

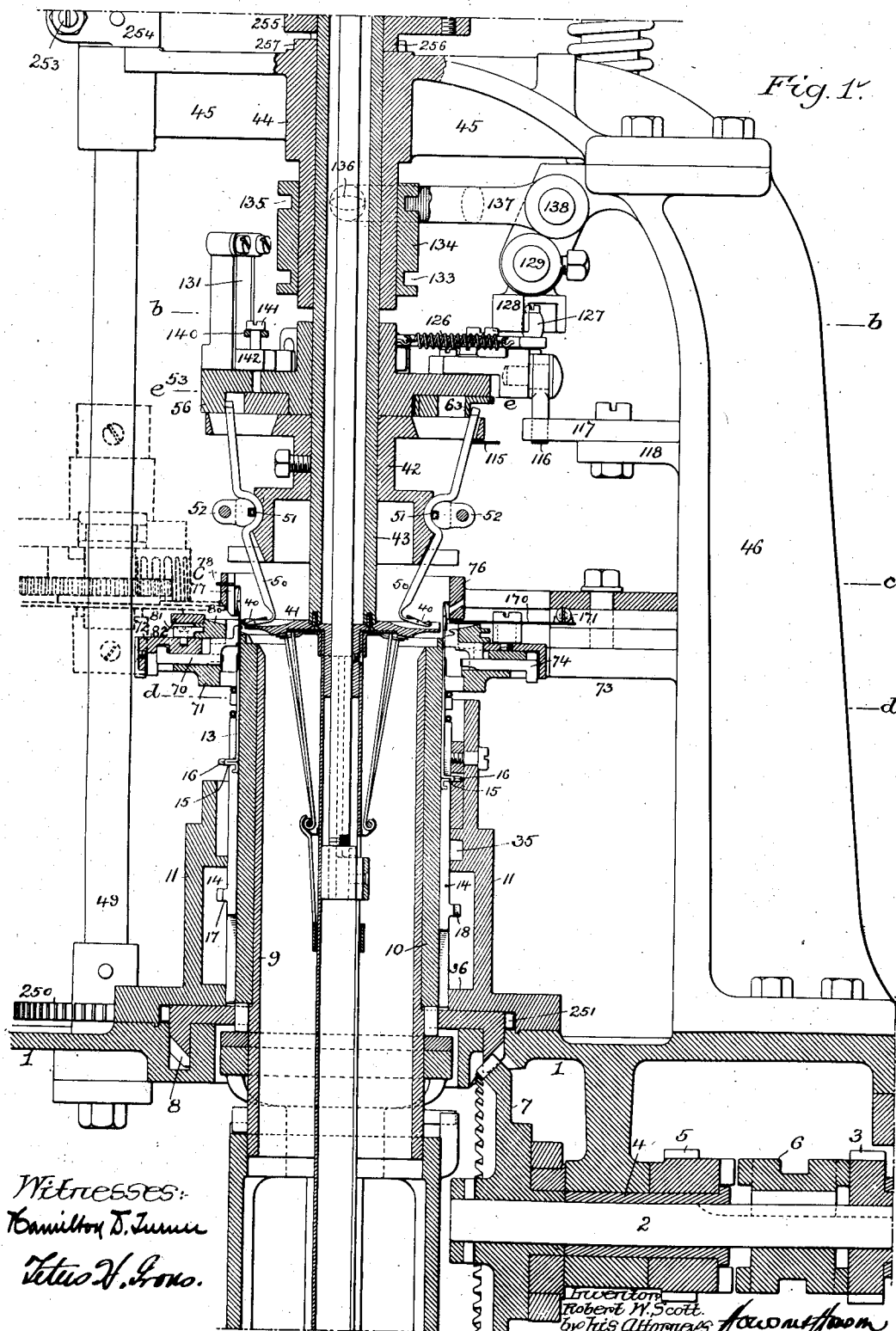
No. 834,763.

R. W. SCOTT.
KNITTING MACHINE.

APPLICATION FILED NOV. 24, 1905.

PATENTED OCT. 30, 1906.

16 SHEETS—SHEET 1.

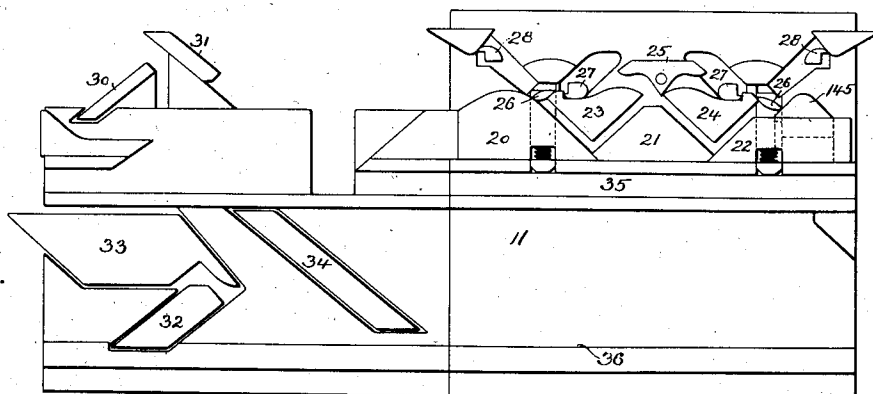
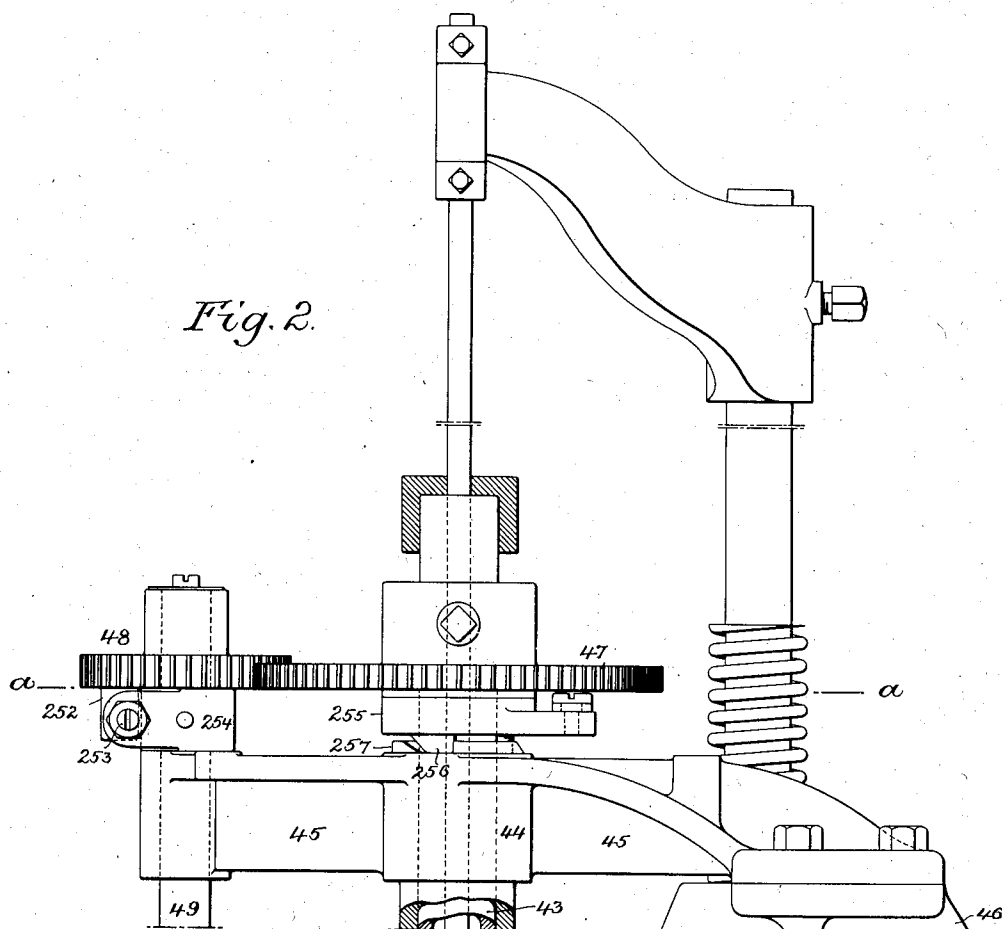


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KNITTING MACHINE.
APPLICATION FILED NOV. 24, 1906.

16 SHEETS—SHEET 2.



Witnesses:
Hamilton D. Turner
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Inventor:
Robert W. Scott.
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No. 834,763.

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KNITTING MACHINE.
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16 SHEETS—SHEET 3.

Fig 4

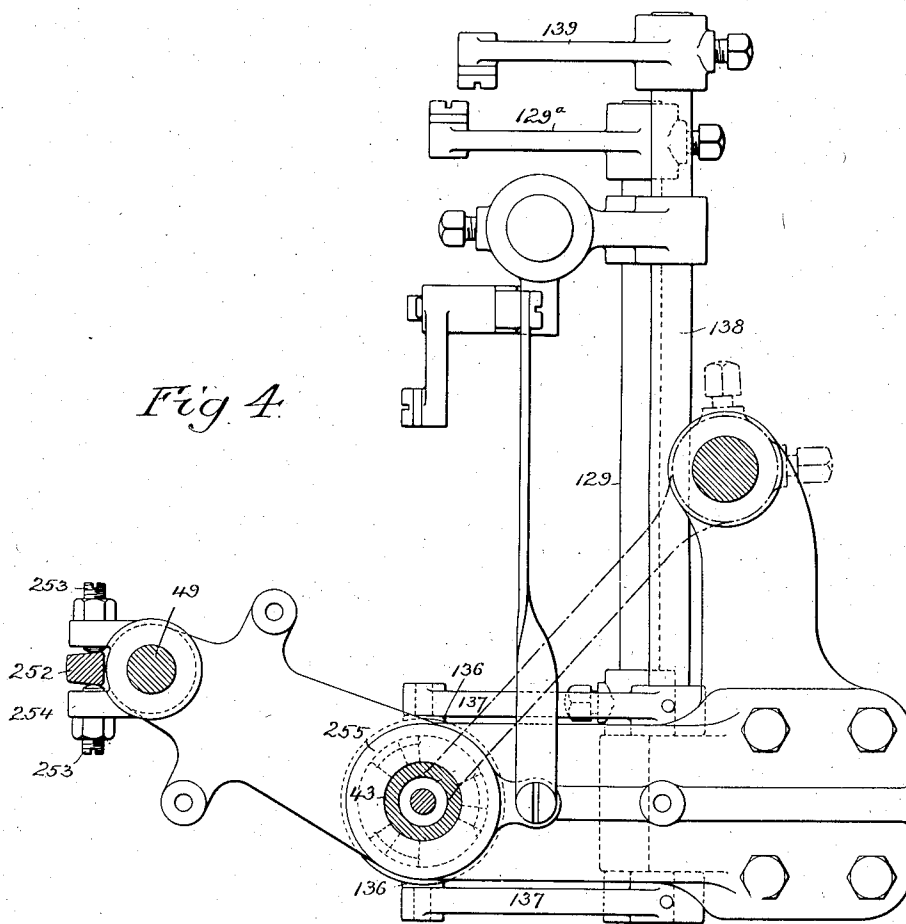
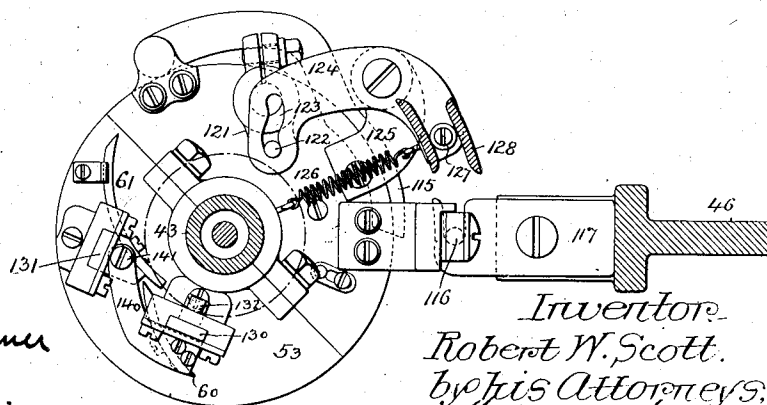


Fig 5



Witnesses:
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No. 834,763.

PATENTED OCT. 30, 1906.

R. W. SCOTT.
KNITTING MACHINE.
APPLICATION FILED NOV. 24, 1905.

16 SHEETS—SHEET 4.

Fig. 8.

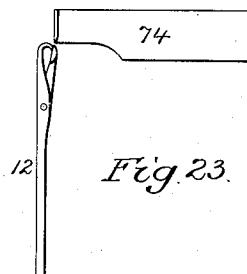
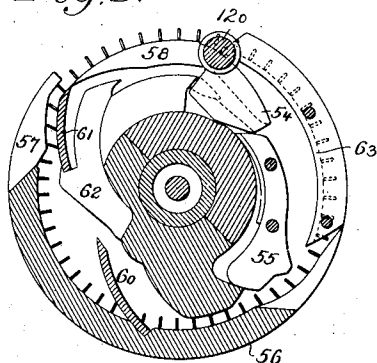


Fig. 23.

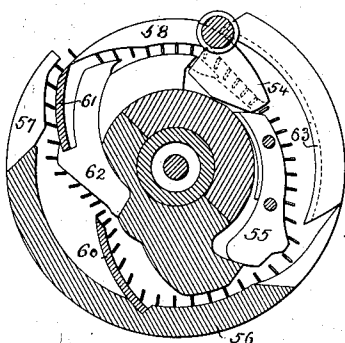


Fig. 21.

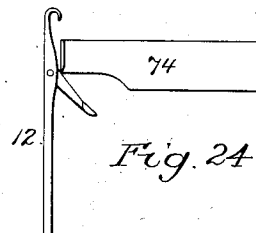


Fig. 24.

Fig. 6

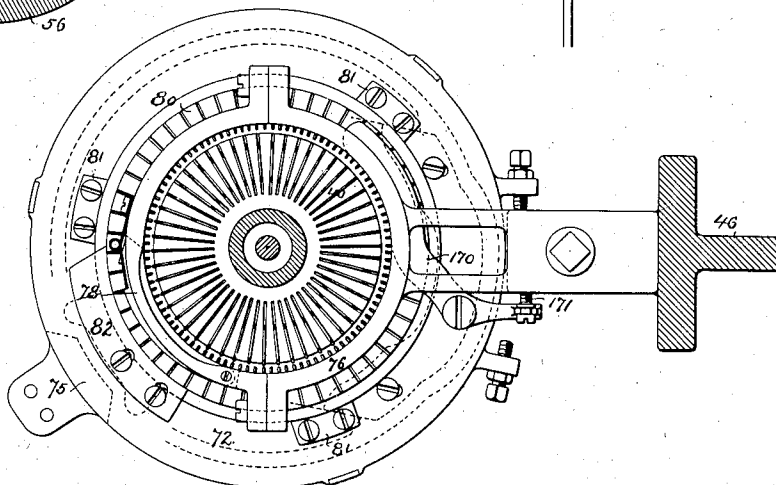
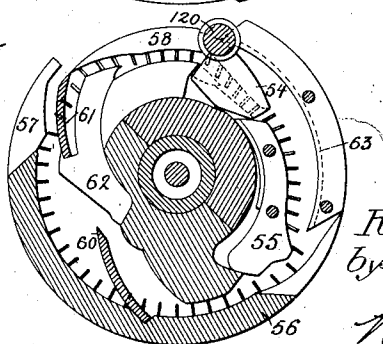


Fig. 8^a



Witnesses:
Hamilton D. Turner
Arthur J. Cross.

