Enformação Mecânica

Calandra

Aplicação típica: Chapas cilindricas sem flecha ou pequena flecha

Controlo
- Afastamento entre os rolos inferiores
- Angulo do rolo superior com a horizontal ou com os eixos concorrentes
- Possibilidade de remoção de um dos rolos

Limitações
- Dimensões da chapa
- Diametro do rolo superior
- Enrolamento junto às baínhas

Quinadeira

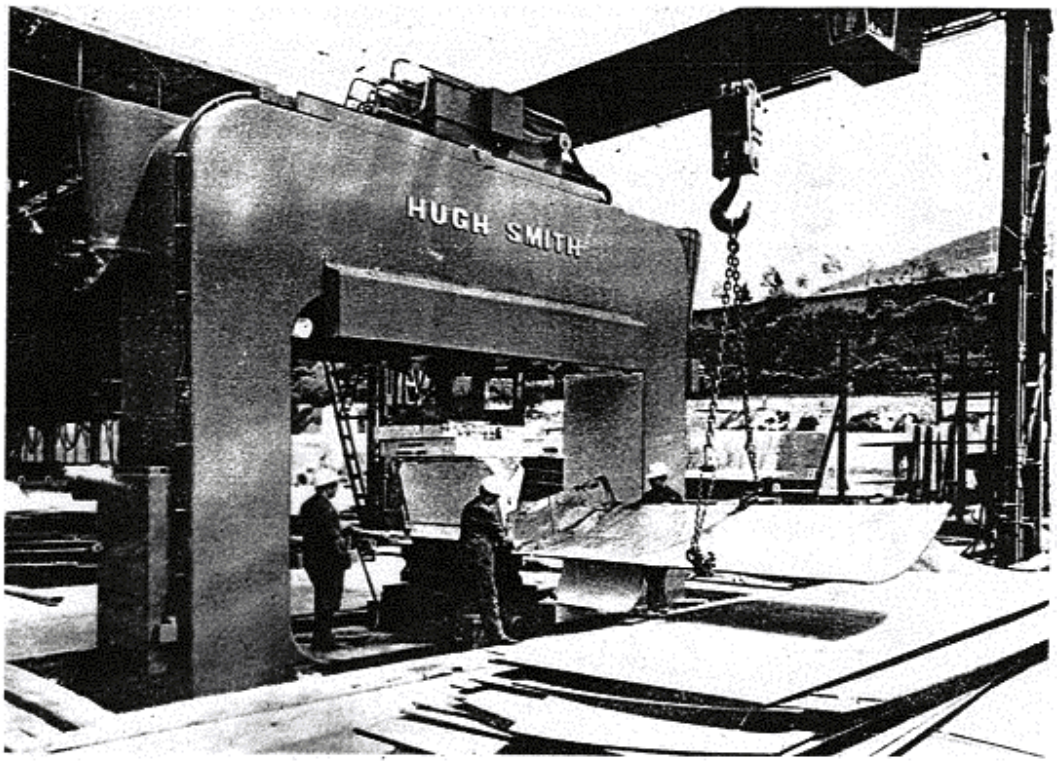
Principais componentes:
- Duas mesas
- Conjunto de matrizes e punções

Fundamento:
- Flexão segundo a espessura e atrito

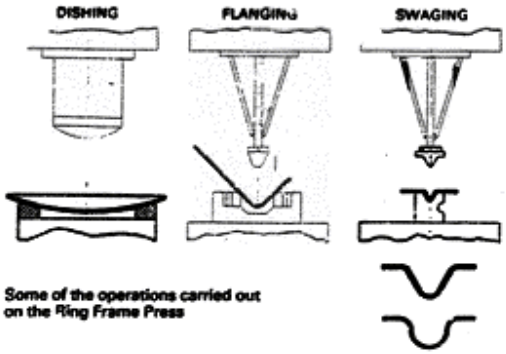
Limitações:
- Rotura do material
- Raio de curvatura local

Tipos de trabalhos:
- Extremidade de chapa para calandragem
- Canelagem
- Manufactura de perfis

Plate Manipulation to many forms ...



The HUGH SMITH RING FRAME PRESS



Some of the operations carried out on the Ring Frame Press

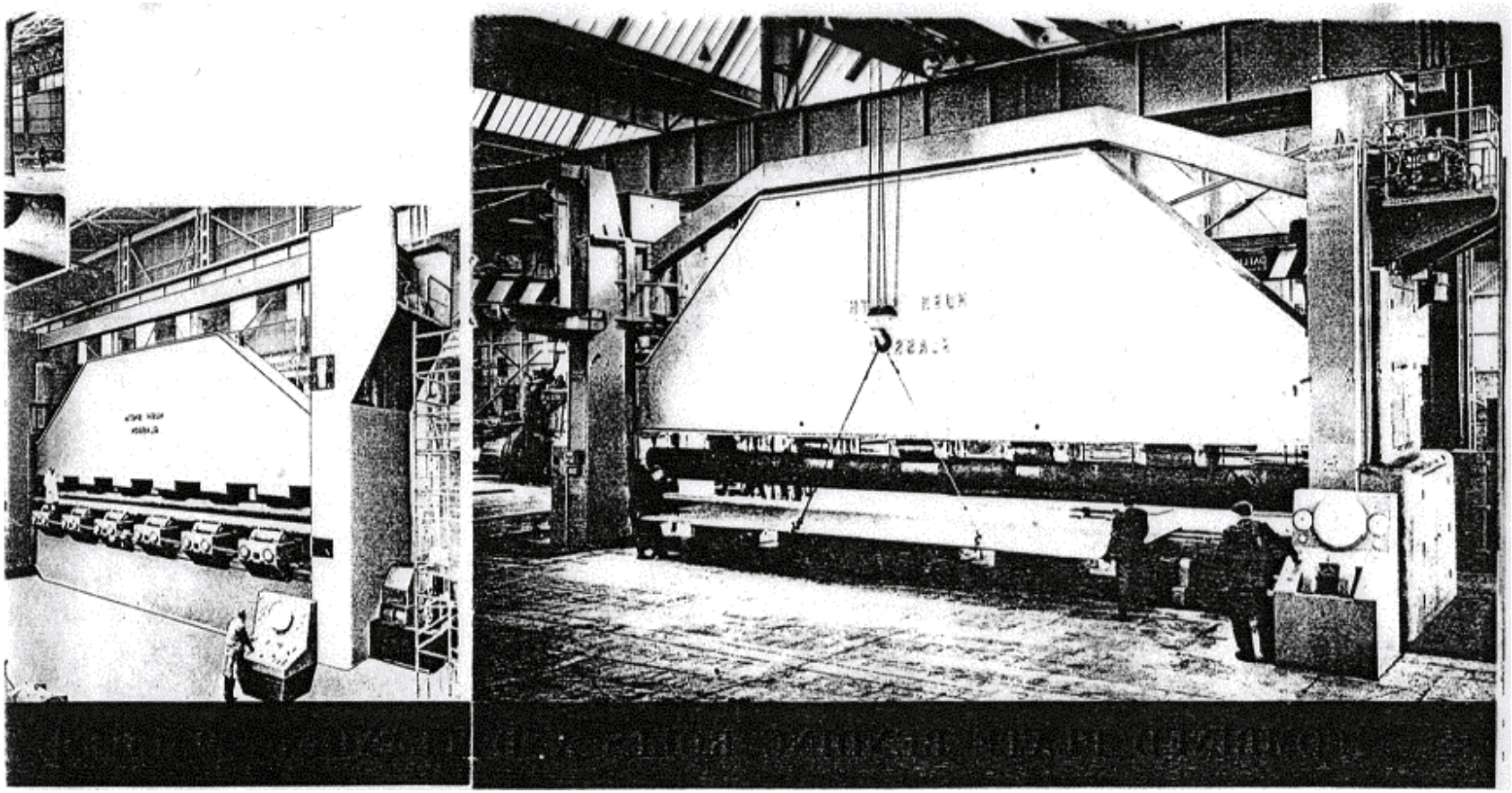
The press is designed for plate forming on a flow line basis and its accuracy is ensured by the rigidity of the heavy unit construction ring frame. Hydraulic operation gives precise control and enables full power to be applied at any point of the stroke and for as long as required.

The ram and table have a motorised traverse within the portal opening and this, along with the 360° rotary adjustment, allows the tools to be positioned exactly and the full width of the plate to be worked progressively. The range of work carried out includes plate flanging, forming and shaping to the widest variety of forms, and if required we can arrange the press to operate in conjunction with overhead or goliath cranes to facilitate plate handling and increase production rates.

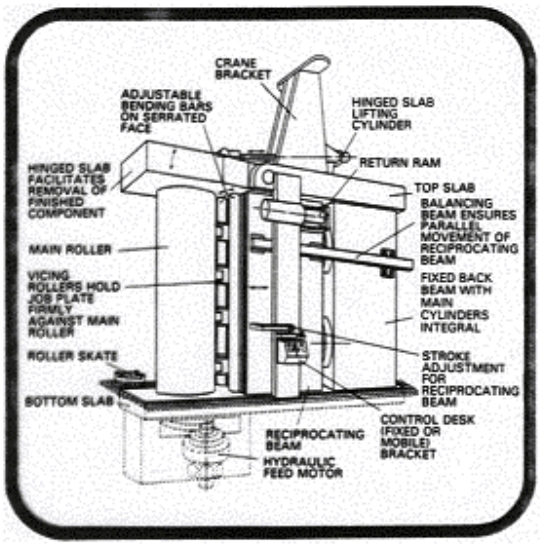
Force Range: 300 tonnes up to 2,000 tonnes
Distance between columns: up to 6m. (20ft)

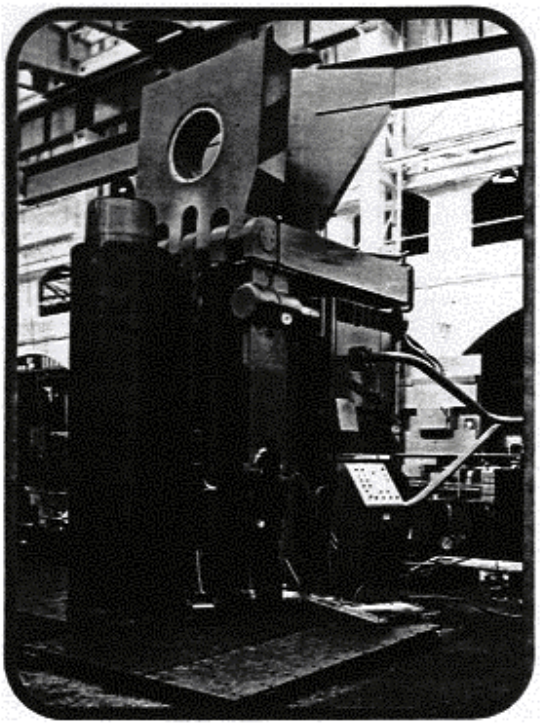
The photograph shows a Hugh Smith 1,000 tonne Ring Frame Press in service at the Hellenic Shipyards Co. at Skaramanga, Greece.

HUGH SMITH (GLASGOW) LTD.
Hamiltonhill Road, GLASGOW, N.2. U.K.
Telephone: 041-336 4141 Telegrams: POSSIL GLASGOW Telex: 77640



Features of the Hugh Smith Vertical Plate Bending Machine





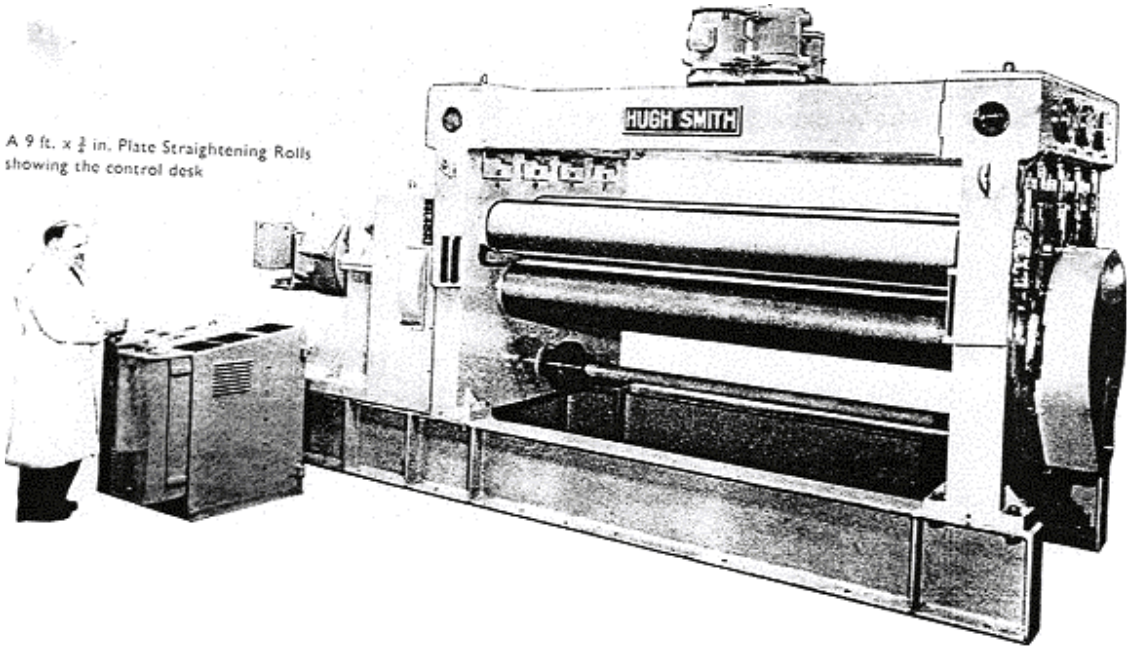
Versatility.
Edge setting.
Re-rolling after welding.
Top hinged slab.
In process measuring available.
Conical forming, without plate skidding.
Automatic plate feed.
Less floor space required.

Plates handled vertically.
Local areas of high yield easily catered for.
Adjustable bending bar centres.
Template can be applied at point of bending.
Ease of adjusting bending bar centres.

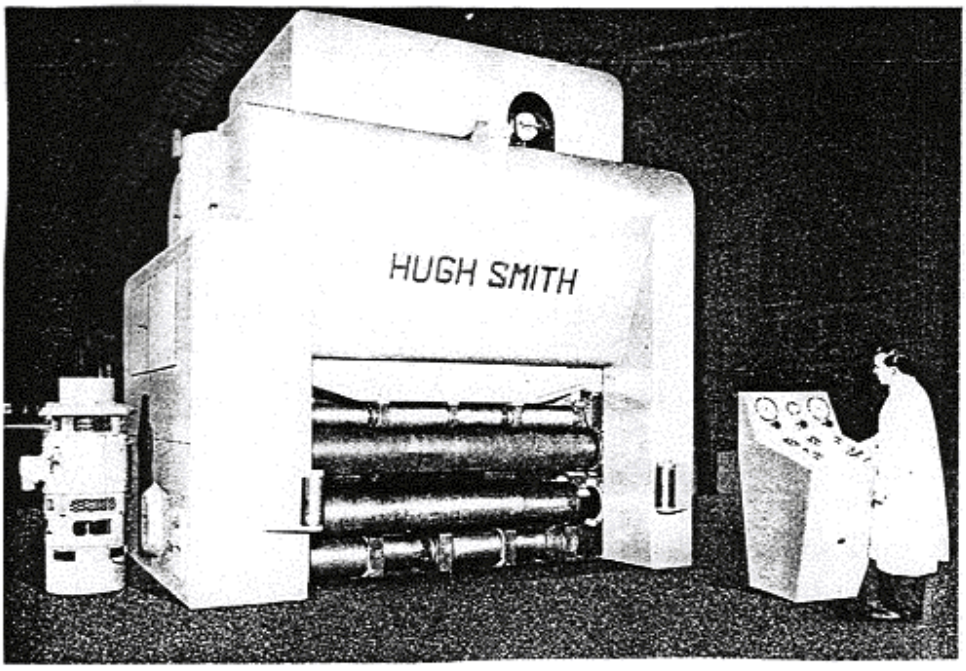
Balancing beam correction.
Ease of plate entry and removal.
Nose bar for flanging work.
Direct acting hydraulics.
Interchangeable rollers.
No need to support long plates by crane.
Guided moving beam.

