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AMENDED SPECIFICATION

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(The Amendments are shown in erased and italic type.)

PATENT SPECIFICATION



Application Date: Sept. 13, 1937. No. 22159/37.

500,230*

Complete Specification Left: Sept. 10, 1938.

Complete Specification Accepted: Feb. 6, 1939.

PROVISIONAL SPECIFICATION

Improvements in Stockings and the like and in the Production thereof

I, ROBERT KIRKLAND MILLS, a British Subject, of 3, Edwards Lane, Sherwood, Nottingham, do hereby declare the nature of this invention to be as follows:—

5 This invention is for improvements in and relating to stockings and the like (particularly stockings which are prone to ladder such as those knitted from pure silk, artificial silk and similar slippery
10 yarns or mixtures thereof) and is concerned with the manufacture of fashioned stockings consisting wholly or in substantial part of ladder-resistant fabric in which the stitch loops are locked by locking loops passed through and around them.
15 Such fabric is first described in the specification of Patent No. 329,098, and is hereinafter referred to as fabric of the type specified. The object of this invention
20 is to provide a practicable method whereby there may be produced a commercially satisfactory fashioned stocking (and by a fashioned stocking is meant one that is shaped by varying the number of wales
25 down the leg) of such fabric.

In making ladies seamless hose (the term "hose" being synonymous with the term "stockings") upon a circular knitting machine it is common practice to
30 shape the leg by progressive variation in the loop size, the loop size being decreased down the leg towards the ankle, or increased upwards from the ankle to the stocking top, according to the direction
35 in which knitting proceeds. This effect, which is rendered more pronounced by the subsequent boarding to which the stocking is subjected, is usually achieved by an axial adjustment of the cylinder in relation to the knitting cams. In this manner a seamless stocking of plain fabric, which is acceptable only in the cheaper ranges of the trade, is produced. For

[Price 4/6]

cheap goods the aforesaid variation in stitch size is not considered unduly deleterious (its disadvantages being offset by the low price) but it is one of the factors which inhibit the application of the seamless method of manufacture to plain-knit stockings that will obtain a good price.

50 In the case of fabric of the type specified, there is a certain optimum relation between the machine gauge and the size of the loops and between the size of the stitch loops and the size of the locking loops, which must be maintained if the best results as regards elasticity appearance and resistance to laddering are to be achieved, (the optimum relation, which varies with various factors such as the material of the yarn and its quality, count and degree of twist, being such that while the locking loop is an efficient lock, yet no stress or other condition is thereby set up in the fabric that impairs
65 its elasticity or resistance to splitting nor is the sheer appearance of the fabric unduly affected). This is a characteristic which is peculiar to the said fabric. Ladies seamless hose of the fabric specified have in fact been produced on seamless hose machines and have been shaped by variation in loop size. This variation in loop size, however, can only be accompanied by a departure from the optimum
75 relation just discussed, and the result is an article which is not entirely commercially satisfactory. It may in particular be mentioned that in the manufacture of seamless hose of fabric of the type specified, two incompatible alternatives present themselves. If the necessary compass at the upper part of the stocking leg, together with the optimum relation at that important locality (important because
85 the fabric in the region of the knee is sub-

jected to severe stress by reason of the flexing of the wearer's leg and the pull of the suspender is to be secured it is necessary to employ a large diameter cylinder and in practice it has been customary to employ for making seamless hose of fabric of the type specified, a cylinder which is some $\frac{1}{4}$ " larger in diameter than would be employed for making the corresponding seamless hose of plain fabric. In consequence, if the stiffening is sufficiently severe to reduce the compass of the tube at the ankle to that which is desirable, there is a radical departure from the optimum relation at the ankle, while on the other hand if the stiffening is less severe, so as to cause a lesser departure from the optimum relation, the ankle is unduly large or baggy. Conversely, if the cylinder diameter be such as to permit of the requisite ankle compass being obtained without too drastic a departure thereat from the optimum relation, the compass at the top of the leg is insufficient, with the result that the knee of the stocking is liable to split.

It will thus be apparent that the manufacture of ladies' seamless stockings, of fabric of the type specified, presents peculiar difficulties and the advantages of the said type of fabric cannot be realised to the fullest extent by the seamless method of manufacture.

It is, of course, possible to maintain the optimum relationship referred to, and at the same time to produce a full fashioned blank, by knitting the said blank on a straight bar knitting machine. This in turn has its disadvantages, however, for in producing fabric of the type specified on a straight bar knitting machine, a course of stitch loops is produced by the traverse of the slur-cock and carrier in one direction, and this course of loops is locked by locking loops produced by the reverse traverse of said slur-cock and carrier. As a consequence the speed of production of full-fashioned stockings when the fabric is of the type specified is substantially slower than that of production of full-fashioned stockings of ordinary plain fabric, with a consequent increase in cost. The present invention overcomes all these disadvantages and difficulties by selecting a circular machine of substantial diameter for the production of the ladder-resistant fabric (or as viewed from an analogous aspect, selecting for the stocking a fabric of the type specified when produced on such a machine), and making the stockings from that fabric by cutting and seaming. By the expression "circular machine", is to be understood a machine in which the loops are produced seriatim along the line

of the needles, in contradistinction to machines which, like straight bar machines, produce all the loops of a course simultaneously. By the expression "substantial diameter" is to be understood a diameter which will enable a stocking leg to be produced without stitch variation or without such stitch variation as would be accompanied by a departure from the optimum relation. The diameter must be such as to give the maximum width required (the top of the stocking if the welt is produced on a separate machine or the welt itself if produced on the selected machine) in stitch optimum.

It may here be said that while it is usual to produce ladies seamless hose on a circular knitting machine of $3\frac{1}{2}$ " to $3\frac{1}{2}$ " diameter, in the exercise of the present invention it is preferred, if the welt is to be knitted on the same machine as the fabric for the remainder of the leg, to use a machine (say a $5\frac{1}{2}$ " diameter machine) which produces fabric the circumferential diameter of which is approximately the same as or even greater than the maximum width of the stocking blank produced on a Cotton's Patent machine. It is in fact known to employ plain fabric produced on circular machines in the production of stockings by cutting and seaming, but this has been done to imitate the more prominent characteristics of fully-fashioned stockings and not to overcome any particular difficulties arising from the nature and structure of the fabric itself, such as are experienced in connection with fabric of the type with which this invention is exclusively concerned. Moreover, stockings made from plain fabric by cutting and seaming suffer from the disadvantage that the seam is very bulky and is not very sound.

The invention provides a method of manufacture of ladder-resistant fashioned stockings, the fabric of which is of the type specified, which consists in employing fabric of said type knitted on a circular machine (as hereinbefore defined) and cutting and seaming said fabric to produce a fashioned leg tube. Desirably the seaming operation follows the cutting, and therefore the method includes the steps of cutting from the fabric a stocking blank of the requisite shape and then seaming together the edges of the shaped blank to produce the fashioned leg tube. It is within the scope of the invention to cut the blank in such manner as to include therein all the portions necessary for the leg, foot, toe and heel, but in the preferred construction the blank is so cut as to omit at least a portion of the foot and is transferred to the needles of a

footing frame and the foot completed thereon. The fabric which is knitted on to the blank by the use of a footing frame may be either plain fabric or it may be
 5 fabric of the type specified. The foot may be of any known or approved type. If an English foot is to be knitted the blank is so cut as to comprise the leg, foot top or instep and the heel tabs. The
 10 inner edges of these heel tabs are run on to the needles of a footing frame and the English foot knitted on in the usual manner. The usual subsequent seaming or linking is thereafter effected. It is not
 15 desirable to employ a French foot for, as in this type of foot the blank is so cut as to include the heel tabs, but not the instep and foot bottom (the said blank therefore terminating in the instep line)
 20 and the inner edges of the heel tabs and the edge of the leg blank along the instep line are run on to the needles of the footer and the foot top and bottom knitted on, the joint at the instep line between the
 25 fabric knitted on the circular or independent needle machine and that knitted on the straight bar machine would be visible.

In an alternative mode of completing an English foot the cut blank terminates
 30 short of the toe. A course of the loops at the toe end of the blank is run onto the needles of a circular knitting machine and a seamless toe punch, followed by a foot bottom, is knitted on to it by reciproca-
 35 tion. In a further alternative, the heel tabs may be run on and knitting may proceed from the heel towards the toe.

The Einseidel type of stocking may be produced according to this invention. To
 40 do so, the blank is cut to include the foot top or instep and the foot bottom (it being understood that the eventual seam extends centrally along the foot bottom). A group of loops at each side of the blank
 45 is run onto the needles of a heeling machine, either before or after cuts have been made inwards from each edge just below the running-on line, and the heel tabs knitted on.

During the production of the fabric mock-fashioning marks may be produced
 50 along suitable parallel, but preferably divergent, lines by tuck stitches or other means, such as loop-transference. Additionally the lines along which the fabric
 55 is to be cut to produce the blank may be indicated by tuck stitches or other stitch variation. If the fabric is tubular it is folded flat prior to cutting, and therefore
 60 a guide line may be produced at the back of the tube by tuck stitches or the like, or by omitting a needle, as a guide to assist in the said folding.

As will readily be appreciated, in the

production of the blank, certain portions
 65 of the fabric are cut away and are waste. In the production of the fabric on a circular knitting machine it is within the scope of this invention to cause the thread
 70 laid at each course to float over the requisite number of needles, instead of being knitted thereby to produce this waste portion. This involves the introduction of
 75 successive needles in the waste area into, or the removal of successive needles from, activity as knitting proceeds. In order to minimise the length of each float, at least one needle, or a plurality of spaced
 80 needles, may be retained in the waste area, so that each thread floats over a plurality of chords of the needle circle.

