No. 753,260. PATENTED MAR. 1, 1904.

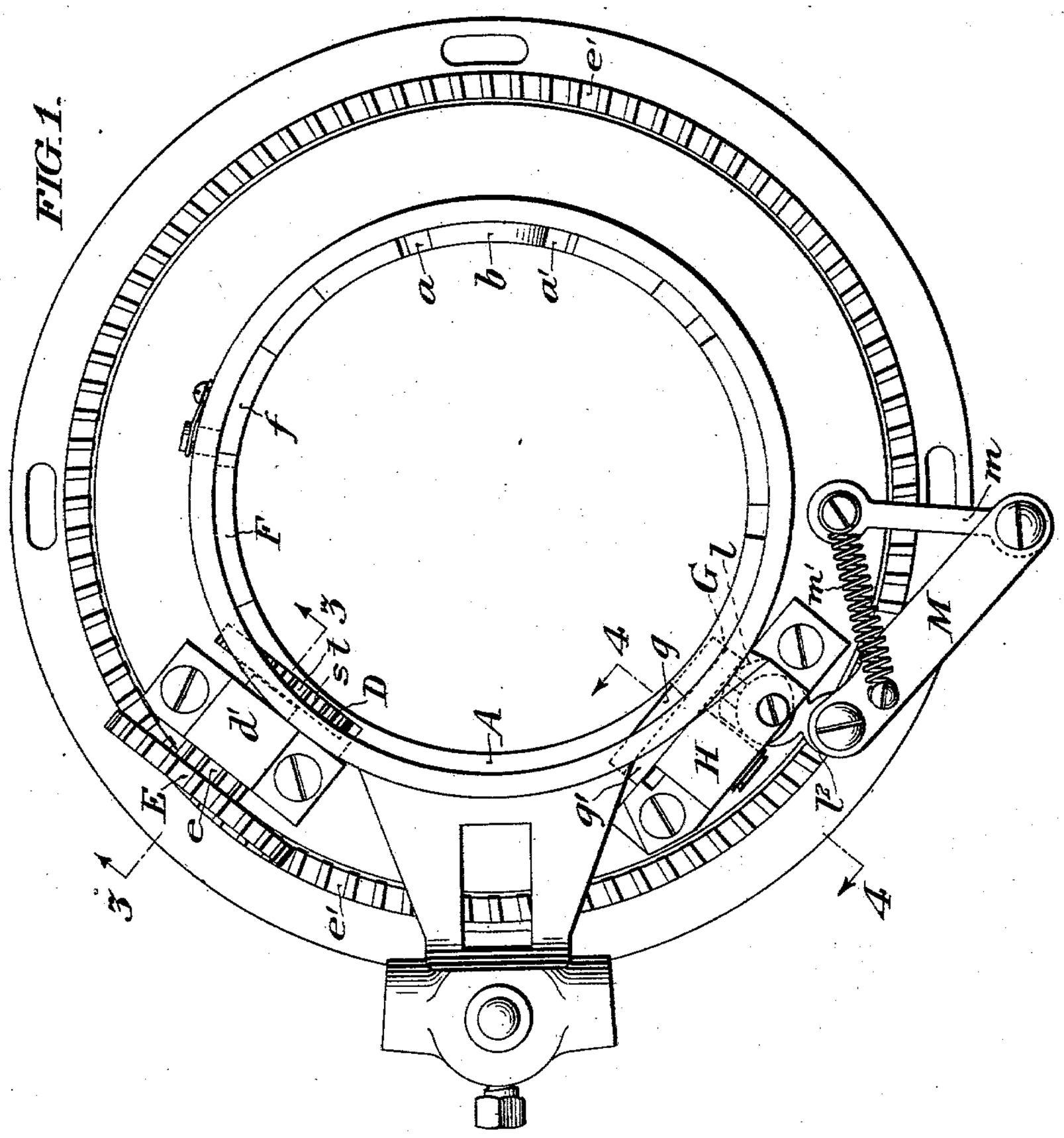
E. A. HIRNER.

PATTERN SWITCH FOR KNITTING MACHINES.

APPLICATION FILED DEC. 7, 1901.

