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SUMMARY

SOME ASPECTS ON THE CHOICE OF ASBESTOS CEMENT MACHINERY 1/

by

K. Thiele,
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Aalborg, Denmark

With a background of [illegible] in the A/C industry, it is the intention [illegible] the factors [illegible] influence the choice of machinery for this industry, [illegible] the conditions [illegible] country.

The following points [illegible]:

1) A [illegible].

2) Little [illegible] industry will [illegible] first under experienced [illegible].

3) It will probably be of importance to [illegible] of different products [illegible] demand of [illegible].

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[illegible] [illegible] [illegible] explosive [illegible] [illegible] [illegible] been erected, [illegible] [illegible] [illegible]. Special care must also be [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] cement in [illegible] [illegible].

b) Special attention should be given to [illegible] [illegible] [illegible] [illegible] [illegible] [illegible], [illegible] available.

c) [illegible] [illegible] [illegible] [illegible], it [illegible] be advisable to [illegible] [illegible] [illegible] of the products and suitable [illegible] of obtaining [illegible].

[illegible] has [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] of this [illegible] [illegible].

The conclusion [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

[illegible] [illegible] [illegible] [illegible] Co. [illegible], [illegible] [illegible] [illegible] [illegible] [illegible] used.

With a background of practical work in direct production in the A/C industry, it is the intention to present some views on the factors which influence the choice of machinery for this industry, especially regarding the conditions of a developing country.

The following points are an attempt to summarize these conditions:

1) A serious lack of capital, particularly hard currency.

2) Little or no technical knowledge and background which implies that creating an industry will necessitate a systematic training of workers and personnel, at first under experienced guidance.

3) It will probably be of importance to be able to produce a large array of different products to cope with the many demands of an expanding society.

4) One must foresee a possibly explosive development once a plant has been erected, and this again should influence plant layout, choosing the location etc. Special care must also be given to the transportation and handling problems which the asbestos cement industry imposes.

5) Special attention should be given to the possibility of using other fibre materials than asbestos, where such are available.

6) If this fibre material is of cellulose origin, it will undoubtedly be advisable to foresee some sort of surface treatment of the products and suitable means of obtaining this

At this point, before discussing the merits and drawbacks of the different types of machines available to the manufacturer, it will be useful to look at the types of products being made by the industry.

Roughly these consist of:

A) Hand-moulded product. In a very large variety made from flat sheets by cutting them to the desired dimensions, and forming them over a mould. The joining process is accomplished simply by wetting the edges and working them together with a wooden hammer or the like. These items can easily in one of the [illegible] or be made in several thousand different sizes and shapes, and often create storage and handling problems.

B) Flat sheets with thickness varying usually from 3 mm to 25-30 mm. More or less sophisticated pressing and cutting processes are involved, and the industrialization of the old building [illegible] an ever increasing demand for stricter tolerances. These [illegible] used for cladding purposes.

C) Corrugated sheets. [illegible], one and the same plant will make at the most 3 or 4 different profiles if not working for export. The lengths of the sheets usually will vary between 2' and 10', [illegible] and 8', however, being the most common lengths.

D) Pipes which divide into 3 categories:

a) [illegible] hand moulded.

b) Low pressure pipes for irrigation purposes, building and sanitary use etc. The length is here usually 3 or 4 metres, and internal diameter [illegible] to [illegible] mm. These pipes may be manufactured with or without sockets.

c) High pressure pipes. These are almost always made without sockets, and the standard lengths are 4 or 5 metres. Internal diameters are usually from 100 mm up to 1,000 mm. The complexity - and price - of the machines that make this type of pipes are far higher than for the former one.

Which [illegible] available for making these products [illegible]

1) The [illegible] material for both flat and corrugated [illegible] hand-moulding.

2) The [illegible] machine which produces corrugated and flat sheet, but will not provide a very suitable material for hand-moulding.

These [illegible] judge to be the only ones to come into [illegible] bearing the specific conditions of a developing country in mind, and I shall therefore limit myself to treat these two [illegible] broadly.

However, [illegible] two new principles of producing [illegible] have appeared that should be mentioned because of their ingenuity and boldness of concept.

3) One [illegible] extrusion process, developed and patented by the American firm Johns-Manville. By adding a so-called hydro-[illegible] to [illegible] of cement, asbestos and water, the material obtains such characteristics that it may be extruded in [illegible] for example the plastic industry does. The products are then cured as usual or autoclaved and obtain properties comparable to ordinary A/C material. In this manner, a vast field of entirely new products are possible which certainly no other method can provide. Although this process is [illegible] an early stage of evolution, and still must cope with children's diseases, my personal feeling

is that it is here to stay and may well one day revolutionize the industry.

4) The other one is the ISPRA way of doing things. This Italian firm has evolved new methods for the actual forming of the A/C products, either by injection of slurry into a mould or by the so called 3 SPV method by which the [illegible] is sucked up on a form. This raw material is then compacted by an ingenious method, using pressurized water through a rubber sleeve system. These production methods are also continuously being improved and will undoubtedly carve out their place in the industry, especially in the field of products now hand-moulded.

5) Finally one method stands out alone due to the use of the raw materials in a dry state. This subject has been treated in various patents by the American firm Johns-Manville, among them especially US patent Nos. 2,[illegible],216 of [illegible] 1945 and 2,444,762. The method essentially consists in that a mixture of fibre and cementitious material is spread on a moving belt, compressed and wetted with the necessary amount of water for hydration, and then finally obtaining the desired finish by applying a veneer of some sort, using embossing rollers.

This method is used in several plants for the manufacturing of decorative panels, shingles and siding sheets. Although the strength of this type of material is far smaller than the material produced by the wet methods and, of course, especially the Hatschek method, it has the significant advantage: the ability to incorporate, in principle, any type of fibre. I therefore cannot either free myself from the thought that here we may have a method which in one way or the other could be applied in the field we are dealing with.

However, all true production men are by nature somewhat conservative and cautious, and I shall therefore continue with the more orthodox and well-proven methods.

The sheet machines I think will be well taken care of when we concentrate on the numbers 1 and 2, and the methods for making pipes should now be mentioned.

The two best known and most widely employed methods for making A/C pipes are:

1. The Mazza method
2. The Magnani method

The first one is characterized by using in principle the same method of picking up the A/C raw material as the Hatschek machine.

The Magnani method differs in this, the material distribution being accomplished in principle by means of gravity.

Although each method has its merits and drawbacks which are mostly discussed among the manufacturers and sales people of pipe machines, the rest of the pipe making procedure is in fact quite similar in both cases. As my own experience comes from working with Magnani pipe machines, I shall therefore use this type as subject without in any way inferring any negative view of other machines - simply lack of practical knowledge hereof.

<u>Sheet making</u>

It is natural to mention the Hatschek machine first. Although invented at the turn of the century, there has been no significant change in the basic working principles, but nevertheless, it still plays a dominating role in the industry. The evolution has rather been directed towards an automatization of the cutting, forming and handling operations to reduce manual labor. However, more recently, efforts have also involved devices for controlling the actual production process by regulating slurry preparation and consistency, forming pressure, the rates of flow, temperatures etc. Compared with the enormous degree of automatization in the paper industry, I would estimate the A/C industry to be 1o-15 years behind.

The dominance of the Hatschek machine is due to its extreme versatility. Even in its simplest and cheapest form - with only one vat - it is possible to produce both flat and corrugated sheets and hand-moulded goods with a production of 3o-4o tons per day. Furthermore, this simple one cylinder machine may be gradually improved and developed, adding first one, the another vat, automatic slurry preparation, automatic corrugator etc. Thus, production may be increased to beyond 13o tons per day.

An example of the simple Hatschek machine is shown in the annexes 1, 2, 3, 4 and 5. Annex no. 1 shows a typical project drawing and plant layout, No. 2 the corresponding technological diagram, and No. 3 is the machine reference list. Nos. 4 and 5 are production tables, giving the expected production rates at various combinations of the parameters and different calculation figures.

With reference to the project drawing a short description of the plant is given in the following:

The asbestos is manually fed to the edgerunner (1), weighed in bags and transported to the hollander (2). The cement is presumed to arrive in bags, and together with the asbestos it is fed manually to the hollander. The water is taken from the recuperation cone (7). When the slurry is ready, it is pumped to the slurry mixer (3) by the centrifugal pump (4) placed in a pit underneath the hollander. Here the final adjustment of the water contents of the slurry takes place.

From the agitator the slurry is pumped to the open slurry distributor (5) which is provided with an overflow back to the mixer. This results in a constant slurry level in the distributor, and consequently a constant rate of feed to the vat. The backwater along with the water coming from the recuperating cyclones (1[illegible]) goes to the pit underneath the sheet machine, from where it is pumped to the recuperation cone. This cone is provided with a partition wall to ensure sedimentation of the asbestos and cement particles, while the purified water overflows to the spray water tank (8). From here a high pressure centrigugal pump feeds the water sprays of the sheet machine.

The size roller is provided with a cutting device that may be operated either manually or semiautomatically, in which case the device is adjusted in accordance with the desired number of revolutions of the roller. The board is trimmed to width on the belt conveyor (12) by means of the trimming device (13), thus rendering unnecessary further operations of this kind. Trimming to length is accomplished when the cross conveyor (14) moves over the conveyor belt. The wet trimmings continue with the belt, and by means of a wheel barrow returned to the hollander.

The cross conveyor is provided with three suction boxes, one plane and two corrugated. The corrugating process is manual and takes place on the corrugating waggon (15) in its outer position. The corrugated steel templates are returned after the stripping process cleaned and oiled from the oiling machine (21) to the feeding position underneath the cross conveyor. The waggon receiving the corrugated A/C sheets and the templates after being stacked is traversed to the curing chamber (7) and then manually stripped.

Without going into details about prices of the separate items, the following table will give a rough idea:

		Appr. price in US$
I	Slurry preparation system	39,000
II	One vat Hatschek sheet machine	60,000
III	Various accessories for the Hatschek machine	4,000
IV	Band and cross conveyors	41,000
V	Sheet transport system	16,000
VI	Steel templates	30,000
VII	Oiling and cleaning device for steel templates	15,000
VIII	Electrical equipment	25,000
IX	Erecting expenses (50% of the price of mechanical and electrical equipment) ..	115,000
X	Plant building (75$/sq.m.)	80,000
	Estimated capital investment US$	425,000

This figure does not include site for buildings, cost of freight, procurement of raw materials for the running in period, setting up workshop facilities etc.

In comparison the equivalent investment figure for erecting a modern 3 vat Hatschek plant would amount to about 1,1 million $, of which approx. 175,000 $ are due to machines and electrical equipment. Although the modern Hatschek machine would be a very interesting subject to go into, I doubt whether it would be advisable to start up a new plant with such an advanced machine. This of course is due to two main reasons. First, more than one million dollars even nowadays is quite a lot of money to raise, and secondly, the difficulty in obtaining sufficiently skilled labor for such a project at the initial stage.

The simple one vat machine, as described, on the other hand in my opinion should be "the best buy" on the market.

The reasons for this are given below:

a) The capital expenditure is reasonable.

b) Its output is flexible and will allow for the types of products in demand. Flat sheets may be produced at a later stage [illegible] a modest investment in additional machinery of uncomplicated nature.

c) The tasks involved in running the machine are relatively uncomplicated and simple and will provide excellent education [illegible] for later more demanding types of work.

d) It is often difficult to foresee, which products will be a success in a given country. Here one gets a solid knowledge of the market conditions before venturing into buying more specialized and expensive machines.

The only drawback is that the Hatschek principle is not very suitable for the use of any non-asbestos fibres. This is due to the fact that the lamination is only 0,2-0,3 mm, and cruder fibres will unavoidably give an unsatisfactory surface, which again necessitates a pressing operation.

However, it is well known that one may produce Hatschek sheets of excellent quality containing cellulose fibres. These sheets may contain anywhere from 5-10% plus 5-15% of cellulose, according to the desired properties of the sheet. It must be remembered, though, that the type of cellulose used for this purpose is not much cheaper than lower grades of asbestos, and anyhow requires the installation of a hydropulper or similar equipment. During the last war, when it was difficult - if not impossible to obtain asbestos in many countries, a production of sheets containing only cellulose fibres was taken up out of need. In Denmark, for example, we still have some intact roofs from that period.

Thus it cannot be denied that sheets containing cellulose based fibres may be used for exterior purposes. But it must be considered a recognized fact that serious problems arise from the swelling and shrinkage properties of these fibres, due to the unavoidable variations in humidity.

One viable way to counteract this is to use a surface coating of some sort. With the enormous growth of the plastic industry during the last decades many new products have evolved and a host of these claim to be "fit" for treating asbestos cement material.

Two categories of these products, however, seem to stand out, namely the paints based on acrylic resin and on chlorinated rubber compounds, due to among other reasons their relative high alcaline resistance. Conversely it must be emphasized that the one-sided application of a layer of a more or less impenetrable nature gives rise to another difficulty, namely warping and, in colder countries, also frost damage.

One interesting possibility should perhaps also be mentioned in this connection, namely the one of coating cellulose based fibres with organic or inorganic substances to render them more stable. This idea is not new, in Denmark, for example, there is a patent No. [illegible] from 1942 on this subject and the preceding German one from 1939. To my knowledge, however, the idea at that time did not meet with success, but with the great steps taken since then in plastics, it might be worth trying again.

