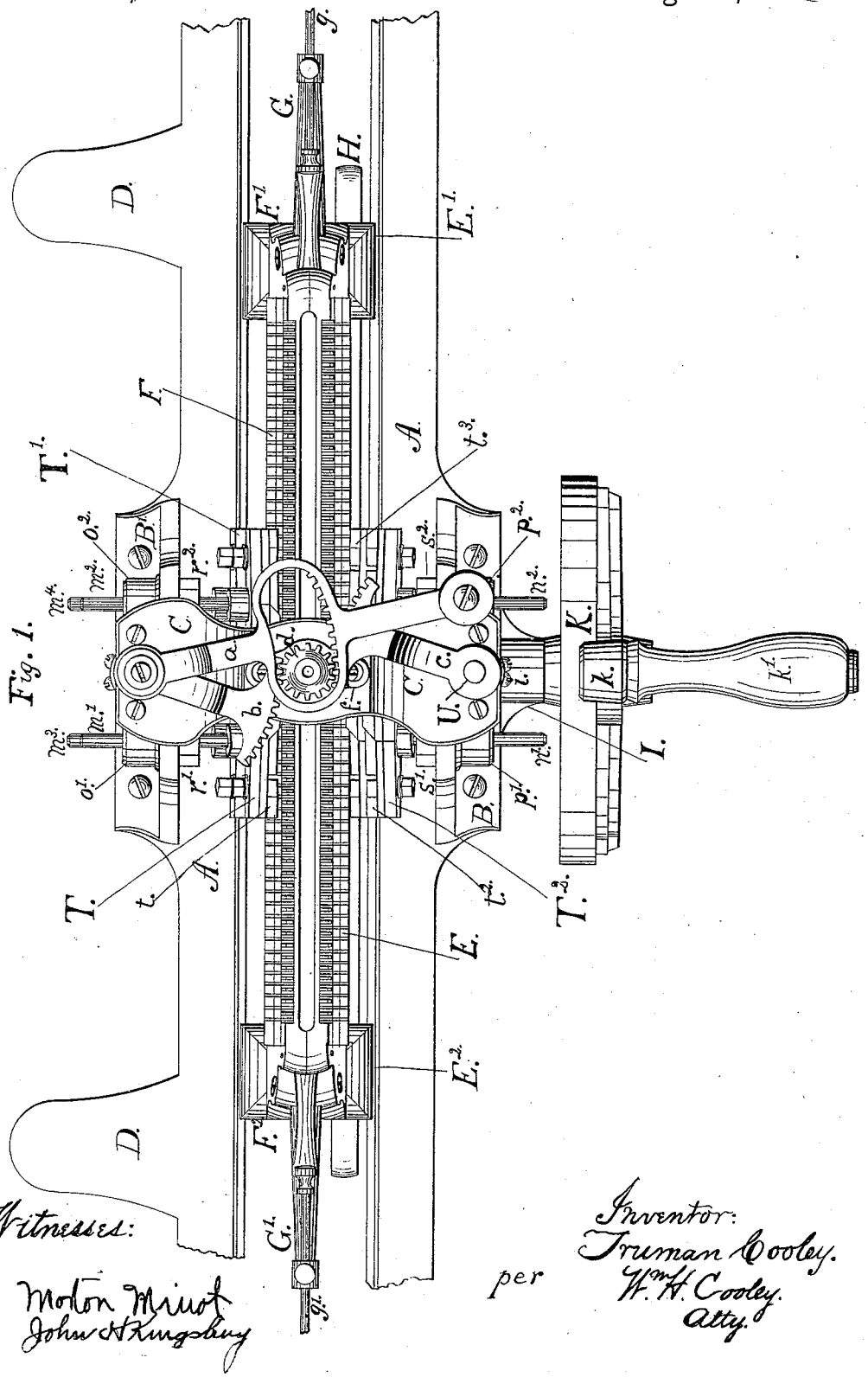
(Model.) 3 Sheets—Sheet 1.

T. COOLEY.

KNITTING MACHINE.

No. 304,178. Patented Aug. 26, 1884.

Fig. 1.



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(Model.) 3 Sheets—Sheet 2.

T. COOLEY.

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Fig. 2.

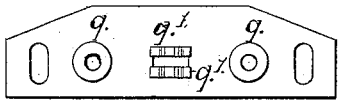


Fig. 3.

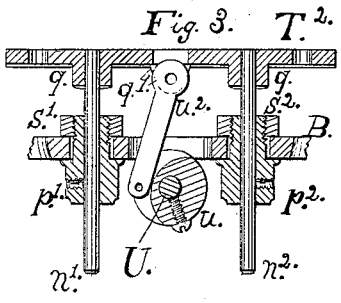


Fig. 4.

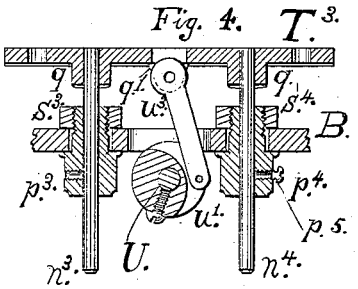


Fig. 5.

