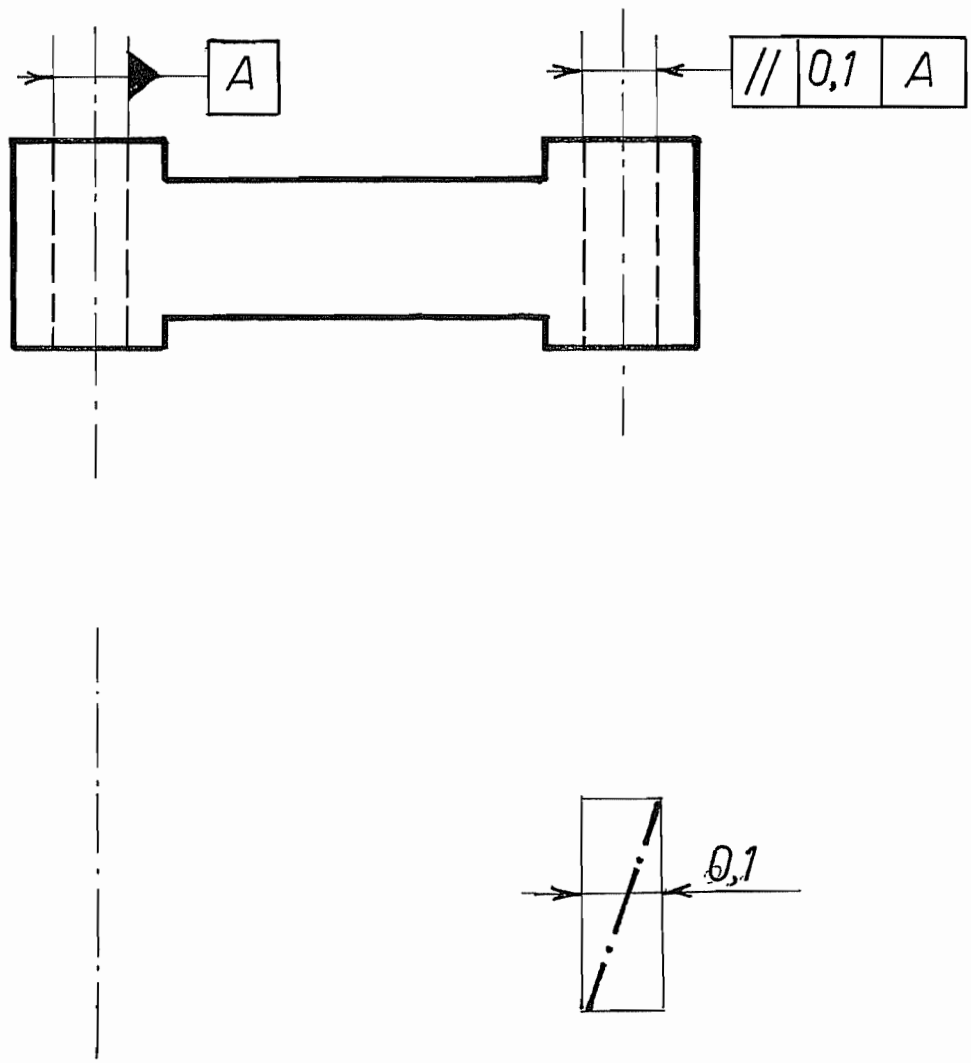


FIG. 14

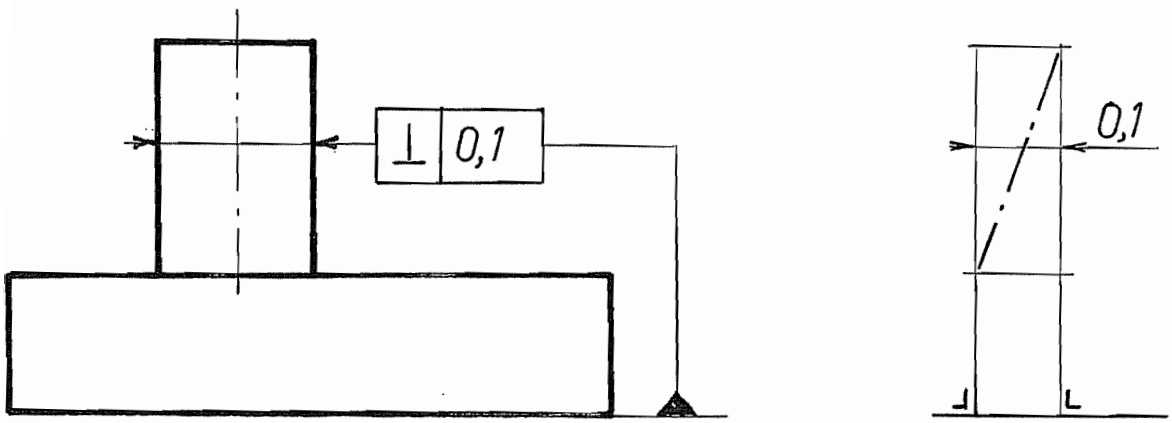


FIG. 15

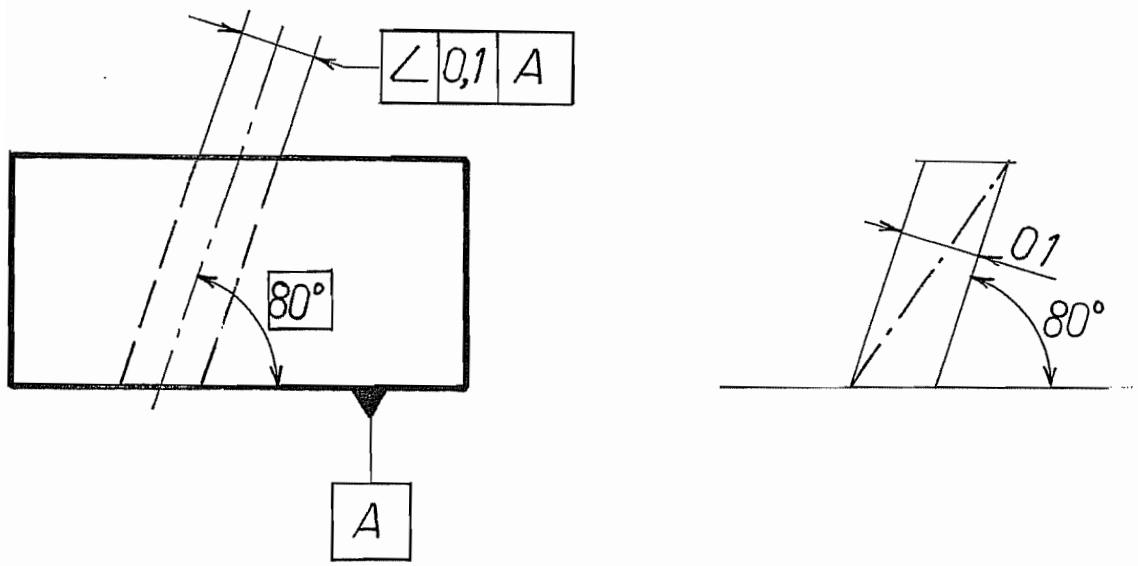


FIG. 16

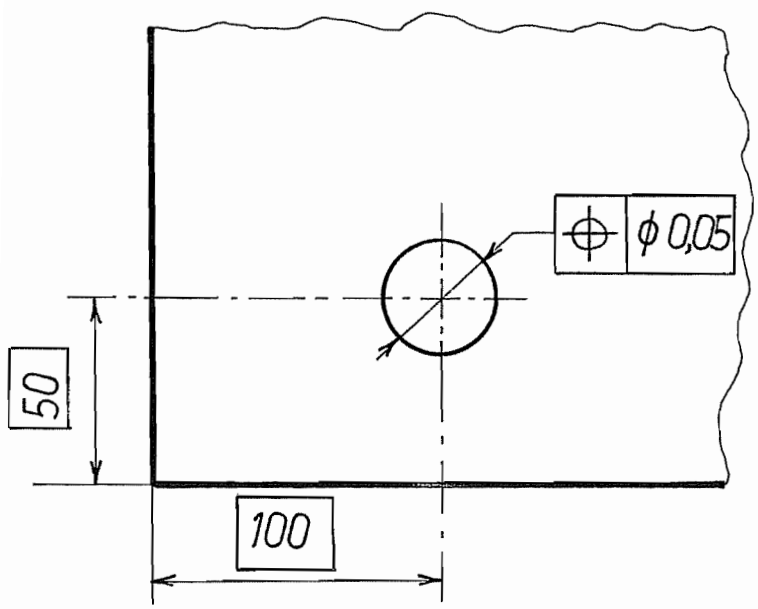


FIG. 17

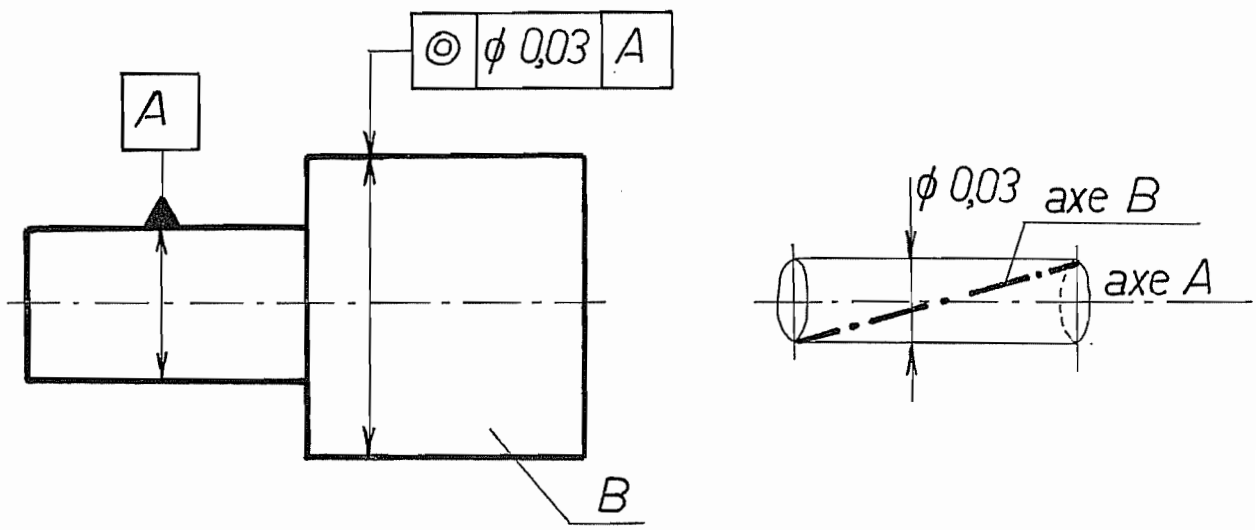
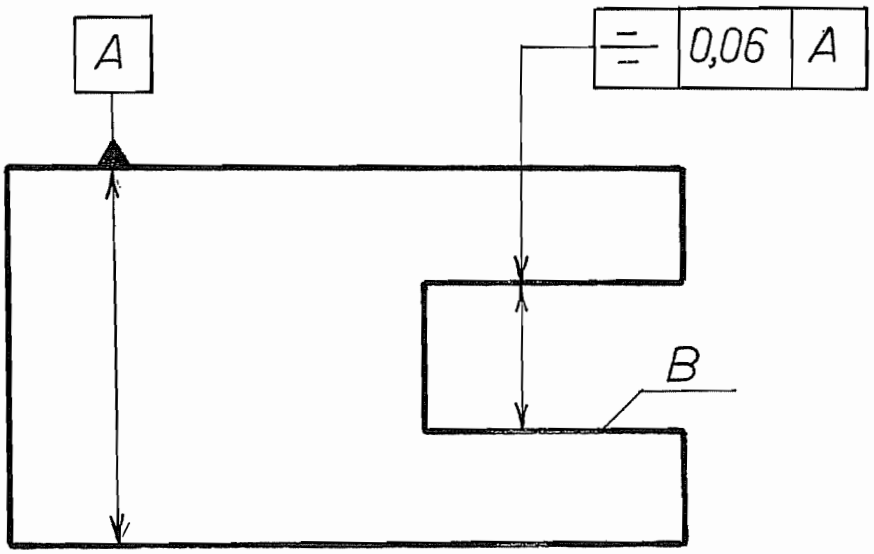


FIG. 18



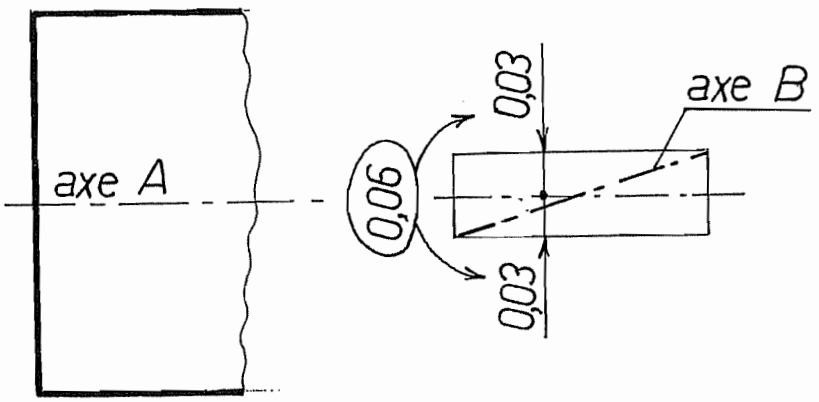


FIG. 19

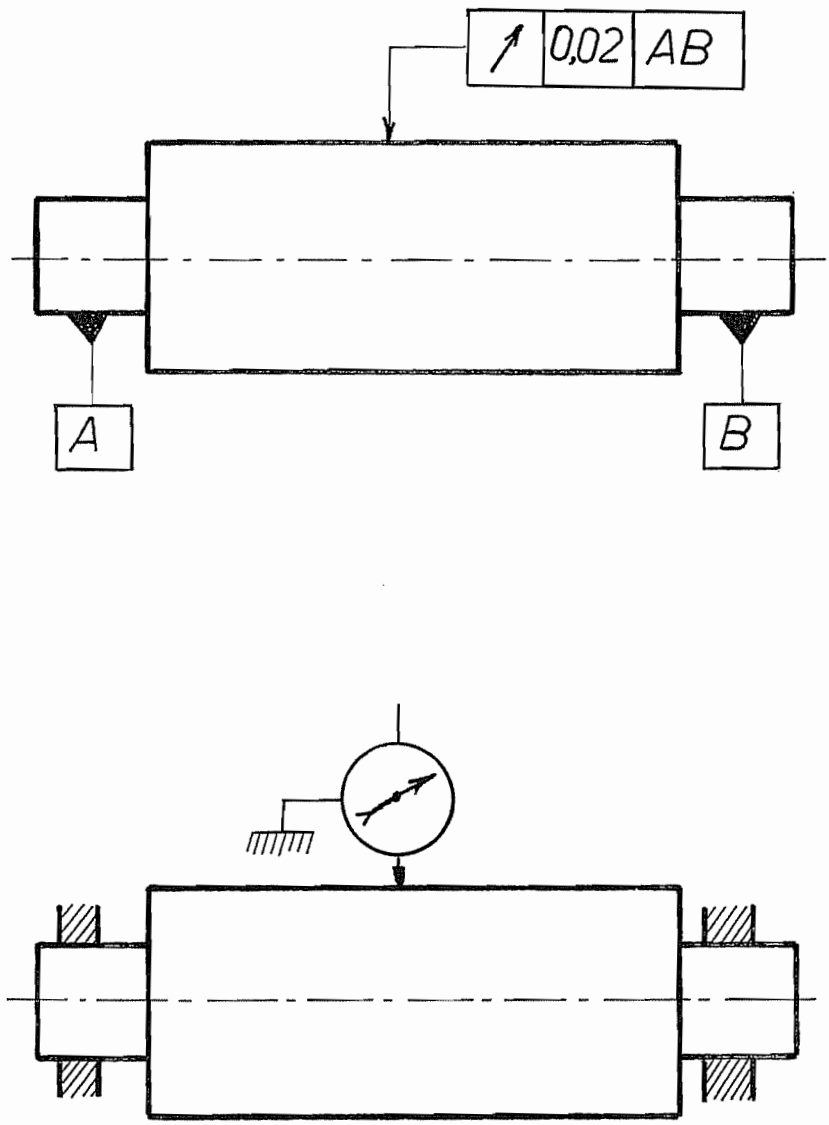


FIG. 20

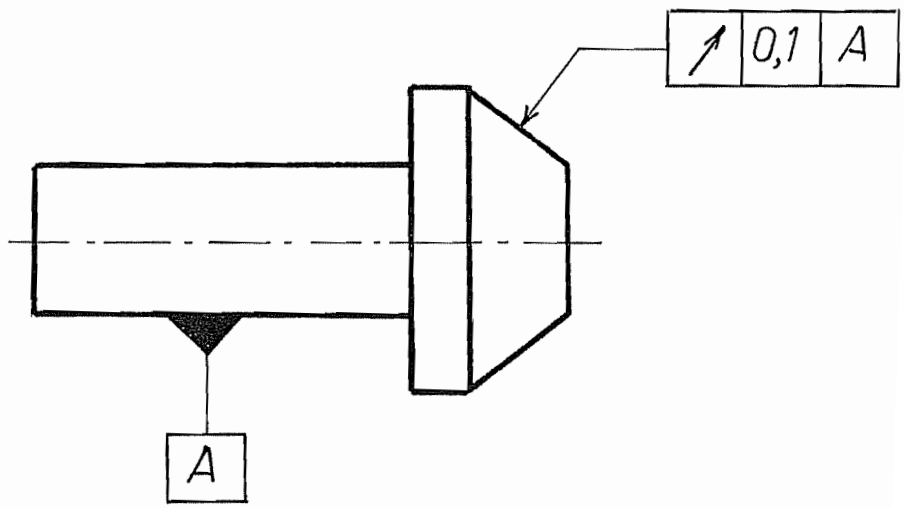


FIG. 21

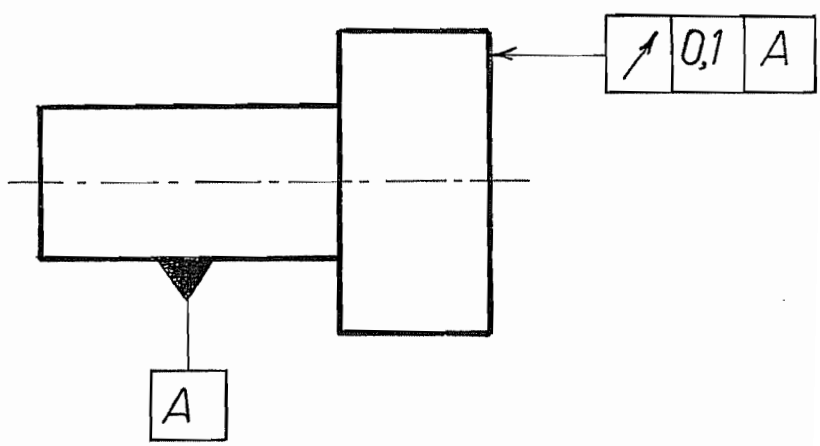
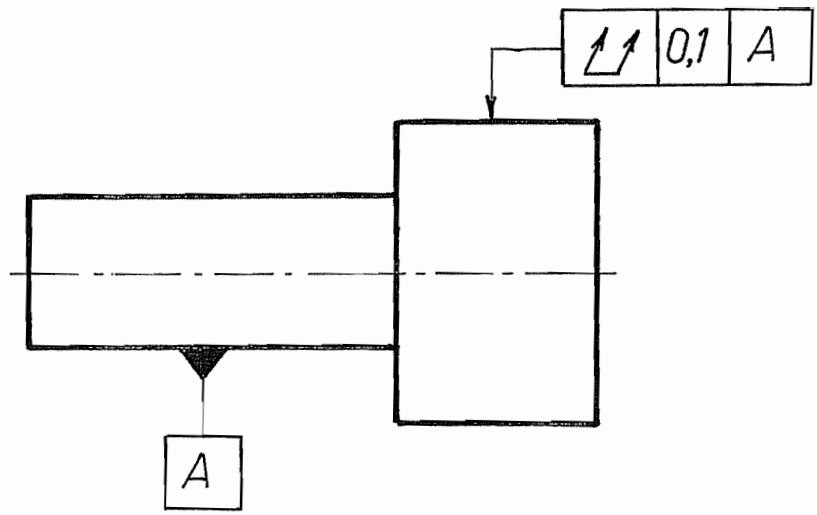


