

A. LEE.
KNITTING MACHINE.

No. 535,705.

Patented Mar. 12, 1895.



Fig 4



Fig 3

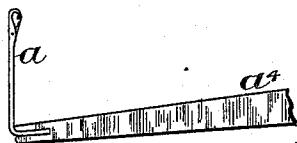


Fig 1



Fig 2

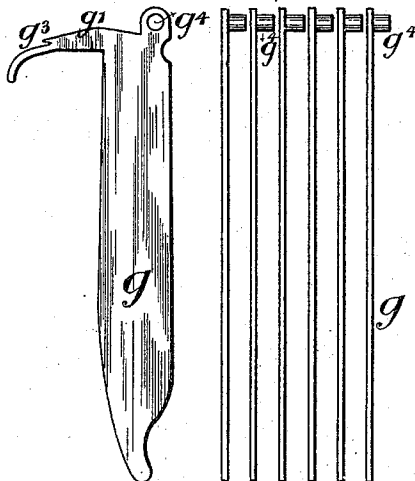


Fig 9

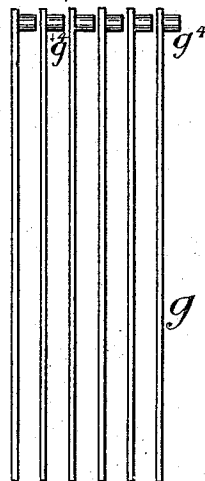


Fig 10

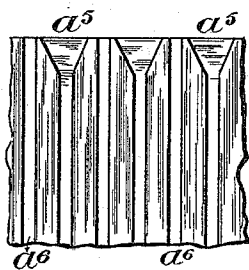


Fig 11

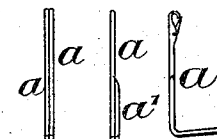


Fig 8



Fig 7

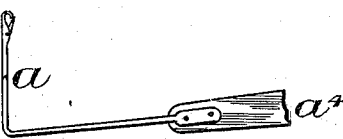


Fig 5



Fig 6

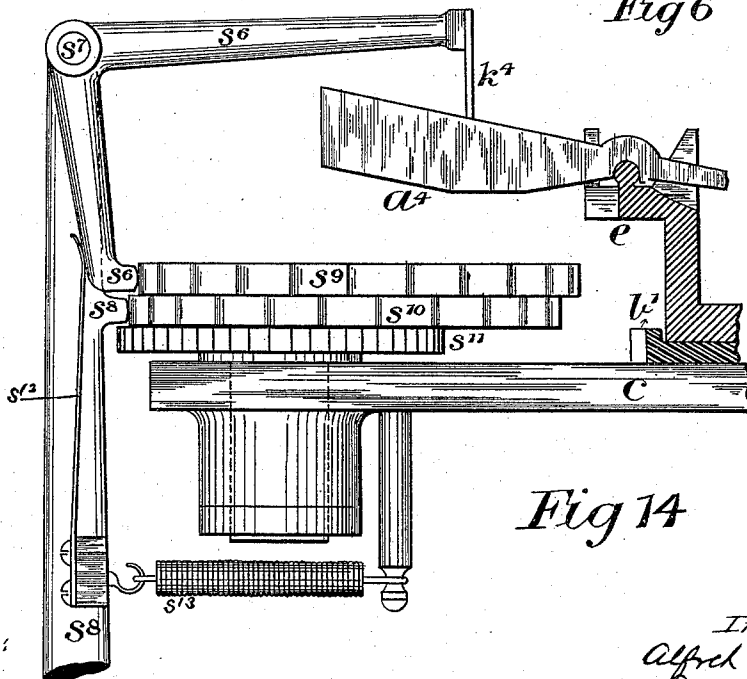


Fig 14

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(No Model.)

