R. W. SCOTT.

ART OF KNITTING REINFORCED FABRICS.

APPLICATION FILED SEPT. 11, 1916.

1,373,769. **Patented Apr. 5, 1921.**

2 SHEETS—SHEET 1.

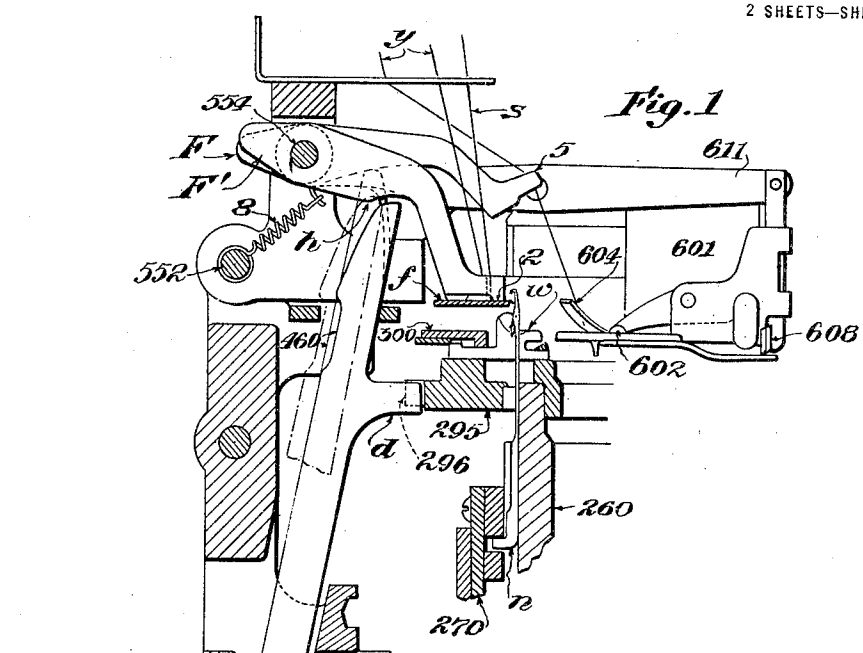


Fig. 1

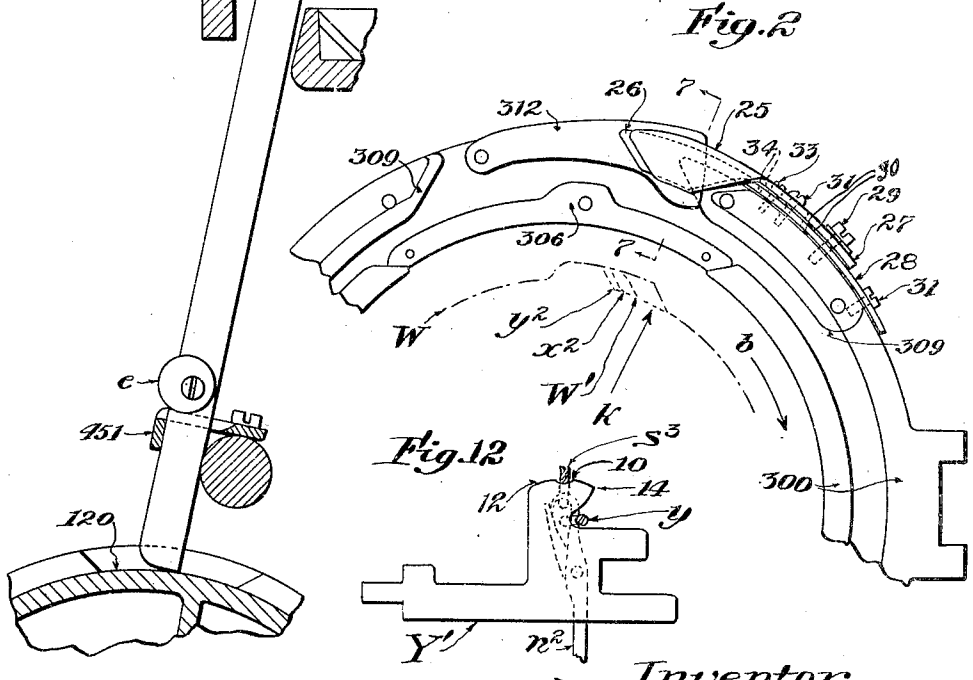


Fig. 2

Fig. 12

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2 SHEETS—SHEET 2.

