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SELECTION, INSTALLATION, STARTING UP AND OPERATION OF THE ELECTROLYTIC TINNING LINE AT "LAMINACION DE BANDAS EN FRIO" (LBF), SPAIN[1/]

by

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1/ The views and opinions expressed in this paper are those of the authors and do not necessarily reflect the views of the secretariat of UNIDO.

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History

1. We should like to begin our account of the development of tin plate production in Spain by drawing attention to the fact, perhaps little known, that our country, in spite of being classified as a developing country as far as industrial capacity is concerned, was, in the field of iron and steel production, a pioneer in the utilization of its rich deposits of iron ore, since at the dawn of its history iron ore was worked and processed at a large number of sites in different parts of Spain.

2. Moreover, the rich fishing grounds around its long coastline, which faces seas of such widely differing characteristics as the Bay of Biscay, the Atlantic Ocean and the Mediterranean, and the horticultural wealth of some of its regions, blessed by nature with optimum conditions for the production of fruit and vegetables of the best quality, resulted also in the early development in Spain of the food conservation industry, and the parallel development of the production of tin plate, as the main raw material for containers for preserved food.

3. Spain's first tin plate factory was installed in the neighbourhood of Ronda (Malaga), by authorization of King Philip V, in 1726, and was called the "Royal Tin Plate Factory of San Miguel de Ronda". It was an "integrated" plant in that it carried out all the operations from the washing of ore and the production of charcoal to the finishing and packing of the tin plate. The first tin plate was produced in 1731 and, according to the information existing, it was of good quality, similar to that produced in Saxony, Bohemia and South Wales. After some years technical and economic difficulties arose which increasingly hampered the company's operations, and these finally ceased in 1788, thus closing the first chapter in the manufacture of tin plate.

4. At the end of the nineteenth century, tin plate production recommenced under the impulse of people in the metal-printing and food-canning sectors, the Goitias, Rochelts, Alonsos and others, who, in co-operation with the mine owners and capitalists of the Vizcaya, were able to assemble the necessary capital to establish two production nuclei, one on the coast (Altos Hornos de Vizcaya, S.A.), and another further inland, in the Basauri area (S.A. Basconia). Both expanded greatly thanks to favourable communications, being located on the outskirts of the town of Bilbao; it is they which began the genuinely industrial production of tin plate in Spain, and, using increasingly mechanized and modern processes, they have always been and still remain the principal Spanish producers.

5. During the last decade of the nineteenth century and the first years of the twentieth century, faced with a hard struggle regarding the problem of tariff protection, the tin plate industry continued to develop, in spite of the poor results achieved, until the point was reached where two thirds of the consumption of the metal-printing and canning industries was of domestic origin and the remaining third of foreign origin, protected by the system of temporary importation for use in the manufacture of containers for export.

Altos Hornos de Vizcaya, S.A. (AHV)

6. In 1885, Messrs. Goitia de Beasain decided to use the sheet bar produced by the "Vizcaya" plant as a raw material for its tin plate, and established, in the marshland of Sestao (Vizcaya), transferred to them by this enterprise, a co-operative plant which was already producing tin plate by 1887, and was known in 1890 by the name "Compañía Anónima La Iberia"; it occupied an area of 15,000 square metres, devoted to the production of tin plate and containers. The plant consisted of nine two-high mills with the associated furnaces, eight polishing stands, six annealing furnaces and eighteen manual tinning "kitchens" with a capacity of 8,000 tonnes/year of tin plate. In 1901 the enterprise merged with "Altos Hornos y Fábricas de Hierro y Acero de Vizcaya" and the "Vizcaya" plant to form a new company named "Altos Hornos de Vizcaya, S.A." (AHV). This historic, pioneer agreement, bringing into being a large new enterprise in the field of iron and steel production, was one of the foundations of the industrialization process in Spain during the first half of this century.

7. In 1925, AHV completely renovated the rolling plant, which consisted of twelve two-high mills of two stands each, of 22.5" x 28", with an annual capacity of 40,000 tonnes, and in 1934 it installed two modern Thomas-Davies double-tank tinning machines with four lines each, to produce 15,000 tonnes/year of tin plate. The process of modernization continued, and in 1960, in addition to the above machinery, the plant included two multi-pile furnaces for annealing, four cold satinizing trains, one normalizing furnace and three pickling units, employing 550 manual workers and other employees in these operations. In 1960 these shops closed with the commencement of tin plate rolling at Laminación de Bandas en Frío (LBF).

8. Altos Hornos de Vizcaya, S.A., is today a vigorous and expanding enterprise, producing annually 1.6 million tonnes of laminates, one million tonnes of hot coils, 250,000 tonnes of sections, 230,000 tonnes of rounds, 100,000 tonnes of (thick) plate, 100,000 tonnes of (thin) sheet, 140,000 tonnes of tin plate and 80,000 tonnes of galvanized sheet.

S.A. Basconia

9. The Sociedad Anónima Basconia was founded in 1892 mainly for the production of tin plate, and it established a plant at Basauri (Vizcaya) with rolling mills, tinning machines and auxiliary shops; tin plate of good quality was produced from 1894 onwards. In 1896, output was 3,500 tonnes. In 1900, open hearth furnaces and new rolling mills were installed, 9,000 tonnes being produced in 1916. In 1926 the equipment was further improved, with a production of 13,500 tonnes, and in 1933 new, modern rolling mills were installed, giving an output of 20,000 tonnes in 1935 and 25,000 tonnes in 1938. During our Civil War (1936-1939) the modernization of the enterprise was interrupted, but in 1954 the mills were mechanized and modernized as a result of an installation from France which was second-hand but used a combined system, making it possible to increase labour productivity and reduce the effort required of the workers, and consequently their fatigue.

10. The company then occupied an area of 142,000 m^2, of which 80,000 m^2 was covered, with a total establishment of 2,400 employees (600 of whom were involved in tin plate production), producing a total of 100,000 tonnes/year of steel, used for the manufacture of tin plate, sheet, sections, rounds, etc.

11. The production of tin plate occupied a group of buildings with a total area of 15,000 m^2, served by several cranes, with ten two-high hot-rolling mills, each of two stands, of 24" x 29", with the associated gas furnaces, pickling and annealing sections, four cold satinizing trains and five tin "kitchens" of the Aetna-Abarcan type, with a total output of 25,000 tonnes/year. This plant ceased operation in 1962 after Laminación de Bandas en Frío began work.

12. Both AHV and Basconia produced tin plate primarily in 28" x 20" boxes of 136 and 108 lb, 20" x 14" boxes of 95, 90 and 85 lb, and 34" x 25" boxes of 126, 146 and 166 lb.

