Aug. 16, 1932. J. LAWSON ET AL 1,872,597

JACQUARD PATTERN MECHANISM FOR KNITTING MACHINES

Filed March 22, 1927 5 Sheets-Sheet 1

Fig. 1

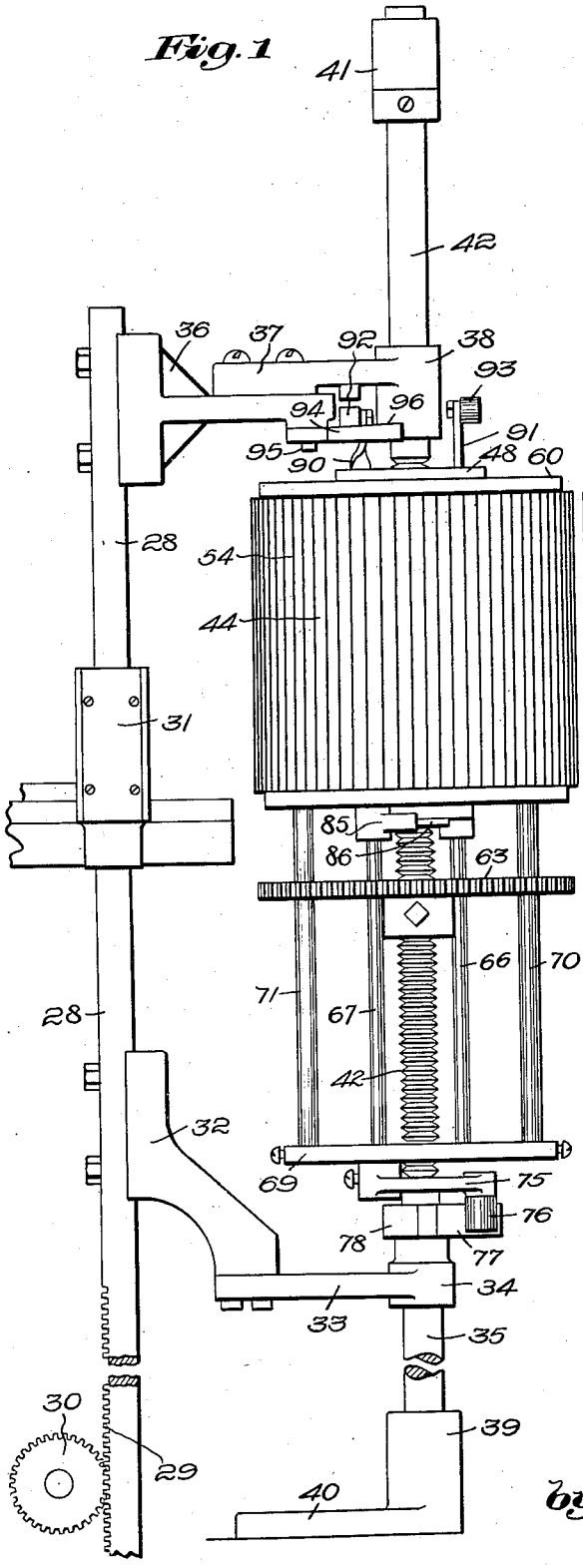
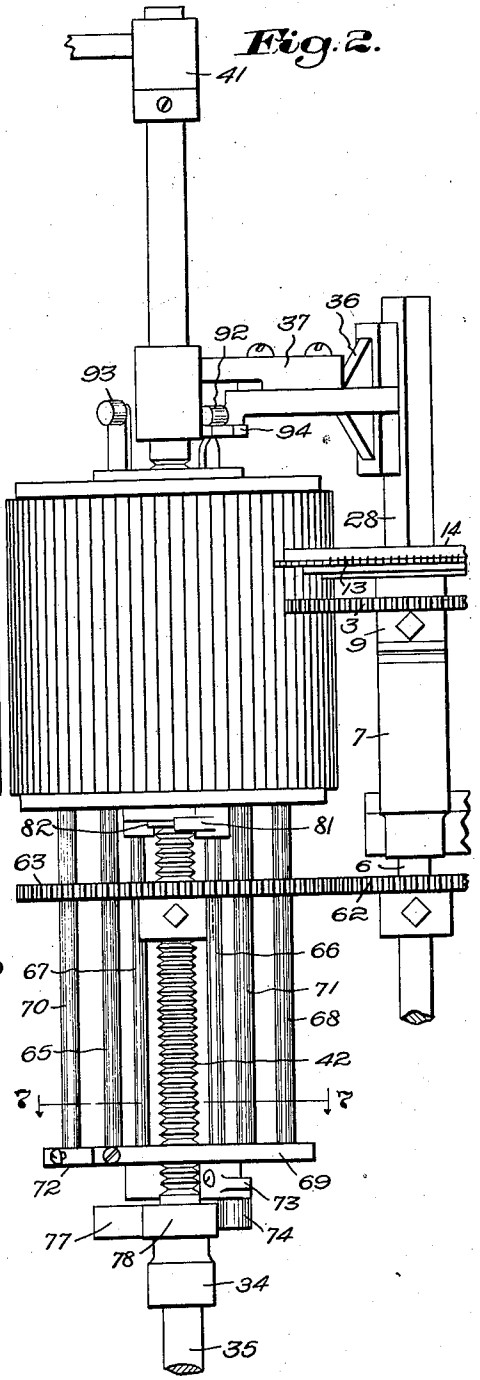


Fig. 2.



Inventors:
John Lawson,
Robert H. Lawson,
by Emery Booth Janney & Varney
Attys.

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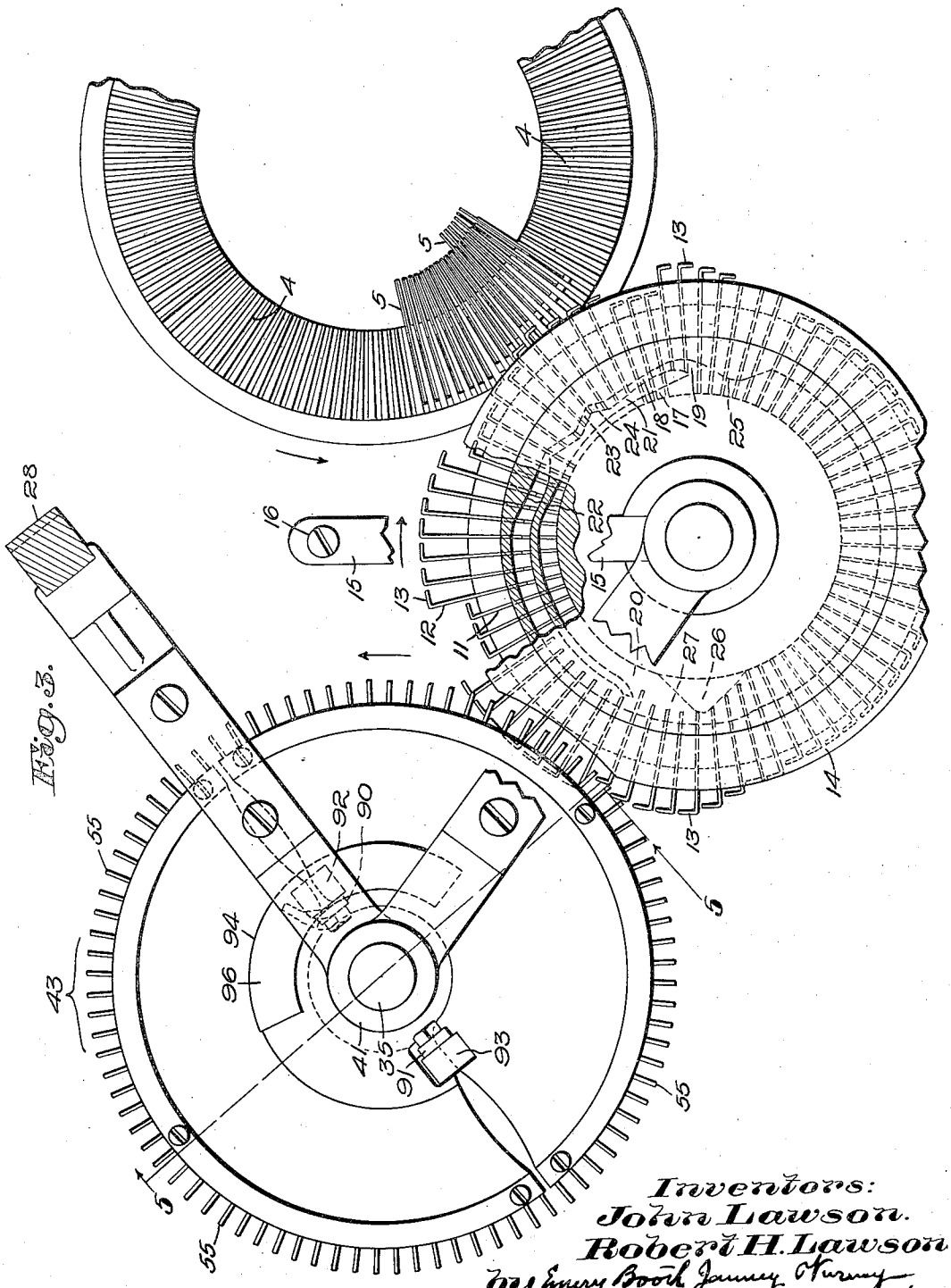


