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Office of The Quartermaster General
Military Planning Division
Research and Development Branch

TEXTILE SERIES - REPORT NO. 42

June 1947

RAYON WEAVING AND THROWING IN GERMANY

Prepared by E. C. Geier, OQMG Consultant
from Reports, Documents and Interviews
obtained by "Textile Finishing Team"
Technical Intelligence Investigators
in Germany

Released for public information
by
The Office of Technical Services
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Field Investigation
Conducted under the Direction of
Headquarters, Theater Service Forces,
European Theater
Office of the Theater Chief Quartermaster
and
Office of Military Government for Germany (U.S.)
Office of Director of Intelligence
Field Information Agency, Technical

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FOREWORD

Following the planning for the initial survey of German technical developments in the field of textiles, it was decided that in view of the importance attached by German research to the development of synthetic chemicals in the field of textile auxiliaries, an extensive investigation should be made of the application of textile auxiliaries and finishing agents.

Accordingly a "Textile Finishing Team" was organized to explore German developments in this field more thoroughly than had been possible by the first investigators sent to Germany.

The reports of this team cover the various aspects of textile finishing, including dyeing and finishing, printing and finishing, hosiery dyeing and dyeing and finishing of wool textiles. The five members of the team were Mr. Elliot Broadbent, Mr. C. Norris Rabold, Mr. Glenn D. Jackson, Jr., Mr. Ernest G. Geier, Mr. Henry D. Grimes and Mr. Thomas R. Smith.

In addition Mr. E. C. Geier, who was the leader of this group and who was personally concerned primarily with investigation of rayon throwing and weaving equipment, contributed in many ways to the accomplishment of this finishing team.

While the reports appear under the names of the individuals who were primarily concerned with the various fields of the investigation, each report represents to a certain degree, the joint efforts of all of the men on the team.

It is believed that correct and reliable information was obtained from the Germans, but it should be understood that the United States Government is not responsible for any inaccuracies of information. Any firm or individual interested in using any of these processes must do so at their own risk insofar as patent violations are concerned.

S. J. KENNEDY
Assistant Director
for
Textiles, Clothing and Footwear

June 1947

RAYON WEAVING AND THROWING IN GERMANY

By Mr. E. C. Geier

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RAYON WEAVING AND THROWING IN GERMANY

By E. C. Geier

A. Introduction:

The rayon weaving and throwing industry occupied a place of great importance in the German economy and industrial life. This was due to the fact that with the advent of rayon, still called artificial silk, or "Kunstseide", the Germans for the first time in history had an opportunity to manufacture textiles from a raw material they could supply themselves without depending upon foreign sources, as was the case with wool, cotton and silk.

Here was a wonderful opportunity for their chemical ingenuity and they made the best of it. In their weaving and knitting mills, in peace and in war, they used two basic synthetic yarns, viz: First, the various continuous filament yarns of the viscose, acetate and cupramonium types, and secondly, the spun rayon or staple yarn types of the various compositions and blends known as "Zellwolle". The latter gained in importance as the war extended into 1944 and 1945 because the supply of other essential raw materials, such as cotton and wool, was practically exhausted.

The reader will note, however, that this report concerns itself mostly with the continuous filament types of yarns, their usage and application, and the mechanical means and methods used by the industry in the weaving and throwing operations during the conversion of these yarns into fabrics for military and peace or civilian purposes.

While the report has been written to give a brief and compact over-all picture of the industry, a special effort has been made, whenever possible, to explain in detail and illustrate manufacturing methods, or mechanical equipment which was found to be different, better, or novel from the American viewpoint.

B. Summary:

In the course of the investigation, which consumed about three months, almost 30 plants were visited. Of these, 18 were made the subject of especially careful inspection due to the fact that in them certain methods or machines were found to be of particular interest. Some might be called discoveries, inasmuch as they were unknown to the United States Textile Industry. The outstanding instances found which merit attention can be summarized as follows:

a. The Double Twist Spindle:

This spindle for uptwisters was developed by the Barmen Maschinenfabrik in Lennep-Remscheid, known under the trade name "BARMAG".

b. <u>The Hollow Spindle:</u>

This is used to convert a two deck uptwister into a combination twister-doubler. Developed and in operation at the Kunstseiden A. G. in Waldniehl, known as "KUAG".

c. <u>The Three Deck Uptwister:</u>

It is used for silk and rayon crepe yarns and was built by Hamel & Company, Chemnitz and Arbon (Switzerland).

d. <u>The Loom Without Superstructure:</u>

This is built by Ruti, Elmag, Schoenherr, Saurer, Roesch, Benninger and Jaeggli.

e. <u>The Plastic Heddle:</u>

It is used to replace steel heddles, developed by Felton and Guilleaume of Mulhouse.

f. <u>The Kreutzwalke:</u>

This apparatus is used on looms to facilitate abnormally high pickage in special fabrics. It is made by Saechsische Maschinenfabrik, Chemnitz.

g. <u>Printing Special Maps:</u>

The formula for the preparation of a rayon fabric and for printing the special maps used by the German Luftwaffe for night flying, was developed and patented by a textile printing plant in Krefeld - Verseidag.

h. <u>The Continuous Process:</u>

The production of cupramonium yarn from spinneret to warp, beam or spool, by J. P. Bemberg of Ober-Barmen.

*

There can be no question but that the developments enumerated should be of decided interest to American plants in their respective fields, and some can even be of great importance. However, considering the scope of the German industry, these instances of progress and improvement or superiority over the United States seem very isolated, and of such specialized character that they had little or no effect on the modernization, or rather, lack of such in the industry as a whole.

To summarize, it can be stated that, with the exception of the specific instances quoted, the German Rayon Weaving and Throwing Industry trails the United States Textile manufacturing methods and equipment by 10-20 years.

However, the owners and managers of the plants visited were fully aware of that fact. Many of them had been in the United States individually, or as members of textile commissions as late as 1936-38 and 1939, and they were well posted regarding the progress which had been made by the American industry in methods and machinery during the last 10-15 years. There was ample evidence indeed that just about at the outbreak of the war many of the leading German mills had made all preparations to revamp their equipment and modernize their manufacturing procedure to a point to make them more competitive in the world markets. These efforts, of course, were totally nullified by the outbreak of hostilities.

The following is a list of the plants and places which were made the subject of particularly close scrutiny and inspection.

C. List of Plants Visited:

Vereinigte Seidenwebereien (4 plants) ("Verseidag")	Krefeld
J. Girmes & Co.	Oedt
Zwirnerei Rhenania	Duelken
Gusken Maschinenfabrik	Duelken
Willi Schmits Tuchfabrik	Munchen-Gladbach
Kampf und Spindler	Hilden
Simon & Frohwien	Leichlingen
Barmag (Barmen Maschinenfabrik)	Remscheid-Lennep
J. P. Bemberg	Barmen Wupperthal
Rheydt Glas Weberei	Rheydt
Kuag (Zwirnerei)	Waldniehl
Lehrspinnerei Denkendorf	Denkendorf
Gerresheimer Glas Werke	Gerresheim
I. G. Farbenindustrie	LeverKusen &Hoechst
Vereinigte Glanzstoff Fabriken	Obernburg
Weberei Wendlingen	Wendlingen
Textil Hochschule	Reutlingen
Courtauld-Glanzstoff	Cologne

D. Origin and Location of Industry:

The spinning of rayon yarns or "Kunstseide" developed in Germany on a commercial scale during the years 1900-1910. The industry grew rapidly and the total poundage produced in viscose, acetate and Bemberg in the 1920's and early 30's represented an important percentage of the world's output. As a matter of fact, for a number of years Germany was the sole producer of "Cupra" or Bemberg yarn. However, beginning about 1925, other countries such as Japan, Italy and the United States entered upon expansion programs of such magnitude that by the outbreak of the war Germany found itself in third place as a rayon producer. Nevertheless, it still was a very important source of supply for all the countries on the continent.

The yarns produced in the early stages were of very inferior quality and offered many difficulties to processors and weavers. Therefore, it was only natural that the silk mills, already accustomed to handling delicate yarns, were the first to take up rayon. Hence, even today an important percentage of the German rayon fabric production comes from what is still known as the silk district, namely, the Krefeld and Elberfeld regions, and the lower Rhine provinces in general. This is particularly true of all the better types of fabrics as well as highly styled novelties, crepes, jacquards and neckwear. Furthermore, all the pile fabrics for apparel, formerly made of silk but now of rayon, come from mills in these regions. The towns and countryside around Krefeld, Munchen-Gladbach and Elberfeld are literally dotted with weaving, throwing and dyeing and finishing plants, large and small.

Later on, as rayon yarns became better and cheaper, the so-called fine cotton mills took up the manufacture of popular or staple types of rayon cloths. Therefore, rayon looms are now also located in considerable numbers in Southern Germany all the way up to Munich and along the Swiss border.

However, the Krefeld area is still considered headquarters for the better fabrics, and is also well known for its excellent educational institutions in connection with textiles.

E. Type of Organization:

Contrary to American practice, in Germany there are very few typical horizontally set up grey mills, certainly no large ones. The few operating on that basis are of the 50 to 200 loom capacity type. Some small weaving plants operate on a commission basis for some larger weaver, -- not for converters. All of the important mills are integrated completely, or at least partially.

As examples, note the extent of vertical integration in the following companies:

a. Vereinigte Seidenwebereien Krefeld (Verseidag):

This firm, also known as United Silk Mills, is the largest in the field of better, and highly styled fabrics and specialties. It is the result of a number of mergers, now controlling the production of about 3000 looms. It is well managed, well staffed and considered one of the most progressive outfits in the industry. Their operations embrace the following:

(1) Entire preparation of all yarns used on their looms, including a very complete throwing division, also making an extensive collection of ratine and boucle yarns.

(2) Weaving a complete line of plain and crepe fabrics for dresses, underwear, neckwear, linings, etc.

(3) Weaving an extensive line of jacquard fabrics for dresses, linings and neckwear.

(4) Weaving a complete line of decorative fabrics for draperies and upholstery.

(5) Weaving a complete line of pile fabrics from transparent velvets to heavy plushes both plain and fancy including imitation furs.

(6) Dyeing and finishing of all plain and crepe fabrics and jacquards.

(7) Dyeing and finishing and embossing of pile fabrics.

(8) Printing of plain, crepe, jacquard and pile fabrics.

(9) Sale of all the various types of fabrics enumerated above to retailers, cutters and jobbers.

(10) Weaving of millers bolting cloth, which is silk.

(11) Maintain an important export division serving every country on the continent and in the Near and Far East.

(12) Finished garments. Now going into the field of making their own finished garments.

b. Kampf & Spindler Hilden near Dusseldorf:

This was found to be a rather unique type of integration, ranging from pulp to woven fabric and subsequently including making their own garments. They operate about 2100 looms. It is important to note that peculiarly enough they are not doing their own dyeing, nor their own spinning of staple yarns. When questioned Mr. Spindler, Sr., stated that dyeing and finishing were done on the outside because they were making too many different qualities to run a dye shop efficiently. As to the spinning of their own staple yarns, the statement was made that plans were ready to proceed with an up-to-date spinning plant when the war broke out. Their activities, pre-war and during, were as follows:

(1) Make all their own rayon (viscose type).

(2) Make all their own staple (viscose type).

(3) Prepare and throw all their yarn requirements including crepe.

(4) Weave a complete line of dress and lining fabrics, plain and crepe.

(5) Weave a complete line of rayon spun fabrics (Zellwolle).

(6) Sell their entire output, after conversion on the outside, directly to cutters and retailers.

(7) Finished Garments. Now preparing to make their own garments.

Both the yarn spinning and the throwing and weaving plant are in the same town, Hilden. The yarn (viscose) is trucked in cakes from the yarn plant to the throwing or weaving mill in an undesulphured state. The yarn remains in this state while passing through the preparatory and weaving departments until the fabric is woven and ready for dyeing and finishing. This they consider not only a decided short cut but claim that the yarn runs better through all departments and therefore their manufacturing costs are considerably lower than competitors.

However, they recognize the fact or rather shortcoming that grey goods woven with undesulphured yarn both in warp and filling cannot be stored any length of time. Therefore, they make it a practice to put the woven goods through a boil-off process within a period of not more than 6 to 8 weeks.

c. Kunstseide A. G. - Elberfeld and Waldniehl:

This firm spins viscose yarns and controls a well equipped rather modern Throwing plant in Waldniehl known as "Kuag". The operations are integrated to the extent of:

(1) A complete line of viscose yarns for weavers and knitters, both bright and dull, in almost every known denier and put up.

(2) They process these yarns into crepes and special yarns and twists for weavers and knitters for underwear and outerwear.

(3) Preparation. They have a special department for preparing Viscose yarns for hosiery mills.

(4) Knitting yarns. They make a complete line of various yarns for home knitting and embroidery purposes.

Generally speaking, every plant visited was integrated to some extent. Most mills with more than 300 looms did their own dyeing and finishing and often also printing. It is for this reason that in comparison with the United States there are in the Rayon Industry in Germany, fewer commission dyers, printers and finishers.

d. Vertical organization:

When questioned, the reasons given for this greater degree of vertical organization set-up were as follows:

(1) Accustomed organization. The industry was originally engaged in making yarn dyed fabrics and therefore was accustomed and organized to deliver their product in the final state directly to the customer without having lost control of any operation.

(2) Most mills make a very diversified line of specialties, the success of which depends in a great many instances upon many special finishes, special treatments, particular methods of printing, or some other means of decorating their fabrics. These special methods they were determined to keep for themselves, and jealously guarded, therefore, found it best to perform all these operations under their own roof, or within their own company and control.

F. Capacity of Industry:

Capacity of the weaving industry is best expressed in number of looms. It was impossible to accurately segregate the silk and rayon looms since they are easily interchangeable, but it is safe to state that the looms running on rayon far outnumbered the silk looms. The ratio was possibly 10 to 1, as a matter of fact, at the time of the investigation very few looms were found mounted with silk warps.

Reliable statistics and information established the number and location of looms as follows:

Looms in place before the war:

Eastern zone	5,500 looms
North and South	35,000 "

Estimated in place after V E Day:

Eastern zone	Do not know - now Russian occupied
North and South	24,000 - now French, British & U. S.

It was impossible to find any data or statistics revealing what these looms produced in yards. From information gathered, however, regarding shifts and hours worked and efficiency achieved, it is obvious that the output was far less, probably only 60% of what the equivalent number of American looms would produce in the United States. Many plants, in peace and war, worked only one 10 hour day shift, and the more aggressive mills operated on a basis of two 10 hour day shifts. No rayon weaving or throwing plant was found working more than 110 hours per week.

G. War Damage:

The damage to weaving plants was considerable. Out of 35,000 looms in the North and South, 11,000 were bombed out of existence or otherwise badly damaged. The 5,500 looms reported prewar as located in the East apparently had disappeared entirely, and possibly were destroyed, or had been removed by the Russian forces. This means that in the North and South, about 30 - 35% of the weaving capacity was put out of action and that, including the East, the industry had suffered a total loss of over 40% in looms. The throwing plants suffered to a lesser extent.

The balance of the looms which were still found in place and the buildings which housed them were in condition good enough to operate except for the important fact that there was no raw material or coal available. The lack of transportation also hindered the building up process. At the time of the investigation about 15% of normal capacity of the industry was functioning. Production was entirely under United States or British military control and the output was for essentials only.

H. War Products:

Up to V E Day the industry had been busily engaged satisfying the demands from the Air Ministry or the Reichsstelle for textiles in Berlin. Since the supplies of cotton and wool had been exhausted, technicians had to resort heavily to the use of synthetics. The only natural fiber still available to them in fair but nevertheless limited quantities was Italian silk.

This was set aside for the most important and essential purpose, viz; fabrics for parachutes, and in particular human escape chutes. Without this source of silk open to them, the Luftwaffe would have been in a most serious predicament because "Perlon", the German counterpart of our nylon, was not sufficiently developed either in quality or quantity to replace silk, or to meet the exacting specifications of a human escape parachute fabric.

Then there are the various grades of cartridge cloths which under normal conditions should be made of silk yarns (bourrette, noils) if human lives are not to be endangered. Nevertheless, the Germans substituted specially treated rayon with all its inherent risks when used for this purpose. This was just so much more evidence that the supply of silk fell far short of their requirements.

The outstanding example of "Ersatz" however, came about through the shortage of wool, and the insistence of the Reichsstelle for textiles to provide the army as well as civilians with warm clothing. As a result German technicians developed a fabric now known as "Wollin Plush" which was woven in several grades, or weights, and produced in large quantities. It is a pile fabric, therefore required plush or velvet looms for its manufacture.

Thus it will be seen that every type of loom was engaged in filling the wants or needs of the German war machine.

These fabrics, their construction and uses, can be described as follows:

a. Human Escape Chute:

Made with silk, woven in the raw, boiled off and finished in the piece. The procedure in weaving and finishing was very similar to American methods. The German specifications call for a taffeta weave whereas a 2-1 twill is used in the United States. In other respects, such as weight, tear and tensile strength, the German cloth comes very close to ours. Their degree of air permeability (porosity) varies from ours due to the difference in weave, however, in discussion with technicians, we learned that they paid much less attention to air permeability and considered it less important than we do in the United States. Examination of small available yardages revealed that a good grade of silk was used, and the workmanship was of high calibre.

