

Jan. 27, 1942.

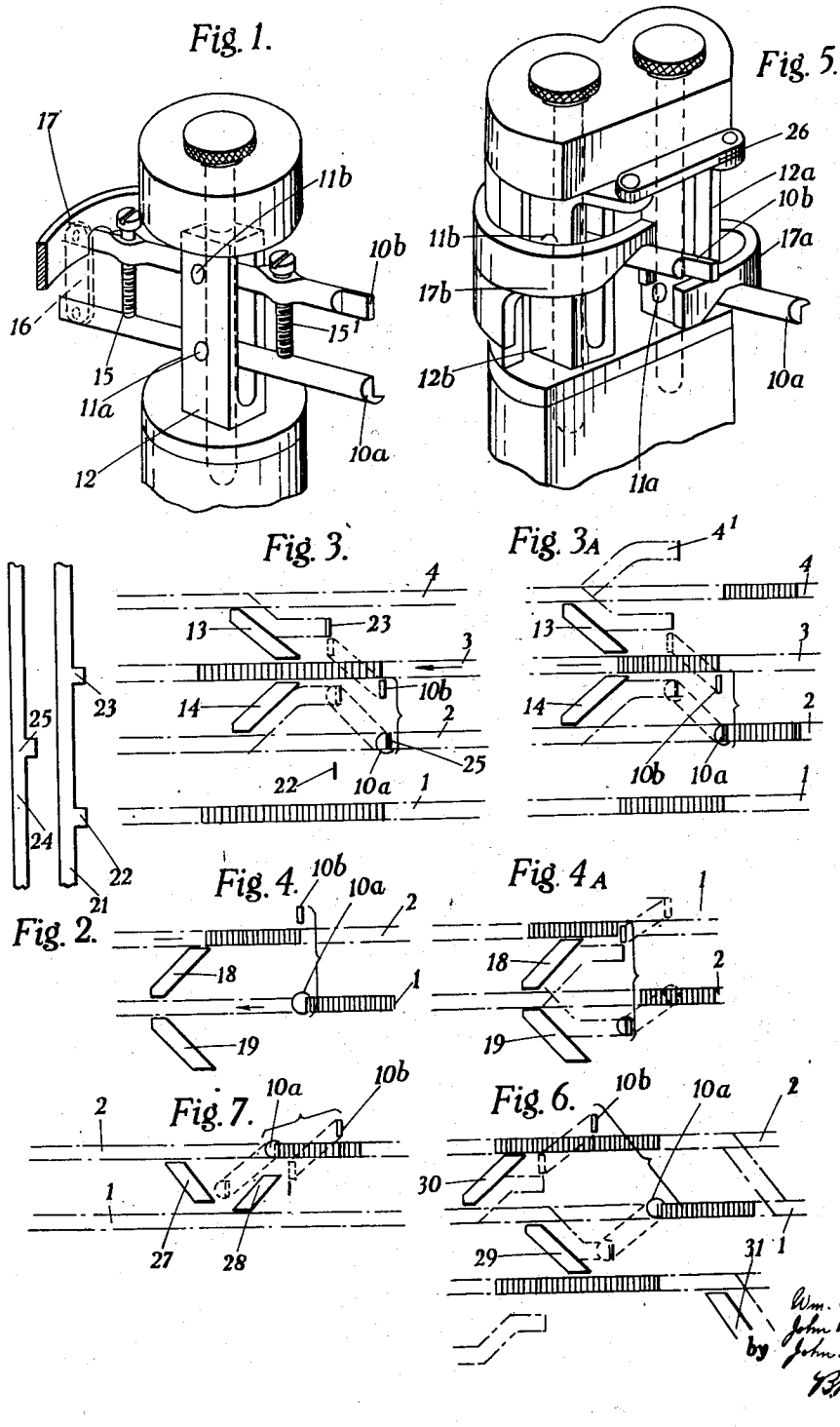
W. E. BOOTON ET AL

2,271,386

KNITTING MACHINE

Filed Feb. 11, 1941

12 Sheets—Sheet 1



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KNITTING MACHINE

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12 Sheets-Sheet 2

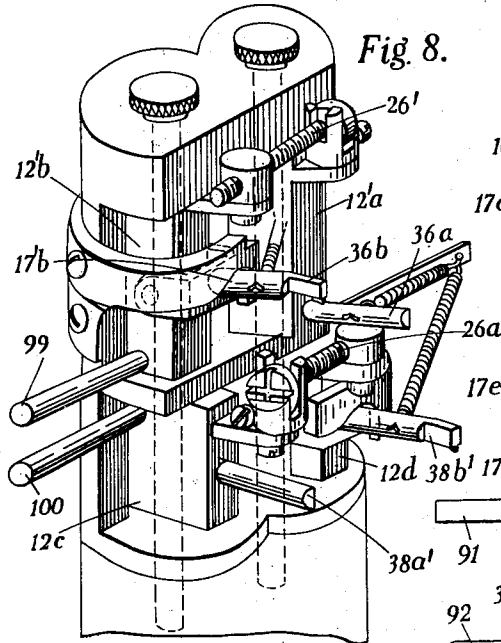


Fig. 8.

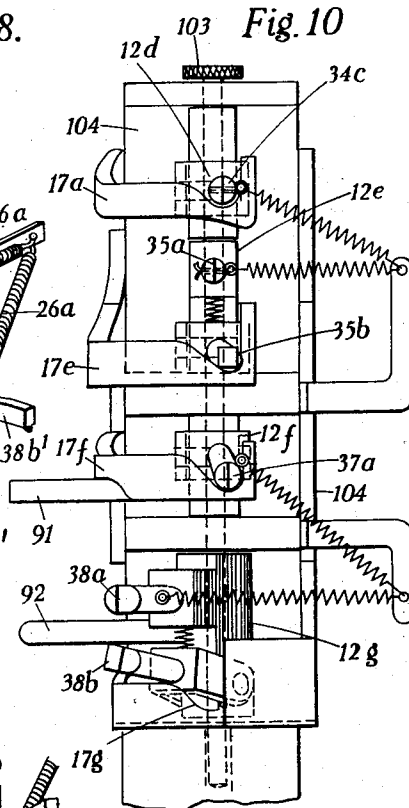


Fig. 10

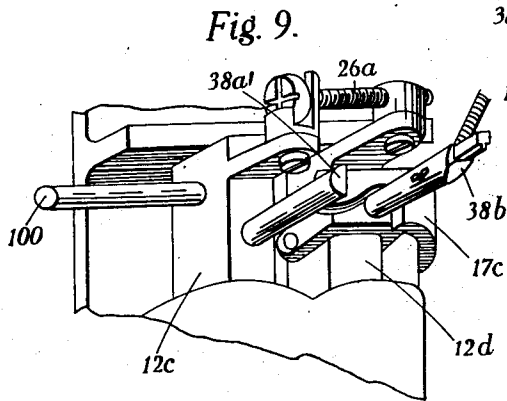


Fig. 9.

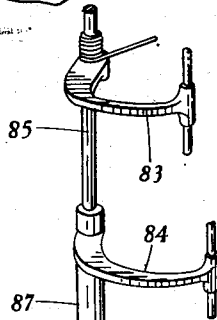
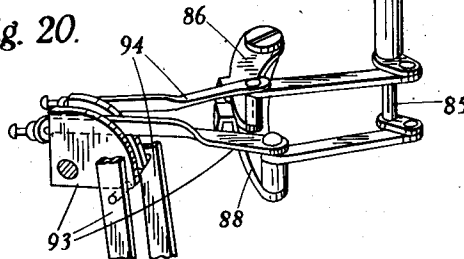


Fig. 20.



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KNITTING MACHINE

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12 Sheets-Sheet 3

Fig. 11.

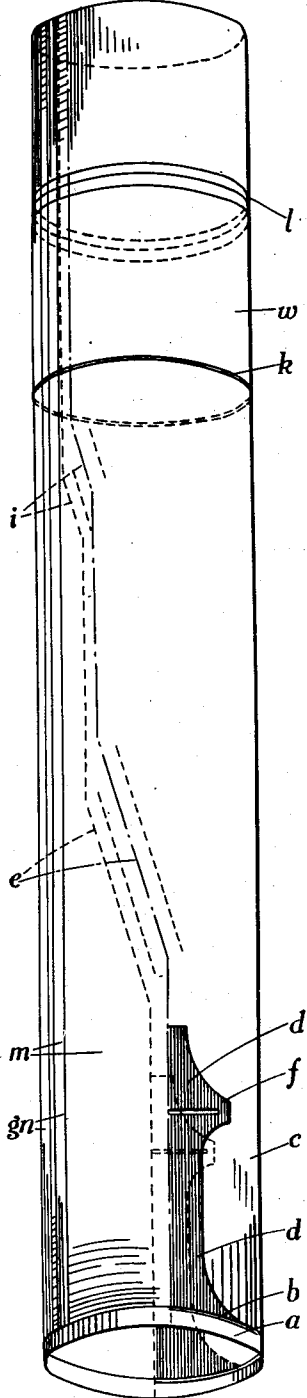
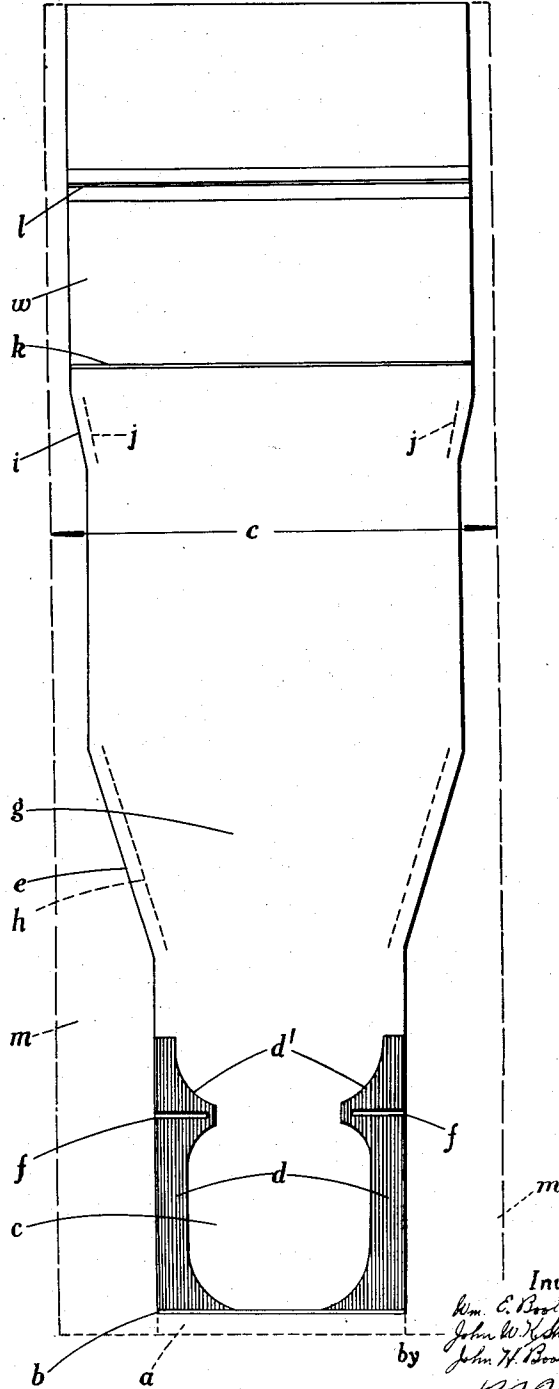


Fig. 12.