Inventor:
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Howe, Brown

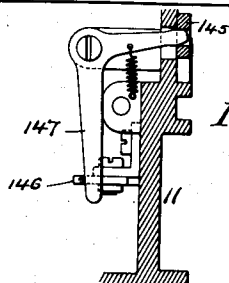
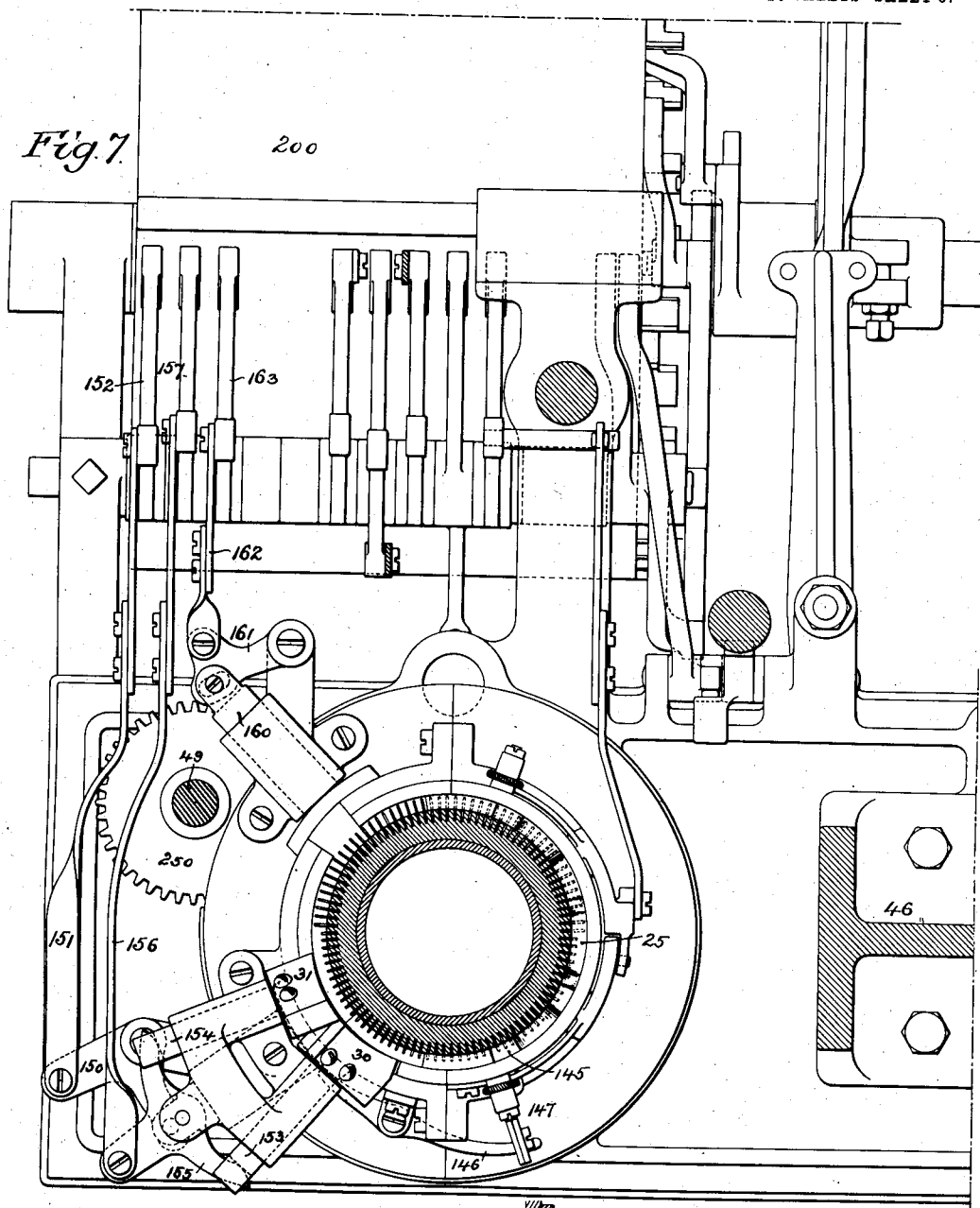
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PATENTED OCT. 30, 1906.

R. W. SCOTT.
KNITTING MACHINE.

APPLICATION FILED NOV. 24, 1905.

16 SHEETS—SHEET 5.



Witnesses:-
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Letus H. Lono.

Fig 3^a Inventor:
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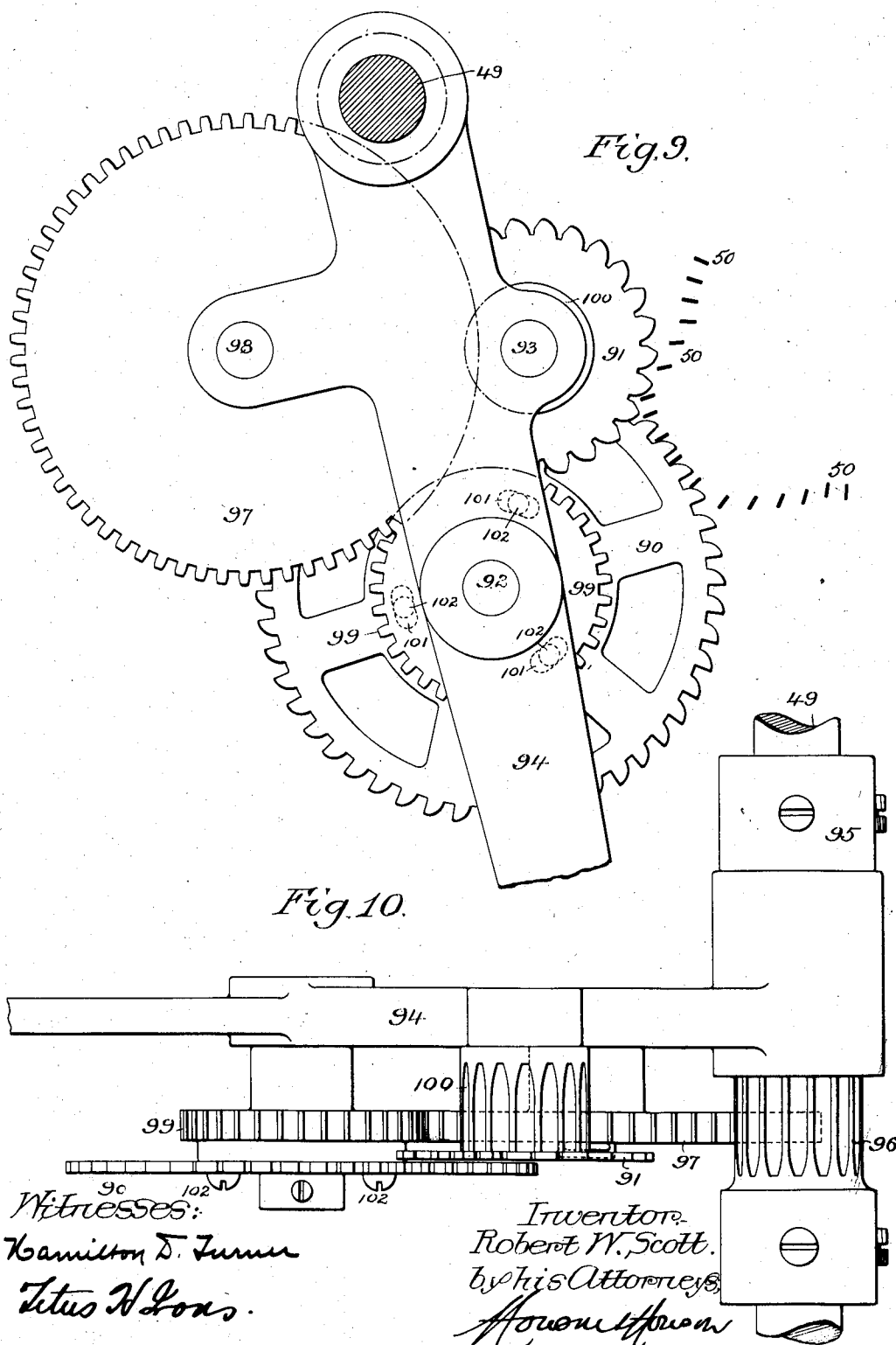
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R. W. SCOTT.

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APPLICATION FILED NOV. 24, 1905.

16 SHEETS—SHEET 6.



No. 834,763.

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R. W. SCOTT.
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16 SHEETS—SHEET 7.

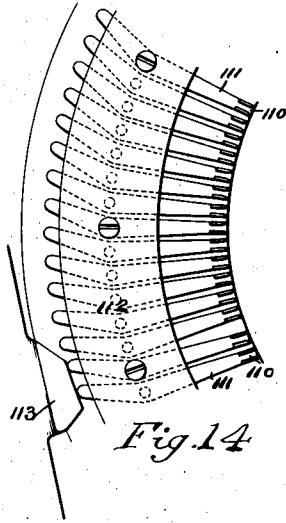


Fig. 12

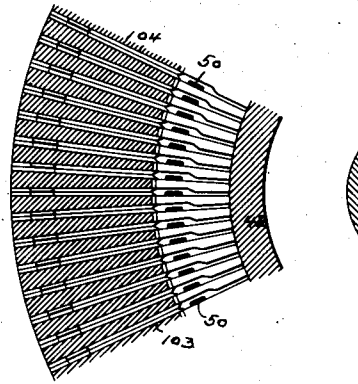


Fig. 13

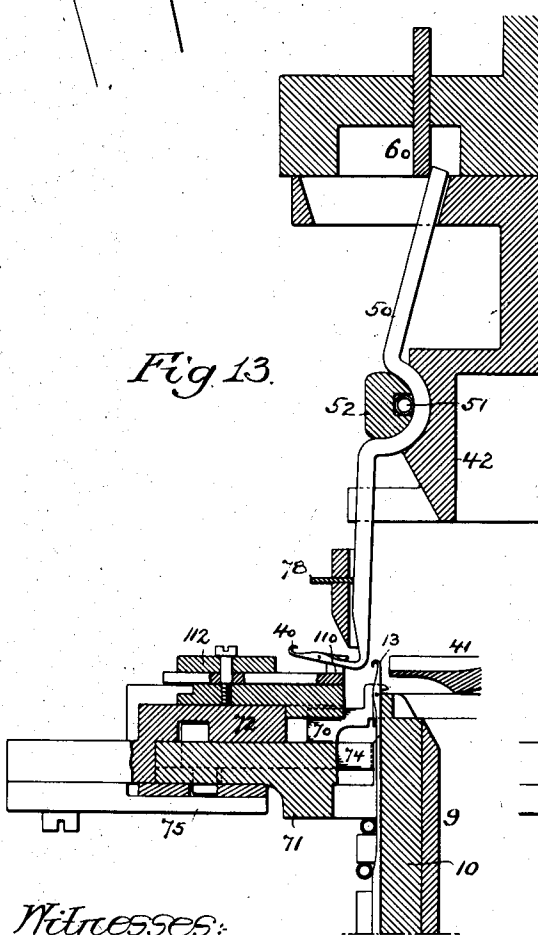
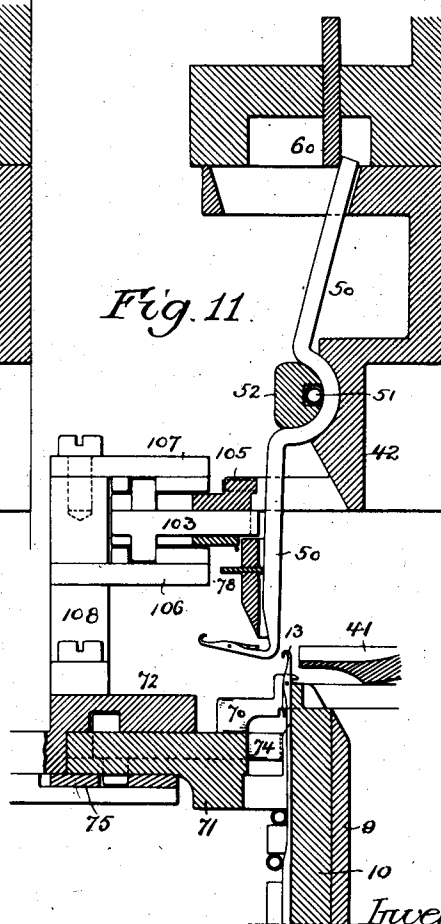


Fig. 11



Witnesses:
Hamilton D. J. J. J.
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Inventor:
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No. 834,763.

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16 SHEETS—SHEET 8.

Fig. 15.

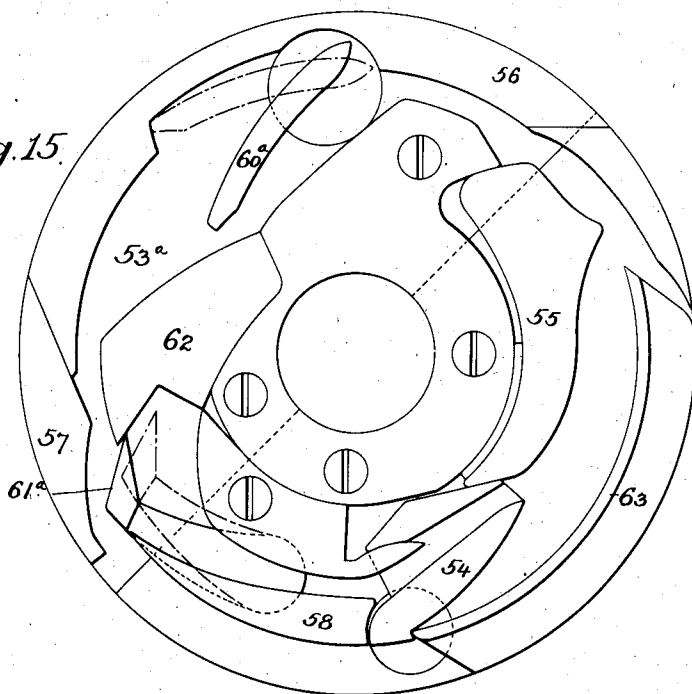
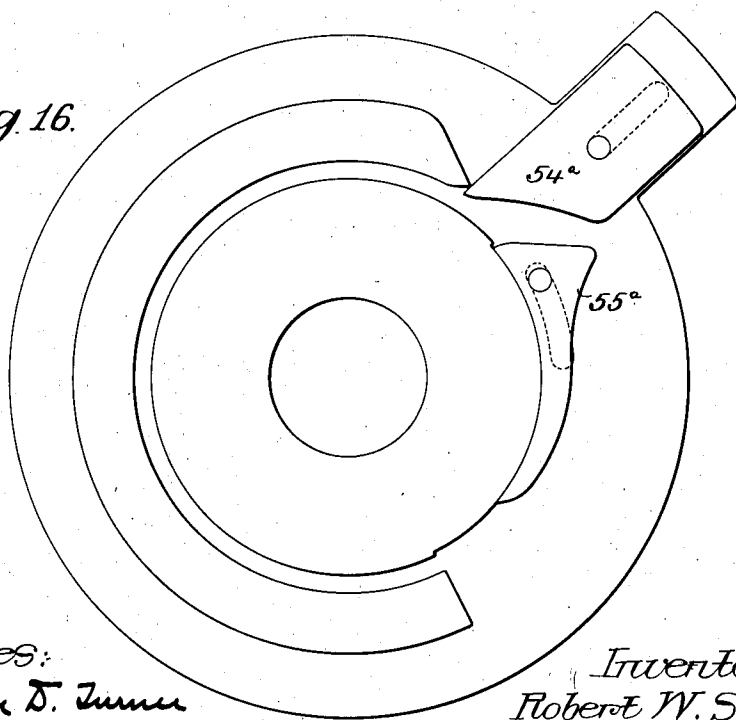


Fig. 16.



