

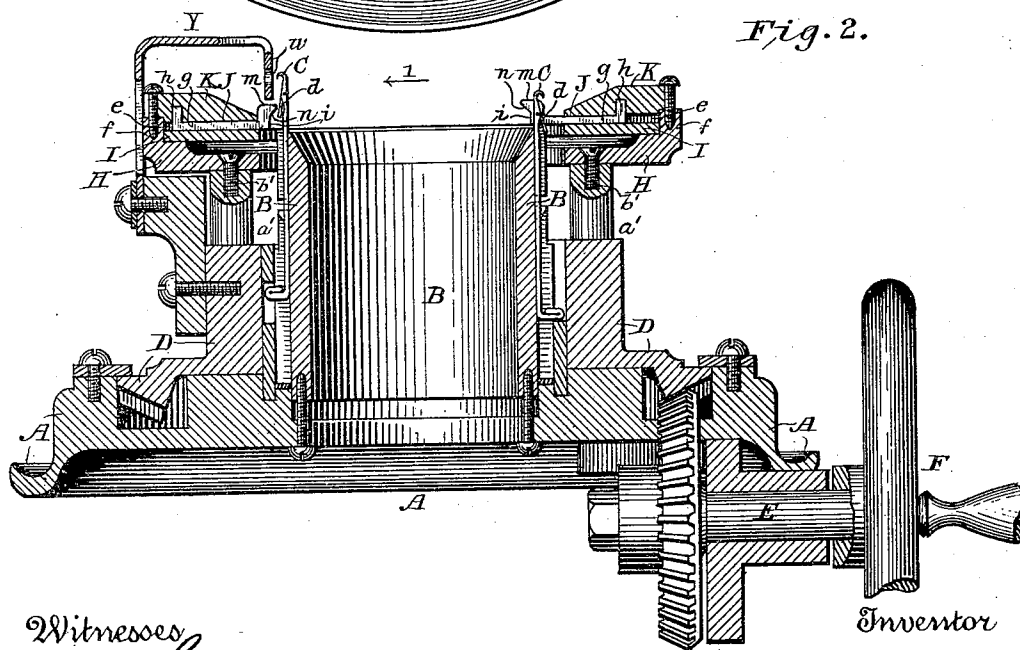
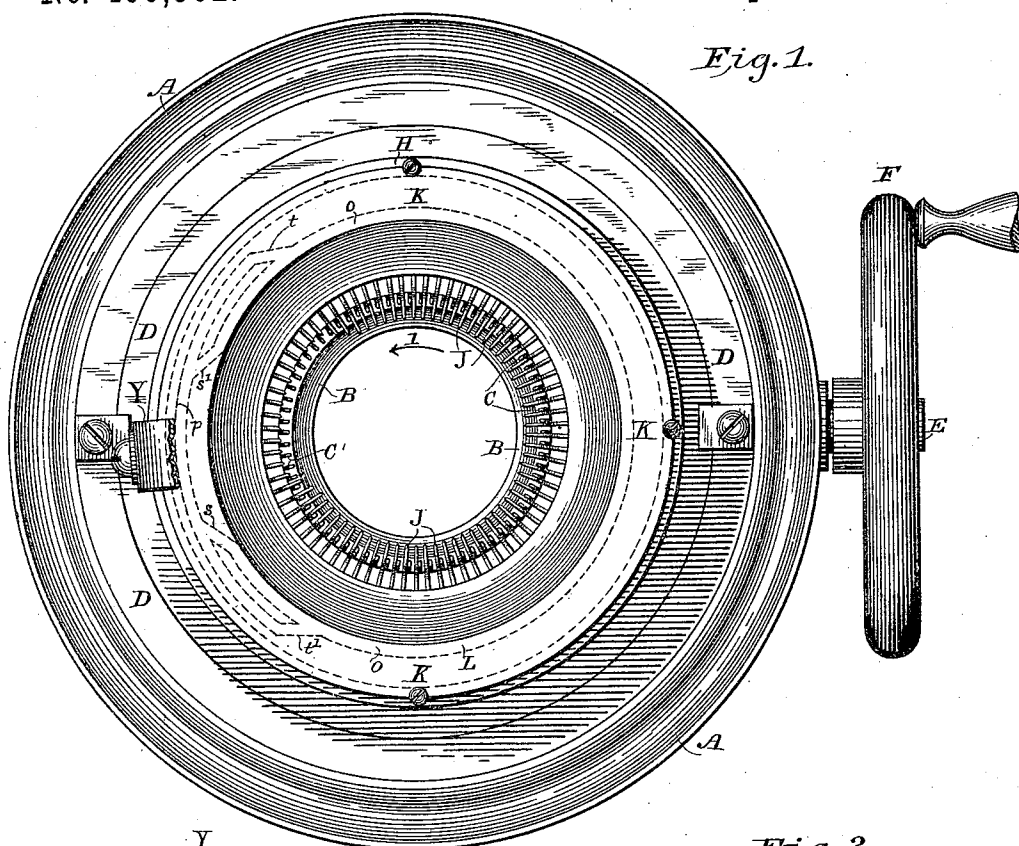
(No Model.)