Laminación de Bandas en Frío (LBF)

13. During the years 1940-1950, the two companies made separate studies of the question of the cold rolling of tin plate and the Government combined the two projects, authorizing the establishment in 1952 of a modern plant for the production of tin plate and (thin) sheet. The equipment was requested in 1955, and in 1957 work began on the construction of the new plant at Echévarri (Vizcaya), on an area of 22,000 m^2, 50,000 m^2 being covered during the first stage and 7,500 m^2 during the second stage, and in 1959 the plant produced the first tin plate with prepared sheet rolled in a continuous mill.

14. Laminación de Bandas en Frío ("Cold Strip Rolling") came into existence as a joint venture of two limited companies, each initially contributing a 50 per cent share. Subsequently Basconia transferred to AHV its option on the hot strip mill, increasing its share in LBF to 67 per cent, and finally, in 1969, AHV acquired practically all Basconia's stock, with the result that LBF belongs indirectly to AHV.

15. The initial equipment was purchased by means of an initial ICA credit and two credits from Eximbank; the investment made up to the present time amounts to 2,650 million pesetas ($38 million) without counting the value of the ground. An estimated breakdown of the investment is as follows: machinery, 60 per cent; buildings, 23 per cent; energy, 8 per cent; auxiliary machinery and shops, 6 per cent; technical assistance and patents, 3 per cent. When the expansion which we are now carrying out is completed, the total investment will be 3,300 million pesetas ($47 million).

16. Today LBF produces cold-rolled sheet, coke tin plate, electrolytic tin plate and galvanized sheet, with an installation of 1,100 mm maximum width composed of (figure 1):

- 1 Wean pickling plant, with sulphuric acid, 80 m/min. 45 t/h of tin plate, 65 t/h of sheet. U = 85%.
- 1 United reversible mill, 12.5" - 37" x 34" - 560 m/min. 12 t/h. Tin plate. U = 82%.

GENERAL PLAN OF LAMINACION DE BANDAS EN FRIO

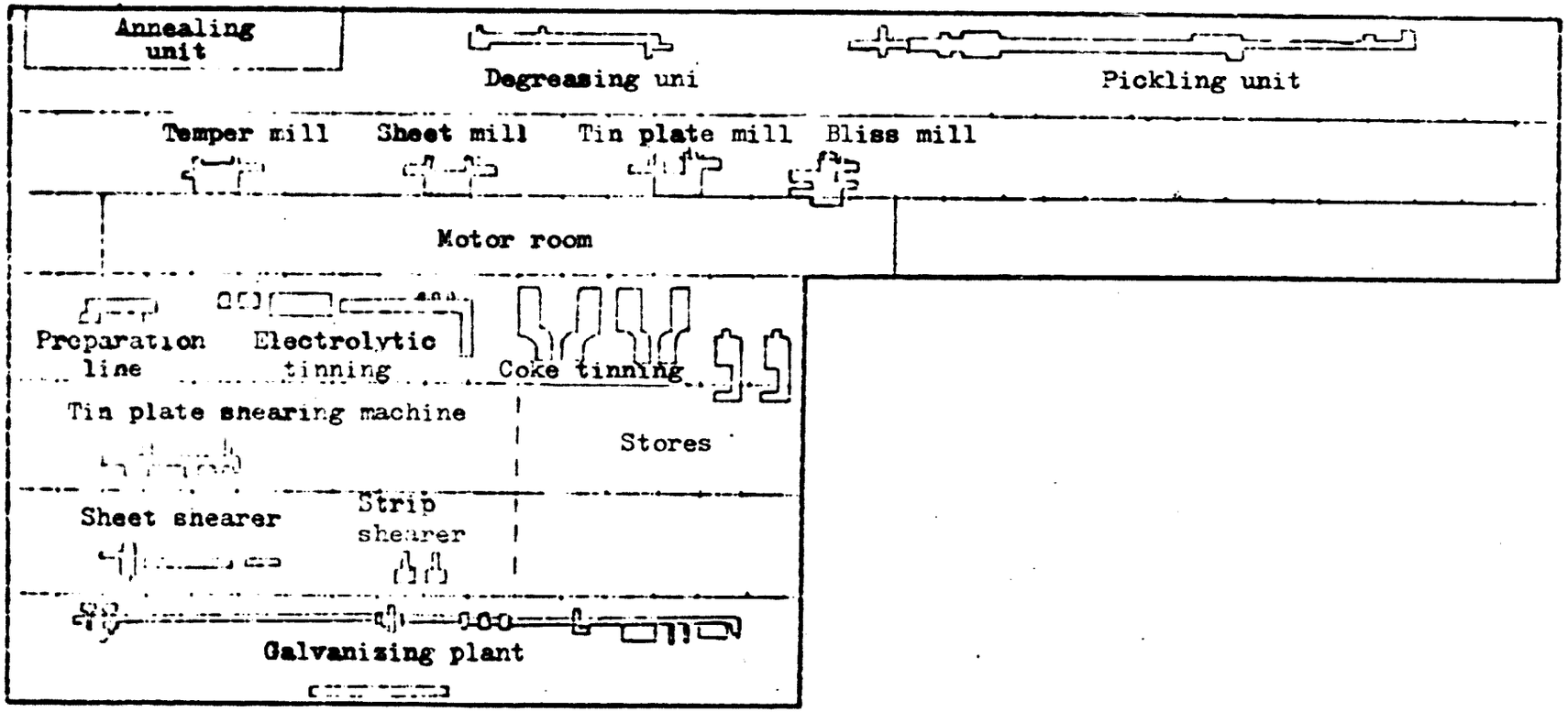


FIG.1

Scale 1:2000

- 1 United reversible mill, 16.5" - 45" x 48" - 360 m/min. 35 t/h. Sheet. U = 82%.
- 1 Bliss reversible mill, 16.5" - 53" x 48" - 950 m/min. 20 t/h. Tin plate. U = 80%. Can also operate as a temper mill.
- 1 Wean electrolytic grease-removal unit, 300 m/min. 18 t/h. Tin plate. U = 90%.
- 21 single-pile annealing furnaces and 54 bases.
- 1 United temper mill of two stands, 17" - 18.5" - 45" x 48" - 950 m/min. 50 t/h. Tin plate 85 t/h. Sheet U = 77%.
- 1 electrolytic tinning line which is described below.
- 2 Wean coke tinning machines, 1.5 t/h. U = 92%.
- 4 coke tinning machines, Aetna type (S.A.B.), 1 t/h. U = 93%.
- 1 shearing machine for prepared sheet, 300 m/min. 14 t/h. U = 90%.
- 1 shearing machine for thin sheet, 90 m/min. 25 t/h. U = 88%.
- 1 shearing machine for strip, 10 t/h.
- 1 Aetna-Standard galvanizing line, Sendzimir, 10 t/h. U = 89%.
- 1 Head-Wrightson tin plate reclassification line, 4,000 sheets/h.