Witnesses:

Hamilton D. Turner

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No. 834,763.

PATENTED OCT. 30, 1906.

R. W. SCOTT.

KNITTING MACHINE.

APPLICATION FILED NOV. 24, 1905.

16 SHEETS—SHEET 9.

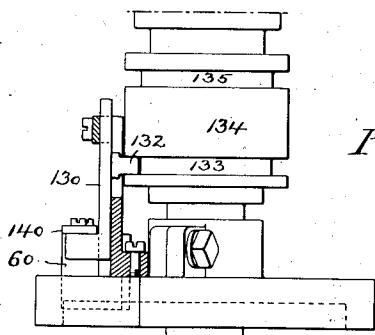


Fig. 25

Fig. 17 Fig. 18 Fig. 19 Fig. 20.

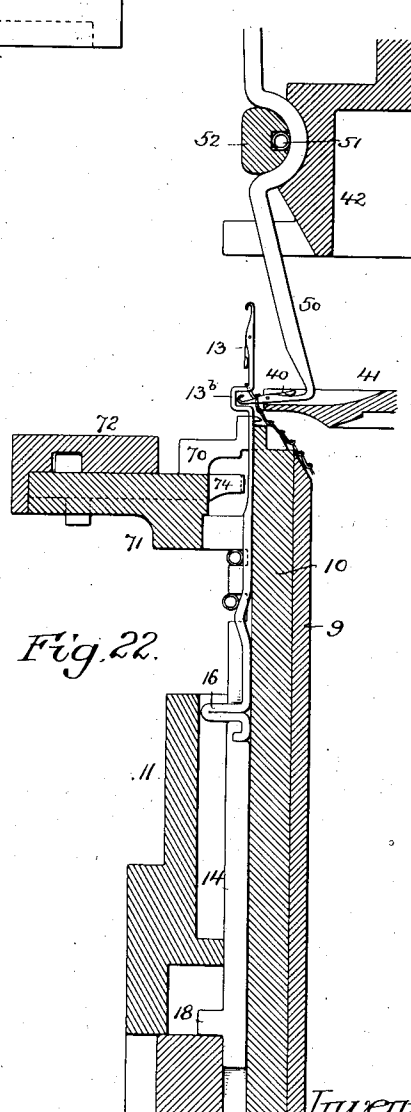
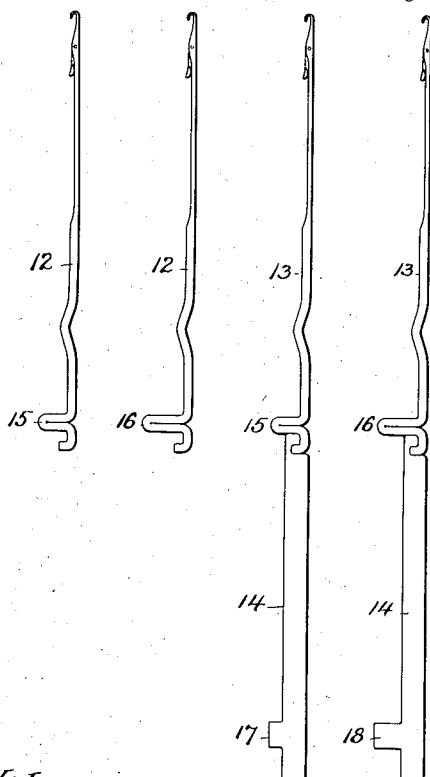


Fig. 22.

Witnesses:

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James H. Brown

No. 834,763.

PATENTED OCT. 30, 1906.

R. W. SCOTT.

KNITTING MACHINE.

APPLICATION FILED NOV. 24, 1905.

16 SHEETS—SHEET 10.

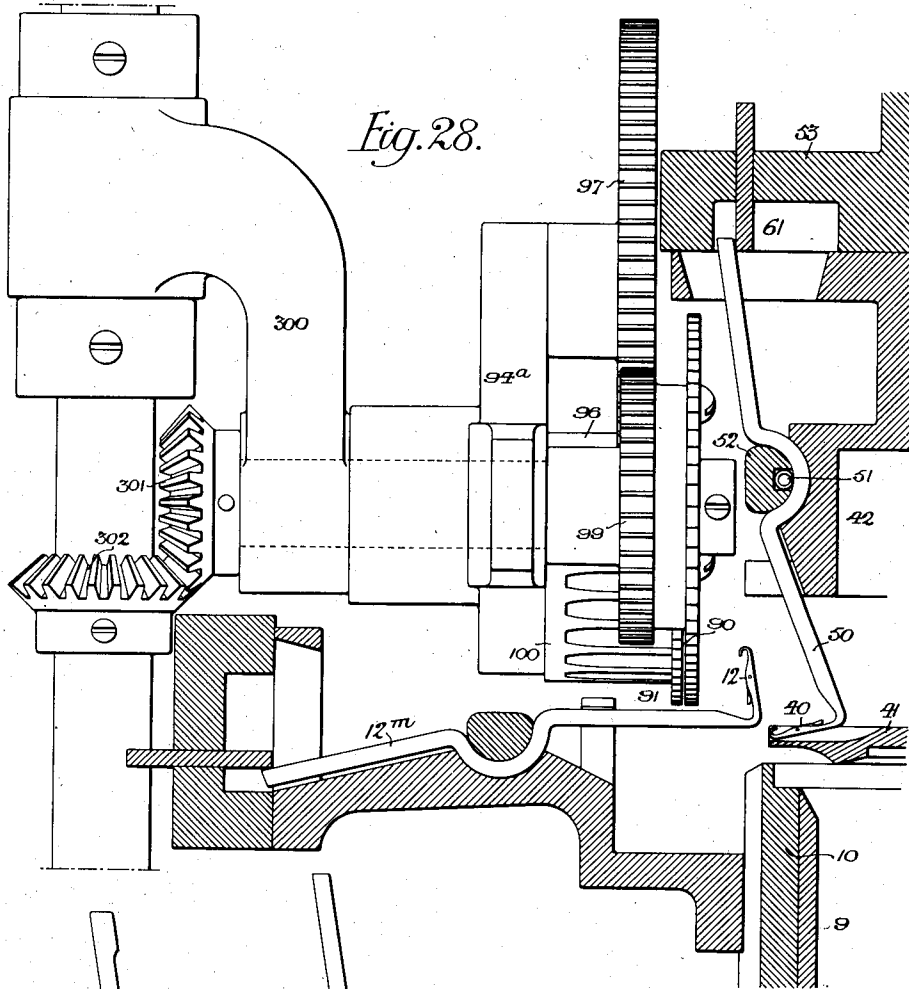


Fig. 28.

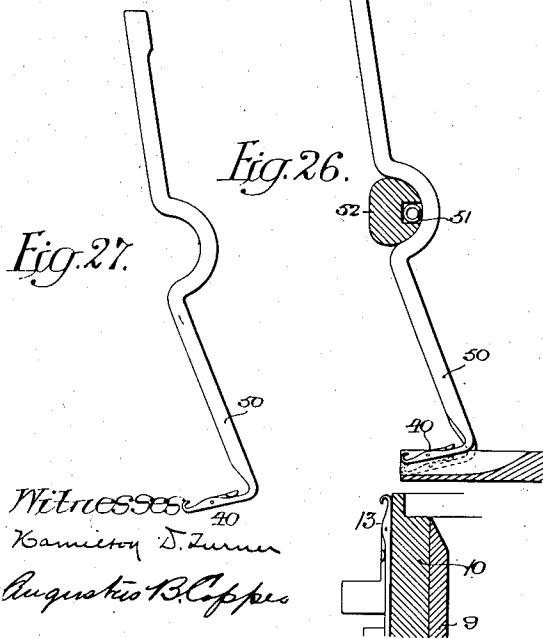
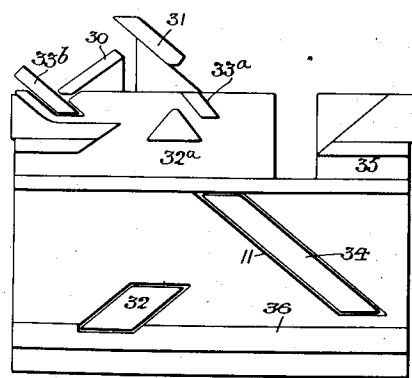


Fig. 26.

Fig. 27.

Witnesses
Kamieton D. Turner
Augustus B. Cope

Fig. 36.



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by his Attorneys,
Hosmer & Brown

No. 834,763.

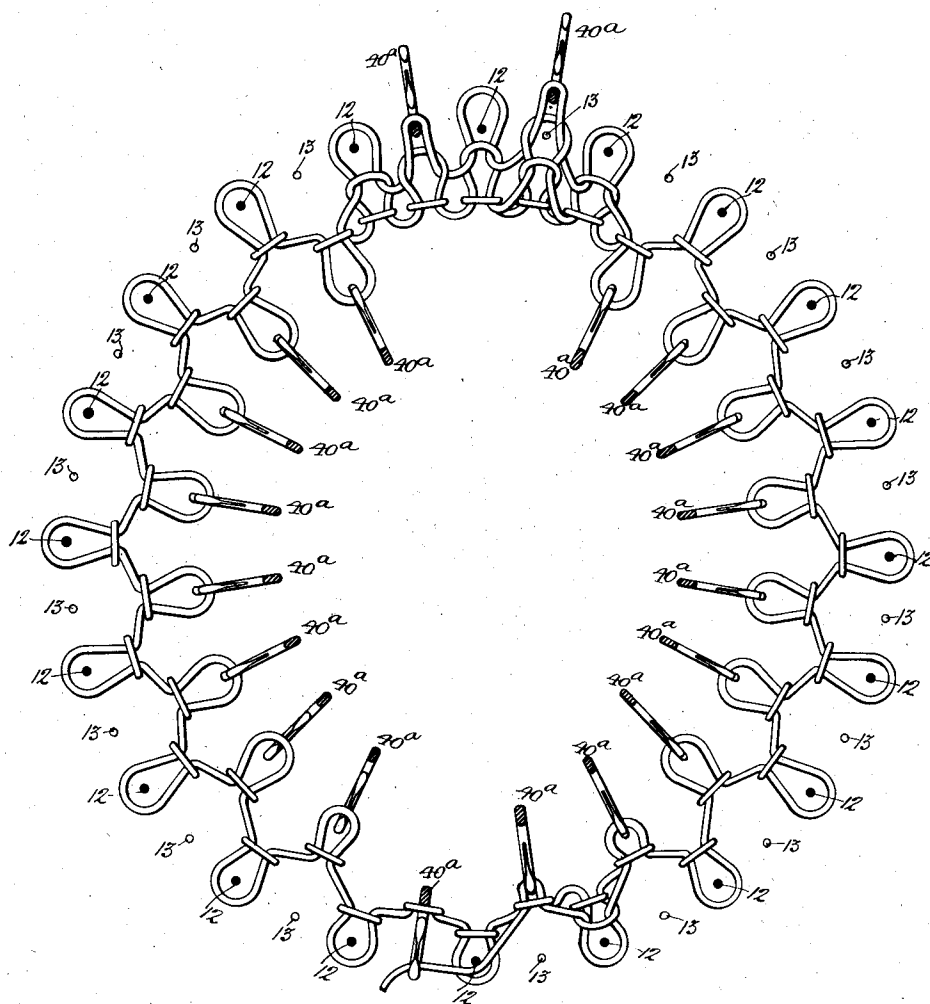
PATENTED OCT. 30, 1906.

R. W. SCOTT.
KNITTING MACHINE.

APPLICATION FILED NOV. 24, 1905.

16 SHEETS—SHEET 11.

Fig. 29.



Witnesses:
Titus H. Goss.
Hamilton D. Turner

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Horn & Horn

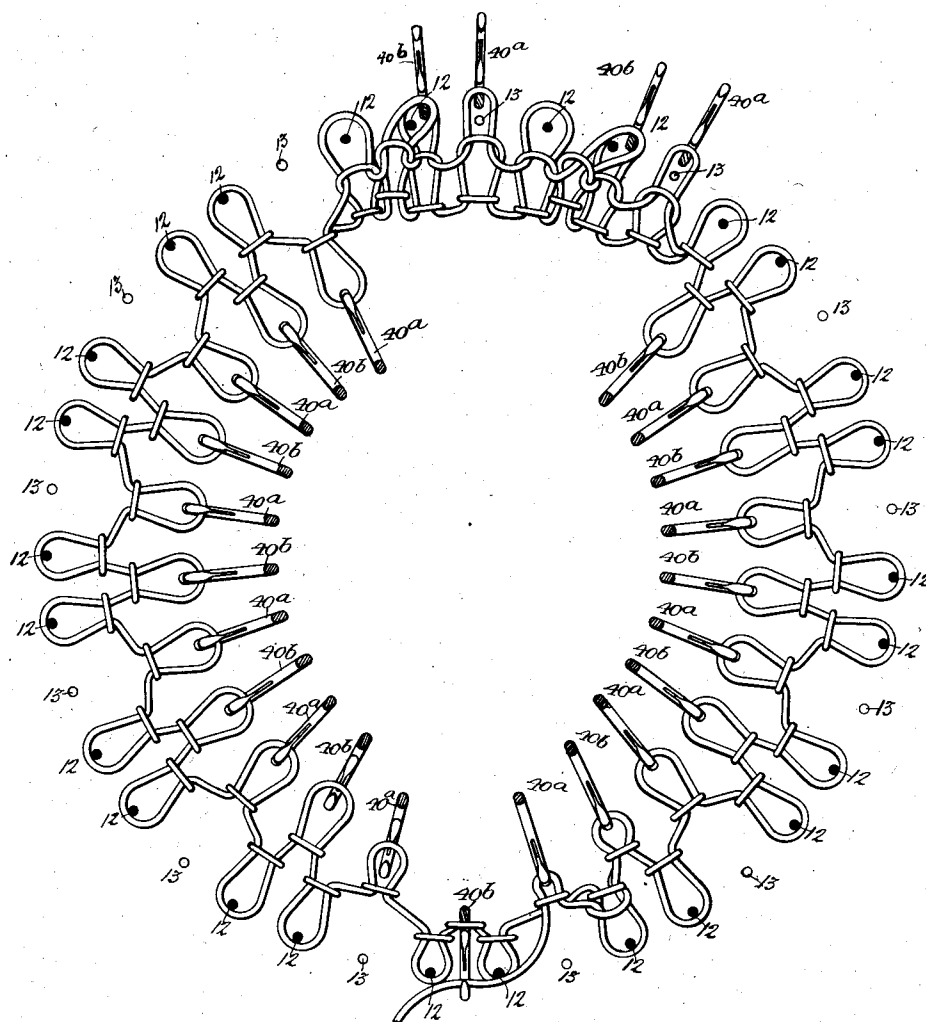
No. 834,763.

