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by

A. Milara,
Poland

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MODERN LIGHT AND MEDIUM ROLLING MILLS FOR THE PRODUCTION OF SECTIONS FOR A VARIED MARKET[1/]

by

A. Mulars,
Poland

SUMMARY

The introduction contains a brief survey of the development of the Polish iron and steel industry and reference is also made to the place at present occupied by that industry on a world scale. Figures are given illustrating steel production before the Second World War, after the War and now. The development of the iron and steel industry is considered against the background of the country's industrialization during the post-war period.

The country's facilities for the production of a wide range of rolling mills is indicated and a number of mills constructed in Poland for export are cited as examples.

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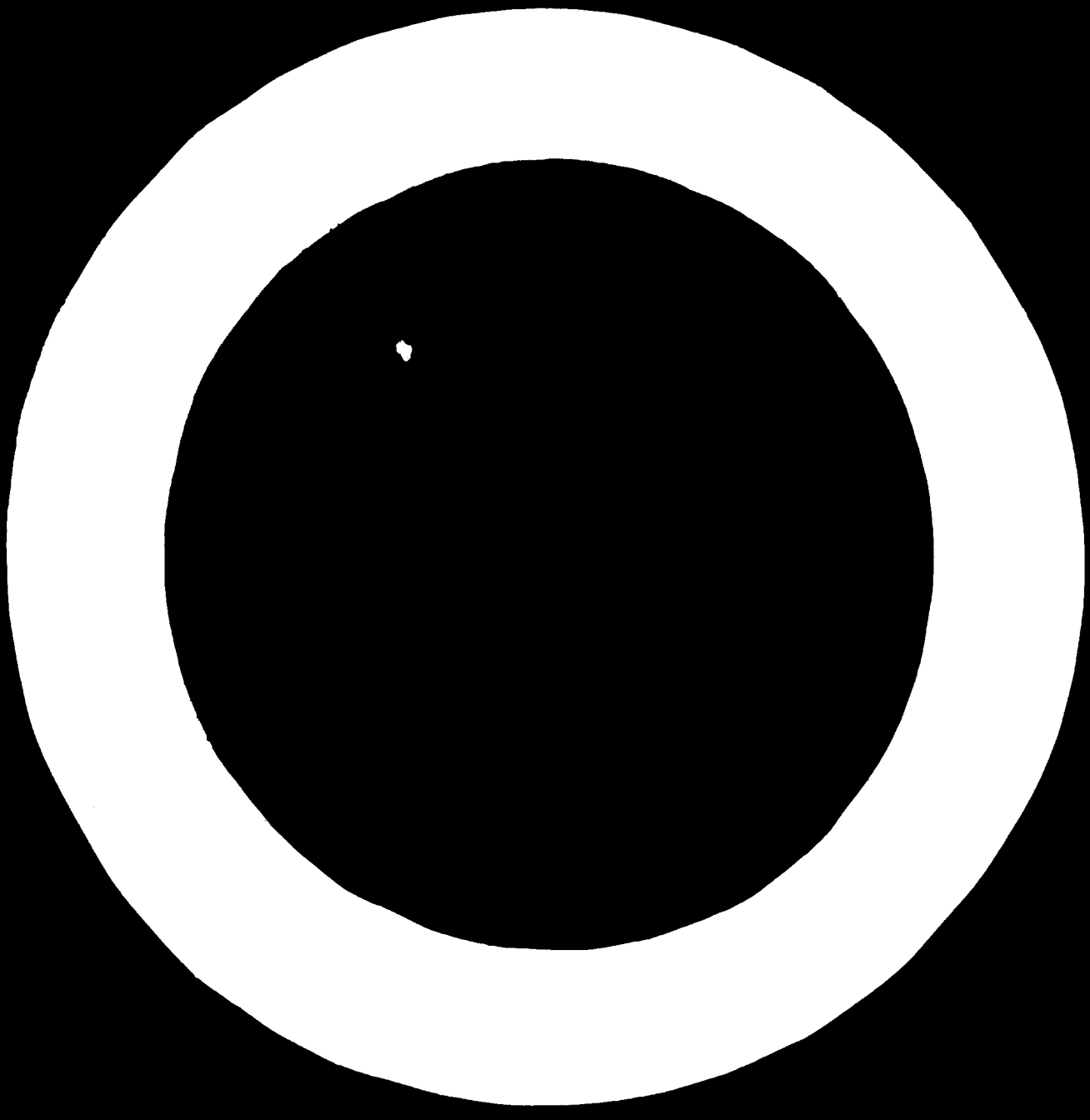