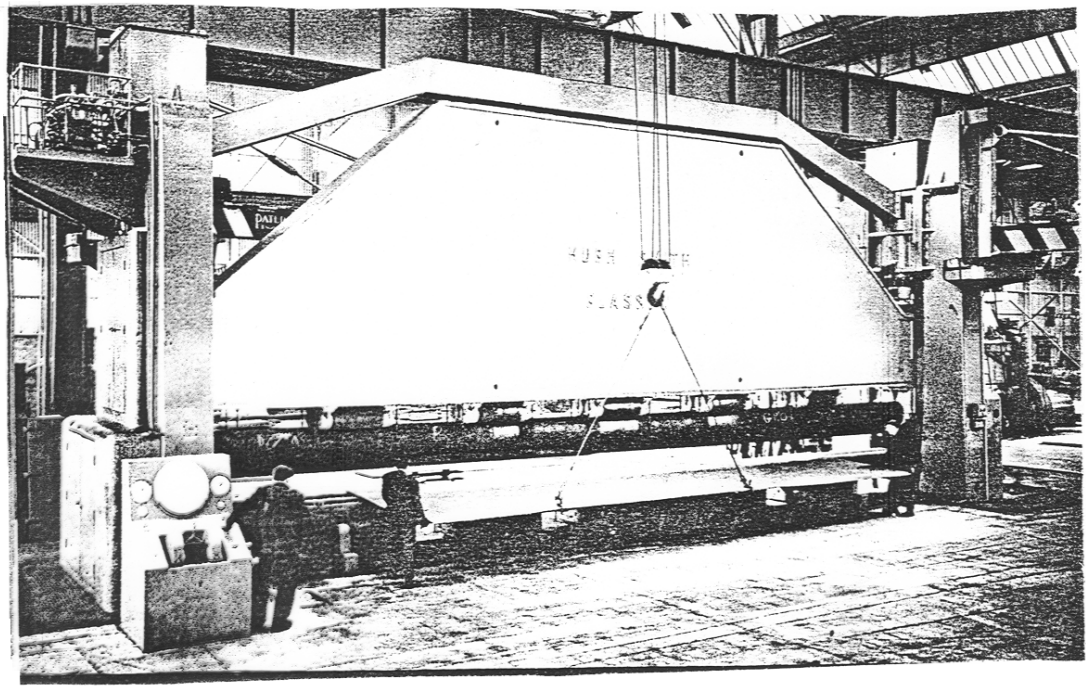
Manifold mounted block hydraulics.
Automatic overload protection.
Correction of overbending is easy.
Hot working can be carried out.
Interlocked safety system.
Nominal installation costs.
Excavations for foundations are minimal.
Scale is not rolled into plate.

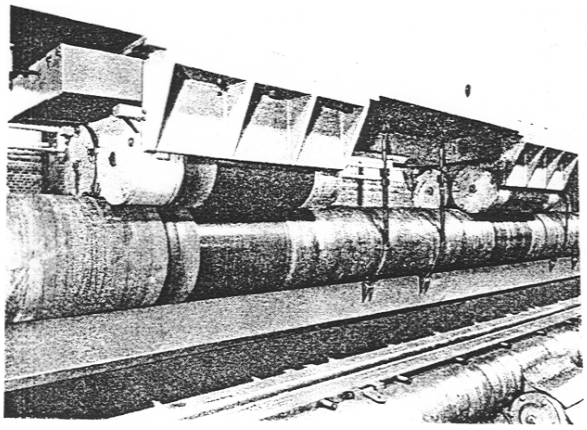
Shown Left:
Hinged Slab (hydraulically operated) shown in the up position for removal of completed drums.



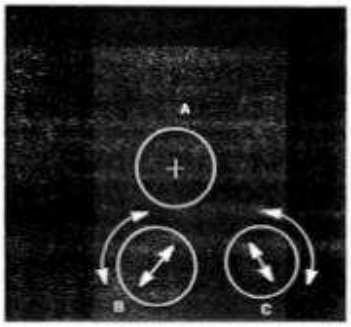
A 9 ft. x $\frac{3}{4}$ in. Plate Straightening Rolls showing the control desk

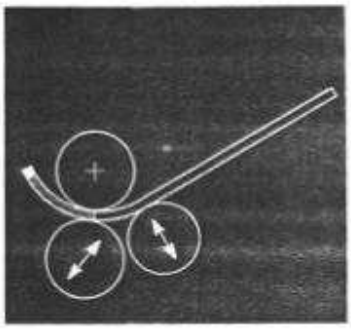


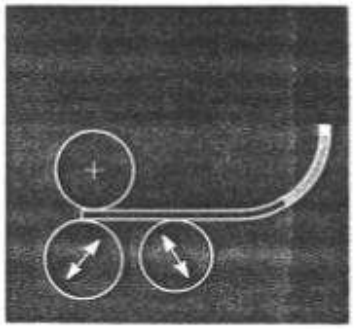


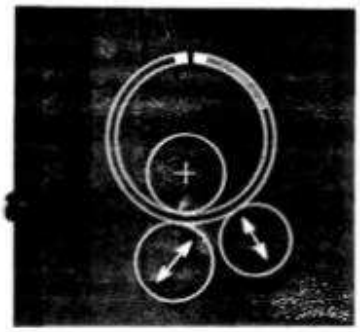


A close-up of top supporting rollers showing variable camber gear with top flanging bar and bottom vee-blocks in position on rollers.









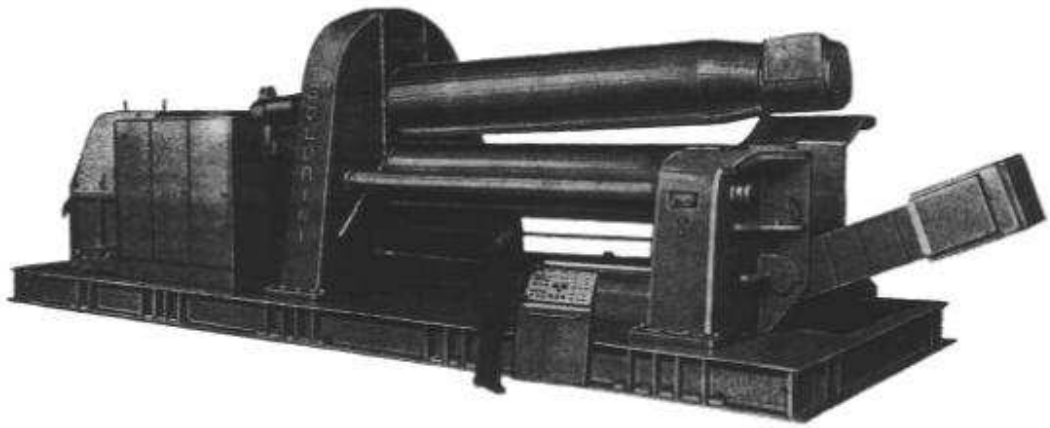
- Per particolari esigenze d'impiego (es.: spessori sottili) questo tipo di macchina così come gli altri da noi costruiti può essere fornito con il rullo superiore motorizzato.

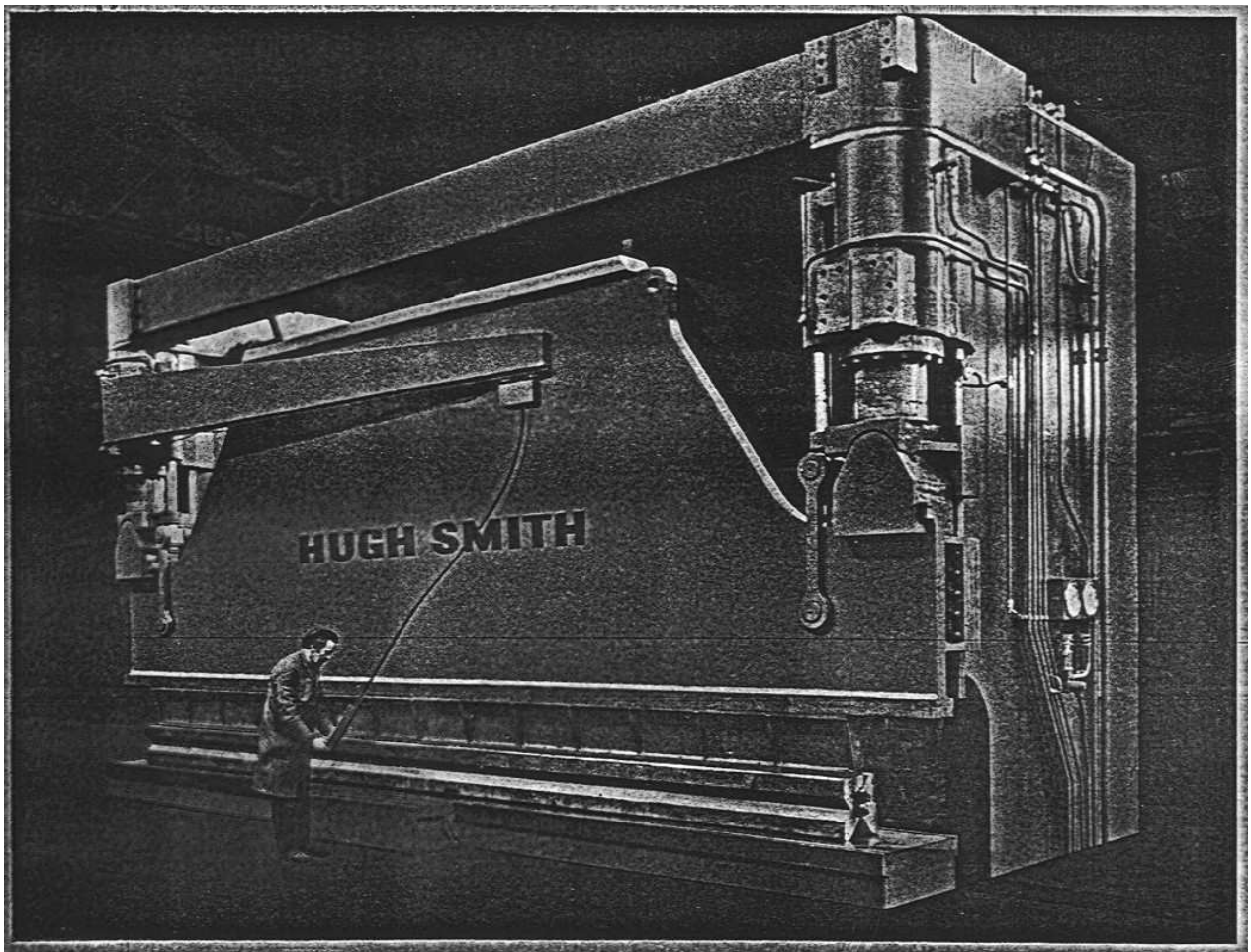
- *Pour des exigences d'emploi particulières (ex.: faibles épaisseurs) ce type de machine ainsi que les autres que nous fabriquons, peut être livré avec rouleau supérieur motorisé.*

- For special requirements (i.e.: thin thickness) this machine as well as all machines built by us, can be supplied with driven top roll.

Pinch type plate bending rolls « SIJ »

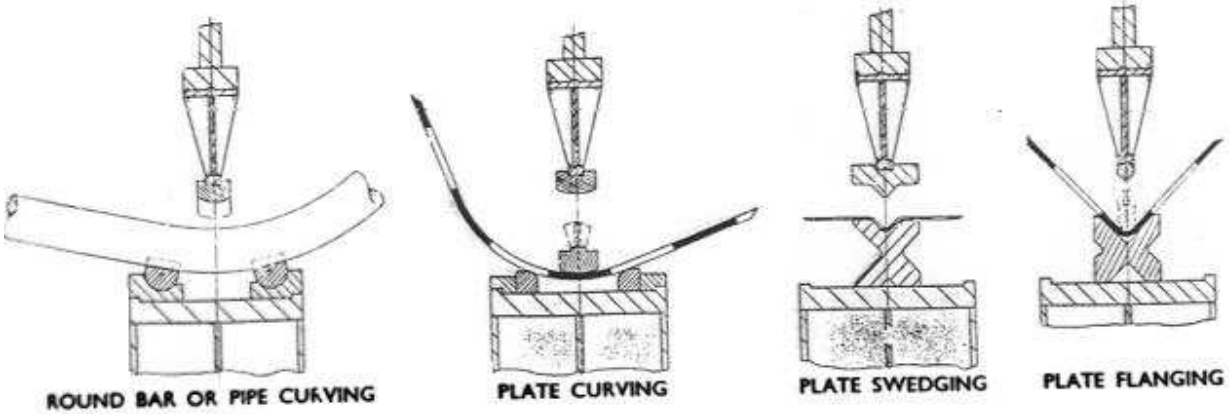
As with all Boldrini Bending Rolls, this machine is built entirely of welded steel plate and heavy sections, normalized after welding to form a strong monoblock base of the component parts. The application of this principle, which minimises the stresses transmitted to the base, makes possible the use of very moderate foundations. The pinch roll B and the bending roll C are driven through universal couplings from the reduction unit to ensure that the plate is bent smoothly without any slipping. The top roll A is an idler and can be replaced by one of smaller diameter in order to obtain smaller cylinders. As a result of continuous metallurgical research, gears, worm wheels, bushes and other components are made from high-duty materials to withstand wear under the most severe conditions. The rolls are of high tensile steel, ground and then surface hardened by our special cold process to avoid scaling. The rolls undergo non-destructive tests and can be supplied to suit the bending of high yield strength and very hard materials. In the reduction unit, the high speed shafts are mounted in ball bearings, whilst bronze alloy bearings are used for the low speed shafts. A range of operating speeds can be selected to suit the particular work to be done. All machines are fully protected against overload by means of limit switches, adjustable relays and pressure switches. The hinged arm is opened and closed hydraulically. It is connected to the upper roll by means of a lever and an adjustable linkage which syncronizes the raising and lowering of the roll with the movement of the hinged arm. The hinged arm is held in position without the use of clamps or locking devices (Boldrini patented system). This reduces idle time and allows top roll adjustment resulting from expansion during hot bending.

