No. 846,430. PATENTED MAR. 5, 1907.

R. W. SCOTT.

OPENWORK KNITTING MACHINE.

APPLICATION FILED SEPT. 20, 1906.

5 SHEETS—SHEET 1.

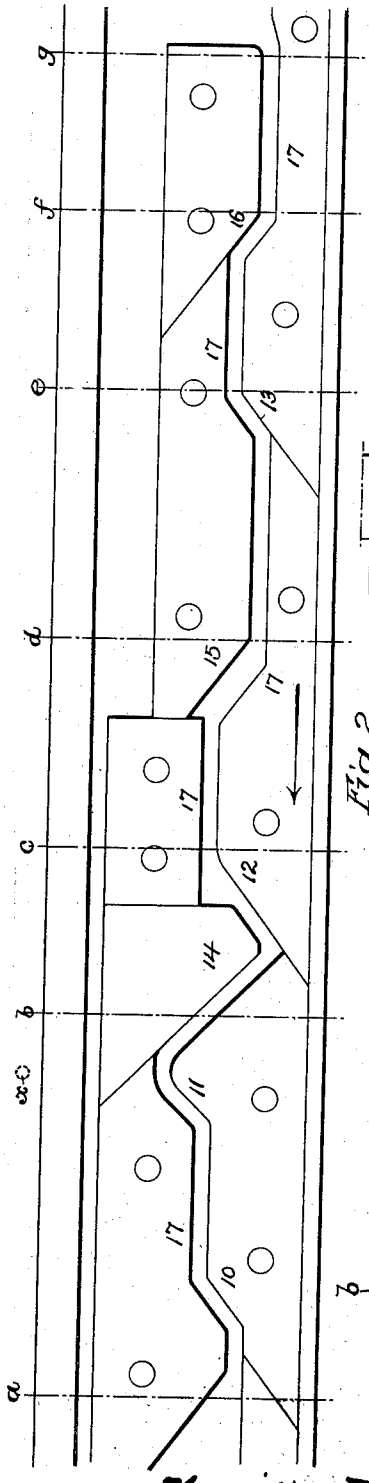


Fig. 2.

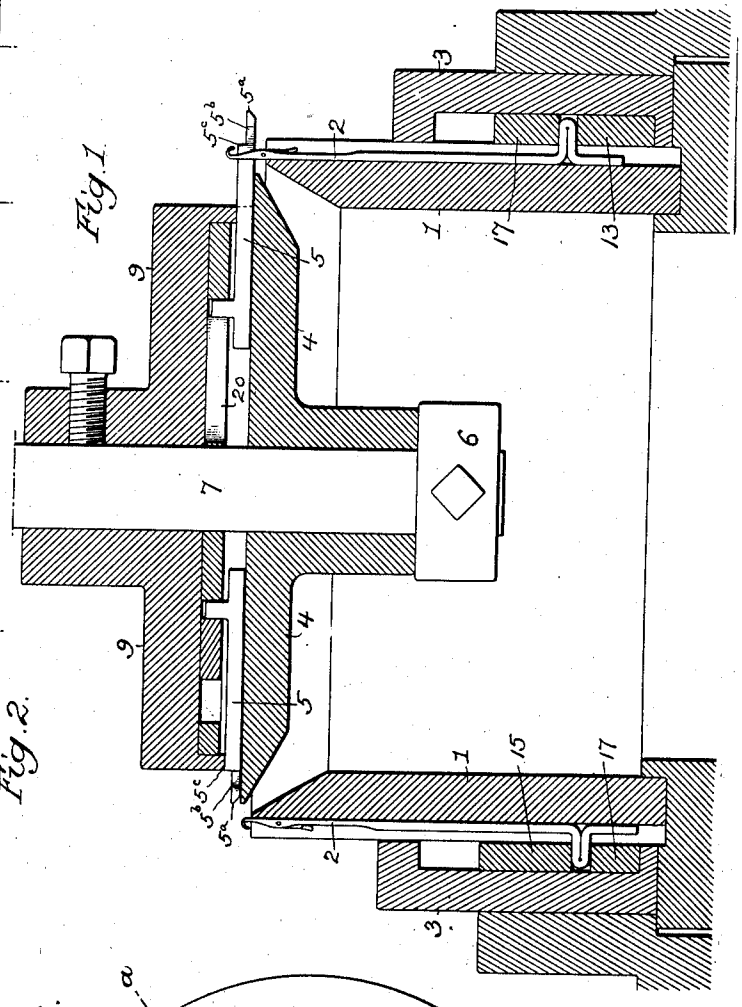


Fig. 1.

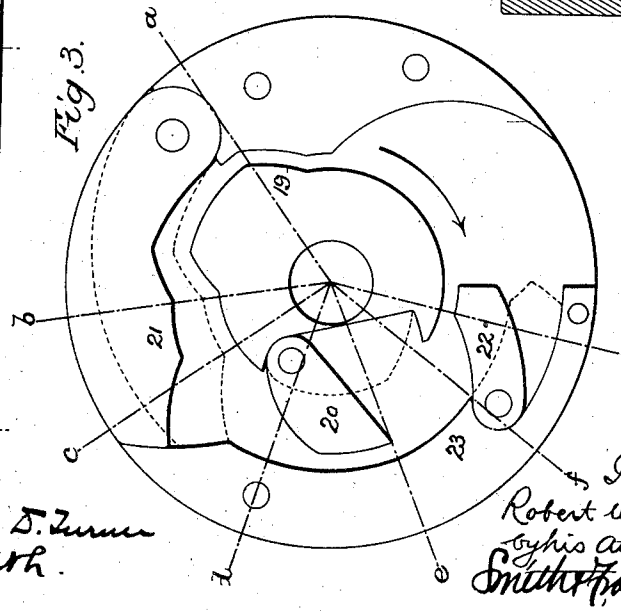


Fig. 3.