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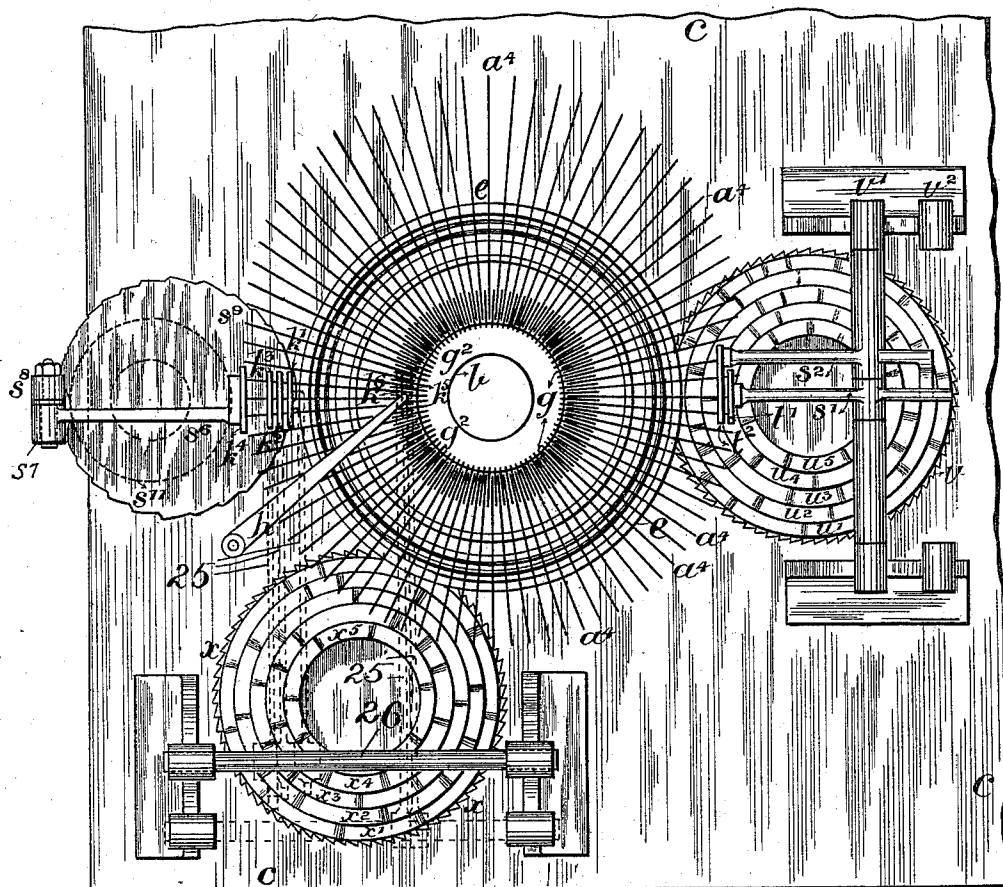


Fig 12

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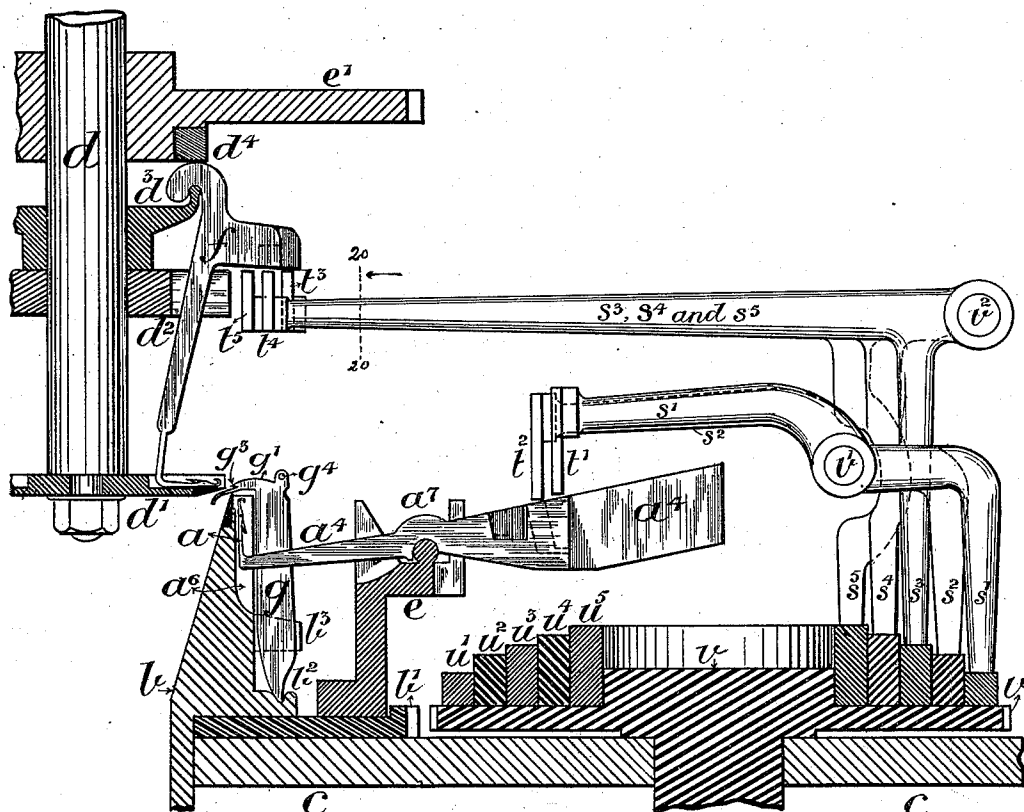


Fig 13

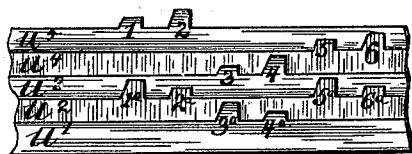


Fig. 22.

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(No Model.)