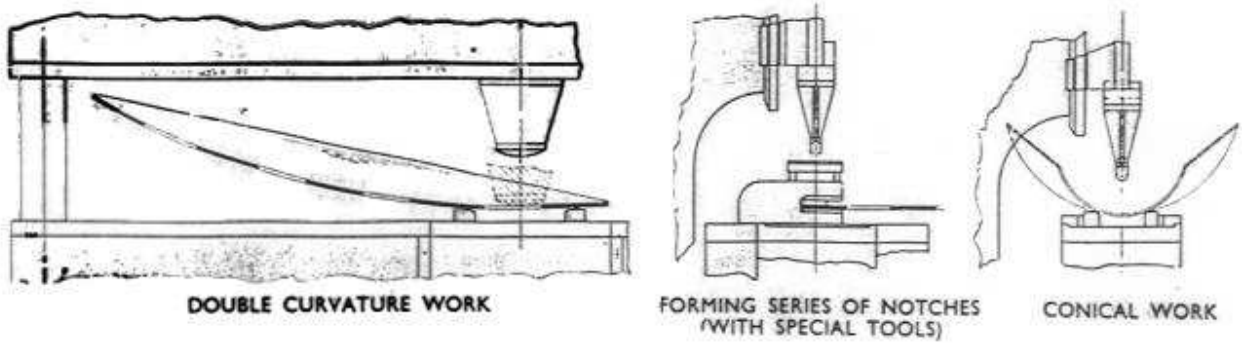


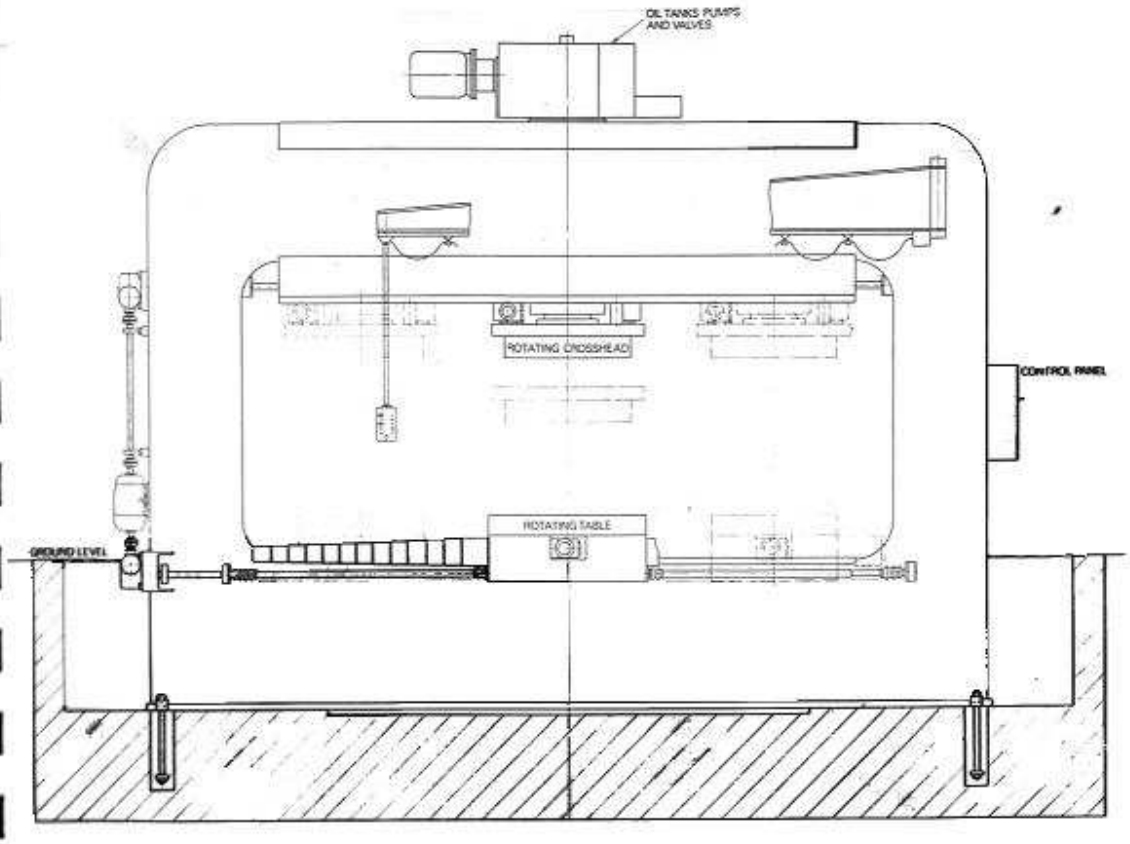


HUGH SMITH UNIVERSAL SHIPBUILDING PRESSES

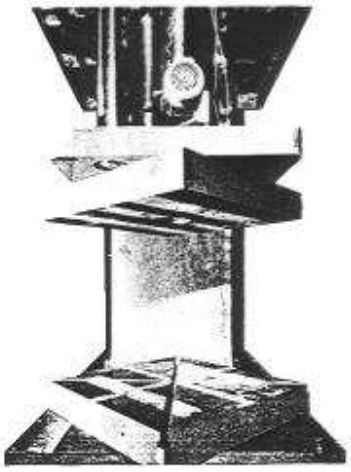
for repair shops and the smaller shipbuilding yards


ROUND BAR OR PIPE CURVING
PLATE CURVING
PLATE SWEDGING
PLATE FLANGING

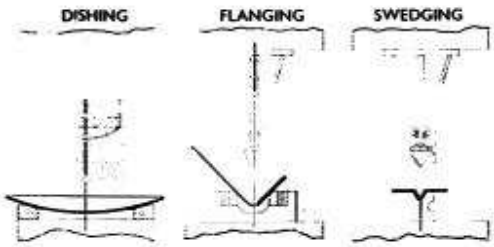

DOUBLE CURVATURE WORK
FORMING SERIES OF NOTCHES (WITH SPECIAL TOOLS)
CONICAL WORK



GENERAL ARRANGEMENT OF THE 1,000 TONNE PRESS WITH TRAVERSING RAM AND TABLE

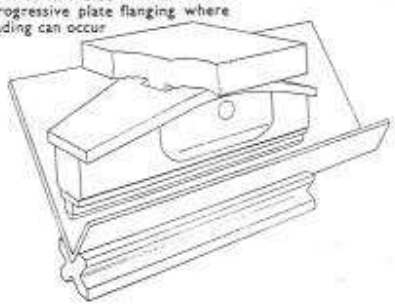


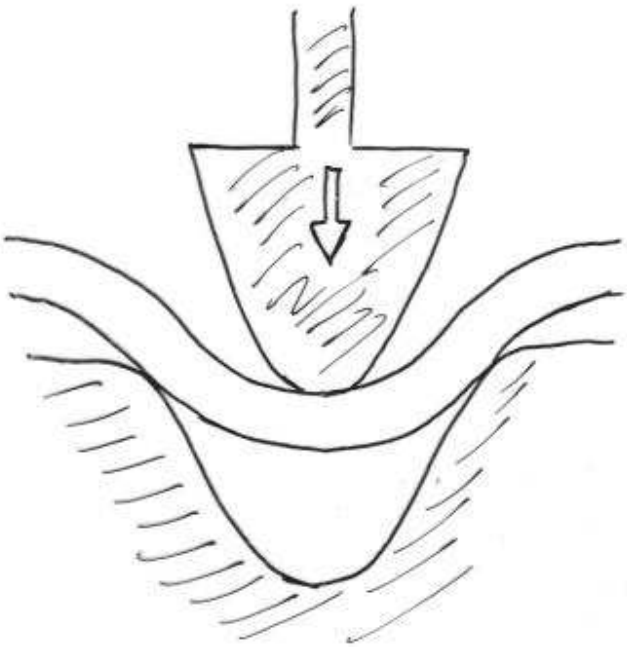
The rotating ram turns through 360°



Some of the operations carried out on the Ring Frame Press

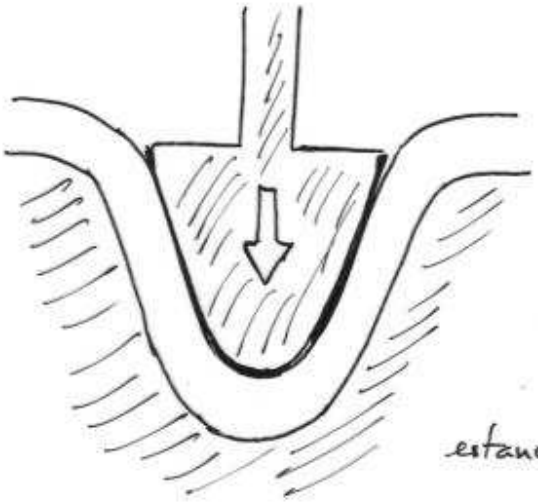
An articulated toolholder is available for use in progressive plate flanging where offset loading can occur





flexão + tracção

estiramento



flexão + compressão

estancamento

estiramento + estancamento moldagem

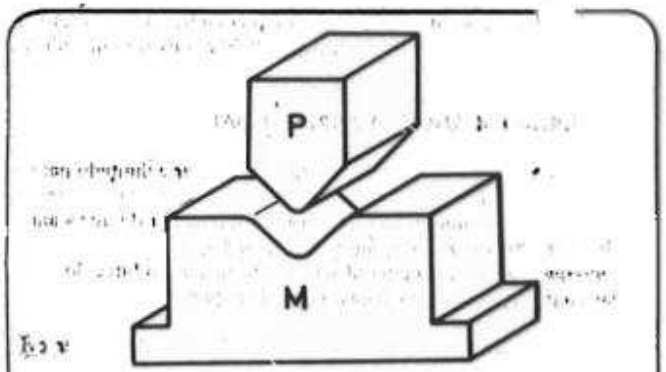


Fig. 42 — *Esquema do trabalho de quinagem*

Fig. 45 — *Definição dos parâmetros de quinagem*

Sendo: r_i — O raio de curvatura ou raio interno de quinagem;
α — O ângulo de quinagem;
β — O ângulo de abertura.

As normas DIN 6.935 recomendam ainda que na quinagem se escolham para raios de quinagem os valores representados na série seguinte:

TABELA XIII

NÚMEROS NORMALIZADOS

r	1	1,2	1,6	2	2,5	3	4	5	6	8	10	12	16	20	25	28	32	36	40	45	50	63	80	100

Os valores da tabela impressos a traço grosso, devem ser preferencialmente escolhidos. Todos estes valores correspodem aos arredondamentos segundo DIN 250.