PATENTED OCT. 30, 1906.

R. W. SCOTT.
KNITTING MACHINE.
APPLICATION FILED NOV. 24, 1906.

16 SHEETS—SHEET 12.

Fig. 50.



Witnesses:
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Hamilton D. Sumner

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No. 834,763.

PATENTED OCT. 30, 1906.

R. W. SCOTT.
KNITTING MACHINE.

APPLICATION FILED NOV. 24, 1905.

16 SHEETS—SHEET 13.

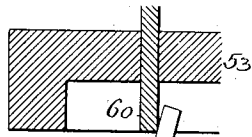


Fig. 31.

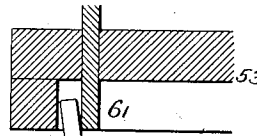
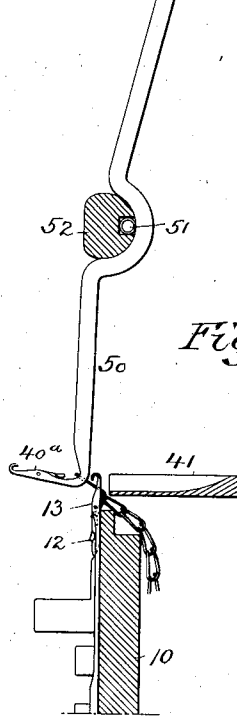


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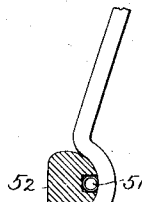
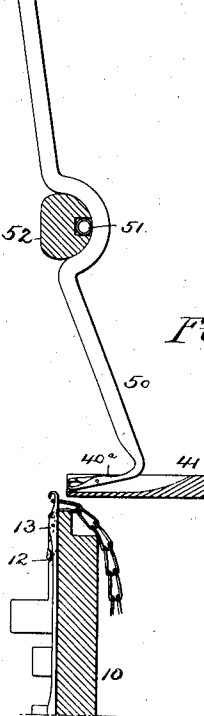


Fig. 33.

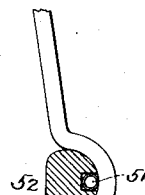
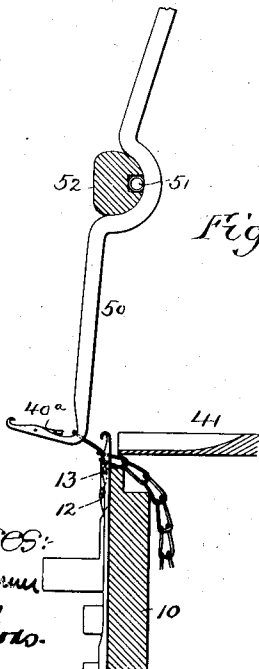
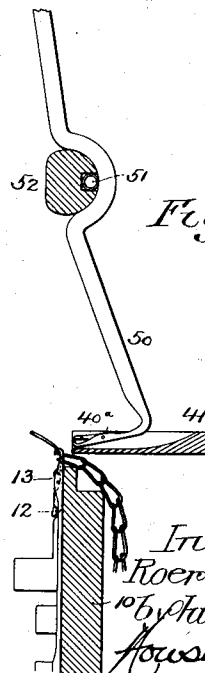


Fig. 34.



Witnesses:
Hamilton S. Turner
Thos H. Leno.

Inventor:
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No. 834,763.

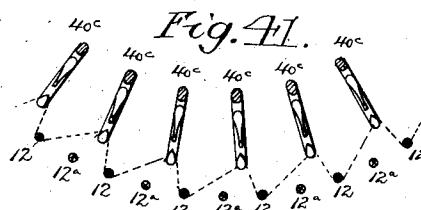
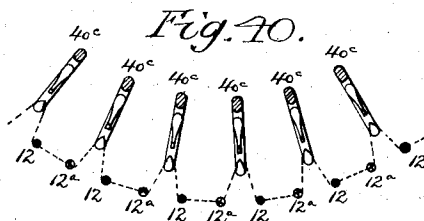
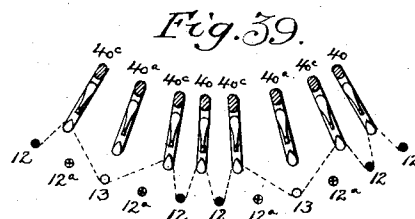
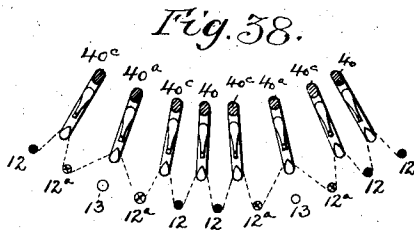
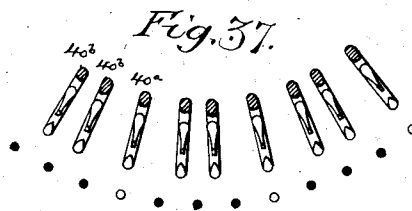
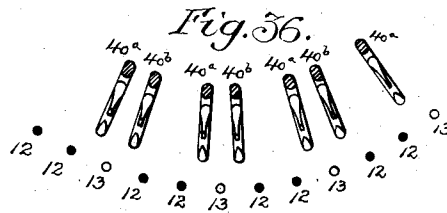
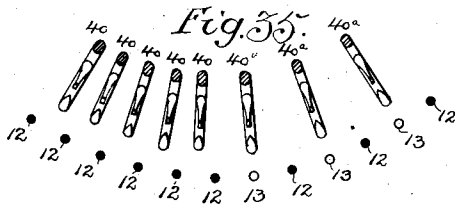
PATENTED OCT. 30, 1906.

R. W. SCOTT.

KNITTING MACHINE.

APPLICATION FILED NOV. 24, 1905.

16 SHEETS—SHEET 14.



Witnesses:

Wills A. Burrows

Hamilton D. Zinner

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Robert W. Scott.

By his Attorneys,

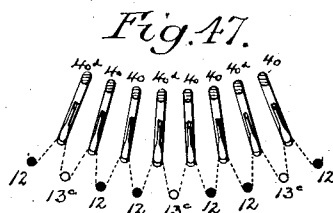
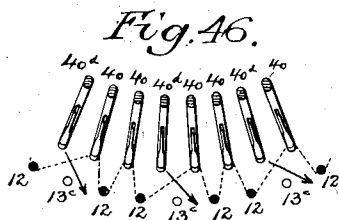
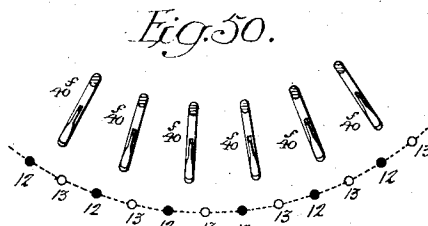
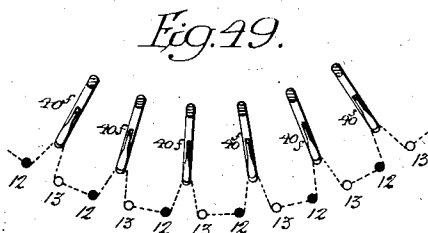
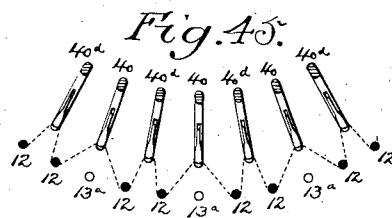
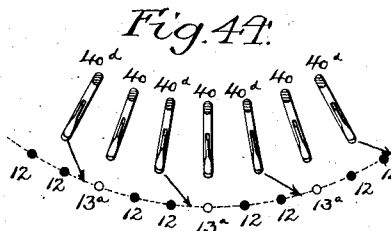
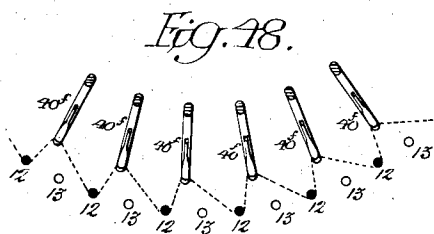
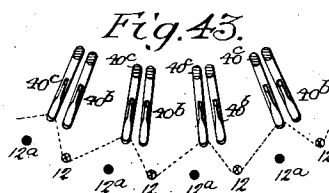
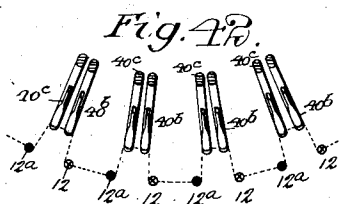
Howe & Howden

No. 834,763.

PATENTED OCT. 30, 1906.

R. W. SCOTT.
KNITTING MACHINE.
APPLICATION FILED NOV. 24, 1905.

16 SHEETS—SHEET 15.



Witnesses:

Walter G. Pullinger

Hamilton D. Turner

Inventor:

Robert W. Scott.

by his Attorneys

Howe & Brown

No. 834,763.

PATENTED OCT. 30, 1906.

R. W. SCOTT.
KNITTING MACHINE.
APPLICATION FILED NOV. 24, 1905.

16 SHEETS—SHEET 16.

Fig. 51.

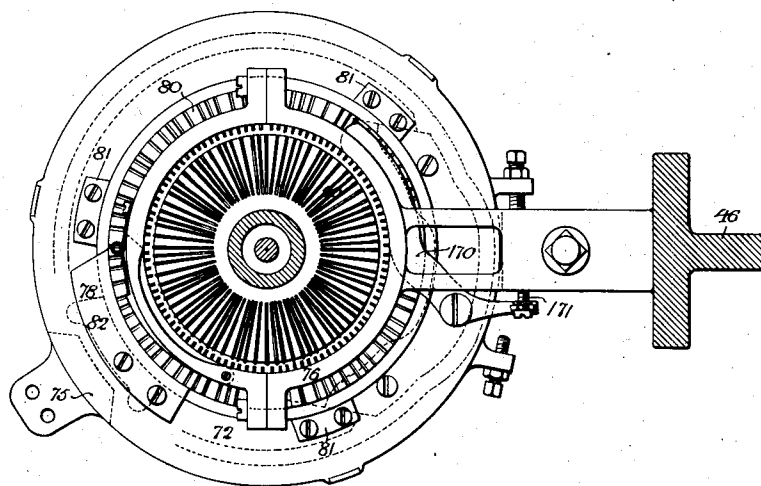
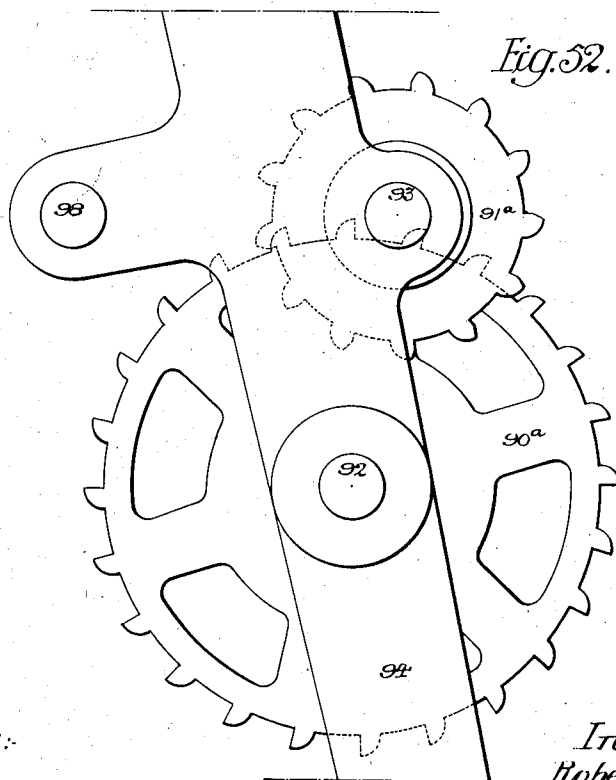


Fig. 52.



Witnesses:

John H. Pullinger
Augustus B. Cooper

Inventor:

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Howard & Howard

UNITED STATES PATENT OFFICE.

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KNITTING-MACHINE.

No. 834,763.

Specification of Letters Patent.

Patented Oct. 30, 1906.

Application filed November 24, 1905. Serial No. 288,911.

To all whom it may concern:

Be it known that I, ROBERT W. SCOTT, a citizen of the United States, residing in Leeds Point, Atlantic county, New Jersey, have invented certain Improvements in Knitting-Machines, of which the following is a specification.

The object of my invention is to so construct a knitting-machine that the web produced thereon may be changed in character—as, for instance, from rib-stitch web to plain-stitch web, or vice versa, the plain-stitch web having either the same or a lesser number of wales than the ribbed web, or if the web is ribbed throughout the character of the rib or the number of wales in the web may be varied, these operations being readily effected by movements of the needles and without stopping the machine or requiring the intervention of the attendant—the invention being therefore especially applicable to automatic machines for the production of hosiery.