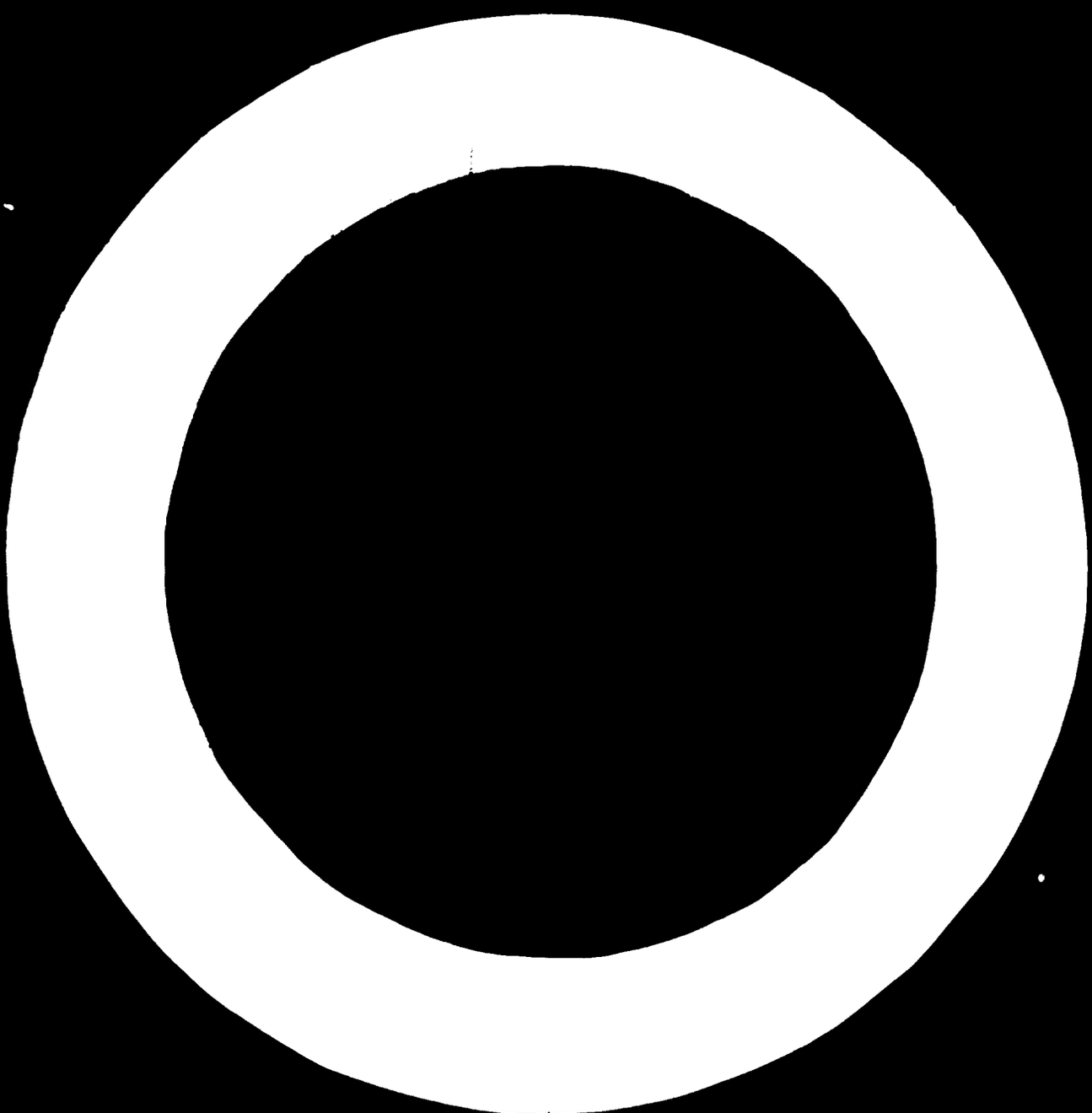

In the main part of the report, which contains descriptions of certain specific types of rolling mill which have been built, the author discusses various types of jobbing mill, medium-section mills and small-section mills.

These descriptions give details of the production schedule, the material processed and the production capacity of each mill, a brief description of the mill's equipment, and a description of the rolling plan and technology. The mills considered are such as may find possible application in the developing countries, in particular jobbing mills rolling high-quality steel according to an adaptable rolling plan and having a medium production capacity suited to a wide range of production requirements. Attention is also paid to the design of mills which can work in conjunction with the plants for the continuous casting of steel which are also being built in Poland and are discussed in another report.

In conclusion, the author lists all the services and supplies which could be offered to possible clients from the Polish side.

It is stressed that owing to the scale of its steel production, its experience in the development of its own iron and steel industry, and its present contacts with developing countries, Poland sees great prospects for consolidating fruitful collaboration with these countries.

The history of the Polish iron and steel industry goes back as far as ancient Roman times, when there was a large basin in the region of the Swientokrzisky mountains where iron was smelted. The iron and steel industry developed at a rapid pace during the period following the second World War, and in 1967 production of rolled sections exceeded 7 million tonnes.

Naturally, when operating on such a production scale, the metallurgical industry must co-ordinate with other organizations; accordingly, Poland has various research institutes, two large planning offices, several construction departments, and a number of engineering works, all to serve the needs of the iron and steel industry.