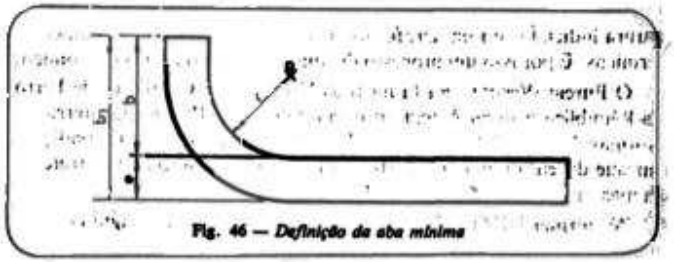


Fig. 46 — *Definição da aba mínima*

TABELA XVIII

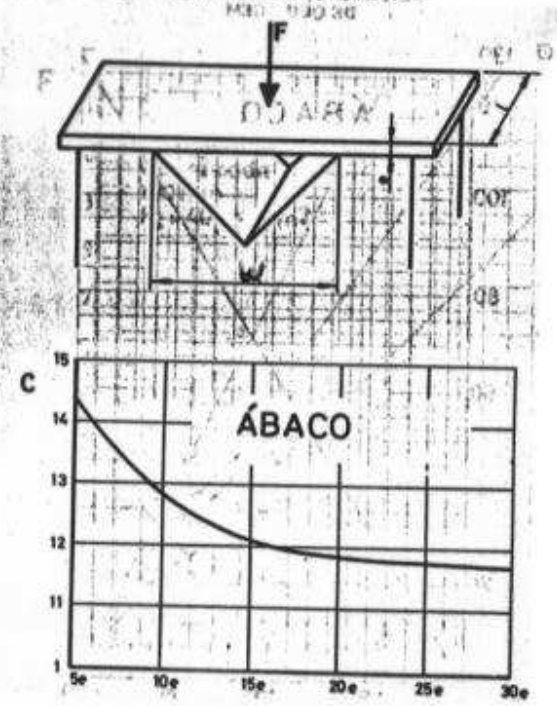
TABELA DE QUINAGEM

Espessura da chapa em mm	0,5	0,8	1,0	1,2	1,5	1,8	2,0	2,5	3,0	4,0	5,0	6,0	7,0	8,0	10	12	14	16	18	20
1	4	11	15	20	27	36	42	60	85	150	230	330	450	590	930	1350	1850	2400	3050	3800
1,5	6	16	22	30	40	54	63	90	125	225	345	495	675	885	1395	2025	2775	3600	4575	5700
2	8	21	30	40	54	72	84	120	170	300	460	660	900	1180	1860	2700	3700	4800	6100	7600
2,5	10	27	37	50	67	90	105	150	210	375	575	825	1125	1475	2325	3375	4625	6000	7625	9500
3	12	32	45	60	81	108	126	180	255	450	690	990	1350	1770	2790	4050	5550	7200	9150	11400
3,5	14	37	52	70	94	126	147	210	295	525	805	1155	1575	2065	3255	4725	6475	8400	10675	13300
4	16	43	60	80	108	144	168	240	340	600	920	1320	1800	2360	3720	5400	7400	9600	12200	15200
4,5	18	48	67	90	121	162	189	270	380	675	1035	1485	2025	2655	4185	6075	8325	10800	13725	17100
5	20	53	75	100	135	180	210	300	425	750	1150	1650	2250	2950	4650	6750	9250	12000	15250	19000
5,5	22	59	82	110	148	198	231	330	465	825	1265	1815	2475	3245	5115	7425	10175	13200	16775	20900
6	24	64	90	120	162	216	252	360	510	900	1380	1980	2700	3540	5580	8100	11100	14400	18300	22800
6,5	26	69	97	130	175	234	273	390	550	975	1495	2145	2925	3835	6045	8775	12025	15600	19825	24700
7	28	75	105	140	189	252	294	420	595	1050	1610	2310	3150	4130	6510	9450	12950	16800	21350	26600
7,5	30	80	112	150	202	270	315	450	635	1125	1725	2475	3375	4425	6975	10125	13875	18000	22875	28500
8	32	85	120	160	216	288	336	480	680	1200	1840	2640	3600	4720	7440	10800	14800	19200	24400	30400
8,5	34	91	127	170	229	306	357	510	720	1275	1955	2805	3825	5015	7905	11475	15725	20400	25925	32300
9	36	96	135	180	243	324	378	540	765	1350	2070	2970	4050	5310	8370	12150	16650	21600	27450	34200
9,5	38	101	142	190	256	342	399	570	805	1425	2185	3135	4275	5605	8835	12825	17575	22800	28975	36100
10	40	107	150	200	270	360	420	600	850	1500	2300	3300	4500	5900	9300	13500	18500	24000	30500	38000
10,5	42	112	157	210	283	378	441	630	890	1575	2415	3465	4725	6195	9765	14175	19425	25200	32025	39900
11	44	117	165	220	297	396	462	660	935	1650	2530	3630	4950	6490	10230	14850	20350	26400	33550	41800
11,5	46	123	172	230	310	414	483	690	975	1725	2645	3795	5175	6785	10695	15525	21275	27600	35075	43700
12	48	128	180	240	324	432	504	720	1020	1800	2760	3960	5400	7080	11160	16200	22200	28800	36600	45600
12,5	50	133	187	250	337	450	525	750	1060	1875	2875	4125	5625	7375	11625	16875	23125	30000	38125	47500
13	52	139	195	260	351	468	546	780	1105	1950	2990	4290	5850	7670	12090	17550	24050	31200	39650	49400
13,5	54	144	202	270	364	486	567	810	1145	2025	3105	4455	6075	7965	12555	18225	24975	32400	41175	51300
14	56	149	210	280	378	504	588	840	1190	2100	3220	4620	6300	8260	13020	18900	25900	33600	42700	53200
14,5	58	155	217	290	391	522	609	870	1230	2175	3335	4785	6525	8555	13485	19575	26825	34800	44225	55100
15	60	160	225	300	405	540	630	900	1275	2250	3450	4950	6750	8850	13950	20250	27750	36000	45750	57000
15,5	62	165	232	310	418	558	651	930	1315	2325	3565	5115	6975	9145	14415	20925	28675	37200	47275	58900
16	64	171	240	320	432	576	672	960	1360	2400	3680	5280	7200	9440	14880	21600	29600	38400	48800	60800
16,5	66	176	247	330	445	594	693	990	1400	2475	3795	5445	7425	9735	15345	22275	30525	39600	50325	62700
17	68	181	255	340	459	612	714	1020	1445	2550	3910	5610	7650	10030	15810	22950	31450	40800	51850	64600
17,5	70	187	262	350	472	630	735	1050	1485	2625	4025	5775	7875	10325	16275	23625	32375	42000	53375	66500
18	72	192	270	360	486	648	756	1080	1530	2700	4140	5940	8100	10620	16740	24300	33300	43200	54900	68400
18,5	74	197	277	370	499	666	777	1110	1570	2775	4255	6105	8325	10915	17205	24975	34225	44400	56425	70300
19	76	203	285	380	513	684	798	1140	1615	2850	4370	6270	8550	11210	17670	25650	35150	45600	57950	72200
19,5	78	208	292	390	526	702	819	1170	1655	2925	4485	6435	8775	11505	18135	26325	36075	46800	59475	74100
20	80	213	300	400	540	720	840	1200	1700	3000	4600	6600	9000	11800	18600	27000	37000	48000	61000	76000

ex.º de um fabricante para uma quinadeira

TABELA XIX

DETERMINAÇÃO DO FACTOR C



$$F = \frac{c \cdot 1{,}25 \; T_{ruptura} \; e^2}{W}$$

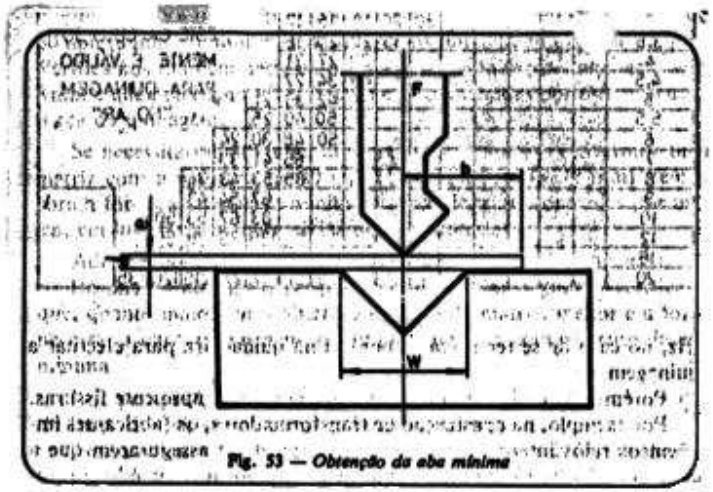


Fig. 53 — *Obtenção da aba mínima*

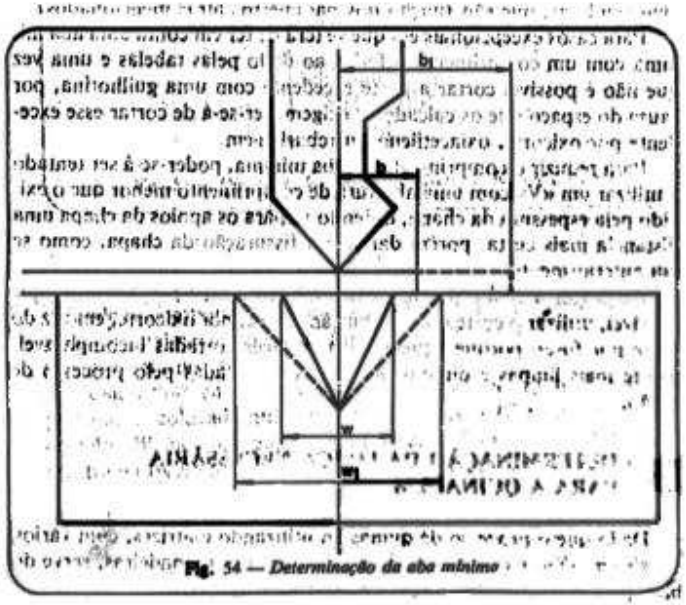


Fig. 54 — *Determinação da aba mínima*

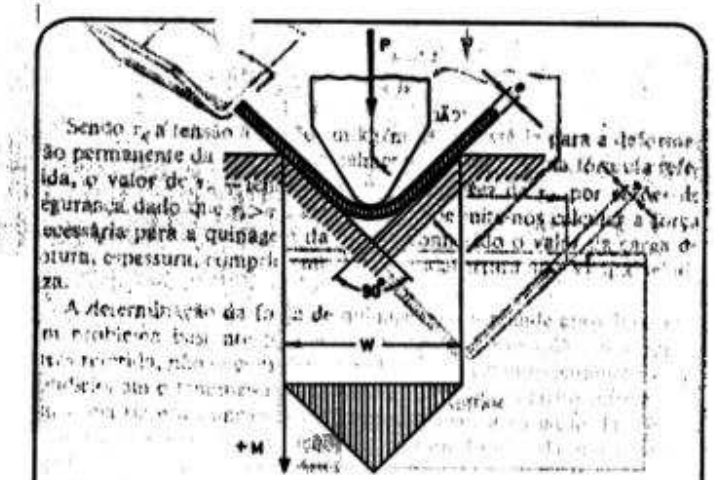


Fig. 55 — *Diagrama dos momentos flectores durante a quinagem*

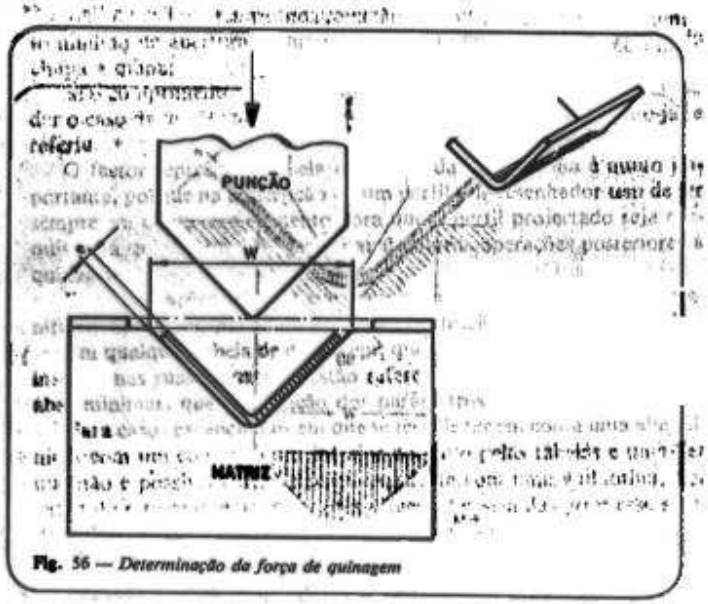


Fig. 56 — *Determinação da força de quinagem*

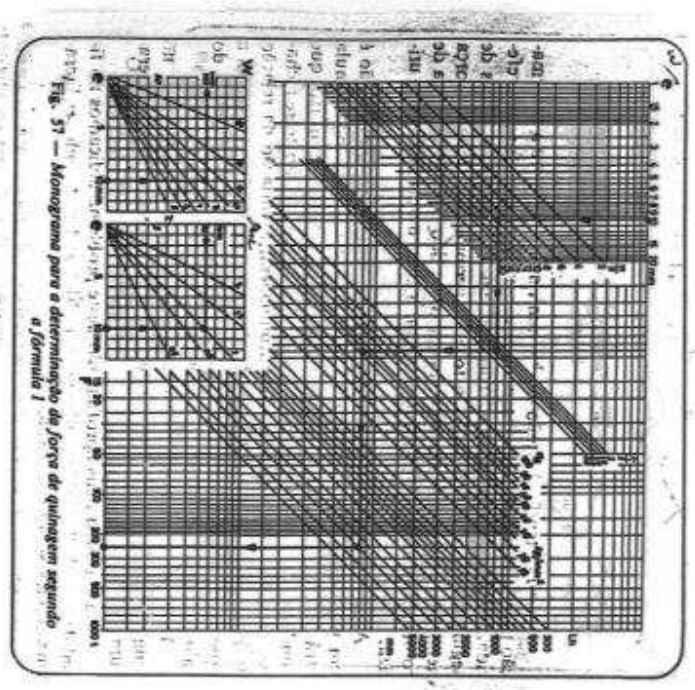


Fig. 57 — Monograma para a determinação da força de quinagem segundo a fórmula 1

$$F = \frac{\quad}{\sqrt{\quad}}$$

TABELA XX

DETERMINAÇÃO DAS FORÇAS DE QUINAGEM

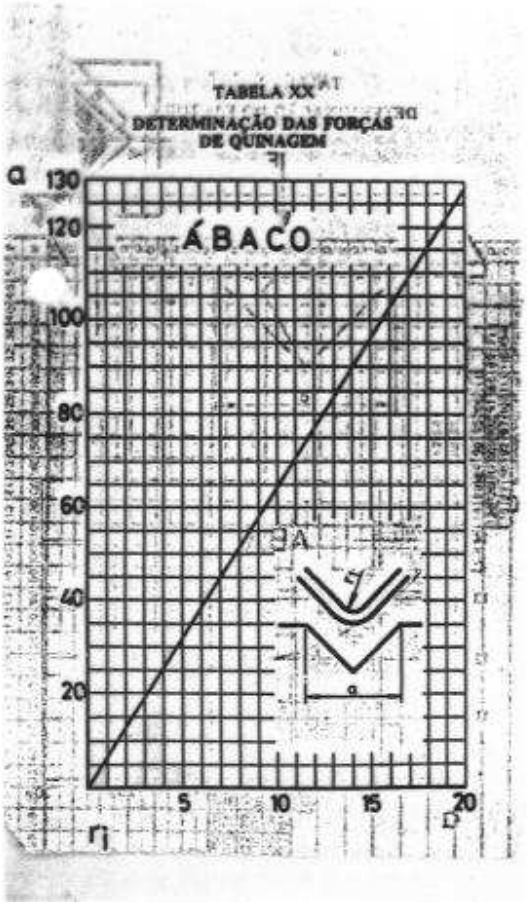
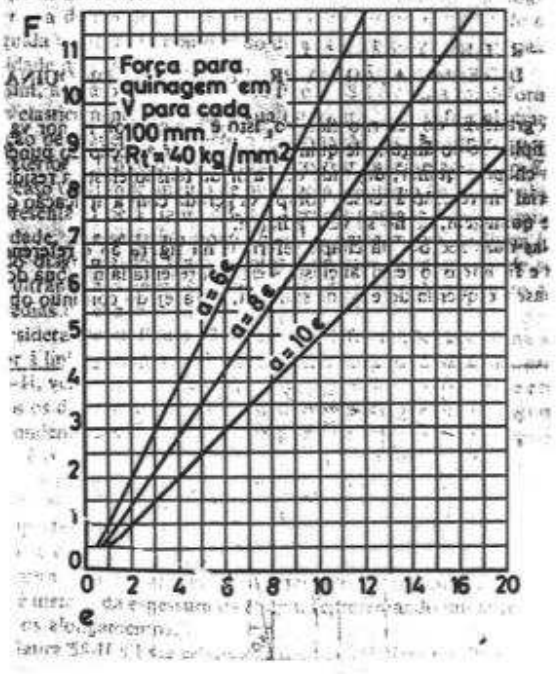


