

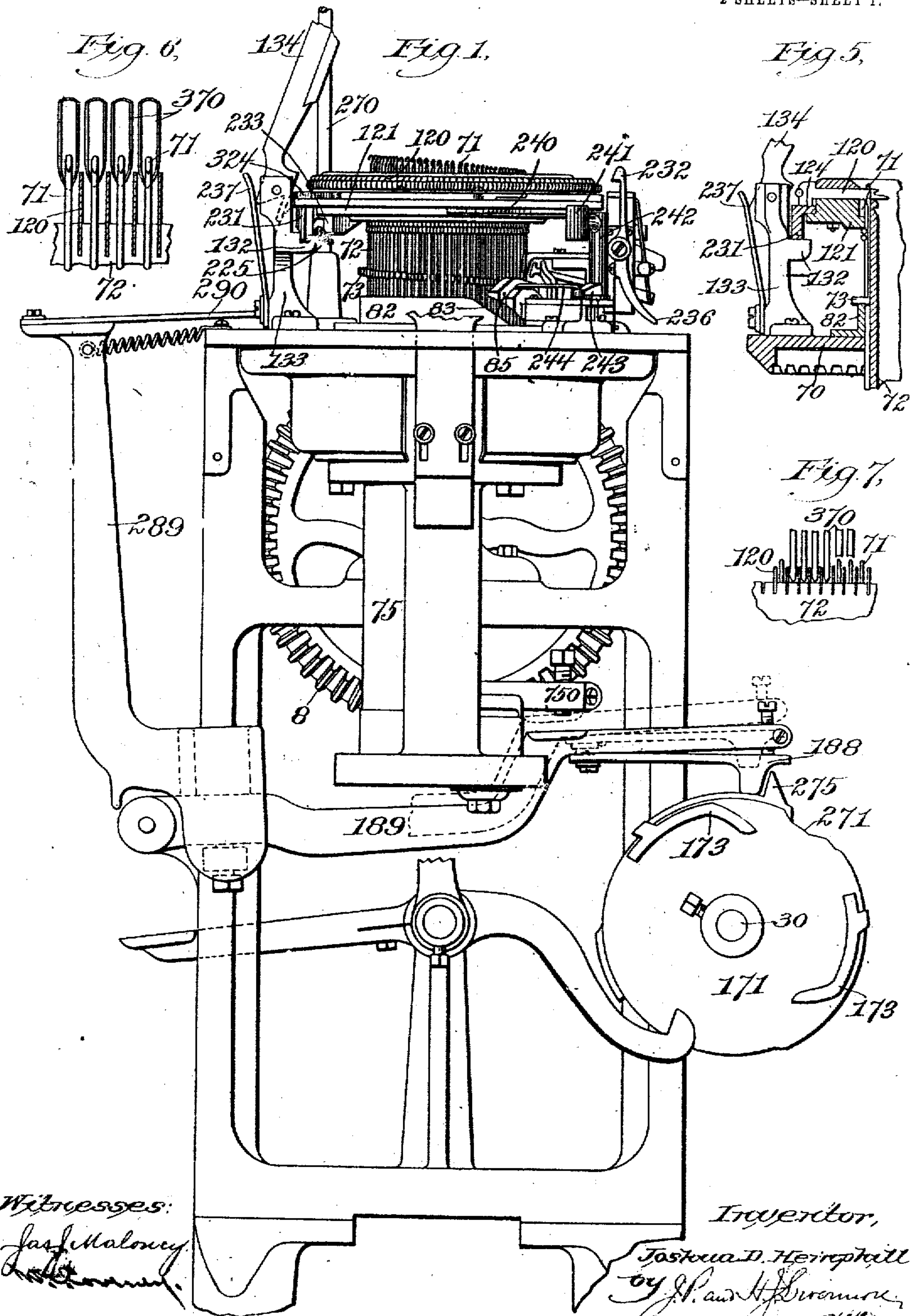
No. 827,367.

PATENTED JULY 31, 1906.