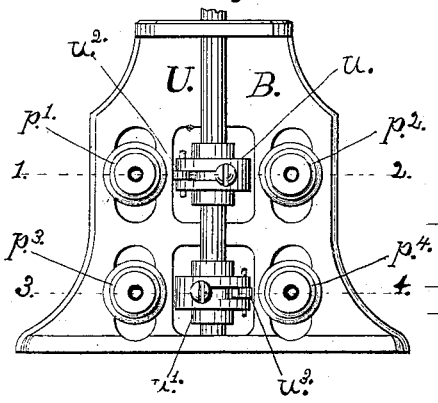


Fig. 6.

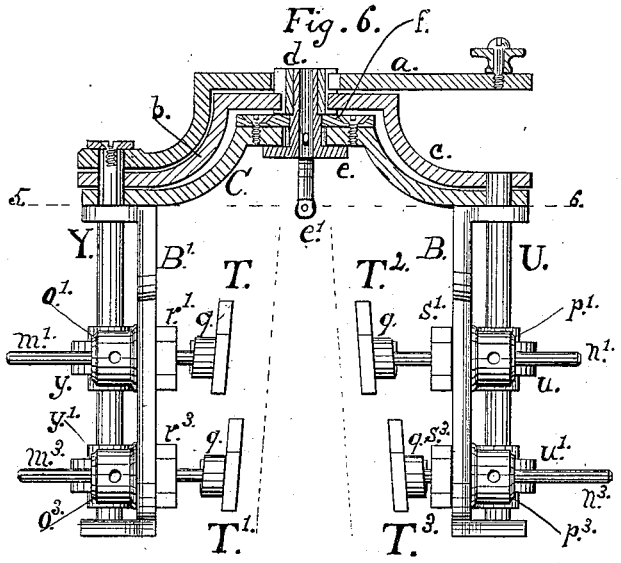


Fig. 7.

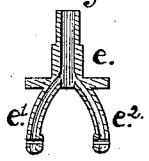
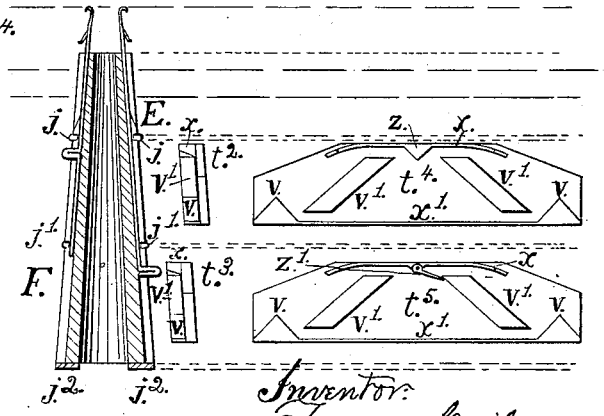


Fig. 8.



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(Model.) 3 Sheets—Sheet 3.

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KNITTING MACHINE.

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Fig. 9.

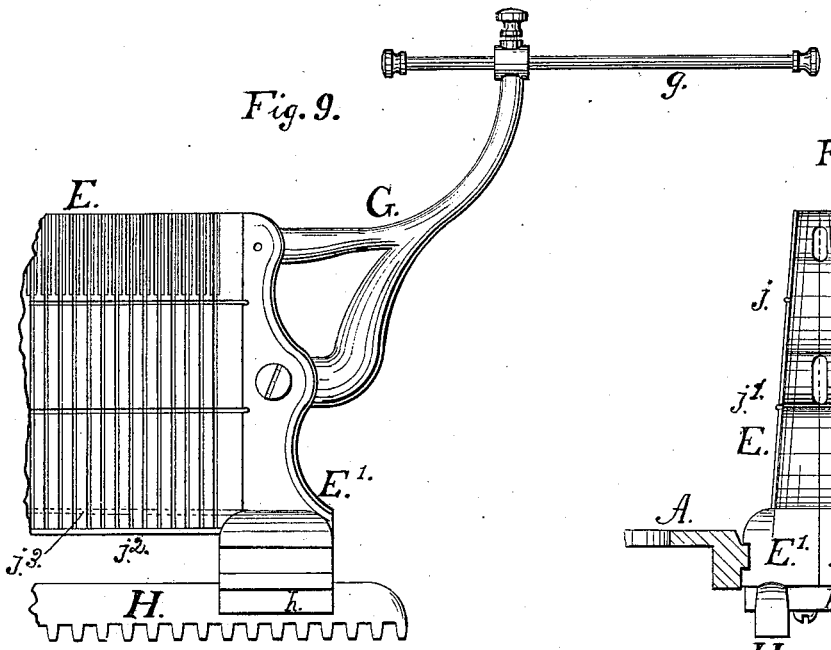


Fig. 10.

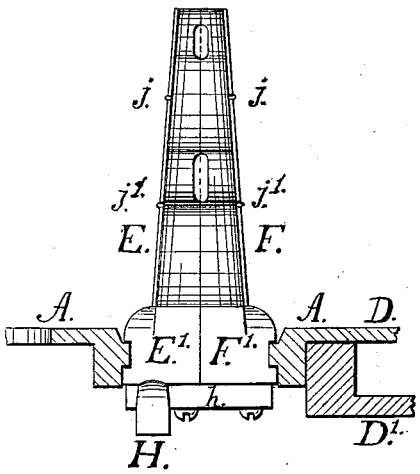


Fig. 11.