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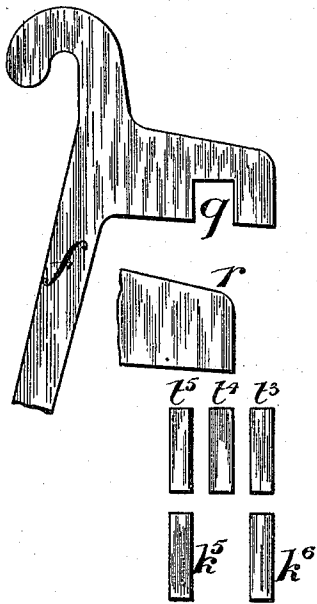


Fig 17

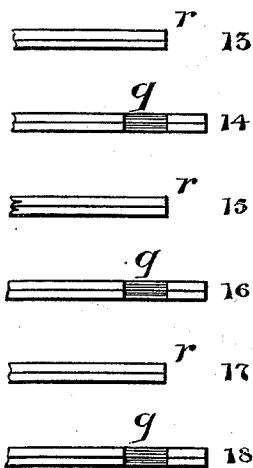


Fig 18

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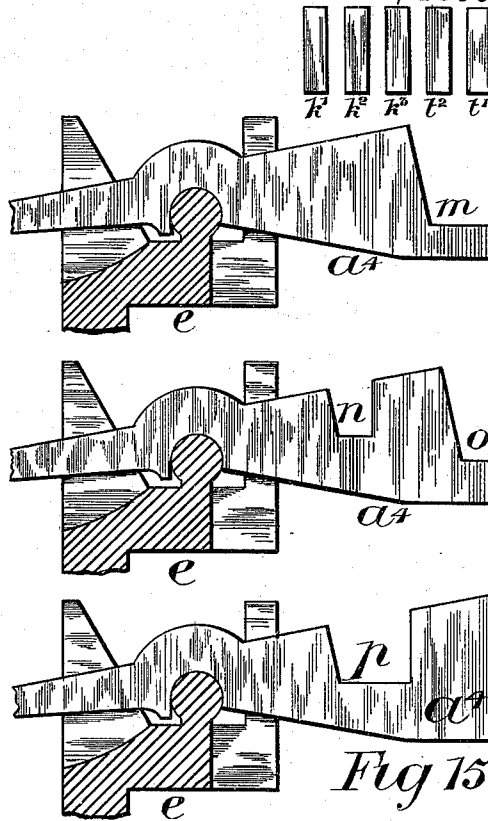


Fig 15

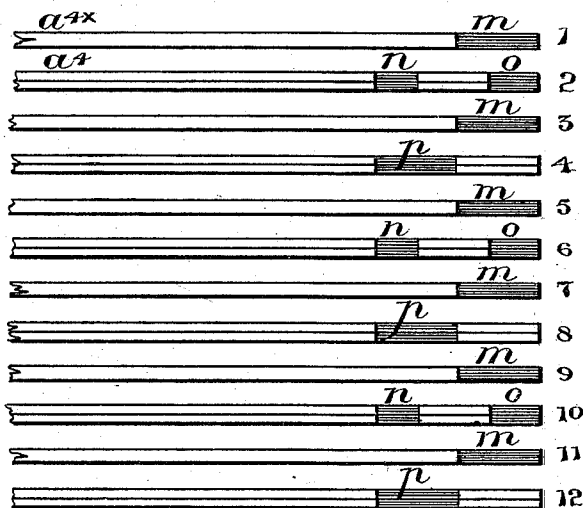


Fig 16

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(No Model.)

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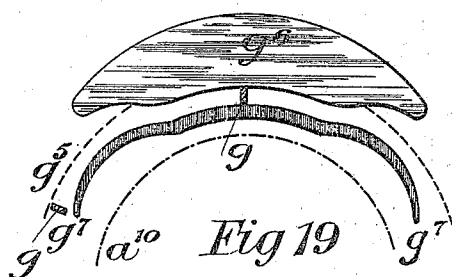


Fig 19

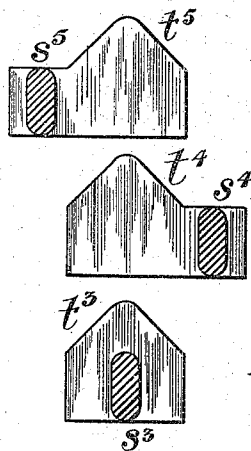


Fig 20

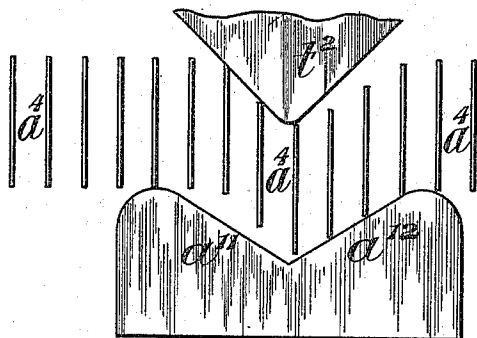


Fig 21

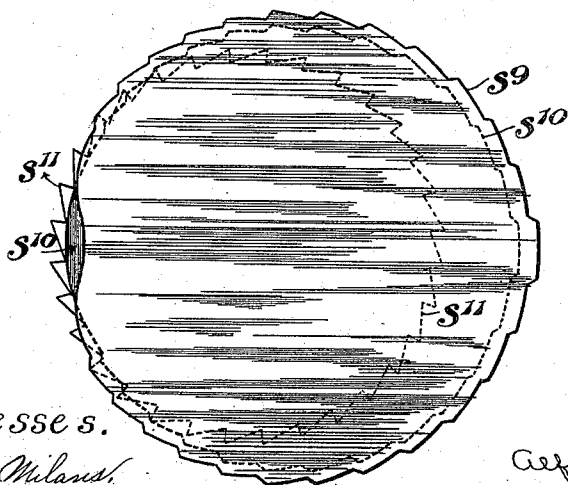


Fig 23

Witnesses.