3 Sheets—Sheet 1.

A. T. L. DAVIS.  
CIRCULAR KNITTING MACHINE.

No. 460,502.

Patented Sept. 29, 1891.



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By his Attorney  
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Fig. 3.

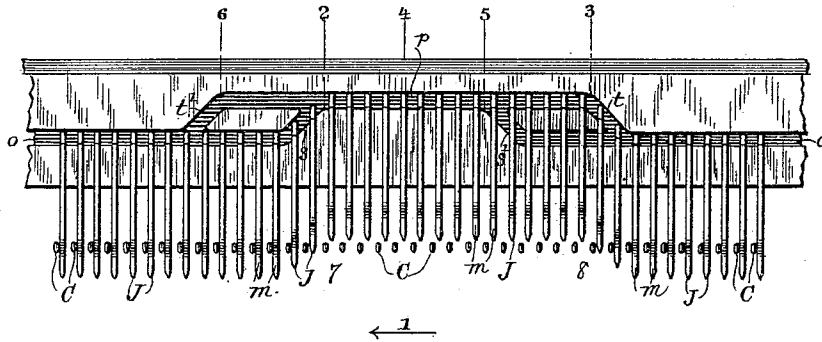


Fig. 4.

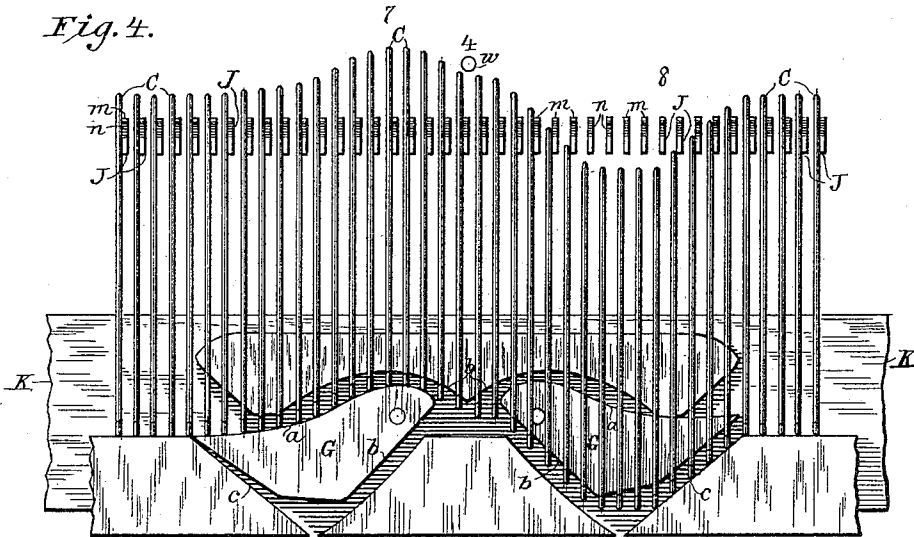
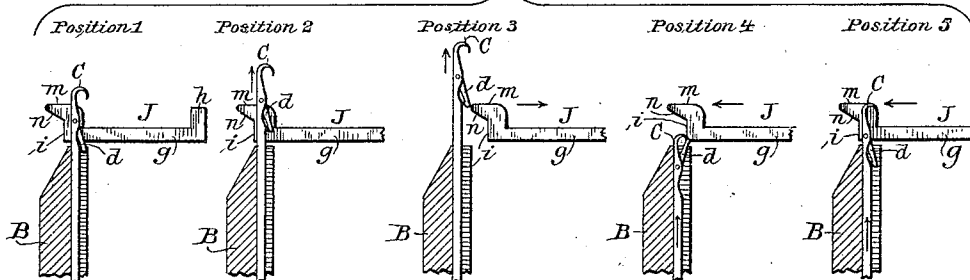


Fig. 5.



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Fig. 6.

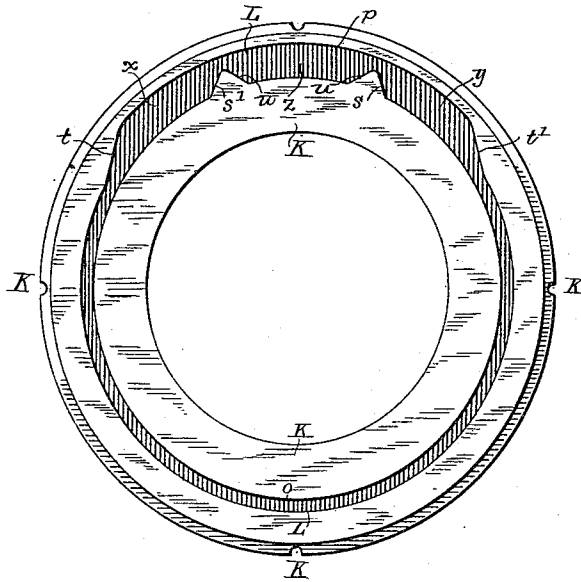


Fig. 7.