Fig. 3

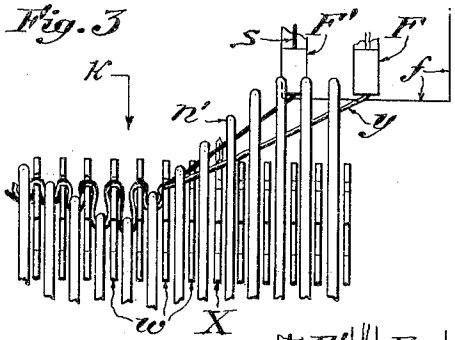


Fig. 4

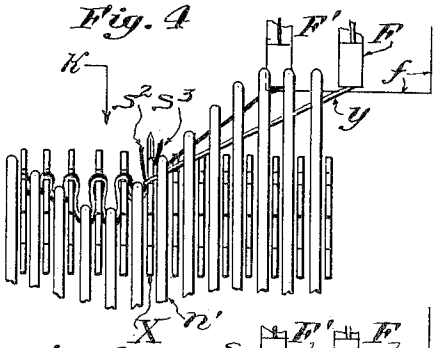


Fig. 5

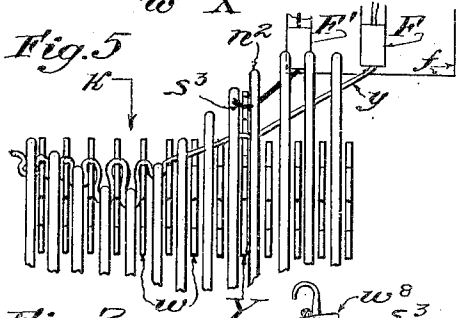


Fig. 6

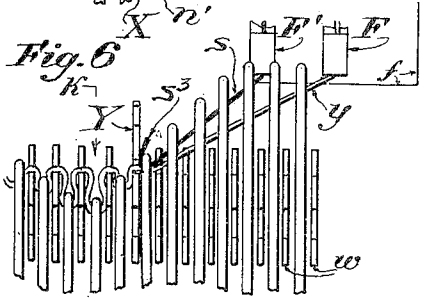


Fig. 7

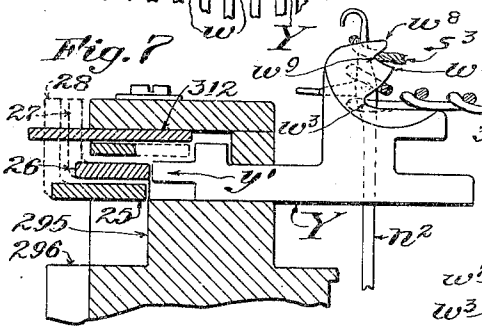


Fig. 8

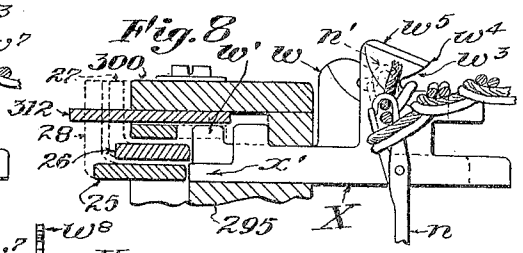
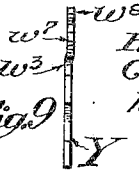