Joseph H. Muland.
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UNITED STATES PATENT OFFICE.

ALFRED LEE, OF NOTTINGHAM, ENGLAND.

KNITTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 535,705, dated March 12, 1895.

Application filed February 12, 1894. Serial No. 499,864. (No model.) Patented in England February 6, 1893, No. 2,665.

To all whom it may concern:

Be it known that I, ALFRED LEE, a subject of the Queen of Great Britain, residing at Nottingham, in the county of Nottingham, England, have invented certain new and useful Improvements in Knitting-Machines, (patented in Great Britain February 6, 1893, No. 2,665;) and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in and is applicable to knitting machines fitted with latch needles, the object of my invention being the production of a knitting machine upon which plain and ribbed fabrics can be made, and upon which the character of the work can be automatically changed from plain to ribbed, or from ribbed to plain, or from one kind of rib to another kind of rib.

I have illustrated my invention by drawings which are referred to in the following description, the drawings showing the application of my invention to a circular knitting machine.

The same parts in the different views are referred to by the same reference letter or figure.

Figure 1 is an elevation of a needle and point mounted on the end of a jack. Fig. 2 is a plan of the same. Fig. 3 is an end elevation of the same. Fig. 4 is an end elevation of a double needle. Fig. 5 is an elevation of a needle and point with bent shank and shortened jack. Fig. 6 is a plan of the same. Fig. 7 is an end elevation of the same. Fig. 8 is an end elevation of a double needle when used with a shortened jack. Fig. 9 is a side elevation of a sinker used for regulating the size of the loop and pushing forward the work. Fig. 10 is a front elevation of a number of sinkers. Fig. 11 is an elevation of a portion of the needle cylinder showing the shape of the needle grooves. Fig. 12 is a plan of a circular knitting machine the ribber head and other parts of the machine being removed. Fig. 13 is a section of a part of the same, part of the ribber head being also shown. Fig. 14 is an elevation of the cam used for making the heel. Fig. 15 is an elevation of the different gradings required for the jacks in the frame of the machine

illustrated with the relative positions of the knitting and transferring cams for acting on the same. Fig. 16 is a diagrammatic plan of the position of the jacks in the machine. Fig. 17 is an elevation of the different gradings required for the jacks in the ribber head belonging to the machine illustrated with the relative positions of the knitting and transferring cams for acting on the same. Fig. 18 is a diagrammatic plan of the position of the jacks in the ribber heads. Figs. 16 and 18 also show the relative position of the jacks in the machine and ribber heads. Fig. 19 is a plan view of the cams used for actuating the sinkers. Fig. 20 is a sectional view on the line 20—20, Fig. 13, showing the shape of the transferring cams. Fig. 21 is an elevation of one of the transferring cams and the cams for raising the jacks into their normal position. Fig. 22 is an edge view of parts of the cams used for operating the transferring cams. Fig. 23 is a plan of the cams used for throwing in and out of action, and moving in and out, the heeling cam.

The needles *a* Figs. 1 to 8 are the same as the ordinary latch needles, two such needles being attached to the same jack *a*⁴ when loops have to be transferred to or from the same, or instead of two needles there may be one needle *a* and a point *a*'. The jacks *a*⁴ carrying the needles and points are in one arrangement made double, the two halves *a*² and *a*³ forming the same being bent as shown in Fig. 2. When a point and a needle are used the latter is recessed at its side to allow the end of the point to enter therein so that the loop will with certainty pass on to the point when the jack is raised. In some cases a single jack is used for the double needles, the needle stem being bent and attached to the shortened jack as shown in Figs. 5 to 8.

The double needle just described,—whether formed of two needles just alike in construction, or of a knitting needle and a shorter part called a point,—is so constructed that the two parts of the needle tend automatically to separate, as represented in Figs. 2 and 6. This tendency to separate usually arises from the elasticity of the parts and the relation which they bear to each other when set upon their carrying jacks, although any operative means which will cause the parts to separate, when

free to do so, may be employed. When in normal working position the two parts of these double needles are held closed together, and side by side, so that they operate as ordinary
5 knitting needles; but when they are moved into certain positions or relations,—as will be presently pointed out, the parts of the needles separate and the loops of thread which are then carried thereby are opened or stretched.

10 The frame cylinder and the ribber head are provided with grooves a^6 (Fig. 11) constituting guides for the needles to slide in, the grooves used for the double needles flaring near their ends or being opened out as shown at a^5 to allow of the needles separating when
15 raised for transferring.