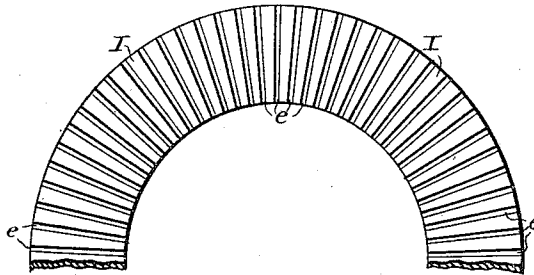


Fig. 8.

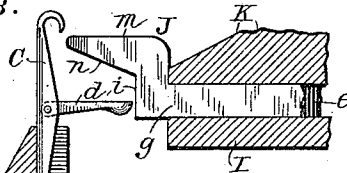


Fig. 9.

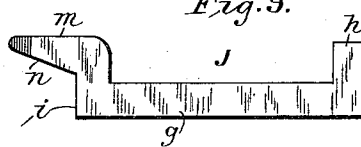


Fig. 10.

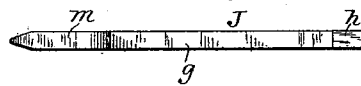
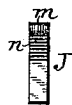


Fig. 11.



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# UNITED STATES PATENT OFFICE.

ALBERT T. L. DAVIS, OF LAKE VILLAGE, NEW HAMPSHIRE, ASSIGNOR TO  
THE PEPPER MANUFACTURING COMPANY, OF SAME PLACE.

## CIRCULAR-KNITTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 460,502, dated September 29, 1891.

Application filed July 30, 1890. Serial No. 360,343. (No model.)

*To all whom it may concern:*

Be it known that I, ALBERT T. L. DAVIS, of Lake Village, in the county of Belknap and State of New Hampshire, have invented certain new and useful Improvements in Circular-Knitting Machines, of which the following is a specification.

This invention relates to that class of circular-knitting machines which are provided with latch-needles arranged in a circle, with operating-cams for actuating the needles, and with devices operating between the needles for casting off the work from the needles and holding and feeding the work down, such devices being known as "cast-off fingers," "sinkers," or "sliding jacks." Among the advantages of these "cast-off fingers" (which term will be used in the succeeding description in referring to these casting-off, feeding, and holding-down devices) in circular latch-needle knitting-machines which may be mentioned are that machines so provided are self-starting, in that the knitting operations may be initiated without the employment of any extraneous devices, such as are commonly employed, and that the usual mechanisms employed for feeding down the knitted web and giving tension thereto may be dispensed with. Such cast-off fingers have also hitherto been employed in circular latch-needle knitting-machines which are capable of knitting a circular web and also of knitting a flat web, the latter operation being effected in the well-known way by throwing out of operation a certain number of the needles and then vibrating the knitting-cams (in case of those machines which have a stationary needle-cylinder and rotary knitting-cams) back and forth through a portion of the revolution.

Now the present invention consists in improvements in the construction of such cast-off fingers and in the mechanism for holding and operating such fingers, the improvements being applicable to circular latch-needle knitting-machines which are capable of knitting both a circular and a flat web, such as are particularly used for knitting stocking-legs and footing the same.

The present improvements are illustrated in the accompanying drawings, wherein—

Figure 1 is a top view of a knitting-machine provided with the present improvements. Fig. 2 is a central vertical longitudinal section thereof. Fig. 3 is a view in the nature of a diagram, illustrating the relation between the cast-off fingers and the knitting-needles and illustrating the manner of operating the cast-off fingers. It will be noted that for the sake of showing clearly the operating-cams of the cast-off fingers they are represented as being placed below the cast-off fingers instead of above them as they are actually located in the machine. Fig. 4 is a plane projection (also in the nature of a diagram) of the inner face of the cam-cylinder, showing the knitting-cams. This figure is a view at right angles to that of Fig. 3. In Fig. 4 the needles and cast-off fingers are represented immediately below or in line with the corresponding needles and fingers, as represented in Fig. 3, the two figures together showing the relative operations of the needles and fingers. Fig. 5 is a view showing different relative positions of one of the needles and the finger adjacent to it. Fig. 6 is an under side view of the cam-disk which operates the cast-off fingers, a modified arrangement of the cams being shown. Fig. 7 is a top view of a portion of the guide-disk for the cast-off fingers. Fig. 8 is an enlarged detail view showing the relative position of one needle and the adjacent cast-off finger when the needle-latch is being closed. Figs. 9, 10, and 11 are side, top, and end views, respectively, of one of the cast-off fingers.

