

[54] **SPREADER-PROPELLER APPARATUS
FOR TUBULAR KNITTED FABRICS**[72] Inventor: **Andrew P. Cecere**, Valley Stream,
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side, N.Y.[22] Filed: **Dec. 24, 1970**[21] Appl. No.: **101,312**[52] U.S. Cl. **26/55 R, 226/193**[51] Int. Cl. **D06c 5/00**[58] Field of Search..... **26/55 R, 55 WC, 56; 226/193**[56] **References Cited****UNITED STATES PATENTS**

2,588,624	3/1952	Evans	26/56 X
3,175,272	3/1965	Cohn et al.....	26/55 R
3,207,616	9/1965	Cohn et al.....	26/55 R X
3,263,458	8/1966	Cohn et al.....	26/55 R UX
3,436,796	4/1969	Coates	26/55 R
3,490,665	1/1970	Jonsson	226/193 X
3,604,079	9/1971	Coates	26/55 R

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[57]

ABSTRACT

The invention is directed to a new spreader-propeller arrangement for handling tubular knitted fabrics in a manner to eliminate marking of the fabric or at least to effect a significant reduction in fabric marking. The new apparatus includes a spreader frame which is received internally of a tube of knitted fabric and is arranged to distend the tube laterally to a flat, two-layered form having a predetermined width. The

spreader frame includes belts and pulleys which engage the internal edge walls of the fabric and cause it to be advanced in the desired direction. Driving of these belts and pulleys is effected through edge drive rolls located on the exterior of the fabric and acting through the fabric edge walls. A unique feature of the invention resides in the provision of an arrangement for supporting the weight of the spreader frame and fabric by means of a small upward vertical component of the driving force of the edge drive rolls, rather than by physical confinement of the spreader frame as has been conventional heretofore, thereby eliminating an important cause of fabric marking. The edge drive rolls of the new apparatus are of cylindrical configuration, as are the spreader frame pulleys with which they cooperate, and the invention provides for vertical supporting of the spreader frame by effecting a controlled misalignment of the rotational axes of the edge drive rolls relative to the spreader pulleys. The desired misalignment is effected by tilting of the spreader frame relative to the edge drive rolls, with the result that, when the edge drive rolls are operated, a slight upward force component is imparted to the spreader frame, sufficient to support the weight of the frame and the fabric passing thereover.

The spreader frame of the invention also incorporates a special combination of hard, cylindrical rolls, selected ones of which are provided with a patterned surface configuration, with the surprising and highly advantageous result of greatly minimizing fabric marking.

The invention includes other significant features, such as low-friction surfacing at critical points, all to the end that delicate and sensitive fabrics may be processed with a practical minimum of process marking from the spreading stage.

