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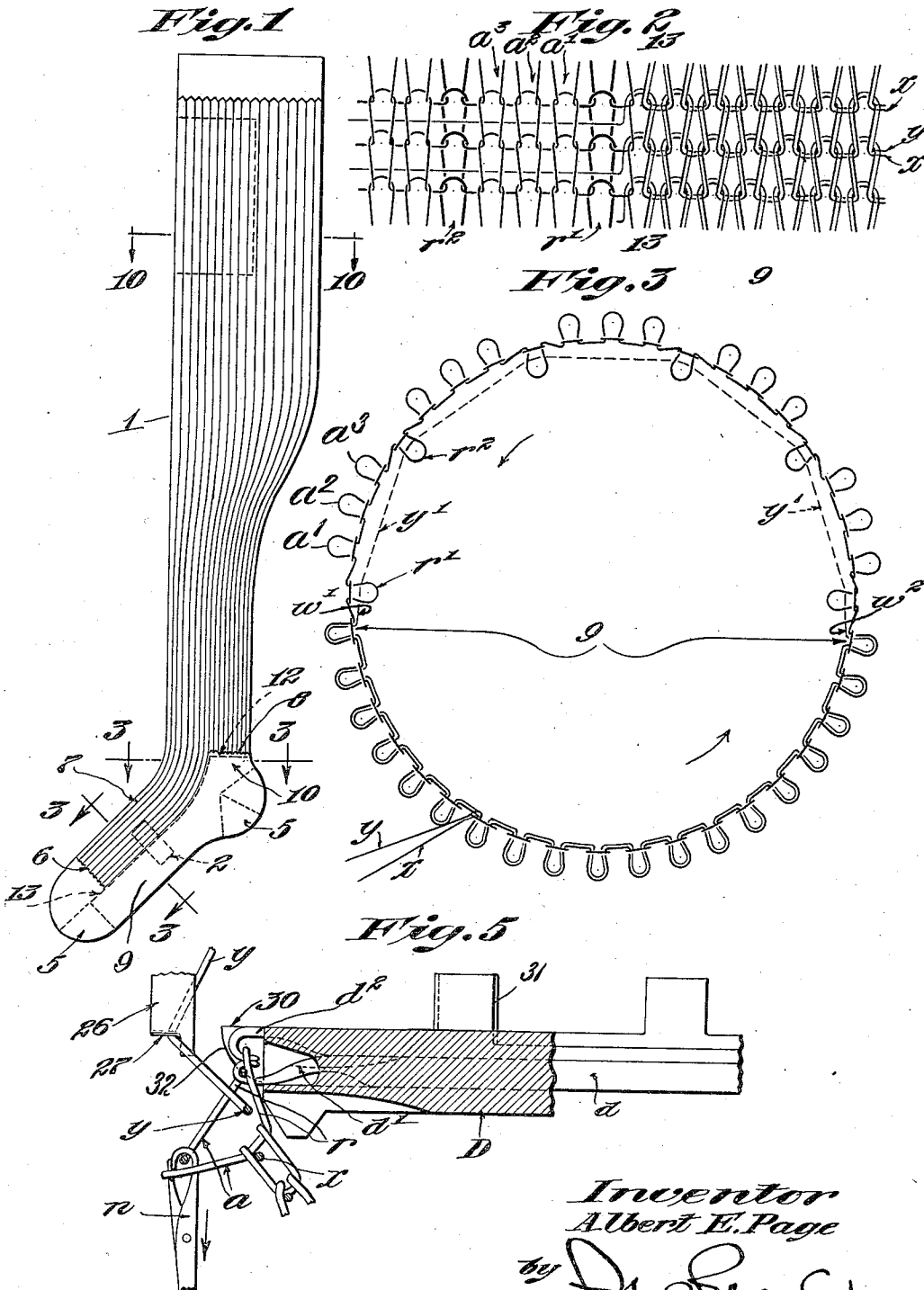
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SPLICED KNIT FABRIC AND METHOD OF KNITTING THE SAME