A is the bed-plate of the knitting-machine upon which the operative parts are mounted, and B is the stationary needle-cylinder fixed thereto, having longitudinal guide-grooves in which the latch-needles C rise and fall. The needles are operated by a rotary cam-cylinder D, which receives motion from a drive-shaft E, which can be operated either by power or by hand, a hand-crank wheel F being shown in the drawings. The cam-cylinder is provided on its inner face with the usual knitting-cams, which co-operate with the needle-butts. Since the machine is used to knit both a circular web and a flat web, it is provided with two sets of knitting-cams, each

set of cams comprising an elevating cam-surface *a*, a depressing cam-surface *b*, and a restoring cam-surface *c*. To enable the knitting operations to be accomplished which-  
 5 ever way the cam-cylinder is rotated, two switch-cams *G* are employed, on which the cam-surfaces *a* and a portion of the cam-surfaces *b* are formed. One of these sets of cams is idle and the other in operation when the  
 10 cam-cylinder is rotating in a given direction. To enable the cam-cylinder to be oscillated back and forth through a portion of a revolution, as when footing a stocking, it is necessary to throw out of operation a portion of  
 15 the needles by lifting them until their butts are out of reach of any of the cams, in order that the switch-cams may be entirely free from any needle-butts when the reversal of the movement of the cam-cylinder is effected.  
 20 The switch-cams are pivoted at their upper corners, so that they normally resume by gravitation their lower operative positions when not upheld by the needle-butts passing beneath them.

25 In Fig. 4 the several positions of the needles are illustrated, showing how they are elevated by the elevating-cam in order to carry the needle-latches *d* entirely above the loops on the needles, how they are lowered to take  
 30 the thread and to carry it below the upper edge of the needle-cylinder and so draw it through the loops on the needles, at the same time closing the latch, and then how they are restored to their normal position with the  
 35 latches open. The thread is supplied by a yarn-guide *Y*, which is fastened to and carried by the cam-cylinder.

40 The machine and its mode of operation, as thus far described, are old and well known and have been minutely described only in order that the relation between the movements of the cast-off fingers and the movements of the  
 45 needles may be clearly understood.

Rigidly secured to the cam-cylinder *D*, so  
 45 as to partake of the movements thereof, (by any suitable means, such as pillars *a'*, carried by the cylinder, and screws *b'*;) is a plate *H*, which supports the guide-disk *I* of the cast-off fingers *J*, and the cam-disk *K*, which operates the cast-off fingers. The guide-disk *I*  
 50 simply rests on the supporting-plate *H* and does not partake of the rotary movement thereof. The guide-disk is formed on its upper horizontal face with a plurality of radial  
 55 linear guide-grooves *e* (see Fig. 7) for the cast-off fingers *J*. These guide-grooves are radial to the axis of the cam-cylinder *D*, are equal in number to the knitting-needles, and are opposite, respectively, to the spaces be-  
 60 tween the knitting-needles. There is one cast-off finger *J* in each of the guide-grooves *e*. Each finger *J* is capable of a longitudinal radial movement in its guide-groove, the path of its movement being perpendicular to that  
 65 of the needles. In the normal state of rest of the cast-off fingers they occupy positions between the needles, and the great majority of

the fingers at any given moment are in this normal position. Consequently the cast-off  
 70 fingers are held by the needles from rotation, and since when the machine is in operation the fingers are always held within their respective guide-grooves the guide-disk *I* is also prevented from rotating with its supporting-plate *H* and the cam-cylinder *D*. The sup-  
 75 porting-plate *H* is formed on its outer periphery with a projecting annular vertical flange *f*, which serves as a guide for the guide-disk *I* and prevents any lateral displacement thereof. The cam-disk *K*, which effects the radial move-  
 80 ments of the cast-off fingers, is rigidly secured to the flange *f* of the plate *H*, so that it rotates with the cam-cylinder *D*. This cam-disk extends horizontally and constitutes a cover for the cast-off fingers and their guide-  
 85 disk, preventing any vertical movement of the fingers or guide-disk and serving to retain the fingers in their respective guide-grooves. This arrangement of the guide-disk for the  
 90 cast-off fingers is attended with several important advantages. The general arrangement of a stationary guide-disk, having radial grooves for the cast-off fingers, and of a rotary cam-disk for operating the cast-off fin-  
 95 gers, which also constitutes a cover for retaining the fingers in place, is old and well known; but, as far as I am aware, in all previous machines of this character the guide-disk has been held stationary by direct positive  
 100 attachment with a fixed part of the machine, necessitating more or less complication in the construction of the machine. In accordance with the present invention, however, the  
 105 guide-disk for the fingers is wholly unattached to any part of the machine and is held from rotation solely by the engagement of the cast-off fingers with the knitting-needles. This arrangement renders the construction of the machine very simple, and enables the  
 110 cast-off fingers to be conveniently applied to any circular-knitting machine of the described type with a minimum alteration of its parts.