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5 SHEETS—SHEET 2.

Fig. 4.

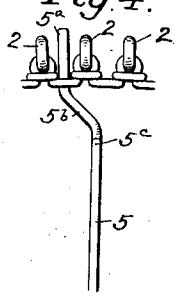


Fig. 5.

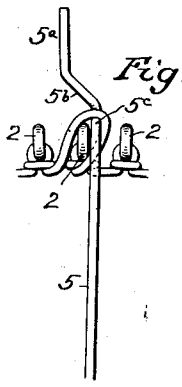


Fig. 6.

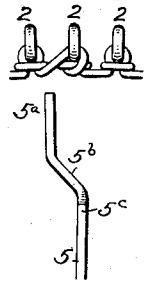


Fig. 12.

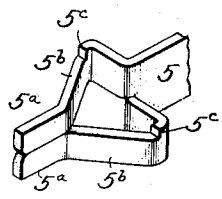


Fig. 13.

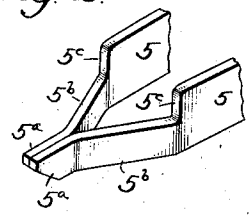
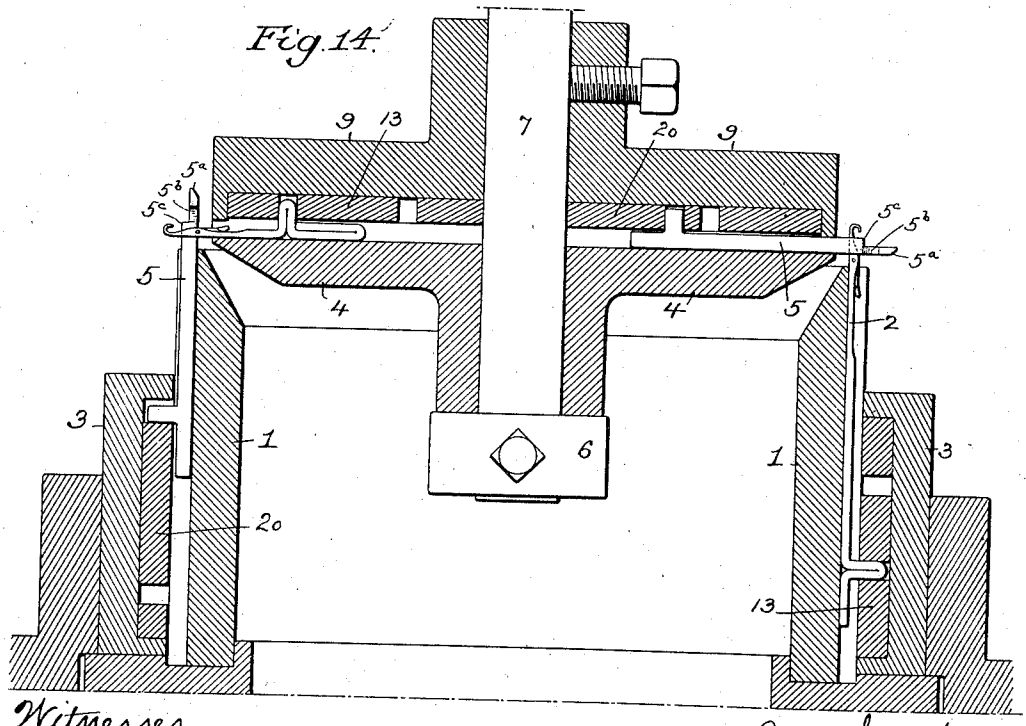


Fig. 14.



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No. 846,430. PATENTED MAR. 5, 1907.

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5 SHEETS—SHEET 3.

Fig. 8.