NO MODEL. 2 SHEETS—SHEET 1.

FIG. 1.



WITNESSES:

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by his attorneys

Fraley & Paul

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NO MODEL. 2 SHEETS—SHEET 2.

FIG. 8.

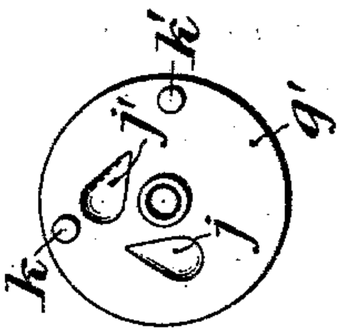


FIG. 7.

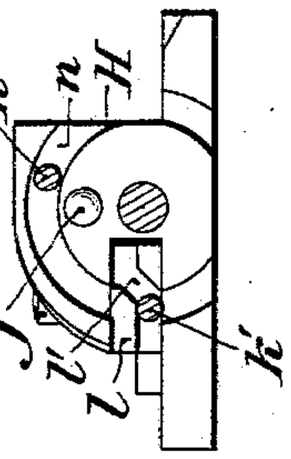


FIG. 6.

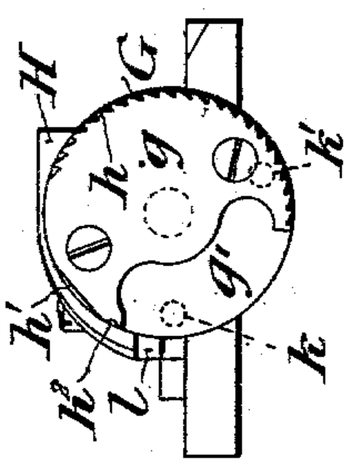


FIG. 5.

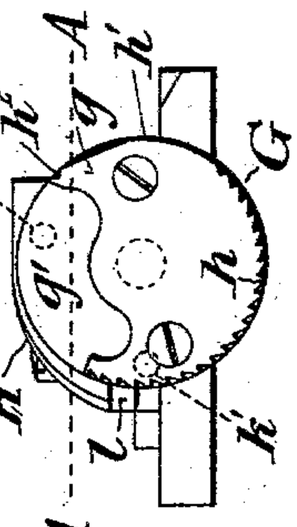


FIG. 2.

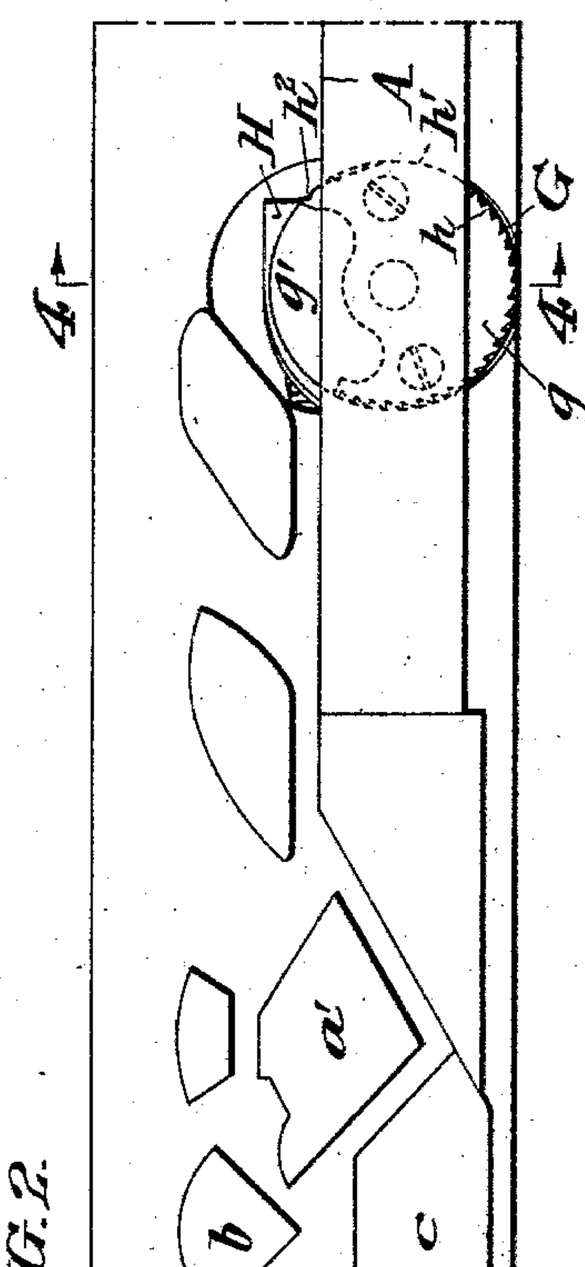


FIG. 4.

