

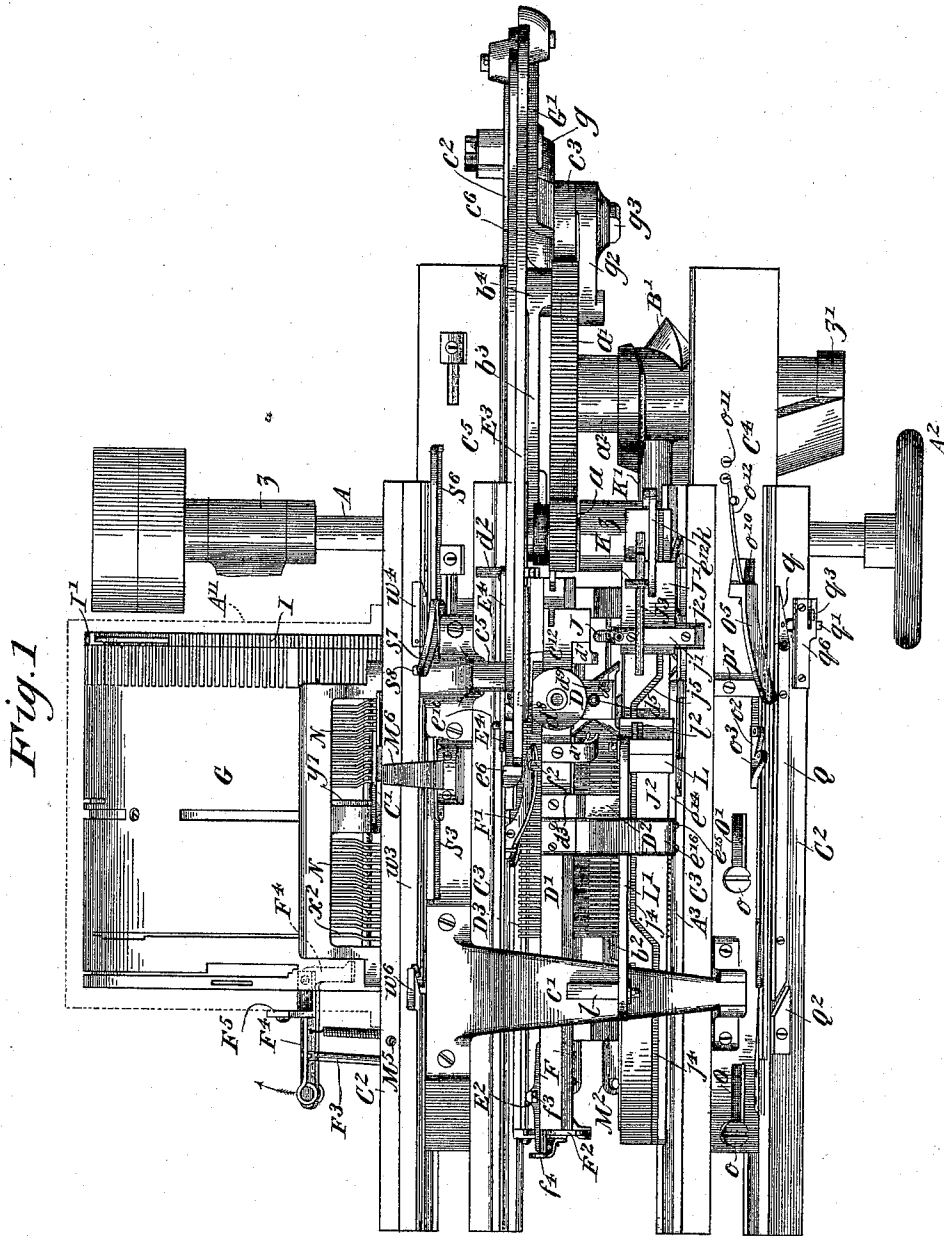
(No Model.)

14 Sheets—Sheet 1.

J. F. NELSON.
KNITTING MACHINE.

No. 585,589.

Patented June 29, 1897.



Witnesses

J. M. Withrow
B. W. Miller

Inventor.