<u>Construction</u>: Warp: 46 ends per cm 20/22 Italian silk 3 ply
Filling: 36 picks per cm 80/88 " " (tram twist)
Weave: Taffeta
Weight: 55 grams per sq.meter (finished)

b. <u>Aerial Delivery Chute</u>:

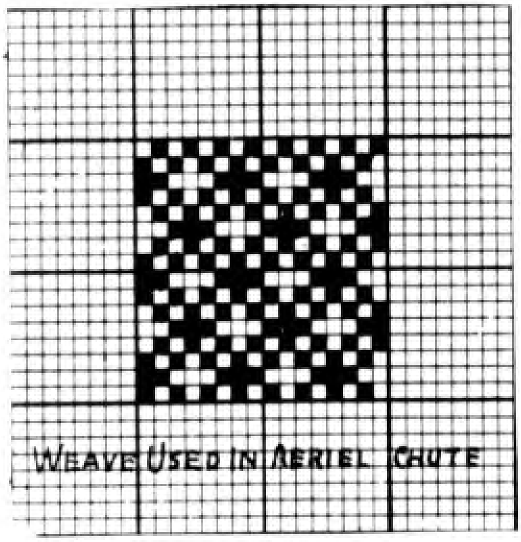
These chutes were used to drop supplies. The specifications called for Bemberg (cupramonium) in warp and filling because it was difficult to reach the specified tensile strength with regular viscose yarn. The construction details are given exactly as obtained from the German chief technician of a plant in Krefeld where considerable quantities of this cloth were being woven.

In the United States, where we had a larger choice of yarns, a medium high tenacity viscose yarn would have been used for this purpose.

Note that the size of the yarn as given in the construction detail is expressed in a metrical number (#150). Specifying yarns by the metric method was followed by a number of mills, and the practice seemed to be growing.

<u>Construction</u>:

Warp: 50 ends per cm. #150 Bemberg
equal to 60 denier 50 filament
Filling: 50 picks per cm. #150 Bemberg
equal to 60 denier 42 filament
Weave: Mock Leno
Weight: 72 - 73 grams per sq. meter finished



c. Flare Chutes - Pyrotechnic:

This fabric was used to retard the descent of all sorts of pyrotechnic flares which were dropped from planes or shot up into the air with special devices. The specifications called for an extremely light fabric with relatively very high strength. In normal or peace times the ideal thread to use would be silk and nylon next. Again, for lack of either in sufficient quantity, the Germans resorted to the next best substitute, Bemberg.

Construction:

Warp: 42 ends per cm #360 (metric) Bemberg (25 denier)
(20 filaments)

Filling: 42 picks per cm #360 " " (25 denier)
(20 filaments)

Weight: 22.8 grms. per sq. meter finished
Weave: Taffeta

d. Cartridge Cloth - Powder Bags:

Several grades of cartridge cloth were used by the German Army and Navy. Only the heaviest types were made of noil or Bourrette (silk waste), and in very limited quantities. Information received indicated that towards the end of the war no silk waste was available. Powder bag fabrics of the lighter weights, which were used in considerable quantities, were made from viscose and acetate rayon. A chemical aftertreatment was necessary to avoid excessive afterglow or gas development after firing.

In contrast to the German situation, the United States husbanded its silk waste and was more resourceful and ingenious in solving the silk yarn supply problem. Attention is called to the fact that the German construction contains acetate in the filling. Questioning of technicians revealed that so much viscose rayon production was converted into cut staple, that continuous filament yarn became very critical, so acetate was intermixed into fabrics wherever possible in order to stretch the supply of viscose.

Construction:

Warp: 65 ends per inch 150 denier viscose
Filling: 77/78 picks per inch shot as follows:
16 picks 150 denier viscose
20 " 100 " acetate
Weave: Taffeta

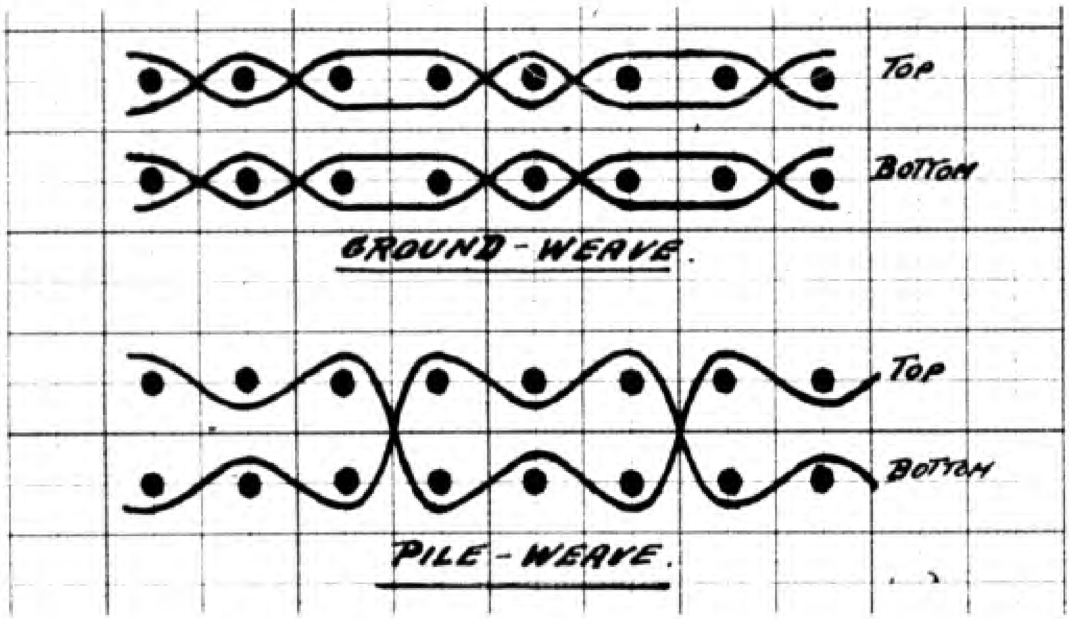
e. Wollin Plush (Immersion Suit):

The finished immersion suit fabric was composed of three layers of cloths, all of which were either viscose or acetate, or a combination of both. The principle of the invention, and the success of the suit, depended upon the capacity or ability of the middle layer to retain permanently a relatively large amount of some chemical powder, and to be of such texture that it would create the greatest possible air space between the outer and inner fabric. This was accomplished by designing a pile fabric of high or long pile. After many experiments the following rayon-acetate plush was adopted as best suited for the purpose.

Construction:

Count: 8.5½ dents per cm (reed)
Warp: Ground - 300 denier viscose, bright
Pile - 120 " acetate, dull
Filling: 26.09 picks per cm 300 denier viscose, bright
Weave: Pile - 3-6 W weave
Ground - 2-1 Twill
Pile length: 19.9 millimeters W pile straight raw
height: 6.6½ " raw
Harness draft: 4 ends ground shafts 1-4
1 " pile " 5
4 " ground " 1-4
1 " pile " 6

Cross cut weave:



f. Wollin Plush (for army vests):

The extreme shortage or lack of wool made it very difficult to provide the German troops with uniforms made of cloths which had high warmth values. This situation became very critical during the winter campaign in Russia. It must also be remembered that Germany did not have access to any important sources of furs and skins suitable for winter clothing. Therefore, technicians resorted to a pile fabric which in many respects was similar to the immersion suit plush. It was claimed that its warmth evaluation was about 80% of wool. However, it could only be used as an interlining, since it had very poor abrasion resistance and was totally unfit as an outer cloth for any garment, particularly a uniform.

Construction:

Count: 9.5½ dents per cm
Warp: Ground - 300 denier viscose, bright
Pile - 120 denier 3 ply acetate, dull
Filling: 34.79 picks per cm 150 denier viscose, bright
Pile length: 16 millimeters straight raw
Harness draft:) same as in sample described in
and Weave :) preceding paragraph

g. Outer Surface Cloth for Immersion Suit:

Inquiries developed the fact that this fabric was selected from several existing constructions as the best available at that time. But experiments were carried on to find the ideal and most effective type of acetate fabric to be used as an outer garment for the important aviators immersion suit. However, at the time of the investigation all suits were made with an outside fabric as described below:

Construction:

Count: 92 x 52 (off loom)
Warp: 125 denier 25 filament acetate, dull, 3 turns
Filling: 300 denier 50 " " " 3 "
Weave: Taffeta

h. Inner Surface Cloth for Immersion Suit:

The lining, or inner garment found at the time of the investigation was also still considered an experiment, and at the time of cessation of hostilities several other fabrics were being prepared for actual tests in an effort to find a construction best suited for this unusual and particular purpose. The one found in the garments was as follows:

Construction:

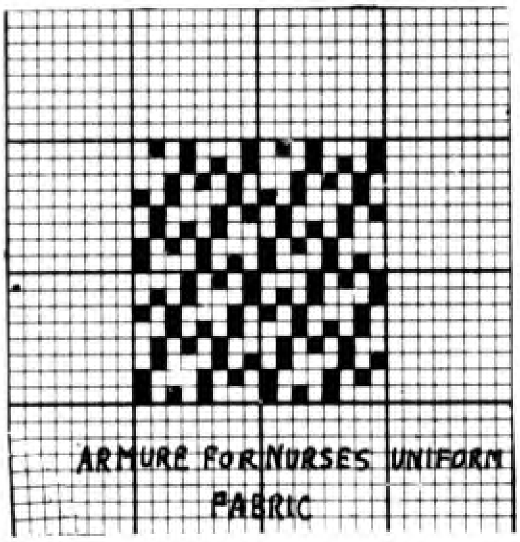
Count: 82 x 60
Warp: 300 denier 58 filament viscose, bright
Filling: 320 " 60 " " "
Weave: 2:1 Twill

i. Nurses Uniforms:

This fabric differed from most others inasmuch as it was a yarn dyed construction instead of the usual piece dye type. It was well conceived and without any doubt very practical and serviceable. The warp was white and the filling fast dye black. The fancy dobby weave used gave the fabric a very attractive appearance, creating a pleasing medium grey color.

Construction:

Count: 30 ends per cm
Warp: #50 metric (180 denier) viscose, white, dull
Filling: 33 picks per cm #60 metric (150 denier) viscose, black, bright
Remarks: Both warp and filling are yarn dyed
Weave: Armure



j. <u>Lining for Army Clothing</u>:

Several types were found, some all viscose, some viscose and acetate, but according to reliable information, a viscose-Bemberg construction was considered the best and recognized as the army's standard. At least this situation existed at the end of the war and at the time of this investigation.

<u>Construction</u>:

Count: 64 ends per cm
Warp: #60 metric (150 denier) viscose, bright
Filling: 24 picks per cm #38 metric (235 denier)
Bemberg, bright
Weave: 5 shaft satin

k. Army Winter Vests:

The photographs #1 and #2 show the Wollin plush fabric and the garment (vest) which was made thereof. I. Girmes & Company, in Oedt had orders for 4,000,000 of these vests, but V.E. Day happened before the first million was finished. These vests were particularly designed for use at the Russian front, and possibly Norway. The garment was sleeveless and without buttons. Instead, it had several cotton tapes with which it was possible to tie the garment snugly around the body. The vest was worn pile side out and under the uniform coat. The lining was an ordinary low grade rayon taffeta fabric. Both pile fabric and lining were dyed a dark navy color.

l. Immersion Suit:

Illustration #3 shows plainly the three layers of cloth used in making the immersion suit. First, in the extreme lower left corner there is the inner fabric, of the white viscose twill to be seen. Then next, with corner turned over, comes the high pile Wollin plush. Note the coarse 300 denier back (ground) of the plush, and most important, note the high, dense (3 ply 120 denier acetate) pile. It is into this pile that the special chemical powder is rubbed. Lastly, observe the dark colored (dark steel grey) outer cloth made of acetate.

The quilting, or stitching together of the three layers in diamond fashion design, not only combines the three fabrics into one, but much more important and absolutely imperative, is the purpose that these "compartments" retain the powder in given areas properly distributed regardless of the shaking caused by the wearer of the garment while he moves around.

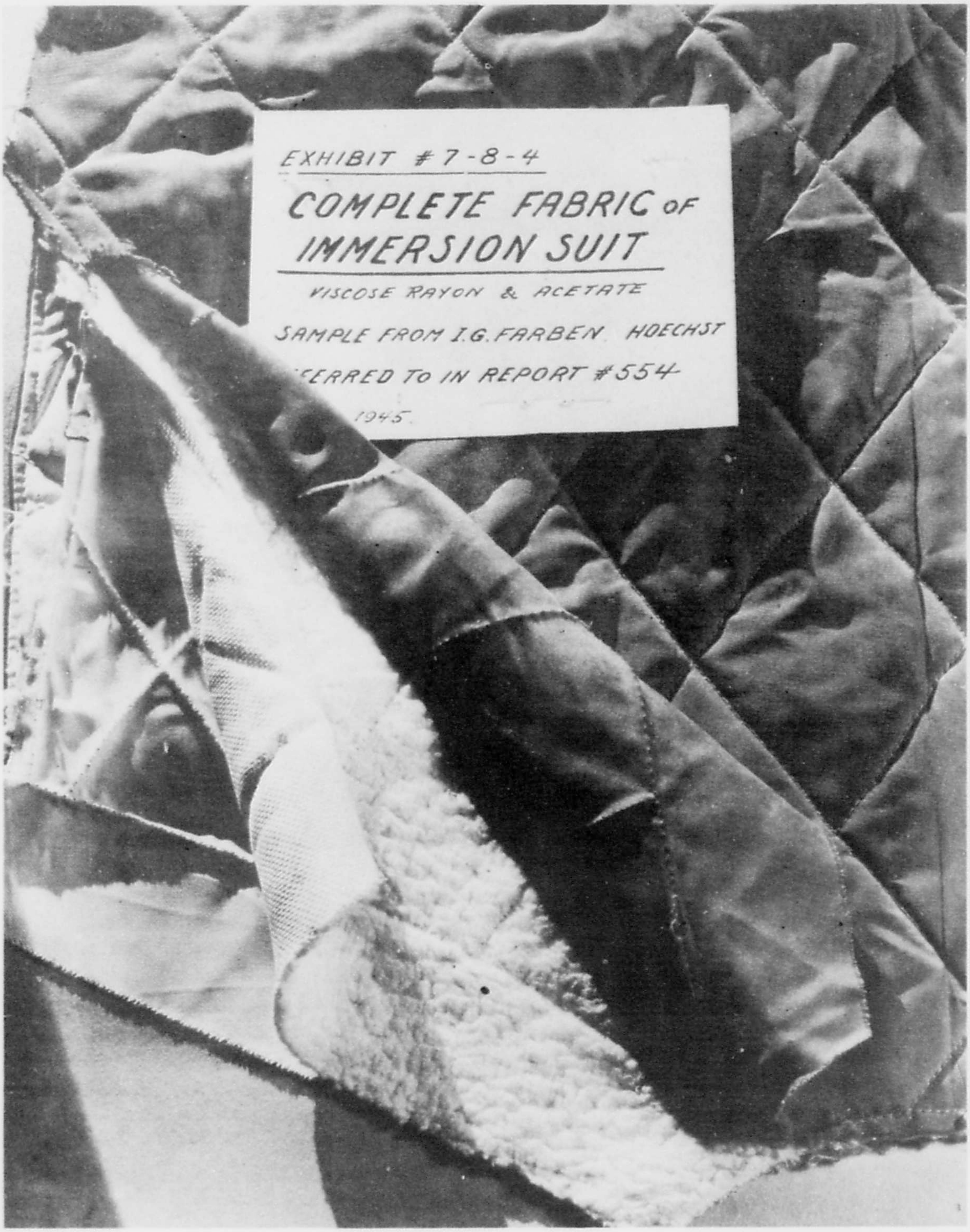
Illustration #4 shows the complete jacket. For full details regarding immersion suit, refer to Meierhan's report.

Fabric for Army Winter Vests

Illustration #1

Army Winter Vests

Illustration #2



Fabric of Immersion Suit
Illustration #3

Immersion Jacket
Illustration #4

I. Preparatory Manufacturing Methods:

a. Soaking and Drying:

All plants use the tub soaking method, with subsequent "whizzing" in extractors, and final drying in heated rooms or drying ovens. The latter are not, by far, up to the American standard of drying equipment.

It was evident that during the years 1939 - 1945 many different soaking formulas were tried out by the German rayon mills. The one which was used by several large companies up to about 1943 was known under the trade name "Gamma". It was a French patented formula using linseed oil and naphtha. It produced a good running yarn after soaking, and the creping effect or pebble in the woven cloth was very satisfactory when the soaking was applied to yarns which were afterwards twisted into crepe. However, the Gamma process had several serious disadvantages, viz:

First, it was expensive because of the ingredients used. These ingredients also became scarce as the war went on.

Secondly, on account of the volatile nature of naphtha and linseed oil and the fumes, the entire process of soaking had to be performed in specially erected separate buildings or rooms, which again meant additional expense. Fire insurance companies insisted on this safeguard.

Thirdly, and possibly most important, the yarn or the woven merchandise so soaked, could not be stored for any length of time without deterioration setting in. This could only be prevented by putting the fabrics through a scouring or boiloff process within four to six weeks after soaking.

Therefore, at the time of the investigation, and for several years previous, most or all German plants had adopted soaking formulas of the gelatin and oil type, similar to American practices. No soaking machines were found; everything was done by the tub method.

b. Winding:

All machines were of the single deck type. They were running at 20% to 30% less speed than run in the United States. This was blamed on the poor yarn. A few plants were equipped with a Swiss, so-called spindle-less winder of the Brugger type. These machines were capable of good, high speed, but poor rayon yarn made it impossible to take advantage of a winder built for high speed. No new developments were found.

c. Warping:

Notwithstanding the fact that the firm of Schlick (Chemnitz) was one of the first in the field of modern high speed warpers, it is strange that so few Schlick warpers or similar equipment was found in rayon weaving mills.

About 80% of all warping machinery is of the old silk reel type. Most reels are not more than 2 - 3 meters in circumference. It is admitted that this old silk system lends itself very well to small orders, and is quite satisfactory for plants that make a great variety of goods and novelties.

Only a few plants had high speed installations known in the United States as the cotton system, such as Schlick warpers or beamers. It seems, however, that mills were gradually equipping themselves with high speed warpers because they were forced during the war to use more and more spun rayon (Zellwolle) which, of course, cannot be handled economically, if at all, with the small silk reels.