Fig. 9



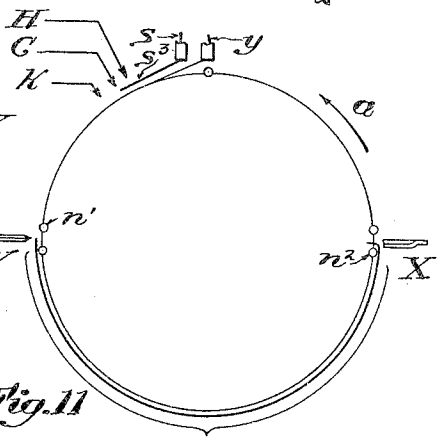


Fig. 11

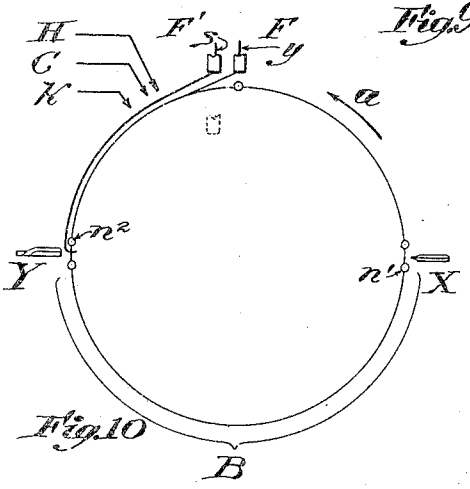


Fig. 10

A

B

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UNITED STATES PATENT OFFICE.

ROBERT W. SCOTT, OF BOSTON, MASSACHUSETTS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO SCOTT & WILLIAMS, INCORPORATED, A CORPORATION OF MASSACHUSETTS.

ART OF KNITTING REINFORCED FABRICS.

1,373,769. Specification of Letters Patent. Patented Apr. 5, 1921.

Application filed September 11, 1916. Serial No. 119,331.

To all whom it may concern:

Be it known that I, ROBERT W. SCOTT, a citizen of the United States, and resident of Boston, in the county of Suffolk and State of Massachusetts, have invented new and useful Improvements in the Art of Knitting Reinforced Fabrics, of which the following is a specification.

This invention relates to the art of knitting sectionally spliced or reinforced fabrics with definite margins and either without projecting yarn-ends, or without such ends of undue length, on a series of instruments such as ordinary knitting machine needles.

Fabrics of this general nature have heretofore been produced only by reciprocatory knitting, in which case the traverse of the splicing yarn is limited to the width of a series of needles defining the spliced area, and the margins of the spliced area are characterized by reversals of the splicing yarn. When the knitting is tubular or circulatory, the spliced area has heretofore been defined by entering and withdrawing a splicing yarn from contact with the needles of the desired series during progress of the knitting, or by causing a different movement of these needles only to enable them to take the yarn; or by clamping the splicing yarn to break it, and releasing the broken end in contact with the body yarn, to cause it again to run in. In any of these cases the lateral margins of the spliced area are defined by the places of entrance and withdrawal of the splicing yarn, or by the irregularly placed beginning and end of the clamped and broken yarn. At one or the other or both of these margins the splicing yarn, when entered and removed from the needles, necessarily is cut or broken at a place more or less removed from the surface of the fabric, leaving an unsightly yarn-end of greater or less extent. Such entrance or removal of the yarn as a machine function necessarily involves the accurate timing of the motion of either the splicing yarn or the needles or both, at entrance and removal of the splicing yarn. Such timing has seldom been secured of such accuracy as infallibly to enter or remove the splicing yarn at the passage of the same needles for course after course, and when secured has necessitated mechanisms difficult to adjust and maintain in adjustment in the hands of unskilled operators. When entry has been by friction of the body yarn and removal by clamping or severing the running yarn, the margins of the spliced area have been irregular and uncertain.

When the splicing yarn is removed from a tubular knit fabric at the margin of a reinforced area by any of the prior methods of forming such areas, the relative travel of the needles in respect of the severing means has heretofore determined that it shall be severed from the fabric at a point distant from the fabric by at least the dimensions of the severing implement and a safe distance between it and the fabric; and in the case of the best practice, the severed supply-end has been held or clamped for reinsertion at a point short of the severed end at the least by the dimensions of the clamping instrument.