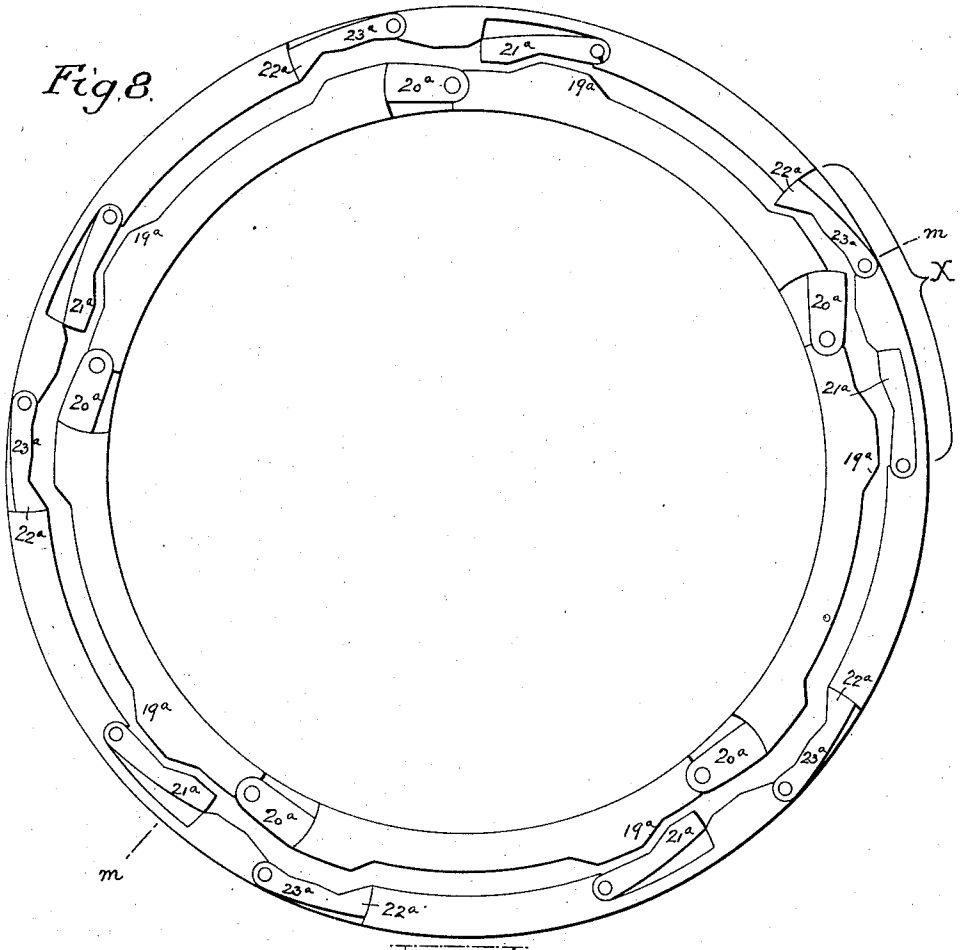
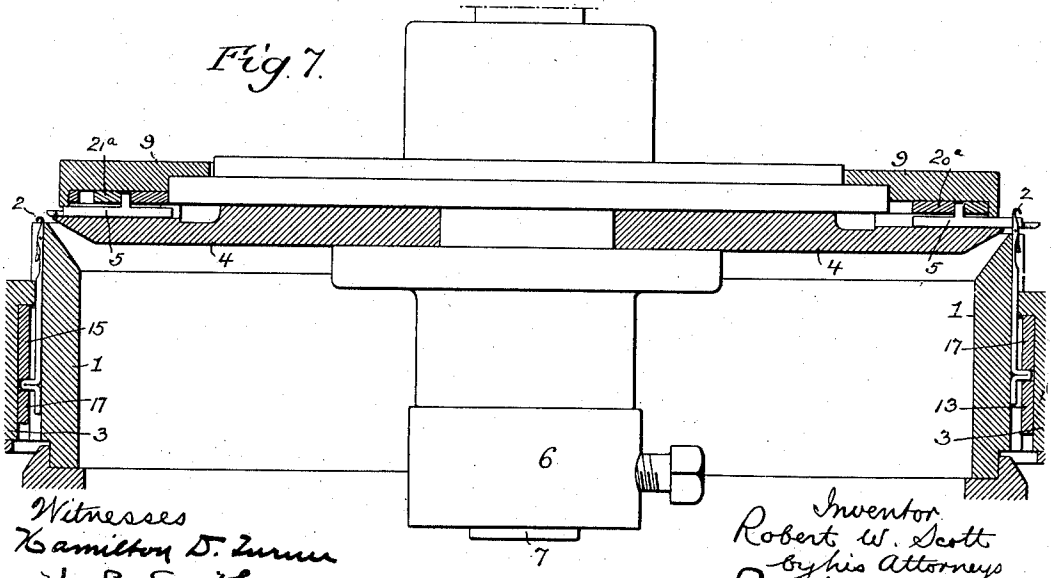


Fig. 7.



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OPENWORK KNITTING MACHINE.

APPLICATION FILED SEPT. 20, 1906.