FIG. 22



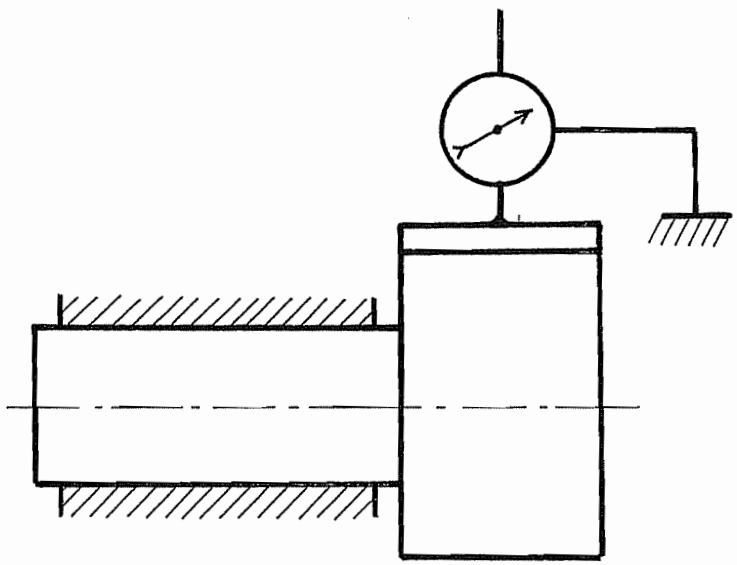


FIG. 23

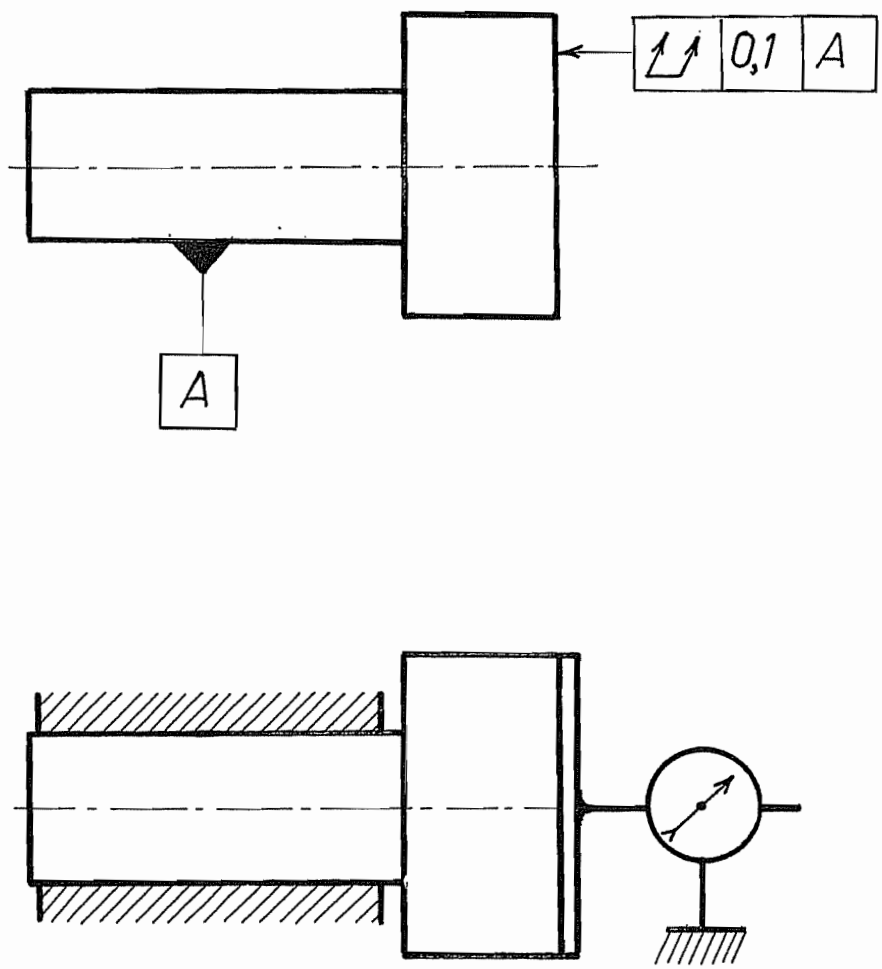


FIG. 24

Chapitre 2

Cotation de fabrication

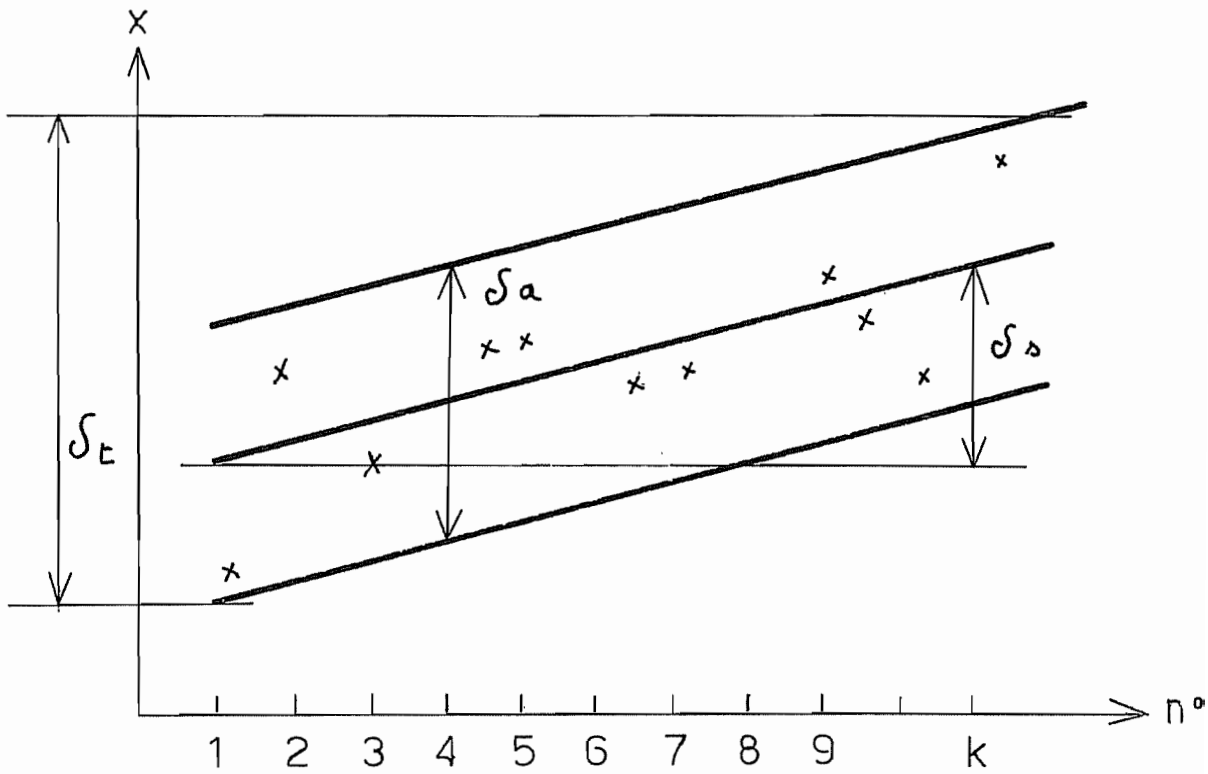


Fig. 1

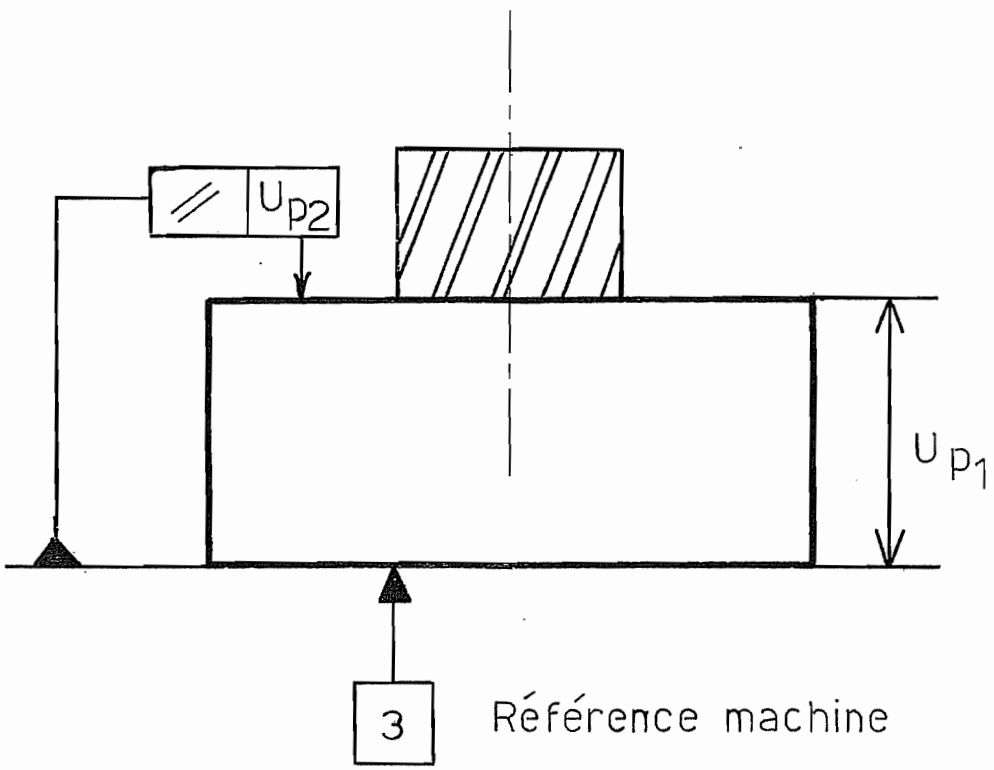


Fig. 2

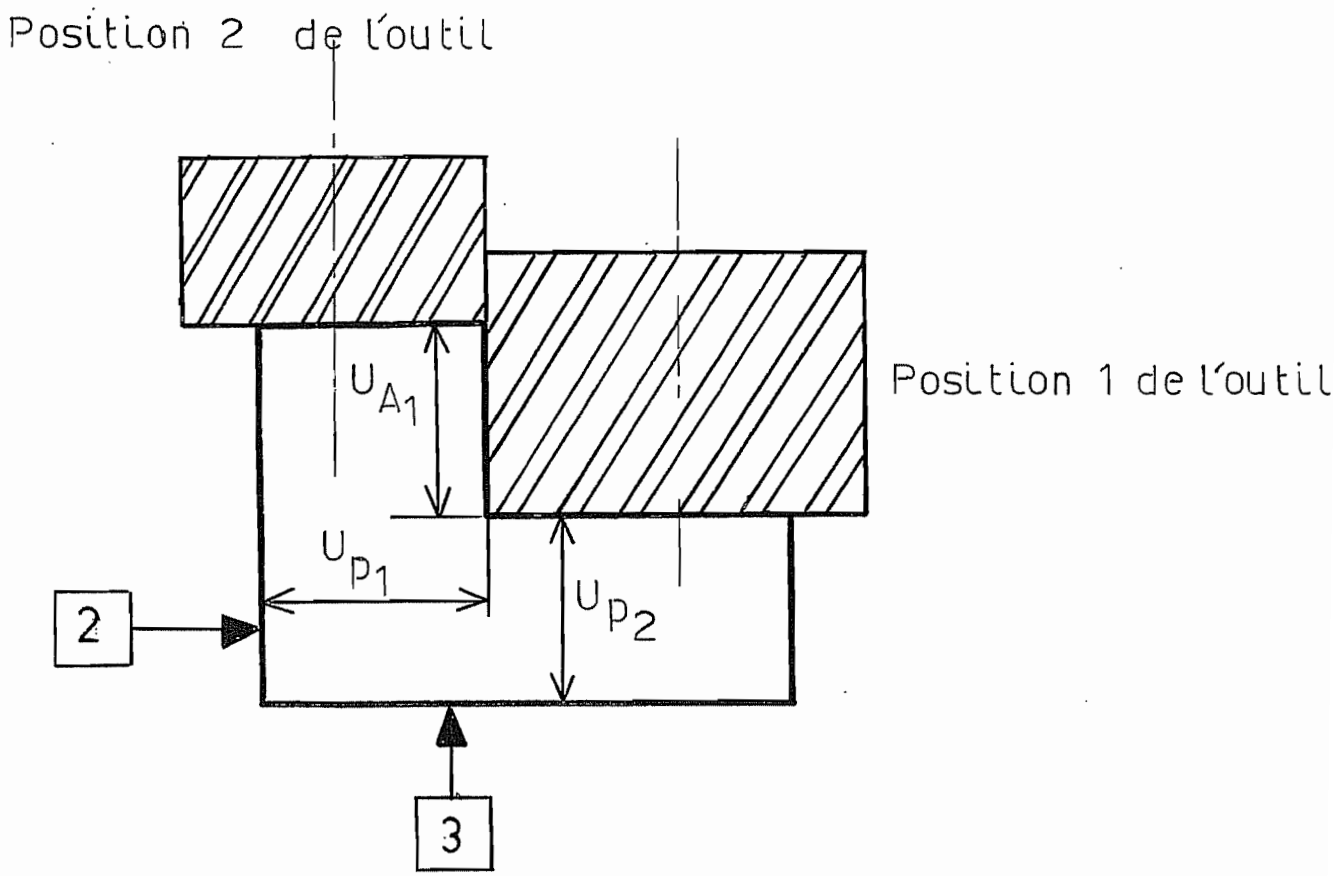


Fig. 3

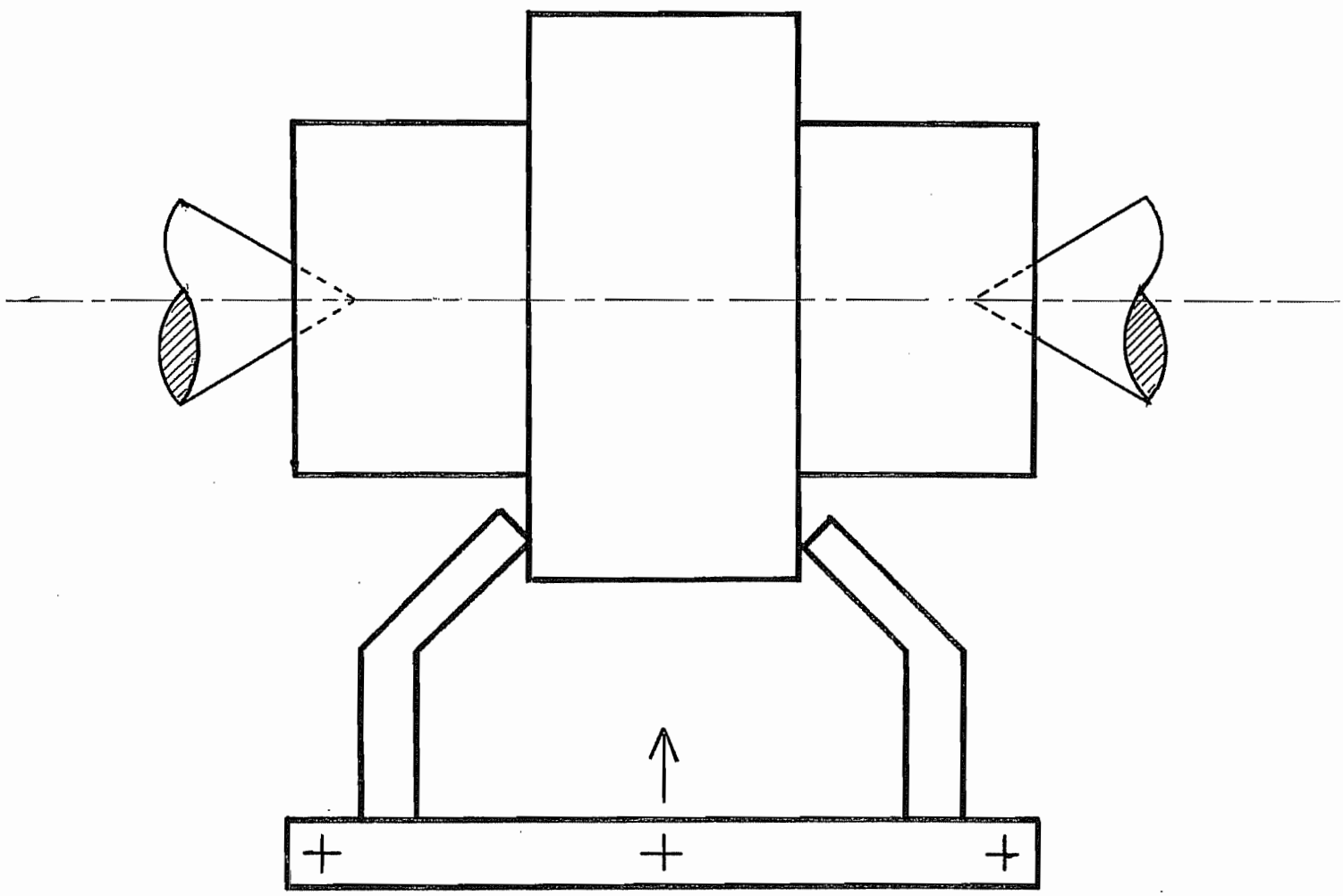


Fig. 4

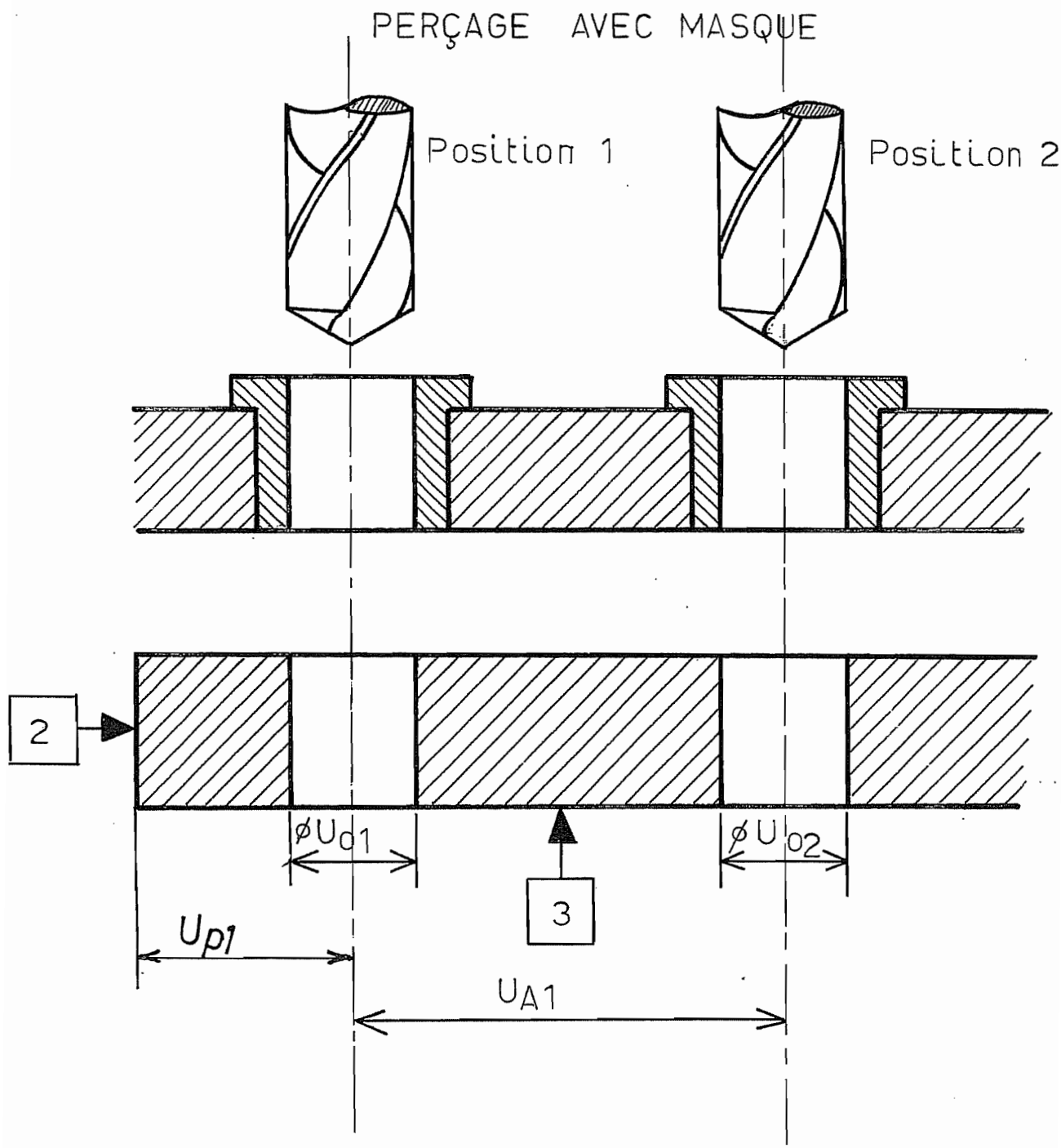

PERÇAGE AVEC MASQUE
Position 1
Position 2
2
3
ØUd1
ØUd2
Up1
UA1

Fig. 5

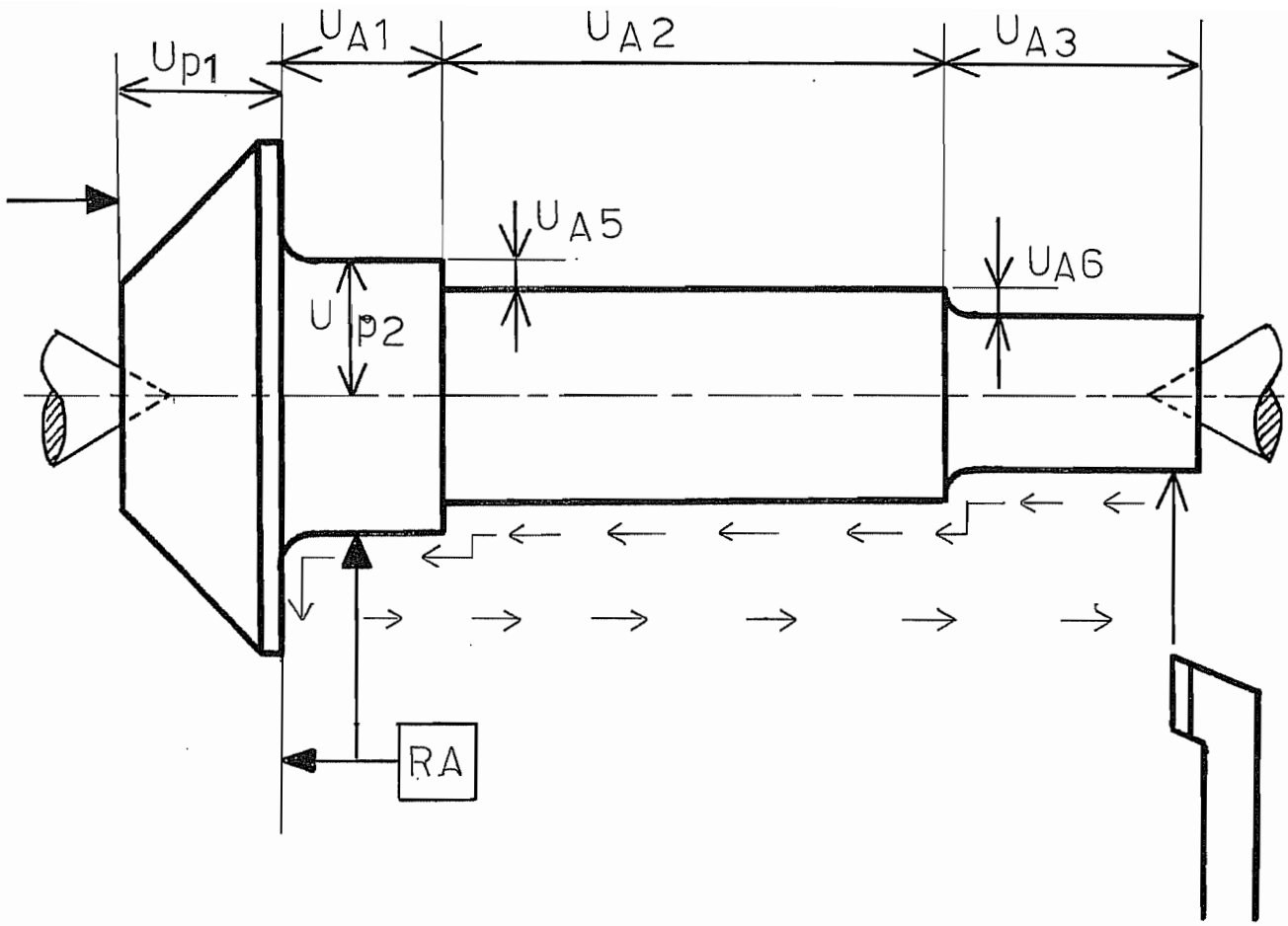


Fig. 6

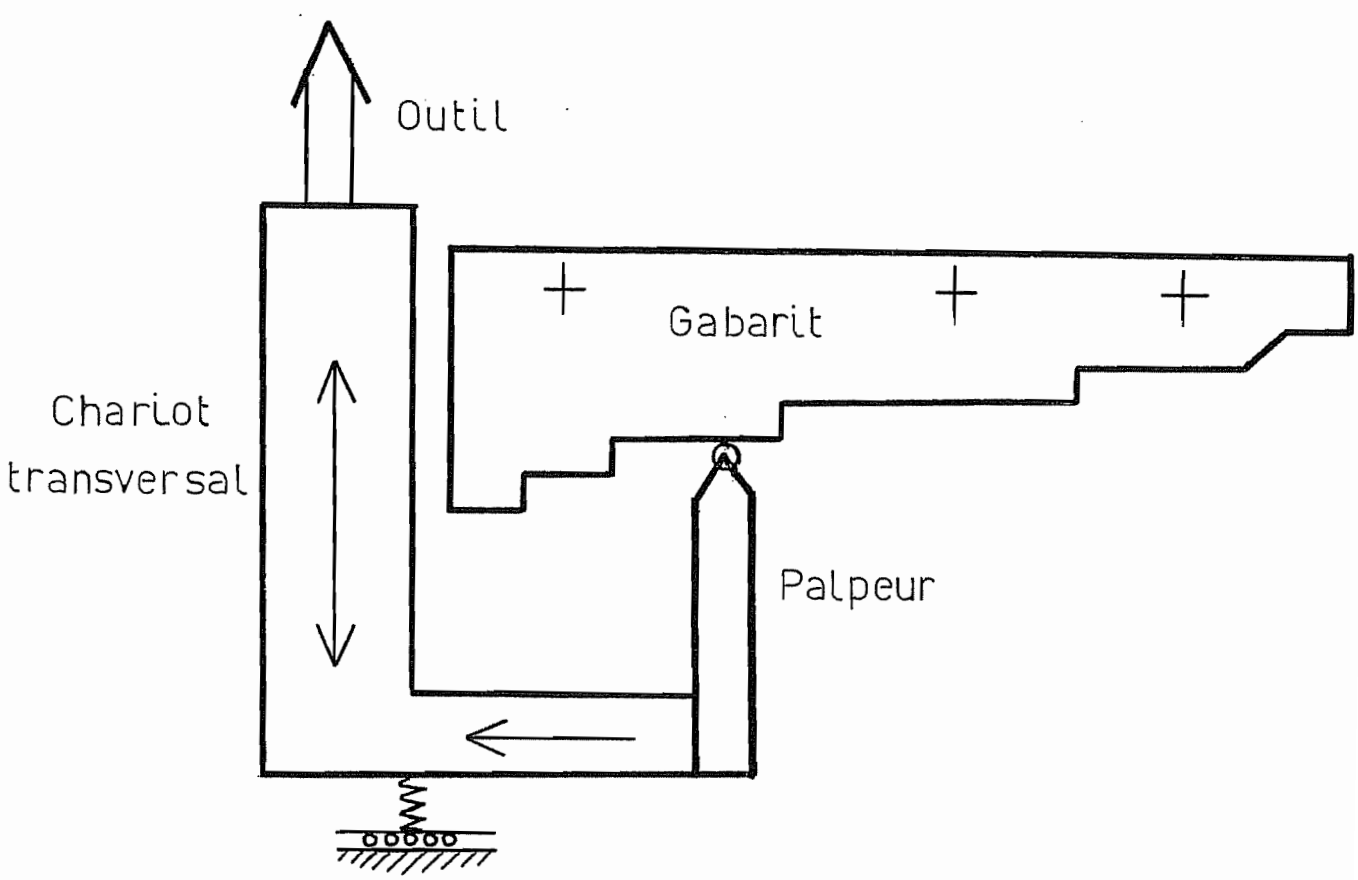


Fig. 7

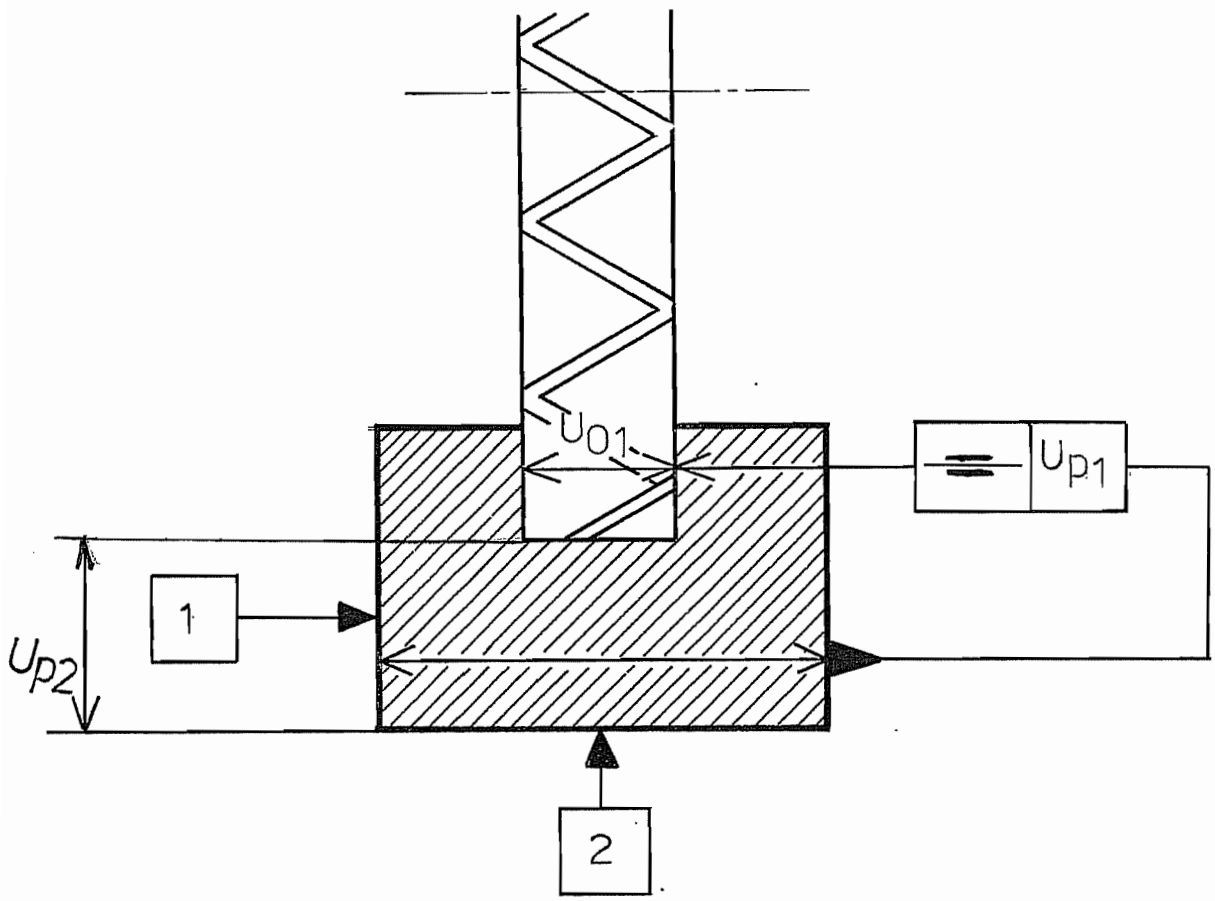


Fig. 8

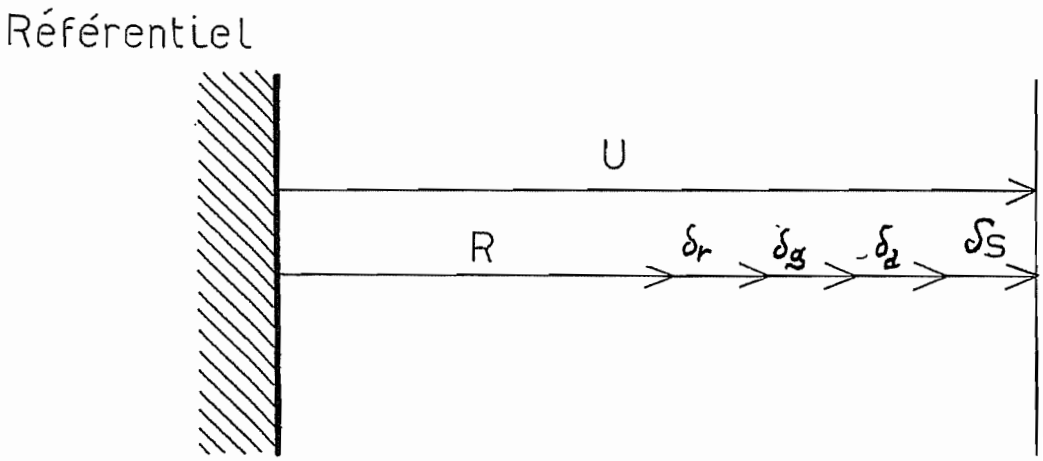


Fig. 9

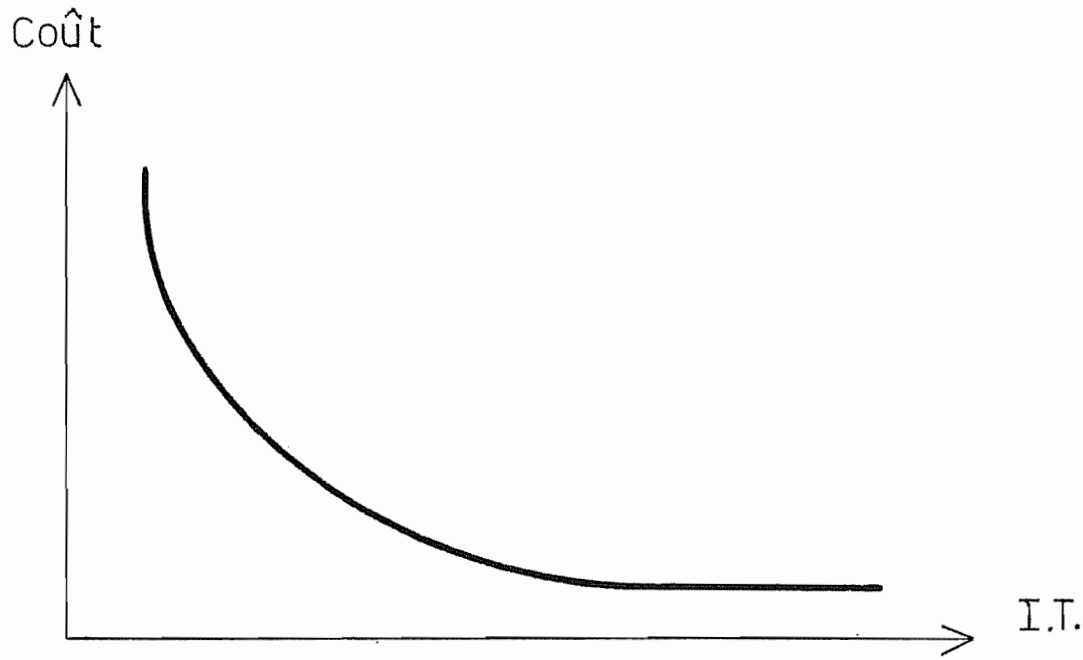


Fig. 10

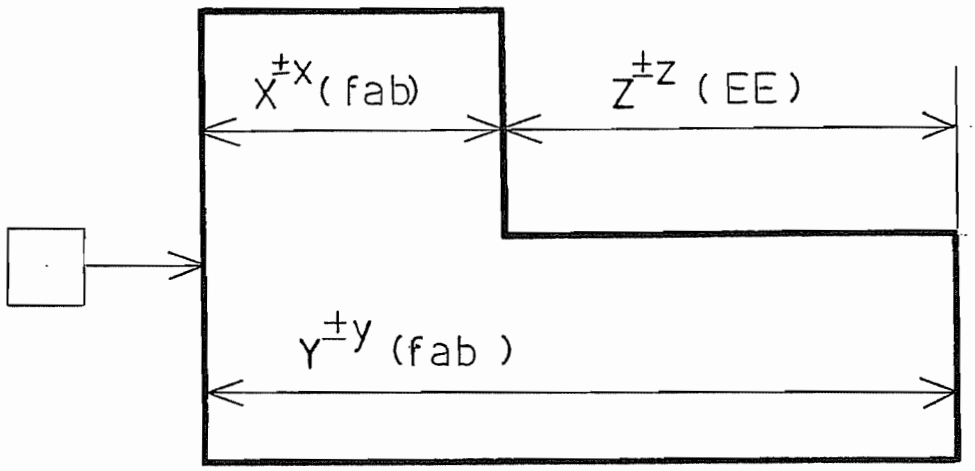


Fig. 11

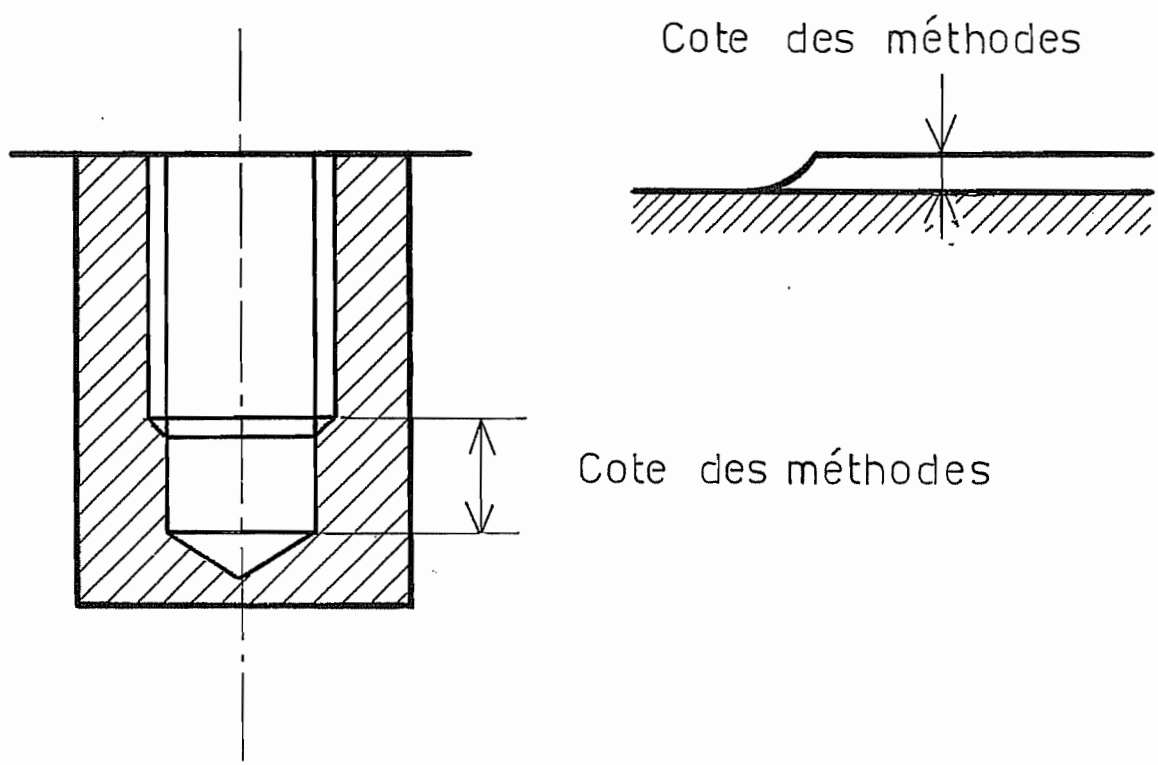


Fig. 12

Transfert de cote

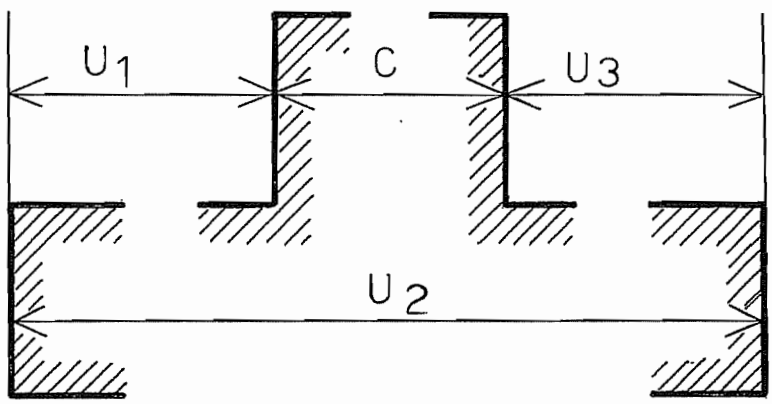
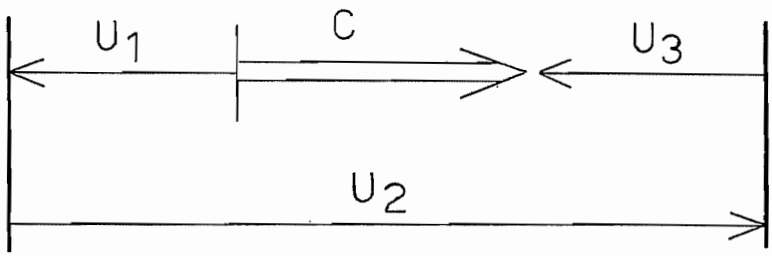