We are already constructing iron and steel works both at home and abroad with our own resources, and we have acquired considerable practical experience in building and operating rolling units or complete rolling mills equipped for the manufacture of small batches of rolled sections on a very wide production scale.

Let us now consider some of these rolling mills.

A typical example of a light/medium jobbing mill designed for rolling a wider assortment of bars from high quality steel on the multi-train system is the mill which we have made for export to Yugoslavia.

The basic production programme includes the rolling of round sections of a diameter of 10 to 60mm and corresponding square, hexagonal and octagonal sections, flat sections of dimensions ranging from 30 x 5mm to 150 x 20mm, flat ribbed bars for springs, and wire rod of a diameter of 6 to 20mm. The raw material from which these are rolled is in the form of billets 80 x 80mm, 100 x 100mm or 140 x 140mm square and 2 or 3 metres long. The production capacity under this programme is approximately 110,000 tonnes/year.

The rolling mill is equipped with two travelling furnaces, each with a capacity of 10 to 15 tonnes/hour and comprises: a 550mm diameter roughing train, consisting of four three-high stands and one two-high stand, driven by a common direct-current motor; a 300mm diameter intermediate train, consisting of seven variably-arranged two-high stands in two groups, driven by a common direct-current motor, and two 260mm diameter finishing trains, each consisting of two variably-arranged two-high stands, driven by a common direct-current motor.

All the roll stands are equipped with roller bearings. The stands of the intermediate and finishing trains are of the caseless type. All the stands are fitted with roller conveyors on the input side. Transport of material to and from the stands in the roughing train is mechanized through the use of power roller conveyors, tilting tables and rope transport devices in both upstream and downstream of the train.