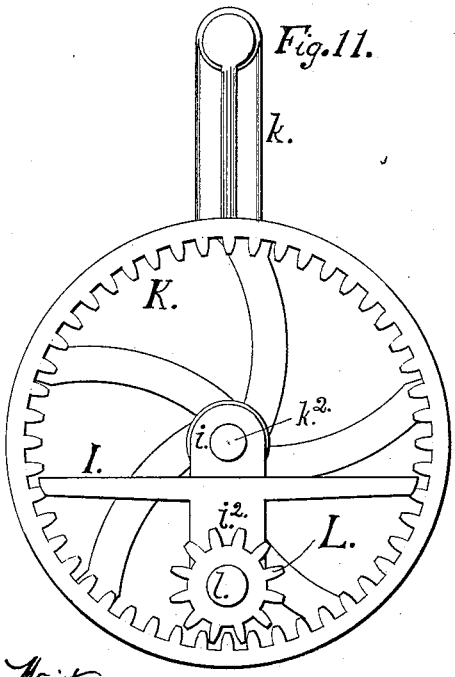
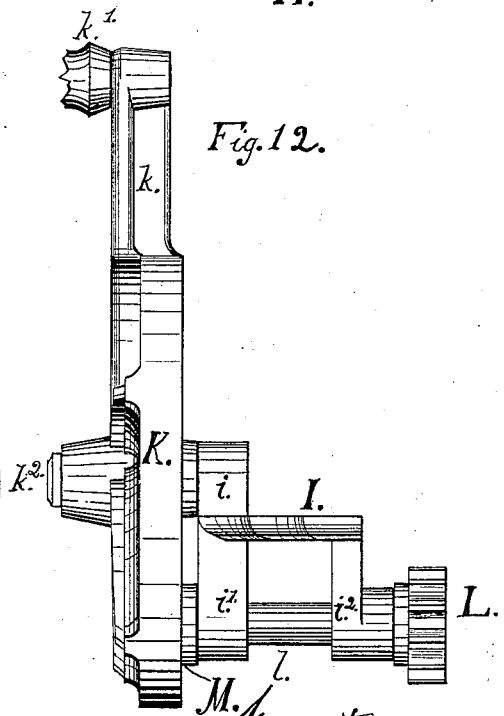


Fig. 12.



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Inventor:
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Atty.

UNITED STATES PATENT OFFICE.

TRUMAN COOLEY, OF BROCKPORT, NEW YORK.

KNITTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 304,178, dated August 26, 1884.

Application filed July 31, 1880. (Model.)

To all whom it may concern:

Be it known that I, TRUMAN COOLEY, a citizen of the United States, residing at Brockport, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Knitting-Machines, of which the following is a specification.

The object of my invention is the construction of a machine which shall be capable, with but slight changes in its adjustments, of knitting either single or double circular work, as desired, which shall have increased capacities for adjustment, and which shall have as many as possible of its corresponding parts exactly similar and interchangeable.

The accompanying drawings, illustrating a knitting-machine embodying my improvements, are as follows:

Figure 1 is a top view of so much of the machine as is essential to illustrate my invention. Fig. 2 is an outside face view of any one of the cam-beds. Figs. 3 and 4 show each a horizontal section through the standard B, with the mechanism thereto attached, taken along the dotted lines 1 2 and 3 4, respectively, shown on Fig. 5. Figs. 3 and 4 show also the cam-beds and their guide-rods attached. Fig. 5 shows an outside face view of standard B, with the cam-beds and their guide-rods removed, so as to show only the standard and its vertical shaft, with the cranks thereon, and their connecting-rods. It also shows the tubular guide-bolts in the outside vertical slots in the standard. Fig. 6 shows a side view of the standards B and B′, with their attachments, and also a side view of the cam-beds with their guide-rods, and above the dotted line 5 6 is shown in vertical section the plate connecting the standards at their upper ends, the shifting-lever, the toothed sectors, and the yarn-carrier, all placed in the center of their motions or courses. Fig. 7 shows a vertical section of the yarn-carrier, taken at right angles with the one shown in Fig. 6. Fig. 8 shows a vertical section through the central portion of the needle-carrier, and taken through the center of any two opposite grooves, showing a needle in each. It also shows a face and side view of an upper and lower cam-plate. It also represents by dotted and broken lines the general operation of the needles, as will be explained. Fig. 9 shows a side view of a part only of the needle-carrier, with the retaining-wires, which serve to keep the needles in place, removed, and beneath the needle-carrier is shown a portion of the rack by which the same is operated; also, at the end of the needle-carrier is shown the arm in which is adjustably secured the rod used to operate automatically the yarn-carrier and the cam-shifter. Fig. 10 represents an end view of the needle-carrier with this arm removed, showing the mortises in which the tenons on the ends of the prongs of this arm are secured. It also shows the manner in which the needle-carrier is connected with and operates on the bed of the machine, which is shown in section. Figs. 11 and 12 represent a rear and side view, respectively, of the driving mechanism to the machine. Noticeably in Figs. 6 and 8 the relative working positions of parts are sacrificed to perspicuity in showing form of construction.