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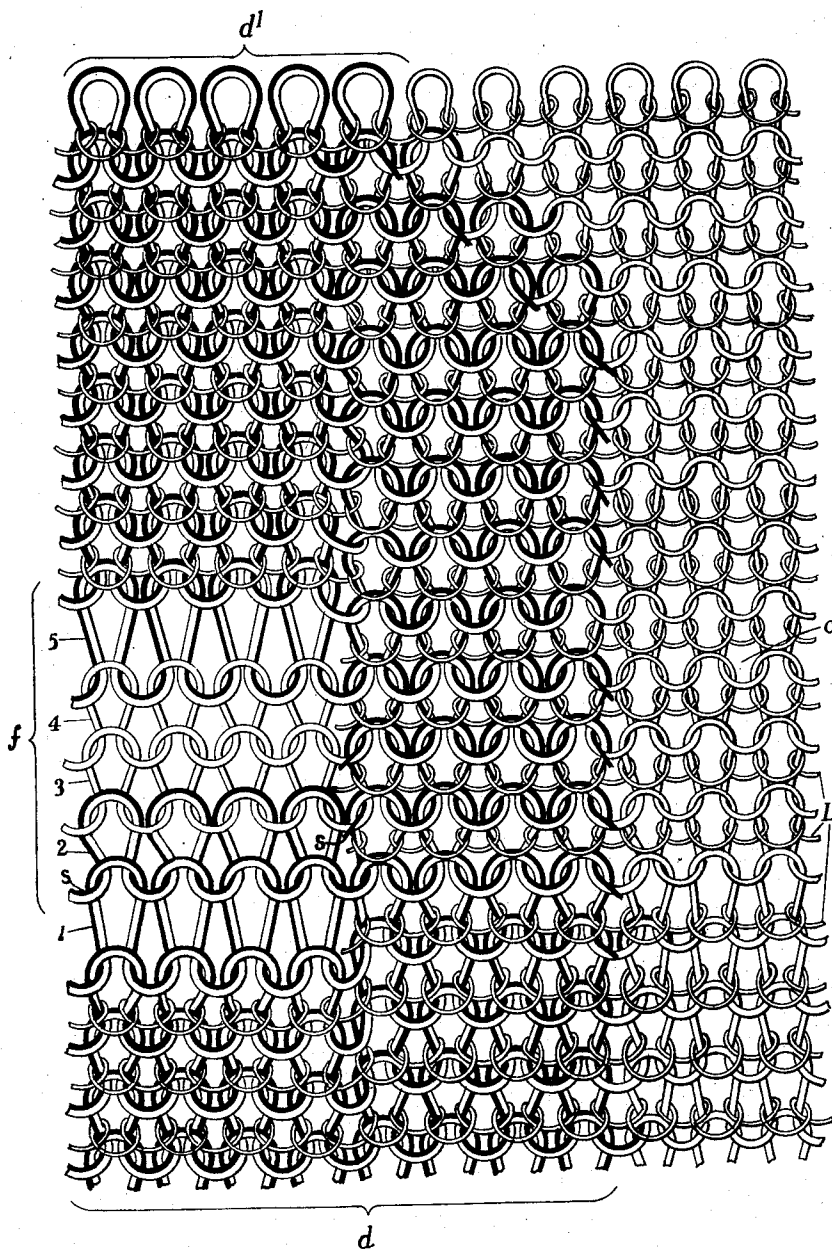
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Fig. 13.



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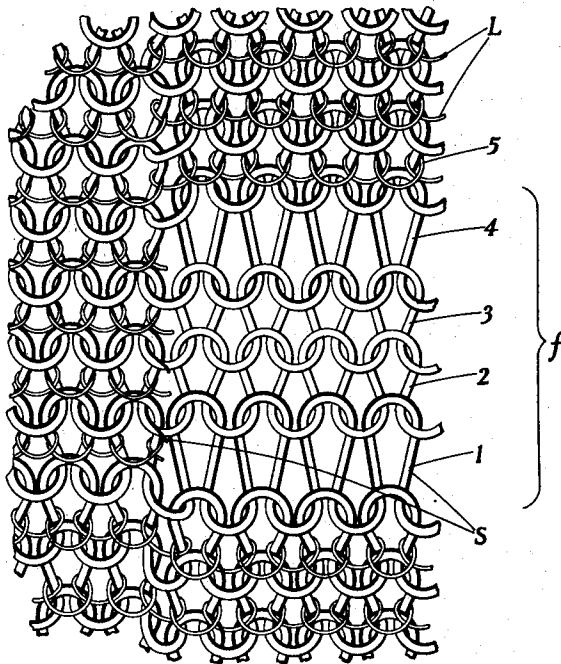
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Fig. 14.



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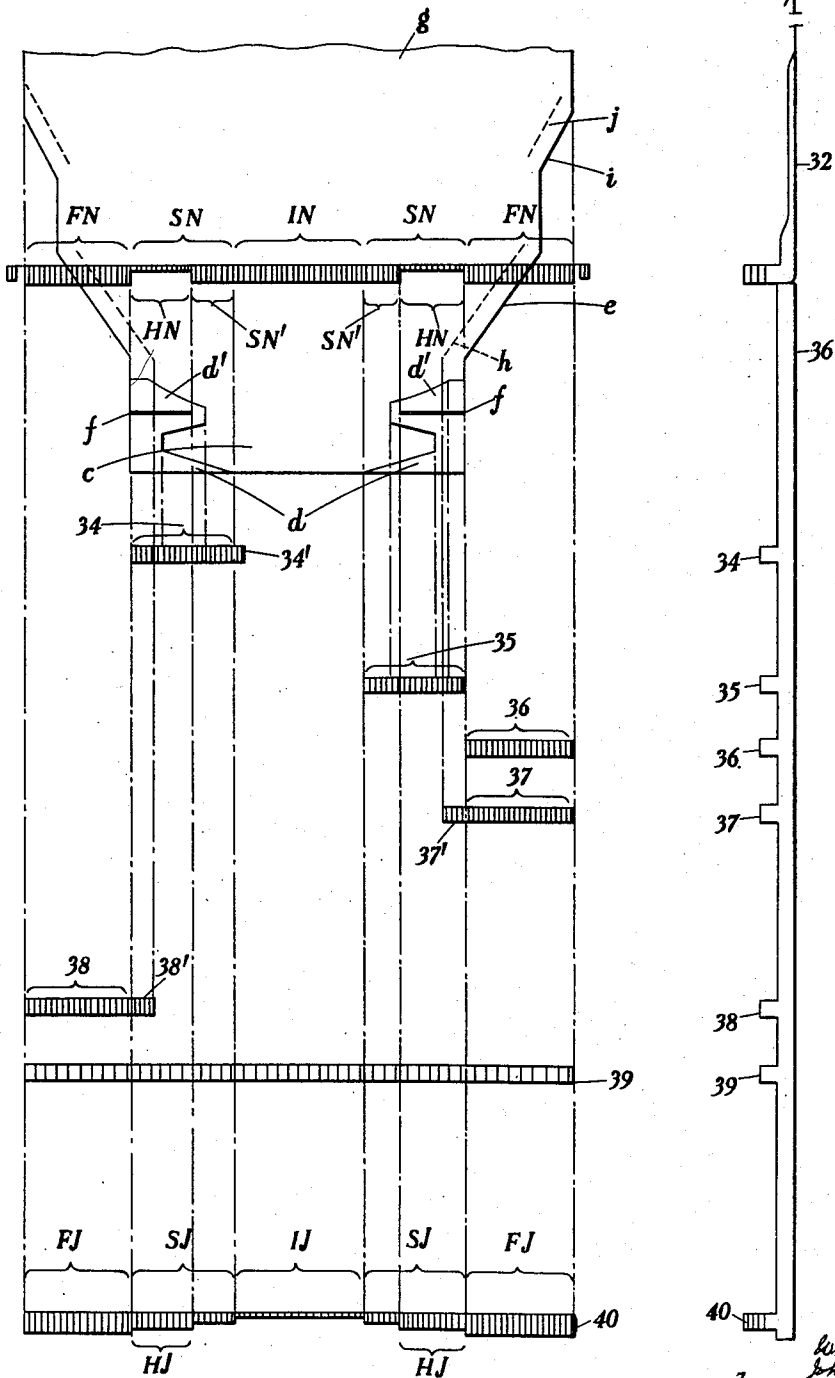
KNITTING MACHINE

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Fig. 15.

Fig. 15A.



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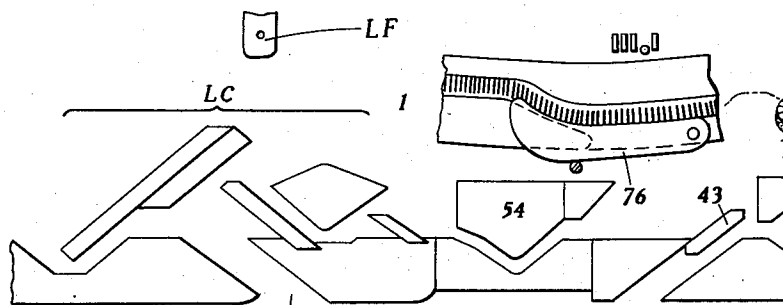
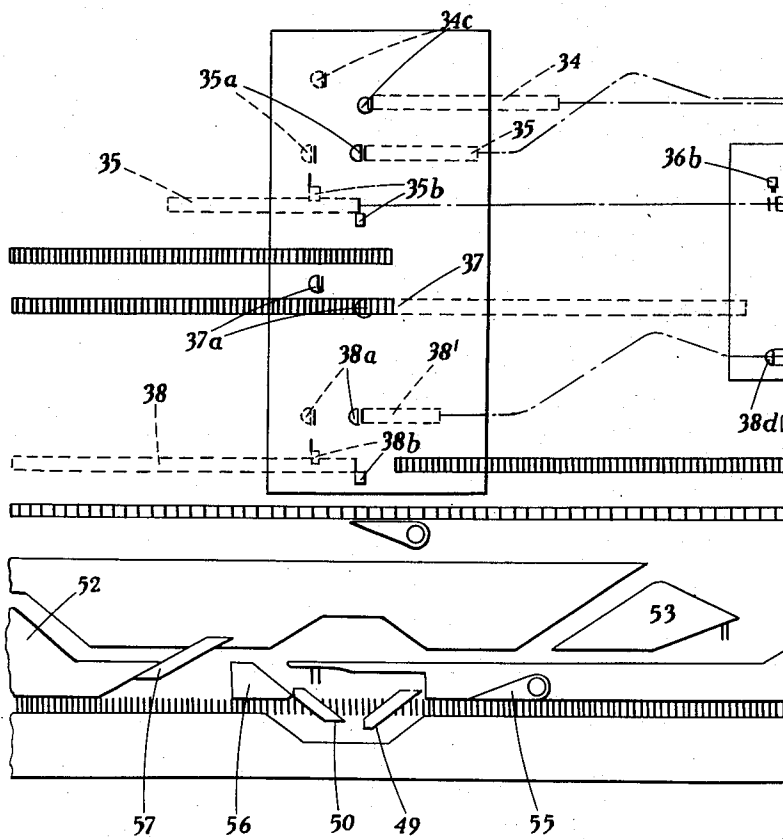


Fig. 16.