Filed May 22, 1925

3 Sheets-Sheet 1



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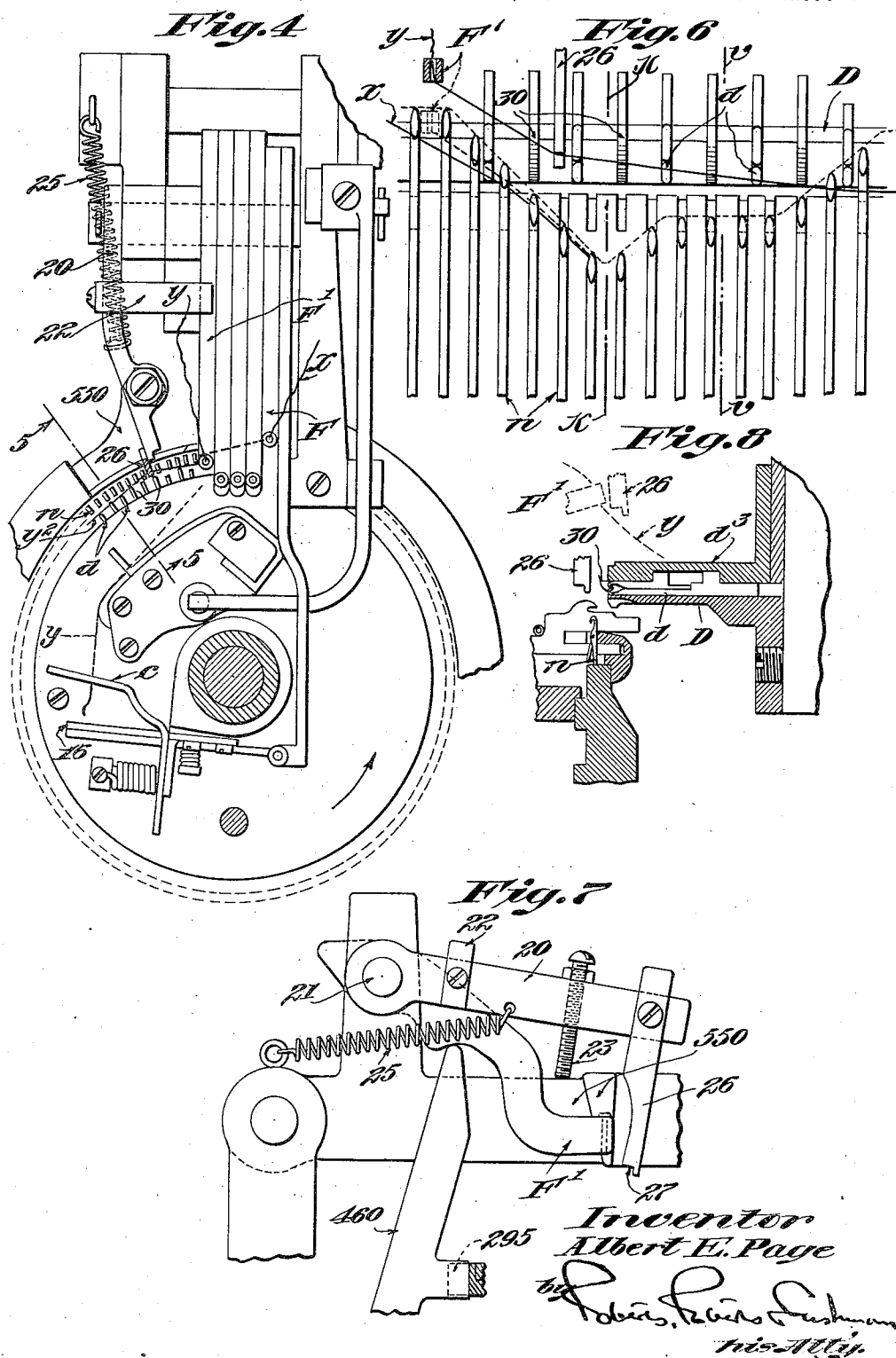