TABELA XXI

DETERMINAÇÃO DAS FORÇAS DE QUINAGEM



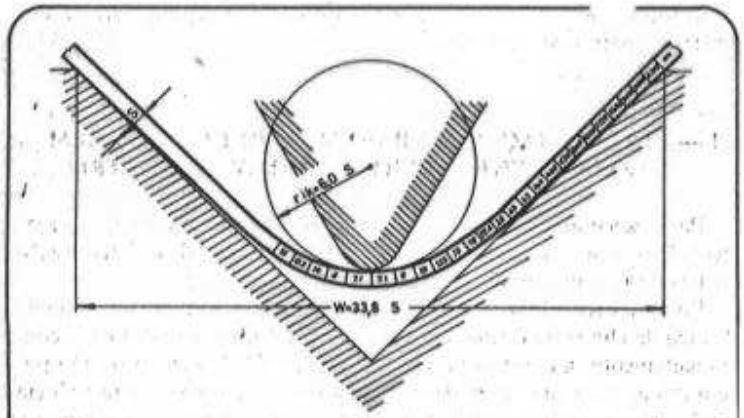


Fig. 47 — *Variação da curvatura numa chapa quinada*

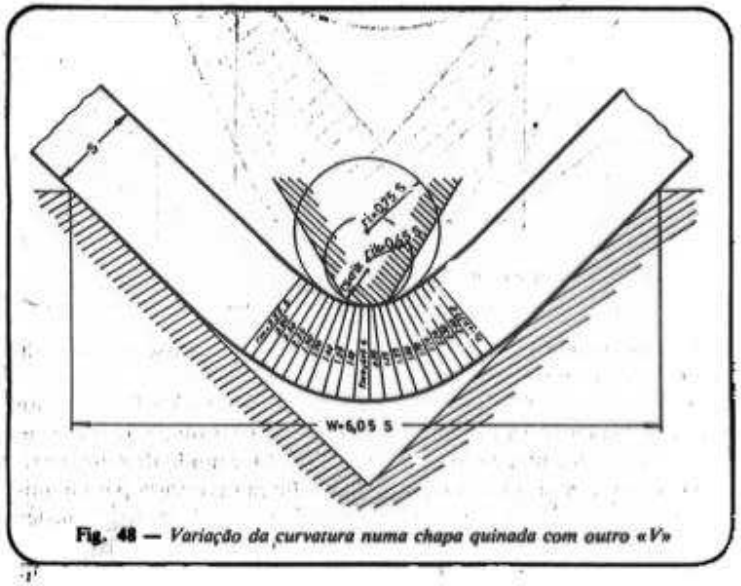


Fig. 48 — *Variação da curvatura numa chapa quinada com outro «V»*

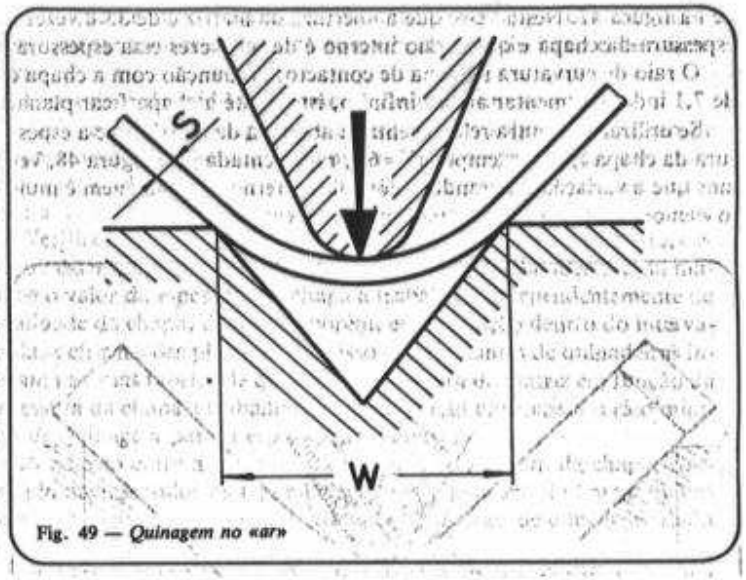


Fig. 49 — *Quinagem no «ar»*

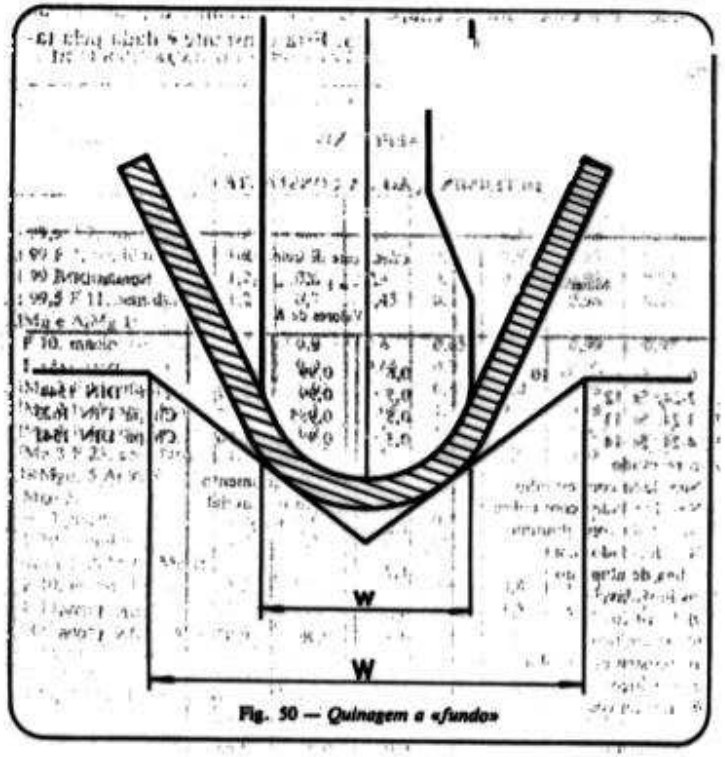
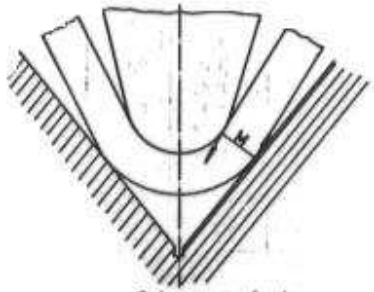
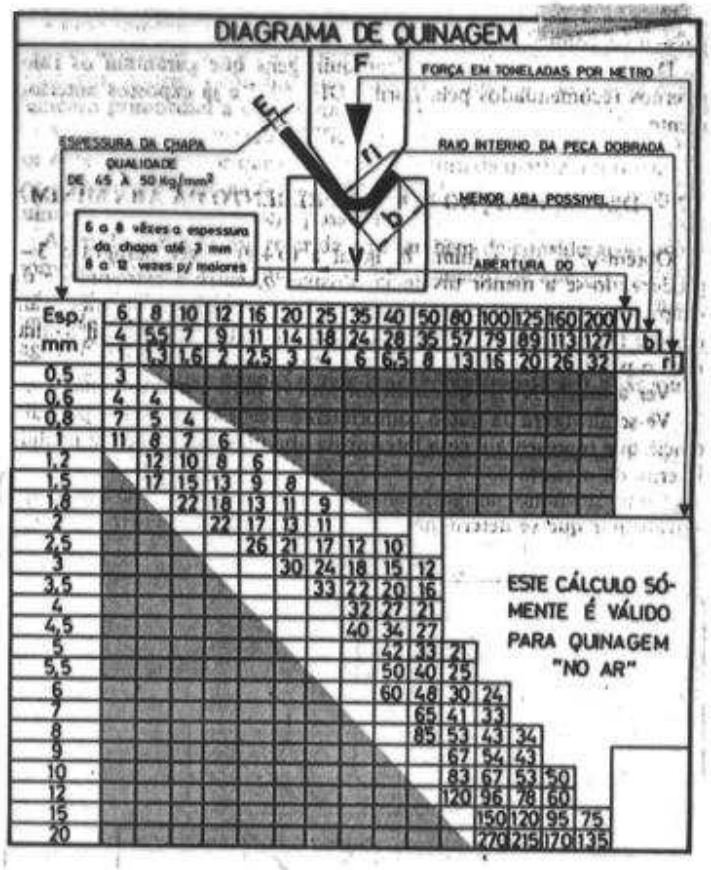


Fig. 50 — *Quinagem a «fundo»*



— *Quinagem a «fundo»*



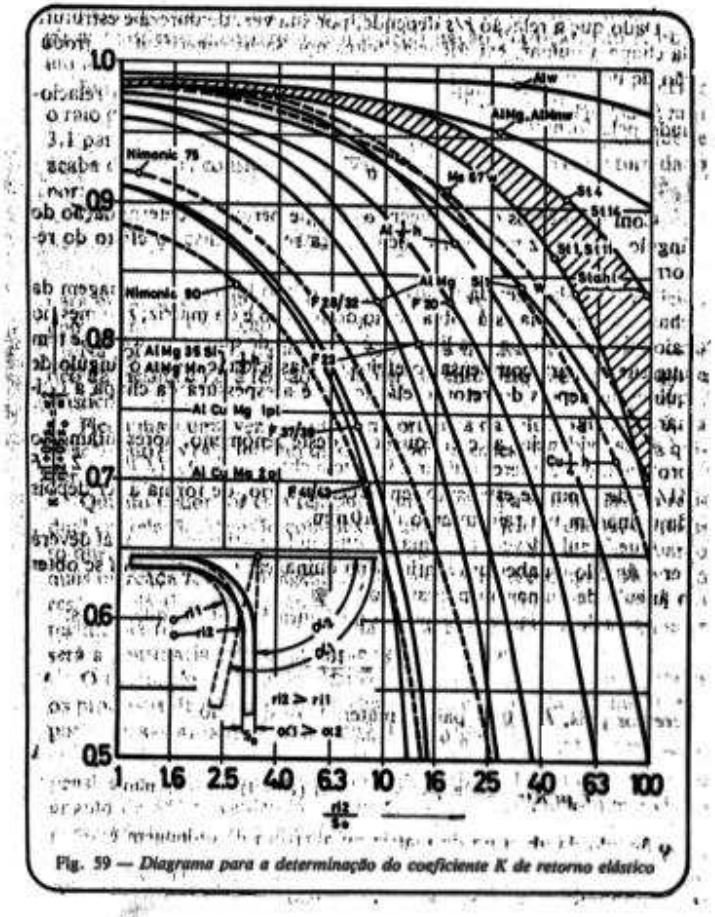


Fig. 59 — *Diagrama para a determinação do coeficiente K de retorno elástico*

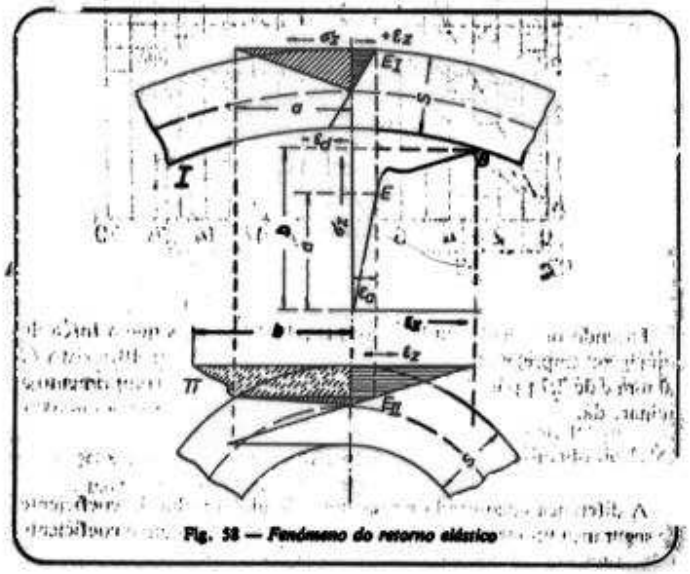


Fig. 58 — *Fenómeno do retorno elástico*

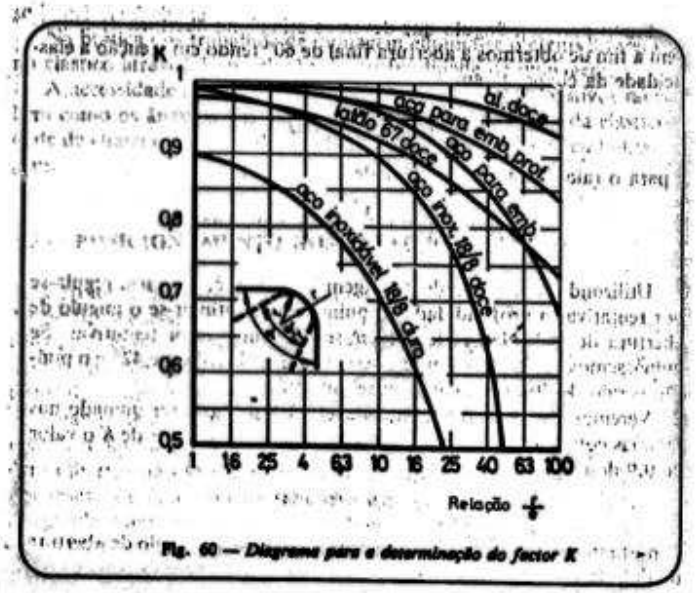
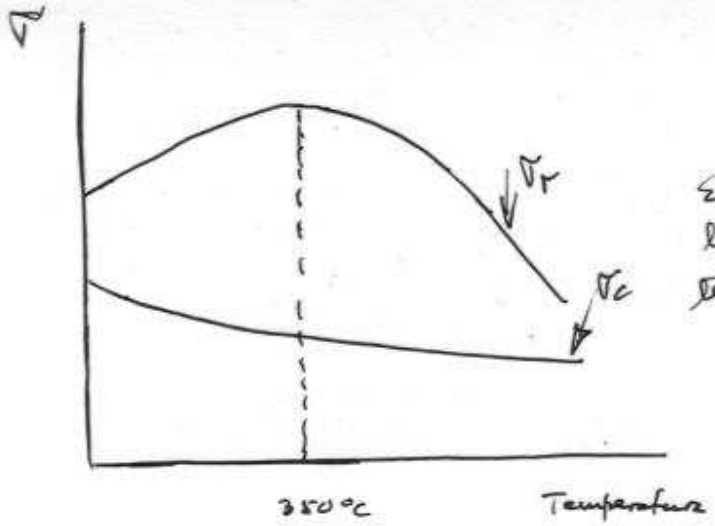
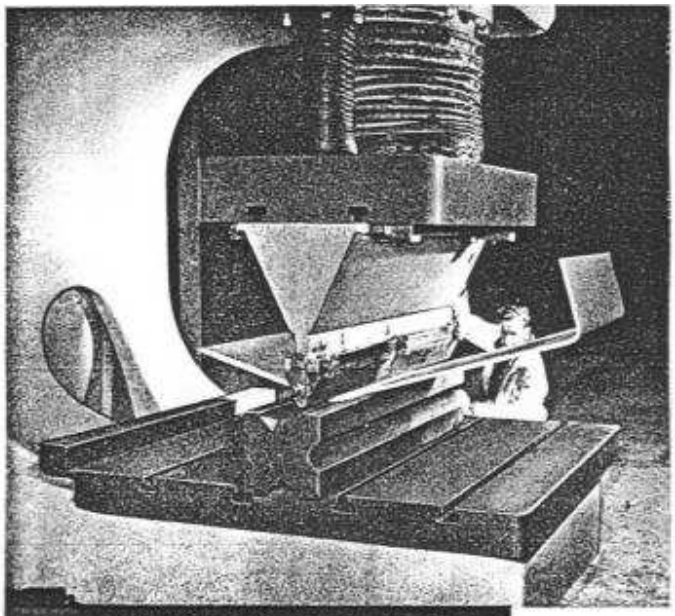


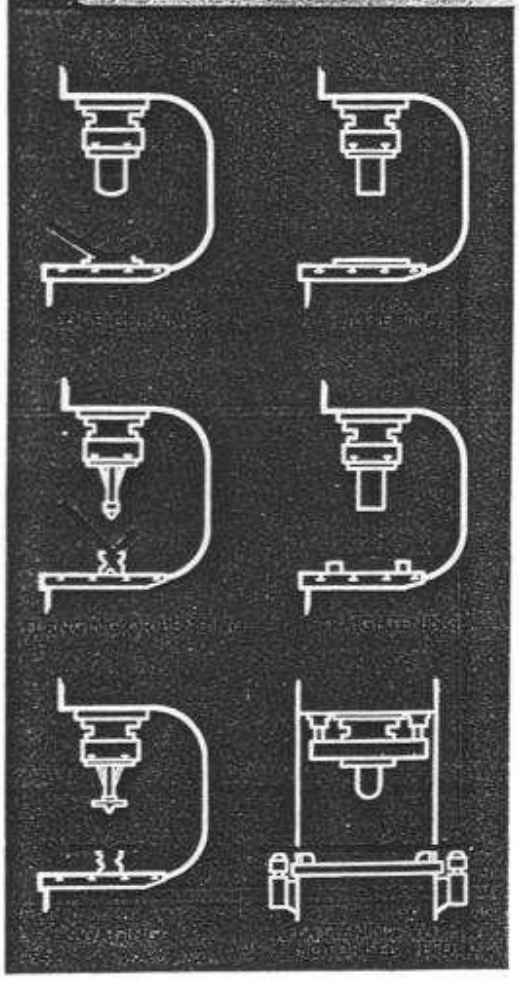
Fig. 60 — *Diagrama para a determinação do factor K*