17. Total output is 320,000 tonnes/year: 100,000 of electrolytic tin plate; 40,000 of coke plate; 100,000 of thin sheet and 80,000 of galvanized sheet.

18. The plant is at present being expanded, with alterations in the pickling, degreasing and galvanizing units and the expansion of the annealing unit, in order to produce, in 1972, 11,000 tonnes of electrolytic tin plate, 40,000 of coke plate, 140,000 of thin sheet and 110,000 of galvanized sheet.

19. We have under study another, larger expansion of our installations, to absorb the 1.8 million tonnes/year output of the hot strip mill which AHV set up in 1966, and which is also being expanded.

20. In addition to our tin plate line, there has been an electrolytic tin plate line of the Ruthner type, 640 mm wide, in existence since 1966 at the enterprise Estéban Orbegozo, S.A., of Lez (Guipúzcoa), with an output of 12,000 tonnes/year, and there is another Ruthner electrolytic line at Laminaciones de Lesaca for various types of surface treatment (chrome plating, coppering, tinning, etc.), which produces some tin plate. There is also an electrolytic tinning line at an advanced stage of construction at the Empresa Nacional Siderurgica, S.A. (ENSIDESA), of 300 m/min, with shears and coilers, and a capacity of 150,000 tonnes/year.

Characteristics of the Spanish market

21. At the beginning of the twentieth century, tin plate was utilized almost exclusively in containers for preserved vegetable products and fish, as Spain had not yet reached an advanced stage of industrial development and its production was based mainly on agriculture, favoured by its excellent climate, and fishing, as a result of its extensive and well-endowed sea-coast. Although already at this time there were industries devoted exclusively to the lithographing and manufacture of tin plate containers, attached to the principal canning centres, owing to the low production of these industries the canner was obliged to keep a small auxiliary shop to produce cans for his own use, thus enabling him at the same time to provide permanent employment for his workers during periods which were off-season for the products he was canning. This situation continued many years for various reasons, of which we may mention particularly the short duration of work seasons in the canning industry, which diminished the incentives for modernizing the factories and shops producing cans and setting up new plants for such production.

22. In the 1940's, a change in the situation of our economy began as a result of the expansion, through irrigation, of the agricultural areas, the modernization of our fishing fleet and the establishment of new industries, with a consequent rise in living levels and increased demand for consumer goods, many of which were of such a nature as to require tin plate containers. These circumstances called for a large supply of containers and thus led to the establishment of several modern plants for the lithographing and manufacture of cans; this reached its height in the years between 1955 and 1965, leading to the gradual closing down or at any rate the modernization of most of the auxiliary shops attached to the canning plants, as they were no longer profitable.

23. We have already remarked that, formerly, almost all the output of tin plate went into the canning of vegetable products and fish. Today, however, this market absorbs only 60 per cent of consumption, the rest being accounted for by containers for various products, notably mineral oils, paints, chemical products, crown caps, cosmetics, aerosols, tobacco, toys, etc. This has somewhat eased the market situation, since formerly the canning factories worked only during the particular season of the fruit, vegetable, fish, etc., being canned.

24. Originally, in Spain (as in the rest of Europe), the tin plate available on the market was coke plate, which, owing to its characteristics in regard to tin content, was useful for the packaging of almost all products, however corrosive. When the production of electrolytic tin plate began abroad, with various grades of coating, and an attempt was made to introduce it in our country, a serious problem arose as a result of lack of experience and information on the part of the users regarding its suitability in containers for particular products, and this, combined with the strength of the tradition in favour of the use of coke plate by canners, slowed down its introduction greatly and prevented it altogether in some sectors.

25. Electrolytic tin plate was received with some mistrust by canners, and there were even those who regarded it definitely as a product of lower quality than coke plate because of its thinner coating and because they were not familiar with the material.

26. Although fully aware of this market situation, we had complete confidence in electrolytic tin plate and therefore, in 1960, purchased a continuous Ferrostan line whose technical and operational details will be indicated later and which began to supply the domestic market with this product in 1963.

Technical assistance for Clients

27. In spite of the good appearance and quality of our electrolytic tin plate from the beginning, it was not completely accepted by the market for the reasons given above, a circumstance necessitating a sustained information campaign, based mainly on practical tests in the canning of various products, with various types of tin coating with or without internal varnishing, to convince the consumer of the identical or

sometimes better performance of the material in comparison with coke plate, and of course at a lower cost and with a container of a better appearance. This procedure is somewhat slow owing to the duration of each test (at least a year), but this is the most effective process in countries like ours where the small-scale canning industry is not adequately equipped to carry them out itself. All these tests were performed by our company, at our expense, with the co-operation of the industries using tin plate containers and the manufacturers of inks, lacquers and varnishes, and with the general assistance of a governmental agency, the Institute of Agro-Chemistry and Food Technology, of Valencia, responsible to the Supreme Council for Scientific Research.

28. Simultaneously with these tests, consumers were provided with indications, purely for purposes of guidance, on the types of tin coating, with or without protective varnishing, most suitable for each product to be canned, and our metallurgical service provided immediate advice on all problems submitted by our clients.

Electrolytic tin plate and coke plate

29. In addition, between 1964 and 1966, 11,000 tonnes of electrolytic tin plate was produced with coatings of 1.25 and 1.35 lb, in order to demonstrate that its performance was similar to that of tin plate made by the hot-dip method. In addition, to publicize the product further, various technical meetings were held at a number of consumption centres, and visits by tin plate users to our plant were organized.

30. In spite of the efforts made to introduce electrolytic tin plate in our market, and the substantial improvement of the varnishes and the techniques for applying them, we have to bear in mind that there are products which, owing to their specific nature, the manner of their cultivation in our country and the existing method of preparation, still require the use of coke plate (stuffed olives, certain tomato concentrates, spinach, peas, cherries, plums, apple juice, salted fish, regional cooked products, etc.). This was one of the reasons for the installation of two modern Wean coke tinning machines in 1962 with electrolytic pickling, a Davis feeder, alkaline cleaning and automatic classification, which are operating satisfactorily at the present time.

31. In addition, as the same prepared sheet is used in the coke tinning plant as for electrolytic plating, we obtain a better quality of coke plate than earlier.

32. Figure 2 shows the evolution of the market for tin plate and its introduction in Spain; the basic feature is a steady rise in consumption. Present consumption of coke plate is 70,000 tonnes/year, representing 26 per cent of the total, and it is estimated that in 1975 the figure will be 45,000 tonnes, or 12 per cent of total consumption.

