FINAL REPORT No. 297
ITEM No. 22, 31

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NORDDEUTSCHE SEEKABELWERKE NORDENHAUS

BRITISH INTELLIGENCE OBJECTIVES
SUB-COMMITTEE

LONDON - H.M. STATIONERY OFFICE

BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE
32 Bryanston Square, London, W.1.

BIOS FINAL REPORT NO. 297

entitled

"NORDDEUTSCHE SEEKABELWERKE NORDENHAUS".

A D D E N D U M

The drawings and photographs mentioned on pages 8 and 10 of the report have now been lodged with :-

Board of Trade,
German Division (Documents Unit),
Lansdowne House,
Berkeley Square, W.1.

Telephone : Grosvenor 4060
Ext 2923

The reference numbers G.B.I. 4024 and BIOS/B 59x should be quoted on all applications for permission to view the documents.

Inserted in
ITS 101/1980

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NORDDEUTSCHE SEEKABELWERKE, NORDENHAUS

Reported by

Lt. Col. Pond, M. of S.

Miscellaneous Chemicals

BIOS Target Numbers
C22/2707, C31/700

BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE
32, Bryanston Square

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Investigator ..... Lt-Col. T. W. M. Pond
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C.I.O.S

REPORT OF MOVEMENTS

Friday, May 25th.

Flew from London to Brussels, from Brussels to Volst. Road transport from Volst air-strip to 21st Army Group H.Q., at Venlo.

Saturday, May 26th.

Awaited Lt. Commander Powell and Captain Lewis, who had got stranded in Brussels the previous day.

Sunday, May 27th.

Road transport from Venlo to Winsen, 20 miles S. Hamburg, advance H.Q., 21st Army Group.

Monday 28th May.

Unavailing search for assessor's report in various I.O's at Winsen, advance 21st Army Group H.Q.

Tuesday, May 29th.

Venlo to Nordenham, via Hamburg and Bremen by road transport.

Wednesday, May 30th.

General examination of plant and personnel in the morning. Interview with Town Major of Brake, 35 miles away, to obtain 15 Kw. current for plant.

Thursday, May 31st.

Apparatus warmed up.

Friday, June 1st.

Morning : apparatus running. Afternoon ; dismantling and packing requisitioned plant.

Saturday, June 2nd.

From Nordenham returned to Winsen by road transport.

Sunday, June 3rd.

From Winsen to Brussels by road transport, (410 miles).

Monday, June 4th.

From Brussels to London by aircraft.

GENERAL INTRODUCTION

On arrival at the factory this was found to be guarded by Lt. V. Hardwick, O.C. No. 11 Platoon, 'C' Company, 1st Royal Bucks, with 17 men. The factory was not included in his original target orders, which did include locally a Focke Wolf factory and a superphosphate factory. He correctly decided that this was by far the most important target and installed himself in this factory, making his own quarters the general office building.

The factory consists of some seven acres of high class brick buildings, being a strip along the left bank of the Weser about five miles from the mouth into the North Sea. It employed 300 without the shipping department, of which 200 were men and 100 women.

There are two shadow factories, one at Feldkiroh in Vorarlberg in Austria and another at Neumark b. Plauen, Saxony.

The factory makes telephone and telegram cables for land and sea, no flex or power cable being made. No rubber is used but gutta percha is used for sea cables and insulation is done by this material, paper, lead or styroflex. The three main types are as follows : -

(1) Long distance trunk cables, repeater and puppinised, 60 to 200 pairs.

(2) Trunk zone, no repeater but puppinised, 20 to 100 pairs.

(3) Local cables, no repeater, not puppinised, up to 1,200 pairs.

On final briefing by Lt. Commander Goodge, Assessor of T Force, 21st Army Group at Winsen, I suggested that a cable expert might accompany me to do that part of the work while I attended to Styroflex alone. Lt. Reede, R.N.V.R., a T Force assessor, was detailed to accompany me. Any information on the cable side, manufacture or machinery, can be obtained from his report.

PERSONNEL

The following is a list of the executive personnel of the factory : -

Chairman ..... Direktor Julius Engler (Swiss)

Active directors ... Direktor Fuhr (Commercial)

Direktor Greis (Shipping)

Direktor Boos. (Technical)

No further reference or contact was made with the first three named.