My machine has a substantial bed-plate, A, of iron, shown only partially in Fig. 1. This bed is continuous or in one piece, the front and rear sides being connected by semicircular ends presenting the same sectional form with the main body of the bed, which is made long enough to admit of the requisite throw of the needle-carrier. Extending to the rear from the back side of the bed A are two projections, D, beneath each one of which is a similar one, D′, but thicker and formed of a separate piece from the bed of the machine, and securely fastened thereto by means of screws or rivets. (Not shown.) One of each of the projections D and D′ is partially shown in section in Fig. 10. By means of thumb-screws or other equivalent devices (not shown) passing through these lower projections, the machine may be clamped to a table or other support.

To the bed A are screwed the slotted standards B and B′, of iron, by means of their lower lateral projections, which rest upon similar projections on the bed A. Standards B and B′, as shown in Figs. 1 and 6, are connected together at the top by means of the curved plate C, of iron, which is screwed at its ends to the upper lateral projections on standards B and B′. Through either end of plate C and

through the upper and lower projections on standards B and B′ are drilled holes, which form the bearings for the vertical shafts U and Y.

To the shaft U are secured the peculiarly-constructed cranks u and u', which communicate motion to the cam-beds T^2 and T^3, respectively, and to the shaft Y are secured the similar cranks, y and y', which communicate motion to the cam-beds T and T′, respectively.

As standard B and its attachment are exactly similar in construction and operation to standard B′ and its attachments, it will be sufficient to explain more fully the construction and operation of standard B and its attachments, for which purpose reference is made to Figs. 1, 3, 4, 5, and 6, where U represents the vertical shaft; u and u', the upper and lower cranks, capable, as shown, of vertical and angular adjustment on shaft U, and secured in any desired position thereon by means of set-screws, as shown. Crank u communicates its motion to cam-bed T^2 by means of the connecting-rod u^2, which articulates with the bed T^2 by means of a pin passing through the two central projections, q' q', shown on the cam-bed in Fig. 2, the lower one only of such projections being shown partially in dotted lines in Figs. 3 and 4, and the end of connecting-rod u^2 extending into the mortise formed between such projections. In the same manner crank u' communicates its motion to cam-bed T^3 by means of the connecting-rod u^3. The motion of cam-bed T^2 is confined to a plain reciprocating motion by means of the guide-rods n' and n^2, securely fastened in the circular projections therefor, q q, formed on cam-bed T^2 near the ends thereof, and passing through the tubular guide-bolts p' and p^2, the threaded shanks of which pass through the upper outside slots in standard B, and are secured in any desired position therein by means of the nuts s' and s^2. In the same manner the motion of cam-bed T^3 is controlled by guide-rods n^3 and n^4, working in the tubular guide-bolts p^3 and p^4, secured in the lower outside slots in standard B by means of the nuts s^3 and s^4.

The letters q' q' are used to designate the central projections on any and all of the cam-beds, while the letters q q are used in the same manner to designate the outside circular projections on all of the cam-beds.

It will be noticed that cranks u and u' are placed with their pins diametrically opposite each other, so that the same motion that throws one cam-bed forward into use throws the other back out of use. The same may be said in regard to the cranks on shaft Y, together with all their connections. The connecting-rods between each of these four cranks and the corresponding cam-bed actuated thereby, it will be seen, pass through the upper and lower middle slots in standards B and B′. All of the slots in standards B and B′ admit of considerable adjustment in height of the cam-beds, together with their guide-rods, connecting-rods, and cranks, each of which cranks is capable of adjustment on its shaft both vertically and angularly, and thereby the cam-beds operated therefrom may be brought into any desired position at any point of the throw of such cranks.

Fig. 2 shows an outside face view of any one of the cam-beds, which, it will be noticed, has near each end, as shown in Fig. 2, a vertical slot, by means of a bolt passing through each of which slots, as shown in Fig. 1, and into the cam-plates t, t', t^2, and t^3, near the ends thereof, the cam-plates are each one secured at each end adjustably in height on their cam-beds.

Referring to Figs. 1 and 6, a is the shifting-lever, articulating at its rear end on the upper end of shaft Y, and held in position thereon by means of a washer and screw, and terminating at its forward end in a handle, as shown. Lever a is widened out at or near its middle on each side by means of semicircular lateral projections, which inclose a broad lateral slot semicircular at its ends, and having its sides in the form of an arc of a circle of which the center is over the center of shaft Y. The front or concave side of this slot has cogs on it engaging those on pinion d, the extreme diameter of which is a little less than the width from front to rear of this slot in lever a. This slot, in turn, is of such a length that the extreme throw of lever a will cause pinion d to make just one-half of a revolution.

Referring to Fig. 6, pinion d is secured to the tubular shaft e, which works in plate f, and passes through an opening in plate C. By means of plate f, which has a slot in each end thereof, as shown, and is secured by means of screws passing therethrough to plate C, this pinion d may be adjusted in position to conform to the requirements of lever a. Pinion d extends down to plate f, and the shaft e is prevented from rising at any time by means of the flange thereon coming just below plate C, all as shown in Fig. 6. Tubular shaft e terminates at its lower end in two curved tubular arms, e' and e^2, through each of which a hole is bored horizontally at or near its lower end, as shown in section in Fig. 7, so that the two strands of yarn, either of the same or different colors, when brought down into shaft e, may be separated, and one brought down through either of the tubes, e' and e^2, passing out from each through the opening on the side thereof toward the center of shaft e. Tubes e' and e^2 are placed just far enough apart to admit of the free and uninterrupted passage between them of the needles when the same are up and in operation.

