Alvin W. Boese Papers.

3M COMPANY

GENERAL OFFICES · 2501 HUDSON ROAD · ST. PAUL 19, MINNESOTA · TEL: 733-1110

Interoffice Correspondence

cc: J. R. Lane - 220-8W
R. J. May - 220-8W
F. R. Owen - 42-1E
A. H. Redpath - 220-8W

Subject: Patterson Instrument Co.

June 7, 1963

AW Boese
I agree - we'll have to watch Patterson
AHR

TO: A. W. BOESE - R.T. & G.W. - 220-8W

FROM: A. E. JOHNSON - TAPE ENGINEERING - 42-1E

On June 5, Mr. Hill of the E. F. Hill Machine Co. called Paul Johnson in Engineering Purchasing. Mr. Hill stated that the Patterson Instrument Company had approached him in regards to their handling Hill's hanking machine.

Mr. Hill has some reservations since he is apprehensive of Patterson coming out with their own line of hanking machines. Mr. Hill wanted to know if 3M was involved and what Hill's future business outlook with 3M was.

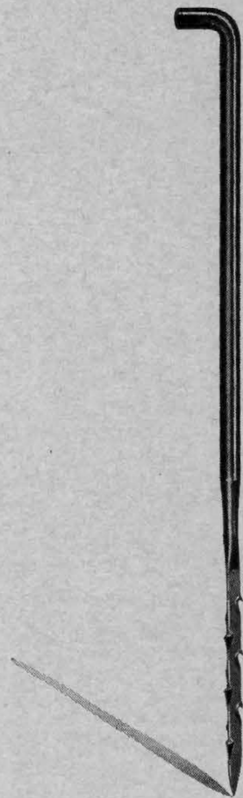
We use Hill's machine as a part of our S-80 and plan to continue to use it until it is replaced by a better design. Apparently the sales of this hanker are very minimal, with Hill's business mainly tied in with our use of his machine (3M has purchased approximately 35 hankers to date).

A E Johnson

AEJ:cmm

Al Redpath
They are evidently developing a form now making it
We should keep our eyes open
AWBoese

Processing



A NEEDLE WITH A FUTURE (IN NON-WOVENS)

Hunter's remarkable new Fiber/Locker Model 16 offers efficiency and economy unequalled in the field of non-wovens. For processing non-woven felting and other light to medium needle applications of natural and synthetic fibers, this machine utilizes two needleboards, providing 96 needles per inch of machine width, as compared to 46 needles on single-needleboard models. This means that lineal production can be doubled, or twice the penetration produced for finer felting, at the same lineal speed. And speaking of speed, the superbly-balanced Model 16 operates at speeds up to 700 strokes per minute *without* special foundation construction. Whatever your needle-felting problems, or if non-wovens are only part of your future picture, Hunter can provide the answers — not only with a variety of Fiber/Locker models, but with all the accessory equipment to furnish a complete non-woven range. For constructive on-the-scene assistance, a Hunter engineer will be glad to visit you, without obligation, of course. Or send for Hunter's ***Fiber/Locker Bulletin C.***

JAMES HUNTER

James Hunter Machine Company, North Adams, Massachusetts
Mauldin, S. C. and Los Angeles, Cal. • Division of Crompton & Knowles Corp.
Machinery for Wet Finishing, Drying, Fiber Processing, Non-Wovens, Garnetting

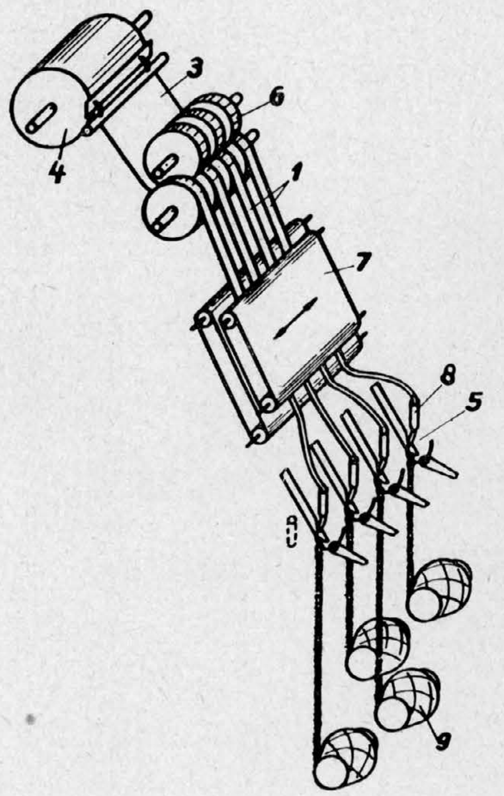
What do you get in the carton besides a machine?