Fig. 13



$$C = -U_1 + U_2 - U_3$$

Fig. 14

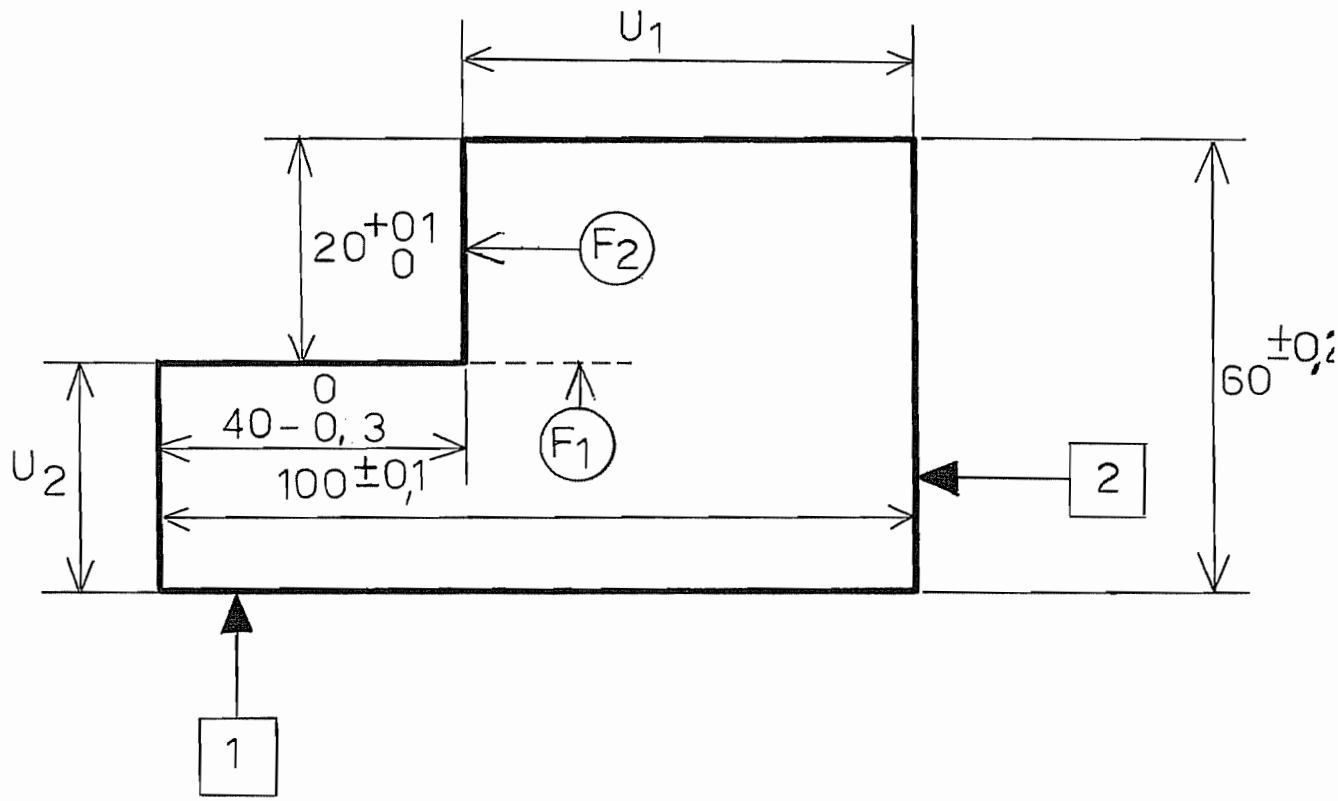


Fig. 15

a) Cote U_1

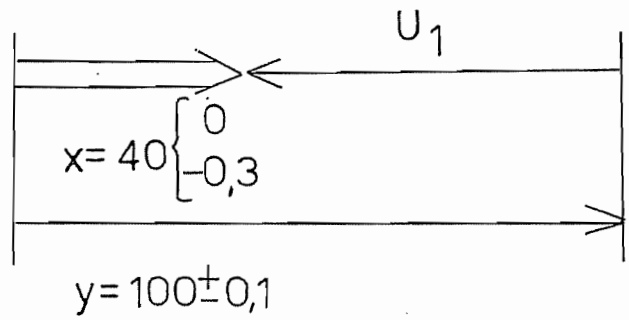


Fig. 16

b) Cote U_2

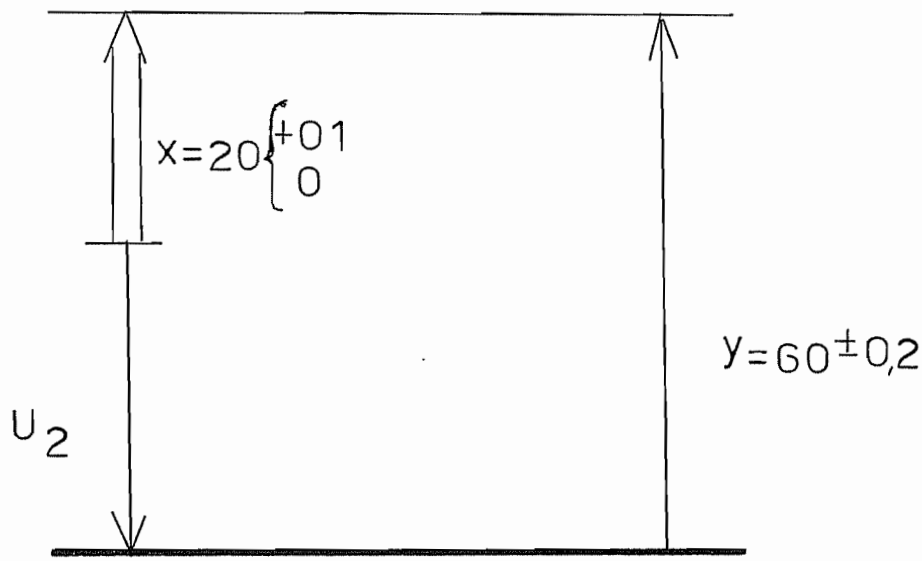


Fig. 17

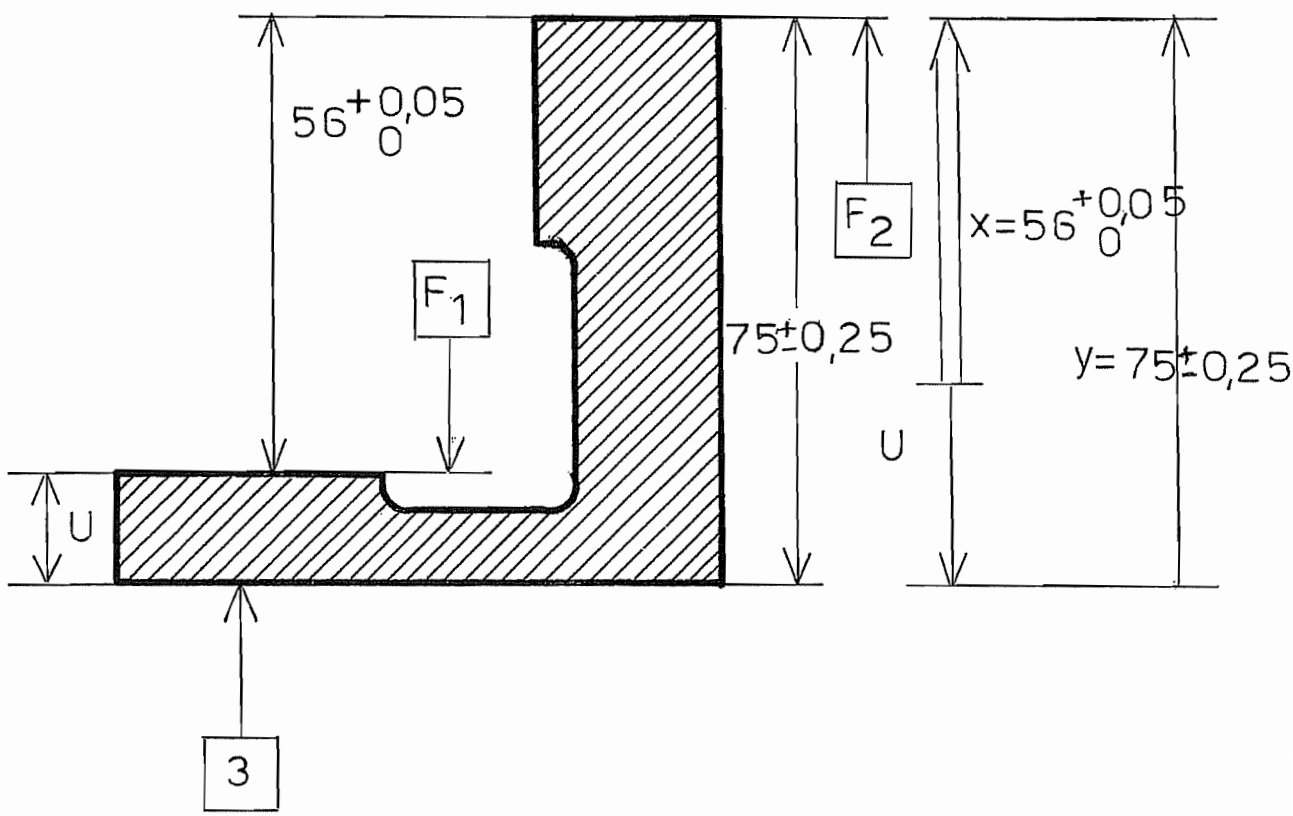


Fig. 18

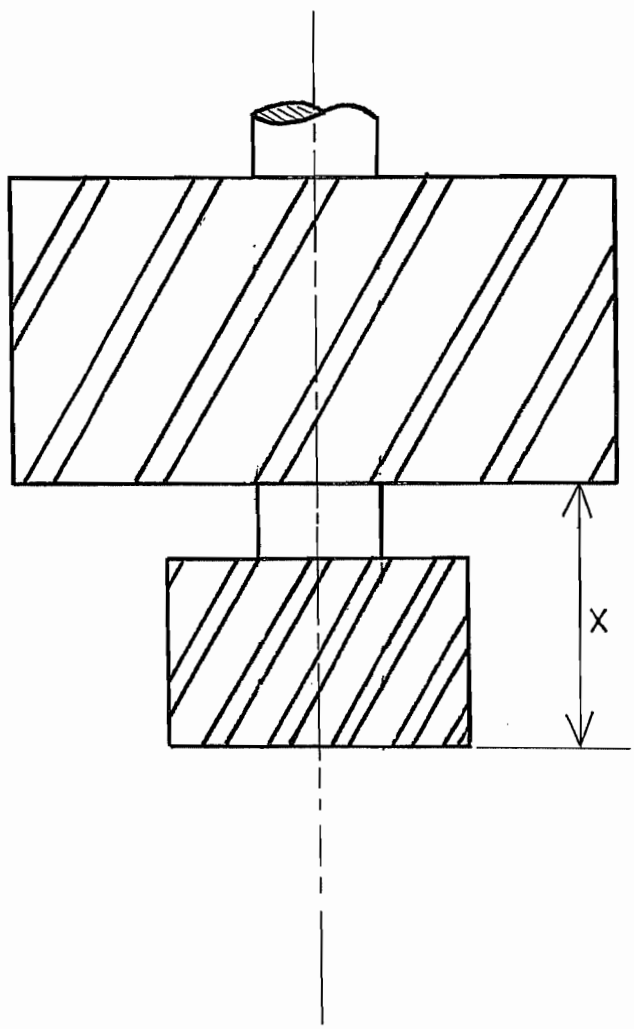


Fig. 19

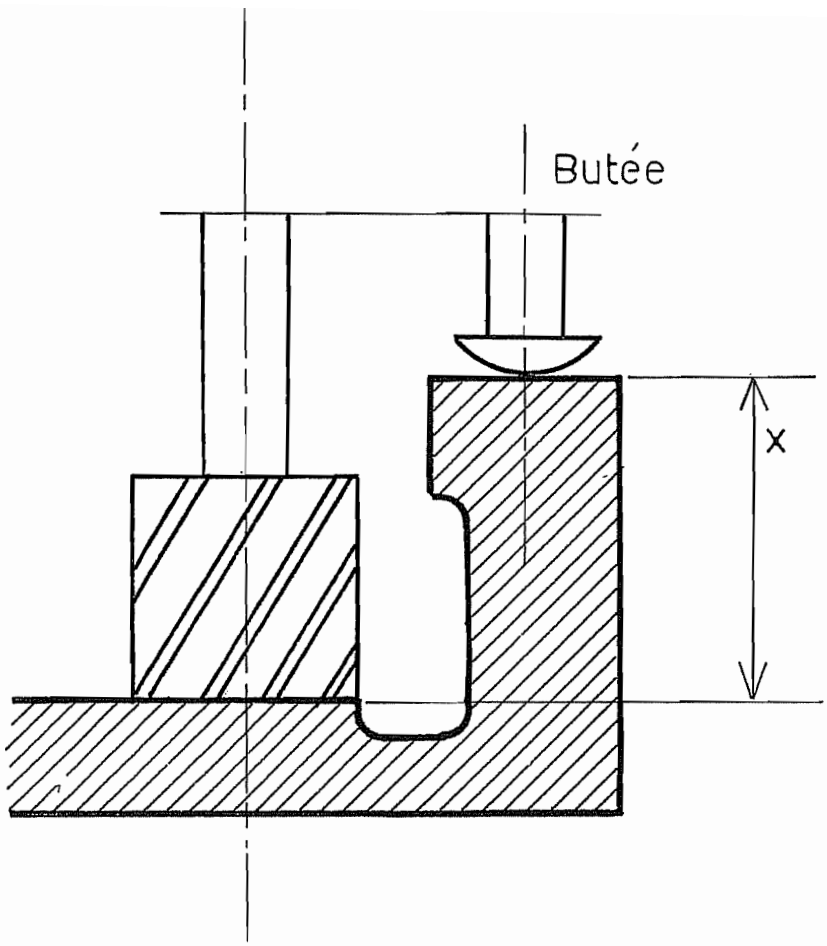


Fig. 20

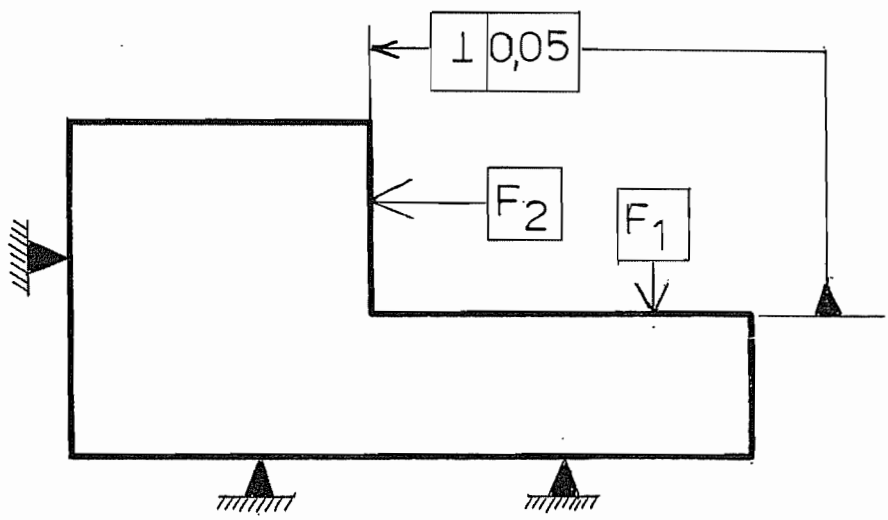


Fig. 21

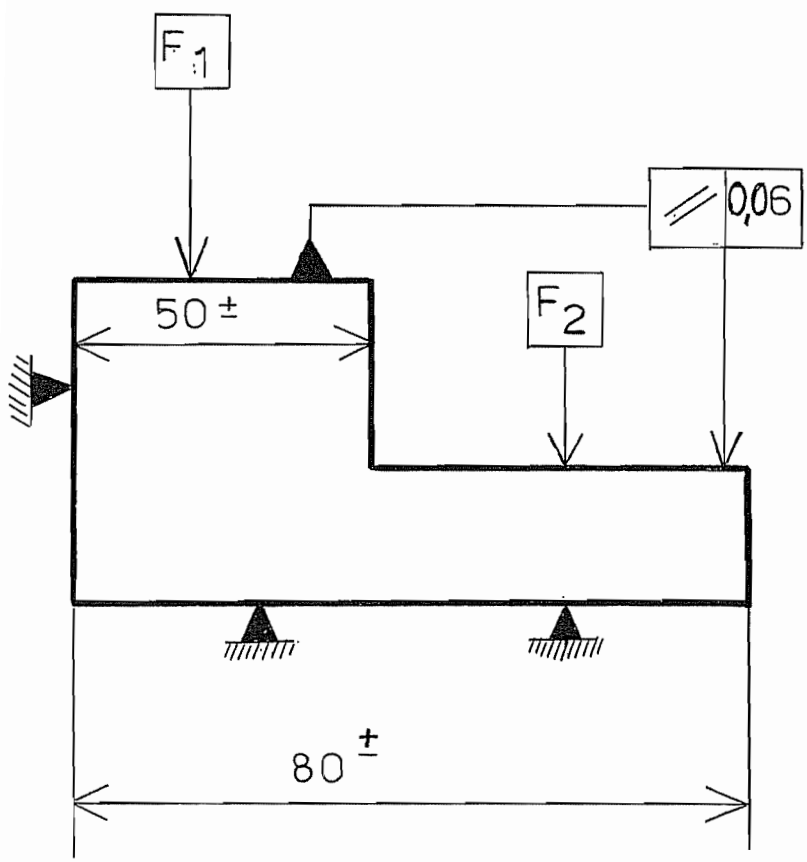


Fig. 22

1er étape ⟶ angle α_1

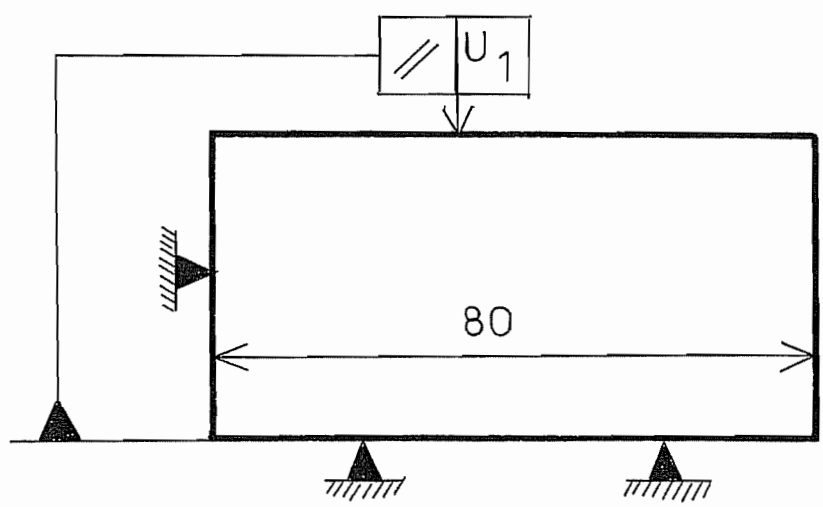


Fig. 23

2ª étape → angle α_2

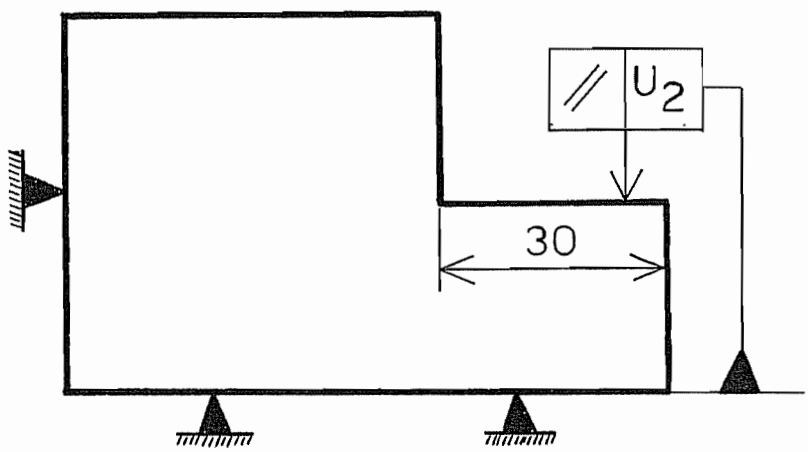


Fig.24

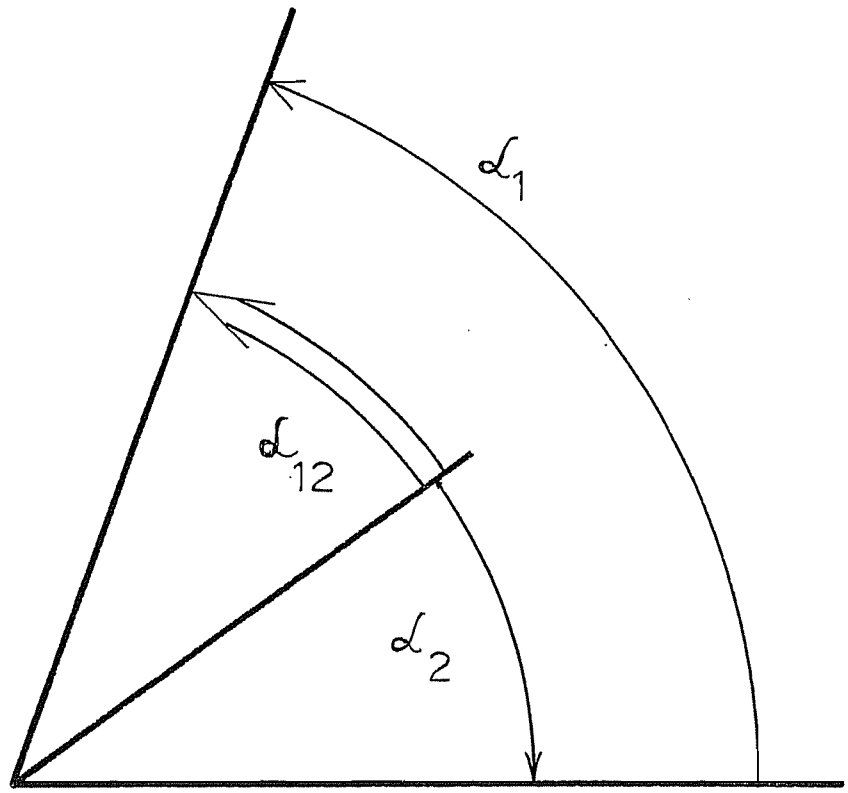


Fig. 25

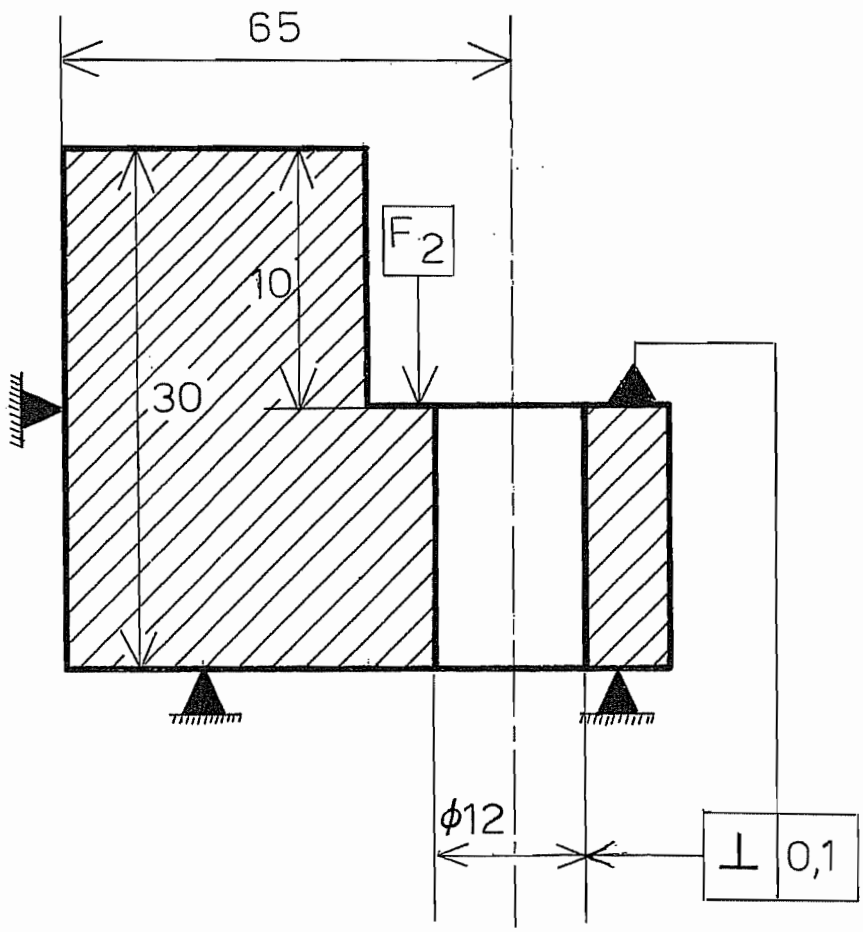


Fig. 26

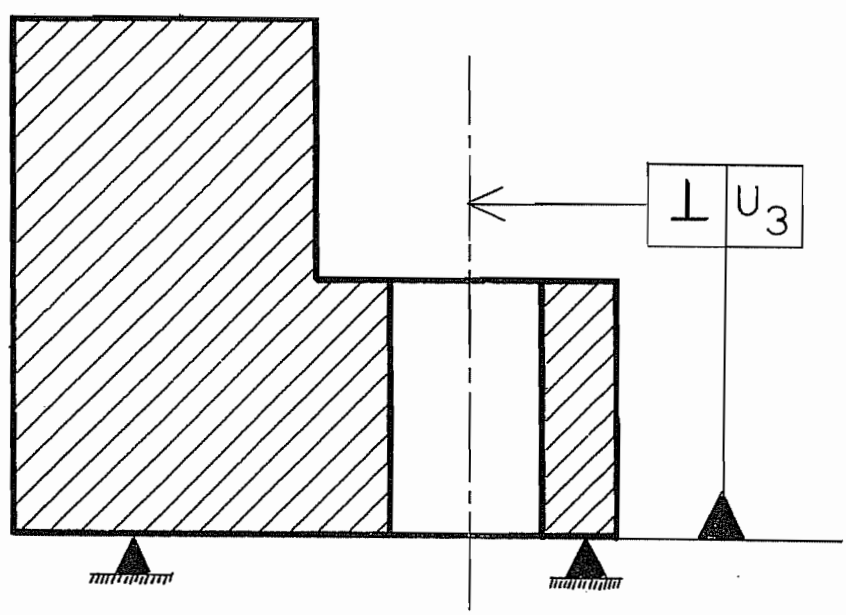


Fig. 27

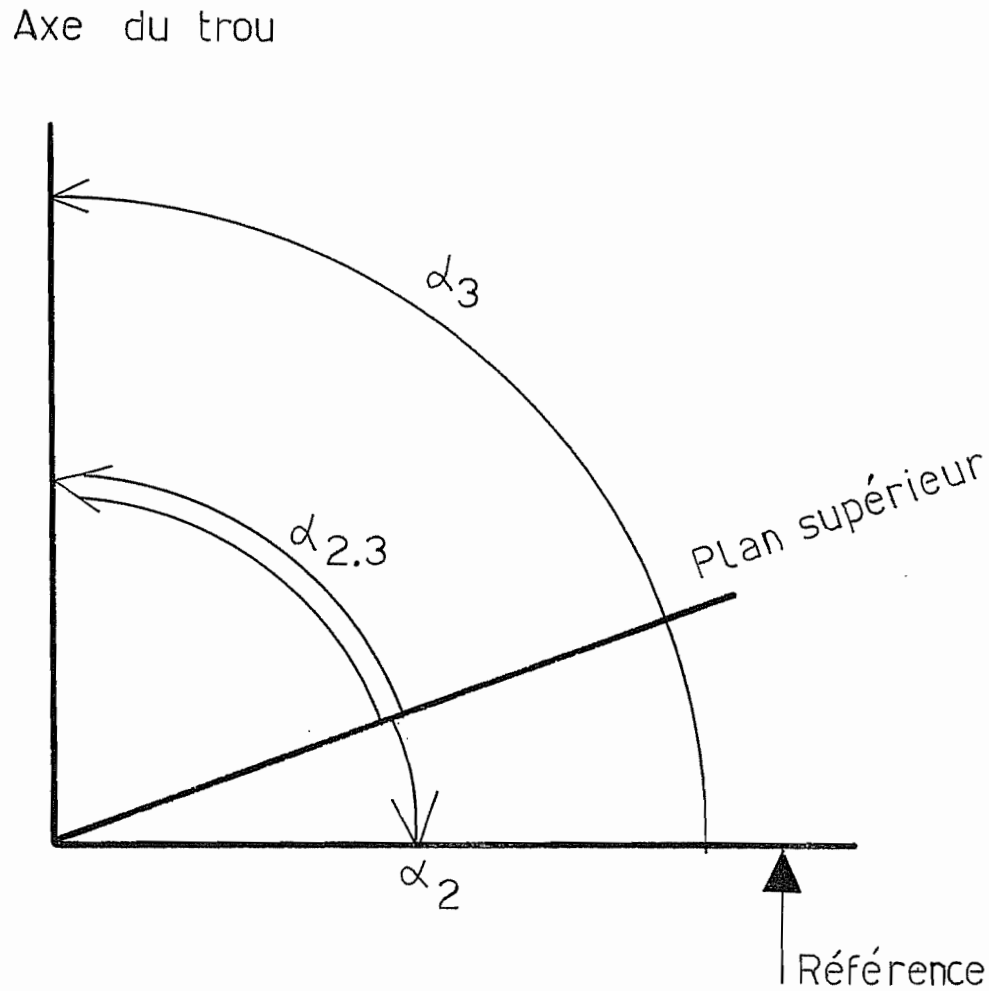

Axe du trou
α_3
$\alpha_{2.3}$
Plan supérieur
α_2
Référence

Fig. 28

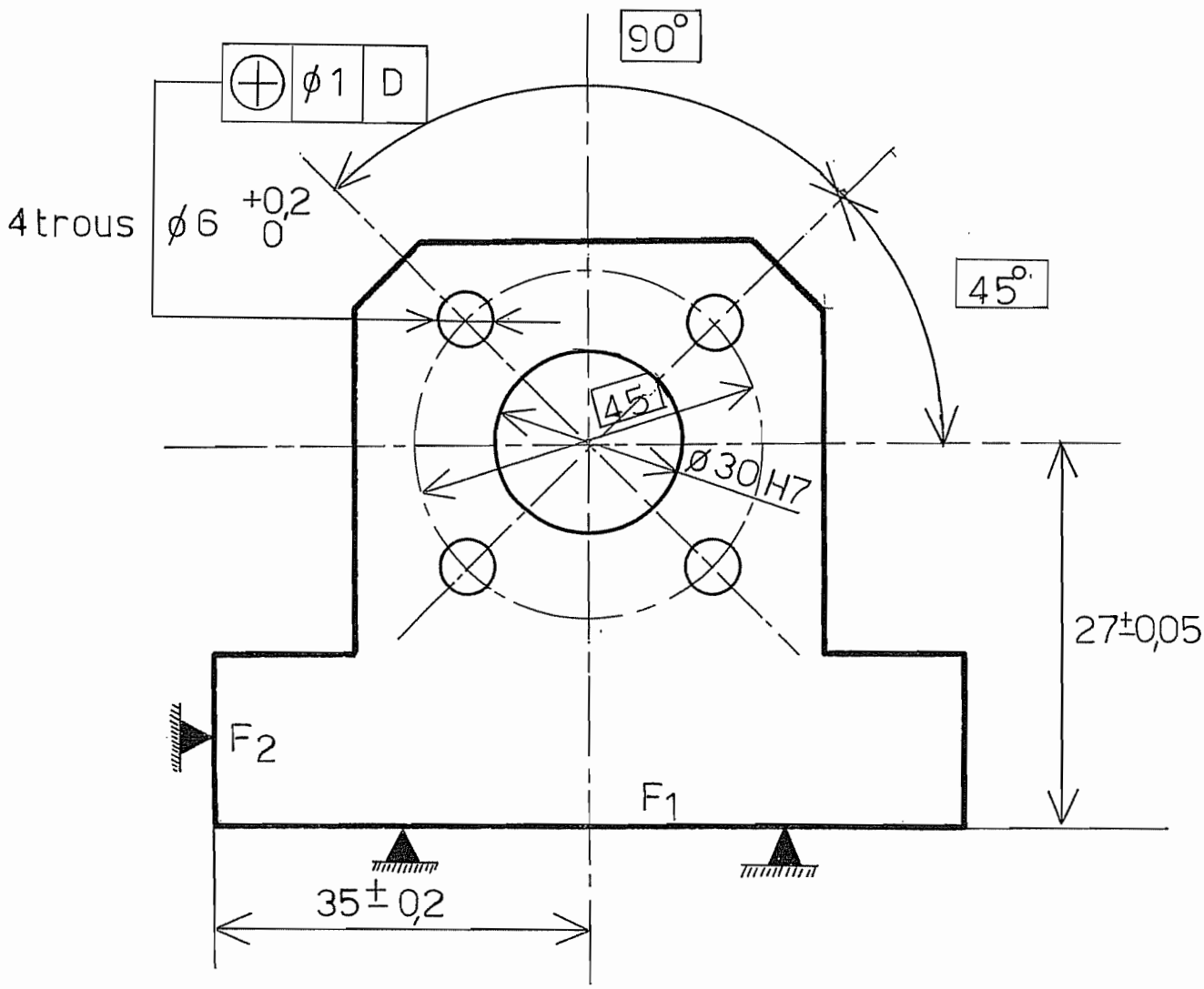


Fig. 29

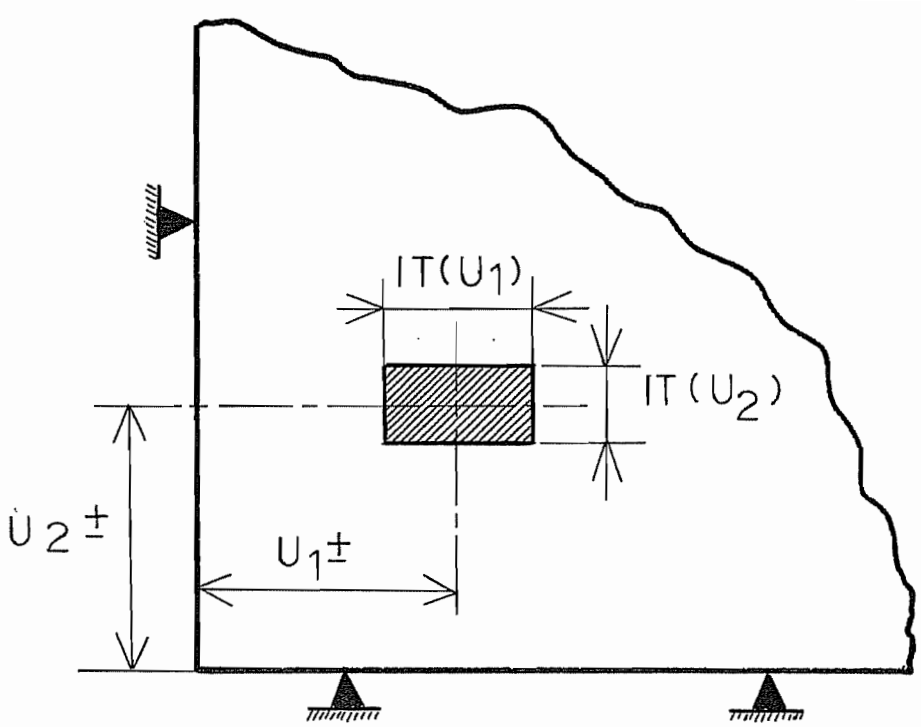
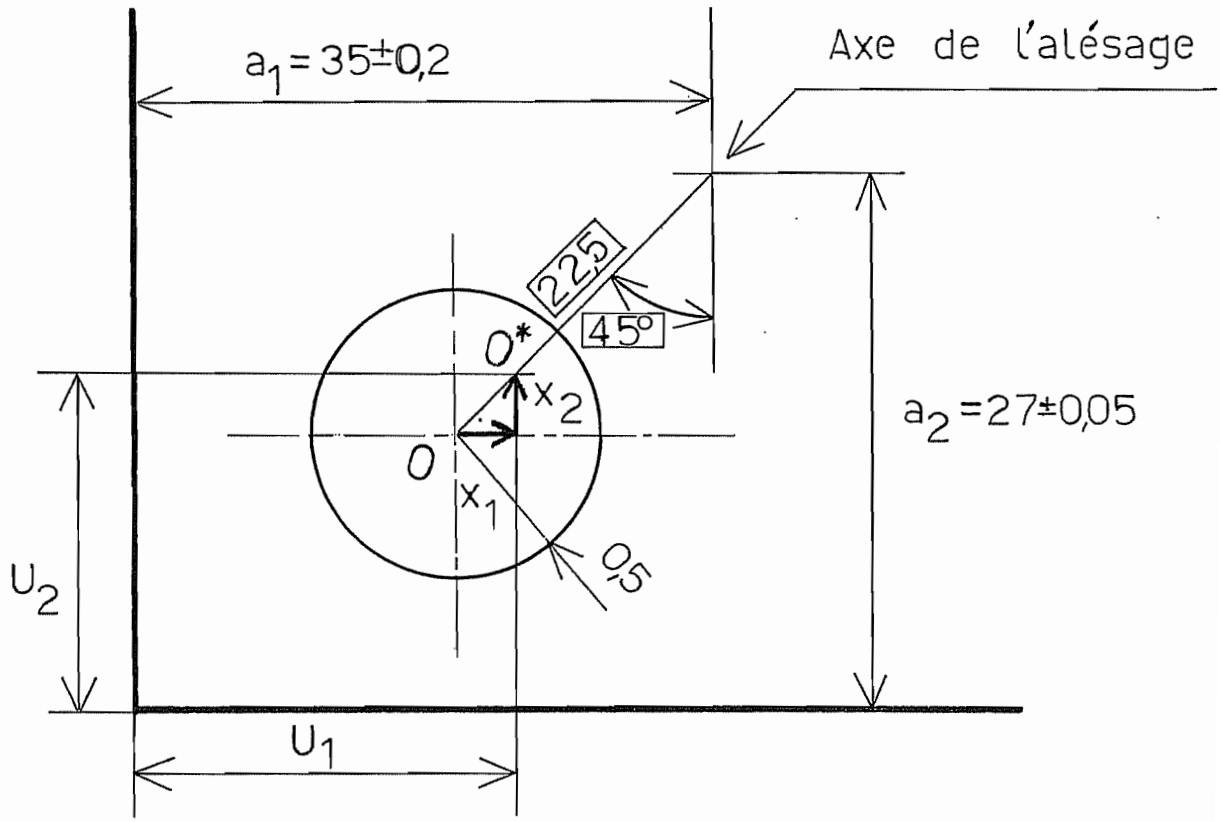


Fig. 30



O : position idéale de l'axe du trou
O* : position réelle de l'axe du trou

Fig. 31

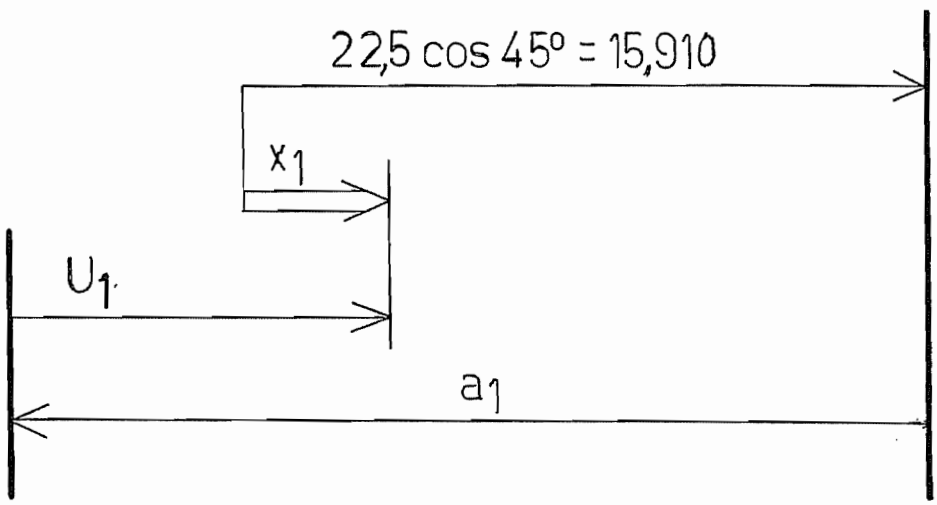


Fig. 32

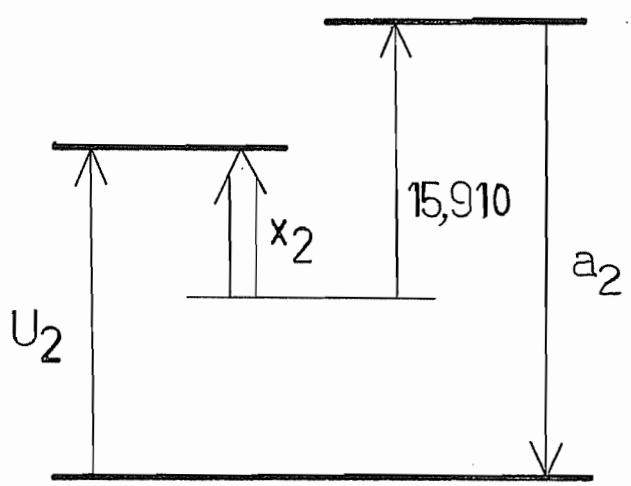


Fig. 33

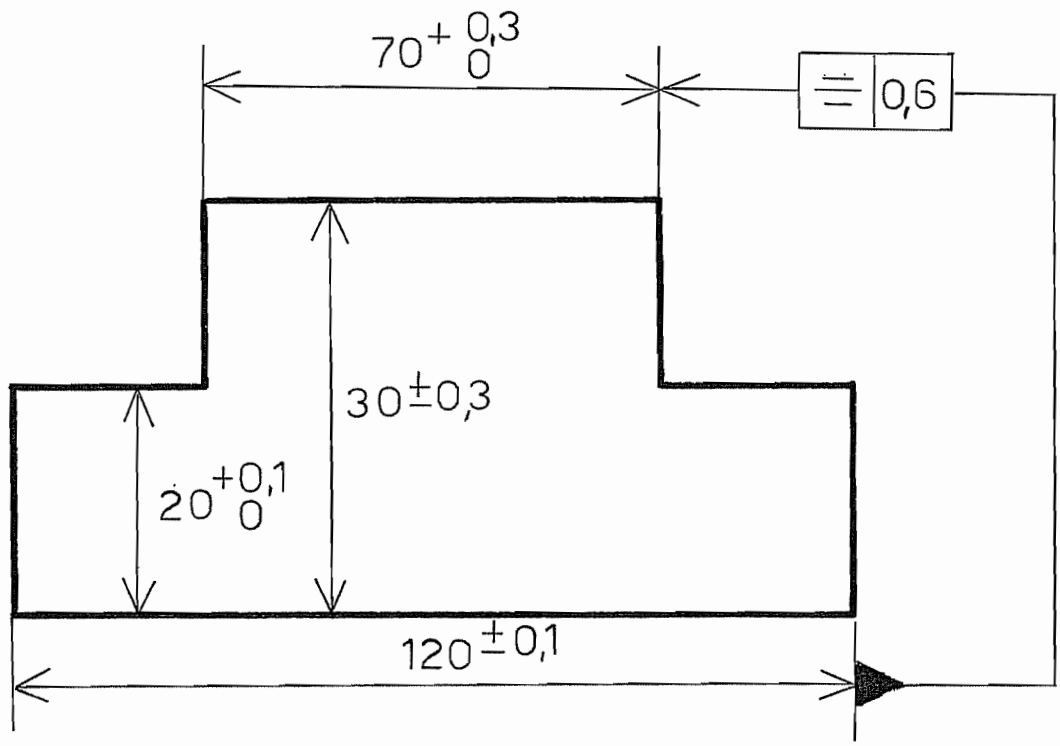


Fig. 34

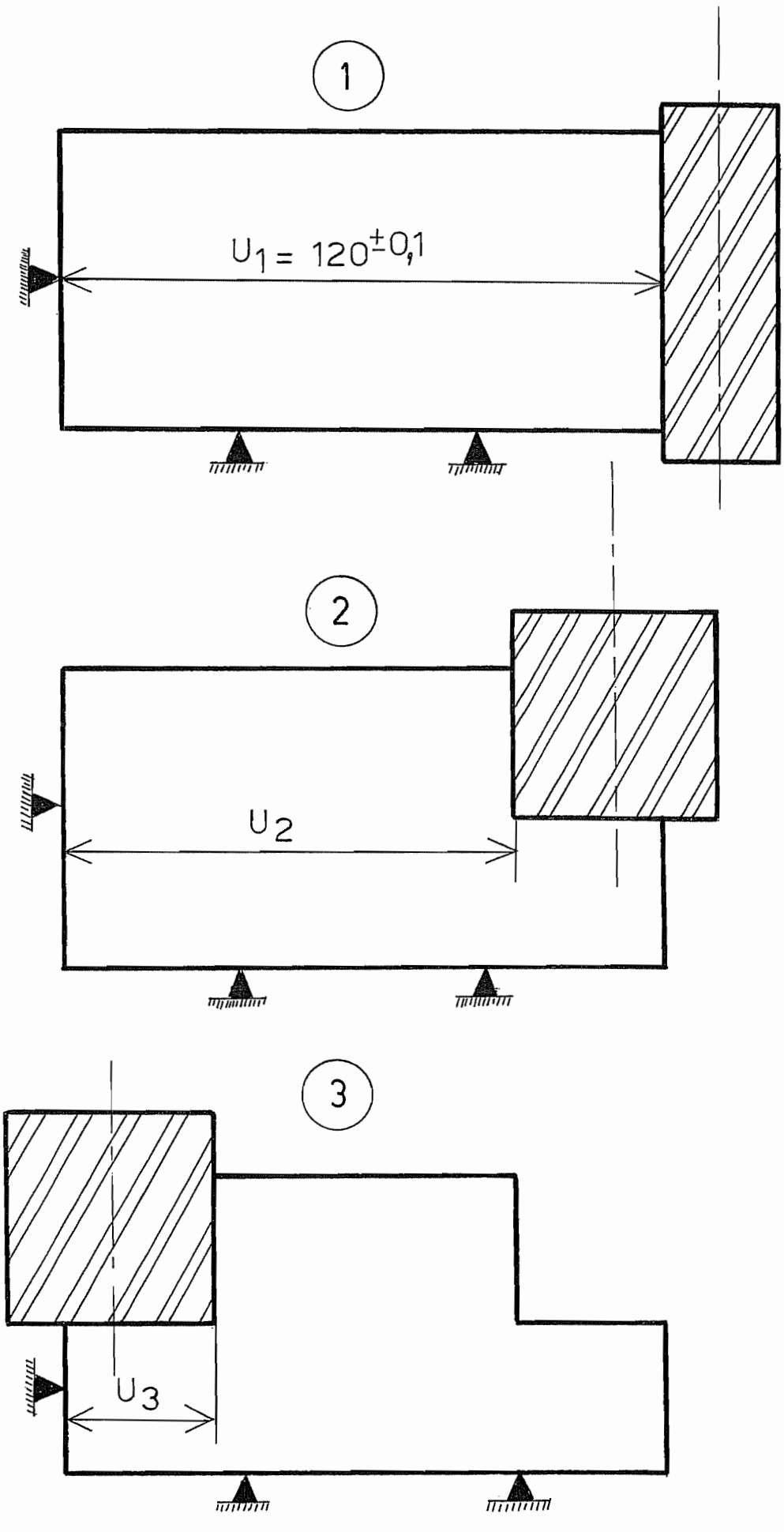


Fig. 35

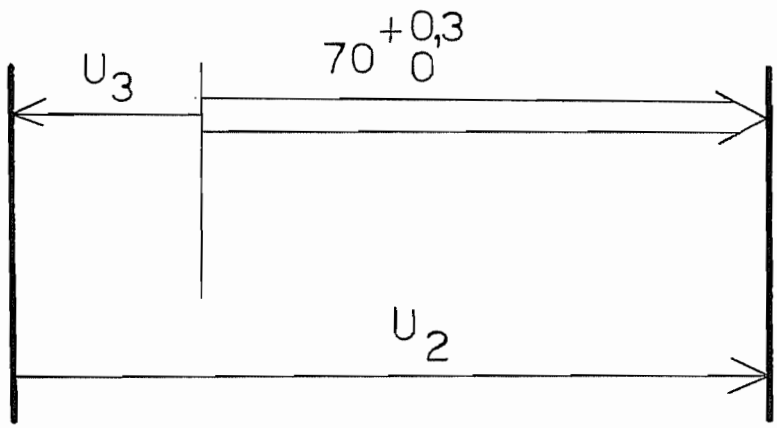


Fig. 36

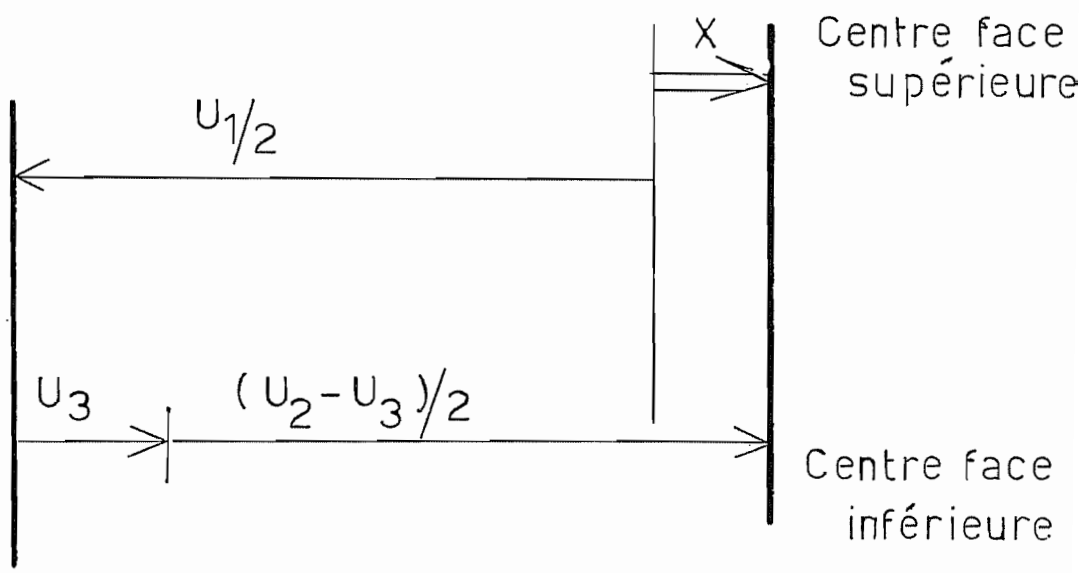

X
Centre face
supérieure
U1/2
U3
(U2-U3)/2
Centre face
inférieure

Fig. 37

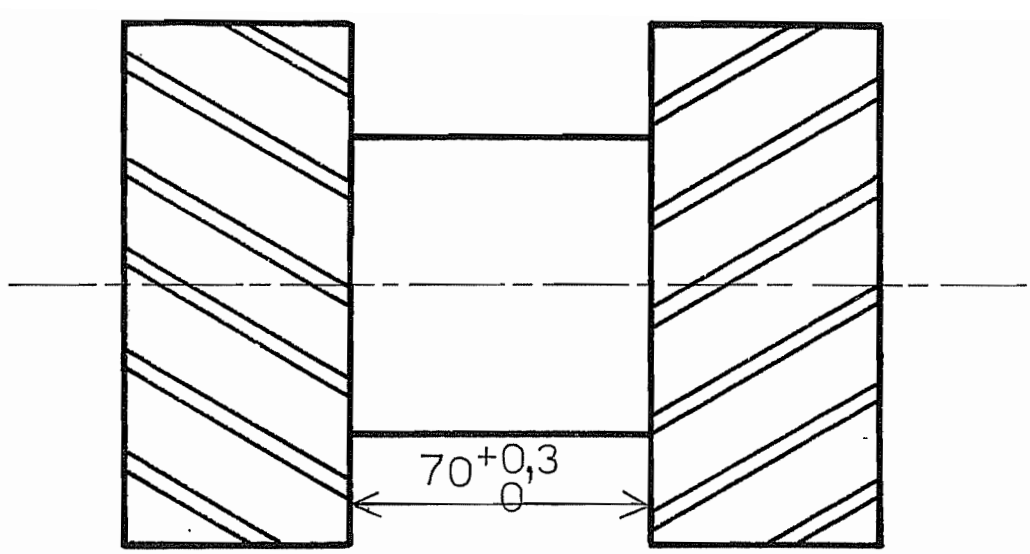


Fig. 38

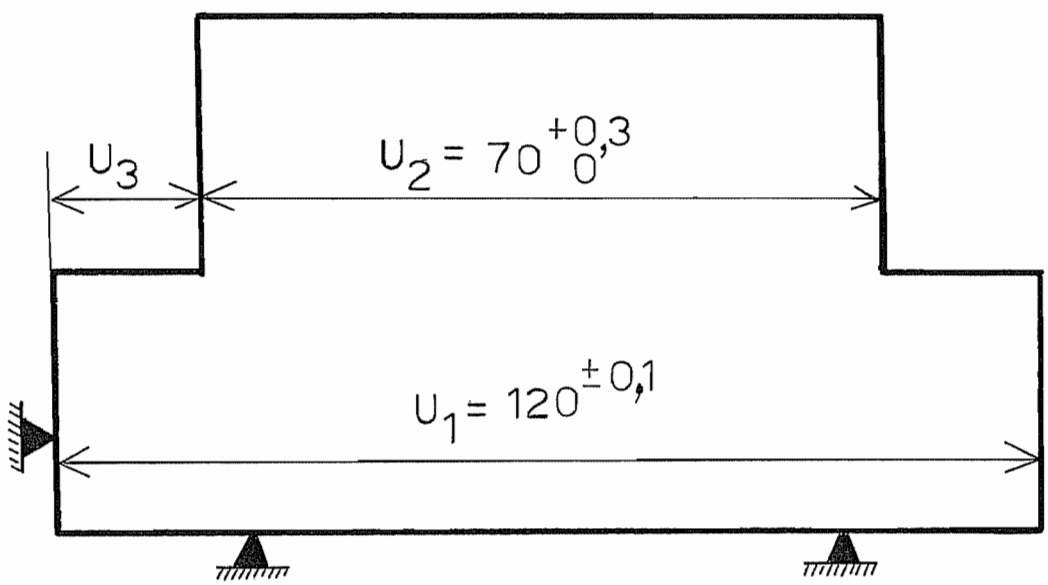


Fig. 39

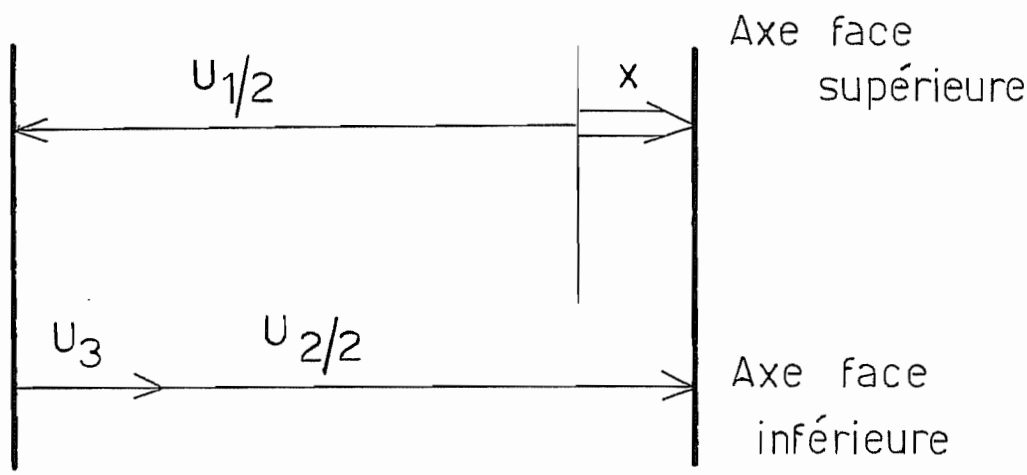


Fig. 40

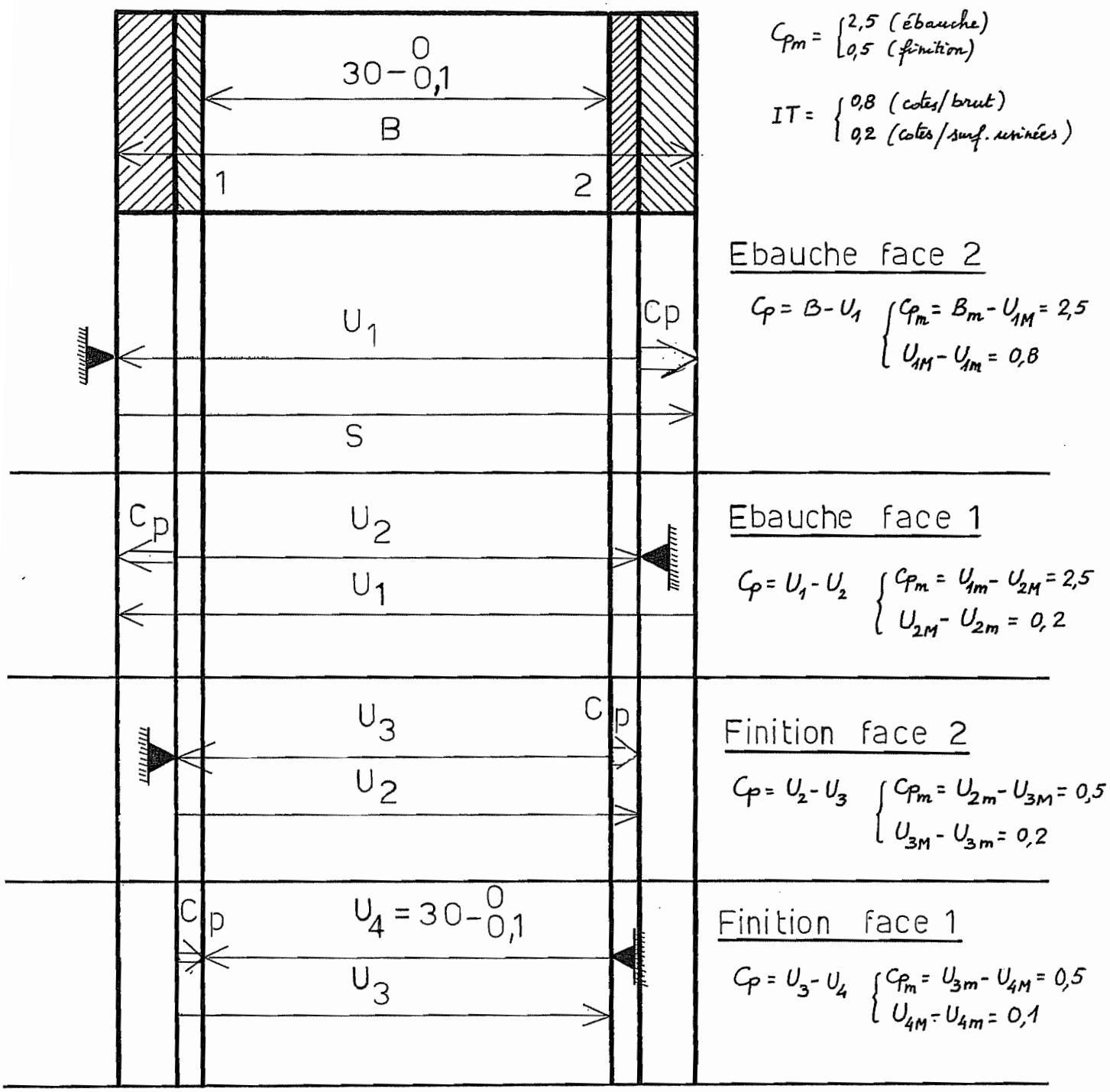

$30^{0}_{-0,1}$
B
1
2
$C_{pm} = \begin{cases} 2,5 \text{ (ébauche)} \\ 0,5 \text{ (finition)} \end{cases}$
$IT = \begin{cases} 0,8 \text{ (cotes/brut)} \\ 0,2 \text{ (cotes/surf. usinées)} \end{cases}$
Ebauche face 2
$C_p = B - U_1$ $\begin{cases} C_{pm} = B_m - U_{1M} = 2,5 \\ U_{1M} - U_{1m} = 0,8 \end{cases}$
U_1
Cp
S
Ebauche face 1
$C_p = U_1 - U_2$ $\begin{cases} C_{pm} = U_{1m} - U_{2M} = 2,5 \\ U_{2M} - U_{2m} = 0,2 \end{cases}$
Cp
U_2
U_1
Finition face 2
$C_p = U_2 - U_3$ $\begin{cases} C_{pm} = U_{2m} - U_{3M} = 0,5 \\ U_{3M} - U_{3m} = 0,2 \end{cases}$
U_3
Cp
U_2
Finition face 1
$C_p = U_3 - U_4$ $\begin{cases} C_{pm} = U_{3m} - U_{4M} = 0,5 \\ U_{4M} - U_{4m} = 0,1 \end{cases}$
Cp
$U_4 = 30^{0}_{-0,1}$
U_3

Fig. 41

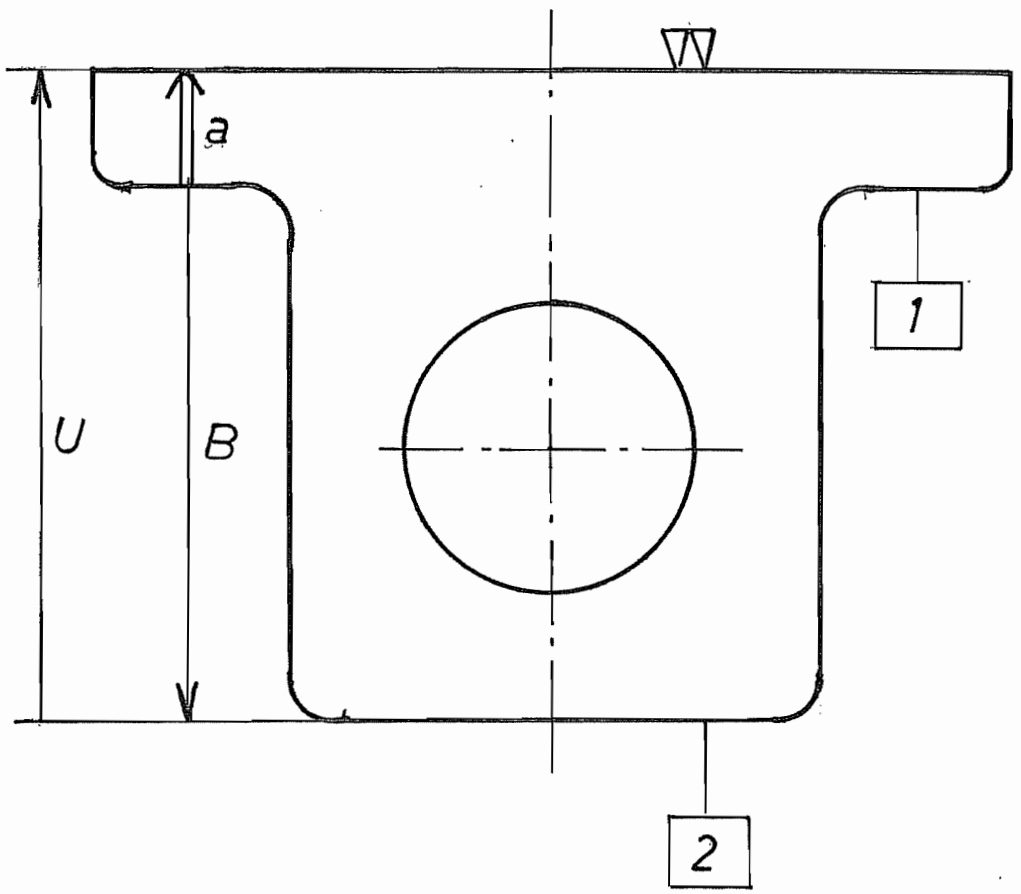
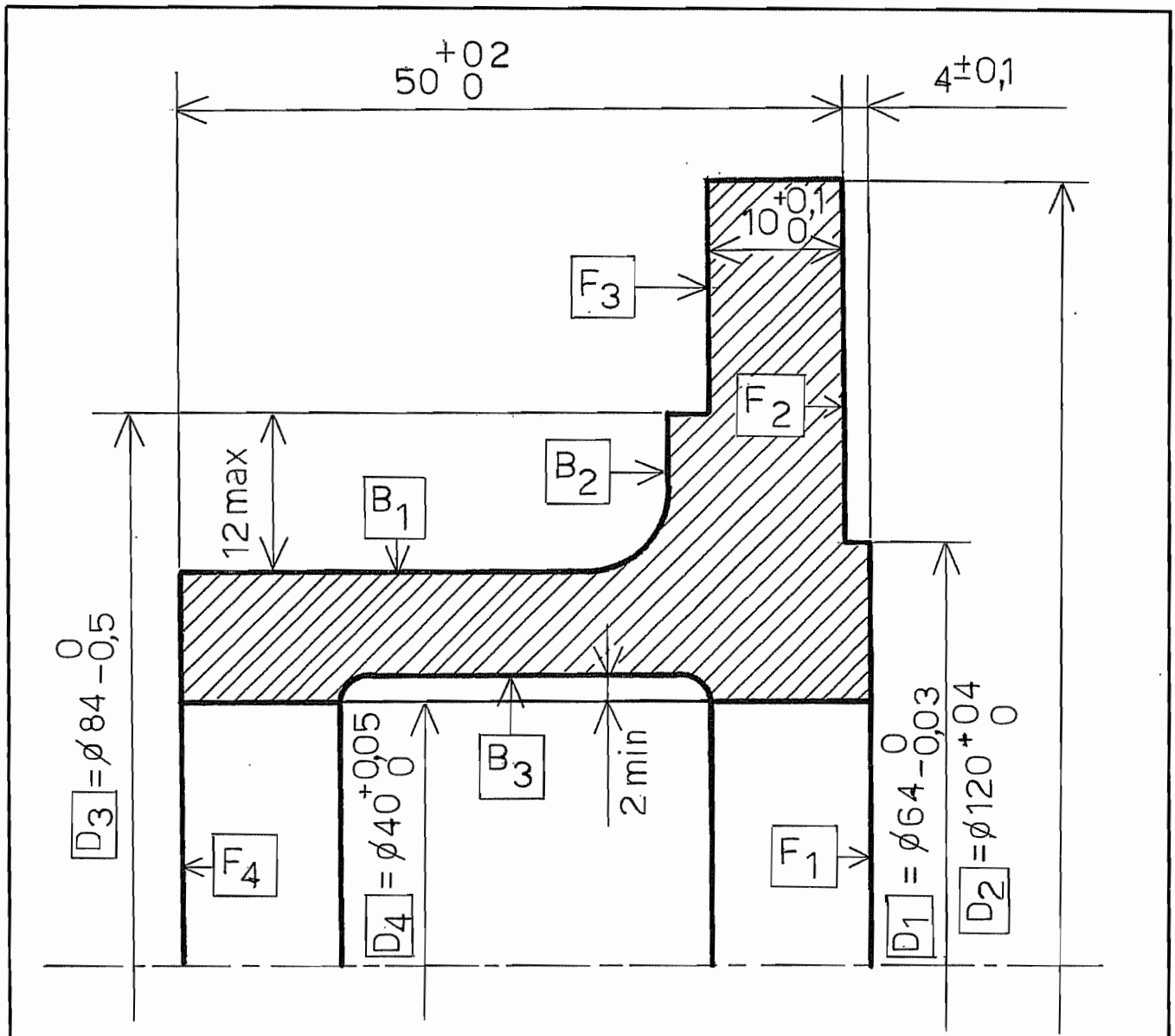


Fig. 42

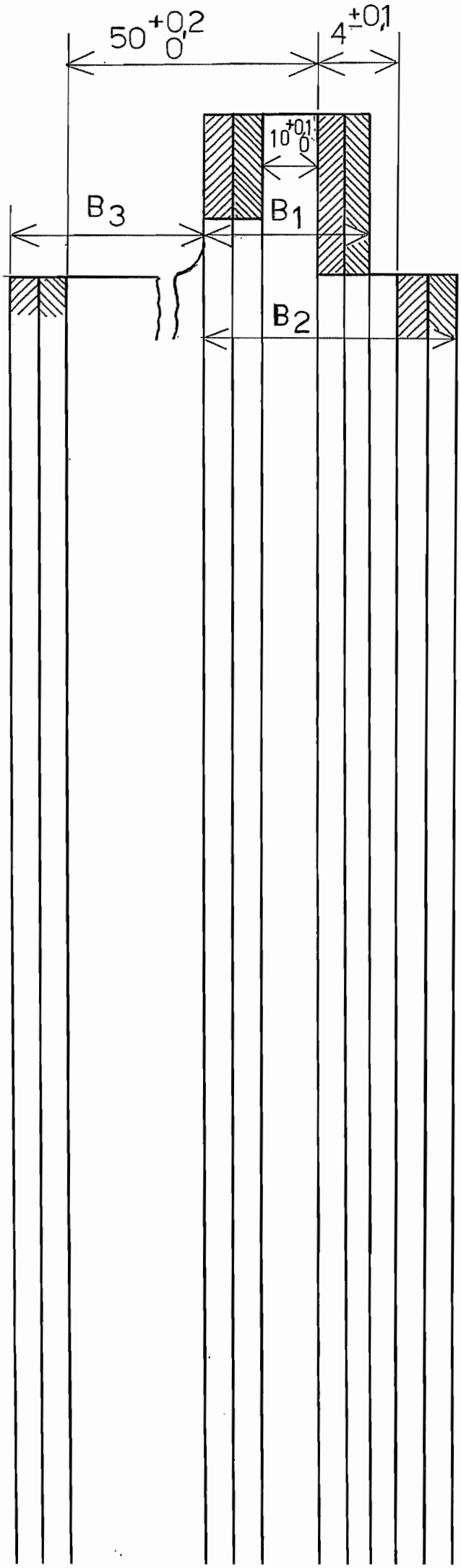


D1	◎	ø 1,5	B1
D2	◎	ø 0,5	D1
D3	◎	ø 0,5	D1
D4	⊥	0,05	F2
D4	◎	ø 0,05	D1

FLASQUE - Ft 20

Ech 2/1

Fig. 43

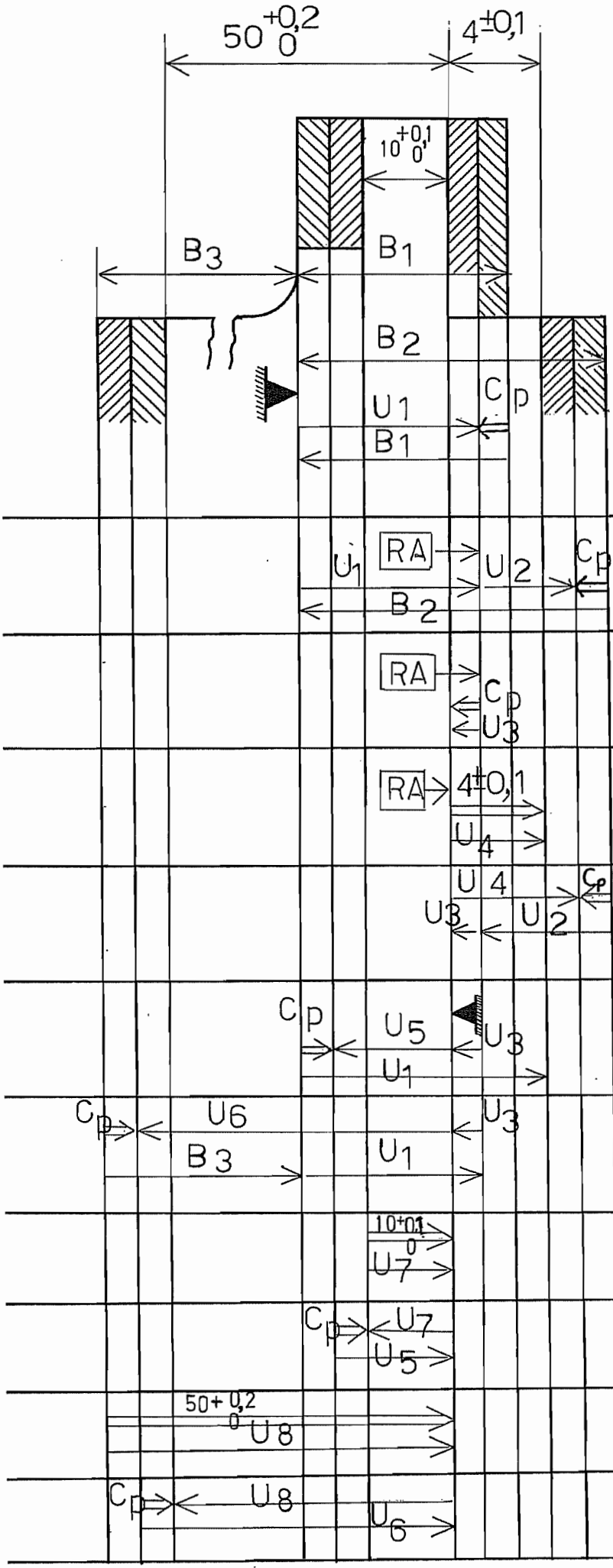


COTES AXIALES

$$Cpm = \begin{cases} 0,5 \text{ finition} \\ 2 \text{ dégrossissage} \end{cases}$$

$$IT = \begin{cases} 0,8 \text{ dégrossissage} \\ 0,2 \text{ finition} \end{cases}$$

Fig. 44



COTES AXIALES

$$Cpm = \begin{cases} 0\,5 \text{ finition} \\ 2 \text{ dégrossissage} \end{cases}$$

$$IT = \begin{cases} 0{,}8 \text{ (dégr)} \rightarrow \text{si réf = suif brute} \\ 0{,}2 \text{ (finition)} \end{cases}$$

Phase 10

$C_{pm} = B_{1m} - U_{1M} = 2$ (a)

$IT(U_1) = 0{,}8$

Réf. aux. = F2 dégrossie

$C_{pm} = B_{2m} - U_{1M} - U_{2M} = 2$ (b)

$IT(U_2) = 0{,}2$

Idem ⇒ U_3 cote directe

$C_{pm} = U_{3m} = 0{,}5$

$IT(U_3) = 0{,}2$

$U_3 = 0{,}5\ ^{+0,2}_{0}$

Réf. aux. = F2 finie ⇒ U_4 cote directe

$U_4 = 4 \pm 0{,}1$

$C_{pm} = U_{2m} + U_{3m} - U_{4M} = 0{,}5$

$U_{2m} = 0{,}5 - 0{,}5 + 4{,}1 = 4{,}1$

$U_2 = 4{,}1\ ^{+0,2}_{0}$

Phase 20

$C_{pm} = U_{1m} - U_{3M} - U_{5M} = 2$ (c)

$IT(U_5) = 0{,}2$

$C_{pm} = B_{3m} + U_{1m} - U_{3M} - U_{6M} = 2$ (d)