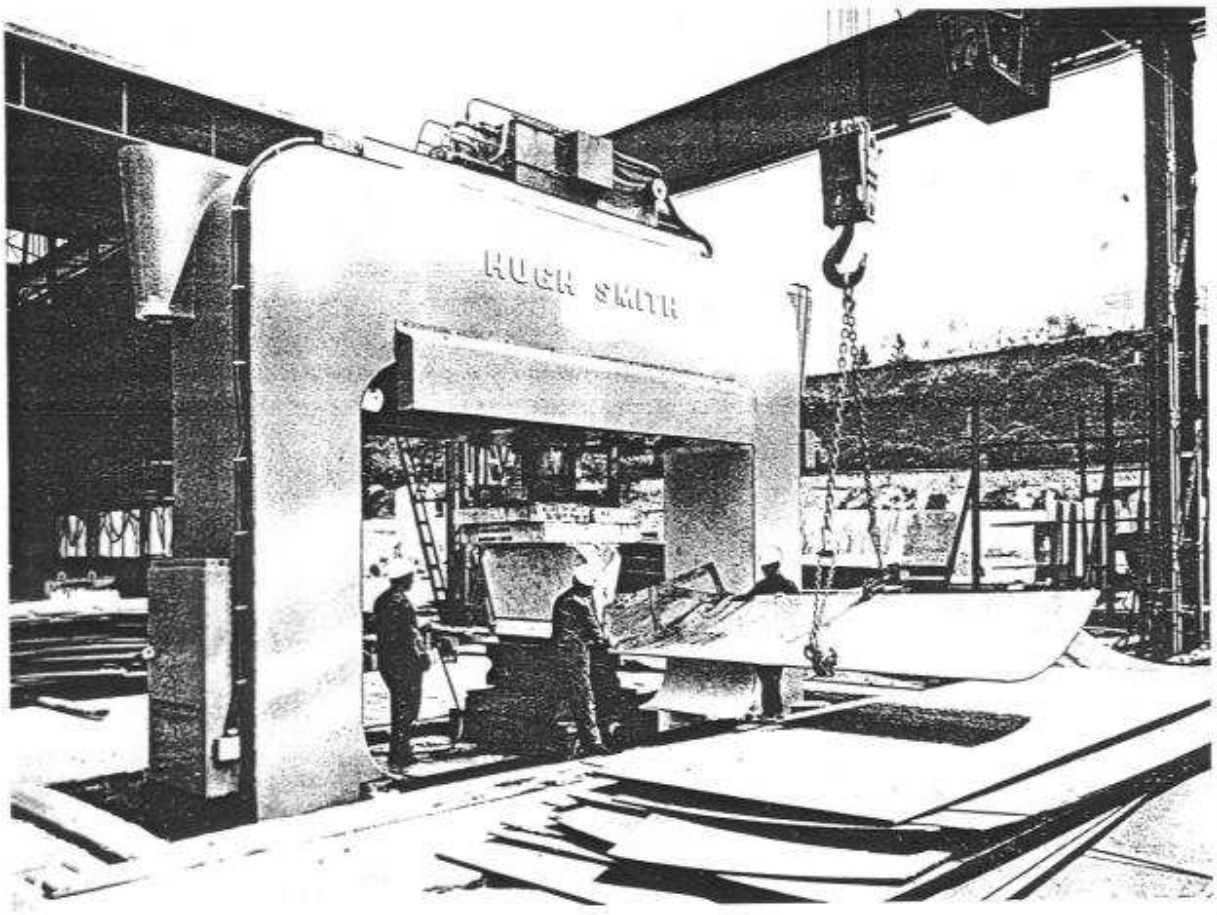


Efeito da temperatura nas tensões limite (aços)

Flanging work in progress on a 500 ton Gap Press







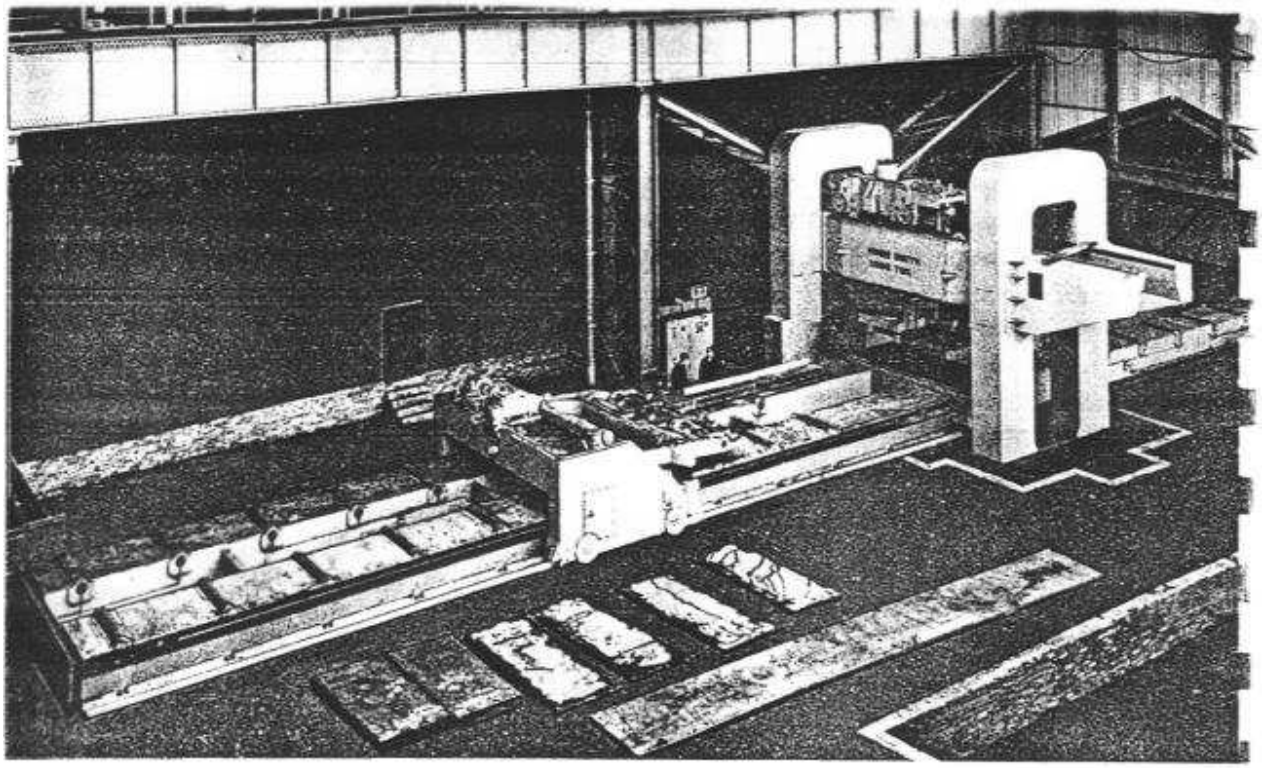
RING FRAME PRESSES

FORCE RANGE: 300 Tonnes up to 2,000 Tonnes

DISTANCE BETWEEN COLUMNS: Up to 6 M.

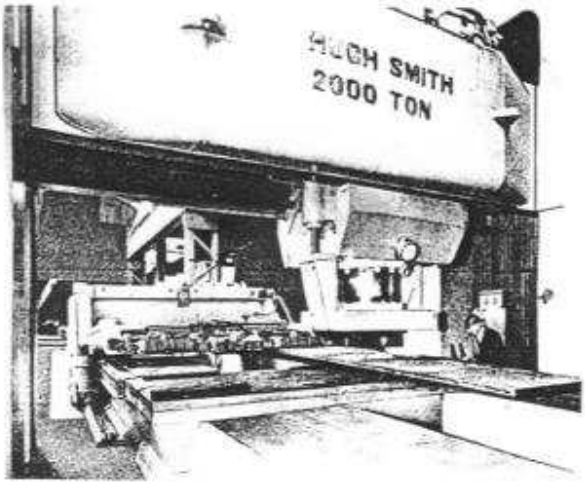
The press is designed for plate forming on a flow line basis and its accuracy is ensured by the rigidity of the heavy unit construction ring frame. Hydraulic operation gives precise control and enables full force to be applied at any point of the stroke and for as long as required.

The ram and table have a motorised traverse within the portal opening and this, along with the 360° rotary adjustment, allows the tools to be positioned exactly and the full width of the plate to be worked progressively. The range of work carried out includes plate flanging, forming and shaping to the widest variety of forms, and if required we can arrange the press to operate in conjunction with overhead or goliath cranes to facilitate plate handling and increase production rates.



STEELWORKS PLATE FLATTENING PRESS

TOP PICTURE: The 2000 tonne press with carriage and 22 m handling table



Positioning carriage with plate-lifting magnets

The 2000 tonnes steelworks press designed to suit the latest U.K. and American steelworks practice can cold straighten mild steel plates up to 4120 mm. wide by 203 mm. thick in weights up to 30 tonnes. Higher tensile plates of slightly less thickness can also be straightened.

The press has a single vertical downstroking cylinder and ram assembly with a horizontal travel across the plate of 4250 mm. Hydraulically operated pins in the bottom table lift the plate for insertion of packing pieces for three point straightening.

All controls of the press and positioning equipment are centralised and the operator has easy access to the plate for straightening and checking.

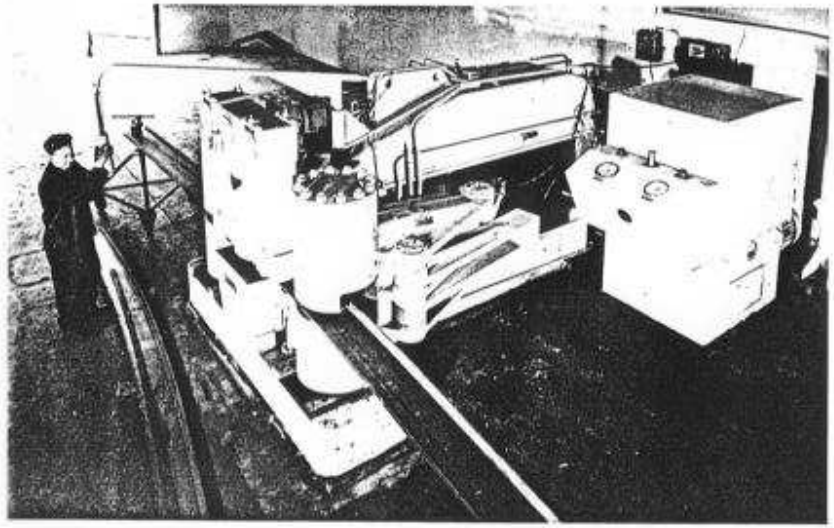


PLATE 27(a) *Skips' cold frame bender of generous capacity. (A machine of a different type is required for some flanged bars i.e. bulb angles, channels, etc.)* (b) *Section drawings showing method of operation.*

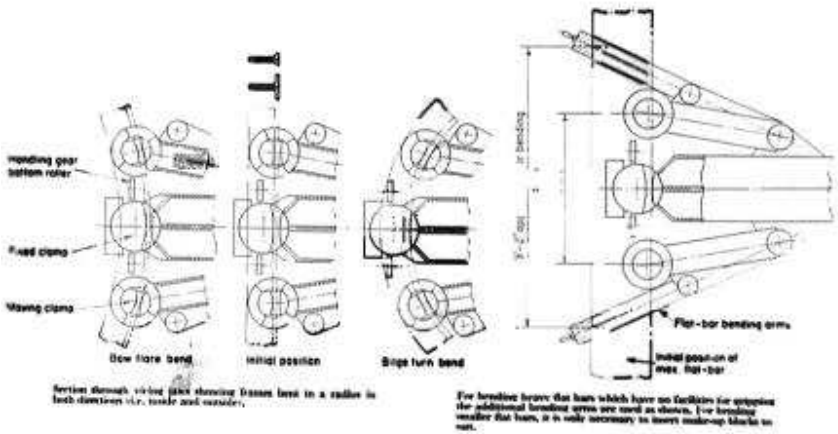


PLATE 28 *A self-propelled butt welder ('Deck Welder') with a universal welding head for Fusarc, Fusarc-CO_2, Fusmelt, Submerged-Arc and MIG welding processes.*