The frame cylinder b Fig. 13 has a bearing in the machine table c and is fitted with a spur wheel b' which is driven by gearing
20 from a vertical shaft, the same shaft giving motion to the ribber head by another spur wheel which gears into the wheel e' . The wheel b' also carries a support and guide e for the jacks a^4 which are held in the same by
25 any suitable cap (not shown) which may rest above the jacks and be supported upon the upward projecting portions a^7 of the guide e . The ribber head (Fig. 13) is suitably supported and is provided with a central shaft d
30 to which the various parts of the head are attached. These parts comprise a needle guide d' cut in a similar way for the needles as the frame cylinder, but with radial instead of parallel grooves. There is also a second
35 guide d^2 for the ribber needle jacks f and a supporting ring d^3 for the same, the jacks being held on the same by a ring d^4 .

The thread is supplied by a carrier or guide h Fig. 12 of any convenient construction, and
40 the loops are formed upon the ribs g' of the sinkers g Figs. 9, 10 and 13, these sinkers being pushed forward as shown at g^2 Fig. 12 for this purpose and drawn back again after the loop has been properly formed by cams or
45 other usual or preferred devices carried from the machine table.

In Fig. 19, the cams which actuate the sinkers, are shown in plan view and in this view the path of the knitting needles is shown by
50 the dotted circle a^{10} , and the path of the outer edge of the sinkers g by the dotted circle g^5 . This path is circular except when influenced by the cams g^6 and g^7 which are arranged to deflect the sinkers whichever way the machine
55 is being turned, as is necessary during the formation of the foot. The cam g^7 is permanently fixed so as to always return the sinkers to one position, while the cam g^6 is adjustably mounted so that its position may be varied,
60 with a result that the size of the loop is altered. Both cams are carried by any convenient brackets from the machine bed. The normal position of the sinkers is that in which the inside bent ends of the same are in contact
65 with the inside of the cylinder, and they are moved to this position after the formation of the loops on their adjacent needles by

means of the cam g^7 which is rigidly attached to the brackets carrying the same. The cam
7 g^6 for moving the sinkers to their knitting position, shown in Fig. 13, is attached to the bracket adjustably by screws and slot or by
other similar means so that it can be moved to or from the needle cylinder, and thus vary
7 the distance the sinkers are moved toward the center of the cylinder, with the result that the length of the loop is thereby varied. The
cams g^6 and g^7 are by preference carried by the same bracket. As the machine rotates
8 the tops of the sinkers come into contact with the cam g^6 and are moved to the position shown in Fig. 13, the forward movement of the sinkers
8 pushing forward the last formed loops and preventing the rise of the loops with the needles. The needles then take the thread which
8 is drawn over the nib of the sinker, and the new loop is formed. The sinkers then come into contact with the end of the cam g^7 and
9 are pushed from the center of the cylinder, with the result that the loops slip off the nibs
9 of the sinkers onto the thin ends of the same, and are held with the bent end of the sinker in contact with the inside of the cylinder by
9 the work itself. These sinkers also prevent the work accumulating at the tops of the needles, for when withdrawn to their normal position
9 the loops slide off the nibs g' and at the next forward movement of the sinkers the loops are pushed clear of the loops about to be
10 formed. The sinkers g are supported at b^2 by the needle cylinder and guided by grooves
10 in a ring b^3 carried by the needle cylinder. They are held in working positions and proper relations to each other by pins g^4 and from
11 rising by the work itself. The size of the loops and consequently the stiffness of the work is regulated by the shape of the nib g' and the
11 amount of motion given to the sinkers between the points g^2 , g^2 , Fig. 12. The cams giving motion to the sinkers are carried from
11 the machine table and fitted with means for regulating the amount of motion as is usual in this class of machines.

The machine I have selected to illustrate my invention is capable of knitting plain work,
1 one and one rib, and three and one rib and of changing automatically from one class of work to another. In a machine for making
1 these different kinds of work, half the total number of needles in the frame cylinder are
1 double needles, and the ribber head has half the number of needles there are in the frame cylinder, but all the needles in the ribber head
1 are double needles. There are six different knitting cams k' k^2 k^3 k^4 k^5 and k^6 . The cam
1 k' is used for making plain work, the cams k^2 and k^5 for one and one ribbed work, the cams
1 k^3 and k^6 for three and one work and the cam k^4 for knitting the heel and toe.

The machine is also provided with five
1 transferring cams t' t^2 t^3 t^4 and t^5 which are used for raising or bringing forward the needles when it is required to transfer the loops
1 from one set of needles to the other. The

cams t' and t'' are carried by levers s' and s'' Figs. 12 and 13 fulcrumed at v' and actuated by cams u' and u'' which are mounted upon a ratchet wheel v having its bearing in the machine table and driven by suitable connecting mechanism the operation of which is controlled by pattern mechanism. The cams t^3 , t^4 and t^5 for acting upon the ribber needles are mounted upon levers s^3 , s^4 and s^5 which are in construction and operation substantially similar to the levers s' and s'' already described and are fulcrumed at v'' and actuated by cams u^3 , u^4 and u^5 also mounted upon the ratchet wheel v .