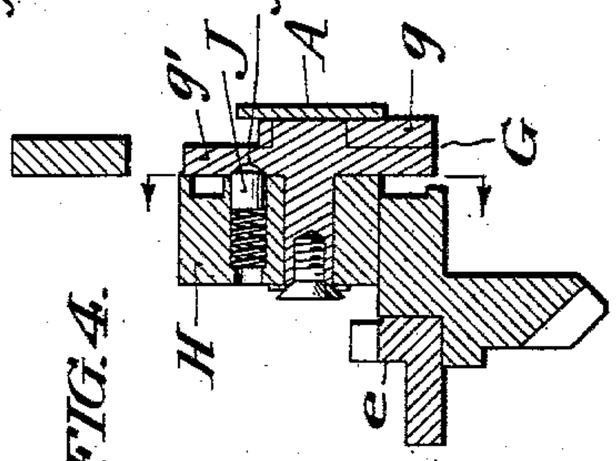
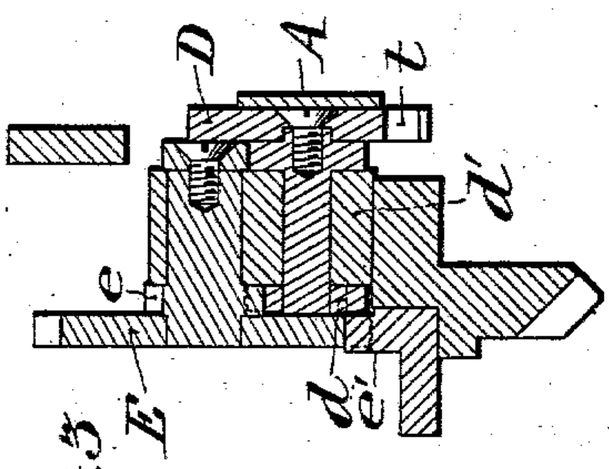


FIG. 3.



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No. 753,260. Patented March 1, 1904.

UNITED STATES PATENT OFFICE.

EMIL A. HIRNER, OF ALLENTOWN, PENNSYLVANIA.

PATTERN-SWITCH FOR KNITTING-MACHINES.

SPECIFICATION forming part of Letters Patent No. 753,260, dated March 1, 1904.

Application filed December 7, 1901. Serial No. 85,040. (No model.)

To all whom it may concern:

Be it known that I, EMIL A. HIRNER, a citizen of the United States, residing at Allentown, in the county of Lehigh and State of Pennsylvania, have invented certain new and useful Improvements in Pattern-Switches for Knitting-Machines, whereof the following is a specification, reference being had to the accompanying drawings.

My invention relates to a pattern-switch to be employed in circular-knitting machines whereby certain of the needles are raised to a higher level than the others and thereafter caused to pursue, during at least a portion of the knitting operation, a different path than the others, whereby special functions are performed by them.

My invention also relates to a switch-cam of special construction, which I call a "rotating jack-cam." As shown in the drawings, this rotating jack-cam is used for the purpose of switching the needles up over the pattern-switch in such a way as to make it inoperative for the purpose of separating or sorting the needles. It is therefore used to render the pattern-switch intermittent in its action. It will, however, be understood that this rotating jack-cam is a switch-cam of general application for any of the numerous purposes in knitting-machines where it is desired by throwing in the switch-cam to cause all of the needles to be raised by it as they pass over it to a higher level than that upon which they were running.