$IT(U_6) = 0{,}2$

$U_7 = 10\ ^{+0,1}_{0}$ Cote directe

$C_{pm} = U_{5m} - U_{7M} = 0{,}5$ $U_{5m} = 0{,}5 + 10{,}1 = 10{,}6$

$U_5 = 10{,}6\ ^{+0,2}_{0}$

$U_8 = 50\ ^{+0,2}_{0}$

$C_{pm} = U_{6m} - U_{8M} = 0{,}5$ $U_{6m} = 0{,}5 + 50{,}2 = 50{,}7$

$U_6 = 50{,}7\ ^{+0,2}_{0}$

Fig. 45

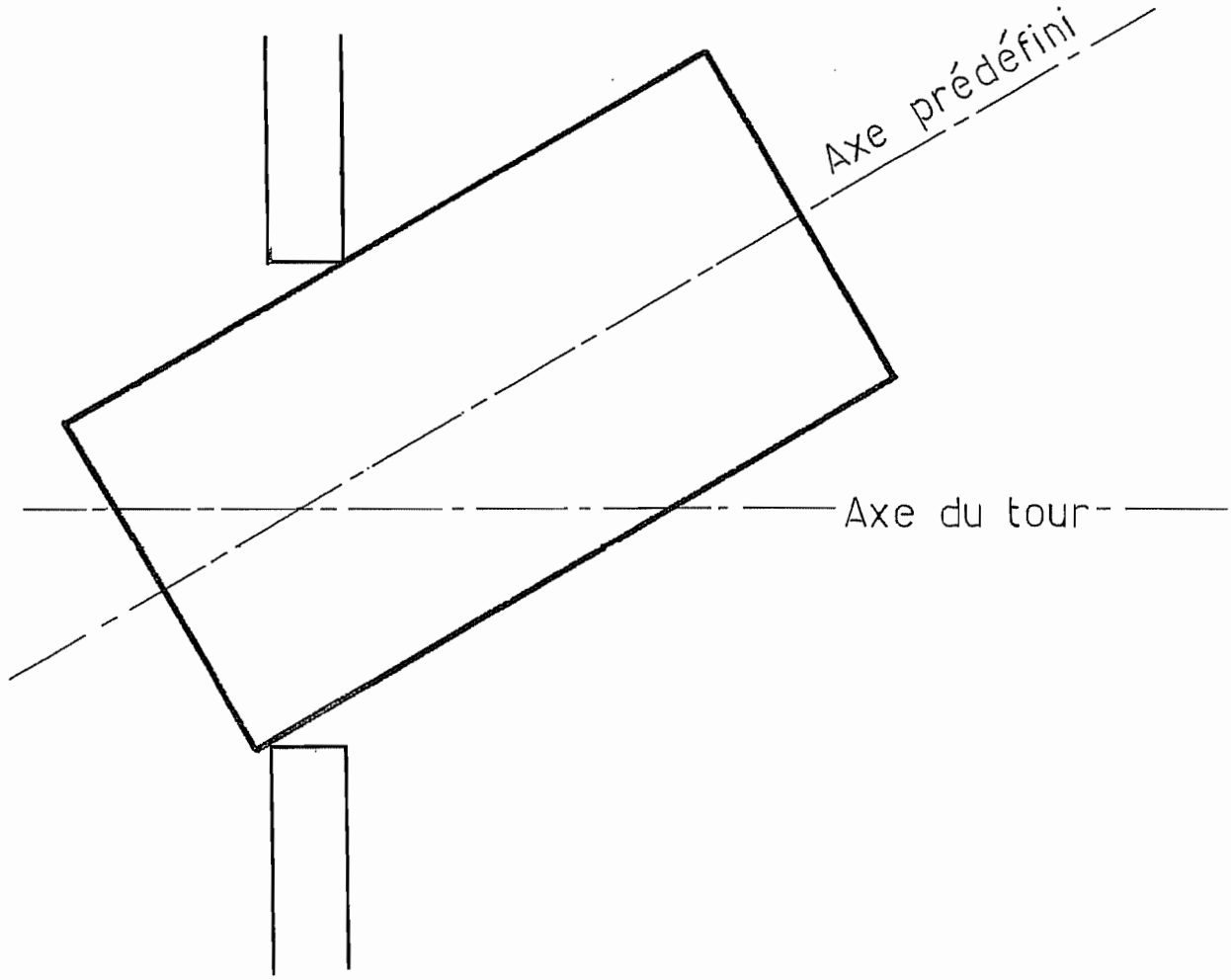
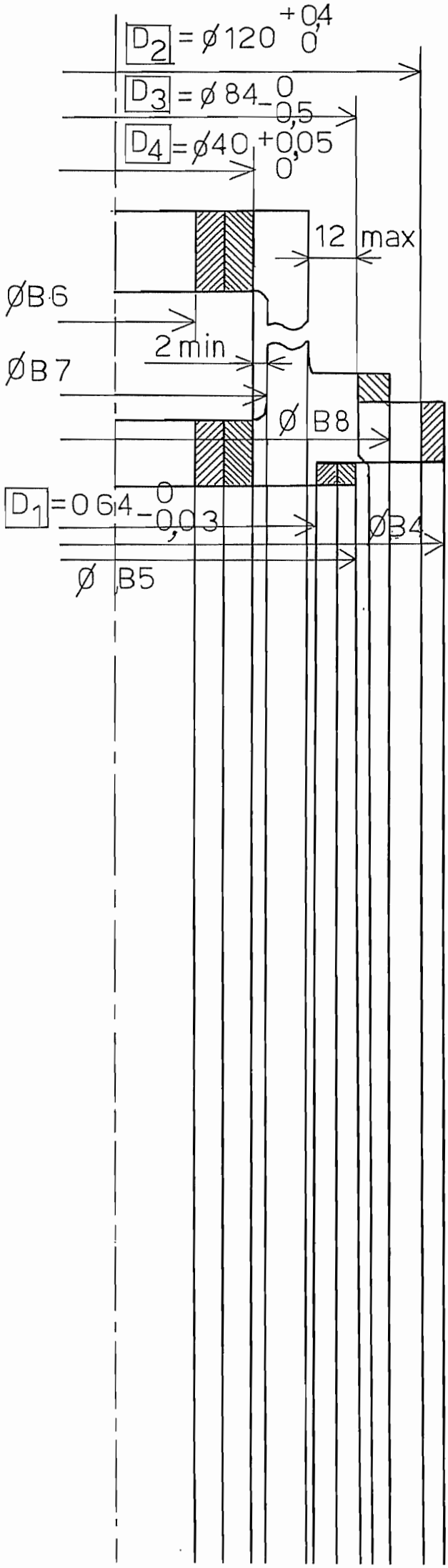


Fig. 46



COTES RADIALES

D_1	◎	ø 1,5	B_1
D_2	◎	ø 0,5	D_1
D_3	◎	ø 0,5	D_1
D_4	⊥	0,05	F_2
D_4	◎	ø 0,05	D_1

Cpm = { 0,5 finition
2 dégrossissage

I.T = { 02 finition
0,8 dégrossissage

Fig. 47

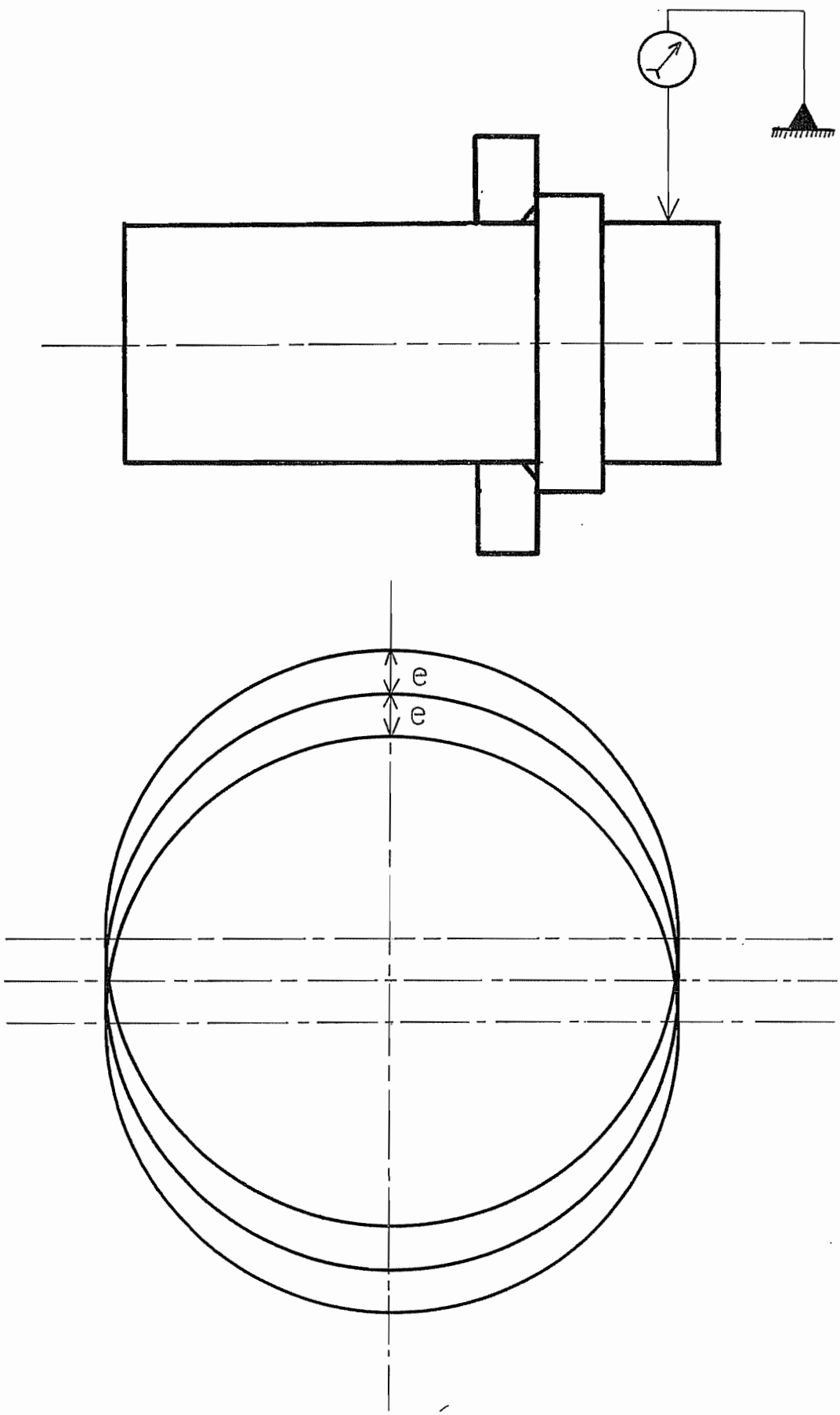
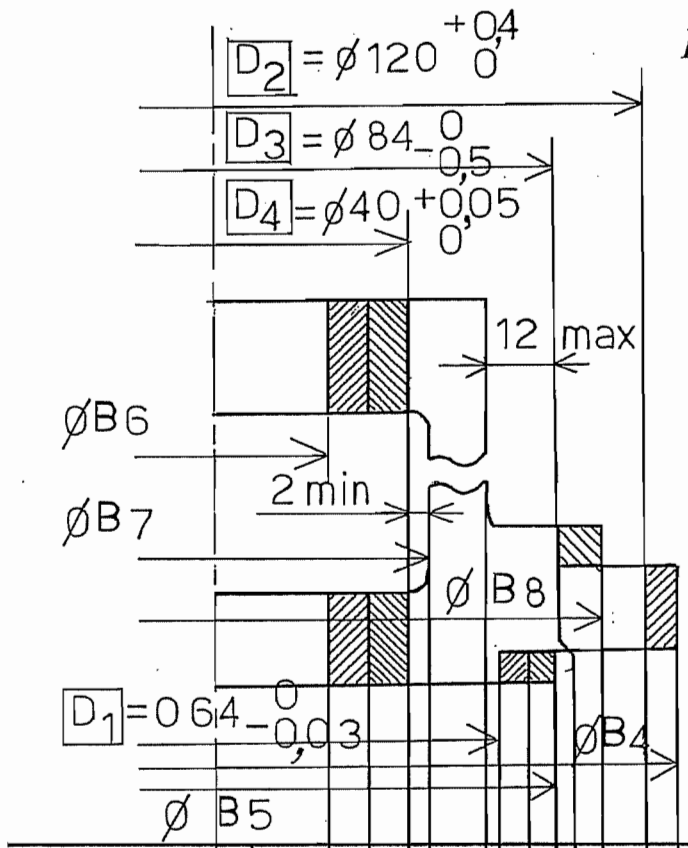


Fig. 48

COTES RADIALES

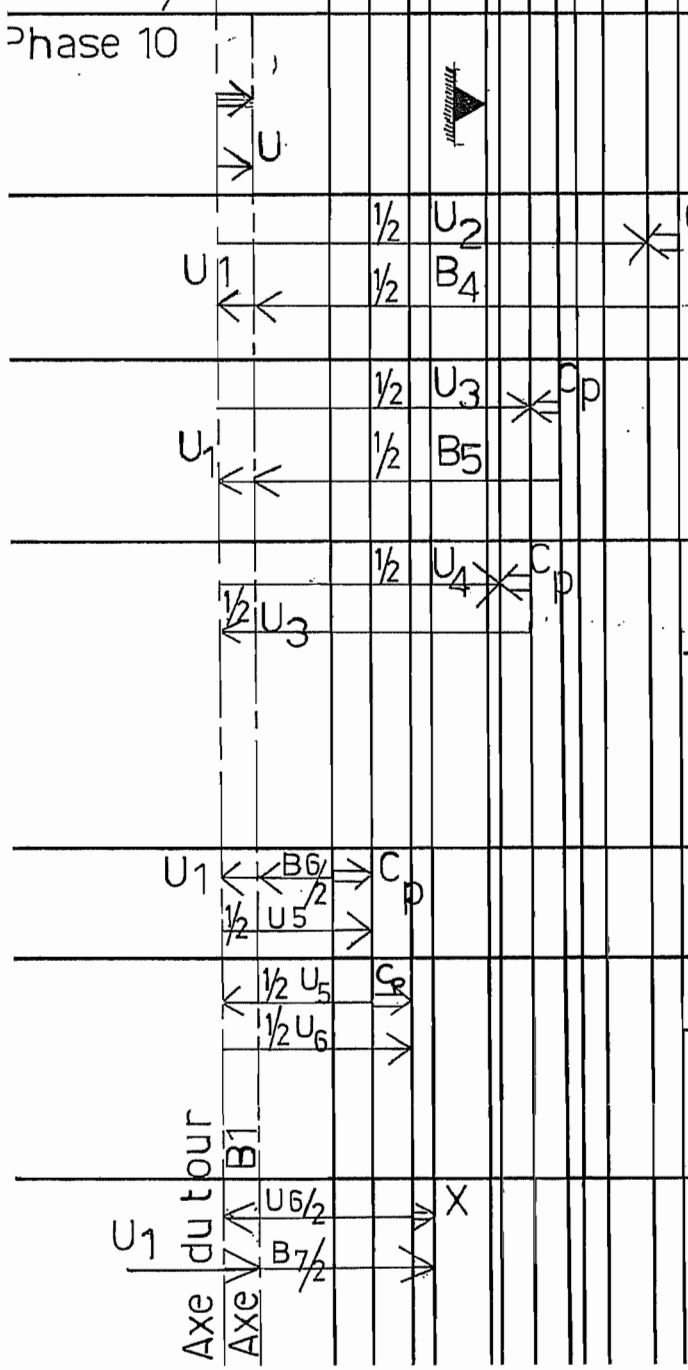
Fig. 49



D_1	◎	ø 1,5	B_1
D_2	◎	ø 0,5	D_1
D_3	◎	ø 0,5	D_1
D_4	⊥	0,05	F_2
D_4	◎	ø 0,05	D_1

$$Cpm = \begin{cases} 0\,5 \text{ finition} \\ 2 \text{ dégrossissage} \end{cases}$$

$$IT = \begin{cases} 0{,}8 \text{ dégrossissage} \\ 0{,}2 \text{ finition} \end{cases}$$



D_1	◎	ø1,5	B_1

$U_1 = 0 \pm 0{,}75$ cote directe

$C_{pm} = \frac{1}{2} B_{4m} + U_{1m} - \frac{1}{2} U_{2M} = 2$ (part du brut) $\quad U_2 = 120^{+0,4}_{0}$

$B_{4m} = 4 - 2(-0{,}75) + 120{,}4 = 125{,}9 \quad B_4 = 125{,}9$ min

$C_{pm} = \frac{1}{2} B_{5m} + U_{1m} - \frac{1}{2} U_{3M} = 2$

$= \frac{1}{2} B_{5m} - 0{,}75 - \frac{1}{2} U_{3M} = 2$

$IT(U_3) = 0{,}8$

$C_{pm} = \frac{1}{2} U_{3m} - \frac{1}{2} U_{4M} = 0{,}5$

$U_{3m} = U_{4M} + 1 = 65 \quad U_4 = 64^{0}_{-0,03}$

Calcul : $U_{3M} = 65 + 0{,}8 = 65{,}8 \quad U_3 = 65^{+0,8}_{0}$

$B_{5m} = 1{,}5 + U_{3M} + 4 = 1{,}5 + 65{,}8 + 4 = 71{,}3$

$B_5 = 71{,}3$ min

$C_{pm} = \frac{1}{2} U_{5m} - U_{1m} - \frac{1}{2} B_{6M} = 2$

$IT(U_5) = 0{,}8$

$C_{pm} = \frac{1}{2} U_{6m} - \frac{1}{2} U_{5M} = 0{,}5 \quad U_6 = 40^{+0,05}_{0}$

Calcul : $U_{5M} = U_{6m} - 1 = 40 - 1 = 39 \quad U_5 = 39^{+0}_{-0,8}$

$B_{6M} = U_{5m} - 2U_{1m} - 4 = 38{,}2 - 2(-0{,}75) - 4 = 32{,}7 \quad B_6 = 32{,}7$ max

$x_m = 2$

$x_m = \frac{1}{2} B_{7m} + U_{1m} - \frac{1}{2} U_{6M}$

$B_{7m} = 2x_m - 2U_{1m} + U_{6M} = 4 - 2(-0{,}75) + 40{,}05 = 45{,}55 \quad B_7 = 45{,}55$ min

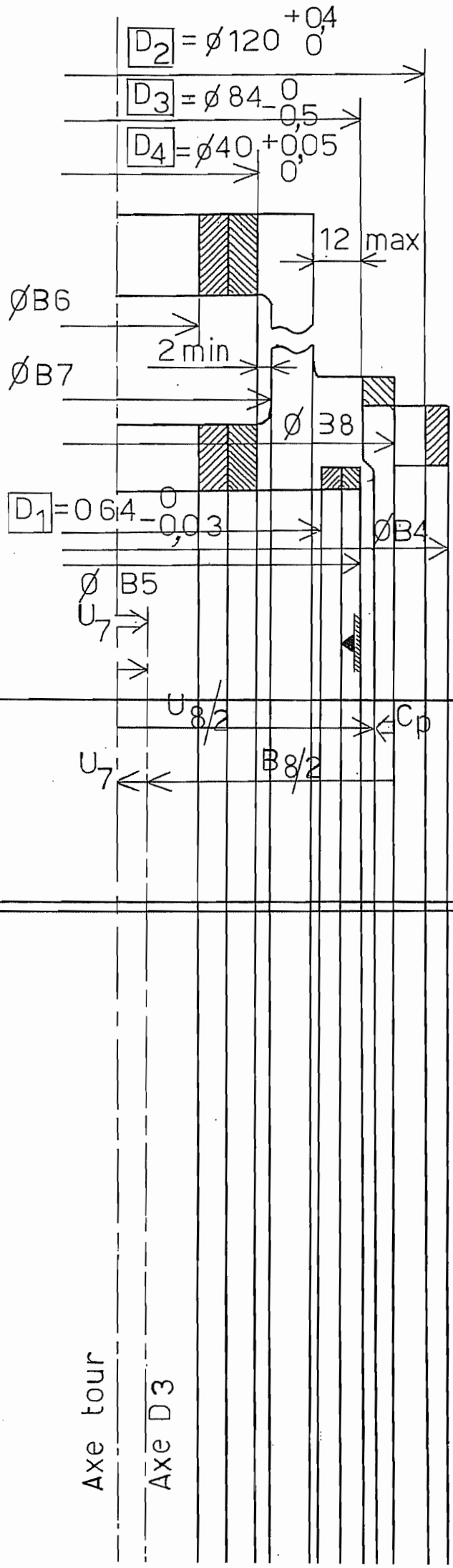


Fig. 50

COTES RADIALES suite

D_1	◎	ø 1,5	B_1
D_2	◎	ø 0,5	D_1
D_3	◎	ø 0,5	D_1
D_4	⊥	0,05	F_2
D_4	◎	ø 0,05	D_1

Cpm = { 0,5 finition
2 dégrossissage

D_3	◎	005	D_1

I.T = { 02 finition
0,8 dégrossissage

$U_7 = 0 \pm 0{,}25$ Cote directe

$U_8 = 84^{\circ}_{-0,5}$

$C_{pm} = \frac{1}{2} B_{8m} + U_{7m} - \frac{1}{2} U_{8M} = 2$

$B_{8m} = 4 - 2U_{7m} + U_{8M} = 4 - 2(-0{,}25) + 84 = 88{,}5$

Mais assuré par le brut B4...