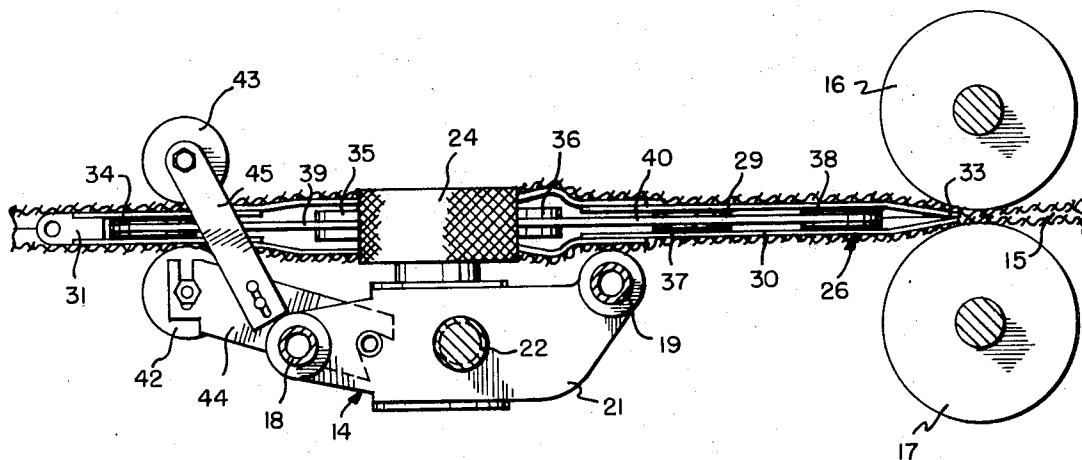
2 Claims, 8 Drawing Figures

FIG. 1

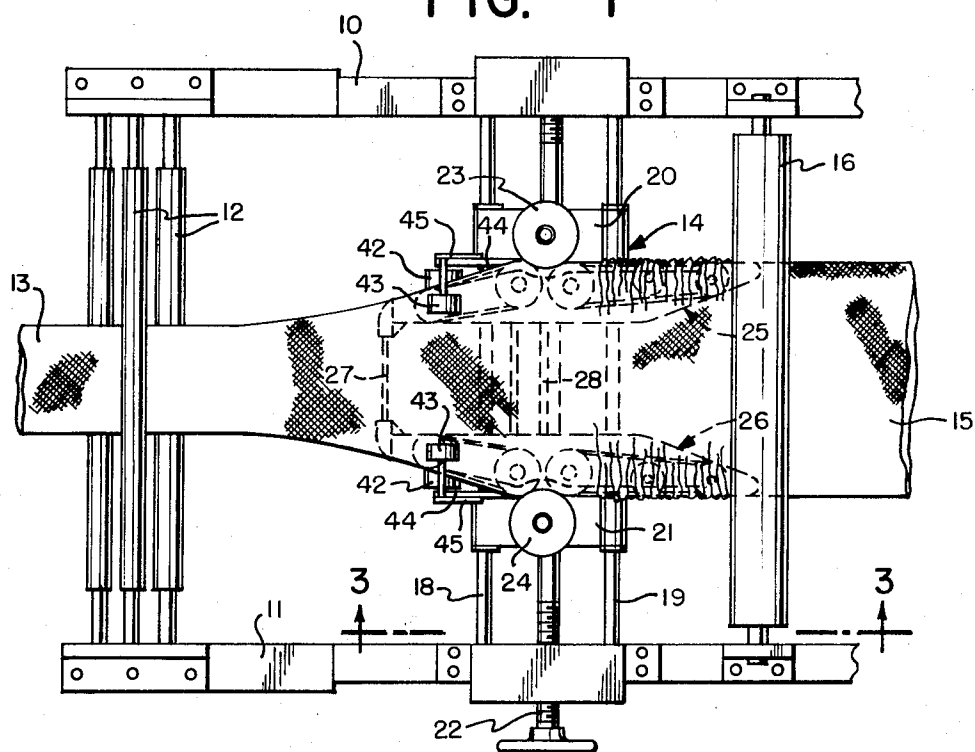
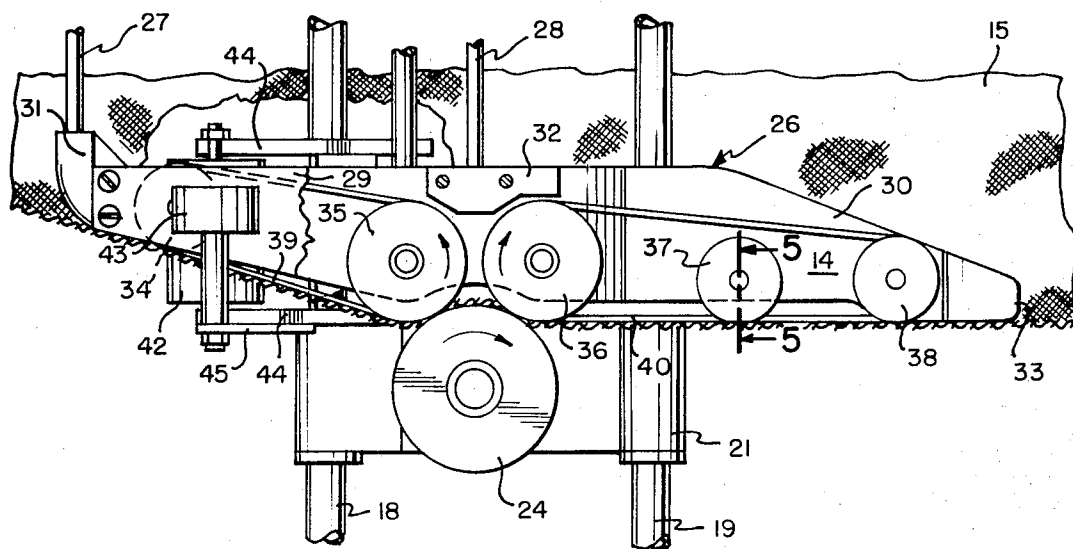