To summarize, it seems possible for the Hatschek machine to produce a sheet, based primarily on fibres of cellulose origin, providing that they have been subjected to a mechanical treatment (defibration, hydropulping and such). Fibres of a cruder nature in my opinion would not be suitable for the Hatschek machine.

As mentioned, the other type of sheet machine I shall comment on is the one developed by the late Italian inventor, Dr. ing. A. Magnani.

The basic working principles of this machine is explained in Annex No. 6. The prepared slurry is pumped to the back and forth moving distributor, and the crude sheet is then calendered and afterwards cut and stacked. The dewatering process is accomplished through the felt by means of the underlying suction boxes. From this short description the two principle advantages should nevertheless be obvious. One is the simple and rugged construction of the machinery, which manifests itself through a decisively better run-factor in comparison with the more complicated Hatschek machine. The other one is the ability to manufacture so-called close nesting profiles by applying more material in crown and valley.

Annex 7 further brings a more detailed layout of a Magnani sheet factory, annex 8 being the corresponding machine reference list. Annex 9 is a technological diagram of the process, and annex 10 gives different calculation figures of interest.

With reference to the project drawing, annex 7, a short description of the plant is given:

Cement transport. The drawing carries a steel bin for cement (9) with two air sluices (11) from which the cement goes through a vibration screen (12) to the cement feed bin with maximum and minimum indicators. The scales is fed by means of a feed screw (13), which is automatically regulated from the scales. The cement transport system is dedusted by means of a filter (8) on the top of the cement bin.

Asbestos preparation. The asbestos is treated in a continuously working edgerunner (6), and it is advisable to ensure a proper mixing of the various types of asbestos before treatment in the edgerunner. The emptying of the asbestos bags is accomplished by placing the open bags on the pneumatically operating bag emptier, which is controlled from the corresponding panel (7). From this panel the addition of water may also be regulated.

Slurry preparation. The cement and the opened asbestos are dosed by means of the automatic weigher. The two raw materials are transported to the continuously working mixer (16) by means of a double flight mixing screw (15). The addition of water takes place in the mixer, and the slurry is led to a feeding trough with agitator, from which it is pumped to the slurry distributor by means of the centrifugal pump (17), on its way passing through the refiner (19). The water contents of the slurry is automatically regulated by the regulator device (18).

The Magnani sheet machine. The sheet machine (21) consists of an endless band of vacuum boxes. These boxes are provided with the profiled, perforated lids, which support the proper felt. The felt is formed by a moulding device to fit the profile of the lids. The slurry distributor moves back and forth, building up the sheet, which is gradually dewatered and then calendered by the back and forth moving calender station. The vacuum pump (23) is connected to the vacuum lids by means of the cheeks, which support the box band. Side trimming is accomplished by means of two rotating cutting discs, and an automatically operating knife trims the sheet to length before it goes to the pneumatic transport table (27). A decomposer (28) receives the wet trimmings, which are returned to the recuperating cone. The endless felt is washed by means of a whipper underneath the machine before returning. The cross conveyor (29) picks up the green sheets and stacks them alternating with form sheets, normally 3 green sheets for every one template. The waggon carrying the finished stack is transported, either by pushing or by truck to the curing chamber, and after curing stripped on the automatical stripping device (32). The operation of the sheet machine and stripping device etc. are controlled from the panels (7).

A normal production rate of this machine is 2000 corrugated sheets of a length of 2500 mm, corresponding to a felt speed of approx. 5 m per minute. However, felt speeds better than 6 m per minute may be achieved under favourable conditions. The max. length of the sheet is here 3000 mm.

Without going into details about prices of the separate items, the following table will give a rough idea:

		Approx. price in US$
I	Cement transport system	15,000
II	Asbestos treatment	50,000
III	Slurry preparation	25,000
IV	Magnani machine with mechanical equipment	220,000
V	Stripping section	40,000
VI	Electrical equipment	45,000
VII	Erecting expenses (30% of the price of mechanical & electrical equipment)	95,000
VIII	Plant building (75$/sq.m.)	210,000
	Estimated capital investment US$	500,000

The production rate of the modern Magnani machine under favourable conditions will attain close to 150 tons per day. Besides corrugated sheets of any desired profile the production of flat sheets is possible too. One significant property of the Magnani material should be mentioned here: the almost monolithic character of its structure, owing to the casting nature of the forming process. Due to this the unit bending strengths are lower than those of the Hatschek products, where the forming process exercises a beneficiary orientation of the fibres.

This fact, when making corrugated sheets, is roughly counterbalanced by the unique functional material distribution quality of the Magnani process. With flat sheets this, of course, is not the case, and experience shows that handmoulding with this material, although possible, is no success. Conversely it is completely feasible to make up to 50 mm thick sheets and even more, if desired. This fact, combined with the already mentioned casting nature of the Magnani process could be suitable for utilizing non-asbestos fibres of far larger variety than the Hatschek process.

Another interesting field is due to the relative ease of introducing reinforcing structural elements not possible in other continuous processes, even iron rods and the like.

In short I do not hesitate to recommend the Magnani machine as one of particular interest in the motley field we are treating, but it must be stated that although, of course, there has been done a certain amount of work in this direction, fare more lies ahead.

Pipemaking

Undoubtedly most developing countries have a great need of pipes to transport both the raw products and the by-products of a dawning industrialization. I shall not go deeper into the merits or disadvantages of the A/C pipes in comparison with competing products, but simply state as a fact that the A/C pipe has earned its well deserved place on the market.

A plant for making high pressure pipes is an expensive affair, and the necessary capital investment for erecting a fully equiped factory would be approx. US$ [illegible],000, of which US$ [illegible], alone is due to the mechanical and electrical equipment. (The mentioned prices are for a [illegible] pipe plant).

Even though it is possible to make light pipes on most of the modern machines of this sort, I nevertheless would recommend starting up with a small plant for making low pressure pipes for much the same reasons as stated under sheet making.

There are, of course, many well known manufacturers of pipe machines, all having their stronger and weaker points. The only reason for my choosing the Magnani pipe machine is, as already mentioned, that I know it well from my daily work.

The working principles employed are illustrated in annex No. 11. The annexes 12 and 13 show the layout of a pipe plant, annex 14 being the corresponding machine reference list. These drawings, however, show two pipe aggregates making respectively 3 and 4 m pipes, whereas the price estimates following briefly refer to only one 3 m aggregate with the necessary installations.

A short description of the illustrated pipe plant based on the layout drawing is given here:

The asbestos is fed to the disintegrator (2) by means of the sack emptier (1) and the opened fibre sucked up underneath the cyclone (3). Two fans (5) provide the necessary air, and dedusting takes place in the filters (4). An edgerunner (6) ensures the final opening and mixing of the fibres, which is then weighed on the scales (7) and emptied into the screw conveyor (8). The cement received in bulk is extracted from the bin (10) through the air sluice (11) and continues through the vibrating screw (12) to a screw conveyor (8) that feeds the scales (7). In the turbo mixer (13) water is added, and the ensuring slurry is pumped to the feeding trough (14) maintaining continuous agitation. From here the slurry is pumped to the pipe moulding machine (17), the first of the three units constituting the proper pipe aggregate. A canvas-clad, hollow steel mandrel under suction forms the inner surface of the pipe, while the outer profile is formed by means of a rotating roller, supported by transversely moving bearings. These permit adjustment of the roller in accordance with the increasing thickness of the A/C pipe, resulting also in a certain compression of the material. The travelling crane (21) carries the steel mandrel with its green A/C pipe to the calender (18), where final compression takes place, also under suction, provided by the vacuum pump (16). The finished A/C pipe is finally taken by crane to the hydraulically operated extracting machine (19). After extraction, wooden plugs or mandrels are inserted to prevent deformation of the somewhat soft pipe. A smaller electric hoist (22) places the green A/C pipe on the roller table (23) for pre-curing during approx. 16 hrs.

The final curing process takes place in the maturing basin (25) normally during 3-7 days, after which the pipes are trimmed and cut to exact measure in the lathelike cutting machine (27).

Not shown is the almost mandatory pressure testing machine and storage areas.

The following price estimate will include essentially the same types of machines as described above, however, it is assumed that the plant is erected in connection with an already existing factory, having the facilities for preparation of asbestos and slurry. Also the cranes and hoists have been excluded, as well as the wooden plugs and mandrels and parts for the pre-curing table, from the assumption that these parts may be procured locally.

The items included thus consist of:

	Approx. price US$
1 pipe moulding machine 1 calender 1 extraction device all for 3 m pipes 1 stirring device for A/C slurry 1 hydraulic accumulator for variable load 1 hydraulic pump unit for operation of pipe machines 1 water-ring vacuum pump 1 cyclone device for separation of water and air 1 centrifugal pump for transport of dirty water	43,000
1 set of steel mandrels, 24 altogether, allowing for the manufacturing of 50, 60, 80, 100, 125, 150, 175, 200, 225, 250, 275 and 300 mm pipes 1 set of necessary moulding rings for moulding roller and calender rollers 1 supporting waggon for transport of steel mandrels	21,000
Electrical eqipment for the above items	6,000
Total capital investment in machines US$	[illegible]

On the pipe plant it is possible to manufacture 3 m long light pipes in accordance with ISO recommendation R-392: Building and sanitary pipes in asbestos cement, type A, with or without sockets.

The average production capacity of the 3 m aggregate is 9 tons per 24 hours, depending on the diameter of the pipes to be made. In comparison a 4 m aggregate will produce 12 tons and a 3 m machine for making pressure pipes [illegible] tons per 24 hrs.

Three men in [illegible] shifts are needed to run one [illegible] aggregate for low pressure pipes, and another [illegible] men will be necessary for trimming, pressure testing, transport etc during daytime.

* * *

Feasibility Survey

In the preceding pages a general review has been given of the different types of machines used in the asbestos cement industry.

However, before tackling the problem of choosing equipment for a specific project, a multitude of information should be available to the investor, in short a feasibility survey must be conducted. The following illustrates the range of questions involved:

Marketing:

What is the extent of the present demand, and how is it satisfied?

Will the market absorb the production of the new plant, or is it necessary to count on import restrictions?

Is the calculated sales price and quality competitive?

Has a distribution plan been set up?

Technical:

Has a realistic time schedule for construction and delivery of equipment been developed?

Have arrangements been made to obtain materials and supplies?

Has a training program been worked out, and are technicians and instructors available?

Do adequate transportation, power, fuel, water and other facilities exist?

Is the layout sufficiently flexible for rapid expansion?

Financial:

What is the nature of the plan to finance the plant?

Is capital available also for expansion?

Summary

Viewed with the eyes of a production man the author has endeavoured to give an outline of the most common types of machinery available to the manufacturer of asbestos cement products, and also a general idea of the economics involved in setting up a new plant.

An attempt has also been made to evaluate which are the stronger and weaker points of the different production methods, especially regarding the possibilities of utilizing other fibre materials than asbestos.

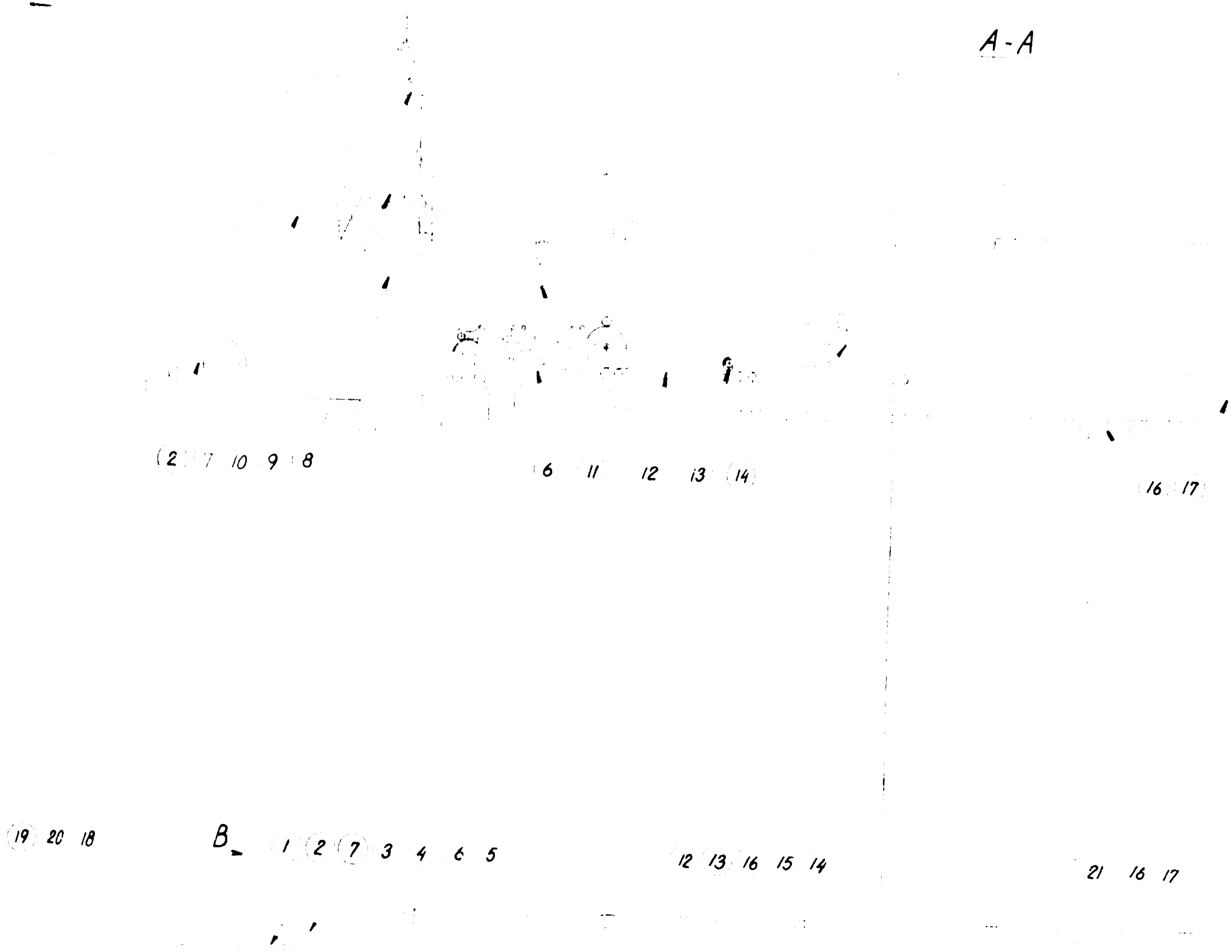
The conclusion to be drawn is that taking everything into consideration the simple one cylinder Hatschek machine in most cases should be the initial step. If, however, the project concentrates on using cruder non-asbestos fibres other types of production machinery seem more indicated.

