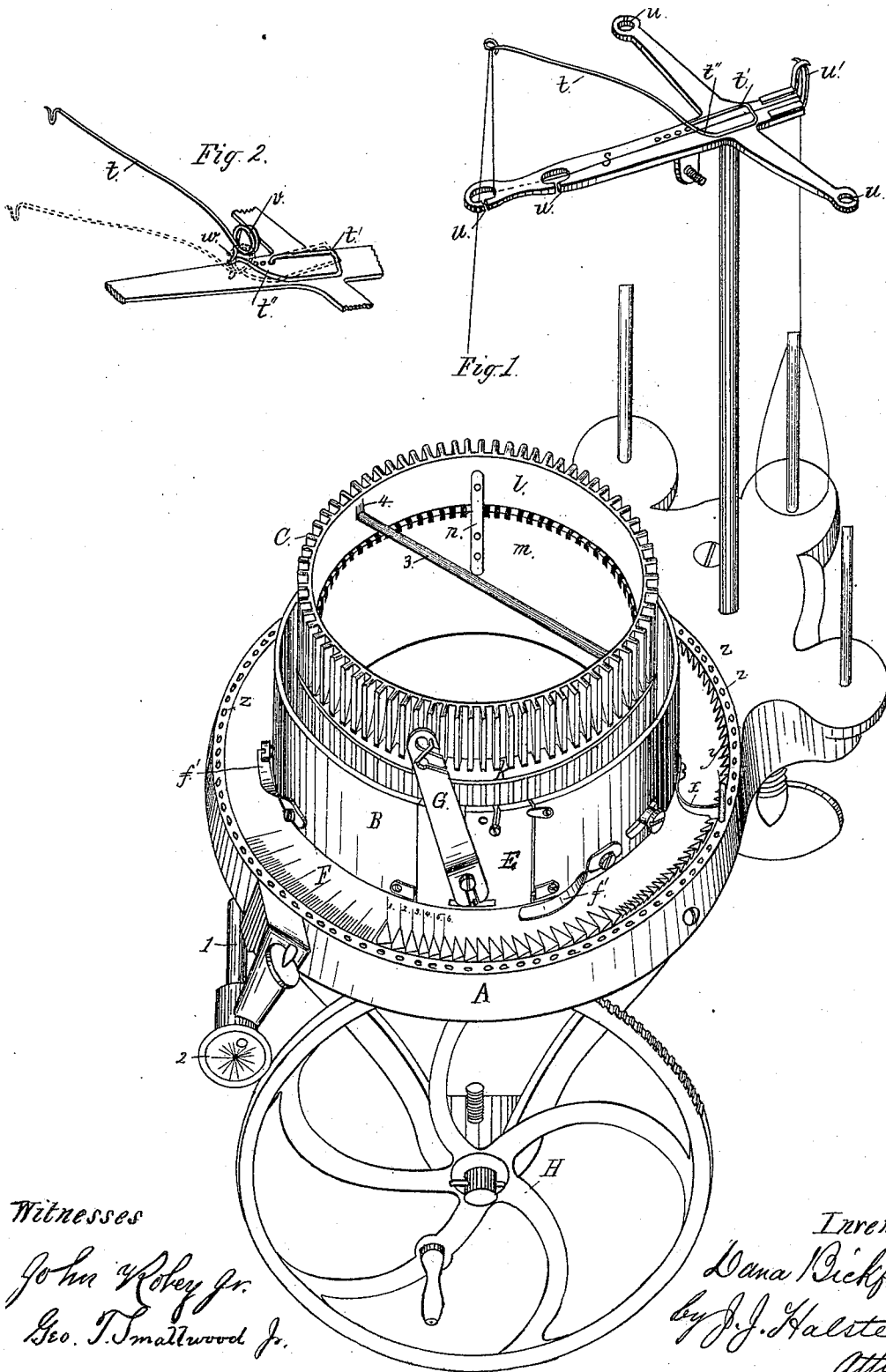


**D. BICKFORD.**  
**CIRCULAR KNITTING-MACHINE.**

No. 174,763.