FIG. 2



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FIG. 3

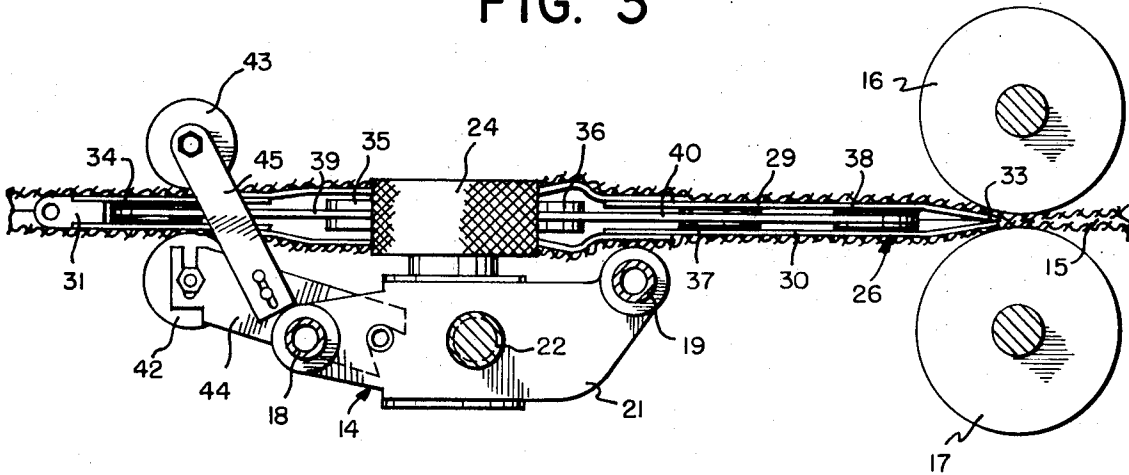


FIG. 4

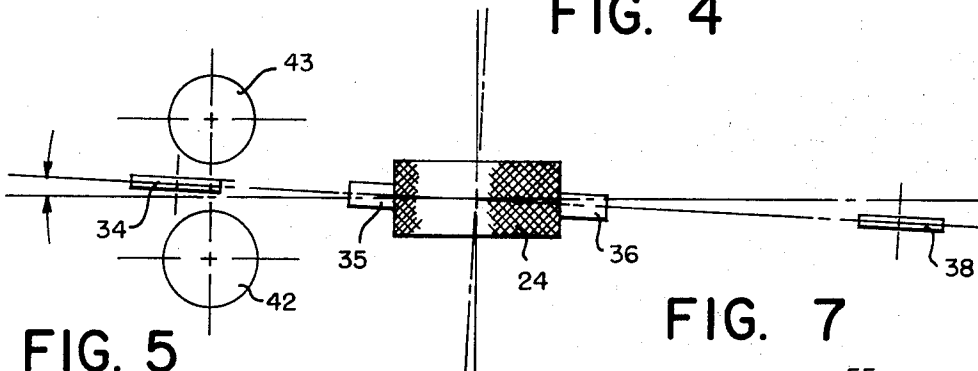


FIG. 5

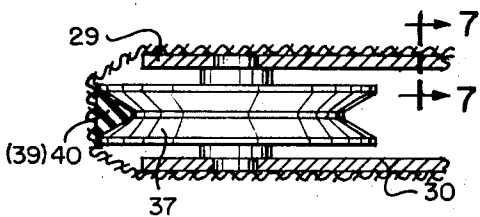


FIG. 7

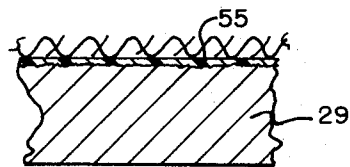


FIG. 8

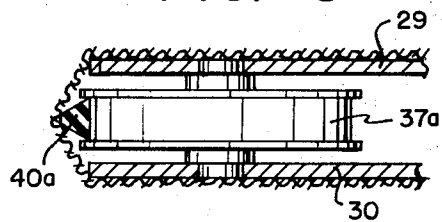
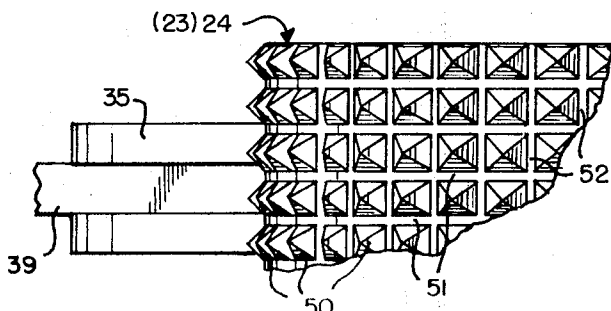


FIG. 6



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SPREADER-PROPELLER APPARATUS FOR TUBULAR KNITTED FABRICS

BACKGROUND AND SUMMARY OF THE INVENTION

In the processing of tubular knitted fabrics, it is conventional at one or more stages of the processing to pass the tubular fabric over a spreader-propeller apparatus. The spreader-propeller apparatus is so characterized by reason of its ability to laterally distend the tubular fabric to flat, two-layered form at a predetermined width, and also its ability to engage the fabric tube internally and convey its edges in an advancing or downstream direction during the distending operation. In conventional processing operations for tubular fabric, the spreader-propeller apparatus may be utilized to advantage in conjunction with wet processing of the fabric, and also in connection with calendering and finishing of dry tubular fabric. The apparatus of the present invention is specifically advantageous for, although not necessarily limited to, use in connection with the wet processing of tubular knitted fabrics, and, in particular, the wet processing of tubular knitted fabrics of "sensitive" constructions. It is designed to carry out the necessary processing in such a manner that the fabric, particularly delicate or sensitive fabric, is not subjected to excessive pressures, abrasions and restraints; these can cause the fabric to have stripe-like marks which detract from its appearance and lower its saleability.

A now-conventional form of spreader-propeller apparatus for tubular knitted fabrics is reflected in the S. Cohn et al., U.S. Pat. No. 2,700,543, granted Jan. 25, 1955. In the apparatus of the patent, there is provided a spreader frame having entry and discharge sections, and the frame is supported and driven by a pair of edge drive rolls engaging the frame between these sections. The entry section of the spreader includes a pair of divergently related belts arranged to engage the fabric internally, and advance its edges in a divergent manner. On the discharge side of the spreader, there is a second pair of belts, usually disposed in parallel relation, and arranged to engage the fabric internally and convey it for a distance at a predetermined width. In the center portion of the frame, the respective pairs of entry side and discharge side belts are trained about pulleys which are received internally of the fabric tube. The downstream pulleys on the entry side belts are closely adjacent to the upstream pulleys of the discharge side belts, to form cooperating pairs, and these cooperating pairs of pulleys are driven through the fabric wall by edge drive rolls forming part of the power train.