An alternative and usual practice has been to float a run of splicing yarn from exit point to entrance point, and thereafter to cut away this float, still leaving ends projecting from the fabric, and thus causing as an additional defect a serious waste of the floated length of yarn.

The present invention has for its general object to avoid the defective results above mentioned and thereby to provide for reinforcing a predetermined area of fabric having definite margins at any desired longitudinal wales of the fabric, to provide at both the leading and following margin an edge of the reinforced area wholly free from projecting ends of yarn, or from such ends of any substantial or detrimental length; and to so conduct this operation as to use all and waste none of the splicing yarn.

Another object is to provide a method of predetermining with exactness the lateral extent of a run of introduced yarn, and to provide a method for beginning and cessation of feeding such a yarn adapted to be practised by machine instruments of the ordinary kind.

In pursuance of the above objects, apparatus not herein claimed for practising my new method involving a new principle of operation may be employed to practice the method, for instance mechanism shown in my divisional application S. No. 177,702, filed June 29, 1917. By creating a knitting wave in a series of knitting instruments and then feeding a main yarn and a splicing yarn at different angles of advance, so that between a selected pair of needles lying be-

tween a knitting wave and the point of exit from the yarn guiding means for the respective yarns, there is provided a separation between the knitting yarn and the splicing yarn enabling the splicing yarn to be (1) severed in place on the needles to end its insertion, and (2) seized in respect to the needles to begin its insertion. When the yarn is severed in this manner the cut-off end of the yarn then runs in a channel determined by the needle hooks, and the closed needle latches, if the machine is a latch needle machine. This end of yarn, now relatively stationary with respect to the running needles, stays in the channel so formed until the splicing yarn is again to accompany the knitting yarn when it is seized in respect to the needles by a device traveling with the needles operating as in the case of the cutting device between the knitting point proper and the yarn guides or fingers. The instruments both for cutting and for clamping the yarn in relation to the needles to again begin feeding it may be formed as a part of the usual web-holders, the vertical separation of the yarns enabling a sharpened upper edge on one severing web-holder (which is given an abnormally early movement of insertion) to take against and cut the splicing yarn between needle wales predetermined by the position of this web-holder in relation to the needles making said wales, and another web-holder at the beginning of the splicing area adapted to seize or aid in seizing the end of yarn, as by having a splicing-yarn seizing notch therein, so that at an abnormally early projection of this seizing web-holder, the trailing end of the splicing yarn is grasped, the next following needle inevitably taking this end of the splicing yarn into the knitting wave proper.

In the accompanying drawings:

Figure 1 is a vertical central section of a knitting machine embodying devices adapted to practice my said method;

Fig. 2 is an under plan view of a web-holder cam cap forming a part of said machine;

Figs. 3, 4, 5 and 6 are diagram internal developments of a series of needles employed in the said machine, illustrating the operation of certain instruments below to be described;

Figs. 7 and 8 are sections on the line 7—7 of Fig. 2 respectively showing the passage of instruments at the leading and at the following edges of the spliced area.

Fig. 9 is an end view of a modification of a yarn seizing web-holder;

Figs. 10 and 11 are diagrams illustrating the knitting of spliced and unspliced portions in the same course; and

Fig. 12 is an elevation of a further modification of the yarn-seizing web-holder.

Referring now to Figs. 10 and 11, the rotary needle cylinder circular machine selected for illustration is adapted to knit a tubular fabric by circular knitting on a series of needles rotating in the direction of the arrows *a* in said figures, and the method and apparatus will be described in connection with the production of fabric having a reinforced area A and a plain or body fabric area B, extending for a plurality of courses in the direction of the length of the fabric, upon such a machine. While the area A may be at any desired part, or separated parts, of the circumference of the tube, an illustrative instance of one area only is shown occupying about half of the tube. But it will be understood that the method described and the new instruments employed are adapted for use without change in straight and other types of machines making fabrics of various kinds, or in circular machines in which the yarn feed devices and cam carrier rotate with respect to a relatively fixed needle carrier.