John F. Nelson

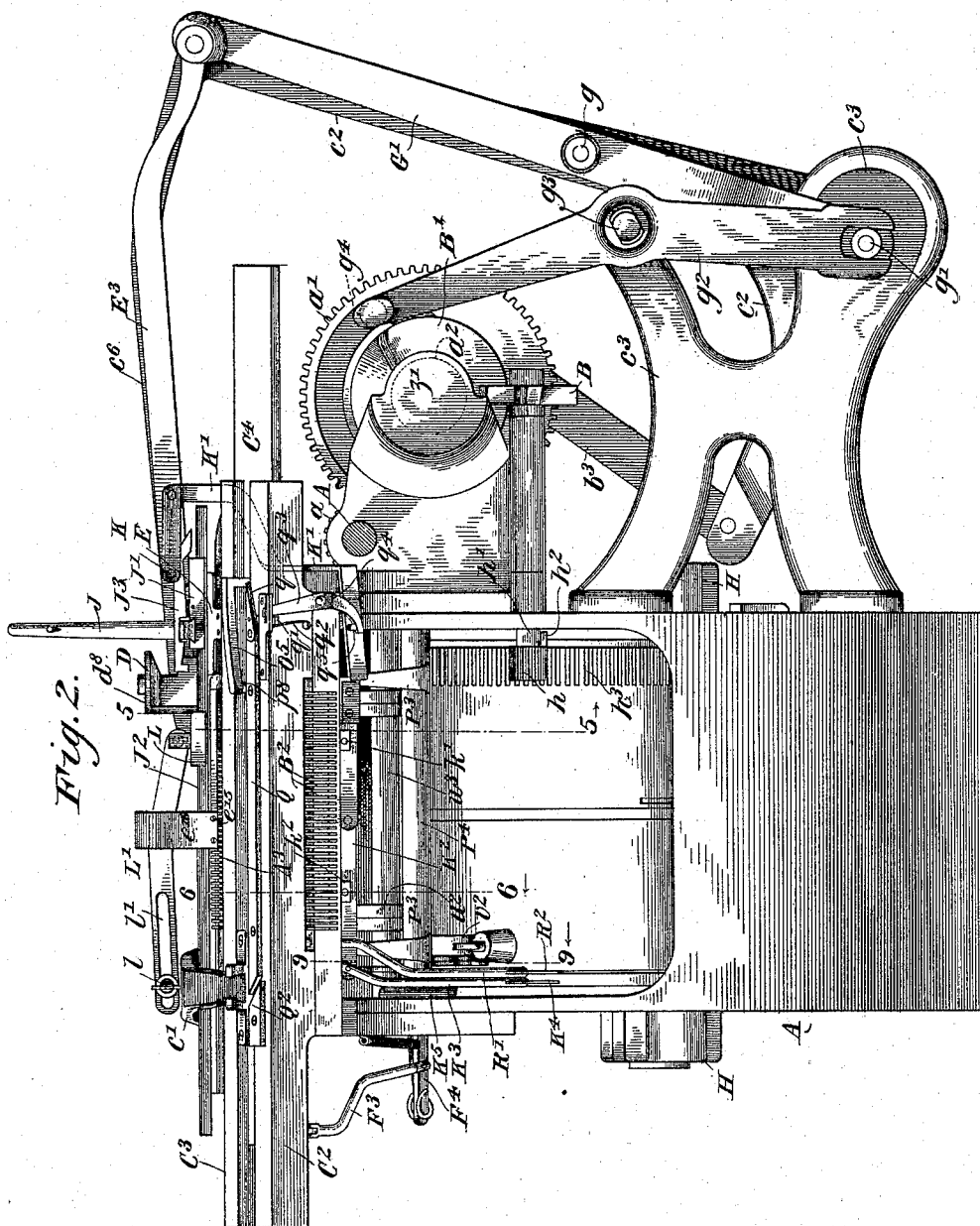
By his Attorneys,

Melvin Davidson Wright

J. F. NELSON.
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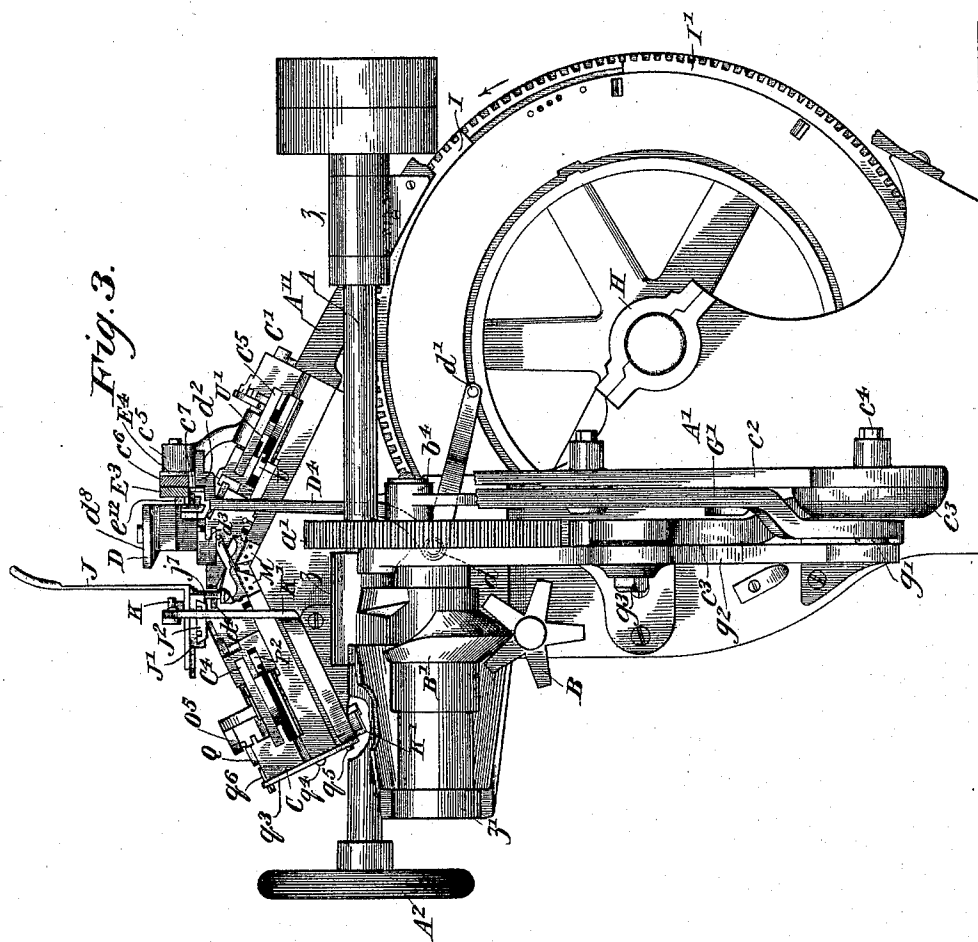
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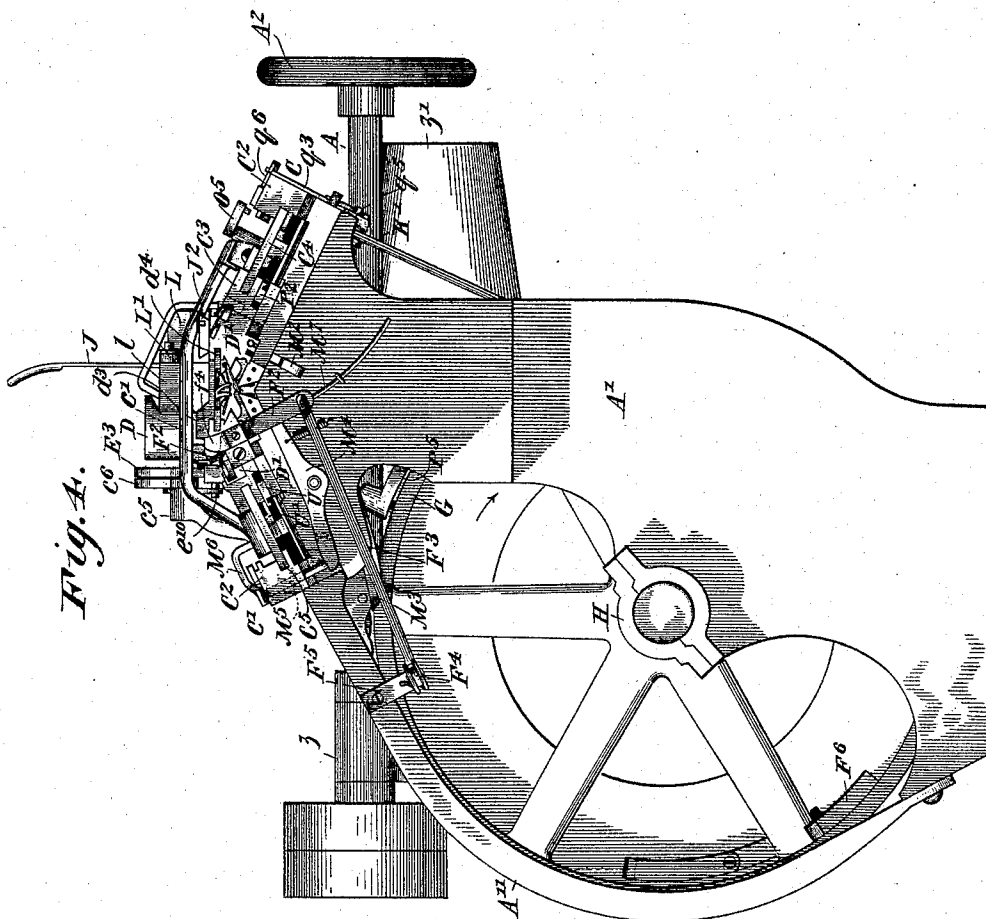
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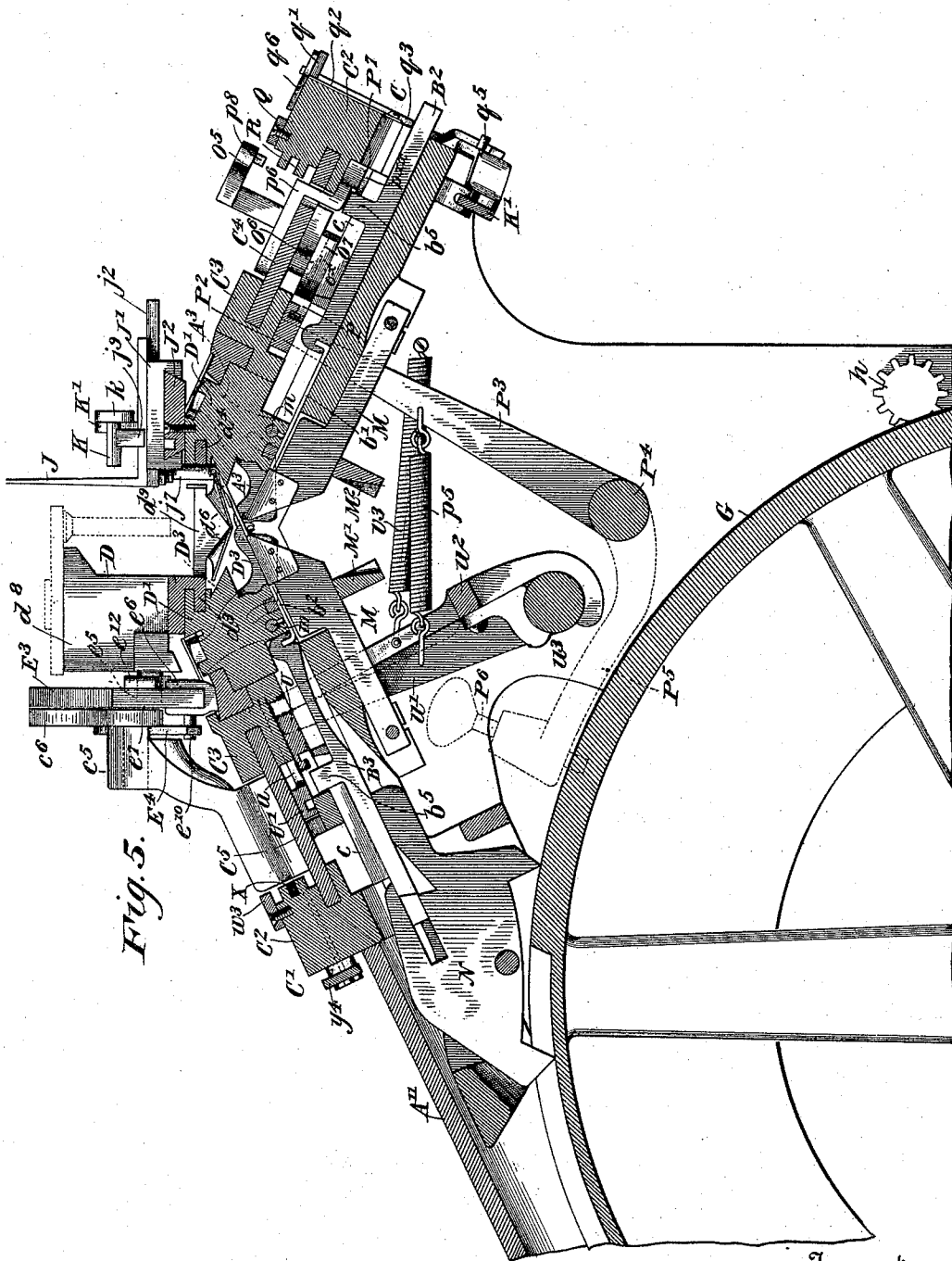
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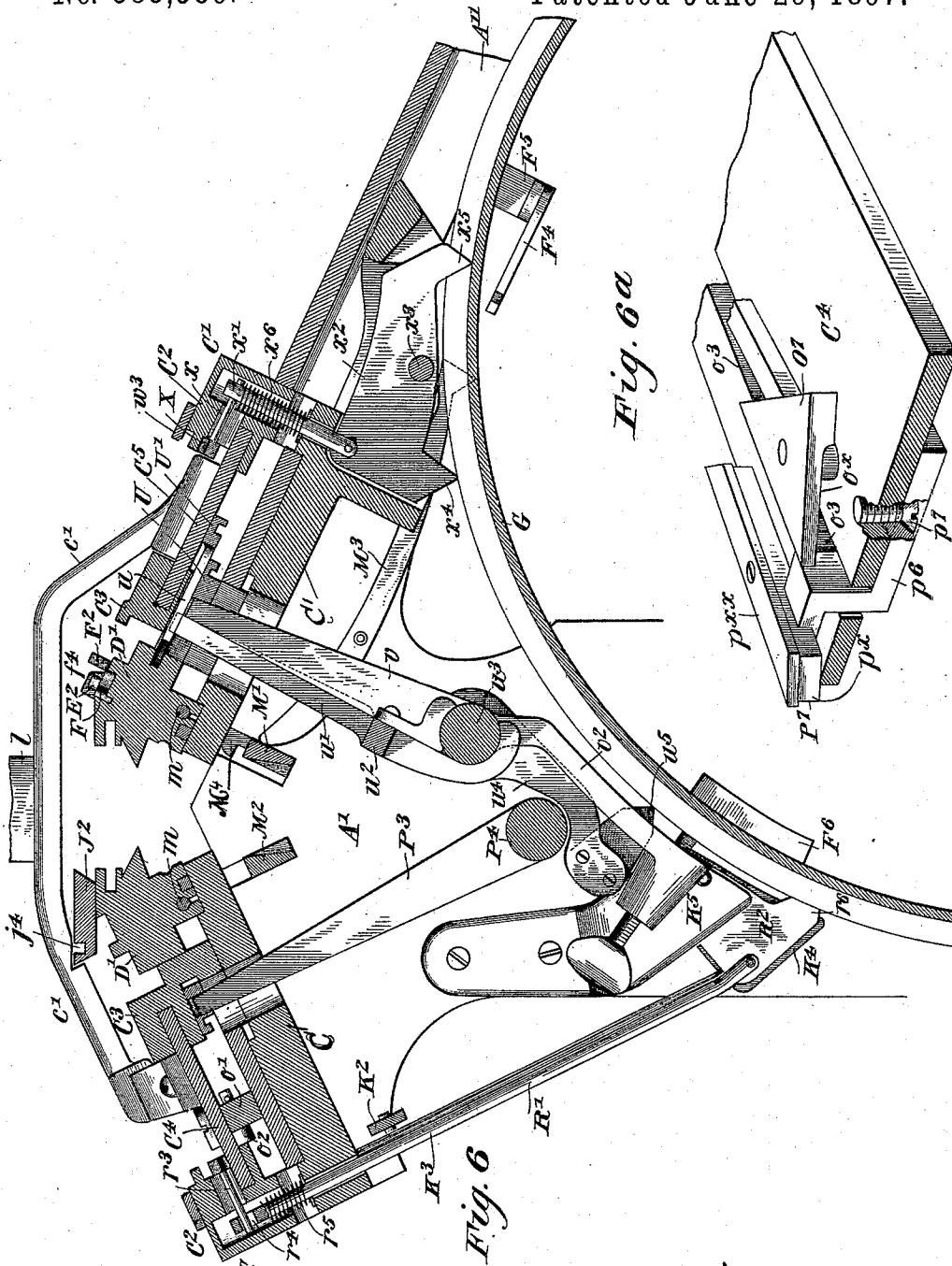
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Fig. 7.

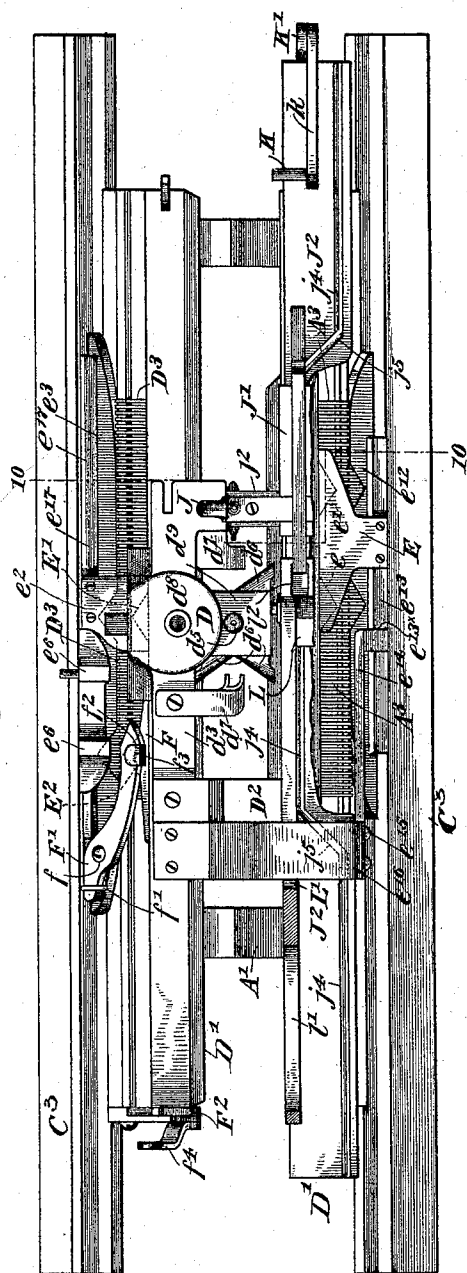
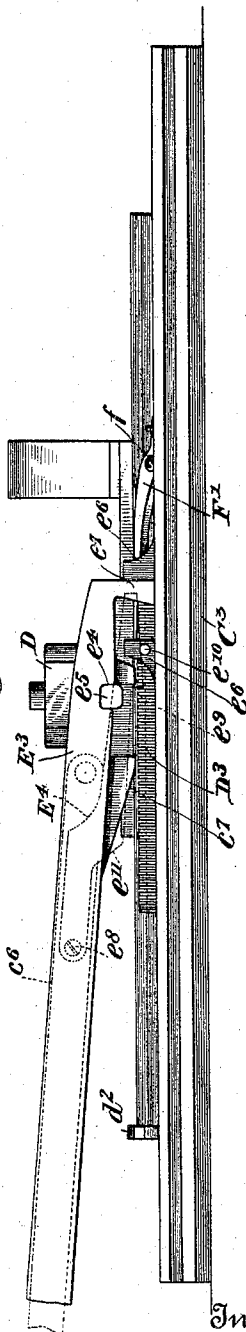


Fig. 8.



