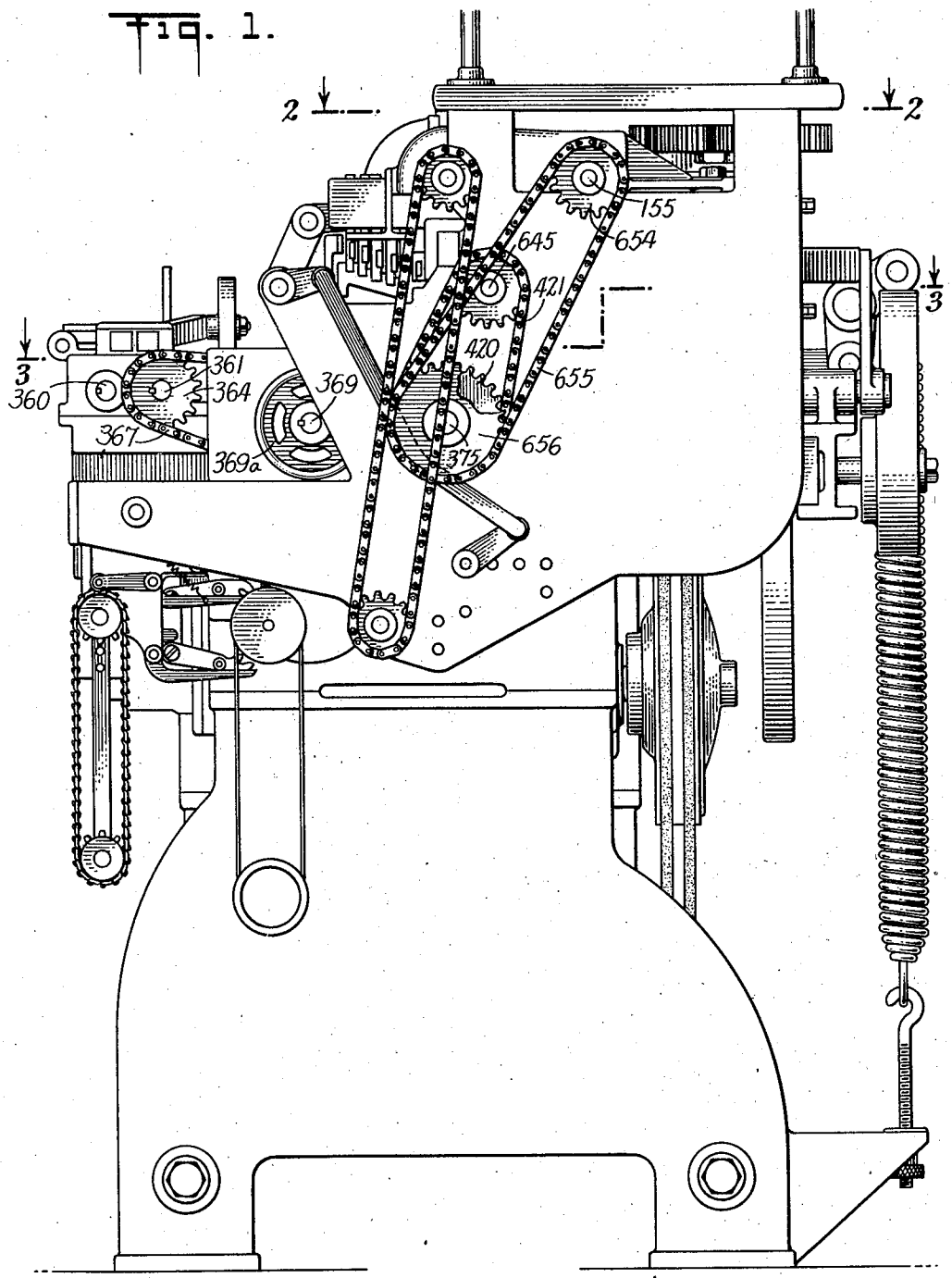
March 5, 1946. T. S. HAYHURST 2,395,819

KNITTING MACHINE

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Fig. 1.



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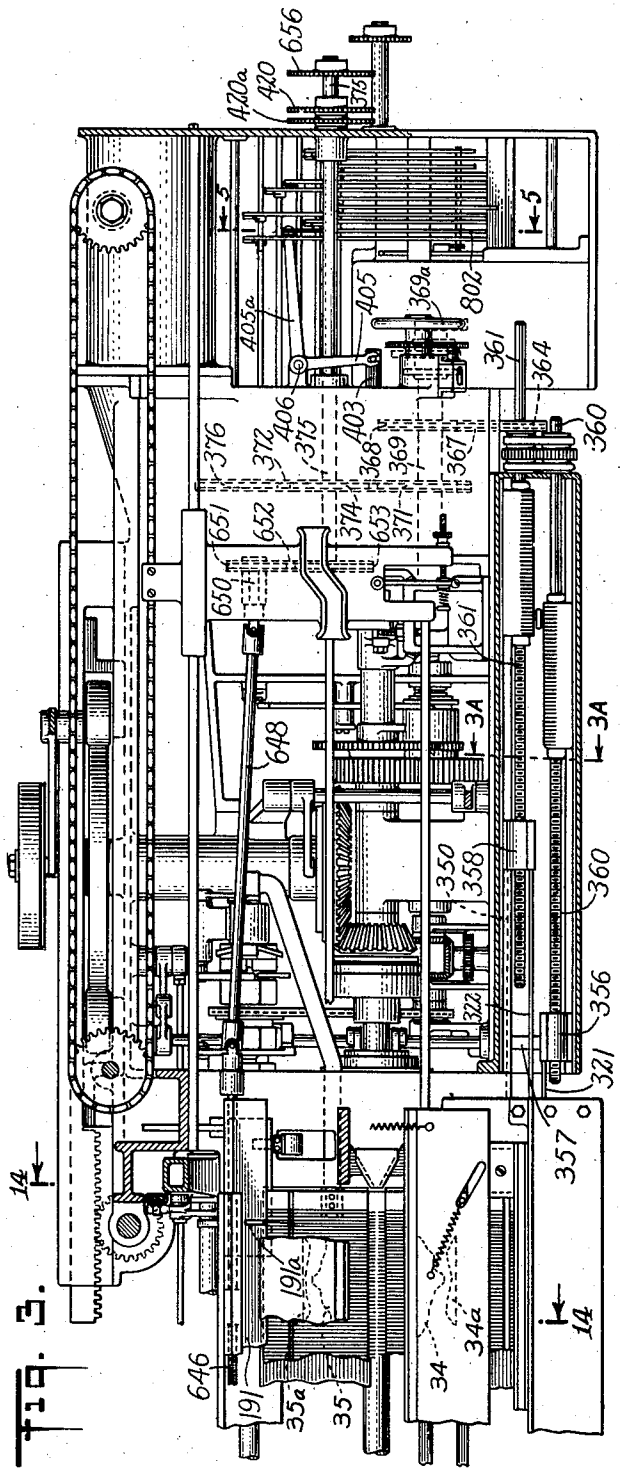


Fig. 3.

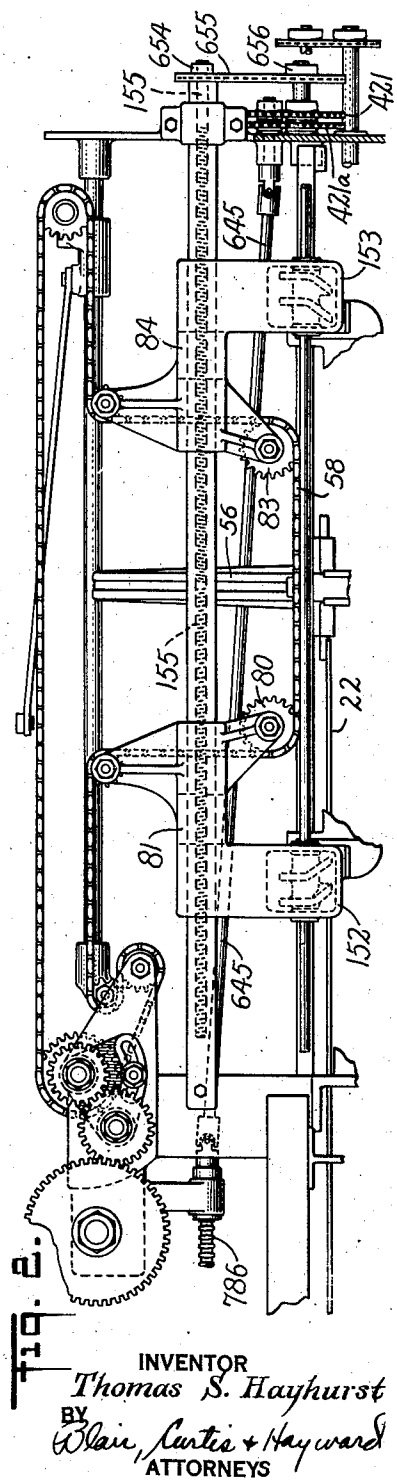


Fig. 2.

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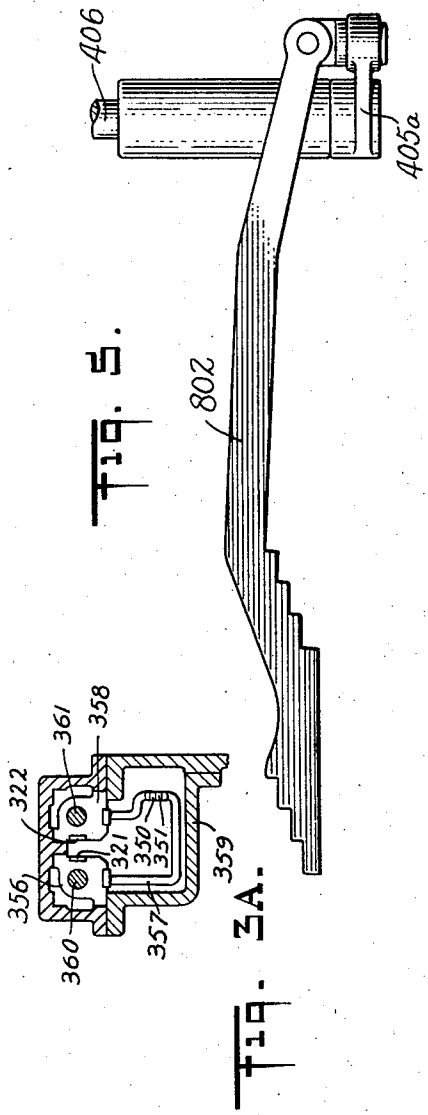


FIG. 5.

FIG. 3A.