Fig. 5.

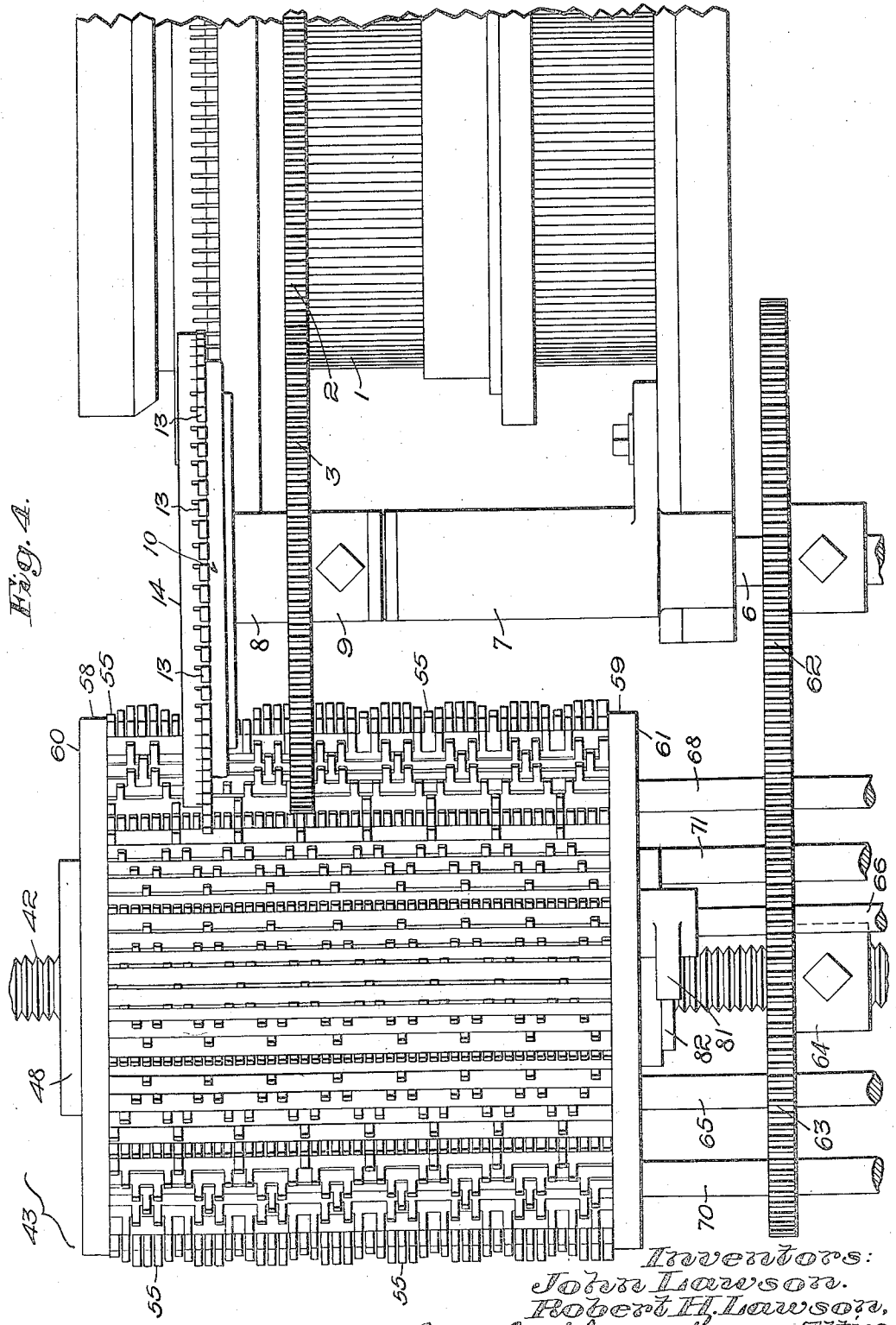
Inventors:
John Lawson.
Robert H. Lawson
by Emery Booth Janney & Varney
Attys

Aug. 16, 1932. J. LAWSON ET AL 1,872,597

JACQUARD PATTERN MECHANISM FOR KNITTING MACHINES

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Fig. 4.



Inventors:
John Lawson.
Robert H. Lawson,
By Emery, Booth, Janney & Varney Attys.

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JACQUARD PATTERN MECHANISM FOR KNITTING MACHINES

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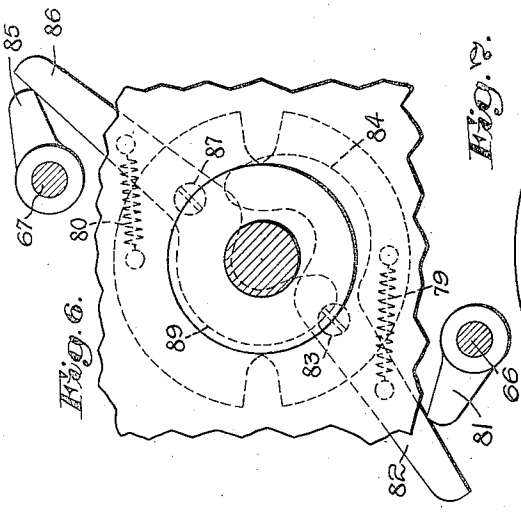


Fig. 6.

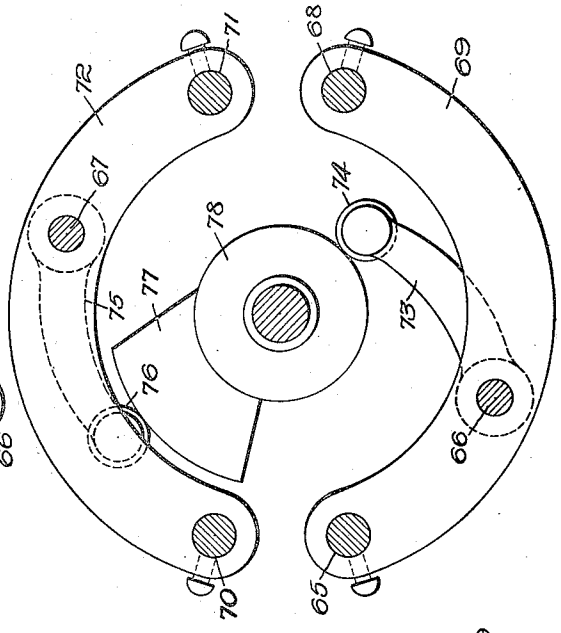


Fig. 7.