5 SHEETS—SHEET 4.

Fig. 10

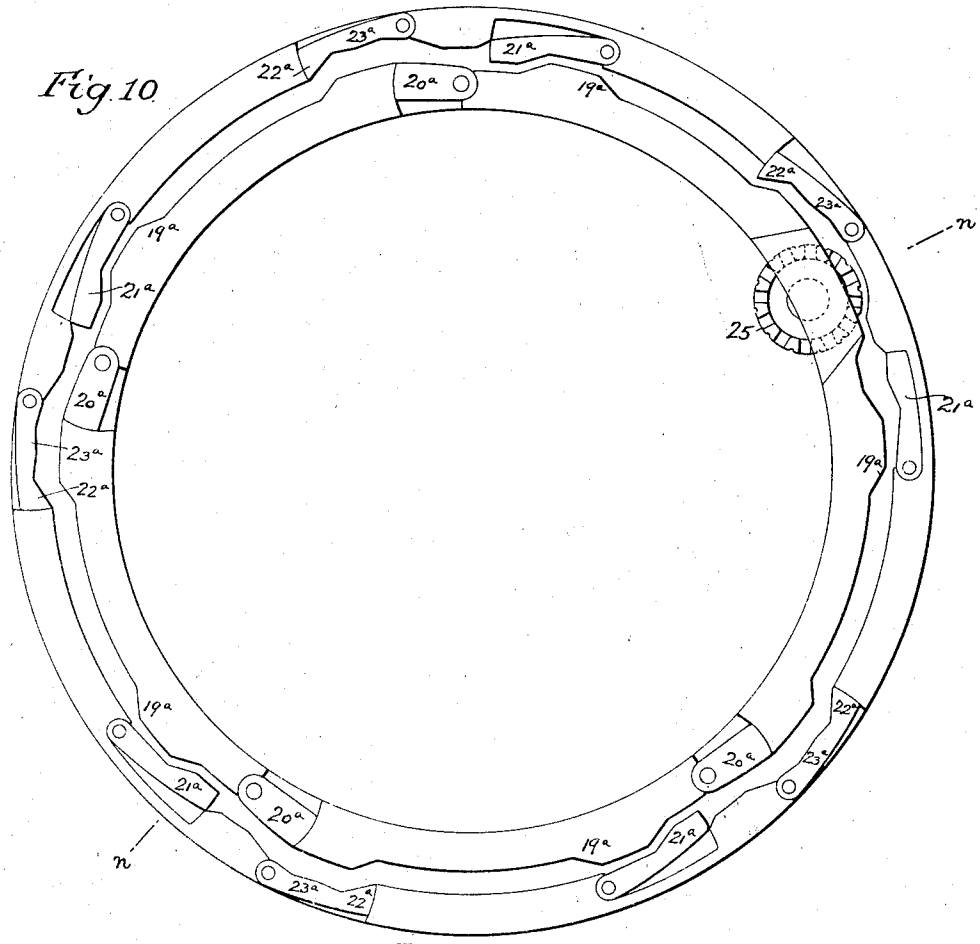
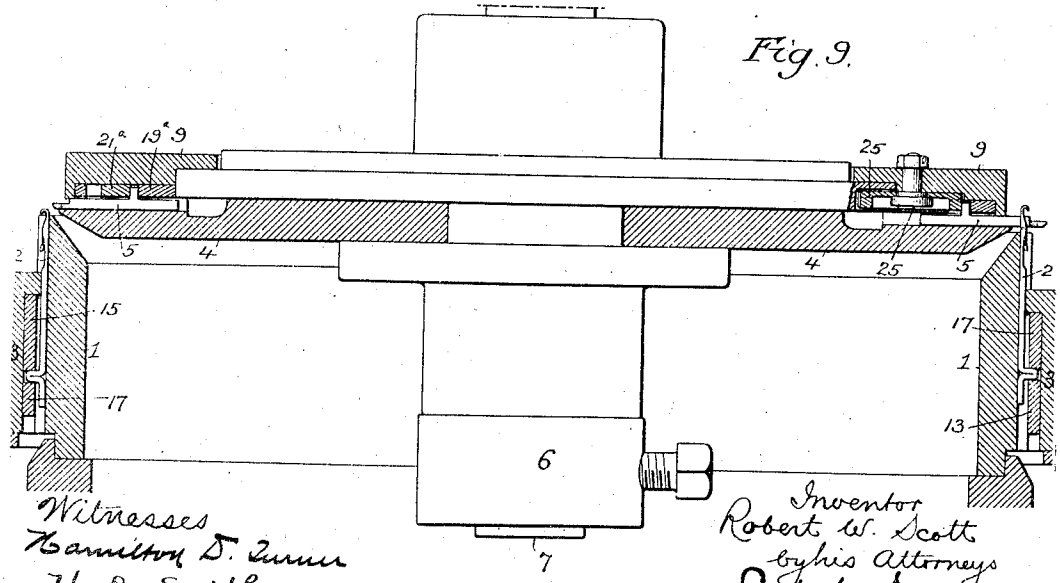


Fig. 9.



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OPENWORK KNITTING MACHINE.

APPLICATION FILED SEPT. 20, 1906.

5 SHEETS—SHEET 5.

Fig. 11.

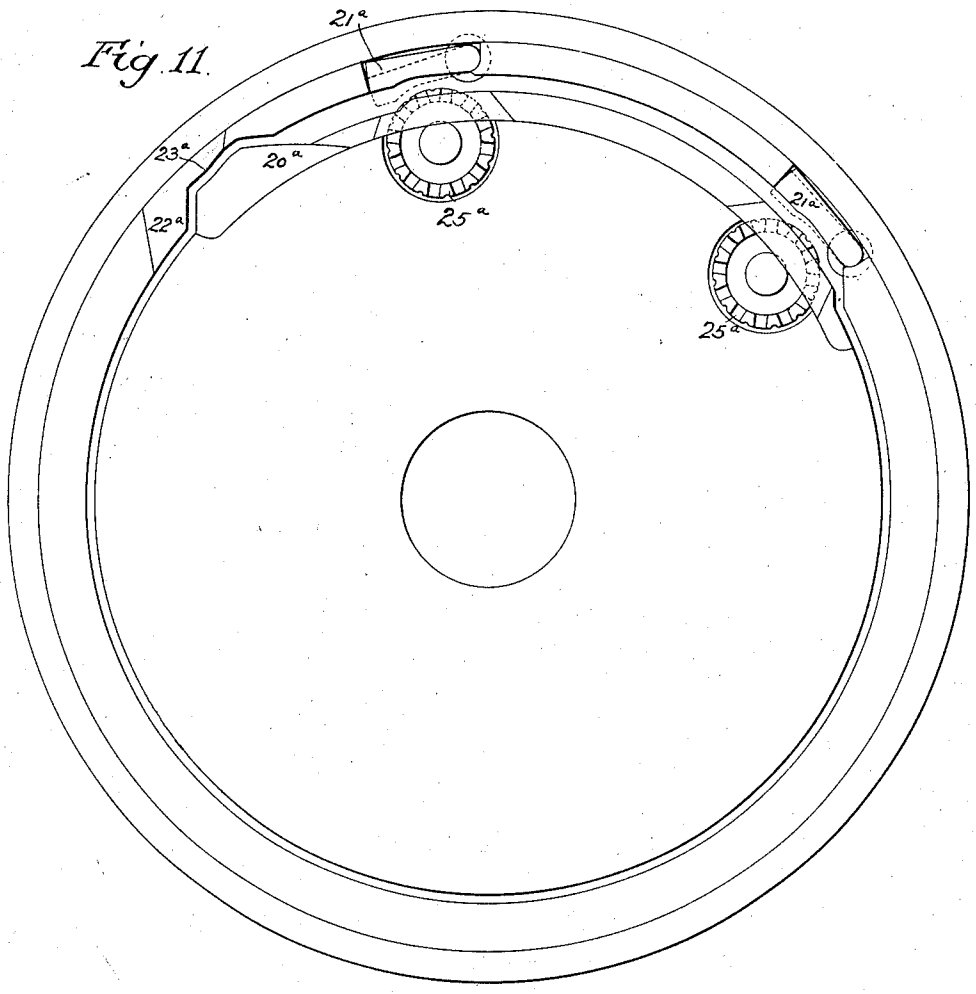


Fig. 15.