Warping speeds, with very few exceptions, were from 10% to 40% lower than United States practices. This again was blamed on very poor raw material (war production).

d. Slashing:

The Germans have always favored what we would consider the old fashioned method of slashing, namely; an arrangement whereby the warp, immediately after passing through the slashing solution and the squeeze roller, is led into a drying chamber. These chambers are about 9' wide, easily 12' to 15' long, and about 8' high. The warp is led through these drying chambers either in a zig zag fashion up and down, or it might also be guided through in a horizontal fashion by being led over rollers back and forth.

The whole arrangement is known as the Zell system of slashing and drying.

It must be admitted that this method of slashing disturbs the warp, or threads very little, and the weaving efficiency obtained from these air dried warps is considered very satisfactory. Experience in the United States with this type of slashing and drying has been that it was expensive, due to low speed.

Anything approaching the American method of slashing with three and five cylinder machines was found in only very few mills. Not a single seven cylinder slashing machine was found anywhere.

The Germans claimed that our method of slashing and drying with cylinders flatens the threads, as a matter of fact, they claimed it may even bake the material and has a weakening effect upon the yarn, consequently, reduces weaving efficiency.

It is well known, of course, that with all the modern controls which we have on our American slashers, we have overcome all these shortcomings. Furthermore, we slash at a speed almost double that of the German method, and our efficiency on the loom is well over 90%, whereas the Germans feel they are doing well with an efficiency of somewhere between 80% and 88% on the looms, and furthermore they operate far less looms per weaver than we do in the United States. A complement of 8 - 10 automatic box looms is considered a full assignment for one weaver.

One manufacturer claimed he was running his Zell dryer and slasher at 80 meters per minute, but subsequent inquiries did not bring forth confirmation of this statement.

As to the type of slashing solution or formula which the Germans used, it was found they preferred solutions containing some volatiles like benzene and naphtha. They were certain these ingredients or agents in their formula prevented overstretching of the warp, consequently gave them better weaving efficiency and better finished merchandise. However, again they also found out that fabrics made with warps which were slashed with these volatile ingredients could not be stored for any length of time without being scoured or boiled off. Furthermore, the fumes created in the slashing room were objected to by the operators, and last but not least, there was a considerable fire hazard.

In 1943 this resulted in slashing solutions composed of ingredients very similar to those used in the United States. One chemical concern promoted a cold slashing solution. It was tried extensively by various weaving plants but was given up entirely in 1945 since it did not give the desired results.

e. Warping-Slashing Shortcut:

One concern in Krefeld developed a shortcut in warping and slashing. They first made their war by the silk method, which means they put their warp on a reel of 3 meters circumference. In the ordinary procedure this warp would be beamed onto the loom beam, which would then be taken to the slasher. However, instead of going through this beaming operation, this firm had arranged their warping machine in such a manner that the entire 3 meter reel with the finished warp on it could be lifted out of the warping machine by means of an overhead crane. Thus the warp reel was brought to the nearby slasher and the slashing operation performed directly from the reel. This is a worthwhile and important saving of the tedious and lengthy operation of beaming. Not only that, but as soon as the reel with the warp was removed from the warping machine, an extra or empty reel was lowered into the machine and the operator was ready within a few minutes to start a new warp. By this method the production of the warping machine was practically doubled and the warp itself had to undergo one less operation. All of this is not only time saving, but certainly helps keep the material in better working condition.

f. Copping (Quilling):

Several installations of the American Leesonia winder were found. This is a well spoken of winder. The most advanced German cop winder seen is the Schlafhorst automatic. It operates similar to the Schweiter built by Whitin in the United States. It is a comparatively recent development and merits watching. It operates by single individual spindle, and not in groups of four like the Hacoba. Another cop winder found in many mills was the Swiss Schaerer of the old type, not the automatic. One installation of Schaerer automatics was inspected and it looked as if it functioned perfectly. While it is an automatic machine, it might be called 90% such, inasmuch as the operator has to doff and replace cops by hand, but the seven spindle revolver arrangement allows her to tend a considerably higher number of spindles than on the old machine. This machine bears watching.

g. Twisting and Entering:

Due to the great variety of qualities which are being made in the German mills they are practically compelled to do most of their twisting and entering by hand. Nevertheless, there is a German made knotting machine in use in some mills (made by Fisher & Company). This knotter is being made in both stationary and portable types. A few mills were using the Swiss Uster knotter. Neither the German or Swiss machines performed better or faster than the American Barber Colman.

J. Throwing Manufacturing Methods:

It is in the field of throwing equipment where the Germans have shown considerable progress. In some respects they not only compare favorably with the United States, but they are a step ahead. All their machines are well built, generally with heavier frames than the American, and considerable attention is given to fine precision machining and elimination of vibration. The German up and down-twisters take up about 10% more floor space but in speed they come very close to American practice. Down-twisters are being operated at 7000-8500 RPM spindle speed, and up-twisters from 9000-11000 RPM.

a. Bobbins, Packages, etc.:

German throwing plants have used large packages or bobbins for some time in plants where rayon was being thrown. Small bobbins of the 3-4 ounce type were only found in mills which before the war still used considerable silk. In rayon throwing plants the bobbins varied from the 6-8 ounce type up to the 1-1/3 pound (600 grams) observed on the Barmag latest up-twister. For some unexplained reason the down twisters were equipped mostly with the smaller type bobbins. This means there was no synchronization of packages or spools between up and down-twisters, which from the American viewpoint is a decided and great disadvantage.

In many instances the take-up package on the up-twisters was not only of good size, as for instance 8-12 ounces or more, but it was of the headless type. Furthermore, these headless packages were tapered at the ends. This was accomplished with a special traverse motion, which in turn means the entire machine had to be doffed at the same time if highest efficiency is demanded. In one plant a few up-twisters were found where an individual tapering device, working independently on every spindle, was being tried out.

Headless packages have been used in Germany, France, Switzerland and Italy as far back as 1924 on all sorts of materials, including crepes of both silk and rayon. However, they were of the small, 3-5 ounce type. Germany was first to apply the idea to larger take up packages. This development is an interesting one, particularly for throwing-weaving integrated mills, and bears watching.

b. Conical Take-Up Package:

Another step forward has been made by arranging the take-up mechanism in such manner that the final package is a cone instead of a parallel tube (also called cheese). This has the advantage of facilitating the drawing off overhead on high speed warpers and automatic quillers.

The size of the packages range from 12 oz. to 18 oz., but on the average are about 1 pound.

c. Barmag Dual Up-Twister:

The Barmen Maschinenfabrik in Remscheid-Lennep is the outstanding builder of throwing machinery. They are generally known under the trade name "BARMAG". They have been pioneers in many developments in up and down-twisters, and are also well known as capable designers and builders of machinery for the rayon yarn producting industry.

One of their recent important and noteworthy developments was the dual up-twister. They call it in German "Doppeldraht" Twisting Machine. By dual or doppel, the indication is given that the machine produces at double efficiency or production. The principle is not new; it is based on the hollow spindle formula, but no one succeeded in putting it to practical application until Barmag tackled the problem and apparently overcame and solved all the difficulties involved.

This investigator visited Barmag the first time in 1936, and at that time was shown the first experimental hollow or dual twist spindles. These early spindles were designed for rayon yarn producers, and capable of only low, or primary twists of about 2 - 10 turns per inch. These machines were rapidly improved so that by 1938 - 1940 a considerable number of spindles were actually in practical use in several large rayon yarn producing plants. More of these installations were added in other plants during 1940 - 1945 because the Barmag equipment was particularly efficient for putting twists into heavy rayon tire yarns.

The advantage was that with the dual principle there was, so to say, no limit on the size or weight of the delivery package, because that package, spool, cake, cone, or whatever it may be, is not rotated, but is stationary.

These low twist dual spindles are fully described in FIAT final report No. 473 by Capt. J. L. Truslow and Mr. Robert Jones.

It was at the instigation and urging of the writer in 1936 that Barmag undertook to experiment with a dual twist spindle capable of putting high or crepe twists into rayon and other fine yarns, as for instance, silk. In this Barmag succeeded, and in November, 1945, they had a sample machine in operation which functioned and performed perfectly in every respect.

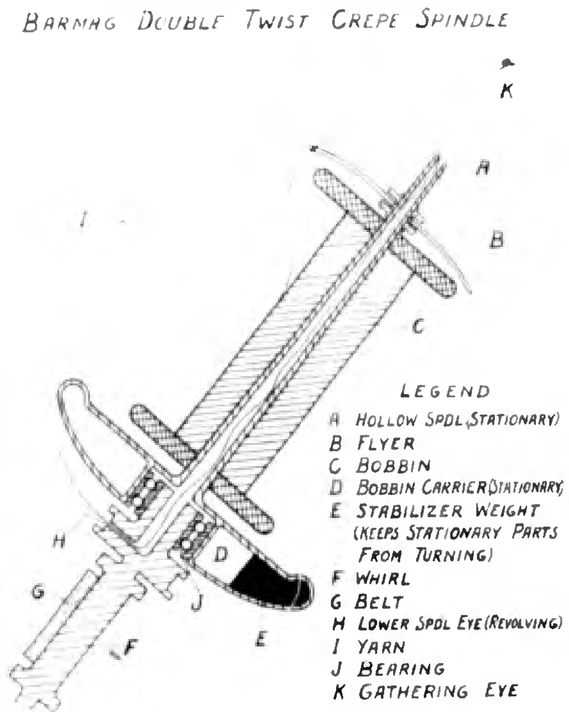


Illustration #5

Illustration #5 shows a crosscut through the crepe spindle, which functions as follows:

Bobbin C is firmly slipped over hollow spindle A which is one piece with bobbin carrier D.

Carrier D is formed like a hollow dish. About one quarter of the hollow space is filled with a heavy metal shown as E, and called stablizer.

D (with A and C) rests through ballbearings J on upper part of whirl F.

Through belt G whirl F is rotated, but because of peculiar position of about 45° angle at which spindle is fixed on frame, the stablizer weight keeps D, A and C stationary, whereas F rotates.

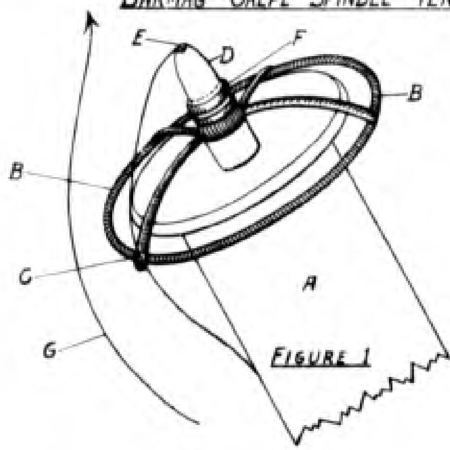
In upper part of F observe opening H, called lower spindle eye, which rotates with F.

Thread I is taken from spool, guided through flyer B into upper opening at A, and out through lower opening eye H. During the unwinding from the spool a first full twist is given to the yarn between spool and opening A. The flyer is loose and rotates by force of the unwinding yarn.

The second full turn or twist is given to the yarn between lower eye H (rotating) and gathering eye K. Thread I balloons around bobbin carrier D.

The tension of the yarn is regulated by the flyer, which is shown in illustration #6. Washers D can be arranged so the tension is light or heavy. The flyer is made of aluminum, is extremely light and well balanced.

BARMAG CREPE SPINDLE TENSION



LEGEND

A SUPPLY SPOOL OR PACKAGE
B ALUMINUM FLYER - EXTREMELY LIGHT
C THREADING EYE FOR YARN COMING OFF SUPPLY SPOOL
D SPINDLE TOP
E OPENING IN HOLLOW SPINDLE
F TENSION WASHERS
G BALLOON OF THREAD GOING TO TAKE-UP SPOOL

Illustration #6

The spindle is capable of very high speed, and at the time of inspection was running at 12,500 RPM actual spindle speed, which is equivalent to 25,000 RPM twisting speed, something certainly never heard of before.

This was more remarkable when one considers the yarn running on this dual twister was 90 denier cupramonium of poor quality, and the twist was 2,200 per meter, or about 50 turns per inch. During the several hours of inspection there were few breaks.

Illustration #7 shows a cross cut and illustration #8 a front view of the Barmag crepe up twister as compared with a United States up-twister (1 lb. package). Note in the cross cut the angle position of the spindle on the German machine.

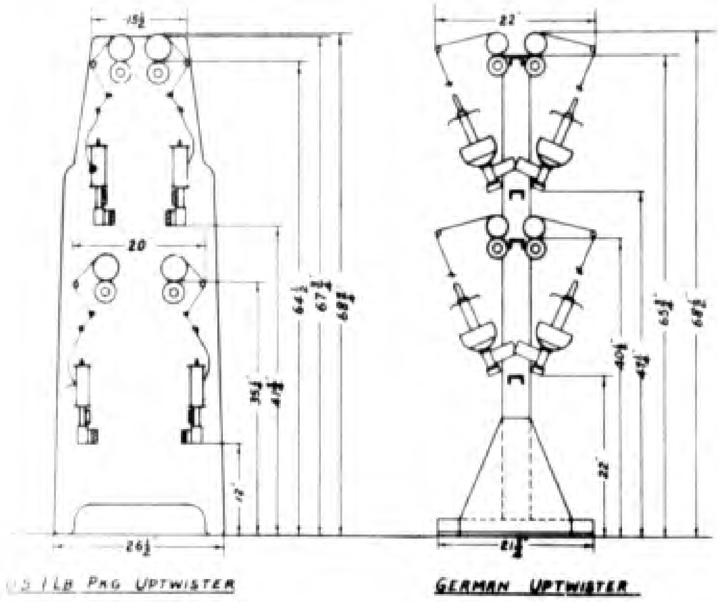


Illustration #7

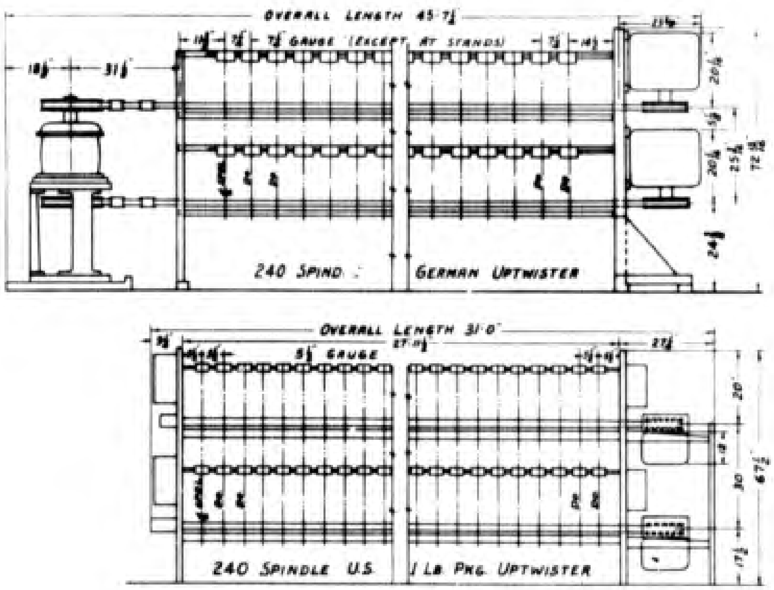


Illustration #8

The experimental frame in operation showed a very economical set up. Some of the pertinent facts and measurements are as follows:

Weight of yarn on take-up package -- 600 grms.
Type take-up package -- headless
Spindle spacing -- 18 cm.
Spindles one side -- 120
Total spindles both sides -- 240
Total length of machine -- 13.9 m.
Total height of 2 deck machine -- 180 cm.
Total width of machine -- 56 cm.
Position of lower spindle -- 62 cm. from floor
Position of upper take-up -- 170 cm. from floor.

From data given above it is obvious that, considering the production per square foot, this machine is very economical from the viewpoint of floorspace, and that essential parts are within easy and comfortable reach of the operator.

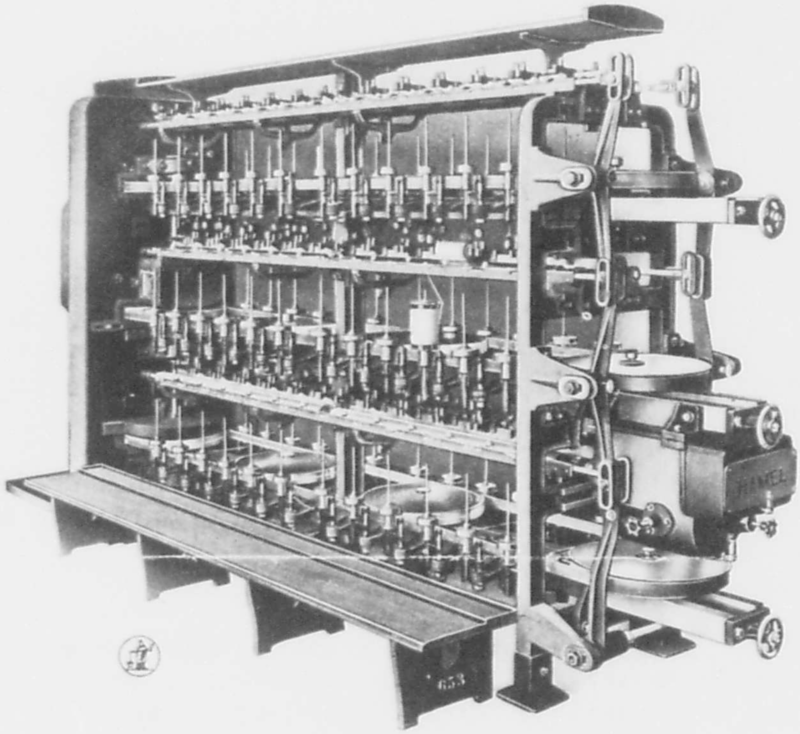
It is also to be noted that the Germans prefer, and advocate, that the motor be on a separate base, in order to avoid vibration in the twisting frame.