Finally the author wishes to express his gratitude to the company F. L. Smidth & Co. A/S, Copenhagen, for ready cooperation received, and for having submitted much of documentary material used.

SHEET FACTORY FOR [illegible] AND CORRUGATED SHEETS.
PROPOSAL.

ANNEX I.

SECTION 1



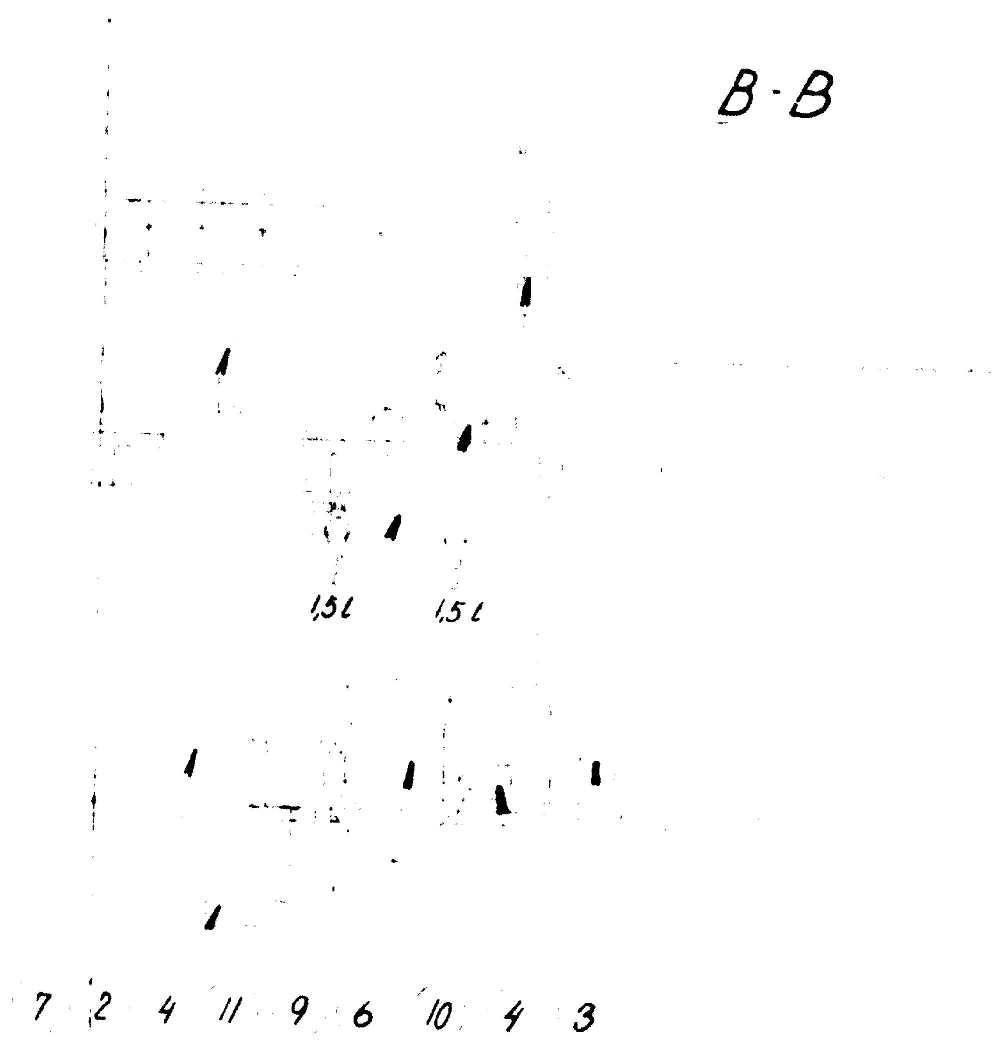
F. L. SMID

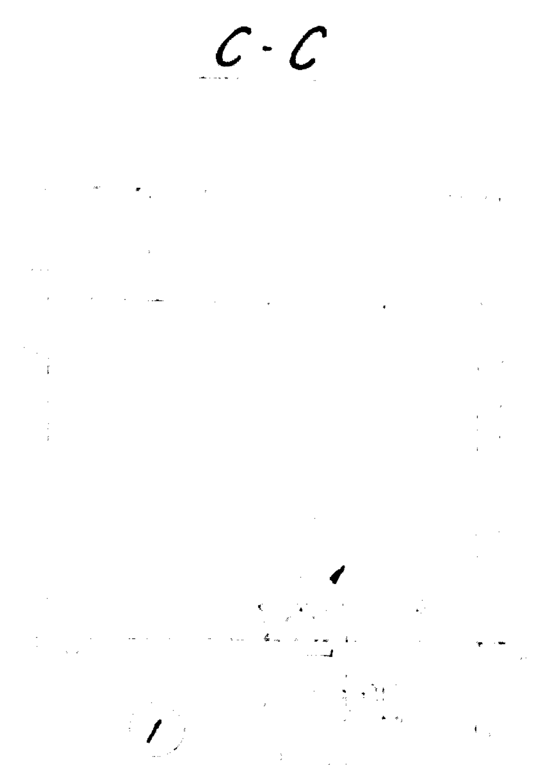
COPENHAGEN

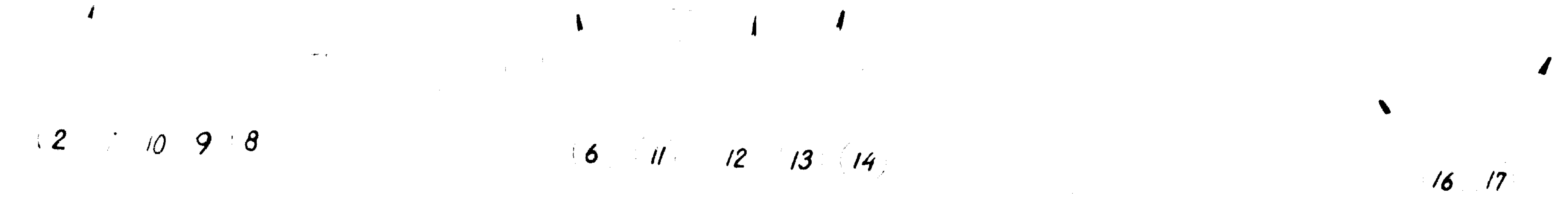
SHEET FACTORY FOR FLAT AND CORRUGATED SHEETS,
PROPOSAL,
No. [illegible]

ANNEX I.

SECTION 2



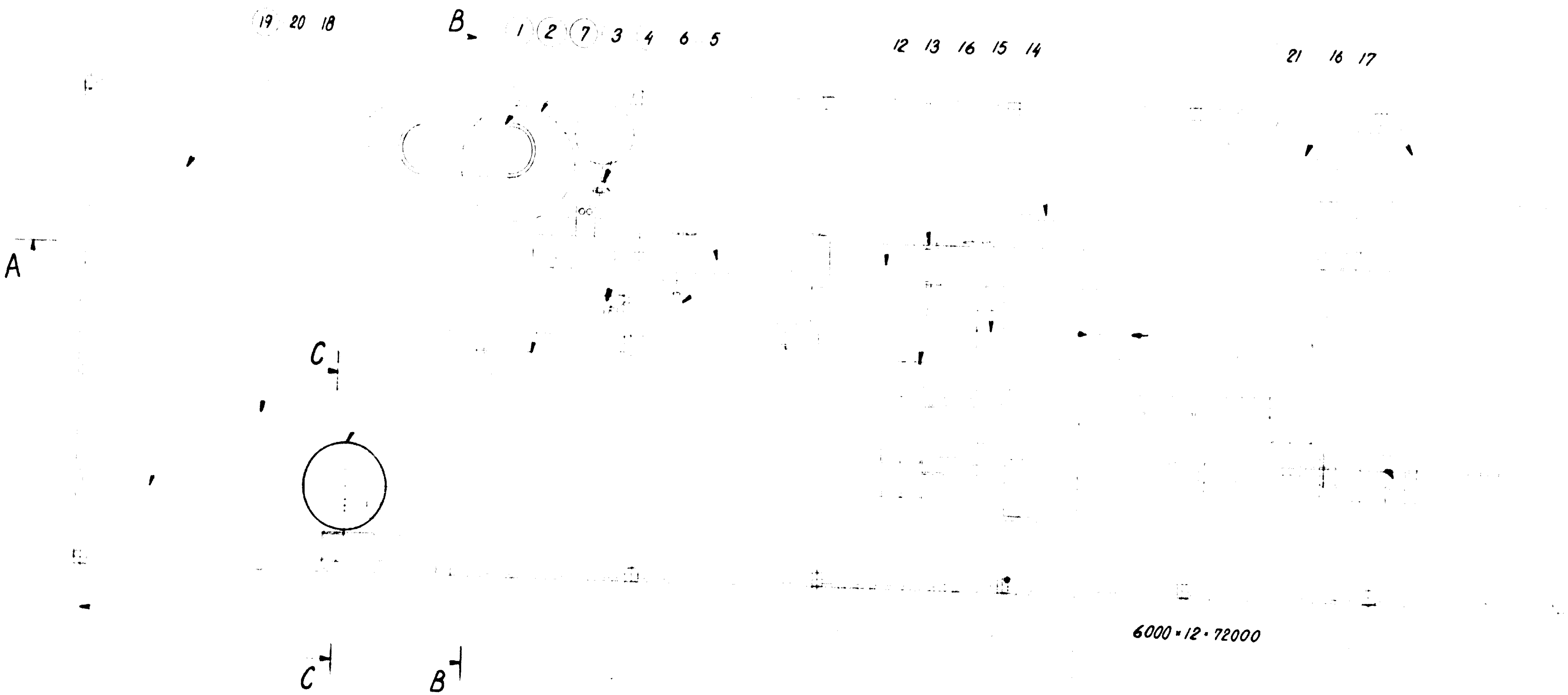




SHELL FACTORY FOR FLAT AND CORRUGATED SHEETS.
PROPOSAL.

ANNEX I.