Each cast-off finger *J* (see Figs. 9, 10, and 11) is formed with a shank *g*, which fits and  
 115 slides in one of the grooves *e*, with a vertically-extending butt *h* at its outer end, which projects above the plane of the upper surface of the guide-disk *I*, with a square vertical shoulder *i* at its inner end, and with an inwardly-projecting hook *m*, having its lower  
 120 face *n* beveled, said beveled face forming an obtuse angle with the shoulder *i*, as shown. Owing to the friction between the plate *H* and guide-disk *I* each of the fingers, when the machine is in operation, is in close contact with  
 125 the needle directly in advance of it. Therefore to enable each finger to move easily inward the inner part of its hook *m* is beveled on the sides, as shown in Fig. 10. The outer butts *h*  
 130 of all the cast-off fingers engage a cam-groove *L* in the under face of the rotary cam-disk *K*. This cam-groove has two circular portions or dwells *o p* concentric with the axis of the cam-cylinder or of the machine. The dwell *o*, hav-

ing the lesser radius, occupies an arc extending the greater portion of the circle, so that normally the cast-off fingers occupy their innermost position, while the dwell *p* of the greater radius occupies a comparatively small arc. As will hereinafter appear, when the operation of these dwells *o* and *p* upon the cast-off fingers is described, the inner margin of the dwell *o* is its operative margin and the outer margin of the dwell *p* is its operative margin. There are two throwing-out cams *s s'* and two drawing-in cams *t t'*, which are formed by the margins of portions of the cam-groove *L* connecting the two dwells. All of the cams *s s' t t'* extend between the two dwells, so that the action of the cams upon the cast-off fingers is to cause their butts *h* to be moved from one of the dwells to the other. The cams *s t* only operate upon the finger-butts *h* when the cam-cylinder *D* is rotated in one direction, while the other cams *s' t'* only operate when the cam-cylinder is rotated in the opposite direction. The operations of the two sets of cams are identical, and they are provided in order that the machine may be used for back-and-forth knitting, as in footing a stocking. Assuming that in the usual operation of the machine, when knitting a circular web, the cam-cylinder and the parts carried thereby move in the direction of the arrow 1, (see Figs. 1 and 3,) the cams *s* and *t* alone operate upon the finger-butts *h*. The horizontal plane in which the cast-off fingers are located is such, relatively to that of the upper edge of the needle-cylinder, that the lower edge of the shank of each finger is slightly above the edge of the needle-cylinder, so that there is no friction between the fingers and the needle-cylinder. When the butt *h* of a cast-off finger is in its normal position—that is to say, in the dwell *o*, having the lesser radius—the square inner shoulder *i* of the finger is nearer the axis of the machine than the rear or inner vertical edge of the adjacent needles. (See position 1, Fig. 5.) The entire inwardly-projecting part of the hook *m* is thus in the normal position of the finger nearer the axis of the machine than the adjacent needles. When, however, the finger is thrown out to its outermost position by the throwing-out cams *s* and its butt is in the dwell *p*, having the greater radius, the finger is entirely free from the adjacent needles, the inner point of the hook *m* being farther from the axis of the machine than the outer edges of the adjacent needles, (see position 3, Figs. 5 and 8,) and when the finger is in this outermost position the distance between its square shoulder *i* and the adjacent needles is sufficient to permit the needle-latches to swing upwardly without danger of encountering the cast-off finger. (See Fig. 8.) It will be noted that when the fingers are thrown out to their outermost position by the throwing-out cam *s* they remain in this position until they are drawn in by the drawing-in cam *t*, as clearly shown in Figs. 1 and 3.

Now in the present machine the movements of the cast-off fingers bear a special relation to those of the knitting-needles. When the needles begin to rise under the action of the elevating-cam *a*, the cast-off fingers still remain in their innermost position, their inwardly-projecting hooks holding the web down and preventing it from being lifted by the frictional contact of the needles and the needle-latches. This is a particular and important function of the cast-off fingers. As soon as the latch of one needle is drawn up entirely free from the loop around the needle, then the cast-off finger following it (the word "following" being here used on the assumption that the needles and fingers which are last acted upon by the knitting-cams are "followed" by those which are first acted upon, or, in other words, referring to Fig. 3, in which the arrow 1 indicates the direction in which the cams are moving, that the needles and fingers at the right "follow" those at the left) is acted upon by the throwing-out cam *s*. This outward movement of the finger is initiated just after the needle-latch of the preceding needle has passed clear through the loop and before the needle has reached its highest position. Position 2, Fig. 5, shows the position of the knitting-needle just before the outward movement of the following cast-off finger commences. The outward movement of the finger is completed simultaneously, or nearly so, with the completion of the upward movement of the preceding adjacent needle, the positions of the needle and finger at this instant being shown at position 3, Fig. 5. The fingers remain in their outermost position during the entire time while the needles are taking yarn, and since the inner points of the finger-hooks *m* are entirely clear from the outer edges of the needles there is no contact between them and the yarn which is being fed to the needles. During the entire action of the depressing-cam *b* upon the needles the fingers occupy their outermost position. The downward movement of the needles obviates any necessity for other means to hold the web down, and the fingers being entirely free from the needle-cylinder the loops on the needles are drawn down upon the upper edge of the needle-cylinder exactly as in an ordinary knitting-machine. As soon, however, as the needles begin to rise under the action of the restoring-cam *c* the fingers begin to move in under the action of the drawing-in cam *t*. Before, however, a particular finger is moved far enough in to come in contact with the web the hook of the needle which it follows is lifted above the upper edge of the needle-cylinder, carrying with it the newly-formed loop. Consequently when the finger moves in the lower edge of its shank does not come in contact with the web or the needle-cylinder, and its square vertical shoulder *i* pushes against the web. Position 4, Fig. 5, shows the position of a finger just as the adjacent