The welt may be of the automatically turned kind (the machine being equipped
 85 with mechanism for the production of such a welt) or it may be produced by folding the fabric over and seaming it in position, or it may be run on. The latter is preferred as this mode has the advantage
 90 that it minimises waste, for a machine of the requisite diameter may be employed for making the welt and a machine of smaller diameter employed for making
 95 the fabric from which the blank is cut. Moreover the knitted welt may be formed with a picot edge, a lace pattern and like effects now popular in welts.

The requisite areas of the resultant
 100 stocking, such as the welt, heel, foot bottom, and toe pouch, may be spliced or knitted of a stouter thread, and this will be effected either on the circular or independent
 105 needle machine or upon the footer, according to the nature and location of said parts, as will be understood by one versed in stocking manufacture.

In this manner there is produced a commercially satisfactory fashioned stocking
 110 of fabric of the type specified, said stocking being commercially satisfactory in that it is produced at a reasonable price and in that the aforesaid optimum relation is maintained at least throughout the leg
 115 or panel with consequent and uniformly good characteristics of elasticity, resistance to laddering, and appearance. The invention includes a stocking produced as herein described.

It is an advantage of a stocking produced from fabric of the type specified,
 120 and in the manner set forth, that the seam at the back of the leg is secure and is not unduly bulky. This is because with this type of fabric the cut edges are not so prone to run, and the seam pull out, as with plain fabric, so that the stitches of
 125 the seam may penetrate the fabric very close to the cut edges.

Dated this 11th day of August, 1937.

ERIC POTTER & CLARKSON,
Chartered Patent Agents,
London and Nottingham.

COMPLETE SPECIFICATION (AMENDED)

Improvements in Stockings and the like and in the Production thereof

I, ROBERT KIRKLAND MILLS, a British Subject, of 3, Edwards Lane, Sherwood, Nottingham, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention is for improvements in and relating to stockings and the like (particularly stockings which are prone to ladder such as those knitted from pure silk, artificial silk, and similar slippery yarns or mixtures thereof) and is concerned with the manufacture of fashioned stockings consisting wholly or in substantial part of ladder-resistant fabric in which the stitch loops are locked by locking loops passed through and around them. Such fabric is hereinafter referred to as fabric of the type specified. The object of this invention is to provide a practicable method whereby there may be produced a commercially satisfactory fashioned stocking (and by a fashioned stocking is meant one that is shaped by varying the number of wales down the leg) of such fabric.

In making ladies seamless hose (the term "hose" being synonymous with the term "stockings") upon a circular knitting machine it is common practice to shape the leg by progressive variation in the loop size, the loop size being decreased down the leg towards the ankle, or increased upwards from the ankle to the stocking top, according to the direction in which the knitting proceeds. This effect, which is rendered more pronounced by the subsequent boarding to which the stocking is subjected, is usually achieved by an axial adjustment of the cylinder in relation to the knitting cams. In this manner a seamless stocking of plain fabric, which is acceptable only in the cheaper ranges of the trade, is produced. For cheap goods the aforesaid variations in stitch size is not considered unduly deleterious (its disadvantages being offset by the low price) but it is one of the factors which inhibit the application of the seamless method of manufacture to plain-knit stockings that will obtain a good price.

In the case of the fabric of the type

specified, there is a certain optimum relation between the machine gauge and the size of the loops and between the size of the stitch loops and the size of the locking loops, which must be maintained without appreciable variation if of the best results as regards elasticity, appearance, and resistance to laddering are to be achieved, (the optimum relation which varies with various factors such as the material of the yarn and its quality, count and degree of twist, being such that while the locking loop is an efficient lock, yet no stress or other condition is thereby set up in the fabric that impairs its elasticity or resistance to splitting nor is the sheer appearance of the fabric unduly affected). This is a characteristic which is peculiar to the said fabric. Ladies seamless hose of the fabric specified have in fact been produced on seamless hose machines and have been shaped by variation in loop size. This variation in loop size, however, can only be accompanied by a departure from the optimum relation just discussed, and the result is an article which is not entirely commercially satisfactory. It may in particular be mentioned that in the manufacture of seamless hose of fabric of the type specified, two incompatible alternatives present themselves. If the necessary compass at the upper part of the stocking leg, together with the optimum relation at that important locality (important because the fabric in the region of the knee is subjected to severe stress by reason of the flexing of the wearer's leg and the pull of the suspender) is to be secured it is necessary to employ a large diameter cylinder and in practice it has been customary to employ for making seamless hose of fabric of the type specified, a cylinder which is some $\frac{1}{2}$ " larger in diameter than would be employed for making the corresponding seamless hose of plain fabric. In consequence, if the stiffening is sufficiently severe to reduce the compass of the tube at the ankle to that which is desirable, there is a radical departure from the optimum relation at the ankle, while on the other hand if the stiffening is less severe, so as to cause a lesser departure from the optimum relation, the angle is unduly large or baggy. Con-

versely, if the cylinder diameter be such as to permit of the requisite angle compass being obtained without too drastic a departure thereat from the optimum relation, the compass at the top of the leg is insufficient with the result that the knee of the stocking is liable to split.

It will thus be apparent that the manufacture of ladies seamless stockings, of fabric of the type specified, presents peculiar difficulties and the advantages of the said type of fabric cannot be realised to the fullest extent by the seamless method of manufacture.

It is, of course, possible to maintain the optimum relationship referred to, and at the same time to produce a full fashioned blank, by knitting the said blank on a straight bar knitting machine. This in turn has its disadvantages, however, for in producing fabric of the type specified on a straight bar knitting machine, a course of stitch loops is produced by the traverse of the slur-cock and carrier in one direction, and this course of loops is locked by locking loops produced by the reverse traverse of said slur-cock and carrier. As a consequence, the speed of production of full-fashioned stockings when the fabric is of the type specified is substantially slower than that of production of full-fashioned stockings of ordinary plain fabric, with a consequent increase in cost. The present invention overcomes all these disadvantages and difficulties by selecting a circular machine of substantial diameter for the production of the ladder-resistant fabric (or as viewed from an analogous aspect, selecting for the stocking a fabric of the type specified when produced on such a machine) and making the stockings from that fabric by cutting and seaming. By the expression "circular machine" is to be understood a machine in which the loops are produced seriatim along the line of the needles, in contradistinction to machines which, like straight bar machines, produce all the loops of a course simultaneously. By the expression "substantial diameter" is to be understood a diameter which will enable a stocking leg to be produced without stitch variation or without such stitch variation as would be accompanied by a departure from the optimum relation. The diameter must be such as to give the maximum width required (the top of the stocking if the welt is produced on a separate machine or the welt itself if produced on the selected machine) in stitch optimum.

It may here be said that while it is usual to produce ladies seamless hose on a circular knitting machine of $3\frac{1}{4}$ " to $3\frac{1}{2}$ "

diameter, in the exercise of the present invention, it is preferred, if the welt is to be knitted on the same machine as the fabric for the remainder of the leg, to use a machine (say, a $5\frac{1}{2}$ " diameter machine) which produces fabric the circumferential diameter of which is approximately the same as or even greater than the maximum width of the stocking blank produced on a Cotton's Patent Machine. It is in fact known to employ plain fabric produced on circular machines in the production of stockings by cutting and seaming, but this has been done to imitate the more prominent characteristics of fully-fashioned stockings and not to overcome any particular difficulties arising from the nature and structure of the fabric itself, such as are experienced in connection with fabric of the type with which this invention is exclusively concerned. Moreover, stockings made from plain fabric by cutting and seaming suffer from the disadvantage that the seam is very bulky and is not very sound.

According to the present invention a stocking is provided having a fashioned leg composed of lock-stitch fabric of the type specified, said leg being cut from tubular fabric produced on a circular knitting machine (~~seamless stocking machine~~) and the optimum size of stitch and stitch locking loop is maintained with no appreciable variation throughout said leg.

The invention also includes the method of producing a ladder-resistant fashioned stocking which consists in knitting on a circular knitting machine a fabric tube comprising lock-stitch fabric of the type specified, maintaining the optimum size of stitch and stitch-locking loop with no appreciable variation throughout the knitting process, and cutting and seaming the tubular fabric to produce a fashioned leg tube. Desirably the seaming operation follows the cutting, and therefore the method includes the steps of cutting from the fabric a stocking blank of the requisite shape and subsequently seaming together the edges of the shaped blank to produce the fashioned leg tube. It is within the scope of the invention to cut the blank in such a manner as to include therein all the portions necessary for the leg, foot, toe, and heel, but in the preferred construction the blank is so cut as to omit at least a portion of the foot and is transferred to the needles of a footing frame and the foot completed thereon. The fabric which is knitted on to the blank by the use of a footing frame may be either plain fabric or it may be fabric of the type specified. The foot may be of any known or approved type. If an English foot is to be knitted the blank is

so cut as to comprise the leg, foot top or instep and the heel tabs. The inner edges of these heel tabs are run on to the needles of a footing frame and the English foot knitted on in the usual manner. The usual subsequent seaming or linking is thereafter effected.

In an alternative mode of completing an English foot the cut blank terminates short of the toe. A course of loops at the toe end of the blank is run on to the needles of a circular knitting machine and a seamless toe pouch, followed by a foot bottom is knitted on to it by reciprocation. In a further alternative, the heel tabs may be run on and knitting may proceed from the heel towards the toe.

The Einseidel type of stocking may be produced according to this invention. To do so, the blank is cut to include the foot top or instep and the foot bottom (it being understood that the eventual seam extends centrally along the foot bottom). A group of loops at each side of the blank is run on to the needles of a heeling machine, either before or after cuts have been made inwards from each edge just below the running-on-line, and the heel tabs knitted on.

During the production of the fabric mock-fashioning marks may be produced along suitable parallel, but preferably divergent, lines by tuck stitches or other means, such as loop-transference. Additionally the lines along which the fabric is to be cut to produce the blank may be indicated by tuck stitches or other stitch variation. If the fabric is tubular it is folded flat prior to cutting, and therefore a guide line may be produced at the back of the tube by tuck stitches or the like, or by omitting a needle, as a guide to assist in the said folding.