When you invest in a machine from Leesona, our technical service is included. Specifically, you get:
Systems Specialists—to brief your operating staff on the capabilities of the machine and the benefits it offers.
Instructors for your fixers—to insure efficient operation and maintenance.
Trainers for your operators—to maximize production output.
Supervisors—for installation and startup.
Industrial Engineers—ready to present and instruct in methods for evaluation of operator-machine performance.
Leesona delivery includes people whose sole responsibility is to see that you get exactly what you ordered—more production, better quality, lower operating costs.
Leesona Corporation, Warwick, R.I.

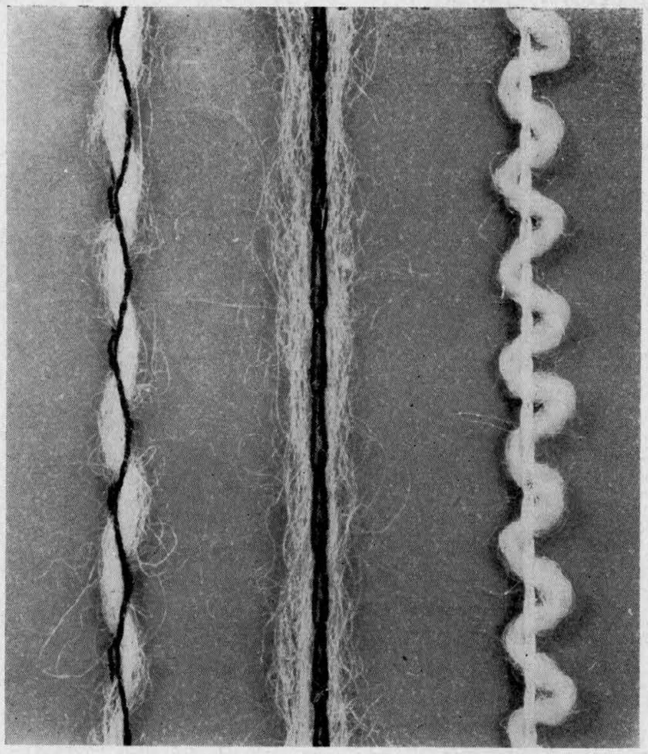
23.5.18

LEESONA

CIRCLE 37 ON READER SERVICE CARD



ABOVE: *Figure 1, a schematic representation of the 'Malifil' process, from the carding unit to cone winding*



ABOVE: *Figure 2, three different type of 'Malifil' yarns. Left to right: yarn produced by sideways displacement of the guide device in front of the compound needle; yarn produced without sideways displacement of the guide; a special effect yarn, produced by using a fully spun yarn, instead of a roving, and stitching the yarn with a shrinkable pvc thread, and then subjecting it to heat treatment. According to Mr. Mauersberger the 'Malifil' process offers a wealth of possibilities for fancy effect yarns, including cross-dyed effects*

Yarns of this type are particularly suitable for women's and men's and children's sports stockings and socks, for sweaters, also for carpet and hand knitting yarns, for woollen blankets, towelling, fine wool materials and fabrics for raising.

Figure 1 is a schematic representation of the process. From the doffer *4* of a woollen card the fleece *3* is taken off in the usual manner. It is then separated by a web divider *6* and rounded between the rubbing leathers *7*. Via the guide *8* this conventional roving is fed to the compound needles of the sew-knitting machine and is stitched by these and subsequently wound onto the cones *9*.

Figure 2 shows three different yarns of this type. Yarn *2.1* was produced by the sideways displacement of the guide *8* in front of the compound needle *5*. The roving is thus alternately bound into the stitch from left to right and from right to left. By displacement of the guide *8* the roving was given a wave-like shape, and a structure is formed which can also be influenced by the stitch length. In addition, the displacement of guide *8* can be regulated in certain repeats and can thus be used to create certain fancy effects in the yarn.