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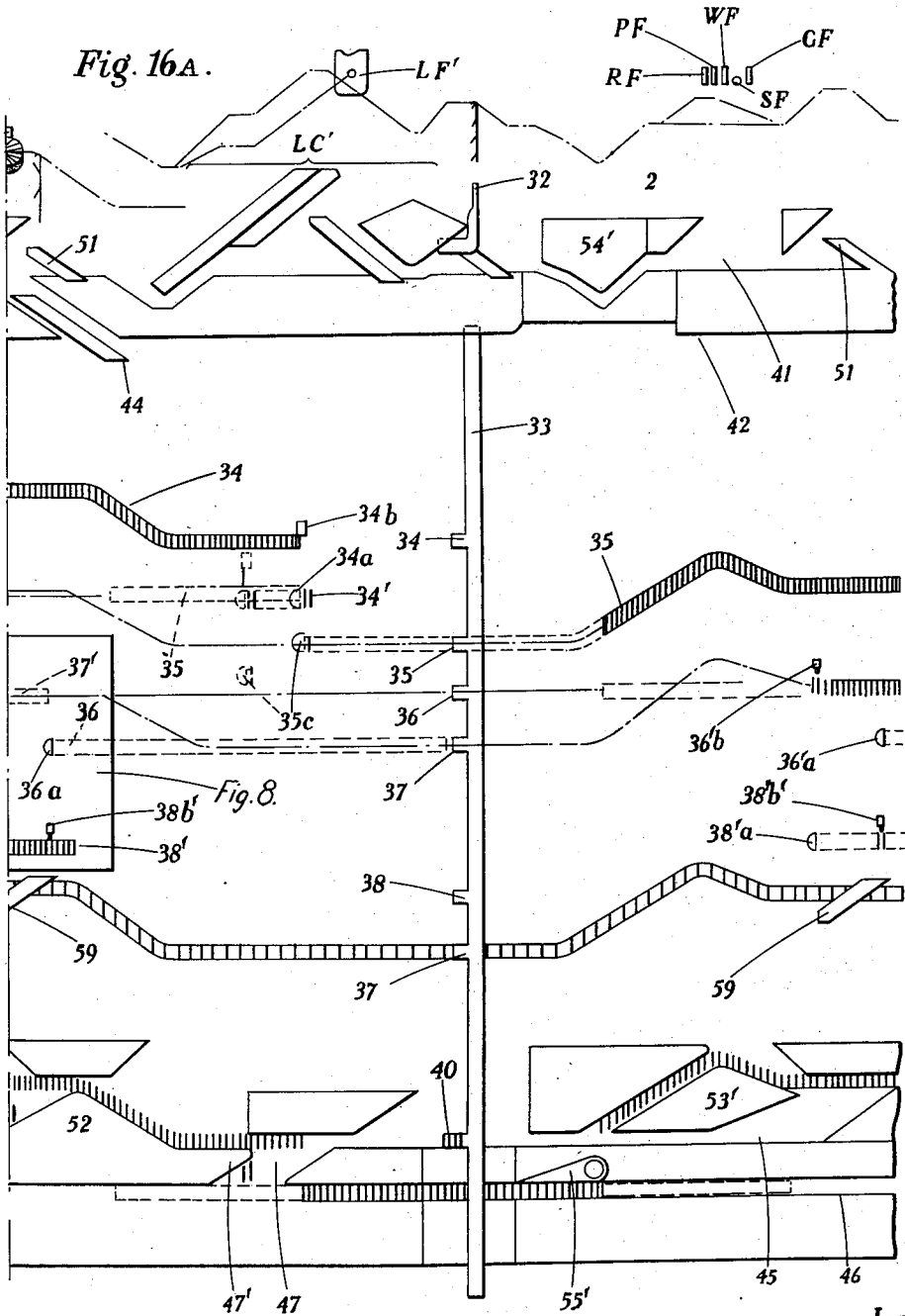
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KNITTING MACHINE

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12 Sheets-Sheet 8



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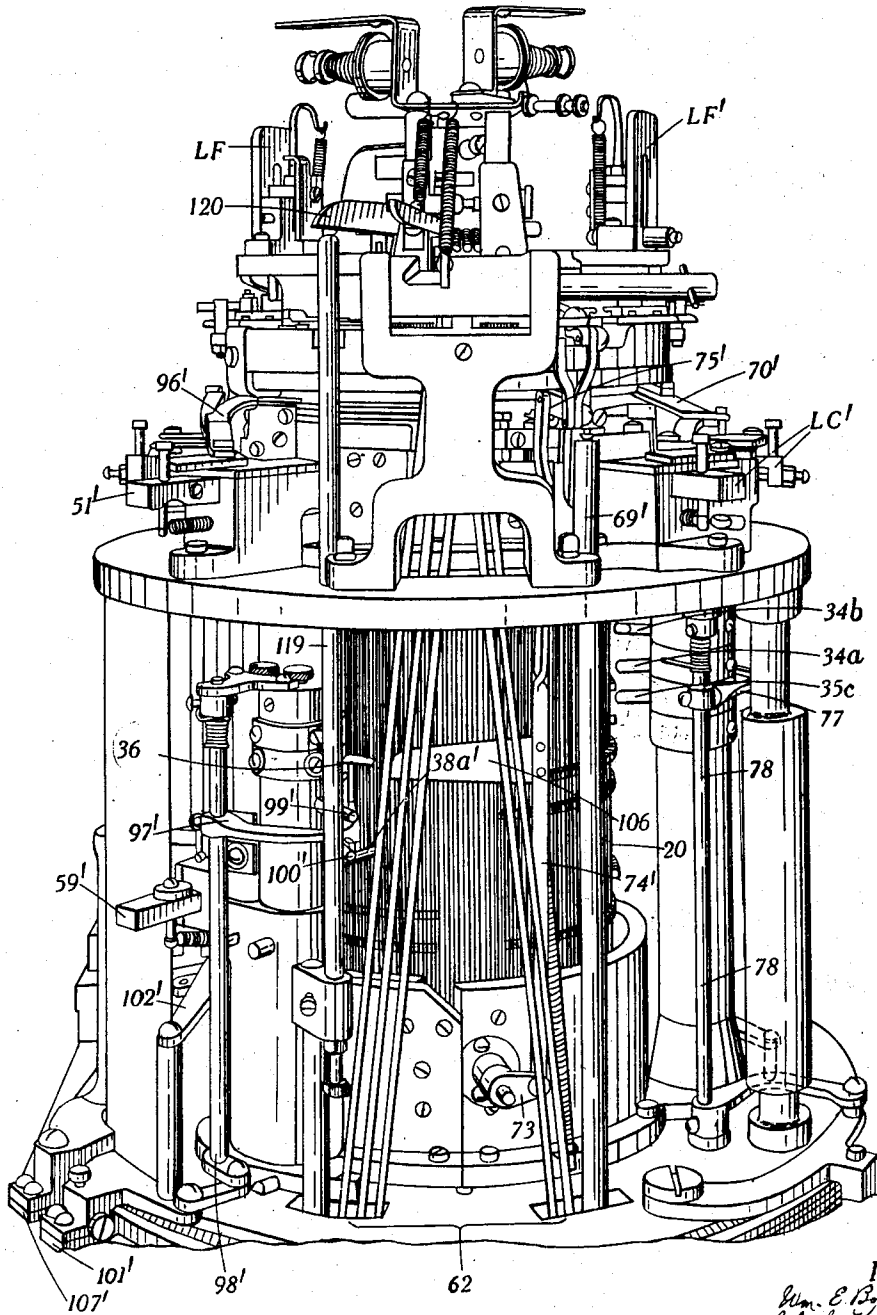
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Fig. 17.



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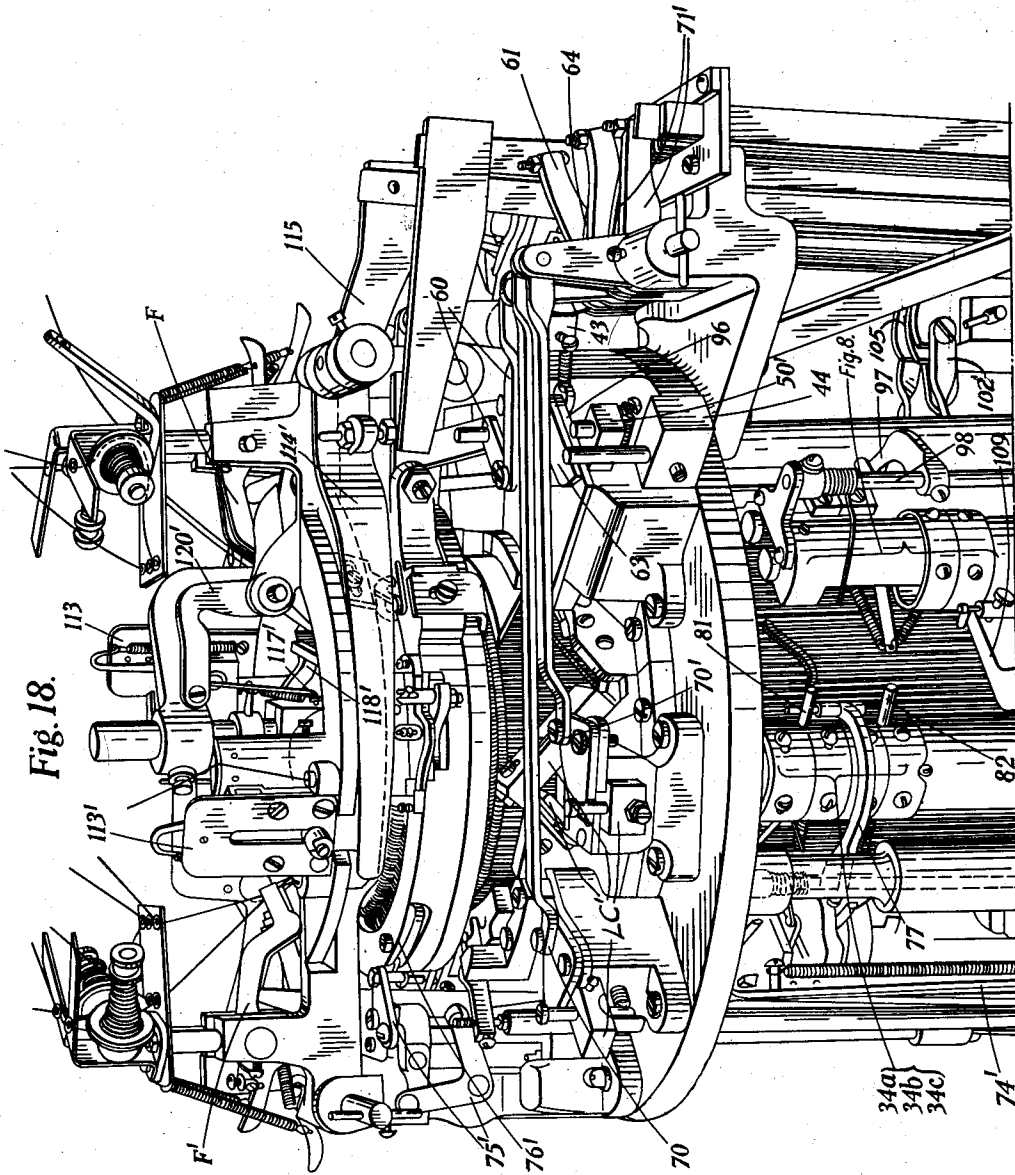