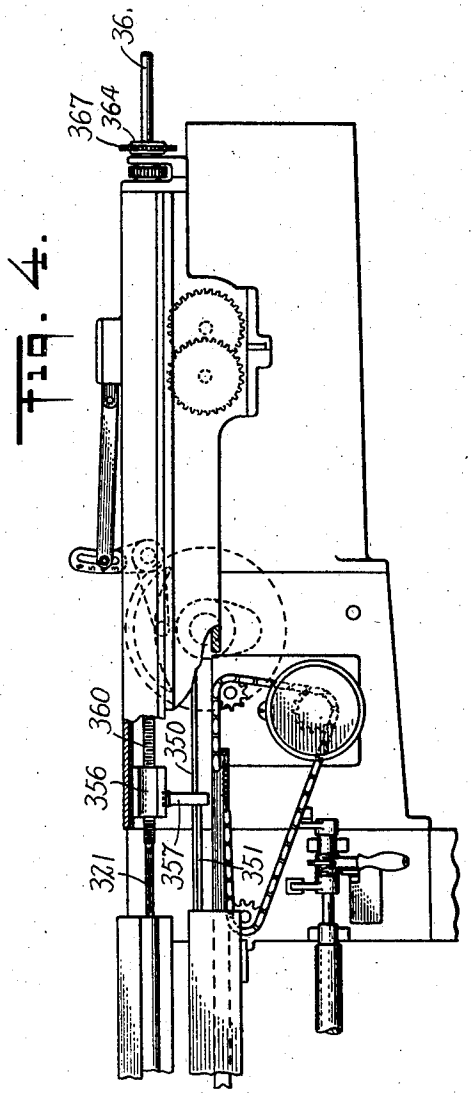


FIG. 4.

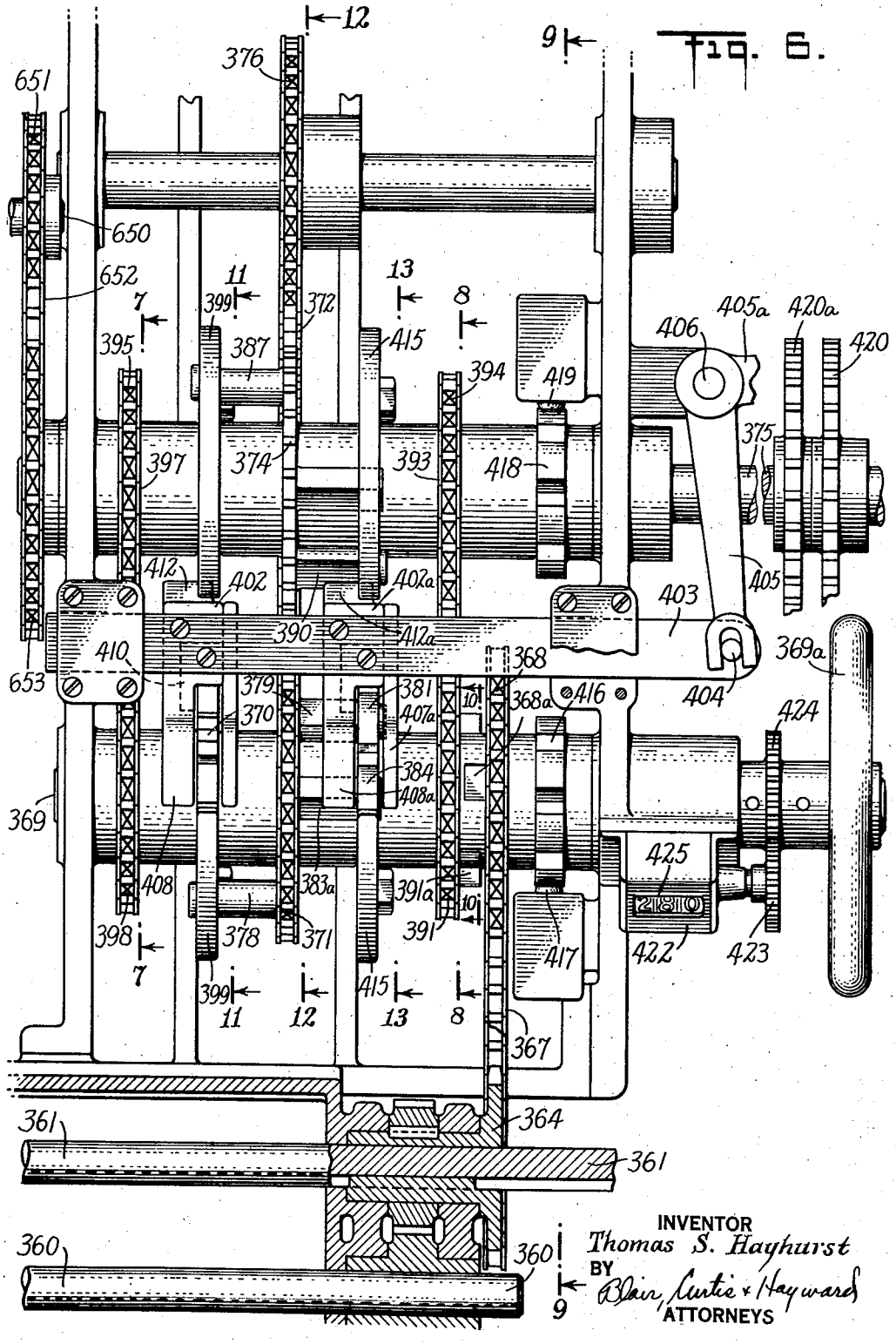
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Fig. 6.

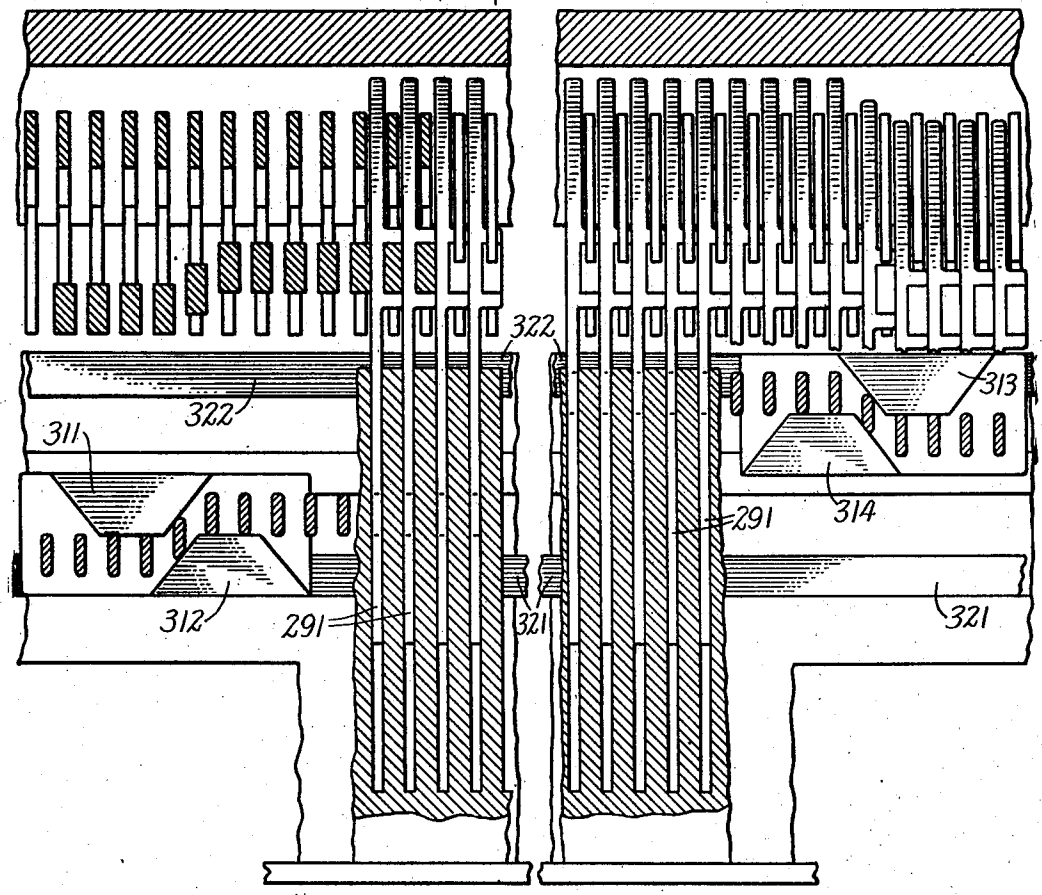


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Fig. 17.



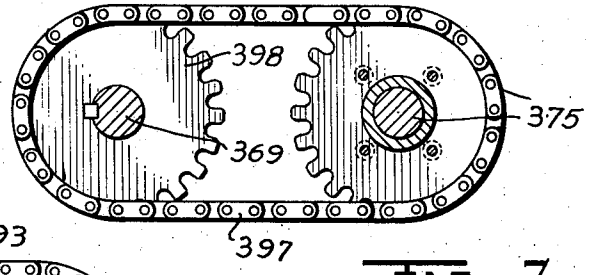
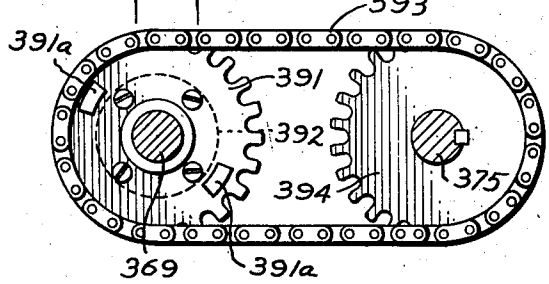


Fig. 7.

Fig. 8.