There are many varieties of switch-cams which have been invented for the purpose just stated. The difficulty which arises in the construction of such a cam is to make it accurately selective in its action at the time when it is being thrown into or out of action—that is to say, it must never leave any needles only partly raised. The problem thus presented is of particular difficulty at the time of throwing a switch-cam out of action. With most cams this involves leaving a series of needles occupying an incline between the upper and lower plane in which they move. Needles in such an intermediate position are liable to run against the point of some succeeding cam or become involved in some other part of the apparatus, whereby their butts are broken or trouble is otherwise caused.

The rotating jack-cam which I have invented is accurately selective in its action and can never, either when going in or out of action, leave any needles in a position intermediate between the extreme planes of its action.

In the accompanying drawings, Figure 1 is a plan view of the cam-cylinder of a circular-knitting machine having applied to it my pattern-switch and also my rotating jack-cam. Fig. 2 is an elevation of the interior of the cam-cylinder developed upon a plane. Fig. 3 is a vertical cross-section taken along the line 3 3 of Figs. 1 and 2, showing the rotating pattern-switch in section. Fig. 4 is a similar section taken along the line 4 4, Figs. 1 and 2, showing the rotating jack-cam in section. Figs. 5, 6, 7, and 8 are detail views of the rotating jack-cam.

Referring to Fig. 2, it will be observed that the interior of the cam-cylinder contains a race or groove formed by the ledge A, in which the hubs of the needles run, as in all circular-knitting machines. This needle-groove is interrupted by knitting-cams, which may be of any of the usual varieties. As I have shown them, *a a'* are the paired stitch-cams, *b* the top center cam, and *c* the bottom center cam. In a plane tangential to this groove and in the relation thereto which is illustrated in Figs. 1 and 2 is set the rotating pattern-switch D, with its upper segment projecting above the needle-groove A. This switch consists of a wheel journaled in a block *d'*, which is set on the base of the outside of the cam-cylinder, in proximity to which the wall of the cam-cylinder is removed sufficiently to allow the wheel to project through it into contact with the needle-hubs. On the other end of the shaft which carries the wheel D is a small gear-wheel *d*, which meshes with a corresponding gear-wheel *e*, which is also journaled in the block *d'*. Alongside the gear-wheel *e* is set the larger gear-wheel E. Outside of the base of the cam-cylinder is the toothed ring *e'*, which is made fast to the bed-plate within which the cam-cylinder rotates. By the train of gear-

ing thus described the wheel D is caused to rotate at a rate which corresponds to the motion of the cam-cylinder. The periphery of the wheel D is furnished with two sorts of transverse grooves—namely, a series of small notches *s*, which are placed at intervals corresponding to the distance between the hubs of successive needles in the needle-cylinder, and a series of larger recesses *t*, which at stated intervals take the place of one or more of the small notches *s*. These larger recesses *t* have a depth equal to the height of the segment of the wheel D which projects above the ledge A. They are preferably enlarged circularly, as seen in Fig. 2, so that the hub of a needle passing along the needle-groove A if it enters one of the large recesses *t* will continue to run along the groove without alteration of the vertical position. On the other hand, the hub of a needle which comes in contact with one of the small notches *s* is positively lifted by the wheel D as it rotates, owing to the engagement of the hub with the notch, and is delivered by the wheel at the level of its top. Between the wheel D and the nearest stitch-cam *a* is placed a triangular cam F, the apex of which is directed toward the wheel and set with its point slightly below the top of the wheel. Needles the hubs of which enter the larger recesses *t* pass along the groove and are deflected by the cam F below the leading stitch-cam *a*, while needles the hubs of which meet the notches *s* and are raised by the wheel are delivered by the cam F above the point of the leading stitch-cam and are by it raised preparatory to their depression by the top center cam *b* and the following stitch-cam *a'*, as in ordinary knitting. The method of knitting by which certain of the needles are deflected into the groove below the leading stitch-cam, while others pass over it, forms *inter alia* the subject-matter of an application filed by me July 5, 1901, Serial No. 67,113, and I have therein described the knitting-stitches which may be formed by adopting this method of operation. There is a marked advantage in causing the wheel D to effect the raising of needles which are to be raised by it by means of engagement with one of the small peripheral notches *s*, in combination with means for positively rotating the wheel at the proper rate of speed. By omitting the notches *s*, so that the smooth peripheral surface of the wheel must raise the needles, a harsh action is occasioned by reason of the angle at which the needle-hubs first meet this periphery. It will be noticed, further, that if the wheel D were not positively rotated, but derived its motion only from the engagement of the needle-hubs with the small notches *s* other difficulties would be encountered, for there would be a tendency to lose the proper relation between the wheel and the needle-hubs, especially if the recess *t* were made broad enough to receive two needles. Furthermore, in an automatic stocking-knitter where at intervals during the knitting operation a fashioning operation is to be performed it is not possible to have the needle-hubs maintain the relation of the wheel D to the knitting operation, because during the enlargement and contraction of the active set of needles the proper relation is necessarily lost and the pattern spoiled. When it is desired to change the pattern, the wheel D is removed and another one having the notches *s* and recesses *t* differently grouped is substituted therefor. The latch-cam *f*, pivoted at the base of cam F, allows needles traveling from the direction of the wheel D to pass freely under it. It serves to prevent needles traveling in the opposite direction (as during reciprocation of the machine) from coming in contact with wheel D.