It is the writer's firm belief that the dual, or double twist, or hollow spindle principle is sound, and workable, and certainly will eventually replace the present conventional method. It is earnestly urged that American textile machine builders give this development their immediate serious attention.

d. <u>Hamel - Three Deck Up-Twister:</u>

There are quite a number of three deck Hamel up-twisters in operation. Naturally, the saving in floor space is considerable. The machine does not give the impression of being crowded. However, it may be that American operators would object to the somewhat extremely low and high points of the machine which have to be served. With ever rising manufacturing costs, this very economical three deck arrangement merits attention. Barmag, one of the foremost builders of throwing machinery, is seriously considering designing a three deck up-twister, but using the dual or hollow spindle principle.

Illustration #9 shows the latest Hamel three deck arrangement in an up-twister. A number of these machines were observed in operation at the Kampf and Spindler plant in Hilden, near Duesseldorf. They performed to complete satisfaction.



Betrieb der Changierbewegung

Illustration #9

Maße und Gewichte Modell LL7

* Die Längenmaße verstehen sich von Außenkante Hauptwand bis Außenkante Endwand

Anzahl der Spindeln		54	108	162	216	270	324	378	
160 mm Teilung	Länge*	2,79	4,32	5,85	7,38	8,91	10,44	11,97 m	
	brutto	1665	2260	3015	3765	4515	5260	5790 kg	
	netto	1330	1810	2410	3010	3610	4210	4630 „	

Anzahl der Spindeln		36	72	120	168	216	264	312	360
180 mm Teilung	Länge	2,41	3,56	5,07	6,58	8,09	9,60	11,11	13,62 m
	brutto	1560	2050	2720	3375	4040	4695	5350	6020 kg
	netto	1245	1645	2170	2700	3225	3755	4280	4810 „

Anzahl der Spindeln		36	72	114	156	198	240	282	324
200 mm Teilung	Länge	2,51	3,76	5,21	6,66	8,11	9,56	11,01	1246 m
	brutto	1600	2140	2770	3400	4030	4660	5290	5920 kg
	netto	1280	1710	2210	2720	3220	3730	4230	4730 „

Die vorstehenden Maße erhöhen sich bei Elektromotorantrieb mit Kraftübertragung durch Keilriemen um etwa 710 mm, bei Transmissionsantrieb mit Fest- und Losscheiben um etwa 460 mm.

Die **Breite** beträgt 1,4 m einschließlich Fußtritt (etwa 0,50 m von Spindelmitte bis Spindelmitte).

Raumbedarf auf 1000 kg brutto etwa 1¾ cbm

Illustration #10

Hamel Dimension Table

The Carl Hamel Company, with plants in Arbon, Switzerland, and Chemnitz (possibly destroyed) are well known as designers and builders of throwing, winding, coning and other special machines for the twisting and packaging of all kinds of yarn.

e. <u>Kuag - Combination Up Twister-Doubler:</u>

Kuag is a rather modern throwing plant operating as a subsidiary of the Kunstseide A. G. of Elberfeld. The Kuag plant is located in Waldniehl which is in the Munchen-Gladbach district.

This concern found itself long on double deck up-twisters, but short of down-twisters, or doubling capacity. They helped themselves in a rather ingenious way by converting a double deck up-twister into a combination twister and doubler. The arrangement is shown in illustration #11.

HOLLOW SPINDLE UP-TWISTING-DOUBLING (KUAG)

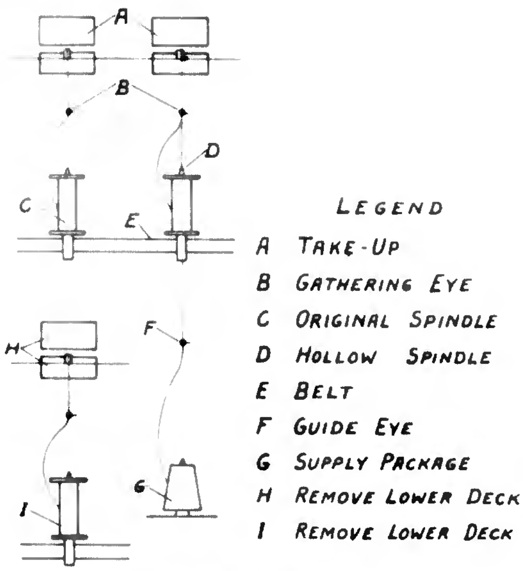


Illustration #11

Lower deck H, I was removed and replaced with a rack to hold cone G. The upper deck and take up rolls were left intact, except that spindle C, which was a conventional spindle, was replaced by D, which is a hollow spindle.

The process then was simply to draw the yarn from cone G through eye F, through hollow spindle D, up through gathering eye B to the take up bobbin. The yarn to be combined with the "cone" yarn was drawn off the bobbin on spindle D, through the gathering eye B to the take up roll. Belt E acting upon spindle D would rotate spindle D and bobbin, and twist the "bobbin" yarn in spiral fashion around the "cone" yarn coming from the lower rack (G). The speed of spindle D, in relation to the speed of the take up roll, would determine the amount of twist or turns per centemeter or inch the finished combination yarn would contain.

A battery of such machines was observed in operation, most of them running on a combination yarn of viscose crepe and acetate or Zellwolle. The finished yarns looked very satisfactory.

f. Down-Twisters:

Nothing new was discovered. All down-twisters seen were of the conventional type of ring twister. Some variation of ring lubrication was noticed, but nothing of importance. Surprisingly, in most mills there was no synchronization in the size of bobbin or package between the up and down-twisting departments.

All machines of all builders take up too much floor space compared with the American doubling machines, generally referred to as 5B's.

The German machines have heavier frames, and motors usually are not "built in", but are on separate stands, in order to reduce or eliminate vibration.

7. Weaving Manufacturing Methods:

a. Looms:

Generally speaking, the weaving equipment found was by far not up to United States standards. Automatic looms were only found in very limited numbers, and in comparatively few rayon weaving mills. Most mills, including some of the larger and important ones, were content to operate the old non-automatic looms, running about 2 - 4 looms per weaver. They could do this and still remain competitive because wages were low, consequently the pressure and need for technological improvements and progress did not exist; certainly by far not to the extent that is the case in the United States.

Only one plant was found claiming that in prewar days they had run 30 automatic looms per weaver on a four shaft simple rayon fabric. These were single shuttle looms of the Northrop automatic cop-changing type. This plant was located in Wendlingen (Neckar) and was a branch of the Suddeutscher Spinnweber Verband, with headquarters in Stuttgart.

There was little evidence of standardization, and there were many plants with a total of 300 looms where three to five different makes were discovered. A phenomena seldom encountered in America is the fact that so many weaving plants, not necessarily only the large ones, at one time or another have built their own looms, sometimes in quantities as little as 50, and possibly up to 200. These "home made" looms were not radically different from others, except for minor details or special gadgets, not very important in the writer's opinion. The cost of such equipment obviously is high.

The automatic looms found, if single shuttle, were of the Northrop type. The automatic box looms, however, were of several different makes. Most of them were old, of almost any of the German, French, or Swiss types, converted into automatics by equipping them with a shuttle change attachment.

The most popular of these attachments seemed to be the French Poncet patent, which can be adapted to almost any type of old loom. The Poncet follows the old American Stafford system, that is, the loom stops for about four picks while the shuttle change takes place.

However, it is important to note that mill owners and managers were fully aware, and well acquainted with the progress which had been made in the United States in the last decade. Therefore, many of the more progressive companies were all prepared to modernize their weaving plants, and in many instances orders had been placed for automatic looms, or attachments to convert an old loom into an automatic.

New looms of various makes were found in several mills, placed there on an experimental basis. Apparently it was the war that stopped further progress. These looms were the product of such builders as:

Saechsische Maschinenfabrik (Schoenherr) - Saxony
Elsaessische Maschinenfabrik A. G. (Elmag) - Alsace
Roscher - Saxony
Ruti - Switzerland
Jaeggli - Switzerland

They were all of the shuttle change type, based on the principle of stopping for a few picks during the shuttle change.

Some German weavers expressed interest in the Saurer loom, built in Arbon, Switzerland. This loom has many new features, the most important one being its flexibility. The makers claim the loom can be operated as a bobbin or shuttle change automatic, and as efficiently as a box loom, or a single shuttle loom.

All new models of German or Swiss looms are equipped with the "in reverse" motion. This means a weaver can turn the loom backward through motor power by means of a special handle or lever conveniently located near the starting handle. This is considered a labor saving feature of importance when the weaver is looking for a lost pick, and it is of particular value where the loom is producing an armure, or a jacquard weave.

Some of these new loom models show the warp stand on separate frames. All of them, however, are equipped with automatic warp letoff motions.

b. <u>Japanese Loom</u>:

During the various interviews with experts and mill managers a very interesting fact came to light, namely; that as recently as 1941 and 1942, the German rayon weavers showed a great deal of interest in the Japanese Sakamoto loom. A few of them had been placed in German plants and were under careful observation.

Persistent questioning revealed the fact that they had no intention of buying any of these looms from Japan, but instead to take the loom and its best features, redesign it to suit German conditions and then build it in Germany. These plans, of course, were impossible of execution on account of the war reverses in 1943 and afterwards.

The best way to demonstrate what they thought of the loom is to reproduce the authentic report made to the industry by Bernhard Bisinger, research director at the Lehrspinnerei Denkendorf, and an authority on weaving equipment.

(1) Report on Sakamoto Loom:

"ZELLWOLLE-LEHRSPINNEREI G.M.B.H. DENKENDORF bei ESSLINGEN a.N.

Denkendorf, June 20, 1941
T 268/22

Report on a SAKAMOTO-LOOM, made after having inspected it at the firm "Textile-works Schindler Co.", Kennelbach, near Bregenz, Vorarlberg.

This Japanese Automatic Weaving Loom, which has been constructed by the firm K. Onishi & Co., Ltd., Mishinocho Satsumabori Nishiku, Osaka, Japan, 80, is built and looks like an ordinary automatic loom, such as has been used until now by the cotton weaving industry. In spite of the fact that the designer has not applied entirely new principles in the construction of the loom, a number of details are shaped and constructed in a manner different from the one customary here. When we compare this automatic loom with ours, we find that the main improvement in its design is the decrease of space needed for it, and the decrease of its weight, and the consumption of power, in spite of the fact that its capacity is equally good or better, and the fact that it is easily handled by foremen and weavers, also that it brings about a decrease of time lost in getting the machine ready to operate, as well as other loss of time. The greatest advantage of this automatic loom, which has also been used in Germany for several years, and which has proved its worth there, is a price which by our standards is abnormally low.

Its cost (including freight) from Kobe on is 930 Yen = RM 540.— including cost of transportation and customs is RM 8/900.00 yet the reed space is approximately 150 cm, whereas a German automatic loom with equal capacity costs RM 14/1600.00.

Technical details (given 159 cm reed space)

1. Proportions:

a) width	2780 cm
b) depth	1240 cm
c) height (height of arch)	130 cm
d) height of working space	83 cm

2. Weight without heald machine ?

3. Construction:

a) reed fastening	loose reed mechanism
b) harness movement	inside treading motion
c) slay	under pick motion, special construction, similar to construction "Lenz"
d) cloth beam	special construction rough roller (sand roller) instead of breast beam
e) delivery of warp	letoff motion both sides by warp
f) fastening of main shaft bearing	special construction, cotter connection
g) mechanism for preserving warp	swinging back rail
h) weft change	automatic change of bobbins Northrop system
i) drive	individual drive with wedge strap transmission of power
j) stop motion	with guide rail

4. Performance:

a) About 180 picks per minute
It has been noticed that inferior material reduces picks to about 150 per minute

b) number of looms per weaver: (without taking into consideration extra men who put on change wheel, transportation helpers) up to 50

c) output 80-90%

d) highest obtainable weight of goods: 250 gr per sq m

e) power needed 0.5 HP

5. Prominent innovations:

a) Low frame, shafts placed comparatively low, low line cross bars give great strength in spite of small weight.

b) Special slay production (Lenz System) results in strong yet soft slay, nevertheless causes extremely small tremor of the loom. All this results in low weight, high number of picks and low requirement of power.

c) Low frame, small depth, easily removable frictional resistance of letting off facilitates servicing by the weaver. This results in efficiency and high number of serviced looms.

d) Easy accessibility of the machine, easy and rapid exchangibility of shafts by cotter connection between bearing and frame, and other conveniences facilitate servicing by the foreman and also increase output.

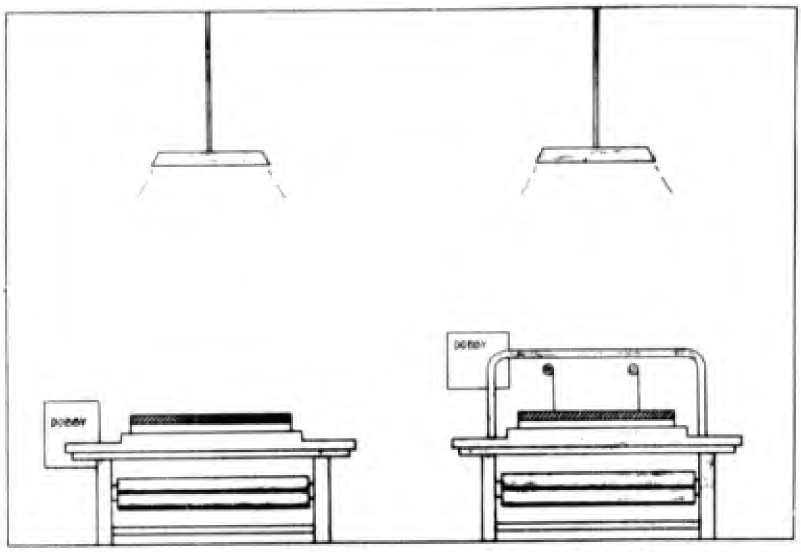
General Estimate

Many construction details of the loom are of suggestive value to the German loom construction industry, especially with respect to easy servicibility, lightweight construction, very low power consumption and cheapness if those constructive elements which would increase the loom's price could be avoided, such as brass bearings, positive weavers beam regulator, lack of superstructure. It should also be possible in Germany to construct such a loom at lower cost than those types that have so far been offered on the market. Since one will have to figure on sensitive material (spun rayon) here the low depth of the Sakamoto loom seems a small easily avoidable disadvantage. The easy serviceability should also, under the four loom system, be a great advantage, considering the expectant lack of manpower in general, and a servicing by women in particular. Compared with the most recent German construction models, however, the advantages of the Japanese loom, apart from its cheapness, are not so big as to make advisable the import of such looms, considering the present day foreign exchange situation. Whether in the future German automatic loom construction of such kind, possibly improved by a shaft lifting lever on the side, a construction of nip rollers, positive weavers beam regulator, central greasing, and other output increasing, also price increasing construction elements should be carried on a grand scale, cannot be decided before a finished model of the Rossmann weaving loom will be ready, because this machine, if proved practical in actual use, would make obsolete all automatic weaving looms of present day construction, including the Sakamoto loom, at least in the cotton and spun rayon field."

(End of German report)

c. Loom Without Superstructure:

Without exception, all new models of German and Swiss looms observed, wherever they were installed, were built without superstructure. There is no doubt but that this streamlined design for a loom has been adopted by all German and Swiss loom builders, and so far as they are concerned, is here to stay. As will be seen from illustration #12 no part of the loom is any higher than either the dobby, which is only shoulder high, or the top of the harness shafts, which is even lower.



Comparison of Looms with and
without Superstructure

Illustration #12

A number of favorable claims are made by the builders and users of the looms, the most significant of which are:

(1) Harness and reed areas receive much more and better light because there are no shadows from higher traverses, etc. This facilitates many functions of the weaver and fixer.

(2) Accessibility:

All parts, particularly the dobby, are easily accessible, facilitating the fixers job.

(3) Supervision:

Decidedly better supervision and control.

(4) No superstructure:

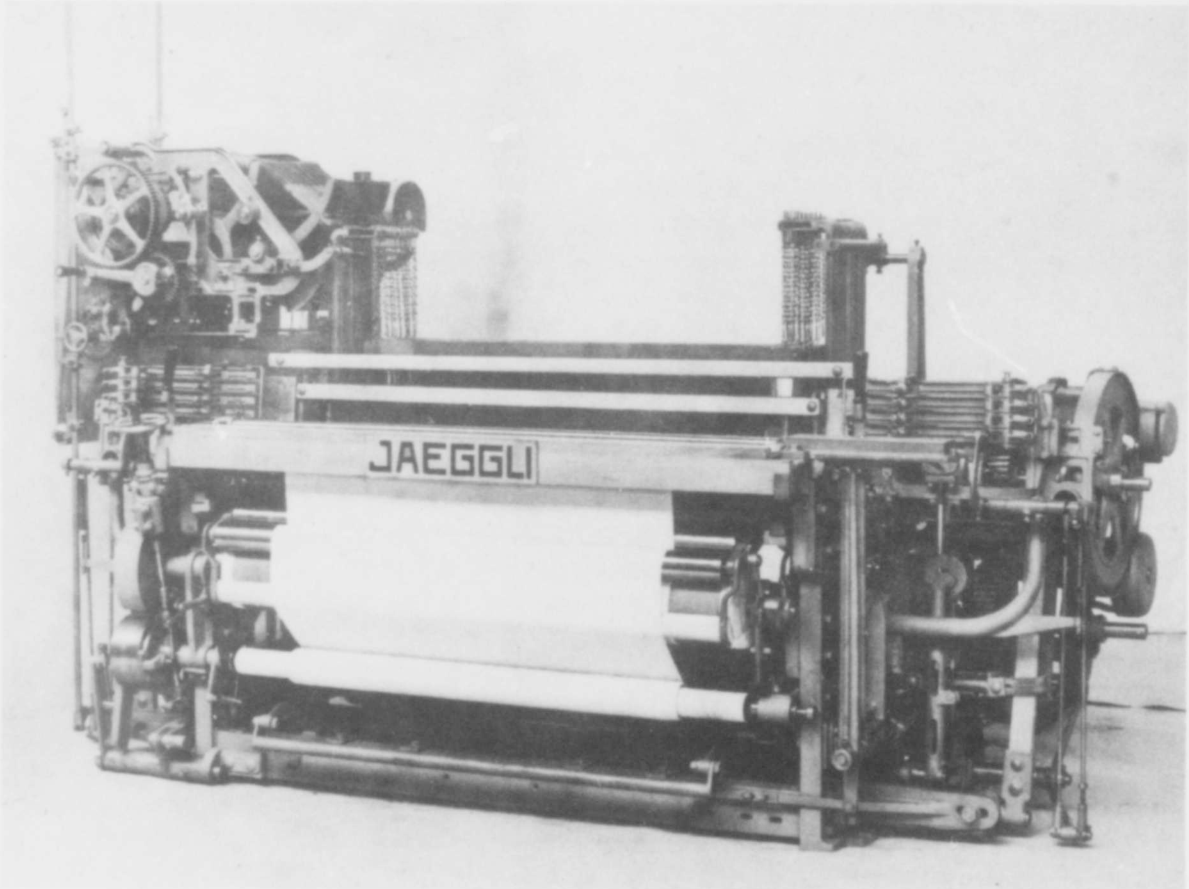
No possibility of dust or waste to accumulate above warp or harness because there is no superstructure.