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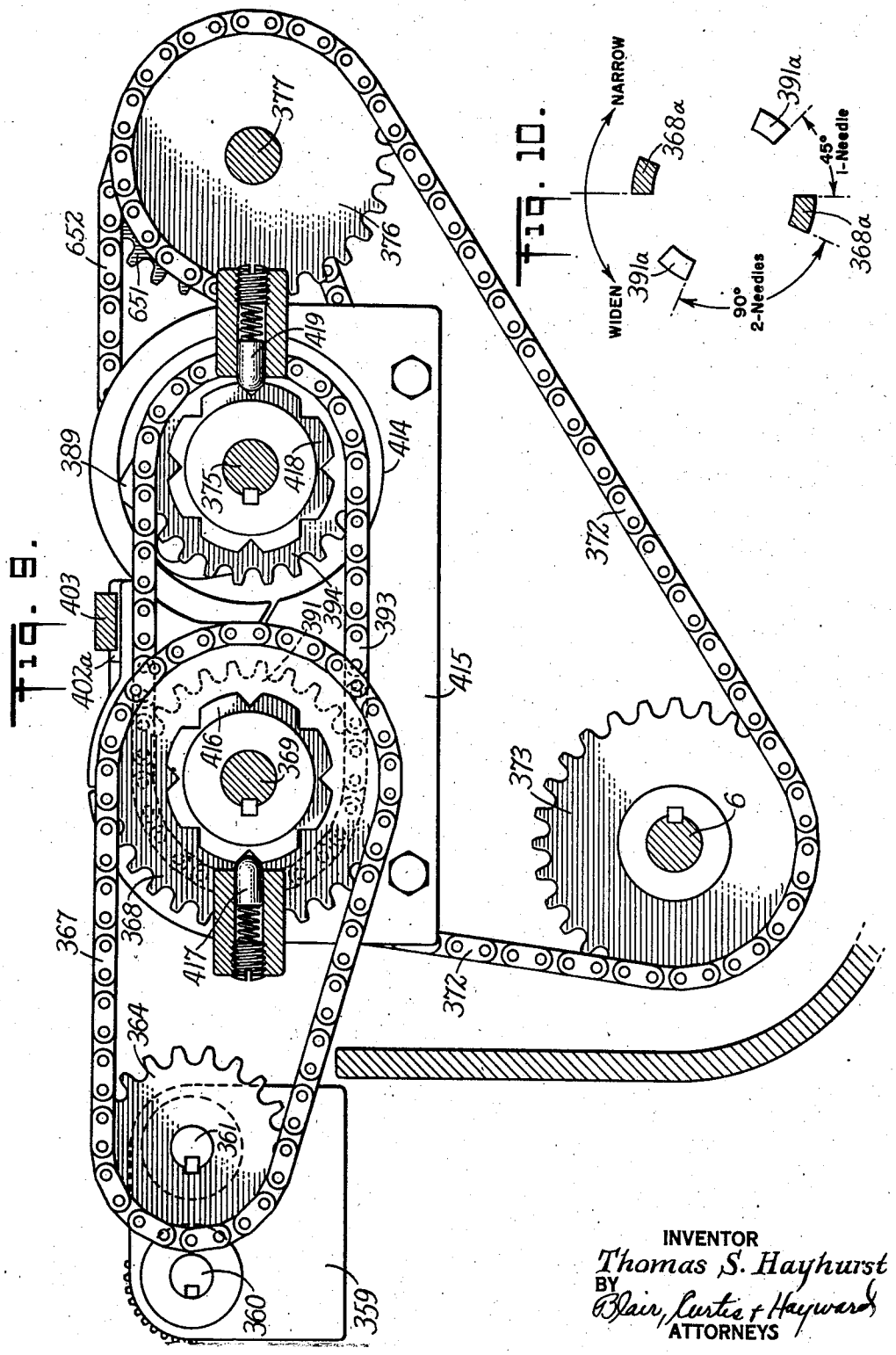


Fig. 5.

Fig. 10.

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Fig. 11.

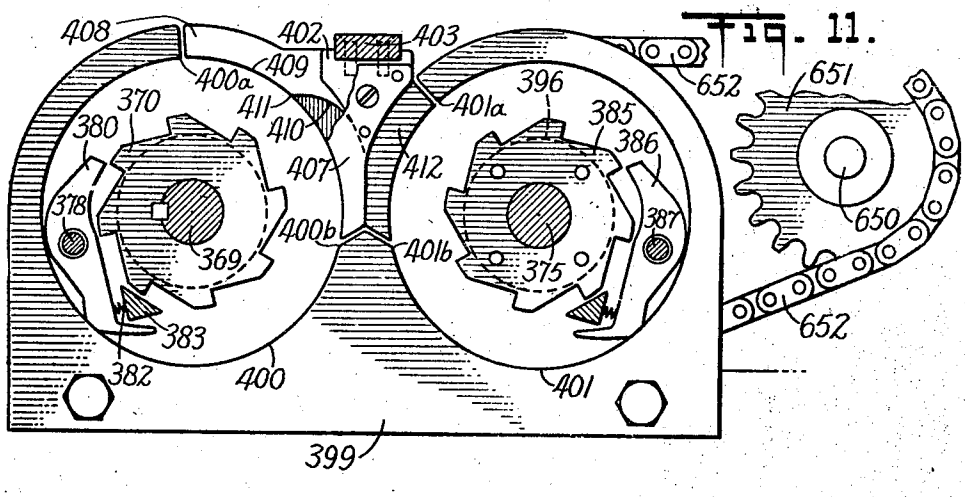


Fig. 12.

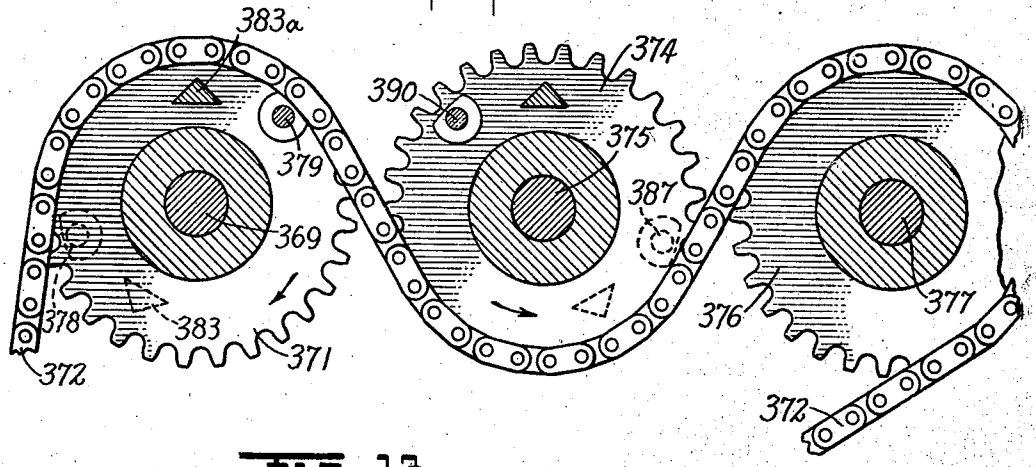
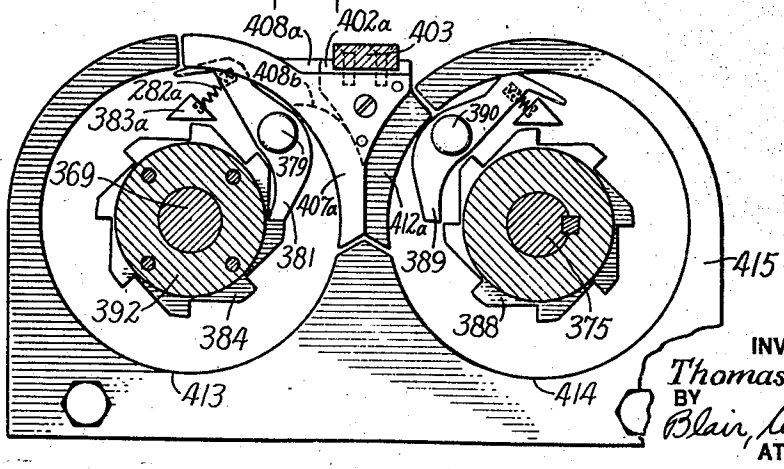


Fig. 13.



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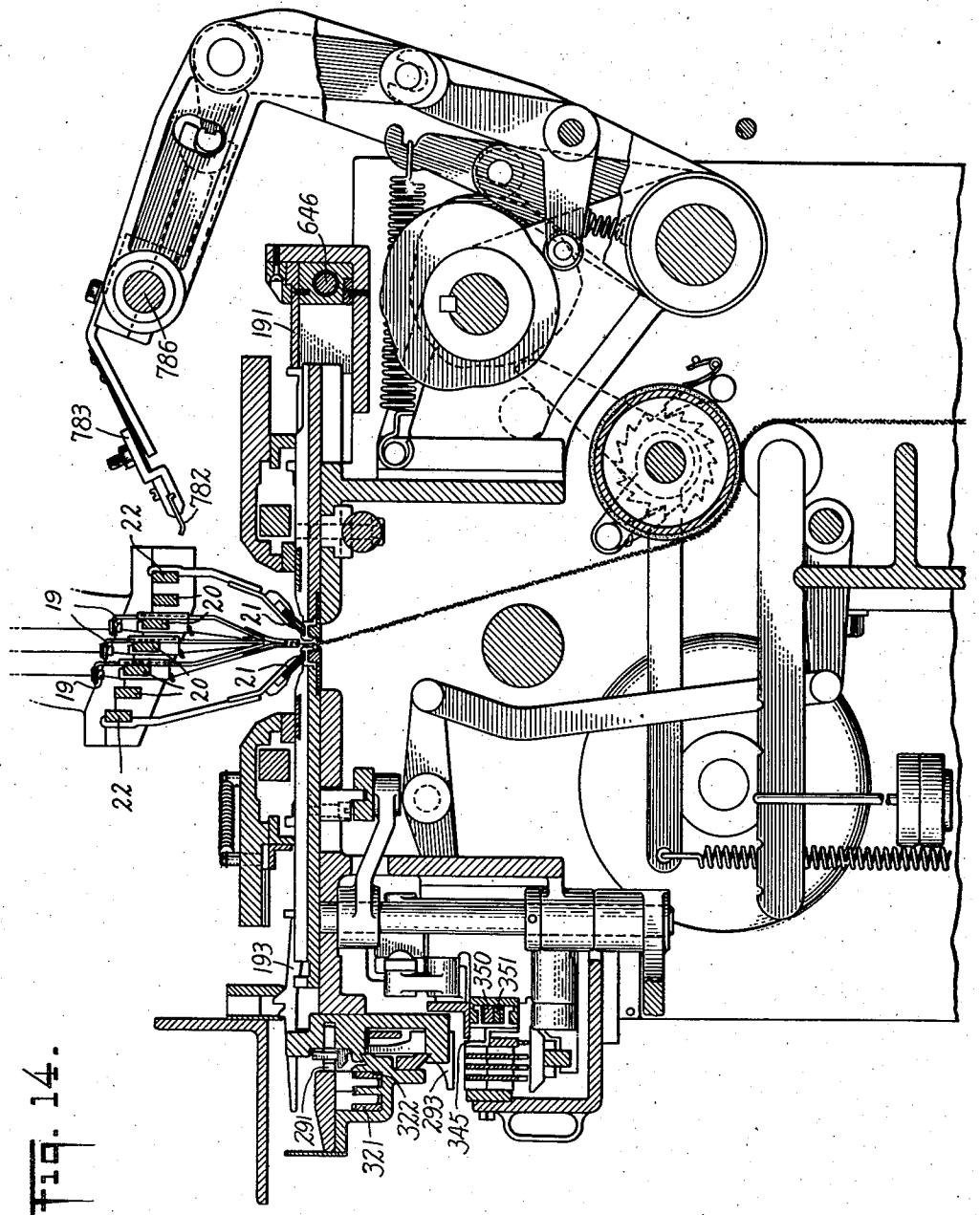


Fig. 14.