Fig. 18.

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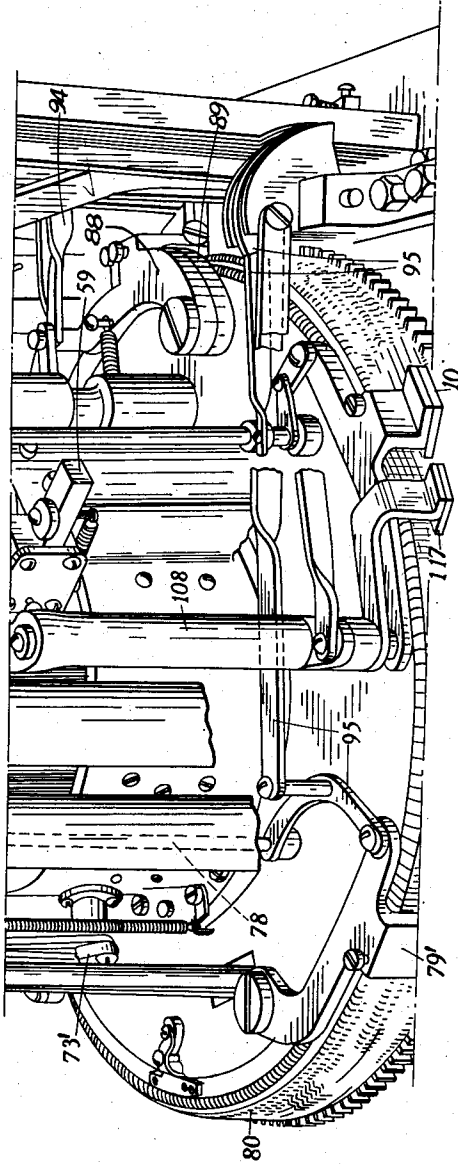
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Fig. 18A.



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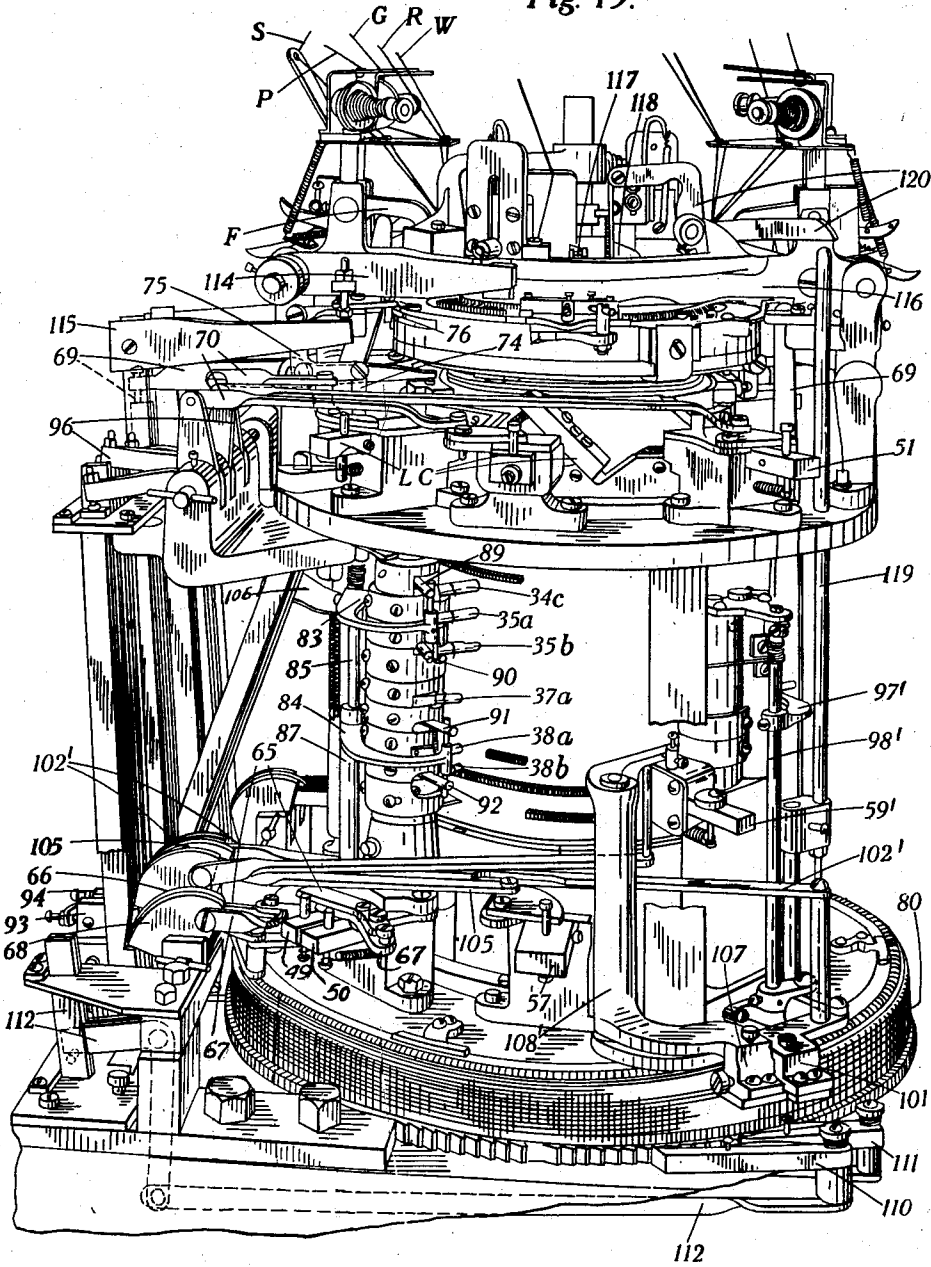
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12 Sheets-Sheet 12

Fig. 19.



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UNITED STATES PATENT OFFICE

2,271,386

KNITTING MACHINE

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Application February 11, 1941, Serial No. 378,464
In Great Britain January 13, 1940

14 Claims. (Cl. 66—48)

This invention is for improvements in or relating to knitting machines and is concerned with a novel picker mechanism for use therein, especially in circular knitting machines. It is well known that pickers are used in seamless hose machines for introducing needles into, or removing them from activity in the production of the heel and toe pouches. These pickers are, however, only capable of picking up or picking down the first butt of a group of butts reaching them, because they occupy a fixed position in relation to the knitting cams, and therefore are rotated or oscillated with said cams in relation to the needle cylinder, being actually operated by the said butt striking them in the course of the relative movement between the cylinder and cams. British Patent No. 469,507 (W. E. Booton) provides an arrangement wherein a picker may operate at the trailing end of a group of butts and, travelling along the line of butts, may work towards the leading end of said group as it picks the butts in succession. The present invention also provides an arrangement whereby a picker may operate at the trailing end of a line of butts or their equivalents, but, as hereinafter appears, this arrangement differs from that according to the aforesaid Letters Patent in that the picker occupies a fixed position in relation to the knitting cams.

As viewed from one aspect this invention provides in a knitting machine incorporating a picker mechanism and a line of instrument butts movable past it repeatedly, an arrangement wherein the picker mechanism is operable by a butt presented to it at one pass and thereby effects or initiates the movement of a butt of a line thereof into a position in which the butt last-mentioned serves to operate the picker mechanism as aforesaid at a subsequent pass. It will be appreciated that upon operation of the picker mechanism by this last-mentioned butt a third butt, belonging to the line thereof, is brought to the picker-operating position, and these operations continue along the line of butts. Thus a picker mechanism, occupying a fixed position in a cam-box, may commence its operations at the trailing end of a line or group of butts and working from that end may pick butts that are successively nearer to the leading end.

It is preferable that the picker mechanism shall move successive butts of the line only part-way towards the picker-operating position, this movement being completed by other means, conveniently a cam. The invention further includes in or for a knitting machine (e. g. a machine as

hereinbefore specified) picker mechanism comprising a plurality of instrument-engaging members for engaging the instruments at spaced locations, one of which is arranged to be displaced by an instrument meeting it and another of which is arranged to pick the instruments, and a connection between said members whereby displacement of the first-said member causes the other to make a picking movement. The foregoing and other features of the invention set out in the appended claims are incorporated in the constructions hereinafter to be described by way of example with reference to the accompanying drawings. In these drawings

Figure 1 is a perspective view of one form of picker mechanism according to this invention.

Figure 2 is a view of instruments utilised in conjunction therewith.

Figures 3 and 3A are diagrams illustrating the operation of the mechanism.

Figures 4 and 4A are similar diagrams illustrating the operation of a modified form of the mechanism shown in Fig. 1.

Figure 5 is a perspective view of another form of picker mechanism according to this invention.

Figure 6 is a diagram illustrating the operation thereof.

Figure 7 is a diagram illustrating the operation of a modification of the mechanism shown in Fig. 5.

Figure 8 is a perspective view of a picker unit or battery according to this invention.

Figure 9 is a perspective view of a portion thereof looking from underneath.

Figure 10 is an elevation of another such battery.

Figure 11 is a perspective view showing a stocking blank in the cylindrical form in which it is produced by the machine hereinafter described incorporating picker mechanism according to this invention.

Figure 12 shows the blank laid out flat.