needle appears above the rim of the needle-cylinder. The inward movement of the fingers is completed before the adjacent needles are fully restored to their normal position, position 5, Fig. 5, showing the position of the needle when the adjacent finger has just completed its inward movement. The fingers move in far enough to cast off the loops previously on the needles and to draw the new loops on the needles to the proper tension, this being accomplished by the square inner vertical faces *i* of the fingers. The hooks *m* serve to hold the web down, and their beveled faces *n* enable them to pass easily over the web in case it should be drawn up unusually high by the action of the needles.

The described construction, arrangement, and operation of the cast-off fingers are attended with important advantages which, it is believed, are not attained by the cast-off fingers which have hitherto been employed. It is important that the fingers should work in a plane above the upper edge or rim of the needle-cylinder, since the fingers thereby operate with minimum friction and there is no liability of cutting or breaking the loops. This feature also, in connection with the complete withdrawal of the fingers from the needles and from the work during the knitting operations of the needles, enables the knitting to be done with the same freedom and facility as if the fingers were not used. No special construction of knitting-needle is required, nor is it necessary that they should be of any additional length. The square shoulders of the fingers alone press upon the web to cast it off and press it back from the needles. This insures evenness of pressure at all stages of the knitting and makes the work uniform. The holding-down hooks are located a considerable distance above the edge of the needle-cylinder, so as to allow freedom for the inward movement of the web; but at the same time they hold the web low enough, so that the latches are freed from the web when the needles are elevated.

The relation between the actions of the finger-operating cams and those of the needle-actuating cams is an important and novel feature. The fingers are withdrawn and freed from the needles during the entire time that the needles are taking the yarn. The fingers are withdrawn at just the exact time when their function of holding down the work ceases, and they are pressed back at the exact time when they are needed. During all of this interval they are free from the needles. It remains therefore only to explain how the finger-actuating cams are constructed in the cam-disk K, so that the operations may be the same whichever way the cam-cylinder D is rotated, and so that the presence of one set of cams will have no effect whatever upon the action of the fingers when the other set of cams is in operation. Hitherto cast-off fingers having the same general objects in view as those herein described have been actuated by cams

so arranged that the fingers are operated whichever way the machine is run; but as far as I am aware both sets of cams act upon the fingers when the machine is running in one direction, the action of one set of cams being, however, superfluous and adding to the friction in operating the machine. The improved operation in the present invention is effected by the relative locations of the cams *s s' t t'* and their points of juncture with the margins of the dwells *o p* and by their relation between the position of these cams and that of the guide-eye *w* in the yarn-guide Y. There is necessarily a fixed relation between the cam-disk K and the yarn-guide Y, since both are rigidly secured to the cam-cylinder D. Now the position of the thread-eye *w* in the yarn-guide is determined by the position of the knitting-cams on the cam-cylinder. The thread-eye must be located approximately in the same vertical plane as the initial point of the needle-depressing cam *b*, (see Fig. 4,) and this point in turn bears a fixed relation to the positions of the cams in the cam-disk K. Now the cast-off fingers occupy their outermost position while the needles are taking the thread, as already set forth, and consequently those fingers which are thus occupying their outermost position at any given instant extend from a point 7 approximately opposite the initial point of the needle-depressing cam *b* to a point approximately opposite the initial point 8 of the needle-restoring cam *c*. Consequently the cast-off fingers in their outermost position are not symmetrical with reference to the thread-eye *w*. If the cast-off fingers in their outermost position were symmetrically located with reference to the thread-eye—that is, if as many of the cast-off fingers in their outermost position were located on one side of the thread-eye as on the other—then a single set of cams *s t* would suffice to operate the cast-off fingers during back-and-forth knitting; but on account of the fact that the thread-eye is not centrally located with reference to the cast-off fingers in their outermost position two separate sets of cams *s t* and *s' t'* are necessary in the cam-disk K to enable back-and-forth knitting to be done. The relative positions of the two sets of cams *s t* and *s' t'* are determined by the following considerations: Regarding the two cams *s t* as the main cams their positions are determined by reference to the operations performed on the needles by the knitting-cams, which relation has already been set forth. The throwing-out cam *s* terminates where it reaches the dwell *p* at the point 2, (see Fig. 3,) and the drawing-in cam *t* starts from the outer margin of the dwell *p* at the point 3, the distance between the two points 2 and 3 determining the time during which the fingers occupy their outermost position. The point 4 indicates the position of the thread-eye *w*, this point being the point through which a vertical plane extending through the axis of the machine and the