33. There has been a noteworthy per capita increase in tin plate consumption in Spain; in 1960 the figure was 2 kg, in 1965 it was 6 kg, and in 1970 it is expected to be 9 kg, thus exceeding per capita consumption in Italy, which was 4 kg in 1960 and will be 7 kg in 1970, and that of France, which was 6 kg in 1960 and will be 8 kg in 1970.

Packaging, weight, standards and formats

34. Among other questions related to our market we should like to mention the problems facing us in regard to certain specific matters such as packaging, the weight of packages, standards and formats.

35. With regard to packaging, we have tried from the beginning to adopt the standards applied abroad in this regard, using paperboard boxes as far as possible and reserving metal packing containers for sea transport. It should be noted that the principal means of transport in Spain is the lorry, a fact which complicated the utilization of board boxes, but the measures adopted to take care of the freight and ensure that it is properly covered have made it possible, as we have said, to expand the practice of packaging in board. We have not yet solved the problem of a domestic supply of cellulose materials with the necessary characteristics, and have been obliged to purchase these on the world market, but we hope, in close liaison with our paper and board plants, to find a solution shortly.

36. It seems desirable, both from the point of view of the manufacturer of tin plate and that of the user, to provide for packages of the maximum weight compatible with handling conditions in our plant and the plants of our customers, and it may be noted in this respect that, with the co-operation of the technical and commercial services, packages are now being produced with an optimum weight of 1,500 kg.

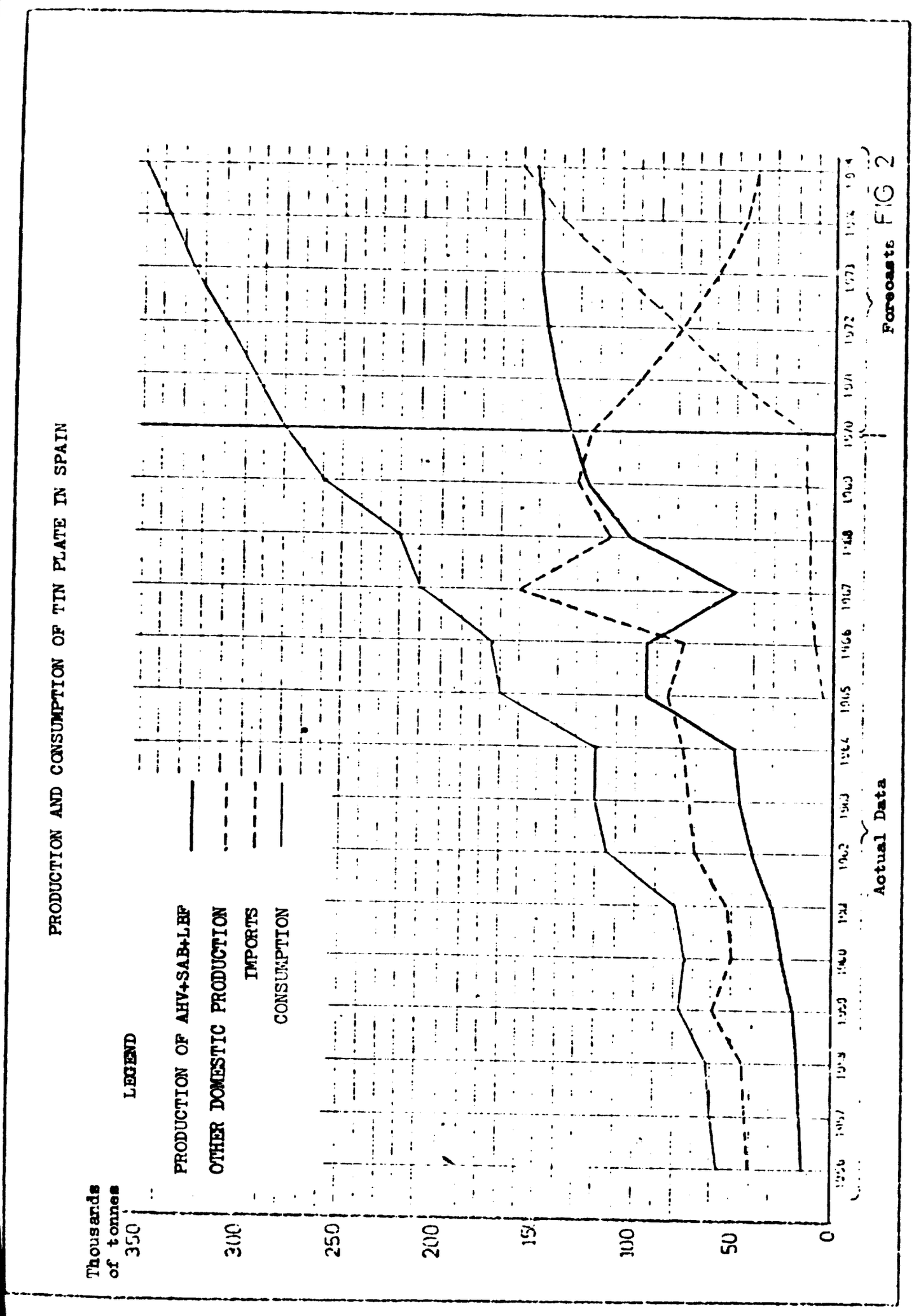

PRODUCTION AND CONSUMPTION OF TIN PLATE IN SPAIN
LEGEND
PRODUCTION OF AHV+SAB+LBF
OTHER DOMESTIC PRODUCTION
IMPORTS
CONSUMPTION
Thousands of tonnes
350
300
250
200
150
100
50
0
1960
1966
1967
1968
1969
1970
1972
Actual Data
Forecasts

FIG 2

37. With regard to the quality standards for controlling our products and ensuring acceptability to customers, we have always applied international standards, and more specifically, in the absence of a national standard, which is still being prepared, we have been guided basically by the Duronorm.

38. There is no demand yet among Spanish canners for tin plate in coil, and we cannot estimate at this time when we will need to have electrolytic tin plate coilers in our plant to meet future demand. However, as will be explained further on, provision is made for an expansion of our electrolytic tinning line which will include the installation of coilers.

39. With regard to formats and the range of thicknesses, we would mention the fact that, at Laminación de Bandas en Frío, we use the metric decimal system but we keep the English measurement in pounds per base box for the tin coatings.

40. The surface unit is still the "box", but in line with the latest tariff amendments we have introduced the base box consisting of 100 sheets instead of that consisting of 112 sheets. We are aiming at the abolition of the "over-run" (an excess amount added in the past in measuring packaged tin plate to compensate for squaring error), but we have so far retained it as we feel that the appropriate time for its abolition has not yet come.