In the accompanying drawings, Figure 1 is a view, partly in elevation and partly in vertical section, showing those portions of the knitting-machine to which my invention particularly relates. Fig. 2 is a view, partly in side elevation and partly in section, showing parts of the machine located above those represented in Fig. 1. Fig. 3 is a side elevation of the cylinder-needle-actuating cams of the machine developed in a flat plane. Fig. 3^a is a sectional view illustrating devices for operating a certain cam of the cam-cylinder. Fig. 3^b is a face view illustrating a modified arrangement of certain cams of the cam-cylinder. Fig. 4 is a sectional plan view on the line *a a*, Fig. 2. Fig. 5 is a sectional plan view on the line *b b*, Fig. 1. Fig. 6 is a sectional plan view on the line *c c*, Fig. 1. Fig. 7 is a sectional plan view on the line *d d*, Fig. 1, certain of the parts shown in the latter figure being omitted. Fig. 8 is a sectional plan view on the line *e e*, Fig. 1. Fig. 8^a is a view similar to Fig. 8, but showing a disposition of the cams differing from that in said figure. Fig. 9 is a sectional plan view of a needle-shogging device employed in connection with the machine for producing certain classes of work. Fig. 10 is a side elevation of the same. Fig. 11 is a vertical section of a modified form of shogging device. Fig. 12 is a sectional plan

view of a portion of the same. Fig. 13 is a view similar to Fig. 11, but illustrating still another form of needle-shogging device. Fig. 14 is a plan view of a part of the same. Fig. 15 is an inverted plan view of a modified form of cam-ring operating in conjunction with dial-needles of the machine. Fig. 16 is a similar view of still another modified form of said ring. Figs. 17 to 20, inclusive, are side elevations showing the different types of cylinder-needles. Fig. 21 is a view similar to Fig. 8, but showing a different arrangement of cams. Fig. 22 is a vertical sectional view of part of the machine, showing the method of transferring a stitch from a cylinder-needle to a dial-needle. Figs. 23 and 24 are views illustrating the operation of a certain latch-opener employed in connection with the cylinder-needles. Fig. 25 is a view, partly in vertical section and partly in elevation, of means for moving certain of the dial-needle-operating cams. Fig. 26 is a sectional view showing an arrangement of dial-needles for producing a certain kind of web. Fig. 27 is a side view of a special needle for like use. Fig. 28 is a sectional view showing the cylinder and dial needles and illustrating shogging devices in connection with the cylinder-needles. Figs. 29 and 30 are views showing, on an exaggerated scale, a set of cylinder and dial needles with stitches upon them and illustrating different methods of transferring stitches. Figs. 31 to 34 are views illustrating how stitches are transferred from needle to needle in accordance with my invention, and Figs. 35 to 50 are views showing arrangements of needles for producing some of the many different forms of fabrics for whose production the machine is available. Fig. 51 is a view similar to Fig. 6, but showing a modified arrangement of needles in the dial; and Fig. 52 is a view showing a modified construction of the shogging-wheels illustrated in Fig. 9. Figs. 1 to 8, inclusive, 8^a, 21, and 25 are upon a smaller scale than the remaining figures.

In Fig. 1 of the drawings, 1 represents the fixed table or bed of the machine, having depending bearings for a shaft 2, on which are mounted, so as to be free to rotate, a spur-wheel 3 and a sleeve 4, with spur-wheel 5, free to rotate upon the sleeve, continuous rotative movement in one direction being imparted to the spur-wheel 3 and back-and-forth move-

ment of partial rotation being imparted to the spur-wheel 5 by any of the forms of mechanism common for this purpose in ordinary knitting-machines. Sliding on but splined to the shaft 2 is a clutch-sleeve 6, which may be moved into engagement with a clutching-face on the spur-wheel 3 when it is desired to rotate the shaft 2 in one direction or into engagement with a clutch-face on the spur-wheel 5 when it is desired to impart back-and-forth movement of partial rotation to the shaft. Secured to the shaft 2 is a bevel-wheel 7, meshing with a bevel-pinion 8, which is secured to a vertical tubular sleeve 9, and upon the latter is mounted a needle-cylinder 10, which engages the sleeve 9, so as to turn therewith, but is free to move vertically thereon to a limited extent in order to vary the draft of the cylinder-needles below the top of the cylinder, and thereby govern the slackness or tightness of the stitch produced, it being understood that the cylinder-needles are operated by cams carried by a cylindrical cam-carrier 11, which is secured to the bed or table 1 and occupies a fixed vertical relation thereto.

The cylinder is provided with ordinary needles 12, Fig. 17, and other needles 13, which are provided with downwardly-extending jacks 14, these needles being disposed with reference to each other in the cylinder in accordance with the character of work which is to be produced by the machine, the needles 13 being intended to have stitches transferred to them from the dial-needles, while the needles 12 either may or may not receive stitches from the dial-needles. The needles 12 and 13 around one half the cylinder have short butts 15, Figs. 17 and 19, to be acted upon by the knitting-cams of the machine, while the needles 12 and 13 on the remaining half of the cylinder have longer butts 16, as shown in Figs. 18 and 20, and certain of the needle-jacks 14 have short butts 17, (see Fig. 19,) while the others have longer butts 18, as illustrated in Fig. 20.

The cam-carrier 11 has, as shown in Fig. 3, lift-cams 20, 21, and 22, depressing-cams 23 and 24, a sliding toe-cam 25, yielding cam-gates 26, lifting-pickers 27, and depressing-pickers 28, all of which are common in ordinary machines for making hose with seamless heel and toe pockets thereon, and said cam-carrier also has the usual cams 30 and 31, the former for raising out of action the needles having long butts 16 before beginning the formation of the heel or toe pocket by back-and-forth knitting upon the remaining needles and the cam 31 being intended for restoring to action after the completion of the heel or toe pocket, said needles having long butts 16.

In addition to the usual cam formation the cam-box 11 has three cams 32, 33, and 34, which act upon the butts of the jacks 14.

In the normal operation of the machine for producing ribbed fabric all of the needles 13 are lowered in the needle-cylinder, so that their butts 15 and 16 are below and out of range of the knitting-cams, said butts traveling in a raceway 35 and the butts of the jacks traveling on the supporting-ledge 36 of the cam-box. When it is desired to bring these needles 13 into action, however, they are first raised and then slightly depressed by the action of the cams 32 and 33 upon the jack-butts, so that they can engage with and receive stitches from the dial-needles, this movement bringing the butts 15 and 16 of said needles 13 into range of the knitting-cams, and thereafter in the operation of the machine stitches are formed upon said needles, as well as upon the ever-active needles 12 of the machine. When it is desired to again put the cylinder-needles 13 out of action, the cam 34 is moved into the path of the jack-butts and acts upon the same to depress the needles 13 and cause them to cast their stitches, the butts 15 and 16 of said needles finally resuming their former position in the race 35, where they will be free from the action of the knitting-cams.

The dial-needles 40 operate in conjunction with a suitably-grooved dial 41 and are pivotally mounted upon a sleeve 42, both dial and sleeve being secured to a central vertical tubular shaft 43, the latter passing through a fixed hub or bearing 44, forming part of a cross-arm 45, which is mounted upon the top of a standard 46, secured to and projecting upwardly from the fixed bed or table 1 of the machine, Figs. 1 and 2. Secured to the upper end of the tubular shaft 43 is a spur-wheel 47, Fig. 2, which meshes with a spur-pinion 48, carried by the upper end of a vertical shaft 49, the latter being adapted to a bearing at the outer end of the cross-arm 45 and also to a bearing in the fixed bed 1 of the machine, said shaft having a spur-wheel 250, which is in mesh with a spur-wheel 251, formed upon the peripheral portion of the bevel-wheel 8. Hence the needle-cylinder 10 and dial 41 of the machine are caused to rotate in unison. The dial can, however, be turned to a slight extent about its axis independently of this driving connection in order to adjust the dial-needles circumferentially in respect to the cylinder-needles, such adjustment being permissible by reason of the fact that the spur-pinion 48 is not rigidly secured to the shaft 49, but has a depending lug 252, which is confined between the ends of opposite set-screws 253, carried by the arms of a forked sleeve 254, secured to the shaft 49, so that by slackening one of these set-screws and screwing up on the other the position of the spur-pinion 48 in respect to the shaft 49 can be slightly changed, with the effect of correspondingly changing the position of the dial 41 in respect to the needle-

cylinder 10, Figs. 1, 2, and 4. The dial 41 can also be raised and lowered to a limited extent in respect to the cylinder, a ring 255 being mounted so as to be free to turn on the shaft 43, the upper face of this ring bearing against the under face of the hub of the spur-wheel 47 and the under face of the ring having depending cams 256, which normally rest upon the top of the bearing 44 on the cross-arm 45, but can by a slight turning movement of the ring 255 be caused to engage with cams 257 on said bearing, thus lifting to any desired extent the dial and parts co-operating therewith, Figs. 2 and 4.

Each dial-needle 40 forms part of an upwardly-bent jack 50, which is guided in upper and lower grooves or slots in the sleeve 42 and at an intermediate point is pivoted to the sleeve, as by providing the jack with a curved portion which is adapted to a correspondingly-curved seat in the sleeve. (See Figs. 1, 11, and 13.) The jacks are normally retained in engagement with the sleeve 42 by means of a surrounding coiled spring 51, which is held in place by a sectional clamping 52, Figs. 1 and 11, the latter also serving as an outboard-bearing for the jacks 50.

Resting upon the top of the sleeve 42 is a dial-cam ring 53, which carries the cams for operating the dial-needle jacks 50, these cams being shown in Fig. 8 and comprising a pivoted swinging cam 54 for projecting the dial-needles in knitting, a cam 55 for retracting the said dial-needles, and a series of guard-cams 56, 57, and 58, the course of the needle-butts when the dial-needles are being actuated so as to knit being represented in Fig. 8^a. The purpose of making the cam 54 adjustable is to be able to retain the dial-needles in the retracted position for one or more courses when it is desired to form a welt upon the knitted tube.

In addition to the cams already enumerated the cam-ring 53 has a pair of cams 60 and 61 and an intermediate cam 62, said cams 60 and 61 being vertically guided in the back of the cam-ring, whereby they can be depressed in order to engage the upper ends of the jacks 50 or can be raised so as to be free from engagement therewith.

The jacks 50 are of different lengths, as shown in Fig. 1. Hence the cam 60, which acts upon said jacks to effect projection of the dial-needles, may be first depressed to such a position as to act only upon the longer jacks and may then be further depressed in order to act upon the shorter jacks as well.

The character of the cam 60 is such that when it is acting upon the jacks 50, as shown in Fig. 21, the dial-needles 40 will be projected to a greater extent than at any time during the knitting operation, and will therefore draw stitches of the web of fabric produced upon said dial-needles outwardly to a position above the cylinder-needles, and the

latter may then be caused to engage the stitches thus drawn into abnormal relation with the cylinder. (See Fig. 28.)

In each machine organized as shown in Fig. 1 it is important that the projection of the dial-needles to the abnormal or transfer point shall be begun at a certain needle of the set without projection of a needle or needles in advance of said abnormally projected needle to a point short of the transfer-point, but beyond the clearing-point—that is to say, with the stitch slipped back of the latch—for if any such needle or needles is thus partially projected it will on being subsequently retracted cast its stitch without transferring the same and will thus cause a drop-stitch or defect in the work. For this reason jacks of different lengths are employed, and the projecting cam 60, while occupying a position above the short jacks, is depressed to such an extent as to be in position to engage the long jacks. Consequently the projection of the dial-needles begins with that having the first long jack, the short jacks in advance of the same not having been acted upon by said cam 60. As soon, however, as the cams 60 61 are in engagement throughout their entire length with the long jacks, as shown in Fig. 21, they can be further depressed, so as to be in position to engage the short jacks as well. Hence by the time that the dial has completed a full rotation all of the dial-needles will have been projected to the transfer-point.

When the projecting-cam 60 is first depressed, the retracting-cam 61 is also depressed to such an extent as to act upon the long jacks, and it follows the further depression of the cam 60, so as to act upon the short jacks. Therefore each dial-needle as soon as it has transferred a stitch to the corresponding cylinder-needle will be retracted and cast the stitch from it, and the jacks will then be directed to the outside of the cam 58 and also to the outside of a cam 63, the effect being to retain the dial-needles in a fully-retracted position at the knitting-point, with the result that said needles will have no further stitches formed upon them until it is again desired to bring them into action, whereupon the cams 60 and 61 are raised out of the path of the jacks 50.

Fig. 21 shows both of the cams 60 and 61 in the depressed position, so as to act upon the jacks 50 to project the dial-needles to the transfer-point and then retract them, and Fig. 8 shows the cam 60 retracted to clear the jacks 50, the cams 61 remaining in action and all of the dial-needles being retracted to permit of the knitting of plain web upon the cylinder-needles. In Figs. 8, 8^a, and 21 the long jacks are shaded and the short jacks are unshaded.

For the purpose of beginning the projection of the cylinder-needles at a certain needle of a set corresponding to the dial-needle

which is to transfer its stitch thereto the jacks which control the needle 13 are provided with the short and long butts 17 and 18, and the cam 32 acts upon these long and short butts in the same way that the cam 60 acts upon the long and short jacks. It is preferable that the jacks having the long butts 18 shall be those of the needles 13, which have long butts 16, these needles, together with the long-butt needles 12, being grouped around one-half of the cylinder and acted upon by the cams 30 and 31 of the cam-box, and the long jacks 50 of the dial-needles are correspondingly arranged in order that the transfer of stitches may begin on a wale corresponding with or adjoining that at the beginning of the heel-pocket upon the knitted tube.

As shown in Figs. 1 and 6, there are just half as many dial-needles as there are cylinder-needles in the machine—that is to say, the needles 12 and 13 are arranged in regular alternation in the needle-cylinder and there is a dial-needle 40 directly in line with each cylinder-needle 13. Hence if the cylinder-needles 12 are out of action and are retained in their retracted position a “one-and-one-rib” web will be produced—that is to say, a web in which single cylinder-needle wales and single dial-needle wales alternate regularly with one another. If, however, dial-needle stitches are transferred to the before inactive cylinder-needles 13, (the latter are put in operation and the dial-needles are moved out of operative position and retained in such inoperative position,) plain web will be produced upon all of the cylinder-needles, said plain web having as many wales of stitches as were formerly contained in the ribbed web. This is what I term a “straight” transfer. If the ribbed web is to contain a greater number of wales than the plain web, there will be a greater number of dial-needles than when the two webs have the same number of wales, and the stitches will be transferred from these excess dial-needles either to formerly-active or formerly-inactive cylinder-needles, depending upon circumstances. In the case of a uniformly-ribbed web—such as one having a one-and-one rib, a two-and-two rib, or the like—the number of dial-needles will exceed one-half the number of cylinder-needles, the excess dial-needles working in radial planes which do not register with the vertical planes of the cylinder-needles and in some cases more than these excess needles may be thus disposed. I therefore provide means for “shogging” or moving laterally such of the dial-needles as are not normally in register with cylinder-needles in order to bring them into such relation with the cooperating cylinder-needles that stitches may be transferred from one to the other. Various forms of shogging mechanism for this purpose will be hereinafter described. This feature of

my invention may be embodied in a machine in which there are no inactive cylinder-needles at any stage of the knitting operation. For instance, the machine may have one hundred cylinder-needles and one hundred dial-needles so disposed that the one-and-one-ribbed fabric produced will have two hundred wales of stitches, each dial-needle transferring a stitch to and doubling it with the stitch upon an adjoining cylinder-needle to produce a plain web having but one hundred wales of stitches. Usually, however, the transfer will be either a straight transfer from each dial-needle to a hitherto inactive cylinder-needle, as before described, so as to produce a plain web having as many wales as the ribbed web, or a transfer which is partly a straight transfer and partly a “doubling” transfer, the latter term meaning a transfer from one needle to another needle which already has a stitch upon it.

