

Aug. 15, 1939.

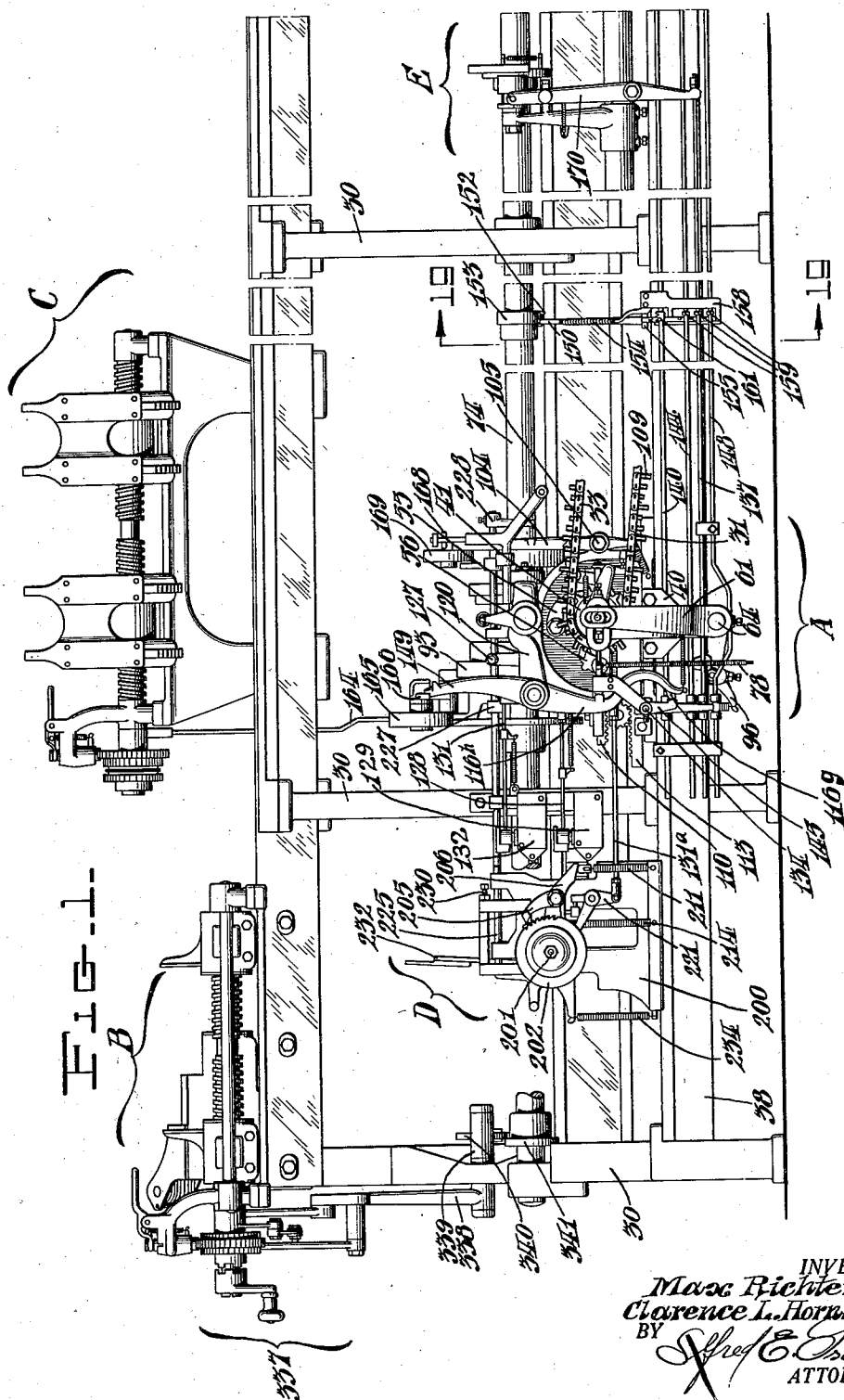
M. RICHTER ET AL

2,169,979

STRAIGHT KNITTING MACHINE

Filed Dec. 11, 1936

23 Sheets-Sheet 1



INVENTORS:
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Aug. 15, 1939.