The shape of the cams used for actuating the needles for knitting and transferring are shown in Fig. 20, the transferring cams t^3 , t^4 and t^5 being selected for illustration. This figure also shows the manner of attaching the levers to the cams, so that the latter may be brought close together without one lever or cam interfering with the other. When in operation, it will be noticed that cams of the shape shown only operate to actuate the needles in one direction, and it is necessary that after a loop has been formed on a needle, or a loop transferred to it, that the needle should be returned to its normal position. This is effected by means of the cams a^{11} or a^{12} Fig. 21, which acting under the jacks a^4 shown, raise them to their normal position after having been depressed by the cam t^2 . There are four of these cams a^{11} , a^{12} placed one at the knitting point and one at the transferring point on both the machine and ribber head.

In Fig. 22 are shown portions of the cams u' , u'' , u^3 , u^4 and u^5 developed.

As shown in Figs. 12 and 13, the cams u' , u'' , u^3 , u^4 and u^5 act upon the transferring cams marked t , the cams u' and u'' acting upon the cams t' and t'' actuating the jacks a^4 while the other cams act upon the ribber needle jacks.

In Fig. 22 the projections 1 and 1^a come into action at practically the same time, the projection 1^a raising the frame needles until they separate while the projection 1 brings forward the ribber needles far enough for them to pass through the stretched loop on the frame needles. After all the loops have been transferred the cams u move forward and the transferring cams are thrown out of action. The above refers to the action of the cams for changing from plain to a one and one rib. The projections 2 and 2^a are for changing from a one and one rib to plain work and it should be noted that the ribber needles are advanced to stretch the loops and the others to receive. The projections 3, 3^a, 4 and 4^a act in the same manner as the projections previously described, but they are for changing from plain to a three and one rib and back again to plain work. The projections 5, 5^a, 6 and 6^a are for changing the work from a three and one to a one and one, and back again.

The knitting cams k' , k^2 , k^3 , k^5 and k^6 are mounted upon levers 25, indicated by dotted lines Fig. 12, similar to those used for the

transferring cams and are actuated by cams x' , x^2 , x^3 , x^4 and x^5 mounted upon and rotated by a ratchet wheel x the motion of which is controlled by pattern mechanism. The cams x' to x^5 (Fig. 12) are placed in a different relative position to the cams u' to u^5 with regard to the knitting cams and transferring cams respectively, but the object and action of both are the same.

The levers 25 are fulcrumed upon a bar or bars 26, Fig. 12.

I have not thought it necessary to further illustrate in detail, the construction of the knitting cams and their operating devices, because, as stated, they are in all essential features, of construction similar to the transfer cams and their actuating mechanism, which have been illustrated in detail.

The cam k^4 for knitting the heel and toe of the stocking or sock is fixed upon a lever s^6 Figs. 12 and 14 which is fulcrumed at s^7 upon another and longer lever s^8 . The levers s^6 and s^8 are actuated by cams s^9 and s^{10} mounted upon a ratchet wheel s^{11} which is actuated by suitable devices controlled by a pattern mechanism.

Fig. 23 shows the cam s^9 for throwing the heeling and toeing cam k^4 in and out of action, the cam s^{10} for moving the cam k^4 to or from the cylinder, and the ratchet wheel s^{11} for rotating the cams s^9 and s^{10} . When a heel is required, the mechanism for working the wheel s^{11} is put into action and the cams s^9 and s^{10} intermittently revolved. The effect of this is first to depress the cam k^4 , its lever s^6 turning about its center s^7 . When the cam k^4 has been brought into action the cam s^{10} commences to push back the lever s^8 so that as the machine oscillates, the heeling needles are thrown out of action, and it is clear that unless the relative positions of the levers s^6 and s^8 are maintained the outward movement of the lever s^8 would quickly allow the cam k^4 to rise out of action. Hence the cams s^9 and s^{10} are designed to push back the heeling cam and at the same time keep it in action, the bevel of the upper edges of the jacks being designed to compensate for the increased leverage at which the cam k^4 acts.

The frame needle jacks in a machine capable of making plain work, one and one rib, and three and one rib, and of changing from one kind of work to another, are of three kinds as shown at Fig. 15, and are arranged in the machine as shown at Fig. 16, in which the jacks marked a^4 are supposed to carry the double needles and the jacks marked a^{4x} the single needles, the single and double needles being placed alternately. One of the jacks is cut away as shown at m , a second jack as at n and o and the third jack as at p , the cut or recessed jacks being then placed in the machine in the order shown in Fig. 16. The ribber needle jacks are also cut or graded, one of them having a cut away portion q and the other is shortened as at r , these jacks being placed in the ribber head alternately.

In Figs. 15, 16, 17, and 18 the relative positions of the knitting and transferring cams, and the needle jacks are shown by the cams k' , k^2 , k^3 , t^2 , t' , t^3 , t^4 , t^5 , k^5 and k^6 .

