OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

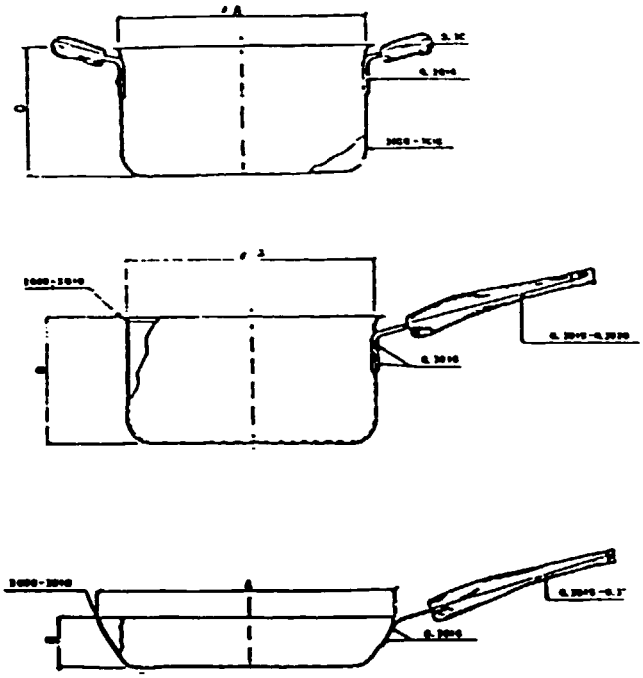
18440

ALUMINIUM NON-STICK HOUSEHOLD UTENSILS

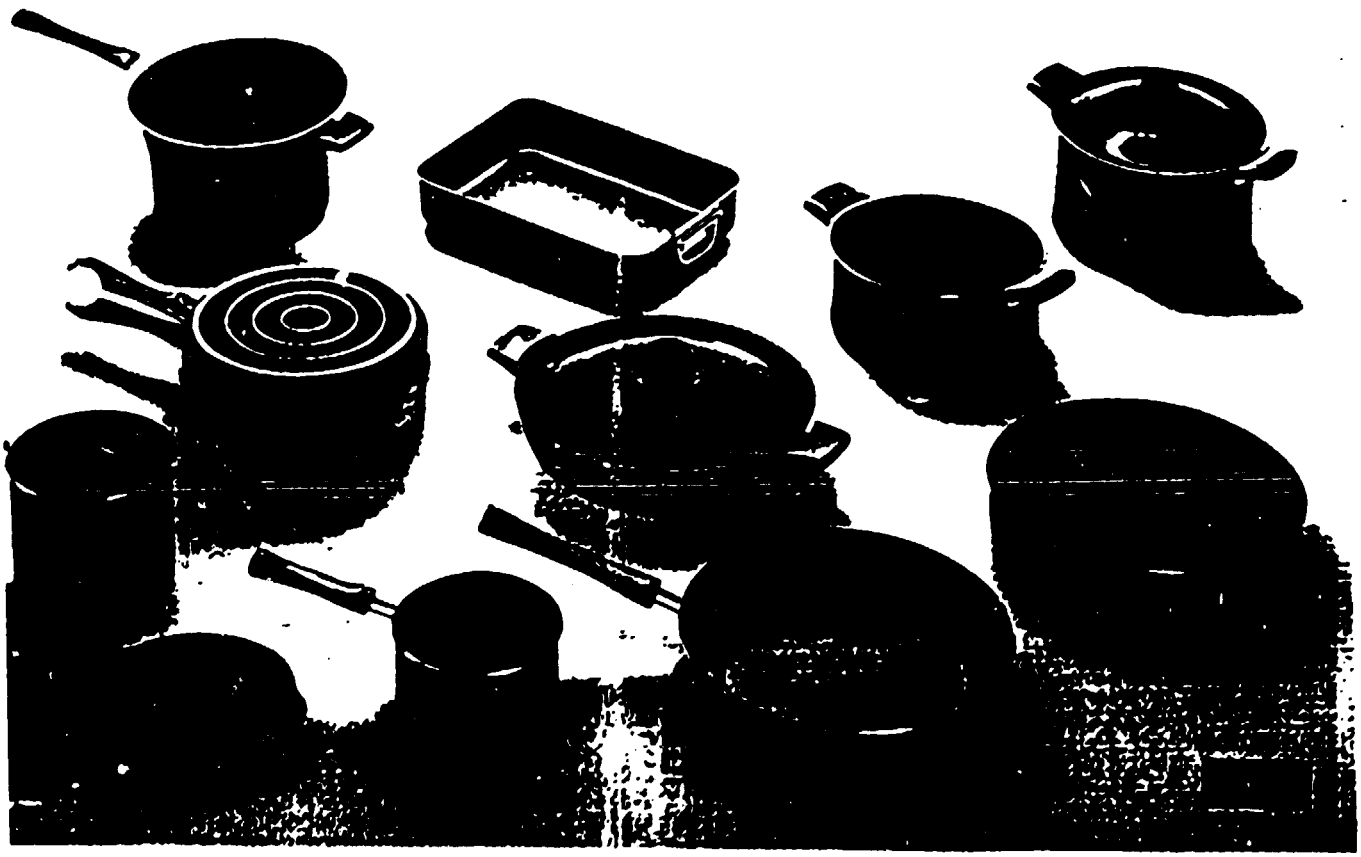
1. PRODUCT DEFINITION

The three different types of articles most frequently used in Europe, the suggested choice and the project production capacity (2 million of pieces on two shifts) are shown in fig. 1; the picture shows the whole article range of this type of production.
The pure aluminium sheet, constituting the product raw material, is coated with PTFE (polytetrafluorethylene) on both its sides, in two different colours or in a sole colour as well; two or a single handles in thermoinsulating material with a metallic core are applied by riveting.
The PTFE coating improves hygiene in food cooking, reduces fats and/or oil consumptions and facilitates vessel cleaning.

FIGURE 1



Cod.	Article	Dimensions Ø mm	B mm	Cap Lt.	Yearly quantity (4000 pc.)
001	Dutch-oven	120	56	0,6	120.000
002	Dutch-oven	140	65	0,9	120.000
003	Dutch-oven	160	72	1,1	120.000
004	Dutch-oven	180	80	1,4	240.000
005	Dutch-oven	200	87	1,8	240.000
006	Dutch-oven	220	100	2,1	120.000
007	Dutch-oven	240	105	2,5	120.000
008	Dutch-oven	260	110	3,0	120.000
009	Frying pan	240	35	2,5	40.000
010	Frying pan	260	37	3,0	60.000
011	Frying pan	280	42	3,4	60.000
012	Frying pan	300	45	4,0	40.000
013	Lid	180			100.000
014	Lid	200			100.000
015	Lid	220			100.000
016	Lid	240			120.000
017	Lid	260			120.000
018	Lid	280			40.000
019	Lid	300			20.000
					2.000.000



2. TECHNOLOGY REVIEW

The products described in fig. 1 can be produced mainly be employing 3 different main types of technologies :

A. Forming of the product from aluminium disc; application of the handles by welding; degreasing, spraying and polymerization of the external decorative coating based on silicone paints i.e. enamel;
B. Deep pickling or blasting of the aluminium disc; PTFE spraying and polymerization in sequence on both sides; forming of the product; application of the handles by riveting and packing;
C. Deep pickling of the aluminium disc; PTFE coating with a roller and polymerization in furnace in sequence on both sides, normally in different colours; forming of the product; handles applying by riveting, and packing.

The process description and scheme given in para. 3 refer to the type "C" technology, which, besides to be the most commonly employed at present, offers for the same investment values, the largest production capacity. For their quality the articles are addressed to the middle and low class market. The low production costs allow competitive market prices.