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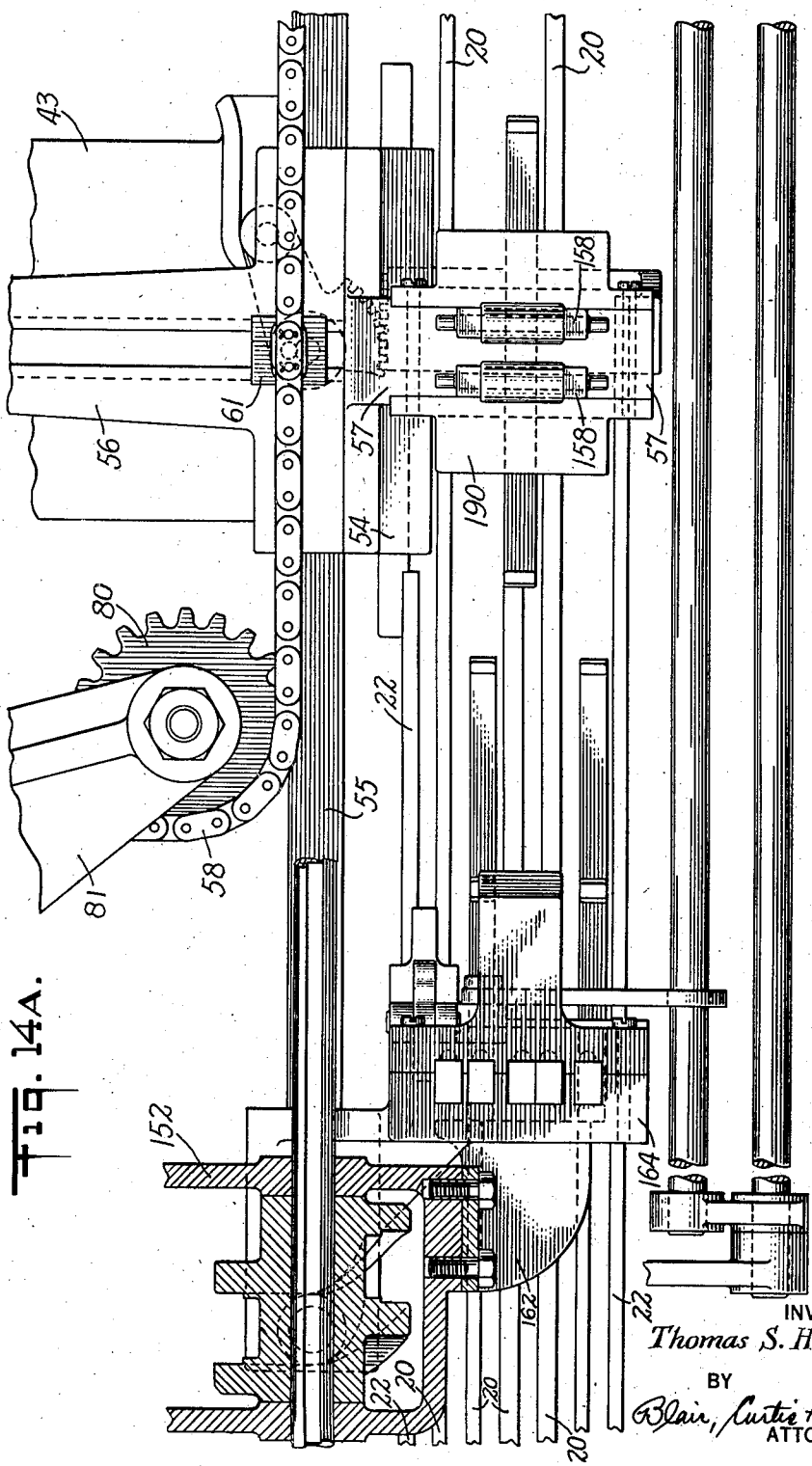


Fig. 14A.

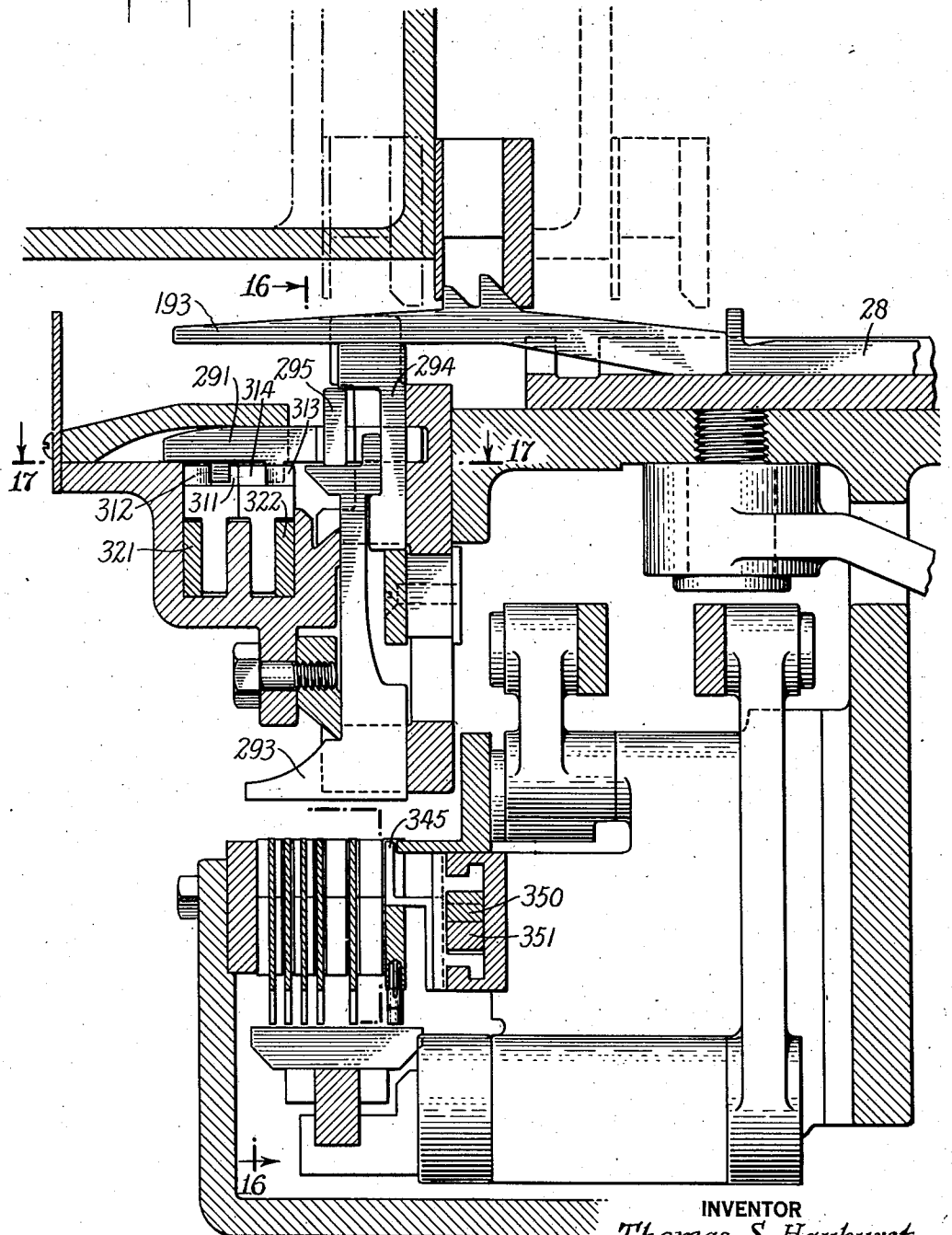
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Fig. 15.



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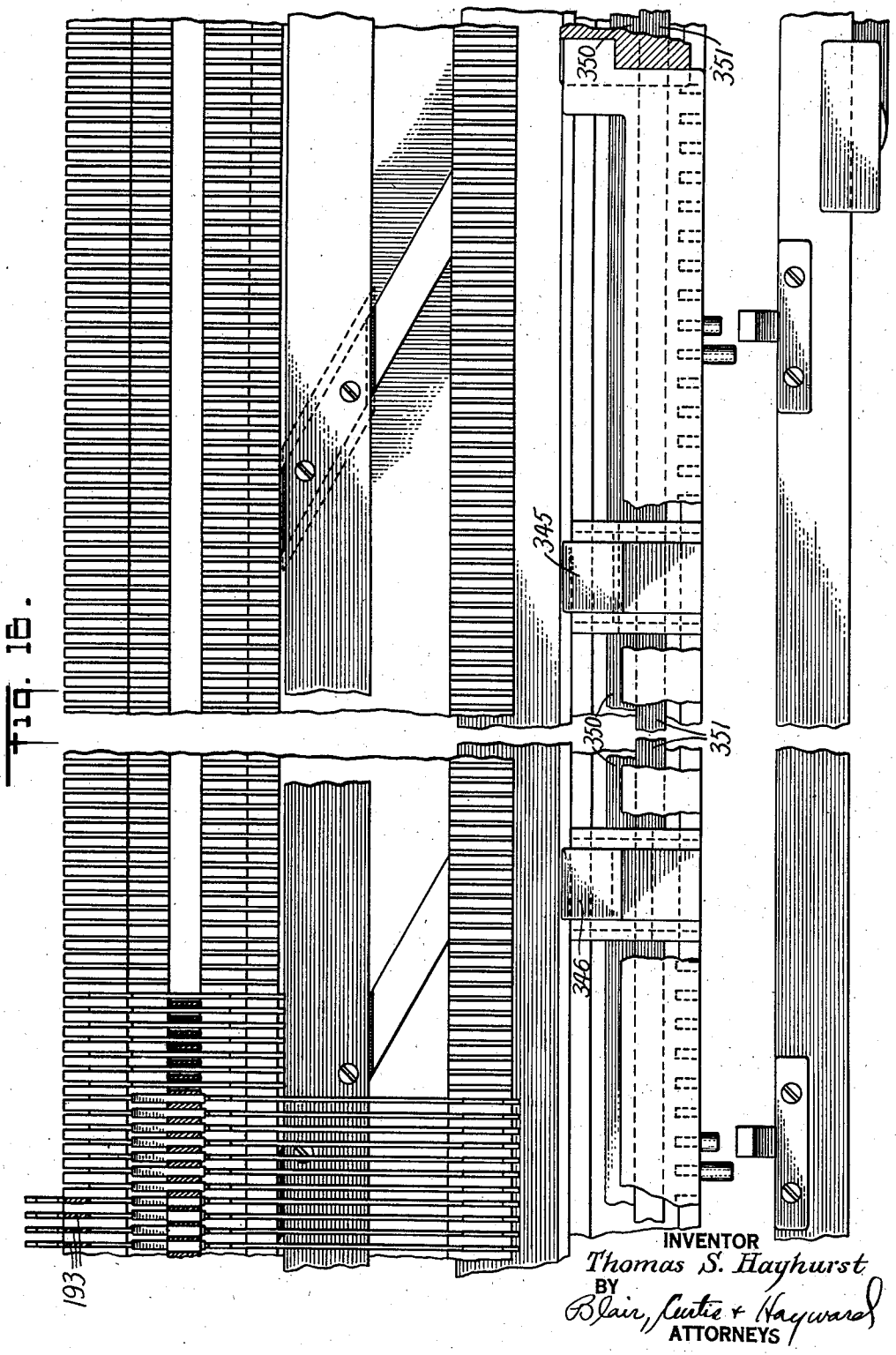


Fig. 16.