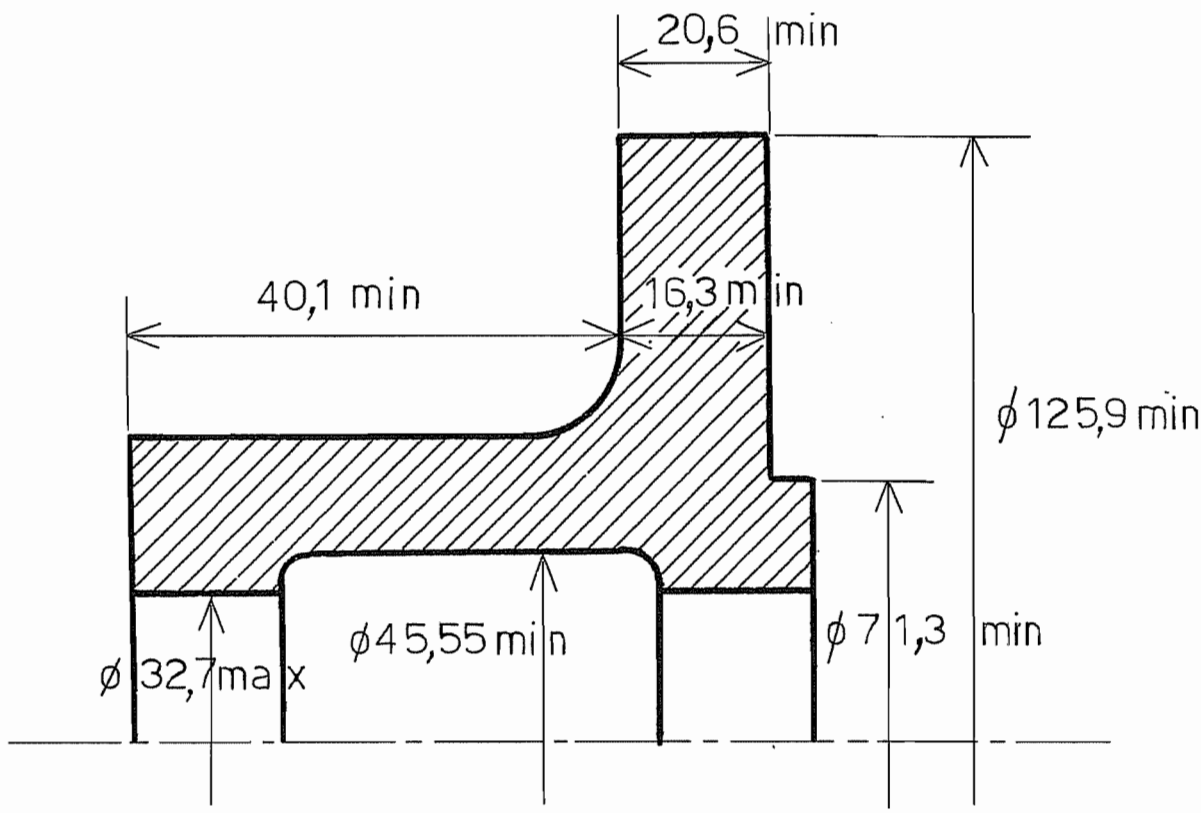


Fig. 51

Chapitre 3

Contraintes résiduelles

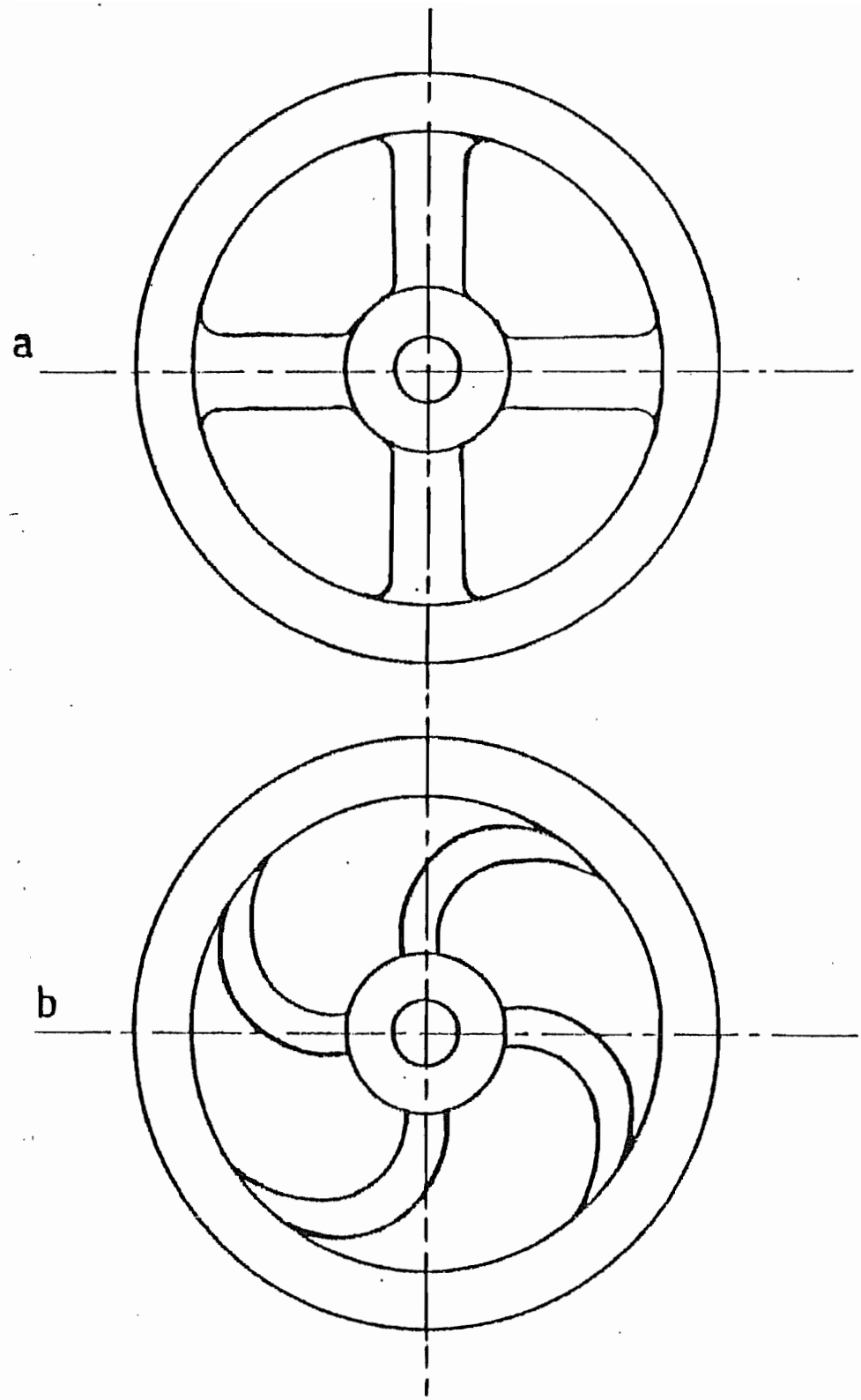


Fig. 1

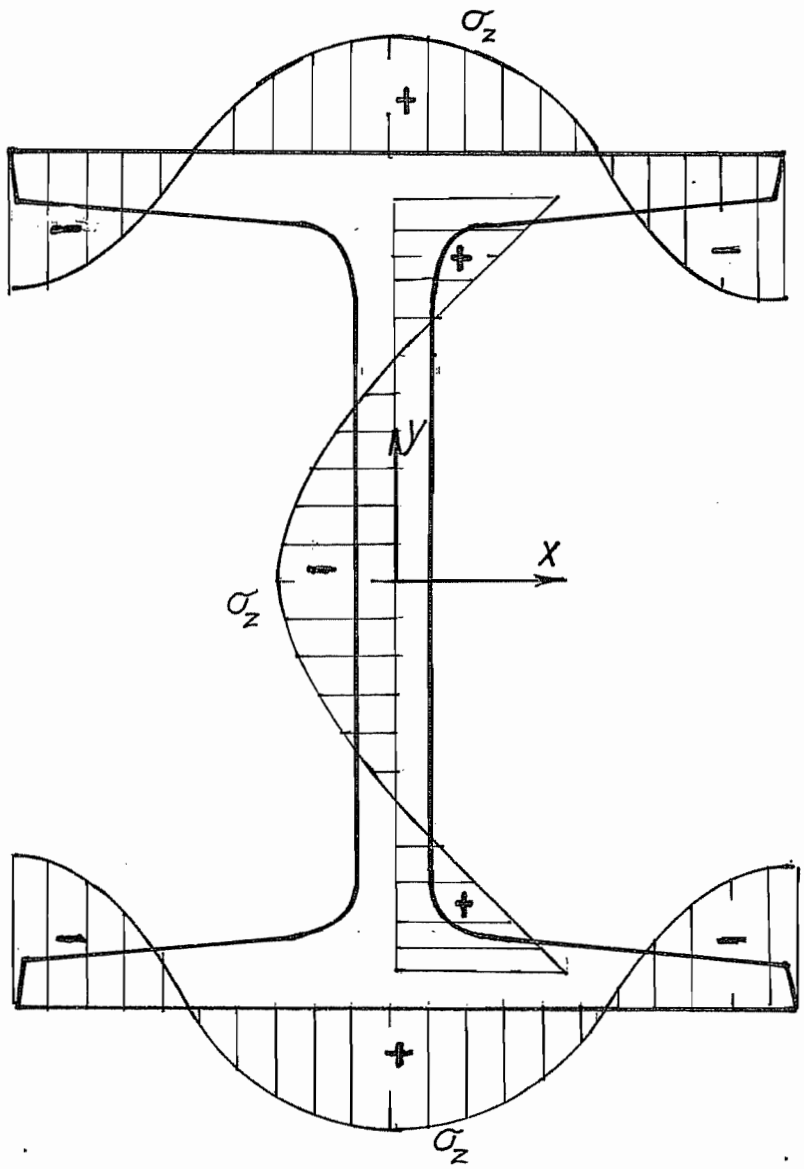


Fig. 2

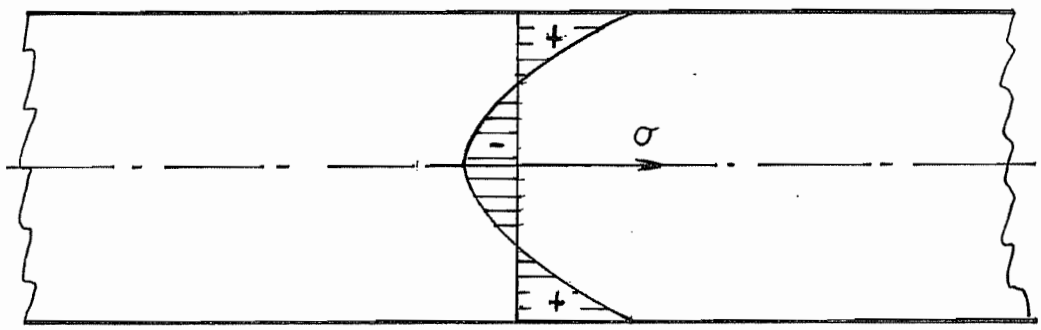


Fig. 3

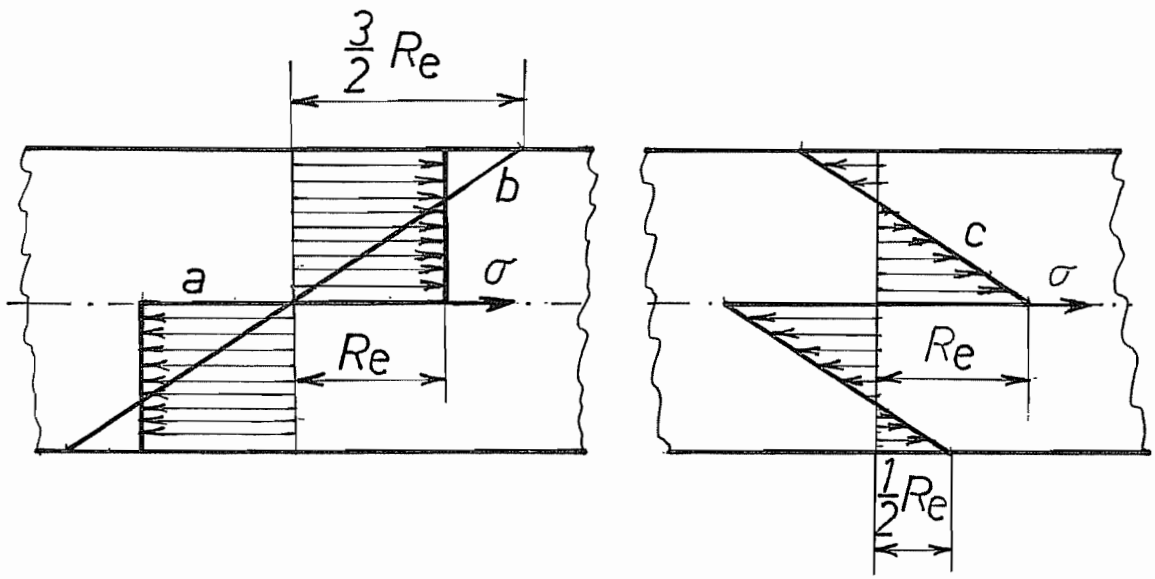


Fig. 4

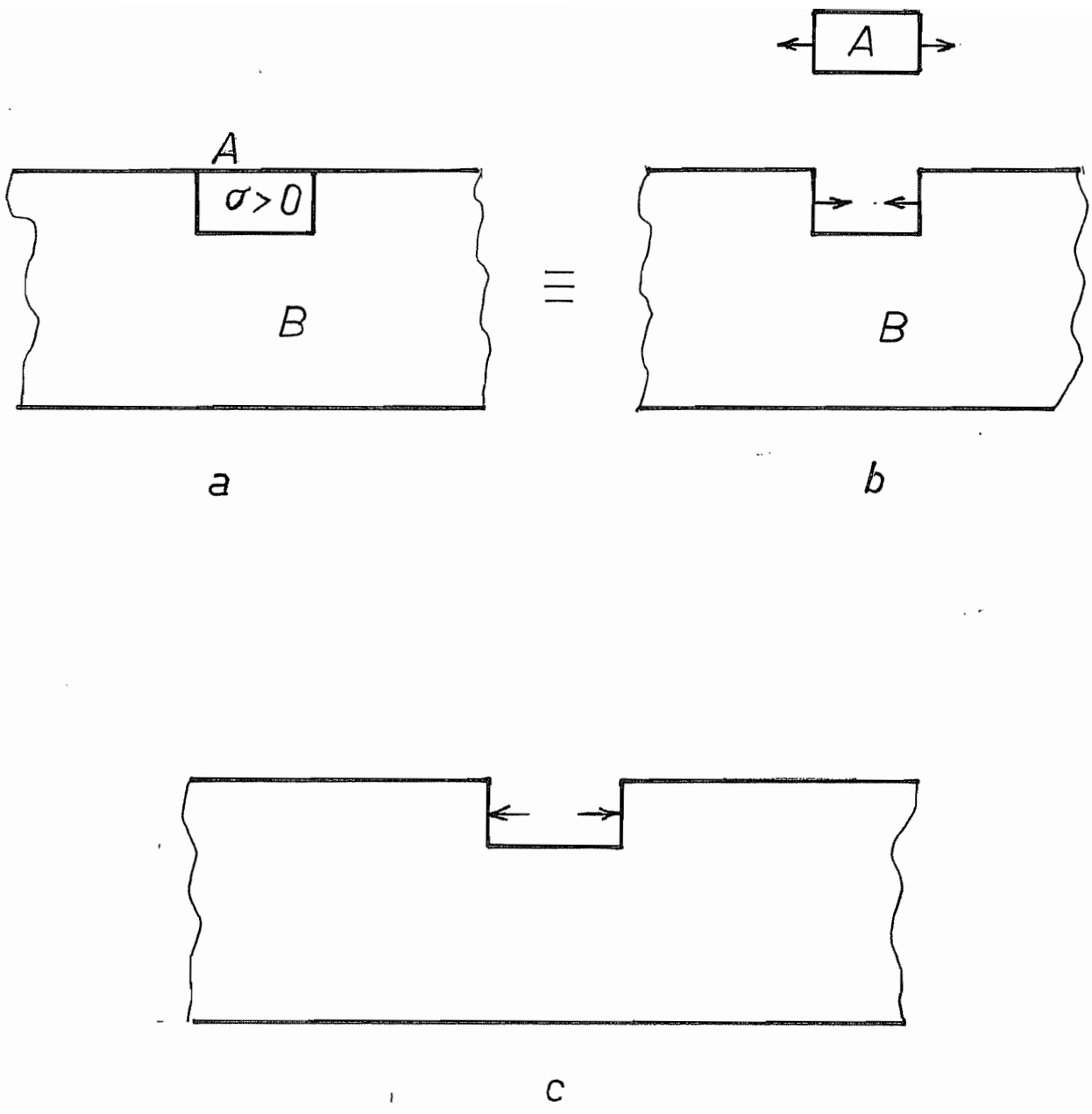


Fig. 5

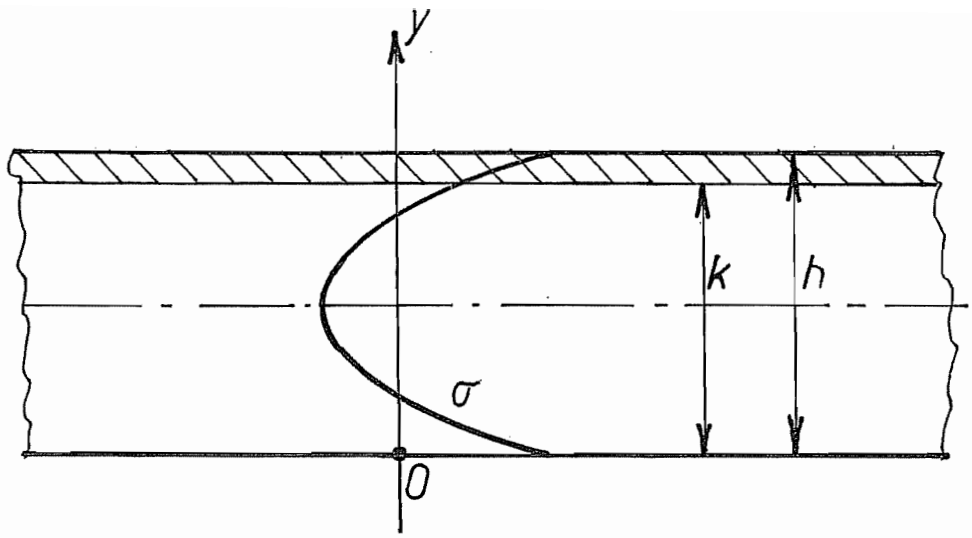


Fig. 6

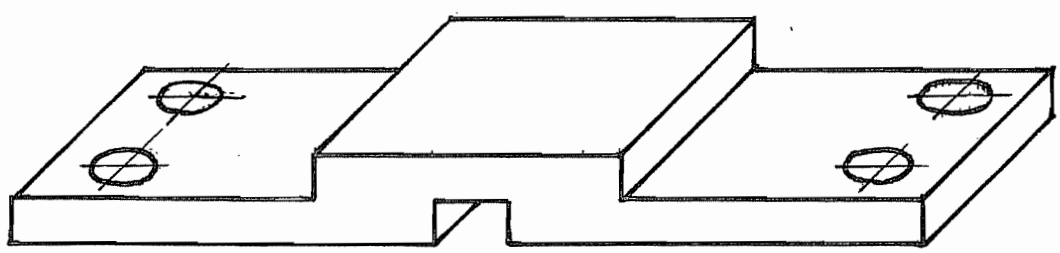


Fig. 7

Chapitre 4

Ablocage des pièces

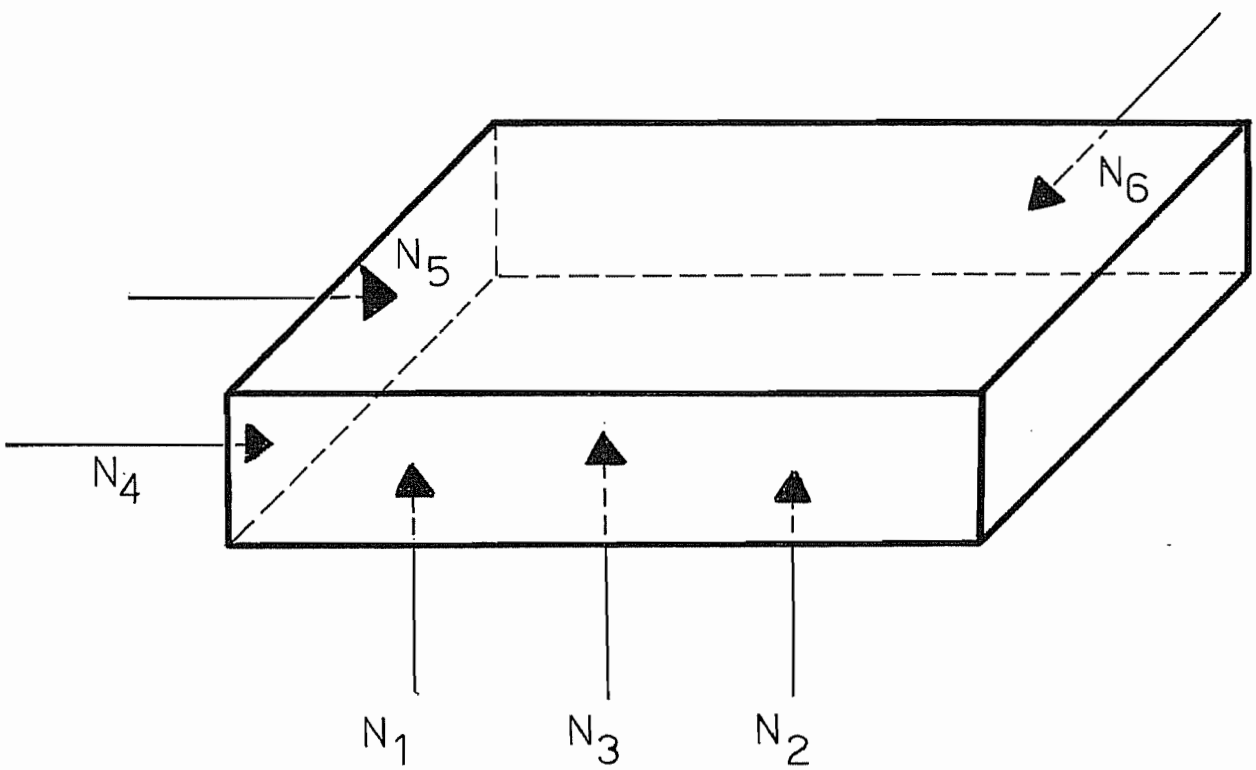


Fig 1

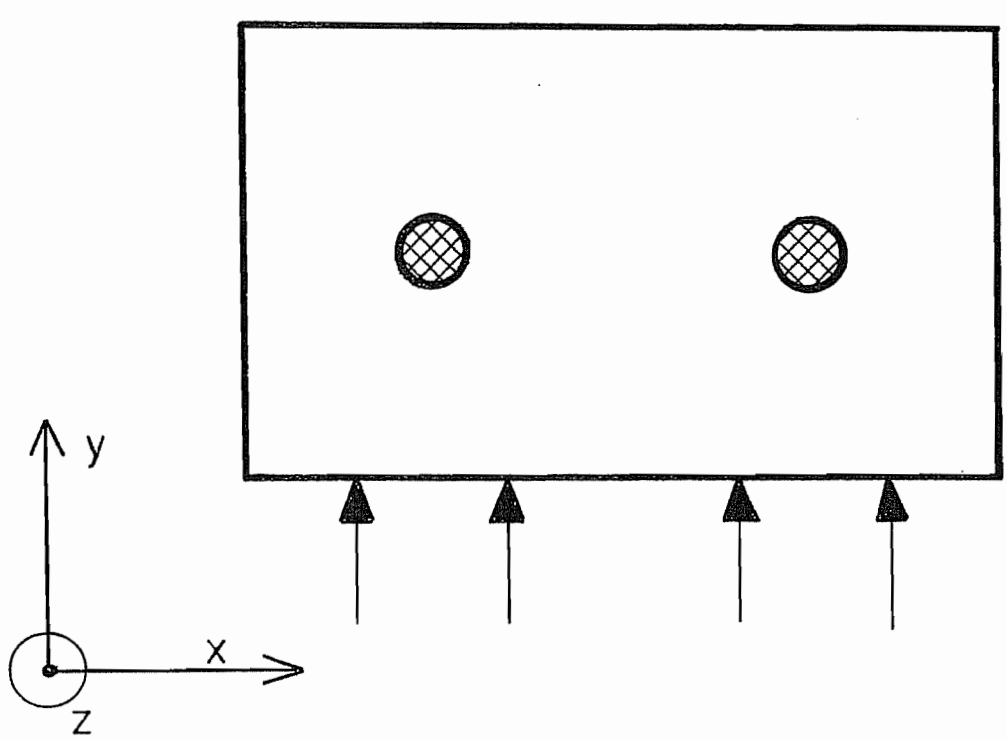


Fig 2

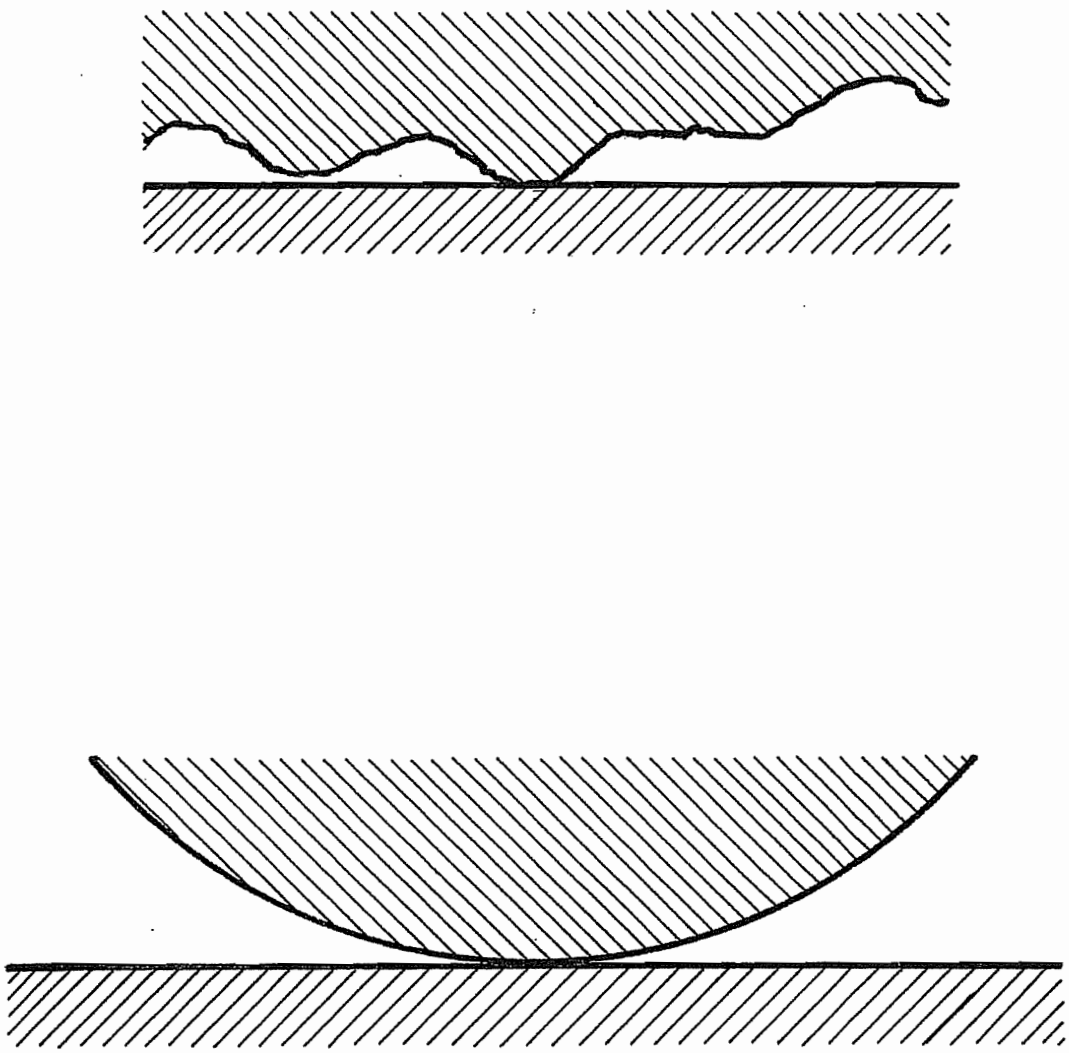


Fig 3

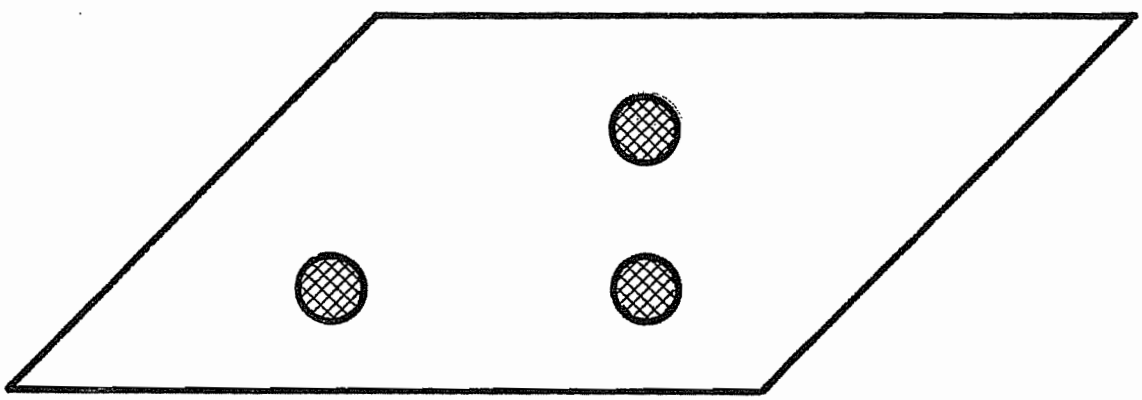


Fig 4

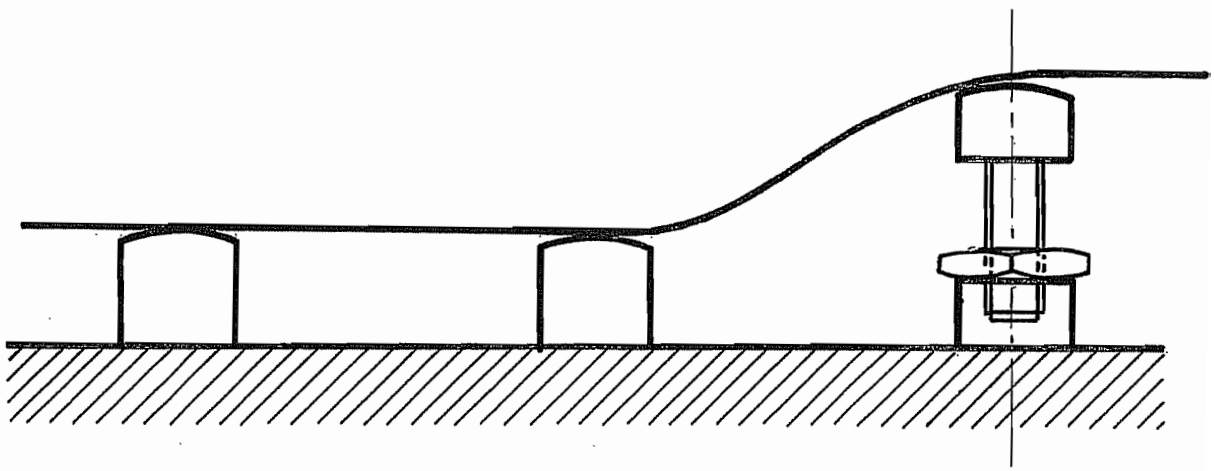


Fig 5

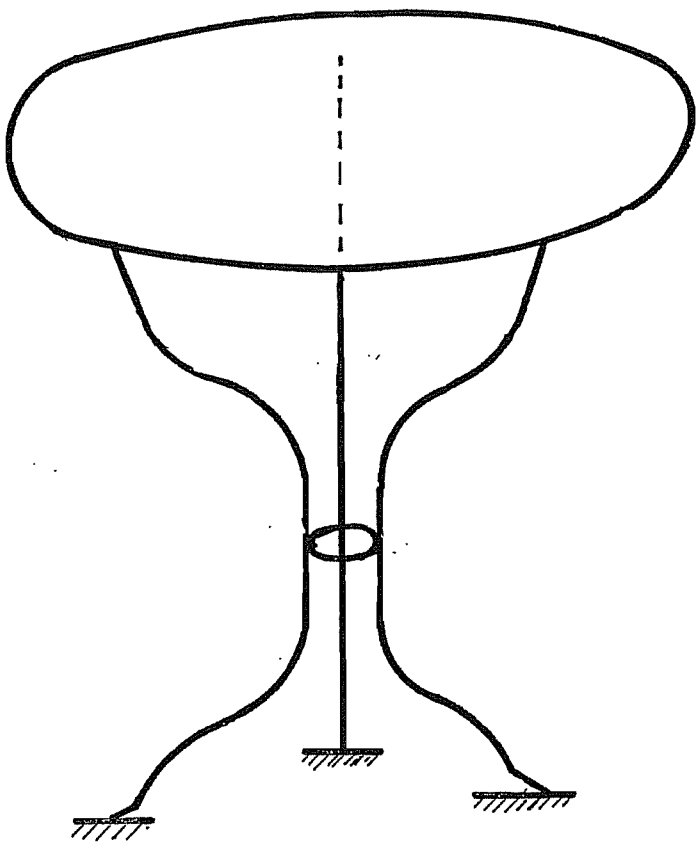


Fig 6

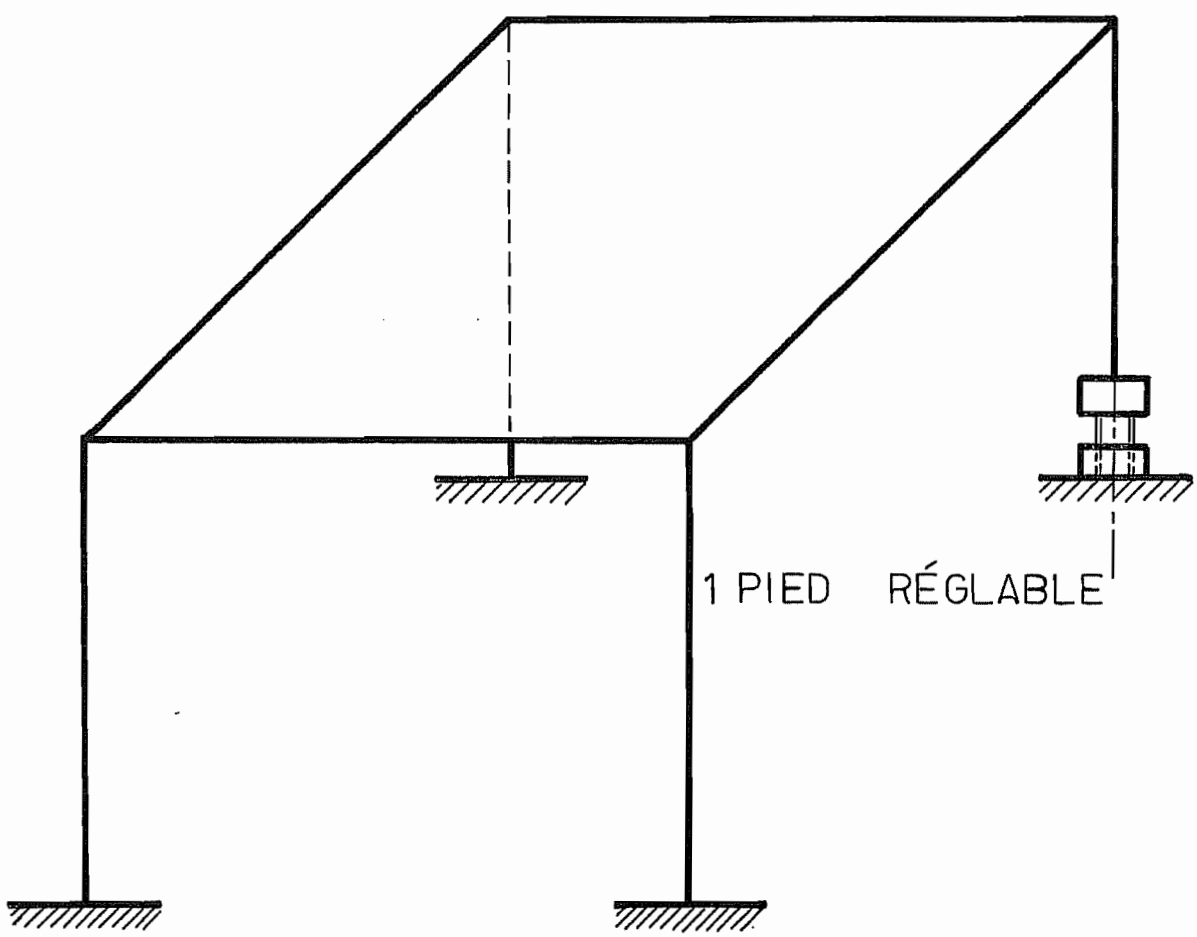


Fig 7

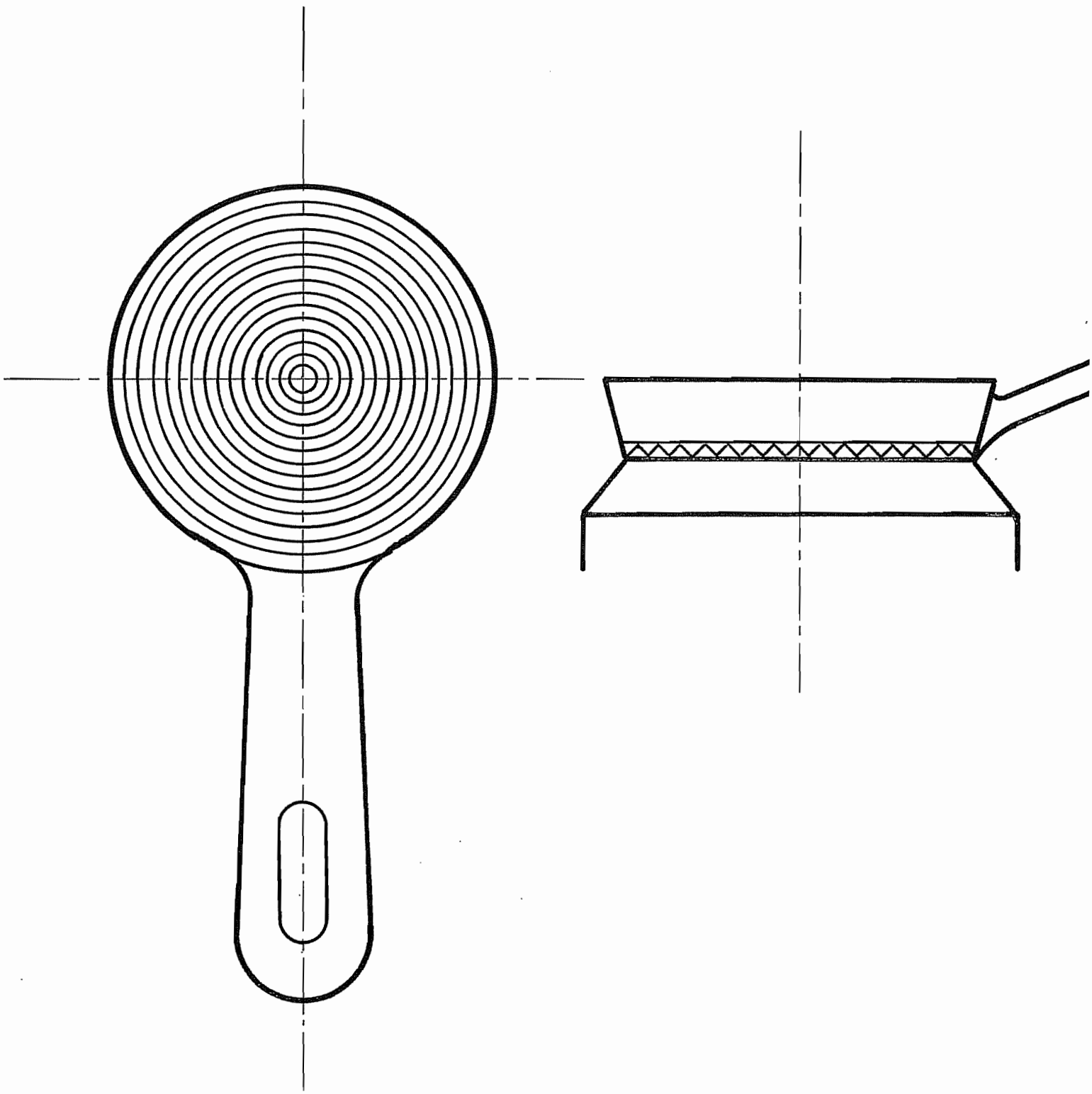


Fig 8

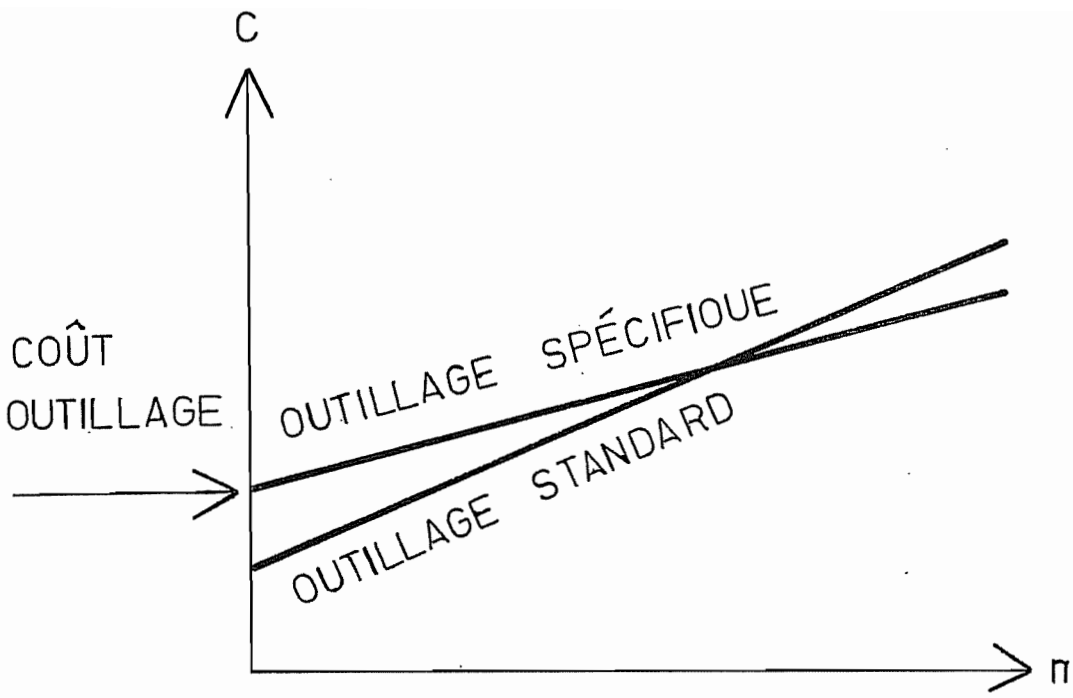

C
COÛT
OUTILLAGE
OUTILLAGE SPÉCIFIOUE
OUTILLAGE STANDARD
n

Fig 9

BORNES

BORNES FIXE - BORNE DÉMONTABLE - BORNE REGLABLE

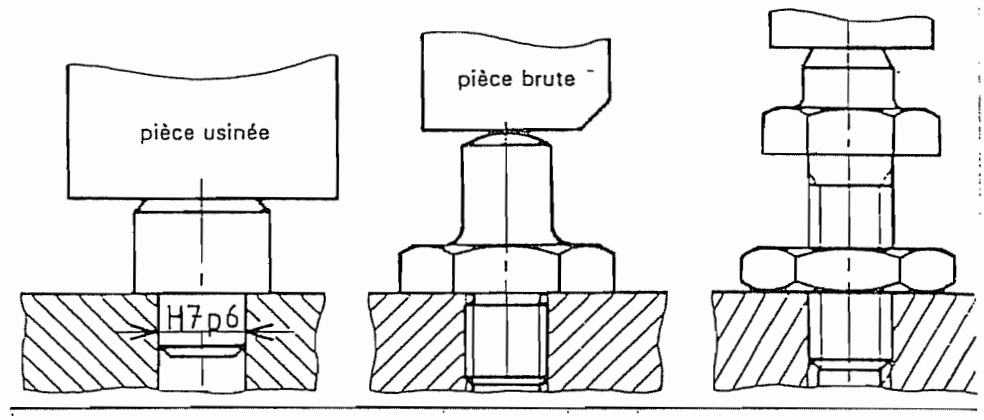
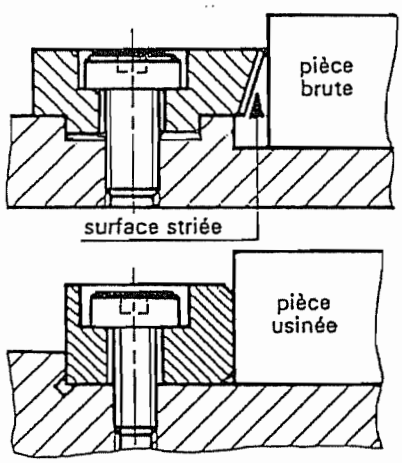


Fig 10

BUTÉES

BUTÉES FIXES



BUTÉE PALONNÉE

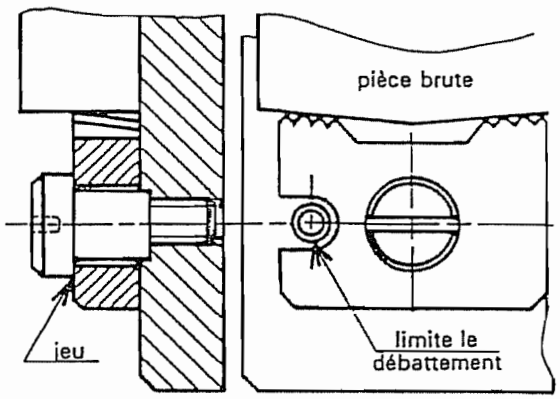


Fig 11

CENTREURS

CENTREURS FIXES CENTREURS DÉMONTABLE

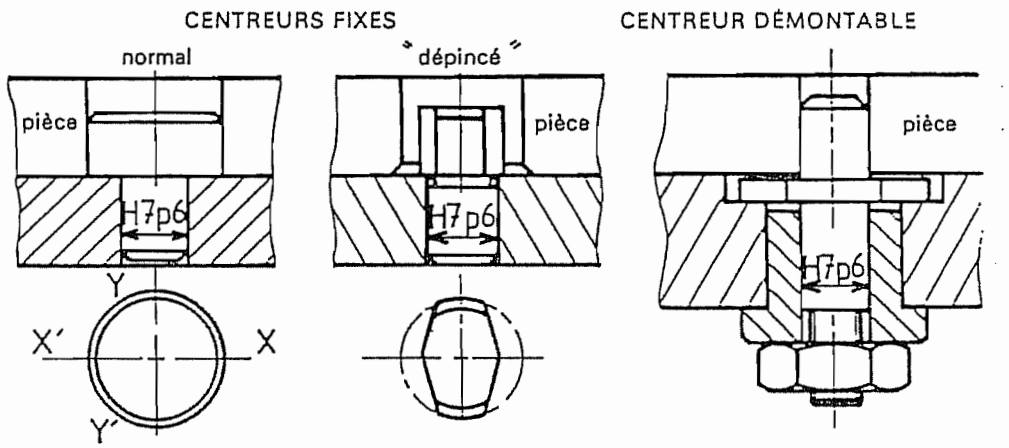


Fig 12

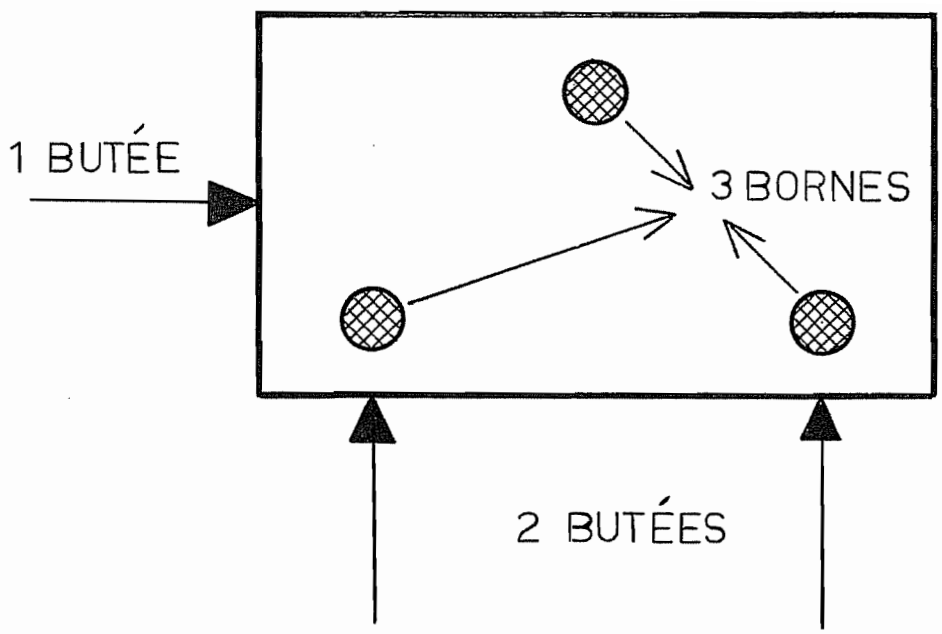
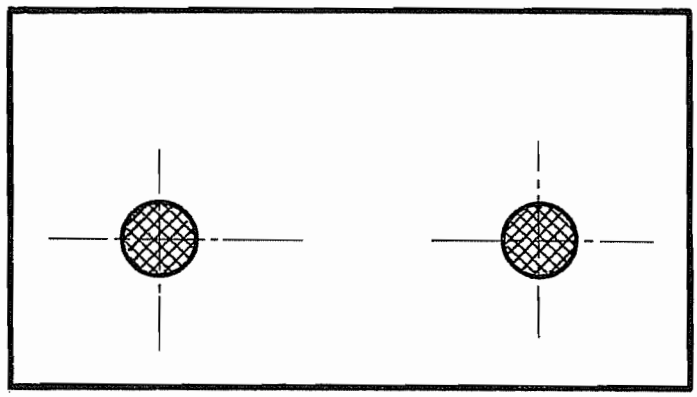


Fig 12 bis



HYPERSTATIQUE

Fig 13

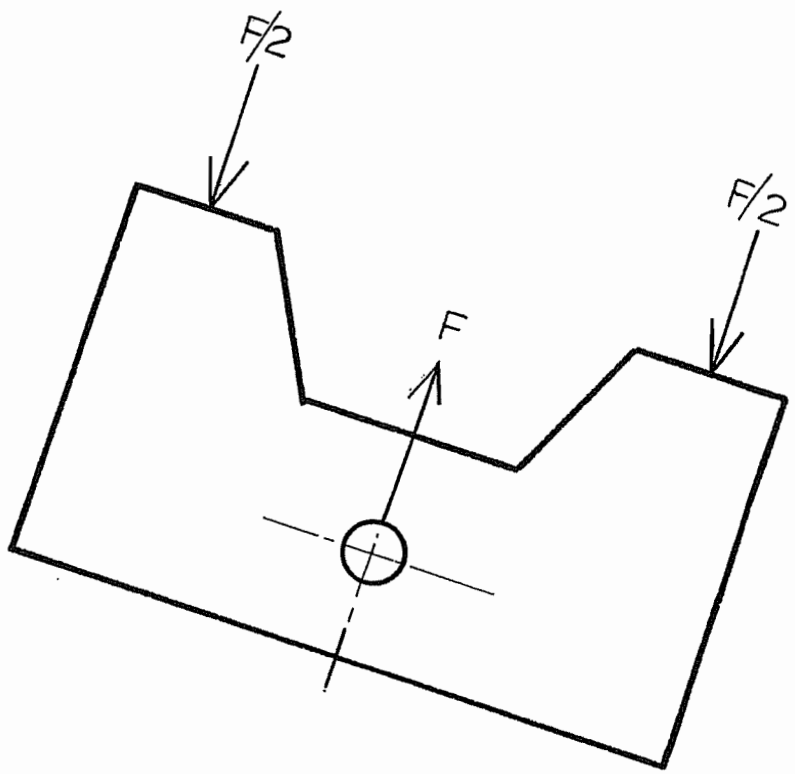
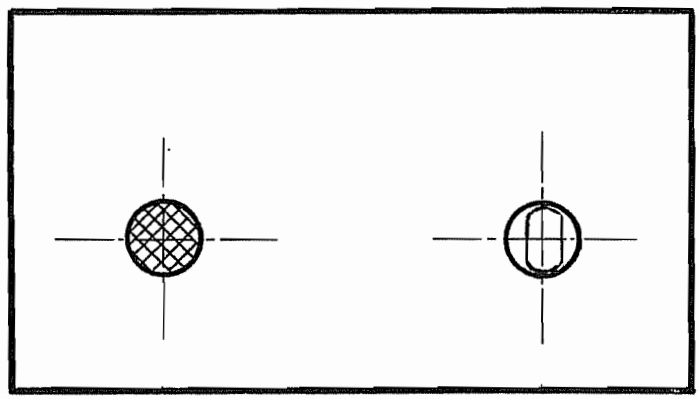


Fig 13 bis



BUTÉE DÉPINCÉE

Fig 14

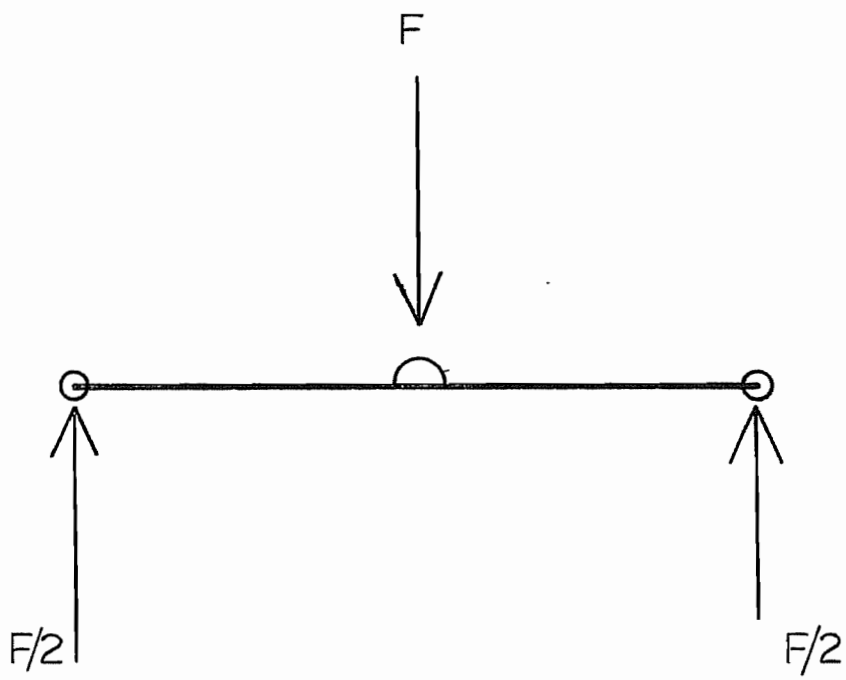


Fig 15

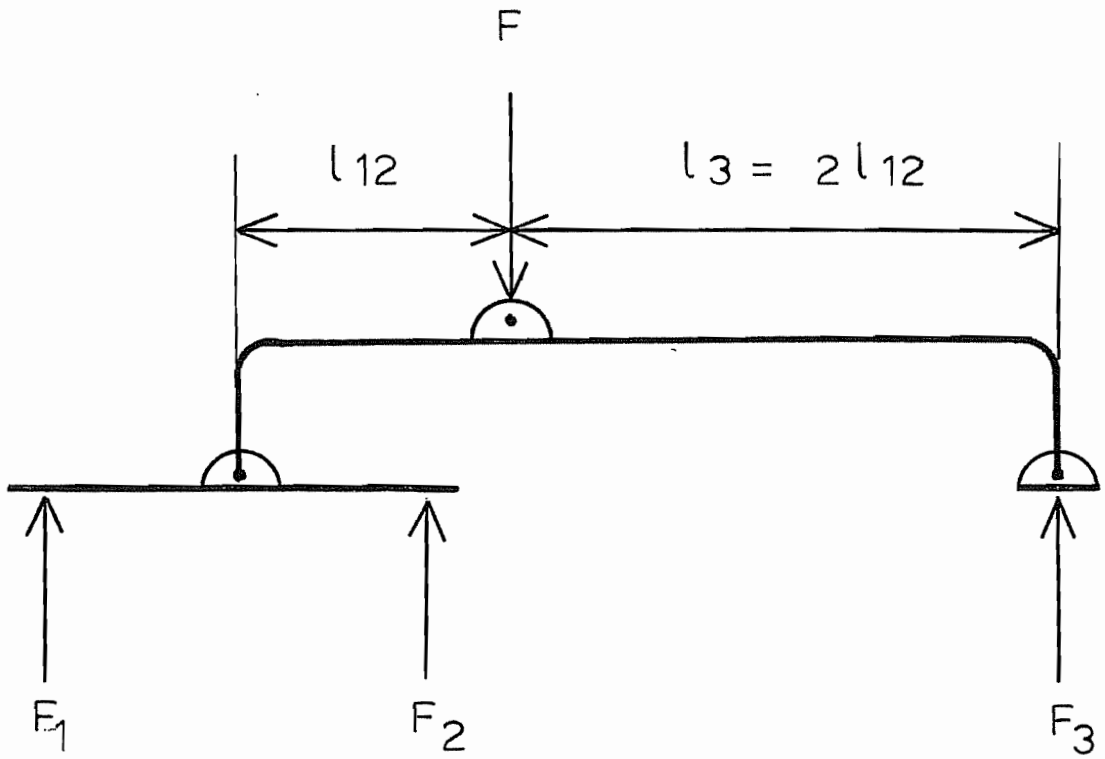


Fig 16

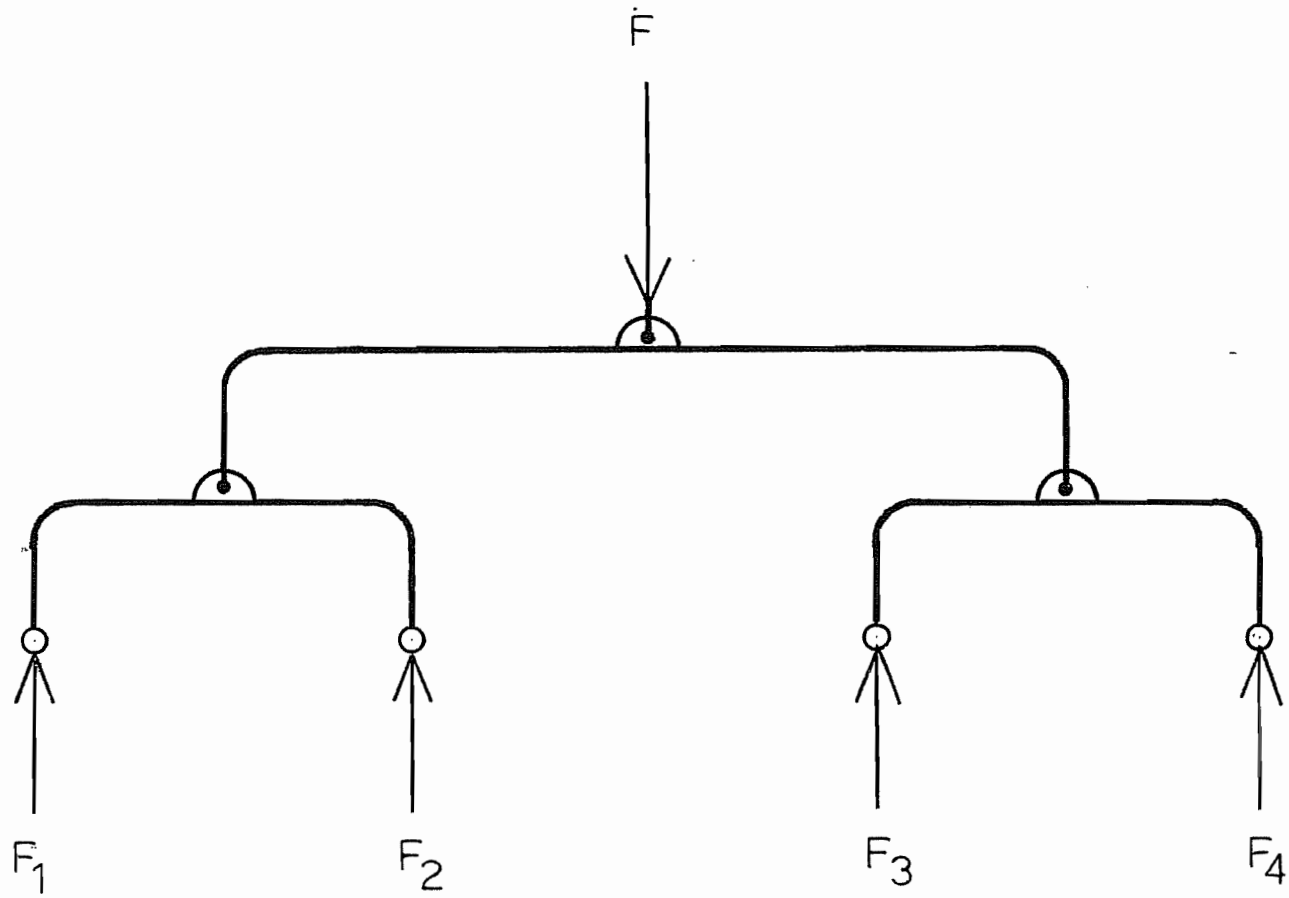


Fig 17

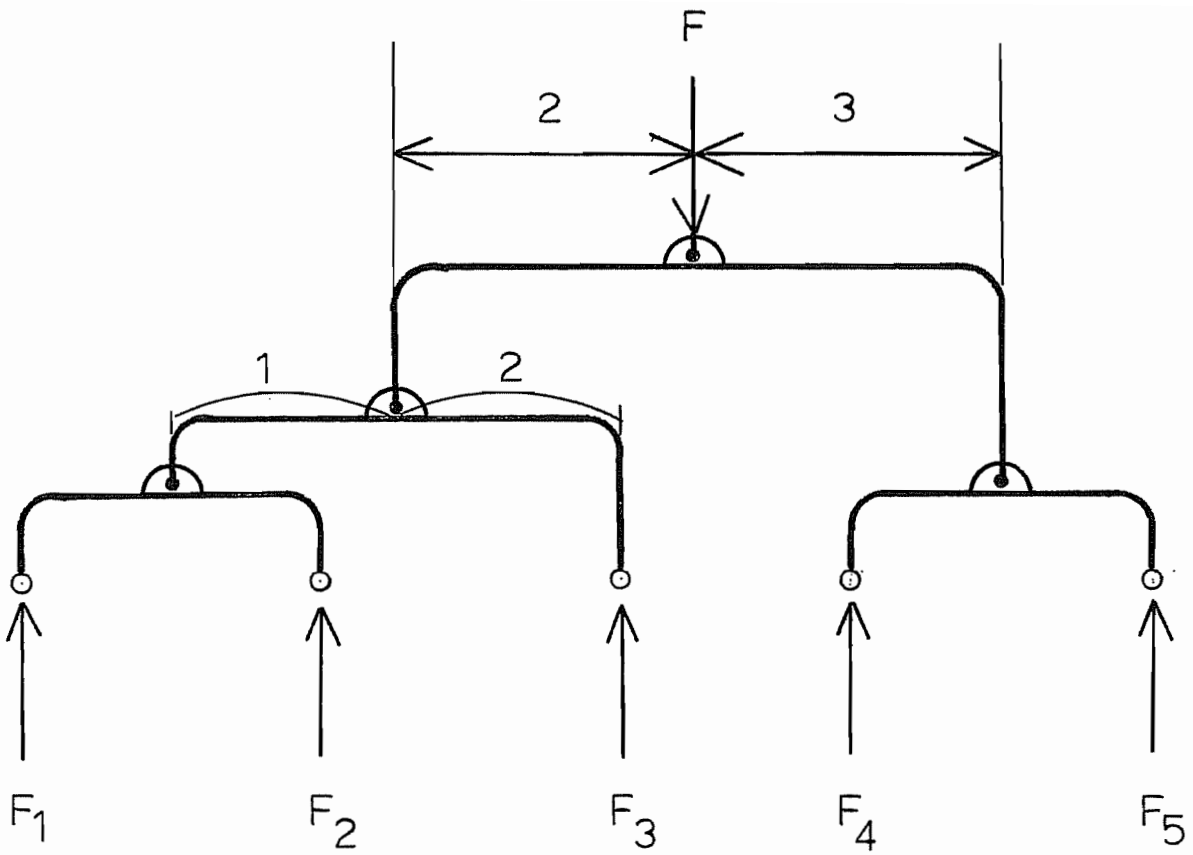


Fig 18

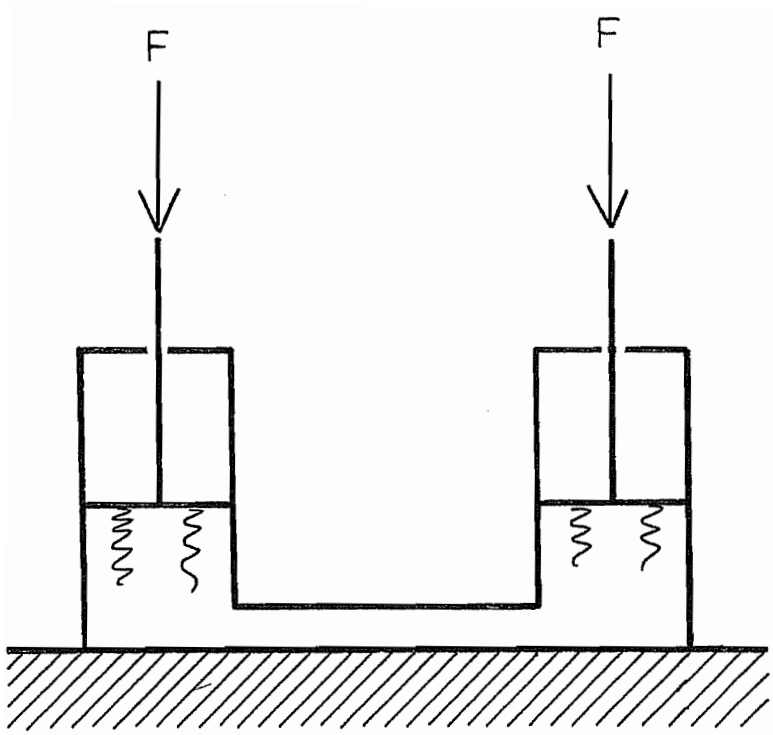


Fig 19

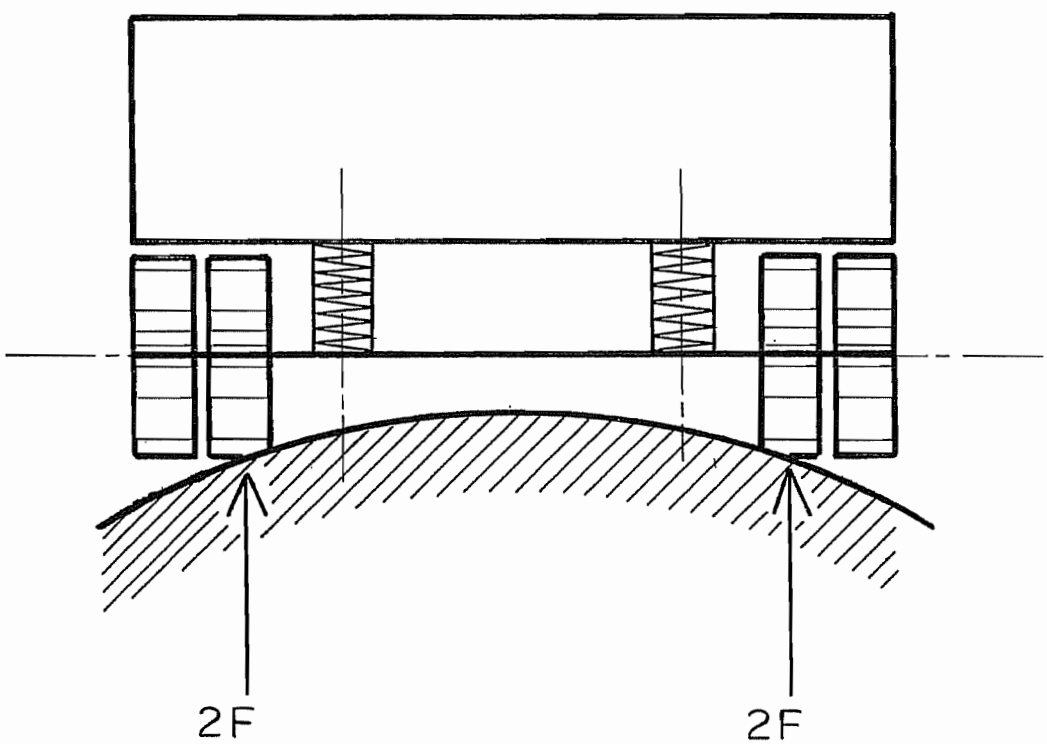


Fig 20

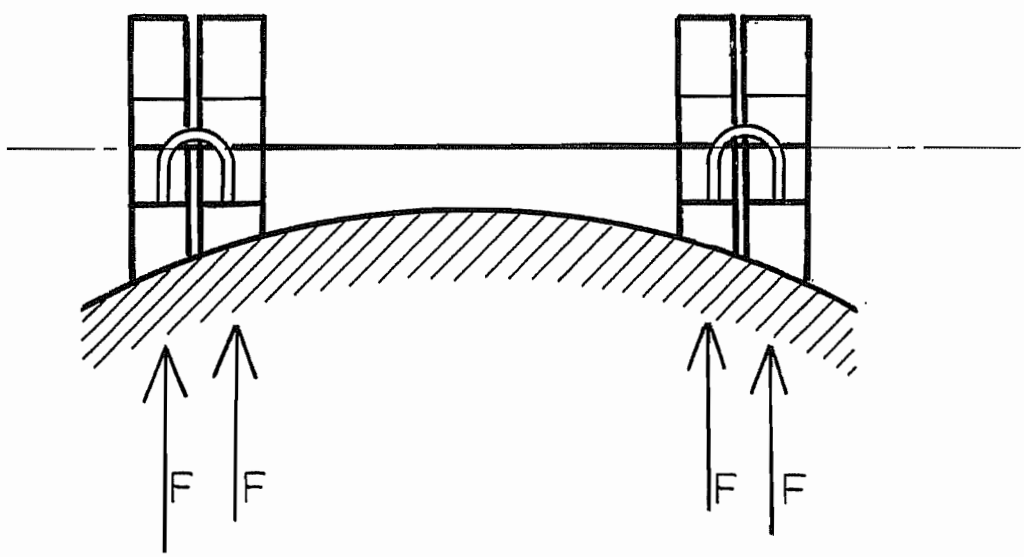


Fig 21

PALONNIER

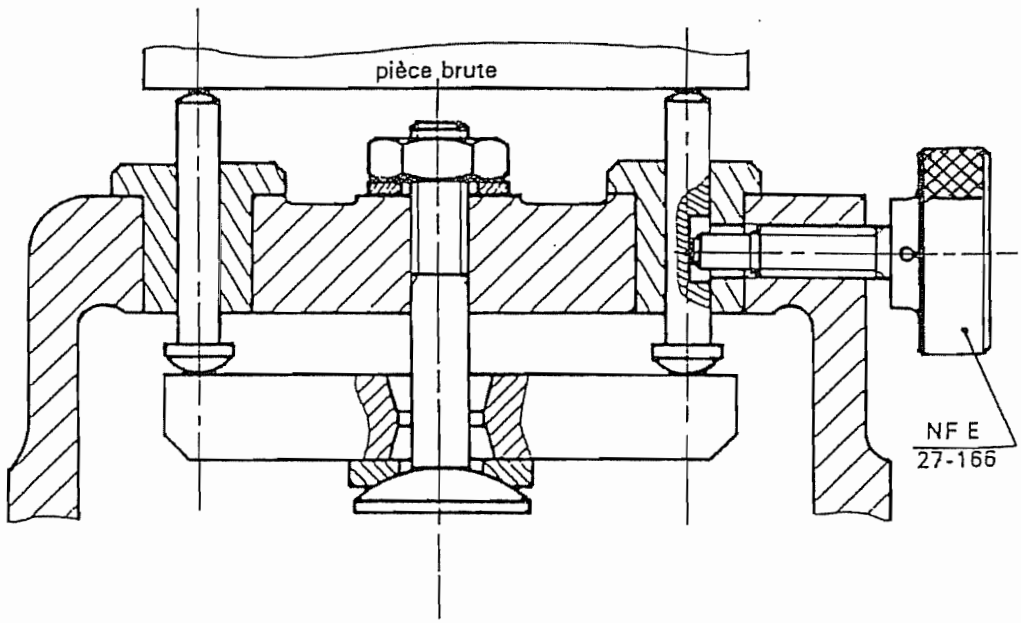
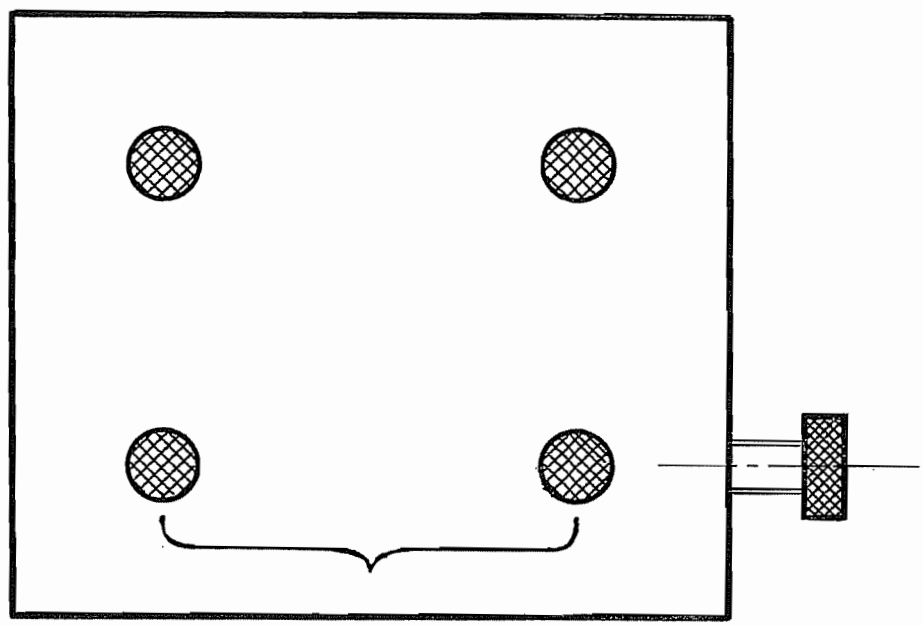