As will readily be appreciated, in the production of the blank, certain portions of the fabric are cut away and are waste. In the production of the fabric on a circular knitting machine it is within the scope of this invention to cause the thread laid at each course to float over the requisite number of needles, instead of being knitted thereby to produce this waste portion. This involves the introduction of successive needles in the waste area into, or the removal of successive needles from, activity as knitting proceeds. In order to minimise the length of each float, at least one needle, or a plurality of spaced needles, may be retained in the waste area, so that each thread floats over a plurality of chords of the needle circle.

The welt may be of the automatically turned kind (the machine being equipped with the mechanism for the production of such a welt) or it may be produced by

folding the fabric over and seaming it in position, or it may be run on. The latter method has the advantage that it minimises waste, for a machine of the requisite diameter may be employed for making the welt and a machine of small diameter employed for making the fabric from which the blank is cut. Moreover, the knitted welt may be formed with a picot ledge, a lace pattern or like effect now popular in welts.

The requisite areas of the resultant stocking, such as the welt, heel, foot bottom, and toe pouch, may be spliced or knitted of a stouter thread, and this will be effected either on the circular or independent needle machine or upon the footer, according to the nature and location of said parts, as will be understood by one versed in stocking manufacture.

In this manner there is produced a commercially satisfactory fashioned stocking of fabric of the type specified, said stockings being commercially satisfactory, in that it is produced at a reasonable price and in that the aforesaid optimum relation is maintained at least throughout the leg or panel with consequent and uniformly good characteristics of elasticity, resistance to laddering, and appearance. The invention includes a stocking produced as herein described.

For the purpose of more fully describing the nature of this invention reference will now be made to the accompanying drawings wherein:—

Fig. 1 illustrates diagrammatically a knitted tube adapted when cut and seamed to form a fashioned stocking having an English foot.

Figure 2 shows a shaped blank produced by cutting the knitted tube of Figure 1 along the dot and dash line, the cut away part being indicated by the marginal dotted line.

Figure 3 shows the shaped blank seamed to form the fashioned stocking, a foot bottom and toe being added as indicated in dotted lines.

Figure 4 illustrates a modified form of fashioned blank cut from a seamless tube for producing a stocking having a French foot.

Figure 5 is an interior development of the cams in a circular knitting machine for the needles and jacks.

Figure 6, illustrates diagrammatically the picker operation on the needle jacks for progressively narrowing the spliced areas.

Figure 7 illustrates diagrammatically the picker operation on the needle jacks for progressively widening the spliced areas.

Figure 8 illustrates diagrammatically

the picker operation on the needle jacks for fashioning and also for producing mock fashion marks.

Figure 9 illustrates the positions around the machine at which long and short butt needles are located.

Figure 10 is a general view in perspective of the main part of a circular knitting machine suitable for producing a fashioned stocking in accordance with this invention.

Figure 11 is an enlarged view of part of the machine shown in Figure 10.

In the preferred method of producing a shaped blank, the part or parts of the knitted tube to be cut away to waste is/are composed of float threads, this being readily accomplished by removing to an inoperative position all or the majority of the needles in the waste area. It will be appreciated that the particular method of producing the fashioned blank for the stocking will vary in accordance with the required shape of blank and with the required shape of the spliced or re-inforced areas.

For example the production of a stocking having an English foot according to the example shown in Figs. 1 to 3 is effected as follows: Knitting is commenced at the toe end of the instep, the requisite number of needles being first pressed off so as to leave in operation only those needles required to produce the width of the instep or foot. A small parallel portion of fabric *a* (say approximately one inch) is first knitted of locked fabric without splicing thread. Splicing thread is now introduced to produce the shaped spliced portions *b* at the toe end of the instep and after the required amount of splicing has been effected the splicing thread is taken out and knitting proceeded with without said thread to a suitable point at which the heel is to be commenced. Splicing thread is again introduced to produce the heel portion *c* at each side of the instep *d* and the spliced areas are progressively widened at *e* and then narrowed as at *f* to the width required for the high splicing, e.g. to a cuban heel width, and the cuban heel portions *g* are then completed. After knitting the required ankle length, fashioning of the fabric is commenced by progressively bringing into operation needles from the idle group, and at the positions *h* and *h*¹ in the leg fabric where widening is effected, mock fashioning is simultaneously effected as indicated at *i* and *i*¹. When the required length of leg has been knitted, a welt is produced, and if desired a picot edge may be formed at the turn of the welt.

It will be appreciated that at that part

of the needle cylinder where the needles are retained in an idle position, the knitting yarn will be floated, and when the knitting of the tube has been completed the waste portion composed of float threads and indicated at *k* is cut away, as also are the two portions *l* below the heel tabs *c* and the initially knitted portion *a* the cutting line being indicated by a dot and dash line. The cut edges of the blanks are now seamed up at the back of the leg, and a foot bottom and toe added in the well known manner; it being appreciated that the foot bottom *m* is connected to the inner edges of the heel tabs *c* as shown in Figure 3.

A fashioned blank for a stocking having a French foot may also be produced from a seamless tube. In the construction shown in Figure 4 the shape of the foot and of the spliced areas therein is such as to provide a spliced foot bottom *n* and spliced toe *o*, and after the blank has been cut from the tube, a short cut is made along a line *p* at each side at the position of the heel, and the blank is transferred to a running-on bar and thence to a machine which knits on the heel tabs *q*. The inner edges *r* and *s* are then united on a linking machine. If desired, however, the knitted tube may be so produced as to provide, when cut, a blank including heel tabs but not including the instep and foot bottom (the blank therefore terminating at the instep line) and the inner edges of the heel tabs and the edge of the blank along the instep line are run onto needles of a footer and the foot top and bottom with toe knitted on.

A method of knitting a shaped or fashioned blank according to this invention on a circular knitting machine (~~seamless-hose-machine~~) will now be described with reference to Figures 5 to 7 of the accompanying drawings. The needles 1 (one of which is shown at the right hand side of Figure 5) are each provided with two pivoted latches spaced one below another on the needle shank, said needles functioning to produce locked or tied stitches.

The needles located around approximately half of the needle cylinder are provided with long butts, the group of long butt needles being indicated at LBN in Figure 9. In the remaining half or part of the cylinder short butt needles are employed, but these may be arranged in two groups indicated at SBN, divided by a small section devoid of needles, which section coincides with the centre back of the stocking leg. The short butt needles are fashioning needles, and co-operating with same are fashioning jacks. The batch of fashioning needles also includes

the needles that are adapted to be operated for mock fashioning. Co-operating with the long butt needles or pre-determined thereof are splicing jacks, it being understood that jacks may be omitted from a number of the instep needles which are not required to receive splicing thread say, for example, when knitting stockings according to Figure 1 to 3.

To produce lock stitch fabric of the type specified there are provided in the machine, needle-operating cams for making normally knitted stitches and other cams for making stitch locking loops and locking said stitches. The normal cams are shown at 2 and the lock stitch cams at 3, in Figure 5, the feed appertaining to the normal stitch forming thread being indicated at NF and the feed for the stitch locking thread at LF. The splicing thread feed is indicated at SF.

Let it be assumed that a stocking is being knitted in accordance with Figures 1 to 3. The needle on the extreme right in Figure 5 is shown in an idle position with its butt at the level of the idle race 4 but when raised to the operative position the needle butts traverse the race 5. When commencing to knit, the short butt needles are pressed off so as to leave those needles in operation for producing the required width of foot. For this purpose a radially movable clearing cam 6 is projected into the cam cylinder from an inoperative to an operative position so as to cause all needles to traverse same and clear their loops, the said cam being subsequently withdrawn. After passing over the clearing cam 6 the needles are lowered by cam 7 to the normal height, and then the short butt needles pass a half-thickness main clearing cam 8 without being raised thereby, and are carried down to the idle position by the down cam 9, which is moved radially from an inoperative to an operative position for this purpose. The long butt needles however, ride up over the main clearing cam 8, and therefore miss the down cam 9 and are maintained in operation; said needles traversing the normal stitch cams 2 and the lock-stitch cam 3 to produce locked fabric.

Knitting on the long butt needles is proceeded with until the required portion *a* of fabric is produced, after which the splicing thread feed SF is brought in and the toe splicing portions *b* are produced.