Conventionally, the belt pulleys are shaped to have a rounded (convex) peripheral surface configuration and the edge drive rolls are provided with deep annular grooves in which cooperating pairs of the belt pulleys are received. The pulleys and edge drive rolls typically are mounted for rotation about vertical axes, and thus the weight of the spreader frame is supported by an interlocking relationship between the convexly rounded belt pulleys and the deeply grooved edge drive rolls.

With spreader-propeller equipment of conventional design, the forces involved in supporting the spreader weight are relatively concentrated and tend to act directly through the wall of the fabric. This tends to

crush or iron the fabric. Particularly with sensitive styles of fabric, such as velour and other pile fabrics, and also with fabrics whose precise color or sheen, for example, is at least partly a function of its precise physical structure, this tendency to crush the fabric may result in a mark or stripe running longitudinally along the fabric, which is difficult, sometimes impossible, to remove. In addition, and possibly of even greater significance, the interaction of convexly rounded belt pulleys and grooved edge drive rolls inherently results in a "rubbing" of the fabric surface under pressure in certain areas, as a function of the differential surface speeds of opposed areas of the rounded pulleys and grooved rolls. In this respect, the peripheral speed of different areas of a rounded pulley will vary as a function of radius, such that the central portions of the pulley surface will have a higher peripheral speed than the edge portions. Exactly the reverse is true of the grooved edge drive rolls, where the edges of the grooves, having larger radii than the center portions, will have higher surface speeds. There is thus an unavoidable mismatching of surface speeds at directly opposed areas of the interengaged pulleys and edge drive rolls. A combination of concentrated weight acting directly through the fabric wall and inherently mismatched surface speeds unavoidably subjects the fabric to conditions which tend to result in undesirable marking.

In accordance with one of the more important aspects of the present invention, a unique arrangement is provided for cooperatively relating the edge drive rolls of the spreader-propeller apparatus with the cooperating pairs of internal belt pulleys, whereby the weight of the spreader frame may be supported by edge drive rolls of cylindrical configuration. By thus avoiding the use of grooved edge drive rolls, it is possible to minimize the application of localized pressure to the fabric, and also to minimize slippage of the roll surfaces against the fabric, both of which are significant sources of fabric marking in conventional apparatus. In order to provide the necessary support of the weight of the spreader frame, utilizing cooperating sets of cylindrical rolls, the spreader frame is oriented in the system as a whole to be tilted slightly downward, from its upstream end to its downstream end, relative to edge drive rolls rotated about vertical axes. Thus, when the edge drive rolls are driven to rotate about their vertical axes, a slight force component is imparted to the cylindrical internal pulleys, acting at right angles to the plane of the spreader frame, in a generally upward direction. By carefully controlling the angle of tilt of the spreader frame relative to the axes of the edge drive rolls, it is possible to precisely balance the spreader frame and cause it, in effect, to float between predetermined limit positions during operation.

Advantageously, the respective edge drive rolls are formed of a resilient material of substantial hardness provided with a multi-pointed surface characteristic over the generally cylindrical roll configuration. The multi-pointed rolls cooperate with smooth cylindrical propeller rolls or pulleys, which are also constructed of a resilient material of substantial hardness. The multi-pointed surface characteristic of the edge drive rolls may be provided by a pyramidal pattern on the surface of the edge drive rolls, somewhat similar to an extreme-

ly coarse knurl. The use of relatively hard materials for the cooperating pulleys and edge drive rolls, which is made practicable by the new configuration, provides an advantageous increase in the service life of the pulleys and rolls.

When knitted fabric is subjected to lateral distension in a spreader-propeller frame, the enlargement of the fabric width is achieved by lateral separation of the longitudinal rows (wales) of knitted loops. Particularly where fabric appearance tends to be a significant function of its specific stitch configuration, any non-uniformity in wale separation, which might occur during lateral distension, could result in undesirable variations in the appearance of the fabric. With conventional equipment, there is a tendency for the fabric to be subjected to some degree of lateral constraint where the fabric is in contact with the spreader frame and spreader belts at the edge regions of the frame. Where such constraint is excessive, there will be greater separation of the fabric wales in the unsupported center portions of the fabric tube than at its edges, and this can impart a longitudinally striped appearance to the fabric, which is, of course, undesirable. In accordance with one of the more specific aspects of the invention, surface portions of the spreader frame contacting the fabric edges are provided with low friction surfacing, such as with tetrafluorinated ethylene polymers (e.g., Teflon). This reduces the lateral constraint of the fabric to a practical minimum and thereby minimizes the striping or "marking" effect on the fabric which tends to result therefrom. To advantage, the low friction surfacing of the spreader frame structure may be provided by surface impregnation.

For a better understanding of the above and other features and advantages of the invention, reference should be made to the following detailed description and to the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of a spreader-propeller apparatus incorporating the features of the invention.

FIG. 2 is an enlarged, fragmentary plan view, with parts broken away, illustrating details of the apparatus of FIG. 1.

FIG. 3 is an enlarged, cross-sectional view taken generally on line 3—3 of FIG. 1, with parts broken away to illustrate further details of construction.