With yarn *2.2* no sideways displacement took place and the roving which has been flattened by pressure rollers was fed through a stationary guide *8*. It is wide enough to be securely stitched without sideways movement of the guide. Unlike yarn *2.1* this yarn is not texturised.

Figure 2.3 shows a special effect. Instead of a roving a fully spun yarn was stitched with a shrinkable pvc thread and then subjected to a heat treatment. The contraction of the sewing thread led to loop formation in the stitched yarn and thus created a fancy yarn (loop yarn). It is obvious therefore that the *Malifil* process offers a wealth of possibilities for fancy effects. In this connection it is also useful to point out that the roving and the stitching thread are usually made of different fibres and thus a variety of cross-dyeing effects can as a rule be obtained.

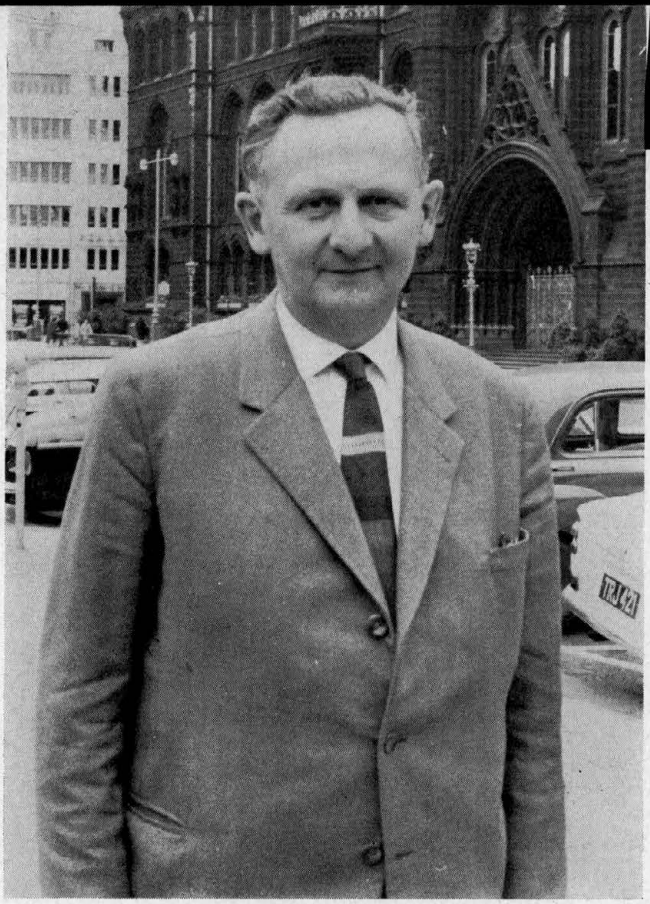
It is particularly important that the desired saving in material can be fully realised. Particular success has been achieved in the knitting sector where savings in material of up to 20% were observed. Alternatively one can achieve substantial improvements in quality with the same amount of material.

With certain yarn structures, tests have revealed a marked reduction in pilling.

The economic advantages of the *Malifil* process are further based on the following factors:

Reduced power consumption compared with spinning; reduced floor space requirements because the thread forming needles are more closely spaced than spindles; the possibility of continuous yarn production without special difficulties or effort by winding onto large packages (cones) which eliminate the need for rewinding.

Also from the point of view of the fibres used there are many new possibilities. It is possible to use fibres which cannot be spun as well as foam tapes or elastic thread. With the latter, the stitching with sewing thread limits the extensibility to a predetermined value which means that



First news of developments with the 'Mali' system to produce yarns and fleece fabrics was published in our September issue. Now, in this exclusive article, the inventor of the 'Mali' system, Ing. Heinrich Mauersberger (left), reveals the thinking behind the new developments and describes the production methods in detail

MALIFIL and VOLTEX:

Yarns and fleeces by the sew-knit process

THE idea of transposing the production speed of the sewing machine into the field of fabric production and of imitating woven fabrics by stitching together warp and weft threads originated early in 1947.

It was realised then that the new path required some complete re-thinking on the part of textile technologists and that such a process could not be put into practice from one day to the next. Equally well known were the views of the machinery makers who are essentially only interested in the manufacture of machines which can immediately be sold in large quantities.