All of the needles to be operated for receiving splicing thread have located thereunder splicing jacks 11, and normally said needles are raised to the height shown in broken lines for receiving a splicing thread at the feed SF by causing the butts 12 on the splicing jacks to ride up and over a cam 13. In order, however,

to produce the gradually reduced splicing areas *b* (Figs 1 and 2) the jacks 11 appertaining to two spaced groups of splicing jacks indicated at SJ in Figs. 6 and 7 are picked down one by one from the innermost jacks of said groups so that the number of needles operating to receive the splicing thread is gradually and progressively reduced. For the sake of clearness only the widened portions, 11*a*, 11*b*, of the jacks 11 are shown in the groups of jacks SJ. This is accomplished by providing a pair of picker blocks 14 and 14*a*, the block 14 being carried by a ring 15 encircling the machine cylinder and capable of being rotated thereon while the block 14*a* is carried by a second ring 16 similarly mounted below the first named ring 15, the two rings, 15, 16, normally tending to rotate in opposite directions under the influence of springs 17 so that the normal tendency is for the two picker blocks 14, 14*a*, to be moved apart. These picker blocks carry pivotally mounted picker elements 18 and 18*a* of the customary type adapted to be pivotally displaced upwardly and downwardly by the vertical sliding movement of plungers 19 and 19*a* within the blocks. When the jacks appertaining to the splicing needles are to be progressively lowered, a picker cam 20, carried by a stationary part of the machine, is moved inwards to a position to engage the plungers 19, 19*a* as the needle cylinder rotates. When the plunger 19 appertaining to one picker block rides up the picker cam 20 the picker 18 is pivotally displaced downwards and co-acts with the innermost jack 11 of one group of splicing jacks to lower same a short distance to the position indicated at the right hand side of Fig. 6. This brings the butt 12 on said lowered jack to a position where same co-acts with and traverses down beneath an inclined cam 21 and in doing so the lowered jack is brought to the position indicated at 11*c* thereby bringing the part of the jack of reduced width located between the widened portions 11*a*, 11*b*, opposite to a fixed wedge shaped projection 22 on the picker block and allows the ring 15 with picker to be moved round the cylinder to the extent of one needle jack and places the picker in position for operating upon the next adjacent jack at the next subsequent rotation of the cylinder. Similarly, as the cylinder rotates the plunger 19*a* appertaining to the next picker block 14*a* also co-acts with the projected picker cam 20 and the innermost jack of the second group of splicing jacks is lowered so as to ride down the cam 21 in the manner above described. This enables the fixed projection 22*a* on the picker block

14a to move to the extent of one needle in to engagement with the next subsequent jack under the influence of the spring 17 operating on the ring 16. In this manner it will be appreciated that the jacks are individually lowered one by one from the inner set of the two groups of splicing jacks, and the needles are thereby progressively operated upon to miss the splicing thread feeder. The picking down of the splicing jacks is continued until the required shaping of the spliced toe areas is effected when the picker cam 20 is moved out of operation. After the full required number of splicing jacks are picked down, the rings 15, 16 are prevented from rotating further in opposite directions, under the influence of the spring 17 by virtue of providing fixed jacks or elements indicated at 23 which are adapted to co-act with abutment members 24 on the picker blocks.

When it is desired progressively to pick up the splicing jacks for gradually widening the splicing areas say for example as at *e* in Figs. 1 and 2, the two picker rings 15, 16, are gradually moved step by step in an opposite direction to that previously described against the influence of the spring 17 and the pickers 18, 18a are pivotally operated to raise the jacks one by one from the upper set of each group of jacks SJ. The method of accomplishing this is illustrated in Fig. 7. An inclined picker cam 25 carried by a stationary part of the machine is projected inwardly into an operative position so as to co-act with the picker plungers 19, 19a as the cylinder rotates. As shown at the right hand side of Fig. 7 the plunger 19 has been lowered by the cam 25 and in so doing the picker 18 has been raised to lift the outermost jack of the group of jacks a sufficient distance to cause the jack butt 12 to co-act with and ride up a lifting cam 26. This raises the jack to a sufficient height to cause the needle co-operating therewith to ride up over the afore-said cam 13 and receive splicing thread. When the jack has been so raised the lowermost widened portion 11b thereof is pushed up on to the inclined face of the fixed projection 22 of the picker block 14 thereby moving the ring 15 and picker block to the extent of one needle against the influence of the spring 17. Similarly, as the cylinder rotates the outermost jack of the other group of splicing jacks is raised and engages the inclined projection 22a to move the ring 16 and picker block 14a to the extent of one needle. By this means, as each outermost jack of the two groups of jacks is raised the pickers 18 and 18a are brought step by step into position for raising the next adjacent jack and

consequently the number of needles raised to the position for receiving splicing thread is progressively increased. The gradual narrowing of the splicing area as at *f* is of course accomplished in a manner similar to that described with reference to the splicing areas *b*. When the full extent of splicing is completed, all of the splicing jacks are lowered to the inoperative position, i.e. to a position wherein same do not operate on the needles to raise them to a position for taking splicing thread.

As aforesaid the fashioning is produced on the short butt needles and as will be understood from the stocking blanks shown in Figs. 2 and 4 said fashioning is produced by widening. This, of course, requires that the number of needles in operation be progressively increased and the section of the needle cylinder over which the yarn is floated correspondingly decreased. In other words, the gap between the two groups of operative short butt needles is gradually reduced. Fig. 8 illustrates a method of accomplishing this. Associated with the needles to be used for fashioning, i.e. the short butt needles, are jacks 27 which are advantageously divided in their length into two parts bearing one upon another. These jacks 27 have widened portions 27a and 27b between which is a narrow portion 27c and adapted to operate on the said narrow portions 27c are pickers 28, 28a pivotally mounted in picker blocks 29, 29a carried respectively by rings 30, 31, which latter encircle the needle cylinder and tend to rotate thereon under the influence of springs 32. The pickers 28, 28a are pivotally displaced by the axial movement in the picker blocks of plungers 33, 33a.

When fashioning is to be produced a picker cam 34 is moved radially inwards so as to co-act with the upper ends of the said axially displaceable plungers 33, 33a, and by so doing pivotally displace the pickers and effect a short upward movement of the jacks 27. This movement is illustrated at the right hand side of Fig. 8, and the movement imparted to the outermost jack is sufficient to bring a butt 35 on the jack to a height sufficient to cause same to engage with and ride up a cam 36. The upward movement imparted to the jack by the cam 36 displaces the widened portion 27a, of the jack to a position above a fixed projection or abutment 37 on the picker block, and by so doing the spring 32 pulls the ring 30 with picker block and pickers round to the extent of one needle, that is to say, to a position at which during the next revolution of the machine the next adjacent jack is raised.

It is to be understood that when the cam 34 co-operates with the plunger 33a and the second picker block 29a a similar operation takes place to raise a jack and

5 with same a needle to a knitting position. At intervals during the fashioning or widening of the fabric mock fashion marks indicated at *i* in Figs. 1 and 2 are also

10 produced, and this is accomplished by picking down the jacks appertaining to selected of the short butt needles. The mock fashion stitches are of course produced along a line parallel with and suitably spaced from the marginal line of the

15 fashioned fabric, consequently the jacks to be picked down must be spaced to the extent of a suitable number of jacks from those that are picked up for fashioning, pickers for the mock fashioning are shown

20 at 38 and 38a said pickers being carried by the blocks 29, 29a associated with the movable rings 30, 31 and being pivotally displaced by the axial movement of the plungers 39, 39a (Fig. 8). When a mock

25 fashion stitch is to be produced a cam 40 is projected inwardly from an inoperative to an operative position, and upwardly displaces the plunger 39. This in turn lowers the picker 38 and presses down a

30 selected jack; the two positions of the picker and jack before and after lowering being shown in Fig. 5. The lowering of the selected jack 27 causes a butt 41 thereon to engage the inclined under face of a

35 lowering cam 13, and as the needles for mock fashioning are short butt needles same have passed the half thickness main clearing cam 8 without being raised to clear, and will therefore pass on to

40 receive stitch thread at the feed 2 without clearing. During the production of the welt it may be desired to produce at the position where the welt is turned over a picot edge.

45 For this purpose the needle jacks are provided with additional butts 42 adapted to be engaged by a small down cam 10 which is adapted to be moved in from an inoperative to an operative position for this

50 purpose. When the jack butts 42 engage this cam 10 the jacks are lowered and the needles are carried down to miss the yarn feeds for a predetermined number of courses. The picot edge butts 42 are provided on selected jacks only, say for example, on one of every four jacks.

55 In figs. 10 and 11 are shown the main parts of a circular knitting machine suitable for the production of a fashioned stocking as before described. One of the distinguishing features of this machine is that knitting is accomplished by circular motion throughout, the mechanism usually provided on a seamless stocking

60 machine for knitting by reciprocation being omitted.

65 The main drive shaft 43 with belt pulleys 44, carries a gear 45 meshing with another and larger gear 46 on a second shaft 47. On this shaft 47 is a bevelled gear 48 (Fig. 11) meshing with another bevelled gear 49 to drive the needle cylinder in the customary manner.

At suitable positions around the machine are radially displaceable picker operating cams. Two of these cams are shown at 20 and 34 in Fig. 10, same being slidably carried in fixed blocks or brackets and being adapted for movement inwards against spring resistance by imparting

75 pivotal motion to arms 50 co-acting with depending pins 51 and operated at predetermined times from a peg wheel or drum 52 through the medium of a crank 53 engaging the periphery of said wheel. This peg wheel or drum 52 is racked round by a pawl and ratchet device. In the arrangement illustrated a ratchet wheel 54 fixed to rotate with the peg wheel is engaged by a pivotal pawl 55 (Fig. 11) carried at one end of a centrally pivoted lever 56, the other end of said lever carrying a truck 57 normally co-acting with a cam 58 rotating with the needle cylinder. Consequently at each revolution of the cylinder the peg wheel is racked.

Rotatably mounted at one side of the lower part of the machine is a drum 59 having pegs or upstanding bits located at predetermined positions on its circumferential face. One of the functions of this drum is to effect selective movement into and out of operation of the several thread feeders while another of its functions is to bluff (render inoperative) the racking mechanism for the aforesaid peg wheel 52 appertaining to the picker cams. This drum 59 is intermittently rotated by a pivoted clawker arm 60 co-acting with a toothed ring or disc 61 on the drum, the clawker being mounted on a short spindle 62 which is itself carried at the upper end of an arm 63 fixed on its lower end to a rotatably mounted cross shaft 64. The short spindle 62 also carries a roller 65 adapted to co-act with a cam 66 mounted on or rotating with the aforesaid gear 46, so that at each revolution of said gear the drum 59 is partially rotated.

The operation of the thread feeders is effected through suitable motion transmitting means from a pivoted finger 67 carried by a cross spindle 68 and having a nose portion bearing on the face of the drum. On this cross spindle 68 is also mounted a bell crank lever 69, one arm of which bears on the drum 59 while the other arm has pivotally connected thereto one end of a rod 70, the other end being turned up or otherwise provided to engage

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a finger portion 71 on the aforesaid pawl-carrying lever 56. The arrangement is such that when the arm 69 engages upstanding bits or the like on the drum 59, a pull is exerted on the pawl-carrying lever 56, to prevent same from being operated by the cam 58, and thereby stopping the racking of the peg wheel 52.