Characteristics of the electrolytic tinning line

41. It was decided in 1960 that the most suitable line for Spain's growing market for electrolytic tin plate would be one having the following characteristics, on a preliminary basis:

- Width of strip = 458 - 1,016 mm
- Length of cut = 458 - 1,016 mm
- Thickness of the strip = 0.16 - 0.61 mm
- Output 70,000 tonnes/year for a product representing 711 x 508 x 0.27 mm and 0.50 lb per base box of tin coating.

42. The Ferrostan system of U.S. Steel was chosen in view of the quality of the product, this being the type of line most suitable for our market and the system most widely used in Europe.

43. The coil preparation and electrolytic tinning lines were installed in the same building as the coke tinning machines, and are arranged as indicated in figure 1.

44. The coil preparation line is a high speed line which will be able in the future to process all the potential capacity of the electrolytic tinning line. The components are arranged as shown in figure 3, and the following may be mentioned in particular: knives of 12" diameter; speed 1,200 m/min; no loop pits; internal diameter of the entry coil 20"; internal diameter of the coil on exit, 16 1/2"; Taylor-Winfield roll welder (soldering machine); collector of edge scrap. It processes coils of up to 13.5 tonnes. It has an X-ray micrometer gauge and Askania edge-centring equipment.

45. The electrolytic tinning line (figure 4) is a conventional line of 228 m/min maximum velocity, with the following equipment: two uncoilers; a loop pit at the entry for 50 m of strip; an electrolytic degreasing tank of 7,500 A; a washing unit; a pickling tank of 7,500 A; another washing unit; 3 tinning tanks of 15,000 A x 19 V each; 1 tank for the recovery of entrained liquid; a Pamler marker; a 1,500 kVA melting tower; a cooling tank; a 7,500 A chemical treatment tank; a washing unit; oiling by means of emulsion and a Trion electrostatic oiler; a Pratt and Whitney X-ray gauge; 2 Linderman hole detectors; 2 Beckman sheet counters; 1 electromechanical classifier; 1 single sheet classifier; 3 stacking machines and one roller conveyor for the formation of packages; 12 Westinghouse silicon rectifiers each of 7,500 A capacity. We have a Hewlett-Packard apparatus for measuring the tin coating on each face.

Stages of implementation

46. The order was sent to Wean and Westinghouse in July 1961. After four months Wean submitted the model ground plans for the engineering work, which was completed in March 1963, having lasted eight months.

47. At the same time Wean also supplied the detailed plant data for the construction in Spain of the metal and mechanical components, construction being completed in December 1962, within a period of six months.

48. Five months after the submission of the order, the supplier made available the basic plans for the pipe work, which was completed in five months.