J. D. HEMPHILL.  
KNITTING MACHINE.

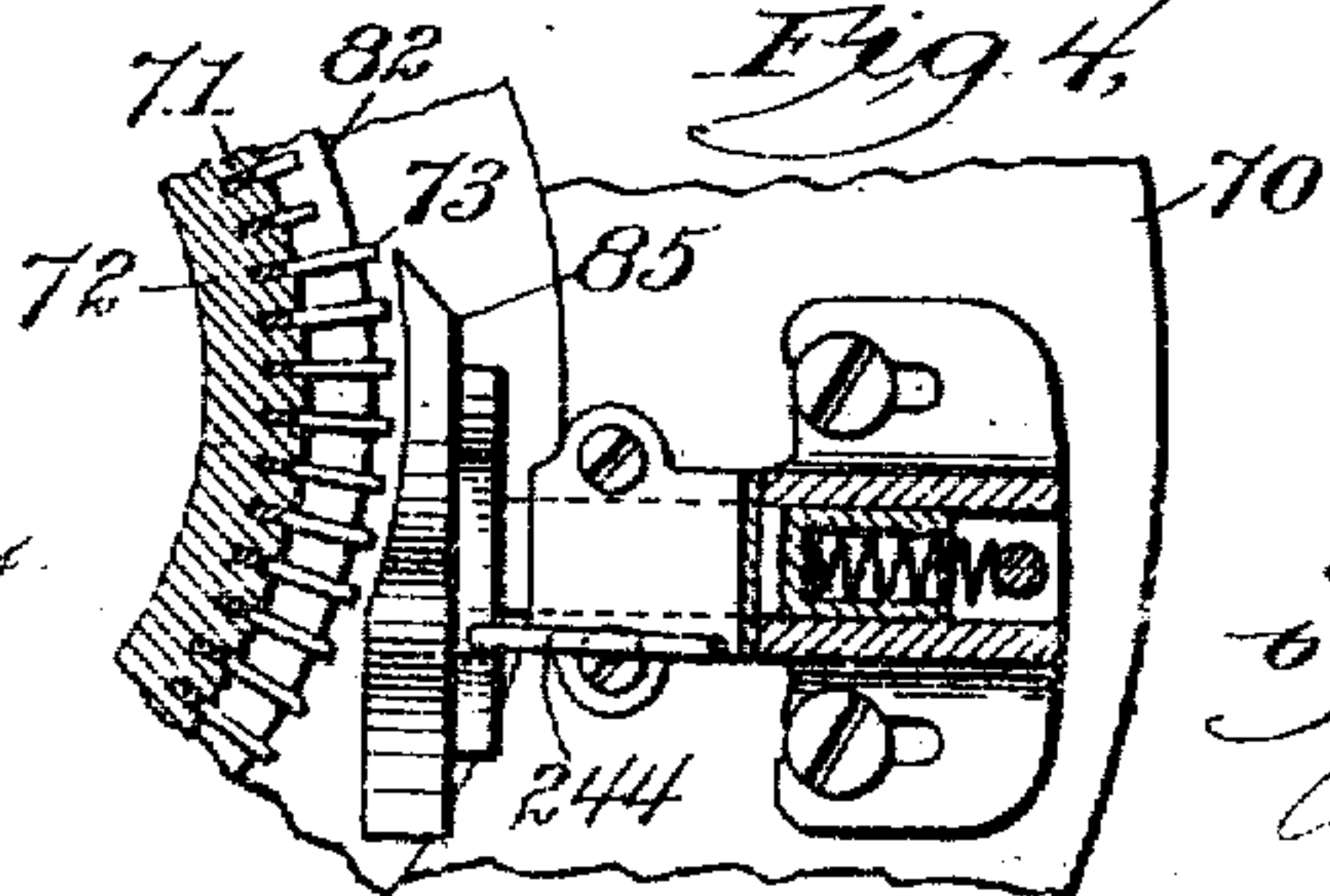