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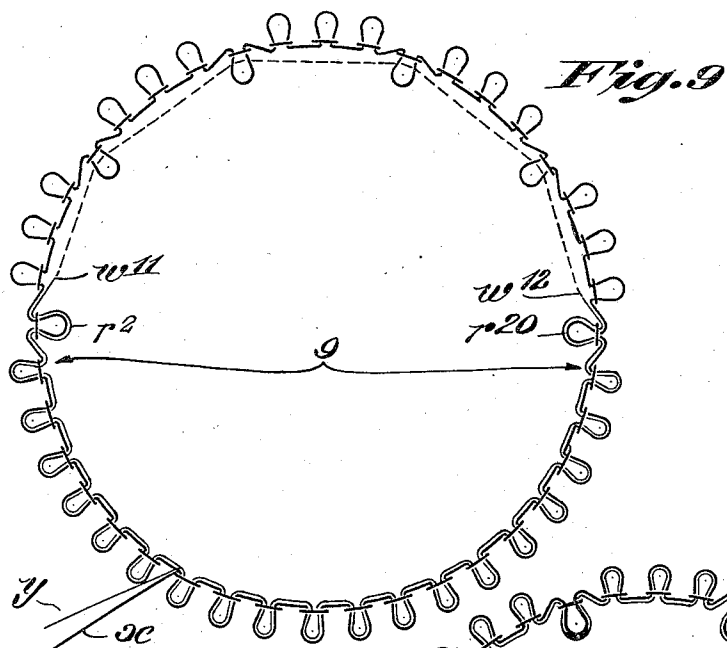
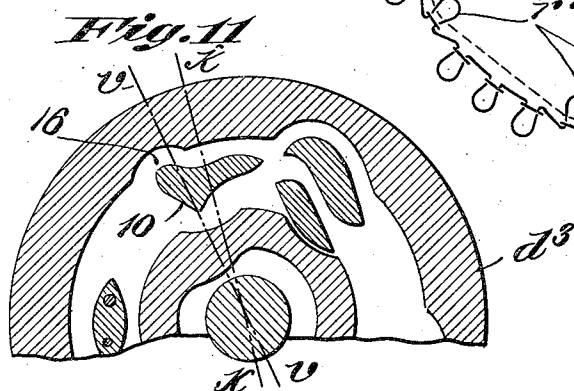
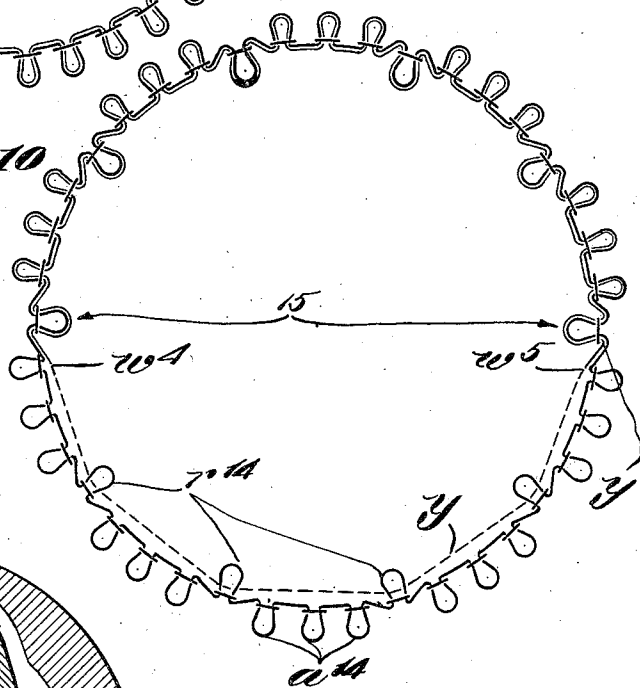