(5) Vibration:

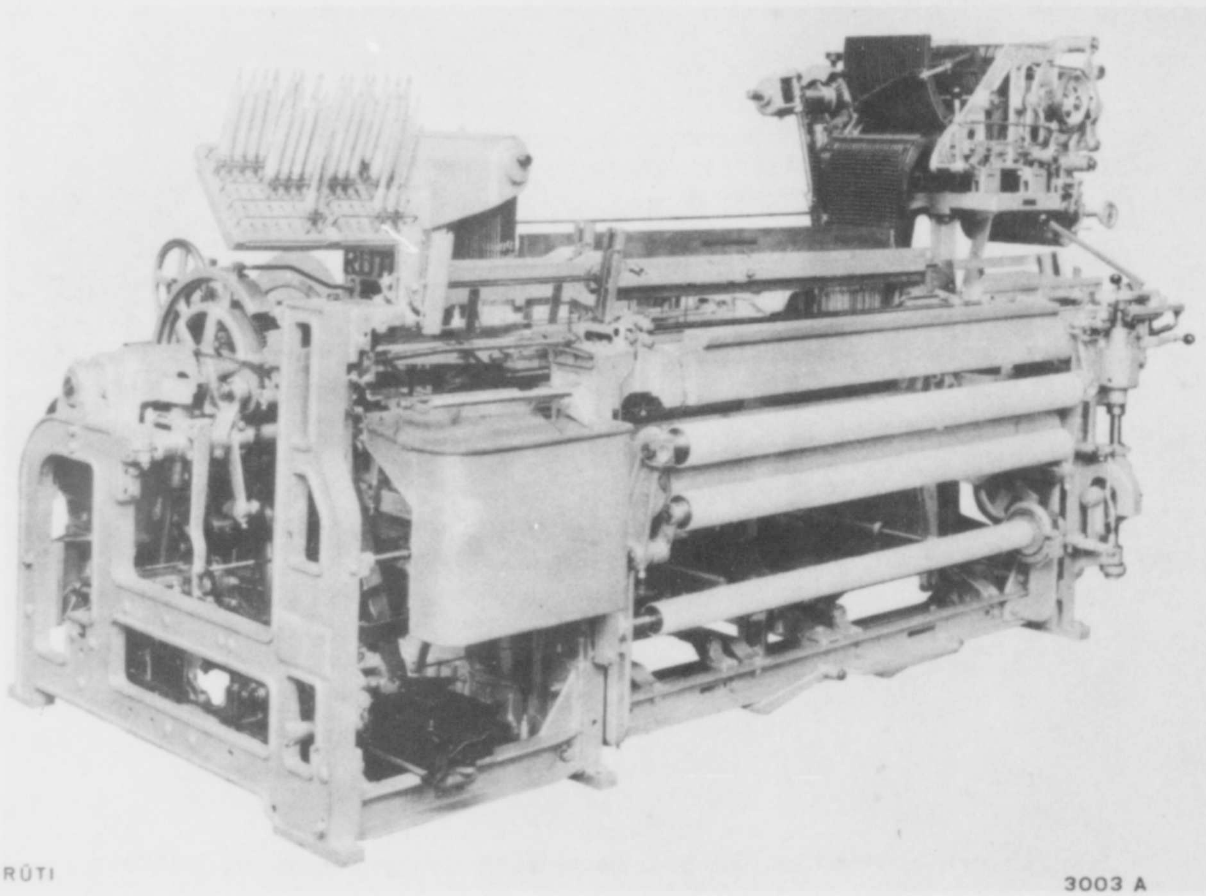
Less or no vibration of loom.

(6) Lighting:

Decidedly better light diffusion all over.

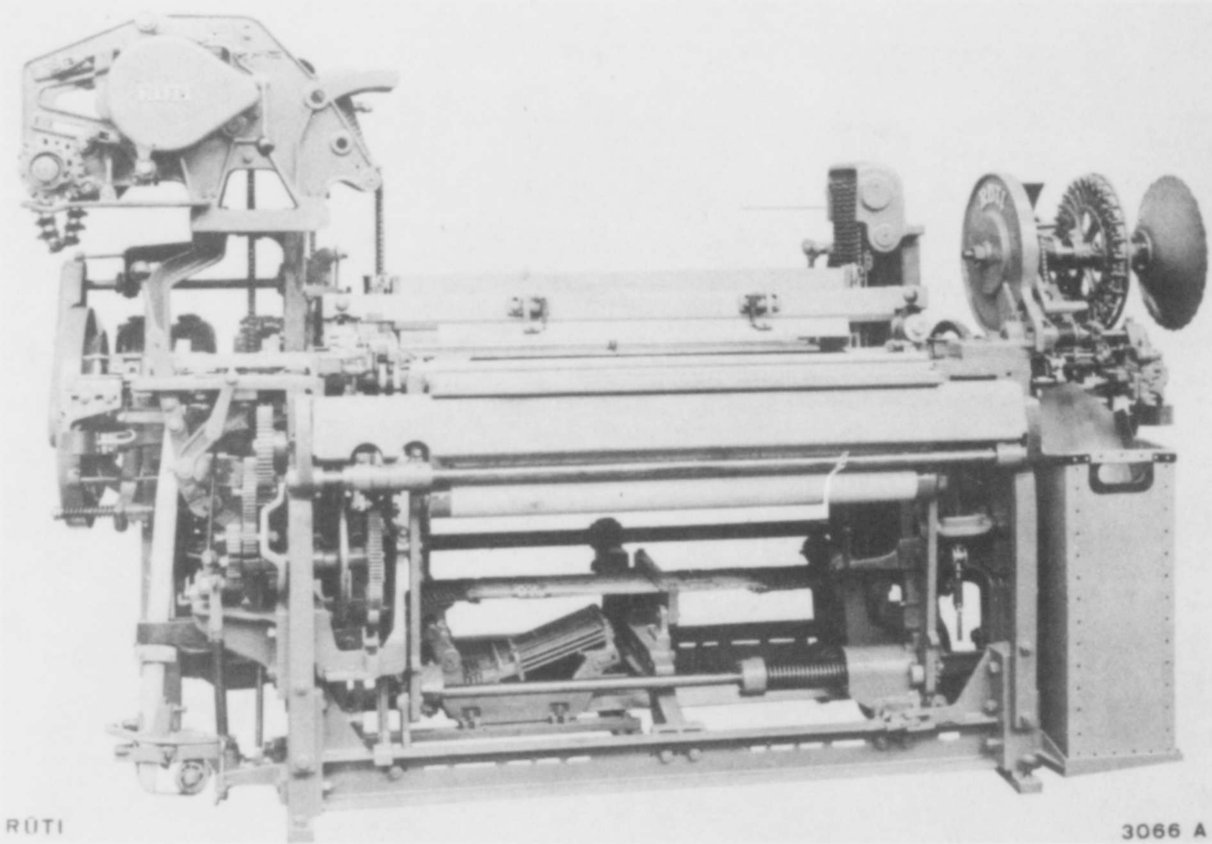


Jaeggli non-automatic 4:4 box loom with dobby for paper pattern
Illustration # 13



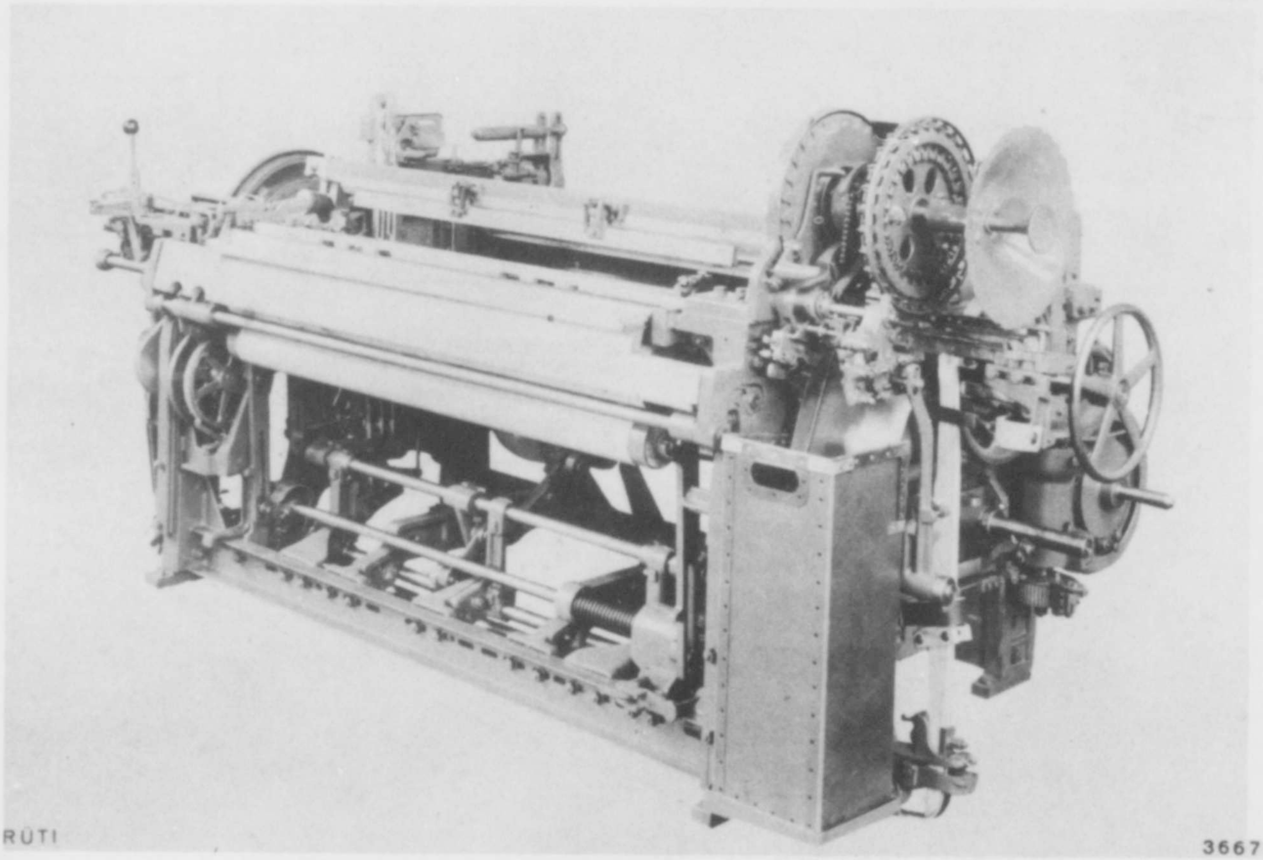
RUTI automatic shuttle change 2:1 box loom with dobby for paper pattern

Illustration #14



RUTI automatic bobbin change single shuttle loom with dobby for wooden peg pattern.

Illustration #15



RUTI automatic bobbin change single shuttle loom with taffetas or cam motion.

Illustration #16

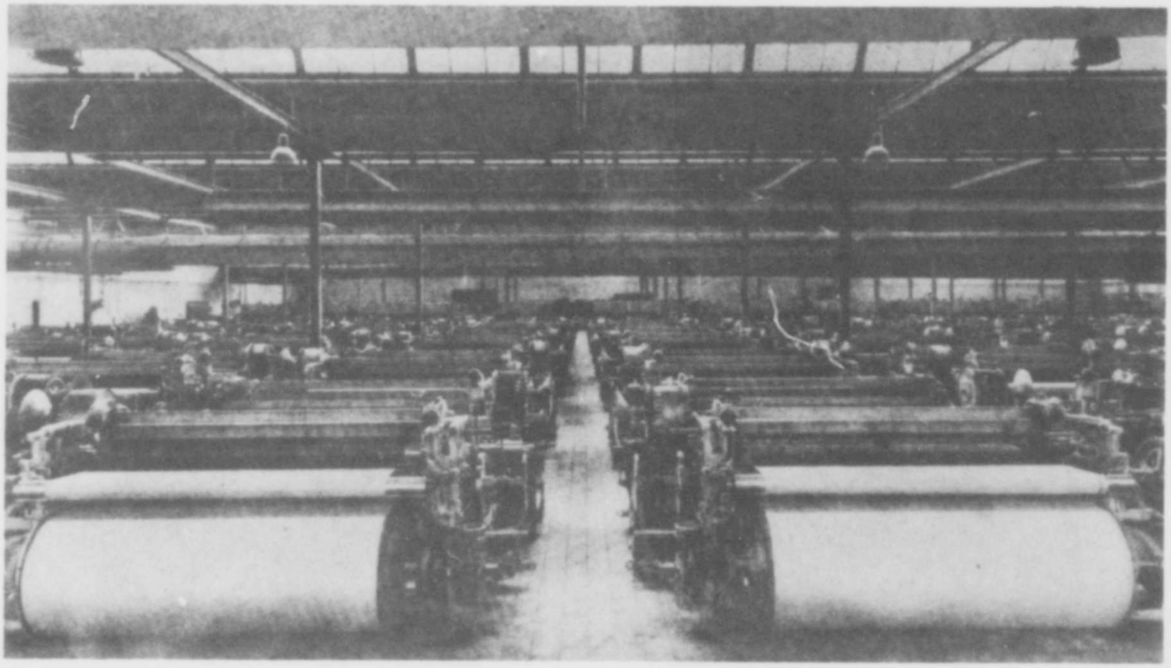
European weave shed showing looms without superstructure

Illustration #17

(7) Appearance:

Generally speaking, creates an all around better looking weave room and a more pleasant place to work in.

This type of loom, minus any part of frame, or any moving part above the harness, permits an unobstructed view of the entire weave room, and in the writer's opinion, merits the attention of American loom builders.



Another weave room showing looms minus the superstructure
Illustration #18

d. **Kreuzwalke - Apparatus Facilitating Increased Pickage:**

In many weaving plants where heavy or very dense fabrics are being woven, that is, fabrics with a pickage which is considered abnormally high, an apparatus is used which facilitates the task of beating the filling into the cloth without creating any undue hardship or causing any mechanical difficulties. It is known in Germany as the "Kreuzwalke"; probably best expressed in English as cross-rod or lease-rod cradle motion.

This apparatus is also used when weaving fabrics which are not necessarily heavy in weight, or thick in diameter, but where extreme or super density is essential. For instance, a men's collar fabric was found which was made of 120 denier Bemberg. It was so tightly woven that it had acquired the appearance of a Van Heusen cotton collar fabric, so far as rigidity was concerned, but it was lighter, silkier looking while very firm and solid.

Woolen and worsted mills also used the apparatus freely in prewar days, and during the war looms weaving suitings from spun rayon yarns also adapted the Kreuzwalke whenever the fabric was of a heavy type.

As early as 1943 reports had reached the QMG's textile research office that the Germans had perfected a fabric with spun rayon which was so tightly woven that it could be considered almost waterproof without being coated. American experts suspected that a mechanical devise or attachment to the loom might be the answer. The discovery of the Kreuzwalke proved them to be right.

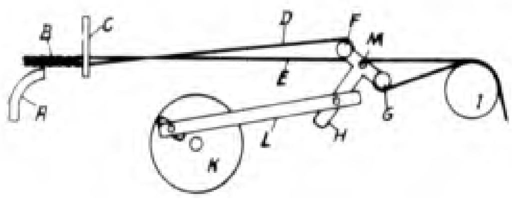
The basic principle of the apparatus is very simple. It is based on the theory that if the warp takeup can be considerably (or abnormally) increased, more picks can be beaten in. However, practical men know that the warp takeup can only be increased by reducing tension considerably, and excessive reduction in tension decidedly interferes with smooth running of the loom and perfection of fabric.

The German experts recognizing all this compromised on this theory by reducing tension in only one half of the warp, leaving the other half taught, or normal, thereby avoiding any mechanical or other disturbance or interference with the running of the loom, or the perfection of the fabric.

Illustration #19 shows the mechanical motion and #20 the three significient positions of the lease rods during the complete cycle of the motion, which consumes two picks.

CROSS ROD CRADLE (KREUZWALKE)

APPARATUS TO FACILITATE ABNORMALLY HIGH PICKAGES



NOTE

Figure 3 Above Shows The Cross-Rods In One Of The 2 Extreme Positions The Cradling Motion Can Of Course Also Be Accomplished By Other Mechanical Means, As Long As F Is Up On One Pick And G On The Next One.