Referring to Figs. 1 and 6, pinion d, it will be seen, engages at the rear the toothed sector b, which in turn is secured to and communicates its motion to shaft Y. Pinion d also engages in front the toothed sector c, which in turn is secured to and communicates its motion to shaft U, whereby it will be seen that

the to-and-fro motion of lever *a* communicates an oscillating motion to shafts U and Y, and thereby, by means of the mechanism already above described, causing a backward and forward movement of the cam-beds with the cam-plates attached, and at the same time each throw of lever *a* causes a semi-revolution of pinion *d* and shaft *e*, causing tubes *e'* and *e²* to exactly change places at each such semi-revolution. Pinion *d*, tubular shaft *e*, and tubular arms *e'* and *e²* constitute the yarn-carrier.

Referring to Figs. 1, 8, 9, and 10, E and F represent the front and rear plates of the needle-carrier, which are of cast-iron, and are exactly similar and interchangeable. Each plate is grooved vertically to a sufficient depth to receive the needles and allow of their free operation behind the retaining-wires *j j* and *j' j'*, which are placed in the horizontal grooves on the outside of each plate, there being two retaining-wires, as shown, on each side of the needle-carrier, the lower wire serving also as a rest for the upper needles, being those operated on only by an upper cam-plate when they are down out of use, the lower needles being those operated on only by a lower cam-plate when the same are down out of use, resting on plates j^2 j^2, secured to the bottom of either side plate of the needle-carrier, as shown. The needles are of the usual form, but proportioned to meet the requirements of this machine. They are arranged in the vertical grooves on each side of the needle-carrier or bed in such a manner that on each side thereof every other vertical groove has in it a long or lower needle capable of being operated only by a lower cam-plate, and every intermediate vertical groove has in it a short or upper needle capable of being operated by an upper cam-plate only. Sometimes when shorter needles are used there may be employed in place of the plates j^2 j^2 retaining-wires located near the bottom of the needle-carrier, and in grooves like the others, the position of one such groove being indicated in dotted lines on Fig. 9 at j^3.

Referring to Fig. 8, which shows at E and F a vertical section of the body of the needle-carrier at or near its center and through the centers of any two of the oppositely-situated vertical grooves in each side thereof, an upper needle is seen at the highest point of its throw in plate F and a lower needle at the highest point of its throw in plate E.

It will be noticed that the vertical grooves on either side of the needle-carrier are widened out just above the upper retaining-wire, so as to give room for the formation therein of the stitches, and that all of the needles, whether operated on by upper or lower cam-plates, have exactly the same throw and take and form their stitches in exactly the same way and all exactly on the same horizontal line.

Referring to Fig. 1, *t*, t^2, and t^3 represent three of the four cam-plates, the cam-plate *t'* being concealed beneath cam-plate *t* and its bed T. The construction of these plates is more fully shown in Fig. 8, where t^2 and t^3 represent a side view of the forward upper and lower cam-plates, and t^4 and t^5 face views of the same. Each cam-plate, as shown in Fig. 8, consists of a thin metallic plate, t^2, t^3, t^4, and t^5, to which is firmly secured at each lower corner thereof the raisers V V, which are also of metal and triangular in form, as shown, and are connected by a thin metallic fence, X', which projects the same distance from the plates as the raisers, and prevents the needles operated on by these plates from falling down out of use or from catching on the inner edge of any of the raisers. Placed at equal distances from the centers of these plates and a short distance above these lower fences, and inclined at equal angles, though in directions such that they approach each other toward the top, are secured the equal rhomboidal prisms V' V', projecting from the plates equally with the raisers. At the top of these plates is another fence, X, extending slightly beyond the angle on either side of the top of the plates, and curving downward slightly at each end. This fence prevents the needles from rising too high from any cause. In the center of the top of each plate and at the center of the upper fence is either a triangular depressor, Z, as shown on face view of plate t^4 in Fig. 8, or a pendulous-arm depressor, Z', as shown on face view of plate t^5 in Fig. 8, the office of either one of which is to throw the needles down, so as that when the center of any cam-plate shall have been passed by any needle, then that needle, by means of the foot or projection thereon, shall be lowered so that such foot or projection shall be caught by the lower and inner edge of the next rhomboidal prism V', and the needle thereby carried down to the lowest point of its throw. As all of the needles work in a similar manner, it will be sufficient to explain more fully the operation of any one of them in connection with the cam-plate which operates it—for instance, one in plate E actuated by cam-plate t^3, a face view of which is shown at t^5. For convenience, suppose the needle-carrier to be moving from left to right with regard to Fig. 8. First, if the needle is down out of use, its foot rests upon one of the plates j^2 at the bottom of the needle-carrier, and it will not be operated upon at all by the cam-plate; but when it is in use it will be sustained by the work in the machine, so as to bring its foot high enough to be engaged by the raiser V at the left-hand end of cam-plate t^5. This will raise it so as to be engaged by the left-hand rhomboidal prism V', which will carry it up along its outer edge and along its top, after leaving which it will encounter the pendulous arm Z', which will lower it so that it will be engaged by and carried down along the inner edge of the right-hand rhomboidal prism V' until it reaches the bottom of the same, between which and fence X' it will pass until it encounters the right-hand raiser V,

which will raise it, and it will pass out from the cam-plate.