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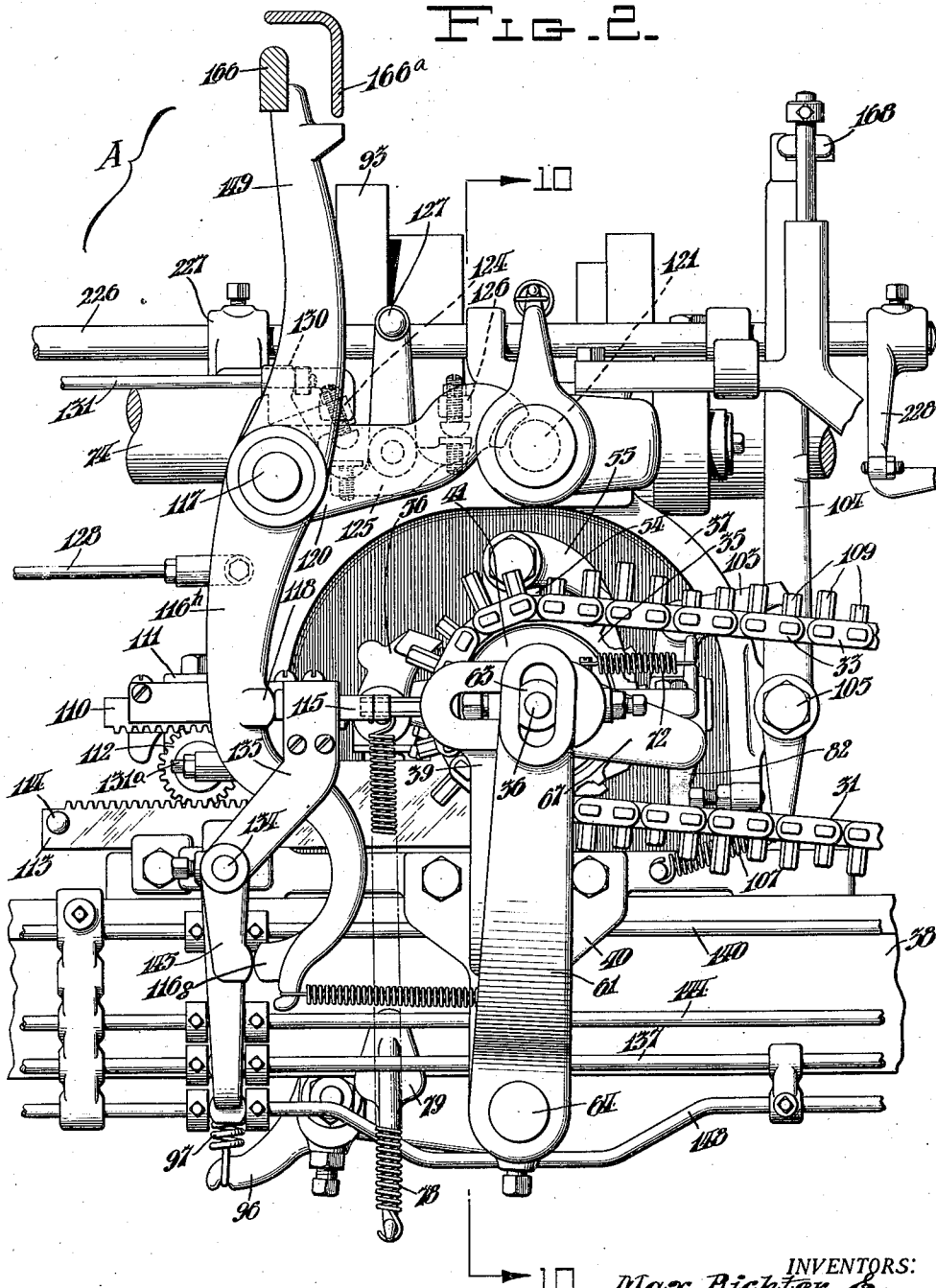
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STRAIGHT KNITTING MACHINE

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FIG. 2.