Patented March 14, 1876.



Witnesses

John Robey Jr.  
Geo. T. Smallwood Jr.

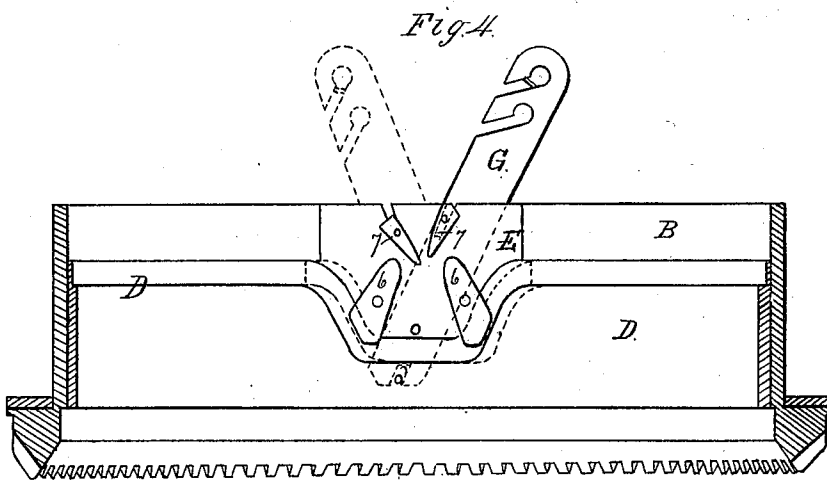
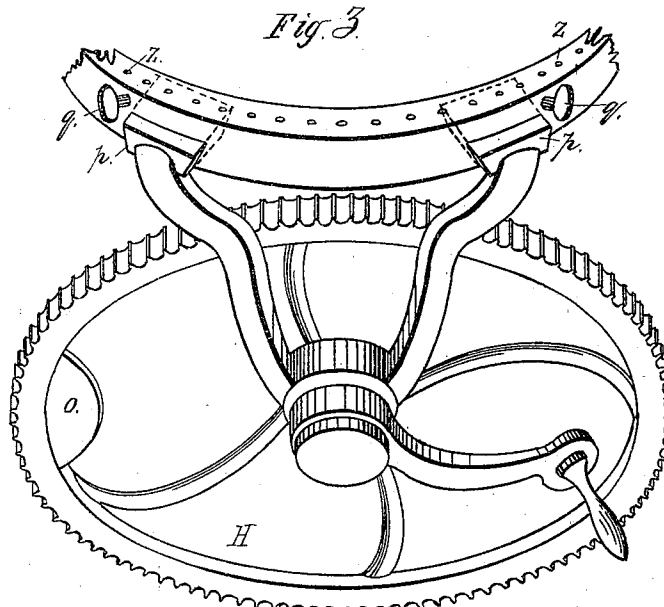
Inventor.

Dana Bickford.  
by J. J. Halsted  
Atty.