Some supplier of technology are :

- MONETA S.p.A. IMPIANTI ED ENGINEERING: Milan, Italy
- TEFAL : France
- IEG Engineering S.A. : Vitoria, Spain
- SWAN Housewears Ltd. : Birmingham, United Kingdom
- BEKA, TUBINGEN, Federal Republic of Germany

which own the above mentioned technologies and have implemented many kitchenwares production plants in the world.

3. DESCRIPTION OF THE PRODUCTION PLANT

3.1 SCHEMATIC PROCESS DESCRIPTION

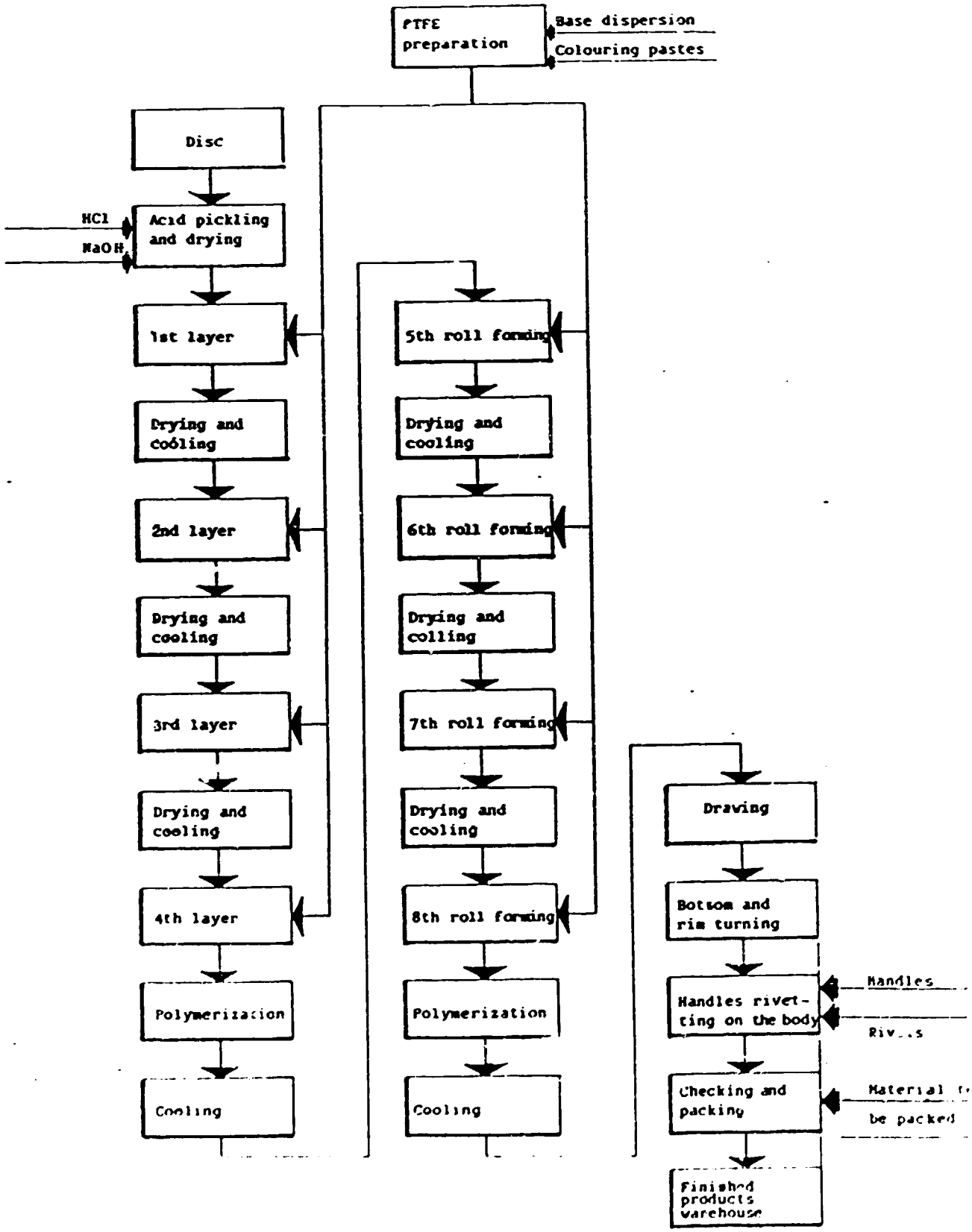
The sequence of the working cycle is shown in the following figure 2.
The use of pre-cut discs as raw material is justified by the following economic reasons :