In Fig. 8 the upper broken line represents the point of highest throw of the tops of the needles, in the same way the middle broken line represents the lowest throw of the needles when in use, and the lower broken line represents the position of the tops of the needles when they are down out of use. The single dotted line represents the top line of the needle-carrier. The upper double dotted line shows the relative position of the upper retaining-wires, and the middle double dotted line shows the relative position of the lower (or middle, as the case may be) retaining-wire, while the lower double dotted line shows the relative position of the plates at the bottom of the needle-carrier used to support the lower needles. Each cam-plate is secured to its corresponding cam-bed by means of bolts, as shown in Fig. 1, and, as hereinbefore described, passing through the vertical slots in the cam-beds. It will be noticed that the cam-plates produce the same operation on the needles, no matter in which direction the needle-carrier happens to be going, so that at each throw of the needle-carrier each needle in use at that throw operates and takes its stitch. Plates E and F of the needle-carrier respectively terminate at each end in enlarged projections E′ E^2 and F′ F^2, extending downward between the sides of the bed of the machine, and grooved to receive and operate upon a tongue projecting inwardly from the inner edge of each side of the bed A of the machine, as shown in Figs. 1 and 10.

Referring to Figs. 1, 9, and 10, to the bottom of the needle-carrier is attached a rack, H, by means of plates *h*, cast solid therewith, and secured to the under side of the needle-carrier by means of screws, as shown, which serve also the purpose of keeping the plates of the needle-carrier together. There are on rack H two of these plates *h*—one at each end—coming just under the projections on the needle-carrier, only one end of which, with its projections thereon, is seen in Fig. 10.

Referring to Figs. 1, 11, and 12, plate I has an upward semicircular projection, *i*, screwed into and projecting horizontally from the center of which is a bolt, k^2, forming the shaft on which revolves wheel K, which has a radially-projecting arm, *k*, to which is attached the handle *k′*, all as shown. Wheel K is geared internally to engage the teeth of a pinion, M, the hub only of which is shown in Fig. 12. This pinion is exactly similar to one, L, secured to the other end of shaft *l*, as shown. Plate I has also two downward projections, *i′* and i^2, which form the bearings for shaft *l*. Plate I is attached to the under side of the extension on the front side of the bed A by means of the same screws which secure the standard B in position, these screws extending down through the bed A and into plate I, whereby pinion L is caused to engage rack H, and the turning of wheel K by means of its handle K′ causes the needle-carrier to move along the bed A from one end of its course to the other, when the motion of wheel K is reversed and the needle-carrier caused to go back again to the other end of its course, and so on.

When it is desired to render the action of the cam-shifter and yarn-carrier automatic, curved arms G and G′, with rods *g* and *g′* adjustably secured therein, as shown in Figs. 1 and 9, are secured to either end of the needle-carrier. Rods *g* and *g′* are enlarged and rounded at their ends, and are secured in any desired position longitudinally in arms G and G′ by means of thumb-screws, as shown. Each prong of the forked arms G and G′ is tenoned into a mortise therefor in the ends of the needle-carrier, and secured therein by means of pins and screws, as shown, which serve the purpose, also, of keeping together the two plates of the needle-carrier. Arms G and G′ are so proportioned in height as to bring the inner ends of the rods *g* and *g′* directly opposite the center of the lateral projections on lever *a*. These rods being adjustable longitudinally, they can cause the shifting-lever *a* to operate for any desired length of throw of the needle-carrier.

Referring to Figs. 1 and 6, cam-beds T and T′ are operated from the cranks *y* and *y′* on shaft Y by means of connecting-rods like those on the other side of the machine, and already described. Cam-bed T has guide-rods m' and m^2 working in guide-bolts o' and o^2, which are secured in position by nuts r' and r^2. Cam-bed T′ has guide-rods m^3 and m^4 working in guide-bolts o^3 and o^4, which are secured in position by the nuts r^3 and r^4. Guide-bolt o^4 and its nut r^4 are not shown on either Figs. 1 or 6, being concealed either behind or below another similar bolt and nut; but their position and function will be understood from the mention here made of them and from the general plan of lettering. All of these guide-bolts have the portion of their shanks coming in the slots in the standards B and B′ so widened out vertically and in the direction of the length of the slots as to prevent their turning therein when the nuts on these bolts are being turned. It will be noticed that each one of the tubular guide-bolts has a threaded and radially-extending hole for the insertion of a set-screw in each guide-bolt, one only of such set-screws being shown at p^5 in Fig. 4, whereby, when desired, each cam-bed, together with its guide-bolts, may be securely held in position at any point of its throw, the object of which will be hereinafter explained.

The machine is constructed, mainly, of cast-iron; but brass, steel, and wrought-iron are used where they are most conducive to strength, durability, and economy. The machine is so put together and adjusted that the needle-carrier is in the center of its throw at the same time that the crank or handle on wheel K is vertically over the center of wheel K, and each cam-plate is adjusted in height on its

cam-bed, and also each cam-bed, together with its connecting-rods, cranks, guide-rods, and guide-bolts, is properly adjusted in height to secure the requisite throw of the needles. Then shifting-lever *a* and pinion *d*, together with the tubular shaft *e* and the arms *e'* and *e²*, which constitute the yarn-carrier, (the function of which, it will be seen, is to carry the yarn continuously, each strand, around the work at such a time and in such a manner as to be properly taken up by the needles,) are so adjusted that when lever *a* is placed at either extreme of its throw, then a line joining the lower extremities of the tubes *e'* and *e²* will be exactly at right angles with the needle-carrier, the yarn, as before stated, being supplied from two bobbins, a strand from one passing down through tube *e'*, and a strand from the other passing down through the tube *e²*, the two strands being joined or tied together in the center.