Referring to Fig. 1, the needles *n* of any desired sort shown as latch needles, may be suitably mounted in a needle carrier 260 and actuated by the usual knitting cams (not shown) on a cam carrier 270 in the usual manner to produce a length of fabric or a knit article such as a stocking.

Coöperating with the needles *n* and held to slide in the radially grooved bed 295 the usual web-holders *w* are provided to perform their customary function. As illustrated in Figs. 1 and 2 a web-holder cam cap 300, held relatively stationary with respect to the rotating needles and web-holders, comprises a withdrawing cam 306 and adjustable advancing cams 309, 309 acting upon butts *w'* of the web-holders *w* to move them out and in with respect to the retracting and advancing needles. The normal wave caused by cams 306 and 309 when the machine is employed in circular knitting, relative travel of the web-holder butts being in the direction of the arrow *b*, Fig. 2, is illustrated by the broken line W, Fig. 2.

The lowest draft of the needles actuated to knit by the active stitch cam takes place in relation to the wave of movement in the web-holders about at the point *k* illustrated in Figs. 2 and 3 to 6.

As now usual in such machines, any desired series of the web-holders *w* may be arranged to be moved in at an earlier time than the normal, to predetermine a longer stitch, a movable cam 312 being provided on cap 300 to engage extra long butts (not shown) of some of the web-holders for that purpose. When this cam is inwardly positioned (for instance, by the means fully shown in my Letters Patent No. 1,152,850, dated September 7, 1915, for this purpose), the longer web-holders move inward on the line W', Fig. 2, at an earlier time than the normal

web-holders, to determine longer stitches. The stitches throughout areas A may be lengthened by this means.

Yarn is fed to the needles from a yarn feed opening or throat, which may be the upper side of a channel plate *f* adapted to determine the lower operative position, under stress of spring 8, of a series of yarn feed fingers F pivoted at 554. One of these, as that finger F′ nearest the observer in Fig. 1 and at the left in Figs. 3 to 6, carries a splicing yarn *s*, the finger F′ having a foot 2 adapted to stand on the throat-plate *f* and clamp the yarn *s* between said plate and the foot 2.

Another one of the fingers F as usual carries the main or body yarn *y*. The yarn *y* and yarn *s* are by the above (or any preferred) means fed to the needles at a different lead or angle of advance, splicing yarn *s* being fed from a point nearer the knitting point *k* than the body yarn *y* (see Figs. 3 to 6).

The yarn fingers or guides F, F′ may be lifted at times to inoperative positions by the operation of suitable automatic means, such as one of the thrust bars 460 resting at their lower ends on a pattern surface or drum 120 having cams for lifting the bars 460 and guides F, F′ to an upper inoperative position as shown at 5, Fig. 1, and when any of the guides is so positioned its yarn, thereby removed from the fabric, is carried into a suitable severing device and clamp, such as the guide 604, clamp 602, and shears 608 operated by the lever 611 and a thrust bar 460 from the pattern surface, which parts may be constructed and operate as shown in my said Patent No. 1,152,850.

Means are provided for clamping and releasing the splicing yarn *s* while its movable guide remains in an operative position. Thrust bar 460 for the splicing yarn finger F′, for instance, may be provided with a lug *d*, which when the pattern drum 120 permits the bar 460 to rest, as shown, in a lower position normally clamping the splicing yarn *s* against the plate *f*, lies in the plane of a cam 296 attached to and rotating with the web-holder bed 295. This cam may be constructed substantially as shown in Fig. 29 of my said Patent No. 1,152,850, with adjustable ends, whereby accurately and adjustably to determine with respect to the series of needles *n* the position at which the lug *d* will be moved by the cam 296. When the lug *d* is so moved, bar 460 rocks on the adjustable stop *e* resting on comb 451, and near the end of its movement away from the center of the cylinder 260 encounters a cam surface *h* on the guide F′ thereby lifting the foot 2 slightly above the plate *f* to release the yarn *s*.

If desired, any suitable or known device operating on the yarn *s* to slacken it when it is not being fed may be employed between the source of supply and the clamp 2, *f*.