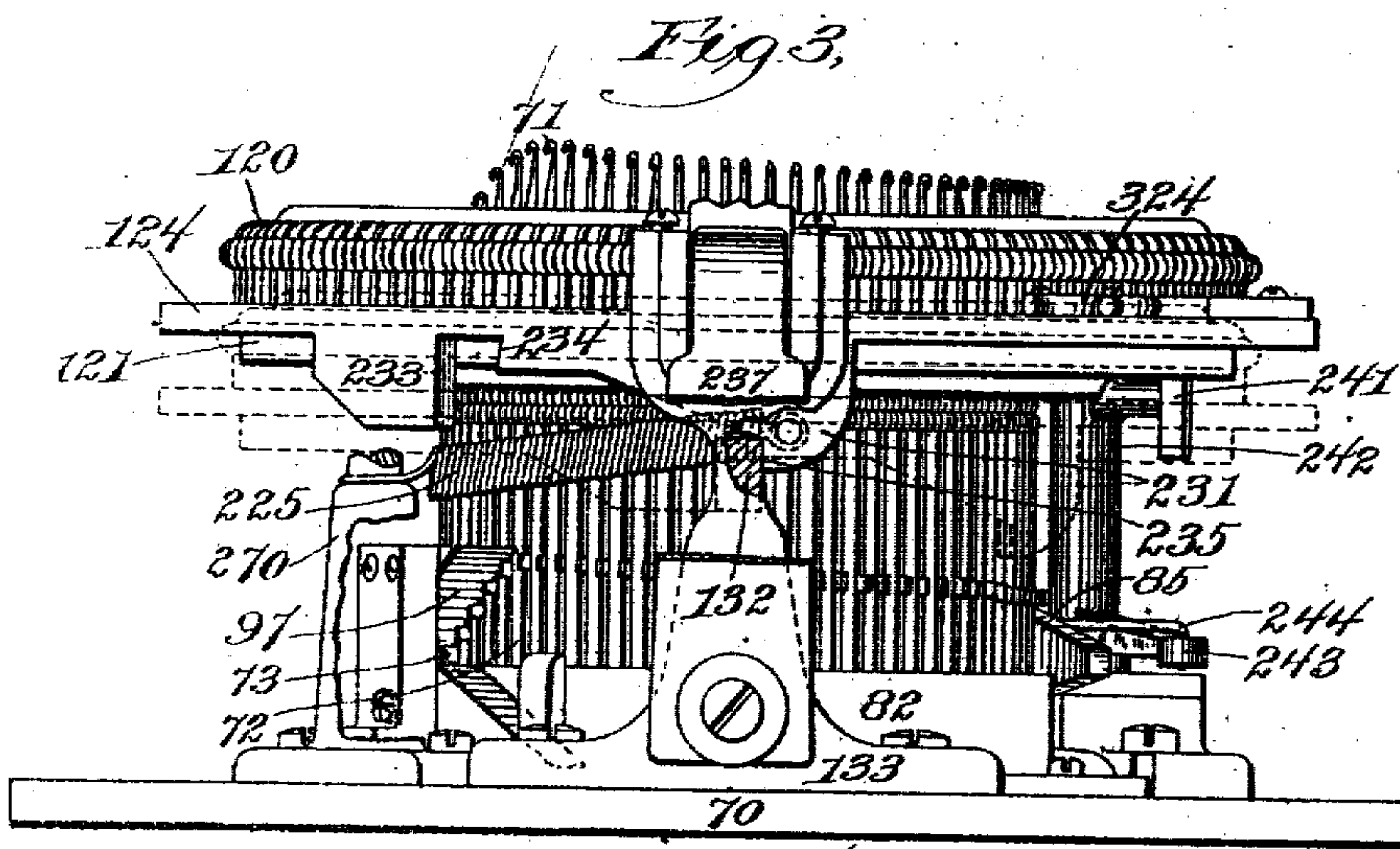
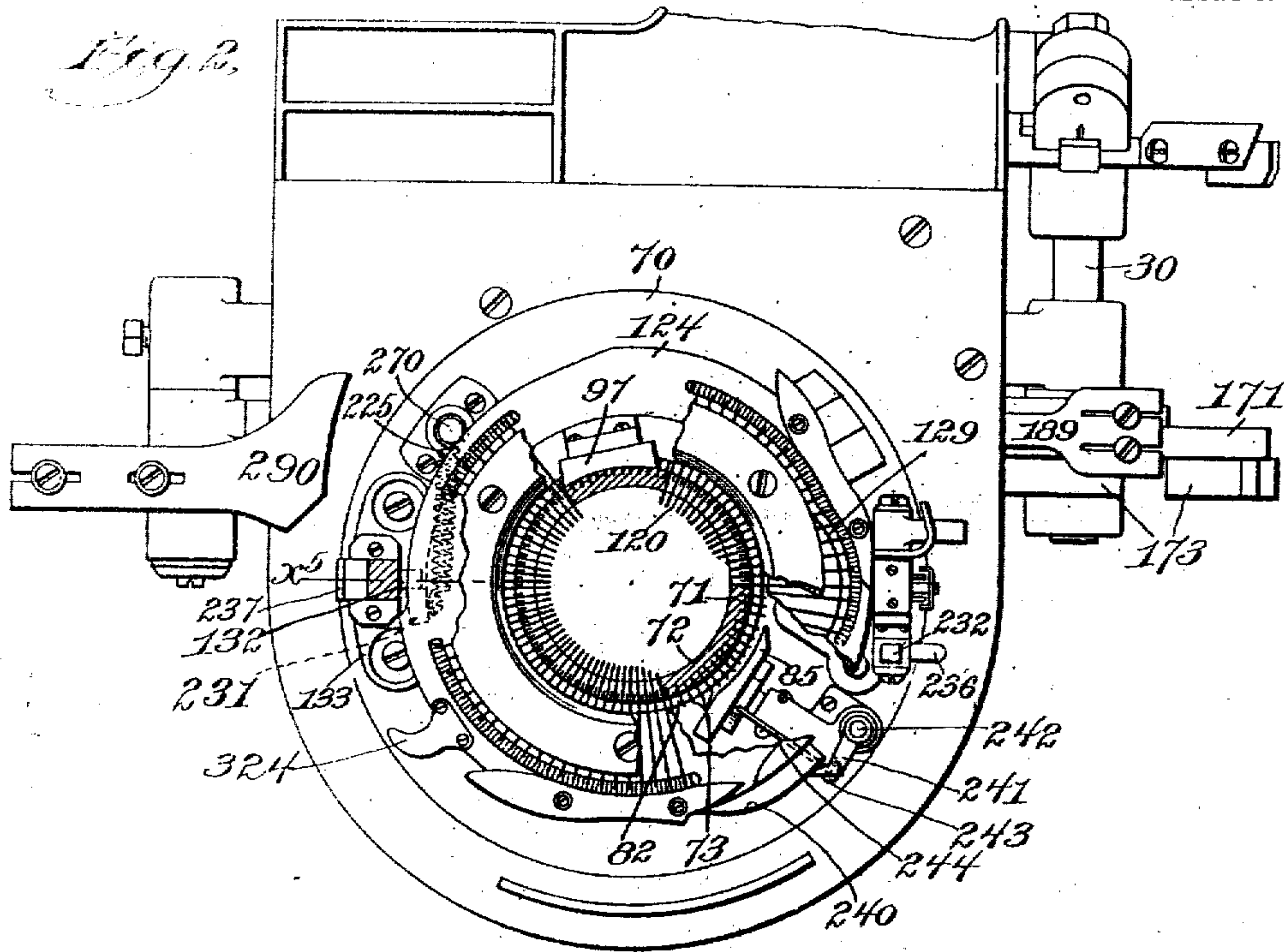
APPLICATION FILED JUNE 30, 1905.