At the end of the drum 59 is a traveling chain 72 which is advantageously racked or traversed by a pivoted clawker 73 co-acting with a toothed ring 74 over which the chain passes. This chain 72 has for one of its functions to throw in to and out of operation the racking mechanism for the drum 59, i.e. for bluffing said racking mechanism as and when desired. One method of accomplishing this is by suitably disposed upstanding bits 75 on said chain with which bits a nose portion at the end of a centrally pivoted arm 76 co-acts. The opposite end of this arm 76 is linked by a link member 77 to a crank arm 78 provided on a sleeve 79 rotatably encircling a cross shaft 64. This sleeve 79 also has fixed thereto a bell crank member 80 the upper arm 81 of which has a bevelled end 82 located beneath the gear engaging portion of the clawker arm 60 which functions to rack the drum. When the pivoted arm 76 co-acts with the upstanding bits on the chain 72, the sleeve 79 is partially rotated and in so doing the bevelled end 82 of the bluffing arm 81 lifts the clawker arm 60 out of engagement with the gear 61 and stops the racking of the drum 59. The chain 72 may also function to operate additional means for bluffing the before described pawl and ratchet device which imparts a rotary movement to the peg wheel or the like associated with the picker cams. To this end suitably spaced upstanding bits 83 on the chain co-operate at the required time with a nose 84 on an arm 85 carried by a sleeve 86 rotatably mounted on the aforesaid spindle 68 which sleeve 86 also carries the aforesaid bell crank 69 one arm of which bears on the drum 59. Consequently, when the nose 84 co-acts with an upstanding bit 83 the bell crank 69 is partially rotated on the spindle 68 and the pawl and ratchet device for operating the peg wheel 52 is bluffed in the manner before described. Although in the machine as before described the customary mechanism for knitting by reciprocation is omitted, a stocking in accordance with this invention may be produced on a circular machine which includes reciprocating mechanism. In such case portions of the stocking foot such for example as heel and toe pockets may be knitted by reciprocation.

It is an advantage of a stocking pro-

duced from fabric of the type specified, and in the manner hereinbefore set forth, that the seat at the back of the leg is secure and is not unduly bulky. This is because with this type of fabric the cut edges are not so prone to run, and the seam pull out, as with plain fabric, therefore in the stocking according to this invention the stitches of the seam may penetrate the fabric very close to the cut edges. Additionally, by virtue of the aforesaid optimum relation being maintained throughout the leg or panel, it will be appreciated that no difficulty is experienced in introducing splicing or reinforcing threads at any position.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A stocking having a fashioned leg (i.e. a leg that is shaped by varying the number of wales down same) composed of lock-stitch fabric of the type specified, said leg being cut from tubular fabric produced on a circular knitting machine (~~seamless stocking machine~~) and the optimum size of stitch and stitch-locking loop being maintained with no appreciable variation throughout said leg.

2. The production of a ladder-resistant fashioned stocking (i.e. a stocking that is shaped by varying the number of wales down the leg) which consists in knitting on a circular knitting machine a fabric tube comprising lock-stitch fabric of the type specified, maintaining the optimum size of stitch and stitch-locking loop with no appreciable variation throughout the knitting process and cutting and seaming the tubular fabric to produce a fashioned leg tube.

3. The production of a ladder-resistant fashioned stocking (i.e. a stocking that is shaped by varying the number of wales down the leg) which consists in knitting by circular motion on a circular knitting machine a tube composed wholly or in the main of fabric of the type specified, maintaining the optimum size of stitch and stitch-locking loop with no appreciable variation throughout the knitting process, cutting from said tube a stocking blank of the requisite shape and subsequently seaming together the cut edges of said blank to produce a fashioned leg tube.

4. The production of a ladder-resistant fashioned stocking according to either of claims 2 or 3 wherein a portion of the stocking foot is knitted as an integral part of the tubular fabric prior to cutting and seaming.

5. The production of a ladder-resistant fashioned stocking according to either of

- claims 2 or 3 wherein the complete foot with the possible exception of the heel is knitted as an integral part of the fabric prior to cutting and seaming.
- 5 6. The production of a ladder-resistant fashioned stocking according to either of claims 2 or 3 wherein a shaped blank of lock-stitch fabric produced by cutting a knitted tube has a foot portion knitted
- 10 thereon by transferring said blank to a separate machine.
7. The production of a ladder-resistant fashioned stocking according to either of claims 2 or 3 wherein a shaped blank produced by cutting the knitted tube embodies a portion of the foot and the remainder of the foot is added by transferring said blank to a separate machine or frame.
- 15 8. The production of a ladder-resistant fashioned stocking according to either of claims 2 or 3 wherein a shaped blank produced by cutting the knitted tube comprises the stocking leg or panel, foot top or instep and in some cases the heel tabs, the remainder of the foot being subsequently added.
- 20 9. The production of a ladder-resistant fashioned stocking according to either of claims 2 or 3 wherein a shaped blank produced by cutting the knitted tube comprises the stocking leg or panel, foot top or instep, foot sole and toe, the heel tabs being subsequently knitted on to said
- 25 blank.
10. A method of production according to any of claims 2 to 9 wherein during the knitting process clearly defined lines are produced in the tubular fabric, along
- 30 which lines the said fabric is cut to provide a shaped blank and seamed to provide a fashioned leg tube with or without a foot or portion thereof.
11. A method of production according to any of claims 2 to 10 wherein during the knitting process a shaped area of lock-stitch fabric is produced with an intervening area composed wholly or in the main of float threads, and the latter area
- 35 is cut away to form a shaped blank which is seamed up at its cut edges to form a fashioned leg tube with or without a foot or portion thereof.
12. A method of production according to any of claims 2 to 11 wherein during the knitting process a shaped area of the lock-stitch fabric is produced, additional thread is introduced into said fabric at intervals to produce spliced or reinforced
- 40 portions, said area of lock-stitch fabric is cut out from the knitted tube in the form of a shaped blank and said blank is seamed up to provide a fashioned leg tube with or without a foot or portion thereof.
13. A circular knitting machine adapted for the production of a stocking according to Claim 1 operating by full circular motion to produce a fabric tube and embodying in combination stitch forming mechanism functioning to produce lock-stitch fabric of the type specified, and means functioning at predetermined times during the circular motion of the machine gradually or progressively to vary the number of needles operated to knit so as to vary the number of stitches made at each revolution and produce a defined area of fabric which can be cut from the fabric tube to provide a shaped blank of lock stitch fabric adapted when seamed up to form a fashioned stocking or stocking leg.
14. A machine according to the last preceding claim and incorporating means functioning at predetermined times to operate a predetermined and variable number of needles to receive splicing or reinforcing thread.
15. A machine according to claims 13 and 14, embodying picker mechanism functioning at predetermined times to operate on jacks associated with selected needles so as to vary from time to time or from course to course the number of needles rendered operative for stitch production per revolution, and also embodying picker mechanism functioning at predetermined times to operate on jacks associated with other selected needles and cause said needles to receive splicing or reinforcing thread.
16. A machine according to any of Claims 13 to 15 and including means functioning at predetermined times to produce tuck stitches on selected needles so as to form mock-fashioning marks in the knitted fabric.
17. A stocking according to Claim 1 provided with an English type of foot, i.e. a foot seamed along its two opposite sides.
18. A stocking according to Claim 1 provided with a French type of foot, i.e. a foot seamed along the centre of its underside.
19. A method of producing a ladder-resistant fashioned stocking substantially as hereinbefore described.
20. A circular knitting machine constructed, arranged and operating substantially as hereinbefore described with reference to the accompanying drawings.
- Dated this 9th day of September, 1938.
ERIC POTTER & CLARKSON,
Chartered Patent Agents,
London and Nottingham.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1940.

Fig. 1.

Fig. 2.

[This Drawing is a reproduction of the Original on a reduced scale.]