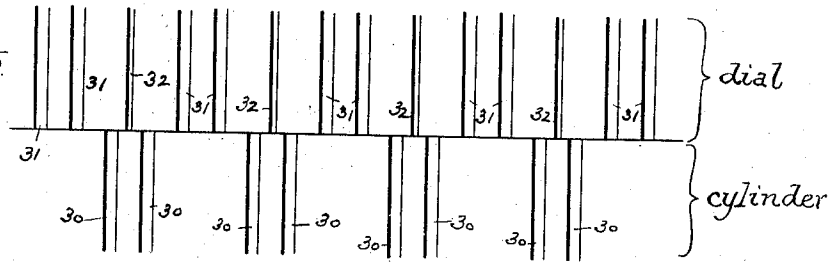
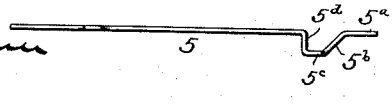


Fig. 16.



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UNITED STATES PATENT OFFICE.

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OPEN-WORK KNITTING-MACHINE.

No. 846,430. Specification of Letters Patent. Patented March 5, 1907.

Application filed September 20, 1906. Serial No. 335,403.

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 Open-Work Knitting-Machines, of which the following is a specification.

The object of my invention is to provide a machine of simple construction for rapidly producing knitted fabrics of meshed or open-work character due to the formation of eyelet-holes in the web, the formation of such eyelet-holes being effected by transferring sinker-wale loops to adjoining needle-wales in the manner set forth in my applications, Serial No. 322,735, filed June 21, 1906, and Serial No. 331,014, filed August 17, 1906.

Although my invention is not necessarily limited in its application to a machine employing latch-needles, it can most readily be adapted to such a machine, and renders it possible to produce an effective eyelet fabric upon a machine of that type in place of the machines emplying spring-beard needles, such as have hitherto been used for this class or work.

In the accompanying drawings, Figure 1 is a vertical sectional view of sufficient of a circular-knitting machine to illustrate my invention. Fig. 2 is a side elevation showing the cams of the cam-cylinder developed in a flat plane. Fig. 3 is an inverted plan view of the dial-cams of the machine. Figs. 4, 5, and 6 are enlarged views illustrating the method of effecting transfer of a sinker-wale loop to an adjoining needle-wale. Fig. 7 is a vertical sectional view on the line *m m*, Fig. 8, of part of a multifeed circular-knitting machine constructed for carrying out my invention. Fig 8 is an inverted plan view of the dial-cams of such machine. Fig. 9 is a vertical sectional view on the line *n n*, Fig. 10, but illustrating a special construction of the machine intended for disposing the eyelet-holes in different wales of the fabric. Fig. 10 is an inverted plan view of the dial-cams of such machine. Fig. 11 is a similar view of the dial cam-cap of a machine intended for transferring a plurality of sinker-wale loops at one time. Figs. 12 and 13 are enlarged perspective views of a special form or transfer device sometimes employed. Fig. 14 is a vertical sectional view of a rib-knitting machine to which my invention has been applied, and Figs. 15 and 16 are views illustrating special features sometimes embodied in a machine of this type.

Referring in the first instance to Figs. 1 to 6 of the drawings, 1 represents the needle-cylinder of an ordinary circular-knitting machine having needles 2, which are vertically reciprocated by cams mounted in a circular cam-box 3, surrounding the needle-cylinder.

Radially guided in a dial 4, similar to that of an ordinary rib-knitting machine, are a series of transfer-points 5, the number of these points and their disposition in respect to the knitting-needles 2 being dependent upon the number and disposition of the vertical rows of eyelet-holes which are to be formed in the knitted web produced by the machine, but in any case being less than one-half of the number of needles in order to produce one or more plain wales between successive eyelet-forming wales.

The machine shown in Figs. 1 to 6 is intended for the production of plain webs. Hence there are no needles in the dial; but my invention is also applicable to machines for producing ribbed web, and therefore provided with dial-needles, as hereinafter explained.

The dial 4 is supported vertically upon a collar 6 at the lower end of a central spindle 7, and to the latter is secured a dial cam-cap 9, which is disposed above the dial 4, and carries the cams whereby the reciprocation of the transfer-points 5 in radial planes is effected.

In the machine shown in Fig. 1 the cam-box 3 and dial cam-cap 9 are intended to be the rotating members, the needle-cylinder 1 and dial 4 being fixed; but my invention is equally applicable to machines in which the needle-cylinder and dial cam-box are fixed.

The cam-cylinder 3 is, as shown in Fig. 2, provided with lift-cams 10, 11, 12, and 13, with depressing-cams 14, 15, and 16, and with a series of guard-cams 17, the purpose of which will be explained hereafter.

The dial cam-cap has a fixed projecting cam 19, an adjustable projecting cam 20, adjustable retracting-cams 21 and 22, and a fixed retracting-cam 23, coöperating with suitable guard-cams, as shown in Fig. 3.

Each of the transfer-points 5 has its outer end 5^a in a different lateral plane from that

of the main stem or shank, these two members of the transfer-point being connected by a diagonally-inclined member 5^b, and said main stem or shank having a vertical shoulder 5^c at the point where said diagonally-inclined member joins the same.