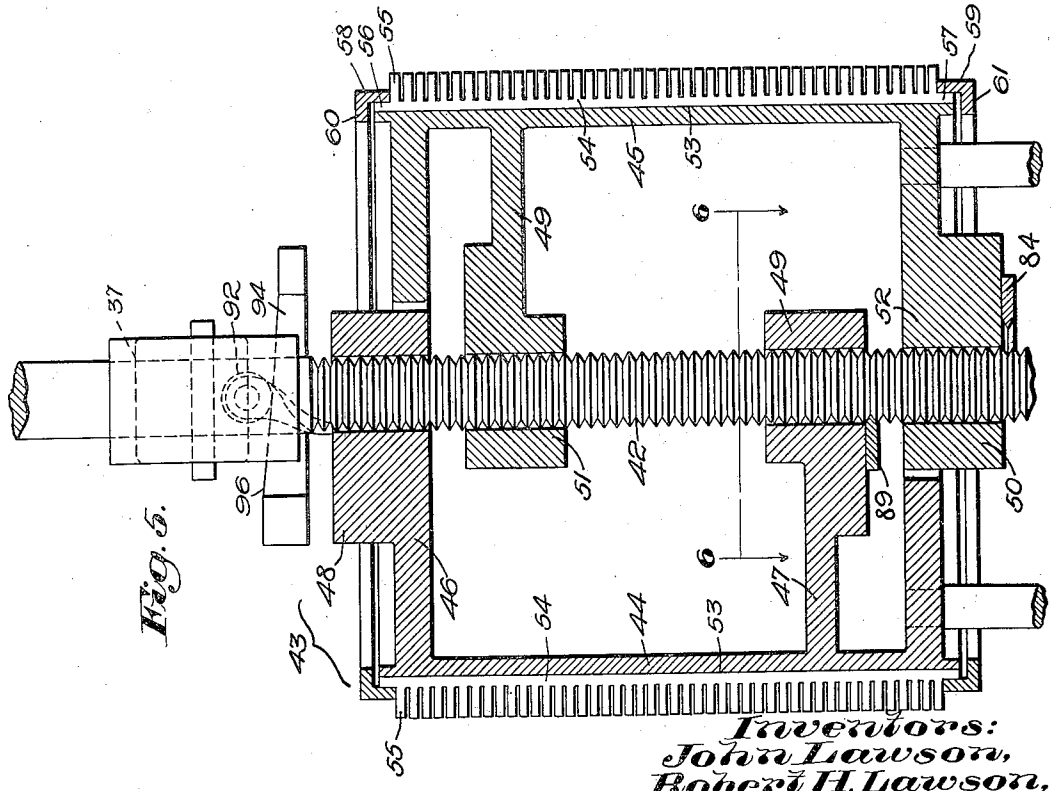


Fig. 5.

Inventors:
John Lawson,
Robert H. Lawson,
by Emery Booth Janney Varney
Attys

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JACQUARD PATTERN MECHANISM FOR KNITTING MACHINES

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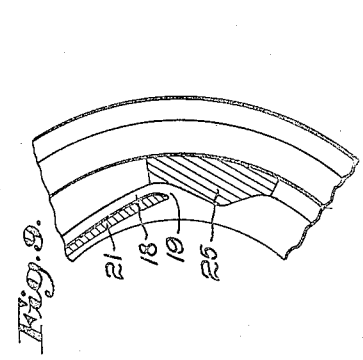


Fig. 9.

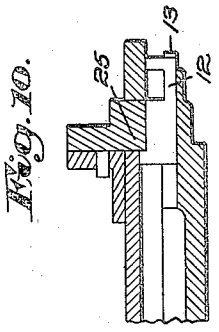


Fig. 10.

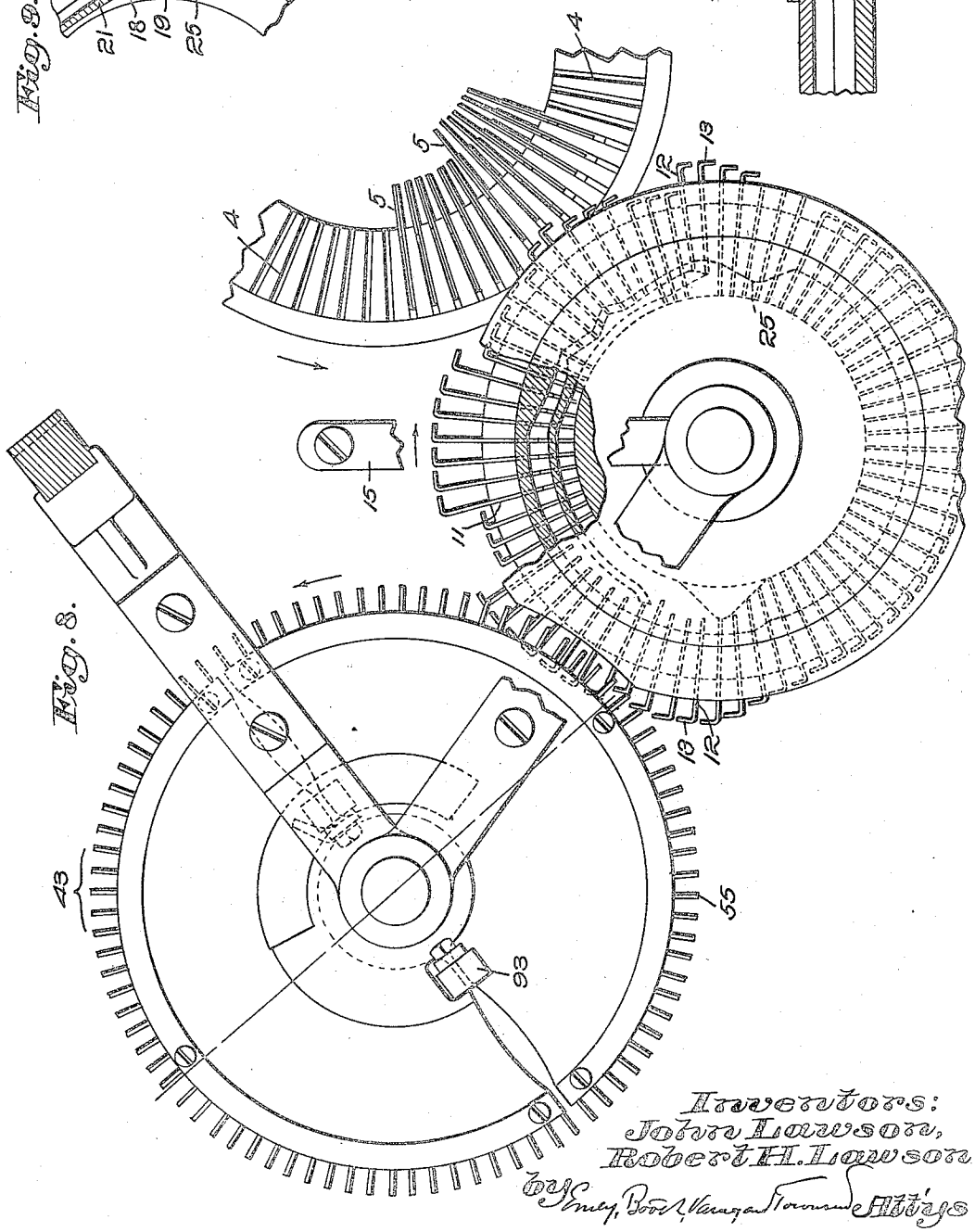


Fig. 8.

Inventors:
John Lawson,
Robert H. Lawson
by Emery, Booth, Vanaman & Emery Attys

Patented Aug. 16, 1932 1,872,597

UNITED STATES PATENT OFFICE

JOHN LAWSON AND ROBERT H. LAWSON, OF PAWTUCKET, RHODE ISLAND, ASSIGNORS TO HEMPHILL COMPANY, OF CENTRAL FALLS, RHODE ISLAND, A CORPORATION OF MASSACHUSETTS

JACQUARD PATTERN MECHANISM FOR KNITTING MACHINES

Application filed March 22, 1927. Serial No. 177,262.

This invention relates to jacquard patterning mechanism for knitting machines.