The basic idea of replacing and imitating woven fabrics by stitched layers of warp and weft was therefore carefully explored in all possible directions in order to find as many fields of application as possible for the newly developed mechanism, the *Malimo* sew-knit machine. This led in quick succession to the development of the *Malimo*, *Maliwatt* and *Malipol* techniques which utilise the same basic machine design with comparatively minor modifications and additions and which in turn gave rise to a great variety of products.

For example, by the use of different yarns. Thus the *Malipol* technique can produce terry towelling when cotton yarns are used; with wool or woollen blends it can produce velours for women's and men's outerwear.

The situation can be summed up by saying that in the application of the sew-knit technique there is such a wealth of possibilities that the pursuit of all of these is likely to slow down rather than hasten further development. This realisation should not, however, prevent the following up of ideas which seem particularly attractive.

Opponents of the *Malimo* technique have for many years obstructed its progress by putting forward the argument that *Malimo* needs a third more material than weaving because there are three systems of threads: warp, weft and stitching thread. In the meantime, however, it has been realised that the question of greater or lesser materials requirements is entirely independent of the number of systems of threads used and depends solely on the weight per square metre. The cloth with the least weight per square metre also has the least materials requirement.

The period of work for the success of the *Malimo* techniques has however given rise to the following iron rule: savings in material are more important than increased productivity.

The new developments of *Malifil* and *Voltex* are based on this principle.

Malifil represents the application of the sew-knit process to spinning. In spinning a multitude of fibres is to a greater or lesser degree parallelised and is fed in the form of slivers or rovings to the spinning process proper (that is, the twisting of these fibres). One thus obtains the necessary strength of the thread for further processing. One loses, however, the major part of the existing volume; this is particularly noticeable in woollen spinning but applies also on the worsted system.

The textile industry has got used to this loss in volume. It means, however, that for example in woven fabrics a greater number of picks per inch is required to obtain satisfactory cover.

The *Malifil* process aims to strengthen the roving without loss of volume, thus saving material. The required strength is obtained not by twisting the fibres but by stitching, in the well-known *Malimo* manner, with a very fine sewing thread through the roving.

This leads to a number of further advantages. New types of patterns can be produced by combining differently coloured slivers or rovings or sewing threads or rovings made from different fibres.

A certain texturising of the yarn can also be achieved by using different stitches when inserting the sewing thread into the roving.

The absence of twist and the lofty structure of the yarn also facilitates penetration of dyestuffs and thus improves the quality of dyeing and speeds it up.

The stitched threads display an astonishingly high abrasion resistance.

Austrians introduce new needling unit

High speed machine built on 'unit construction' principle

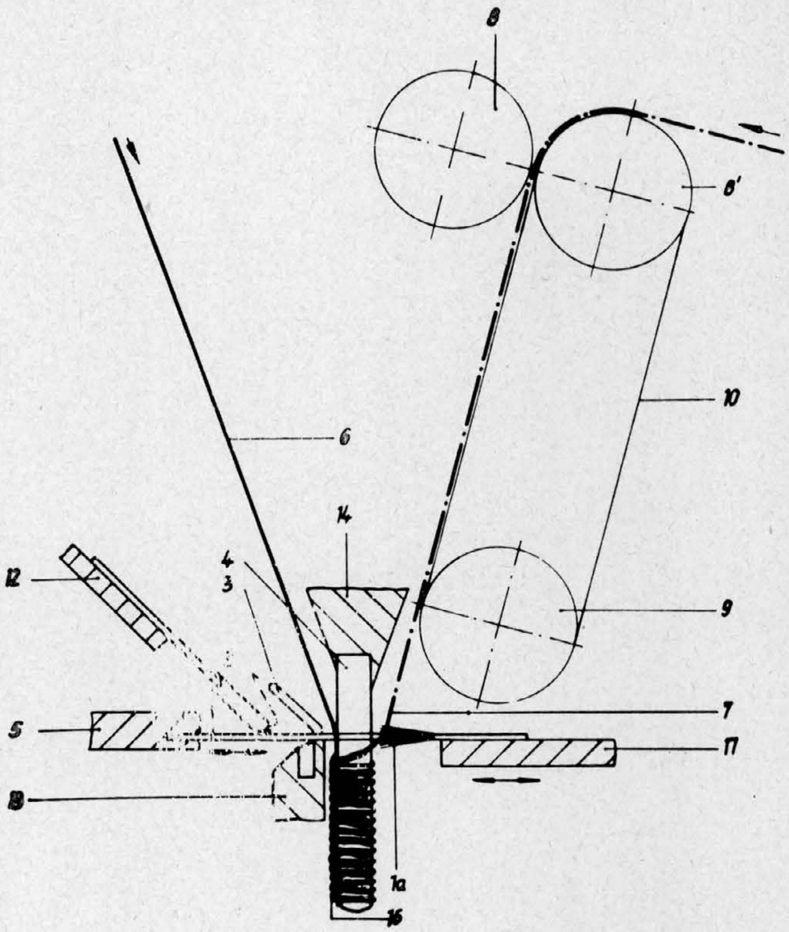
A NEW nonwoven needling machine, designated the *NL6*, has been introduced by the Austrian textile machine building firm of Dr. Ernst Fehrer Spezialmaschienfabrik, Linz. It is a high speed machine, developed from previous models made by the company, but a new *unit construction* method of building has now made it possible to offer the machine in a wide range of operating widths: from 78 in. to 354 in. The machine is being offered as a solo machine, and as part of an integrated nonwovens line, called the *N6*.