The stands in the intermediate and finishing trains are likewise equipped with mechanized transport installations before and after the trains. The rolling mill is provided with three alternative ways of dealing with the rolled material. The sections rolled in the middle train are sawn into commercial lengths and transferred either into a mechanical cooler or into a rope-type cooler. The sections rolled in the intermediate trains are cut by flying shears into lengths to fit the cooler and are fed into a mechanical cooler or sent, without cutting, into a Garrett-type coiler.

The sections rolled in the finishing train are conveyed to a Garrett-type coiler and the coils are cooled horizontally in a hook-type cooler.

The finishing line is equipped with roller straighteners and also with straightener-cutters for straightening and cutting lengths of bar from the coils.

Despite its very wide production range, the rolling mill is almost completely mechanized and even partially automated. The use of travelling furnaces, roller bearings, sturdily constructed stands and roller drives for the stands ensures the manufacture of a high quality product.

Another type of medium- and small-section mill, a staggered mill for rolling bars from high-quality steel, is at present under construction at a Polish works.

This mill is planned to go into production this year. The main production schedule is for round bars 16-60mm in diameter and square, hexagonal and flat bars. The raw material is 100 x 100mm or 120 x 120mm billets up to 6 metres in length. Planned production capacity is about 250,000 tonnes/year.

The mill is equipped with two travelling furnaces and includes a 550mm diameter three-high first roughing stand driven by a direct-current electric motor and a continuous roughing train consisting of four 400mm diameter two-high stands, in N-U arrangement, driven separately by direct-current electric motors.

The intermediate train, arranged in a staggered pattern, consists of four 400mm and 350mm diameter horizontally-arranged two-high stands, driven separately by direct-current electric motors, and a continuous finishing mill, consisting of two 300mm and 280mm diameter two-high stands, in N-U arrangement, driven separately by direct-current electric motors.

Downstream of the last stand there are flying shears to cut the whole output into lengths to fit the cooler or commercial lengths.

Bars which require hot processing are cut by the flying shears into commercial lengths and then transferred to special equipment which delivers them to the pits for controlled cooling or to the furnaces for heat treatment. The remaining bars are passed to a roller cooler, downstream of which there are 800-tonne shears for cutting them to commercial lengths. The finishing mill has a wide range of equipment for heat treatment and other finishing operations.

The mechanical equipment is centrally lubricated with grease or oil as required.

The mill as a whole is predominantly mechanized and partially automated.

A small-section mill for rolling a wide range of bars, wire and hot-rolled strip from high-quality steel has been designed to operate on a semi-continuous basis. The basic production programme comprises round bars 10-20mm in diameter, square, hexagonal and flat bars, wire 5.5-22mm in diameter in coils weighing up to 450kg, and hot-rolled strip 70-300mm wide and 1.5-5mm thick.

The raw material for rolling the bars and wire is in the form of 100 x 100mm billets 3 or 6 metres long and weighing 225 or 450kg, while the hot-rolled strip is rolled from 100 x 100-230mm flat billets. The average production capacity under the mixed schedule is about 140,000 tonnes/year. The mill is equipped with two travelling furnaces with a production capacity of up to 30 tonnes/hour and includes a 500mm diameter first roughing train, consisting of two three-high stands 500mm in diameter, driven by two direct-current motors through a gear drive and single reduction gearing; a 350mm diameter continuous roughing train with 6 rolling stands and three 400mm diameter edgers; a continuous finishing train for hot-rolled strip, consisting of two four-high 280 and 500mm diameter rolling stands driven separately by direct-current motors, and a set of finishing equipment for rods, bars and wire, consisting of 7 two-stand rolling trains of variable arrangement, driven by direct-current electric motors.

Only one type of main-drive motor is used throughout the whole mill.

The roughing-train stands are mechanized through the use of power roller conveyors, manipulators and transfers upstream of the train and tilting tables and power roller conveyors downstream of the train. The roller conveyor linking the first roughing train to the continuous roughing mill is equipped with flying shears of the oscillating type to crop the ends of the bars.