In order that the principle of the invention may be readily understood, we have disclosed a single embodiment of the mechanism of our invention in the accompanying drawings, wherein—

Fig. 1 is a rear elevation of the jacquard drum and means to move the same up and down;

Fig. 2 is a front elevation of the mechanism shown in Fig. 1;

Fig. 3 is a plan view of the needle cylinder and sinker ring, the dial disk with its jacks, and the jacquard drum;

Fig. 4 is a front elevation of the needle cylinder, the dial disk and the jacquard drum;

Fig. 5 is a vertical transverse section taken through the jacquard drum, upon the line 5—5 of Fig. 3;

Fig. 6 is a horizontal section upon the line 6—6 of Fig. 5;

Fig. 7 is a section upon the line 7—7 of Fig. 2.

Fig. 8 is a view similar to Fig. 3, but showing the use of one jack to each instrumentality; and

Figs. 9 and 10 show means for automatically operating a cam of the dial disk.

While the jacquard patterning mechanism herein disclosed may be employed in connection with other types of knitting machines than that here indicated, we have selected for illustration a circular hosiery knitting machine, such, for example, as of the general type known as the Banner and disclosed in the patent to Hemphill, No. 933,443. The patterning may be effected by any desired or suitable stitch structural variation that is within the scope of the invention, as, for example, plating or reverse plating, tucking, open sinker loop or so-called lace work. Without limiting our invention thereto, we have herein disclosed means for effecting patterning through plating and reverse plating. In effecting plating and reverse plating we preferably employ the principles of operation disclosed in the patent to Robert H. Lawson, No. 1,605,896, and refer to that patent for a full disclosure of special instrumentalities and regular web holders, one of each of which is positioned in each of the grooves of the sinker ring. Relative movement of the needles and the said instrumentalities, and preferably movement of said instrumentalities transversely of the needle series, effects yarn or thread engagement, so that two plating yarns which are fed in a plating relation are reversed in position desirably during the loop forming operation, so that the face or front thread appears at the back of the fabric and vice versa, all as fully disclosed in said Patent No. 1,605,896.

As disclosed in said Lawson Patent No. 1,605,896, there is provided one or more dial disks, of the general type shown at 44, 45 in said patent, for effecting the positioning of the said instrumentalities. Desirably, however, instead of employing the precise form of dial disk shown in that patent, we provide a dial disk of the general type shown in our copending application Ser. No. 145,512, wherein are disclosed jacks positioned in grooves of the dial disk. The mechanism herein shown, however, so far as the dial disk is concerned, constitutes a marked advance in the art, in that the jacks of the dial disk are themselves movable in and out into inoperative and operative positions respectively, and thereby individually control the positions of the instrumentalities which directly engage the thread or threads to effect reverse plating.

By the mechanism shown in the patent to Lawson, No. 1,605,896, change from plating to reverse plating or the reverse may be effected at any wale of the fabric at will. While this is true of each wale so far as any one course considered alone is concerned, there are limitations in the action of the mechanism therein disclosed which prevent change from plating to reverse plating or the reverse at each and every loop of any course regardless of what has been done in each and every preceding course and regardless of what may be done in each and every succeeding course. An important object of the present invention is to provide means whereby, throughout an extended number of courses,

change may be made from plating to reverse plating, or the reverse, at each and every loop or stitch throughout all of said courses, regardless of what has been done or is to be done at any of the other loops or stitches of any of said number of courses. In the mechanism shown, we have provided a jacquard drum or member of such height or length as to control all the stitches throughout forty-eight consecutive courses, assuming that the jacquard drum is racked continuously in one direction, one step for each course. If, however, the drum be not racked every course or if, at the end of a racking movement in one direction as far as possible, it be correspondingly racked in the opposite direction, it will be obvious that the number of courses controlled is greatly increased. The purpose of our invention (assuming merely for the purpose of description that the patterning or designing is effected by change from plating to reverse plating, or the reverse) is to provide figures of various sizes, or pictures, names, letters or other representations throughout a very extensive part of the stocking.

Referring to the drawings, we have in Fig. 4 represented at 1 the needle cylinder of a circular hosiery knitting machine, such, for example, as that shown in the Lawson Patent No. 1,605,896. The said cylinder being in this embodiment of the invention rotatable, (which need not be described in detail) has fast thereon a gear 2 meshing with a gear 3. At its upper end the knitting machine is provided with any desired and preferably the usual web holder bed ring provided with radial grooves as indicated in Fig. 3 at 4. Each of the said grooves receives not only the usual web holder or so-called sinker such as shown in the said Lawson Patent No. 1,605,896, but also reecives a special instrumentality 5 of the general character shown in said Patent No. 1,605,896, said elements being wholly disconnected from each other and capable of independent radial movement in the said grooves. For further description of the manner in which said instrumentalities cooperate effecting changes from plating to reverse plating, reference is made to said patent.

For further disclosure of the manner in which the regular web holders and the special instrumentalities are controlled in their radial grooves for in and out movement, we make reference to our co-pending application Serial No. 174,176, now Patent No. 1,720,649. As therein fully disclosed, we provide in the sinker cam ring three substantially concentric pathways, the innermost of which receives the butts of the regular web holders, which are moved in and out in the usual manner. The special instrumentalities are longer than the regular web holders, and the butts thereof are adapted to be received either in the outermost pathway or in the intermediate pathway. When said butts are in the outermost pathway, normal plating occurs at the needles corresponding thereto. A cam or other suitable means controls the communication between the intermediate pathway and the outermost pathway, so that when said instrumentalities are pushed inward by selecting means (such, for example, as the jacks in the dial cam to be herein described), the butts of such instrumentalities pass into the intermediate pathway and therefore cooperate to effect reverse plating at the needles corresponding thereto, all of which will be clearly understood by reference to said application and also by reference to said Lawson Patent No. 1,605,896.

The needle cylinder is provided with independent needles of any suitable type but preferably of the latch needle type, and a series of yarn fingers is provided, among which yarn fingers are two so relatively positioned that the two threads therefrom are fed to the needles in a plating relation. If desired, greater tension may be imparted to one of the threads than to the other. For example, greater tension may be imparted to the thread that is fed lowermost to the needles, as disclosed in the patent to Lawson, No. 1,605,895.

The gear 3 is fast for rotating movement upon a spindle 6 of the general character shown at 22 in our co-pending application Ser. No. 145,512. The said spindle 6 is supported in a suitable bearing 7 mounted in the bed plate of the machine. We have stated that the gear 2 is upon the needle cylinder. This is because in this embodiment of the invention the needle cylinder is rotatable, but our invention is obviously not limited to knitting mechanism wherein the needle cylinder is rotatable, and wherein the gear, such as 2, is provided upon the needle cylinder.

Upon the spindle 6 are fast collars 8, 9, and fast upon the upper end of said spindle a jack receiving dial disk is generally indicated at 10, and which is in transverse alignment with the sinker cam ring, substantially as indicated in our co-pending application Ser. No. 145,512. The said disk is rotated in a clockwise direction, as indicated by the arrow in Fig. 3, and in its upper face are provided radial grooves 11, each of which receives a jack 12, the outer end whereof is bent at substantially right angles, though upon an arc, as indicated at 13. We have shown each of said bent ends 13 as of sufficient extent to engage and thereupon to move radially inward two special instrumentalities 5, so that their butts pass from the outermost pathway in which they are positioned during normal plating into the intermediate pathway for effecting reverse plating. If desired, however, each of said bent ends 13 may control but a single special instrumentality, in which case we would provide as many jacks 12 as there