The company describes the first unit in the line as a *sheet machine*. The first part of this unit consists of a hopper feeder, which has recently been redesigned to incorporate a wider (63 in.) feed box. From the feeder the fibre passes to a picker drum, where the opening action begun in the hopper is continued, and the fibre is then distributed in a uniform even web. It then travels to a second picker where the final full-width web is produced. The sheet machine, called the *V6*, can produce uniform webs in weights ranging from $1\frac{5}{8}$ oz. to $6\frac{1}{2}$ oz. a sq. ft. It is made in four types, with maximum working widths of 82 in., 126 in., 169 in. and 212 in. A 354 in. maximum working width type is to be offered in the near future.

By coupling the *V6* to a *fine-sheet machine*, a *VS6* unit is formed, capable of producing webs with weights ranging from $\frac{3}{16}$ oz. to $6\frac{1}{2}$ oz. a sq. ft., to a guaranteed weight accuracy of +5%, independent of width. Delivery speeds up to 33 ft. a minute are possible, it is claimed. In the *VS6*, the web formed by the *V6* is used as a preliminary web and, when it is fed to the fine-sheet machine, it is subjected to a third opening cycle, the final web being formed on a suction drum. This web can then be fed either to the needling unit or it can be consolidated by using a spraying/drying unit.

The output of the *V6* and of the *VS6* is dependent on four factors: the weight per unit area of the web to be produced; the delivery speed of the web produced; the working width of the machine; and the type of fibre being processed. With a web weight of $\frac{5}{16}$ oz. a sq. ft. and a delivery speed of around 26 ft. a minute, output is about 106 lb. an hour for each metre of working width. A web weight of $1\frac{5}{8}$ oz. and a delivery speed of 13 ft. a minute gives an output rate of around 264 lb. for each metre of working width, while a weight of $4\frac{7}{8}$ oz. and a speed approaching 10 ft. a minute gives an output of 595 lb.

To complete the integrated line, the company also supplies transverse and longitudinal cutters, and take-up devices. Spraying and drying units for chemical consolidation of the web are also offered.



LEFT: *Figure 3, a schematic representation of the 'Voltex' process. Mr. Mauersberger explains that 'Voltex' eliminates the spinning process proper, because the fibre web is fed directly from the card to the fabric and firmly locked in place. Production speeds of 100 to 165 metres an hour are possible, it is said*

excessive stretch is avoided and the processing properties particularly of elastic and foam are greatly improved.

To sum up: the new *Malifil* threads offer a great many new possibilities at lower production costs than the classical process. *Malifil* was developed at the Institute for Textile Machinery at Karl-Marx-Stradt.

The *Voltex* process, however, owes its development to the successful efforts of the Research Institute for Textile Technology, Karl-Marx-Stadt.