5 I will now describe the method of transferring the loops from one set of needles to the other.

Supposing first that plain work is being made; and that it is desired to change to a
10 one and one rib. To do this the cam t^2 comes into action and depresses all the frame jacks carrying double needles until the same are raised into the recesses at the top of the grooves in the needle cylinder, these needles
15 being raised in succession as the machine revolves. The double needles or the needles and points then separate, and at the same time the cam t^5 acts upon the ribber needle jacks and carries the needles or the needles
20 and points through the stretched loops on the frame needles. The ribber needles are not brought into the recesses at the end of grooves in the ribber head, but only far enough to carry the hook of the ribber needles through
25 the stretched loop on the frame needles. The loops are thus transferred from half the needles in the frame cylinder to all the needles in the ribber head. When the needles from which the loops were first transferred reach
30 the knitting cams, the cam k' is thrown out of action and the cams k^2 and k^5 into action. It will be noticed the cam t^2 acts upon all the double frame needles indicated by the even numbers 2 to 12, and the knitting cam k^2 upon
35 all the single needles indicated by the numbers 1 to 11, that is, only upon those needles in the frame cylinder, which retain their loops. In the ribber head the transferring cam t^5 and the knitting cam k^5 act upon all the ribber
40 needles, and in this case that can be done as there are only half as many needles in the ribber head as there are in the frame cylinder. Hence all the needles in the ribber head must for a one and one rib have a loop transferred to them, and equally so must all the
45 same needles knit. After making a one and one rib it may be necessary to again make plain work. This is done by bringing into action the same transferring cams t^2 and t^5
50 but the amount of motion now given to the needles is reversed, by reason of the amounts of motion imparted respectively to the levers which carry the transferring cams from the cams w^2 and w^5 the ribber needles being
55 brought forward far enough for them to enter the recesses in the needle grooves and open, thus stretching the loops on the ribber needles, and through which the hooks of the double frame needles are passed. The knitting
60 cams k^2 and k^5 are also thrown out of action and the cam k' into action. Suppose again plain work is being made and it is desired to change to a three and one rib. This is done by bringing into action the transferring cams
65 t' and t^3 , the former acting on the needles numbered 4, 8, 12, the loops of which are then transferred to needles 14, 16, and 18. The

work is then made by the knitting cams k^3 and k^6 , the former acting upon the needles 1, 2, 3, 5, 6, 7, 9, 10, 11, and the latter cam k^6 upon
70 the needles 14, 16 and 18. If it is desired to change back again to plain work the same transferring cams are brought into action, the loops transferred and the work made by the cam k' , the cams k^3 and k^6 being thrown
75 out of action. It may also be necessary to change from a one and one rib to a three and one rib as in making a ribbed leg after a rib top. For a one and one rib the work is made
80 on the needles 1, 13, 3, 14, 5, 15, 7, 16, 9, 17 and 11, 18 and to change from a one and one rib to a three and one rib half the loops on the ribber head have to be transferred back to the frame needles. This is done by bringing
85 into action the transferring cams t^2 and t^4 by which the loops are transferred from the needles 13, 15, and 17 to the needles 2, 6, 10, and the three and one rib is then made on the
90 needles 1, 2, 3, 14, 5, 6, 7, 16, 9, 10, 11, and 18, the knitting cams k^3 and k^6 being in action. If it is desired to change from a three and one rib to a one and one rib, it is necessary
95 that the loops on the needles 2, 6, and 10 be transferred to the needles 13, 15, and 17, this being done by the transferring cams t^2 and t^4 and the work is made by the cams k^2 and k^5 . It will be noticed that in both the latter operations the cam t^2 acts upon the needles 2, 4,
100 6, 8, 10 and 12 instead of upon the needles 2, 6, and 10, only, but as the needles 4, 8 and 12 have no loops upon them, and the corresponding ribber needles 14, 16, and 18 are not brought forward no disadvantages arise from raising the needles 4, 8 and 12.

When making a stocking or sock on my improved machine, the welt is first made in the
105 usual way, and is followed by the rib top, generally of a one and one rib. The leg is then made either plain or a three and one rib, the loops being transferred as required by the
110 methods previously described. Up to this point the machine has rotated continuously in one direction but for making the heel it is necessary that the machine should make about
115 half a revolution first in one direction and then in the other the loops on the ribber needles being first transferred to the frame needles. This oscillation is produced by suitable
120 mechanism. At the same time as the oscillating motion commences the cams which have been in operation are thrown out of action and the cam k^4 is brought into action, and operates upon those jacks shown in the upper half of
125 Fig. 12. The heel is then made by the cam k^4 which is by the cam s^9 first brought into action for knitting, and is then by the conjoint action of the cams s^9 and s^{10} upon the levers
130 s^6 and s^3 , in the manner already described, gradually moved from the cylinder or the center of the machine, the lengths of the jacks being so graded that at each oscillation of the machine two needles, one at each side of the
135 center of the heel are thrown out of action until there are only about a dozen needles at

work. The tops of the jacks are made at such an angle that the increased leverage at which the cam k^4 acts is compensated for by the increased motion given to the extended ends of the jacks. The cam k^4 then commences to traverse back again, acting upon two additional needles at each oscillation of the machine until the full number of heeling needles are in action when the cam k^4 is thrown out of action and a plain foot knitted by the cam k' . The toe of the stocking or sock is afterward made by the cam k^4 which is actuated in exactly the same way as it is when making the foot.