The relation of the cams of the dial cam-cap to the cams of the cylinder 3 will be understood on reference to the lines *a*, *b*, *c*, *d*, *e*, *f*, and *g* in Figs. 2 and 3, the direction of movement of the cam-cylinder and dial cam-cap being as indicated by the arrows in said figures, and the line *b* indicating the point at which the needles 2 engage the knitting-yarn from the yarn-guide *x*, whose lateral relation to the cams is represented by the dotted circle in Fig. 2, the vertical position of the guide, however, being considerably higher than there represented.

Supposing that the needles and transfer-points are fully retracted, the operation of the machine when the cams of the dial cam-cap are adjusted to the positions shown by full lines in Fig. 3 will be as follows: The transfer-points 5 will first be projected by the cam 19 until their outer ends 5^a occupy a position between adjoining cylinder-needles, as represented in Fig. 4, and the needles will then be first partially projected by the cam 10 and afterward fully projected by the cam 11, so as to be in position to receive the yarn from the yarn-guide *x*. When the needles are retracted by the cam 14 so as to engage and draw stitches of said knitting-yarn, the sinker-wales will be engaged and held by the outer ends 5^a of the transfer-points, and said sinker-wales will then be slackened by the partial rise of the needles due to the action of the lift-cam 12 thereon, the needles being then partially depressed again by the cam 15, so as to lower their hooks to a point just below the backs of the transfer-points, as shown at the left-hand side of Fig. 1. The said transfer-points are then projected by the action of the cam 20, which has the effect of bringing the diagonally-inclined members of said transfer-points into action upon the sinker-wale loops previously deposited upon the outer members 5^a, and this causes a lateral displacement of said loops, as well as a slight outward displacement of the same, due to the action of the shoulder 6 thereon, the parts being now in the relation to each other shown in Fig. 5.

The transfer-points remain in the projected position until the needles have, by the action of the cam 13, been projected to the position shown at the right-hand side of Fig. 1, so as to enter the sinker-wale loops which have previously been displaced into the path of the needles, as shown in Fig. 5. The transfer-points are then partially retracted by the action of the cam 23 of the dial cam-cap in order to slacken the sinker-wale loops, so that when the needles which are to receive the same are retracted by the action of the cam 16 their hooks will engage said sinker-wale loops, which are then released by the full withdrawal of the transfer-points under the action of the cam 22, the relation of the parts now being as illustrated in Fig. 6. By reason of this transfer of the sinker-wale loops into adjoining needles-wales eyelet-holes are produced in the knitted web, and these eyelet-holes may be produced in any desired sinker-wales of the web, depending upon the number and disposition of the transfer-points in respect to the needles of the machine. The production of eyelet-holes, however, presupposes not only the formation of plain wales between the eyelet-forming wales, but also the formation of one or more regular courses of knitting between these, in which the sinker-wale loops are transferred in the manner before described, and in order to effect this result in a single-feed machine, such as that represented in Figs. 1, 2, and 3, I depress the cams 21 and 20 after each transfer to the positions shown by dotted lines in Fig. 3, whereby the transfer-points, although projected by the cam 19 to the position shown in Fig. 4, will be retracted by the action of the cam 21 before they reach the line *b*, at which the needles are retracted by the cam 14 in order to cause their hooks to engage the knitting-yarn. Consequently the sinker-wales will be formed below the transfer-points instead of above and upon the same, and this operation may be continued for as many courses as it may be desired to have intervene between the eyelet-hole courses.

The same result may be effected even if the projecting cam 20 is not retracted to the position shown by dotted lines in Fig. 3, the projection of the empty transfer-points in such case causing them to act as web-holders when the needles are projected to the position shown at the right-hand side of Fig. 1 by the action of the cam 13.

If the cam 20 is adjusted to the retracted position shown by dotted lines without retracting the cam 21, the result will be the slackening of the sinker-wales due to the laying of the same upon the outer ends 5^a of the transfer-points without effecting transfer and this operation is preferably performed in a course preceding that in which the transfer operation is effected in order to increase the size of the eyelet-hole thereby produced.

If it is desired to effect the simultaneous transfer of a plurality of successively-formed sinker-wale loops, such result can be effected by adjusting the cams 20 and 22 to the positions shown by dotted lines in Fig. 3 and permitting the cam 21 to remain in the position shown by full lines in said figure. The consequence of this will be that the transfer-points will remain in the partially-projected position shown in Fig. 4 until the desired

number of sinker-wale loops have been formed thereon, whereupon a restoration of the cams 20 and 22 to the positions shown by full lines in Fig. 3 will cause the full projection and subsequent retraction of the transfer-points, so as to effect transfer of the pairs or groups of sinker-wale loops onto the adjoining cylinder-needles.

In order to effect lateral spreading of the sinker-wale loop so as to engage a needle on each side of the same, I may use a transfer-point with forked head split horizontally, one member of said forked head having its diagonal portion 5^b extending in one direction and the other member having its diagonal portion 5^b extending in the opposite direction, as shown, for instance, in Fig. 12, or I may use two transfer-points having their outer ends 5^a either side by side, as in Fig. 13, or in the same vertical plane, as in Fig. 12, one of these transfer-points having its diagonal portion 5^b extending in one direction, and the other having its diagonal portion 5^b extending in the opposite direction. When the transfer-point is provided with a forked head, as in Fig. 12, the outer end of each of the members of the fork will be sufficiently resilient to permit the loop of yarn drawn down by the hooks of the needles to spread said outer members so as to pass between them when the transfer-point is retracted, and the same is true of the transfer-points shown in Fig. 13.