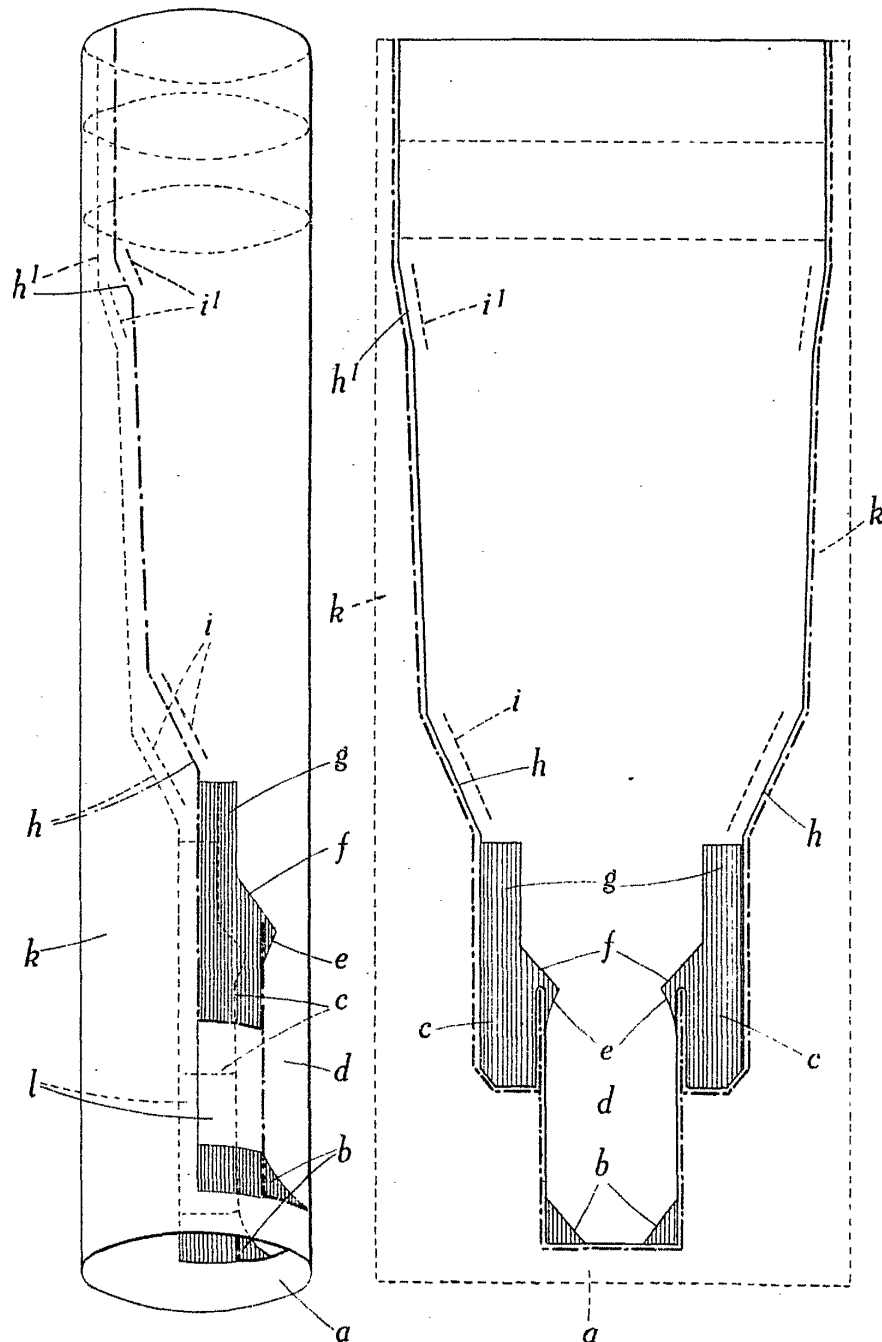


Fig. 3.

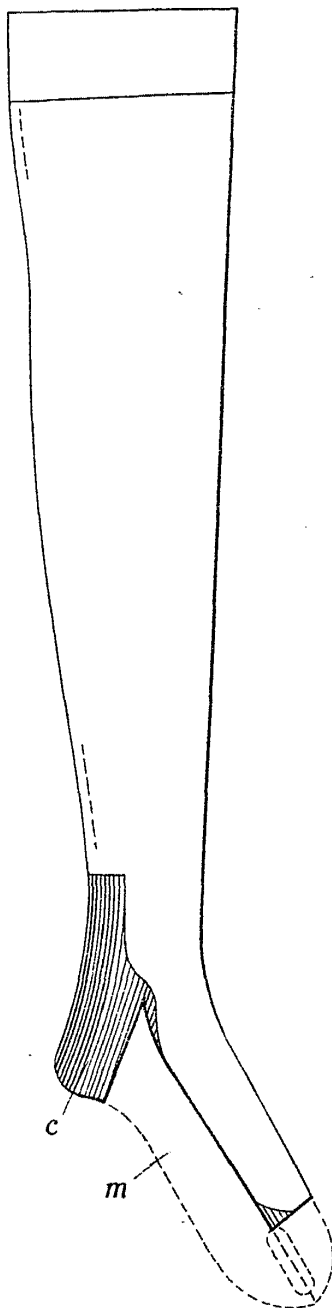
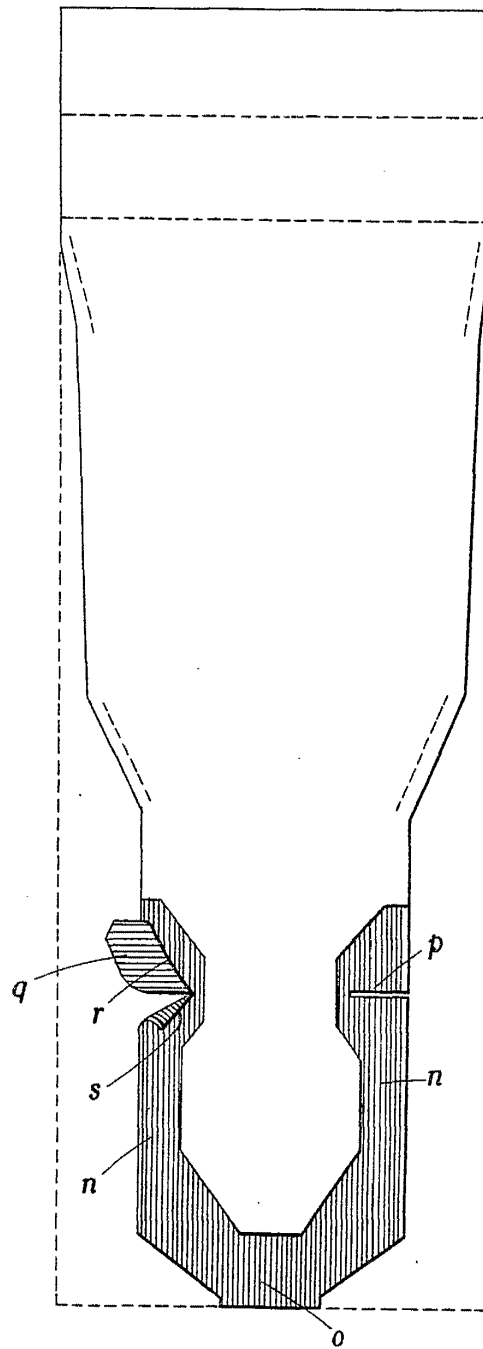
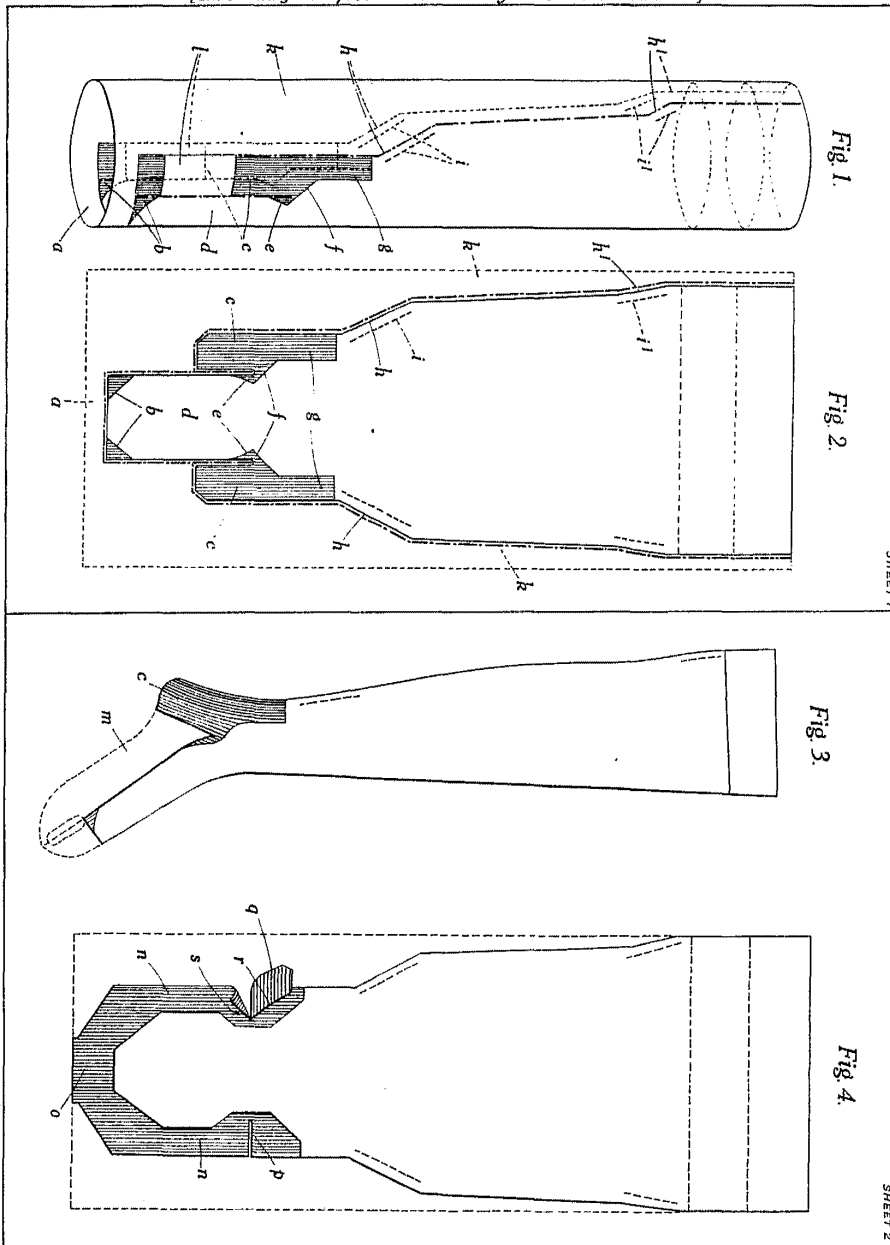


Fig. 4.