LEGEND

A BREAST BEAM
B CLOTH & BEAT-UP
C REED
D ONE HALF OF WARP ENDS
E OTHER-HALF OF WARP ENDS
F CROSS ROD No 1
G CROSS ROD No. 2
H CRADLE LEVER
I WHIP ROLL
K ECCENTRIC
L CONNECTING ROD
M ROCKING CENTER PIN

Illustration #19

The mechanical motion works as follows:

Eccentric K is driven by the picking shaft of the loom, the gearing ratio being 1 to 1. If K is driven from the crankshaft, the ration is 2 to 1. L is the connecting rod from eccentric K to cradling bracket H, which is T shaped, swinging in pin and bearing M. The usual wood or glass lease rods are replaced by fairly heavy stainless steel rods F and G. The warp from beam I is drawn through the lease rods in the usual manner, viz; when half warp D is under G and over F the other half of the warp E is over G and under F.

It can readily be seen that by rotating K the connecting rod L causes bracket H to rock or cradle around turning pin M. This forces lease rods F and G to be alternately one pick in extreme high and next pick in extreme low position.

Illustration #20 shows the three typical positions of the lease rods, and the effect on the tension of the warp, as well as the correct timing in connection with the reed or beat-up motion.

CROSS ROD CRADLE (KREUZWALKE)

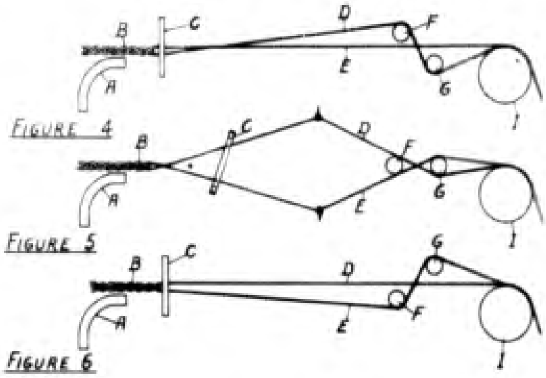


FIG. 4 - First Extreme Position - Rod F Up - Warp-Half D Taut E Loose
Shed Closed, Reed On Beat-Up

FIG. 5 - Neutral Position - Rods F & G Neutral or Level Position
Shed Open Reed In Back Position.

FIG. 6 - Second Extreme Position - Rod G Up Warp-Half E Taut D Loose
Shed Closed, Reed On Beat Up.

LEGEND

A BREAST BEAM	E OTHER-HALF WARP
B CLOTH	F CROSS-ROD No 1
C REED	G CROSS-ROD No 2
D ONE-HALF WARP	I WHIP ROLL

Illustration #20

In illustration #20, figure 4, lease rod F is in the extreme high position, and G is in the extreme low. This relaxes warp half E, and puts all the tension on warp half D. The latter is that half or portion of the warp which passes, in its travel from warp beam I to cloth B, over rod F, but under rod G. Warp half E, on the other hand, follows a straight course from beam to cloth. This extreme position (F high G low) is reached and held at the moment the reed beats up the pick, as shown with reed being in extreme forward position. Note that the shed is closed while pick is beaten up.

The subsequent position is called neutral, as shown in figure 5, illustration #20. The lease rods F and G are in horizontal line, the shed is open, reed C or lay is back. Both warp halfs D and E are under eqfal tension, and distance or course from warp beam to cloth is the same for both.

Figure 6, illustration #20, shows another extreme position of the lease rods, however, completely reversed, viz; with rod G in high, and F in low, bringing about relaxation of warp portion D (formerly taut) and showing tension or strain on E (formerly relaxed). Reed C again in forward position and shed closed.

These are the three steps by which part of the warp is kept loose while pick is being beaten up, with shed just about to close.

The theory of the German experts of the effect of this Kreuswalke motion is best explained by referring to illustration #21.

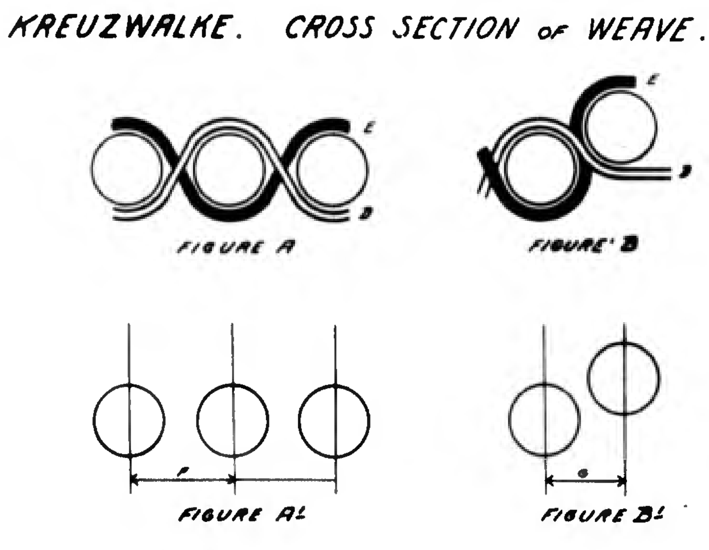


Illustration #21

Figure A is a cross cut of a conventional weave showing E and D as the two warp halfs. Figure A1 shows the distance from center of one pick to another, this being F.

Figure B shows the cross cut of the same weave when the Kreuzwalke has been used. At the moment of the beat-up of the reed, warp D was kept taught (first extreme position figure 4) and E was loose or relaxed. This meant that E was resisting less to the pick beat-up than D, consequently, the pick slides upward, absorbing or taking up more of warp half E than of D. Again drawing a line from center to center of 2 picks as in figure B1, the distance found is G. Compare G with F in figure A1 and it becomes clear why woven cloth B is denser, or has more picks than A.

It must be added that the picks do not remain out of line, that is, high and low, as shown in figure B. They align themselves perfectly in the course of weaving, with the result that a denser cloth has been produced.

Other claims by technicians and German weaving experts in connection with the Kreuzwalke were:

(1) It makes possible a pickage of 8% to 12% above what would be called normal.

(2) It produces better regularity in dense or heavy fabrics.

(3) It eliminates or reduces considerably so-called reed marks.

e. Dobbies:

With the exception of a few small plants, all looms observed in rayon weaving mills are equipped with dobbies. Most of them were of the 25 shaft type, and surprisingly many were made by Staubli of Horgen, Switzerland.

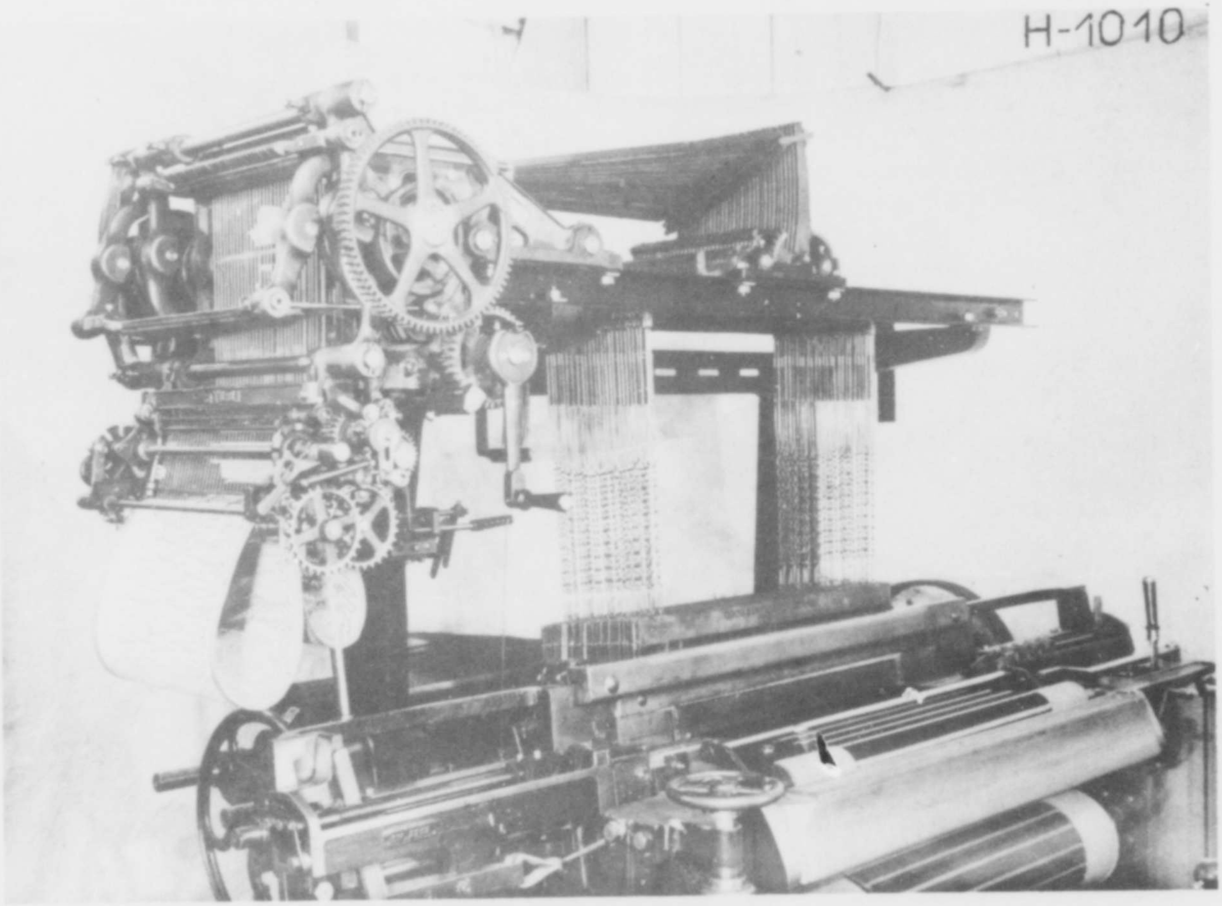
These dobbies, both the German and Swiss, are well built and machined, and very carefully designed.

The outstanding feature, however, is the almost complete change from wooden or metal pattern chains, to a paper design. This endless paper design or pattern resembles a jacquard design of the Verdol type and has many very appealing advantages.

First of all, a very long pattern can be cut on a very short length of paper, and it is easily stored away as a permanent record, taking up very little space.

Secondly, the cost is low, and the cutting or making of the pattern is much easier and takes less time than making a wooden bar chain, or a chain for a gem head.

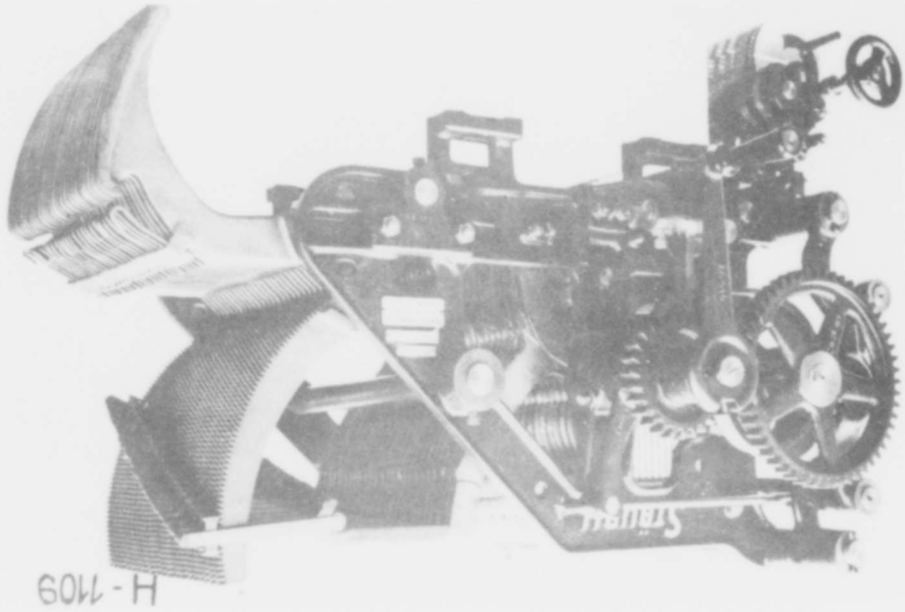
Thirdly, it is cleaner, and extremely long patterns can be put in the loom without erecting racks such as is often necessary when using conventional wooden bar or iron link chains.



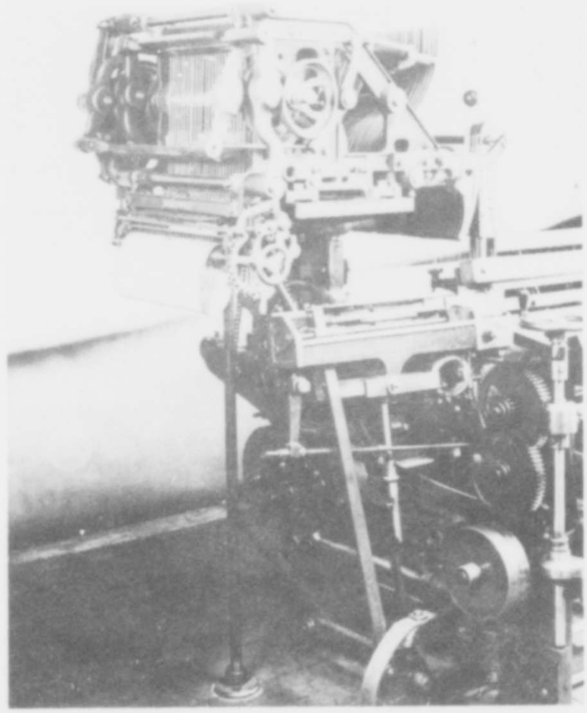
Staubli double lift dobby - 2 paper pattern cylinders mounted on conventional loom with superstructure

Illustration #22

Illustration #23



Staubli single cylinder dobby-double lift - with paper pattern built for modern loom without superstructure



Staubli single cylinder dobby - paper pattern built for modern loom without superstructure

Illustration #24

Fourthly, in cases where a group of 20, 30, 100 or more looms are run on the same pattern it is only necessary to cut one master pattern. As many as needed, thousands if desired, can be cut mechanically on duplicating or copying machines without any effort and in a very short time.

This paper pattern arrangement is a step towards progress. European dobbies so equipped are considered by the writer as more modern than ours in the United States.

f. Loom Assignments:

Since the industry was completely disorganized and disrupted, data given is based on information gathered, not on actual conditions found. None of the mills visited were running more than 20%. In many instances a weaver was given only one loom, instead of the usual 4 or 6, in order to spread employment.

However, it was very evident that the Germans were far behind the United States in their conception of multi-loom operations. The German mill men or production managers who were familiar with American methods were quick to explain that neither their quality or standard of raw material, nor the type of loom employed, would permit them to equal American performances. Even with their new German or Swiss automatic looms, they admitted they could not come up to us, again, because of poorer quality rayon yarns. And once more they expressed preference for smaller loom assignments because with lower wages they could afford it, and by having a weaver attend less looms they thereby hoped to attain higher efficiency.

The most reliable information regarding loom assignments was obtained in Krefeld, and is applicable to most rayon weaving mills in that territory.

Non-automatic box looms	2-4	looms	per	weaver
Automatic box looms - rayon	8	"	"	"
Automatic plain or box looms - silk	12	"	"	"

Registering surprise that they should run more looms per weaver on silk than on rayon, they promptly answered that their rayon yarns were not of very good quality, particularly during the war. However, information was received, but could not be confirmed, that a weaving plant in Sudetenland had run 30 looms per weaver on a Bemberg staple fabric. Also, a mill in Wendlingen claimed they had run 30 single shuttle looms to a weaver before the war on a simple 4 shaft rayon taffeta.

The impression left with this investigator is that the German mills have a long way to go to equal our efficient weave shed conditions.

g. Harnesses and Heddles:

Harness and heddle equipment in most mills was found to be of the conventional type. Shafts were of the usual design (wood) and in many mills the twisted wire heddles were preponderantly in use. Some of the more progressive mills worked with flat steel heddles.

Considerable experimenting apparently had been conducted during 1941 - 1943 with electric warp stop motions operating through the heddles in the harness, but results were not sufficiently encouraging, and no large installations were found or reported.

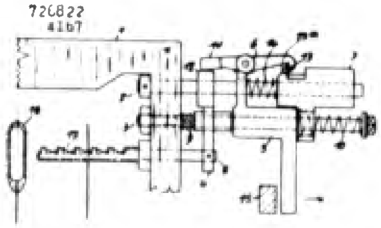
The general principle of this stop motion harness was nothing new to the investigator, since years ago it had been tried in the United States also, and the firm of Grob & Company, in Switzerland, has specialized in electric harness stop motions for many years. The drawback is that this system of warp thread control cannot be used when two or more ends are entered in one heddle, or when the warp is of very high density, such as is the case with heavy satins.

One German firm, E. Th. Wagner of Chemnitz, had perfected a mechanical harness warp stop motion which was constructed on the principle of the sliding rod, very similar to many conventional American systems, except that in the German arrangement the harness heddle took the place and function of the drop wire. The German harness seemed to operate quite well, but in the writer's opinion would be considered too complicated and delicate in adjustment for our high speed weaving operations in the United States.

Another so-called mechanical harness warp stop motion was patented under No. D.R.P. 726,822. The patent had been applied for on June 19, 1938 by Fritz Reh of Plauen (Vogtland). Illustration #25 is a copy of a description which appeared in a German textile magazine. Again the disadvantage is that multiple thread entering per single heddle prevents the stop motion from functioning properly. It is applicable only where one end is entered in each harness heddle, and even in such case it will only work satisfactorily if the warp is not of great density.