2 SHEETS—SHEET 1.



J. D. HEMPHILL.  
KNITTING MACHINE.  
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2 SHEETS—SHEET 2.



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# UNITED STATES PATENT OFFICE.

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## KNITTING-MACHINE.

No. 827,867.

Specification of Letters Patent.

Patented July 31, 1906.

Application filed June 30, 1905. Serial No. 267,818.

*To all whom it may concern:*

Be it known that I, JOSHUA D. HEMPHILL, a citizen of the United States, residing in Pawtucket, county of Providence, and State of Rhode Island, have invented an Improvement in Knitting-Machines, of which the following description, in connection with the accompanying drawings, is a specification, like figures on the drawings representing like parts.

This invention is embodied in a knitting-machine of the kind commonly employed in knitting hosiery, and relates especially to appliances for facilitating the operations involved in transferring a cuff of ribbed material to the needles which operate to make the plain-knit portion of the hosiery.

For convenience of illustration the invention is shown applied to a machine substantially such as is shown in my prior patent, No 629,503, dated July 25, 1899, although, obviously, the essential features of the invention are applicable to other machines of similar character by the proper modifications in details of the construction of the appliances to cause them to cooperate properly with the mechanism of the machines to which they are applied.

The machine shown in my former patent is of the kind known as a "full-automatic" machine, in which the narrowing and widening is performed at the heel and toe by changing from round-and-round to reciprocating knitting, and throwing a series of needles out of operation simultaneously, and thereafter throwing additional needles out of operation one at a time for the narrowing, and returning the said needles into operation in the widening, and thereafter bringing the entire set of needles into operation for the circular knitting.

The requisite changes in operation of the knitting instrumentalities are produced by controlling-cams on a change cam-shaft, which is advanced intermittently at the proper times and by suitable mechanism controls the driving mechanism and needle-operating instrumentalities in the machine, effecting the changes in movement of the knitting-cams from circular to reciprocating and the reverse at the proper times and also the changes in the knitting-cams and special needle-operating devices concerned in the

narrowing and widening operations at the proper times and causing the machine to be automatically stopped or disconnected from the driving power when a stocking is completed. The operator therefore has only to apply a ribbed cuff to the needles and to start the machine, after which it will run without further attention until another stocking is completed.

As set forth in my former patent, the operation of transferring a ribbed cuff to the circular machine involves certain preparatory operations, which in the machine of my former patent include the rotation of the main shaft and cam-cylinder by hand after the machine is stopped or disconnected from the driving power. These operations also include the lifting of the latch-guard ring and yarn guide or guides connected therewith, so that the yarn will not be presented to the needle-hooks, after which the operator turns the cam-cylinder at least once around, which runs off the previously-knit stocking, the yarn having been broken between the stocking and yarn-guide either before or after the work is run off from the needles. The cam-cylinder is then properly turned by the operator to bring all of the needles to a common level to receive the transfer-ring, which is then applied and the cuff transferred therefrom to the needles, after which the latch-guard ring and yarn-guide are placed back in normal position and the machine started. In machines of this class the relation of the needle-cylinder to the knitting cams or surfaces controlling the needle-butts is such that when the needles are leveled by the proper operation of the cams their ends stand at a considerable height above the top of the needle-cylinder, and by reason of the flexibility of the needle-shanks the ends of the needles when thus elevated are commonly not spaced with exact uniformity. This renders it difficult to apply the transfer-ring properly, and it frequently happens that one or more of the quills of the transfer-ring fail to engage properly with the corresponding needles, which results in the dropping of the corresponding stitches when the cuff is drawn from the quills of the transfer-ring onto the needles. This involves a loss of time on the part of the operator in picking up the dropped stitches before the machine can be started and also



requires operators of considerable skill to attend the machines. These objections have heretofore been partially obviated by providing machines of this class with a device by which the needle-cylinder may be raised by a hand operation while the machine is not running and after the needle-butts have been disengaged from the draw-down or stitch cams which operate the needles in knitting and also by providing hand-operated means whereby the needles may be depressed substantially to the level of the top of the cylinder after the latter has been raised.

The present invention consists, mainly, in a mechanism operated as a part of the machine by merely turning the main or power-driven shaft to raise the needle-cylinder after the stocking has been completed and before the needles are leveled to receive the transfer-ring and also to disengage the draw-down cam from the needle-butts when the cylinder is thus raised, so that the needle-butts may thereafter be leveled by the action of the cams at the usual position relative to the cams, but with their hooked ends approximately at the level of the top of the now abnormally elevated needle-cylinder. The hooked ends of the needles are thus uniformly spaced by the effect of the grooves of the needle-cylinder and lie between the usual web-holders, the result being that the transfer-ring when applied will have its quills registered accurately with the needles, the points of the quills entering between the web-holders or "sinkers," as they are sometimes called, with each quill embracing the hook end of the needle lying between the two adjacent web-holders.