are special instrumentalities 5. Our invention is not limited in this respect, for although we have herein shown one half as many jacks 12 as there are special instrumentalities 5, the number of jacks may be the same as the number of needles or the number of jacks 12 may bear any desired ratio to the number of special instrumentalities 5. The said dial disk having the radial grooves and the jacks 12 are rotated by the gear 3 under and with relation to a fixed cap 14 provided with suitable cams and pathways. The said cap 14 is held from rotation in any suitable manner, as by means of a bar 15 connected to the upper face of said cap and extending to a stud 16 which is supported upon the frame of the machine. The said cap 14 is provided with an inner pathway 17 and an outer pathway 18 which communicate as indicated at 19, and also at a substantially diametrical point 20, as clearly shown in Fig. 3. Between the said pathways 17, 18, is provided a cam or set of cam formations 21. The upstanding butts of the jacks 12 are adapted to be received in either of said pathways 17, 18. If they are positioned in the innermost pathway 17, they are so withdrawn or positioned that, in their movement past the corresponding instrumentality or instrumentalities 5, they do not act to move the latter from the outermost pathway thereof to the intermediate pathway, but leave them in said outermost pathway, so that at the needles corresponding thereto normal plating occurs. If, however, the butts of any jacks 12 are moved or guided outwardly, so that their butts come into the outermost pathway 18, then the said jacks engage by their bent ends 13 with a pair of special instrumentalities 5 and move the same inwardly in their grooves, so that their butts are positioned in the intermediate pathway hereinbefore referred to, and therefore reverse plating occurs at the needles corresponding thereto. The cam formation or shape of the cam member 21 is such that as the jacks 12, after passing the jacquard drum, approach the sinker cam ring, they are drawn inwardly, if such jacks are in the outer pathway 18, so that they will not engage with special instrumentalities 5 to which they do not pertain. The formation for effecting such inward movement is indicated at 22 in Fig. 3. Immediately thereafter, as indicated at 23, the said jacks in the outermost pathway 18 are forced outward so that their bent ends 13 directly engage the ends of two special instrumentalities (or one special instrumentality if the number of jacks 12 is the same as the number of special instrumentalities 5). Beyond the cam formation 23 is a formation 24, by means of which the jacks 12 are withdrawn, and circumferentially beyond said formation 24 is a cam 25 by which all of said jacks 12 are moved inward to their greatest extent. They continue in their innermost position until in their travel they reach a cam 26 substantially opposite thereto, by which all of the jacks 12 are projected to their full extent for presentation to the jacquard drum, the formations upon which determine whether the said jacks 12 are to remain in their outermost position and therefore to engage special instrumentalities 5 and push the latter into their reverse plating position, or whether they are to be themselves pushed inward by the formations upon the jacquard drum, so that in the continued turning movement of the dial disk, such pushed in jacks 12 do not engage their special instrumentalities 5, thus permitting said special instrumentalities 5 to remain in their outermost or normal plating position. Engagement between the corresponding formations upon the jacquard drum and the jacks 12 is effected at such a time in the turning movement of the dial disk 10 as to cause any such functioning formation of the jacquard drum to push the corresponding jack 12 inward into the inclined opening 27 of the pathway 17, as indicated at the left hand side of the dial disk in Fig. 3.

We provide means for moving or lifting the cam 25, upward out of functioning relation with the butts of the jacks 12 during heel and toe work, and desirably do this automatically so that, during heel and toe work, the plating mechanism is not functioning and the usual heel and toe yarn may be and is fed instead of the two plating yarns. In Figs. 9 and 10, the cam 25 is shown as structurally distinct from other parts so that it may be elevated out of functioning relation with the jack 12, and in Fig. 10, said cam is shown provided with a laterally extended pin by which at proper times the said cam may be automatically lifted out of functioning position.

Having thus described the arrangement of the jacks 12 and the effect of their movement from their innermost position, where they do not act upon their corresponding instrumentalities 5, into their outermost position where they engage their corresponding instrumentalities 5 and push them inward for effecting reverse plating, which change in position of the jacks 12 is controlled by the jacquard drum, we will now describe one form of jacquard drum or member which may be employed for the purpose. Our invention is not limited to any particular form of jacquard controlling member, as it will be understood that any suitable means giving a true jacquard control of the jacks 12 may be employed. We prefer, however, to use a drum which is constantly rotated in one direction and which is gradually racked or moved step by step upward or downward (that is, axially) so that the formations upon said jacquard drum may be presented to and act upon the jacks 12. We provide the

jacquard drum with any desired number of circumferential rows of projections or formations, each circumferential row corresponding to one course in the knitting operation, and it will therefore be understood that the number of possible projections or formations in each such circumferential row may be the same as the number of needles in the knitting machine, so that each formation in each circumferential row of the jacquard drum controls a loop or stitch in that course. In a knitting machine of coarse gauge especially, we provide as many possible projections in each row as there are needles in the needle cylinder, but in the disclosed embodiment of the invention, wherein the number of jacks 12 is but one half the number of special instrumentalities 5, the number of possible formations in each circumferential row of the jacquard form is one half the number of needles in the needle cylinder; in other words, the number of possible projections in each row of the jacquard drum is the same as the number of jacks 12 in the dial disk.

While the formation upon the jacquard drum may be of any suitable character, our invention not being limited or restricted in this respect, we preferably provide a number of strips, which are inserted in or applied to the circumference of the jacquard drum lengthwise of said drum, and upon each strip we provide for a number of projections, the total possible number representing the number of courses of the stocking or other knitted article that may thus be controlled, assuming that the drum is moved or racked lengthwise for each revolution of the needle cylinder. If each such strip had all the possible projections thereon, it would follow that in each course the corresponding jack would be moved inward viewing Fig. 3 and hence the corresponding pair of special instrumentalities 5 would remain in their outer position and normal plating would result. If, however, one or more projections is or are removed from any one strip, such removal results in reverse plating at the needles corresponding thereto in the course or courses where such projection or projections is or are removed, all of which will be evident from the foregoing description.

We have stated that the jacquard drum is constantly rotated in one direction. It is, however, important that while projections upon the jacquard drum are acting upon the bent ends 13 of the jacks 12, there be no movement of said projections in a lengthwise direction. Since, however, the jacquard drum is itself to be racked or moved one step for each course of the knitting operation (unless the requirements of the pattern are such as to prevent a lengthwise movement of the drum upon the completion of any given course), it follows that the problem is presented of holding the functioning projection or projections upon the jacquard drum stationary (except for rotative movement of the drum) while said projection or projections are in engagement with the corresponding jacks 12, but at the same time providing for moving the jacquard drum sufficiently, so that in the next course the next row or next desired row of circumferentially extending projections upon the jacquard drum come into functioning engagement with the jacks 12. In the present embodiment of our invention, we have solved this problem by forming the drum in a plurality of segments, each of the full length of the drum, each segment whereof any formations are at a given instant engaging jacks 12, being held stationary, except in a rotative sense, at said given instant. In the present embodiment of the invention, we provide two such segments, each of which therefore embraces one hundred and eighty degrees of the drum, and we provide means whereby the segment any of whose projections are in engagement with jacks 12 is at such time of engagement held from lengthwise movement while continuing the turning movement. At the same time the other segment is being racked or moved step by step according to the dictates of the pattern. When the first mentioned segment has passed in its rotating movement far enough so that none of its projections is in engagement with a jack 12, that segment at once comes under the control of means for racking the same in the required direction, the other segment now being held from a racking movement, because certain of its formations are now brought into engagement with certain of the jacks 12.

Referring more particularly to Figs. 1, 2, 5 and 7, we have therein represented an upright bar or rack 28, the teeth 29 of which are engaged by the teeth of a pinion 30. The pinion 30 is controlled in its rotative movement by two ratchets (not shown), the teeth whereof extend in opposite directions and the pawls of which are operated so as to turn said ratchets and thereby to turn the pinion 30 in one direction or the other. Each ratchet when in operation imparts a step by step movement to the pinion 30 and the said ratchets, through the pawls thereof, are under the control of pattern mechanism, such, for example, as a pattern chain, so that, according to the dictation of the pattern chain, the pinion 30 may be constantly moved in a step by step manner in one direction, or such step by step movement may be suspended for any desired number of courses or any variation of the movements of the two ratchets may be provided, all in accordance with the pattern control, with the result that the pattern drum as a whole may be racked or moved step by step from one end to the other, and then correspondingly moved in a reverse direction back to the starting point, or, as stated, any variation or modification of such step by step

movement may be employed. Assuming for purpose of illustration that the jacquard drum has forty-eight circumferential rows of projections, a constant step-by-step movement of the rack 28 in one direction would control each stitch in each of said forty-eight courses without any unnecessary duplication of the patterns to any extent whatever throughout the forty-eight courses, and upon similar return movement of the drum whatever pattern was produced during said forty-eight courses is produced in a reverse direction in the next forty-eight courses. The possibilities therefore of the invention are very great. The means referred to for pattern control of the pinion 30 is disclosed and claimed in our copending application Serial No. 182,060 and is not claimed herein.