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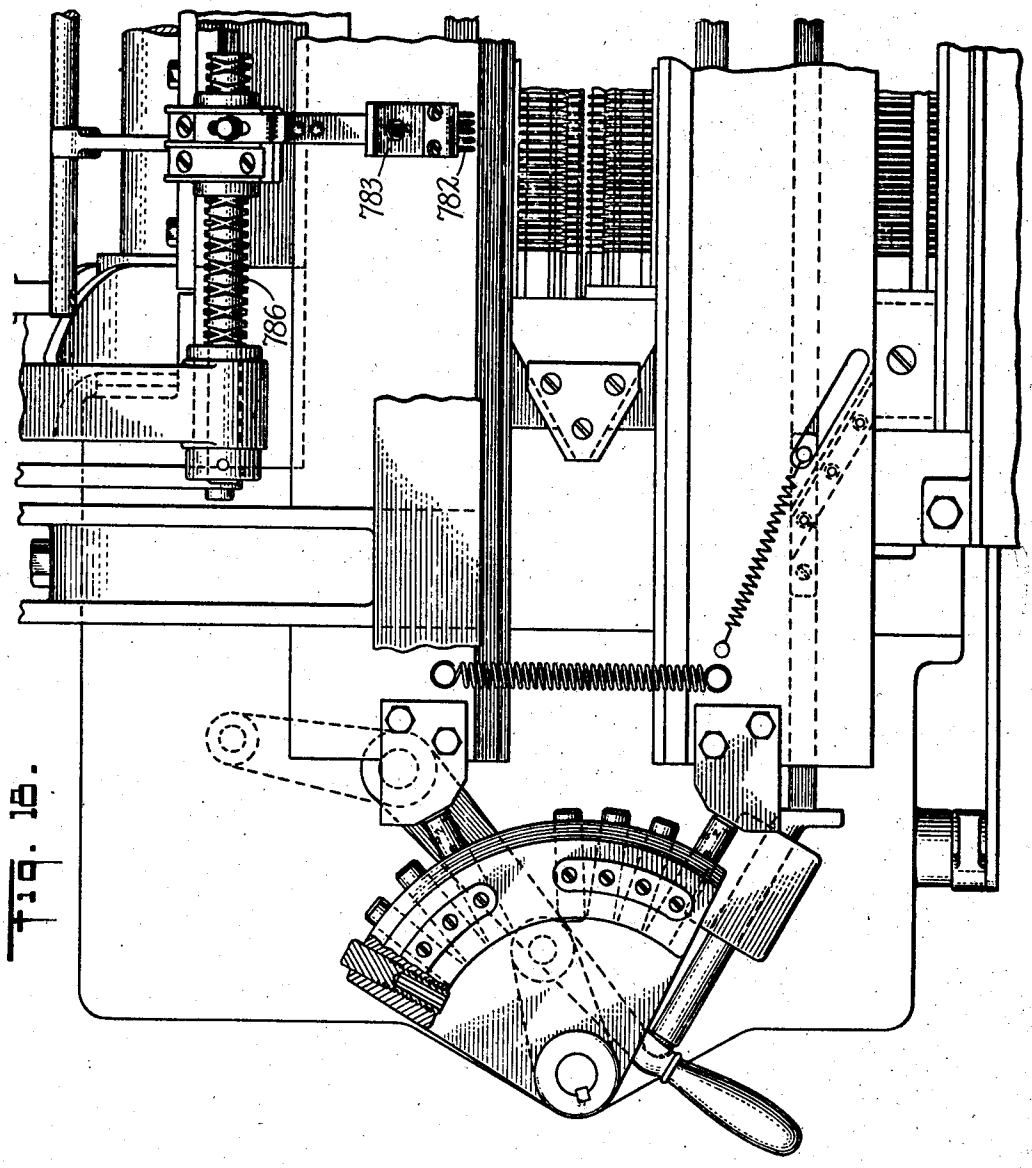


Fig. 18.

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Patented Mar. 5, 1946 2,395,819

UNITED STATES PATENT OFFICE

2,395,819

KNITTING MACHINE

Thomas S. Hayhurst, Belle Harbor, N. Y., assignor to Max Nydegger, Summit, N. J.

Application April 13, 1944, Serial No. 530,766

19 Claims. (Cl. 66—63)

The present invention relates to an improvement in knitting machines. Objects of said invention have been to provide improved mechanism for conditioning predetermined control jacks in knitting machines, more particularly of the links or knit purl type, to effect widening and narrowing in connection with fashioning; and to provide corresponding adjustments of the operative positions of decker devices, of thread feeding and thread changing devices, and of the rear bed push-in bar for racking.

One embodiment of my invention in a form adapted for use in an automatic multiple flat links machine is described in the following specification and shown in the appended drawings wherein:

Figure 1 is a view in elevation of the right end of a links-links knitting machine embodying the improved widening and narrowing devices and related mechanisms employed in fashioning;

Figure 2, a plan view from the line 2—2 of Figure 1, showing portions of mechanisms positioned rearwardly and at the end of the machine shown in Figure 1;

Figure 3, a horizontal section on the line 3—3 of Figure 1;

Figure 3A, a fragmentary view in vertical section on the line 3A—3A of Figure 3;

Figure 4, an enlarged view, in front elevation and with parts broken away, of a portion of the end of the machine shown in Figure 1;

Figure 5, a fragmentary view on the line 5—5 of Figure 3 showing the control link associated with the automatic widening and narrowing control devices employed in fashioning;

Figure 6, an enlarged fragmentary view in plan of a portion of Figure 3 and with parts broken away to show portions of automatic widening and narrowing control devices employed in fashioning;

Figure 7, a fragmentary view partly in vertical section on the line 7—7 of Figure 6;

Figure 8, a fragmentary view partly in vertical section on the line 8—8 of Figure 6;

Figure 9, a transverse vertical section on the line 9—9 of Figure 6;

Figure 10, a transverse vertical section on the line 10—10 of Figure 6;

Figure 11, a transverse vertical section on the line 11—11 of Figure 6 showing portions which control movement more particularly of the jack positioning or conditioning devices in widening and narrowing for fashioning;

Figure 12, a transverse vertical section on the line 12—12 of Figure 6;

Figure 13, a transverse vertical section on the line 13—13 of Figure 6, showing portions which control movement more particularly of decking, rack skip, and thread change devices in widening and narrowing for fashioning;

Figure 14, a transverse vertical section on the line 14—14 of Figure 3;

Figure 14A, a fragmentary plan view, enlarged, with parts in horizontal section showing portions of the thread change and lead change devices in relation to the stitch cam drive and the thread carrier and brush actuating devices in a course from left to right;

Figure 15, a portion of Figure 14 further enlarged to more clearly show parts of needle jack conditioning devices;

Figure 16, a view partly in longitudinal vertical section on the line 16—16 of Figure 15 and with portions broken away and with some parts removed;

Figure 17, a horizontal section on enlarged scale on the line 17—17 of Figure 15; and

Figure 18, an enlarged plan view of parts of the left end portion of the machine with some parts removed and some broken away.

As shown in Figure 15, the needle jacks 28, are selectively positioned to effect narrowing and widening, as well as other pattern characteristics, by a group or set of control jacks for each needle, including the push jack 193, connecting jack 294 engaging an under edge portion of said push jack, a main jack 293, an interposed jack 295, and a cross jack 291.

In fashioning, the effect of said control jacks on the positioning of the needle jacks is determined by cross jack 291 and said interposed jack 295 engaged thereby. Thus, when said cross jack is moved outwardly, left Figure 15, interposed jack 295 is displaced from its normal operative position so that connecting jack 294 is not influenced by any positioning lift of main jack 293. Accordingly, the corresponding push jack 193 and needle jack 28 remain or become idle and the fabric is narrowed to that extent in the next course. Said jacks can be restored to active condition for widening only when interposed jack 295 again occupies its normal position between connecting jack 294 and main jack 293.

Each operation of narrowing in fashioning is accompanied by a decking operation. Where the narrowing includes idling of two needles at each edge, for example, stitches are transferred inwardly from a group of needles including said two idled needles to a group of corresponding number located inwardly and adjacent to said

two idled needles. Therefore, some of said control jacks are also conditioned to position the predetermined number of needles for decking in proper synchronism with the idling or narrowing step.

Accordingly, cams 311, 312 and 313, 314 which operate said cross jacks 291, as two at each edge with each step of narrowing, are mounted on and moved respectively by endwise movement of rods 321 and 322, Figure 17. The lift plates 345 and 346, each of which imparts conditioning movement to the group of main jacks at each edge of the work selected for decking, are mounted on and are moved to the extent of two needles with each step of narrowing by endwise movement of rods 350 and 351 respectively, Figure 16. Movement of rods 321, 322, 350 and 351 in the reverse directions produces the necessary changes for widening.

As shown in Figures 3, 3A, and 4, rods 321 and 351, are connected to move with nut 356 on worm shaft 360 and rods 322 and 350 are connected to move with nut 358 on worm shaft 361. Both said shafts are rotated together by suitable connections from a sprocket 364 on worm shaft 361, Figure 9, to move said nuts 356 and 358 simultaneously in opposite directions.

The mechanism presently to be described controls the direction and extent of rotation of said worm shafts 360 and 361 and of the resulting endwise movement of the several slide rods 321, 322, 350 and 351 actuated thereby. Said movement determines how many and which needles shall be involved in each widening or narrowing operation and in the decking operation immediately preceding each narrowing. Accordingly, sprocket 364 on the outer end portion of the worm shaft 361, is driven by a chain 367 actuated by a sprocket 368 on intermediate shaft 369 for widening and narrowing or fashioning control, Figures 6 to 13.

Mechanism is also provided whereby portions of decking, thread feeding, thread change, and rear bed needle jack pushing in or actuating devices are positioned or conditioned in synchronism or spaced time relation with said narrowing and widening movements of said slide rods 321, 351 and 322, 350 respectively.

For positioning the holder or carrier 783 of the decker points 782 longitudinally of the needle bed, connection is made between said fashioning shaft 369, another intermediate shaft 375, decker drive shaft 645, and worm shaft 786, Figures 1, 2 and 14, by which the sets of decker points, as 782, Figure 18, in each needle section are adjusted toward and from each other in narrowing and widening.

Shaft 369 is also operatively connected with worm shaft 155 and the thread and brush carrier actuating and thread carrier changing devices adjustably positioned thereby through said shaft 375 and chain 655, Figures 1, 2, 6, 14, and 14A. Thread carriers 19, Figure 14A, are mounted on supports or bars 20 and brushes 21 are mounted on supports or bars 22. Said bars 20 and 22 are driven from arm 56 actuated by chain 58, Figure 2. Said bars 20 are releasably connected with arm 56 by keepers 158 on arm 190 carried by bracket 57 on driving arm 56. Said bars 22 are connected with said arm 56 through bracket 54. Accordingly, in narrowing and widening, the thread and brush carriers operate over courses which vary in length in accordance with the number of needles idled or added; and portions of the thread change mechanism including the thread carrier retaining heads 152, 153 and connected devices are adjusted correspondingly so that a thread change may be made in any course and at any condition of widening and narrowing.

For this purpose, said head, as 154, Figure 14A, carrying devices for releasably retaining said thread carrier bars 20 and claimed in my co-pending application Serial No. 530,763, are moved with brackets, as 81 and 84, Figure 2, actuated by rotation of said worm shaft 155 which also simultaneously repositions sprockets 80 and 83 engaging chain 58 which drives said arm 56.