In order to transfer a stitch to an ever-active needle, the latter will be raised to the transfer-point to receive the stitch; but it must not thereafter be moved to inactive position, as are the intermittently-active needles. One method of accomplishing the desired result is shown in Fig. 3^b. In this construction the lower cam 32, which acts upon the butts of the jacks 14, does not lift the latter sufficiently to raise the needles 13 to the transfer-point, this duty being performed by an upper cam 32^a, which acts upon the butts of the partially-raised needles and completes the raising of the same. A cam 33^a cooperates with this cam 32^a for the performance of the same duty as the cam 33 in the construction shown in Fig. 3. A cam 33^b acts upon the butts of the ever-active needles 12 in order to depress the same prior to their relevation to the transfer-point by the cam 32^a after the dial-needles have been properly projected above the same. As the ever-active needles have no depending jacks, they will of course be free from the influence of the cam 34, and hence will not at any time be retracted to inactive position thereby. The cam 33^b can be projected and retracted in the same manner as the cam 32, although it is by preference independent thereof. It may, however, be under the same control as the shogging-wheels, hereinafter referred to.

In Fig. 31 I have shown a dial-needle 40^a projected to such position that the corresponding and hitherto inactive cylinder-needle 13 can rise behind the bent shank of the dial-needle, and thus enter the stitch upon the latter. If the dial-needle is now retracted, it will crowd past the projected cylinder-needle and in casting its stitch will transfer or deliver the same to said projected cylinder-needle, as shown in Fig. 32, or if it is not desired to thus crowd one needle past the other either the cylinder-needle or the dial-needle may be shogged before such retraction of the dial-needle.

In Fig. 33 I have shown a dial-needle 40^a projected to such an extent as to bring into range of the receiving cylinder-needle 12 a stitch of the rib-wale which has been formed previously to that upon the dial-needle. Hence if after being projected so as to engage said stitch the cylinder-needle is slightly retracted until its hook is below the dial-needle the latter can then be retracted to cast the stitch upon it without contact with the receiving cylinder-needle. (See Fig. 34.) If the stitch thus cast by the dial-needle can slip over the top of the cylinder-needle, the result when the knitting of plain web upon all of the cylinder-needles is proceeded with will be that the stitches which have been cast from the dial-needles will pull into the adjoining standing wales, the yarn being drawn across the engaged stitches; but if the stitches cast from the dial-needles are caught by the cylinder-needles, together with the stitches directly engaged thereby, either when said stitches are cast off by the dial-needles or when the cylinder-needles subsequently rise, as at the knitting-point, both stitches will be cast from the cylinder-needles when the first course of plain web is knitted, and the stitches of said first course of plain web will engage with both of the rib-stitches.

If the previously inactive cylinder-needle engages directly with the rib-stitch upon the dial-needle, the only change in the wale will be in the direction of the stitches therein, the rib portion of the wale having the stitches pulled to the rear of the web and the plain portion of the wale having the stitches pulled to the face of the same.

In Fig. 29 I have shown an exaggerated or diagrammatic representation of a set of cylinder and dial needles arranged as in the machine just described and shown in Figs. 1 and 6, showing at the lower portion of the figure the needles in the act of knitting to produce a one-and-one rib and at the upper portion of the figure the dial-needles 40^a in the act of transferring rib-stitches to the hitherto inactive cylinder-needles 13, one of the dial-needles being shown in the fully-projected position and carrying a previously-formed rib-stitch into position to be engaged by the rising cylinder-needle 13 and a following dial-needle being shown in a partially-projected position. For the reason before alluded to the dial-needles in advance of that which is fully projected have not been projected at all. Hence there is no risk of drop-stitches as there would be if any of said needles had been projected far enough to clear its stitch and then retracted without transferring its stitch.

In Fig. 30 I have shown in an exaggerated or diagrammatic form a set of cylinder and dial needles disposed in accordance with my invention and designed to effect a partial

straight transfer of rib-stitches to hitherto inactive cylinder-needles and a partial doubling transfer of rib-stitches to hitherto active cylinder-needles. In this arrangement each inactive cylinder-needle 13 alternates with a pair of active cylinder-needles 12, and every other one of the dial-needles 40^a is disposed in line with an inactive cylinder-needle, while each of the alternate dial-needles 40^b is disposed between a pair of active cylinder-needles. The transfer of the rib-stitches is effected by a straight projection of the dial-needles 40^a and by a combined projection and lateral shogging of the dial-needles 40^b. At the bottom of the view the needles are shown as in the act of knitting a one-and-one-rib web, while at the top of the view two of the dial-needles 40^a are shown in position to transfer their stitches to previously-inactive cylinder-needles 13, and two of the dial-needles 40^b are shown projected and shogged in order to transfer their stitches to previously-active cylinder-needles 12, on which needles said rib-stitches will be doubled with the stitches already carried by said needles 12. In this view the cylinder-needles are shown as engaging directly with the stitches upon the dial-needles; but it will be evident that by a further projection of said dial-needles, as in Fig. 29, previously-formed rib-stitches can be brought into position to engage the cylinder-needles, as hereinbefore described, and it will also be evident that the arrangement of needles in the cylinder and dial may be varied in many different ways.

In Figs. 35 to 50 I have shown parts of circles of cylinder and dial needles indicating relative arrangements of the same for producing a number of different forms of fabric in accordance with my invention.

The arrangement shown in Fig. 35 is one whereby change can be effected from one-and-one-rib web to plain web in one portion of the fabric, while still maintaining the production of ribbed web in another portion of the fabric, the needles 12 and 40 being always in action, but the needles 40^a transferring their stitches to the hitherto inactive needles 13 in changing from ribbed web to plain web in the other portion of the fabric.

The arrangement shown in Fig. 36 is intended for producing a two-and-two-ribbed web when the cylinder-needles 13 are out of action, but for producing either a plain web or a three-and-one-ribbed web when said cylinder-needles 13 are in action, plain web being produced by shogging both of the dial-needles 40^a and 40^b in the same direction to transfer the stitch from the needle 40^b to a previously-active needle 12 and from the needle 40^a to a previously-inactive needle 13 or by shogging them successively in different directions, so as to transfer the stitch first from dial-needle 40^a to the previously-inactive cylinder-needle 13 and then from the

dial-needle 40^b to said cylinder-needle 13, and a three-and-one rib being produced by transferring a stitch from one of the dial-needles 40^a or 40^b only to the previously-in-

5 active cylinder-needle 13.
In Fig. 37 I have illustrated an arrangement in which each dial-needle 40^a, which effects a straight transfer of a rib-stitch to a previously-inactive cylinder-needle 13 alternates with two dial-needles 40^b, each of which transfers its stitch to an adjoining active cylinder-needle 12.

It is also possible to construct a machine in accordance with my invention in which 15 stitches can be transferred from cylinder-needles to dial-needles by so constructing each cylinder transfer-needle that it will present a lug or projection for engaging the stitch upon the needle and pulling the web into such position that its stitches can be engaged by the properly-projected dial-needles. Fig. 22 shows a cylinder-needle of this character having in its shank a yoked portion 13^b for the reception of the hooked end of the 20 dial-needle which has engaged a plain-wale stitch in advance of that upon the cylinder-needle, and this same construction may be adopted in connection with the dial-needles of machines in which the ordinary flat dial and a dial cam-plate directly above the same are employed in place of the swinging jacks shown in Fig. 1, and in some machines some or all of the needles, both of the cylinder and dial, may be constructed and combined 30 with cams such as described, whereby they can carry to the transfer position stitches of the web produced upon them in order that transfer can be effected from a dial-needle to a cylinder-needle, or vice versa, in any desired portion of the web.

In machines of this character change can be effected from ribbed web having a certain number of wales to ribbed web having a lesser or greater number of wales or from 45 plain web to ribbed web. Thus in Figs. 38 and 39 I have shown an arrangement of needles whereby change can be effected from one-and-one-rib web having a greater number of wales to one-and-one-rib web having a lesser number of wales by transferring stitches from dial-needles 40^a to previously-inactive cylinder-needles 13 and also by transferring stitches from previously-active cylinder-needles 12^a, one on each side of each of said needles 13, to previously-active dial-needles 40^c, other dial-needles 40 remaining in action in producing both webs and the course of the knitting-yarn being shown by dotted lines in the two figures.

60 The arrangement of needles shown in Figs. 40 and 41 is intended to effect a change from ribbed web having a greater number of wales to ribbed web having a lesser number of wales by transferring stitches from previously-active cylinder-needles 12^a to previ-

ously-active dial-needles 40^c, and in Figs. 42 and 43 I have shown an arrangement whereby a change from two-and-two-rib web to one-and-one-rib web can be effected by transferring stitches from previously-active cylinder-needles 12^a to previously-active dial-needles 40^c and from previously-active dial-needles 40^b to previously-active cylinder-needles 12.

By the arrangement shown in Figs. 44 75 and 45 change is effected from plain web, produced upon the cylinder-needles only, as in Fig. 44, to one-and-one-rib web by transferring stitches from the cylinder-needles 13^a to dial-needles 40 and introducing other dial-needles 40^d, which normally operate between the ever-active cylinder-needles 12, as shown in Fig. 45, but are introduced in the primary course between one of said cylinder-needles 12 and a cylinder-needle 13^a, (see arrows, 85 Fig. 44,) so as to laterally displace the initial loops formed upon them, and thus prevent the formation of eyelet-holes, this lateral displacement of the dial-needles being effected by the shogging devices, hereinafter described, or equivalent mechanism. 90

It may here be noted that in a machine of the character shown in Fig. 1 transfer from a cylinder-needle to a dial-needle which is normally in a different plane is preferably effected by shogging the dial-needle rather than the cylinder-needle, because of the greater ease with which such movement can be effected, especially when the dial-needles are mounted upon swinging jacks which can be projected from the grooves of the dial, as hereinbefore described. 100

In Figs. 46 and 47 I have shown an arrangement of needles whereby change can be effected from one-and-one-rib web having a lesser number of wales to one-and-one-rib web having a greater number of wales, the cylinder-needles 13^c being normally inactive in the production of the smaller web and each dial-needle 40^d being shogged in producing the first course of the larger web, so as to be projected on the far side of the introduced needle 13^c. (See arrows, Fig. 46.) 110

In many cases it is advisable to first change from one character of ribbed web to another containing a greater number of wales and then from ribbed web to plain web. Thus a stocking may be started with a one-and-one-ribbed web for the top. This may be changed to a two-and-one-ribbed web for the leg and this to a plain web for the foot. 120 Figs. 48, 49, and 50 show an arrangement of needles whereby the knitting of such a web may be effected. The course of the yarn in knitting one-and-one-ribbed web is shown in Fig. 48, knitting being effected upon the cylinder-needles 12 and the dial-needles 40^d, the cylinder-needles 13 being inactive. To change from one-and-one-ribbed web to two-and-one-ribbed web, the dial-needles are pro- 130

jected and shogged, so that the previously-inactive cylinder-needles 13 can engage stitches in a course in advance of that upon said dial-needles; but the latter are not until they have received fresh yarn retracted to such an extent as to cast their stitches. Hence all of the cylinder and dial needles will cooperate in the production of the two-and-one-ribbed web, as shown in Fig. 49. In changing from two-and-one-ribbed web to plain web rib-stitches are transferred by the dial-needles either to the needles 12 or 13 and the dial-needles are then withdrawn, so as to cast the stitches from them, as shown in Fig. 50.

The above recitation of the various uses of my improved machine will be sufficient to indicate to those skilled in the art how the same can be adapted for the production of any desired character of fabric, whether partly plain and partly ribbed or ribbed throughout, but having a different character of rib or different number of wales in one part than in another.

In each of the arrangements of needles shown in Figs. 30, 35 to 39, and 42 to 47 the number of needles in the dial is in excess of one-half of the number of needles in the cylinder.

The cylinder is by preference cut or grooved so as to present a uniform gage, and the cylinder-needles are therefore equidistantly disposed and a uniform gage of plain web is insured. The dial may have the needles disposed equidistantly, as in Figs. 29, 30, 40, 41, and 44 to 50, or said dial-needles may be closer to each other at some points in the set than at others—as, for instance, in Figs. 35 to 39 and 42 and 43 or in Fig. 51, which shows the dial and cylinder in organized relation to one another. In any construction of machine, however, in which there is a surplus of wales in the ribbed web as compared with the number of wales in the plain web cooperating cylinder and dial needles will be in closer lateral relation to each other at some points in the set than at others, and in order to insure substantial uniformity of gage in the ribbed fabric those needles of the dial which occupy the closer lateral relation to the cylinder-needles may be manipulated to provide an excess of yarn, tending to produce a substantially equidistant disposal of the wales in the ribbed portion of the web. For instance, the closely-disposed dial-needles may be raised to a greater extent above the cylinder-needles than are the other dial-needles, as shown in Fig. 26, or the closely-disposed dial-needles may constitute the primary or stitch-drawing needles and may be retracted to a greater extent than the other dial-needle by thickening those portions of their jacks which are acted upon by the retracting-cam, as shown in Fig. 27, or when the cylinder-needles are

the primary needles an excess draft may be imparted to those of the cylinder-needles which operate in conjunction with the closely-disposed dial-needles.

Operating in conjunction with the cylinder-needles are the usual reciprocating web-holders 70, Figs. 1, 11, and 13, which are guided radially in grooves in a ring 71, mounted on the needle-cylinder, and are actuated by cams in a ring 72, which has projecting arms with adjustable screws to be struck by a bracket 73 on the fixed standard 46, as in the usual manner, and cooperating with said needles are also radially-reciprocating latch opening and guarding bits 74, likewise radially guided in the ring 71 and actuated by a cam-ring 75, Figs. 11 and 13, mounted on the ring 72, the inner ends of these bits being bent and serving when the bits are projected to engage the latch of a rising needle, as shown in Fig. 23, but opening said latch and retaining the same in said open position, as shown in Fig. 24, until the rise of the needle frees the latch from the control of the bit.

The yarn-feeding ring 76 is mounted on the bracket 73 and extends around the machine, being recessed, as at 77, at a point opposite the yarn-feeding point, so as to permit of the abnormal projection of the needle-jacks 50, said recessed portion of the ring being provided with a spring-actuated plate 78, which can be pushed outward against the tension of its spring under the pressure of the jacks 50, but will be restored to normal position by said spring as soon as released from pressure of said jacks and will thus act as a latch-protector for the cylinder-needles when the latter are raised above their normal knitting position. (See Figs. 1, 6, and 11.)