The starting point here was the well-known *Malipol* process where pile loops of woollen yarn are stitched into a base fabric. The loops are subsequently transformed into a bulky layer of fibres by raising, whereby the disintegration of the pile loops formed from yarn is only possible to a limited extent. This shortcoming is eliminated by the *Voltex* process where the spinning process for the pile thread is by-passed and fibre bundles are stitched into the ground fabric.

Figure 3 is a schematic representation of the *Voltex* process.

The loop forming part corresponds almost completely to that of the *Malipol* machine. There are the compound needles *1* on the bar *5*, the holding wires *2* on bar *12* as well as the pile sinkers *4* and the off-takers *3*. The ground fabric *6* runs between the fixed pile sinkers *4* and the wires *3* and is pierced by the needles *1*. The latter also pierce the fibre web *7* which is delivered by the apron *10*. On bar *17*, instead of the guide needles there is a flat brush which, however, carries out the same kind of movement as the needles (sideways and up and down). It brushes fibres from the web *7* into the open hooks of the compound needle *1* and these are subsequently pulled through to the other side of the base fabric *6*. The fibres are thus formed into loops and firmly bound in.

It is important that the web should be delivered at an adequate rate. The speed of apron is therefore in excess of the speed of the ground fabric. A particular advantage of the *Voltex* process lies in the increased production rate compared with conventional pile fabrics, tufted carpets and sliver-knitted goods.

Voltex eliminates the spinning process proper because the fibre web is fed directly from the card to the fabric and firmly locked. The change of warp beams or the replenishment of the pile thread creel is eliminated and thus a labour saving is achieved. The rapid throughput of material also leads to a better return on invested capital. Production rates are in the region of 100 to 165 metres an hour and since there is no possibility of yarn breaks and very few machine breakdowns the efficiency is very high.

The *Voltex* process is suitable for the manufacture of shoe linings, plush-like fabrics, outerwear, imitation fur and for floor coverings. Such *Malimo-Voltex* fabrics are light but nevertheless have very good heat insulation properties and good air permeability. With regard to strength and dimensional stability all requirements are met. Finishing can be carried out on conventional machines. It is also of importance that fibres of coarse denier can be processed without difficulty. Large-scale production of *Malimo-Voltex* materials is in progress at the VEB Volltuchwerk Crimmitschau, DDR. Licences for both processes have been given to Crompton & Knowles-Malimo Inc., USA.

World Manmade Fibre Imports—1965-1966

(Exports shown in alternate issues)

CELLULOSIC STAPLE

	July-Sept. 1965 Th. lb.	Oct.-Dec. 1965 Th. lb.	Jan.-Mar. 1966 Th. lb.	Apr.-June 1966 Th. lb.
Common Market				
Belgium/Lux.	4,736	6,034	4,766	*
France	3,782	5,064	4,686	4,452
West Germany	8,444	9,256	9,178	8,282
Italy	3,146	2,778	4,327	3,993
Netherlands	2,130	2,004	2,054	2,108
EFTA				
Austria	1,309	1,210	1,360	*
UK	7,380	7,590	7,850	7,530
Denmark	2,136	2,152	2,055(h)	1,916(h)
Finland	451	628	374	583
Norway	552	508	614	742
Portugal	5,968	4,356	2,684	4,235
Sweden	1,780	2,290	2,382	1,580
Switzerland	1,786	2,502	2,145	2,459
Others				
Canada	1,124	1,210	*	*
Greece	3,646	4,732	5,552	*
India	56	158	16	*
Irish Rep.(j)	991(a)	338	391	511
Israel	920	1,174	1,441	710
New Zealand	1,456	953(a)	953(a)	953(a)
S. Africa	23,786	*	*	*
Spain	210	442	1,080	968
USA	18,120(c)	21,026(c)	22,710	27,787