Mechanischer Kettfadenwächter im Webschaft

Fritz Reh, Plauen, Vogtl. (Anmelder und Erfinder). DRP. 726822 (19. 6. 38). Die Sperrschiene od. dgl. 8 ist mit einem unter Federwirkung 9 stehenden Hebel od. dgl. 4 fest verbunden, der bei gehobener Litze zusammen mit einem einen schwenkbaren Doppelhebel 6 aufweisenden Anschlag 5 und einem von einer Nase 13 des Doppelhebels 6 entgegen Feder-



wirkung 14 gehaltenen Schieber 7 entgegen der Wirkung einer Rückholfeder 10 bei Schafttiefstellung längs verschoben wird. Fällt eine Litze infolge Kettfadenbruches, so ist der Hebel 4 gehindert, der Längsbewegung des Anschlages 5 und des Schiebers 7 zu folgen, der üblicherweise auf dem Hebel 4 aufliegende Arm 11 des Doppelhebels 6 fällt von dem Hebel 4 ab, der Doppelhebel 6 schwingt aus und gibt hierdurch mit seiner Nase 13 einen am Schieber 7 angeordneten Haken 13, frei, so daß der Schieber 7 unter Wirkung der Feder 14 in eine immer gleichmäßige Endlage ohne Belastung und unabhängig vom Hebel 4 verschoben ist und den Stillstand des Webstuhles sofort oder beim Hochgang des Schaftes einleitet. Gl.

Fritz Reh Warp Stop Motion

Illustration #25

h. <u>Plastic Heddle</u>:

Almost by accident, on an unauthorized casual visit to a worsted mill on a Sunday morning, a harness was discovered which was made up entirely of plastic heddles.

This heddle, illustration #26, is a typical example of German "Ersatz". Since fine qualities of steel became very scarce during the war the Berlin control office in 1944 requested that experiments be made to replace steel heddles with a synthetic material.

The harness inspected had four shafts and a total of about 2,000 heddles. The mill manager had kept a record showing that only eight heddles had been broken during the three months when the harness was being tried out and observed. All of the breaks were in the top loop where the strain of the lift is concentrated.

This was the first and only plastic heddle harness in use in Germany, and probably in the world. Considering that by 1944 the Germans lacked many basic ingredients to make good plastics, and this harness was the first attempt, it must be admitted the results were very encouraging.

EXHIBIT #11.

PLASTIC HEDDLE

REFERRED TO IN REPORT
#554.

SAMPLE OBTAINED FROM:
SIMON & FROHWEIN IN
LEICHLINGEN

NOV. 17. 1945.

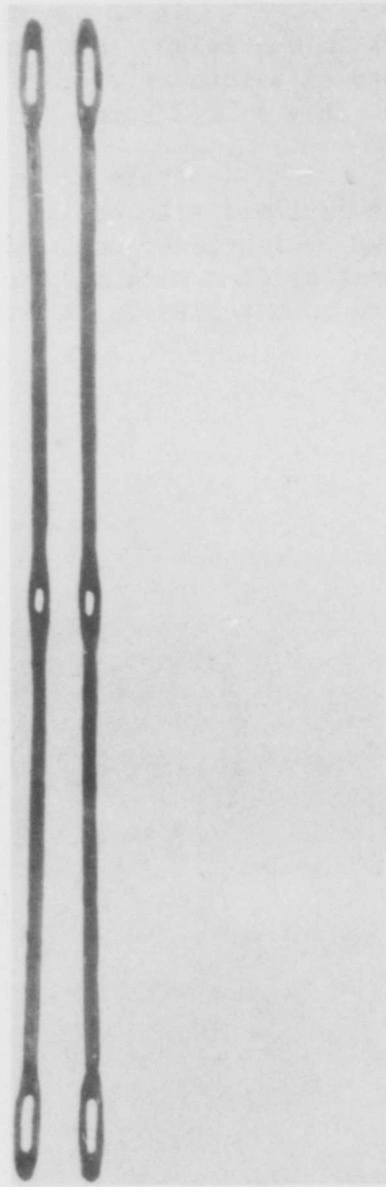
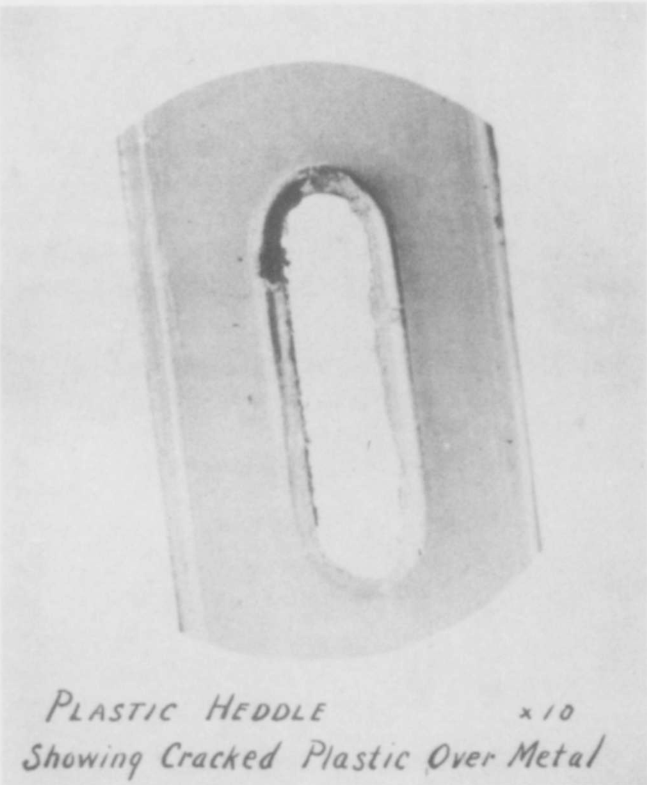


Illustration #26

Since the mill was not running, the harness was not in operation. But when it actually was on the loom it was used on a spun rayon warp (Zellwolle) of rather coarse size, possibly a 16/2 yarn.

While the heddle, as a whole, is of plastic, the eye is lined with metal. The process of making the heddle looks like an intricate one. Unfortunately, the factory where these first heddles were made was reported totally destroyed. The name of the firm is Felton and Guillaume, in Cologne and Mulhouse.



Two micro-photographs of Heddle Eye

Illustration #27

Two micro-photographs of the heddle eye are shown to illustrate how the eye was "lined" with a metal ring. This ring was held in place by a film of the plastic solution which covered the ring entirely, or expressed differently, the metal eye was totally imbedded in the plastic. Through three months of continuous use the plastic film which was in direct contact with the metal eye, and which was very thin, cracked and peeled off in spots as shown in the photograph. Nevertheless, the experts considered the initial results with this plastic heddle very encouraging and stated that had the war continued they would have expanded their research and experiments in this field, and felt confident that a satisfactory plastic heddle could be produced, and at a low cost.

1. Wages:

During the entire period of the Nazi regime, hourly wages in Germany were comparatively low, but employment was steady. A working day in 1932 - 1938 consisted of ten hours, and when the country started war preparations on a large scale, the work day was longer. Therefore, notwithstanding the low wages per hour, the income or take home pay was a satisfactory one to the working man due to the long hours.

Wages and other conditions of employment between management and labor were set in 1934 and practically never changed until 1945.

Hourly rates paid during the war in a typical rayon weaving plant in the Krefeld region were as follows:

Preparatory Department	Marks	-.55	to	-.65	per	hour
Weavers		-.65	"	-.85	"	"
Average through plant		-.60	"	-.65	"	"
Starting rate				-.45	"	"

In a typical woolen and worsted weaving plant the rates were:

Preparatory Department	Marks	-.75	to	-.90	per	hour
Weavers - 1 loom				.85	"	"
2 looms				1.20	"	"
6 looms				1.50	"	"

In comparison to the above textile wages, note the hourly rates paid at the Krupp Works in Essen:

Male, Skilled		Marks -.90 to 1.05 per hour
	Unskilled	-.75 " -.85 " "

All female, 75% of above for similar work.

It is difficult to compare these German wages with ours, since the present exchange of ten Allied marks to one dollar would be an arbitrary basis. It would mean that a weaver at the most could earn 8.5 cents per hour. But even when the 85 pfenning which the weaver could earn is translated into American cents on a prewar basis, he would only earn 34 cents per hour, and that would be a top notch expert rayon weaver. A good worsted or woolen mill weaver on a prewar exchange basis would make 48 cents to 60 cents per hour, running 2 to 6 looms respectively.

A skilled Krupp Works machinist would earn from 40 cents to 50 cents per hour.

It must be emphasized that these wages in textile mills and many others were set in 1932 - 1936, and were frozen until 1945. During all those years there were no strikes, and hours per day ranged from 9 - 14 during the war. Labor disputes were settled without interruption of production, and in most cases a final verdict was given by the Labor Division "Gauleiter" within 48 hours. In 1936 the writer actually was a witness to one of these procedures, and was amazed at the shortcut method and speed with which the "arbitration machinery" went into motion and a final decision was rendered. And it was final, and lived up to by both parties. If the decision was against the worker and, if as a consequence he did not live up to it, he could be discharged immediately and had no recourse to any relief or unemployment funds nor could he be engaged by any other factory.

j. <u>Rayon Yarn Prices and Qualities</u>:

From the list of rayon yarn prices, illustrated later, one discovers at once the important point that the Germans have not reached the degree of standardization of American yarn producers. This is particularly true of the viscose type rayon. There, of course, is always the distinction between bright and dull yarns, but in addition to this the Germans show the following subgrading:

Quality I for warps
II " "
I " filling
II " "

Inferior for all purposes.

Against the above, American producers have standardized into two grades, viz; regular and inferior.

In Bemberg they come closer to the American grading method, but they add a special "Neckwear" yarn, which is a twisted yarn, carefully inspected and selected for jacquard and high count fabrics.

In the acetate grading they have about the same arrangement as we have, namely; various deniers but only one grade of bright and dull.

Generally, the deniers commonly used in Germany in the various type yarns are very similar to ours. The 100 and 150 are very popular, but in peace time they favored fine deniers more than we do in the United States. Due to their smaller loom assignments and slower speeds throughout the different operations they can afford to make some complicated shaft fabrics of fine denier viscose or cupramonium yarn which we definitely would not find attractive from many viewpoints.

Due to the fact that cupramonium yarn was developed so early in Germany, it still remains one of the most important yarns in their various fabrics. Comparatively speaking, Bemberg is a much more important yarn in Germany than it is in the United States.

Without exception German yarns are inferior to American production. This is particularly true of the viscose and acetate types. Much of their weavers' difficulties, such as low speeds, small assignments and other manufacturing procedures, where they do not measure up to American practices, were ascribed to or blamed on the poor quality of yarns.

Preise für die gebräuchlichsten Titers Kunstseide

Viskose-Kunstseide (4% Skonto u. bis zu 4% Ums.-Vergütung müssen noch abgezogen werden)

Titer	We I S. gl.	We I S. matt	We II S. gl.	We II S. matt	We I Kette gl.	We I Kette matt	We II Kette gl.	We II Kette matt
60 uf.	6.15	6.50	5.75	6.10	6.45	6.80	6.05	6.40
100 ff.	5.10	5.45	-	-	5.40	5.75	-	-
120 uf.	4.25	4.80	4.15	4.40	4.40	4.95	4.30	4.55
150 uf.	3.95	4.55	3.85	4.20	4.10	4.70	4.-	4.35
300 uf.	3.25	3.60	3.15	3.50	3.40	3.75	3.30	3.65

Kupfer-Kunstseide (4% Skonto u. bis zu 4% Ums.-Vergütung müssen noch abgezogen werden)

Titer	Kraw. Kette	Naturglanz HW ohne Dr.	Naturglanz HW Kettdr.	Matesa HW ohne Dr.	Matesa HW Kettdr.
40	-	7.85	-	-	-
60	7.50 x)	6.15	8.65 x)	6.50	9.-
80	6.75 x)	5.85	7.35 xx)	6.20	7.70
120	5.35 xx)	4.80	5.80 xx)	5.15	6.15

x) = 300 Drh./m
xx) = 200 " "

Acetat-Kunstseide (4% Skonto u. bis zu 4% Ums.-Vergütung müssen noch abgezogen werden)

Titer	glänzend X-Spulen	glänzend Cones	matt X-Spulen	matt Cones
60	6.20	6.40	6.60	6.80
75	5.40	5.50	5.80	5.90
100	5.05	5.15	5.45	5.55
120	4.70	4.80	5.10	5.20
150	4.50	4.60	4.90	5.-

20. Dezember 1945.

A German Price List for Yarn, Krefeld, Germany

German Rayon Yarn Prices in Marks - Nov. 1945

Viscose Type

Den.	Quality 1 Filling Br.	Quality 1 Filling Dull	Quality 11 Filling Br.	Quality 11 Filling Dull	Quality 1 Warp Br.	Quality 1 Warp Dull	Quality 11 Warp Br.	Quality 11 Warp Dull	U. S. cones Br.	U. S. cones Dull
60	6.15	6.50	5.75	6.10	6.45	6.80	6.05	6.40		
100	5.10	5.45	-	-	5.40	5.75	-	-	.73	.73
120	4.25	4.80	4.15	4.40	4.40	4.95	4.30	4.55		
150	3.95	4.55	3.85	4.20	4.10	4.70	4.00	4.35	.55	.55
300	3.25	3.60	3.15	3.50	3.40	3.75	3.30	3.65	.49	.49

Bemberg Type

Den.	Neckwear Warps		Bright No Twist	Bright Twist		Matesa No Twist	Matesa Twist		U. S. Skeins Br. No Twist
60	7.50	7½t.	6.15	8.65	7½t.	6.50	9	7½t.	
80	6.75	"	5.85	7.35	4 t.	6.20	7.70	4 t.	
120	5.35	4 t.	4.80	5.80	"	5.15	6.15	"	.65

Acetate Type

Den.	Bright Spools	Bright Cones	Dull Spools	Dull Cones	U. S. Cones Br.	U. S. Cones Dull
60	6.20	6.40	6.60	6.80		
75	5.40	5.50	5.80	5.90	.80	.80
100	5.05	5.15	5.45	5.55	.73	.73
120	4.70	4.80	5.10	5.20	.65	.65
150	4.50	4.60	4.90	5.00	.56	.56

L. Miscellanea:

In the course of his travels the investigator, urged by curiosity, often called at plants which were not directly in the rayon weaving or throwing business. In a few of such instances the visits were more than just worth while, they were recompensed through the fact that information and data were obtained which proved to be of considerable interest to people at home engaged in these respective lines of manufacture. The findings of some of these visits are related in the following paragraphs.

a. Fiberglas Fabrics:

During the war the Germans tried very hard to develop their Glas-Textile industry and to increase the output of fiberglas yarns of the continuous filament type. They were fully aware of the importance of these fabrics for many war purposes. Several small weaving plants were reported to have operated some looms on such fabrics, but the most important company specializing in fiberglas weaving was the Rheydt Glas Weaving Company in Rheydt, near Munchen-Gladbach. This mill was owned and managed by Walter Klevers, operated about 100 looms, all of which were running on one quality of glass fabric since 1939. This fabric was strictly a war essential, used for insulation purposes in the electrical field. The construction of the fabric was as follows:

Warp:	50 ends per inch
Filling:	50 picks " "
Warp material:	180/3 fiberglas (900/3 American)
Filling "	180/3 " "
Width:	1 meter (39½")
Twist in warp and filling:	4/4½ turns

The fiberglas yarn for this fabric was made by the Gerresheimer Glas Works in Gerresheim. The yarn was of poor quality, the weaving plant could not give more than 2 to 4 looms to a weaver, and even then the productive efficiency was only 60 - 65%.

The Germans were well aware of the progress which had been made in the United States in the development of various size yarns and in the weaving of glas fabrics. However, they were unable to benefit by it because they never succeeded in making any other size than #180 which is equivalent to the American #900, which size is limited in its application. Furthermore, the total German production of fiberglas yarn was very small. At best, it was sufficient to run only about 150 looms.

b. German Aviator's Maps:

Going through the badly damaged dyeing, printing and finishing plant of the Vereinigte Seidenwebereien, Krefeld, the writer's attention was attracted and his curiosity aroused by a stack of folded material which looked like a heap of newspapers. Upon closer inspection it developed that they were military maps used by the "Luftwaffe" pilots. There were both day and night flying types. Compared with American maps, they were quite different in many respects, particularly the night flying specimens.

Many of these maps had, of course, been found in crashed captured planes, but the process of printing and the place where they were made was still unknown. This was easily explained by the fact that the maps were not made in a regular printing establishment or by a map printer.

The visit to this weaving, dyeing and finishing plant in Krefeld revealed that they had done practically all the printing of these aviators maps for the Luftwaffe during the entire war.

The reason for this was that Dr. Ulrich Lange, who w - the inventor of the special printing process used, is the general manager of this plant, and therefore undertook to exploit his invention in his own shop, and at the same time safeguard the patent secret.

These maps were not made by the usual textile roller printing process, but rather by an entirely new method. They were first printed on an oily specially prepared paper, called the carrier, or intermediary. From this the print was transferred by pressure and heat upon a rayon cloth. This rayon cloth also had first undergone special treatment which made it shrink proof and expansion proof regardless of whether exposed to high or low temperatures. The fabric is also crease proof and generally considered indestructible.

In emergencies the pilots used the maps for seat cushions, raincoats, tents, or to patch up a hole somewhere.

When flying at night fluorescent type maps were used and pilots had a small lamp of 24 volts attached to their headgear.

Experts consider the maps of excellent and extraordinary quality. Specimens have been confiscated and are in the possession of the United States Government.

A complete copy of the patent covering the process was also seized and translated. The English text follows:

TRANSLATION OF GERMAN PATENT
NO. 740024, CLASS 15K GROUP 901
V37837 IV a/15K

METHOD TO PRODUCE DURABLE, PARTICULARLY MULTICOLORED MAPS

The present invention refers to a method to produce durable, weatherproof maps, surveyor's maps, etc. according to which flat prints, and especially offset prints are transferred upon a "carrier" made of paper, or the like, and printed with transferable ink. This is done by pressing and heating and subsequent stripping of the "carrier", upon a cloth which is coated with thermoplastic resins, such as polyvinyl, polyacryl, polystyrene, or similar compounds, with the addition of pigments.