- lower costs in buying the raw material, as the high quantity of scraps resulting when using coils are re-employed by the aluminium manufacturer;

- lower investment, considering the high cost of the cutting line, which among other things, is not justified by the required productions.

The disc surface is first made rough by dipping it in an acid solution (subsequently neutralized) and then dried in hot air.
Four layers of PTFE are applied on each disc side which are then polymerized at high temperatures. The body is then cool-formed by drawing with moulds on hydraulic press; the bottom and rim turning is carried out on production lathes with automatic starters. The thermoinsulating handles are fixed to the body by the rivet machines, which effects the piercing and the automatic riveting. In order to protect the product during transport and marketing, it is usually packed in plastic film bags made by the bag filling machine, fed by coils of PE or PVC films.
The manufacturing cycle is practically continuous with a dwell of the discs at the furnaces discharge, as to permit the coating stabilization. The handling of semi-finished products is carried out with containers and fork lifts. The manufacturing unit is provided with the equipment to obtain the coloured PTFE mixtures and its regenerations during the productive cycle. The process machines can manufacture the range of products described in para. 1 at a working rate of 4,000 hours/year, on 2 daily shifts, with an exploitation of the machines of about 85% of their capacity.
The whole plant, working practically in continuous, has a sole expansion box stocking between the teflon application and the drawing. The part of handles in thermoinsulating material is produced by the thermomelting of thermosetting plastic granules and its injection in moulds, set on automatic hydraulic presses. The metallic parts of the handles are made by many forming stations set on mechanic presses, where the cutting and bending of the sheet are performed from a coil automatically fed;

Figure no. 2


PTFE preparation
Base dispersion
Colouring pastes
Disc
HCl
NaOH
Acid pickling and drying
1st layer
Drying and cooling
2nd layer
Drying and cooling
3rd layer
Drying and cooling
4th layer
Polymerization
Cooling
5th roll forming
Drying and cooling
6th roll forming
Drying and colling
7th roll forming
Drying and cooling
8th roll forming
Polymerization
Cooling
Draving
Bottom and rim turning
Handles riveting on the body
Handles
Riv..s
Checking and packing
Material
be packed
Finished products warehouse

3.2 LIST OF MACHINES

3.2.1 Production machinery

ITEM N.	DESCRIPTION	Q.TY N.
101	Deep pickling plant of the aluminium discs with bridge crane for the baskets transfer and exhausting plant for acid and alkaline flue gas.	1
201-202	Motorized wire net conveyor belt for feeding of the discs to the 1st coating machine.	2
203÷210	Coating machine equipped with two motorized rollers, with manual regulation of the distance of the rollers and of the feed speed.	8
211÷216	Motorized wire net conveyor belt equipped with infrared rays passivation hood and blowing air cooling hood.	6
217÷220	Pneumatic membrane pump for PTFE feeding to the coating machine	4
251-252	3 zones polymerization furnace in continuos cycle with blowing air cooling tunnel for the discs and metallic wire net conveyor belt.	2
301-302	Hydraulic press at 2 opposite effects, 100 tons capacity	2
304	Hydraulic press equipped with gripping toggle of the tables for thermosetting plastic injection molding, 190 tons capacity	1
306	Automatic variable pitch feeder for steel narrow coils equipped with pneumatic grippers; max travels 150 mm.	1