thread-eye would pass. This point 4 is, as shown, nearer the point 2 than it is to the point 3. Now in laying out the cams  $s'$   $t'$ , which operate upon the fingers when the cam-disk K is moving in the opposite direction, it is only necessary to observe that the throwing-out cam  $s'$  must terminate where it reaches the dwell  $p$  at a point 5, which is just the same distance on one side from the point 4 as the point 2 is distant from the point 4 on the other side, and that the drawing-in cam  $t'$  starts from the outer margin of the dwell  $p$  at the point 6, which is the same distance on one side from the point 4 as the point 3 is distant from the point 4 on the other side. Consequently the distance along the dwell  $p$ , between the points 5 and 6, is just equal to the distance between the points 2 and 3, and the dwell  $p$  is longer than the arc in which the finger-butts travel therein when the cam-disk is turned in one direction. As the result of this construction the two drawing-in cams are outside of the two throwing-out cams.

In Figs. 1 and 3 the cams  $s$   $s'$   $t$   $t'$  are shown as margins of separate and distinct grooves connecting the two dwells  $o$  and  $p$ . In practice, however, the modification shown in Fig. 6 is preferred and used. It will be noted by reference to Fig. 3 that the finger-butts are acted upon only by the outer margin of the dwell  $p$  and by the inner margin of the dwell  $o$ , that the drawing-in cams  $t$   $t'$  are the outer margins of two of the grooves extending between the dwells  $o$  and  $p$ , and that the cams  $s$   $s'$  are the inner margins of two of the grooves extending between the dwells  $o$  and  $p$ . It will be further noted that the operative face or margin of the dwell  $p$  merges into or joins the drawing-in cams  $t$   $t'$ , and that the operative face or margin of the dwell  $o$  merges into or joins the throwing-out cams  $s$   $s'$ . In Fig. 6 these margins are preserved, and the cam-disk is formed with the recesses  $x$ ,  $y$ , and  $z$  by cutting away (or leaving unfilled by cam-blocks) the superfluous portions of the under face of the cam-disk. This construction with the recesses  $x$ ,  $y$ , and  $z$  is much to be preferred, and is the most practical one.

In the construction shown in Figs. 1 and 3 the raised portions or blocks between the cams  $s$  and  $t'$  and between the cams  $s'$  and  $t$  are very apt to interfere with the reversal of the movement of the cam-disk, since in the case of such reversal the finger-butts are liable to strike the corners of said blocks. This difficulty is entirely avoided by the presence of the recesses  $x$  and  $y$ , which permit the easy and free reversal of the movement of the cam-disk. The several recesses  $x$ ,  $y$ , and  $z$  also facilitate placing the cam-disk in position. The side margins  $u$   $u'$  of the recess  $z$  (which is between the cams  $s$   $s'$ ) are inclined, as shown, so that if a finger is longitudinally displaced when opposite this

recess it will be restored to its proper position.

I claim as my invention—

1. The needle-cylinder of a circular-knitting machine, its needles, and a cam-cylinder carrying the needle-actuating cams, in combination with a guide-disk, cast-off fingers carried by said guide-disk and movable thereon, said fingers being movable between said needles, and a cam-disk operating said fingers and secured to said cam-cylinder, said guide-disk being supported by said cam-cylinder, but being stationary relatively to said needle-cylinder, said guide-disk being wholly unattached to the cam-cylinder or any part of the machine and being held stationary with reference to the needle-cylinder by the engagement of the cast-off fingers with the knitting-needles, substantially as set forth.

2. The stationary needle-cylinder of a circular-knitting machine, its needles, and a rotary cam-cylinder carrying the needle-actuating cams, in combination with a supporting-plate rigidly attached to said cam-cylinder, said plate having a vertically-projecting peripheral flange, a guide-disk seated upon said plate within said flange, said guide-disk being unattached to said plate, cast-off fingers carried by said guide-disk and movable thereon, said fingers being movable between said needles, a portion of said fingers being always located between the needles, whereby said fingers and said guide-disk are held stationary, and a cam-disk for actuating said fingers secured to the flange of said plate, so as to rotate therewith and covering said guide-disk, substantially as set forth.