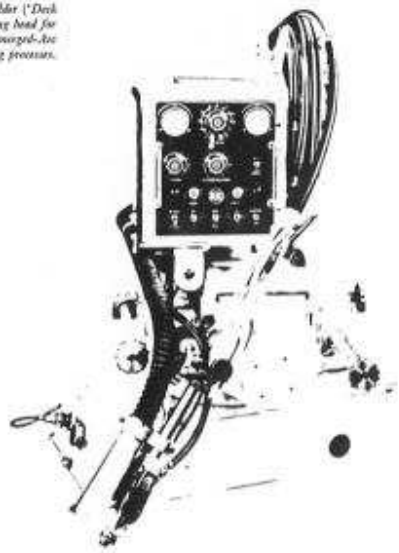
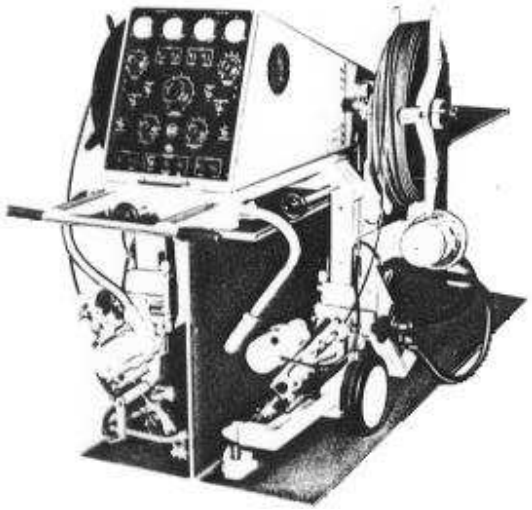
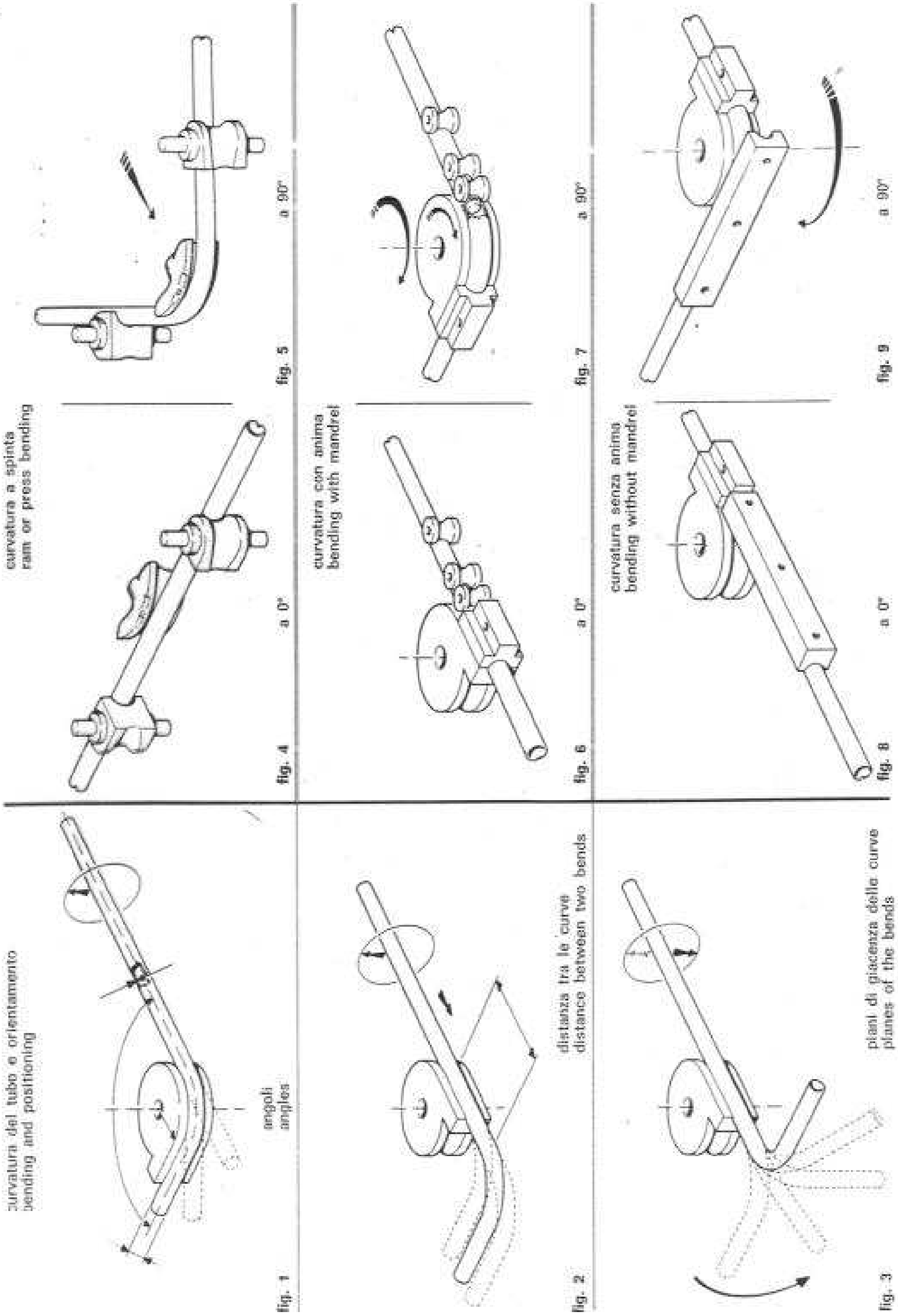
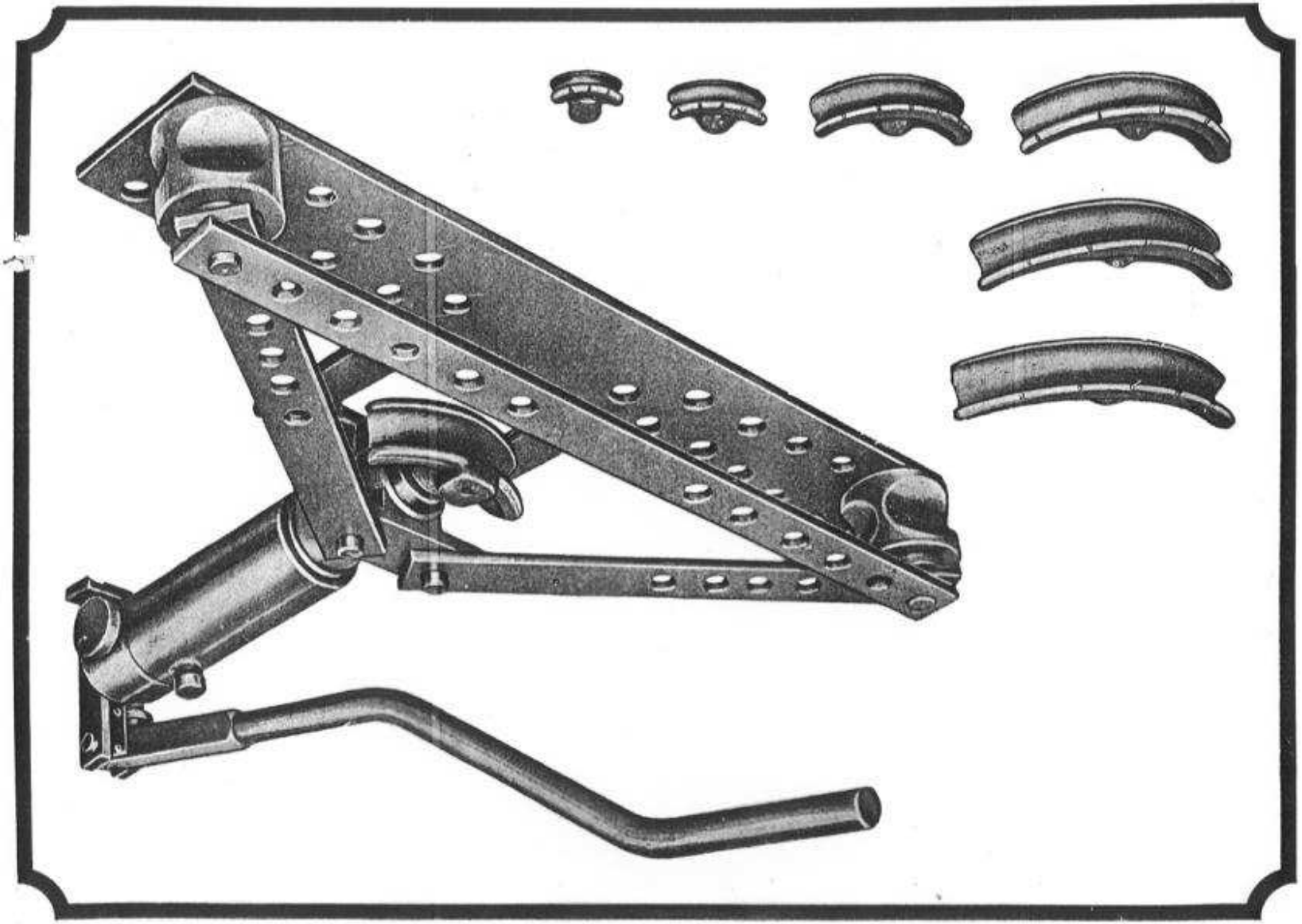


PLATE 29 *Self-propelled twin fillet welder for use with both Fusarc-CO_2 and submerged-Arc processes.*



METODI E SISTEMI DI CURVATURA METHODS AND SYSTEMS OF BENDING	TAVOLA - TABLE N° 001 DATA - DATE GENNAIO 1975





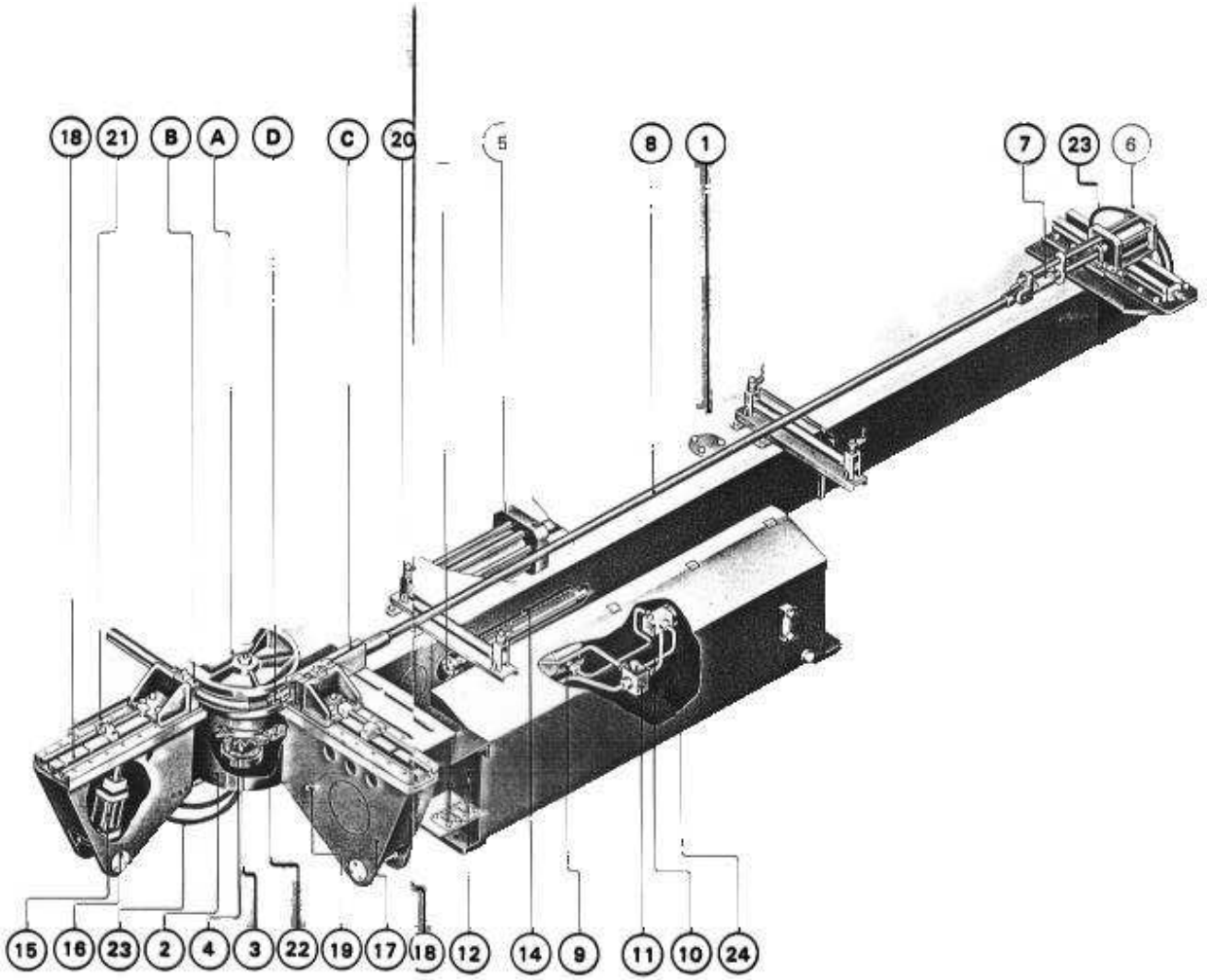
Construction

BENDING TOOLS

A – Bending Form
B – Clamp Die
C – Pressure Die
D – Mandrel

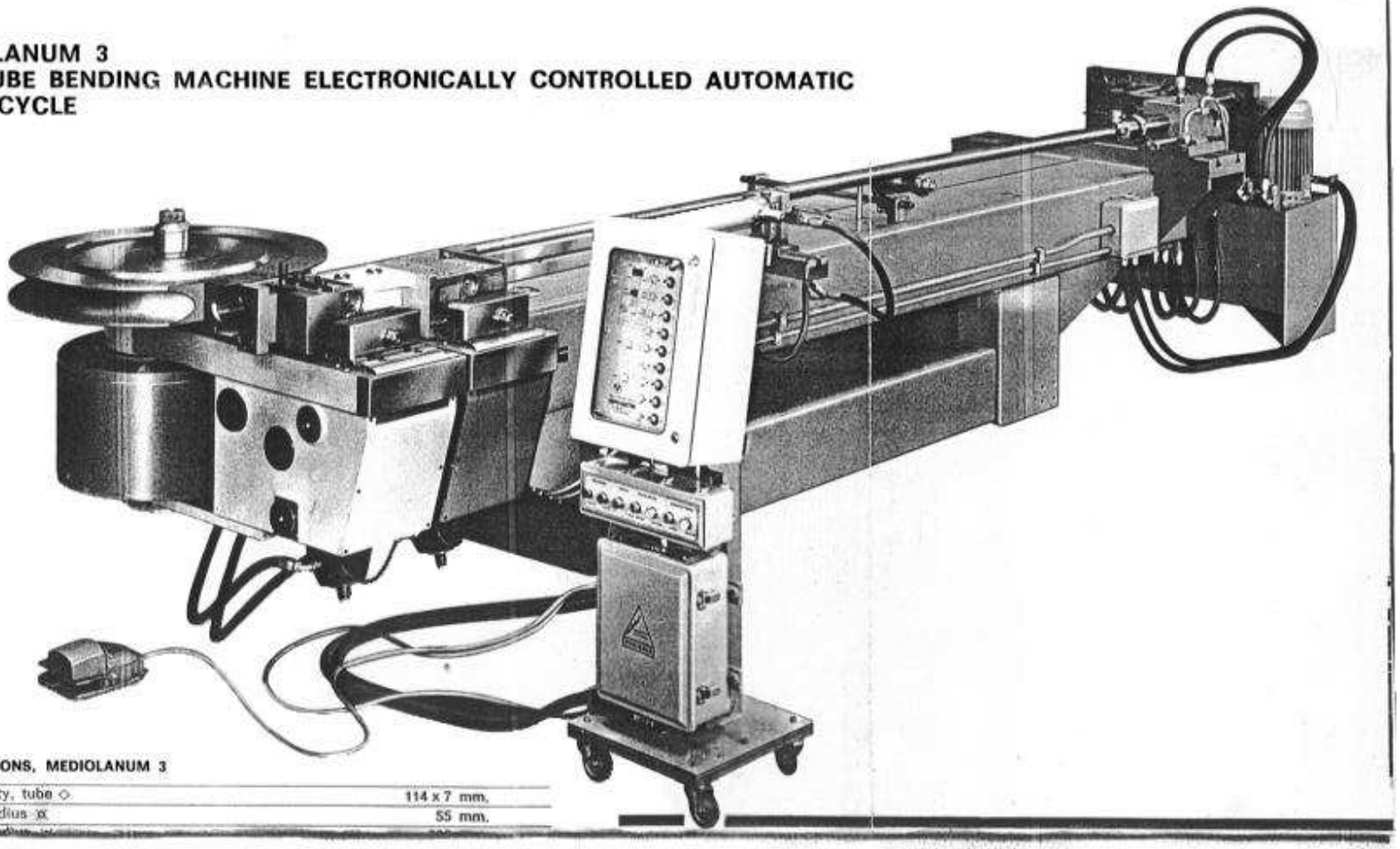
BENDING MACHINE

1 – Main Body
2 – Head
3 – Main shaft
4 – Taper roller bearings
5 – Main drive cylinder
6 – Mandrel extractor
7 – Adjustable turnbuckle for positioning mandrel
8 – Mandrel rod
9 – High pressure oil pump
10 – Pressure relief valve
11 – Sequence check valve
12 – Operation lever
13 – Bending angle scale
14 – Angle of bend selector (4 step shifting)
15 – Clamp die cylinder
16 – Rotating table
17 – Stationary table
18 – Sliding table
19 – Automatic stop bar
20 – Pipe supporting device
21 – Pipe roller
22 – Stud roller chain
23 – High pressure hydraulic hose
24 – Oil tank