When the dial-needles are designed simply to transfer rib-stitches to previously inactive cylinder-needles, and hence do not have to be laterally shogged, I prefer to use in connection with said dial-needles an outer ring 80, grooved for the reception of each dial-needle when the same is normally projected, this ring resting upon the ring 71 and being retained in position vertically by means of clips 81, secured to the top of the cam-ring 72. Mounted upon the ring 81 is a plate 82, which by contact with the hooks of the abnormally projected dial-needles serves to limit the extent of projection of the same, Figs. 1 and 6.

When the dial-needles are to be shogged laterally, the ring 80 and the parts carried thereby will be omitted, as will also that portion of the yarn-feeding ring 76 which would otherwise interfere with the proper operation of said shogging devices, the latter being preferably located as shown by dotted lines in Fig. 1.

Various forms of mechanism for effecting the shogging of the dial-needles may be

adopted in accordance with my invention. Thus in Figs. 9 and 10 I have shown for effecting this purpose a pair of rotating wheels 90 and 91, each having beveled teeth and
 5 each driven so that their peripheral portions move at the same speed as the dial-needle jacks with which they engage, the teeth of the wheel 90 being beveled in one direction to deflect the jacks and dial-needles in one direction from their normal position and the
 10 teeth of the wheel 91 being beveled in the opposite direction to restore said dial-needles and jacks to their normal position before they are again retracted into the grooves of the dial. The wheels 90 and 91 are mounted,
 15 respectively, upon studs 92 and 93, secured to and depending from an arm 94, which is pivotally mounted upon the vertical shaft 49, so that it can be swung thereon in order to carry the shogging-wheels 90 and 91 into
 20 or out of engagement with the dial-needle jacks 50, depending upon whether it is or is not desired to effect lateral shogging of the same. The arm 94 is vertically confined
 25 upon the shaft 49 by fitting snugly between a collar 95 on said shaft and a spur-pinion 96, also secured thereto, as shown in Fig. 10. Constant rotation of the shogging-wheels 90 and 91 is effected by gearing them to the
 30 shaft 49, such gearing comprising, in addition to the spur-pinion 96, a spur-wheel 97, mounted on a stud 98 on the arm 94 and meshing with spur-pinions 99 and 100, secured, respectively, to the shogging-wheels
 35 90 and 91. The shogging-wheel 90 has segmental slots 101 for the passage of clamp-bolts 102, Fig. 9, secured to the spur-pinion 99. Hence a limited amount of circumferential adjustment of the wheel 90 is permitted in order to provide for the most effective
 40 action of its beveled teeth upon the dial-needle jacks 50.

In the modification of the shogging device shown in Figs. 11 and 12 reciprocating
 45 bits 103 and 104 are employed, these bits being guided radially in a ring 105, secured to the jack-carrying ring 42 of the machine, the bits 103 being reciprocated by cams 106 below the ring 105 and the bits 104 being reciprocated by cams 107, located above said ring,
 50 both sets of cams being carried by studs 108, mounted on the web-holder-operating cam-ring 72, as shown in Fig. 11. The bits 103 have their inner ends beveled in one direction, and the bits 104 have their inner ends
 55 beveled in the opposite direction, whereby when it is desired to shog the projected dial-needle jacks in one direction the bits 103 are projected so that their beveled ends will engage and laterally move to the desired extent
 60 such projected jacks, restoration of the jacks to their normal position being effected by withdrawal of the bits 103 and projection of the reversely-beveled bits 104. The lower-
 65 most grooves in the jack supporting and

guiding ring 42 will in this case be widened at the outer ends, as shown in Fig. 12 in order to permit of the lateral shogging of the jacks 50.

In the modified shogging device shown in
 70 Figs. 13 and 14 the shanks of the dial-needles are directly engaged by jaws 110 upon the inner ends of bits 111, which are pivotally mounted upon a ring 112, carried by the ring
 75 72, these bits having rearwardly-projecting ends or butts which when acted upon by a suitable cam 113 on the arm 94 will cause the jaws 110 of the bits to deflect the needles to the desired extent, the needle-jacks 50 in this
 80 case fitting snugly in the lowermost grooves of the jack supporting and guiding ring 42, so that the lateral movement of the needle under the influence of the cam-actuated bit 111 will spring that portion of the jack below
 85 said guide, the resiliency of the jack causing it to reassume its normal position as soon as the bit is relieved from the influence of the cam.

To prevent excessive outward movement of the upper ends of the jacks when they
 90 have been acted upon by the cam 61, a stop-cam plate 115 is carried by the upper portion of the jack-supporting sleeve 42, and to prevent rotation of the cam-ring 53 with the jack-supporting ring and jacks a depending
 95 pin 116, mounted upon the cam-ring 53, engages with a slotted arm 117, mounted upon and projecting inward from a bracket 118 on the fixed standard 46, Figs. 1 and 5.

The swinging cam 54 of the upper dial-cam
 100 ring has a pivot-pin 120, which is provided on the back of the cam-ring 53 with an arm 121, Fig. 5, said arm having a pin 122, which enters a cam-slot 123 in a lever 124, pivoted to a bracket 125 on the cam-ring 53 and
 105 acted upon by a coiled spring 126, which tends to maintain in the swinging cam 54 constantly in the position shown in Fig. 8—that is to say, in position to project the dial-needles to the knitting-point.
 110

At one point in the rotation of the cam-ring 53 an antifriction-roller 127 on the lever 124 passes between the jaws of a yoke 128, carried by a rock-shaft 129, which is free to turn in a bracket on the fixed standard 46 and has
 115 an arm 129^a, Fig. 4, which is under the control of a suitable pattern-drum 200, so that on a certain revolution of the cam-ring 53 and at a time when the antifriction-roller 127 is in engagement with the yoke 128 the latter
 120 can be swung outwardly to cause an outward swing of the pivoted cam 54, which after being retained in the outward position for any desired number of revolutions of the machine can be again restored to its normal position
 125 by moving the yoke 128 inwardly when the roller 127 is again in engagement with the same.

The cams 60 and 61 are carried, respectively, by slides 130 and 131, mounted so as
 130

to be free to move vertically on suitable guides on the back of the cam-ring 53, and the slide 130 has a projecting stud 132, Figs. 5 and 25, which engages with the lower groove 133 in a sliding collar 134, mounted so as to be free to move vertically on a depending portion of the hub 44 of the top cross-bar 45 of the machine, as shown in Figs. 1 and 25. The said collar has an upper groove 135, which is engaged by studs 136 on arms 137, projecting inwardly from a rock-shaft 138, mounted in the same bracket which carries the rock-shaft 129, said shaft being provided with an arm 139, which is under control of the pattern-drum 200, so that the collar 134 can be caused to rise and fall at appropriate intervals. Projecting from the slide 130 is an arm 140, which engages a headed stud 141, projecting upwardly from a foot 142 at the base of the slide 131, which carries the cam 61. (See Fig. 1.)

When both of the cams 60 and 61 are fully lowered, the arm 140 rests upon the top of the foot 142 of the slide 131; but the distance between said foot and the head of the stud 141 is such that the cam 60 can be raised from the path of the dial-needle jacks 50 without imparting such lifting movement to the cam 61 as will free said jacks from its control. Hence after all of the dial-needles have been projected to the transfer-point by the cam 60 and have then been withdrawn by the cam 61 to inoperative position after casting their stitches the cam 60 can be partially raised and will not then have any further projecting effect upon the dial-needle jacks, while still leaving the same under the control of the retracting-cam 61. (See Figs. 1 and 21.) When the cam 61 is retracted, the cam 57 will move the upper ends of the jacks 50 inwardly to a position which will bring them under the control of the cam 58, whereby they are directed to the knitting-cams. (See Fig. 8^a.) Downward movement of the cam 60 sufficiently to cause it to act upon the long jacks 50 will depress the cam 61 into position to bring these jacks within its range, and further downward movement of said cam 60 will effect a like further movement of the cam 61.

In Fig. 15 of the drawings I have shown a modified construction of cams for operating the dial-needle jacks, this construction being intended to render unnecessary the use of long and short jacks or the sliding cams, such as shown in Fig. 8, substituting for the latter swinging cams which act to start the abnormal projection of the dial-needles at a certain needle of the set and also act to subsequently retract said projected needles in the same manner. In this device the cams 54, 55, 56, 57, 58, 62, and 63 are substantially the same as in the cam-ring shown in Fig. 8; but instead of the vertical sliding cams 60 and 61 there are used two swinging cams 60^a and

61^a. Normally—that is to say, during the ordinary knitting operation—the cam 60^a occupies the outward position and the cam 61^a occupies the inward position, as shown by dotted lines in Fig. 15; but when it is desired to abnormally project the dial-needles to the transfer-point and to subsequently retract the same in order to cast the stitches therefrom said cams 60^a and 61^a are moved to the positions shown by full lines in said Fig. 15. It will be observed that the pivotal point of each of the cams 60^a and 61^a is so disposed in respect to the axis of the cam-ring 53^a that as the point of the cam 60^a is swung inward or that of the cam 61^a outward it advances in respect to a radial line drawn through it when it was in its inoperative position, and this advance of the point of the cam during its swinging movement enables it to keep pace with the advancing movement of the needle-jacks. Hence the jack which was just about to leave the point of the cam when the latter was in its inoperative position still remains under control of the cam as the latter swings and until it has been fully moved to its operative position, and full projection or retraction can, therefore, be effected at a given needle of the set without any projecting or retracting influence upon the needles in advance of the same.

In Fig. 16 I have shown a still simpler cam arrangement for actuating the dial-needle jacks. In this construction the position of rest of the dial-needles is designed to beat the abnormally projected or transfer point, a cam 55^a retracting them and a cam 54^a again projecting them. The knitting-yarn is fed to the needles when their shanks have been withdrawn to a point inside the line of the cylinder-needles, and their retraction then continues until they have cast their old stitches and drawn the new loops. All that is necessary in order to effect the transfer of a stitch from a dial to a cylinder-needle in this machine, therefore, will be to raise the receiving cylinder-needle at a point remote from the knitting-point and then to retract the dial-needle by means of the cam 55^a, so as to cast its stitch, the cam 54^a being withdrawn radially and the needle permitted to remain in the retracted position. The cam 55^a is adjustable circumferentially and can thus retract the needles at a point away from the yarn-feed in forming a welt or transferring stitches, and it should also be adjustable vertically and used in connection with long and short jacks 50 in the same manner as the cam 61 in order to begin the retraction of the dial-needles at a certain needle.

In connection with the knitting-cams of the machine is used a follower-cam 145, which occupies an elevated position during the knitting of plain work upon the cyl-

5 under-needles only, as shown in Fig. 3. Hence during such knitting the position of rest of the needles is at the clearing-point—that is to say, with their stitches slipped back of the latches. It is not advisable, however, to permit the cylinder-needles to occupy this elevated rest position during the knitting of ribbed fabric. Hence the cam 145 should be retracted in changing from plain work to ribbed work and again projected in changing from ribwork to plain work. For this reason there is a connection between the cam 145 and the cam 34, this connection comprising a lever 146, which at one end engages a bell-crank lever 147, Fig. 3^a, also in engagement with the sliding cam 145, the other end of said lever 146 bearing upon the back of the cam 34. As the said cam is moved outwardly, therefore, in order to permit the normally inactive cylinder-needles to be raised into active position and receive stitches from the dial-needles, the cam 145 will also be raised to operative position; but as the cam 34 is moved inwardly to engage the butts on the jacks of the cylinder-needles 13, and thus draw the same down into inoperative position again, the cam 145 will likewise be depressed by the action of the spring 147^a, Fig. 3^a.

30 Movement of the cam 34 is effected by connecting said cam to a lever 150, which is connected by a link 151 to another lever 152, which may be under control of the drum 200. The cams 30 and 31 are carried by slides 153 and 154, which are engaged by two of the arms of a three-armed lever 155, the latter being connected by a link 156 to a lever 157, which can also be controlled by the drum 200. The cams 32 and 33 are carried by a slide 160, which is engaged by a lever 161, the latter being connected by a link 162 to a lever 163, likewise adapted to be controlled by the drum, all as shown in Fig. 7.

45 When it is desired to shog the cylinder-needles as well as, or instead of, the dial-needles, said cylinder-needles should, by preference, be mounted upon jacks in the same manner as the dial-needles, so that they can be raised clear of the grooves of the needle-cylinder when they are to be shogged. Such construction is shown in Fig. 28, in which the needle-carrying jack is indicated at 12^m. In this case the shogging-wheels may be carried by an arm 94^a, pivotally mounted on a frame 300, which is properly supported upon the shaft 49 and has a driving-shaft geared by bevel-wheels 301 and 302 to said shaft 49, the arm 94^a being capable of vertical movement, which will permit the shogging-wheels to be moved into and out of engagement with the jacks 12^m. As shown, the wheels are out of such operative engagement. It will of course be understood that in either case the shogging-wheels will be so cut or

65 will have their teeth so arranged as to properly select the needles which are to be shogged, and the reciprocating or vibrating shogging-bits, if used, will also be disposed with reference to like operation. As an instance of such modified construction of shogging-wheels I may refer to Fig. 52, which shows the wheels 90^a 91^a cut to shog certain of the needles, but having no shogging action upon needles alternating therewith.

75 While I prefer to use the swinging dial-needle jacks which I have shown and described, my invention can, of course, be applied to machines having the ordinary horizontal dial and dial-cam plate provided with cams for imparting reciprocating movement to the dial-needles, in which case the latter may be provided with stitch-engaging yokes, such as that shown upon the cylinder-needle in Fig. 22, and although I have described my invention as used in connection with that type of machine in which the cylinder and dial rotate and the cylinder-cam box and dial-cam ring do not, it will be evident that the invention can be applied with equal facility to a machine of the opposite type—namely, one in which the cylinder and dial are stationary and the cam-box and cam-ring rotate—and my invention is not limited in its application to circular or rotating machines, but is applicable as well to straight or reciprocating machines.

100 I am aware that it has heretofore been proposed in a machine having two sets of needles to transfer stitches from needles of one set to needles of the other set, to change from ribbed work to plain work, or to vary the character of the ribbed fabric which is being produced; but in no prior machine with which I am familiar has there been the excess of needles in the dial to which I have referred or any shogging of a needle of one set in respect to a needle of the other set for the purpose of transferring a stitch, and in such prior machines some means other than the relative movement of the needles themselves has been relied upon in order to effect the transfer—such, for instance, as a special form of needle or a special stitch-spreader independent of the needle and operated independently thereof—and my invention as to its main features is distinct from machines of this type and enables me to produce a machine of much finer gage, since the needles which I use are ordinary needles in the sense that they have no side projections or devices for laterally expanding a stitch, and hence can be disposed as closely together as in an ordinary knitting-machine.

125 I do not in this application claim the special or detailed features of construction of the machine which I have shown and described, except in so far as they may be considered embodiments of the broader claims which I

make, nor do I limit myself to such details of construction, as they may be varied in many ways within the knowledge of those skilled in the art without departing from the essential principles of my invention.

The stitches which in the claims are referred to as being transferred from needles of one set to needles of the other set may be either the stitches actually upon the transferring-needles or stitches in a preceding course of the web produced upon said needles, except where the latter are specifically indicated.