SYNTHETIC STAPLE

	July-Sept. 1965 Th. lb.	Oct.-Dec. 1965 Th. lb.	Jan.-Mar. 1966 Th. lb.	Apr.-June 1966 Th. lb.
Common Market				
Belgium/Lux.	8,679	10,476	11,188	*
France	4,084	6,512	8,160	11,326
West Germany	3,544	3,702	4,904	5,958
Italy	4,756	5,220	7,552	8,610
Netherlands	3,320	2,986	3,402	3,818
EFTA				
Austria	1,892	2,380	2,272	2,824
UK	7,470	7,570	8,840	6,700
Denmark	698	806	920	964
Finland	696	894	1,092	1,141
Norway	612	1,148	754	1,061
Portugal	3,632	2,974	1,852	2,462
Sweden	1,844	2,016	2,636	1,722
Switzerland	2,024	1,987	2,274	2,626
Others				
Australia	3,137	1,779	1,658	4,527
Canada	2,595	3,691	*	*
Greece	784	1,276	982	1,006
India	1,384	466	686	*
Irish Rep.	536	782	683	846
Israel	1,318	932	1,170	1,463
New Zealand	294	289	295	382
S. Africa	2,096	1,302	*	*
Spain	4,824	5,775	7,258	8,544
USA	16,927(c)	17,032(c)	22,280	21,276

FILAMENT CELLULOSIC YARN

	July-Sept. 1965 Th. lb.	Oct.-Dec. 1965 Th. lb.	Jan.-Mar. 1966 Th. lb.	Apr.-June 1966 Th. lb.
Common Market				
Belgium/Lux.	2,370	3,138	3,480	*
France	2,510	3,374	3,952	4,064
West Germany	9,864	12,282	10,890	10,324
Italy	1,228	2,554	1,628	2,365
Netherlands	1,350	1,368	1,284	1,208
EFTA				
Austria	1,284	1,606	2,074	*
UK	1,310	520	620	1,100
Denmark	568	852	720	592
Finland	730	942	610	908
Norway	178	187	228	228
Portugal	838	874	600	712
Sweden	742	990	1,018	868
Switzerland	788	742	608	522
Others				
Canada(f)(k)	1,199	1,099	*	*
Greece	354	386	336	*
Hong Kong	1,146	1,006	909	914
India	516	354	608	*
Irish Rep.(f)	997	923	942	1,095
Israel	2,272	1,634	2,270	1,630
New Zealand	305	191(a)	191(a)	191(a)
S. Africa	2,341	*	*	*
Spain	192	294	492	372
USA	1,509(c)	1,420(c)	1,262	931

SPUN CELLULOSIC YARN

	July-Sept. 1965 Th. lb.	Oct.-Dec. 1965 Th. lb.	Jan.-Mar. 1966 Th. lb.	Apr.-June 1966 Th. lb.
Common Market				
Belgium/Lux.	2,251	4,422	4,968	*
France	148	356	602	776
West Germany	4,592	5,005	4,462	4,248
Italy	322	226	710	238
Netherlands	2,636	3,289	3,056	3,071
EFTA				
UK(b)	450	430	300	580
Denmark	520	580	590	774
Finland	328	334	314	401
Norway	80	55	36	43
Sweden	578	544	539	415
Switzerland	1,368	1,296	1,244	1,198
Austria	1,082	1,006	1,092	*
Others				
Hong Kong	171	148	50	—
New Zealand	85	110(a)	110(a)	110(a)
S. Africa	193	*	*	*
Spain	5	7	33	2
USA(b)	64(c)	64(c)	196	621

SYNTHETIC YARN

	July-Sept. 1965 Th. lb.	Oct.-Dec. 1965 Th. lb.	Jan.-Mar. 1966 Th. lb.	Apr.-June 1966 Th. lb.
Common Market				
Belgium/Lux.	4,712	6,730	7,958	*
France	4,719	7,538	9,152	9,906
West Germany	11,324	15,802	15,386	15,718
Italy	1,040	1,648	2,050	2,427
Netherlands	5,876	8,088	8,624	7,872
EFTA				
Austria	3,572	4,290	4,682	4,866
UK(d)	5,670	6,620	9,980	8,910
Denmark	3,047	4,008	3,780	4,120
Finland	1,562	2,214	2,830	3,218
Norway	2,884	3,478	3,534	3,140
Portugal	2,724	3,720	1,500	3,004
Sweden	4,546	6,364	5,756	5,516
Switzerland	2,396	2,706	3,150	3,544
Others				
Australia	2,790	2,419	2,188	3,101
Canada	2,376	2,254	*	*
Greece	756	966	759	777
Hong Kong	1,095	1,312	1,165	2,050
India	2,894	1,826	2,240	*
Irish Rep.	753	1,019	974	1,025
Israel	1,294	1,096	1,548	1,752
New Zealand	648	488	238	494
S. Africa	3,664	2,382	*	*
Spain	4,616	5,408	5,332	5,134
USA(d)	1,810(c)	3,249(c)	1,454	2,741