The manner in which the yarn carrier or guide operates is as follows: Starting with the needle-carrier at either extreme of its throw and with lever *a* at either extreme of its throw, the needle-carrier is caused to move along its course toward the other extreme thereof, the yarn being fed or supplied to those needles located in the front side of the needle-carrier from that tubular arm of the yarn-carrier which at that one throw of the needle-carrier happens to be over the needles in the front side thereof, and being fed to those needles located in the rear side of the needle-carrier from that tubular arm of the yarn-carrier which happens at that same throw of the needle-carrier to be over the needles in the rear side thereof. Then, when the needle-carrier has passed to the extreme of its throw in one direction required for the work in the machine, the shifting-lever *a* is moved to the other extreme of its course, thus crossing the yarn at the end of the work and causing each strand to be carried continuously around the work, each in a direction opposite to the other, so that when the needle-carrier is again caused to pass to the extreme of its course in the opposite direction that tubular arm of the yarn-carrier which supplies yarn to the needles in one side of the needle-bed during one throw thereof will supply yarn to the needles in the opposite side of the needle-carrier during the next succeeding throw thereof.

The tension of the yarn may be controlled by any suitable device for that purpose, (not shown,) and the work, it will of course be understood, passes down through the longitudinal opening therefor in the center of the needle-carrier, through which it may be continuously drawn by means of weights suspended from the lower end of the work and adjusted in amount to suit the tension requirements thereof.

The work being set up and started in substantially the usual manner, the operation of the machine is as follows: First, when it is desired to knit double, in addition to the adjustments already described, (which apply to knitting either double or single,) the cranks *u* and *u'* on shaft U and the cranks *y* and *y'* on the shaft Y are each so adjusted angularly on their shafts that when the shifting-lever *a* is at either extreme of its throw there shall be brought forward and toward the needle-carrier, so as to engage and operate the needles therein, one cam bed and plate only upon each side thereof, that cam bed and plate upon each side of the needle-carrier which is thrown forward and into use when the shifting-lever *a* is at one extreme of its throw being thrown back and out of use when this shifting-lever is moved to the other extreme of its throw. Then, shifting-lever *a* being placed at either extreme of its throw, the needle-carrier is caused, by means of the mechanism already described, to pass to the extreme of its throw in one direction, when the shifting-lever *a* is moved to the other extreme of its throw, and then the needle-carrier is moved to the other extreme of its course, and then first the shifting-lever and then the needle-carrier are moved again to the opposite extremes of their respective courses, and so on. Thereby it will be seen that at any one throw of the needle-carrier only every other needle upon each side thereof operates and takes its stitch, and that those needles operating at any one throw do not operate at the next succeeding throw, the result of which, it will be seen, is that, as every other needle only on each side of the needle-carrier is brought into operation at any one throw thereof, each needle in operation at any one throw of the needle-carrier forms a stitch between those formed by the preceding throw and immediately in front of or outside of the yarn or thread connecting those stitches that were formed by and during the preceding throw, thus rendering the work double—that is, having yarns or back stitches on the inside connecting every other stitch, and just behind every intermediate one shown on the outside of the work. The effect of this, when yarns of two different colors are used, is to produce a fabric having a series of unbroken longitudinal stripes upon the outside and a clouded appearance upon the inside or back of the work.

Of course it will be understood that any two similarly-situated stripes upon opposite sides of the work will be of the same or of different color, according as needles situated exactly opposite each other in the needle-carrier are caused to take their stitches during alternate throws or during the same throw of the needle carrier. These changes may be effected, it will be seen, first, by the placing of the needles either so that upper needles shall be opposite to upper needles and lower needles opposite to lower needles, or so that upper needles shall be opposite to lower needles; second, by the adjustment of the cam-beds with their plates attached, so that an upper

one on one side of the needle-carrier is thrown forward and into use at the same time with a lower one upon the other side, or so that both upper cam-beds with their plates attached are brought into use at any one throw, and both lower ones at the next throw of the needle-carrier.

When it is desired to knit single, the connecting-rods w^2 and w^3, together with the corresponding ones on the other side of the machine, are either disconnected from their cranks, or, preferably, entirely removed, and all four cam-beds, with their cam-plates attached, are pushed forward by hand toward the needle-carrier, so as to just clear the same and operate the needles therein, and all are securely fastened in that position by means of the set-screws already mentioned, which are screwed into the threaded holes shown in the tubular guide-bolts, one only of such set-screws being shown at p^5 in Fig. 4. Wherefore it will be seen that as each cam-bed, with its plate attached, is kept in use at each and every throw of the needle-carrier, each and every needle therein operates and takes its stitch at each and every throw thereof, the operation of the machine in all other respects being the same as for knitting double. In knitting single, there being no back stitches, the yarn passes directly from any one stitch to the next adjacent one, thereby requiring practically only one-half as many movements of the needle-carrier to produce a fabric of a given length as are required to produce a fabric of the same length knit double. Single work when knit from yarns of two colors presents a series of lateral stripes upon both the outside and the inside of the work, those upon the outside being zigzag and those upon the inside being straight.