The splicing yarn may be originally entered upon the needles in any ordinary or usual manner, for instance by moving the splicing yarn finger F′ from the position shown at 5, the splicing yarn then being held in the clamp 602, down to the operative position shown in Fig. 1, this movement being occasioned by pattern surface 120 and occurring when the cam 296 is positioned to hold the foot 2 away from the plate 5 to permit the splicing yarn to be entered and to pass into the knitting wave as usual. At this initial entrance of the splicing yarn a single projecting end of yarn *s* representing the yarn extending to the clamp 602 is left on the inside of the fabric.

At predetermined places among the needles, instead of one of the web-holders *w*, one or more severing web-holders X each having a web-holder notch w^3, a beak w^4 and a sharpened upper surface w^5 is placed in a groove in the bed 295 between two of the needles (Figs. 3 to 6, and 8). Referring to Figs. 3 and 4, this severing web-holder is adapted to be operated for the ordinary web-holder functions with respect to the yarn *y*, but by reason of the difference in lead between the yarn *y* and the yarn *s* the beak w^4 is adapted to take between splicing yarn entering the needles and the body yarn *y* entering the needles upon giving the severing web-holder an inward movement at an earlier time than the normal inward movement of the web-holders. The action of the needles thereafter serves to draw against its upper sharpened surface w^5 that portion of the yarn *s* taken between two adjacent needles. The result is to sever the splicing yarn between two predetermined needle wales, as illustrated in Fig. 4, the leading severed end s^2 being immediately bound into the knit stitch beginning to be formed when the severing operation takes place. For clearness, Figs. 3 to 6 do not show the previously knit courses.

The following severed portion s^3 is left free in the hook of the leading needle *n′* of those needles upon which reinforced fabric is not to be formed. The severing action may be and preferably is aided by permitting the yarn guide F′ to clamp the splicing yarn by means of its foot 2 at this time, the lug *d* then running off the adjustable rear end of the cam 296. In some cases, however, a suitable tension on the yarn *s* may be employed, the devices for clamping and slackening the yarn *s* being dispensed with.

The end s^3 of the yarn *s* having been cut by the described means at a predetermined place with respect to the yarn guide F′, and the end of the yarn *s* being clamped, the said end s^3 then lies in the hooks of the needles *n*, and in a vertually tubular passage defined

by the closed latches of the needles traveling down the knitting-wave and the nearby hooks of the web-holders w. No ordinary movement of the machine can withdraw the yarn end s^3 so positioned, further relative movement of the needles with respect to the guide F′ occurring without changing the position of the end s^3 (Figs. 4 and 11), which remains in contact with the needles during the knitting of the yarn y alone for the remainder, or any desired part of the remainder, of the course.

To enable the yarn s again to be fed beginning at a predetermined needle without any appreciable projecting end, the machine is also provided with a seizing web-holder Y, best shown in Fig. 7, at the leading edge of each area A. This instrument has a yarn throat w^6 functioning as an ordinary web-holder, and a beak w^7, preferably somewhat higher than the corresponding beak w^4 of the severing web-holder, and a second beak w^8, separated by a notch w^9 between the beaks and at a height to take over the end s^3 of the yarn s lying in the described relation to the needles. If the seizing web-holder Y is now given an inward movement at an earlier time than the normal web-holders, the end s^3 of the splicing yarn taken in the notch of the seizing instrument will be bent around the leading needle n^2 of that series upon which reinforced fabric is to be knit, and so determine the entrance of the splicing yarn and the margin of the spliced area A at the wale from this predetermined needle n^2. This action may be aided by causing the needle n^2 and the seizing web-holder Y to clamp the end s^3 of the yarn s between them. One way of doing this is illustrated in Fig. 5, the needle n^2 being bent to the left as shown, to rub against one face of the seizing web-holder Y. Alternatively, as illustrated in Fig. 9, the web-holder Y may be laterally offset to the rear with respect to the direction of motion of the needles as shown, so as to rub against and clamp the yarn with respect to a straight leading needle n^2; or a comparatively thick seizing web-holder Y may be employed between normal needles.