The mechanism forming the subject of the present invention also comprises means for supporting the needle-cylinder in its elevated position after the machine has stopped running, which supporting means are adapted to be manipulated by the operator to lower the needle-cylinder to normal working position after the transfer-ring has been applied so that the machine may be started on the knitting of the next stocking directly after the ribbed cuff has been transferred to the needles.

Figure 1 is a side elevation of a sufficient portion of a knitting-machine to illustrate the application of the present invention thereto, the needle-cylinder being shown in the elevated position resulting from the action of the appliances forming the subject of the present invention. Fig. 2 is a plan view of a sufficient portion of the machine to illustrate the present invention, parts being broken away to show parts located below. Fig. 3 is a side elevation of the upper part of the needle-cylinder and the cam-carrier and appurtenances thereto involved in the present invention. Fig. 4 is a sectional plan showing the knitting-cam disengaged from

the needle-butts to admit of the elevation of the needle-cylinder without drawing and retaining a portion of the needles below the desired level. Fig. 5 is a sectional detail on line x<sup>5</sup> of Fig. 2, and Figs. 6 and 7 are details illustrating the operation of applying the quills of the transfer-ring to the needles in the raised needle-cylinder.

For an understanding of a complete knitting-machine to which the improvements forming the subject of the present invention are applicable reference may be had to my prior patent, No. 629,503, dated July 25, 1899, the parts of which necessary for an understanding of the present invention are shown in connection with the appliances forming the subject of the present invention and are marked with the same reference characters as employed in said Patent No. 629,503.

The main instrumentalities of the knitting-machine to which the present invention may be applied may be such as commonly employed in circular-knitting machines for knitting hosiery and in the example here shown comprise a needle-cylinder and a knitting-cam carrier, which is provided with suitable cams for acting upon the butts of the needles, driven with a continuous round-and-round movement or with a reciprocating movement when required by gearing from a power-driven shaft, one of the gear-wheels of which is shown at 8, Fig. 1.

The changes in the knitting operation required for the production of a stocking are produced by cams upon a cam-shaft, hereinafter called the "change" cam-shaft, which is advanced from time to time as the knitting proceeds and when the heel of the stocking is reached shifts the gearing so that the cam-carrier is reciprocated and at the same time controls the knitting-cams so that approximately one-half of the needles are thrown out of operation and additional needles are thrown out one at a time as the reciprocating knitting proceeds, after which a further change produced by one of the cams on the cam-wheel 171, carried by the shaft 30, causes additional needles to be thrown into operation one at a time in widening, after which a further change is made by an advance movement of the cam-shaft 30, by which the parts are brought into condition to proceed with the round-and-round knitting for the tubular foot of the stocking, and when the toe is reached a similar series of operations is performed to those performed at the heel, and when round-and-round knitting has been resumed for a few courses the stocking is completed.

In the machine of my former patent, taken as an illustration of a machine to which the present invention may be applied, two stitch-drawing knitting-cams are employed, one of which operates in the round-and-round knitting and in the strokes of the reciprocating



knitting in the same direction as the round-and-round knitting, while the other operates in the reverse strokes of the reciprocating knitting. Each of these cams is so constructed as to be thrown out of operative engagement with the needle-butts in the movement of the cam-carrier in the opposite direction to that in which said cam operates to depress the needles in the loop-drawing operation.

The entire cycle of operations of the knitting instrumentalities necessary to knit a stocking from the ribbed cuff applied to the needles at the beginning of the operation to the end of the toe are produced in response to a single full rotation of the change-cam shaft 30, and the appliances forming the subject of the present invention are called into operation about at the close of the said cycle and, as herein shown, by a cam projection 275 on the periphery of the cam-disk 171, which projection acts upon the lever 189, which was employed in the machine of my former patent to raise and lower the needle-cylinder slightly during the knitting operation to vary the length of the loops drawn by the needles, and thereby fashion the tubular portions made in the round-and-round knitting. The said cam projection 275 acts upon the lever 189 in an advance movement of the cam-shaft 30, which takes place after round-and-round knitting has been resumed at the completion of the stocking, said projection 275 raising the lever 189 to the dotted-line position and acting upon the projection 750, connected with the web-guard 75, to which the needle-cylinder 72 is affixed, the result being that the needle-cylinder is elevated by the action of the cam projection 275 to a level above any which it occupies when the knitting is going on and to such level relative to the knitting-cam carrier and cams that the hooks of the needles are approximately at the level of the web-holders 120, as shown in Figs. 6 and 7, when the needle-butts are on the top of the ledge pertaining to the cam-carrier, which ledge determines the upper working level of the needles during the knitting operation—that is, in the knitting operation when the needle-cylinder is at its normal level the needles rest with their butts upon the ring 82 in the intervals between the downward loop-drawing operations of the needles produced by the stitch-cams 85 and when the butts are on the ring 82, during the knitting operation, the hook ends and latches of the needles are projected entirely above the top of the needle-cylinder and the web-holders 120 and are in the position to take the yarn for the knitting operation which is produced in the round-and-round knitting by the draw-down or stitch cam 85, beneath which the needle-butts pass when the needles are descending to draw the loops, after which the needle-butts are raised by the inclined