ITEM N.	DESCRIPTION	Q.TY N.
307	Steel narrow coils decoiler equipped with clutch brake for the coil stretch regulation.	1
321÷324	Automatic lathe, with hydraulic workcrane and programmable working cycle.	4
351÷353	Punching and rivetting machine for selfdrilling full rivets, max. diam. 8 mm.	3
361	Motorized conveyor belt in shock resistant material, at adjustable feeding speed.	1
362	Neutral rollers sliding tables for collection of packed product	1
371÷373	Bags packaging machine for plastic with thermowelded edges	3

3.2.2 Laboratory

ITEM N.	DESCRIPTION	Q.TY N.
901	Motorized mixing tumbler at two running positions for PTFE drums of 25 l max.	1
902	Propeller mixer for PTFE and colouring paste	1
903	Bascule balance with dial and multiple turns power weght indicator up to 150 Kg.	1
904	Electronic measuring device for paints thickness on non ferrous metals.	1

ITEM N.	DESCRIPTION	Q.TY N.
905	Electronic measuring device for surface roughness.	1
906	Magnifying speedlessly-variable microscope with measuring range at reflecting light, power : 50 enlargements.	1
907	Set of glass material, test tubes and reagents for chemical lab.	1

3.2.3 Molds

ITEM N.	DESCRIPTION	Q.TY N.
1301	Mold for the dutch-oven body drawing, cm 12-14-16-18-20-22-24 26	8
1315	Mold for the frying pan drawing, cm 24-26-28-30	4
1320	Mold for the lid drawing, cm 18-20-22-24-26-28-30	7
1325	Piece holder mold for rim, surface and bottom turning of the dutch-oven, cm 12-14-16-18-20-22-24-26 (2 for each diam.)	16
1330	Piece holder mold for rim, surface and bottom turning of the frying pan, cm 24-26-28-30 (2 for each diameter).	8
1335	Piece holder form for the lid rim turning, cm 18-20-22-24-26-30 (2 for each diameter)	14
1340	Multi-impressions mold for forging of thermosetting plastic knobs, size 2 and 3.	2

ITEM N.	DESCRIPTION	Q.TY N.
1345	Multi-impressions mold for forging of thermosetting plastic long handle, size 2 and 3.	2
1350 ÷ 1355	Multi-stations mold for shearing and bending of the metallic support for knobs and handles	6

3.2.4 Automation (optional)

ITEM N.	DESCRIPTION	Q.TY N.
501+502	Automatic feeder for the discs to the 1st coating machine	2
503	Automatic discharge of the PTFE coated discs.	1
503-504	Automatic feeder of the coated discs on the drawing mold.	2
505-509	Articles charging and discharging robot from the production lathes	4

3.2.5 Complementary plants (optional)

ITEM N.	DESCRIPTION	Q.TY N.
701	Stocking plant for hydrocloric acid and caustic soda with 2 feeding pumps, 2 tanks, capacity 10,000 lt for the sodic hydrate	1
702	Semiautomatic plant for the diluition of the fused (solid) caustic soda in 200 lt drums.	1
703	Automatic plant for the neutralization of the polluting wastes and the muds separation.	1

3.2.6 Machine shop

ITEM N.	DESCRIPTION	Q.TY N.
9001	Parallel lathe, nose height 300 mm, max distance 1500 mm	1
9002	Surface crush grinding, max workable surface 300 x 600 mm	1
9003	Horizontal and vertical head drilling machine, table 230 x 1200 mm	1
9004	Disc double wheel grinder for tools, diam. 200 x 20 mm	1
9010	Set of manual and electric tools	1

3.3 COST OF MACHINERY AND EQUIPMENT

Estimated price for know-how, engineering, machinery and equipment, including sea packing, FOB European port, is presently (1988) :

U.S. $ 2,100,000

This price includes all machinery, equipment and moulds required to manufacture the products specified in para. 1, according to the equipment list of previous para. 3.2.1, 3.2.2 and 3.2.3. Price of spare parts for two years operation sea packed and FOB European port is (1988) :

U.S. $ 105,000

Budget prices for options indicated in para. 3.2.4, 3.2.5 and 3.2.6 are the following (1988) :