COIL PREPARATION LINE

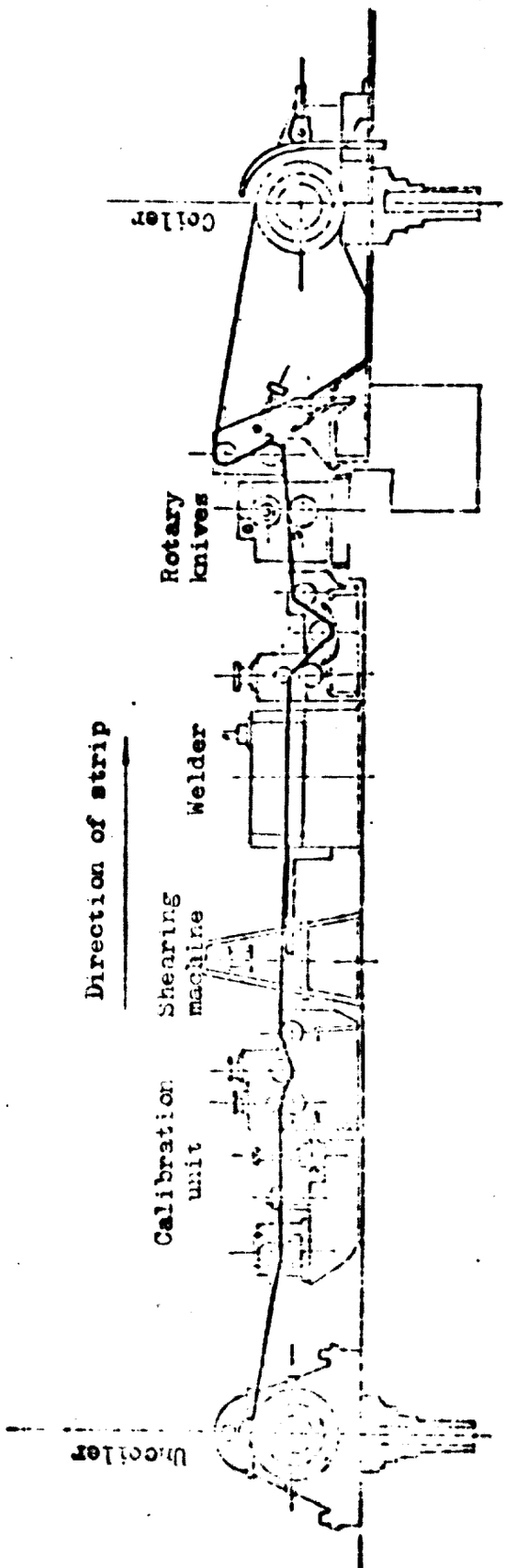


FIG. 3

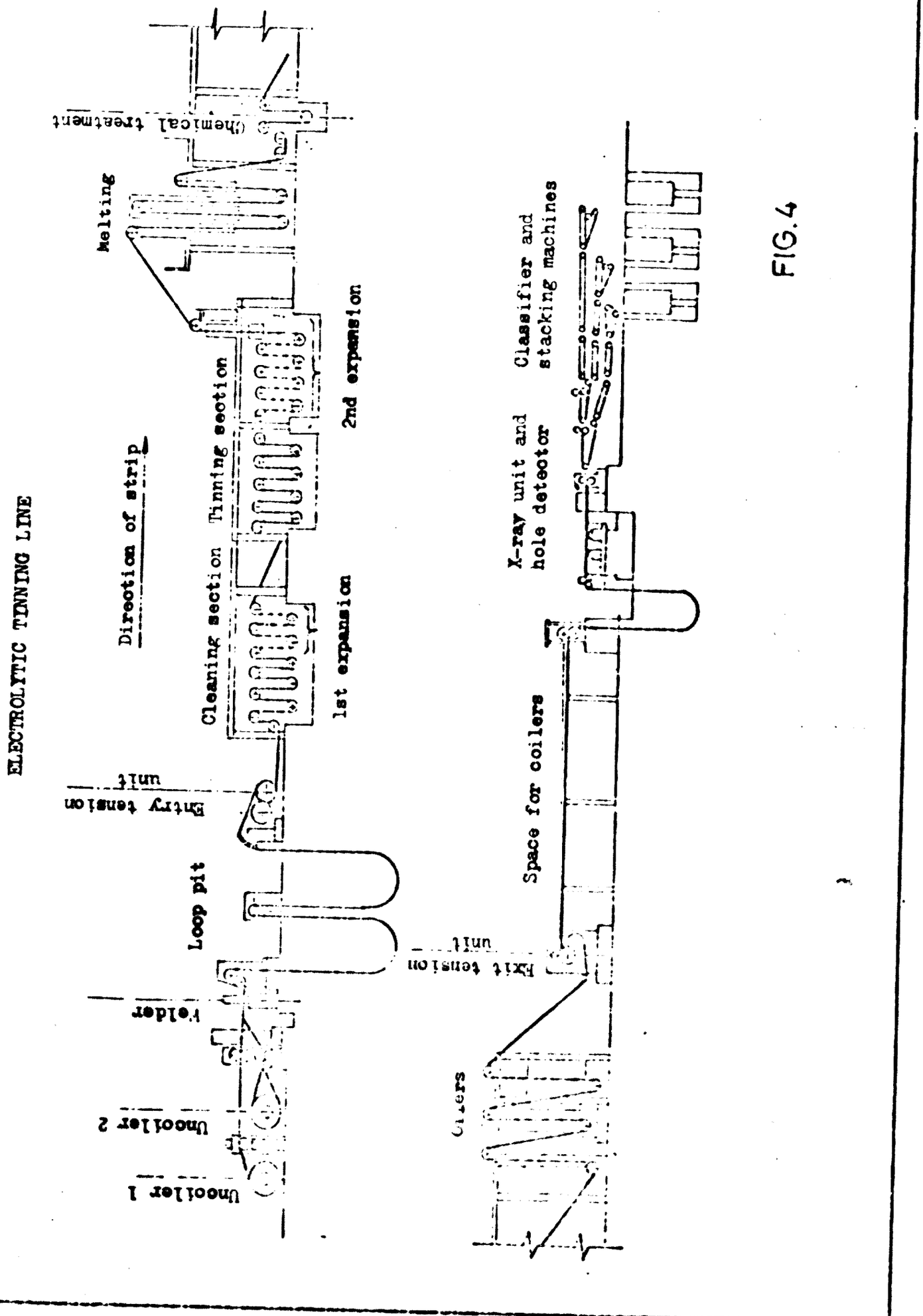

ELECTROLYTIC TINNING LINE
Direction of strip
Chemical treatment
Melting
Cleaning section
Tinning section
2nd expansion
1st expansion
Entry tension unit
Loop pit
Exit tension unit
Space for coilers
X-ray unit and hole detector
Classifier and stacking machines
Uncoiler 1
Uncoiler 2
Coilers

FIG.4

49. The shipping of the equipment began twelve months after the submission of the order, and delivery continued over another twelve months, at the end of which time the mechanical and electrical equipment was completed.

50. We began assembly eight months from the date of submission of the order, and it took a total of eighteen months, so that the line could start up in September 1963.

Domestic construction

51. The following components were designed and constructed in Spain: ramps for storing and removal of coil; equipment for vapour and fume extraction and the ventilation of the basement; receptacles for pickling, degreasing and the electrolyte; chemical treatment; metal structure for the tanks in the section for preparation and electrolysis, melting tower, oiler and stackers; roller conveyor for the removal of packages, covers, guards, railings, anchor bolts, etc.

52. We also carried out the detailed engineering studies on the electrical equipment and on the installation of motors, generators, rectifiers, wiring, bus-bars, transformers, 5,000 V and 380 V power supply, lighting, loud speakers, etc.

53. In addition there was the pipework project for the hydraulic, alkaline, electrolyte, oil, passivation, industrial water, demineralized water, purified water, residual water, compressed air, steam and other circuits.

Manpower training

54. It is very important to provide adequate training for the manpower to operate these highly automated installations, which require careful maintenance and must produce good quality tin plate; the method of accelerated vocational training was therefore used for training the new personnel or adapting the skills of the excess manpower from the hot tin plate mills, which were already dismantled.

55. Simultaneously with the assembly of the machinery, we selected some of our own personnel to meet future needs for foremen and operators, giving them, at our plant, a general, basic training course and another theoretical course on the production, quality and specific characteristics of electrolytic tin plate.

56. After this first 120-hour period of training, the final selection was carried out in January-April 1963 on the basis of the aptitudes and professional background of the personnel and the results of the course. After this a team made up of 5 engineers and 10 operatives, followed an apprenticeship course at a Ferrostan line very similar to ours in Belgium (Phenix Works), during June and July 1963.

57. These employees took a decisive part in the final phase of assembly, cold tests, final adjustment of the plant and preparation of the manuals on safety and operation, as well as metallurgical practice and practice in the laboratory, now installed. From these 10 operatives the foremen, principal operatives and output operatives were selected.

58. Our present establishment consists of the following personnel per work shift in the electrolytic tinning line: 2 operatives in the preparation line; 8 in the tinning line; 2 in the auxiliary services (basement and anodes); 2 on the crane and truck; 4 package preparers; 1 electrician; 2 mechanics. There are 2 operatives on the classification line, in the laboratory there are 2 analysts, and the quality control service is staffed by one controller per shift.

59. The main problem was to obtain a quality of tin plate similar to the product already available on the domestic market, coming mainly from Europe, and it was therefore necessary, before the final tests were initiated, to send a few thousand tonnes of our prepared sheet for electrolytic tinning in the United Kingdom and Germany, so that the results could be studied. This led us to make a complete overhaul of our operating practices in regard to pickling, rolling, degreasing and tempering in order to obtain a sheet of good surface appearance and suitable temper. Decisive during this final stage was the technical advice provided by the team which was sent to LBF by U.S. Steel to analyse the results obtained in regard to quality, yield and the utilization of plant and materials.

60. In view of the market difficulties described earlier, the line worked on the basis of one shift during the first year, two during the second, and three shifts a day in 1965. This discontinuous system of operation, combined with the need to produce tin plate of 1.25 and 1.35 lb with only three tanks of 45,000 A gave rise to the common problem of electrolyte loss through oxidation of the tin as a result of

operation with high temperatures and current densities. The only systematic quality defects during the first few years were quench stains, a problem which was solved through modification of the flow and temperature of the water in the tank concerned, and wood grain appearance, which was corrected by improving the cleaning of the strip. Other, less serious problems, were the shortage of capacity for the refrigeration of the electrolyte and the marks from the upper roller of the melting tower, especially with dull-finished tin plate; this was corrected through Ipalon covering.

Expansion of the electrolytic tinning line

61. During the first year of operation, products with various finishings, coatings and tempers were manufactured in all the formats demanded on the domestic market, and, although production was only at one third of capacity, it was decided to expand tinning capacity in order to be able to meet future demand for heavy coatings.