Figures 13 and 14 show enlarged views of portions of fabric near the left and right-hand edges of the blank respectively in order to disclose the construction of the heel lines *f* hereinafter referred to.

Figure 15 shows a portion of a stocking blank very much fore-shortened, and also shows the grouping of the various needle and jack butts hereinafter referred to.

Figure 15A shows a needle and its jack.

Figures 16 and 16A together constitute a development showing the various cams with which the knitting machine is equipped.

Figure 17 is a front perspective view of the machine showing the relevant parts thereof.

Figures 18 and 18A together constitute a perspective view looking from the right-hand side of Fig. 17.

Figure 19 is a view similar to Fig. 18, but looking from the left-hand side of Fig. 17; and

Figure 20 is a perspective detail view of portions of the actuating and control means for the battery of pickers shown in Fig. 10.

In Figure 1 there is illustrated one picker mechanism according to this invention. The picker arm 10a is pivoted about a horizontal axis 11a in a block 12 which may rock about a vertical axis. This picker arm 10a is arranged to be struck and swung by the first butt of a group of butts which reach it. These movements are communicated to another arm 10b which is likewise pivoted in the block 12 about a horizontal axis 11b so that the said arm 10b picks a butt at a different level. The connections may either be by way of set screws 15, 15', or a link indicated at 16. The picker arm 10a may be arranged to be displaced upwardly or downwardly. In the illustrated construction it is arranged to be displaced upwardly as it swings sideways, and to this end it is provided with a guide plate 17 having an appropriate ramp. One mode of operation of this picker mechanism is illustrated in Figs. 2, 3 and 3A. The instrument bed (such as the needle cylinder 20 hereinafter referred to) is provided with instruments 21 having butts 22 and 23 at two different levels grouped as shown in Fig. 3, there being one group of butts 22 at a lower or reserve level 1 and a group of butts 23 at another level 3. At the trailing end of the group of instruments 21 there is located another instrument 24 having a butt 25 at a control level 2. As the group of instruments passes the picker mechanism the butt 25 strikes the arm 10a and causes the latter to swing sideways and upwards to raise butt 25, the arm subsequently being disengaged from butt 25 by continued relative movement between the instrument bed and the picker mechanism and the butt 25 being returned to the control level 2 by the down cam 14. The arm 10b is also caused to swing sideways and upwards to bring the last butt 23 of level 3 into the range of a raising cam 13 whereby said butt is raised still further to an operative level 4. This continued upward movement of the instrument 21 brings the lowermost butt 22 thereon from the reserve level 1 into the control level 2 and places it in front of the operating butt 25. Therefore it is this last-mentioned butt 22 that operates the picker mechanism at the next pass of the instruments. It will therefore be appreciated that the picker mechanism picks progressively from the trailing end of the group of instruments towards the leading end thereof. An intermediate stage in the picking operations is shown in Fig. 3A in which it will be observed that butts have been removed from the reserve level 1 to the control level 2 and from the level 3 to the operating level 4. Incidentally as each instrument 21 is raised by arm 10a, its upper butt 23 is temporarily raised to level 4', but it is immediately restored from that level to level 4 by the cam 14.

It will be appreciated that instead of the driving arm 10a being arranged to swing upwards it may be arranged to swing downwards, and the arm 10b may be arranged to swing upwards or downwards. This latter is illustrated in Figs. 4 and 4A. These figures illustrate the fact that

butts are progressively picked from the group at the top level 2 and are added to a group at a lower level 1, cams 18 and 19 co-operating.

Instead of the picker arms 10a, 10b being located immediately one above the other they may be spaced apart in the direction of relative movement between the instrument bed and the picker mechanism. For example in Fig. 5 the picker 10a is pivoted about its horizontal axis 11a in a block 12a movable about a vertical axis and the picker 10b is pivoted about its horizontal axis 11b in another block 12b movable about another vertical axis, and these two blocks are connected together by a link 26. It will be appreciated that the picker 10a may be arranged to swing upwards or downwards and the picker 10b may be arranged to swing in the same direction or in the reverse direction. In the illustrated construction they both swing in the same direction, the picker 10a being provided with a guide plate 17a and the picker 10b with a guide plate 17b.

In Fig. 5 the operating picker 10a is shown in advance of the driven picker 10b and the operation of a mechanism of this character is diagrammatically illustrated in Fig. 6. It will be seen that the picker 10a lowers a butt from level 1 into the range of a returning cam 29 while the picker 10b lowers a butt, in advance of the butt which strikes picker 10a, from an upper level 2 into the range of a lowering cam 30 which brings said butt to level 1. This butt may be left in at this level or it may be subsequently returned to upper level 2 by raising cam 31 operating on butts provided on those instruments which have butts at the upper level 2. It is within the scope of the invention progressively to add butts at the leading end of the group at level 1 by mechanism herein described (e. g. as in Figs. 4 and 4A).

Another modification of the mechanism shown in Fig. 5, wherein the picker 10a is located after the picker 10b but both pickers operate on butts located at the same level, is illustrated in Fig. 7. The picker 10a picks down the first butt on a group reaching it at level 2 while the picker 10b picks down a subsequent butt. This latter butt is brought into the range of a down cam 28 by which it is lowered to level 1, but the butt picked down by picker 10a is restored by an up cam 27. Here again it is within the scope of the invention to add butts to the front end of the group at level 2 by mechanism herein described. It is within the scope of the invention to arrange the driving picker arm to swing sideways only, as hereinafter described with reference to Figs. 8-10.

The picker mechanism herein described and illustrated has been devised to effect the needle movements in a circular knitting machine of the kind arranged to knit a blank by rotation and to fashion said blank by controlling needles to vary the width of a gap in the active needles. Such a knitting machine embodying the picker mechanism is hereinafter described, but before proceeding to a description of the machine it is preferable first to describe the blank which is produced.

The stocking blank shown in Figs. 11-16 is made entirely by rotation, the number of needles that knit being varied to produce a shaped area of fabric the edges of which are connected by float threads. In Fig. 11 the fabric is shown at the right-hand side of the tube, while the float threads extend over the left-hand portion of the tube circumference. The boundary of

the knitted fabric at that portion of the tube which faces the observer in Fig. 11 is indicated by a chain dotted line. In Fig. 12 the developed circumference of the needle cylinder is indicated by the dotted lines between which the dimension line marked C extends, and the boundaries of the fabric blank are indicated by full lines. The stocking blank is preferably produced according to British Patent No. 500,230* but it may be mentioned that the float threads may be cut out during the manufacture of the stocking instead of being cut out subsequently.

The stocking is knitted from the toe upwards and in Figs. 11, 12 and 15 a blank with a French foot is illustrated, although it may be pointed out that an English foot may likewise be produced. At the commencement of knitting all needles other than the group of needles for knitting the instep and sole portion of the blank are pressed off, and a certain number of roving courses indicated at *a* are knitted. Next a slack running-on course *b* is produced so as to permit the blank subsequently to be run-on to the needles of a footing machine by which the toe is knitted. Thereafter locked fabric according to British Patent No. 329,098 is knitted to form the foot and instep portion, *c* but the marginal areas *d* of this portion are spliced as in a "slipper" foot. It will be noticed that each spliced area *d* is narrowed as knitting proceeds upwards from the toe, then continues at a constant width, and subsequently is again widened to a width somewhat less than the original width. In this second-mentioned widened area, indication lines marked *f* in Figs. 11 and 12 and shown on a large scale in Figs. 13 and 14 are produced. It is intended that the blank should be cut along these lines and the high heel portions *d'* hereinafter mentioned shall be run-on to the needles of a heeling machine and heel tabs knitted on to said portions. In the production of these lines *f* matters are so arranged that the locking thread L is excluded from a certain group of the needles at each edge of the blank for a plurality of courses so that unlocked fabric is produced. An initial and a terminal course in each line *f* is spliced, but is slackened, and in intermediate courses the splicing thread S is excluded so as to give a clear indication as to where the blank is to be cut and the extent of the cuts. The construction of these lines *f* is hereinafter described in greater detail. The cuts at *f* are made in the unspliced portions and extend inwards as far as the commencement of splicing. As a result they terminate short of the inner margins of the spliced areas, as will readily be appreciated from Figs. 11-14. Therefore the corners of the heels, being spliced, are strengthened. Thereafter all the needles so far in action produce locked fabric and the spliced areas are gradually narrowed to produce the high heel portions *d'* and at the appropriate time the splicing thread S is taken out. Knitting then proceeds until it is desired to widen the fabric along the lines *e* to produce the widened portion *g* of the leg. This widening is effected by introducing additional needles into activity, and it is preferably accompanied by the production of mock-fashion marks. As shown in Figs. 11 and 12 the lines of mock-fashion marks *h* may be parallel to the edges *e* of the blank so that in the finished stocking, when the edges of the blank are seamed together, said mock fashion lines are parallel to one another. Alternatively the lines of mock-fashion marks *h*

may be arranged to converge upwardly or downwardly in the finished stocking. The mock-fashion marks are preferably produced by tuck stitching, but they may be produced by any other known suitable means. After the leg has been widened to a sufficient extent a further parallel portion of the blank is produced and then it is again widened as at *i* in the equivalent of what in a stocking produced on a Cotton's Patent machine is known as the "thigh narrowings." This widening at *i* may be accompanied by the production of mock-fashion marks *j* which in the finished stocking may be parallel or may converge upwardly or downwardly. By the widening at *i* the blank is brought to its maximum compass or width, so that that arc of the needle circle in which knitting does not take place is reduced to a minimum. Thereafter the fabric *w* for the welt is knitted above the line marked *k*. This line *k* may be taken to indicate a narrow band of reinforced fabric (knitted of a yarn R hereinafter referred to) to hold the stitches when the welt is closed by sewing and/or it may be taken to represent a line of open-work such as is sometimes introduced immediately below the welt. The welt itself is knitted of a comparatively stout yarn which is marked W in Fig. 19 and it may or may not be made of locked fabric, as desired. At the line *l* a picot edge is formed, conveniently by causing spaced needles to hold their loops for a few courses. It is within the scope of the invention to knit that part *w* of the welt which lies below the picot edge *l* of the same or similar yarn (e. g. natural or art silk) as the leg or panel *g* and to introduce the stouter yarn W after the picot edge has been made.