Automation	: U.S. $ 530,000
Accessories	: U.S. $ 80,000
Workshop	: U.S. $ 125,000
Relevant spare parts	: U.S. $ 40,000

3.4 ERECTION COSTS (EX-EUROPE)

Erection of delivered machinery and equipment will require Contractor's specialists and unskilled people

and erection equipment supplied by the Client. Estimated price for the assistance of Contractor's specialists, including commissioning and start up of the plant is (1988) :

U.S. $ 200,000

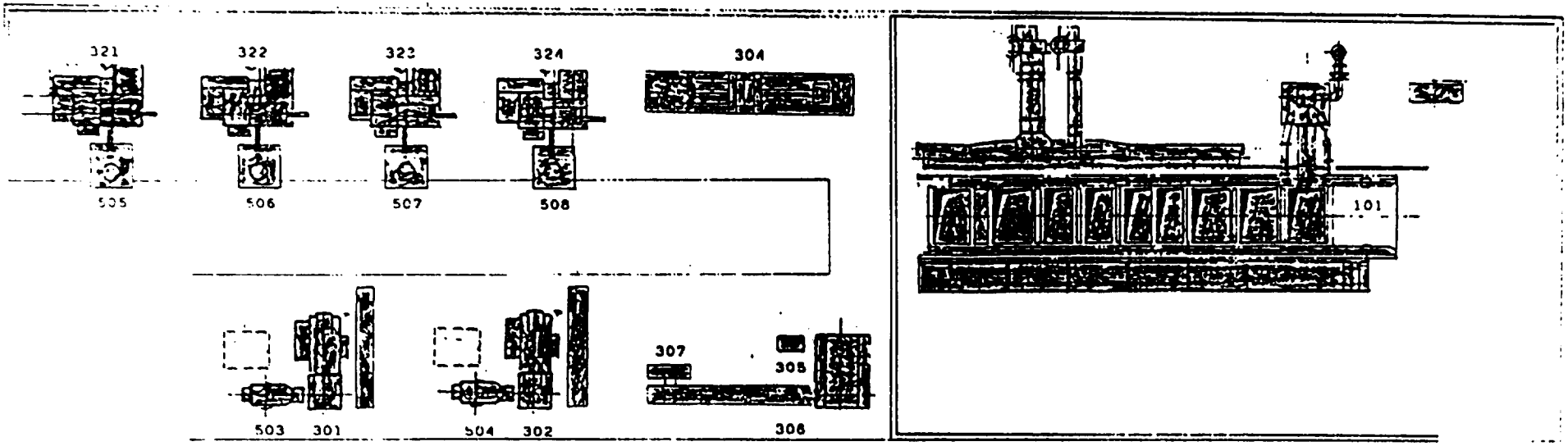
Said price includes air travels, board and lodging of specialists.