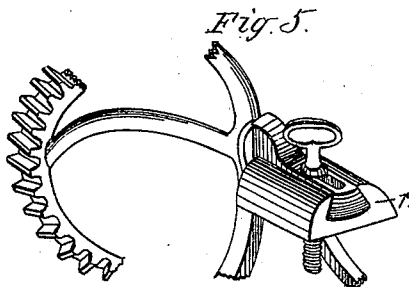
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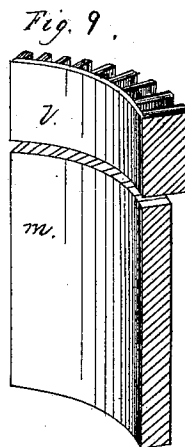
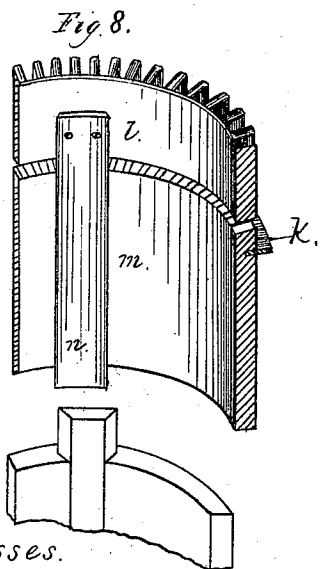
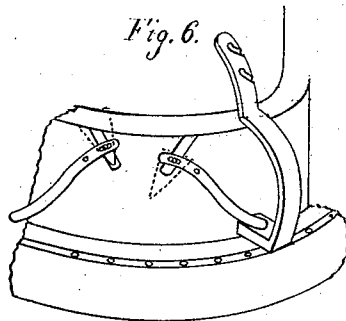
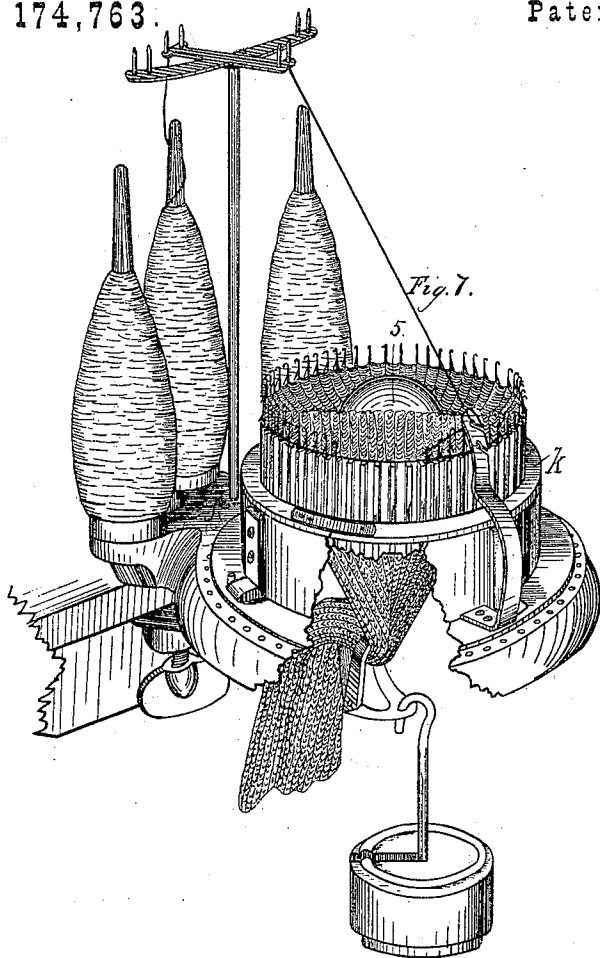


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John Robey, Jr.

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# UNITED STATES PATENT OFFICE.

DANA BICKFORD, OF NEW YORK, N. Y.

## IMPROVEMENT IN CIRCULAR-KNITTING MACHINES.

Specification forming part of Letters Patent No. **174,763**, dated March 14, 1876; application filed May 24, 1875.

### *To all whom it may concern:*

Be it known that I, DANA BICKFORD, of the city, county, and State of New York, have invented certain Improvements in Knitting-Machines; and I do hereby declare that the following, taken in connection with the drawings which accompany and form part of this specification, is a description of my invention sufficient to enable those skilled in the art to practice it.