Under Direktor Boos were the following : -

Cable cores - Herr Logemann.

Cable armour - Herr Wohlken.

Electrical tests - Herr Reingardt.

Styroflex - Herr Mennemann.

Factory engineer - Herr Weidau.

As and when necessary foremen and workmen were called in, with whom no contact was made, the entire information being gathered from Direktor Boos and Herrn Mennemann and Weidau.

GENERAL PLANT DESCRIPTION

There are six production and two research machines installed at Nordenham. These were manufactured by Berstorff A.-G., of Hanover. The six production machines are installed in line, each in its own glass-windowed, wooden compartment, complete with adjustable sliding glass roof, nine feet high. The reason for this will become apparent later.

The general scheme of the plant is identical with apparatus installed in this country, consisting of an electrically heated extrusion machine, spreader or fish-tail, knives and rolling equipment. The output of finished foil, of all dimensions, was stated for last year to have been 15 tons per month, which should be read as crude foil and which links up with the figure of 3 kilos of polystyrene per hour per machine.

So important was this manufacture considered by the German government that two shadow factories were erected (see page 4), but these are stated only to be making threads.

The polystyrene is added from a hopper as a powder in a continuous stream, as, even after filters, it was stated only to have sufficient homogeneity if this course was adopted.

The whole principle of their extrusion is that the work is done in an atmosphere up to 50 C, the heat of the glass-windowed compartments being generated by radiation from the extrusion machines.

The thinner the foil to be made the higher the temperature in the compartment, and, in the case of the thinnest material made - 10 mu. - the temperature is maintained at 50°C. In this battery of machines, which once started were kept running day and night and only stopped for cleaning of the styrene filters, the middle compartments, i.e. those less liable to lose heat by radiation, were always used for the thinnest foil.

Constant temperature and air conditions for making satisfactory, first quality, 10 mu., foil can not be obtained in less than 24 hours continuous running.

The workpeople have ten years' experience and a lot of complicated measuring machinery has been replaced by trained fingers. The workmen watch the operation from the outside of the compartment and only enter it to make the necessary adjustments. It was further stated, and believed, that during the manufacture of the 10 mu. material anybody walking past the shielded spreader would tear the film, and examination of the film on the spreader in the case of thin materials, 60 mu. to 10 mu. is done from the underside.

It should be noted here that the whole installation is wired for 220 D.C current obtained from steam turbine generation.

DETAILED PLANT DESCRIPTION

EXTRUSION

The extrusion machines were of two types, one more modern than the other, their differences only being that the old type was V-belt driven and the new type by direct coupling, in both cases with a 5 h.p. motor.

Further, the old machines had square extrusion heads while the modern model is rounded, but this is merely to facilitate the removal of the plate and filters to be cleaned. The extrusion head that has been requisitioned for transfer to this country is of the latter type.

A drawing of the whole plant lay-out was requisitioned and is being sent under separate cover to this country and a detailed drawing of the two types of extrusion head is also on the way.

The extrusion machine is not fitted with a variable speed gear but continually extrudes at three kilos per hour.

The screw is of regular, i.e. non-diminishing, pitch, and is very deep, the outside diameter being 200 millimetres with a shaft of 80 millimetres leaving 60 millimetres for the depth.

Right angle extrusion is not used or advised by them since this causes blind spots in the melted polystyrene chamber where radiation could occur.

Contrary to British belief, the polystyrene is not cooled on entering the extrusion headto get rid of the work heat, but is insulated to keep up the temperature.

There are three heating coils on the extrusion head which are insulated.

Extrusion of an oval tube to facilitate spreading is not necessary and was not tried even experimentally. The extrusion nozzle has a 30 millimetre adjustable finishing straight to give good surface, as is the British practice.

Precise measurements of the extruded polystyrene tube were not taken but the extrusion head will give these. It is of the order of 6 centimetres in diameter with a wall thickness, before swelling takes place during extrusion, of $\frac{1}{2}$ millimetre.

The built-in filters vary with the thickness of the foil to be made, but usually consist of fine mesh bronze,

samples of which are in the extrusion head, and which are backed by thicker mesh wire gauze to prevent deformation by pressure. The purpose of these filters is twofold : -

(1) to increase homogeneity of the extruded material.