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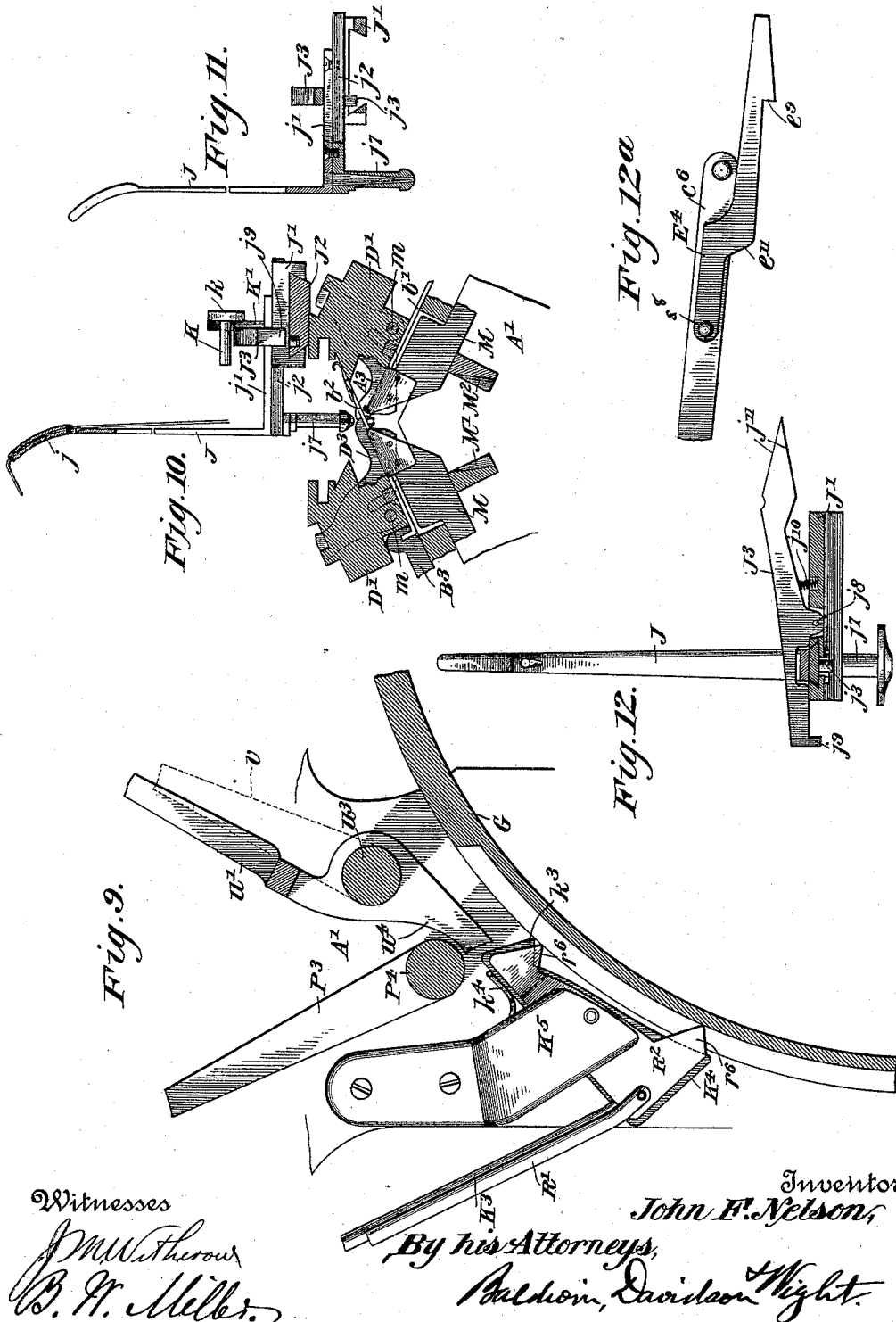
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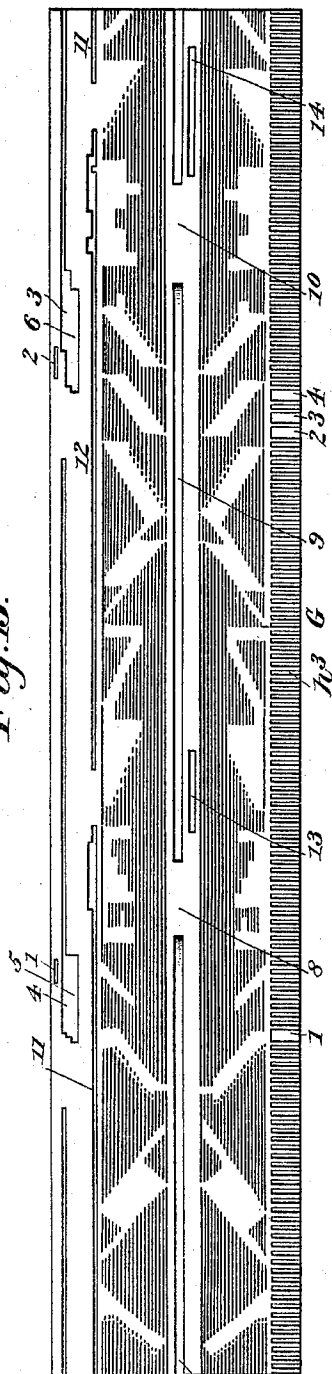
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Fig. 13.



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Fig. 15.

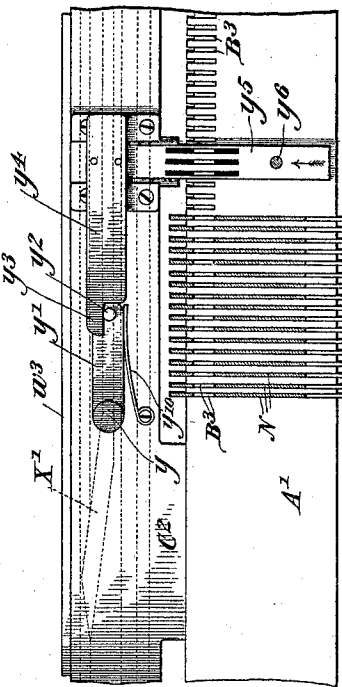
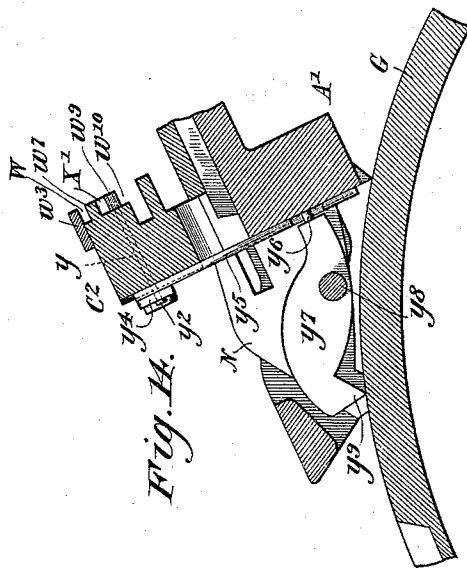


Fig. 14.



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Fig. 16.

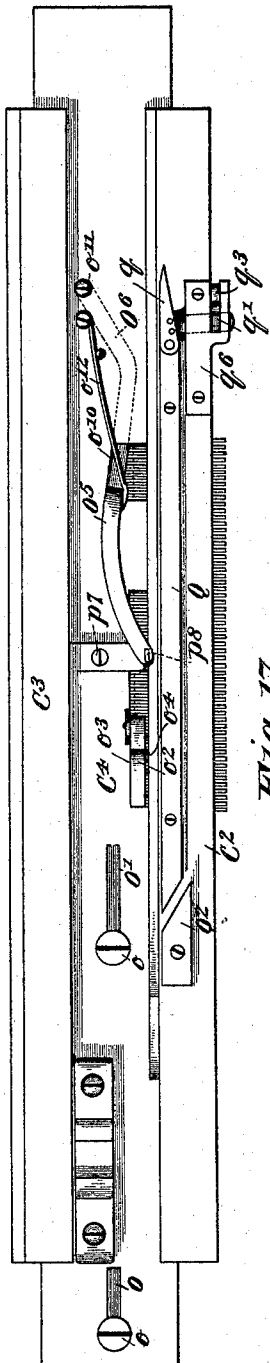


Fig. 17.

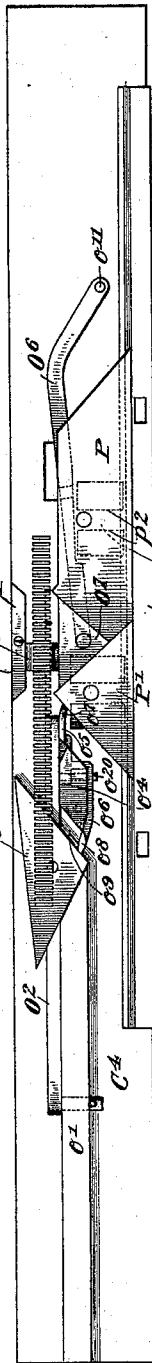


Fig. 18.

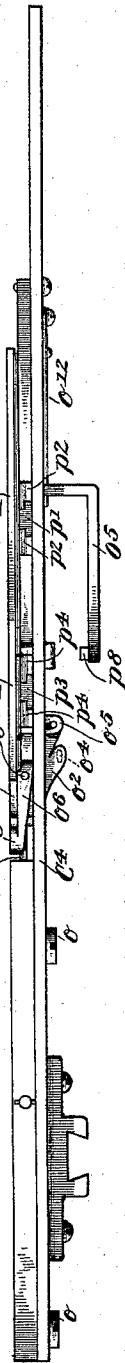
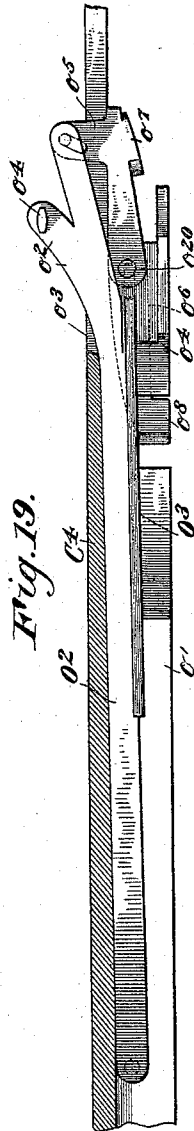


Fig. 19.



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Fig. 24.

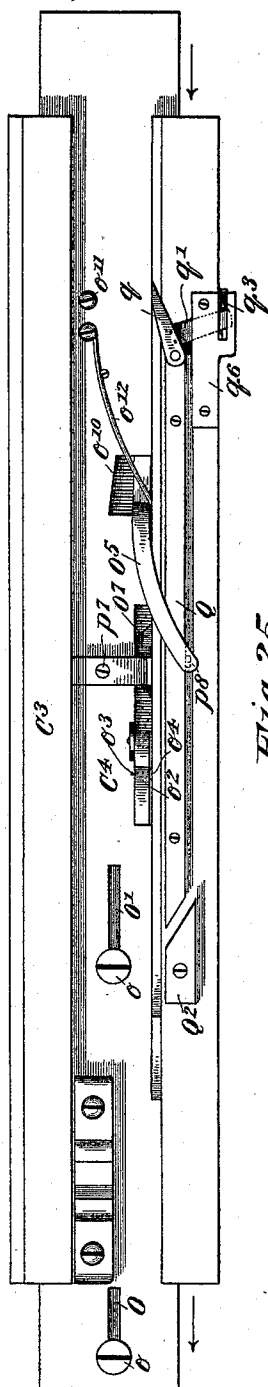


Fig. 25.