My invention consists in a machine, constructed as hereinafter set forth, whereby, when driven either forward or reversed, its parts are entirely automatic in their action; in a needle-rest made separate or detached from its adjacent parts, and so that the cam-cylinder or cam-plate, or the gear-ring, or both, can be taken off and put on at option without disturbing other parts; in combining the needle-rest, the cam-ring or plate, and the gear-ring, so that one, two, or all of them may serve to actuate the yarn-carrier; in resting a detached needle-rest directly on the bed of the machine, or upon slides, screws, or equivalent bearing or supports on the cam-ring or needle-cylinder; in such a construction of the needle-cylinder in parts, one above the other, and with open space between them, so that, if desired, needles can be put in or taken out without disturbing the clasp that holds them in place; in a removable bar or rod, or equivalent device, for holding down the work while knitting a heel or toe of a stocking, or similar work; in a scaled or index ring or segment for registering the number of courses knitted, combined with mechanism for shifting it for each course; in combining with the ring-clasp which holds the needles in place a needle-cylinder constructed as hereinafter described, and whereby the needles may be readily removed or inserted without the displacement of the clasp; in the arrangement of the cam-plate and needle-rest relatively to each other, so that one of them may be shifted to or from the other, so as to overcome the distance between the needle rest or guide and the cams; in other details hereinafter stated, and the construction as a whole, whereby the machine is rendered completely automatic in its action.

In the drawings, Figure 1 is a perspective

view of a machine embodying my improvements; Fig. 2, a modification of the take-up; Fig. 3, a section, showing the adjustable and removable hanger for the driving-wheel, and also the balanced wheel; Fig. 4, a section, showing the retractable needle-rest, the gear-ring, the cam-plate, and the pivoted thread-carrier; Fig. 5, a detail view of a device for adjusting the driving-wheel. Fig. 6 shows a device for automatically operating the switches. Fig. 7 shows the extra weight and the position of the cross-bar and fabric when knitting a heel or toe; Fig. 8, a section, showing the adjustability of the upper part of the needle-cylinder, with the needle-clasp below the open space; and Fig. 9, a modification, showing the upper section of the upper cylinder projecting over a lower portion.

A is the frame; B, the cam-cylinder; C, the needle-cylinder; D, the needle-rest; E, the cam-plate; F, the scaled or registering ring; G, the yarn-carrier; H, the balanced driving-wheel.

The cam-cylinder I make in two or more parts, and the needle-rest D is made separate and distinct therefrom, and is made to fit loosely inside of the cam-plate or ring, and so that they may shift relatively to each other, and it rests on the gear-ring or driving part of the machine. The cams may be attached either to a separate plate or to the gear-ring, or to the needle rest, as found most desirable. I have shown them on a separate plate, E, pivoted at its lower side to the ring B, so that when desired its upper side may, by any suitable means, be held to position, so that the cams will act upon the needles, or be unlocked and the plate swung outward sufficiently to render the cams inoperative upon the needles whenever it may be advisable to leave the machine with work upon it, or to revolve it without making stitches.

The needle-rest D may rest directly on the bed of the machine, upon separate bearings inside the cam-ring, or upon the needle-cylinder; and it may be so arranged that, as the machine is revolved in either direction, the forward part of the cams or switches will strike against the needle-rest and carry it around, (if not otherwise connected,) so that it will come in contact with the other side of the

cams. This overcomes a serious objection to fixed or stationary cams and needle-rests, as it fills and overcomes the space existing between the ends of the cams and the needle-rest, and altogether dispenses with any need of devices for making the switches automatic.

The yarn-carrier may also be attached to the needle-rest, or arranged in such a manner as to be automatically changed by it; or it can be connected with the gear-ring or cam-plate. I have shown it as centered on the cam-plate, and arranged to be shifted as the cam-ring or rest is shifted. These parts, being constructed substantially as shown, allow the cam cylinder to be taken entirely off, or raised out of action with the gear or driving part, and yet to leave the needles and the needle-rest in position; or the cam and gear part can all be taken off, leaving the other parts in position.

K is a ring or clasp, for holding the needles to place.

The needle-cylinder or comb I make in two or more parts, such as are illustrated at *lm* in Fig. 1, and connect them together, so as to leave a separation or space between them.