(2) to remove dirt which comes in the crude polystyrene - German war packing consisting of paper sacks - and particles of iron from the hammer mill which grinds the material delivered in crystal form.

SPREADER

The spreader is precisely as shown in the original article in "Kunststoffe" in 1940, and wheels replace the ball-bearings in the British model. They resemble flattened cotton reels and are made of good quality mild steel. The two wheels on either side of the spreader, nearer the extrusion head, are of a different diameter from the rest which are about 1 centimetre. The wheels are all mounted on very small ball-bearings and must occasionally be oiled, and, in any case, kept free from styrene. Should one wheel stop the foil is broken.

The fish-plate is held into the extrusion head by a long thread, precisely as in the British example. A boss 15 millimetres long on the extrusion head takes the thread and the fish-plate is screwed in so that the distance from the flat face of the head to the inside of the rectangular boss at the angle of the spreader is 75 millimetres.

The thickness of the foil is controlled not by increasing the speed of extrusion, which remains constant, but by varying the take-off speed on the winding equipment. Calculation of the stretch ratio of film to tube periphery, including the unstretched trimmings, gives 3:1, which is considerably less than the figure in the original Germany article of 4.5:1.

Air cooling takes place by two jets, adjustable to any height or direction, one on each side of the collar of the spreader. It is important to realise that their function is to breathe out air to the shoulder of the foil as it is formed, in contra-distinction to blowing. A thin sheet of metal protects the spreader on either side from unnecessary air current disturbance, it extends from the cutting gear to the extrusion head, being two feet high at the former and a foot high at the latter.

CUTTING AND WINDING GEAR.

The cutting is done by safety razor blades held at an angle of 45° on either side of the foil at a distance of 2.5 centimetres from the edge. These are adjustable transversely by sliding along holding bars or vertically by a lever system with locking pins. The actual position of the point of the blades is about one inch in front of the first roller. The trimmings thus formed continue in a horizontal line, whereas the two formed films diverge at an angle of about 30°, up and down respectively, to the winding gear.

The trimmings pass through tapered chute guides on to a separate roller which exerts on the trimmings a higher tension than exists on the foils themselves. The roller for the trimmings is ribbed as shown in Sketch II and the method of varying the tension is shown. The thinner the foil the greater must be the suspended weight until for the 10 mu. material the weight is on the end of the spreader side of the two arms.

The speed of the foil take-off is varied firstly by changing the sprockets and secondly by varying the resistance from 0.25 to 3 amps. on a geared motor doing about 18 R.P.M.

No drawing was available of this rolling equipment as it was bought from an outside manufacturer, but it is standard equipment. Two photographs and a copy of the original quotation are among the documents requisitioned.

STARTING UP

It must be remembered that the staff have ten years' experience and starting up presents no difficulties to them. The chief thing to bear in mind is that heat uniformity of the operation and the room, as outlined in the section on general plant, must be established before foil drawing commences.

There is no special starting device as was suspected, e.g. pivotting at the angle of the spreader; the tube is pulled over the spreader by means of four pairs of pliers held by two men.

RUNNING

It must be recognised that this problem is considered solved by the Germans after ten years' experience but they still, for first class material, record 30% rejects of thick foil (above 60 mu.) and 50% rejects under 60 mu., as being satisfactory. This is on top of the trimmings, representing 20% of the original material which is naturally scrapped.

Various thicknesses of foils are made, varying from 150 down to 10 mu. In commerce thin material is required in widths up to 60 millimetres, and in thick up to 250 millimetres - the maximum width the machine can make.

The temperature conditions throughout vary widely and depend on the thickness of the material being made. The complete graph of running instructions is among the documents requisitioned, but some idea is given by the figures below. Temperatures are not measured in or round the spreader itself and the thickness of the foil as it travels after the cutting knives is measured by the micrometer gauge which allows insertion over the foil to a depth of 15 centimetres.

The body temperature of the extrusion press varied from 160°C for 10 mu. to 120°C for 150 mu. Similarly the temperature of the extrusion head varies as follows : -

10 mu	210°C
200 mu	200°C
30 mu	180°C
80 mu	164°C
150 mu	140°C

It will immediately be remarked that these temperatures are above or very close to the temperature of depolymerisation of polystyrene. To a certain extent this actually occurs and the whole atmosphere reeks of styrene. Also this vapour condenses on the window frames of the sliding ceiling and depolymerises, giving stalactite of polystyrene. That this damages the colour of the material is obvious, but in these extremely thin layers this is not important and the formation of styrene oxide is in any case very small.