I will now describe the rotating jack-cam, which, as shown in the drawings, is so placed as to be capable of throwing the pattern-switch mechanism into or out of action, whereby courses or intervals of figured knitting may be succeeded by courses or intervals of plain knitting. This jack-cam is in the form of a disk G, set in a plane tangential to the needle-groove, with its upper segment projecting above the groove and in the relation to it which is shown in Figs. 1 and 2. The disk G consists of two similar and united circular plates *g g'*. Of these the inner plate *g* is partially cut away, so that a portion (say about a quarter) of the periphery is altogether lacking. The greater part of the intact periphery is fitted with teeth *h* at intervals corresponding to the distance between the needle-hubs. These teeth are succeeded by a smooth and partially-flattened surface *h'*, which is itself succeeded by a single tooth h^2, after which the cut-away portion again recurs. The outer plate *g'* has formed upon its outer face two stop-holes *j j'* and carries two fixed pins *k k'*. The jack-cam is journaled in block H, set on the base of the outside of the cam-cylinder, in proximity to which the wall of the cam-cylinder is removed sufficiently to allow the projection through it of the jack-cam into the plane in which the needle-hubs travel. Within block H is also set the spring-projected stop-pin J, the rounded end of which falls into the stop-holes *j j'* as the jack-cam rotates. These stop-holes have an elongated edge on the advancing side, whereby, although the entrance of the stop-pin into them is abrupt, its exit is easily accomplished. The pins *k k'* are farther from the center of the disk than the stop-holes, and an annular groove *n* is cut in the face of the block H, within which they rotate. This groove is interrupted at one point by the insertion of an oscillating block *l*, having a diagonal groove *l'* cut in that face which is opposed to the jack-cam. The oscillating block *l* is pivoted within block H and has an outwardly-projecting