The rack 28 is suitably supported for a lengthwise movement in a guide 31, and near its lower end, as shown in Fig. 1, said rack has secured thereto a bracket 32, an arm or extension 33 whereof encircles at 34 a shaft 35. At or near its upper end the rack 28 has secured thereto a bracket 36, to which, with capacity for lengthwise adjustment by slots and bolts, as indicated in Fig. 1, is secured a bracket 37, a hub 38 of which encircles the said shaft 35. The said shaft is stepped in a bearing 39 which is secured to the frame of the machine at 40, and at its upper end the said shaft 35 is received in suitable bearings 41 carried in a bracket upon the framing of the machine.

The said shaft 35 is provided with a suitable number, as, for example, forty-eight or more, circumferential grooves or notches 42. The shaft is not, strictly speaking, a threaded shaft, although it may be defined as a shaft the threads whereof are of zero pitch. The purpose of the said grooves 42 is to provide for engagement therewith one after another of a jaw or other suitable member, one of which is provided upon each half or segment of the drum. So long as either jaw is in engagement with one of the grooves 42, that half or segment of the drum remains without racking movement, but the shifting of that jaw into engagement with another groove 42 occurs as the increment of racking movement referred to ceases.

The jacquard drum as a whole is indicated at 43 in the several figures, and the two segments or halves of the drum are indicated at 44, 45 respectively. The segment 44 is provided with two inwardly extending desirably semi-circular webs or flanges 46, 47 terminating at their inner ends in hubs 48, 49, encircling the said shaft 35. The segment or half drum 45 is provided with inwardly extending webs 49, 50 terminating in similar hubs 51, 52, also encircling the shaft 39, all as clearly shown in Fig. 5.

The outer surface of the entire drum is lengthwise grooved, as indicated at 53, in a manner generally similar to a needle cylinder, and in each of said grooves is positioned a strip 54 having forty-eight possible projections or formations 55 slightly spaced from each other. Such strip, for convenience or description, we refer to as a jack selector strip. Such strip is preferably made of metal and, according to the design or pattern, the projections 55 which are not employed, are cut away before the strip is inserted. It will be evident that the strips must be and are very accurately relatively positioned in their respective grooves 53, so that the corresponding projections 55 for each course of the fabric are in exact circumferential alignment. Each of said strips 54 has an upper reduced end 56 and a lower reduced end 57, which are respectively engaged by the flanges 58, 59 of semi-circular caps 60, 61, which are secured to the ends of the drum by screws or otherwise after all of the strips have been positioned.

Any suitable means may be provided to rotate the jacquard drum. For the purpose, we have herein represented a gear 62 which as shown in Fig. 4 is fast upon the rotating spindle 6. The said gear meshes with and drives the gear 63 which, by collar 64 or otherwise, is made fast upon the shaft 35 so as constantly to rotate the same in one direction. The gear 63 has a series of openings extending therethrough for the reception of a series of rods, four of which are shown at 65, 66, 67, 68 in Fig. 2. The rods 65, 68 are secured at their lower ends to a segment 69, shown also in Fig. 7, and the said rods 65, 68 pertain to one of the sections or halves of the drum. The other section or half of the drum is provided with similar rods 70, 71, which at their lower ends are connected to a similar segment 72. Upon the rod 66 at the lower end thereof, as indicated in Figs. 1 and 2, is a lever arm 73, which at its free end is provided with a roll 74. Between the rods 70, 71 is the rod 67, which rod is connected to the segment 72 and has pivoted thereon the lever arm 75 which at the free end carries a roll 76 similar to the roll 74. The said rolls 74, 76 are adapted to engage in turn in the rotation of the jacquard drum and the segments 69, 72, with a cam 77 carried by or formed with a hub 78 supported by the bracket 34 shown in Fig. 1, so that as the rack or bar 28 moves up or down the hub 78 with the cam 77 move up and down therewith. The action of the stationary cam 77 is to cause each lever arm 75, 73 in turn to swing outwardly, and as soon as each roll 74, 76, rides past the cam 77, its arm 73 or 75 is moved inwardly by a suitable tension spring 79, 80 connected thereto and to the framing of the machine.

The purpose of the cam 77 and the arms 73, 75 is to control two jaws, one pertaining to each segment or half of the drum, which

jaws are respectively brought into engagement with a notch 42 in the shaft 35 or removed therefrom, it being understood that one of such jaws and one only is in engagement at any given time with a notch or groove upon the shaft 35, so that the corresponding segment or half of the jacquard drum is held stationary in a lengthwise sense, but is permitted to continue its rotation.

The rod 66 extends upward to the lower end of the jacquard drum and there has fast thereon an arm, cam or tappet 81 which is in engagement with the arm 82 of a lever pivoted at 83 to the hub 52, shown in Fig. 5. Said lever is continued beyond the pivotal point 83 and is provided with a jaw 84, which in Fig. 6 is shown in an unlocked condition, as shown also in Fig. 5. Therefore the segment or half of the drum 45 is not in position to be racked or moved axially. The arm or cam 81 is moved by the cam 77 so that it periodically swings the lever 82 upon its pivot 83 against the tension of the spring 79 so as to unlock the jaw.

On the corresponding rod 67 is a cam or tappet 85 which is in engagement with the lever arm 86. The said lever is pivoted at 87 upon the hub 49 of the other drum segment 44, and is provided with a jaw 89, which, as shown in Fig. 6 and also in Fig. 5, is in engagement with one of the circumferential grooves 42 of the shaft 35, whereby said segment 44 is held against axial movement for the time being. The cam or tappet 85 similarly periodically effects the release of the jaw 89 from a groove 42 through the action of the cam 77. It is to be understood that in each rotation of the entire drum the jaws 84 and 85 are respectively in engagement with respective grooves 42, during half such rotation.

Any suitable means may be provided to impart an incremental movement to each half of the drum 43 in turn, or in other words, in each rotation of the drum 43, one half of the drum is temporarily under the influence of means to give it an incremental advance or retardation, and then is under the influence for the second half of such rotation of means, whereby it is locked to the shaft 35 and is thus held against axial movement.

Each drum segment or half drum is provided with an upwardly extending rod or arm shown respectively at 90, 91 in Fig. 1. The said arms carry rolls shown respectively at 92, 93, and each roll in the rotation of the drum is received upon a substantially semi-circular runway or cam 94, which is secured as indicated at 95 to the under side of the bracket 36. The upper face of said runway is sloped or of cam formation, as indicated at 96, and the slope is just sufficient to elevate the corresponding segment of the drum to bring the next circumferential row of projections 55 into transverse alignment with the jacks 12.

At or substantially at the time a roll 92 or 93 passes off the cam 96 the supporting jaw pertaining thereto is released and snaps into the next circumferential groove 42. The cam 96 obviously does not raise either drum section after the jaw for that drum section has snapped into its supporting notch or groove 42. That is to say, each roll 92 or 93 drops off the cam 96 not later than the time of entry of the jaw for that drum section into the next supporting notch or groove 42.

We have stated that the jacks 12 are rendered inactive during the knitting of the heel. In order to continue a desired design or pattern over the instep, the racking of the drum section is discontinued during the knitting of the heel. In order to do this, a cam (not shown), desirably upon the main cam shaft of the machine, discontinues the racking of the pattern drum by rendering inactive the pawl or pawls controlling the rotation of the pinion 30.

While we have described this invention with particular relation to the knitting of hosiery, it is to be understood that the invention is adapted to the knitting of other fabrics, whether tubular or not.