In applying my invention to a multifeed machine as many sets of cams will be employed in the cam-cylinder and dial-cam cap as there are yarn-feeds in the machine, Figs. 7 and 8 showing a machine intended for using five feeds, the cam-cap having five sets of cams 19^a, 20^a, 21^a, 22^a, and 23^a, which perform the same functions as the corresponding cams 19, 20, 21, 22, and 23 of Fig. 3, only one set of these cams (lettered X) being adjusted for effecting the transferring operation, the cams corresponding with the other four feeds being adjusted to inoperative position in order to form four plain courses of stitches between successive eyelet-hole courses.

Figs. 9 and 10 illustrate an arrangement of cams in a dial-cam cap of a five-feed knitting-machine and show also one means which may be employed for effecting the formation of eyelet-holes first in one wale of the web and then in an adjoining wale of the same. In this machine the plain projecting cam 20^a is replaced by a rotating notched wheel 25, having alternate shallow and deep notches, the shallow notches engaging the butts of the transfer-points and serving to project the same to the transfer position, but the deep notches permitting the butts to pass the wheel without such projection. The number of transfer-points in the dial in this case should be one more or one less than an even multiple of the number of notches in the wheel. For instance, if the latter has twelve notches the number of transfer-points in the dial may be twenty-three or twenty-five, thirty-five or thirty-seven, forty-seven or forty-nine, or so on, the result being that on one revolution of the machine the transfer-points 1 3 5 7 9, &c., will be projected and the transfer-points 2 4 6 8 10, &c., will not be projected, this order being reversed on the next rotation of the machine.

Fig. 11 illustrates an arrangement of cams which may be used in the dial-cam cap of a multifeed knitting-machine for the purpose of effecting the simultaneous transfer of a plurality of sinker-wale loops. In this embodiment of my invention two notched wheels 25^a are employed, one in conjunction with each of two successive cams 21^a, these wheels having the effect of projecting alternate transfer-points to the receiving position in the same manner as the wheel 25 of Figs. 9 and 10 projects them to the transfer position, the following cams 20^a, 22^a, and 23^a effecting the projection of the transfer-points to the transfer position and their subsequent retraction in order to cast the transferred loops. The use of the second wheel 25^a is for the purpose of insuring the proper projection at the second feed of such of the transfer-points as may after having been projected by the preceding wheel at the first feed have become accidentally retracted from such projected position between the first and second feeds.

In applying my invention to a rib-knitting machine the sinker-wales may be transferred either to cylinder-needle wales or to dial-needle wales or sometimes to one and sometimes to the other, the transfer-points for transferring the sinker-wale loops to the cylinder-needles being carried by the needle-dial and alternating with pairs or series of needles therein and the points for transferring the sinker-wale loops to the dial-needles being carried by the cylinder and likewise alternating with pairs or series of needles therein. A machine of this type is illustrated in Fig. 14, the dial transfer-point being shown at the right-hand side of said figure in position to transfer a sinker-wale loop to a cylinder-needle and a cylinder transfer-point being shown at the left-hand side of the view in position to transfer a sinker-wale loop to a dial-needle. This may be either a single or a multi feed machine; but in the former case the cams for operating the transfer-points should be adjustable to inoperative position in order to provide for the formation of one or more plain courses between successive eyelet courses. The dial-needle-operating cams in a machine of this character will have an action upon the dial-needles similar to the action of the cams of the cam-cylinder upon

the cylinder-needles—that is to say, said dial-needles will be operated not only to knit, but also to receive the transferred sinker-wale loops.

Fig. 15 illustrates in diagrammatic form the arrangement of needle and transfer-point grooves in the cylinder and dial of a machine for making two-and-two ribbed web with eylet-holes formed by displacing sinker-wale loops between adjoining cylinder-needls, 30 representing the needle-grooves of the cylinder, 31 representing the needle-grooves of the dial, and 32 representing the transfer-point grooves. In a machine of this type I prefer to use a transfer-point having the stem 5 and outer end 5^a in the same longitudinal plane as shown in Fig. 16, the diagonal portion 5^b of the point being connected to the stem by a right-angled portion 5^d. By reason of this construction the groove for the transfer-point can be formed midway of the pairs of needle-grooves in the dial, whereas if a transfer-point of the character shown in Fig. 4 was employed the groove for its reception would have to be formed in the space between one of the dial-grooves and the adjoining cylinder-groove, and in machines of relatively fine gage this space is insufficient.

Either of the forms of transfer-point which I have shown and described is free from any hook, latch, or other obstruction, such as forms part of a transfer-needle, and the sinker-wale loops can therefore be cast from the points without difficulty and with a minimum amount of reciprocating movement of the point. Consequently the use of such points is always preferred, although my invention in its broader embodiments is not limited to such use, but contemplates the use of transfer-needles or transfer devices as well.

I claim—

1. The combination, in a knitting-machine, of needles, means for knitting thereupon, means for transferring sinker-wale loops to adjoining needles, and means for forming one or more plain wales and courses between the wales and courses in which such transfer is effected.

2. The combination, in a knitting-machine, of needles, means for knitting thereupon, means for transferring simultaneously to an adjoining needle or needles sinker-wale loops in a plurality of courses, and means for forming one or more plain wales and courses between the wales and courses in which the transfer is effected.

3. The combination, in a knitting-machine, of needles, means for knitting thereupon, means for transferring sinker-wale loops to adjoining needles, means for forming one or more plain wales and courses between the wales and courses in which such transfer is effected, and means for slackening the sinker-wale loop in advance of the transferred loop or loops.