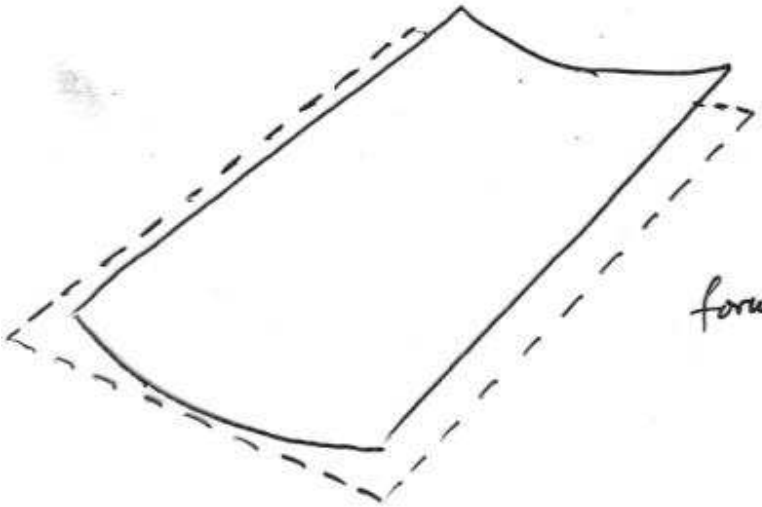
MODEL-6

MEDIOLANUM 3
IS A TUBE BENDING MACHINE ELECTRONICALLY CONTROLLED AUTOMATIC WORK CYCLE

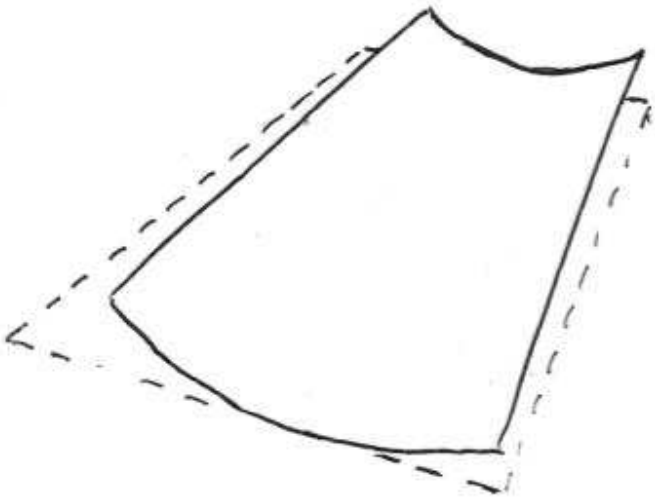


SPECIFICATIONS, MEDIOLANUM 3

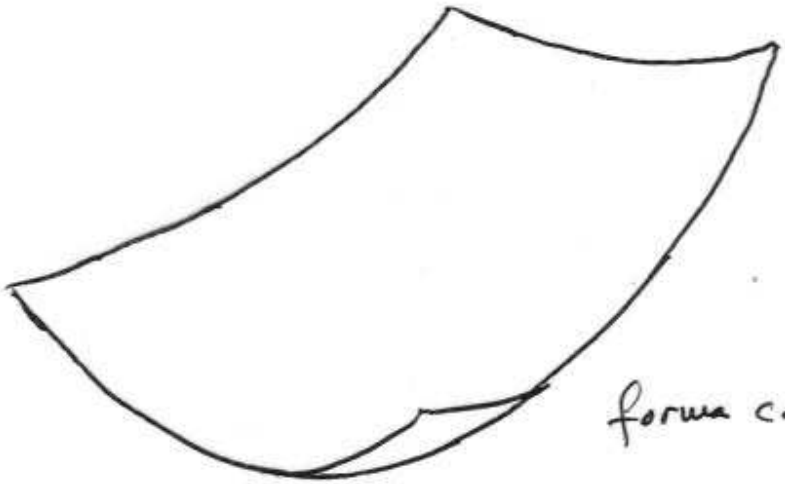
Max. capacity, tube ◇	114 x 7 mm.
Minimum radius ⊄	55 mm.
Max. [illegible] radius ⊄	[illegible]



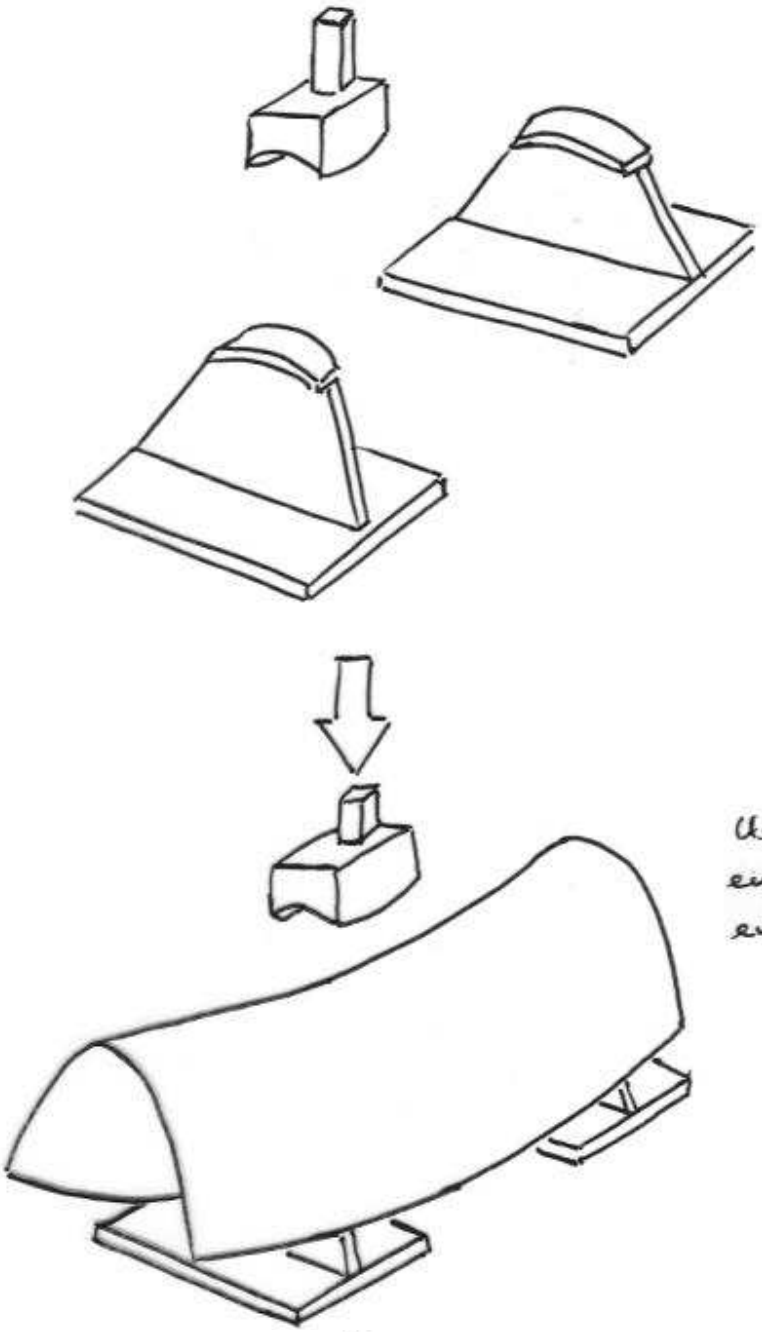
forma cilíndrica



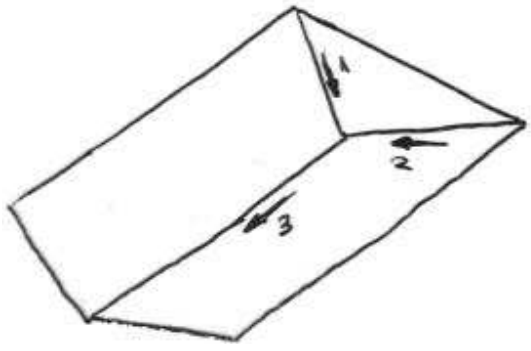
forma cónica



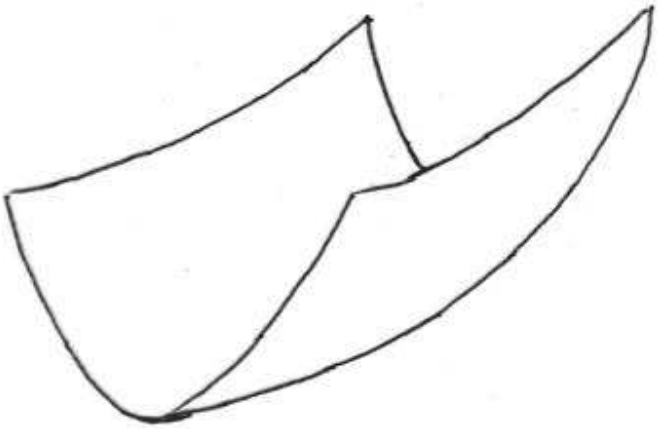
forma copada



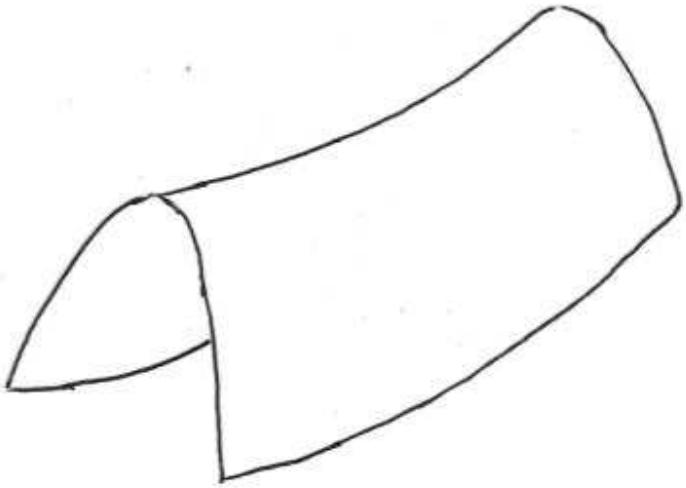
Uma solução para enformar chapas em sela



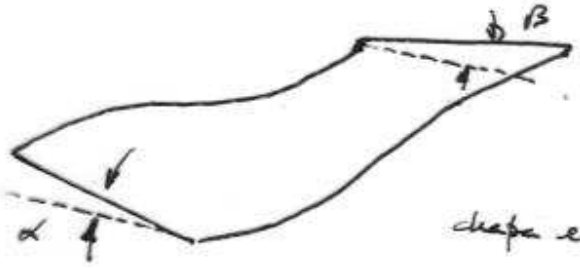
Chapa em telhado



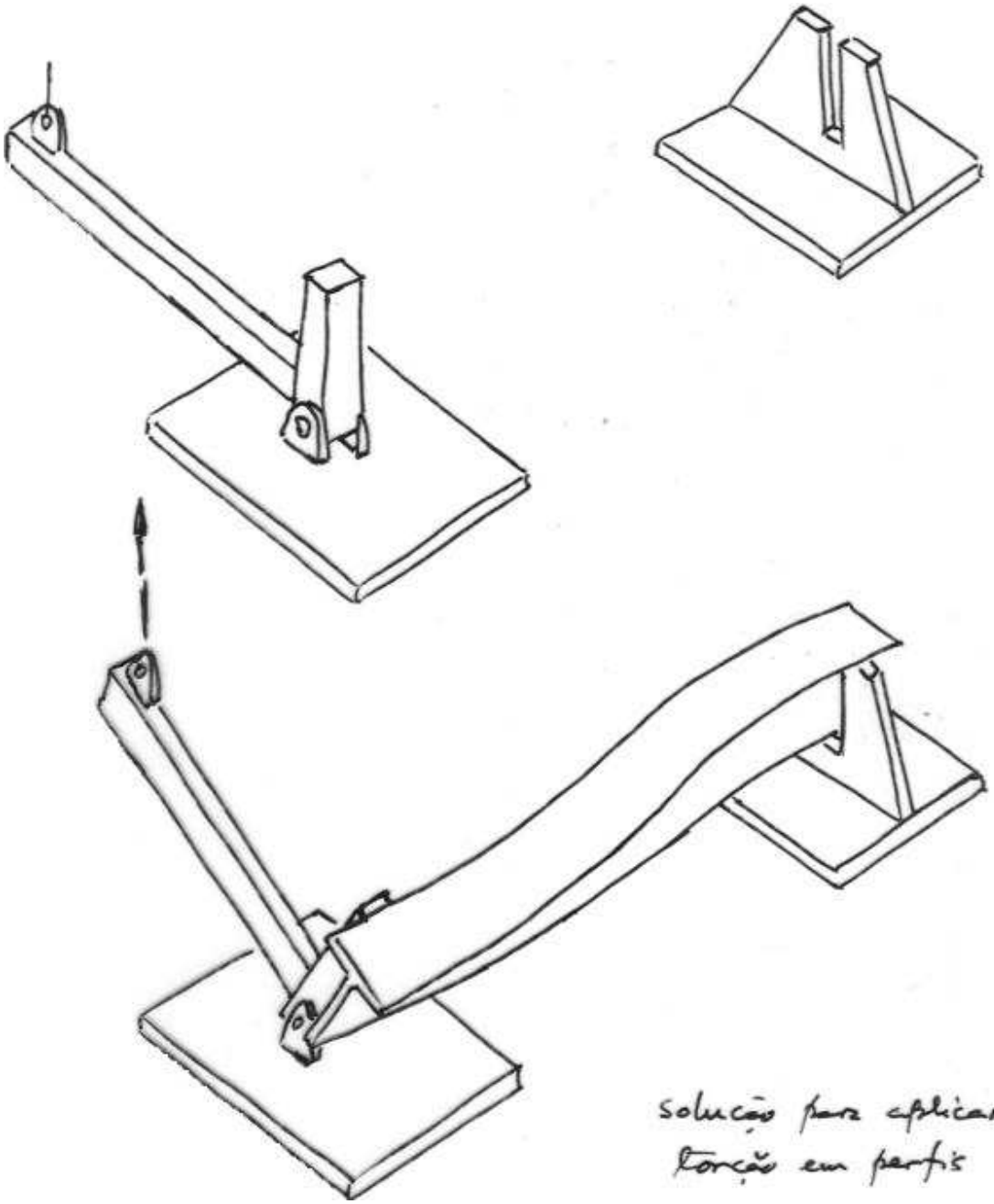
Enformação em "concha"



Enformação em "sela"



chapa em ventarola



solução para aplicar
força em perfis

Aplicação de Calores

Pontos de calor – Ventosas

Linhas de calor
- Acção de quinagem e contracção longitudinal
- Enformação em concha
- Condições de trabalho: Restricção ao movimento, pesos, grampos
- Aplicação: aquecimento lento e arrefecimento rápido
- Outros: posição do eixo neutro relativamente à linha de calor
- Calores continuos e descontinuos
- Profundidade de aquecimento

Calores em V
- Calores a toda a espessura
- Forma em V aplicados nas baínhas
- Problemas: formação de gelhas, elevadas tensões internas
- Auxiliar da enformação mecânica

Tipos de chapas

Chapas copadas
Chapas cilindricas
- Sem flecha
- Com flecha
  - Em concha
  - Em sela

Chapas em ventoinha
Chapas em telhado
Chapas cónicas