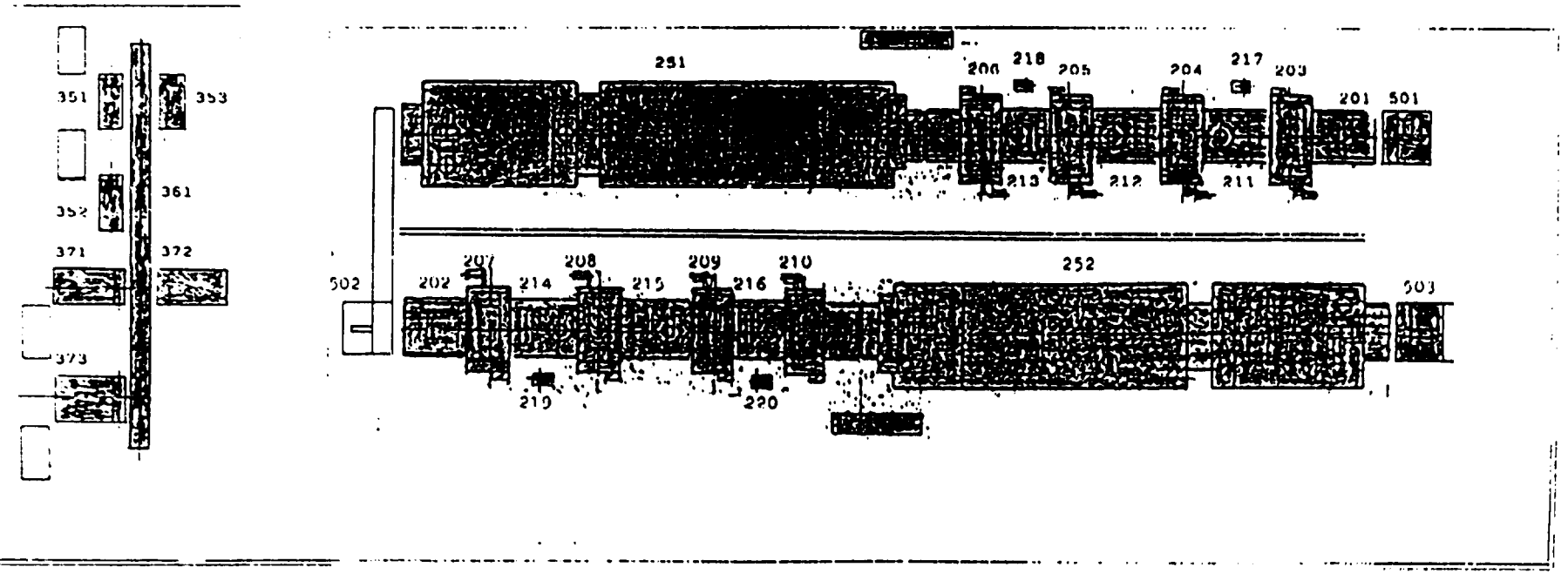
3.5 LAY-OUT AND CIVIL WORKS

The following drawing (fig. 3) shows a possible lay-out of the manufacturing machines. The minimum area required for this department is about 25 x 50 m = 1250 m^2. This area must be increased by those required for the warehouse of raw materials and consumables and finished products, the workshops, the air compressors rooms, the electric cabin, the fuel stokehold (if required), the marketing and administration offices.
The warehouse dimensioning depends on the type of organization for the stocked materials and sales; for the other needs the position is determined by the type and the dimension of the building involved.
As to permit a global dimensioning, we quote hereunder some values of the size of the areas which are not shown in fig. 3 :

- warehouse for a volume of raw materials and consumables covering 6 months of production	m^2	800
- warehouse for finished products packing and package materials covering 1 month of production	m^2	1000
- air compressor room	m^2	50
- transformer room (with medium voltage transformers)	m^2	50
- fuel storage	m^2	25
- marketing and administrative offices for 5-6 persons	m^2	100

The building for the manufacture of household utensils does not need special requirements; a steel structure with sandwich panels for roof and walls could be the most suitable. No bridge-cranes are required. Free internal height should be at least 6 m; lighting should be about 300 lux.
Forced ventilation with about 8 volumes/h as exchange rate is recommended. Paved area should bear a concentrated load of 5,000 Kg/m^2 as required by fork lifts, and should have the superior layer hardened with quartz-cement. No special cautions are requested for fire fighting.


321
322
322
324
304
505
506
507
508
503
301
504
302
307
305
306
101


351
353
361
352
371
372
373
251
206
218
205
204
217
203
201
501
213
212
211
502
202
207
214
208
215
209
216
210
252
503
219
220

4. REQUIREMENTS AND COSTS OF RAW MATERIALS, CONSUMABLES AND UTILITIES

4.1 REQUIRED RAW MATERIALS AND CONSUMABLE ITEMS AND THEIR PRICES (FREE AT WORK IN EUROPE)

For the production of the types and quantities of the articles mentioned in para. 1 the following materials are yearly required :