Fig 22



PALONNÉ PUIS FIXÉ

Fig 23

APPUI SENSITIF

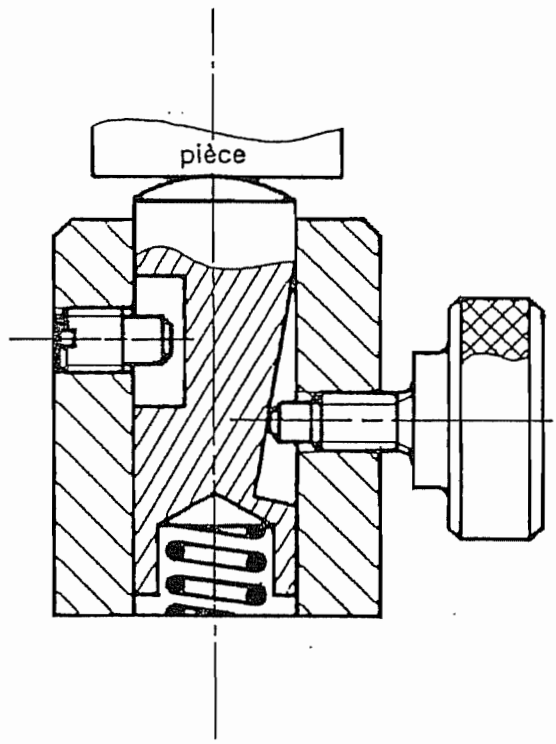


Fig 24

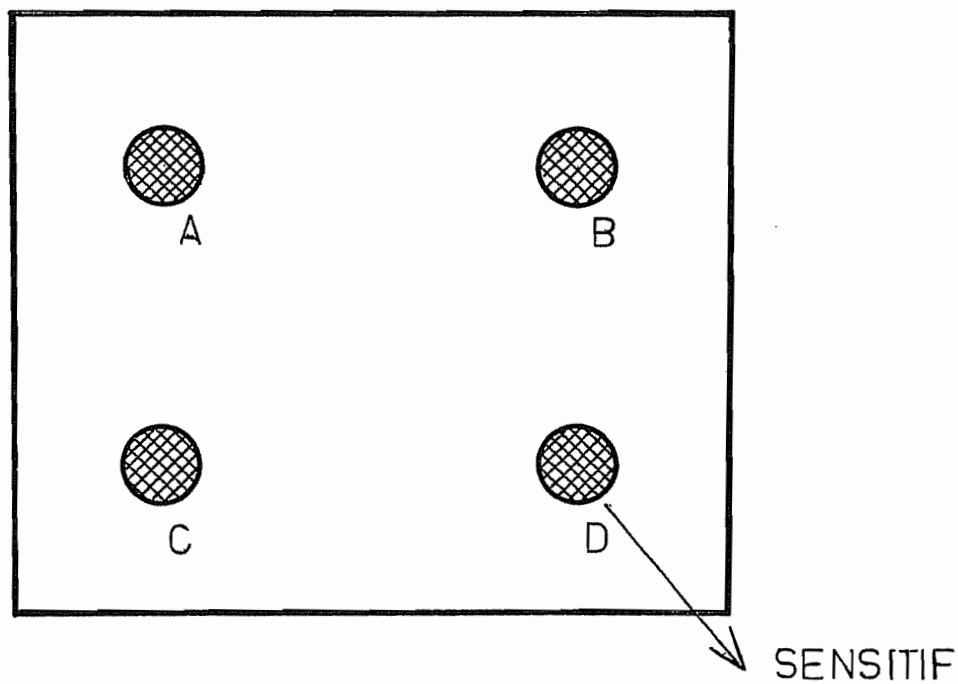


Fig 25

DÉTROMPEUR

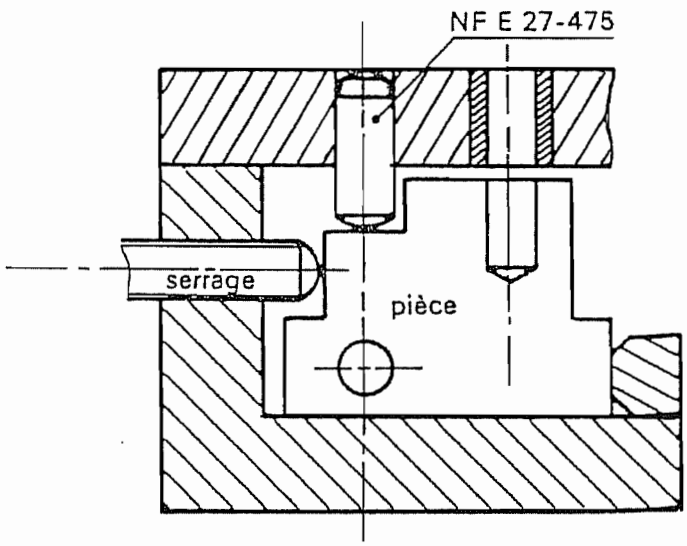
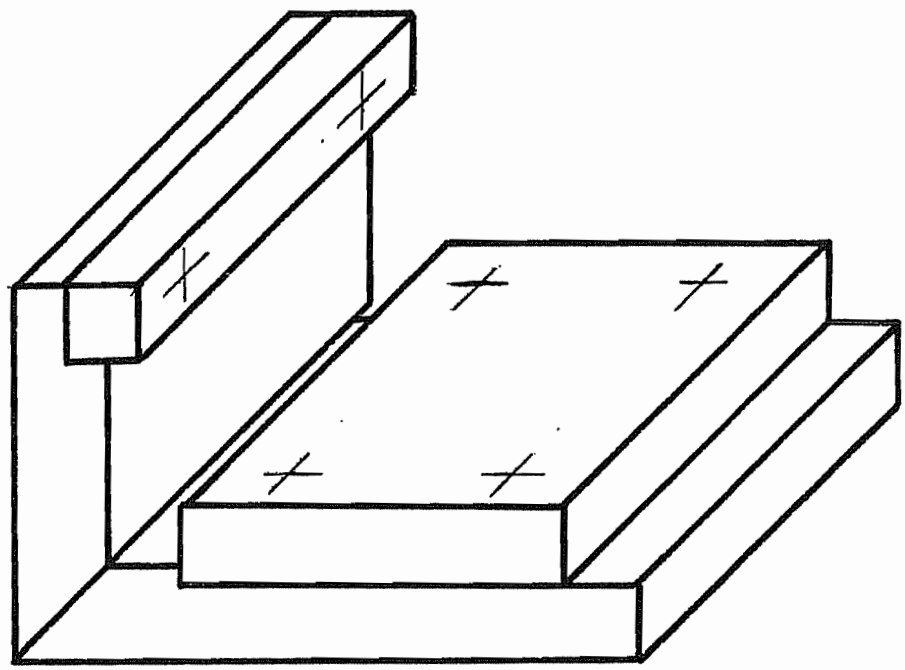
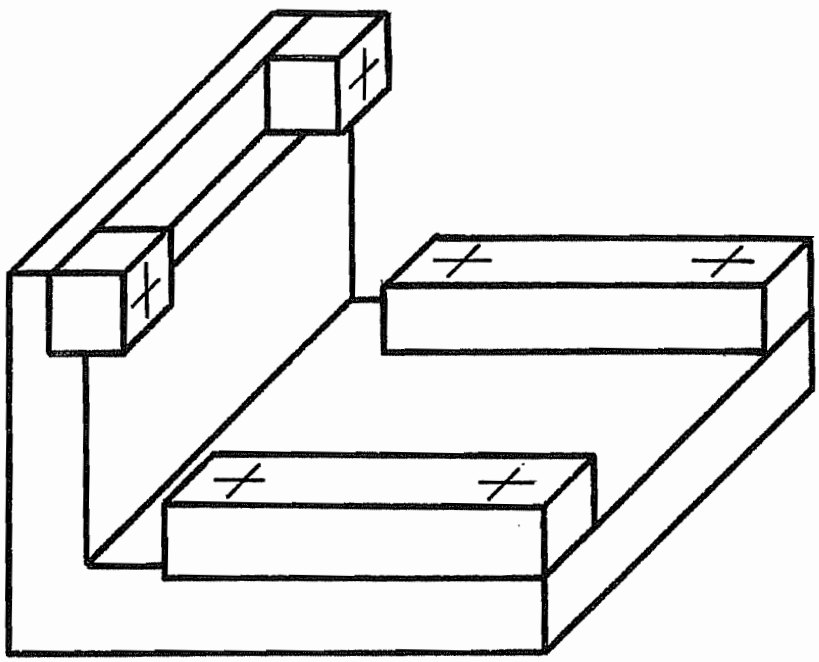


Fig 26



APPUI PLAN - TRAIT POUR SURFACES USINÉES

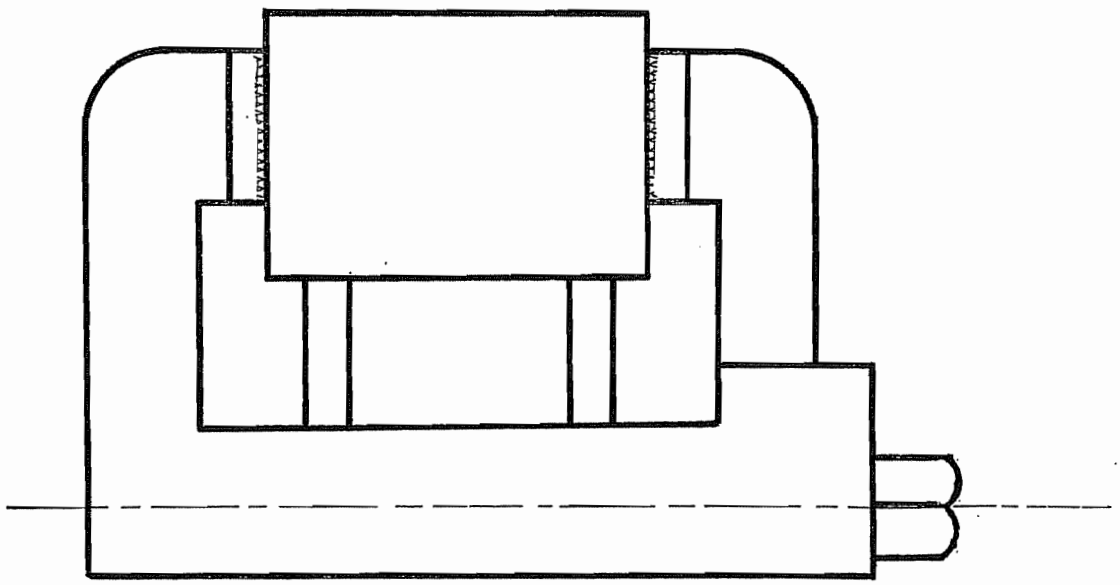
Fig 27



IDEM, AVEC RÉGLETTES

MOINS HYPERSTATIOU

Fig 28



PRISE EN ÉTAU SUR DEUX RÉGLETTES
RECTIFIÉES

Fig 29

MONTAGE ENTRE POINTES

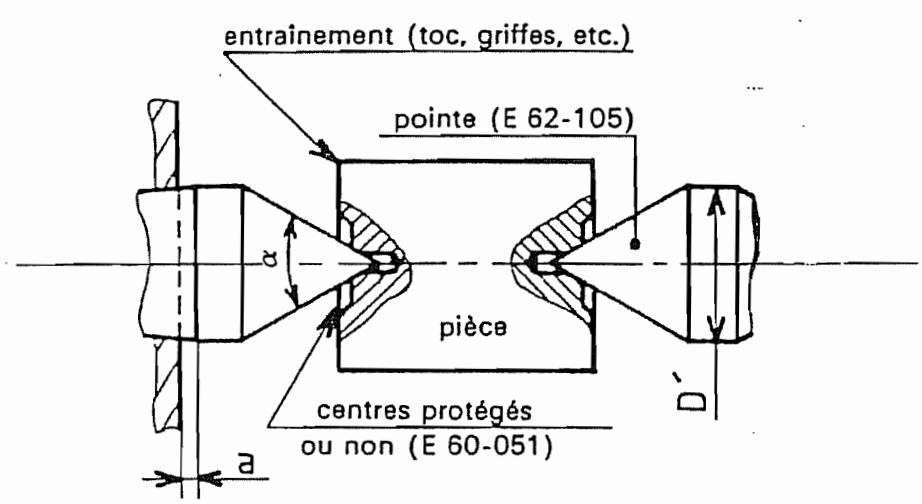


Fig 30

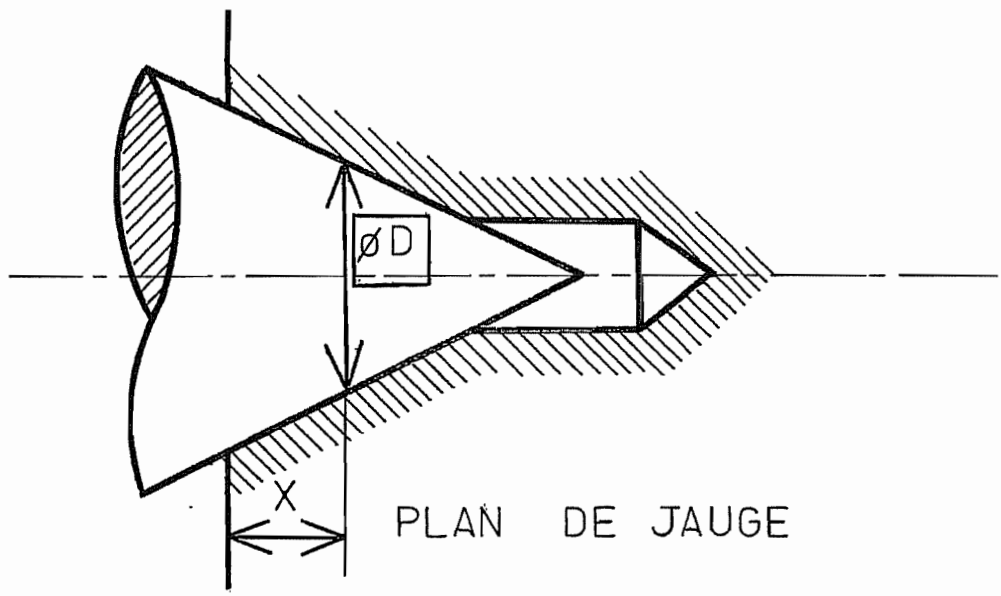


Fig 31

POINTE À RESSORT

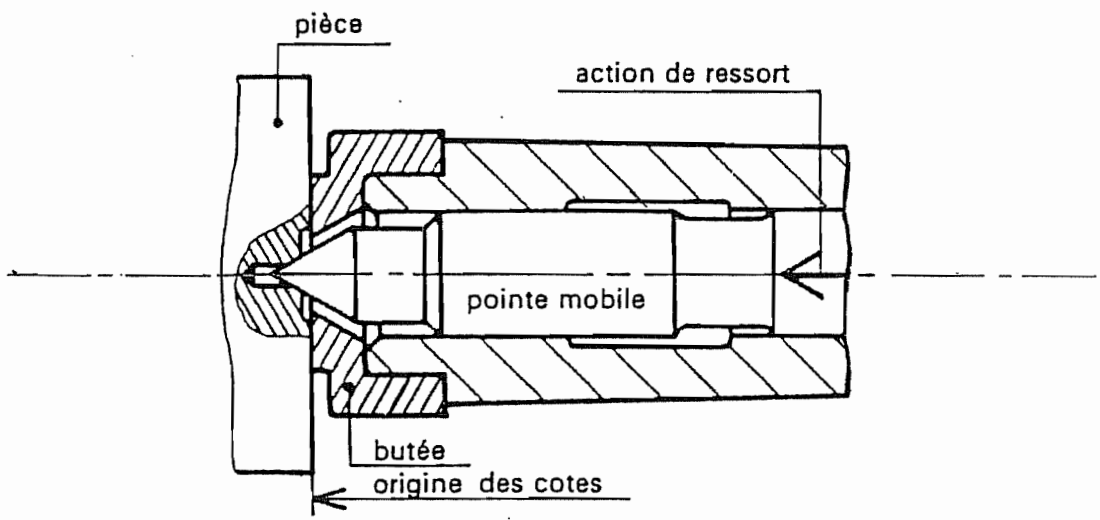


Fig 32

EFFET DU FAUX-ROND DE LA POINTE TOURNANTE

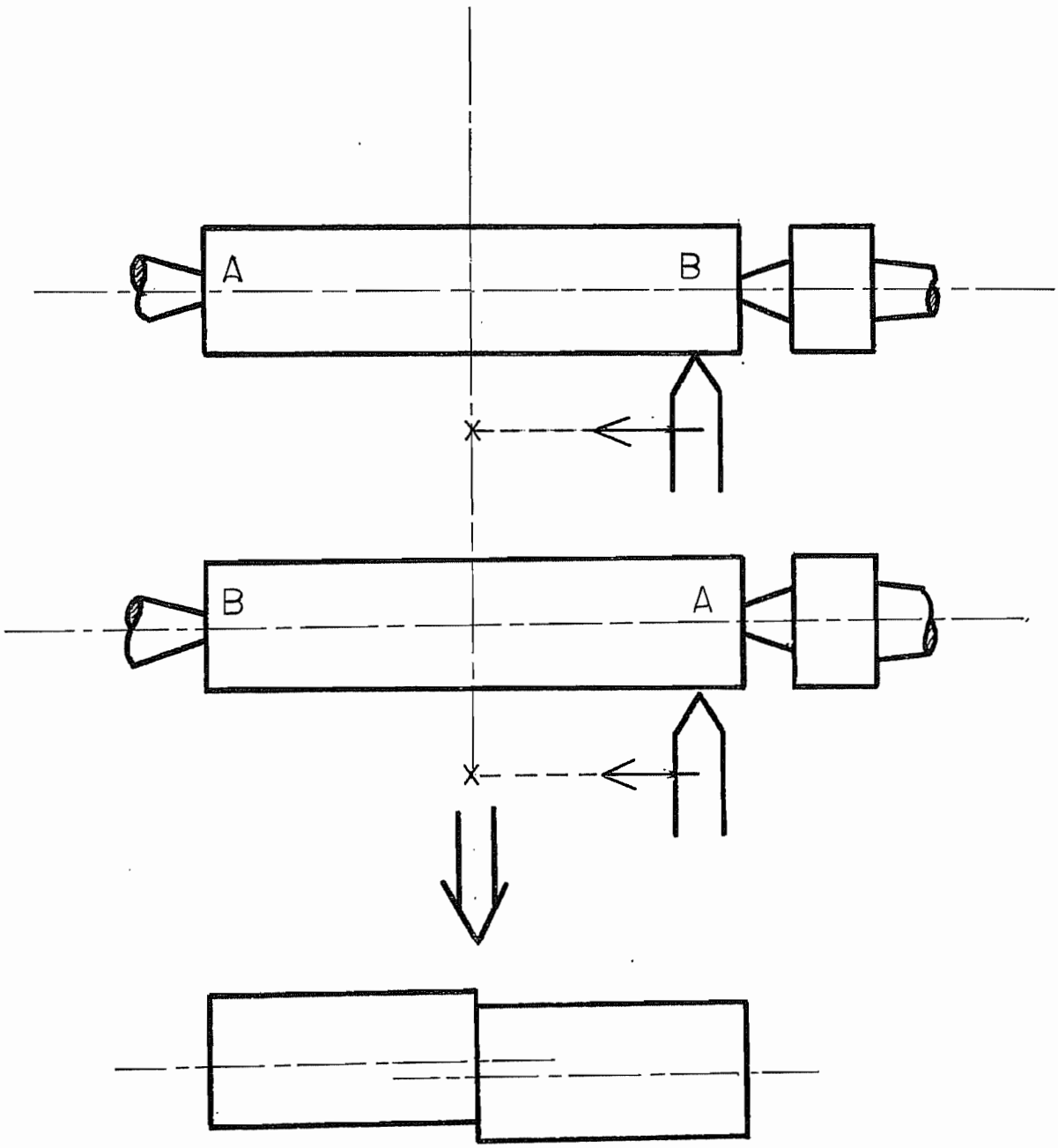


Fig 33

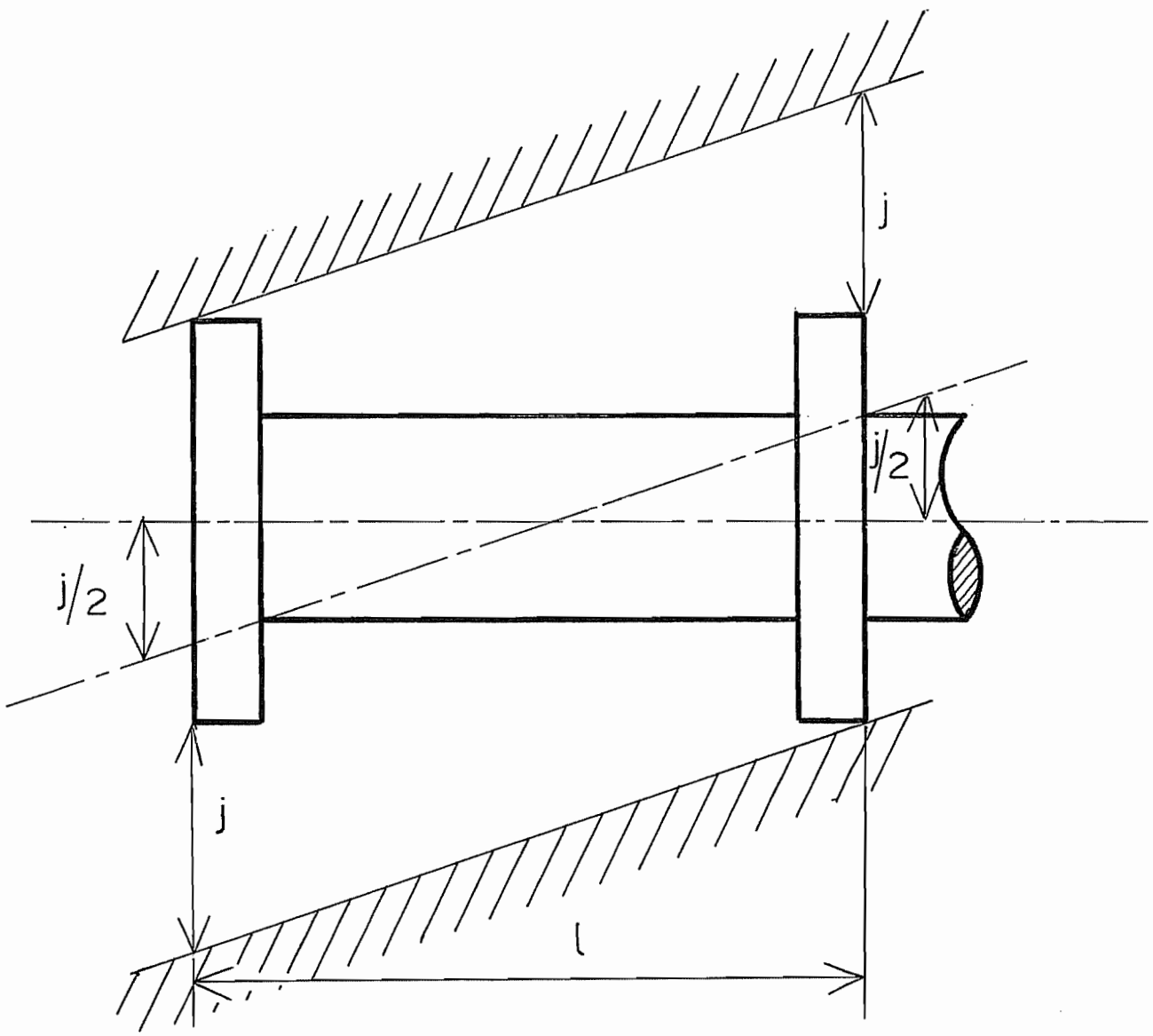


Fig 34

CENTRAGE LONG

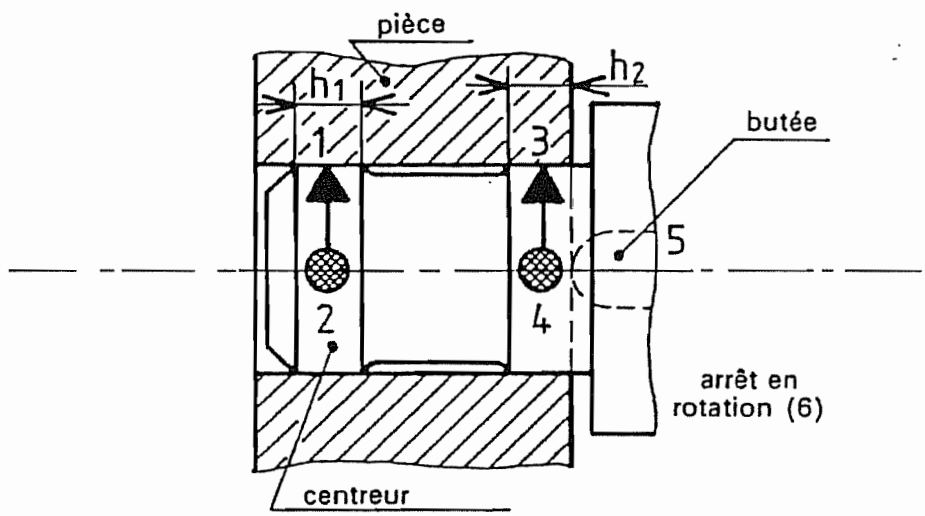


Fig 35

CENTRAGE COURT

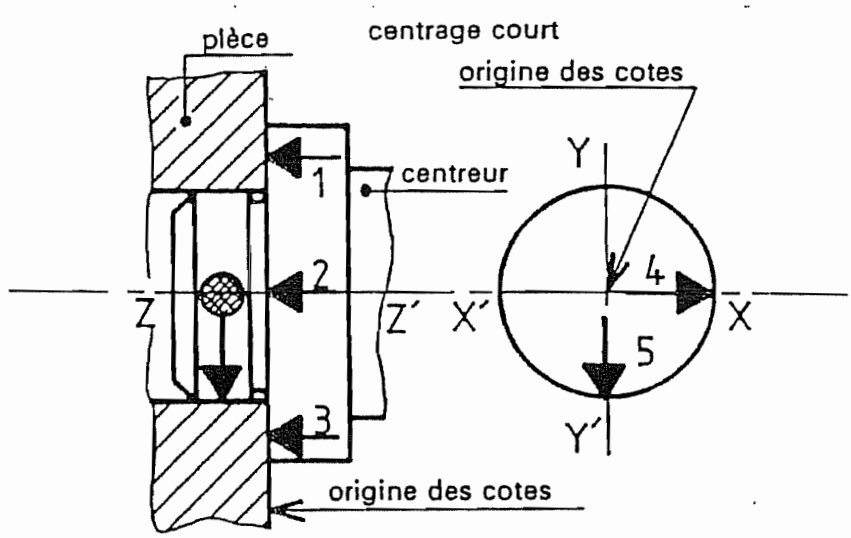


Fig 36

MANDRIN À SERRAGE CONCENTRIQUE

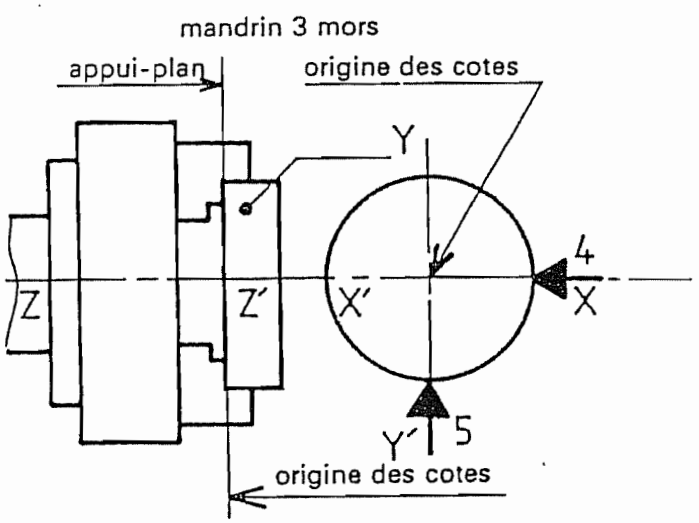
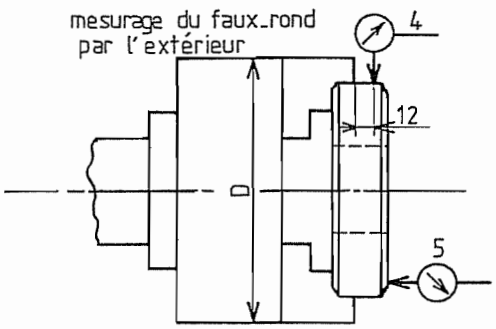


Fig 37

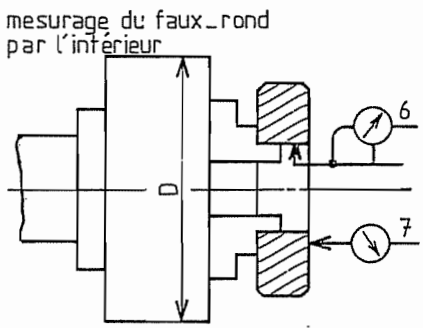
PRÉCISION DE LA PRISE EN MANDRIN

NF E 62-100 / 101 / 102 / 109



mesurage du voile de la face avant
au plus près du diametre extérieur.

Opérations	Diamètre du mandrin D	① Écart toléré
4	D ≤ 315	0,075
	315 < D ≤ 630	0,10
	630 < D ≤ 1 000	0,125
5	D ≤ 200	0,04
	200 < D ≤ 400	0,07
	400 < D ≤ 630	0,10
	630 < D ≤ 1 000	0,125



mesurage du voile de la face avant
au plus près du diamètre intérieur.

Opérations	Diamètre du mandrin D	② Écart toléré
6	D ≤ 315	0,075
	315 < D ≤ 630	0,10
	630 < D ≤ 1 000	0,125
7	D ≤ 200	0,03
	200 < D ≤ 400	0,04
	400 < D ≤ 630	0,05
	630 < D ≤ 1 000	0,06

Fig 38

USINAGE DE MORS DOUX

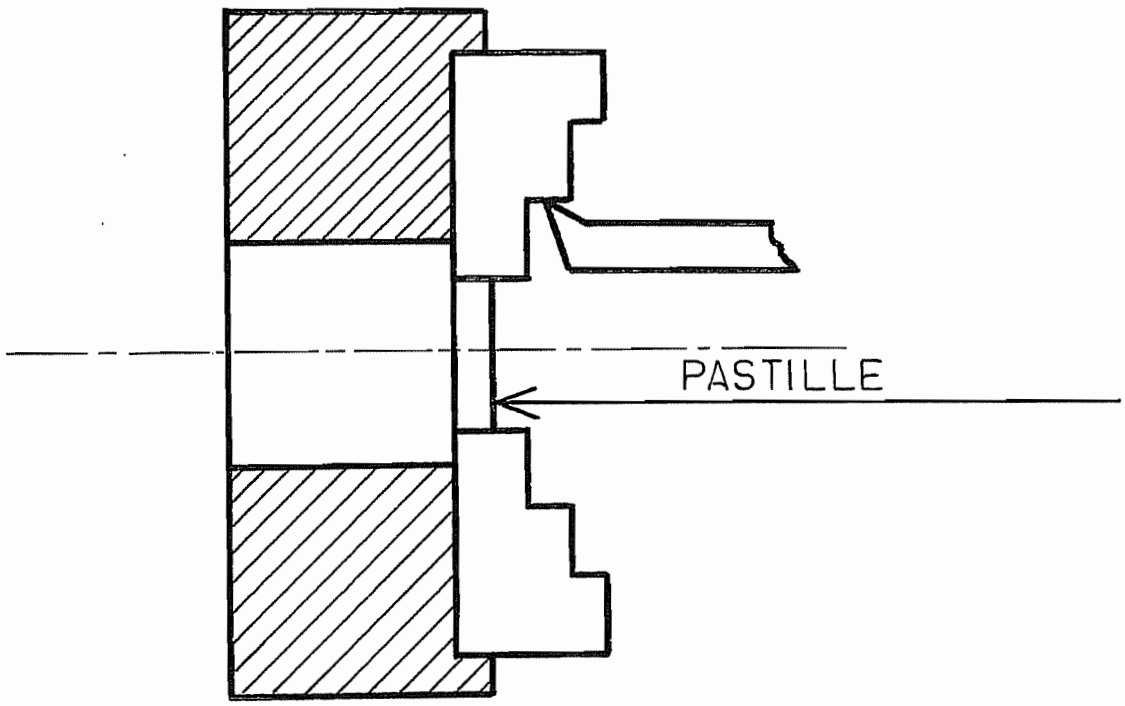


Fig 39

(1) NEUTRALISATION DES EFFORTS

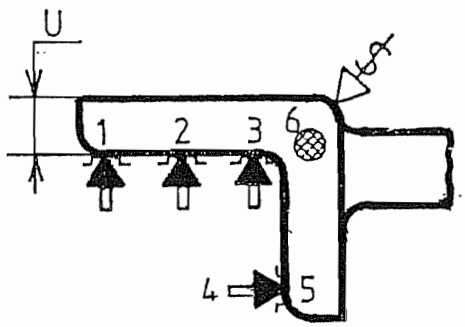


Fig 40

(2) CONTNUITÉ DE LA MATIÈRE

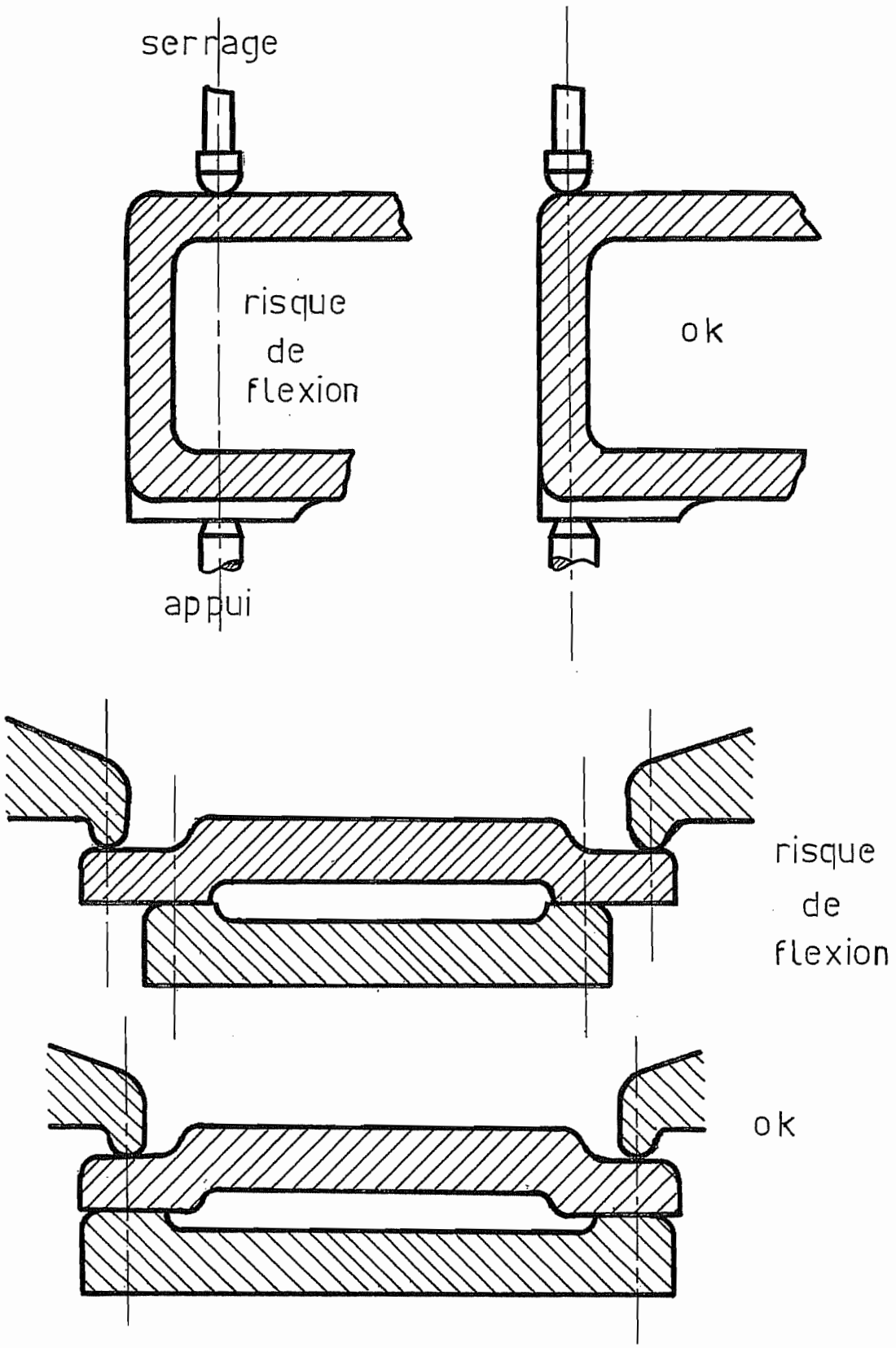


Fig 41

(3) SIMPLIFIER ET RÉDUIRE LES PONTS DE SERRAGE

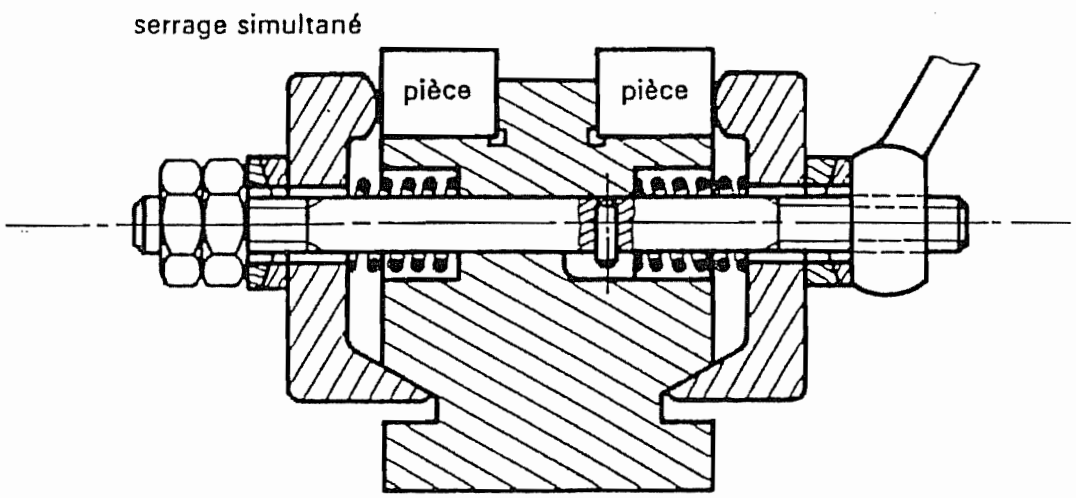


Fig 42

(4) SERRAGE PALONNÉ

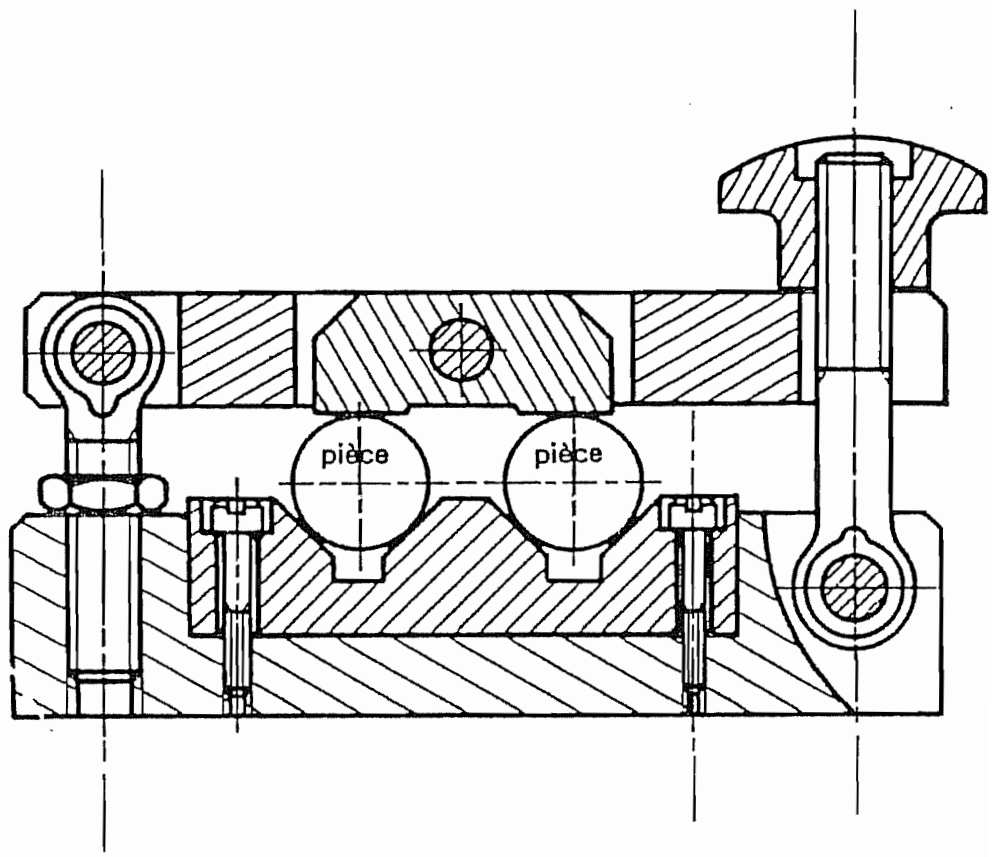


Fig 43

(5) EVITER LES PRESSIONS DE SERRAGE EXCESSIVES

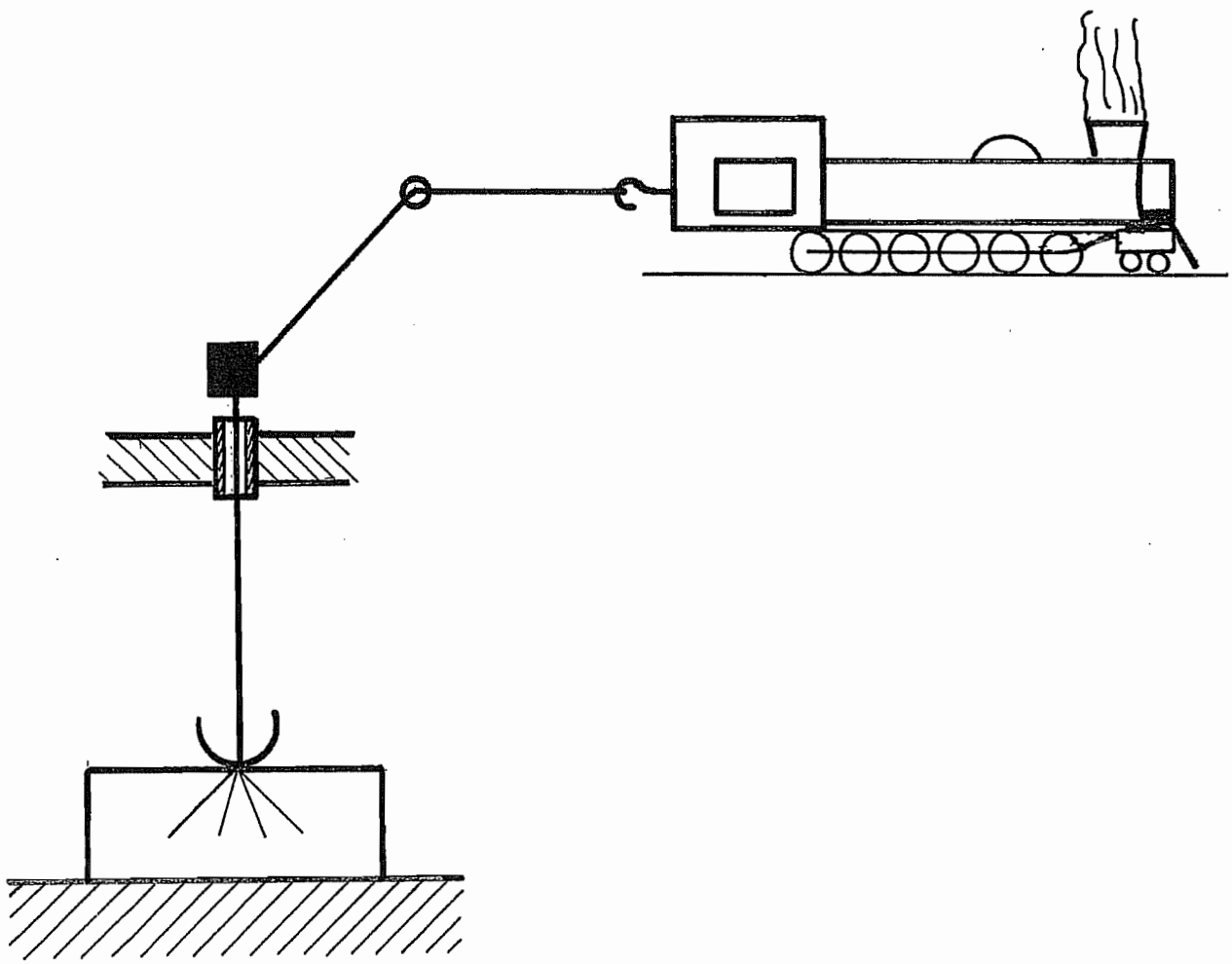
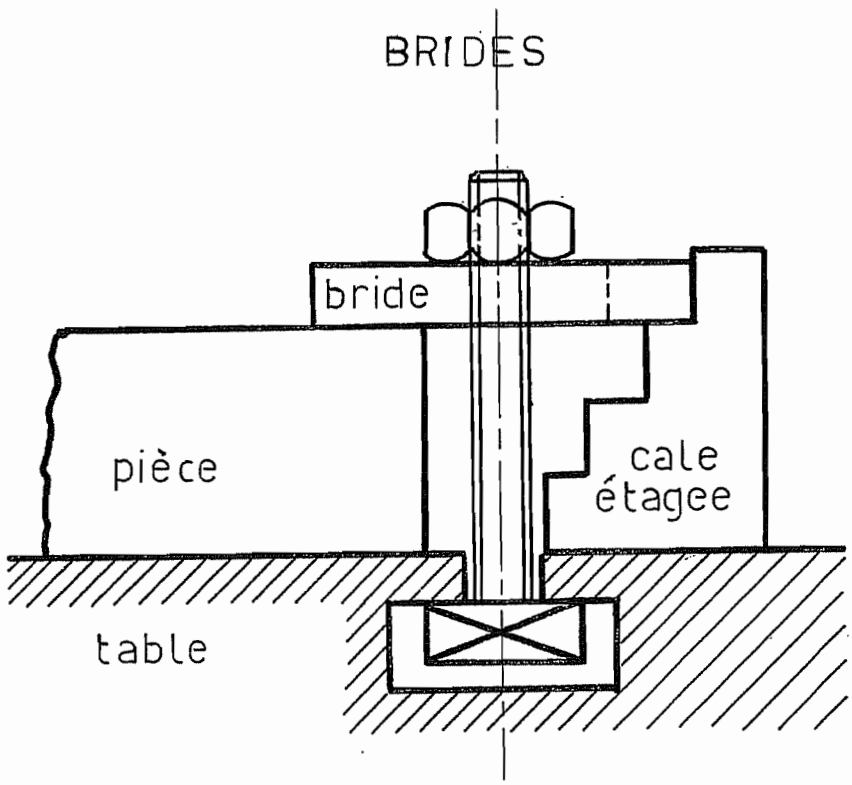
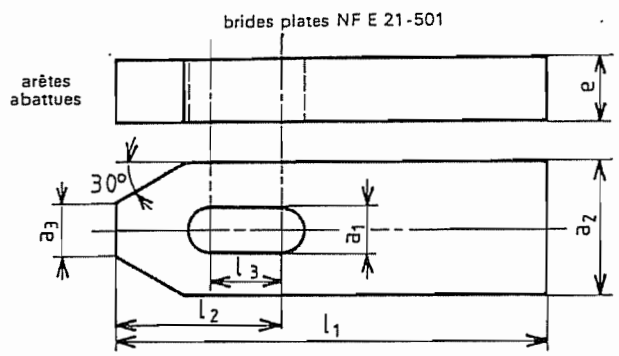
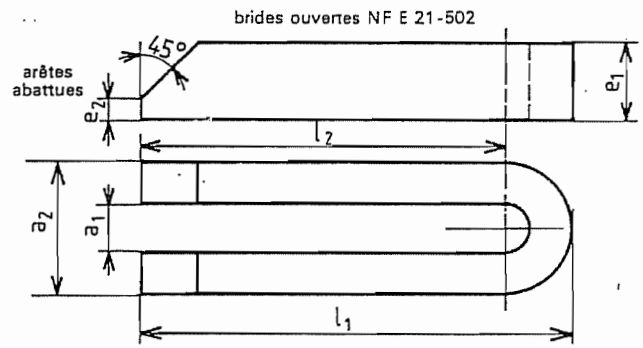
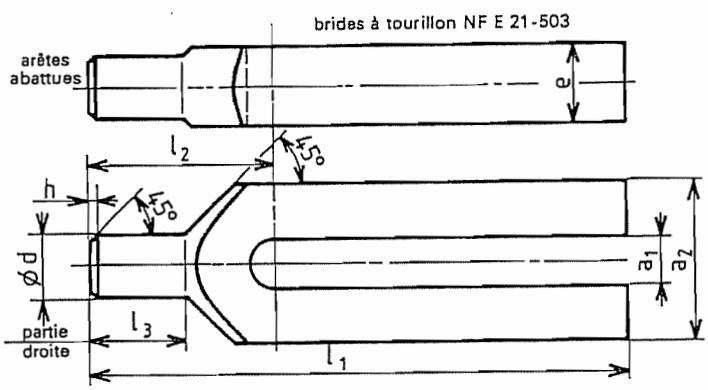