FIG. 4 is a simplified, schematic representation of the apparatus of FIG. 1, illustrating the manner in which the weight of the spreader frame is supported by a component of the rotational motion of the edge drive rolls.

FIG. 5 is an enlarged, fragmentary, cross-sectional view taken generally on line 5—5 of FIG. 2.

FIG. 6 is an enlarged, fragmentary elevational view showing details of the multi-pointed surface characteristics of the edge drive rolls of the new apparatus.

FIG. 7 is an enlarged, fragmentary, cross-sectional view taken generally on line 7—7 of FIG. 5.

FIG. 8 is an enlarged, fragmentary, cross-sectional view, similar to FIG. 5, showing a modified form of propeller belt arrangement.

DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

Referring now to the drawings, the reference numerals 10, 11 designate elements of a machine frame forming part of the processing installation. At the extreme end of the machine frame, there may be provided a plurality of rollers 12 arranged to provide a sinuous path for incoming tubular knitted fabric 13 derived from an appropriate source (not shown). Passage of the fabric 13 through the rollers 12 causes a slight amount of longitudinal tension to be applied to the fabric for control purposes and to cause the fabric to be presented in smooth, flat form. Downstream of the tension rollers 12 is a spreader-propeller unit, generally designated by the numeral 14 and to be described in greater detail. The spreader-propeller receives the incoming fabric 13, distends it to a predetermined width, and discharges the uniformly distended fabric 15 between a pair of rollers 16, 17. Most advantageously, the incoming fabric 13 is wet from previous liquid processing, for optimum performance. However, in some instances, the incoming fabric may be dry, in which case a steaming operation (not shown) is associated with the distending sequence.

Extending laterally between the machine frames 10, 11 are a pair of spaced, guide rods 18, 19 on which are slideably supported, a pair of edge drive carriages 20, 21. The carriages 20, 21, are engaged by a rotatable threaded shaft 22, which is oppositely threaded at its respective ends, such that rotation of the shaft causes symmetrical inward or outward adjustment of the edge drive carriages 20, 21.

Each of the carriages 20, 21 mounts an edge drive roll 23, 24 for rotation about a vertical axis. Rotation of the edge drive roll is effected advantageously by means of a driven splined shaft (not shown), which extends between the machine frames 10, 11, and has an appropriate slidable driving connection with the rolls 23, 24. Such a driving arrangement is conventional and is described in the beforementioned S. Cohn et al. U.S. Pat. No. 2,700,543.

Positioned between the edge drive rolls 23, 24 is the spreader-propeller frame 14. The frame 14 is of symmetrical construction and includes longitudinally extending frame sections 25, 26, connected by telescopically adjustable spacing rods 27, 28.

In typical configuration, the individual frame sections 25, 26 are comprised of upper and lower frame plates 29, 30. These are connected at the upstream end of the frame by spacer blocks 31, and in the middle portion of the frame by spacer blocks 32. At the downstream end, the frame plates 29, 30, advantageously may be brought into contacting relation at 33.

The frame plates 29, 30 journal a plurality of pulleys 34, 38 inclusive, which carry propeller belts 39, 40. The belt 39, which may be referred to as the upstream belt, is trained about the pulleys 34, 35, and these pulleys are so disposed, as reflected in FIG. 2, that the outer reach of the belt lies slightly outside of the outer edges of the frame plates 29, 30. The belt 40, which may be referred to as the downstream belt, is trained principally about the pulleys 36, 38. These pulleys are arranged so the outer reach of the belt lies somewhat outside the outer edges of the frame plates 29, 30 as in

the case of the upstream belt 39. The idler pulley 37 engages an intermediate portion of the outer reach of the belt 40 to provide additional support thereof, and the desirability and number of such idler pulleys will, of course, be a function of the distance between the primary pulleys 36, 38, as will be readily understood.

As reflected in FIG. 1, the pulleys 35, 36, which may be sometimes referred to herein for convenience as the propeller rolls, are journaled in the frames 25, 26 in slightly spaced relationship. Further, the axes of the respective propeller rolls 35, 36 of a cooperating pair are disposed in a parallel relation. The arrangement is such that cooperating pairs of propeller rolls 35, 36 at each side are enabled to partially receive the respective edge drive rolls 23, 24. Thus, when the spreader frame is appropriately supported in the apparatus (in the manner to be hereinafter described) and the spreader is adjusted by means of the rods 27, 28 to a predetermined, desired width, the edge drive rolls 23, 24 may be adjusted inward toward the pairs of propeller rolls. In the properly adjusted positions of the edge drive rolls, the spreader frame is held against forward or rearward movement relative to the machine frame by the cooperative action of the edge drive rolls and the propeller rolls, as will be appreciated upon examination of FIGS. 1, and 2.

In the illustrated arrangement, the longitudinal dimensions of the downstream or discharge section of the spreader frame are related in a predetermined manner to the distance between the axes of the edge drive rolls 23, 24 and the axes of the calender or processing rolls 16, 17. The relationship is such, that when the spreader frame is properly received in and confined by the edge drive rolls 23, 24, the downstream extremities 33 of the spreader frame are disposed near the processing rolls 16, 17, typically terminating near, but somewhat upstream of the narrowest portion of the bight formed by the rollers. The arrangement is such that, when the spreader frame is properly positioned by the edge drive rolls 23, 24, the discharge end of the spreader frame desirably remains out of contact with the processing rolls 16, 17.