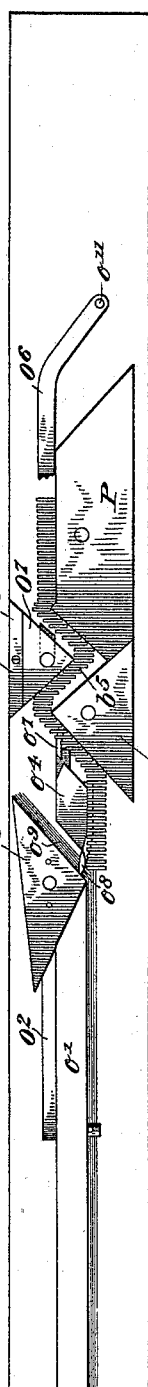


Fig. 26.

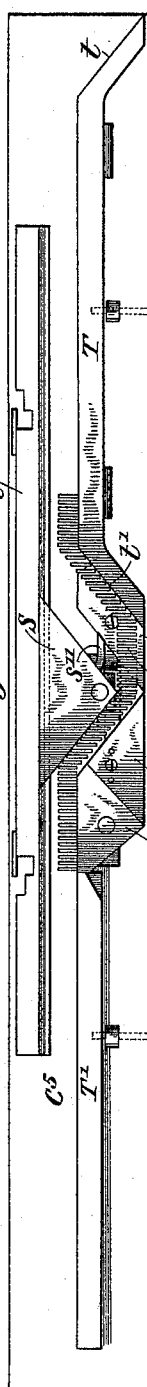
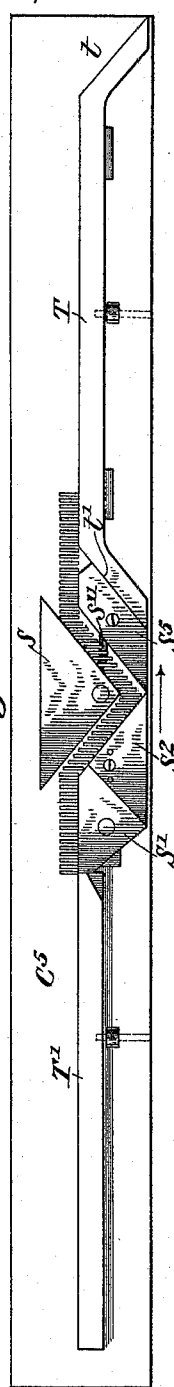


Fig. 27.



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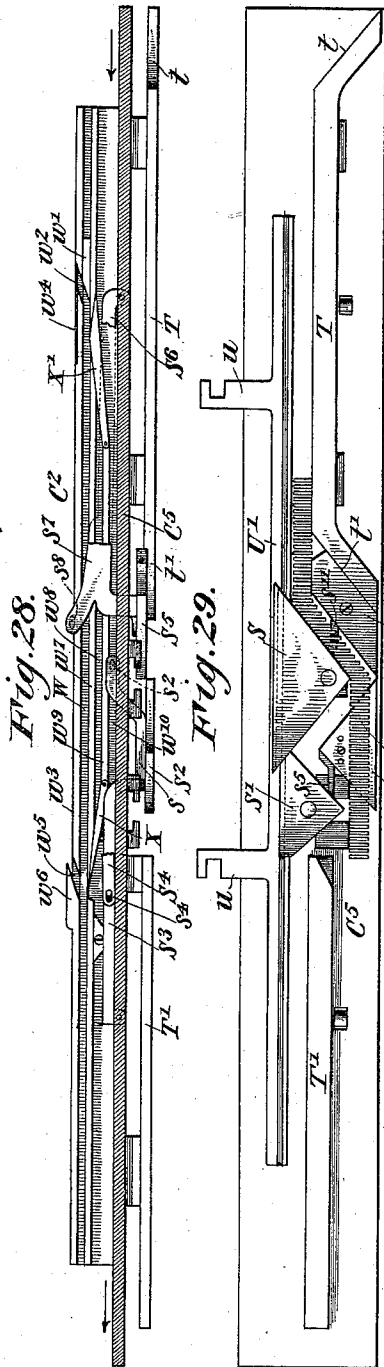


Fig. 30.

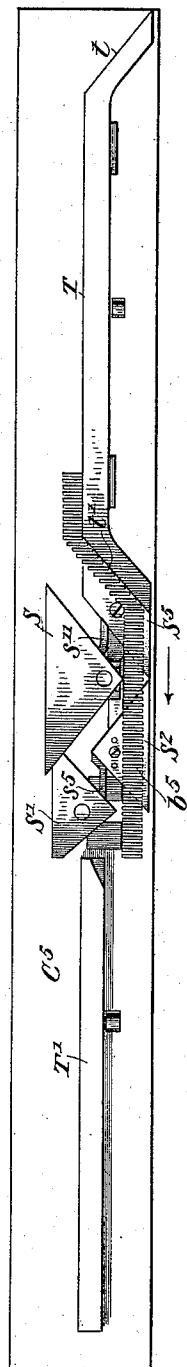
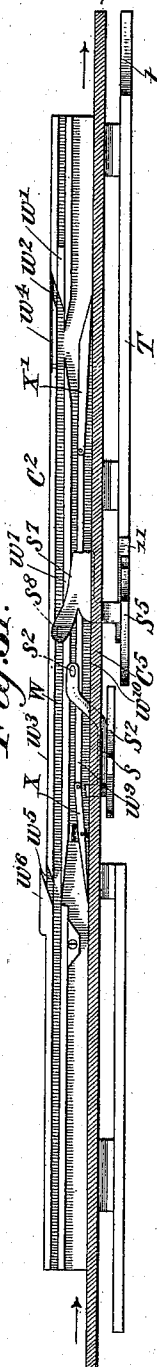


Fig. 31.



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Fig. 32.

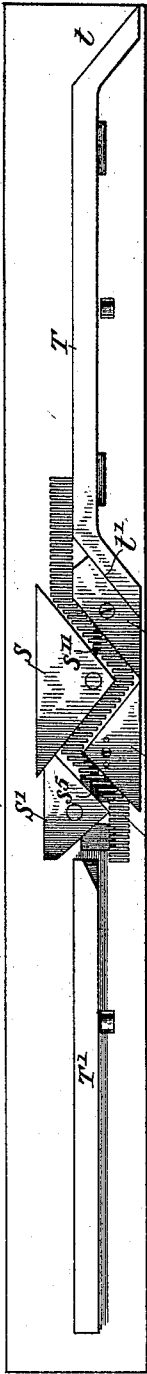


Fig. 33.

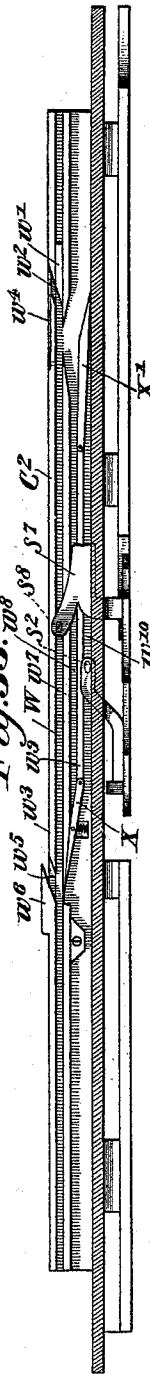


Fig. 34.

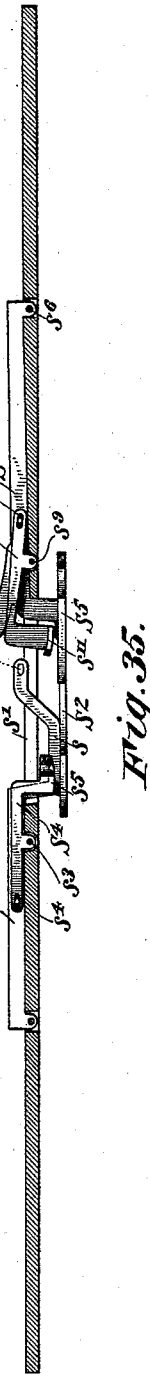
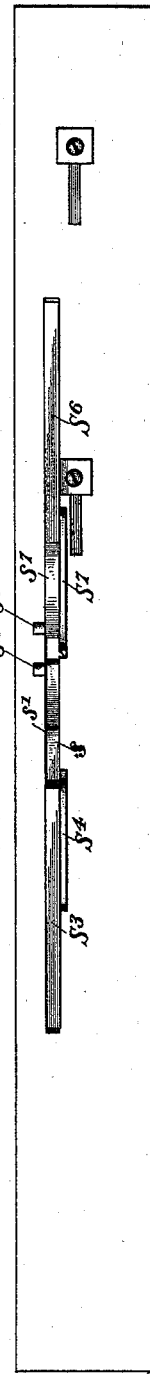


Fig. 35.



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UNITED STATES PATENT OFFICE.

JOHN F. NELSON, OF ROCKFORD, ILLINOIS.

KNITTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 585,589, dated June 29, 1897.

Application filed May 22, 1896. Serial No. 592,606. (No model.)

To all whom it may concern:

Be it known that I, JOHN F. NELSON, a citizen of the United States, residing at Rockford, in the county of Winnebago and State of Illinois, have invented certain new and useful Improvements in Knitting-Machines, of which the following is a specification.

This invention relates to knitting-machines of the class known as "straight-row" or "parallel-row" knitting machines, especially to the type of this class of machines known as the "Nelson" machine, now extensively used at Rockford, Illinois, and shown in Letters Patent to John Nelson, No. 214,308, of April 15, 1879, and No. 576,881, of February 9, 1897. These machines are adapted to knit tubular goods generally, but are especially adapted for knitting socks and hose.

The Nelson machine in operation knits the toe and the heel by the needles of the back row only and the foot and the leg of the sock or stocking by the needles of both the front and back rows. In knitting the toe and the heel the needles of the back row knit twice for each reciprocation or double stroke of the cam-carrying slide, but while knitting the foot and leg the needles of the front and back rows are each actuated but once for each reciprocation or double stroke of the cam-carrying slides, one round being knit at each reciprocation.

The object of my invention is to increase the speed of knitting by causing all the needles, when knitting the foot and leg of the sock or stocking, to knit twice during each reciprocation of their cams. For this purpose I employ an auxiliary yarn-carrier which lays yarn in the needles of both the front and back rows, which are advanced after their retraction immediately following the passage of the first or main yarn-carrier—that is to say, all the needles are actuated twice during a stroke of their cams in one direction and take yarn at two different points from the main and auxiliary yarn-carriers, thus knitting two rows instead of one, as heretofore, at each reciprocation of the slides. Therefore the output of the machine is obviously largely increased. Practically it takes half as long as formerly to knit the foot or that part of the sock between the toe

and the heel and half as long to knit the leg or that part of the sock above the heel.

My improvements may be embodied in machines differing in details of construction, but in the accompanying drawings I have shown them as embodied in the Nelson machine and have shown so much of such a machine as is necessary to understand the construction, organization, and operation of my present improvements.