	Q.ty Kg	price US $/Kg (1988)
A. 99.5% aluminium discs in the thickness from 1.6 to 2.5 mm, diam. from 210 up to 435 mm	800,000	3.3
B. Galvanized or stainless steel in coils, thickness 1.5 mm, 40 mm width	70,000	0.75÷2.9
C. Liquid solution based on PTFE already coloured	18,000	10
D. Hydrochloric acid (HCl) mixed with water at 30% (70% of water)	250,000	0.16
E. Sodium hydroxide (NaOH) mixed with water at 30% (70% of water)	15,000	0.32
F. Screws for the assembling of knobs and handles on the metallic support	2,600,000	0.03
G. Plastic film in reels, width mm 400 abt	7,000	1.48
H. Corrugated cartoon boxes for multiple package	no. to be defined	
I. Thermosetting plastic in grains	120,000	1.25

4.2 UTILITIES, CHARACTERISTICS AND CONSUMPTIONS

The utilities to be supplied to the plant with their relative consumptions required for the machines included in para. 3.2.1 ÷ 3.2.3 are listed hereunder (in brackets the total consumptions including also the optional sections, are given) :

Fresh drinking water

- Continuous supply	
- Minimum pressure	2 Bar
- Hardness	less than 40°F
- Colour	transparent
- Turbidity	absent
- pH	from 6 up to 8
- Temperature	not more than 25°C
- Uses	m^3/h (peak) : 6
	m^3/d (average) : 40

Fuel oil

- Viscosity (38°C)	from 2 up to 5.4 centistokes
- Density	from 0.840 upto 0.860 at 15°C
- Low heating value	about 10,000 Kcal/Kg
- Expected consumptions	7 Kg/h (peak)
	50 Kg/d (average)

Compressed air

Compressed air is requested at the battery limits of the plant (or of the machines) with the following characteristics :

- Pressure	7 Kg/cm^2 (Dew point 2°C oilless)
- Expected consumption	25 (75) Nm^3/h (peak)
	200 (600) Nm^3/d (average).

5. MAINTENANCE COST

The annual maintenance cost, including spare parts, at full production, can be assumed as 4% - 6% of the machinery and equipment cost.

6. MANPOWER REQUIREMENTS

For the running of the plant the following direct manpower is required :

- Production manager	n. 1 per day
- Unskilled manpower	n. 25 per shift
- Mechanician	n. 1 per shift
- Electrician	n. 1 per shift
- Foreman	n. 1 per shift

7. PRODUCTION PERIOD AND COST

7.1 CONSTRUCTION PERIOD

Supply, erection and start-up to the plant require a period of 8 months, provided that the civil works and the utilities plants have been completed within the 5th month.

7.2 PREPRODUCTION EXPENSES

A training programme for three persons (electr., mechanic, and prod. manager), to be carried out in the Contractor's country, is suggested for two months. Board and lodging and local transportation for trainees, interpreter, trainers and use of machinery and raw materials, can be estimated (1988) at :

US $ 160,000.

8. PRODUCTION PROGRAMME

The designed plant production capacity can be reached within two years.

9. EUROPEAN COSTS AND PRICES OF THE PRODUCT

On the basis of statistical data, the average production cost in Europe of the items listed in para. 1 is US $ 1,85 for each piece. As for the sale price the following figures can be considered :

Code	Item	diam/cm	Unit price US $ (1988)
001	Dutch-oven	12	3.6
002	Dutch-oven	14	4.1
003	Dutch-oven	16	4.8
004	Dutch-oven	18	6.3
005	Dutch-oven	20	7.1
006	Dutch-oven	22	8.0
007	Dutch-oven	24	9.4
008	Dutch-oven	26	11.9
009	Frying pan	24	5.3
010	Frying pan	26	5.9
011	Frying pan	28	6.6
012	Frying pan	30	7.3
013	Lid	18	2.7
014	Lid	20	2.9
015	Lid	22	3.1
016	Lid	24	3.4
017	Lid	26	3.8
018	Lid	28	4.2
019	Lid	30	4.6