As regards the air this is entirely a matter of experience. In the manufacture of 20 mu. material, which was watched, the air pressure was 75 millimetres of water. The extrusion head at the same time was 195°C and the body of the extrusion machine 145°C. Purposely the film was broken and the elevation angle of the air regulators was spoiled and the adjustment of the valve controlling the air quantity was changed - and that without the knowledge of the operator. On being instructed to start up the foil was reinserted and within

thirty seconds the operator had deduced that several maladjustments had taken place. Within ten minutes they were remaking 20 mu. material satisfactorily, but although the quantity of air (75 millimetres water pressure) was re-established, the actual position of the jets except for their vertical fixing was different.

The air is directed in a gentle continuous stream at the middle of one of the two larger wheels of the spreader. The angles from which it comes and the distance of the nozzle from the film on either side, however, may be different.

The thermometer on the wall of the 10' x 6' cabin read 35°C and this was unsatisfactorily low for the material in question (20 mu.) but it was unavoidable as this was the only one of the six cabins which was working. As stated, the temperature should be 45°C for this thickness of foil and 50°C for a 10 mu. foil.

The method of controlling the foil during manufacture by electrical or optical means has been abandoned in favour of micrometer and experience. Details of the optical method for controlling and testing uniformity of thickness are among the documents requisitioned. The foreman agreed that thick edges were a sign that the material was too hot and further pointed out that trimmed foil proceeding from the knives to the rollers should never be flat, or in any case never completely flat, but in a slightly wavy condition. Further, for heavy foils, i.e. those between 100 and 150 mu. the travelling foil in this position must have dropped edges owing to its own weight.

MISCELLANEOUS

The first scrap from the process is the 2.5 centimetres cut off top and bottom on both sides which, together with the portion covering the wheels vertically, makes about 12 centimetres out of 62 centimetres, which is the distance of complete stretch. This represents an unavoidable minimum scrap loss of 20%. This is melted down, pigmented, ground and used as an injection material for toothpaste tubes shoulders and caps. The reject from the thinner foil is used for lining the metal body of the toothpaste tube to protect the material with which the tube is to be filled from the metal, but this raises the price of the tube from 1 pfennig, pre-war, to 6 pfennigs.

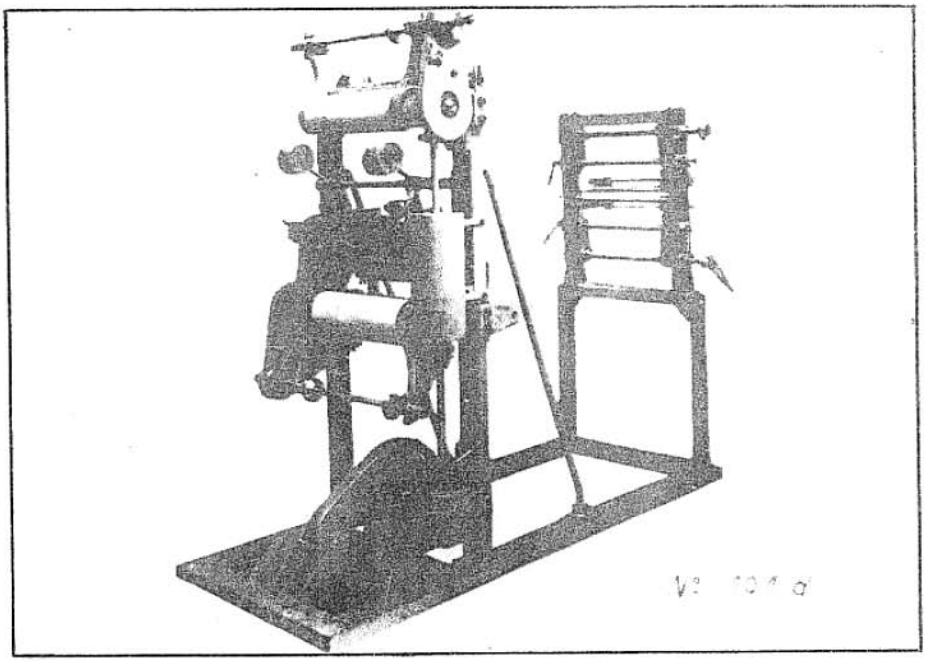
The only use to which the grade A material is put is the manufacture of high frequency cable cores and condensers.