Figure 1 shows a plan of a Nelson knitting-machine embodying my improvements, the casing of the cylinder being shown in dotted lines. Fig. 2 shows a front elevation of the same; Fig. 3, a right-hand side elevation with some of the parts broken away; Fig. 4, a left-hand side elevation. Fig. 5 shows, on an enlarged scale, a transverse section on the line 5 5 of Fig. 2. Fig. 6 shows, on an enlarged scale, a transverse section on the line 6 6 of Fig. 2, but looking in the opposite direction from that in which Fig. 5 is viewed. Fig. 6^a shows in perspective and in section the manner of securing to the front slide an abutment for the auxiliary advancing cam. Fig. 7 is a detail plan view, on an enlarged scale, showing particularly the yarn-carriers as they appear when both are in operation. Fig. 8 shows a rear view of the same, illustrating particularly the construction and operation of the pitmen which actuate the yarn-carriers and the cam-slides and the presser-hook-operating mechanism. Fig. 9 is a detail view, on an enlarged scale, in transverse section on the line 9 9 of Fig. 2, showing particularly part of the mechanism for actuating the switches which control the grooves forming part of the needle-cam-actuating mechanism and also part of the mechanism for shifting some of the cams. Fig. 10 shows a transverse section on the line 10 10 of Fig. 7. Fig. 11 is a detail view in section of the auxiliary yarn-carrier. Fig. 12 is a view, partly in elevation and partly in section, on a larger scale, of the auxiliary yarn-carrier. Fig. 12^a is a detail view of part of the presser-hook-actuating mechanism. Fig. 13 shows a view of the pattern-cylinder developed. Fig. 14 is a detail view, on an enlarged scale and in section, showing particularly the mechanism for operating one of the switches at the rear of

the machine. Fig. 15 is a rear view of part of the mechanism shown in Fig. 14. The remaining figures of the drawings show the cams for operating the front and back rows of needles and their actuating mechanism. Fig. 16 is a detail plan view of the front slide and its cams, showing their position when the toe of the sock is being knit by the needles of the back row, it being understood that the front needles remain inoperative while the toe is being knit, although, of course, the front slide is reciprocated with the back slide. Fig. 17 is a bottom plan view of the front slide and its cams, showing how the cams pass the needle-operating devices without actuating them. Fig. 18 is an edge view of the front slide, cams, &c., shown in Figs. 16 and 17. Fig. 19 is a detail view, on an enlarged scale and in section, of a portion of the front slide and the operating devices carried thereby. Fig. 20 shows a longitudinal section of the front slide and its cams, the mechanism being in the same position as that shown in Fig. 17. This figure also shows the cam-grooves for raising and lowering the cams. Fig. 21 is a bottom plan view of the front slide and its cams, showing particularly the arrangement of the cams when knitting two or ten rounds at the end of the formation of the toe and at the top of the sock, respectively. When the cams are thus arranged, only one yarn-carrier is in operation. Fig. 22 is a similar view, but shows the operation of the cams when the slide is moved in the opposite direction to that in which it is supposed to move in Fig. 21. Fig. 23 shows a longitudinal section of the front slide and its cams, the parts being arranged as they appear in Fig. 21. This figure also shows the grooves for raising and depressing the cams. Fig. 24 is a detail top plan view of the front slide, showing particularly the means whereby the cams are operated. When in the position shown in Fig. 24, both yarn-carriers are used and the foot or the leg portion of the sock is being formed. Fig. 25 is a bottom plan view of the front slide and its cams with the parts in the position shown in Fig. 24 and the slide moving to the left. When the slide is moved to the right, the cams will assume the position shown in Fig. 22. Fig. 26 is a bottom plan view of the back slide and its cams, showing the arrangement of the cams when the needles are knitting the heel and toe and when the slide is moving to the left. Fig. 27 is a similar view showing the arrangement of the cams when the slide is moving to the right. Fig. 28 shows a longitudinal section of the back slide and its cams with the mechanism arranged as it appears in Fig. 26. This figure also shows the grooves for operating the cam-shifting mechanism. Fig. 29 shows a bottom plan view of the back slide with the cams arranged to knit the two or ten rounds at the end of the toe and top of the sock, respectively. The slide is supposed to move to the right, and one yarn-carrier is in operation. When the cams on the back slide

are arranged as in this figure, the cams on the front slide are arranged as they appear in Fig. 21. Fig. 30 is a similar view, but shows the arrangement of the cams when the slide is moved to the left. Fig. 31 shows a longitudinal section of the back slide and its cams, the mechanism being arranged as it appears in Fig. 29. This figure also shows the grooves for operating the cam-shifting mechanism. Fig. 32 shows a bottom plan view of the back slide and its cams and indicates the arrangement of the cams when the needles are knitting the foot or the leg of the sock and both yarn-carriers are being used. The slide is supposed to be moving to the right. In the return movement to the left the cams assume the position shown in Fig. 30. Fig. 33 shows a longitudinal sectional view of the back slide and its cams with the mechanism arranged as shown in Fig. 32. This figure also shows the grooves for operating the cam-shifting mechanism. Fig. 34 is a detail longitudinal section of the back slide and the parts carried thereby. Fig. 35 shows a plan view thereof.

The driving-shaft A, extending transversely of the machine, is mounted in suitable bearings z in the main frame A', which may be of any suitable construction. A hand-wheel A² is secured to the front end of the driving-shaft, and at its rear end the driving-shaft is provided with fast and loose pulleys, as usual. A pinion a on the driving-shaft meshes with a main actuating gear-wheel a' on a stud-axle a^2 , mounted in suitable bearings z' and connected with a cam-wheel or irregular snail-gear B', which gears with a star-pinion B for operating the pattern-cylinder, as will hereinafter be explained.

A front needle-bed C and rear needle-bed C' are each slotted and provided with a slotted steel plate c to constitute guide-grooves for the front and rear rows of needles b' b^2 , respectively, as well as for their jacks B² B³. The bed-plates are inclined as heretofore and provided each with a lower longitudinal grooved guide-bar or channel-plate C² and an upper longitudinal grooved guide-bar or channel-plate C³. A front main cam-slide C⁴ and a back main cam-slide C⁵, rigidly connected by a yoke c' , reciprocate longitudinally in their guideways in the front and back channel-plates. These main cam-slides carry cams for actuating the two rows of needles to advance and retract them and are reciprocated by the mechanism next to be explained.

An elbow-lever c^2 , pivotally mounted upon the main frame-bracket c^3 by a stud c^4 , is connected at the upper end of its longer arm with a bracket c^5 on the back main cam-slide C⁵ by means of a pitman or link c^6 . The other end, or the shorter arm of the elbow-lever, is linked by a connecting-rod b^3 with a wrist-pin b^4 on the gear-wheel a' . The result of this construction is that the main cam-slides are caused to reciprocate together or make two strokes for each revolution of their actuating-gear a' and to operate the two rows of needles

by their cams in the manner hereinafter described.

The main yarn-carrier D comprises a rear longitudinal frame-bar d^3 and a front frame-bar d^4 , connected at one end by an end piece D^2 . The frame-bars are guided in ways formed in the adjacent or inner edges of guide-bars D' , secured to the needle-beds over their inner edges above and on opposite sides of the central opening from the needles. A bracket d^9 projects from the rear longitudinal frame-bar d^3 , and in it is formed an eye d^5 , through which the yarn passes. The yarn-carrier is also provided with horns d^6 for opening the latches of the front and back rows of needles and with shoes d^7 for holding down the needles against any tendency to rise out of operative position when in action. A dome d^8 is secured to the frame-bar d^3 and serves to support the usual devices for feeding a plurality of yarns. In Fig. 5 it is shown in dotted lines as provided with a tube through which yarn may be guided to the eye d^5 .

A cam-carrier E, provided with cams for actuating the presser-hooks A^3 at the front of the machine, is connected with the frame of the yarn-carrier in the manner hereinafter described. Fig. 7 shows clearly the construction and arrangement of the devices for actuating the front presser-hooks. The cam-carrier E is mounted on a bar e^{12} , which is provided with ribs e^{13} , which are adapted to reciprocate in guides in the front bars D' and C^3 . The ribs e^{13} are provided with a recess e^{13x} , in which fits the end of an arm e^{14} , secured at e^{15} to a yoke e^{16} , secured to the end piece D^2 of the yarn-carrier frame. The yoke e^{16} overlaps the end piece D^2 , and the screws shown in Fig. 7 secure the yoke to the end piece, which lies under it. This cam-carrier moves coincidentally with the yarn-carrier frame and has no movement independently thereof. It carries two cams $e e'$, as indicated in dotted lines in Fig. 7. One of said cams actuates the presser-hooks for the main yarn-carrier, and the other one actuates the presser-hooks for the auxiliary yarn-carrier. The presser-hooks D^3 on the opposite side of the machine are actuated by a main presser-hook cam E' and an auxiliary presser-hook cam E^2 . The main cam E' is shown in dotted lines in Fig. 7. It is connected by a plate e^2 with the rib e^{17} on the slide e^3 , which is formed, as heretofore, to reciprocate in suitable guides in the bars C^3 and D' . In like manner the cam carrier or slide E for the front row of presser-hooks slides in guides in the corresponding bars D' and C^3 , and both slides are tapered at their ends to readily pass by the upwardly-projecting ends of the presser-hooks.

The main presser-hook cam for the back row of needles has a movement independently of the yarn-carrier, its slide e^3 having secured to it two upwardly-projecting lugs $e^5 e^6$, between which projects a downwardly-extending tooth e^7 on the pitman E^3 . By this arrangement it will be observed that at each end of the stroke

of the pitman the cam E' will remain stationary or dwell. This construction and operation are well known, having been used for many years in the Nelson machines, and is substantially the same as that shown in the Nelson patent, No. 576,881, above mentioned. Inasmuch as the needles of the back row are operated for forming the toe and the heel of the sock while the front row is inactive, and inasmuch as in my machine the auxiliary yarn-carrier is only used while both sets of needles are in operation, it is desirable (and, in fact, necessary in the machine as here shown) that the cam for operating the back presser-hooks for the auxiliary yarn-carrier should be detached from the cam for operating the presser-hooks for the main yarn-carrier during the formation of the heel and the toe, and it should be brought into operation only when both sets of needles and both yarn-carriers are in use.

The cam E^2 is formed on a slide F, adapted to reciprocate in a groove formed in the back bar D' . When out of operation, it stands at the left-hand end of the machine. The slide e^3 is provided with a catch-pawl F' , pivoted at f , and its front end is pressed toward the front of the machine by a spring f' . At its front end the catch-pawl is formed with a notch f^2 , adapted to engage with a lug f^3 on the cam E^2 . When thus engaged, the auxiliary cam E^2 moves back and forth coincidentally with the main cam E' . The engagement or separation of the catch-pawl F' with the auxiliary cam E^2 is controlled by an arm F^2 at the left-hand end of the machine, which, when turned to the left, as shown in Fig. 4, bears upon the catch-pawl F' and so moves it that it will reciprocate without engaging with the auxiliary cam, but when the arm F^2 is moved to the right, as viewed in Fig. 7, the catch-pawl is free to engage with the auxiliary cam when at the end of its stroke to the left and will then carry it back and forth with the main cam E' until the arm F^2 is again operated to separate the pawl from the cam E^2 , which will then be left at the left-hand end of the machine, as before, in position ready to be taken up by the catch-pawl when needed. A bent finger f^4 prevents the auxiliary cam E^2 from moving too far to the left. The arm F^2 is pivoted to the rear bar D' , and at its lower end it is connected with a link F^3 , joined to a bell-crank lever F^4 , pivotally connected with a bracket F^5 , depending from the casing A^1 . The shorter arm of the bell-crank lever engages at times with one or the other of the two ribs F^6 on the inner side of the pattern-cylinder G. When thus engaged, (which occurs when the foot or leg is being formed,) the arm F^2 permits the engagement of the catch-pawl F' with the auxiliary cam, but when the bell-crank lever is disengaged from the rib F^6 the arm F^2 prevents the engagement of the catch-pawl with the auxiliary cam.

The yarn-carrier is actuated by the pitman E^3 , which is provided with a notch e^4 , engag-

ing a lug e^5 , projecting from the yarn-carrier. The pitman E^3 is pivotally connected to the upper end of a lever G' , jointed at g to the elbow-lever c^3 , and provided at its lower end with a roller-carrying stud g' , engaging the forked end of a lever g^3 , pivoted at g^3 to the main frame-bracket c^3 , and at its upper end carrying a roller g^4 , which enters a groove in the actuating gear-wheel a' . This groove is suitably shaped to give the proper movement to the yarn-carrier and to the cams for operating the presser-hooks, allowing of the usual proper amount of dwell at each stroke and at the proper times.