In conjunction with the upstream portion of the spreader frame, there is provided an auxiliary supporting facility comprising lower auxiliary supporting rollers 42, and upper auxiliary confining rollers 43. The auxiliary supporting rollers 42 are carried by brackets 44 extending upward and rearward from the edge drive carriages 20, 21, and the auxiliary confining rollers 43 typically are supported in cantilever fashion by brackets 45, mounted on the supporting roll brackets 44. The arrangement is such that the auxiliary supporting and confining rollers 42, 43 are carried by, and adjustable inward and outward with, the edge drive rolls 23, 24 and thus maintain a predetermined relationship with the spreader frame when the edge drive rolls are properly positioned relative thereto. As reflected particularly in FIG. 2, the operative position of the supporting and confining rollers 42, 43 is directly underlying and overlying the frame plates 30, 29.

In accordance with one of the important aspects of the invention, the auxiliary supporting rollers 42 are positioned to establish, in conjunction with edge drive rolls and carriages, a predetermined reference plane for the spreader frame. Advantageously, the reference

plane is adjustable within limits, either by adjustment of the brackets 44, relative to the edge drive carriages 20, 21, or by adjustment of the supporting rollers 42 on their brackets, or both. The predetermined reference plane thus provided is such that, when the equipment is at rest, the downstream end of the spreader frame is below the upstream end, and the axes of the propeller rolls 35, 36 are thus slightly skewed relative to the axes of the edge drive rolls 23, 24. For convenience of reference, this skewed relationship of the propeller roll axes may be referred to herein as a downward tilt. The downward tilt thus provided may be only 1° or 2° in a typical installation.

It will be understood, of course, that it is the relative disposition of the propeller rolls and edge drive rolls that is controlling, and the desired skewed relationship may be achieved by tilting one set of rolls on the other, or even tilting both sets in appropriate relation. In the illustrated apparatus, the critical downward tilt of the spreader frame is provided by appropriate adjustment of the position of the auxiliary supporting rollers 42, relative to the edge drive rolls 23, 24. Thus, assuming the edge drive rolls 23, 24 to be disposed on vertical axes, the supporting rollers 42 are so adjusted as to raise the upstream end of the spreader frame slightly above the downstream extremity 33. Desirably, the auxiliary confining rollers 43 are adjustably located above the supporting rollers 42, a distance exceeding the combined thickness of the spreader frame and a fabric tube passing thereover. Accordingly, under normal operating conditions, neither the confining rollers 43, nor the auxiliary supporting rollers 42, will have significant pressure contact with fabric passing over the surfaces of the spreader frame.

When the system of the invention is in operation, tubular knitted fabric 13 at a relatively narrow incoming width is drawn over the spreader frame, previously set so that its discharge or downstream portion is at a predetermined desired width. The spreader frame and fabric are then positioned between the edge drive rolls 23, 24, and the edge drive rolls are adjusted inward into light contact with the fabric. When the equipment is set into motion by rotation of the edge drive rolls 23, 24, the propeller rolls 35, 36 are caused to be rotated therewith. However, by reason of the slightly skewed relationship between the propeller rolls and the edge drive rolls, the rotary motion of the edge drive rolls in a horizontal plane imparts to the propeller rolls a small vertically upward force component, which is a function of the angle of downward tilt of the propeller rolls. The spreader frame, tends to be urged in an upward direction by this vertical force component. By proper adjustment of the height of auxiliary supporting rollers 42, in relation to the length and weight of the spreader frame, and the unit weight of the fabric, it is possible to so control the upward force component imparted by the edge drive rolls as to almost perfectly balance the weight of the spreader frame and the fabric passing over it.

Under most ideal conditions, the upstream end of the spreader frame will simply float between the auxiliary supporting and confining rollers 42, 43 without making significant pressure contact with either of them. More realistically, considering uncontrollable variables which the system will be exposed to during normal

production operations, the adjustment of downward tilt of the spreader frame will be such that the fabric may have a lightly touching contact from time to time with one or the other of the supporting or confining rollers. Even so, extraordinary improvements are realized in the number and degree of pressures brought to bear on the fabric during its passage over the spreader frame, so that the fabric is maintained as free as practicable of pressure markings, which otherwise might appear as longitudinally extending stripe-like marks along the edge areas of the fabric tube.