Fig 44


BRIDES
bride
pièce
cale
étagee
table


brides plates NF E 21-501
arêtes
abattues
e
30°
a3
a1
a2
l3
l2
l1


brides ouvertes NF E 21-502
arêtes
abattues
45°
e2
e1
l2
a2
a1
l1


brides à tourillon NF E 21-503
arêtes
abattues
e
l2
45°
h
45°
ød
partie
droite
l3
a1
a2
l1

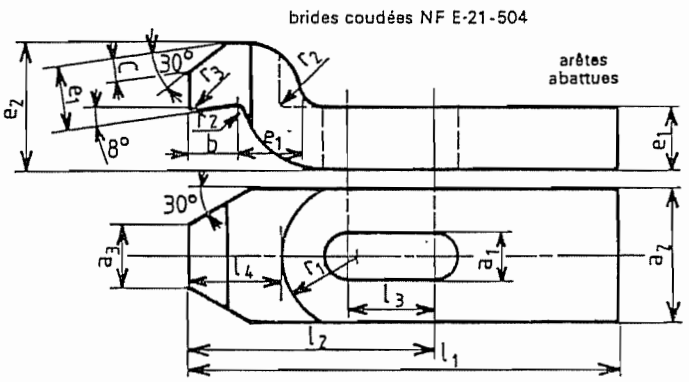
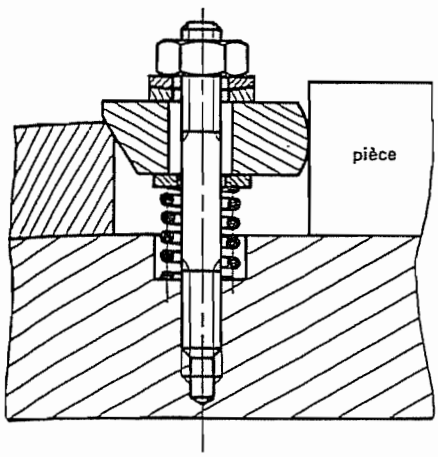

brides coudées NF E-21-504
arêtes
abattues
C
30°
r3
r2
e2
e1
r2
8°
b
e1
e1
30°
a3
l4
r1
a1
l3
a2
l2
l1

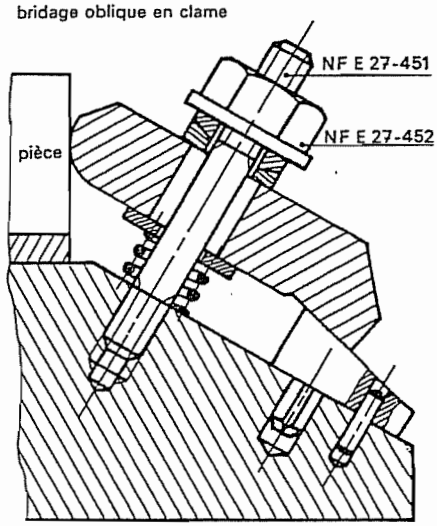
Fig 45

EXEMPLES DE RÉALISATION

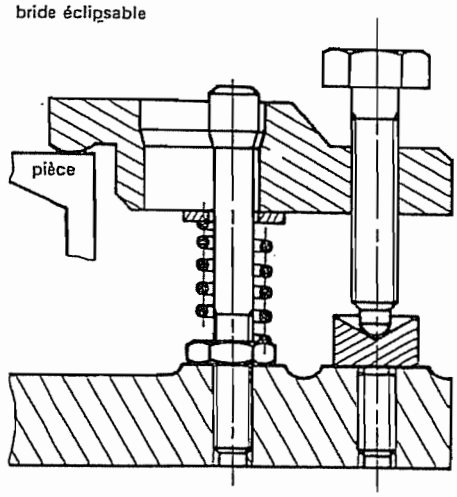
vis et bride à actions combinées



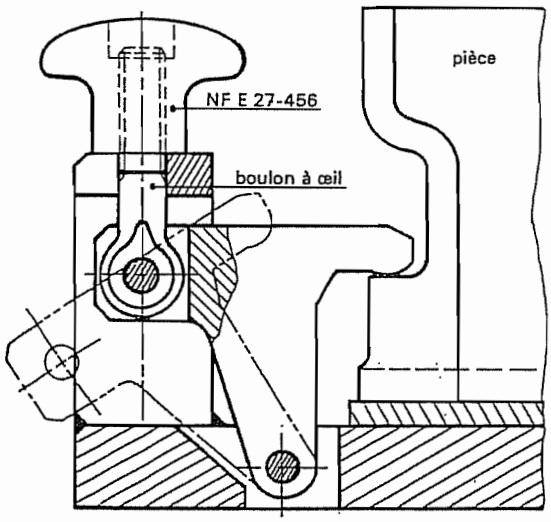
bridage oblique en clame



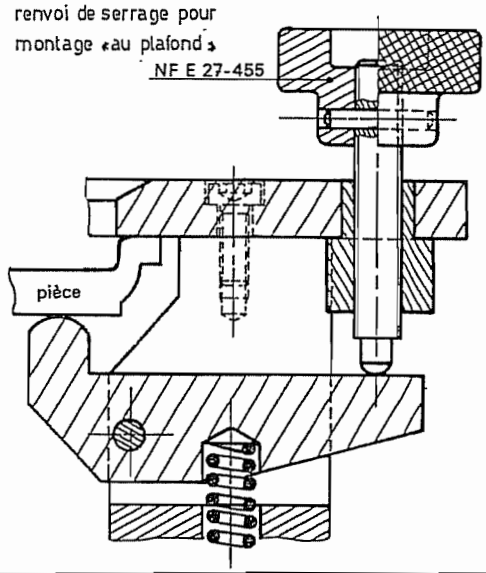
bride éclipsable



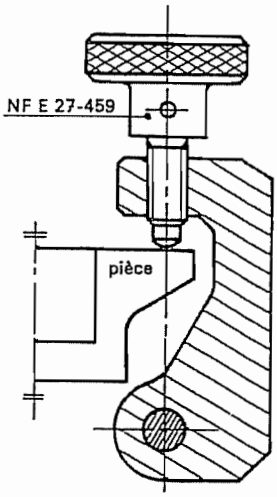
bride éclipsable



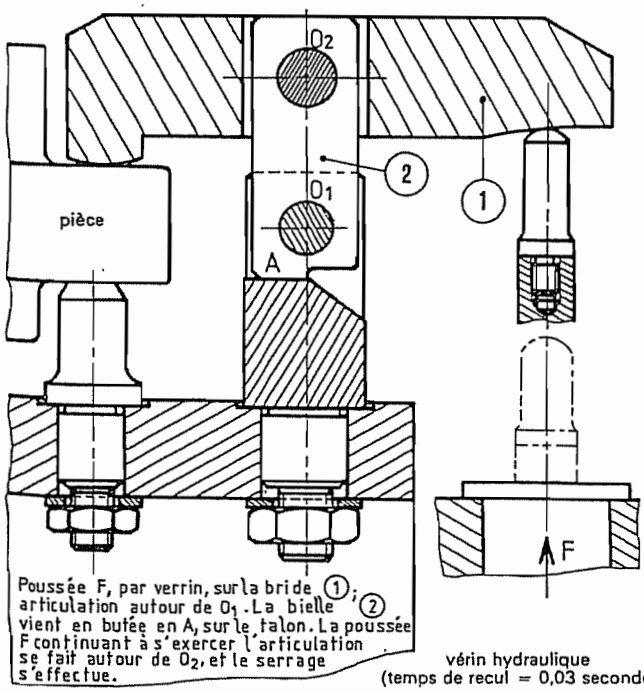
renvoi de serrage pour montage «au plafond»



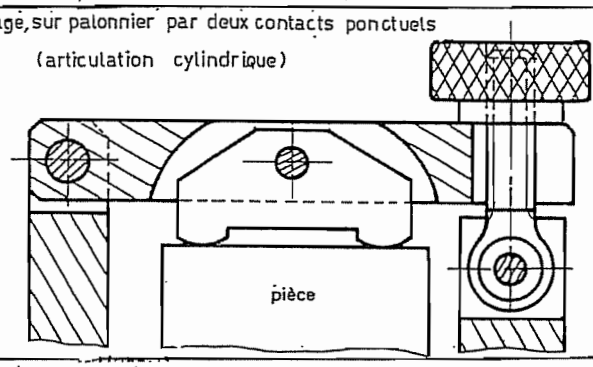
renvoi de serrage



bride à évolution et serrage rapides



serrage, sur palonnier par deux contacts ponctuels (articulation cylindrique)



serrage, sur palonnier par contacts plan (articulation sphérique)