surface 83 at the end of the ledge 82. The cam projection 275 raises the lever 189 and needle-cylinder temporarily as the said cam projection passes the bearing-block 188 of the lever 189 and thereafter permits the lever 189 to drop back to normal working position, as shown in full lines, Fig. 1; so that the needle-cylinder may be subsequently lowered to working position in order that the machine may begin the knitting operation upon the next stocking after a ribbed cuff has been transferred to the needles. In order that the needle-cylinder may remain in elevated position for the transfer operation after its lever 189 has thus dropped back, an additional support for the needle-cylinder is provided; a suitable and convenient construction of which is best shown in Fig. 3. The said needle-cylinder support comprises a cam or projection 231, connected with the web-holder-actuating cam-ring 124, mounted in the usual relation to the web-holder bed 121, rigidly affixed to the top of the needle-cylinder. The said web-holder cam-ring 124 accordingly is so connected with the needle-cylinder as to have no independent vertical movement, (see Fig. 5,) but has a rotary movement about the web-holder bed 121 on the needle-cylinder, being actuated in the said rotary movement by a projection 132 on the upright 133, supported on the knitting-cam carrier 70, said projection normally engaging between the two walls 233 234 of a notch formed at the end of the cam projection 231 when the needle-cylinder is at normal working level, as indicated in dotted lines, Fig. 3.

By reason of the connection between the needle-cylinder and web-holder cam-ring 124, which prevents independent movement in a vertical direction, it is obvious that the said web-holder cam-ring will be raised when the needle-cylinder is raised and, conversely, if the web-holder cam-ring should be raised or should be held up or supported after being raised it will also support the needle-cylinder in the corresponding raised position. The lifting of the needle-cylinder by the action of the cam projection 275, as before described, will, near the beginning of the said lifting movement, disengage the shoulder 234 of the cam projection at the lower side of the web-holder cam-ring from its actuating projection 132, which is connected with the knitting cam-carrier and has no vertical movement. This disengagement of the shoulder 234 permits the web-holder cam-ring 124 to move around the needle-cylinder independently of the knitting-cam carrier and relative to the rotation of the latter in the round-and-round knitting, and the said web-holder cam-ring is acted upon by a spring 225, connected with an upright 270, fixed to the knitting-cam carrier 70, said spring tending to turn



the web-holder cam-ring 124 relative to the knitting-cam ring 70 in a direction opposite to the rotation of the latter in the round-and-round knitting. The cam projection 231 from the web-holder cam-ring 124 has an inclined portion between the shoulder 234, by which said ring is driven in the knitting operation, and a shoulder 235, which by engagement with the projection 132 limits the movement of the web-holder cam-ring relative to the knitting-cam ring in the direction reverse to the rotation of the latter in circular knitting. The said inclined surface engages with the projection 132 during the rising of the needle-cylinder and web-holder cam-ring produced by the cam projection 275, as before described, the said inclined surface permitting the web-holder cam-ring 124 to turn with reference to the knitting-cam carrier in proportion as the needle-cylinder rises, and by the time that the needle-cylinder has attained its full elevation due to the cam projection 275 the web-holder cam-ring 124 has moved far enough to bring the shoulder 235 in engagement with the projection 132, which prevents further movement in this direction of the web-holder cam-ring relative to the knitting-cam carrier. The portion of the cam projection 231 adjacent to the shoulder 235 now rests upon the top of the projection 132 of the cam-carrier, and thus sustains the web-holder cam-ring and the needle-cylinder in the elevated position after the cam projection 275 that elevated them has passed the block 188 on the lever 189 and permitted the latter to drop to normal working position. In order that the needles may not be drawn down into the grooves of the needle-cylinder during this operation of raising the needle-cylinder the stitch-cam 85 which operates in the circular knitting is disengaged from the needle-butts automatically, this disengagement being effected by a cam projection 240 (see Fig. 2) on the periphery of the web-holder cam-ring 124, which cam 240 engages with an arm 241 on a rock-shaft 242, supported on the cam-carrier and provided with another arm 243, connected with the knitting-cam 85 by a suitable link 244. By these connections, the specific construction of which is of course immaterial, the movement of the web-holder cam-ring 124 relative to the knitting-cam carrier which takes place when the shoulder 234 is disengaged from the projection 132 at the beginning of the rise of the needle-cylinder causes the knitting-cam 85 to be moved radially outward far enough to clear the butts 73 of all the needles, as shown in Fig. 4, the result being that the needles are free to rise with the needle-cylinder as the latter rises in response to the action of the cam projection 275. After the needle-cylinder has been raised, as above described, it will be retained in elevated position by the web-holder cam-ring 124 as long as that remains