The shaping of the blank is effected by introducing needles into knitting activity. The machine has two feeding positions marked 1 and 2 in Fig. 16, and at each feeding position there is provided the necessary complement of feeders and knitting cams for producing knitted stitches. Therefore two courses are produced at each revolution. Likewise if it is desired to produce locked fabric according to said British Patent No. 329,098 locking cams are provided at each position (said cams being grouped under brackets LC and LC') and the needles 32 have two latches as is shown in Fig. 16. The needles are provided with butts of contrasting lengths as illustrated in Fig. 15. There is a central group of instep needles, indicated under the bracket IN in Fig. 15, having three-quarter butts. This group is flanked by groups of splicing needles SN each of which groups is sub-divided into two groups indicated at SN¹ and HN, the groups HN having butts of medium length and the groups SN¹ having slightly longer butts. These groups SN are again flanked by groups of fashioning needles FN having long butts. Since in Fig. 15 the developed circumference of the needle cylinder 20 is indicated by the dimensional arrow C, it will be appreciated that between the adjacent ends of fashioning groups FN there is a portion of the needle circle which has not been accounted for. This portion may be entirely void of needles; in other words there may be a gap in the needle circle indicated by the broken brackets Gp so that at each rotation of the needle cylinder (or of the cam box as the case may be) floating threads are laid across said gap. Although this gap is a very narrow one when all the needles of groups FN have been brought into activity, yet at the commencement of the stock-

ing blank (when said groups FN are inactive) the gap is quite wide and the floating threads *m* are long. In order to ensure that the first active needle at one side of the gap takes and knits the fed thread with accuracy, it is desirable to minimise the lengths of the floats. Therefore a few short butt needles indicated at *Gn* in Fig. 15 are introduced into this gap. These needles always knit, but they do not take any part in the formation of the stocking blank. They only produce narrow bands of fabric one of which is indicated at *gn* in Fig. 11 within the gap so that the length of the floating threads *m* is always minimised, and cutting of the float threads is facilitated.

Beneath each needle 32 and working in the same track in the needle cylinder 20 there is a jack 33. These jacks 33 have butts at seven different levels indicated respectively at 34-40. The butts are grouped as illustrated in Fig. 15. The left-hand group of splicing needles SN (Fig. 15) has beneath it jacks SJ with butts at level 34, but it is to be pointed out that the jacks below the first two needles of the adjacent group IN also have butts 34' at level 34 for the purpose hereinafter referred to. The jacks SJ below the other group of needles SN have butts at level 35. The jacks FJ below the right-hand group of fashioning needles FN have butts at level 36 and also at level 37, but in addition a few jacks below the adjacent needles of group SN have butts 37' at said level. Likewise the jacks FJ below the other group of fashioning needles FN have butts at level 38 and beneath a few of the adjacent needles SN there are also jacks with butts 38' at said level. At level 39 suitably spaced jacks are provided with butts for forming a picot edge, while at level 40 each jack has a butt, said butts being of contrasting length as shown in Fig. 15. The jacks IJ beneath the instep needles IN have short butts. The splicing jacks SJ beneath the groups of splicing needles SN have medium butts, but said splicing jacks are subdivided into two groups; the jacks HJ (which correspond to the heel lines *f*) have longer butts than the jacks beneath the needles SN¹. The jacks FJ beneath the fashioning needles FN have long butts.

The needle butts either follow an active race 41 or an inactive race 42, there being a bolt cam 43 for leading the needles from the active to the inactive track and a bolt cam 44 for raising them. The jack butts at level 40 likewise follow either an active race indicated generally at 45 or an inactive race 46, there being a gap 47 at the second feeding position whereat the butts 40 may be lowered to the inactive race.

At the termination of one stocking blank and prior to the commencement of the next one the butts of all needles are pursuing the active track 41, while the butts 40 of the fashioning jacks FJ are pursuing the inactive track 46 and the butts of the jacks SJ and IJ are pursuing the active track 45. To commence the next blank it is necessary to press off the fashioning needles FJ. To do so, bolt cam 43 is introduced part-way to engage only the butts of the fashioning needles and to lower them to inactive track 42. Bolt cam 44 is likewise introduced so that at each revolution said fashioning needles FJ are raised again, to bring their latches across the latch-opening brush 48. This temporary elevation to the brush 48 occurs at each revolution until said needles are required for fashioning. Bolt cam 43 is operated by mechanism 60, 61 75

(Fig. 18) and one of a group of push rods 62 at the back of the machine, from the main drum (not shown) of the machine. Bolt cam 44 is operated in a like manner, a portion of the mechanism being shown at 63 and 64. Attention is directed to the fact that at this period bolt cams 49, 50 associated with the jack race 46 are out. These latter cams are operated by mechanism including 63, 64 and 67, 68 respectively, from the main drum.

The necessary number of roving courses *a* is now produced, the active needles SN and IN clearing at cams 51 and 51' in advance of the two feeding positions, although the jacks SJ associated with needles SN are raised by the jack clearing cams 52, 52' and the splicing cams 53, 53'. The slack course *b* is produced by temporarily lowering the stitch cam 54 at the first feeding position. Said stitch cam is operated by control 69, Fig. 19, and one of the aforesaid push rods 62. To commence the splicing the locking cams LC and LC' are introduced as well as the splicing feeders SF and SF'. The locking cams LC' are controlled by means, best shown in Fig. 18, comprising rods 70', and bell crank levers 71', by two of the push rods 62. The cams LC are controlled in a like manner (Fig. 19) by rods 70 and levers 71. As a result the jacks SJ underneath the needle groups SN are elevated by cams 53, 53', so that the associated needles take and knit the splicing thread S as well as the ground thread G. It is necessary, however, that the spliced loops shall be slackened. To this end feelers 55 and 55' are provided which ride on the butts of the jacks in the inactive race 46. Wherever there is a gap between said butts the feelers drop down and by mechanism hereinafter described serve to produce slack loops. It will therefore be appreciated that as jacks are progressively moved down from the active race 45 to the inactive race 46 to narrow the spliced areas *d* at each side of the blank, the spliced areas are simultaneously and progressively slackened. The converse, of course, takes place as the jacks are picked up to widen the spliced areas. Referring to Figs. 16, 17, the feeler 55' is connected to a lever 73', vertical rod 74' and bell crank levers 75' controlling a sinker knockingover cam 76' which imparts additional advance to the sinkers to produce slack loops. Feeler 55 is likewise connected to rod 74, bell crank lever 75 and cam 76. In order to narrow the spliced areas *d* the jack butts at levels 34 and 35 are employed. Considering the group of jack butts at the left-hand side of the blank (Fig. 15) it will be appreciated that in order to narrow the corresponding spliced area said butts must be picked down progressively from the trailing end thereof (i. e. from the right-hand end Fig. 15). To do so use is made of a picker mechanism having picker arms 34a, 34b, the former being adapted to swing sideways when struck by a butt and the latter being adapted to swing sideways and downwards. At this stage the jacks SJ beneath the needles SN are elevated but those (IJ) beneath the instep needles IN are in lower track 46. Hence the two butts 34' provided at level 34 on the jacks beneath the end needles of group IN are at a lower level than the corresponding butts 34 of jacks SJ beneath the needle group SN, as shown in Fig. 16. As the needles travel round said butts 34' strike the driving picker arm 34a, swing it and cause the picker arm 34b to swing downwards and sideways thereby lowering the last splicing jack. As a result the butt on this jack at level 40 is brought

into the gap 47 and is lowered by cam 47' to the inactive race 46 so as to miss splicing cams 53, 53'. By this downward movement the butt provided on said lowered splicing jack at level 34 is added in front of the butts 34'. Hence the jacks SJ are picked down progressively one by one (or more) at each revolution, there being one needle less knitting the splicing thread at feeder 1 than at feeder 2. This continues until the spliced area has been sufficiently reduced, when the picker mechanism 34a, 34b is taken out of operation by means hereinafter described.

It will be appreciated that at the other edge of the blank the splicing jacks SJ must be picked down progressively working from the leading end of their group of butts at level 35. This is effected by a down picker having a single swinging arm 35c operating in the usual manner. Said down picking continues until the spliced area has been sufficiently narrowed and the picker is taken out of operation. The parallel parts of the spliced areas *d* are now knitted.

This arrangement of these splicing pickers 34a, 34b and 35c is substantially similar to that of pickers 35a, 35b and 34c shown at the top of Fig. 10 (except that picker 35c is below the mechanism 34a, 34b) and therefore needs no further description here. It may be mentioned, however, that they are controlled by an arm 77 on a rock shaft 78 operated by a feeler 79 from a pin drum 80 surrounding the base of the needle cylinder. The said arm 77 engages pins 81, 82 on the rocking picker blocks. The feeler 79 is arranged to be bluffed from the main drum of the machine by means indicated generally at 95.

It is eventually necessary to widen the spliced areas *d* towards the heel, and it will be appreciated that the picking arrangements must be the reverse of those employed for narrowing the spliced areas. Therefore, again first considering the left-hand group of splicing jacks SJ (Fig. 15), it will be appreciated that of the butts at level 34 some at the left-hand end of the group are in a raised position because the associated needles have not been rendered incapable of splicing, while the others are in a lower position owing to the operation of picker mechanism 34a, 34b. Picking is therefore effected at the leading end of the lowered butts by a conventional up-picker having a single picker arm 34c (Fig. 10) said picker being located at feeding position 1 and operating to raise the jacks one by one so that their butts 40 engage cams 50, 56 and pass into the active race 45. Likewise the group of splicing butts at level 35 is subdivided into two sub groups, a lowered leading sub group followed by a raised sub group. Picking must take place from the trailing end of this lowered sub group at level 35, and this is effected by picker mechanism having a driving arm 35a which swings sideways and drives a second picking arm 35b which swings sideways and upwards. The arm 35a is struck by the first butt of the second mentioned sub group and so serves to raise the last butt of the first mentioned or lower sub group. Thereby the butt with which this last jack of the lowered sub group is provided at level 40 is brought to a cam 56 and is raised from the inactive track 46 to the active track 45, a corresponding needle being thereafter caused to take the splicing thread. It will readily be appreciated that these up picking operations continue until the desired width of the spliced areas at the heel is attained, when the picker mechanisms 35a, 35b and 34c are ren-

dered inoperative. Thereafter the width of the spliced areas is again reduced by picker mechanisms 34a, 34b and 35c until, when the desired reduction has been effected, said picker mechanisms are rendered inoperative.

The battery of pickers shown in Fig. 10 is controlled by arms 83, 84 from the drum 80. Arm 83 engaging control pin 89 of picker 34c and pin 90 of mechanism 35a, 35b, is mounted on a vertical shaft 85 rocked by feeler 86. Arm 84 engaging control pin 91 of picker 37a and pin 92 of mechanism 38a, 38b, is mounted on sleeve 87 (surrounding shaft 85) which is rocked by feeler 88. Feeler 88 may be bluffed by means indicated at 93 from the drum of the machine and feeler 86 by like means 94, Fig. 20.