The pitman c^6 carries a latch E^4 , pivoted at e^8 and having a shoulder at e^9 , adapted to engage with a laterally-projecting pin e^{10} on the right-hand lug e^6 of the slide of the presser-hook cam E' . The arrangement is such that after the yarn-carrier has stopped moving and the main cam-carrying slides C^4 C^5 continue to move to the right the latch will engage the pin e^{10} and will further move the main back presser-hook cam E' , so that it may be drawn to the right beyond the presser-hooks in order that it may act on all of them. At the opposite end of the machine—that is to say, the left-hand end—the arrangement is such that the cam-slides may move a short distance while the yarn-carrier is at rest, and the latch will fall in behind the pin e^{10} . The yarn-carrier then assumes a position in advance of the presser-hook cams and the mechanism then moves to the right. While the details of construction are somewhat varied from those shown in the Nelson patents above referred to, the mode of operation is substantially the same. A bell-crank lever D^4 is pivoted at d to the main frame, and one of its arms carries a stud d' , entering a groove in the pattern-cylinder. The other is provided with a head d^2 , suitably shaped to act upon the incline e^{11} of the latch E^4 , to raise it after it has moved the cam E' , in order that the cam-carrying slides may move without moving the yarn-carrier or the presser-hook-actuating cams.

The drawings show the pitman E^3 as provided with an inclined flange c^7 , which is adapted to ride over the head d^2 of the bell-crank lever D^4 when the latter is moved into its path. This occurs when a sock is completed, and the yarn-carrier is stopped when the needles are being operated to cast off the sock. The groove d in the pattern-cylinder is suitably shaped to effect the proper movement of the bell-crank lever D^4 . It will be understood that when the pitman E^3 is raised the lug e^5 on the yarn-carrier leaves the notch e^4 , so that the pitman can reciprocate without moving the yarn-carrier. A flange e^{12} on the pitman facilitates the movement of the end of the pitman past the yarn-carrier when the former is raised.

The pattern-cylinder G is mounted in suitable bearings H in the main frame and revolves in the direction indicated by the ar-

row. It is actuated by means of a pinion h on a shaft h' , with which the star-wheel B is connected. This pinion is provided with a single laterally-extending tooth h^2 , adapted to gear with the segments $I I'$ on the pattern-cylinder. The pinion itself engages with teeth h^3 , formed on the cylinder.

As in the prior Nelson machines, the pinion h turns the pattern-cylinder G by its engagement with the teeth h^3 therein when the toe and the heel are being formed. When that part of the stocking between the toe and the heel and that part above the heel are being formed, the pinion h will occupy one of the spaces 1, 2, 3, or 4 in the pattern-cylinder, while the tooth h^2 will engage one of the segments I or I' . These segments do not form any part of my invention. They are the same in construction and operation as those of the prior Nelson machines and as shown and described in the Nelson Patent No. 576,881, of February 9, 1897, above mentioned. Briefly stated, however, the operation is to cause the pattern-cylinder to remain at rest while the foot or the leg of the stocking is being formed, permitting both the front and back rows of needles to be operated and to cause the pattern-cylinder to come into operation at the proper times to fashion the toe or the heel. The pattern-cylinder is, however, provided with grooves and suitably-formed surfaces for operating the devices used in my improved machine for actuating the auxiliary yarn-carrier and the mechanism used in connection therewith.

The auxiliary yarn-carrier in the present instance is shown as consisting of a vertical arm J , provided with a guide-groove j for the yarn, and having at its lower end a lateral extension j' , secured to a transversely-moving slide j^2 , which has a dovetail connection with the yarn-carrier-supporting slide J' , that is adapted to reciprocate back and forth on a guide-bar J^2 , parallel with the front main cam-slide. The slide j^2 is free to move at times transversely of the supporting-slide J' and carries on its under side a pin j^3 , which projects into a groove formed in the guide-bar J^2 . By this means the slide j^2 is given its transverse movement and is held in position when moving straight across the machine. The guide-bar J^2 , as shown in Fig. 7, is provided on its upper side with a groove j^4 , extending from end to end thereof, but provided with inclined portions j^5 , which remove a portion of the groove laterally from the end portions—that is to say, the groove j^4 extends from the left-hand end of the guide-bar toward the right, is then bent or inclined at j^5 inwardly toward the center of the machine, and then extends along the inner edge of the guide-bar parallel with the portion of the groove at the left end thereof, is then bent or inclined inwardly, and joined with the portion of the groove j^4 at the right-hand end of the machine, corresponding in all respects with that at the left-hand end.

The supporting-slide J' is adapted to move from end to end of the guide-bar J², and the pin j³ moves from end to end of the guide-groove j⁴, causing the yarn-carrier at first to move away from the right-hand end of the machine, with its delivery end removed from the needles in which the yarn is to be laid, to the inner portion of the groove between the inclined portions j⁵, so as to cause the delivery end of the yarn-carrier to move over the needles in which the yarn is to be laid. The yarn-carrier is withdrawn at the opposite end of the guide-bar when the pin j³ passes down the incline and into that portion of the groove at the left-hand end of the machine. The inner end of the slide j² carries a hanger j⁷, which has a vertical opening through which the yarn is fed. The yarn-carrier is tapered or suitably formed at its opposite ends to pass over the needles and act upon them in the usual way, as in other yarn-carriers.

A catch-pawl J³ is pivoted at j⁸ to the slide J' and is provided at one end with a hook j⁹, pressed downwardly by a spring j¹⁰. The end of the catch-bar opposite the hooked end is provided with a double incline j¹¹, adapted to engage with a pin K, projecting from the arm k of a frame K'. The arm k projects over the right-hand end of the guide-bar J², and the frame to which it is attached extends downwardly therefrom, then inwardly, then forwardly, and then laterally across the front of the machine, being pivoted at k' to a bracket extending downwardly from the bed of the machine. It is then prolonged and pivotally connected with a lever K², pivoted to a bracket k² and having its left-hand end connected with a vertical rod K³, which is connected at its lower end with a shoe K⁴, pivoted on a bracket K⁵. This shoe has a pointed rear end or toe k³, which is held upon the periphery of the cylinder or caused to enter a groove therein by a spring k⁴, which presses upon the rear end of the shoe.

A yarn-carrier-actuating slide L on the guide-bar J² is connected by a pitman L' with an arm l on the yoke c'. The pitman is slotted at l', and the yoke has a movement independent of the movement of the slide at each end of each stroke, as will be obvious from the construction shown. The slide L has a socket l², adapted to receive the hook j⁹ on the catch-pawl J³. When the arm k is moved or held to depress the pin K, the hook j⁹ will be elevated and the slide L will reciprocate without carrying with it the auxiliary yarn-carrier; but when the arm k is elevated the hook j⁹ will enter the socket l² and the slides L and J² will be connected and reciprocate together. When the auxiliary carrier is in operation, it always follows the main yarn-carrier, and when the yarn-carriers arrive at the end of a stroke the auxiliary yarn-carrier is moved laterally out of the path of the main yarn-carrier. The main yarn-carrier is moved for a short distance to the left without mov-

ing the auxiliary yarn-carrier, the slot l' in the pitman L permitting of this independent movement. As soon as the arm l has traversed the slot the auxiliary yarn-carrier is moved with the main yarn-carrier, the pin j³ guiding it first forwardly and then transversely behind the main yarn-carrier. At the left-hand end of the machine substantially the same operation occurs, viz: The auxiliary yarn-carrier is withdrawn laterally and is held until the main yarn-carrier has moved some distance to the right. Then it is again brought into operative position.

The needles b' and b² are of usual construction and are mounted in jacks B² B³, as heretofore, which are provided with upwardly-projecting lugs b⁵, as usual. The needles are also supported by swingingsupports M in the usual manner, and the fashioning-needles of the back row have their jacks mounted in supports N, constructed and operated in the same manner as in the prior Nelson machines. The grooves in the pattern-cylinder for operating the supports of the fashioning-needles are indicated diagrammatically in Fig. 13.

The presser-hooks are constructed and mounted in the same way as heretofore, being pivoted at m, as indicated in Fig. 5.

The needle-supports rest on longitudinal bars M' M², of usual construction. These bars may be moved longitudinally to lower the needle-supports to permit the needles to be removed and replaced. One of said bars M' is actuated at the proper time to operate the "dropping-needle"—that is, the needle which holds the thread when beginning to knit a stocking. M³ indicates the lever which moves the bar M' laterally to depress the dropping-needle, and M⁴ indicates the spring-catch which dogs the bar, while M⁵ indicates the vertically-moving pin which actuates the dog M⁴ to release the bar M' after the dropping-needle has performed its function. The pin M⁵ is operated by an arm M⁶, secured to the back cam-slide C⁵. A spring M⁷ tends to push the bar M' backwardly, as viewed in Fig. 4. This mechanism forms no part of my invention, as it has long been used in the Nelson machines.

The front main cam-slide C⁴ is slotted at O O', and through these slots extend screws o, which are connected with a bar o' on the under side of the slide. The construction is such as to permit the bar to have a longitudinal adjustment, if necessary. To the bar o' is pivoted a lever O², to which is secured a triangular cam O³. The lever is extended beyond this cam and has a projection o², which extends through a slot o³ in the slide C⁴. This projection carries a lug o⁴, which enters a guide-groove hereinafter described. The extension o² is connected by a slot-and-pin connection with a lever o⁵, which is connected with another lever o⁶. The levers o⁵ and o⁶ are rigidly connected together, as shown in Fig. 17. As there shown, the lever o⁶ extends but a short distance beyond its pivot o²⁰. It

is then continued laterally, as shown in dotted lines in Fig. 17, and joins the lever o^5 , as there indicated. These levers o^5 and o^6 are provided at their ends with lugs o^7 o^8 , and they are arranged on opposite sides of a guide-block O^4 . The arrangement is such that when the cam O^3 is depressed the lug o^8 will be elevated and the lug o^7 depressed. There is a space o^9 between the cam O^3 and guide-block O^4 , which is open when the cam O^3 is depressed, but closed by the lug o^8 when the cam O^3 is elevated. An arm O^5 extends through an opening o^{10} in the slide C^4 and is secured to a lever O^6 , pivoted at o^{11} to the under side of the slide C^4 , and pressed backwardly by a spring o^{12} . The lever O^6 carries a triangular auxiliary advancing-cam O^7 , which is only used when the auxiliary yarn-carrier is in operation.

A retracting-cam P , of usual construction, is provided with an extension p' , which has a sliding connection with guides p^2 , and a triangular retracting-cam P' has an extension p^3 , having a sliding connection with guides p^4 on the under side of the slide C^4 . These cams P and P' are connected with a tension-bar P^2 , which is secured at its opposite ends to the arms P^3 , projecting upwardly and forwardly from a rock-shaft P^4 , which has secured to it a rearwardly-extending arm P^5 , having a set-screw P^6 , held in a guide in the periphery of the pattern-cylinder by a spring p^5 . A short rail P^7 , formed of a piece p^x and a wearing-piece p^{xx} , is arranged on the under side of the front slide opposite the cam O^7 and acts as an abutment to limit the movement of this cam forwardly or away from the cams P and P' . The rail is shown as secured to an arm p^6 , which is secured by a screw p^7 to the top of the slide C^4 and which extends down through the slot o^3 in the slide and is then bent laterally and secured in any suitable way to the part p^x of the rail. The wearing-piece p^{xx} is secured by a screw, as shown, to the inner portion of the rail. The auxiliary cam O^7 is recessed at o^x to clear the arm p^6 as it moves toward the rail P^7 . This construction is very clearly shown in Fig. 6^a, besides being correctly shown in other figures of the drawings. The rail P^7 is so shaped as to form a continuation or a part of the cam O^7 when said cam is in operation, as indicated in Fig. 25, and as there shown the two parts O^7 and P^7 form a cam of sufficient size to properly operate the jacks, but when the cam O^7 is out of operation, as shown in Fig. 21, the lugs on the jacks can move straight across the cam O^7 , as there indicated. If the part P^7 were also retracted, this part would project beyond the edges of the cams P and P' and would interfere with the proper operation of the machine. It will thus be understood that the rail P^7 acts not only as an abutment for the cam O^7 , but also forms part of it when said cam is active.