The finishing train stands for bars and wire are likewise mechanized by the use of power conveyors upstream and downstream of the train. The train is provided with three material reception intakes.

After being rolled in four-high stands the hot-rolled steel passes to coilers which have a vertical axis of rotation. The resultant coils are pushed onto an apron conveyor, from which they are removed after cooling by a four-armed doffing system, to be hoisted by crane to the coil store.

After being rolled in the finishing train, the bars pass along the roller conveyor to the flying shears. After being cut into lengths to fit the cooler they pass along another roller conveyor into a mechanical cooler. After the cooler they are cut to commercial lengths by 350-tonne shears, while wire is passed to Garrett-type coilers. The coils are then hooked directly onto a hook-type cooler, through which they pass in a horizontal position. On emerging from the cooler they are seized by a four-armed rotating doffing system, from which they are hoisted by crane to the coil store.

The design of the mill, together with the sturdy construction of the rolling stands, which are equipped with roll bearings (except for the roughing train stands) and roller devices, ensures a high quality of production.

The plant is almost entirely mechanized and partially automated. The mechanical equipment is centrally lubricated with grease or oil, as required. Scale is removed from the rolling installations by water pressure. Before the heated billet passes to the first stand, it is descaled by water at a pressure of 100 atmospheres. This mill has been working since 1964 at a Polish steelworks.

Another type of small-section mill designed by us is one for rolling small bars and sections from carbon steel. The production programme of this mill is for round bars 12-28mm in diameter, bars of various other cross-sections, flat bars from

20 x 6mm to 30 x 10mm and angle sections 30 x 30 x 4mm. These products are rolled from 180 x 180, 160 x 160 or 140 x 140mm billets 1.3m long or from ingots weighing 250kg.

The output of the plant varies from 11 to 25 tonnes/hour depending on the production schedule. The mill is equipped with two continuous furnaces each having a maximum capacity of 15 tonnes/hour, and comprises a roughing train consisting of two 550mm diameter three-high rolling stands driven by a common alternating-current motor, an intermediate train consisting of three 380mm diameter three-high rolling stands driven by a common direct-current motor, and a finishing train consisting of five 280mm diameter two-high stands in variable arrangement, driven by a common direct-current motor.

After being cut by one of the two flying shears into suitable lengths, the rolled bars are cooled in a mechanical cooler, after which they are cut into commercial lengths by 200-tonne shears. The delivery of billets to the roughing train stands is mechanized through the use of power roller conveyors, manipulators and transfers upstream of the train and tilting tables and power roller conveyors downstream of it. The delivery of billets to the intermediate-train stands and the finishing train stands is also mechanized through the use of conveyors upstream and downstream of the train.

The capital investments required for this mill are low, there is a high degree of mechanization, and the mill is suitable for working in conjunction with a continuous casting plant. Coupled with such a plant, a mill of this type, using large-section billets, will provide a relatively cheap means of converting steel into a wide range of rolled products.

I should like to mention at this point that plants for the continuous casting of steel are also being constructed in Poland. A separate report is being presented on such plants.

We are at present building a small-section mill for one of the Arab countries. This mill is designed for rolling small bars, sections and wire from carbon steel. The production schedule covers round bars 10-25mm in diameter, bars of various other cross-sections, angle sections, channel sections, etc. and wire 6-10mm in diameter in coils weighing up to 225kg. The starting material is billets 80 x 80 or 100 x 100mm square and 3 or 6 metres long, weighing up to 450kg. The production capacity of the mill is about 75,000 tonnes/year with double-shift working.

The mill, which is equipped with one continuous furnace, comprises a 500mm diameter three-high first roughing stand driven by an alternating-current motor, a continuous roughing train consisting of six 350mm diameter two-high stands driven by two or three direct-current motors, and a finishing mill for bars consisting of two or three 350mm diameter rolling trains in variable arrangements and one 260mm diameter two-high two-stand rolling train of variable arrangement driven by a direct-current motor.