A particularly significant advantage of the above described arrangement, is that vertical support of the spreader frame is provided by means of the edge drive rollers without, however, resorting to grooving or otherwise shaping the edge drive rolls and/or propeller rolls. As will be appreciated, where the peripheral surface portions of the edge drive rolls and/or propeller rolls are formed to have interengaged rounded and grooved configurations, directly opposed portions of the respective rolls will have different surface speeds, and forcible rubbing of the fabric confined under pressure therebetween, is inevitable. In fundamental contrast, the system of the present invention enables the vertical support of the spreader frame to be derived at least in part by a unique interaction of edge drive and propeller rolls of cylindrical surface configuration. The cylindrical rolls give two important advantages: First, severe rubbing of the fabric from surface speed differentials is avoided. Second, the vertical weight-supporting forces act generally along the fabric wall, rather than directly through it, to minimize crushing forces. In a preferred form of the invention, the edge drive and the propeller rolls are advantageously formed of resilient, but relatively hard materials having low heat conductivity. A nylon based material, made available commercially by Polymer Corporation under its trade designation "Nylotron" has been found to be very satisfactory. The propeller rolls are most advantageously of flat, cylindrical surface configuration, excepting for appropriate angular recesses for the reception of propeller belts 39, 40 in substantially flush relation. The Nylotron desirably is of 100 durometer hardness (Shore Durometer), which corresponds to the resilience of "dead hard" rubber.

Advantageously, the edge drive rolls 23, 24 have outer portions formed of a material such as molded polyurethane, and this also may be a "dead hard" (100 Durometer) material. As will be understood, in the case of both the propeller rolls 35, 36 and the edge drive rolls 23, 24, the resilient outer material may be typically molded about a suitable metal hub to accommodate journaling and/or driving of the roll, as the case may be. The utilization of relatively hard materials for the edge drive and propellers, is advantageous because of the increased wearing life which is realized. The use of such materials, without resulting in a detrimental degree of fabric marking, is made practicable by reason of the cylindrical configuration of the rolls.

In accordance with one aspect of the invention, one or the other of the edge drive rolls or propeller rolls is provided with a so-called multi-pointed surface pattern upon its otherwise generally cylindrical overall configuration. Most advantageously, the multi-pointed surface is provided on the edge drive rolls, with the cylindrical

surfaces of the propeller rolls being substantially smooth. A particularly suitable form of multi-pointed surface pattern is formed by providing on the edge drive roll surfaces a large plurality of pyramid-like projections 50. As reflected in FIG. 6, these may be provided by machining or otherwise forming circumferential and axial grooves 51, 52, in the roll surface to form radially projecting points of more or less equilateral pyramid configuration. In one advantageous form of the invention, the pyramid-like points were on the order of one-quarter inch on a side, providing for widely spaced, limited area contact with the fabric as it passes between the edge drive rolls and the cooperating propeller rolls. Other "multi-pointed" arrangements are also suitable. The principal requirement being that the pressure contact between the edge drive and propeller rolls occur at a plurality of relatively small, spaced-apart areas.

By maintaining the necessary driving relationship between the edge drive rolls and the propeller rolls with the limited contact of spaced points or areas of limited size, crush lines on the fabric edges are largely avoided and such deformation of the fabric as unavoidably results from the pressure of the points 50 thereon has a subdued visibility by reason of the interrupted character of the contact.

As reflected in FIGS. 3 and 4, the axial or vertical dimensions of the edge drive rolls 23, 24, desirably are considerably greater than the vertical dimension of the propeller rolls 35, 36. This enables the spreader-frame 14 to wander through a slight vertical excursion within the limits of its normal operating characteristics without affecting the continuity of the contact between the edge drive and the propeller rolls as well as continuity of the pressure contacts on the fabric. The limits of vertical excursion are, of course, determined by the adjustments of the rollers 42, 43.

In accordance with another specific aspect of the invention, provision is made for maintaining at a realistic minimum, the lateral (particularly) as well as the longitudinal constraint of the fabric during its passage over the spreader frame. As will be observed in FIGS. 1 and 2, when the fabric is distended by the frame, the center portions of the fabric are free of contact with any surfaces and therefore are entirely free to undergo the geometrical adjustments of stitch configuration, etc., that necessarily accompany the distending process. Side margins of the fabric, however, are in sliding contact with the frame plates 29, 30, and the edge extremities of the fabric are, of course, in engagement with the propeller belts 39, 40. To some extent, therefore, these regions of the fabric tend to be constrained against lateral adjustment. In severe cases, this could result in a significantly greater separation or widening of the wales or longitudinal stitch lines in the center portions of the fabric, relative to the more constrained edge portions. Since knitted fabrics have an inherent interdependency of length and width, this could result in geometrical distortions in the fabric. It could also result in a longitudinally striped effect in the fabric as a function of the different degrees of wale separation across the fabric width.

To minimize fabric constraint on the spreader frame, particularly in the lateral direction, the frame plates 29, 30, are provided, in regions of contact with the fabric,

with a low friction surfacing material. To advantage, this may be in the form of an effectively integral outer-surface layer 55 (see FIG. 7) of tetrafluoroethylene (TFE) polymer molecules, but it may also be provided by means such as Teflon film surfacing, for example. Advantageously, the TFE surface is of a type producible under the so-called "Tufram" process of the General Magniplate Corp. of Belleville, N.J. The Tufram process utilizes an aluminum base material, of which the frame plates 29, 30, are constructed, and involves, as a first step, the formation of a very thin (typically 1 to 4 mils) layer of aluminum oxide. The hard ceramic surface thus formed by the aluminum oxide coating is then impregnated with extremely small (typically under 1 micron) particles of TFE, providing a smooth, extremely hard surface exhibiting many of the characteristics of tetrafluoroethylene polymers insofar as low friction properties are concerned.