in the position relative to its actuating projection 132 on the knitting-cam carrier (shown in full lines in Fig. 3) whether the machine continues running or is stopped, and inasmuch as it must be stopped before the operator can apply the transferrer with the ribbed cuff to the needles it may be stopped automatically by any suitable mechanism—such, for example, as that shown in Patent No. 629,503—in response to the movement of the change cam-shaft 30 that carries the projection 275 past the block 188 on the lever 189. The needles by reason of their frictional engagement with the grooves of the needle-cylinder will be elevated with the needle-cylinder when the latter is raised by the cam projection 275, and at the completion of the lifting of the needle-cylinder will be left in approximately the position indicated in Figs. 1 and 3. A further rotation of the cam-carrier, however, amounting to one full rotation after the needle-cylinder has been fully raised, will cause the cam 97 (see Fig. 3) to depress the needles relative to the needle-cylinder, until their butts are brought to the level of the top of the ring 82, the operation on the needles being the same as that which takes place when the cam 97 restores the idle needles to working position after widening and narrowing in the regular knitting operation, and serving to bring the needles to a level in the raised cylinder with their hooked ends approximately at the level of the tops of the web-holders 120, so that the points of the quills 370 of the transfer-ring may enter between the web-holders in the operation of applying the quills to the needles, as shown in Fig. 6, the result being that the quills of the transfer-ring when applied rest on the top of the needle-cylinder properly engaged with the needles, as shown in Fig. 7, without especial care on the part of the operator. In Fig. 6 the parts are enlarged and are viewed looking toward the outside surface of the needle-cylinder, while in Fig. 7 the parts are of about usual size and represented as seen looking toward the inside surface of the needle-cylinder. This leveling of the needles at approximately the level of the web-holders by the action of the cam 97 may be conveniently performed by turning the main shaft after the machine has been stopped, automatically or otherwise, as it is commonly necessary for the operator to turn the cam-carrier by turning the main driving-shaft by hand to bring the cam-carrier and appurtenances mounted thereon, such as the yarn-guide, to convenient position for applying the transfer-ring, and the same operation which locates the cam-carrier properly for transfer also will serve to bring the needles to the level of the web-holders, the same as in the machine of my former patent where the needles were leveled with their hooks at considerable height above the needle-cylinder



by the operator turning the main shaft and cam-carrier by hand after the machine is stopped. After the transfer-ring has been applied to the needles and located relative thereto by engagement with the web-holders, as has been described, it is necessary to lower the needle-cylinder in order that the machine may be in proper condition to resume knitting as soon as the cuff has been pulled from the quills of the transfer-ring onto the needles, and the lowering is commonly performed before the loops have been pulled from the transfer-quills onto the needles, and said lowering of the needle-cylinder thus effects a deeper or fuller overlap or engagement between the quills and loopers. The needle-cylinder is thus lowered, and the parts are all restored to proper position to resume circular knitting merely by turning the web-holder cam-ring 124 relative to the knitting-cam carrier until the notch between the shoulders 233 234 of said ring comes into coincidence with and said shoulders are engaged by the projection 132 of the cam-carrier. The web-holder cam-ring 124 is provided with a handle or finger-piece 324 to facilitate this movement, which is performed by the operator merely turning the web-holder cam-ring in opposition to the force of the spring 225 until the shoulder 234 drops over the projection 132 of the cam-carrier. The needle-cylinder is permitted to descend in this movement as the incline of the cam 231 passes over the projection 132, the said needle-cylinder resuming its normal working level as soon as the projection 132 enters the notch or space between the shoulders 233 234.

In the machine of my former patent, as is common in machines of this class having two knitting-cams for the reciprocating knitting, the web-holder cam-ring is driven by the knitting-cam carrier by a lost-motion connection, such that the cam-surface of the web-holder cam-ring that moves the web-holders radially outward is in the proper position relative to the needles which are knitting, whichever direction the cam-carrier may be turning. In the present machine, however, there is substantially no lost motion between the knitting-cam carrier and the web-holder cam-ring during the knitting operation; but the web-holder cam-ring is provided with two cam-surfaces 129, one only of which is shown in Fig. 2, one properly located for cooperation of the web-holders with the needles in the movement of the cam-carrier in one direction and the other for such cooperation in the movement of the cam-carrier in the opposite direction in reciprocating knitting. One or the other of said cams consequently produces a movement of the web-holders which may be regarded as an idle movement, as it is unnecessary for the proper cooperation of the web-holders with the needles; but this idle move-

ment of the web-holders does no harm, and this construction obviates the necessity of the lost motion between the knitting-cam carrier and the web-holding cam-ring, and thus renders the movement of the web-holder cam-ring relative to the knitting-cam available for effecting the support of the needle-cylinder and the lowering of the needle-cylinder to operative position, as has been hereinbefore described. The slight vertical movement given to the needle-cylinder during the knitting operation for the purpose of controlling the length of the stitches is insufficient to disengage the projection 132 from the shoulder 234, and the notch between the shoulders 233 234 is deep enough to accommodate all of the vertical movement of the needle-cylinder required for controlling the length of stitch.

The construction herein shown, wherein the web-holder cam-ring is employed to support the needle-cylinder when elevated and also to carry and operate the cam which throws the stitch-cam out of operation when the needle-cylinder is elevated, is convenient and effective for the purpose intended; but the invention is not limited to this specific construction, as it is obvious that various constructions might be employed as an equivalent for the construction herein shown as an element of the means for insuring the elevation of the needle-cylinder for the transfer operation.