The well known maps mounted on Linen have the disadvantage that they are manufactured from a large number of individual parts, which must be glued on at a certain distance from each other. These sections never have an accurate fit. Therefore, the map printers were striving for means by which a map could be printed directly upon the cloth. The direct printing on fabrics, however, was not possible, due to the elongation and smoothness of fabrics which did not permit an accurate fit. Experiments were made to stiffen the print cloth by means of a finish or by laminating it temporarily with paper, so that they could be printed like paper.

For the same reason, it was also tried to employ thermoplastic resins such as polyvinyl, polyacryl, polystyrene or similar compounds under pressure upon fabric surfaces. No known method produced satisfactory results, because all printed cloth was distorted in the printing press so that no true fit of the print was obtained. Furthermore, each color had to be transferred separately upon the previously prepared and cut sheet.

In accordance with the present invention for the manufacturing of durable and especially multicolored maps, an oiled "carrier" of paper or the like is used to transfer upon cloth, prints made with transferable printing colors. This "carrier" is then transferred upon the cloth by pressure and heat and subsequent pulling off of the "carrier". The cloth has been coated with thermoplastic resins mixed with Pigments. A process is known to provide Celluloid products such as used for collars and cuffs, with colored designs. According to this process a "carrier" of paper on which colored prints have been made is being transferred under application of pressure and heat upon Celluloid-foils, from which the "carrier" is pulled off.

This known procedure cannot be easily applied to maps since rigid Celluloid-foils do not answer the requirements of maps in regard to folding and bending. Besides, in the process known, the "carrier" used is not oiled, a step in the procedure of this invention, which is very important, in order to prevent losses of the colored print on the "carrier", when they are transferred to the cloth coated with resins. By oiling the "carrier" it is accomplished that in one way no larger quantities of color can penetrate into the paper used for the "carrier" and on the other hand that the "carrier" may be stripped without having larger quantities of ink stick to it and thus lose this ink for the print.

Furthermore, this invention distinguishes itself from the process known by the use of transferable printing inks, e. g., printing ink is applied which is mixed with a non-polymerizing oil instead of a drying oil.

The application of an oiled "carrier" is known in a procedure to manufacture designs produced by pressing in which the color of the design is put on a sheet, the sheet is dried and the design preprinted with varnish or colored varnish, powdered with resinous powder, which is melted in. At places where the varnish touches the previously colored paper, the color of the design comes off so that it can be transferred later on by pressing. Not only is it unnecessary, according to the present invention, to effect a print by the use of varnish or colored varnish, and to melt the resinous powder, but the oiling of the "carrier" serves in this case only the purpose to affix the color, which is preferably bronze, to the "carrier". Maps, and especially Multicolored maps, cannot be produced according to this type of application of pressed designs.

In the present invention, maps may be printed by ordinary printing methods as for instance by offset printing in inverted script on paper. When later on the paper is transferred upon the cloth and pulled off the map appears in direct print. Ordinary printing colors are used, which contain non-polymerizing oils instead of drying oils. The colors printed on the "carrier" show relatively poor fastness to crocking; however, since they permeate the coating made by the respective resins at the subsequently effected transfer, they obtain a perfectly satisfactory fastness to crocking; the transfer is done under pressure with heat upon the cloth coated with thermoplastic resins.

Suitable for the execution of the present invention are the following textile fabrics: Rayon, Spun Rayon, Linen, Cotton, etc. The coating with the thermoplastic resins is done according to known procedures; for example in order to obtain a White ground Pigments such as titanium dioxide are added to the resins and brushed on.

A basic principle of the invention is to incorporate to the maps, in a particular simple manner, luminous colors, such as fluoreseent, phosphorescent or radioactive substances, by compounding same with the resins. In doing this, it became possible to obtain a fluorescent effect in the ground of the map by exposing it to short wave radiation, as for instance, ultra-violet light. If, for the print of the "carrier", dyestuffs are used that contain fluorescent, phosphorescent or radioactive substances, or the like, which may be activated by short wave rays, then a luminous print may be produced in addition to the illuminated ground by exposure to light rays.

The maps produced according to the invention excel in comparison to maps produced by known methods in possessing a letter tear strength, crease resistance and water repellency. The water repellency can be further increased by coating the reverse side of the cloth with thermoplastic resins. The maps can be covered with writing which can be erased because the permeated dyestuffs are fast to crocking. The heat resistance and ease of folding of the maps produced according to this invention are remarkable.

Following is an example according to which the execution of the method of the invention is explained.

EXAMPLE

A well sized offset print paper is treated in an offset machine with a fatty paste and printed subsequently in the usual manner, by using a zincplate. In the zincplate the picture of the map has been etched invertedly, with ordinary dyestuffs, which do not contain any polymerizing oils. The negative offset print obtained in such manner is then inserted between two glazed paper pressboards, or metal plates, with the pieces of cloth to be printed, which have been previously prepared with thermoplastic resins. The insertion is done in such a way that the layer with the thermoplastic resins comes in contact with the printed side of the paper map. According to the printing press used, 20 or 30 or more paper maps may be worked with the corresponding pieces of cloth. By pressing in a hydraulic or mechanical press, at a temperature of 120° C. and applying a pressure of about 10 kg. per square centimeter for a duration of approximately 2 hours, the transfer of the print takes place from the paper upon the prepared cloth. During this time, the dyestuff of the paper map has permeated the sheet with the thermoplastic resins and the paper used as a "carrier" can now be pulled off.

The preparation of the cloth to be printed is done by brushing several times with an ammonium-alkali watery dispersion of polyacrylacidester. For the first few brushings a dispersion is applied which contains

100 parts Polyacrylacidester
50 parts water
40 parts talc

For subsequent brushings in place of talc a colored Pigment is used, such as titanium dioxide. In place of the colored pigments one of the well known inorganic or organic fluorescent substances may be applied, if it is desirable to obtain maps luminated in ultra-violet light. By addition of dyestuffs, the synthetic coat may be produced in any other desirable shade instead of White. For the last brushings, a 30% solution of polyacrylacidester in ethyl acetate is applied. The preparation of the cloth must be such that the interstices of the fabric are completely filled in and that over the entire cloth there is present a thin synthetic layer.

PATENT CLAIMS

A method to produce durable, especially multicolored maps, according to which flat prints, particularly offset prints, are transferred upon a "carrier" made of paper or the like, with transferable colors. By pressing and heating and subsequent stripping of the "carrier", the prints made on the oiled "carrier" are transferred upon cloth coated with thermoplastic resins mixed with Pigments.

By "carrier" is meant an intermediary in the process of decalcomania.

c. Continuous Process of "Cupra" Yarn from Spinneret to Warp Beam or Spool:

On a chance visit that the writer would find one of the officials of the Bemberg plant whom he had met in 1936, a call was made at OberBarmen, where the large Bemberg plant was located. The call was very worthwhile.

Contact was made with the party wanted, but of the factory there was little left to be seen. It was one of the places which had been given a most thorough pounding by our bombers, and of the actual operating departments, there was practically nothing left but twisted steel, roofless buildings and piles of bricks.

However, the two officials in charge showed the investigator through the ruins to a corner of the plant where a room of about 100' x 100' had been restored, and in which were installed two machines of revolutionary design producing Cupramonium yarn by a continuous spinning method, viz; from spinneret to a one pound spool or headless package.

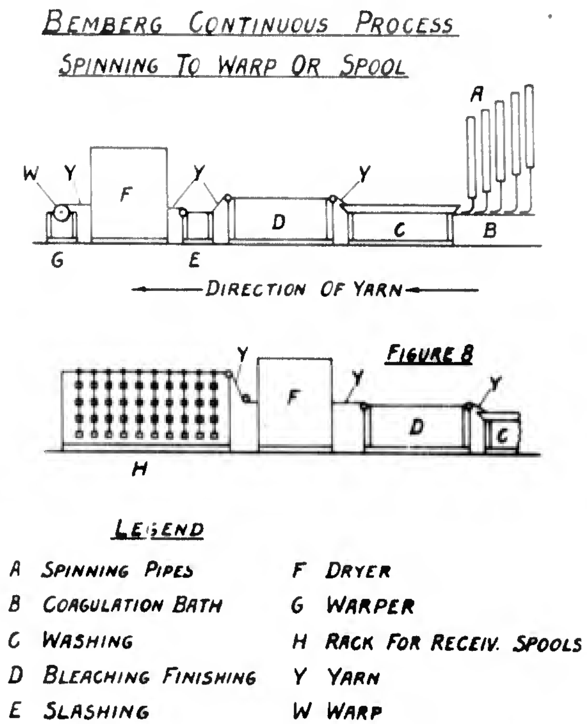


Illustration #28

The upper part of illustration #28 shows a rough side view of the Spinning-Warping setup.

There are 5 tiers of spinning "pipes" shown as A (side view). Each tier has 100 spinnerets or ends. The cupra solution is extruded into coagulation bath B. From there the 500 solid, coagulated threads are led into washing bath C, and bleaching and finishing tubs or baths D. Since speed of the thread is practically dictated or determined by the spinning and coagulation process at A - B, the subsequent processes at C and D are synchronized by the length of the baths or size of tubs plus an arrangement guiding the 500 threads over rollers while in the baths to obtain the full effect of each of the operations in C and D.

At E the 500 end warp is led into a slashing pan with its subsequent squeeze rollers, hence the warp goes into dryer F.

F is a hot air (chamber) dryer of the Zell type. Again through up and down rollers the warp is kept in the hot chamber long enough to come out perfectly dry, which means that only sufficient moisture is left to make the yarn behave well in beaming and subsequent operations.

At W the now finished, slashed and dry cupra yarn, i. e., 500 ends, is beamed on a section beam.

The whole process from spinneret to beam consumes between 2 and 3 minutes.

It is to be noted that the yarn is zero twist. At the time of inspection 200 denier yarn was being produced and beamed.

The beams (section beams) are now ready to be delivered to the weaver. Since each beam has 500 ends, the weaver will adjust his fabric construction to call for warps of total endages in multiples of 500. Therefore, his only function is to assemble as many of the section beams as he needs on to one loom beam and he is ready to operate.

It was reported that preliminary, but rather extensive trial runs made in a large weaving plant in Sudetenland proved that the warps ran extremely well enabling one weaver to run 30 looms on a simple 4 shaft single shuttle fabric. Such performance is far better than has been achieved in the German rayon weaving industry on other yarns.

While the foregoing explains how this continuous process converts solution into yarn on beams, there are many applications and uses for cupra yarn other than on loom beams. Very often cupra yarn toes into knitted fabrics, or ribbons. For some purposes it must be doubled, or plied with another yarn, and since some of the most popular cupra fabrics call for twist in the yarn, it means the yarn must be thrown.

For such purpose or end use the continuous process has been designed and arranged to put the yarn on tubes or bobbins instead of beams. This means that each individual thread is wound on an individual package, which in this case was a headless tube of about 1 pound of yarn content based on 200 denier cupra yarn. Again the yarn was of the zero twist type and completely finished, but not slashed.

The lower part of illustration #28 shows the process is identical to the spinneret-warping except that the yarn is not slashed. After emerging from bleaching and finishing bath D it enters directly into drying chamber F. From there the 500 ends are led to a creel with 250 takeup tubes on each side, and wound onto a headless tube (cheese). The yarn is now ready for any subsequent operation required to convert it into fabric of any sort.

M. Textile Research:

It is a well known fact that the Germans have always been extremely research minded. For many years before the war the writer had an opportunity to observe the close relation and contacts among various industries and their laboratories as well as instructors of the many and important universities.

In the textile field the same contact was actively and continuously maintained between mills and all the smaller and larger textile schools, some of which have the status of junior colleges. Through this close relationship between actual plant operations and students of schools the latter learned to appreciate the value of research in industry. For years after graduation, therefore, these young men brought into industry well patterned ideas and principles of research as applied in the textile industry.

It is mainly for this reason that research departments were definitely better organized and developed in the German rayon weaving and throwing plants than is the case in the United States. This was particularly true in pre-war years. During an extended visit of the rayon weaving and throwing industry in the lower Rhine provinces in 1936, the writer actually was amazed at the extent to which most plants had gone in setting up research staffs, and careful observation by the writer during the recent investigation revealed the fact that these staffs were maintained during the war and in many cases still functioning in December, 1945. Of the many chemists and engineering experts whom the writer located during the recent trip he had already met about 10 in 1936, and they were still with the same organizations in 1945. These research men were either chemists or mechanical or electrical engineers, and in one case an economist was doing research work for a large rayon fabric mill in connection with export distribution and marketing problems. All these men had a Ph. D. degree and were considered topnotchers in their respective fields. They kept in close contact with their universities and laboratories and in many cases an active correspondence was kept up between these men and the professors at the respective universities or textile schools.

It must also be stated, and even emphasized, that all research men, whether chemists or mechanical or electrical engineers, at all times maintained close contact with the respective branches of the I. G. with its all embracing and ever present branches at Hoechst, Ludwigshafen or LeverKusen.

N. Management Staffs:

In some plants or companies the management or operating staffs were very elaborately set up; at least this was the impression when compared with our American ideas.

A typical example was found in a throwing plant employing not more than about 350 people and covering about 75,000 sq. ft. of floorspace. The staff, from top down, included:

The Manager, a doctor of mechanical engineering.
The Assistant Manager, a doctor of chemical engineering.
A Chemist, with a doctor's degree, in charge of quite an elaborate chemical laboratory, larger and better than most American throwing mills maintain.
An Assistant Chemist, for routine and control work.
A Plant Superintendent, with a title of mechanical engineer obtained from a "Technikum" where a student can get a diploma giving him the degree of mechanical engineer, but cannot get a Ph. D. degree.
Department Supervisors, of whom there were at least 5 or 6.

Then there were the lesser talents such as foremen, office clerks, etc.

In contrast to the above, an American throwing plant of similar size would operate with one General Manager, an Assistant, who most likely would be in charge of one of the three shifts, two more shift supervisors and a few department foremen. It is doubtful whether a plant of such size would have its own chemist. It can also be stated that most likely all these staff men in an American plant would be practical men who have come up through the ranks.

Another good example of the German conception of a mill staff was found in a large integrated weaving, throwing and finishing plant, viz:

An engineer with a Ph.D. degree in both mechanical and electrical engineering for plant and production.
A chemist with a doctor's degree specializing in managing the print division.
A chemist with a doctor's degree managing dyeing and finishing.
An engineer, also Ph.D., for building, construction and maintenance.

Each one of the above had under them a small staff of assistants and clerks.
Several chemists, some with doctor's degree, doing routine and control work.
A very elaborate, far flung styling staff and department.
An expert on export business, with many branch offices.
An expert on finances, superseding what we call treasurer.
Two members of the Board of Directors who gave their full time to the company in an advisory capacity.

Then, of course, there were in addition all the rest of the offices, positions, and jobs such as we find in our own industrial organizations.

While this German company rates as one of the most important in Europe, in the United States it would rank about fifth or sixth in the rayon manufacturing field.

It is the writer's opinion, in some respects, the Germans in their quest for scientific solutions of everything, their love for details and gadgets, their mania for approaching anything and everybody by the media of science, charts and blueprints, and last, but not least, by their unquestionable ability for thoroughness, have been led somewhat astray, and have gone beyond what we would consider a practical, sound, efficient and economical operating and management staff setup in the textile industry.

A few years ago, before the war, it is true we had few college men on our staff and in our plants, but this is being corrected. Decided progress has been made during the war, and mills are continuing to include in their staffs more men with better scholastic background, but it is being done without going to the extremes cited as existing in German plants.

O. <u>German Rayon Weavers as Future Competitors</u>:

One does not need to be an economist, or tariff expert to realize that the German mills when back on their feet can, and most likely will be keen potential competitors, and this refers only to what we call export markets.

Certainly all indications are that they will be helped to rebuild their industries, particularly peace time industries such as textiles, and if so, they will have little difficulty in recapturing their old markets, such as the Near East, some of the Far East, and without any doubt they will again invade the South American countries.

The writer's opinion is based, not on possible exchange or tariff conditions, but on the simple, fundamental premise and undeniable fact that the German textile worker, whether man or woman, young or old, is willing to go back and work hard; work ten hours a day at a very nominal, maybe even low wage, and some mills may operate two shifts of ten hours each if the manpower is available. They understand the export business; in many ways they stole a page from the British book by making special efforts to adapt themselves to the trading customs of their export countries, and by making fabrics, even if only in small quantities, especially designed and constructed for the particular climate, or particular type of garment worn in such country.

The writer had the opportunity to examine several voluminous sample collections representing fabrics exported in pre-war days. It was simply amazing to see how far the Germans would go to complicate their manufacturing routine in order to capture a new market or to retain it against competition. A typical case in point can be quoted.

A German manufacturer tried to capture the business in a certain province of India. Having ascertained the date of the prince's or Maharaja's birthday, he proceeded and printed the picture of the ruler's family on a silk velvet fabric. The arrangement was such that the prints could be used as pillow covers, for furniture covering, or framed as "portraits". They were exquisite, in multicolor, and made at great expense. Only about 50 were made and presented to the ruler with the compliments of the German manufacturer. This market was his thereafter.

We must expect that, as conditions permit, the German rayon weaver will again open agencies all over the world and send scores of men to thoroughly cover any field or territory, no matter where, if it holds out any promise as an export possibility. He will be willing, as heretofore, to do business at cost to begin with, be satisfied to capture the market first, and make profits later.

P. <u>Conclusion</u>:

It is true that mechanically we not only excel but are far ahead of the German rayon weaving and throwing industry. This is particularly true in the field of automatic looms, and regarding labor saving devices in the preparatory and throwing departments.

Similarly, we are ahead of them in creating and conceiving practical and serviceable fabric constructions and translating such into the American conception of streamlined manufacturing, all making for economical production, and consequently low costs.

Nevertheless, as true as it is that at present we have nothing to fear from them, it does not preclude the fact or possibility that there is nothing we can learn from them.

Many of the ideas and mechanical processes described in the foregoing report can be used in part or whole, or worked out to suit our conditions. Certainly if put through a proper process of "Americanization" many can be beneficially applied and profitably put into practice in our industry.

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