arm l^2, to the end of which is pivoted a link M, the other end of which is pivoted to the lever m, which is pivoted on the base of the outside of the cam-cylinder and projects radially therefrom. A coiled spring m', made fast at one end to the base of the cam-cylinder and at the other to the link M near its pivotal attachment to the arm l^2, by its tension maintains the block l in the position shown in Fig. 7 of the drawings, where the diagonal groove l' completely interrupts the annular groove n, so that rotation of the jack-cam is prevented by contact of one of the pins k k' with the side of the diagonal groove l'. The pins k k' are set so that this stoppage of the jack-cam occurs in two positions, the first of which (in which k' is in the groove l') is shown in Fig. 5, while the second (in which k is in the groove) is that shown in Fig. 6. In both of these positions the jack-cam while held from forward rotation by the pins k k' is held from backward rotation by the entrance of stop-pin J into one of the stop-holes j j', which oppose their abrupt edges to such backward motion. The position of Fig. 5 is that in which the jack-cam is wholly inoperative, because its cut-away portion is uppermost and offers no resistance to the continued travel of the needle-hubs along the level of the ledge A, which level is indicated by the dotted lines A A of the figure. It is true that, as shown in Fig. 5 and also in Fig. 2, the far corner of the jack-cam, carrying the single tooth h^2, projects slightly above the level of the ledge A, upon which the hubs of the needles run; but this does not disturb the operation of the machine, because, as shown more clearly in Fig. 1, the disk G is so set in relation to the wheel of the cam-cylinder that this far corner of the jack-cam is removed beyond the reach of the needle-hubs. As long, therefore, as the jack-cam remains in this position the needle-hubs travel along the ledge continuously until they meet the pattern-switch D and are by it sorted in accordance with the pattern to which it is cut. When, however, it is desired to prevent the further action of the pattern-switch, the jack-cam is thrown into operation. This is effected by an oscillation of block l, effected by pressure upon the projecting end of lever m, which communicates its motion through the link M to the oscillating block. Such pressure may be applied by a cam-surface presented in proper relation to the cylinder as it revolves and capable of being moved into and out of operation at proper intervals. This cam-surface and the method of its operation, however, form no part of the present invention, as the pressure upon the lever m may be applied manually at proper intervals and the same result obtained. By the oscillation of block l thus effected the diagonal groove l' is moved away from the center of the jack-cam, thereby forcing the advance of the pin k', which is in engagement with it sufficiently to compel it to clear the other end of the groove, whereby it is delivered into the annular groove n upon the farther side of the oscillating block. This movement effects a sufficient partial rotation of the jack-cam to bring one or more of the teeth on its intact portion above the level of the ledge A, whereupon the contact of the advancing needle-hubs with these teeth continues the rotation of the jack-cam until the other pin, k, comes in contact with the oscillating block l, which has in the meantime returned to its normal position. This effects the stoppage of the jack-cam in the position of Fig. 6, where, as will be observed, its smooth edge h' is presented in an oblique position to the advancing needle-hubs, so that it operates as an ordinary cam-incline or switch-cam. While in this position all of the needles as they pass are sufficiently advanced by it to entirely clear the pattern-switch D, and therefore to pass over the cam F and thereafter into the knitting operation in the usual way and without sorting. When now the time comes to again throw switch D into operation, the pressure is again applied to the lever m, whereupon the oscillation of block l thus effected slightly advances the rotating jack-cam, bringing the single notch h^2 above the level of the ledge A. This is engaged by the first advancing needle, which rotates the jack-cam until its further motion is stopped by the pin k'. In the course of this rotation the single needle, which has engaged the notch h^2, is raised to the level which removes it from the operation of the switch D; but all the succeeding needles passing over the cut-away portion of the jack-cam proceed without change of level and are therefore within the range of the operation of the switch D. By the operation of the jack-cam thus described it is possible to throw its cam-incline into and out of operation at intervals without ever leaving any needles in a position intermediate between the highest and lowest level which mark its field of operation.

The rotating jack-cam admits of great variation in its details, the essential element being the rotating partially-cut-away discoid cam interposed segmentally in the needle-groove.

By the phrase "interposed segmentally," as used here and in the claims, I mean the interposition of the wheel in the needle-groove in such a way that the normal continuance of the needle-groove would divide the wheel into segments and with its plane tangential to the periphery of the needle-cylinder.

Having thus described my invention, I claim—

1. In a circular-knitting machine, a pattern-switch consisting of a wheel interposed segmentally in the needle-groove said wheel having transverse notches or recesses in its periphery at intervals corresponding to the spaces

between the needle-hubs; a fixed rack outside the cam-cylinder; a pinion engaging said rack mounted on a shaft which carries another pinion which engages a third pinion upon the axis of the wheel, whereby its outer segment is caused to rotate in the same direction as the travel of the needle-hubs and at the same speed, substantially as described.

2. In a circular-knitting machine, the combination of the cam-cylinder having a needle-groove with stitch-cams interposed therein; a pattern-switch consisting of a wheel the upper part of which is interposed segmentally in the needle-groove alongside of the leading stitch-cam, said wheel having small notches cut in its periphery by which the needle-hubs are delivered over the leading stitch-cam and large recesses cut in its periphery by which the needle-hubs are delivered below the leading stitch-cam, substantially as described.