3. The needle-cylinder of a circular-knitting machine, its needles, said needles having a reciprocating movement, and means for reciprocating said needles, in combination with cast-off fingers located between said needles and having a reciprocating movement in a plane perpendicular to that in which the needles move, and means for reciprocating said fingers, each of said fingers having a face or shoulder parallel with the path of the needles, the reciprocation of each finger being sufficient to carry said face or shoulder from a position within the adjacent needles to a position exterior to said needles and back again, substantially as set forth.

4. A cast-off finger for a knitting-machine, having a square inner shoulder and an inwardly-projecting holding-hook above said shoulder, substantially as set forth.

5. A cast-off finger for a knitting-machine, having an inwardly-projecting holding-hook having its point beveled laterally, substantially as set forth.

6. The needle-cylinder of a knitting-machine and its needles, in combination with cast-off fingers and the guide-disk thereof, the guide-disk being located in a plane perpendicular to the axis of the needle-cylinder and in such a position that the lower edges

of said cast-off-fingers are above the upper edge of said needle-cylinder, substantially as set forth.

7. The needle-cylinder of a knitting-machine, its vertically-reciprocating needles, and the cam-cylinder having needle-actuating cams, in combination with horizontally and longitudinally reciprocating cast-off fingers which move back and forth between said needles, a guide-disk in which said fingers are mounted, and a cam-disk for operating said fingers, each of said fingers having a vertical inner shoulder and an inwardly-projecting hook above said shoulder, the movement of each of said fingers being sufficient in one direction to bring said vertical shoulder to a position inside of the adjacent needles and in the other direction to carry the inner point of the finger-hook entirely outside of said needles, substantially as set forth.

8. The needle-cylinder of a knitting-machine, its needles, the knitting-cams actuating said needles, cast-off fingers which move back and forth between said needles, and the guide-disk for said fingers, in combination with throwing-out and drawing-in cams which actuate said fingers, said cams acting to throw out said fingers when the needles rise to take the yarn and to draw in said fingers when the needles rise to cast off their loops, there being a dwell concentric with the axis of the machine between the outer ends of said cams, whereby said fingers occupy their outermost position during the entire time while the needles are taking the yarn, and a concentric dwell between the inner ends of said cams, whereby said fingers occupy their innermost position while the needles are not in operation, substantially as set forth.

9. The needle-cylinder of a knitting-machine, its needles, the cam-cylinder having two sets of knitting-cams, whereby said needles may be actuated in whichever way the machine is run, a guide-disk, and cast-off fingers which reciprocate on said guide-disk between said needles, in combination with a cam-disk having two independent sets of throwing-out and drawing-in cams which act upon said fingers, one set acting upon said fingers and the other set being wholly idle when the machine is run in one direction, and vice versa, and a dwell concentric with the axis of the machine, which co-operates with the outer ends of all of said cams, so that the fingers occupy their outermost position during the entire time that the knitting-needles are

taking the yarn in whichever way the machine is run, substantially as set forth.

10. The cam-disk for operating the cast-off fingers of a knitting-machine, said disk having two dwells of different radii and two throwing-out and two drawing-in cams extending between said dwells, substantially as set forth.

11. The cam-disk for operating the cast-off fingers of a knitting-machine, said disk having a cam-groove which includes two dwells *o* and *p* of different radii, (the dwell *p* having the greater radius,) two drawing-in cams *t* and *t'*, extending between said dwells, the operative face or margin of said dwell *p* merging into and joining said drawing-in cams *t t'*, and two throwing-out cams *s s'*, extending between said dwells, the operative face or margin of said dwell *o* merging into and joining said throwing-out cams *s s'*, said cams *s s'* being located between said cams *t t'*, substantially as set forth.

12. The cam-disk for operating the cast-off fingers of a knitting-machine, said disk having the dwells *o p*, the cams *s, s', t, and t'*, as specified, and the recesses *x y z*, as set forth.

13. The cam-disk for operating the cast-off fingers of a knitting-machine, said disk having circular dwells *o p*, the dwell *p* having the greater radius, the drawing-in cams *t t'*, extending between said dwells *o p*, the throwing-out cams *s s'*, extending between said dwells *o p*, said cams *s s'* being located between said cams *t t'*, and recesses *x* and *y*, the recess *x* being formed between the working faces or margins of the cams *s' t* and the recess *y* being located between the working faces of the cams *s t'*, substantially as set forth.

14. The cam-disk for operating the cast-off fingers of a knitting-machine, said disk having circular dwells *o p*, the dwell *p* having the greater radius, the throwing-out cams *s s'*, extending between said dwells *o p*, and the recess *z*, located between said cams *s s'* and merging into said dwell *p*, said recess having the inclined side margins *u u*, substantially as set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

ALBERT T. L. DAVIS.

Witnesses:

GEO. A. SANDERS,  
V. E. HADLEY.