62. The changes are reflected in figure 4, and consist essentially of the following:

Degreasing unit with conductor rollers;
Pickling unit with Carpenter 20 conductor rollers and the installation of a second tank;
Three additional tinning tanks with 45,000 A intensity (90,000 in all) and two electrolyte circulating pumps;
Second "drag-out" unit, to allow better recovery of the electrolyte;
Installation of conductor rollers in the chemical treatment section;
Six stationary rectifiers of 7,500 A/unit for the tinning section;
Additional control equipment;
Auxiliary piping equipment.

63. The order went to Wean and Westinghouse in January 1966, and the engineering then began. No building work was necessary (apart from foundations for the motors, etc.). We designed and constructed in Spain the metal structures for the new tanks, the complete tanks themselves except for the Garlock locking devices, the tank bottom rollers and related drive parts, and all the deflector rollers apart from the Carpenter 20 rollers; all the piping circuits for pickling, degreasing, the electrolyte, cooling water, steam, oiling, etc., together with transformers, wiring, bus-bars, lighting, and distribution at 5,000 and 380 V.

64. Twelve months after the submission of the order the imported equipment was received, the domestic components having been constructed by that time. The assembly of both imported and domestic equipment could be effected to a large extent without stopping the line, thanks to very accurate and detailed engineering studies which made it possible to reduce the stoppage to 14 days.

65. It will be seen from figure 4 that provision has been made for a further possible expansion during a third stage, with the installation of two coilers and one decoiler, allowing a substantial increase in the capacity of the line.

66. In the project which we are at present studying consideration is being given both to this possibility and to the installation of another line in the same building for light coatings (0.25 - 0.50 lb), capable also of producing tin-free steel. What is not envisaged at the present time is the production of double-reduction tin plate by our company. It is possible that at a future date, after the present project is completed, we will be able to adapt our existing reversible mills for this type of production.

67. Total investment made up to the present date in the electrolytic line and the preparation line amounts to 350 million pesetas (US$ 5 million), without counting the building, the general energy networks already in existence, and technical assistance and patent costs. On the basis of certain criteria, this investment can be broken down into: civil engineering work, 4 per cent; non-electrical equipment, 48 per cent; electrical equipment, 30 per cent; assembly of non-electrical equipment, 5 per cent; assembly of electrical equipment, 5 per cent; auxiliary and laboratory equipment, 3 per cent; project engineering studies, 2 per cent; miscellaneous, 3 per cent.

68. During the last few years the line has worked on the basis of three shifts per working day, and during this available working time we have considerably reduced stoppage hours thanks to an efficient preventive maintenance service which carries out programmed inspections, examines new equipment and supplies and checks replacement parts.

69. The principal maintenance problems during the first years of operation of the line were roller alignment, mechanical malfunctioning of the shearing machine and leveller, and electrical malfunctioning in the sheet classification system.

70. Abnormal roller alignment causes displacement and gives the strip a wavy edge. It has been eliminated through preventive inspection every nine months with measuring apparatus with a tolerance of 0.02 mm/metre and, naturally, the alignment and levelling of each roller when it is changed on account of wear or damage.

71. The mechanical malfunctioning of the shearing machine and leveller produced errors in the length of sheets and stoppages for the changing of straight knives. This has been corrected through preventive maintenance, and more accurate mounting of the knives.

72. Electronic malfunctioning in the classification system introduced sheets with holes into the packages, and this has been corrected by modifications in the detector and in the guiding of the strip. In addition, a routine check of the system is carried out once every shift.

73. In the first few years stoppages due to mechanical and electrical break-downs represented 7 per cent and 8 per cent respectively of operating time, and at the present date stoppages due to unforeseen break-downs account for the following percentages of available working time: mechanical break-downs, 2.20 per cent; electrical break-downs, 1.50 per cent. Five per cent is set aside for programmed inspection. The auxiliary production operations such as changing of rollers and knives, attending to jamming and strip breakage and cleaning are carried out by the line personnel with 4.5 per cent stoppage time; there is also substantial stoppage for changes of programme (width, length, finishing, etc.), to the extent of 3.5 per cent, so that utilization time is 83 per cent.

Characteristics of the products obtained

74. We produce approximately 50 per cent light coatings (0.25 and 0.50 lb/base box). Coatings of 1.25 and 1.35 lb, which formerly represented 11 per cent of the electrolytic tin plate produced, had not been included in our output for three years, and perhaps for this reason the percentage of plate with a 1.00 lb coating has increased in these latter years, and is now 25 per cent. The consumption of differentially coated tin plate has also increased, and now accounts for 12 per cent of the total.

75. We produce polished, stone and dull finishes, the last-mentioned in 0.25 lb plate for crown caps, representing 10 per cent of production.

76. Despite the standardization of cans for preserved vegetable products and fish, we still produce more than 2,000 different formats, as a result of the fact that each canner still uses the traditional formats which he utilized initially to suit the machinery he had, and today the manufacturers all employ different dimensions of tin plate to produce the same standardized can. This presents us with serious problems in regard to the diversification of hot-rolled coil, short production programmes, low utilization of plant and stocking of finished products. We are therefore currently giving preference to nine formats which are those used in the standardized containers, and we hope to improve this situation in the near future.

77. The width of the strip has not increased greatly, averaging around 747 mm with a range from 680 to 910 mm. Lengths vary from 460 to 1,016 mm, with an average of 565 mm.

78. Average thickness is continuing to decrease; it was 0.27 mm in 1962 and 0.25 mm in 1969, with the prospect in a few years of reaching the normal thicknesses of conventional tin plate, allowing the manufacture of more economic containers, competitive with those of aluminium, glass or paper. The range runs from 0.18 mm to 0.38 mm.

79. The line produces "unassorted" and "waste". The latter is processed in the reclassification line, giving "unassorted" (in three thickness ranges) and 4th quality. Including this reclassification operation, the yield of the line is 91 per cent "unassorted" and, in terms of hot-rolled coil, 82 per cent, owing to the higher wastage rate of the reversible mill.

Summary

80. The first tin plate was produced in Spain in 1731.

81. Altos Hornos de Vizcaya, S.A., and S.A. Basconia were the first Spanish enterprises to establish installations of a substantial size for the manufacture of coke plate - in 1885 and 1892 respectively.

82. In 1954, S.A. Basoonia set up the first mechanized installation for the hot-rolling of tin plate by the so-called "combined" system.

83. From 1959 onwards, the two companies mentioned above, acting jointly, on a fifty-fifty basis, set up the plant bearing the name "Laminación de Bandas en Frío", at Echévarri (Vizcaya), for the production of tin plate, sheet and galvanized sheet.