Fig. 10



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UNITED STATES PATENT OFFICE

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SPLICED KNIT FABRIC AND METHOD OF KNITTING THE SAME

Application filed May 22, 1925. Serial No. 32,046.

This invention relates to splicing or reinforcing stockings and other hosiery, especially hosiery of the kind having contiguous ribbed and plain portions, for example having a ribbed fabric instep and a plain fabric sole, heel, and section above the heel. The invention is particularly applicable to manufacture by circular or seamless tubular knitting, in which it is necessary or desirable to reinforce by splicing a section of the tubular product having lengthwise extending boundaries.

Invention in knitting machines has supplied machines for automatically knitting ribbed hosiery having plain fabric soles, heels and toes, for example the machine shown, described and claimed in the application of Robert W. Scott, Serial No. 559,506, filed May 9, 1922, Patent #1,641,554 dated September 6, 1927, and machines of this type are in great and growing use. Stockings of the kind indicated are not necessarily spliced when made of woolen yarn, or thick heavy cotton yarns, but when the decorative and useful ribbed instep stockings are made of light thin yarns, and especially when made of silk, it is desirable to provide a reinforced fabric at the sole, and at the back of the ankle above the heel. The narrowed and widened heels and toes may be spliced as usual, by feeding double or multiple yarns during reciprocatory motions of the machine for knitting these parts.

A successful device for splicing must be such as to cause a supplemental or splicing yarn to enter the hooks of the needles employed in knitting the section to be spliced along with the main or body yarn at each course knit with reliable accuracy in respect to entering the splicing yarn at the same needle and causing it to leave the fabric at the same needle during the making of so many courses as are necessary to provide a sufficient length of the spliced area. The competent performance of the entering and leaving operation is best secured by that type of yarn feeding yarn guide which can be relied upon to enter its yarn by rapid downward and outward motion and to withdraw its yarn by upward and inward motion in re-

spect to that set of needles employed to knit the plain portions of the fabric.

If and when instruments of the instrument dial necessarily are co-operating with the knitting wave in the cylinder needles of the machine, either the instruments themselves or the yarn loops necessarily engaged in them for the purpose of knitting ribbed fabric close the annular space between the margin of the dial and the interior surface of the space defined by the cylinder needles, and in this case it is difficult to provide for permitting the float of withdrawn splicing yarn to extend across the circle of active cylinder needles in the position of a chord or diameter, and the needles dial is in the way of a float extending above the dial.

I have therefore devised a spliced article of hosiery having laterally contiguous ribbed and plain portions, the plain portion or a part of the plain portion or any desired part of the ribbed portion, such as the knee of a stocking, being spliced, and the extent or run of the splicing yarn from exit margin to entrance margin of the spliced area in each course being disposed of by engagement with the inwardly-drawn or back wales of the ribbed knitting, so that it shall not have to be extended across the space within the needles.

One object of this invention is to provide such a structure, and a method of making this structure, in which that portion of the splicing yarn extending from exit margin to entrance margin of the spliced area is so engaged with the remainder of the knit tube as to permit the splicing yarn to be cut at or near the margins, leaving that portion engaged with and back of the ribbed fabric to be removed by a drawing operation, and preferably by a drawing operation carried out upon a number of the lightly-engaged splicing yarns at the same time. Another object of the invention is to devise yarn feeding devices adapted to dispose of the splicing yarn extending from exit margin to entrance margin of the spliced area in relation to the forming ribbed fabric in such a way as to occasionally include the splicing yarn in the space between the faces of the ribbed portion

of the fabric, and to float the splicing yarn behind the face-drawn or plain or front wales of the fabric of the unspliced portions of the article which are laterally contiguous to the spliced portions.

The invention will now be described with reference to specific instances of the fabric, method, and apparatus for making the fabric and practising the method shown by way of illustration in the accompanying drawings, in which:

Fig. 1 is a side elevation of a ribbed instep stocking containing splicing of the kind mentioned;

Fig. 2 is a face diagram in elevation of a portion of the fabric, showing the area 2, Fig. 1;

Fig. 3 is a diagram in plan illustrating the structure in section during manufacture on either of the lines 3—3 of Fig. 1;

Fig. 4 is a detail view in plan showing the splicing and main yarn feeding devices of a cylinder and dial rib knitting machine adapted to practise the operations of this disclosure;

Fig. 5 is a diametrical section in elevation on the line 5—5 of Fig. 4, on an enlarged scale;

Fig. 6 is an exterior developed view of the cylinder needles, the dial margin and the splicing yarn feed guide at the knitting wave;

Fig. 7 is a side elevation of yarn feeding and splicing yarn positioning parts shown in Fig. 4;

Fig. 8 is a section similar to Fig. 5 on a smaller scale showing another and inoperative position of parts;

Fig. 9 is a diagram similar to Fig. 3 showing a modification;

Fig. 10 is a diagram section at line 10—10 of Fig. 1 showing spliced fabric at the knee of the stocking;

Fig. 11 is a section in plan showing dial cams of a preferred form for use with the needles and certain jacks of the kind illustrated.