THREADS.

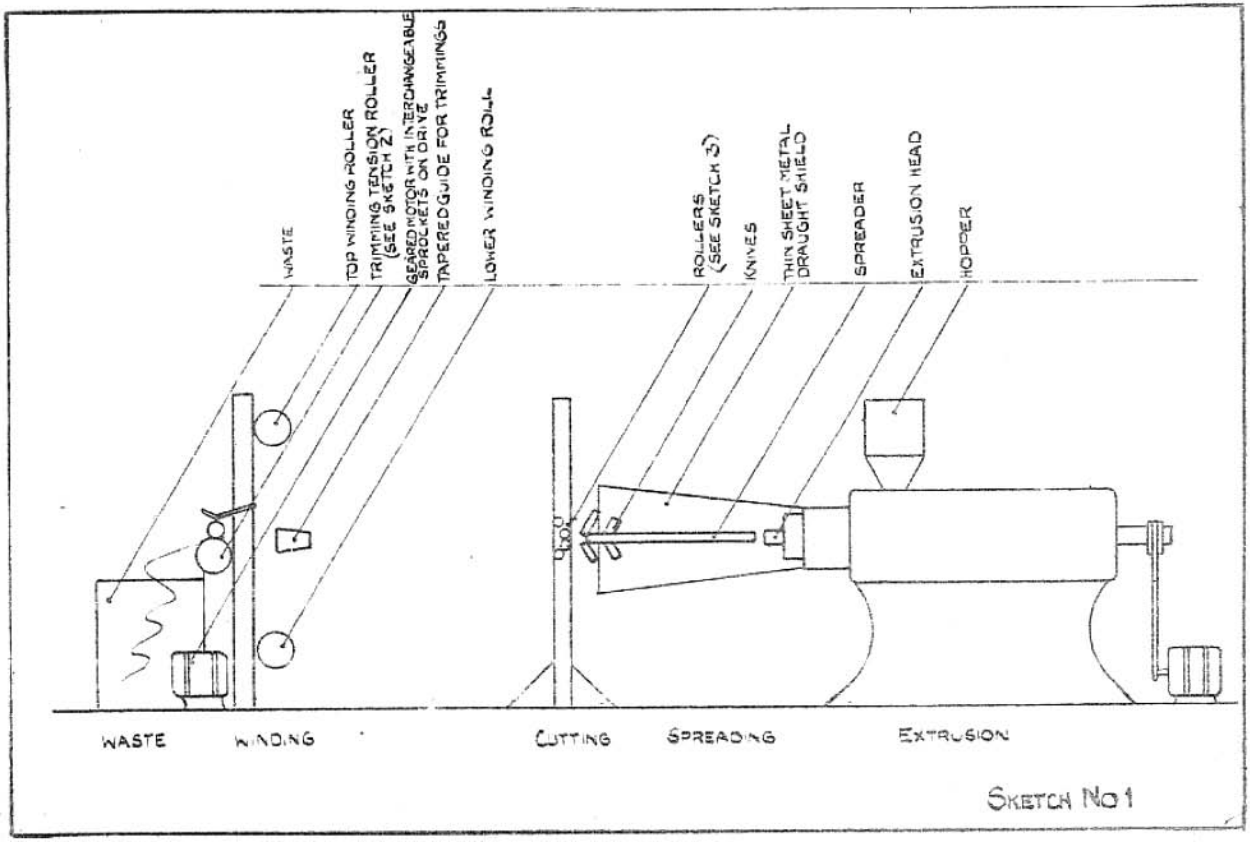
No threads are made at Nordenham but they are made entirely at Neumark and Feldkirch. They turn out 1.5 kilos of thread per hour from 40 nipples screwed into an oblong extrusion head, behind which is placed a medium sized metal filter. All the nipples are of the same size and are replaced if a finer or coarser thread is required. Apart from this, experiments had been made pre-war on polystyrene silk, of which a sample is available. This was done through platinum jets but the development never came to anything as there was no market to be found for the material.