The finishing train for wire is of the continuous type and consists of six 260mm diameter two-high rolling stands driven by two direct-current motors.

The delivery of billets to the roughing stand is mechanized through the use of power roller conveyors and manipulators upstream of the stand and a tilting table downstream of it. Downstream of the continuous roughing mill there are flying shears to crop the ends and to cut the bar in an emergency.

The delivery of billets to the finishing train stands for bars is mechanized through the use of conveyors upstream and downstream of the train. When the rolling operation involves extracting the whole bar from the rollers, delivery of the bar is mechanized by the use of power roller conveyors and transfers. The rolled bars, after being cut by flying shears into suitable lengths, are then passed along a roller conveyor to a mechanical cooler, on emerging from which they are cut to commercial lengths by 250-tonne shears. Wire is coiled on Garrett-type coilers into coils weighing up to 225kg and is then hooked onto a hook-type cooler. The coils leave the cooler in the horizontal position and are taken up by a four-armed doffing apparatus, from which they are hoisted by a crane into the store.

The caseless stands used in the mill are of sturdy construction. This, together with the use of roller bearings and roller devices, ensures high-quality production. The mechanical equipment is centrally lubricated with grease or oil, as required. The mill is almost entirely mechanized and partially automated.

My last example of a type of small-section mill is one with a low level of mechanization and low production capacity, but with a relatively wide range of products, designed for rolling small bars, sections and wire from carbon steel. The production schedule covers round bars, 20-28mm in diameter, bars of various other cross-sections, flat bars (25-50) x (6-12)mm, small sections, and wire 6-10mm in diameter.

The raw material for these sections is in the form of billets 65 x 65 x 1500mm and 75 x 75 or 100 x 100 x 2000mm, and the capacity of the mill varies between 2 and 6 tonnes/hour depending on the production schedule.

The mill is equipped with a coal-fired continuous furnace (throughput up to 6 tonnes/hour) and comprises a roughing train consisting of two 420mm diameter three-high stands driven by a common alternating-current electric motor and a finishing train consisting of five 280mm diameter two-high rolling stands of variable arrangement driven by a common alternating-current electric motor through two-speed reduction gear. Billets are delivered to the roughing section manually, using suspended tongs. The finishing-train stands are fed manually in rolling operations where the entire bar is extracted from the rolls, but feeding is partly mechanized by means of a conveyor system downstream of the rolls when carrying out to-and-fro rolling.

Wire is coiled on Garrett-type coilers designed to take coils weighing up to 100kg.

The bars and sections are passed to a cooler. At the specific request of the pruchaser the cooler has been made in the form of a stationary lattice and the roller conveyors are not powered. Downstream of the cooler are 100-tonne shears for cutting the bars to commercial lengths. This mill has been made for export to India.

In using these examples to illustrate our experience in the design and construction of rolling mills, I wish to stress that they do not exhaust all our possibilities in this field.

We are also in a position:

- to provide expert advice and technical consultations, technical documentation (basic data, specifications, technical projects and working drawings),
- to supply the necessary equipment for plants,
- to install plants and bring them into operation,
- to train staff,
- to pass on our experience.

The manufacture and supply of plant and equipment may cover a large number of different items. In agreed cases particular components, units and design details

which are normally comprised in the supply of a complete set of equipment may be omitted from the manufacture and supply schedule. Here also this is a question of co-operation in drawing-up the plans and making and supplying the equipment.

I should like to stress yet again that in view of the scale of Polish steel production, our experience in the development of our own iron and steel industry and our current contacts with developing countries, we see excellent future prospects for further consolidating our fruitful co-operation with these countries.

May I conclude by expressing the hope that this report may be of some help to us in attaining this purpose and thanking all those present for their attention.