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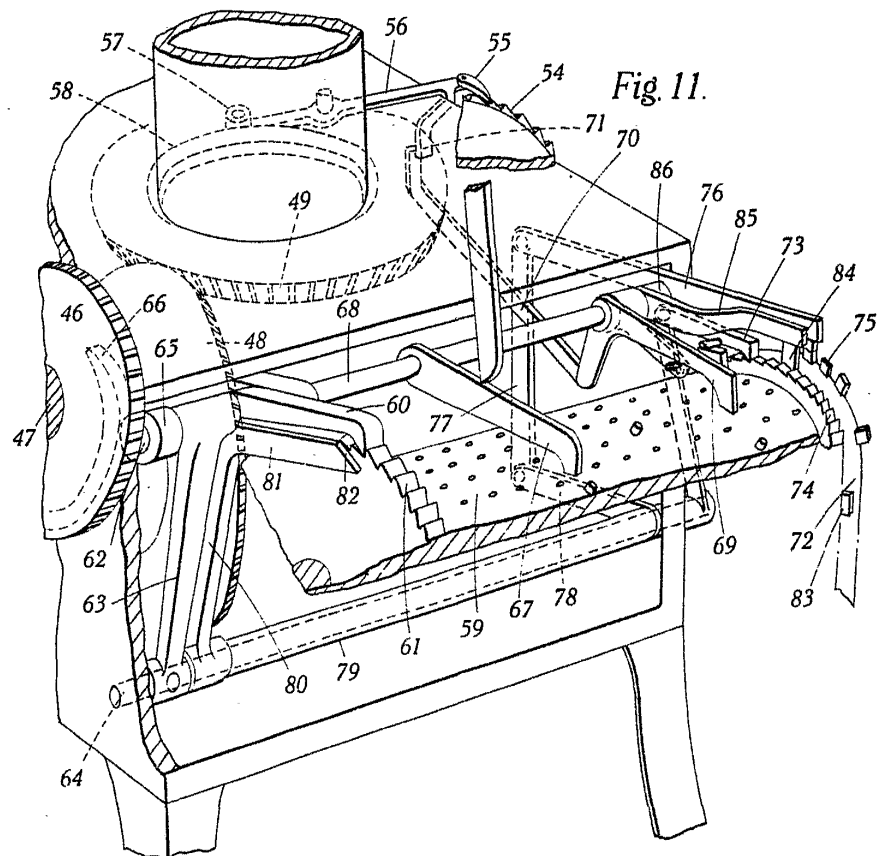
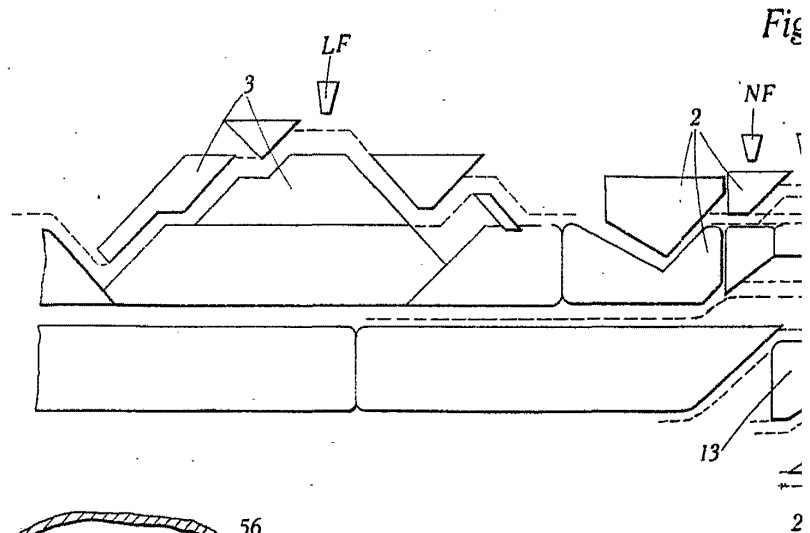
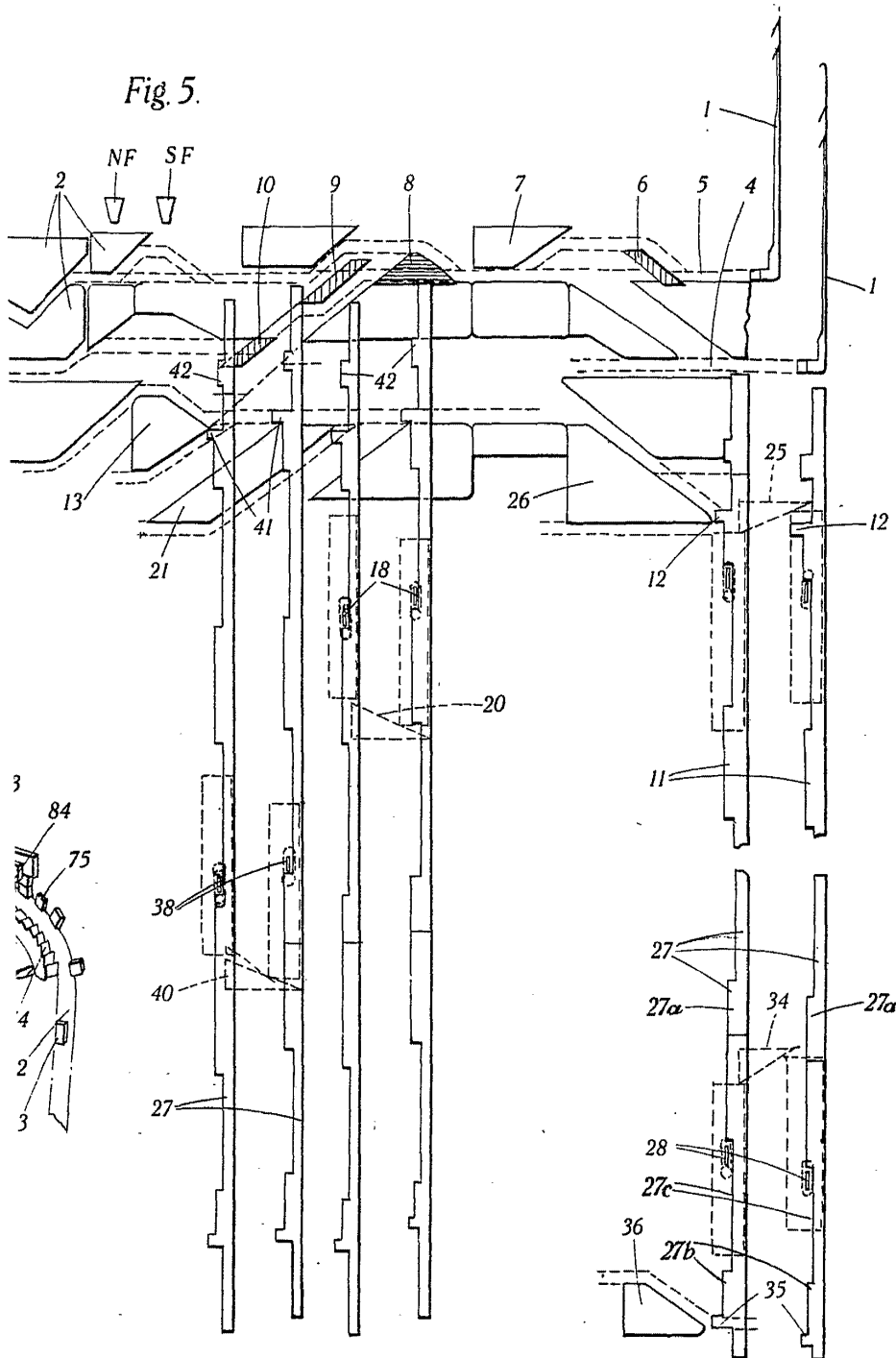
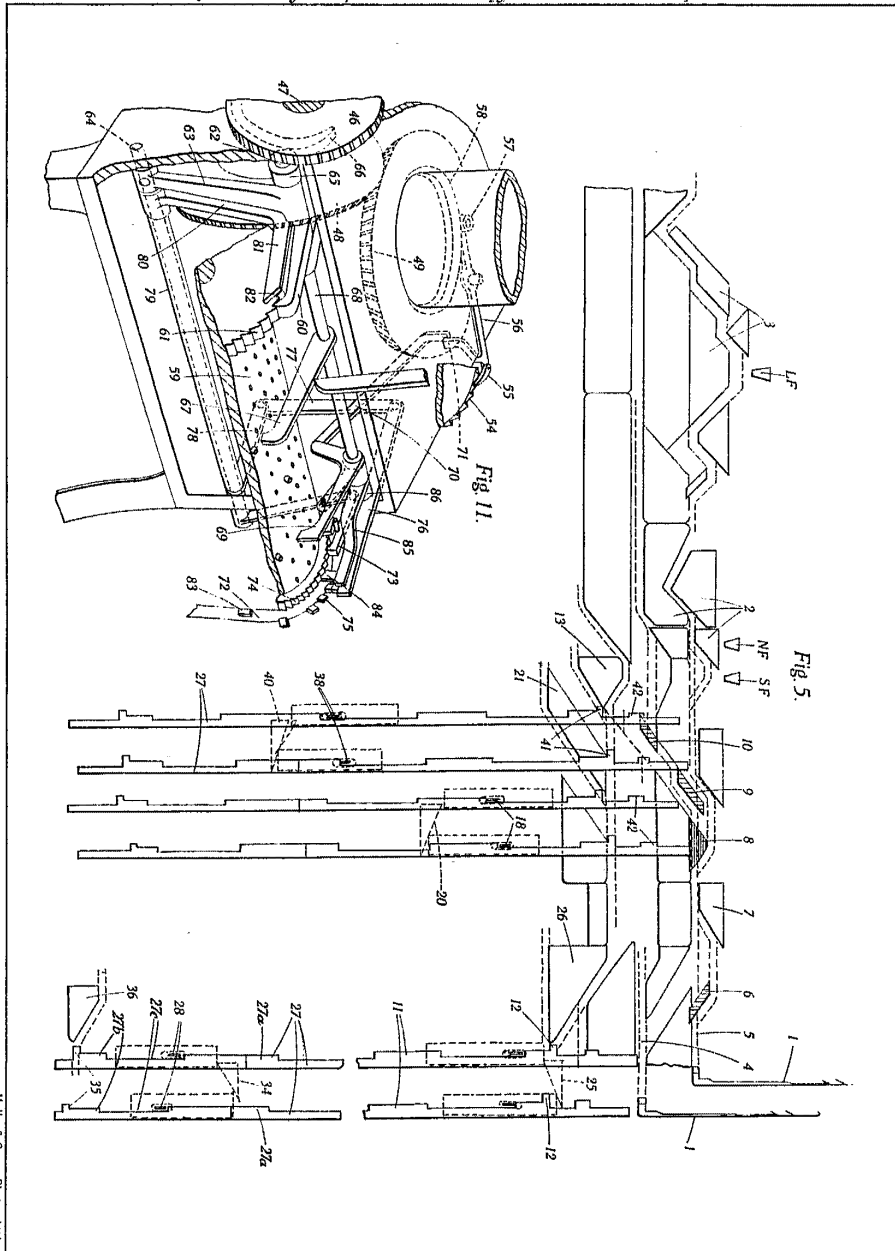
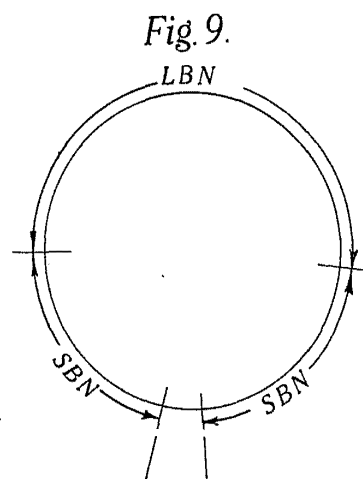
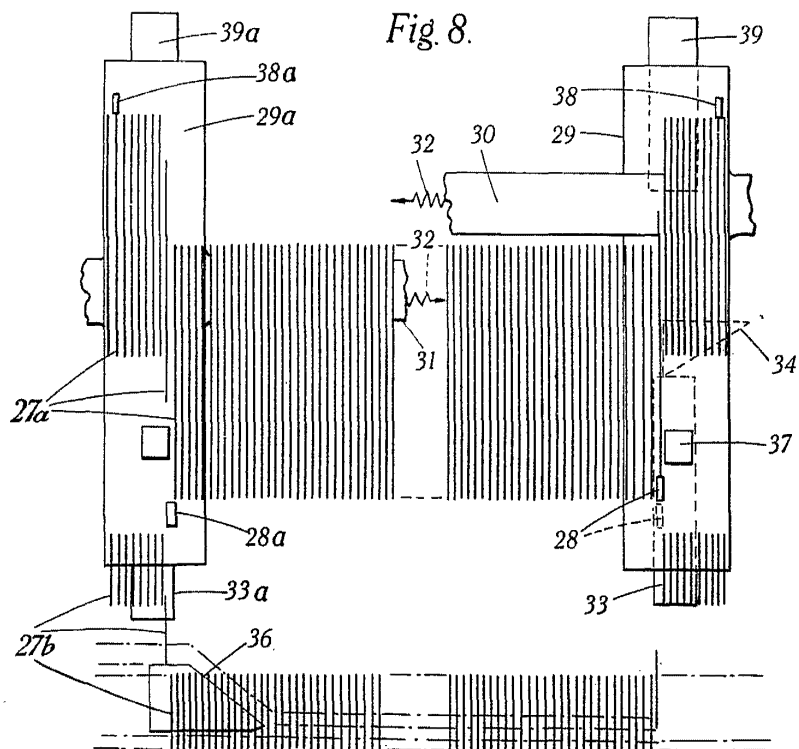
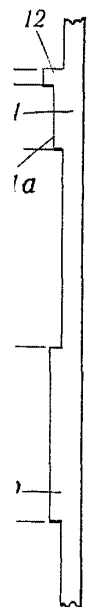
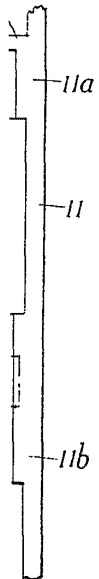