The clasp K may be placed either in the upper or lower part of this separation or space; or it may be placed in an ordinary groove at any point below such separation.

The part *l* may be vertically adjustable relatively to the part *m* by having its connecting-piece (a simple form of which is shown at *n*) movable in dovetails or otherwise, and held by adjusting-screws. This permits a lengthening or shortening of the stitches.

The space between *l* and *m* facilitates the insertion and removal of the needles, and does not require the removal or loosening of the ring-clasp; and another advantage due to making the part *l* separate is that it may be made of harder metal or steel than the lower parts of the cylinder require, thus economizing the cost of making and grooving the needle-cylinder, and also affording facility of substituting one part *l* for another, and permitting the casting in molds of the grooved parts.

The driving-wheel I make larger than usual, in order to secure more speed of the machine for the same number of the revolutions of the wheel. I also, whenever found desirable, make the wheel and handle to balance, weighting the wheel on the side opposite its handle, or otherwise, so as to equalize and balance the handle, thus allowing the wheel, when the machine is stopped, to remain in the position in which it is left, instead of making a partial revolution or falling back, as heretofore. This prevents any bad results due to falling back or moving forward beyond the precise point where the operator finds it necessary to stop the work. A weight on the wheel for such purpose is shown at *o* in Fig. 3.

The bearings or support for the hanger which sustain the wheel I sometimes make adjustable, as shown at *pp* in Fig. 3. This not only permits the wheel to be readily put into or out of engagement with the other driv-

ing parts of the machine; but it also allows the ready removal of the hanger, bearing, and wheel, for packing and transportation or other purposes. These parts may be held to any adjusted position by any appropriate device. By way of illustration, I have shown thumb-screws *q q*, put in in such a way as to bear against that part of the hanger which is to be connected to the machine.

In Fig. 5, I have shown also an adjusting device, whereby the wheel may be adjusted in the hanger without adjusting the hanger, *r* in this figure indicating a portion of the hanger.

The bearing for the wheel may be placed on either side of the wheel, as preferred.

The take-up device and yarn-guide are shown in Fig. 1.

The arm *s* extends over the center of the needle-ring, and the take-up *t* is inserted in the arm, and secured, and is then bent back and doubled, so as to repose on the arm, as seen at *t'*, and is then carried or bent forward and its free end, having an eye for the yarn, is then bent upward, substantially as shown. The arm *s* has appropriate open slots *u*, into and out of which the yarn may be slipped; and it has a peculiar eye, *u'*, with two lapping parts, which, while permitting the ready insertion of the yarn, prevent its slipping out when the machine is in rapid motion. When the take-up is in use the yarn takes the route shown in the drawing, and the double or bend *t'* presses the yarn upon this arm until the pull of the yarn rocks the spring on its curve *t''*, and lifts the bend *t'* to release the yarn at that point, as seen in dotted lines in Fig. 2.

In this described construction of the spring take-up, its back portion acts as a check to prevent the yarn being drawn from the spool instead of from the yarn-carrier, when the spring reacts.

In Fig. 2 is shown a modification of this take-up, the spring in this case being coiled at one part, as seen at *v*, and having a lateral bend or projection at *w*, for the purpose of causing the back or doubled end to be lifted to the position shown in dotted lines, when the spring has been pulled down enough to bear on such projection.

The devices for registering the number of courses is shown in Fig. 1. The ring F is provided with a scale and notched. It may be either an entire ring or a portion or segment of a ring. The notches may be of any appropriate size or form, (two different sizes being shown by way of illustration,) adapted to receive a spring tooth or detent, *x*, which, in every revolution of the machine, will come in contact with a pin, *y*, on the frame, and thus be forced into the notch next adjacent to the one in which it previously lodged. The scale or index thus, at any stage, indicates the number of courses knitted. The pin may be shifted to any of the holes *z*, as desired. The registering of the number of courses also

gives the number of stitches, as each full course has a defined number of stitches, corresponding with the number of needles employed in the cylinder. The ring F is held down by a friction spring or springs, *f'*.