SECTION 3



16 17

F. L. SMIDTH & Co A/S.
KØBENHAVN
COPENHAGEN COPENHAGUE

C-C

21 16 17

A

15000

SECTION 4

00 × 12 · 72000

For numbers see Machine Reference
List no 4 002438

Annex No. I

F. L. SMIDTH & CO. A/S, KØBENHAVN
COPENHAGEN COPENHAGUE

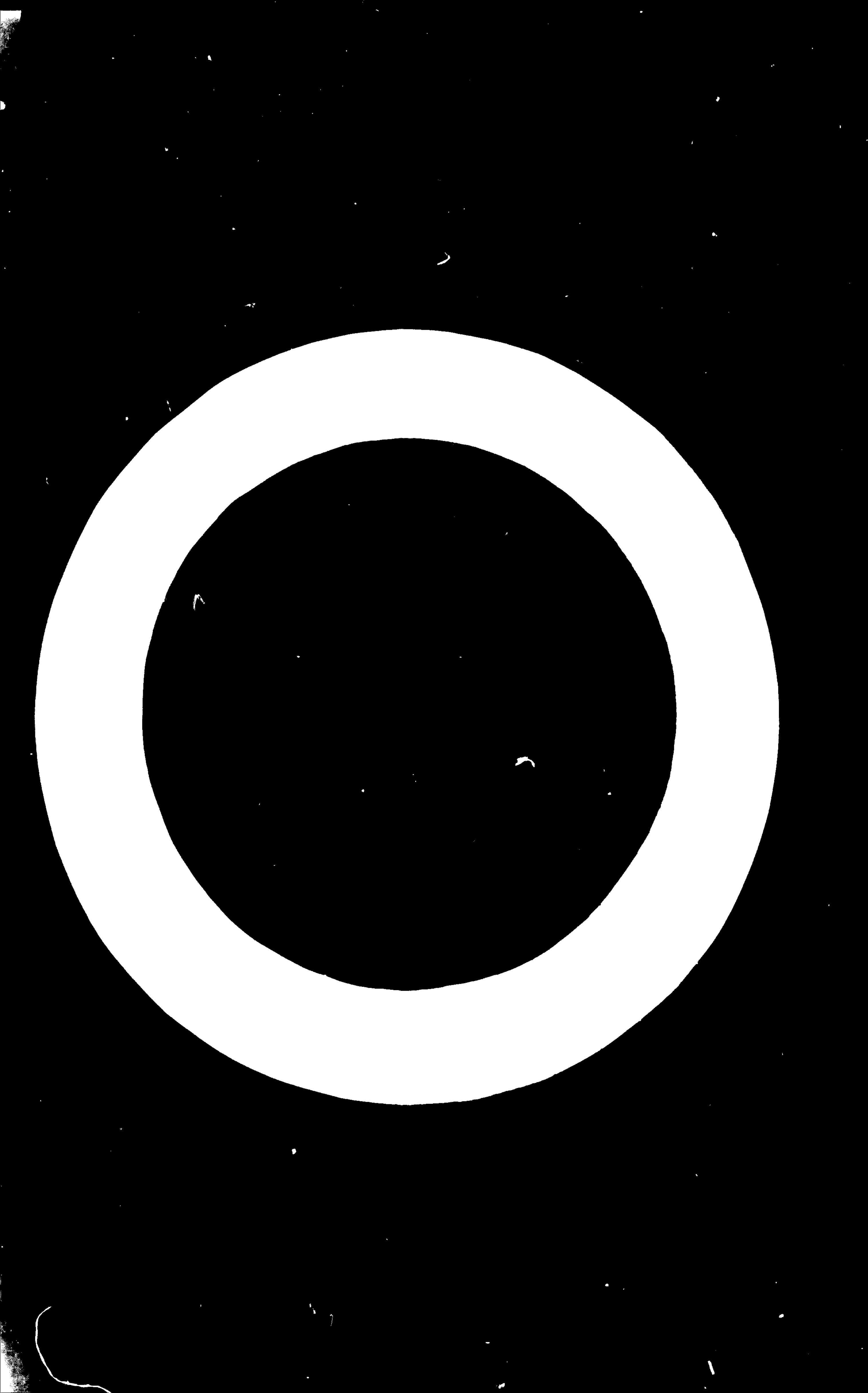
Sheet Factory for flat and corrugated Sheets
Proposal

1:100 NO. 2.011034

Pure water
Slurry
Dirty water
Compressed air
C Compressor

Annex No. II

F. L. SMIDTH & CO. A/S, KØBENHAVN COPENHAGEN COPENHAGUE
SHEET FACTORY TECHNOLOGICAL DIAGRAM
NO 2011037



Annex No. 3

1. Edge runner
2. Hollander
3. Slurry mixer
4. Centrifugal pump
5. Slurry distributor
6. Hatschek sheet machine
7. Recuperating cone
8. Spray water tank
9. Vacuum pump
10. Recuperating cyclones
11. Travelling hoists
12. Conveyor belt for sheets
13. Side trimming cutters
14. Cross conveyor
15. Waggon for manual corrugation
16. Traverse pit
17. Curing chamber
18. Scales
19. Cement reception (not shown)
20. Asbestos reception (not shown)
21. Oiling and cleansing machine

Hatschek Sheet Factory Machine Reference List	F.L.Smidth & Co. 4.002458

One Vat Hatschek Machine

Production Table

Profile mm	Length mm	Width mm	Thickness mm	Weight of sheet kilos	Circumference of size roller	Cyclus time of [illegible]	Felt speed m/min.	Production/24 h. Run factor 0.85 m	No. of sheets	t	Run factor 1.0 m	No. of sheets	t	Template hardening time [illegible] hours on sheet/load
[illegible]7x51	3050	1100	6	40	37[illegible]0	20	45	3650	815	32,6	[illegible]	960	38,4	
	2440+ 1220			21,8 15,0					815 815	30		960 960	30,5 15,3	
	2130+ 1550			27,8 20					815 815	39		960 960	26,7 [illegible]	
x)	2x1830			23,9					1630	[illegible]9		[illegible]	[illegible]	(5[illegible]) [illegible]o
	1830+ 2x 915			[illegible] 11,0					[illegible] 1030	30		[illegible] 2[illegible]	22,[illegible] [illegible]	
	2x1830	1100	5	20	37[illegible]	25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	2x1830		8	32		12[illegible]		[illegible]	1225	[illegible]	[illegible]	[illegible]	[illegible]	
	2x1830	1100	6	2[illegible],9	3750	[illegible],5	55	[illegible]	[illegible]	47,6	[illegible]	[illegible]	5[illegible]	
		[illegible]3[illegible]		21,5						42,[illegible]			50,[illegible]	

Conditions: 1 sieve cylinder; 1 revolution of size roller ~ 1/3 mm sheet thickness ~ 15 rev. for 5 mm sheet
15 - - 6 - -
24 - - 8 - -

Max. felt speed: 55 m/min.

Corrugation of sheets partly manual ~ low cyclustime
(time of cyclus chosen according to felt speed)

x) Production: $\frac{45 \times 60 \times 24}{18} = 3600$ m/24 h ~ $\frac{3600}{3,75}$ ~ 960 sheets/24 hrs.

1 Cylinder Hatschek Sheet Machine Plant

Calculation figures

Estimated number of operators:

Per shift for running the machine:

1	for edgerunner
1	for hollander
1	for sheet machine
1	for band and cross conveyor
2 or 3	for [illegible]
2	for stripping and changing waggons
1	for relieving of operation personnel
9-1o	per shift

In addition a corresponding number of men will be required for handling asbestos and cement, transporting sheets and other products. Depending on the percentage of hand goods to be made anywhere from 1o to 3o men are necessary for this work. Further [illegible] fitter, 1 electrician and 1 or 2 foremen will be needed, making the total number of men in daytime from [illegible].

Estimated power consumption:

Total hp installed in sheet plant	2oo
Load factor	o,7
Effective hp	14o
Estimated daily maximum KVA load	19o

Estimated water consumption:

Theoretical water consumption with 2o-25% of water of crystallization and humidity in finished product at a production of 4o tons of sheeting: 8 tons of water or 1/3 cu.m./h. The practical water consumption will, however, be between 3 and 1o times this amount, depending on the recuperation facilities. Averagely a factor of [illegible] can be employed, i.e. 2 cu.m./h.

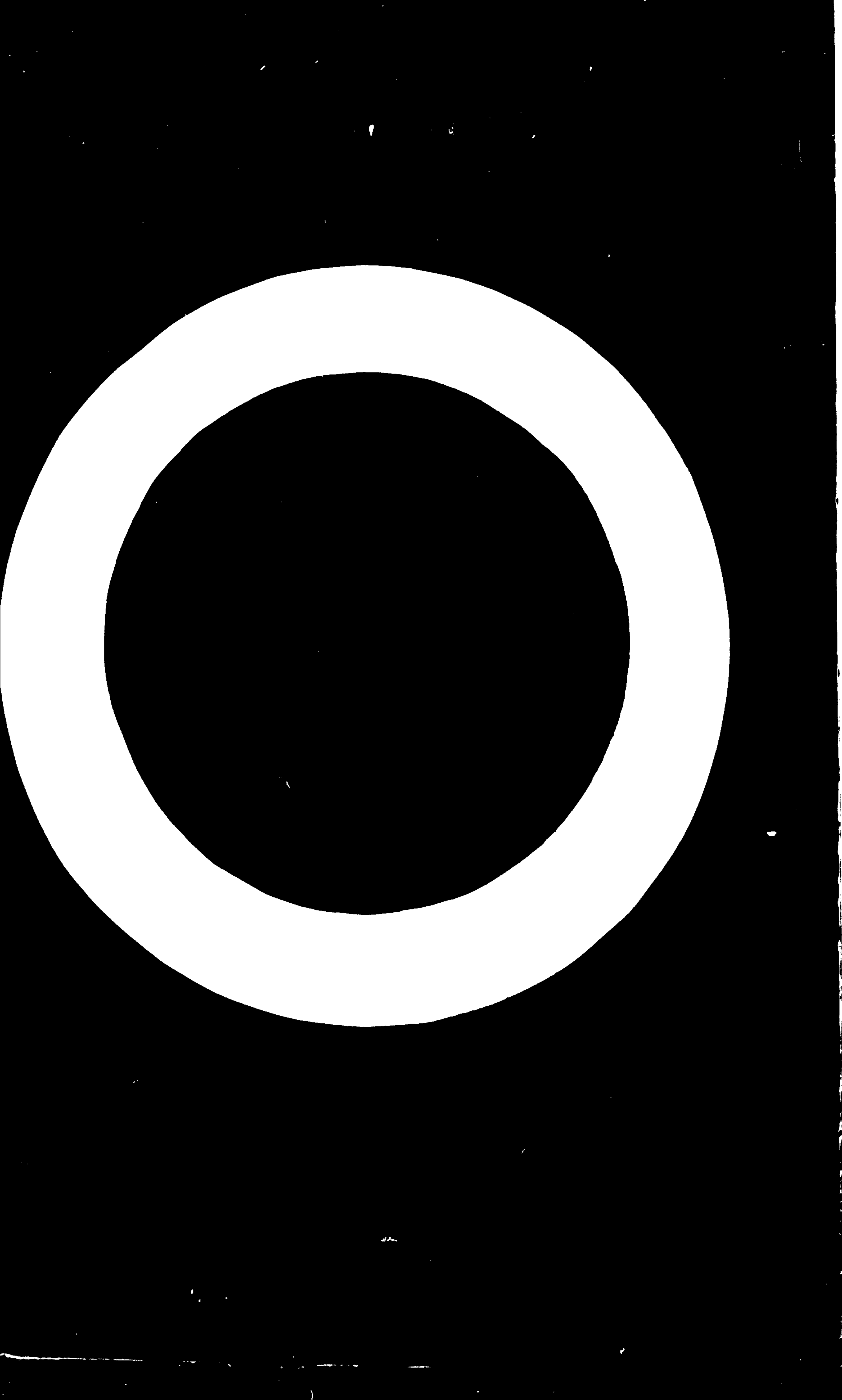
Thus, an overflow of waste water from the plant of about 2 cu.m./h containing o,o3% dry material will have to be calculated with.

Sheet store capacity:

Gross store area = 24 x 15 = 36o m^2
Storing capacity: 2,5 t/m^2 incl. of 35% for connecting roads
Sheets stacked on pallets: 3 x 1oo pieces
Daily production about 4o tons

Total store capacity: $\frac{360 \times 2{,}5}{40}$ = 25 days ≈ 4 weeks

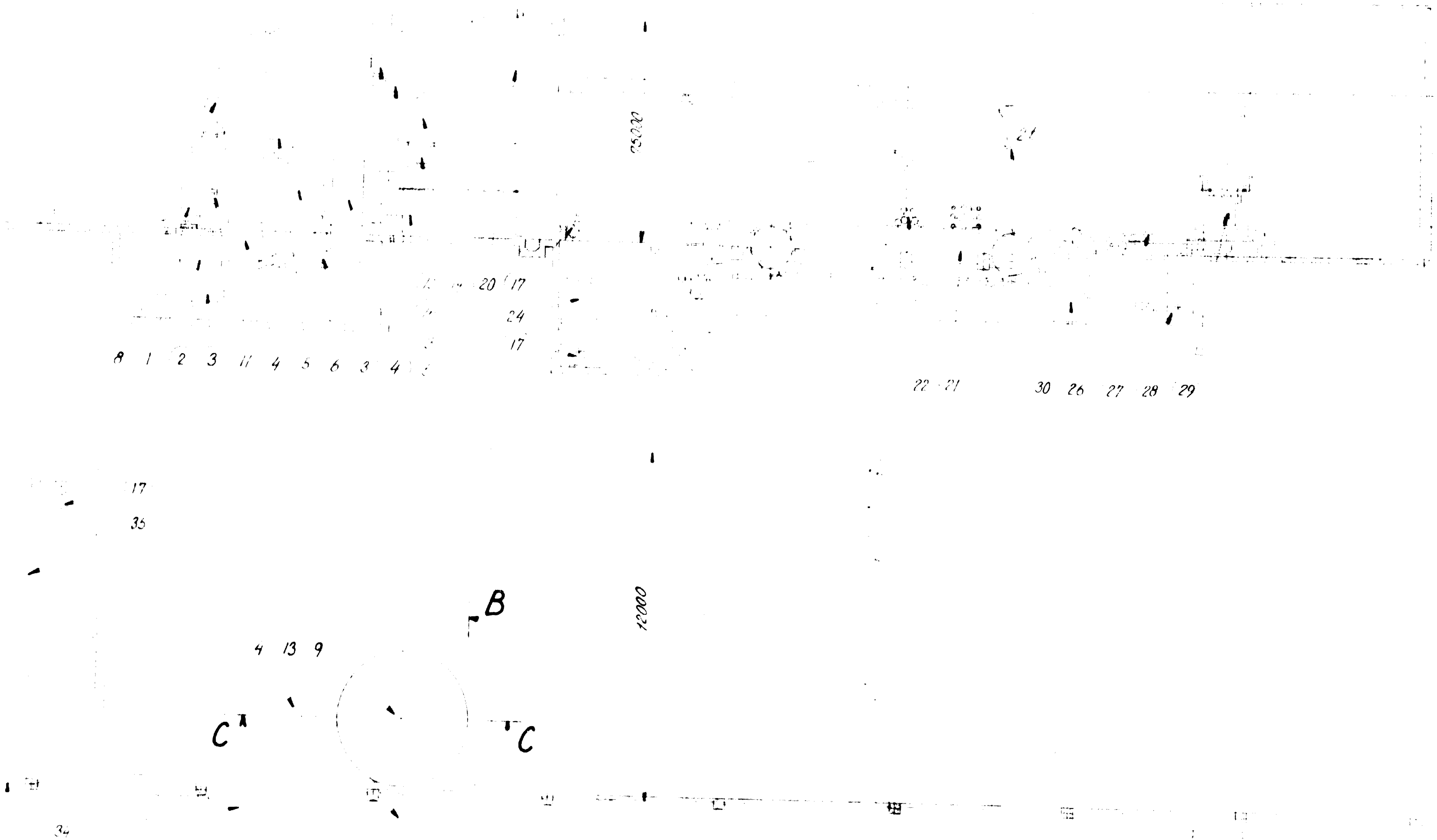
For hand moulded products the storing capacity is significantly smaller: o,3 - o,5 t/m^2