During the production of the wide heel portions of the spliced areas the heel lines *f* are produced and reference is directed to Figs. 13 and 14. The locking cams LC and LC' are partially retracted to miss the short butts of needles HN. The stitch cam 54 is temporarily lowered when the first needle of the trailing group HN reaches it. Therefore slackened and spliced loops are produced on said needles as indicated in course 1 (Fig. 14). The stitch cam 54 is returned to normal and the stitch cam 54' is temporarily lowered by means of control 69'. Therefore the needles HN at the left-hand edge of the blank knit spliced slackened loops at the front feeding position as indicated at course 1 (Fig. 13). This stitch cam 54' is returned to normal position as the last needle of leading group HN passes it. Cams 49, 50 and 57 (the latter by means of control 105) are now partially inserted so that the jacks HJ at the right-hand edge of the blank are lowered. These jacks HJ therefore miss the splicing cams 53, 53', and the right-hand group of needles HN knits at position 2 an unspliced and unlocked course of normal loops (see 2, Fig. 14). Since the jacks HJ of the left-hand group of needles HN have not yet been lowered from the active race 45 the needles HN at the left-hand edge of the blank knit spliced but unlocked loops of normal length at position 1, as shown at 2 in Fig. 13, but for their third course the right-hand group of needles HN knit an unspliced course at position 2. After knitting the second course, at position 1, the needles of the left-hand group HN have their jacks HJ lowered to the inactive track and hence upon reaching the front feeding position 1 said needles knit an unspliced third course. The cam 57 is now retracted so that cams 49 and 50 serve to elevate the jacks of the two groups HJ. As the first needle of the right-hand group HN reaches position 1 the stitch cam 54' is lowered so that the said needles HN produce a slackened but spliced course as shown at 4, Fig. 14. About the same time the left-hand group of needles HN knits an unspliced fourth course at position 2, their jacks not having yet been raised owing to the position of cams 49, 50 with regard to splicing cam 53. Locking cams LC are introduced, with the result that the trailing group of needles HN knits a locked fifth course at position 2. The leading group of needles HN, on reaching the front knitting position knits a slackened and spliced fifth course, the cam 54' being returned to normal position as the last said needle passes it. Locking cams LC' are inserted, so that the sixth course, Fig. 14, is locked, and the leading group of needles HN also knits a locked sixth course at position 2.

At the appropriate stage following the heel it

is necessary to widen the blank by introducing needles of groups FN and also to produce mock fashion marks along lines parallel with the upwardly divergent fashioned edges of the blank. Before these operations are commenced the feelers 55, 55' are idled and the press off cam 43 and the up cam 44 are retracted. These feelers are controlled simultaneously with the splicing feeders. The control for 55' is shown in Fig. 17 and consists of a projection 106' projecting from the rod 74' to the splicing feeder push rod (one of group 62'). Feeler 55 is controlled similarly. As a result of these operations the fashioning needles FN are no longer elevated at each revolution to the latch-opening brush 48. The needle clearing cams 51 and 51' are likewise retracted to facilitate subsequent mock fashioning and needles clear at cams 53 and 53'. Cam 51' is controlled from the main drum, through one of push rods 62, by mechanism indicated generally at 96' in Fig. 19. Cam 51 is likewise controlled through mechanism indicated generally at 96 in Fig. 18. The cams 49 and 50 are introduced. Cam 49 engages the long butts with which the fashioning jacks FJ are provided at 40 and lowers them. Cam 50 in co-operation with cam 56 raises jacks SJ and IJ so that their butts are passed to the active race 45 to clear at cams 52, 52'. Cams 49 and 50 are then withdrawn.

In order to fashion and mock fashion up the right-hand side of the blank (Fig. 15) picking may be effected from the leading end of the group of needles to be dealt with, and for this purpose the jack butts at levels 36 and 37 are employed in conjunction with the battery of pickers shown in Figs. 8 and 9. It will be remembered that at level 37 there is a certain number of jack butts 37' beneath the needles HN. The jacks on which these butts are provided are elevated, whereas the jacks FJ are lowered. Hence in Fig. 16 the butts 37' are shown above the butts 36. These butts 36 strike a picker arm 36a which swings sideways and drives a picker arm 36b which swings sideways and descends and lowers the first two jacks having butts 37'. The butts 40 on said lowered jacks therefore pass beneath the cam 53 and the associated needles tuck at position 1. A like mock-fashioning operation is performed in advance of position 2, by means of picker mechanism 36'a and 36'b, the jack butts 40 passing beneath cam 53'. The first butt of the group provided on jacks FJ at level 37 strikes a single picker arm 37a and the associated jack is elevated so that its lower butt at 40 travels up cam 56 to the active race whereby the associated needle is introduced into knitting activity through gap 58. This introduction of successive needles continues at spaced courses. When each needle is introduced into activity another butt from level 37 is added at the trailing end of the group 37' and the first butt at the leading end of group 36 is elevated. Hence the mock fashion line *h* follows a fashioned edge *e*, the mock fashioning picker mechanism 36a, 36b and 36'a, 36'b, being controlled to come into operation at spaced courses.

To fashion and mock fashion on the leading group of fashioning needles FN the butts at level 38 are employed. Here again it will be recollected that certain of the jacks HJ are provided with a butt at level 38, in addition to jacks FJ. These butts on jacks HJ are indicated at 38' and they are in a raised position compared with the butts on jacks FJ. The first butt of the group 38' strikes a picker arm 38a and swings it side-

ways, said picker arm drives another picker arm 38b which swings sideways and upwards and elevates the jack to cam 56 whereby the associated needle is introduced into knitting activity through gap 58. The mock fashioning is also effected by means of the butts 38'. Before the associated needles enter the knitting cams at position 1 the first of said jack butts strikes a picker arm 38a' and swings it sideways, said picker arm drives another picker arm 38b' and swings it sideways and downwards to lower two of the butts of group 38' so that the butts 40 of the associated jacks pass below cam 53 and the associated needles tuck. Like mock-fashioning operations are performed in advance of feeding position 2 by means of picker mechanism 38'a, 38'b'. This fashioning *e* and mock fashioning *h* continues up the leg for the desired width until the fashioning and mock fashioning pickers are placed out of operation. Subsequently they are again re-introduced for the leg fashionings *i* and *j*, at the completion of which all the needles are traversing the active race 41.

Referring to Fig. 8 there is a driving arm 36a secured to a rocking block 12'a to swing sideways and to drive the picker arm 36b which is pivoted about a horizontal axis in a rocking block 12'b, the two blocks being connected by means indicated at 26' and the picker 36b being guided by guide plate 17'b, and spring biased downwards, to move to the right and upwards. It will therefore be appreciated that when the first butt of a group at one level strikes arm 36a it is swung sideways and arm 36b is swung sideways and downwards to lower a butt located at a higher level and in advance of the driving butt. If now butts are added progressively in advance of the driving butt the arm 36b picks progressively forward from the trailing end of its group of butts. The mechanism immediately below that just described consists of a driving arm 38a' fixed in a rocking block 12c and driving through connection 26a a rocking block 12d in which the picker arm 38b' is pivoted about a horizontal axis, said arm being guided by the guide plate 17c and spring biased upwards. It will be appreciated that upon the arm 38a' being struck by the leading butt of the group thereof the arm 38b' lowers a subsequent butt of the same group and if butts are progressively added to the leading end of the group the arm 38b' picks progressively forward towards the leading end of the group. It will be understood that by swinging the picker blocks to the left as viewed in Figure 8 the picker mechanism may be thrown out of operation. For this purpose there is a control pin 99 projecting from block 12'b and a control pin 100 projecting from block 12c.

In the battery of pickers illustrated in Figure 10 all the picker arms are movable about the same vertical axis. There is an up picker 34c secured to a picker block 12d and provided with a guide plate 17b and a control pin 89. Next below there is a block 12e carrying a driving picker arm 35a and an arm 35b which is pivoted in the block for movement about a horizontal axis and is provided with a guide plate 17e. This block has a control pin 90. Next follows an up picker 37a resembling 34c. It has a block 12f and guide plate 17f. Finally there is picker mechanism comprising a driving arm 38a and a driven arm 38b, the mechanism resembling that of mechanism 35a, 35b. Arm 38a is fixed in block 12g carrying a control pin 92 while arm 38b is pivoted in said block for movement about a

horizontal axis. The guide plate is indicated at 17g. All the picker blocks of Figure 10 are pivoted for movement about a common vertical spindle 103 in a support 104, and the arms are spring biased downwards, and it will be understood that pickers 34c and 37a are each adapted to pick the first butt of a line thereof reaching them at their respective levels. If picker arm 35a is struck by a driving butt at one level the arm 35b raises a butt at a lower level, which latter butt is slightly to the rear of the driving butt, and of course if butts are progressively added in front of the driving butt, picker 35b picks progressively towards the leading end of the group thereof. Mechanism 38a, 38b operates similarly.

The battery of pickers shown in Fig. 8 is controlled by an arm 97 which is located on shaft 98 to engage control pins 99, 100, and is operated by feeler 101 from drum 80. The said feeler may be bluffed, from the main drum of the machine, by means indicated generally at 102, Fig. 19. The battery of pickers 36'a, 36'b, 38'a' and 38'b' is similarly constructed, and therefore does not require illustration in detail; corresponding control and bluffing means is indicated at 97—102'.

It may here be emphasized that whereas needle-selection, for varying the spliced areas and for fashioning takes place only in advance of position 1, needle selection for mock fashioning takes place in advance of each position.

When it is desired to produce the picot edge *p* picot cams 59, 59' are introduced to lower the jack butts at level 39 so that the associated jacks and needles are not raised by cams 53 and 53'. The said needles therefore produce tuck stitches. These two cams 59, 59' are both controlled in a similar manner. Cam 59 is controlled from drum 80 by a feeler 107, shaft 108, and lever 109, Fig. 18. The controls for 59' are shown in Fig. 19 and are numbered 107', 108' and 109'.

The drum 80 is racked by two sets of racking mechanism indicated at 110 and 111, Fig. 19, and the racking mechanism may be bluffed by means indicated at 112. Two sets of racking mechanism are required, because the size of the ring 53 necessitates a complete revolution thereof for fashioning and a complete revolution for splicing, and each revolution necessitates racking at different intervals.

The various yarns, other than the locking yarns, are fed by a battery of interchangeable feeders at each feeding position, these feeders being indicated generally at F and F' in Figs. 18 and 19. They are respectively controlled by push rods of groups 62, 62' from the main drum, and since the arrangement is substantially identical at each feeding position it is only necessary to refer to the controls for position 1, which are shown in Fig. 17.

The locking yarns are fed by vertically movable feeder plates 113, 113'. The former is controlled by lever 114, and an arm 115 on one of the push rods of groups 62; plate 113' is likewise controlled by means 114', 115'.

The arrangements in the interior of the latch guard ring 116 advantageous comprise trapping mechanism indicated at 117, 117' and cutting mechanism indicated at 118, 118'. These mechanisms may be of any suitable construction and therefore do not require illustration in detail. Mechanisms 117 and 118, for feeding position 1, are controlled by push rod 119 and

lever 120, and mechanisms 117' and 118', for position 2, are controlled by lever 120' and a push rod included in the group 62.