Referring now to Figs. 1, 2 and 3, the stocking 1 may have any pattern of ribbed leg, which may have any usual or desirable type of welt at the top, and may be provided with any usual or desirable fashioned heel and toe pockets 5, 5. The ribbed structure characteristic of the leg 1 extends without change from the line 6 over the instep portion of the stocking 7 and thence to the top of the stocking, whereas the ribbed construction at the back of the leg 1 of the stocking extends from the line 8 above the heel up the leg. The sole portion 9 and the area 10 above the heel at the back of the ankle are plain fabric to the marginal ribbed wale of the instep portion 7, in a lateral sense, and any desired portion of the sections 9 and 10 of the fabric may be provided with splicing reinforcement,

extending, for example, from the toe pocket 5 to the line 12 above the heel, the sectional splicing having a lateral margin at the line 13; the ribbed portions of this stocking may have any desired pattern of rib, as shown best in Figs. 2 and 3. The ribbed pattern for example may comprise the rib or back wales r^1 , r^2 , etc. between each of which are three face wales a^1 , a^2 , a^3 , etc. The plain fabric of the sole section 9 may be knit of the body yarn x continuous with the body yarn for the instep section 7; this, for example, may be a light or heavy silk or cotton yarn. In the sole portion 9 the yarn x is accompanied by and interknit in each loop with a splicing supplemental yarn y . At the line 13 this splicing yarn y is taken out of interknitting relation with the yarn x , and caused to float in front of the rib wales r^1 , r^2 , etc. and behind the face wales a^1 , a^2 , a^3 , etc.

As best shown in Figs. 3 and 5, this may be done by causing the splicing yarn to pass out of position to be taken by the hooks of that set of needles first to knit, e. g. the cylinder needles n , and by causing the splicing yarn to lie exteriorly to the loops r of the ribbed wales, and interior of the loops a of the face wales as these lie in the hooks respectively of the dial or rib needles d and of the needles n . As best shown in Fig. 3, the result of this is to cause that portion of the yarn y extending around the inside of the instep of the illustrative stocking to be caught in front of the dial loops r^1 , r^2 , etc. of the ribbed section of the knitting.

These results are accomplished as best shown in Figs. 4 to 8 inclusive by providing a rib knitting machine, as shown, of the type illustrated in said application for patent of Robert W. Scott, Serial No. 559,506, Patent No. 1,641,554, with the splicing yarn guide F^1 adapted and arranged to be operated substantially in accordance with the disclosure of the patent to Robert W. Scott, No. 1,256,062, dated February 12, 1918, and including for this purpose a longitudinally and laterally movable thrust bar 460, adapted and arranged to co-operate with a segmental cam 295 on a rotating part of the machine to lift the splicing yarn guide F^1 during the passage of the segment 7 of the illustrative stocking to an upper position of the yarn feeding end of the guide F^1 illustrated in full lines in Fig. 6, and as shown in plan in Fig. 4. Whenever the thrust bar 460 is longitudinally lifted, then the inward end of the splicing yarn guide F^1 is carried upward and inward further, substantially to the position indicated in dotted lines in Fig. 8. When the thrust bar 460 is neither thrown outward nor lifted, the splicing yarn guide F^1 is in the operative position illustrated in Fig. 7.