Where racking over two needles, for example, takes place in a course employing less than all the needles in each section, it is clear that with the active needles positioned for "one and one" or links-links operation, as is customary in racking, certain active needles in the rear bed will be brought into alignment with certain inactive needles at rest in the front bed. Thus in each needle section, one active end needle in the rear bed will come opposite an inactive needle in the front bed. The next normal jack and needle positioning motion, as by a rear push-in bar 191, Figure 3, would therefore cause said active rear bed needle to be pushed into the slot occupied by said inactive front bed needle.

As shown in Figure 3, the rear push-in bar 191 is cut away at spaced intervals to form rack skip openings or slots 191a in its needle jack engaging edge. One such opening is provided for each needle section and is of such extent and so positioned as to lie above the rear needle bed with at least a portion thereof opposite those two of the needle bed slots holding the first two needles beyond the last active needle working in the front bed. Connection of said rear push-in bar 191 with fashioning shaft 369 to insure proper operative relation of said rack skip slots 191a under all conditions of widening and narrowing, is made through shaft 375, worm shaft 646, and shaft 648, Figures 3, 6 and 14.

As shown in Figure 12, a sprocket or sprocket wheel 371 loosely mounted on shaft 369 is driven continuously in one direction by a chain 372 from a drive sprocket or sprocket wheel 373 secured on main drive shaft 6, Figure 9.

A sprocket or sprocket wheel 374 loosely mounted on shaft 375 is driven continuously in the opposite direction by said chain 372 which also engages an idler sprocket or sprocket wheel 376 on a shaft 377.

Shaft 369 has a ratchet wheel 370, Figure 11, and a sprocket wheel 398, Figure 7, keyed thereon at one side, left, Figure 6, of sprocket 371. A ratchet wheel 385, Figure 11, and a sprocket wheel 395 secured thereto, Figure 7, are loosely mounted on said shaft 375 at the left, Figure 6, of said sprocket wheel 374. These devices at the left of sprocket wheels 371 and 374, respectively, cooperate with each other and with other devices to actuate shaft 369 in widening and narrowing.

Shaft 375 is actuated by similar but slightly modified devices at the right, Figure 6, of said sprockets 371 and 374 respectively to effect adjustments of decking, thread carrying and changing, and rack-skip mechanisms in connection with widening and narrowing.

Control of the direction and extent of rotation of fashioning shaft 369, and hence of the selection of needles to be idled in narrowing, or to be conditioned for return to active knitting in widening, and control of the direction and extent of rotation of shaft 375 and hence of the direction and

extent of adjusting movement of the several mechanisms thereby controlled, is effected through clutch devices operatively interposed between said shaft 369 and said sprocket 371 and between shaft 375 and said sprocket 374.

In the illustrated embodiment, Figures 6, 11 and 12, said sprocket 371 has a pawl supporting lug 378 extending to the left, Figure 6, toward ratchet wheel 370, and a similar pawl supporting lug 379 extending to the right but angularly spaced from said lug 378. A narrowing pawl 380, Figure 11, is mounted at the end of lug 378 in position to engage said ratchet wheel 370 keyed on shaft 369; and a similar narrowing pawl 381, Figure 13, is mounted at the end of lug 379 in position to engage ratchet wheel 384 secured to the hub 392 of a sprocket wheel 391 loosely mounted on shaft 369, Figures 8 and 13. Pawl 380 is biased by a spring 382 interposed between said pawl and an arm 383 also extending laterally from sprocket 371 adjacent to lug 378, Figure 11. A similar arrangement at the right of sprocket 371, Figure 6, biases pawl 381 by means of spring 382*a* bearing on an arm 383*a*, Figure 13.

The narrowing control devices including the ratchet wheel 370 fixed on fashioning shaft 369 and its pawl 380 cooperate with widening control devices including the ratchet wheel 385 loose on shaft 375. widening pawl 386, and the sprockets 395 and 398, Figure 7, to control the direction and extent of rotation of shaft 369. Said pawl 386 is mounted at the end of a pawl supporting lug 387 extending to the left of said sprocket 374 loose on shaft 375, Figure 6.

As seen in Figure 13, the narrowing control devices including the ratchet wheel 384, loose on shaft 369, pawl 381, and the sprockets 391 and 394, Figure 8. cooperate with widening control devices including the ratchet wheel 388 keyed on shaft 375 and the widening pawl 389 which is mounted at the end of a pawl supporting lug 390 extending to the right of said sprocket 374, Figure 6, to control the direction and extent of rotation of said shaft 375. As shown in Figures 6 and 8, the sprocket 391 is loose on said shaft 369 but secured, as by screws, to hub 392 of said ratchet wheel 384, Figure 13, which is loose on shaft 369. A drive chain 393 connects sprocket 391 with sprocket 394 keyed to shaft 375, Figure 8. Sprocket 395, Figure 7, is loose on said shaft 375 and secured, as by screws, to hub 396 of ratchet wheel 385, Figure 11. A chain 397 connects sprocket 395 with the sprocket 398 keyed to shaft 369, Figure 7.

The machine illustrated in the drawings provides selective clutch control devices which permit narrowing by one notch, narrowing by two notches, and widening by one notch. The same control devices determine the direction and extent of rotation of shafts 369 and 375. Although the latter operates in each instance shortly after the former, all settings and repositionings are completed in the same change cycle.

Said control is exercised in part through the pawls 380 and 386 at the left of sprockets 371 and 374 and through the pawls 381 and 389 at the right thereof, Figure 6.

Means for controlling the operation and extent of movement of the above mentioned pawls 380 and 386 and their respective ratchet wheels 370 and 385, Figure 11, and thus to actuate shaft 369 include a fixed plate 399 provided with spaced openings, one of which, left in said Figure 11, has its interior cylindrical surface 400 concentric with shaft 369 and the other of which, right in said Figure 11, has its interior cylindrical surface 401 concentric with shaft 375. The thickness of plate 399 is such as to provide an adequate guide bearing and retainer for said pawls 380 and 386, portions of which ride on the interior surfaces 400 and 401 thereof, respectively.

Pawl guiding surface 400 is interrupted by a long gap for narrowing to the extent of two needles as shown, and guiding surface 401 by a short gap, for widening to the extent of one needle, as shown. It will be apparent that when, during rotation of drive sprocket 371, Figure 12, and with the parts positioned as shown in Figure 6, the lug 378 thereon is advanced clockwise, Figure 11, the heel of pawl 380, will disengage guide surface 400 as it passes the edge 400*a* thereof, unless prevented by control means to be described. During such disengagement, the nose of pawl 380 is deflected inwardly by the spring 382 to engage a tooth of ratchet wheel 370 and so to advance said wheel and rotate shaft 369 through a corresponding angle to effect narrowing. This motion will be arrested as soon as the heel of pawl 380 re-engages guide surface 400 at edge 400*b*.

Pawl 386 operates in a similar manner but opposite direction, to effect widening, being disengaged from its guide surface 401 at edge 401*a* and re-engaged therewith at edge 401*b*, unless obstructed, as by closing of the short gap, between edges 401*a* and 401*b*. The rotation of shaft 369, when effected as above described, does not rotate sprocket 391 which is loose thereon, Figure 8. Hence no motion is transmitted by said shaft 369 to shaft 375 through chain 393 and sprocket 394, Figure 9. These are, however, subsequently rotated to a like extent in each change cycle by devices at the right of sprockets 371 and 374, Figure 6, in a manner to be described.

Means for controlling, i. e. opening and closing, the aforesaid gaps 400*a*—400*b* and 401*a*—401*b* in plate 399 to actuate shaft 369 comprise a gate assembly including a block 402 secured to a slide bar 403 provided with a lug 404, Figure 6, and mounted to slide endwise to and from different operative positions. Controlled endwise sliding movement is imparted to said slide bar 403 by a yoke lever 405 secured at the upper end of vertical shaft 406 and actuated to advance and retract said bar different distances by any suitable means. In the automatically controlled machine, as illustrated in the drawings, an arm 405*a* on the lower end of shaft 406 is pivotally connected at its outer end with a link 802, Figure 3, which is actuated endwise to swing said arm 405*a* to and from different angular positions by means indicated in part in Figures 1, 3 and 5.

As shown in Figures 6 and 11, block 402 on slide bar 403 carries at one side (right, Figure 6) a narrow gate piece 407 having a cylindrical under surface which, when moved left, Figure 6, to an operative position in the long gap of frame 399, closes the same to prevent any deflection of pawl 380 during rotation of drive sprocket 371.

Spaced from said gate piece 407 and at the other (left) side of block 402, Figure 6, is a wide gate piece 408 having a cylindrical under surface 409, Figure 11, the upper portion of which extends across the whole width of said gate piece 408. The lower portion of said under surface is interrupted by a recess 410 about half the width of said surface and forming therewith a disengagement edge at 411, Figure 11. This arrangement provides in effect a gate piece with a long cylindrical under surface and an adjacent short cylindrical under surface. Thus, when said gate

piece 408 is moved with the block 402 one stage to the right, Figure 6, and above the long gap with said recess 410 opposite the path of pawl 380, the heel of said pawl 380 will ride along the short under surface and disengage at edge 411. This provides in effect a short gap, (the recess 410) corresponding in extent to the short gap in guide surface 401. If the gate piece 408 is moved farther to the right to bring the unrecessed or long outer portion of its cylindrical under surface opposite the path of pawl 380, the long gap 400*a*—400*b* will remain closed during rotation of drive sprocket 371.

Block 402 also carries a third gate piece 412, Figure 11, positioned to close short gap 401*a*—401*b* in all positions of block 402 except that wherein gate piece 407 is in position to close the long gap 400*a*—400*b* previously described.

Slide bar 403 which carries the block 402 and the set of gate pieces 407, 408 and 412, Figure 11, above described, also carries a similar block 402*a*, Figure 13, and another similar set of gate pieces, both of which sets are selectively movable simultaneously by said bar 403 to and from a neutral and three operative positions in relation to the pawls 380 and 386, Figure 11, and pawls 381 and 389, Figure 13, respectively. For example, as to pawls 380 and 386, in a first operative or extreme left position, Figure 6, of said slide bar 403, the long gap 400*a*—400*b* is closed by gate piece 407; and the short gap 401*a*—401*b*, Figure 11, is open. This permits operation of pawl 386 during rotation of sprocket 371 to actuate shaft 369 counterclockwise, Figure 11, through sprocket 395, chain 397, and sprocket 398, Figure 7, to the extent of one notch for widening.

A second operative position of slide bar 403 is that shown in full lines in Figure 6, and wherein the long gap is full open and the short gap is closed by gate piece 412. This permits operation of pawl 380 to actuate shaft 369 through ratchet wheel 370, two notches for narrowing.

In a third operative position of said slide bar 403, the recess 410 of gate piece 408 comes opposite the path of movement of pawl 380 to actuate shaft 369 one notch for narrowing; and the short gap 401*a*—401*b* is closed by gate piece 412.

In the neutral or extreme right position of slide bar 403, Figure 6, gate piece 408 closes the long gap (narrowing) and gate piece 412 closes the short gap (widening). In this position of said gate pieces, no pawl is actuated and both shafts 369 and 375 remain at rest.