Subsequent to the production of the picot edge, jack cams 49, 50 and 57 are inserted. Cam 57 lowers all the jack butts from the active track 46. Cam 49 lowers the long butts of jacks FJ, so that said butts subsequently miss cam 50, but does not lower the butts on jacks SJ and IJ. These butts are therefore engaged by cam 50 and are passed by cam 56 back to the active race (cam 57 being withdrawn at the end of one revolution) so that they are prepared for the splicing selection. The needle clearing cams 51 and 51' are also introduced since the jacks FJ, being in the idle race, will no longer clear at cams 52, 52'.

We claim:

1. In a knitting machine having an instrument bed, a line of individually-movable instruments therein and a row of projections on said instruments, the combination of a control projection at the trailing end of said row but spaced therefrom in the direction of movement of the instruments in the bed, and picker mechanism between which and the bed relative movement along the line of instruments takes place in the operation of the machine, the direction of which movement is along the row of projections towards the trailing end at which the control projection is located, which picker mechanism comprises a body, a member mounted thereon for engagement and displacement by the control projection in said relative movement, a picker mounted on the body for picking movement and having a picking extremity, spaced from said member, for engaging and displacing a projection at the trailing end of the row to a position in front of the control projection, said displaced projection serving in turn as a control projection whereby picking takes place progressively forward from the trailing end of the row, and an operating connection between the member and picker.

2. In a circular knitting machine arranged to knit by rotation a stocking blank and to fashion said blank by the introduction of fashioning needles into activity to narrow a gap between active needles, a needle cylinder, needles therein including two groups of fashioning needles, a leading group for fashioning at one edge of the blank and a trailing group for fashioning at the other edge, knitting butts on the needles, an upper active track for the needle butts and a lower inactive track therefor, a set of knitting cams in the active track, thread feeders, a butt passage leading from the inactive to the active track, jacks beneath the fashioning needles, fashioning butts at one level on the trailing group of fashioning jacks, picker mechanism for picking said butts upward, working progressively from the leading end of the group of butts, and for thereby raising the fashioning needles of the trailing group progressively into activity through the passage, fashioning butts at another level on the leading group of fashioning jacks, a picker-operating element at the trailing end of the last-mentioned butts, and fashioning picker mechanism, for operating on the jacks of the last said group to introduce the fashioning needles of the leading group progressively into activity by moving the needle butts upwards through the passage and for progressively adding jack butts, from the trailing end of the group thereof, in front of the operating element to serve in turn as operating elements, which mechanism

comprises a member displaceable by the control element in the rotation of the machine, a picker movable upwards by said displacement to raise the last butt, for the time being, of the leading group of fashioning jack butts and for thereby initiating (a) movement of said last butt to a position in front of the operating element, to serve in turn as an operating element, and (b) introductory movement of a fashioning needle, and a connection between said member and picker.

3. In a circular knitting machine arranged to knit by rotation and to produce a spliced area in the fabric by the control of needles and having a needle cylinder and sliding instruments therein, variable splicing mechanism for controlling the needles in shaping the spliced area, comprising a group of butts at one level on the instruments, a picker-driving element at the trailing end of said group but occupying a different level at the commencement of the spliced area, and means for adding said butts progressively in front of said element to act in turn as driving elements and for moving the needles in shaping the spliced area, which means comprises a member displaceable by a driving element as the machine rotates, a picker driven by said member to pick a butt from the trailing end of the said group, and a driving connection between the said member and picker.

4. In a circular knitting machine arranged to knit by rotation and to produce mock fashion marks along a line diagonal to the wales by the control of needles, said machine having a needle cylinder and sliding instruments therein associated with the needles; mock fashioning mechanism comprising a group of projections at one level on a group of the instruments, a group of projections on instruments at the trailing end of the first said group but occupying a different level at the commencement of mock fashioning, means for progressively exchanging projections between the trailing end of the first group and the leading end of the second group by moving the instruments during rotation of the machine, a member displaced by the first projection of the second group during rotation of the machine, a picker movable by said member to displace a projection of the first group and thereby to control the associated needle in the production of a mock fashion mark, and an operating connection between said member and picker.

5. In a circular knitting machine arranged to knit by rotation and to produce mock fashion marks along a line diagonal to the wales by the control of needles, said machine having a needle cylinder and sliding instruments therein associated with the needles; mock fashioning mechanism comprising a group of projections at one level on a group of instruments associated with mock fashioning needles, means for effecting a progressive variation in the number of projections contained in said group, said variation taking place at the leading end thereof, a member displaceable by being struck, in rotation of the machine, by the projection at the leading end of the group, a picker movable by said member to displace a subsequent projection of the group and thereby to control the associated needle in the production of a mock fashion mark, and an operating connection between said member and picker.

6. A combination according to claim 1, wherein the picker initiates movement of the projection at the end of the row, and including cam means

for completing its movement into position in front of the control projection.

7. In a circular knitting machine for producing a hose blank mainly by rotation and for fashioning said blank by controlling fashioning needles to produce a gap, of varying width, in the fabric, said machine having a needle cylinder and knitting cams that partake of relative rotation in knitting, and needles in said cylinder, including fashioning needles for fashioning at each edge of the blank, the combination of a line of fashioning butts associated with the fashioning needles for one edge of the blank, means for displacing said butts from the line, working progressively rearwards from the first butt past the knitting cams in said relative rotation, a line of fashioning butts associated with the fashioning needles for the other edge of the blank, a control projection carried by the cylinder at the rear end of the second line but normally spaced from said line in the direction of the length of the cylinder, and fashioning picker mechanism, having a stationary location in respect to the knitting cams to partake of said relative rotation, for progressively picking the rearward butts of said second line to take their place in front of the control element to serve in turn as control elements and for thereby controlling the associated needles in fashioning, which mechanism comprises a driving member for engagement with and limited displacement, in the rotation of the machine, by the control element for the time being, a picker operating at the rear end of said second line to pick on such displacement, and an operating connection between said member and picker.

8. In a circular knitting machine for knitting by rotation and of the kind having a needle cylinder and knitting cams that partake of relative rotation in knitting, and needles in said cylinder, the combination of a circumferential row of butts associated with certain of said needles to control them, a control projection carried by the cylinder at the trailing end of said row but normally occupying a different level in the cylinder, picker mechanism for gradually picking the butts of said row, working forward from the rear end thereof, to add them in front of the control projection to serve in turn as control projections and for controlling the associated needles by said butt displacement, whereby a group of butts is built up at said different level, which picker mechanism has a stationary location in relation to the cams and comprises a member for contact with and limited displacement by the control element, for the time being, in the rotation of the machine, and a picker driven thereby to pick the rearward of said row of butts to take its place in front of the control projection, and other picker mechanism, also having a stationary location in relation to the cams, for picking among said built-up group of butts, which other mechanism comprises a member for contact with and limited displacement by the first, for the time being, of the butts in said group, a picker for picking among the butts of the group at a predetermined distance behind said first butt and for thereby controlling the needle associated with each butt picked by it, and an operating connection between the last said member and picker whereby said displacement of the member operates the picker.

9. In a circular knitting machine for knitting by rotation and of the kind having a needle cylinder and knitting cams that partake of relative rotation in knitting, and needles in said cylinder,

the combination of a circumferential row of butts associated with certain of said needles to control them, a control projection carried by the cylinder at the trailing end of said row but normally occupying a different level in the cylinder, picker mechanism for gradually picking the butts of said row, working forward from the rear end thereof, to add them in front of the control projection to serve in turn as control projections and for controlling the associated needles by said butt displacement, whereby a group of butts is built up at said different level, which picker mechanism has a stationary location in relation to the cams and comprises a member for contact with and limited displacement by the control element, for the time being, in the rotation of the machine, and a picker driven thereby to pick the rearward of said row of butts to take its place in front of the control projection.

10. In a combination according to claim 8, a circumferential row of butts associated with others of the needles to control them, means operated repeatedly to remove the leading butt, for the time being, to another level thereby gradually to build up leading and trailing sub-groups of butts at different levels, and picker mechanism having a stationary location with respect to the cams and comprising a member for contact with and limited displacement by the first, for the time being, of the butts in the trailing sub-group, a picker for picking among the butts of the leading sub-group at a predetermined distance in advance of said first butt and for thereby controlling the needle associated with each butt picked by it, and an operating connection between the last mentioned picker and member.

11. A machine according to claim 2, having two sets of knitting cams for knitting two courses at each revolution, a locking yarn feeder following each set of knitting cams, a set of locking cams to each locking feeder for controlling the needles to draw locking loops of said locking yarn through the loops knitted at the preceding knitting cams and to cast off said locking loops over said knitted loops, means for producing a spliced area in locked fabric at each edge of the blank, means for excluding the splicing thread from a predetermined number of wales at each edge of the blank, less than the number of spliced wales, and for a few courses, to produce heel guide severance lines, and means for shaping the inner margins of the spliced areas.

12. In a knitting machine having an instrument bed, a line of individually-movable instruments therein, and a row of projections on said instruments, the combination of a control projection at the trailing end of said row but spaced therefrom in the direction of movement of the instruments in the bed, and means for moving projections from the trailing end of the row to take up a position in front of the control projection and to serve in turn as control projections, which means comprises a member between which and the bed relative movement takes place along

the line of instruments in the operation of the machine, whereby said member and the row of projections pass one another repeatedly, said member being disposed for engagement with and limited displacement by the control projection for the time being, in the course of said relative movement; a picker actuated by said member in its movement to pick a projection from the trailing end of the row for positioning in front of the control projection for the time being to serve in turn as a control projection; and an operating connection between said member and picker.

13. In a circular knitting machine for knitting by rotation, of the kind having a needle cylinder and knitting cams that partake of relative rotation in knitting, and needles in said cylinder, the combination of a circumferential row of butts associated with certain of said needles to control them; a control projection carried by the cylinder at the trailing end of said row but normally occupying a different level in the cylinder; mechanism for gradually moving the butts of said row, working forward from the rear end thereof, to add them in front of the control projection to serve in turn as control projections and for controlling the associated needles by said butt displacement, whereby a group of butts is built up at said different level in front of the first said control projection, which mechanism has a stationary location in relation to the cams and comprises a member for contact with and limited displacement by the control projection, for the time being, in the rotation of the machine; a picker driven thereby to pick a butt from the rear of said row of butts for displacement to said different level in front of the control projection; and an operating connection between said member and picker.

14. In a knitting machine having an instrument bed, a line of individually-movable instruments therein and a row of projections on said instruments; picker mechanism between which and the instrument bed relative movement takes place along the line of the instruments in the operation of the machine whereby the row of projections and said mechanism pass one another repeatedly, which mechanism comprises a picker for effecting a progressive variation, at the leading end of said row, in the projections included in it; a driving member for contact with and limited displacement, in the direction of the length of said row, by the leading projection for the time being; means mounting said member for displacement in said direction only and for restraining it against movement transversely of said row; a second picker for picking projections from said row at a location spaced rearwardly from the front end thereof; and an operating connection between said driving member and the second picker.

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