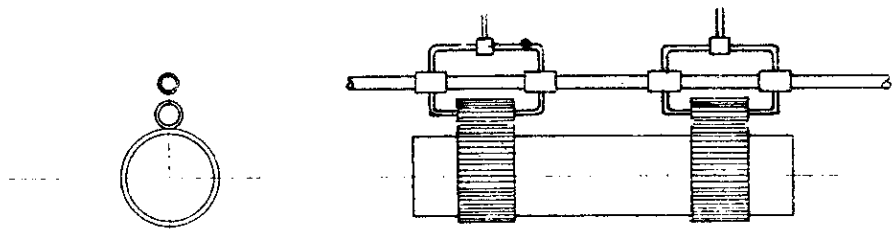
CONTROLLED PRICES.

Foils used in cable manufacture were sold by weight according to thickness. The usual material, 150 to 60 mu., was sold at 12 marks the kilo. The thinner material, 60 to 20 mu., was sold at 40 marks the kilo, whereas the more recently developed 10 mu. material was sold at 50 marks the kilo.



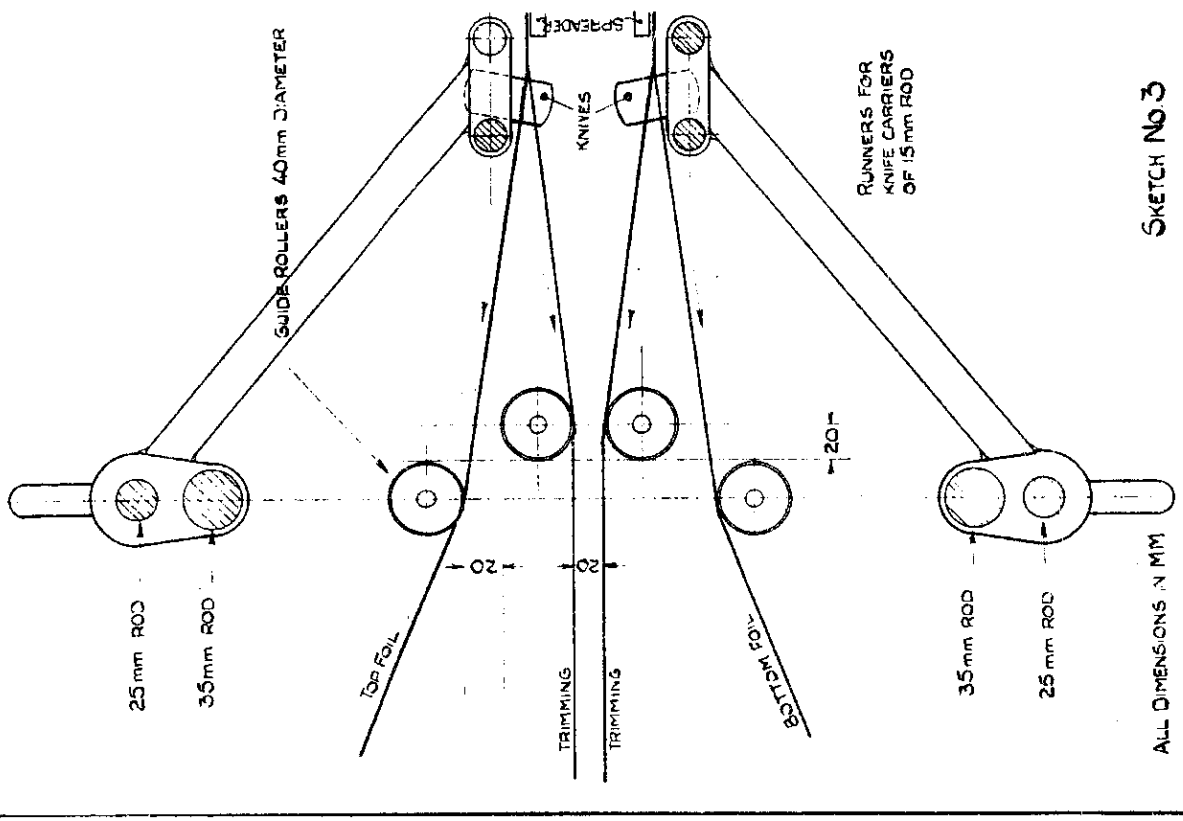