4. The combination, in a knitting-machine, of needles, means for knitting thereupon, means for transferring sinker-wale loops whereby the same loop engages needles on opposite sides of it, and means for forming one or more plain wales and courses between the wales and courses in which such transfer is effected.

5. The combination, in a knitting-machine, of needles, means for knitting thereupon, transfer-points, each consisting of a stem with inclined transfer portion and an unobstructed loop-supporting portion beyond the same, means for advancing or retracting said points to engage, displace and release certain sinker-wale loops of the web, and means for operating the needles to engage and receive said loops.

6. The combination, in a knitting-machine, of needles, means for knitting thereupon, transfer-points, each consisting of a stem with inclined transfer portion having a shoulder at the base of the same, and an outer unobstructed loop-supporting portion, means for advancing and retracting said points to engage, displace and release certain sinker-wale loops of the web, and means for operating the needles to engage and receive said loops.

7. The combination, in a knitting-machine, of needles, means for knitting thereupon, means for transferring sinker-wale loops to an adjoining needle or needles, and means for preventing engagement of the sinker-wales by the transfer devices in some of the courses whereby the said sinker-wales in such courses are not displaced.

8. The combination, in a knitting-machine, of needles, means for knitting thereupon, means for transferring sinker-wale loops to an adjoining needle or needles, and means for retracting the transfer devices, in knitting some of the courses, before they reach the point at which the sinker-wale loops will be laid upon them.

9. The combination, in a knitting-machine, of needles, means for knitting thereupon, means for transferring sinker-wale loops to an adjoining needle or needles, and means for engaging the transfer devices with the sinker-wale loops but arresting the transfer operation for one or more courses.

10. The combination, in a knitting-machine, of needles, means for knitting thereupon, sinker-wale-loop-transfer devices, a cam for projecting the same into position for receiving the sinker-wale loops, and an adjustable cam which permits the transfer devices to remain in said projected position or retracts the same in order to cause them to miss the loops.

11. The combination, in a knitting-machine, of needles, means for knitting thereupon, sinker-wale-loop-transfer devices, a cam for projecting the same to receive said

sinker-wale loops, and a cam for further projecting the same to effect transfer of said loops, said latter cam being adjustable to inoperative position.

12. The combination, in a knitting-machine, of needles, means for knitting thereupon, sinker-wale-loop-transfer devices, a cam for projecting the same to engage said sinker-wale loops, a cam for further projecting them to effect transfer of said loops, and a cam for retracting the transfer devices in order to cast the loops, both of said latter cams being adjustable to inoperative position.

13. The combination, in a knitting-machine, of needles, means for knitting thereupon, sinker-wale-loop-transfer devices, and means for causing certain of the latter to coact with certain of the knitting-needles and others to coact subsequently with others of said knitting-needles.

14. The combination, in a knitting-machine, of needles, means for knitting thereupon, sinker-wale-loop-transfer devices, and a rotating wheel for operating said transfer devices in sets.

15. The combination, in a knitting-machine, of needles, means for knitting thereupon, and sinker-wale-transfer devices constructed to receive a sinker-wale loop and laterally spread the same for engagement with the needles on opposite sides of it.

16. The combination, in a knitting-machine, of needles, means for knitting thereupon, and a sinker-wale-transfer device constructed to receive a sinker-wale loop and spread the same for engagement with the needles on opposite sides of it, said transfer device having members between which the transferred loop can pass when said transfer device is retracted.

17. The combination, in a rib-knitting machine, of two sets of needles, means for knitting thereupon, sinker-wale-transfer devices, and means for operating same to receive sinker-wale loops and transfer them to needles of one set.

18. The combination, in a rib-knitting machine, of needles, means for knitting thereupon, sinker-wale-transfer devices, and means for operating same to receive sinker-wale loops and transfer them to adjoining needles, some of said sinker-wale devices coacting with needles of one set and others coacting with needles of the other set.

19. A transfer-point for knitting-machines, said point having a stem, a diagonal transfer member formed by an open bend in the stem, and an unobstructed loop-supporting member outwardly beyond said transfer member.

20. A transfer-point for knitting-machines, said point having a stem, a diagonal transfer member formed by an open bend in the stem and having a shoulder at the base of the same, and an unobstructed loop-supporting member outwardly beyond said transfer member.

21. A transfer-point for knitting-machines, said point having a stem, a diagonal transfer member, formed by an open bend in the stem, and an unobstructed loop-supporting member outwardly beyond said transfer member and in the same longitudinal plane as the stem.

22. A transfer-point for knitting-machines, said point having a stem, a diagonal transfer member formed by an open bend in the stem and having a shoulder at its base, and an unobstructed loop-supporting member outwardly beyond said transfer member and in the same longitudinal plane as the stem.

23. A transfer-point for knitting-machines, said point having a stem, and a diagonal transfer member with stem connection at its base at a right angle to the stem and a loop-supporting member at its outer end.

24. A transfer-point for knitting-machines, said point having a stem, and a diagonal transfer member with stem connection at its base at a right angle to the stem and a loop-supporting member at its outer end, said stem and loop-supporting member being in the same longitudinal plane.

25. The combination, in a knitting-machine, of needles, means for knitting thereupon, and means for transferring simultaneously to an adjoining needle or needles sinker-wale loops in a plurality of courses.

26. The combination, in a knitting-machine, of needles, means for knitting thereupon, means for transferring simultaneously to an adjoining needle or needles, sinker-wale loops in a plurality of courses, and means for forming one or more plain courses between successive groups of transferred courses.

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

ROBERT W. SCOTT.

Witnesses:

HAMILTON D. TURNER,

KATE A. BEADLE.