In order to induce the splicing yarn y taken out of knitting relation upon an elevation of splicing yarn guide F^1 to the position shown

in Fig. 6 to acquire the described relation to the ribbed fabric, the machine is provided with a lever 20 on the same pivotal axis 21 as the main yarn guide F and the splicing yarn guide F¹, said lever 20 carrying a yoke 22 to take over and engage with top of the splicing yarn guide F¹ in its most upward positions and having a stop screw 23 to engage the upper surface of the latch ring 550 of the machine. The position of the lever 20 is such as to cause it when in its lowermost position, as induced by a tension spring 25, to position the lower end of an auxiliary splicing yarn positioning instrument 26 as illustrated in Figs. 5, 7 and 8. The positioning instrument 26, referring now to Figs. 4 and 6, may operate just above the depression wave in the cylinder needles *n*, and, in the direction of rotation of the needles *n* at a point ahead of the place of projection of the dial needles *d* following the indrawing movement of the dial needles to knit.

The instrument 26 is provided at its under side with a notch 27 which, because of the above mentioned dispositions, is caused to receive the splicing yarn withdrawn by the moderate upward motion of the splicing yarn guide to the place illustrated in full lines in Fig. 6.

Because of the relative heights of the parts, their relative motion to each other, and the relationship of the partly elevated splicing yarn guide to the needles *d* and other instruments carried by the dial D of the knitting machine, the intervention of the instrument 26 is desirable to hold the splicing yarn outwardly and downwardly, see Fig. 4, to make sure of such a position for the tangential run γ^2 of the splicing yarn as will inevitably take it into the space in front of the loops *r*, above the loops *a*, and inside of the needles *n*.

While I may rely upon an instrument such as that shown at 26 to accomplish this, I prefer to insure the operation of the instrument 26 to this effect by providing in the needle dial jacks 30 having butts 31 and downwardly beveled ends 32, which may be placed and moved in dial grooves intervening between those occupied by the dial needles *d*, as shown, and which will have the effect, particularly as the jacks 30 in succession pass into contact with the tangential run γ^2 of the splicing yarn, to ride down and depress the splicing yarn beneath the level of the loop drawing hooked elements *d*¹ of the two-part dial needles *d*, of which the cast-off elements *d*² are about to be projected beyond the idle position shown in Fig. 5.

Referring to Figs. 6 and 11, the cylinder needles are depressed for knitting to their lowest point at the radial plane *k*; *k*, and the dial needle parts *d*¹ are withdrawn to their innermost position by dial stitch cam 10 at the radial plane *v*, *v*. Following the plane *k*, *k*, the dial needle parts *d*² are projected by

the cam groove at 16, Fig. 11. By causing the butts 31 of the jacks 30 to be actuated by this groove 16 the desired projecting motion of the jacks 30 preceding and following the most withdrawn position of the dial needle parts *d*¹ is effected. If the dial needles are single needles, instead of two-part needles, the jacks 30 may be actuated by any suitable dial cam groove giving them an outward motion in the same relative position.

While it conduces to certain operation to move the jacks 30 radially as mentioned, in some cases the jacks may be fixed in projected position and perform the same function of riding down the withdrawn splicing yarn to a position below the outwardly moving dial needles, and above the loops carried by these dial needles.

When ever the splicing yarn guide F¹ is carried upward out of action, for example at the line 12 of Fig. 1, in order to cause cessation of splicing, the lever 20 is lifted by contact of the yoke 22 with the top edge of the splicing yarn guide F¹ and the instrument 26 passes to the dotted line position shown in Fig. 8. At this time the splicing yarn γ floats over the top of the dial cap *d*³ and into the position shown in dotted lines in Fig. 4 in respect to the margin of the dial and its instruments, and when in this position the splicing yarn is preferably clamped by the clamp *c* and cut by the shears 16.

Referring now to Figs. 1, 7 and 10, when it is desired to splice the stocking sectionally elsewhere, for example at the area 15, at the knee, Figs. 1 and 10, the splicing yarn γ may be fed to the appropriate segment of the needles, and elsewhere engaged between the rib wales, such as *r*¹⁴ and the face wales *a*¹⁴, Fig. 10, and that part of the circumference merely engaged in the rib wales may be removed subsequently; by severing at *w*⁴, *w*⁵ in the way explained above, for instance.

When the front part of the stocking is spliced, as at 15, the parts are operated to cause the yarn guide F¹ to occupy the position shown in Fig. 7 during passage of the segment of needles to be spliced. This may be done by altering the relation of the cam 295 to the rotating part carrying it or operating the bar 460 or the splicing yarn guide by another differently timed connection.