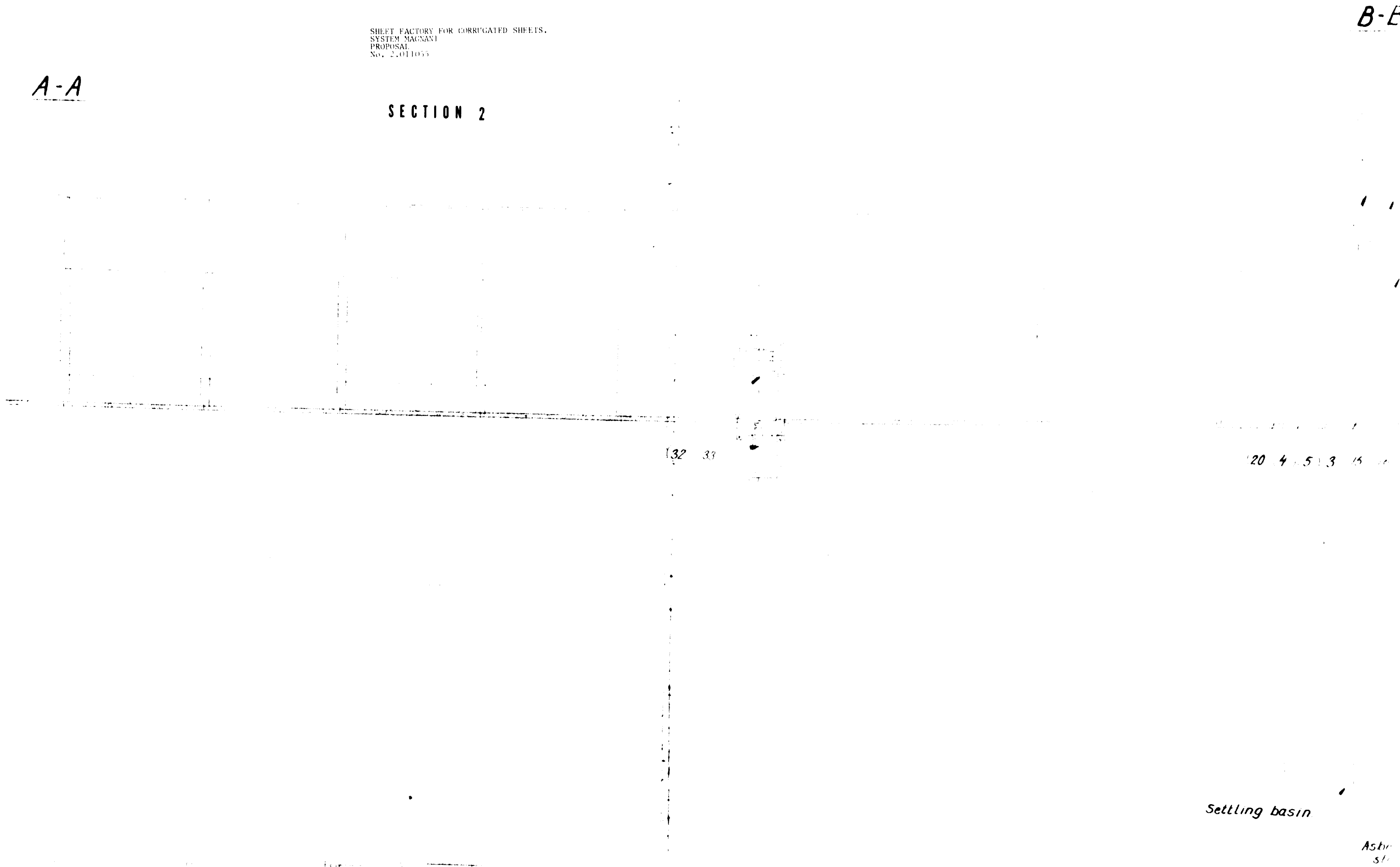
SHEET FACTORY FOR CORRUGATED SHEETS.
SYSTEM MAGNANI
PROPOSAL
No. 2.011055

SECTION 1

A-A

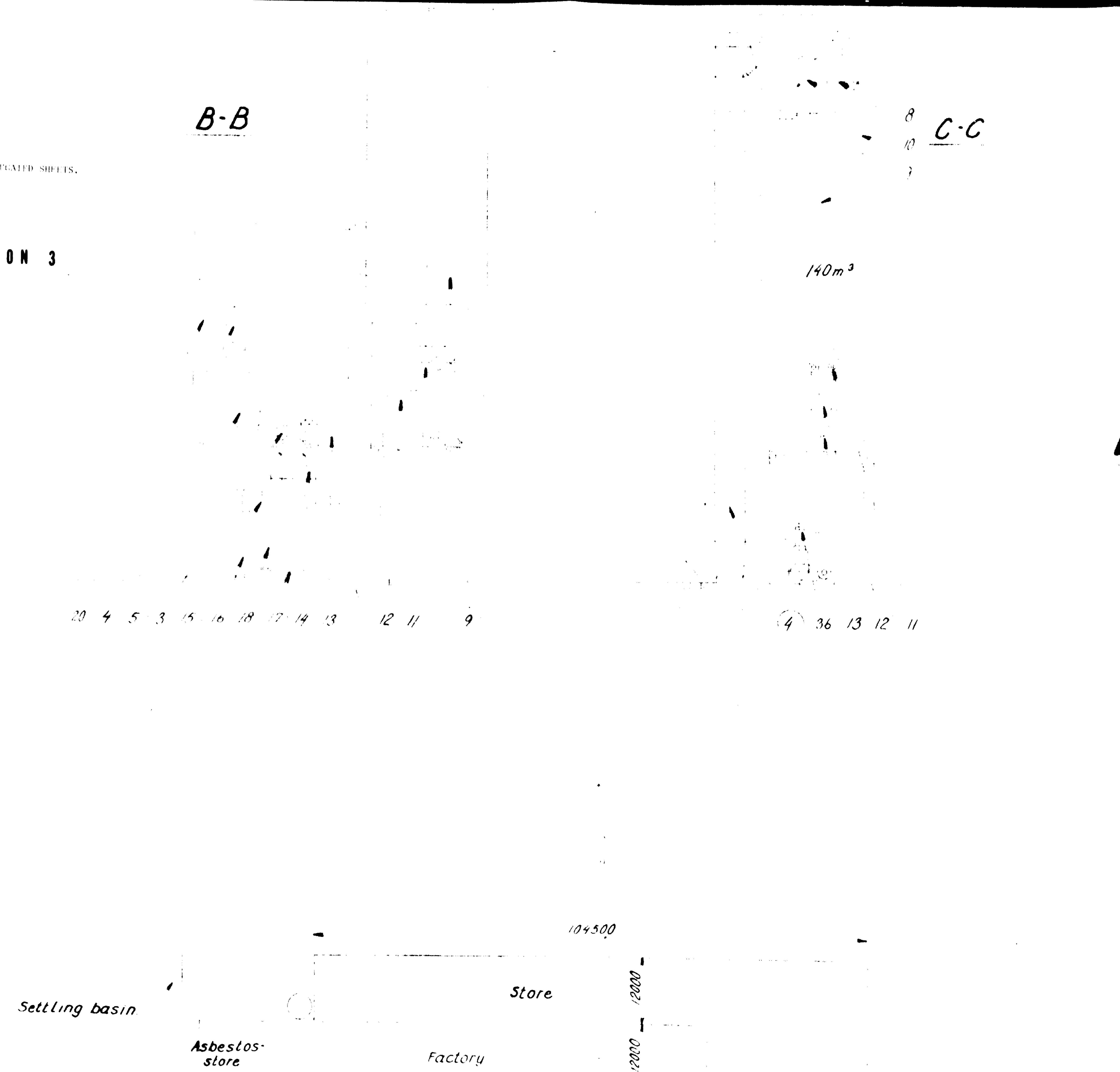


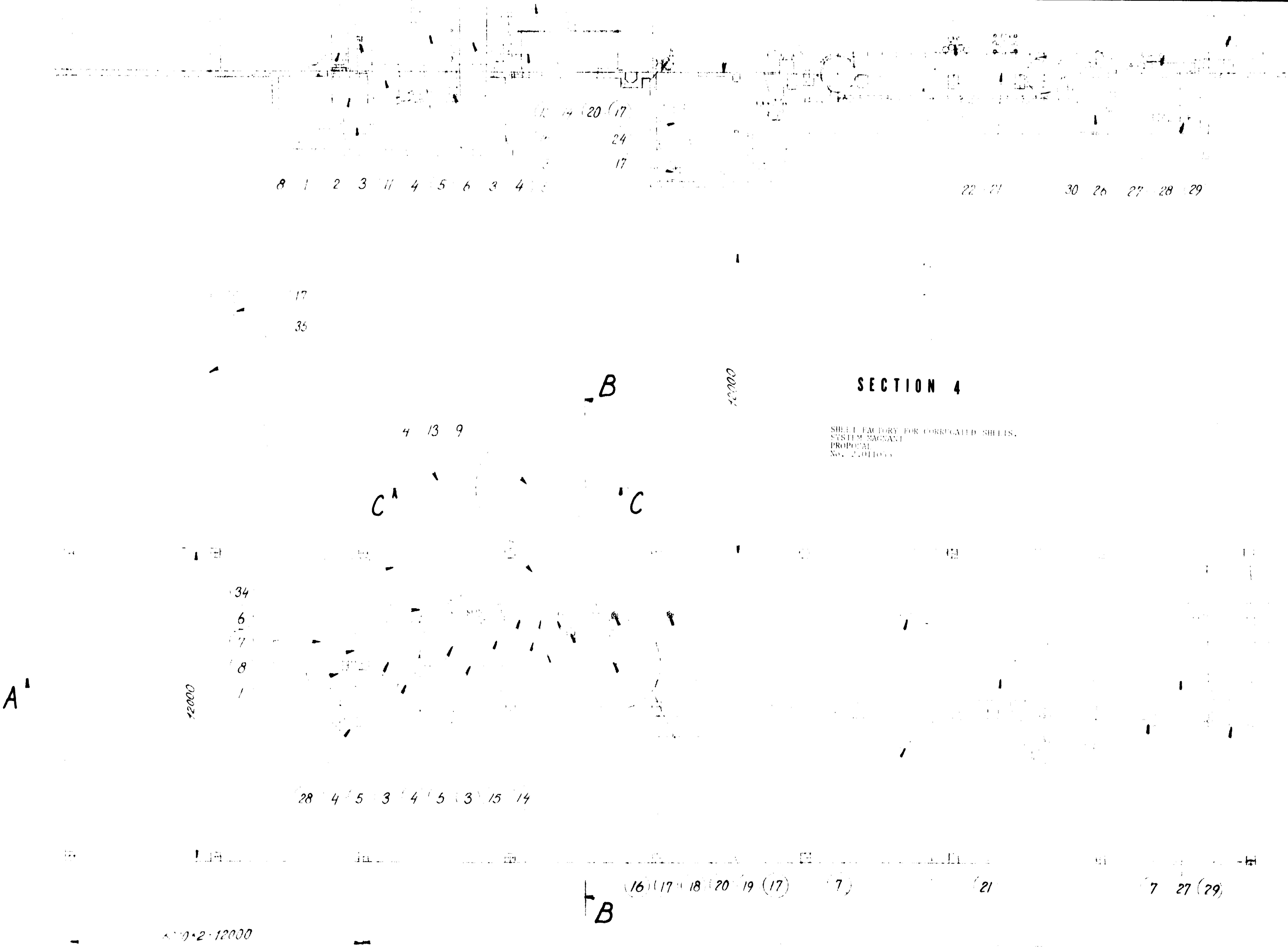
SECTION 2



SHEET FACTORY FOR CORRUGATED SHEETS,
SYSTEM MAGNANI
PROPOSAL
No. 2.01105

SECTION 3



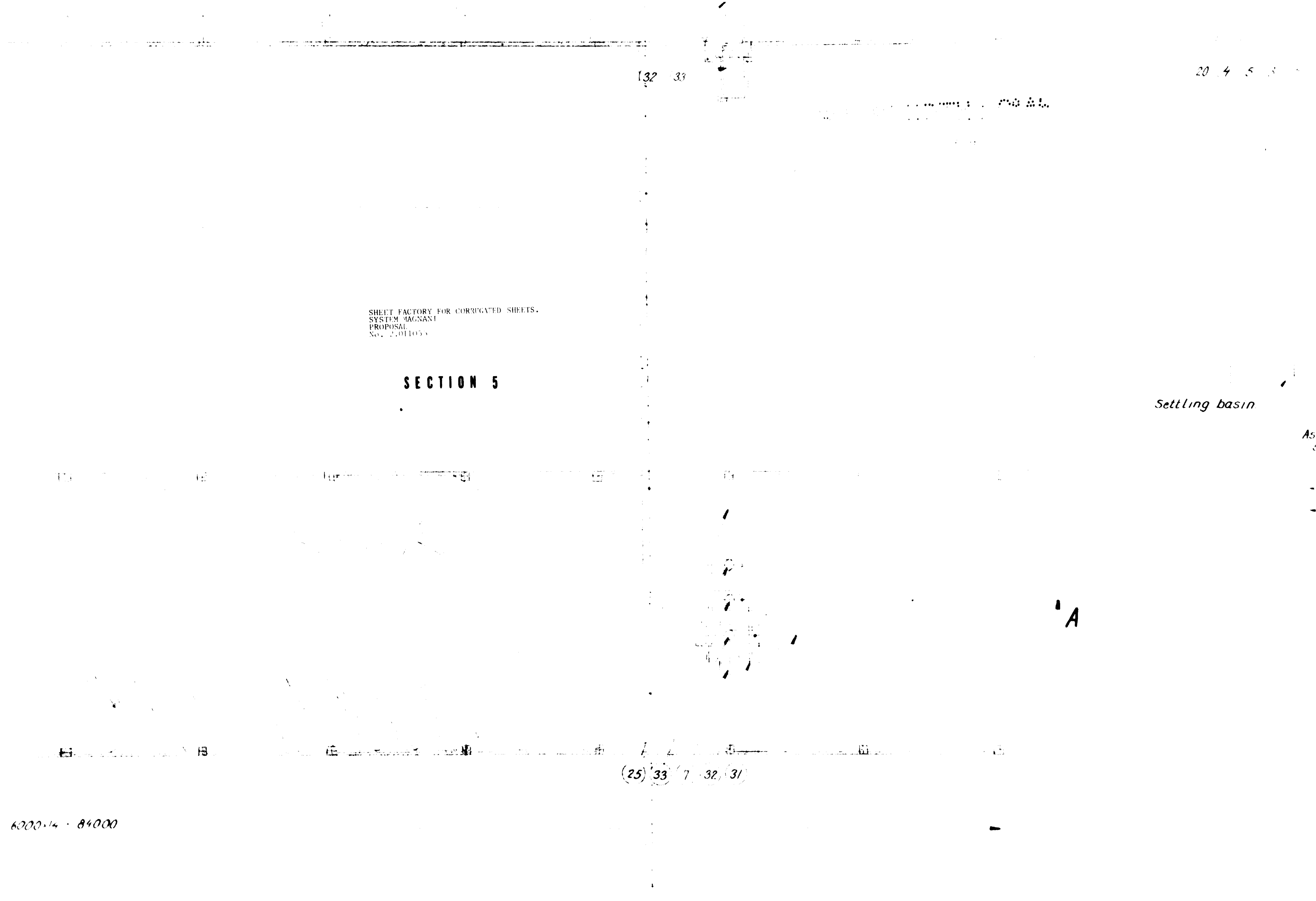


SECTION 4

SHEET FACTORY FOR CORRUGATED SHEETS.
SYSTEM MAGNANI
PROPOSAL
No. 2.01105

SHEET FACTORY FOR CORRUGATED SHEETS.
SYSTEM MAGNANI
PROPOSAL
No. 2.011055

SECTION 5



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SECTION 6

Annex No. VII

F. L. SMIDTH & Co. A/S, KOBENHAVN
COPENHAGEN COPENHAGUE

1:100 No. 2.011055

For numbers, see Machine Reference List No 4.022434

Annex No.

1. Sack emptier
2. Asbestos mixer
3. Screw conveyor
4. Belt elevator
5. Dual flight screw conveyor
6. Edge runner
7. Control desk
8. Dedusting filter
9. Cement silo
10. Indicator
11. Air slides
12. Vibrating screen
13. Feed screw for cement
14. Automatic weigher
15. Double flight mixing screw
16. Stirring device
17. Centrifugal pump
18. Slurry regulator
19. Refiner
20. Cone tank
21. Sheet machine, system Magnani
22. Slurry distributor
23. Vacuum pump
24. Cyclone
25. Pump station
26. Decomposer
27. Pneumatic transport table
28. Fan
29. Cross conveyor