Winding Machine



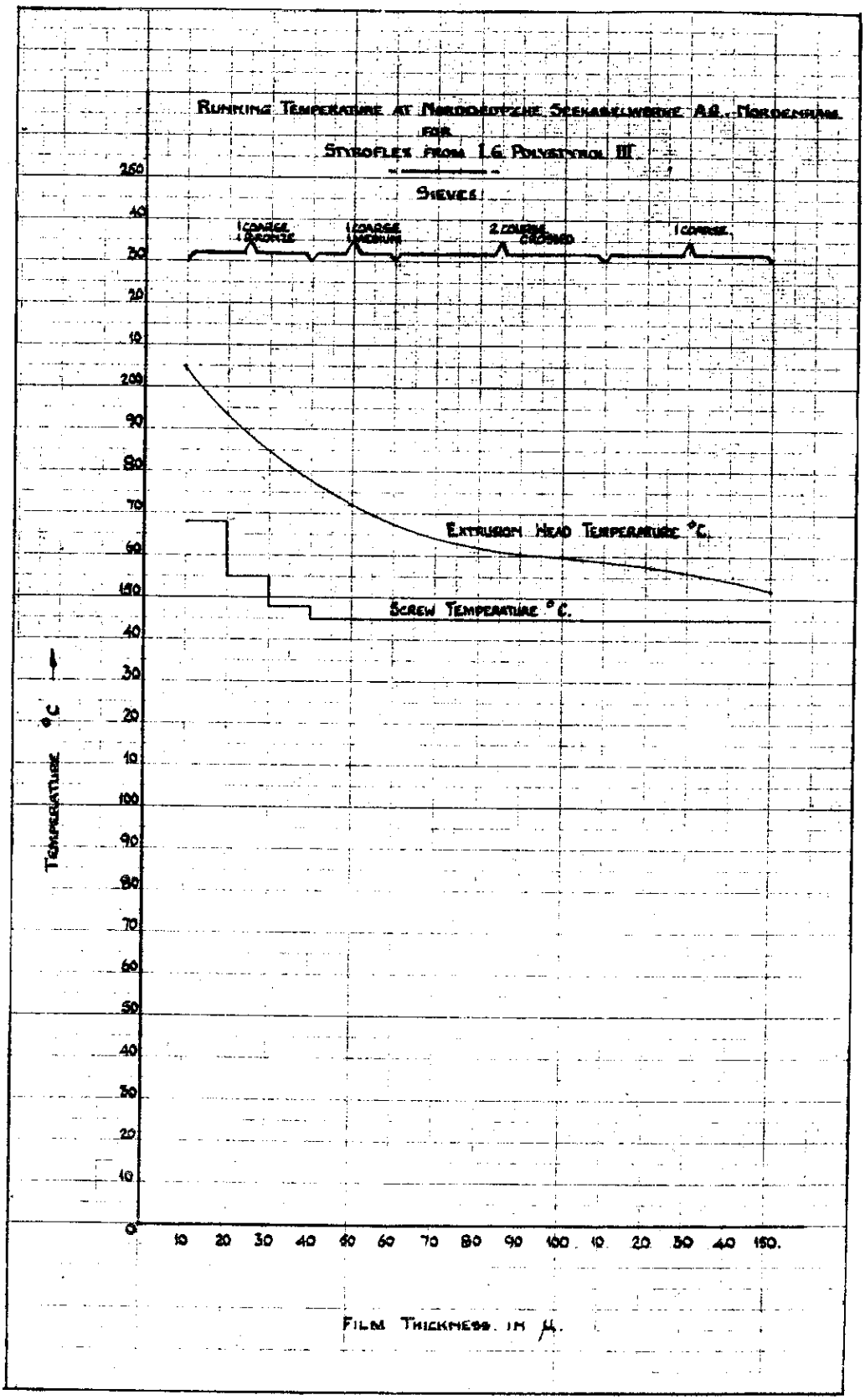


TENSION ROLLER FOR TRIMMINGS

SKETCH No2.



SKETCH No3


Running Temperature at Norrköpings Spinnereiverke A.B., Norrköping
for
Styrofles from I.G. Polystyrol III
Sieves
1 coarse + bronze
1 coarse medium
2 coarse crowned
1 coarse
Extrusion Head Temperature °C.
Screw Temperature °C.
Temperature °C
Film Thickness in μ.