It will be understood that the cams P and P' are not shifted except slightly to change the tension, as is common in prior machines

of this class. The auxiliary advancing-cam O^7 is operated to actuate the needles when the auxiliary yarn-carrier is in use. When the auxiliary yarn-carrier is not in use, the cam is in the inactive position shown in Figs. 17, 21, and 22. When the cam O^7 is active, it occupies the position shown in Fig. 25.

The arm O^5 carries at its outer end a lug p^8 , which, when the auxiliary yarn-carrier is in operation, traverses a guideway on the front channel-bar C^2 . This guideway is formed by a rail Q , a short plate Q^2 , and a switch q . There is a short space between the rail Q and the plate Q^2 . When the lug p^8 traverses the guide, it first passes along the rear side of the rail Q , around switch q , then along the front side of the rail, then between the left-hand end of the rail and the plate Q^2 , and then back again along the rear side of the rail. When the lug on the arm O^5 traverses this guideway, it will throw the auxiliary cam O^7 into and out of operation at each reciprocation or double stroke of the front cam-slide—that is to say, on the stroke from left to right the auxiliary cam will be out of operation, while on the stroke from right to left the auxiliary cam will be in operation, as indicated in Fig. 25.

The switch q is operated at the proper times by connections with the frame K' . An arm q' on the switch projects forwardly past a spring q^2 , which presses the end of the arm against the upper end of a bell-crank lever q^3 , pivoted at q^4 to the frame of the machine and having its lower end arranged under a pin q^5 , projecting from the frame K' . The upper end of the lever q^3 is guided by a slotted plate q^6 . The organization is such that when the frame K' is raised to permit the auxiliary yarn-carrier to commence operating the lever q^3 will be released and the spring q^2 will move the arm q' and thereby the switch q .

The lug o^4 on the arm O^2 is adapted to enter a guide in the front channel-plate or guide-bar C^2 . This groove is formed on opposite sides of a rail R , which has at one end a switch r and at the opposite end a switch r' . The switch r' is pressed downwardly by a spring r^2 and is not connected with any operating mechanism, but is free to be raised and lowered by the lug o^4 . The switch r , however, is positively actuated by a rod R' , which is connected with the switch by a pin r^3 , that extends through a slot r^4 in the rod. The pin r^3 is normally raised by a spring r^5 . At its lower end the rod R' is connected with a shoe R^2 , having at front and rear triangular projections or lugs r^6 , which are adapted to enter grooves in the pattern-cylinder or to bear upon the periphery thereof. The arrangement is such that at the proper times the rod R' is operated to shift the switch r to the position shown in Fig. 23, causing the lug o^4 to reciprocate first above the rail R and then below it, thus shifting the cam O^3 at each reciprocation or double stroke of the slide. The spring r^5 and the

slotted connection r^4 between the pin and the rod R' permit the switch r to be moved by the lug o^4 and then spring back again to the position shown in Fig. 23 after the lug has passed. As soon, however, as the shoe R^2 is shifted the switch r is shifted to the position shown in Fig. 20 and the lug o^4 is caused to reciprocate in the groove above the rail R , and will therefore not cause any movement of the cam O^3 , which will always be elevated out of operative position, as indicated in Fig. 17, and therefore the needles will not be operated, but the lugs on the jacks will pass over the cam O^3 and along the edges of the cams P , P' , and O^7 , as shown in Fig. 17. When the cams are in the position shown in Fig. 17, the needles of the back row are being operated to form the toe or the heel.

As soon as the formation of the toe is completed the cam O^3 is lowered into operative position, as shown in Figs. 21 and 22, and two rounds are knit on the sock before the auxiliary yarn-carrier is brought into operation, the lugs on the jacks being moved, as shown in Fig. 21, when the cam-slide moves to the left and, as shown in Fig. 22, when the cam-slide moves to the right. As soon as these two rounds are knit by the front and the back rows of needles the cam O^7 is brought into operation in the manner above described and as indicated in Fig. 25. When the auxiliary cam O^7 is in operation, the several cams will occupy the position shown in Fig. 25, when the slide is moved to the left and the needles will be operated in the manner indicated by the lugs of the jacks. On the return stroke the cam O^7 will be shifted to the position shown in Fig. 22 and the needles will be advanced by the cam O^3 . It will be understood that the cams P P' are always the retracting-cams, while the cams O^3 O^7 when in operation act to advance the needles.

The back cam-slide C^5 and its cams are shown in Fig. 26 and the following figures. The slide is provided with a triangular retracting-cam S , which always occupies the same position when in operation, but may be shifted to vary the tension. A smaller triangular retracting-cam S' is arranged at the left-hand side of the cam S and may be moved from the position shown in Fig. 27 to that shown in Fig. 29 when desired. A triangular advancing-cam S^2 has its apex pointing toward the apex of the triangular space formed between the cams S and S' and is secured to a projection s of a lever S^3 , pivotally connected to the cam-slide C^5 . The projection s extends through a slot s' in the slide C^5 to the under side of the slide, where it is secured to the cam S^2 . It then extends back through the slot and is provided with a lug s^2 , adapted to enter a guide-groove, as will be hereinafter explained. A lever S^4 is pivotally connected with the slide at s^3 in Fig. 34 and is connected by a slot-and-pin connection s^4 with the lever S^3 . This lever S^4 carries an angular guide-piece s^5 , which is depressed when the cam S^2

is elevated and is elevated when the cam S^2 is depressed by the connections just described. A fourth advancing-cam S^5 is secured to the inwardly-projecting end of a lever S^6 , pivotally connected at s^6 to the upper side of the slide C^5 . This lever is provided with an extension s^7 , formed with a lug s^8 , adapted to move in guide-grooves, hereinafter described, for the purpose of elevating and depressing the cam S^5 . A smaller lever S^7 is pivoted at s^9 to the slide C^5 and has a slot-and-pin connection at s^{10} with the lever S^6 . At its opposite end the lever S^7 carries a guide-block s^{11} , which is depressed when the cam S^5 is elevated and is elevated when the cam S^5 is depressed by the connections just described. The back slide also carries a rail T , having an inclined end t at the right-hand end of the slide C^5 and an inclined end t' adjacent to the cam S^5 . This inclined end t' at times acts as a cam to advance the needles. A rail T' , carried by the slide at its opposite end, extends from near the left-hand end of the slide to the cam S' . The cams S and S' , while not having an up-and-down movement like the cams S^2 and S^5 , are moved back and forth to a limited extent toward the cams S^2 and S^5 by the bars U U' . The larger cam S is connected with the bar U , while the smaller one S' is connected with the bar U' . The bar U' is connected by means of its arms u with the upwardly-projecting arms w' , which extend from a frame w^2 , pivoted on the rock-shaft w^3 . This frame is provided with a downwardly and forwardly extending arm w^4 , which carries a shoe w^5 , adapted to work in a groove in the pattern-cylinder and on the periphery thereof. The bar U is connected to arms v , which extend forwardly to the rock-shaft w^3 , which is provided with a forwardly and downwardly extending arm v^2 , carrying a set-screw, the inner end of which is adapted to bear on the periphery of the pattern-cylinder and also to enter grooves therein.

Springs v^3 v^5 tend to pull the bars U and U' forwardly, and when the bars are moved forwardly they are thus moved against the force of the springs, but are held yieldingly and afford the proper yielding tension. The bar U' is moved at the proper time to shift the cam S' from the position shown in Fig. 26 to that shown in Fig. 32.

The levers S^3 and S^6 , which raise and lower the cams S^2 and S^5 , are operated by the guide-grooves in the rear guide-bar C^2 . As shown in Figs. 28, 31, and 33, there is a guide-groove W extending from end to end of the bar C^2 . It is closed, however, a short distance from the right-hand end of the bar C^2 by a block w' , having an inclined inner end w^2 . The groove W is covered by a flange w^3 , and the top of this flange forms a guide for the lug s^8 of the lever S^6 . An inclined way connects the groove W with the guideway on the top of the flange w^3 . This way is normally closed by a flat spring w^4 , which readily yields when pressed upwardly to open the way, but which

closes the way when pressed downwardly or released.

A guideway w^5 connects the groove W with the guide on top of the flange, a block w^6 being employed at the left-hand end of this groove to guide the lug properly downwardly into the groove W when traveling to the left. Beneath the rail w^7 at the bottom of the groove W there is a guide-groove w^8 , below which there is a rail w^9 . At one end of this rail there is a switch X and at the opposite end a switch X', the exact formation or shape of which is clearly shown in Figs. 28, 31, and 33. Beneath the rail w^9 there is another guideway w^{10} . The switch X is connected by a pin x with a vertically-arranged bar x' , which at its lower end is pivotally connected with a shoe x^2 , pivoted on a bar x^3 . The shoe is provided with pointed ends x^4 x^5 , which are adapted to bear on the periphery of the pattern-cylinder and to enter grooves therein. A spring x^6 tends to raise the pin x to lift the switch to the position shown in Fig. 33. When thus lifted, the switch is free to be moved downwardly to the position shown in Fig. 31 against the force of the spring x^6 , but will immediately return to the position shown in Fig. 33 when relieved. The switch X' is connected at y with an arm y' , carrying a pin y^2 , which extends under a finger y^3 on an arm y^4 , projecting laterally from a vertically-sliding bar y^5 , arranged centrally of the machine. This bar is slotted, as shown, to permit some of the needle-jacks to extend through it, and it is free to move vertically without interference with the jacks.

The slide y^5 is connected by means of a lug y^6 to the front end of a shoe y^7 , pivoted at y^8 and having a pointed rear end y^9 , adapted to bear upon the periphery of the pattern-cylinder or in grooves therein. By the proper formation of the pattern-cylinder the lever y^7 is moved to raise and lower the vertically-sliding bar y^5 and thus to operate the switch X'. The lateral arm y^4 only moves the arm y' in one direction—viz., downwardly. A spring y^{10} moves the arm in the opposite direction.

It will be understood that the cams S and S' are retracting-cams, while the cams S² and S⁵ act when in operation to advance the needles. When the back slide is knitting the heel or the toe of the sock, the cams of the back slide are in the positions shown in Figs. 26 to 28, inclusive, the lugs s^2 and s^8 traversing the guides indicated in Fig. 28, the effect being to alternately raise and depress the cam S⁵, as indicated in Figs. 26 and 27, and to hold the cam S² down in operative position.

Figs. 29 and 30 show the positions of the cams when the needles of the back row in connection with the needles of the front row are knitting two rounds just above the toe or ten rounds at the top of the stocking. Fig. 29 shows the position of the cams when the cam-slide is moving to the right. When moving in the opposite direction, the cams

are arranged as shown in Fig. 30. The guides traversed by the lugs s^2 and s^8 are indicated in Fig. 31.

Figs. 32 and 33 show the position of the cams and the movement of the lugs s^2 and s^8 when the slides are moved in the direction indicated by the arrows and the auxiliary yarn-carrier is in use. At this time both the cams S² and S⁵ are in operative position and the cams S and S' are also in operative position, so that the needles are actuated twice to knit a double row with the yarn supplied by the two yarn-carriers. When the slide moves to the left, the cams will assume the position shown in Fig. 30 and the double operation of the needles is prevented. These changes occur at each reciprocation during the formation of the foot and leg of the stocking.