84. In 1969, AHV acquired practically all the stock of SAB, and is today the exclusive owner of LBF.

85. LBF now has a production capacity of 40,000 tonnes of coke tin plate and 100,000 tonnes of electrolytic tin plate.

86. At the present time, 60 per cent of Spanish consumption of tin plate is accounted for by the canning industry.

87. The introduction of electrolytic tin plate in Spain encountered some difficulties owing to unfamiliarity with the product and its wrong use in earlier times, on the basis of imported materials.

88. An important part was played by the establishment of a metallurgical service providing technical assistance to customers, through which we made a sustained effort to spread information on the characteristics, methods of manufacture and applications of electrolytic tin plate.

89. In order to begin selling electrolytic tin plate in Spain, we had to produce it initially with heavy coatings of 1.25 and 1.35 lb/base box.

90. As our customers gradually came to understand and appreciate the characteristics and advantages of electrolytic tin plate, we improved the quality of our coke plate, which still occupies an important place in the market (about 26 per cent).

91. Questions to be considered are the problems of packing, the weight of packages, standards and formats.

92. We use two reversible mills and a two-stand temper mill in the production of the plate.

93. Our electrolytic tinning line is of the "Ferrostan" type, constructed by Wean with Westinghouse electrical equipment, with a speed of 228 m/min.

94. Initially it was equipped with three tanks of 15,000 A each, but subsequently its capacity was doubled and now we have six tanks with a total capacity of 90,000 A.

95. The line dates from 1963, when it started up, two years after the order was submitted for the equipment, the assembly lasting a total of 18 months.

96. The construction of a large proportion of the mechanical and metal components, as well as all the detailed mechanical and electrical engineering, took place in Spain.

97. We placed great stress on manpower training, and we received assistance for this purpose from U.S. Steel under the agreement on the Ferrostan licence and a special additional contract signed subsequently.

98. Under this contract we sent our personnel to follow an apprenticeship course at the Phenix Works enterprise in Belgium, which was equipped with a line very similar to ours.

99. In 1967, as has been said, the capacity of the electrolytic tinning line was expanded from 45,000 A to 90,000 A, with a total stoppage time of fourteen days for the changeover.

100. A further expansion of the line is envisaged, with a 50 per cent increase in speed and the installation of coilers.

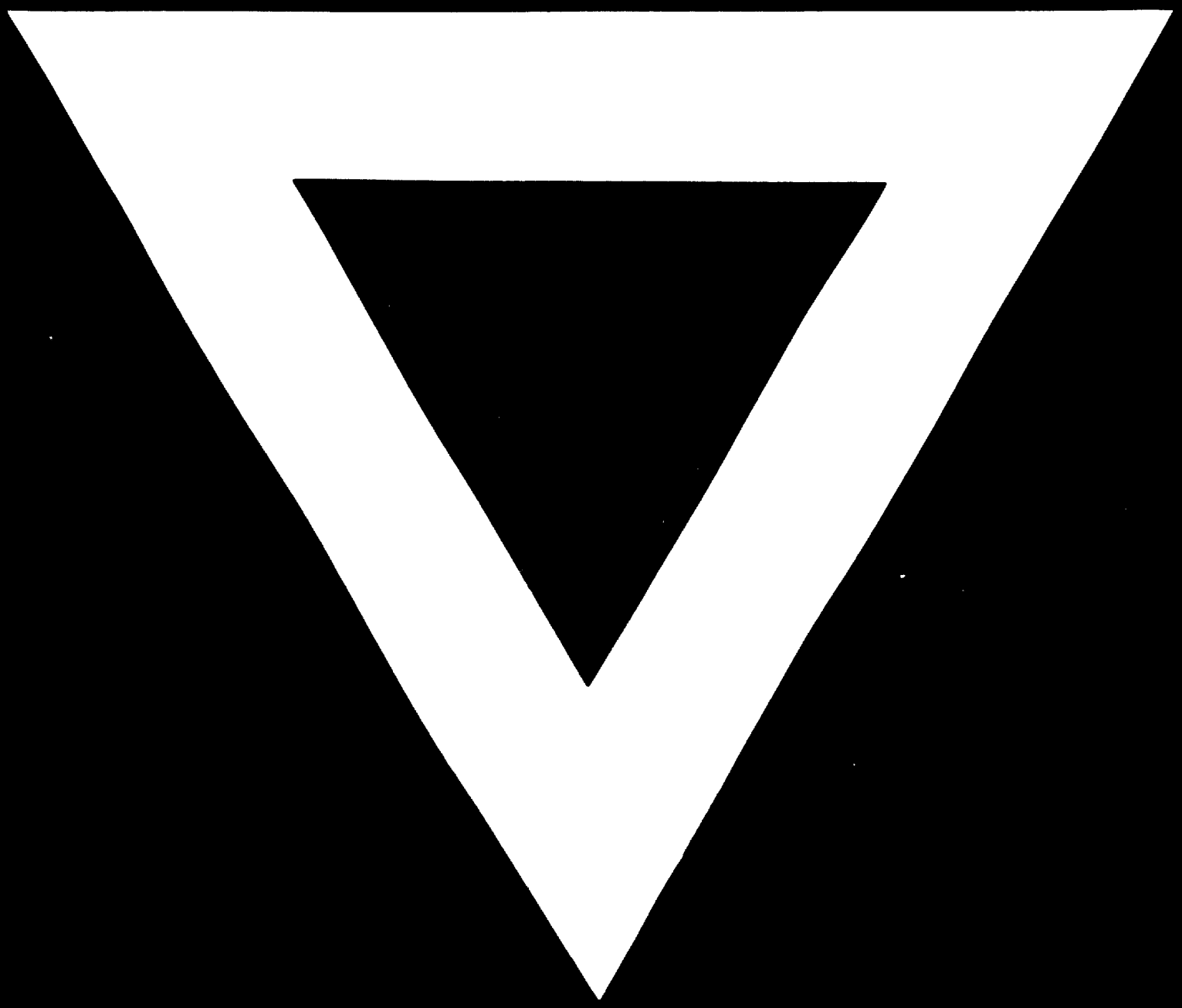
101. Provision is not made for the line to produce tin-free steel.

102. Fifty per cent of our production is lightly coated tin plate (less than 0.50 lb). Differentially coated tin plate represents 12 per cent.

103. There is extreme diversity of formats, with the format of 711 x 508 mm predominating and a clear tendency towards greater width and lesser thicknesses.

Conclusion

We would hope that the foregoing has served to give a clear idea of the development of tin plate production in Spain, and more specifically in our enterprise, together with the characteristics of our equipment, and the circumstances of its selection, installation and starting up. In any event, we remain at your disposal for any supplementary information you may require.



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