Fig. 5.



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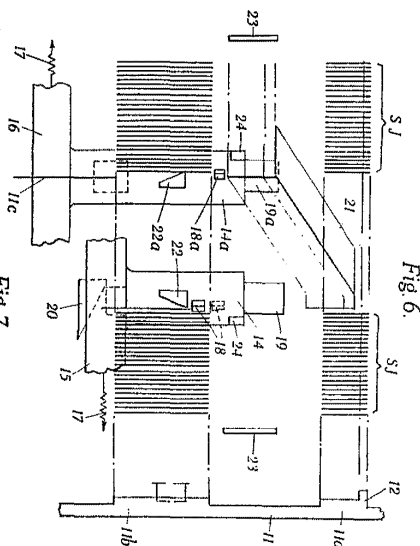


Fig. 6.

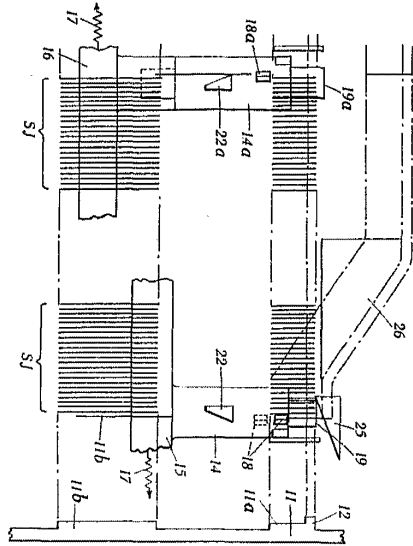


Fig. 7.

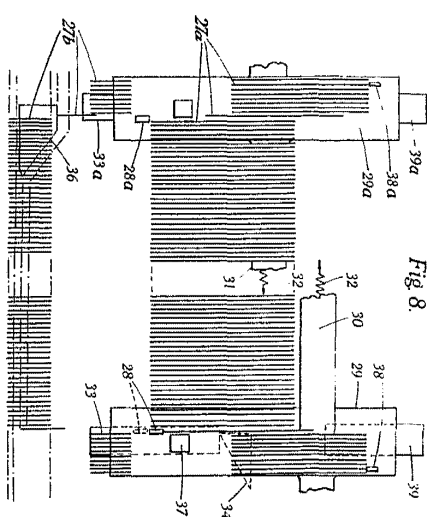


Fig. 8.

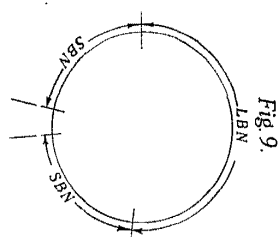
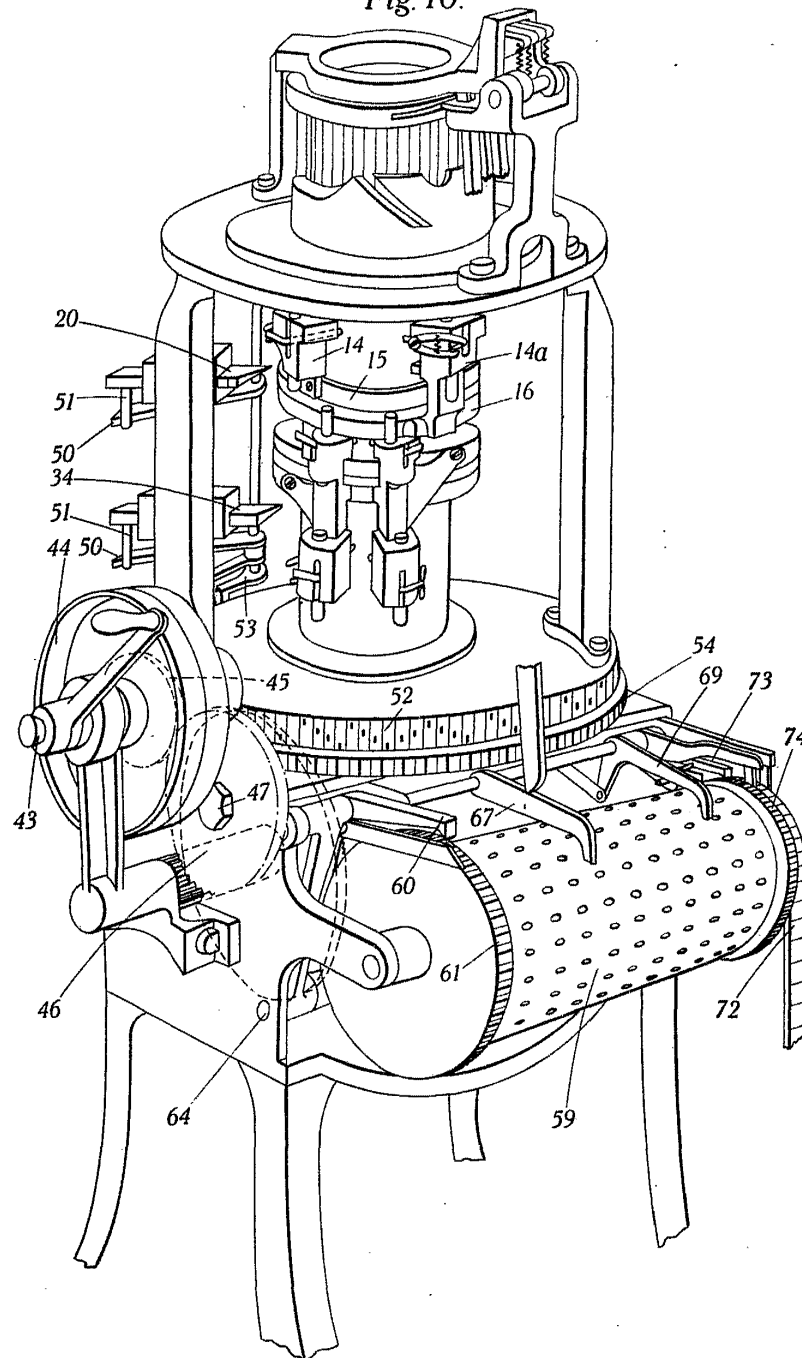


Fig. 9.

Fig. 10.



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