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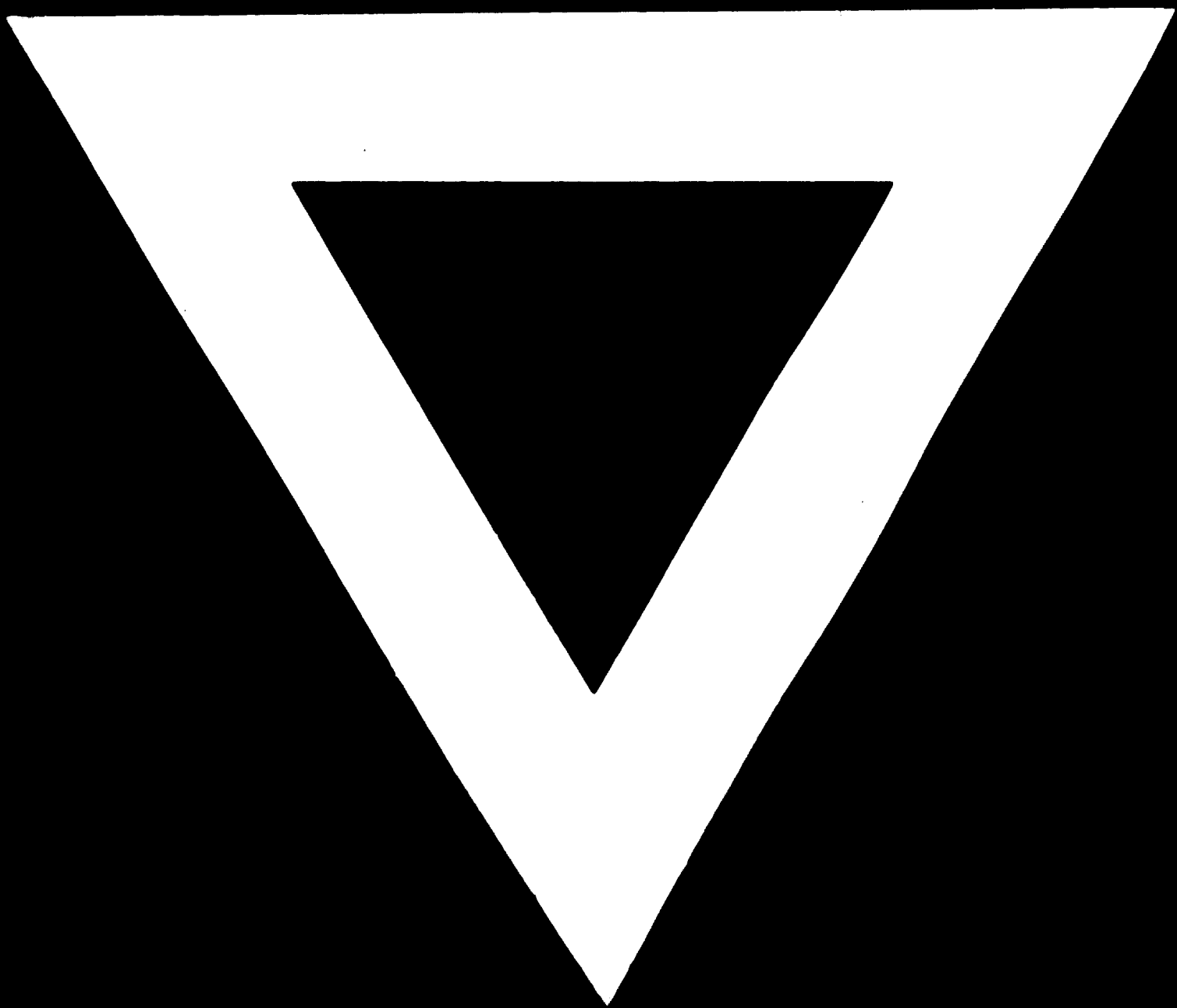

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