3. In a circular-knitting machine, a rotating discoid cam interposed segmentally in the needle-groove of the cam-cylinder; a part of said disk, not less than the segment cut off by the cam-groove, being cut away; in combination with means for intermittently rotating said cam so as to present at intervals to the needles, either the intact or the cut-away portion, whereby the transition of the cam from one portion to the other can never leave any needle in a position intermediate between the extreme planes bounding its sphere of action, substantially as described.

4. In a circular-knitting machine, a rotating discoid cam interposed segmentally in the needle-groove of the cam-cylinder; a part of said disk, substantially equal to the segment cut off by the cam-groove, being cut away; in combination with means for intermittently rotating said cam so as to present at intervals to the needles, either the intact or the cut-away portion, whereby the transition of the cam from one position to the other can never leave any needle in a position intermediate between the extreme planes bounding its sphere of action, substantially as described.

5. In a circular-knitting machine, a pattern-switch consisting of a grooved wheel interposed segmentally in the needle-groove of the cam-cylinder, whereby certain of the needles are raised to a higher level than the others; in combination with a jack-cam consisting of a partially cut-away rotating disk also interposed segmentally in the needle-groove of the cam-cylinder, whereby the pattern-switch is rendered intermittent in its action, substantially as described.

6. In a circular-knitting machine, the combination of mechanism operating upon the needle-hubs of the needle-groove for sorting said needles according to a set pattern; a rotating jack-cam, also set in the needle-groove, consisting of a disk having part of its periphery cut away; and mechanism for partially rotating said jack-cam at intervals, whereby while the cut-away portion of the jack-cam is in line with the needle-groove, all of the needles are within reach of the sorting mechanism, and while the intact portion of the jack-cam is in line with the needle-groove all of the needles are thrown out of reach of the sorting mechanism, substantially as described.

7. In a circular-knitting machine, the combination of mechanism, operating upon the needle-hubs within the needle-groove, for sorting said needles according to a set pattern; a rotating jack-cam, also set in the needle-groove, consisting of a disk having part of its periphery cut away, and the intact portion toothed with a smooth cam-surface intervening among the teeth; mechanism for advancing the disk one or more teeth at set intervals; and stops whereby its further rotation by the action of the needle-hubs is caused to cease alternately at the cut-away portion and at the smooth cam-surface, the former leaving all of the needles within reach of the sorting mechanism and the latter throwing all of them out of reach of the sorting mechanism, substantially as described.

8. In a circular-knitting machine, a rotating discoid cam interposed segmentally in the needle-groove of the cam-cylinder, the periphery of said discoid cam presenting successively a cut-away portion, a single tooth, a partially-flattened cam-surface, and a series of teeth, substantially as described.

9. In a circular-knitting machine, a rotating discoid cam interposed segmentally in the needle-groove of the cam-cylinder, having a cut-away portion, a toothed portion, and a cam portion which occupies the balance of its periphery, substantially as described.

10. In a circular-knitting machine, a rotating discoid cam interposed segmentally in the needle-groove of the cam-cylinder, having a cut-away portion not less than its projecting segment, and a cam portion; means whereby it is normally sustained at rest with either the cut-away portion or the cam portion opposed to the advancing line of the needles; and one or more teeth intervening between the cam portion and the cut-away portion at either side, whereby a slight motion of rotation given it causes a tooth to meet the advancing needles, whereby its further intermittent rotation for the reversal of its position is effected by the needles themselves, substantially as described.

11. In a circular-knitting machine, a rotating discoid cam interposed segmentally in the needle-groove of the cam-cylinder, having a cut-away portion, and also a cam portion of which the part which first meets the advancing line of needles is flattened, substantially as described.

12. In a circular-knitting machine, a switch-cam consisting of a partial segment of a disk pivoted below the needle-groove of the cam-

cylinder in a plane tangential to the periphery of the needle-cylinder; in combination with means for rotating said segment upon its pivot either to a position where it is wholly below the needle-groove, whereby the needles are allowed to pass it without action, or further to a position whereby a portion of its periphery forms a cam-incline which raises the needles above the needle-groove, substantially as described.

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