It will be evident from the foregoing disclosure that the invention is for application to circular knitting machines of the independent needle type having at the knitting head needle-cooperating elements whereby stitch variation may be effected. We employ the term "needle-cooperating elements at the knitting head" with broad meaning, as applicants are not, except where the claims specifically so state, limited to the use of the invention for effecting changes in plating, and they are not limited to the effecting of changes in plating by instrumentalities as referred to.

Having thus described one specific embodiment of means whereby the method of our invention may be carried out and whereby the article of our invention may be made, it is to be understood that although specific terms are employed, they are used in a generic and descriptive sense and not for the purpose of limitation, the scope of the invention being set forth in the following claims.

We claim:

1. A circular knitting machine adapted to knit an article of extended length, and having independent needles, and having means to feed two yarns thereto in a plating relation, instrumentalities other than said feeding means cooperating with one or more of the yarns to effect change from normal plating to reverse plating, or the reverse, movable jack like members controlling the movements of said instrumentalities, and

jacquard means for controlling the movement of said jacks.

2. A circular knitting machine adapted to knit an article of extended length, and having independent needles, and having means to feed two yarns thereto in a plating relation, instrumentalities other than said feeding means cooperating with one or more of the yarns to effect change from normal plating to reverse plating, or the reverse, a series of movable jacks for controlling the movements of said instrumentalities, and jacquard means for controlling in each course of the fabric the movements of said jacks irrespective of the movements of said jacks in any preceding course of said fabric.

3. In jacquard mechanism for knitting machines, a member adapted to control instrumentalities that themselves control designing in the fabric, said member being composed of a plurality of parts, all of which carry formations for acting upon said instrumentalities, and means to cause the rotation of the entire member and means to present different parts of the surface thereof for acting upon instrumentalities but to hold from other movement than rotation that portion of the member whose formations are functioning at the time being upon said instrumentalities.

4. In jacquard mechanism for knitting machines, a jacquard drum having a series of circumferential rows of formations adapted to act upon instrumentalities that control the designing at the needles, said drum being composed of a plurality of segments, means to rotate the drum as an entirety, means incrementally and periodically to move each segment of the drum so as to present another row of formations for action upon the instrumentalities, and means to hold against such incremental movement that segment of the drum whose formations are at the time being functioning upon the instrumentalities.

5. In jacquard mechanism for knitting machines, a jacquard drum having a series of circumferential rows of formations adapted to act upon instrumentalities that control the designing at the needles, said drum being composed of a plurality of segments, means to rotate the drum as an entirety, and means whereby during each such rotation of the drum each segment is temporarily held against incremental movement and then is given a non-rotative incremental movement to present different parts of the surface thereof for acting upon instrumentalities.

6. In jacquard mechanism for knitting machines, a jacquard drum having a series of circumferential rows of formations adapted to act upon instrumentalities that control the designing at the needles, said drum being composed of a plurality of segments, means to rotate the drum as an entirety, cam means to move incrementally one segment of the drum in an axial direction through a part of the rotation of the drum while another segment of the drum is held against axial movement but continuing its rotative movement.

7. In jacquard mechanism for knitting machines, a jacquard drum having a series of circumferential rows of formations adapted to act upon instrumentalities that control the designing at the needles, said drums being composed of a plurality of segments, means to rotate the drum as an entirety, a shaft whereon the drum is mounted, said shaft having circumferential grooves, jaws upon the several drum segments periodically to engage grooves upon said shaft, and means periodically to release said jaws from said grooves.

8. In jacquard mechanism for knitting machines, a jacquard drum having a series of circumferential rows of formations adapted to act upon instrumentalities that control the designing at the needles, said drum being composed of a plurality of segments, means to rotate the drum as an entriety, a shaft whereon the drum is supported, said shaft having circumferential grooves, jaws carried respectively by the drum segments, means to cause release and engagement of said jaws with the notches of said shaft, and means whereby when a jaw is released from the shaft, the segment thereof is moved in an axial direction for the purpose specified.

9. In mechanism for effecting normal and reverse plating in knitted fabrics, a circular series of independent needles, instrumentalities movable transversely of the needles and adapted through thread engagement to control the formation of normal and/or reversely plated loops at each wale, a series of jacks to act upon said instrumentalities, said jacks being movable from operative to inoperative position, and the reverse, and means controlling the movement of said jacks, said means including a jacquard drum having an extended series of circumferential rows of formations to act upon said jacks, means to rotate said drum, and means to impart incremental non-rotative movement to said drum to present different parts of the surface thereof for acting upon jacks.

10. In mechanism for effecting normal and reverse plating in knitted fabrics, a circular series of independent needles, instrumentalities movable transversely of the needles and adapted through thread engagement to control the formation of normal and/or reversely plated loops at each wale, a series of jacks to act upon said instrumentalities, said jacks being movable from operative to inoperative position, and the reverse, and means control-

ling the movement of said jacks, said means comprising a drum made up of a series of segments, each segment carrying formations to act upon said jacks, means to rotate the drum as an entirety, means to hold each segment stationary save for its rotative movement while the formations of that segment are acting upon the jacks, and means to impart incremental movement to each segment at some time during each revolution of the drum to present different parts of the surface thereof for acting upon jacks.

11. In mechanism for effecting normal and reverse plating in knitted fabrics, a circular series of independent needles, instrumentalities movable transversely of the needles and adapted through thread engagement to control the formation of normal and/or reversely plated loops at each wale, a series of jacks to act upon said instrumentalities, said jacks being movable from operative to inoperative position, and the reverse, and means controlling the movement of said jacks, said means including a drum, means to rotate the drum as an entirety, said drum having a series of segments, each of the full length of the drum and together making up the circumference thereof, means whereby each segment of the drum in turn is shifted incrementally so as to present another row of formations to the jacks.

12. In a circular, independent needle, knitting machine having at the knitting head needle cooperating elements, whereby normal and reverse plating may be effected, a rotatable member of the knitting head, a drum rotatable in synchronism with said member, said drum having a plurality of readily removable lengthwise strips each provided with a plurality of formations, whereby the functioning or non-functioning of needle cooperating elements at the knitting head is controlled by said formations and means to impart step-by-step axial movement to said drum to bring different portions of said strips into functioning position.

13. In a circular, independent needle, knitting machine having at the knitting head needle cooperating elements whereby normal and reverse plating may be effected, a rotatable member of the knitting head, a drum rotatable in synchronism with said member, said drum having a plurality of readily removable lengthwise strips, each provided with a plurality of formations, whereby the functioning or non-functioning of needle cooperating elements at the knitting head is controlled by said formations, and means for axially moving said drum so as to present successive formations of said strips for controlling the functioning or non-functioning of the needle engaging elements.

14. In a circular, independent needle, knitting machine having at the knitting head needle cooperating elements whereby stitch structural variation may be effected, a rotatable member of the knitting head, a drum rotatable in synchronism with said member, said drum having a series of readily removable strips extending lengthwise the drum, each strip having a relatively large number of formations to control the functioning or non-functioning of the needle cooperating elements at the knitting head, and means to move said drum axially so as to present other formations of the strips for the purpose stated.

15. In a circular, independent needle, knitting machine having at the knitting head needle cooperating elements whereby stitch structural variation may be effected, a rotatable member of the knitting head, a drum rotatable in synchronism with said member, said drum being composed of a plurality of sections, each having a series of formations which control the functioning or non-functioning of needle cooperating elements at the knitting head, and means for shifting a section of the drum without shifting another section thereof, whereby the shifting of a section effects the presentation of other formations thereof, and whereby the non-shifted section or sections continues to function with respect to its formations.

16. In a circular, independent needle knitting machine having at the knitting head needle cooperating elements whereby stitch structural variation may be effected, a rotatable member of the knitting head, a drum rotatable in synchronism with said member, said drum being composed of a series of separate sections, each having strips provided with formations which control the functioning or non-functioning of needle cooperating elements at the knitting head, and means to shift less than all the sections at a time whereby one section may, as to its strips, be functioning upon elements of the knitting head while another section is being shifted.