The bobbin-winder and its stand or support are shown in Fig. 1. It consists of a spindle to receive the bobbin, mounted in a bearing in a hanger or bracket, removably secured to the machine in any appropriate manner, the spindle having a friction-wheel, 2, which may be brought at will into or out of contact with the driving-wheel H, or it may be so located as to be driven by any other running part of the machine.

The adjustment of the driving-wheel admits of the latter being used to actuate the winder, while disengaged from the gear-ring. Under such adjustment the winder only may be driven, while the machine proper is at rest.

The removability of the winding device from the machine allows of greater compactness in packing machines for the market, and the operator can put it on or off at option in a moment; and the device also is less expensive than the separate winding-machines.

For holding down the work when knitting a heel or toe of a stocking, or similar work, I employ a simple rod or bar, 3, (see Fig. 1,) lodged loosely and removably in notches 4 made in the inside of the needle-ring, and the main body of the knitted goods being held down by the customary weights. After the leg of a stocking or sock, &c., has been made, this bar is put in place, as shown, and under the knitted fabric, and the buckle and weight are then drawn up close to the machine, and an extra weight, as shown at 5 in Fig. 7, is then laid into that part of the knitted goods which hangs on the other side of the bar 3, and this weight will then run down with and carry the work being knitted, as the machine is being run backward and forward. This bar is a most important improvement and aids in knitting the heel or toe of a stocking, or other goods of that shape.

Instead of the extra weight, the hand may be used in connection with the bar to hold the work down, or both, if required.

The upper part or section *l* of the needle-cylinder may have its outer circumference larger than that of the lower part *m*, (see Fig. 9,) so as to project beyond it, and thus serve to hold down the cam-ring to place. This construction is shown in Fig. 9. Or the ring *k* for holding the needles to place may be attached to the lower or under section of the needle-cylinder, as shown in Fig. 8, and in such case this needle ring or clasp can also

admit of the needles being put in or taken out without the need of opening or removing the clasp. The clasp may remain fixed in position, and the needle-cylinder may be unclamped or unscrewed at the bottom, when it is necessary to take the machine to pieces. The needle clasp or ring may be endless, if desired, or open.

The cams and switches for operating the needles, and automatically effecting the changes, on reversing the machine, are shown in Figs. 4 and 6.

In Fig. 4, the parts 6 6 are fixed or stationary, and the parts 7 7 are shifting parts, to be changed automatically, as shown in Fig. 6, or in any well-known manner.

I claim—

1. The combination, with the cam-ring B, and the detachable and movable needle-rest D, of the yarn-carrier G connected thereto, whereby the said yarn-carrier is automatically operated and brought into proper relative position to deliver the yarn to the needles upon the rotation of the machine in either direction, substantially as and for the purpose set forth.

2. The needle-cylinder C, formed of the two grooved parts *l m*, constructed substantially as described, whereby the needles may be inserted or removed without the necessity of disturbing the clasp.

3. The combination, with the needle-cylinder, having notches 4, of the bar or rod for holding down the work, substantially as described.

4. The combination, with the scaled or indexed ring or segment, of the pin *y*, spring-tooth *x*, and friction spring or springs *f'*.

5. The cam-carrying plate and needle-rest, constructed and combined as described, so that one of them may be shifted upon the other, to overcome the distance between the needle rest or guide and the cams, substantially as shown and described.

6. A yarn-stand, constructed substantially as shown and described, in combination with the take-up wire, the yarn-carrier, and spool-stand, all constructed and arranged to operate substantially as described.

7. In combination with the cam-ring B, and the cams or switches 6 6 connected thereto, the detachable and movable needle-rest D, arranged as described, whereby all the needles are automatically operated in knitting a heel, toe, or flat web, with all needles in place, substantially as described.

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Witnesses:

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