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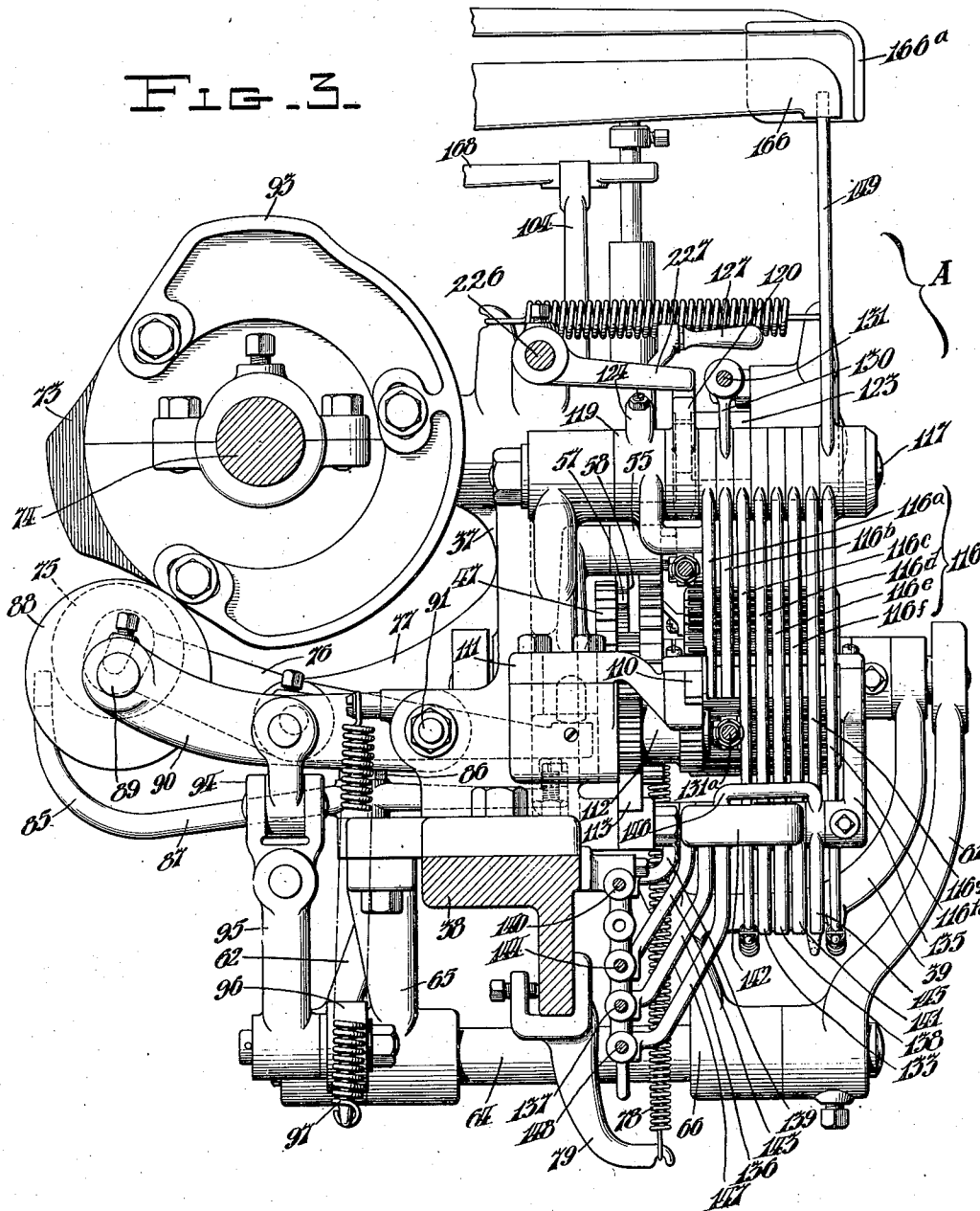
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FIG. 3.