17. In a circular, independent needle, knitting machine having at the knitting head needle cooperating elements whereby stitch structural variation may be effected, a rotatable member of the knitting head, a drum rotatable in synchronism with said member, said drum having a plurality of individually shiftable sections separated along lines lengthwise the drum, each section having its own formations to function with respect to the needle cooperating elements of the knitting head.

18. In a circular, independent needle, knitting machine having at the knitting head needle cooperating elements whereby stitch structural variations may be effected, a rotatable member of the knitting head, a drum rotatable in synchronism with said member, said drum having a plurality of sections separated along lines lengthwise the drum, each section having its own formations to function

with respect to the needle cooperating elements of the knitting head, and means to shift a section of the drum without at the same time shifting another section thereof, whereby an unshifted section continues to function by its formations with respect to the needle cooperating elements of the knitting head.

19. In a circular, independent needle, knitting machine having at the knitting head needle cooperating elements whereby stitch variation may be effected, a rotatable member of the knitting head, a drum rotatable in synchronism with said member, means to rotate said drum and without interrupting the said rotation to shift a portion of the surface of the drum with respect to other parts of the surface, whereby formations on the non-shifted portion may function with said needle cooperating elements while formations on the shifting portion are being shifted.

20. In a circular, independent needle, knitting machine having at the knitting head needle cooperating elements whereby stitch structural variation may be effected, a rotatable member of the knitting head, a drum rotatable in synchronism with said member, said drum being provided with a series of formations, whereby the functioning or non-functioning of needle cooperating elements at the knitting head is controlled, a rotatable member having jack-like instrumentalities adapted to be moved by said formations, said instrumentalities according to their selection by the drum being adapted to present themselves to elements of the knitting head and to control the movements thereof.

21. In a circular, independent needle knitting machine having at the knitting head needle coperating elements whereby stitch structural variation may be effected, a rotatable member of the knitting head, a drum rotatable in synchronism with said member, said drum being provided with a series of formations, whereby the functioning or non-functioning of needle cooperating elements at the knitting head is controlled, a rotatable member having jack-like instrumentalities adapted to be moved by the said formations into temporarily non-functioning position, leaving the other jack-like instrumentalities to present themselves to elements of the knitting head to move the same.

22. In a circular, independent needle, knitting machine having at the knitting head needle cooperating elements whereby stitch structural variation may be effected, a rotatable member of the knitting head, a drum rotatable in synchronism with said member, said drum being provided with a series of formations, whereby the functioning or non-functioning of needle cooperating elements at the knitting head is controlled, a rotatable member having jack-like instrumentalities adapted to be moved by the said formations into temporarily non-functioning position, leaving the other jack-like instrumentalities to present themselves to elements of the knitting head to move the same, and means axially to move the said drum so that different formations thereon may be presented to the said jack-like instrumentalities.

23. In a circular, independent needle, knitting machine having at the knitting head needle cooperating elements whereby stitch structural variation may be effected, a rotatable member of the knitting head, a drum rotatable in synchronism with said member, said drum being provided with a series of formations, whereby the functioning or non-functioning of needle cooperating elements at the knitting head is controlled, a rotatable member having jack-like instrumentalities adapted to be moved by the said formations into temporarily non-functioning position, leaving the other jack-like instrumentalities to present themselves to elements of the knitting head to move the same, and means axially to move the said drum so that different formations thereon may be presented to the said jack-like instrumentalities, said drum being composed of a series of separate sections, each having its own formations.

24. In a circular, independent needle, knitting machine having at the knitting head needle cooperating elements for effecting normal and reverse plating, a member rotatable in synchronism with the rotatable part of the knitting head, said member having a series of movable jack-like elements provided with butt like parts and having a plurality of pathways for the reception of said butt like parts, and a selective member to act upon said jacks so as to control the functioning thereof.

25. In a circular, independent needle, knitting machine having at the knitting head, needle cooperating elements for effecting normal and reverse plating, a member rotatable in synchronism with the rotatable part of the knitting head, said member having a series of movable jack-like elements provided with butt like parts and having a plurality of pathways for the reception of said butt like parts, a jacquard member having formations to cause the sliding of said jacks of the rotatable member, and means to cause projection of all the jacks of said member for presentation to the jacquard member.

26. In a circular, independent needle, knitting machine having at the knitting head, needle cooperating elements for effecting normal and reverse plating, a member rotatable in synchronism with the rotatable part of the knitting head, said member having a series of lengthwise slidable jacks adapted to cooperate with the needle cooper-

ating elements, a jacquard drum having formations to act upon said jacks and to control the sliding thereof.

27. In a circular, independent needle, knitting machine having at the knitting head, needle cooperating elements for effecting stitch structural variation, a member rotatable in synchronism with the rotatable part of the knitting head, said member having a series of movable jack like elements provided with butt like parts and having a plurality of pathways for the reception of said butt like parts, a jacquard drum having a series of formations and means to move said drum so as to present different series of formations to the said jacks, and whereby desired jacks will be pushed lengthwise and said pushed jacks do not act in their pushed position upon the needle cooperating elements at the knitting head.

28. In a circular, independent needle, knitting machine having at the knitting head, needle cooperating elements for effecting stitch structural variation, a member rotatable in synchronism with the rotatable part of the knitting head, said member having a series of movable jack like elements provided with butt like parts and having a plurality of pathways for the reception of said butt like parts, and means for rendering said rotatable member inactive to function during the knitting of fashioning work.

29. In a circular, independent needle, knitting machine having at the knitting head, needle cooperating elements for effecting stitch structural variation, and a jacquard drum having a series of formations to control the functioning or non-functioning of said needle cooperating elements in different courses, said drum having a shaft 35 provided with separate, non-communicating notches 42 corresponding to respective courses, and means cooperating with said notches for positioning said drum in different positions in an axial direction.

30. In a circular, independent needle, knitting machine having at the knitting head, needle operating elements for effecting stitch structural variation, and a jacquard drum having a series of formations to control the functioning or non-functioning of said needle cooperating elements in different courses, said drum having a shaft 35 provided with notches 42 corresponding to respective courses, said drum being composed of a series of sections each having a jaw to engage the said notches.

31. In a circular, independent needle, knitting machine having at the knitting head, needle cooperating elements for effecting stitch structural variation, and a jacquard drum having a series of formations to control the functioning or non-functioning of said needle cooperating elements in different courses, said drum having a shaft 35 provided with notches 42 corresponding to respective courses, said drum having a series of segments each provided with its own formations, and means to guide each segment along the shaft 35.

32. A jacquard drum for controlling the functioning of needle cooperating elements at the knitting head, provided with jack selector strips extending lengthwise the drum, each strip having one or more formations thereon to determine and control the functioning or non-functioning of needle cooperating elements at the knitting head, a rotatable needle cylinder having sinker-like instrumentalities to engage two yarns fed in a plating relation and to change the plating relation of said threads, and means between and operatively related to said jacquard drum and said sinker-like instrumentalities for acting upon said sinker instrumentalities, whereby changes from normal to reverse plating are effected in accordance with the jack selector strips.

33. A jacquard drum to control the functioning or non-functioning of needle cooperating elements at the knitting head, provided with a series of sections each having its own formations which cooperate in the functioning of said elements, means to rotate said drum, jaw like devices to hold each section, and means to cause the release of the jaw devices for each section during rotation of the jacquard drum for the purpose stated.

34. In a circular, independent needle, knitting machine having at the knitting head needle cooperating elements for effecting plating and reverse plating upon the needles, a rotatable member of the knitting head, a drum rotatable in synchronism with said member, said drum having successive circumferentially extending series of formations to function in the control of the said needle cooperating elements, thereby to effect plating and reverse plating, and means to move said drum axially so as to present different series of said formations for controlling the functioning of said elements, said formations all being provided upon readily removable strips extending lengthwise the said drum.

In testimony whereof, we have signed our names to this specification.

JOHN LAWSON.
ROBERT H. LAWSON.