30. Travelling crane
31. Pallet conveyor
32. Stripping device
33. Lift
34. Distribution board
35. Settling basin
36. Compressor

Sheet Machine, system Magnani. Machine Reference List.	F. L. SMIDTH & CO. 4002434

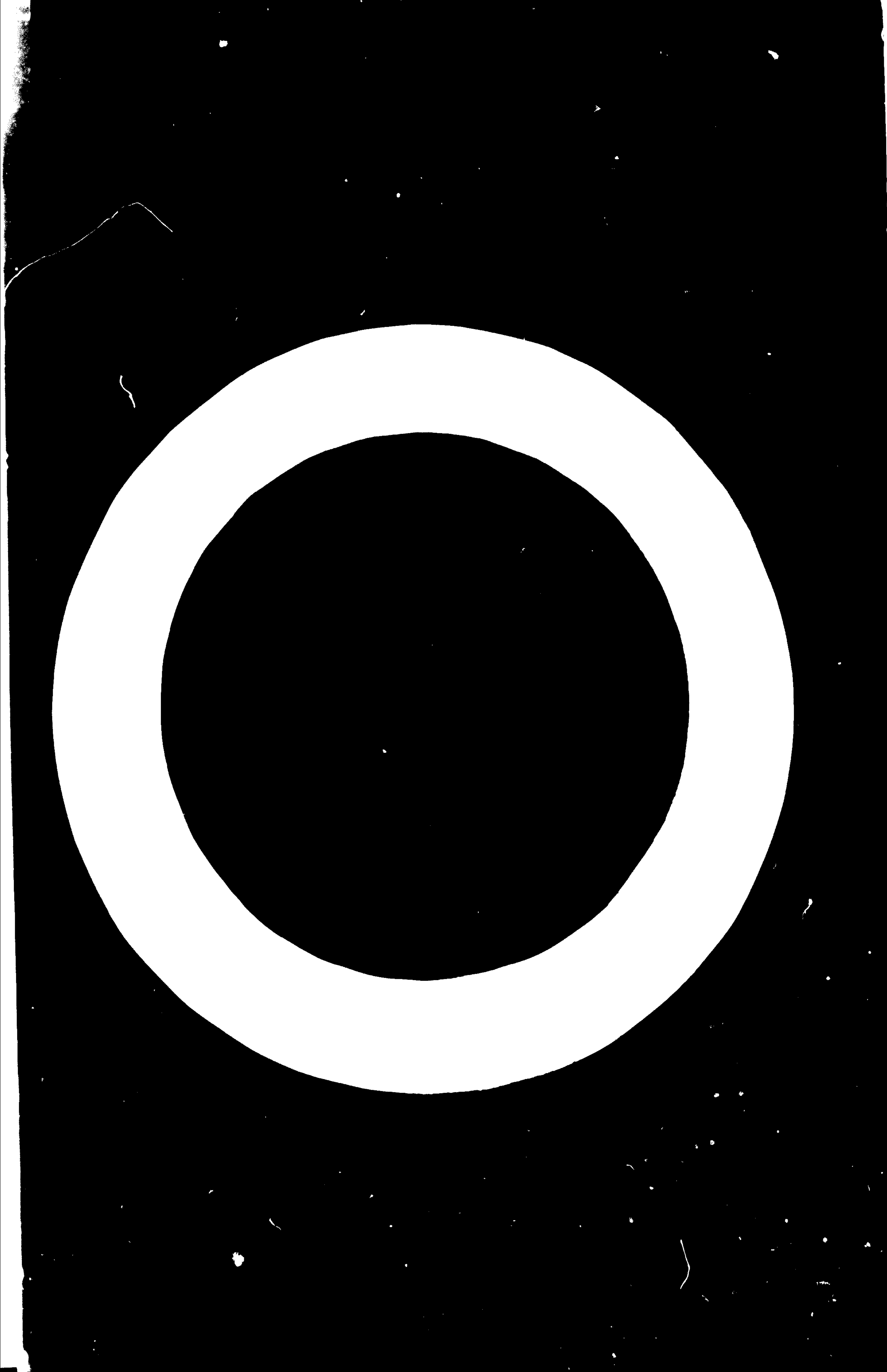
Control lines electric
Compressed air
Pure water
Slurry
Dirty water
C Compressor
R Relay

Annex No IX

F. L. SMIDTH & Co. A/S, KØBENHAVN
COPENHAGEN COPENHAGUE

SHEET FACTORY
SYSTEM MAGNANI
TECHNOLOGICAL DIAGRAM

No. 2.011056



Magnani Sheet Plant

Calculation Figures

Estimated number of operators:

In shift work:

1 for edge runner
3 for running the sheet machine
2 for stripping and changing waggons
1 for relieving of personnel

7 per shift plus 1 foreman

In addition about 10 men will be needed for handling purposes etc. Further 1 fitter and 1 electrician plus 1 foreman will make the total number of men in daytime about 15.

Estimated power consumption:

Total hp installed in plant	300
Load factor	0,7
Effective hp	210
Estimated daily max. KVA load	275

Estimated water consumption:

Theoretical water consumption with 25 per cent of water in sheets at a production of 140 tons: 35 tons of water = 1,5 cu.m/h. Under normal conditions there will be little or no waste water except, of course, when cleaning etc.

Sheet Store Capacity:

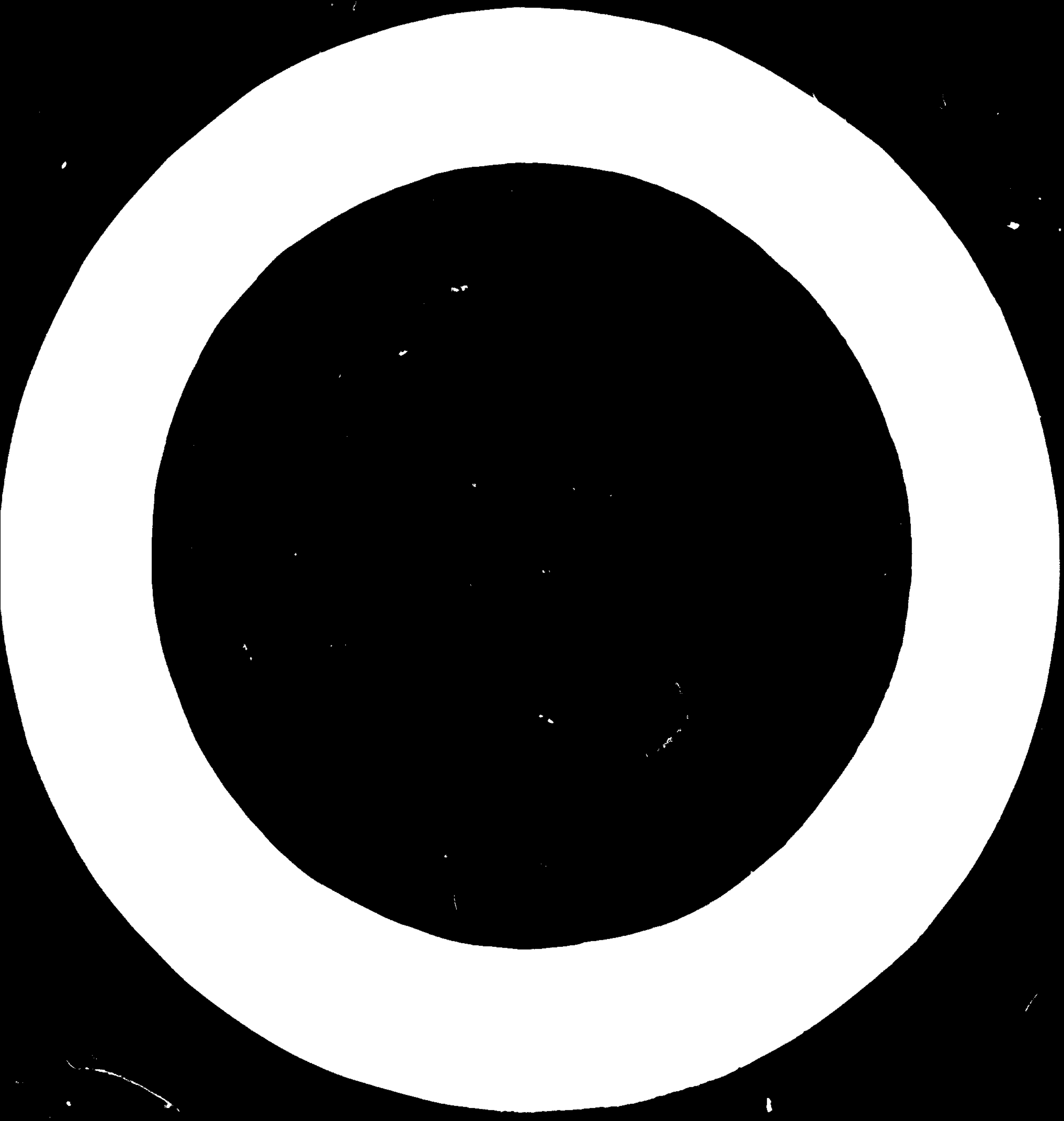
Gross store area: 133,3 x 12 = 1600 m^2

Storing capacity: 3,2 t/m^2 inclusive of 35% for connecting roads

Sheets stocked on pallets: 3 x 100 pieces

Daily production: 140 tons

Total store capacity: $\frac{1500 \times 3,2}{140}$ = 35 days = 6 weeks



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2 OF 2

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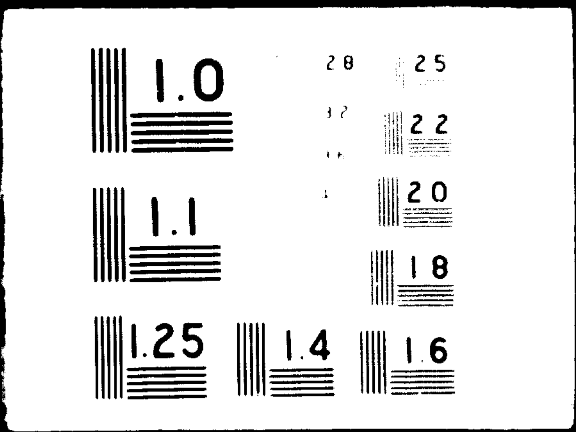
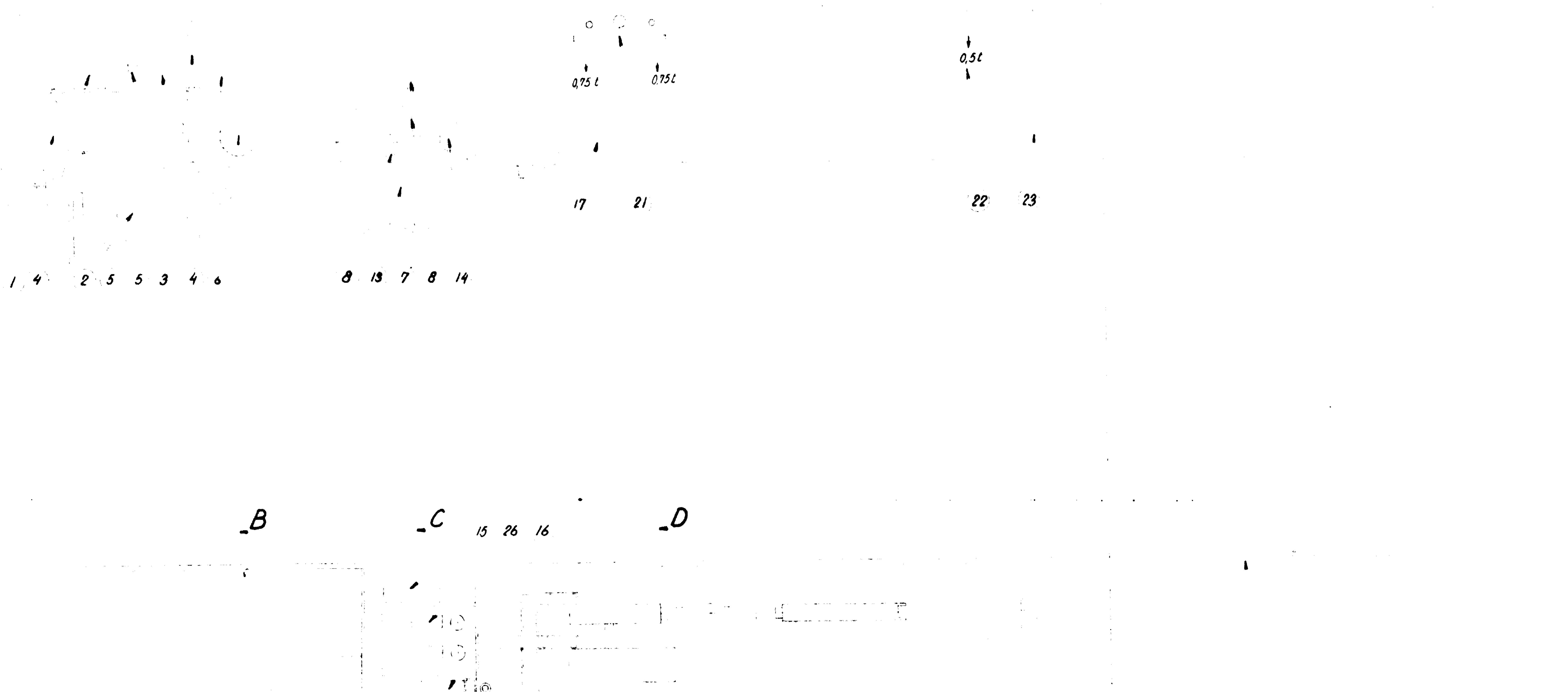


We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards, even though the best possible copy was used for preparing the master fiche.

ANNEX IX.

ASBESTOS CEMENT PIPE FACTORY.
PROPOSAL
SHEET 1

SECTION 1

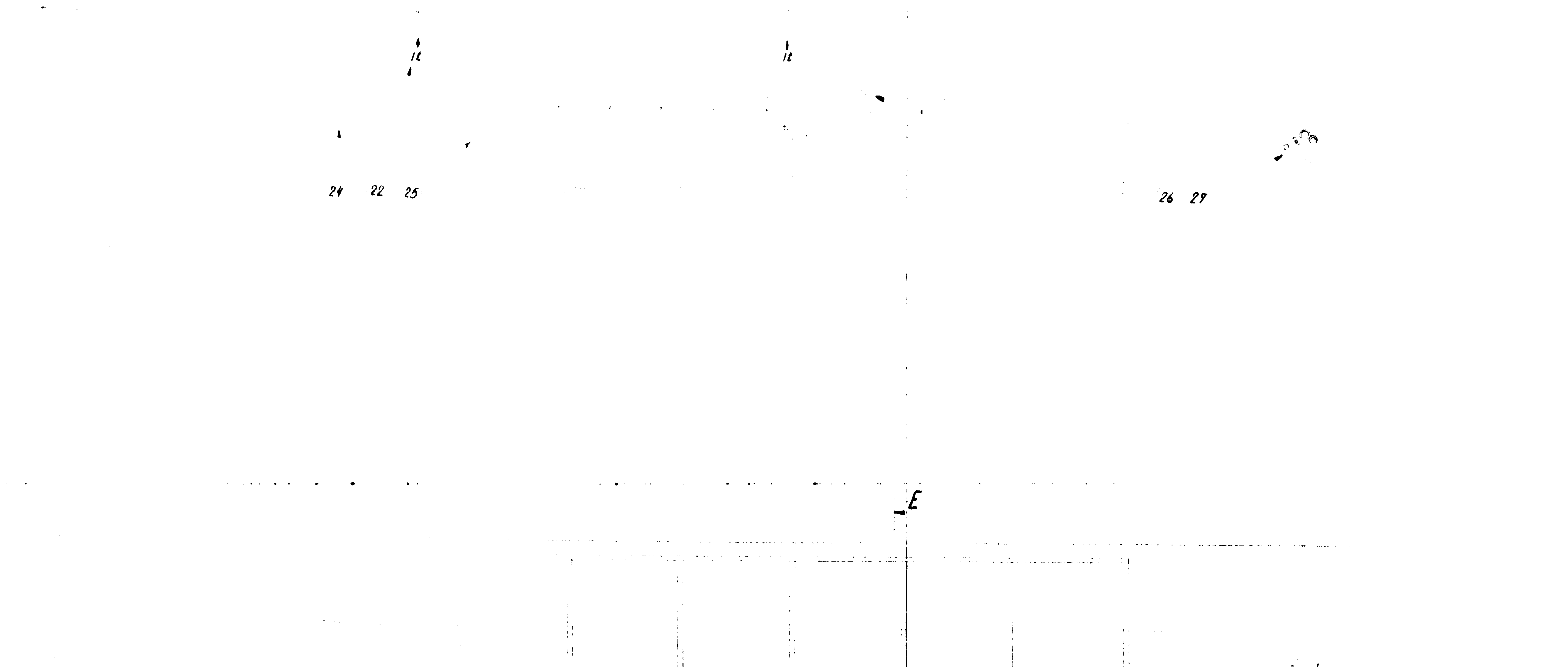


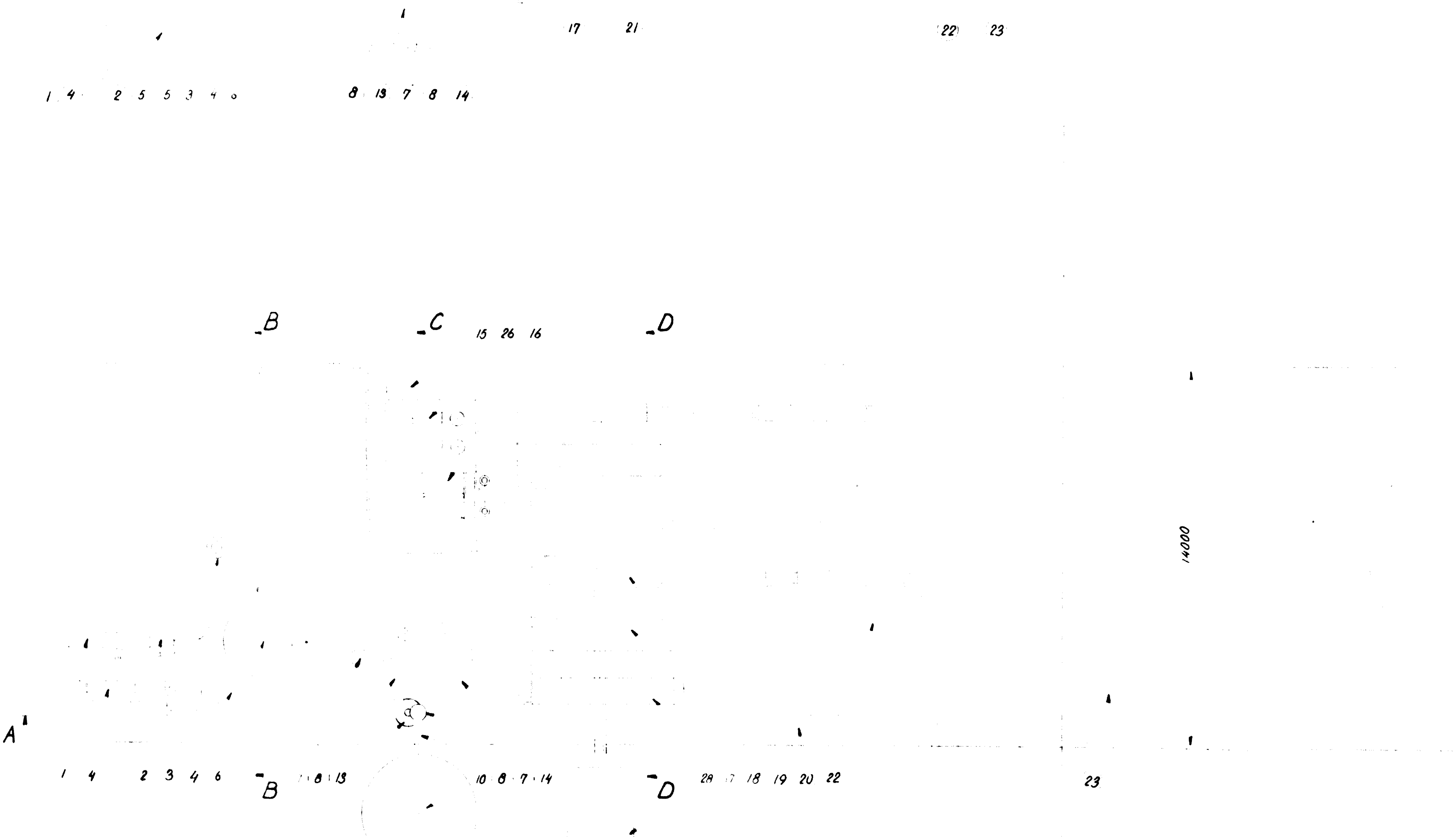
ANNEX IX.