Operation of the devices for controlling the position of slide bar 403 is so timed in relation to the angular position of the pawl carrying sprockets 371 and 374 that selective endwise movements of said bar 403 occur only when the pawls carried by said sprockets are in retracted condition, i. e. with their heel portions riding respectively on the several cylindrical guiding and retaining surfaces 400 and 401 of the openings in the plate 399, Figure 11, and surfaces 413 and 414 of the openings in plate 415, Figure 13.

As shown in Figures 6 and 9, the shaft 369 has keyed thereto a notched wheel 416 cooperating with a spring pressed friction detent 417; and shaft 375 has a similar notched wheel 418 cooperating with a spring pressed friction detent 419. When for example as above described, bar 403 is in "third" position and pawl 380 is actuated to turn shaft 369 for narrowing, the extent of rotation thereof will be the equivalent of the angular distance from one peripheral notch to the next on said wheel 416. The detents 417 and 419 bear frictionally on the peripheries of said notched wheels 416 and 418, respectively, to arrest rotation of shafts 369 and 375 and thus more accurately control the extent of movement of narrowing, widening, decking, thread carrying, thread changing, and rack skip controlling instrumentalities operatively related thereto.

In the embodiment shown, the pawls 380 and 386, Figure 11, operating shaft 369, control the positioning of the selective jack actuating devices in widening and narrowing; whereas the pawls 381 and 389 operating shaft 375, Figure 13, control movement of translation of the thread feeding and thread changing, the rack skip means and the decking devices. Movement is transmitted to the latter from shaft 375, through a sprocket 420 thereon, a chain 421, an auxiliary sprocket 420*a* and an auxiliary chain 421*a*, Figure 12, to a decker assembly moving shaft 645, Figures 1 and 2. Sprocket 420*a* is loose on shaft 375 and has a spring connection with sprocket 420 for controlling backlash or lost motion. In a suitable arrangement for this purpose, not illustrated, the hub of sprocket 420*a* for example is provided with spaced arcuate recesses, each of which receives a compression spring with one end thereof bearing against an end of the recess. Sprocket 420 has lugs each extending laterally into one of said recesses and each engaging the other end of the spring therein.

Said pawls 381 and 389 also control widening and narrowing movement of the brackets 81 and 84, Figure 2, thereby effecting equivalent adjustment of the idler gears 80 and 83 connected with thread feeding and of the heads 152 and 153 connected with the thread change mechanisms. For this purpose the screw shaft 155, Figure 2, carries a sprocket 654 driven by a chain 655 from sprocket 656 fixed at the end, right, of shaft 375, Figure 1. The connection for control of the rack skip devices via shaft 648 is made through sprocket 653 at the inner, left, end of shaft 375, Figure 6, as previously described.

With slide bar 403 in the "second" position, a narrowing operation takes place involving a number of needles determined by the rotation of shaft 369 to the extent of two notches. If the parts be so calibrated that one notch of said angular movement corresponds to transverse movement of the narrowing cams 311 and 313, Figure 17, past one cross jack 291, and transverse movement of lifting plates 345 and 346, Figure 16, past the corresponding main jack 293, the described two notch rotation of shaft 369 effected by the control parts in their said "second" position will produce narrowing by two needles at each edge of the work. The "third" position which produces a one notch rotation of shaft 369 will, therefore, produce narrowing by one needle at each edge.

With slide bar 403 in the "first" position, as above described, i. e. with the long gap closed and the short gap open, shaft 369 is rotated in the opposite direction from that occurring in the "second" and "third" positions. In this case, said shaft rotates only one notch which therefore produces widening at each edge of the fabric by one needle.

Considering further the mode of operation of pawls 381 and 389, Figure 13, it is noted that these pawls are mounted on the lugs 379 and 390, respectively, Figure 12, which are angularly spaced on their several sprockets 371 and 374 about 210° behind the lugs 378 (dotted) and 387

(dotted), respectively, in the direction of rotation of said sprockets, as shown by the arrows applied thereto. As seen in Figures 6 and 13, slide bar **403** carries the block **402***a* and a second set of gate pieces like those previously described in connection with block **402**, Figure 11, and actuated simultaneously therewith to control the long gap in guide surface **413** and the short gap in guide surface **414** of plate **415**. Accordingly, during each rotation of sprockets **371** and **374**, with bar **403** in the first, second, or third positions, pawls **380** and **386** are actuated and shaft **369** is thereby rotated a predetermined extent and direction to effect corresponding narrowing or widening. Therefore, when the lugs **379** and **390** reach their pawl releasing positions 210° later in the same cycle of rotation of said sprockets **371** and **374**, a corresponding effect is produced on shaft **375** and therefrom in a manner previously described to portions of the decking devices, to the thread feeding and change devices, and to said rack skip actuating devices for imparting endwise movement to the push-in bar **191**.

In terms of operating result, controlled movement of devices employed in selecting needles for widening and narrowing and for decking is transmitted from main shaft **6** through the intermediate shaft **369**; whereas for decking, thread feeding and thread change, and skip slot positioning in racking, corresponding adjustment thereof is effected through the intermediate shaft **375**. Control in widening and in the corresponding outward movement of translation or adjustment of portions of the aforesaid decking and other controlled devices is related to sprocket **374**; whereas control in narrowing and in the corresponding inward movement of translation or adjustment of portions of the decking and other controlled devices is related to sprocket **371**.

Manual adjustment of fashioning devices and connected mechanisms

Under conditions which require manual adjustment of the fashioning devices and other instrumentalities operatively connected therewith, lengthwise of the needle bed, shafts **369** and **375**, Figure 6, are rotatable by hand. For this purpose, a hand wheel **369***a* is secured to an end portion of one of them, for example shaft **369**, so that said shaft may be manually rotated at will in either direction when slide bar **403** is in neutral position. This directly controls the position of devices actuated by said shaft through chain **367** to narrow the fabric by idling predetermined edge needles and to widen it by restoring said needles to active condition.

Equivalent and simultaneous widening and narrowing adjustments of the decker point carriers, of portions of the thread and brush carriers and the thread change devices, and of the rack skip slot in the rear push-in bar are transmitted from said shaft **369** through sprocket **368** thereon to sprocket **391** and thus to chain **393** and shaft **375**, Figures 6 and 10.

For this purpose, said sprocket **368** is fitted with laterally extending lugs **368***a* and sprocket **391** with similar lugs **391***a*. The angular extent of said lugs and their arrangement on the respective sprockets is such that, at each rotation of shaft **369** in either direction there is a lag between the beginning of that rotation and the rotation of shaft **375**. For example, with shaft **369** rotating in the direction of widening, it will turn to the extent of one notch, or the equivalent of movement of the widening devices to the extent of one needle, before shaft **375** begins to rotate for widening. Also, with shaft **369** rotating in the direction of narrowing, it will turn to the extent of two notches before shaft **375** begins to rotate for narrowing. Therefore, after any such rotation of shaft **369** by hand and before resuming power operation, said shaft must be reversed manually one notch on the notched wheel **416** for widening and two notches for narrowing. This adjustment brings the parts into proper operative relation for normal knitting procedure.

Manual operation of shaft **369** as above described is effected independently of rotation of main drive shaft **6**, because the narrowing pawls **380** and **381** and the widening pawls **386** and **389** are maintained out of engagement with their respective ratchet wheels by the gates **408**, **408***a*, **412** and **412***a*, with slide bar **403** in inoperative position.

Active needle indicator

As shown in Figure 6, a device for continuously indicating how many needles are idle and/or working includes an adding and subtracting instrument **422** of any suitable construction connected by a pinion **423** to a gear **424** on shaft **369**. In a multiple machine, i. e. one having a plurality of needle sections, each set of cooperating front and rear knitting cams will be adjusted initially to operate over a given maximum number of needles. During full width operation, this is the number which will be indicated at the window **425**. Assuming such as number to be 280, the instrument will be set accordingly at the beginning of the working of a given pattern; or, if the initial courses of the work are narrower than later courses, the indicator can be set to show the actual number of active needles employed at the start. Thereafter during widening and narrowing the indicator reading will vary in response to each widening and narrowing rotation of shaft **369**. This arrangement provides a convenient check on the accuracy of the needle selecting portions of the widening and narrowing control devices.

The above described mechanisms provide adequately flexible and positively operating devices for co-ordinating various functions in knitting machine operation. They are effectively employed especially in a full automatic multiple machine of the links type, wherein instrumentalities are provided by which the widest range of pattern variations or characteristics can be introduced into the product. Thus, where the contour of the product requires narrowing and widening steps, i. e. the idling and activating of end or edge needles in some predetermined sequence, my improved control mechanism insures not only accurate and certain idling but also the necessary corresponding adjustments of decking, thread feeding, thread changing, and rear push-in devices, the adjustment of the latter being related to racking.

The above described mechanisms are also shown and described but not independently claimed in my co-pending application Serial No. 530,761 filed herewith and of which the present application is in effect a division.

I claim:

1. In a straight knitting machine having a plurality of needle jacks and independent needles, a plurality of sets of control jacks operatively connected thereto, cams operatively engaging portions of said sets of control jacks, and means

for moving said cams to and from different operative positions to actuate different sets of control jacks, the combination of an intermediate shaft operatively connected to actuate said cam moving means, a drive shaft, a clutch operatively interposed between said drive shaft and said intermediate shaft, and means for moving portions of said clutch to and from different positions in relation to other portions thereof to vary the extent of rotation imparted to said intermediate shaft from said drive shaft.

2. In a straight knitting machine having a plurality of needle jacks and independent needles, a plurality of sets of control jacks operatively connected thereto, cams operatively engaging portions of said sets of control jacks, and means for moving said cams to and from different operative positions to actuate different sets of control jacks, the combination of an intermediate shaft operatively connected to actuate said cam moving means, a drive shaft, a clutch operatively interposed between said drive shaft and said intermediate shaft, and means for moving portions of said clutch to and from different positions in relation to other portions thereof to vary the direction of rotation imparted through said clutch to said intermediate shaft from said drive shaft.

3. In a straight knitting machine having a plurality of needle jacks and independent needles, a plurality of sets of control jacks operatively connected thereto, cams operatively engaging portions of said sets of control jacks, and means for moving said cams to and from different operative positions to actuate different sets of control jacks, the combination of an intermediate shaft operatively connected to actuate said cam moving means, a drive shaft, a clutch operatively interposed between said drive shaft and said intermediate shaft, and means for moving portions of said clutch to and from different positions in relation to other portions thereof to vary the direction and extent of rotation imparted through said clutch to said intermediate shaft from said drive shaft.

4. In a straight knitting machine having independent needles and instrumentalities some of which are adjustable in one direction for narrowing and in the opposite direction for widening and others of which are convergently adjustable for narrowing and divergently adjustable for widening, and separate means for moving said instrumentalities to effect said adjustments, the combination of a drive shaft rotatable in one direction, a pair of intermediate shafts each rotatable in opposite directions and one of which is operatively connected to said means for moving some of said instrumentalities and the other of which is operatively connected to said means for moving others of said instrumentalities, clutch means operatively positioned between said drive shaft and each of said intermediate shafts and including a rotatable pawl carrier and pawls mounted thereon, each in fixed angular spaced relation to the other, and means for simultaneously moving portions of said clutch means into operative position in relation to said pawls to bring one and then the other thereof into operative position to rotate one and then the other of said intermediate shafts.