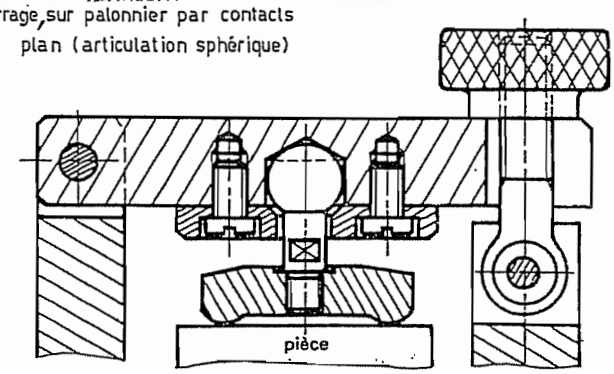


Fig 46

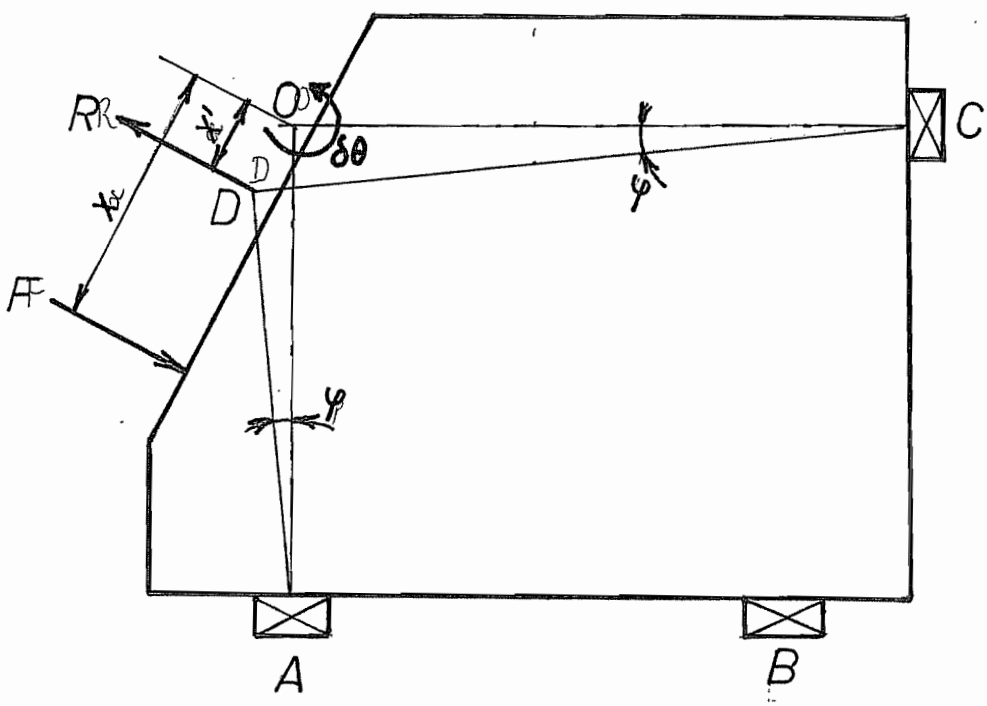


Fig. 47

Chapitre 5

Machines-outils à commande numérique

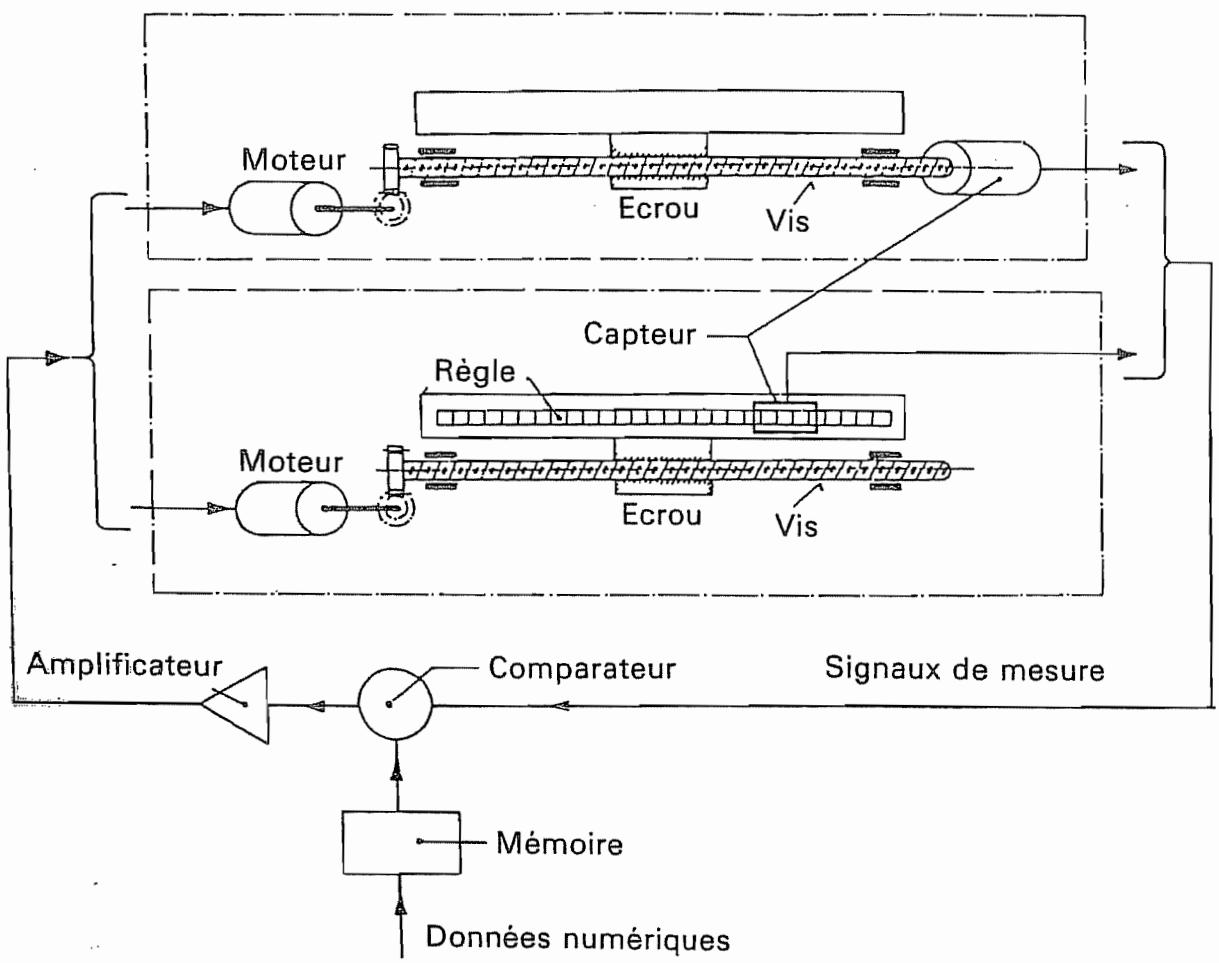


Fig. 1:
Les éléments de base d'un mouvement commandé numériquement

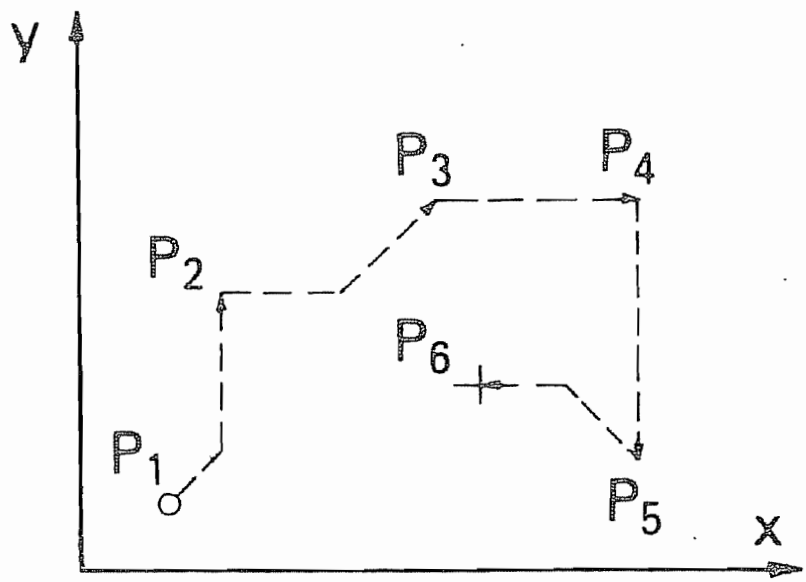


Fig. 2:
Commande point par point

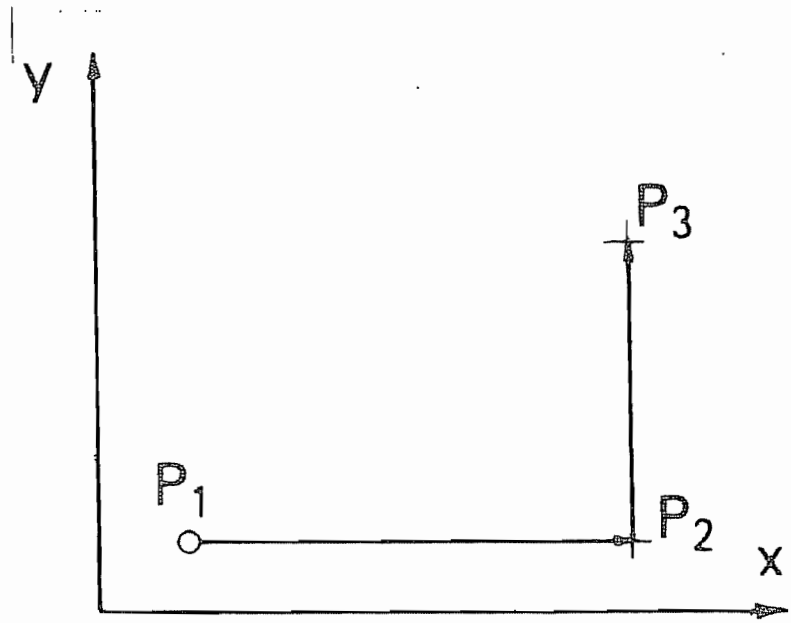


Fig. 3:
Commande paraxiale

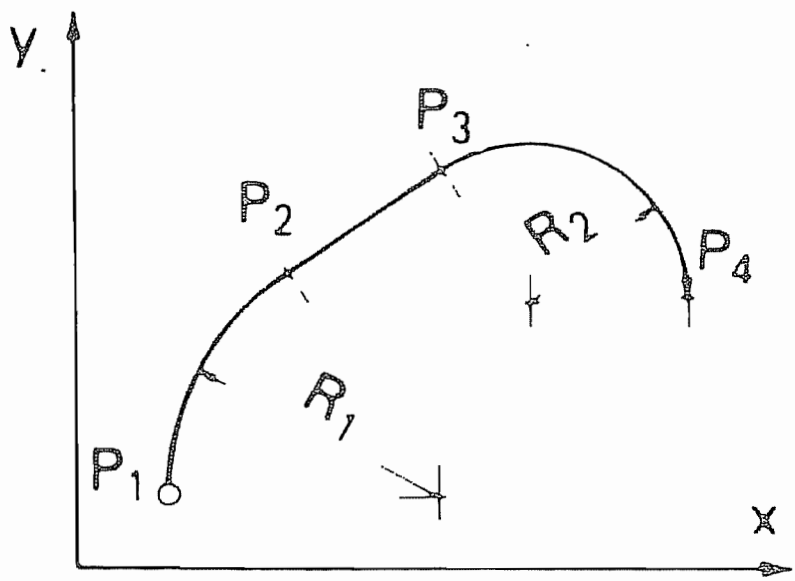


Fig. 4:
Commande de
contournage

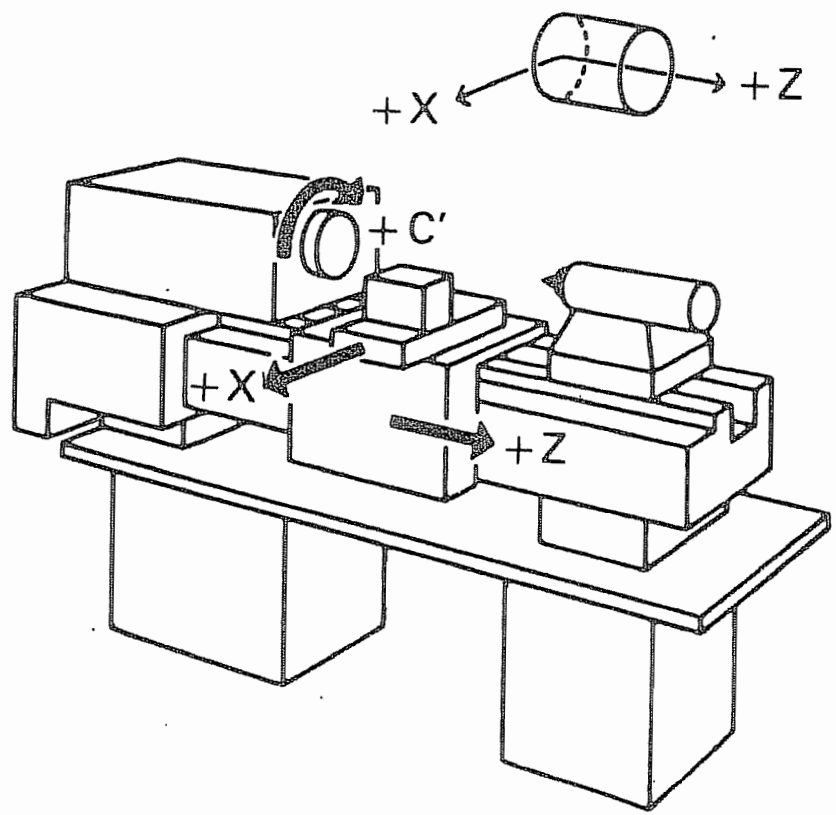


Fig. 5 :
Désignation des axes
et sens de comptage sur le tour

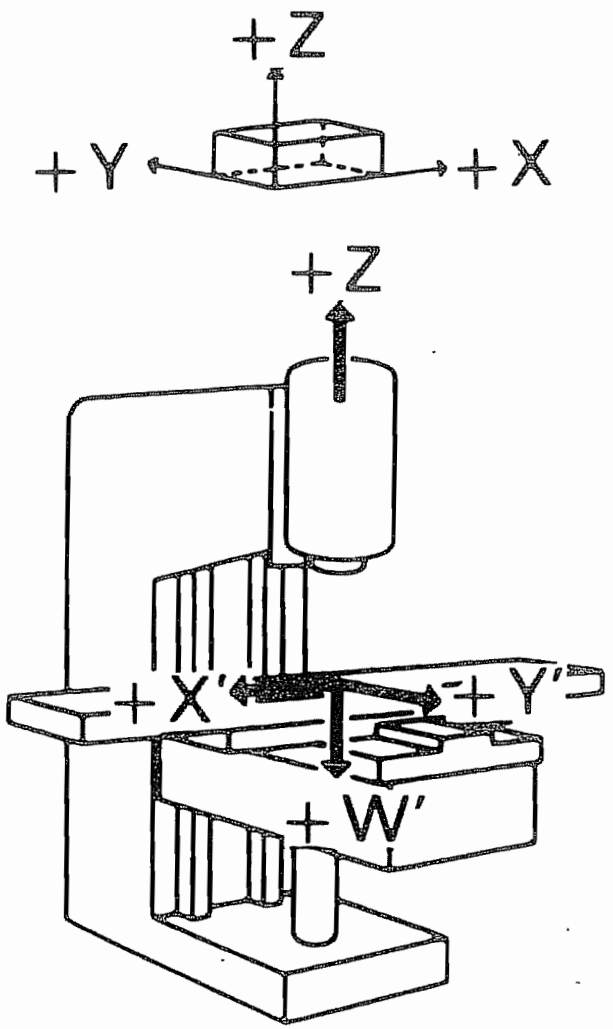


Fig. 6 :
Désignation des axes et sens de comptage sur la fraiseuse

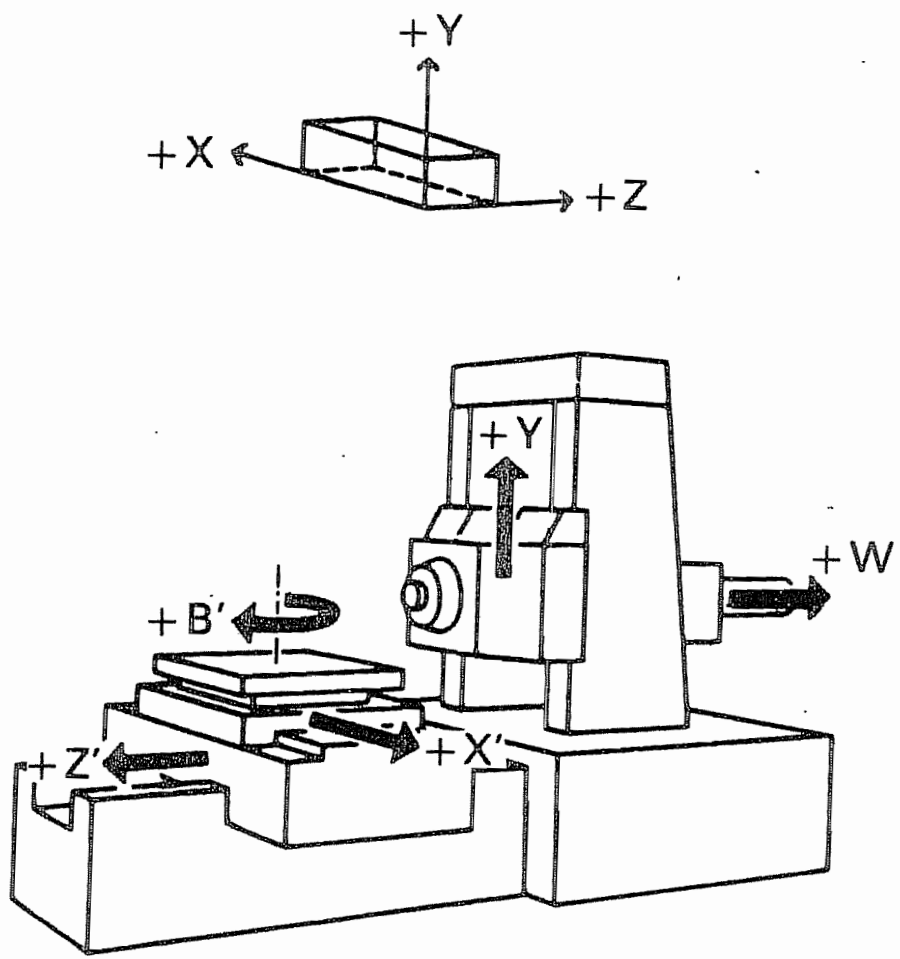


Fig. 7 :
Désignation des axes et sens de comptage sur l'aléseuse

FRAISEUSE - ALESEUSE UNIVERSELLE

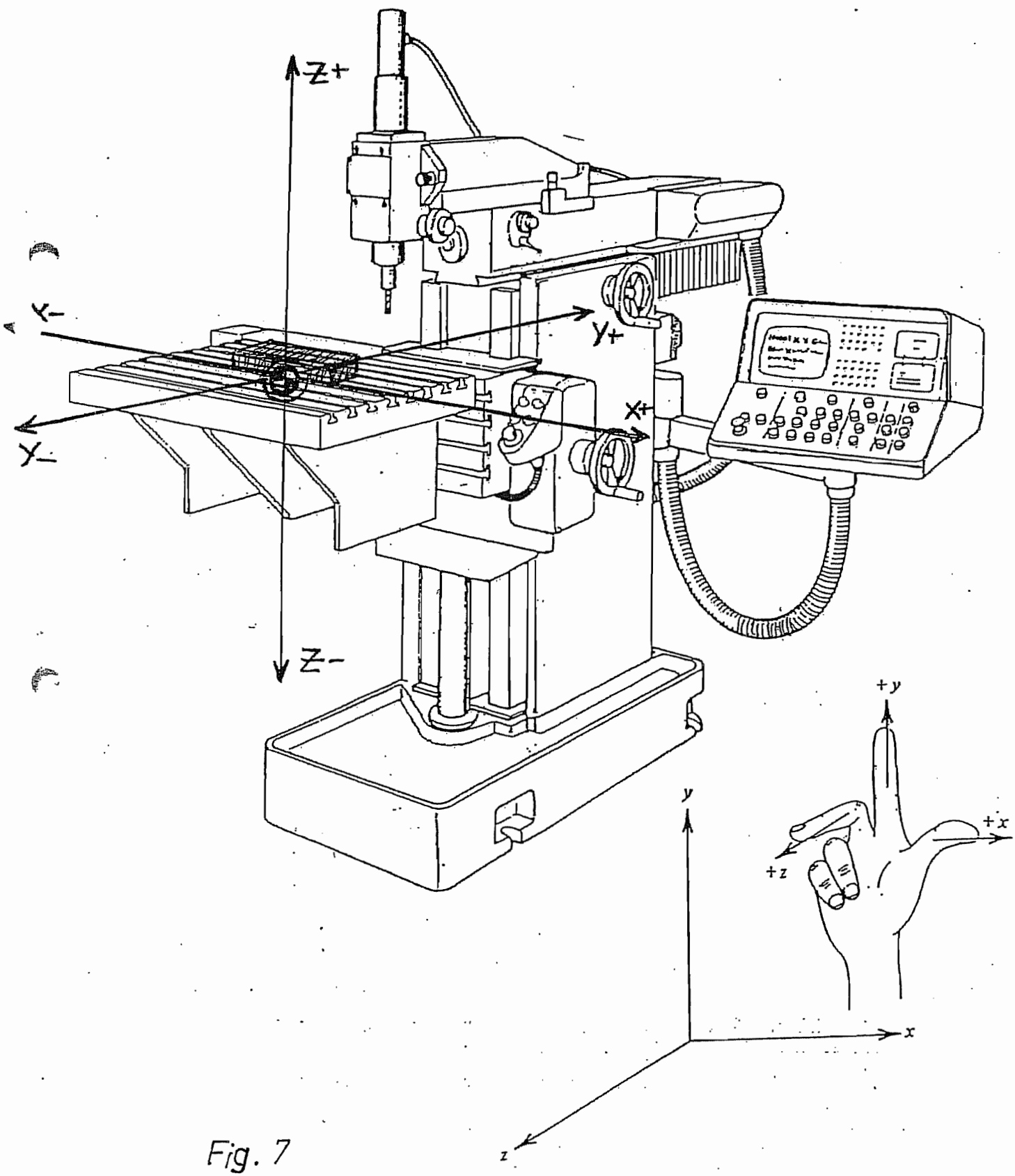


Fig. 7

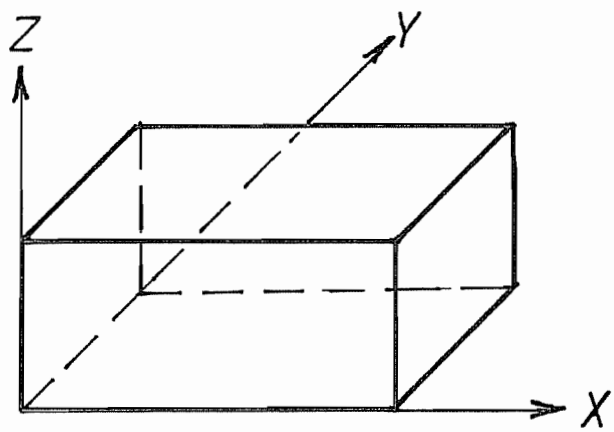


Fig. 8

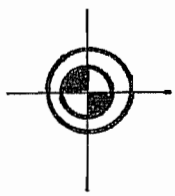


Fig. 9

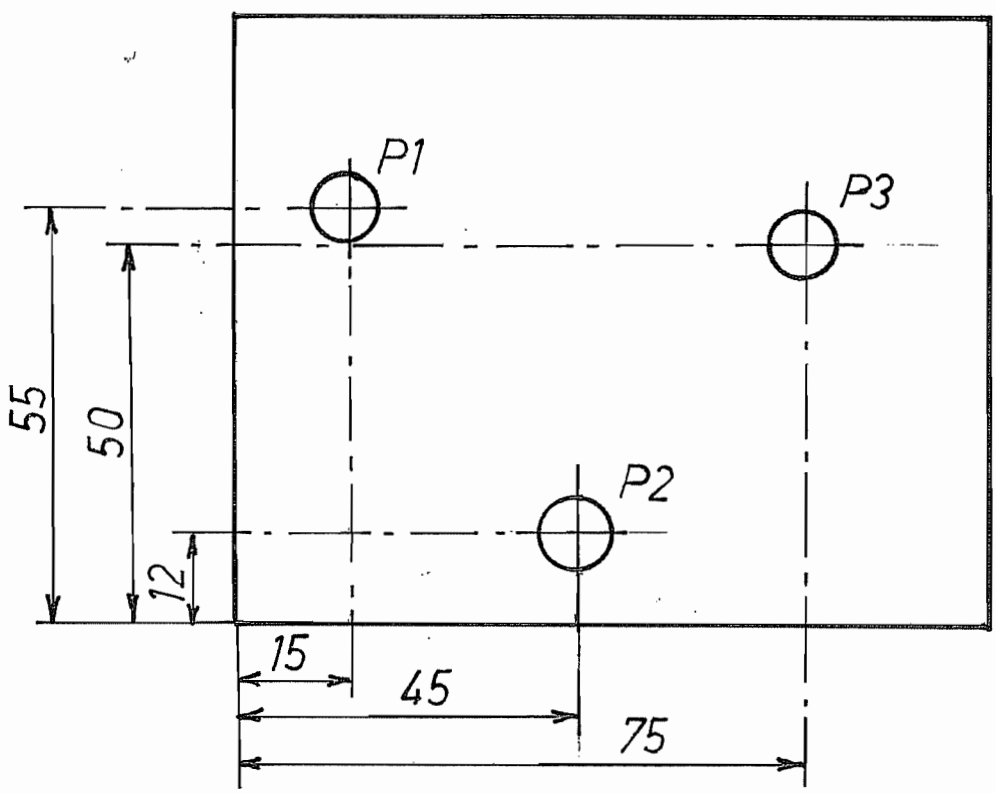


Fig. 10

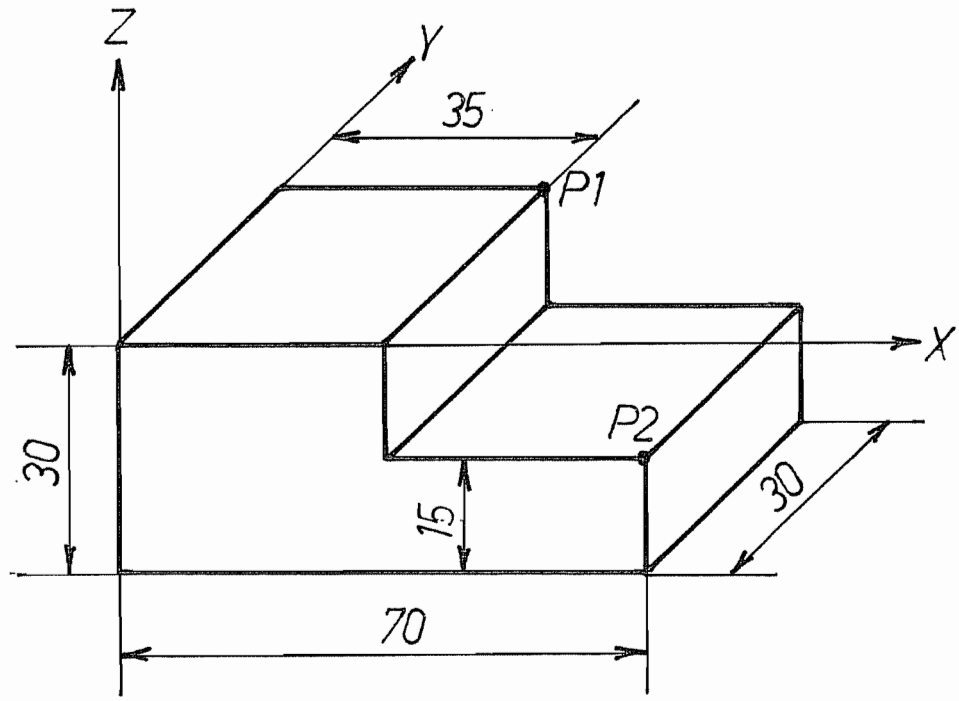


Fig. 11

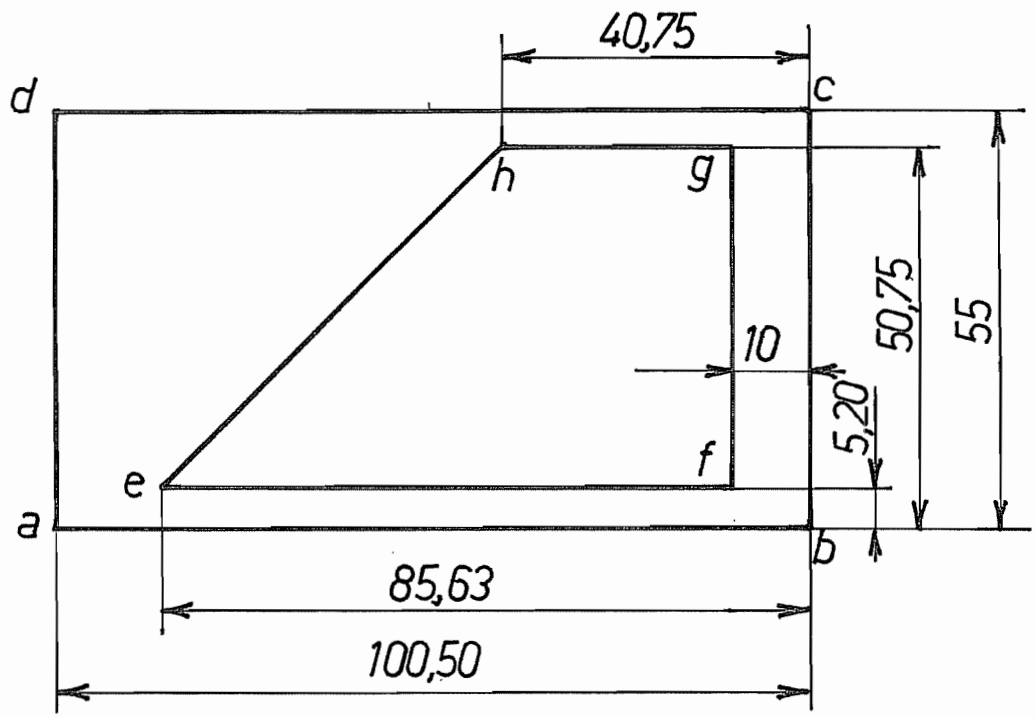


Fig. 12

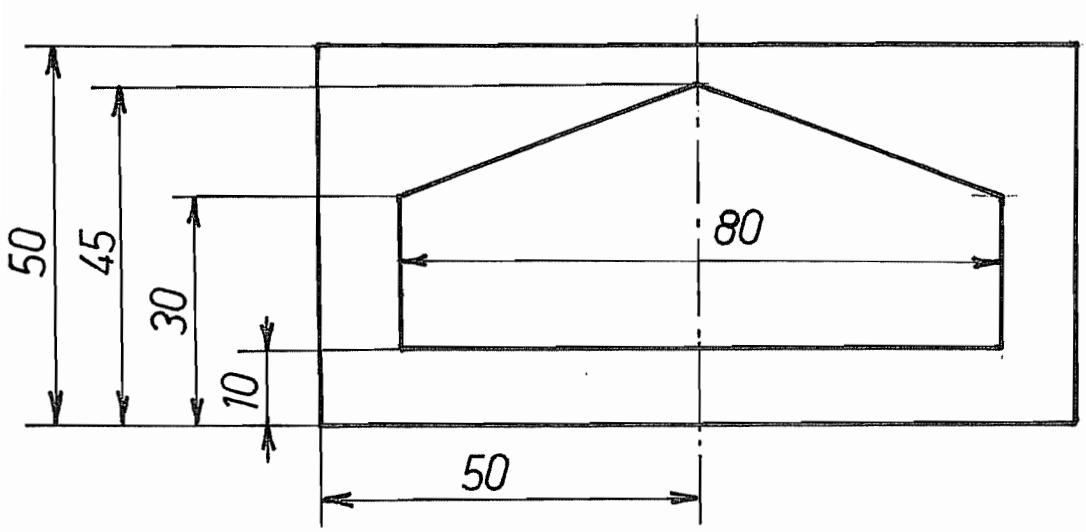


Fig. 13

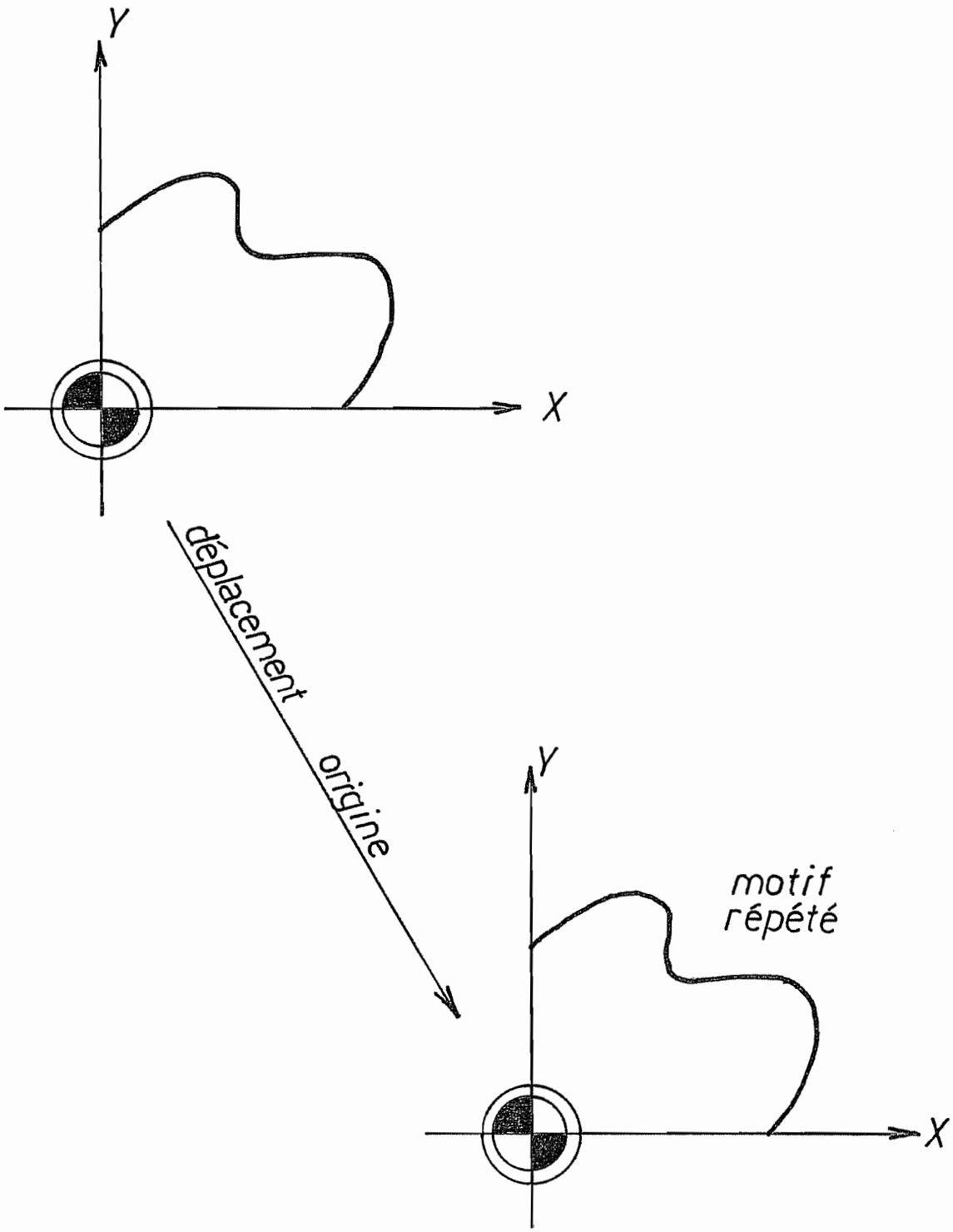


Fig. 14

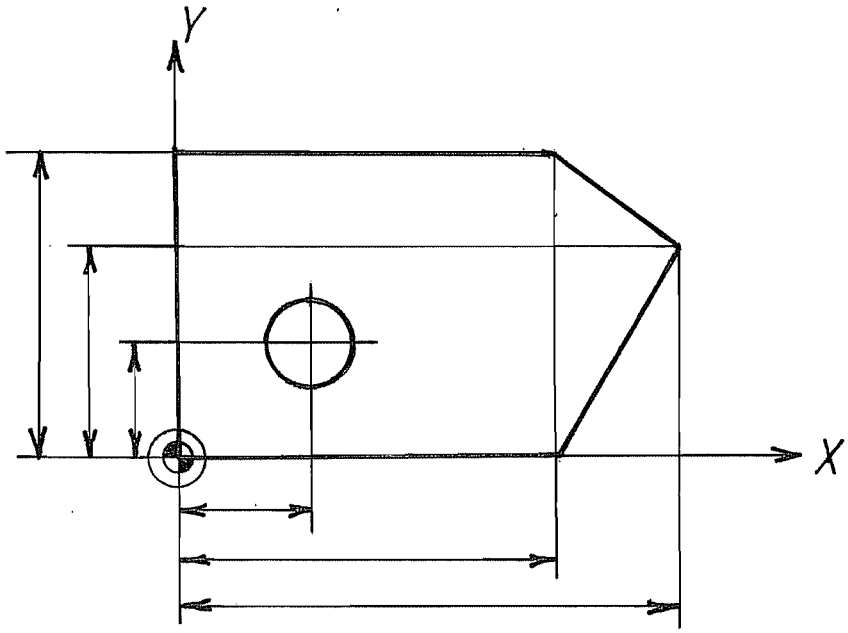


Fig. 15 : cotation absolue

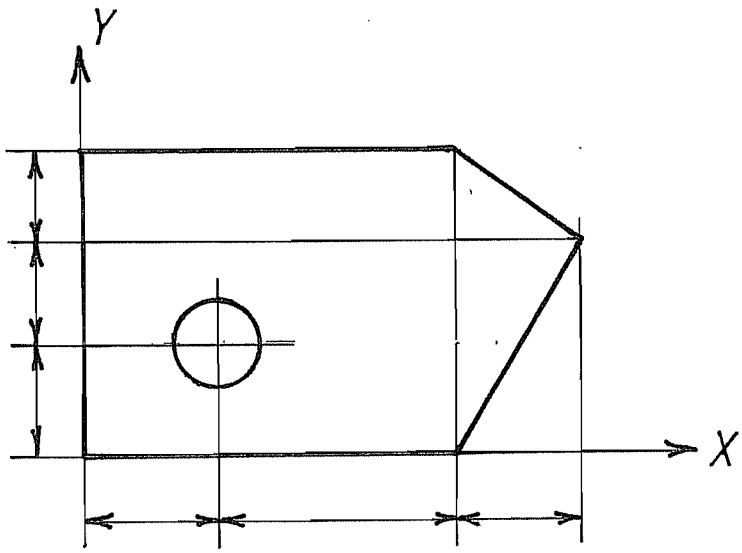


Fig. 16 : cotation relative

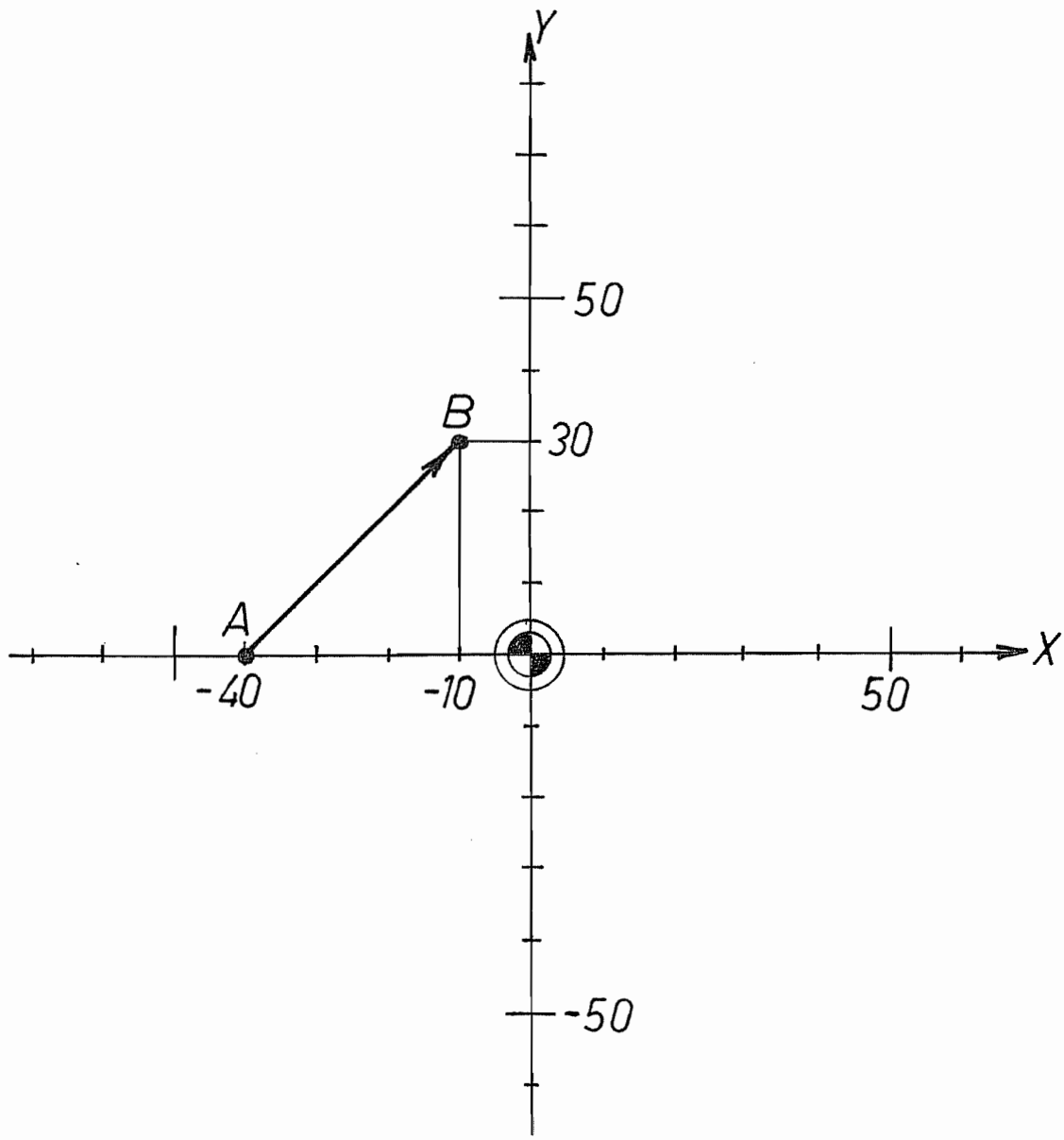


Fig. 17

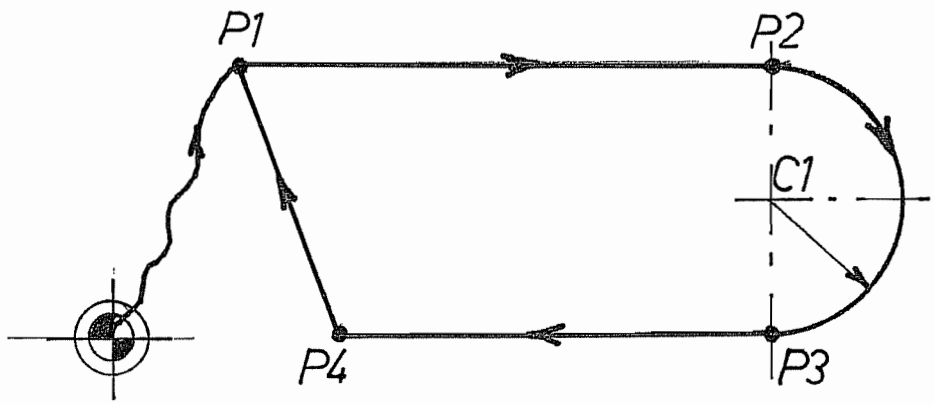


Fig 18

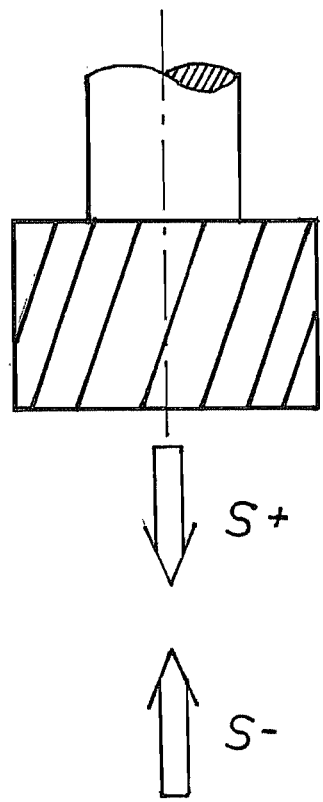


Fig. 19

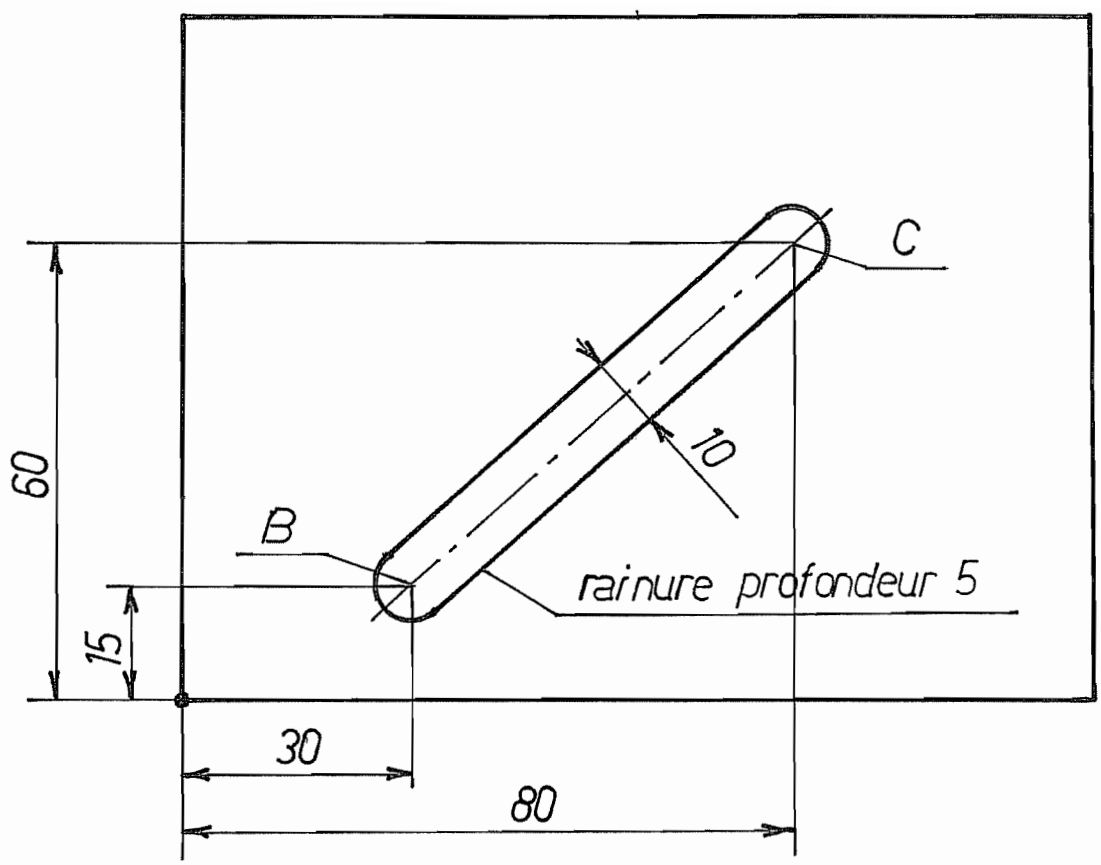


Fig. 20

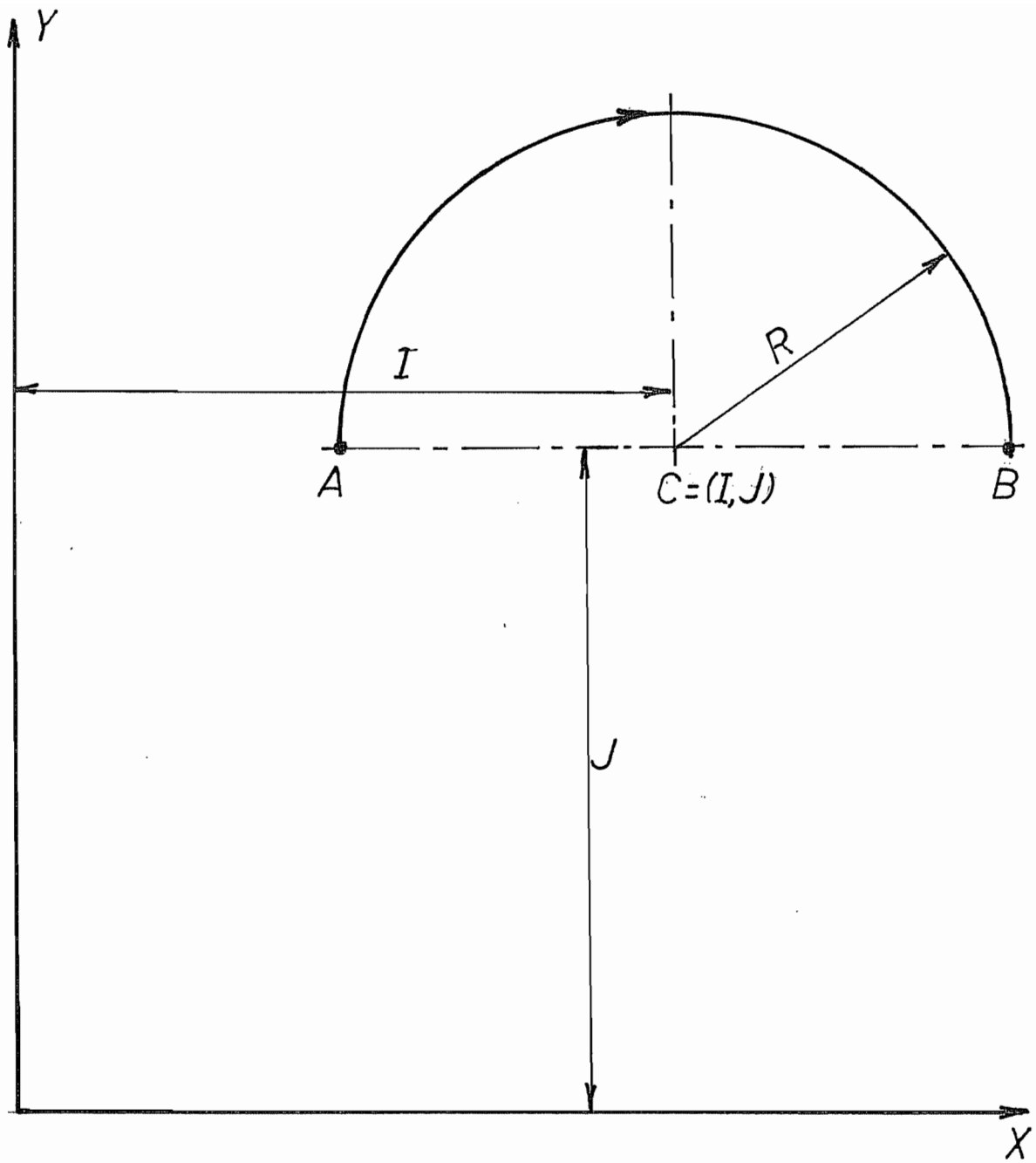


Fig. 21

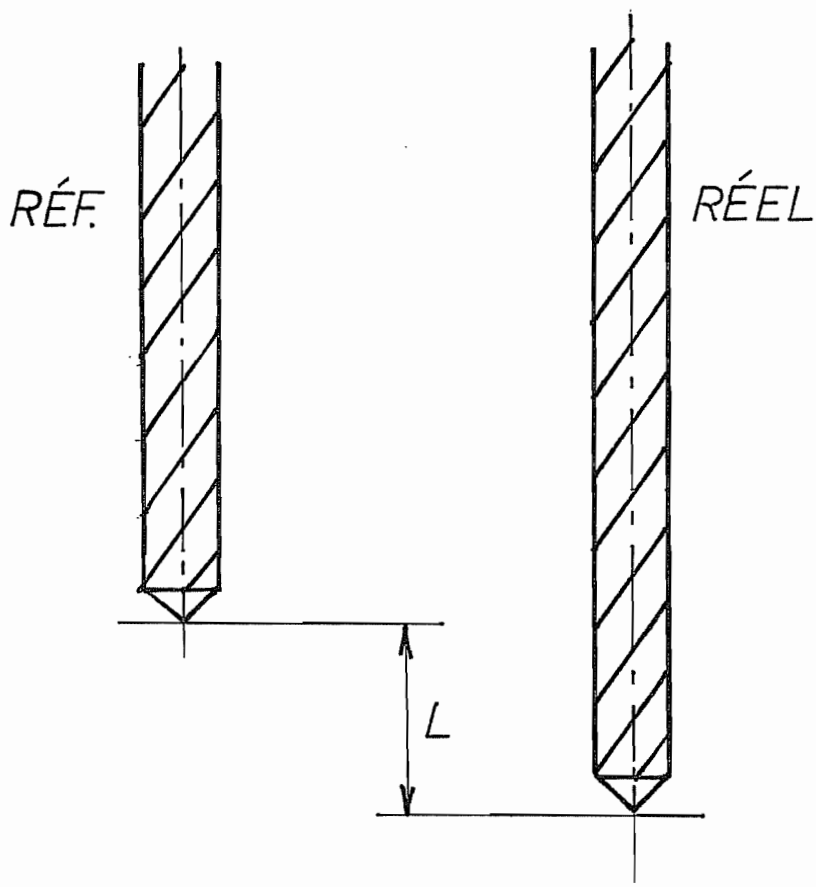


Fig. 22

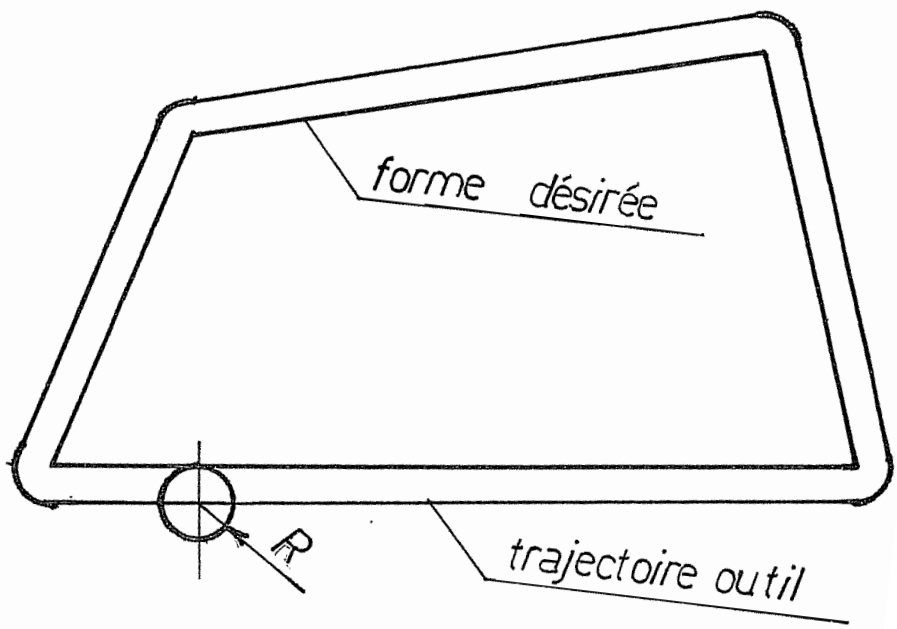
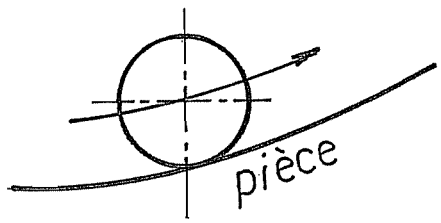
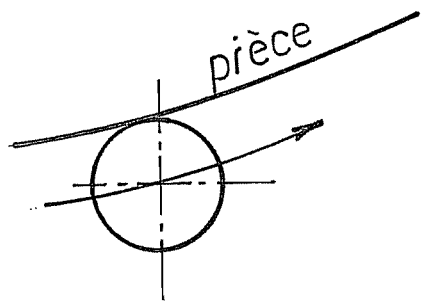


Fig. 23



Outil à gauche
G41



Outil à droite
G42

Fig. 24

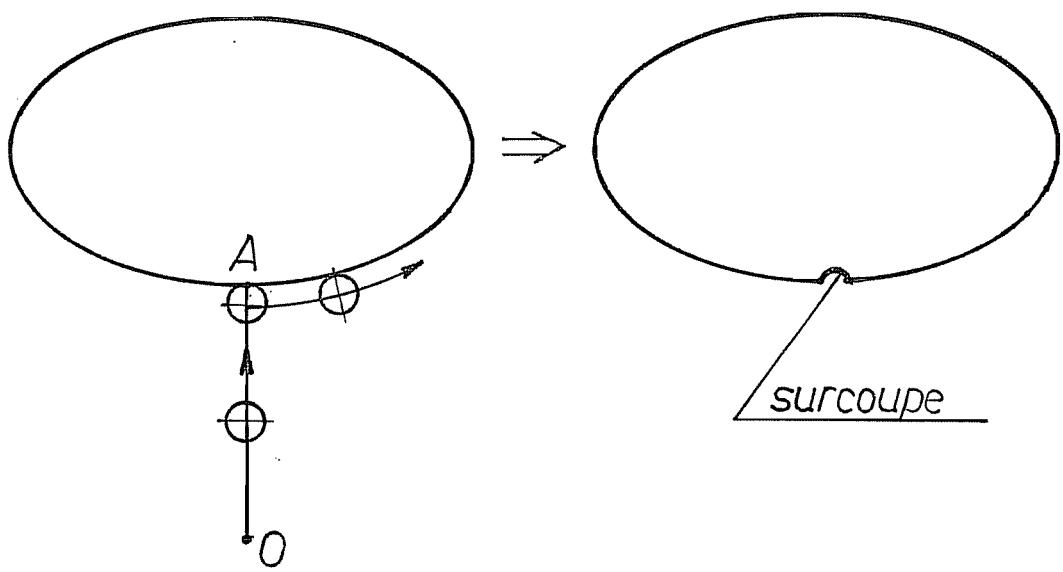


Fig. 25

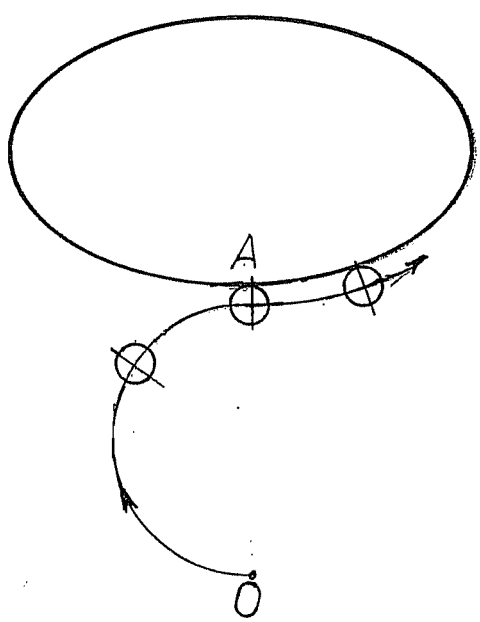


Fig. 26

Chapitre 6

Optimisation en chariotage

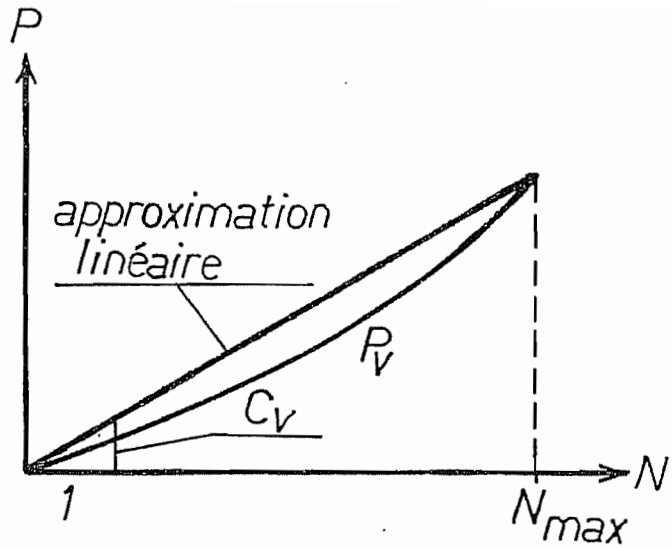

P
approximation
linéaire
P_V
C_V
1
N
N_{max}

FIG. 1

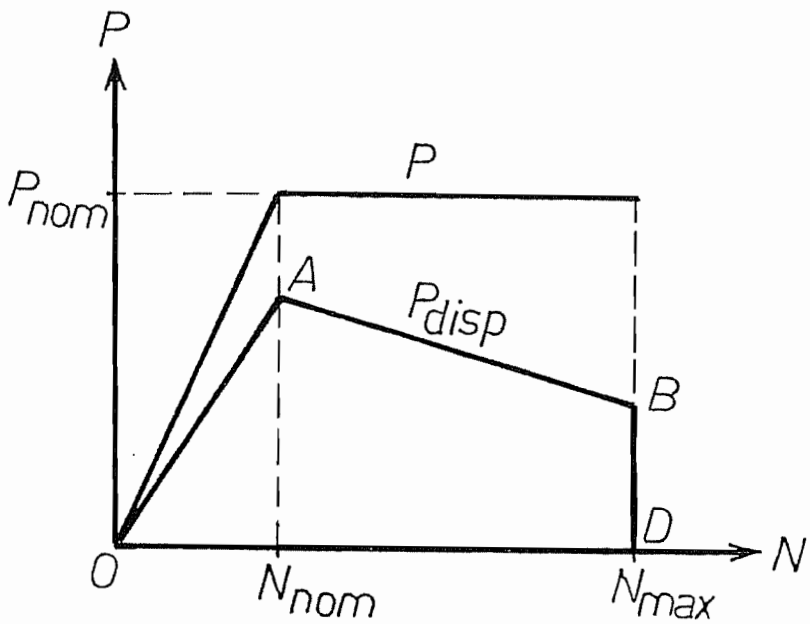

P
P_{nom}
P
A
P_{disp}
B
D
O
N
N_{nom}
N_{max}

FIG. 2

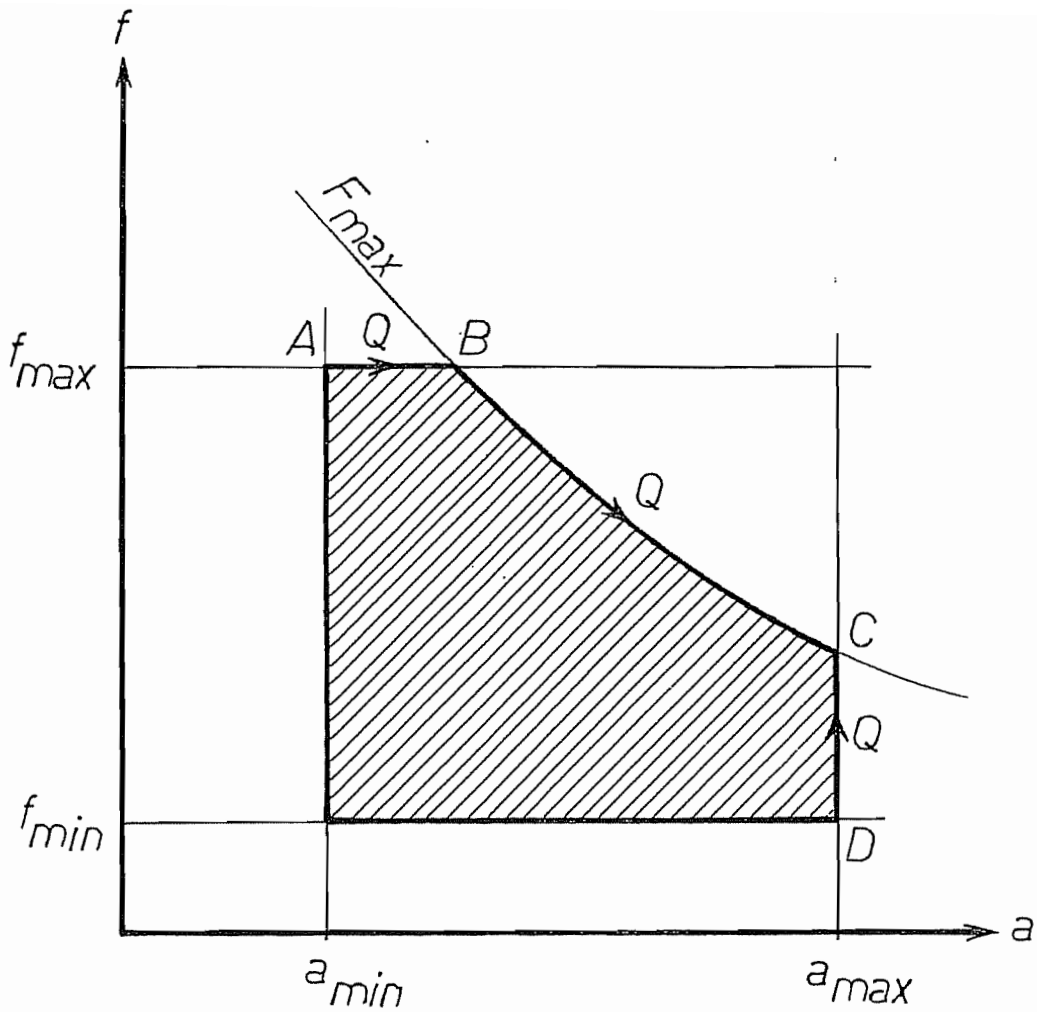


FIG . 3

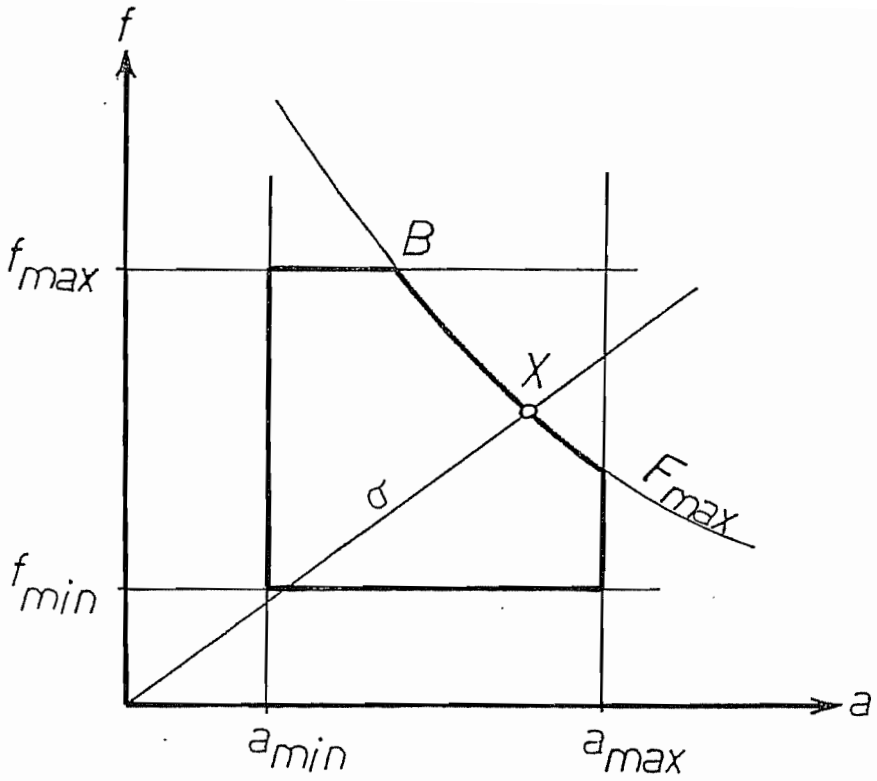


FIG. 4

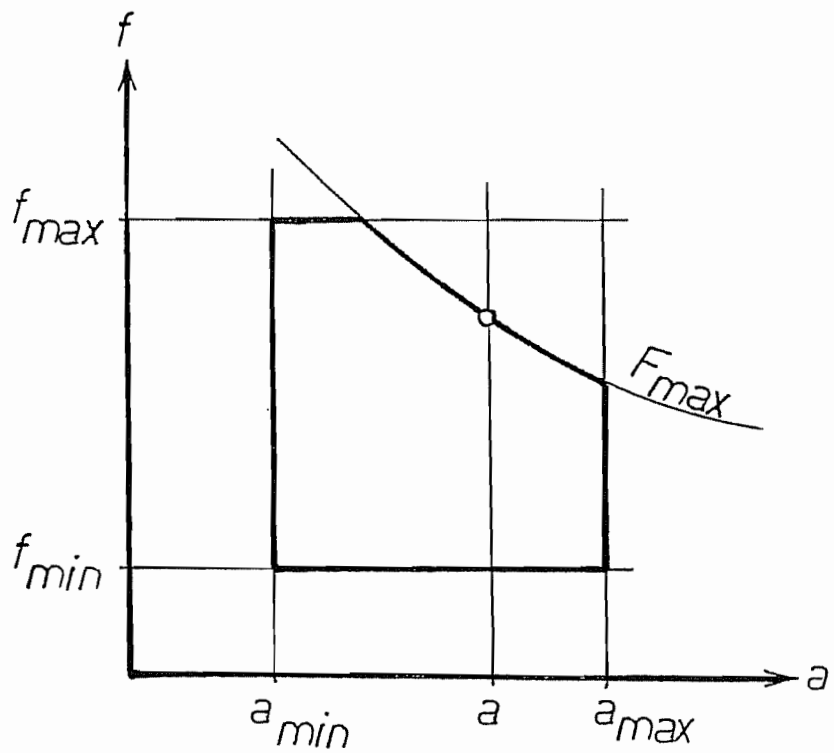


FIG. 5

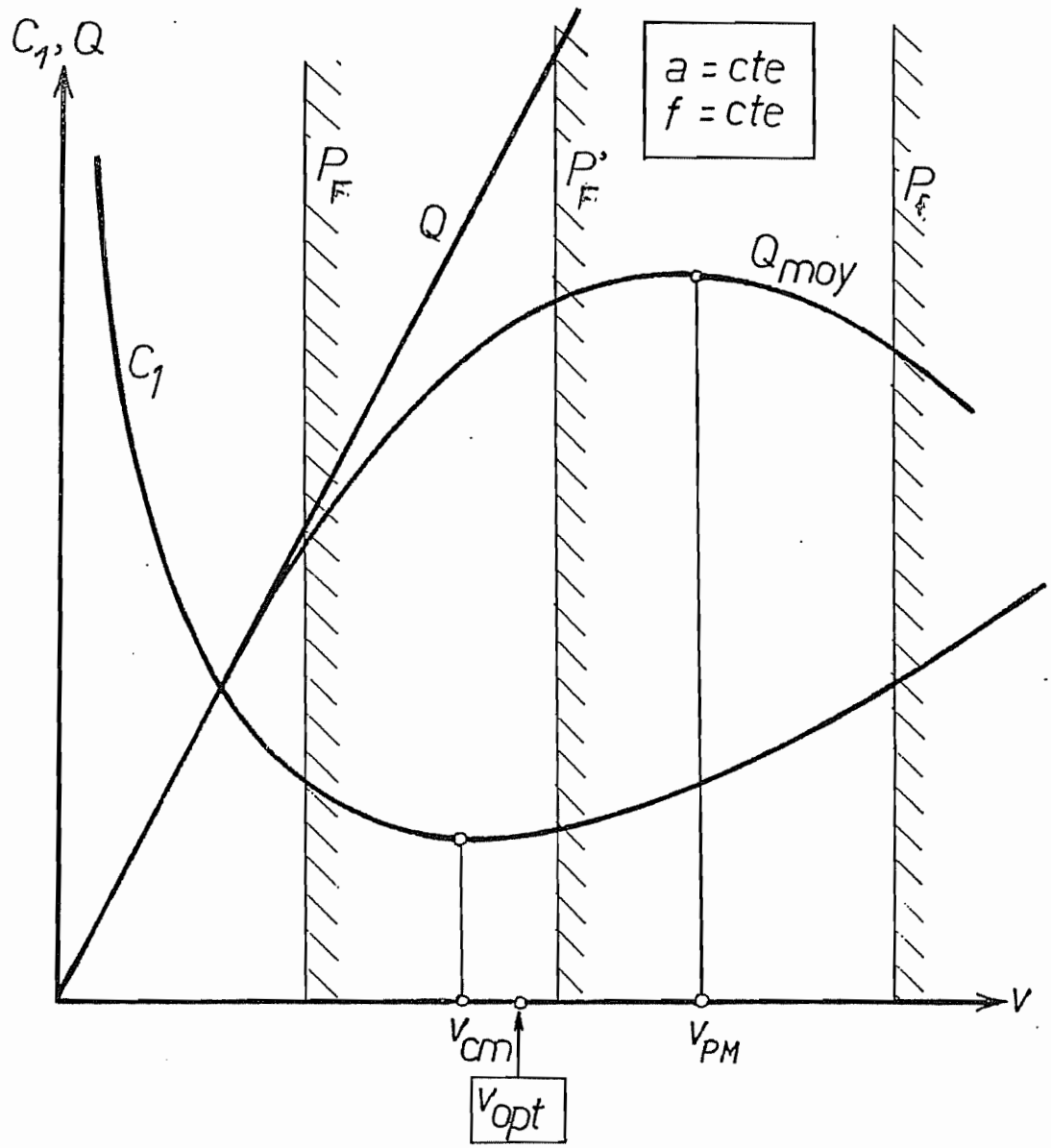


FIG. 6

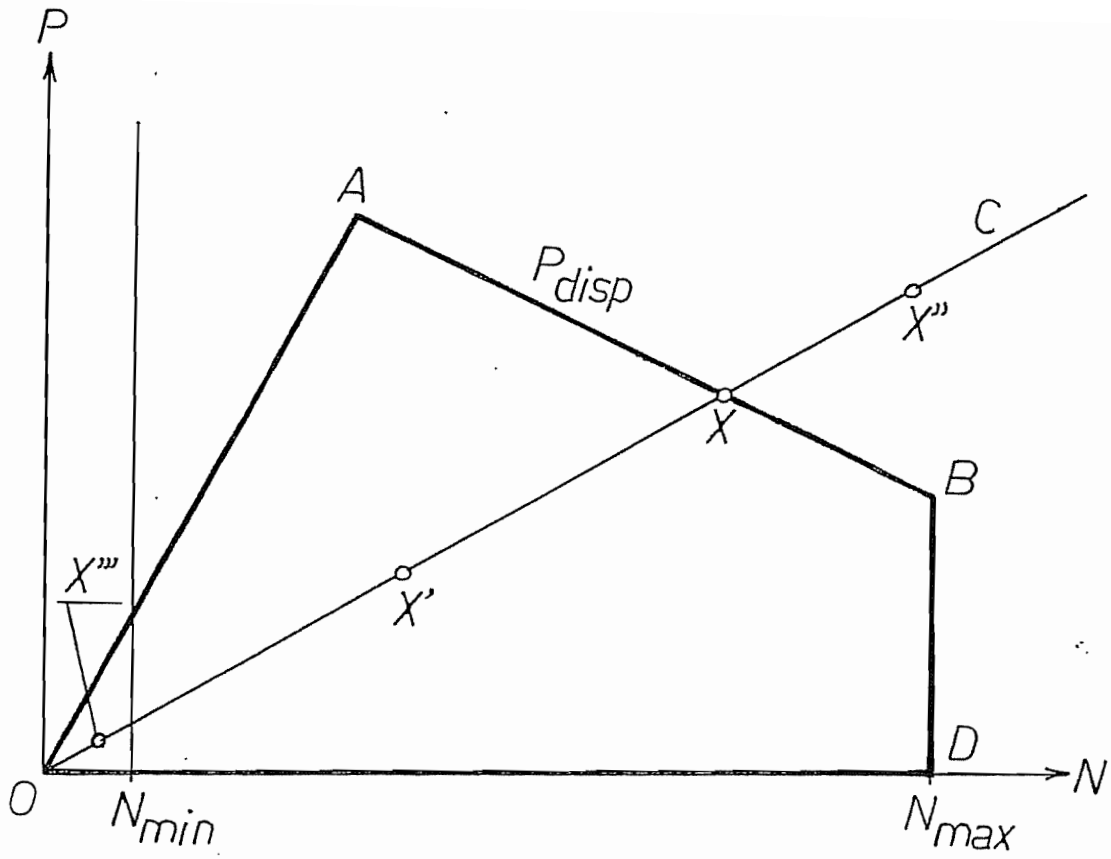


FIG. 7

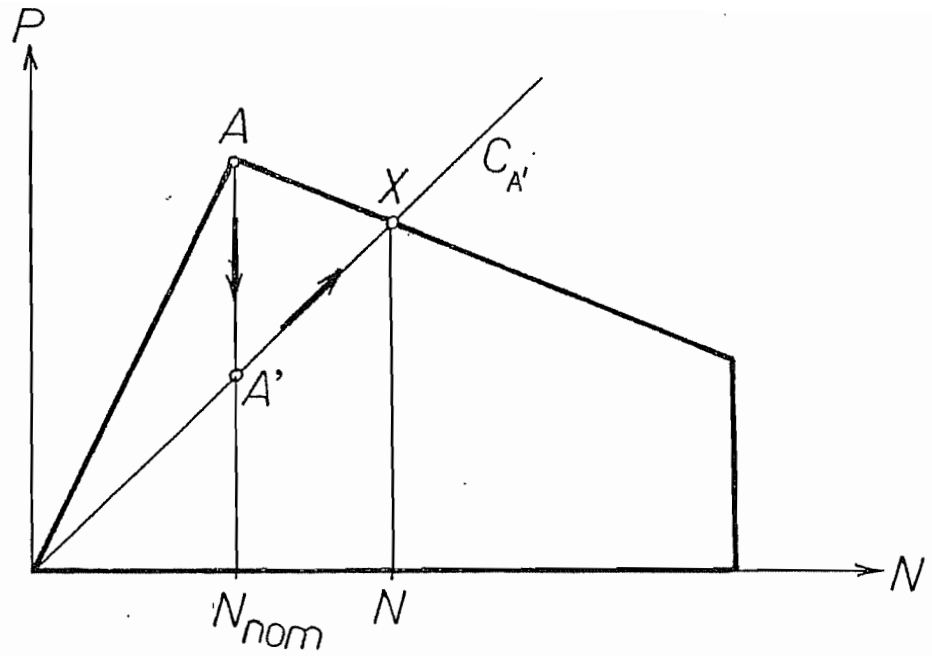


FIG. 8