When a stocking has been knit and removed from the machine, the splicing yarn extending across the instep in floats γ ¹ may be left in the stocking, unless the stocking is of such light and transparent structure as to make its removal desirable, being sufficiently slack where it is not interknitted to avoid limiting any necessary lateral stretch of the unspliced segment. If the floated yarn is to be removed, a recommended procedure is to cut all of the yarns γ at *w*¹ by a suitable severing instrument inserted between the rib loops in wale *r*² and the marginal

spliced wale; to run any suitable dull pointed implement in the direction of the wales between the floats y^1 and the face wales at the other side of the stocking, whereupon the cut ends will be withdrawn through their loose engagements behind the ribbed loops in wales r^1 , r^2 , etc. until all of the runs of the yarn y behind the instep or other unspliced segment have been removed from engagement, and then to cut the freed splicing yarn floats at w^2 in any usual way of trimming off splicing yarn floats. If desired, the floated splicing yarns may be cut instead on the instep side of the first rib wale of the instep fabric beyond the margins of splicing on each side. Or, as shown in Fig. 9, the splicing may be arranged to extend beyond the plain knit segment, such as the sole 9, into the adjacent one or more rib wales r^2 , r^{20} etc. of the ribbed segment. In either case, the cut ends of the splicing yarn are favorably placed to avoid working out of the fabric to the face surface.

I do not herein claim the machine and the mechanical method required to be divided from the original contents of this application, and for which I filed a divisional application Serial No. 429,940, filed February 20, 1930.

I claim:

1. A seamless stocking having a spliced sole, the splicing yarn for the sole being removably engaged on the interior or back face of the fabric behind the yarns forming a part of the instep portion of the stocking.
2. A stocking having a ribbed instep, a plain fabric heel, sole and toe, and a seamless spliced sole, the ribbed instep and spliced sole being laterally contiguous and formed of the same continuous course of a body yarn accompanied by a splicing yarn, the splicing yarn being engaged with and behind but not interknit with the instep fabric.
3. A partly ribbed and partly plain fabric seamless stocking having a ribbed portion sectionally spliced, an unspliced segment of said ribbed portion bearing runs of splicing yarn engaged between back and face wales of the ribbed knitting.
4. A stocking having a ribbed instep, a plain fabric heel, sole and toe, and a seamless spliced sole, runs of the splicing yarn for the sole being removably engaged with the fabric of the ribbed instep.
5. A stocking having a ribbed instep and angle, a plain fabric heel, sole and toe, and a spliced plain fabric section above the heel, runs of the splicing yarn for the said spliced section being removably engaged with the fabric of the ribbed angle.
6. A knit stocking having a ribbed instep and a conjunct plain fabric sole, the courses being continuous through both kinds of fabric, the sole fabric having a sectionally spliced area with longitudinal margins, the splicing yarn of each course of the sole floating behind

the face wales of the ribbed instep and passing between the back and adjacent face wales.

7. Method of knitting sectionally spliced partly ribbed and partly plain articles of hosiery comprising knitting in successive circular courses plain fabric sections of a main and a splicing yarn and laterally contiguous sections of ribbed fabric of the main yarn only, and including in each course of the unspliced fabric between back wale loops of the ribbed fabric and adjacent face wale loops unknit runs of the splicing yarn continuous from margin to margin of the spliced section.

8. Method of making stockings having laterally contiguous areas of ribbed and plain knit fabric, the plain fabric being spliced, comprising interknitting a main and splicing yarn during knitting of the plain fabric areas, engaging the splicing yarn between the face and back wales of the ribbed fabric portions, and severing and withdrawing the runs of splicing yarn engaged with the ribbed fabric portions.

9. Method of knitting sectionally spliced hosiery comprising knitting in successive circular courses plain fabric sections of spliced fabric, and sections of unspliced fabric, the spliced sections comprising a body yarn and a splicing yarn interknit together, and causing the splicing yarn to engage the unspliced fabric at the place of separated needle wales only on the inner or back face of the unspliced fabric in each course.

Signed by me at New York, New York, this eighth day of May, 1925.

ALBERT E. PAGE.