As shown in Fig. 12, a modified form of seizing web-holder Y′ may be employed having a notch 10 on its relatively high top 12, and a beak 14 at the same height as the beak w^7 of the form above described. Seizing web-holder Y′ is adapted to be moved forward a shorter distance than the web-holder Y, the downward movement of the needle n^2 taking the yarn-end s^3 against its side face, with the same effect as above described.

Referring now to Figs. 10 and 11, the relative location of the knitting wave k and the yarn guides F′ and F being as shown, the place of actuation of the severing web-holder X may be at the point C, and the place of operation of the seizing web-holder Y may be at the point H, both lying between the knitting point k and the respective yarn guides.

Inasmuch as both the seizing web-holder and the severing web-holder travel with the needles, clamping of the yarn end s^3 with respect to the needle n^2 insures entrance of the splicing yarn at the wale from this needle, and the manner of performing the operation insures a minimum length of the end s^3 with respect to the surface of the fabric. In practice, this end may be so short as to be buried in the ensuing stitch taken on the needle n^2. The length of this end is determined by the relative position of the points C and H, or by the relative time of opening of clamp 2, f, or by both.

Whenever the seizing web-holder Y is operated the splicing yarn may be released by the operation of thrust bar 460 and cam 296 to open clamp 2, f. The relative times of releasing the yarn s and actuating the seizing web-holder Y are accurately related by rotation together of the parts Y and 296 as attachments of the bed 295.

At the longitudinal end of the spliced area, the yarn guide F′ is moved to the position shown at 5 by the action of the cam surface 120 on its thrust bar, and the yarn s is received by the guide 604, clamped at 602 and cut at 608 until it is desired again to splice a part of the tube, when the operation is repeated.

Any desired means may be employed for giving the described movements to the seizing web-holder and the severing web-holder, but I prefer the means shown in Figs. 2, 7 and 8, comprising tails x' and y' at different vertical positions on the respective severing web-holder X and seizing web-holder Y, and suitably positioned cams 25 and 26 respectively operating the severing and seizing devices. As shown, these cams may be mounted on any suitable part such as the web-holder cap 300, and preferably are arranged for independent adjustment radially and circumferentially. For instance, a circumferential upturned portion 27, 28 of each cam may be slotted for a common holding screw 29, the respective parts being spaced from each other and the cam cap by washers 30, the part 28 of cam 26 having a screw 31 for independently clamping it, and a screw 33 in the cam cap free in slots 34 of different widths in parts 27, 28, for radially adjusting part 28 and cam 26 only. Cam 25 may be independently radially adjusted by a large headed screw 31 in the slots 34, the mounting parts 27, 28 of both cams being slightly resilient. When the cams are adjusted, the beaks of the severing and seizing web-holders move inwardly under the

influence of the respective cams 26 and 25, at the proper time, for instance as shown at x^2 and y^2 in Fig. 2.

While I have described specific machine devices in explanation of the steps of the method practised by their operation, it will be understood that the steps taken in introducing and severing the splicing yarn are independent of the particular mechanisms by which they are carried out. It is obvious, for instance, that I have herein disclosed an order of operations relating to the distribution of and interknitting of yarns to produce, by virtue of the new principle involved, a new result. It is obvious that the steps of progressive supply or feeding of a body and an additional or splicing yarn at different angles of advance or lead, and the inserting between these yarns, at the instruments upon which the knitting is to be performed first a severing implement to end the inclusion in the fabric of one of these yarns; and thereafter working upon the severed end temporarily to attach it to one of the knitting instruments, constitute a method wholly independent of the particular means or any organized mechanism for practising the same. It is, for instance, obvious that the difference in lead or angle of advance of the body and splicing yarns might be secured by feeding the yarns from the same vertical plane but at different heights, without altering the relation of yarns by which a severing implement, whether or not that described and shown, and whether hand or machine operated, can be introduced between predetermined wales to sever the splicing yarn only in such a manner as to bind the severed end into the stitch. Likewise the steps taken in introducing the leading end of the splicing yarn, involving temporary attachment of this end to the hook, needle, or other knitting implement, are generic steps which might and obviously can be practised by hand or by a variety of machine devices; and I am not to be understood by having described certain preferred machine devices thereby to imply any necessity for use of such instruments or their equivalents for the successful practice of the art or method hereinafter claimed, or to limit my invention to the mere function of the apparatus claimed.