It will be readly understood that by a combination of the two adjustments and methods of operation just described the machine may be caused to produce circular work single upon one side and double upon the other side of the needle-carrier.

In knitting either single or double work, narrowing in or widening out is effected by throwing or passing more needles down out of use or up into use. In knitting double the operation of the yarn-carrier and cam-shifter, and in knitting single the operation of the yarn-carrier, may be rendered automatic, and for any desired throw of the needle-carrier, to suit the width of the work, in the manner already explained, by means of the rods *g* and *g'*, secured in the arms G and G', after being adjusted longitudinally therein.

Having thus described my invention, what I claim is—

1. The combination of the lever *a*, pinion *d*, plate *f*, tubular shaft *e*, provided with the tubular arms *e'* and e^2, bed A, and means for supporting lever *a* and plate *f*, all substantially as and for the purpose described.

2. The combination, with the bed-plate A, needle-carrier E F, needles located and adapted to operate therein, and means for reciprocating said needle-carrier, of lever *a*, plate *f*, pinion *d*, tubular shaft *e*, provided with its tubular arms *e'* and e^2, and means for supporting said plate and lever, substantially as shown and described.

3. The combination of bed A, needle-carrier E F, needles located and adapted to operate therein, means for reciprocating the needle-carrier, arms G and G', and rods *g* and *g'*, adjustably secured in said arms, with lever *a*, pinion *d*, plate *f*, tubular shaft *e*, provided with its tubular arms *e'* and e^2, and means for supporting said lever and plate, all substantially as shown and described.

4. The combination, with the bed A, standards B and B', plate C, lever *a*, pinion *d*, shaft *e*, and plate *f*, of the toothed sectors *b* and *c*, shafts U and Y, cranks *u u'* and *y y'* on each respectively, cam-beds T, T', T^2, and T^3, and the connecting-rods shown between each and its corresponding crank, all substantially as shown and described.

5. The combination of bed A, standards B and B', plate C, lever *a*, pinion *d*, shaft *e*, plate *f*, toothed sectors *b* and *c*, shafts U and Y, cranks *u u'* and *y y'* on each respectively, cam-beds T, T', T^2, and T^3, the connecting-rods shown between each such cam-bed and its corresponding crank, and the cam-plates *t*, *t'*, t^2, and t^3, all substantially as shown and described.

6. The combination, with the bed A, standards B and B', needle-carrier E F, needles located and adapted to operate therein, and means for reciprocating the needle-carrier, of lever *a*, pinion *d*, shaft *e*, plate *f*, means for supporting said lever and plate, toothed sectors *b* and *c*, shafts U and Y, cranks *u u'* and *y y'*, cam-beds T, T', T^2, and T^3, and the connecting-rods shown between each and its corresponding crank, all substantially as shown and described.

7. The combination, with the bed A, standards B and B', needle-carrier E F, needles located and adapted to operate therein, means for reciprocating the needle-carrier, arms G and G', and rods *g* and *g'*, adjustably secured in said arms, of lever *a*, pinion *d*, shaft *e*, plate *f*, means for supporting said lever and plate, cam-beds T, T', T^2, and T^3, and means such as shown for operating said cam-beds from said lever *a* and pinion *d*, all substantially as shown and described.

8. The combination, with the bed A, standards B and B', needle-carrier E F, needles located and adapted to operate therein, means for reciprocating the needle-carrier, arms G and G', and rods *g* and *g'*, adjustably secured in said arms, of lever *a*, pinion *d*, shaft *e*, provided with the tubular arms *e'* and e^2, plate *f*, means for supporting said lever and plate, cam-beds T, T', T^2, and T^3, and means such as shown for operating said cam-beds from said lever *a* and pinion *d*, all substantially as shown and described.

9. The combination of the bed A, needle-carrier E F, needles located and adapted to operate therein, means for reciprocating the needle-carrier, arms G and G′, rods *g* and *g′*, adjustably secured in said arms, lever *a*, pinion *d*, shaft *e*, provided with the tubular arms *e′* and *e²*, plate *f*, means for supporting said lever and plate, cam-beds T, T′, T², and T³, means such as shown for operating said cam-beds from said lever *a* and pinion *d*, and the cam-plates *t*, *t′*, *t²*, and *t³*, each adjustably secured upon its corresponding cam-bed, all substantially as shown and described.

10. The combination of the cam-beds T, T′, T², and T³, with the guide-rods *m′* and *m²*, *m³* and *m⁴*, *n′* and *n²*, and *n³* and *n⁴*, attached to each respectively, the tubular guide-bolts *o′*, *o²*, *o³*, *o⁴*, *p′*, *p²*, *p³*, and *p⁴*, in which each such guide-rod works respectively, the nuts *r′*, *r²*, *r³*, *r⁴*, *s′*, *s²*, *s³*, and *s⁴* respectively securing each of said guide-bolts in position, and the standards B and B′, all substantially as shown and described.

TRUMAN COOLEY.

Witnesses:
JOHN H. KINGSLEY,
MORTON MINOT.