I claim—

1. The combination, in a knitting-machine, of two sets of needles of ordinary width, with means for knitting upon the needles and means for transferring stitches from needles of one set to needles of the other set by relative movement thereof, needles from which the stitches are transferred operating in planes coincident with those of the needles which receive the stitches.

2. The combination, in a knitting-machine, of two sets of needles of ordinary width, with means for knitting upon the needles and means for transferring stitches from needles of one set to needles of the other set by relative movement of the needles, without other instrumentality engaging the stitch at the time of transfer, needles from which the stitches are transferred operating in planes coincident with those of the needles which receive the stitches.

3. The combination, in a knitting-machine, of two sets of needles of ordinary width with means for knitting upon certain of the needles of one set without knitting upon the remaining needles of said set, and for knitting upon the needles of the other set, and means for transferring stitches from the latter needles to the previously inactive needles of the first set by relative movement of the needles.

4. The combination, in a knitting-machine, of two sets of needles, with means for knitting upon the needles, and means whereby needles of one set may be projected each into a place formerly occupied by a portion of a needle of the other set to engage and receive a stitch of the web produced by the latter needle.

5. The combination, in a knitting-machine, of two sets of needles, with means for knitting upon the needles, and means whereby stitch-carrying needles of one set may be projected each into a place formerly occupied by a portion of a needle of the other set to engage and receive a stitch of the web produced by the latter needle.

6. The combination, in a knitting-machine, of two sets of needles, with means for knitting upon the needles, and means whereby needles of one set may be caused to engage stitches in

a course preceding that carried by needles of the other set.

7. The combination, in a knitting-machine, of two sets of needles, with means for knitting upon the needles, and means for projecting needles of one set, so far in the rear of the stitch-engaging portions of needles of the other set, that said projecting needles of the one set will engage stitches in a course preceding that carried by the needles of the other set.

8. The combination, in a knitting-machine, of two sets of needles, with means for knitting upon the needles, and means for projecting previously-active needles of one set to the rear of the stitch-engaging portions of needles of the other set, to engage stitches of the web in a course preceding that carried by the latter needles.

9. The combination, in a knitting-machine, of two sets of needles, with means for knitting thereupon, the needles of one set being susceptible of projection to carry stitches of the web produced thereby into position for engagement with needles of the other set, and means for automatically beginning the projection of the latter needles at a certain needle of the set without projecting to the clearing-point a needle or needles in advance of the fully-projected needle.

10. The combination, in a knitting-machine, of two sets of needles, with means for knitting thereupon, the needles of one set being susceptible of projection to carry stitches of the web produced thereby into position for engagement with needles of the other set, and means for automatically beginning such projection at a certain needle of the set without projecting to the clearing-point a needle or needles in advance of the fully-projected needle.

11. The combination, in a knitting-machine, of two sets of needles, with means for knitting thereupon, the needles of one set being susceptible of projection to carry stitches of the web produced thereby into position for engagement with needles of the other set, and means for automatically beginning the projection of both sets of needles at a certain needle in each set, without projecting to the clearing-point a needle or needles in advance of the fully-projected needle.

12. The combination, in a knitting-machine, of two sets of needles, with means for knitting thereupon, the needles of one set being susceptible of projection to carry stitches of the web produced thereby into position for engagement with needles of the other set, means for automatically beginning such projection at a certain needle of the set without projecting to the clearing-point a needle or needles in advance of the fully-projected needle, and means for then withdrawing said

fully-projected needles to inoperative position and maintaining them in such inoperative position.

13. The combination, in a knitting-machine, of two sets of needles, with means for knitting thereupon, the needles of either set being susceptible of projection to carry stitches of the web produced thereby into position for engagement with needles of the other set, means for automatically beginning such projection at a certain needle in each set without projecting to the clearing-point a needle or needles in advance of the fully-projected needle, and means for then withdrawing said fully-projected needles to inoperative position and maintaining them in such inoperative position.

14. The combination, in a knitting-machine, of two sets of needles, with means for knitting upon the needles, and means for transferring stitches from needles of one set to needles of the other set, said means including devices for laterally shogging some of the needles of one set in respect to needles of the other set to transfer stitches therefrom, without disturbing the lateral relations of the remaining needles.

15. The combination, in a knitting-machine, of two sets of needles, with means for knitting upon the needles, and means for transferring stitches from needles of one set to needles of the other set by a combined lateral shogging movement and a movement in the normal direction of movement of the needles, as in knitting.

16. The combination, in a knitting-machine, of two sets of needles, with means for knitting upon the needles, and means for transferring stitches from needles of either set to needles of the other set by a combined lateral shogging movement and a movement in the normal direction of movement of the needles, as in knitting.

17. The combination, in a knitting-machine, of two sets of needles, with means for knitting upon the needles, and means for transferring stitches from needles of one set to needles of the other set by relative movement of the needles, movement of some of the transferring-needles being in the normal direction of movement of said needles, as in knitting, and movement of the other transferring-needles being in said normal direction and also in a lateral direction.

18. The combination, in a knitting-machine, of two sets of needles, with means for knitting upon the needles, means for transferring stitches from needles of one set to needles of the other set, by relative movement of the needles, and means for laterally shogging needles of one set, without lateral displacement of the remaining needles of said set.

19. The combination, in a knitting-machine,

of two sets of needles, with means for knitting upon the needles, means for laterally shogging needles of one set, and means whereby needles of one set may be projected each into a place formerly occupied by a portion of a needle of the other set to engage and receive a stitch of the web produced by the latter needle.

20. The combination, in a knitting-machine, of two sets of needles, with means for knitting upon the needles, means for laterally shogging needles of one set, and means whereby needles of the other set may be projected each into a place formerly occupied by a portion of a needle of the other set to engage and receive a stitch of the web produced by the latter needle.

21. The combination, in a knitting-machine, of two sets of needles, with means for knitting upon the needles of one set, and, in the first place, upon some only of the needles of the other set, and afterward upon all of the needles of said latter set, means for projecting in their normal line of movement certain of the needles of the one set and for both projecting and laterally shogging other needles of said set, and means for projecting previously-inactive needles of the other set to the rear of the stitch-engaging portions of said projected needles of the one set, to engage stitches of the web produced thereon.

22. The combination, in a knitting-machine, of two sets of needles, with means for knitting upon needles of one set, and in the first place upon some only of the needles of the other set, and afterward upon all of the needles of said latter set, means for projecting in their normal line of movement certain of the needles of the one set and for both projecting and laterally shogging other needles of said set, means for projecting previously-inactive needles of the other set to the rear of the stitch-engaging portions of the projected needles, of the one set, and means for projecting previously-active needles of said other set to the rear of the stitch-engaging portions of the projected and shogged needles of the one set, to engage stitches of the web produced thereon.

23. The combination, in a knitting-machine, of two sets of needles, with means for knitting upon the needles, means for laterally shogging some of the needles, and means whereby needles of one set may be projected to the rear of the stitch-engaging portions of needles of the other set to engage stitches of a course preceding that carried by the latter needles.

24. The combination, in a knitting-machine, of two sets of needles, with means for knitting upon the needles, means for laterally shogging needles of one set, and means whereby needles of the other set may be projected to the rear of the stitch-engaging portions

tions of said shogged needles, to engage stitches of a course preceding that carried by said shogged needles.

25. The combination, in a knitting-machine, of two sets of needles, with means for knitting upon needles of one set, and in the first place, upon some only of the needles of the other set, and finally upon all of the needles of the latter set, means for projecting in their normal line of movement certain of the needles of the one set and for both projecting and laterally shogging other needles of said set, and means whereby the previously-inactive needles of the other set are projected to the rear of the stitch-engaging portions of the projected needles of the one set to engage stitches in a course preceding that carried by said needles.

26. The combination, in a knitting-machine, of two sets of needles, with means for knitting upon needles of one set, and in the first place, upon some only of the needles of the other set, and finally upon all of the needles of the latter set, means for projecting in their normal line of movement certain of the needles of the one set and for both projecting and laterally shogging other needles of said set, and means whereby the previously-inactive needles of the other set are projected to the rear of the stitch-engaging portions of the projected needles of the one set, and previously-active needles of the other set are projected to the rear of the stitch-engaging portions of the projected and shogged needles of the one set, whereby said needles of the other set engage stitches in a course preceding that carried by the needles from which the transfer is to be made.

27. The combination, in a knitting-machine, of two sets of needles, one set of needles having shoulders for engaging the stitches upon them, with means for knitting upon the needles, and means whereby needles of the other set may be projected each into a place formerly occupied by a shouldered portion of a needle of the other set, to engage and receive a stitch of the web produced thereby.

28. The combination, in a knitting-machine, of two sets of needles, one set of needles having bent shanks for engaging the stitches upon them, with means for knitting upon the needles, and means whereby needles of the other set may be projected each into a place formerly occupied by a shouldered portion of a needle of the other set, to engage and receive a stitch of the web produced thereby.

29. The combination in a knitting-machine of two sets of needles having shoulders for engaging the stitches upon them, with means for knitting upon the needles, and means whereby said shouldered needles may be projected in such relation to needles of the

other set that the latter may engage stitches in a course preceding that engaged by said shouldered needles.

30. The combination, in a knitting-machine, of two sets of needles, one set of needles having bent shanks for engaging the stitches upon them, with means for knitting upon the needles, and means whereby said bent shanks of the needles may be projected in such relation to needles of the other set that the latter may engage stitches in a course preceding that engaged by the bent shanks.

31. The combination, in a knitting-machine, of two sets of needles, with means for knitting upon certain of the needles of one set without knitting upon the remaining needles of said set and for knitting upon needles of the other set in excess of the number of inactive needles in the first set, and means for transferring stitches from needles of the second set to needles of the first set.

32. The combination, in a knitting-machine, of two sets of needles, with means for knitting upon certain of the needles of one set without knitting upon the remaining needles of said set and for knitting upon needles of the other set in excess of the number of inactive needles in the first set, and means for transferring stitches from some of the needles of the second set to previously-inactive needles of the first set and from other needles of said second set to previously-active needles of the first set.

33. The combination, in a knitting-machine, of two sets of needles, with means for knitting upon the needles, means for transferring stitches formed upon needles of one set to needles of the other set, the transferred stitches being first those of one course and then those of another course of the web produced upon said transferring-needles, and means for knitting web upon said transferring-needles between successive transfers.

34. The combination, in a knitting-machine, of two sets of needles, with means for knitting first upon certain needles of the first set without knitting upon the remaining needles of said set and for knitting upon needles of the second set, means for then knitting upon all of the needles of the first set and upon needles of the second set, and means for transferring stitches formed upon needles of the second set to needles of the first set without casting from said needles of the second set the stitches last formed upon them.

35. The combination, in a knitting-machine, of two sets of needles, with means for knitting first upon certain needles of the first set, without knitting upon the remaining needles of said first set and for knitting upon needles of the second set, and then upon all of the needles of the first set and upon needles of the second set, and means for trans-

ferring from needles of the second set to previously-inactive needles of the first set stitches of the web produced upon needles of the second set without casting from the latter the stitches which are upon them.

36. The combination, in a knitting-machine, of two sets of needles, with means for knitting, firstly, upon certain needles of the first set and upon needles of the second set, secondly, upon all of the needles of the first set and needles of the second set, and thirdly, upon needles of the first set only, means whereby, between the first and second knitting operations, stitches of the web produced upon needles of the second set are transferred to needles of the first set without casting from said needles of the second set the stitches which are upon them, and means whereby between the second and third knitting operations, stitches are transferred from needles of the second set to needles of the first set and the stitches are cast from said needles of the second set.

37. The combination, in a knitting-machine, of two sets of needles, with means for knitting, firstly, upon certain needles of the first set without knitting upon the remaining needles of said first set and for knitting upon needles of the second set, secondly, upon all of the needles of the first set and needles of the second set, and thirdly, upon needles of the first set only, means whereby, between the first and second knitting operations, stitches of the web produced upon needles of the second set are transferred to previously-inactive needles of the first set without casting from said needles of the second set the stitches which are upon them, and means whereby between the second and third knitting operations, stitches are transferred from needles of the second set to previously-active needles of the first set and the stitches are cast from said needles of the second set.

38. The combination, in a knitting-machine, of two sets of needles, those of one set being in closer lateral relation to cooperating needles of the other set at some points in the set than at others, with means for knitting upon the needles and means for transferring stitches from needles of one set to needles of the other set.

39. The combination, in a knitting-machine, of two sets of needles, those of one set being in closer lateral relation to needles of the other set at some points in the set than at others, with means for knitting upon the needles, means for transferring stitches from needles of one set to needles of the other set, and means for drawing longer stitches upon closely-arranged needles than upon needles which are farther apart.

40. The combination, in a knitting-machine, of two sets of needles, those of one set being disposed equidistantly and those of the other set being closer together at some points

in the set than at others, with means for knitting upon the needles, and means for transferring stitches from needles of one set to needles of the other set.

41. The combination, in a knitting-machine, of two sets of needles, those of one set being disposed equidistantly and those of the other set being closer together at some points in the set than at others, with means for knitting upon the needles, and means for transferring stitches from needles of the non-uniform set to needles of the other set.

42. The combination, in a knitting-machine, of two sets of needles, those of one set being disposed equidistantly and those of the other set being closer together at some points in the set than at others, with means for knitting upon the needles, and means for drawing longer stitches upon the closely-arranged needles than upon the needles which are more widely separated.

43. The combination, in a knitting-machine, of two sets of needles, one set comprising ever-active needles and intermittently-active needles, and means for transferring stitches from some of the needles of the other set to the ever-active needles, and from some of the needles of said other set to intermittently-active needles.

44. The combination, in a knitting-machine, of two sets of needles, the first set comprising ever-active needles and intermittently-active needles, means for projecting both ever-active and intermittently-active needles to the transfer-point, means for moving needles of the second set to position for transferring stitches to both ever-active and intermittently-active needles of the first set, and means for moving to inactive position said intermittently-active needles.

45. The combination in a knitting-machine of two sets of needles, means for knitting thereupon, and means for laterally shogging individual needles of one set in order to change their lateral relation to needles of the other set.

46. The combination in a knitting-machine of two sets of needles, means for knitting thereupon, and means for laterally shogging individual needles of each set in order to change their lateral relation to needles of the other set.

47. The combination in a knitting-machine of a needle having a pivoted jack disposed at an angle to the needle, means for moving the needle in its normal direction of knitting movement, and a shogging device acting upon the jack at a point between its pivot and the needle and serving to impart movement to the needle in a direction transverse to that of its normal knitting movement.

48. The combination in a knitting-machine of two sets of needles, each carried by a pivoted jack disposed at an angle to the nee-

dle, means for imparting to said needles movement in the normal direction of knitting, and shogging devices acting upon the jacks of each set of needles at a point between the pivot and the needle and serving to impart to said needles movement in a direction transverse to that of the normal knitting movement.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ROBERT W. SCOTT.

Witnesses:

KATE A. BEADLE,
JOS. H. KLEIN.