ASBESTOS CEMENT PIPE FACTORY,
PROPOSAL

A-A

SECTION 2

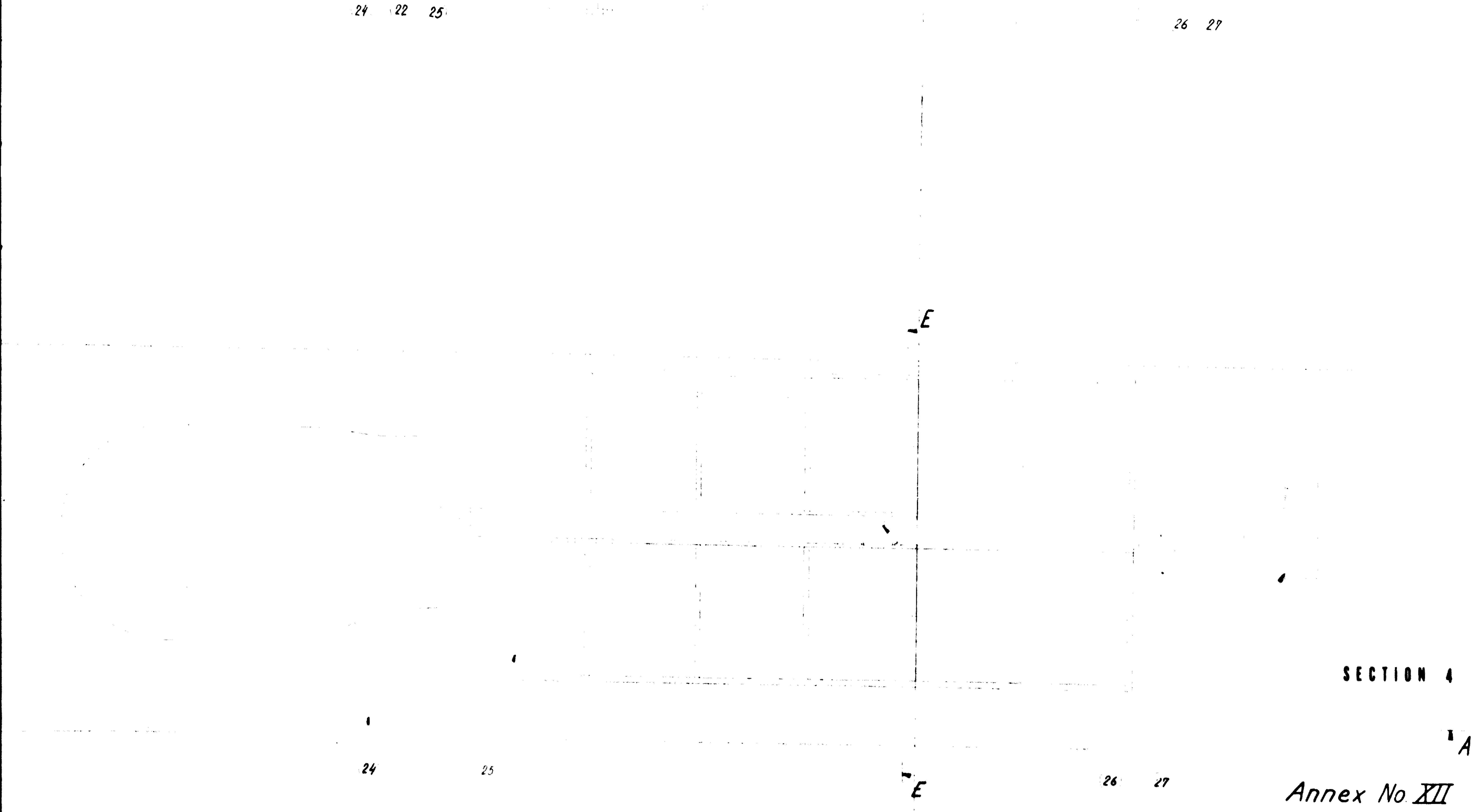




ANNEX IX.

ASBESTOS CEMENT PIPE FACTORY.
PROPOSAL
SHEET 1
No. 2,002411

SECTION 3



For numbers, see Machine Reference List No - 002402

Annex No. XII

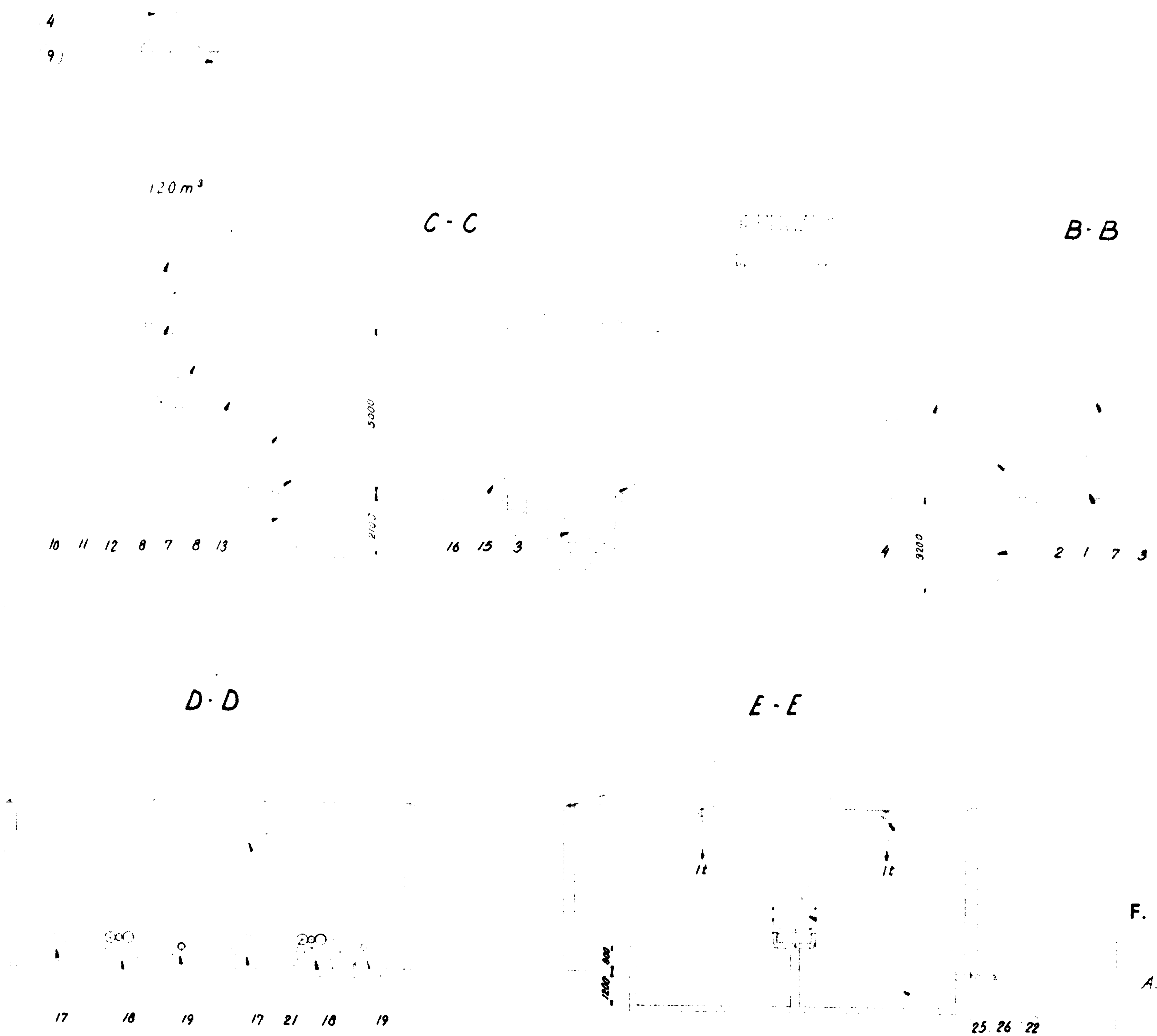
F. L. SMIDTH & Co. A/S, KØBENHAVN
COPENHAGEN COPENHAGUE

Asbestos Cement Pipe Factory

Proposal

Sheet 1

1:100 No. 2.002411



For numbers, see Machine Reference List, No. 2.002402

Annex No. XIII

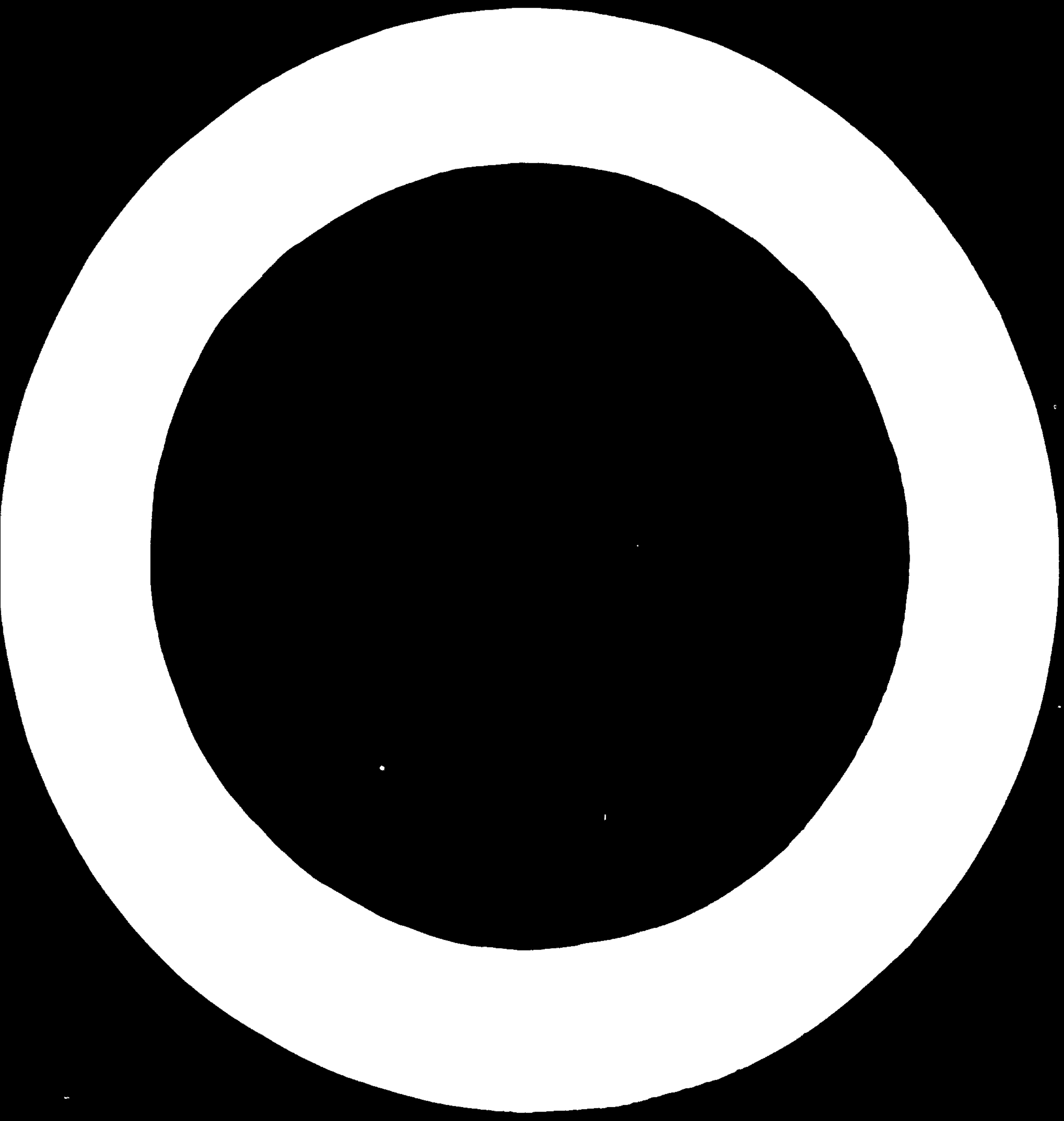
F. L. SMIDTH & Co. A/S, KØBENHAVN
COPENHAGEN COPENHAGUE

Asbestos Cement Pipe Factory

Proposal

Sheet 2

1:100 No. 2.002412



Annex No. 11

1. Pneumatically operated sack emptier
2. Disentegrator
3. Cyclone
4. Filter
5. Fan
6. Edge runner
7. Weigher
8. Screw conveyor
9. Indicator
10. Silo for cement
11. Air sluice
12. Vibration screen
13. Turbo mixer
14. Stirring device
15. Vacuum pump
16. Pump station
17. Pipe moulding machine
18. Calender
19. Extracting device
20. Shelves for steel mandrels
21. Electric crane
22. Electric hoist
23. Roller table
24. Shelves for wooden mandrels
25. Maturing basin
26. Centrifugal pump
27. Cutting machine
28. Setting basin

Pipe Factory Machine Reference List	F.L.Smidth & Co. 4.[illegible]402

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