The polymer-impregnated aluminum oxide surface of the spreader frame plates minimizes the friction effects acting upon the fabric during the distending phases and enables the necessary geometrical readjustments to occur with maximum uniformity throughout the whole of the fabric. Further, in this connection, and as reflected in FIG. 5, for example, the propeller belts 39, 40 desirably are of a minimum width (height) consistent with the need to maintain a sufficient degree of driving contact with the fabric edges. Desirably, the belts 39, 40 are more or less conventional type Vee belts, as reflected in FIG. 5. In certain instances, where the requirements of distending and propelling the fabric permit, it may be advantageous to reverse the normal configuration of the Vee belts 39, 40 to cause the narrow face of the belt to face outwardly and contact the fabric wall. In cases where adequate propelling force is provided by such a belt configuration, it may be utilized to provide optimum freedom of lateral constraint of the fabric during the distension phase. An advantageous arrangement to this end is reflected in FIG. 8 of the drawings, illustrating the Vee belt 40a with its narrow side facing outward.

The spreader-propeller system of the invention is especially advantageous for the processing of "sensitive", tubular knitted fabrics, that is, those which are especially susceptible to marking as a result of pressure contacts and/or geometric distortion resulting from non-uniform application of forces to the fabric during the distending phase. The utilization of edge drive and propeller rolls of generally cylindrical exterior configuration is uniquely advantageous in that the pressures acting on the fabric, by reason of the cooperative relationship of the edge drive and propeller rolls, are kept at a minimum level consistent with the need for effectively driving the propeller belts through the fabric wall. Further, by engaging the fabric wall between rolls of general cylindrical configuration, rubbing of the fabric, otherwise unavoidable where rolls of rounded and grooved peripheral wall configuration are utilized, is minimized or entirely avoided.

Vertical support of the weight of the spreader frame is achieved in a unique manner by orienting the frame with a slight downward tilt, such that the rotation of the edge drive rolls 23, 24 imparts a slight upward force component to the propeller rolls, sufficient to at least substantially offset the weight of the spreader frame

and the fabric passing thereover. Auxiliary supporting and confining rolls 42, 43 assure that the spreader frame maintains a predetermined approximate orientation at all times. However, to the extent that the fabric passing over the spreader may contact one or the other of the rolls 42, 43, the light pressures thus applied to the fabric would be significantly less than otherwise, since the spreader frame has at least an approximate floating balance as a result of its downwardly tilted orientation.

An additional specific feature of significance resides in the construction of one or the other of the propeller and edge drive rolls of resilient (preferably hard) materials, with the edge drive rolls (preferably) being formed with a "multi-pointed" surface characteristic, such that the fabric is engaged between a smooth roll surface and a multi-pointed surface. The described arrangement of rolls affords adequate driving contact between the edge drive and propeller rolls, while further minimizing the visibility to the eye of any residual fabric marking. Although either one or the other of the propeller rolls or edge drive rolls could be of multi-pointed surface structure (with the other being smooth), it is more advantageous to provide the multi-pointed surface on the edge drive rolls, which contact the exterior surface in the fabric.

Additional processing advantages are derived from the apparatus of the invention by constructing the fabric-contacting surfaces of the stationary frame plates to provide low friction surfacing. This may be achieved by first forming a thin aluminum oxide film on the aluminum plates, and then impregnating the porous ceramic aluminum oxide layer with microscopic TFE particles and thereby forming a continuous lubricating surface. By thus significantly improving the lubricity of the fabric-contacting surfaces, fabric marking, otherwise tending to result from sliding of the fabric over a non-moving surface is reduced. Further, and more importantly, lateral constraint of the fabric during the distending phase is greatly minimized, accommodating uniform adjustment of the fabric wales across the entire width of the fabric and thus providing a more attractive, higher quality finished product.

It should be understood, of course, that the specific form of the invention herein illustrated and described is intended to be representative only, as certain changes may be made therein without departing from the clear teachings of the disclosure. Accordingly, reference should be made to the following appended claims in determining the full scope of the invention.

I claim:

1. A spreader-propeller apparatus for advancing and distending tubular knitted fabrics, comprising
 - a. an internal spreader frame including a pair of propeller rolls at each side,
 - b. a pair of driven edge drive rolls mounted one on each side of the spreader frame,
 - c. said propeller rolls and edge drive rolls being of a resilient, relatively hard material,
 - d. said edge drive rolls being positioned to have frictional working contact with the respective pairs of propeller rolls through a fabric wall interposed therebetween,
 - e. the regions of working contact between the propeller and edge drive rolls being of generally cylindrical configuration, and

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f. the working surface areas of the rolls of at least said edge drive or propeller rolls having a multi-pointed surface characteristic of said resilient, relatively hard material;
whereby the pressure contact between the edge drive and propeller rolls occurs at a plurality of relatively small, spaced apart areas which avoids severe rubbing and hence marking of tubular

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knitted fabrics treated thereby.
2. A spreader-propeller apparatus according to claim 1, further characterized by
a. said propeller rolls and said edge drive rolls having surface portions formed of material of relatively low heat conductivity.

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