What I claim is:

1. The art of knitting fabrics having areas reinforced by forming parts of courses containing a splicing yarn and a body yarn interknit together comprising as a step severing the splicing yarn between adjacent places for new loops in predetermined wales of the fabric during formation of said loops and of the fabric.

2. The art of knitting fabrics having areas reinforced by forming parts of courses containing a splicing yarn and a body yarn interknit together comprising as a step severing the splicing yarn between the place of its engagement in the forming loop of a predetermined wale of the fabric and the place to be occupied by the next successive loop in another wale during formation of the fabric, and thereafter repeating said severing operation in successive courses between the same wales.

3. The art of knitting fabrics having areas reinforced by forming parts of courses containing a splicing yarn and a body yarn interknit together comprising as a step severing the splicing yarn in the plane of the fabric between predetermined wales of the fabric during formation of the fabric, and thereafter introducing the severed end at another wale in the same course.

4. The art of knitting fabrics having areas reinforced by forming parts of courses containing a splicing yarn and a body yarn interknit together comprising as a step severing the splicing yarn between adjacent places for new loops in predetermined wales of the fabric during formation of the fabric, thereafter removing the severed end to another place in the fabric, and there interknitting it with the body yarn.

5. The art of knitting fabrics having areas reinforced by forming parts of courses containing a splicing yarn and a body yarn interknit together comprising as a step severing the splicing yarn between unfinished and forming loops in predetermined wales of the fabric during formation of the fabric, thereafter removing the severed end to another predetermined wale in the fabric, and then interknitting it with the body yarn in a predetermined number of wales.

6. The art of knitting fabrics having reinforced areas on a series of instruments including the steps laying a body yarn and a splicing yarn upon said instruments and knitting said yarns together at a series of said instruments; and severing the splicing yarn only between instruments at which knitting is subsequently effected.

7. The art of knitting fabrics having reinforced areas on a series of instruments including the steps repeatedly laying a body yarn and a splicing yarn upon the same predetermined part of said series of instruments and knitting said yarns together at a series of said instruments; and thereafter severing the splicing yarn only between instruments at which knitting is subsequently effected and at one end of said part of the series of instruments.

8. The art of knitting fabrics having sectional reinforced areas on a series of instruments comprising laying a body yarn on said instruments and repeatedly laying on and severing at one margin of the same part only of said series of instruments a length of splicing yarn, both ends of the yarn being

laid upon and in relation to particular instruments of the series whereby accurately to determine the length of and the position of the severed length.

9. The art of knitting fabrics having sectional reinforced areas on a series of instruments comprising laying a body yarn on said instruments and laying on the same part only of said series of instruments a measured and severed length of splicing yarn, the distance between the severed ends being measured by and the same as the space between certain instruments of the series.

10. The art of knitting spliced fabrics comprising feeding to a series of knitting instruments at different angles a body and a splicing yarn, then severing at and upon the instruments the splicing yarn, maintaining the severed supply-end of the splicing yarn in contact with the instruments, and thereafter seizing the said supply-end in respect to a particular one of said instruments to begin its reintroduction to the fabric formed at the wale knit at said instrument.

11. The art of knitting spliced fabrics comprising feeding to a series of knitting instruments at different angles a body and a splicing yarn, then clamping between instruments and source of supply and severing at and upon the instruments the splicing yarn, maintaining the severed supply-end of the splicing yarn in contact with the instruments, and thereafter seizing the said supply-end in respect to an instrument of said series and releasing the splicing yarn to begin its reintroduction to the fabric formed at the wale knit at said instrument.

Signed by me at Boston, Massachusetts, this eighth day of September, 1916.

ROBERT W. SCOTT.