It should also be understood that with different arrangements of needles and cams other ribs in addition to those described may be made. Thus if all the needles in the frame cylinder were double needles, and the ribber head had the same number of needles as the frame cylinder, all of which were also double needles, it would be possible to make every kind of rib and to change from one kind of rib to any other kind, by suitably grading or cutting the jacks and using a corresponding arrangement of transferring and knitting cams. The jacks are graded upon the following method, that is to say: if the loops are to be transferred say from all the odd numbered needles, the transferring cams must act upon those needles and the knitting cam miss the same needles. This is done by cutting a recess in those jacks which have to miss the transferring cam, and also a recess in those jacks which have to miss the knitting cams.

It should also be noted that if the loops are to be transferred from the frame needles to the ribber needles the frame jacks must be raised into the recess at the top of the grooves in the needle cylinder so that the double needles will separate and stretch the loops on the same. The ribber needles must be brought forward sufficiently far to pass the hooks of the same through the stretched loops on the frame needles. If, however, the loops are to be transferred from the ribber needles to the frame needles, then the former must be brought forward sufficiently far to enable the needles to separate, and the frame needles are then raised so that the hooks of the same pass through the stretched loops on the ribber needles.

In making a stocking or sock it is sometimes required to make a ribbed leg and a partly ribbed foot. This kind of foot can be made on the machine I have described by providing appropriate transfer cams to effect a transfer of loops from the frame to the ribber needles around one-half only of the machine, corresponding knitting cams being provided to control the knitting operations, and throwing in and out of action the necessary knitting cams at each revolution of the head; that is, allowing the cam k' and all of the frame needles, to be in action during the knitting of the sole of the foot, and the cams k^3 and k^6 and the frame and ribber needles which

they respectively actuate for the other part of the foot if this has a three and one rib; or the cams k^2 and k^5 and the frame and ribber needles which they respectively actuate for a one and one rib. The same kind of foot can however be more conveniently made by specially grading the jacks for this operation, and employing separate cams.

In addition to the mechanism hereinbefore described the machine is fitted with fixed cams for returning the needles to their normal positions after they have passed the transferring and knitting cams as illustrated in Fig. 21 and heretofore described. Four such cams are used, two for the frame needles and two for the ribber needles. It should also be understood that unless otherwise mentioned the levers carrying the various cams are held in contact with the cams actuating the same by means of suitable springs. Such springs s^{12} and s^{13} are represented in Fig. 14, as holding the levers s^6 and s^8 in engagement with their operating cams s^9 and s^{10} .

Having now described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. A double knitting machine needle the two parts of which have provisions in virtue of which they tend to separate from each other, substantially as described.

2. In a knitting machine, the combination of a double needle the two parts of which are arranged side by side, and have provisions in virtue of which they tend to separate, and a bed or cylinder having provisions which hold closed, side by side, the parts of the needle while performing its usual knitting operations, substantially as described.

3. In a knitting machine, the combination of the double needles having provisions in virtue of which the two parts of each needle tend to separate, the guides for the needles having flaring ends, mechanism for operating the needles, and means for moving the needles into the flaring portions of their guides, whereby the two parts thereof may separate, substantially as and for the purposes hereinbefore set forth.

4. In a knitting machine, the combination of a knitting frame having mounted therein double needles the parts of which have provisions in virtue of which they tend to separate and thereby stretch the loops thereon when moved into certain positions, another frame carrying knitting needles, mechanism for operating the needles in such frames to cause them to knit, and transfer mechanism arranged to move the double needles into positions to permit them to separate and stretch the loops, and at the same time to cause the needles of the other frame to enter such loops and take them from the double needles, substantially as described.

5. In a knitting machine, the combination of a frame carrying double knitting needles the two parts of which lie side by side and are normally held closed together, but have

provisions in virtue of which they tend to separate, another frame carrying similar double needles, means for holding the needles closed during their knitting operations, and transfer mechanism arranged to move the double needles in one frame into position to permit their parts to separate, and at the same time cause the needles of the other frame to take the loops therefrom, substantially as and for the purposes set forth.

6. In a knitting machine, the combination of two frames carrying double needles, which double needles have provisions in virtue of which the parts tend normally to separate, the recessed jacks which carry the needles, the knitting cams which act upon such jacks, and the transfer cams which act upon such jacks, substantially as described.

7. In a knitting machine, the combination of two frames carrying double needles, the recessed jacks which carry the needles, the transfer cams which operate upon a portion of the jacks in one frame for causing the loops on the needles carried thereby to be transferred to needles in the other frame, and knitting cams which operate the needles to which the loops have been transferred, and

knitting cams which operate the remaining needles bearing loops in the first said frame, substantially as set forth.

8. In a knitting machine, the combination of a frame carrying double needles, the recessed jacks which carry the needles, another frame carrying needles, the transfer cams, the knitting cams, and the sinkers *g* provided with the nibs *g'*, substantially as set forth.

9. In a knitting machine, the combination of a frame carrying double needles, the recessed jacks upon which the needles are mounted, the knitting cams and the transfer cams for operating upon such jacks, another frame also carrying double needles and having recessed jacks, and the transfer and knitting cams for operating upon the jacks of such second frame, substantially as and for the purposes hereinbefore set forth.

In testimony that I claim the foregoing I have hereunto set my hand this 8th day of January, 1894.

ALFRED LEE.

Witnesses:

WM. HY. POTTER,
F. PARROTT.