It is necessary before the machine is supplied with a cuff to begin knitting a new stocking that the finished stocking should be run off from the needles. This may be done in any suitable or usual way before the appliances for raising the needle-cylinder forming the subject of the present invention come into action. For example, the machine might be automatically stopped after the completion of the previously-knit stocking and at a point one or more rotations of the main driving-shaft in advance of the one which turns the change cam-shaft 30, so as to cause the projection 275 to raise the needle-cylinder. Then the operator might break the yarn in the usual manner and start the machine either by power or by turning the main shaft by hand, and in the next following rotation of the knitting-cam carrier the previously-knit work would be run off the needles, after which in the further rotation of the main shaft the change cam-shaft 30 would be advanced and cause the projection 275 to raise the needle-cylinder, as hereinbefore described, all of the operations other than the breaking of the yarn required for running off the work raising the needle-cylinder and leveling the needles in the raised cylinder preparatory to receiving the transfer-ring being performed automatically—that is, by the mechanism of the machine in response to the rotation of the main



driving-shaft. As herein shown, however, the machine is provided with appliances for running off the work when completed which form the subject of another application for Letters Patent, Serial No. 267,819, filed June 30, 1905, said appliances comprising a trip-cam 290, mounted on an arm 289, connected with the lever 189, said trip-cam 290 being caused to move radially toward the knitting-cam carrier in response to a depression 271 in the cam-disk 171, and when thus moved inward engaging the end 236 of a latch 232, mounted on the cam-carrier, which latch holds the needle-latch guard-ring 134 in working position while the knitting is going on. The said latch-guard ring is acted upon by a spring 237, which lifts the latch-guard ring when released by the tripping of the latch 232 by the trip-cam 290 far enough to carry the yarn passing through the yarn-guide connected with the latch-guard ring 134 out of reach of the needles which in going through their next knitting movement in the subsequent rotation of the cam-carrier cast off the loops of the last course of the finished stocking. This takes place in a revolution of the cam-carrier before the needle-cylinder is raised, and consequently before the knitting-cam 85 is withdrawn from position to act on the needles.

It has been deemed unnecessary to show in the present case the complete mechanism for actuating the cam-carrier and for advancing the change cam-shaft 30 and for stopping the machine at the end of a cycle of movements determined by the rotation of said cam-shaft, as such mechanism is well known in machines of this character and constitutes no part of the present invention and a concrete example of such mechanism is fully shown in my prior patent, No. 629,503, to which reference may be had for a knowledge of such mechanism, if desired.

The invention herein described is applicable to various machines in which plain knit-work is knit to ribbed work produced in another machine and transferred to the needles of the machine in which the plain knitting is performed.

I claim—

1. In a knitting-machine, the combination of a main driving-shaft, needle-cylinder, and knitting-cams with mechanism actuated from the said main shaft for raising the needle-cylinder relative to the knitting-cams above working position; and a support for retaining the needle-cylinder in elevated position after the cylinder-raising means have ceased to act, substantially as and for the purpose described.

2. A knitting-machine comprising a main driving-shaft, needle-cylinder and knitting-

cams, combined with means actuated by said driving-shaft for raising the needle-cylinder above its working level, and means for disengaging the needle-depressing switch-cam from the needle-butts during the rise of the needle-cylinder, substantially as and for the purpose described.

3. The combination of the needle-cylinder and knitting-cam carrier of a knitting-machine with means for raising the needle-cylinder above working position; means for withdrawing the stitch-cam from engagement with the needle-butts; and means for supporting the said cylinder in raised position after the cylinder-raising means have ceased to act.

4. A knitting-machine comprising a main driving-shaft, a needle-cylinder, knitting-cams, and a change cam-shaft for controlling changes in the knitting operation actuated from said main shaft, combined with means controlled by said change cam-shaft for raising the needle-cylinder above its working level, and means for supporting the needle-cylinder in lifted position after the cylinder-raising means have ceased to act, substantially as and for the purpose described.

5. A knitting-machine comprising a needle-cylinder and knitting-cam carrier; a web-holder bed and web-holder cam-ring operated by the knitting-cam carrier; and a change cam-shaft governing the changes in the knitting operation, combined with mechanism actuated by the change cam-shaft for raising the needle-cylinder relative to the cam-carrier above working position; and means connected with the web-holder cam-ring for supporting the raised needle-cylinder, and for withdrawing the stitch-cam from operative engagement with the needle-butts, substantially as and for the purpose described.

6. A knitting-machine comprising a needle-cylinder, a web-holder bed and a web-holder cam-ring mounted upon said needle-cylinder, and means for raising the needle-cylinder above its working level, and a knitting-cam carrier combined with means pertaining to said knitting-cam carrier for rotating said web-holder cam-ring in unison therewith during the knitting operation and adapted to permit independent rotary movement of said web-holder cam-ring when the needle-cylinder is raised above normal working position.

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

JOSHUA D. HEMPHILL.

Witnesses:

ALEX D. SALINGER,  
J. JEROME HAHN.