5. In a straight knitting machine having independent needles cam means and decking devices adjustable convergently for narrowing and divergently for widening, and separate means for moving said cam means and said decking devices respectively to effect said convergent and divergent adjustments, the combination of a drive shaft rotatable in one direction, a first intermediate shaft rotatable in opposite directions and operatively connected to said means for moving the cam means, a second intermediate shaft rotatable in opposite directions and operatively connected to said means for moving the decking devices, clutch means operatively interposed between said drive shaft and said respective intermediate shafts, means for simultaneously moving portions of said clutch means to and from different positions in relation to other portions thereof to vary the direction and extent of rotation of said intermediate shafts, said clutch means including pawls mounted in angularly spaced relation on a rotatable carrier, and one of which operates to effect rotation of said first intermediate shaft and the other of which operates to effect rotation of said second intermediate shaft during a single rotation of said drive shaft.

6. In a straight knitting machine provided with independent needles and having fashioning devices whereby the needles are idled for narrowing and are rendered active for widening and wherein other devices are provided as for decking, for operating thread and brush carriers, and for changing thread, the combination of a fashioning control shaft, a sprocket loosely mounted thereon, a sprocket fixed thereon and arranged and adapted to drive said fashioning devices, a secondary shaft arranged and adapted to drive said other devices, means for effecting operative driving connection between said loose sprocket and said secondary shaft, means for manually rotating one of said shafts, and means interposed between said loose sprocket and said fixed sprocket to rotate one of said sprockets when the other sprocket is actuated by rotation of one of said shafts.

7. In a straight knitting machine, having a needle bed, independent needles therein, a thread carrier operatively arranged in relation to said needles, and thread carrier driving means, the combination of a needle position controlling cam, means for moving said cam in one direction to idle said needles in narrowing and in the opposite direction to activate said needles in widening, and means operatively connected to said thread carrier driving means and to said cam moving means to diminish the extent of thread feeding movement of said thread carrier driving means when said cam is moved in the direction to idle said needles and to increase the extent of thread feeding movement of said thread carrier driving means when said cam is moved in the opposite direction.

8. In a straight knitting machine having a needle bed, independent needles therein, a brush carrier operatively arranged in relation to said needles, and brush carrier driving means, the combination of a needle position controlling cam, means for moving said cam in one direction to idle said needles in narrowing and in the opposite direction to activate said needles in widening, and means operatively connected to said brush carrier driving means and to said cam moving means to diminish the extent of operative movement of said brush carrier driving means when said cam is moved in the direction to idle said needles and to increase the extent of operative movement of said brush carrier driving means when said cam is moved in the opposite direction.

9. In a straight knitting machine having a

needle bed, independent needles therein, a plurality of reciprocatable thread carrier supports, thread carriers mounted on said supports and operatively arranged in relation to said needles, adjustable means for releasably retaining said thread carrier supports in inoperative position, and driving means for reciprocating said thread carrier supports, said driving means including devices for engaging and disengaging said supports, the combination of a needle position controlling cam, means for moving said cam in one direction to idle said needles in narrowing and in the opposite direction to activate said needles in widening, and means operatively connected to said adjustable thread carrier support retaining means and to said cam moving means to effect adjusting movement of said retaining means in one direction when needles are idled by said cam for narrowing and in the opposite direction when needles are activated by said cam for widening.

10. In a straight knitting machine having a needle bed, independent needles therein, a decker point carrier movable in stitch transferring operations toward said needles to engage stitch loops thereon and away from said needles to disengage said stitch loops, the combination of, a needle position controlling cam movable in one direction to idle said needles in narrowing and in the opposite direction to activate said needles in widening, and means operatively connected to said cam and to said decker point carrier to effect movement of said carrier longitudinally of said needle bed in one direction when needles are idled by said cam for narrowing and in the opposite direction when needles are activated by said cam for widening.

11. In a straight knitting machine having opposed needle beds one of which is movable for racking, independent needles and needle jacks therein, means for effecting racking movement of said movable bed, a needle jack actuating push-in bar operatively related to the needle jacks in said movable bed, means for moving said push-in bar in a direction to actuate said needle jacks, and means for moving said push-in bar in the direction of racking movement of said movable needle bed, the combination of a needle position controlling cam cooperating with needles in the other of said beds, means for moving said cam in one direction to idle said needles in narrowing and in the other direction to activate said needles in widening, and means operatively connected to said push-in bar and to said cam moving means and arranged and adapted to move said push-in bar and said cam together and in the same direction.

12. In a straight independent needle knitting machine having instrumentalities adjustable for narrowing or widening and a drive shaft, the combination of an intermediate shaft, a sprocket loosely mounted on said intermediate shaft and connected to be driven from said drive shaft, a ratchet wheel secured on said intermediate shaft, a pawl pivoted on and rotatable with said sprocket and biased in a direction to engage said ratchet wheel, means disposed in a portion of the path of said pawl for retaining said pawl out of engagement with said ratchet wheel, a gate piece, and means for moving said gate piece into and out of operative relation to the remaining portion of the path of said pawl whereby, when said gate piece is in said operative relation, said pawl remains disengaged from said ratchet wheel and, when said gate piece is out of said operative relation, said pawl is released from said retaining means to engage and turn said ratchet wheel and said intermediate shaft.

13. In a straight independent needle knitting machine having instrumentalities adjustable for narrowing or widening and a drive shaft, the combination of a first intermediate shaft operatively connected to some of said instrumentalities, a second intermediate shaft operatively connected to other of said instrumentalities, a first sprocket loosely mounted on said first intermediate shaft and connected to be driven from said drive shaft, a second sprocket loosely mounted on said first intermediate shaft and operatively connected to drive said second intermediate shaft, a first ratchet wheel secured on said first intermediate shaft, a second ratchet wheel secured to said second sprocket, a first pawl pivoted on and rotatable with said first sprocket and arranged and adapted to actuate said first ratchet wheel and said first intermediate shaft, and a second pawl pivoted on said first sprocket in angularly spaced relation to said first pawl, said second pawl being rotatable with said first sprocket and arranged and adapted to actuate said second ratchet wheel, said second sprocket and said second intermediate shaft in spaced time relation to actuation of said first intermediate shaft.

14. In a straight independent needle knitting machine having instrumentalities adjustable in one direction for narrowing and in the opposite direction for widening, the combination of a pair of intermediate shafts arranged and adapted to actuate said instrumentalities, a ratchet loosely mounted on each shaft and connected to a driving sprocket, a driven sprocket secured to each shaft, a ratchet secured to each shaft, a rotatable pawl carrier loosely mounted on each shaft, each pawl carrier having a pair of pawls, one arranged to actuate said ratchet connected to the driving sprocket and the other arranged to actuate said ratchet secured to the shaft, and a chain connecting the driving sprocket on each shaft with the driven sprocket on the other shaft, means for effecting engagement and disengagement of said pawls with said ratchets, and means for actuating said rotatable pawl carriers.

15. In a straight independent needle knitting machine having instrumentalities which are adjustable in one direction for narrowing and in the opposite direction for widening and a drive shaft, the combination of a pair of intermediate shafts operatively connected to said adjustable instrumentalities, a pawl carrier loosely mounted on each of said intermediate shafts and connected to be driven from said drive shaft, a ratchet wheel secured on each of said intermediate shafts, a narrowing pawl and a widening pawl, each of said pawls being pivoted on and rotatable with one of said pawl carriers and biased to engage one of said ratchet wheels, pawl retaining means fixed in a portion of the path of rotation of each of said pawls for holding said pawls out of engagement with said ratchet wheels, a gate piece carrier, a narrowing gate piece and a widening gate piece mounted thereon, and means for moving said gate piece carrier to bring one or the other of said gate pieces into operative relation to one of said pawl retaining means, whereby one of said pawls remains disengaged from its ratchet wheel and the other of said pawls is released to engage its ratchet wheel.

16. In a straight knitting machine having a plurality of needle jacks and independent needles, a plurality of sets of control jacks operatively connected thereto, cams operatively engaging

portions of said sets of control jacks, means for moving said cams to and from different operative positions to actuate different sets of control jacks and a drive shaft, the combination of an intermediate shaft operatively connected to actuate said cam moving means, a clutch operatively interposed between said drive shaft and said intermediate shaft and including a ratchet on said intermediate shaft, a pawl operatively connected for continuous rotation with said drive shaft and biased toward said ratchet and a gate piece movable into and out of operative position in relation to said pawl, and means for moving said gate piece in one direction to bring said gate piece into engagement with said pawl to hold the latter in biased position and in the opposite direction to release said pawl into engagement with said ratchet to impart rotation to said intermediate shaft from said drive shaft.

17. In a straight knitting machine having independent needles and instrumentalities adjustable in one direction in narrowing and in the opposite direction in widening and a drive shaft, the combination of a pair of intermediate shafts each rotatable in opposite directions and one of which is operatively connected to move some of said instrumentalities and the other of which is operatively connected to move other of said instrumentalities, a first clutch device operatively related to one of said intermediate shafts, a second clutch device operatively related to the other of said intermediate shafts, each of said clutch devices having gate pieces and regularly spaced rotatably mounted pawls operatively connected for continuous rotation with said drive shaft, and means arranged and adapted to move the gate pieces of one of said clutch devices to and from operative position to effect rotation of said intermediate shafts one after the other in one direction for narrowing and to move the gate pieces of the other of said clutch devices to and from operative position to effect rotation of said intermediate shafts one after the other in the opposite direction for widening.

18. In a straight knitting machine of the independent needle type wherein fashioning devices are movable in one direction for narrowing and in the opposite direction for widening and are actuated from a drive shaft, the combination of a pair of spaced parallel intermediate shafts, each provided with a ratchet wheel secured thereon, a rotatable pawl carrier loosely mounted on each intermediate shaft and driven from said drive shaft and having driving connection with the other intermediate shaft, a pawl pivoted on each of said carriers and biased toward said ratchet wheels, a pawl retainer operatively arranged in relation to each pawl and having a gate portion movable into and out of operative pawl engaging position, a gate bar operatively connecting said gate portions and means for actuating said gate bar.

19. In a straight independent needle knitting machine having a plurality of independently conditionable needle jacks, a main drive shaft, an intermediate shaft, clutch means operatively interposed between said drive shaft and said intermediate shaft and a screw shaft operated from said intermediate shaft, the combination of means for conditioning some of said needle jacks for narrowing, separate means for conditioning others of said needle jacks for decking, means mounted on said screw shaft and arranged and adapted to transmit simultaneous conditioning movement from said screw shaft to both of said conditioning means, and means operatively interposed between said clutch means and said intermediate shaft and arranged and adapted to connect and disconnect said independent shaft and said drive shaft.

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