FILAMENT CELLULOSIC FABRICS

	July-Sept. 1965 Th. lb.	Oct.-Dec. 1965 Th. lb.	Jan.-Mar. 1966 Th. lb.	Apr.-June 1966 Th. lb.
Common Market				
Belgium/Lux.	2,424	2,778	2,896	*
France	1,619	2,513	2,154	2,455
West Germany	4,952(e)	5,936(e)	6,222	4,798
Italy	906	1,132	1,350	1,294
Netherlands	2,610	2,798	2,744	2,814
EFTA				
Austria	366	374	460	*
Denmark(e)	542	544	583	449
Norway	680	764	858	818
Switzerland	406	508	500	470
	Th. Sq. Yds.	*Th. Sq. Yds.*	*Th. Sq. Yds.*	*Th. Sq. Yds.*
UK	8,820	10,330	10,360	8,300
Sweden(e)	2,609	3,064	3,213	2,406
Others				
Irish Rep.(e)	1,724	1,487	1,569	1,685
New Zealand(g)	2,687	2,791(a)	2,791(a)	2,791(a)
S. Africa	6,969	*	*	*
	Th. lb.	*Th. lb.*	*Th. lb.*	*Th. lb.*
Canada(f)	4,716	6,111	*	*

SPUN CELLULOSIC FABRICS

	July-Sept. 1965 Th. lb.	Oct.-Dec. 1965 Th. lb.	Jan.-Mar. 1966 Th. lb.	Apr.-June 1966 Th. lb.
Common Market				
Belgium/Lux.	1,395	1,785	1,564	*
France	1,974	3,834	3,876	3,186
West Germany	7,884	9,136	8,654	7,010
Italy	312	580	1,052	1,456
Netherlands	4,326	5,078	4,796	4,640
EFTA				
Austria	1,022	960	1,010	*
Denmark(e)	1,298	1,410	1,544	1,314
Norway	587	567	768	422
Switzerland	782	878	876	802
	Th. Sq. Yds.	*Th. Sq. Yds.*	*Th. Sq. Yds.*	*Th. Sq. Yds.*
UK	7,950	9,720	11,690	8,300
Sweden(e)	5,789	6,272	6,517	5,324
Others				
Irish Rep.(e)	278	365	510	469
New Zealand(g)	3,647	2,855(a)	2,855(a)	2,855(a)
S. Africa	13,941	*	*	*

SYNTHETIC FABRICS

	July-Sept. 1965 Th. lb.	Oct.-Dec. 1965 Th. lb.	Jan.-Mar. 1966 Th. lb.	Apr.-June 1966 Th. lb.
Common Market				
Belgium/Lux.	3,240	4,492	4,134	*
France	1,814	2,742	3,514	3,955
West Germany	5,326	7,244	8,544	7,620
Italy	1,774	2,894	3,844	2,516
Netherlands	4,714	6,440	6,752	6,072
EFTA				
Austria	820	954	1,348	*
Denmark	1,928	2,012	2,264	2,032
Norway	886	1,174	1,400	1,198
Sweden	2,276	2,080	2,255	2,109
Switzerland	1,026	1,152	1,316	1,148
	Th. Sq. Yds.	*Th. Sq. Yds.*	*Th. Sq. Yds.*	*Th. Sq. Yds.*
UK	5,600	5,390	6,560	5,600
Others				
Australia(g)	4,895	3,962	4,704	4,623
Irish Rep.	1,178	894	1,046	1,144
New Zealand(g)	3,826	3,126	2,618	3,249
S. Africa	10,218	10,264	*	*
	Th. lb.	*Th. lb.*	*Th. lb.*	*Th. lb.*
Canada	1,284	1,702	*	*

Notes: * Not yet available. (a) Based on average. (b) Including synthetic. (c) Textile Economics Bureau Inc. (d) Filament only. (e) Woven. (f) Including spun. (g) Woven excluding tyre fabrics. (h) Excluding tow. (j) Including waste. (k) Excluding tyre yarn.