It will be understood that when the cams of the back slide are in the position shown in Fig. 26 and the heel or the toe is being knit the cams of the front slide are in the position shown in Fig. 17. When the cams of the back slide are in the position shown in Figs. 29 and 30, the cams of the front slide are in the positions shown in Figs. 21 and 22, and when the cams of the back slide are in the position shown in Fig. 32 the cams of the front slide are in the position shown in Fig. 25.

The pattern-cylinder G is suitably formed to operate the shoes K⁴ and R², which operate the switches q and r , respectively, and the shoes x^2 and y^7 , which operate the switches X and X' at the back of the machine. The set-screw P⁶ on the lever-arm P⁵ operates upon a suitably-formed way in the central portion of the cylinder, while the shoe w^3 , which actuates the frame w^2 , operates on the periphery of the cylinder and in suitable grooves therein. When the toe of the stocking is being formed, the toe k^3 of the shoe K⁴, which operates the devices for connecting and disconnecting the auxiliary yarn-carrier, will ride upon the periphery of the cylinder. When the foot is being formed, the toe k^3 of the shoe will be in the groove 1, and when the leg is being formed it will be in the groove 2. While the heel is being formed it will ride upon the periphery of the cylinder. The front lug r^6 of the shoe R², which operates the switch r , rides in the groove 3 while the heel of the stocking is being formed and in the groove 4 while the toe is being formed. While the foot and leg are being formed it rides upon the periphery of the cylinder. In like manner the shoe w^3 , which operates the cam S' of the set of cams for the back row of needles, enters the groove 5 while the foot is being formed and the groove 6 while the leg is being formed. The set-screw P⁶ of the arm P⁵, which regulates the tension of the front cams P P', rides in suitably-formed ways 7, 8, 9, and 10 in the central portion of the cylinder. The end x^5 of the shoe x^2 , for operating the switch X at the left-hand side of the

back of the machine, enters a groove 11 when the foot of the stocking is being formed and a groove 12 when the leg is being formed. The end y^p of the shoe y^r lies in the grooves 13 14, respectively, when the foot and leg are being formed.

Fig. 13 shows approximately the correct arrangement of the several grooves and elevations, but obviously the arrangement may be varied to suit the requirements of the machines to which my invention is applied.

In knitting a stocking the yarn, which is supplied to the yarn-carriers in any suitable way, is laid on the needles and the knitting is started or the "set-up" is effected in the usual way. The toe of the stocking is knit by the back row of needles only, the cams operating as indicated in Figs. 26, 27, and 28 and the pattern-cylinder moving and actuating the fashioning-needles, as heretofore. The cams for the front row of needles are at this time in the positions indicated in Figs. 17 and 20. After the toe is formed two rounds are knit by both the front and back rows of needles, the actuating-cams being arranged, as indicated in Figs. 21, 22, and 23, at the front of the machine and, as indicated in Figs. 29, 30, and 31, at the back. After these two rounds are formed the mechanism is shifted, causing the supporting-slide J' of the auxiliary yarn-carrier to engage with the actuating-slide L , and to be reciprocated back and forth with the main yarn-carrier in the manner above explained. The two yarn-carriers continue to operate simultaneously until the foot is completed, when the auxiliary yarn-carrier is released, and the heel is formed by the fashioning-needles. The auxiliary yarn-carrier is again brought into operation after the heel is formed, and continues to operate with the main yarn-carrier until the leg of the stocking is nearly completed, when it is thrown out of operation and ten rounds are knit by the front and back rows of needles with a single yarn-carrier. The positions of the needle-actuating cams while the foot and the leg of the sock are being formed are indicated in Figs. 25, 32, and 33. When the ten rounds are being knit at the top of the leg, the cams are in the positions indicated in Figs. 21, 22, 23, 29, 30, and 31.

The diagram drawings, Figs. 16 to 35, inclusive, it will be observed, clearly indicate the different changes which occur in the positions of the cams at both front and back of the machine, the three different positions of the cams incident to the three different kinds of work to be performed being indicated by the several groups of figures above described.

I claim as my invention—

1. A straight-row-knitting machine provided with two yarn-carriers, both of which supply yarn successively at a single stroke in one direction to all the needles on one side, and on the return stroke supply yarn to all the needles on the opposite side and mechanism for actuating the yarn-carriers and needles.

2. A straight-row-knitting machine provided with front and back rows of needles, two yarn-carriers, cams for advancing the needles of the front row and for retracting them twice during a single stroke in one direction of the yarn-carriers to cause them to take yarn from both yarn-carriers, cams for advancing the needles of the back row and for retracting them twice on the return stroke of the yarn-carriers to cause them to take yarn from both yarn-carriers, means for actuating the cams, means for simultaneously reciprocating the yarn-carriers, and means for at times holding one of the yarn-carriers out of operation.

3. A knitting-machine provided with front and back rows of needles and with two yarn-carriers, two sets of cams for operating the needles of the front and back rows, mechanism for reciprocating the yarn-carriers, and mechanism for actuating the cams to cause each needle of the front row to take yarn from both yarn-carriers successively during a single stroke thereof, and mechanism for actuating the cams to cause each needle in the back row to take yarn from both yarn-carriers successively during the return stroke of the yarn-carriers.

4. A straight-row-knitting machine provided with two yarn-carriers and two rows of needles, cams for actuating the needles of the front row to knit the yarn supplied by the main yarn-carrier and for actuating the needles of the front row to knit yarn supplied by the auxiliary yarn-carrier immediately after knitting yarn supplied by the main yarn-carrier, means for correspondingly actuating the needles of the back row to take yarn from both yarn-carriers on the return stroke of the yarn-carriers, means for throwing the auxiliary yarn-carrier out of operation, and means for throwing out of operation corresponding cams when the auxiliary yarn-carrier ceases to operate.

5. A knitting-machine provided with front and back rows of needles, a main yarn-carrier, an auxiliary yarn-carrier, slides carrying cams for actuating all the needles in both the front and back rows to take yarn from the main and auxiliary yarn-carriers, means for automatically throwing into and out of operation the auxiliary yarn-carrier, and means for holding permanently out of operation the auxiliary cam, O^1 , on the front slide and also the cam, S^2 , on the back slide when the auxiliary yarn-carrier is at rest, and means for properly controlling and operating the remaining cams.

6. A knitting-machine provided with two yarn-carriers and two rows of needles, cams on the back slide for operating the needles, two retracting-cams on the front slide, a main advancing-cam, an auxiliary advancing-cam, O^1 , which is vibrated at the end of each stroke

of the cam-slides when both yarn-carriers are in operation, and a short rail P' against which the cam O' abuts, for the purpose specified.

7. A knitting-machine provided with a main yarn-carrier and an auxiliary yarn-carrier, means for reciprocating the yarn-carriers simultaneously, a front slide having two retracting-cams, a main advancing-cam, means for automatically moving this cam into and out of operation, an auxiliary advancing-cam, means for holding it out of operation while the auxiliary yarn-carrier is at rest, means for bringing the auxiliary advancing-cam into operation while the auxiliary yarn-carrier is in operation, a back cam-carrying slide, two retracting-cams thereon, two advancing-cams, and means for bringing into operation both advancing-cams and both retracting-cams only when both yarn-carriers are in use.

8. A knitting-machine provided with a main yarn-carrier, and an auxiliary yarn-carrier, means for reciprocating the main yarn-carrier, a slide for reciprocating the auxiliary yarn-carrier, means for at times automatically connecting the auxiliary yarn-carrier with its slide to cause it to move with the main yarn-carrier, and means for automatically at times separating it therefrom.

9. In a knitting-machine, the combination of the main and auxiliary yarn-carriers, the main cam-slides, means for actuating the main yarn-carrier, the actuating-slide for the auxiliary yarn-carrier, a pitman connecting said slide with the main cam-slides, and a detachable connection between said actuating-slide and the auxiliary yarn-carrier.

10. A straight-row-knitting machine provided with two yarn-carriers both of which supply yarn successively at a single stroke in one direction to all the needles on one side, and on the return stroke supply yarn to all the needles on the opposite side, mechanism for actuating the yarn-carriers and needles and devices for maintaining the same relative position of the yarn-carriers when moving in both directions.

11. In a knitting-machine, the combination of the reciprocating main yarn-carrier, the reciprocating auxiliary yarn-carrier adapted to move at times simultaneously with the main yarn-carrier, and means for moving the auxiliary yarn-carrier laterally relatively to the path of the main yarn-carrier and also in a path parallel therewith.

12. In a knitting-machine, the combination of a reciprocating main cam-slide, the slotted pitman connected therewith, the yarn-carrier-actuating slide, the yarn-carrier-supporting slide, and means for connecting the supporting-slide with the actuating-slide.

13. In a knitting-machine, the combination of the yarn-carrier-actuating slide, the yarn-carrier-supporting slide, the grooved guide-bar on which these slides reciprocate, the transversely-moving slide j², and a pin car-

ried thereby which enters a groove in the guide-bar.

14. A straight-row-knitting machine provided with two yarn-carriers both of which supply yarn successively at a single stroke in one direction to the needles on one side and on the return stroke supply yarn to the needles on the opposite side, mechanism for reciprocating the yarn-carriers and actuating the needles, said mechanism having provisions in virtue of which the needles of one side only form stitches during the stroke in one direction, and the needles of the other side only during the stroke in the opposite direction, whereby tubular work is produced.

15. In a knitting-machine, the front slide provided with the advancing-cam O³, the retracting-cams P P', the auxiliary advancing-cam O⁷ and means for moving the auxiliary cam into and out of operation.

16. In a knitting-machine, the front slide provided with the cams O³ O⁴, P P', and O⁷, for the purpose specified.

17. In a knitting-machine, the combination of the back cam-carrying slide, the stationary retracting-cam, the movable retracting-cam, the rising-and-falling advancing-cams, and means for actuating said cams for the purpose set forth.

18. In a knitting-machine, the combination with the back slide of the cams S S', S² S⁵, and rail T, having the incline t', for the purpose specified.

19. A knitting-machine provided with presser-hooks and two yarn-carriers, and cams for operating the presser-hooks twice during each stroke of the yarn-carriers.

20. A knitting-machine provided with presser-hooks and two yarn-carriers, and duplicate cams for operating the presser-hooks twice during each stroke of the yarn-carriers.

21. A knitting-machine provided with presser-hooks and two yarn-carriers, and two cams moving coincidentally with the main yarn-carrier to actuate the front presser-hooks.

22. A knitting-machine provided with presser-hooks and two yarn-carriers, a cam reciprocated by the main yarn-carrier to actuate the presser-hooks of the back row, and an auxiliary cam detachably connected with the first-mentioned cam to at times cause a second actuation of the presser-hooks.

23. In a knitting-machine, the combination with the back row of presser-hooks, of the main presser-hook-actuating cam, the auxiliary cam, the catch-pawl for connecting the auxiliary cam with the main cam, and means for disengaging the pawl from the auxiliary cam.

24. In a knitting-machine, the combination of the slide provided with a cam for actuating the presser-hooks, the pitman provided with a tooth adapted to move back and forth between lugs projecting from said slide, an auxiliary cam connected with the main cam, a

pitman for actuating the slides carrying the needle-actuating cams, and a latch carried by the pitman engaging at times with a pin carried by the slide to which the presser-hook-
5 actuating cam is secured.

25. A straight-row-knitting machine adapted to automatically knit a series of socks, comprising means for automatically starting the knitting with both rows of needles after the
10 completion of a sock, a main yarn-carrier adapted to guide thread to the needles to form the toe and the heel, an auxiliary yarn-guide adapted to guide thread to the needles to assist the main yarn-carrier in forming the foot

and the leg, means for continuously actuating 15 the main yarn-carrier during the formation of the sock, devices for holding the auxiliary yarn-carrier out of operation while the toe and heel are being formed, and devices for automatically throwing the auxiliary yarn- 20 carrier into operation to assist the main yarn-carrier while forming the foot and the leg.

In testimony whereof I have hereunto subscribed my name.

JOHN F. NELSON.

Witnesses:

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