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STRAIGHT KNITTING MACHINE

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FIG. 4.

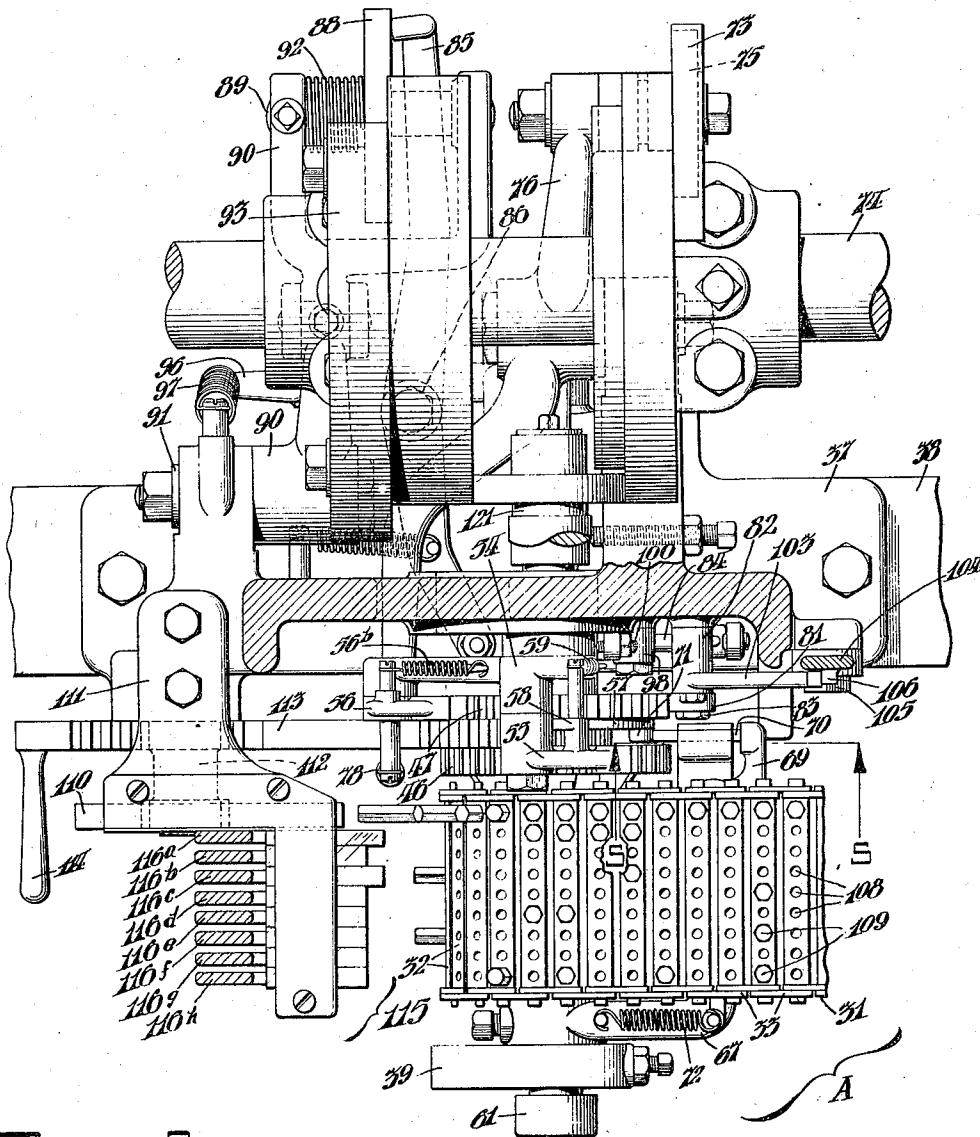


FIG. 5.

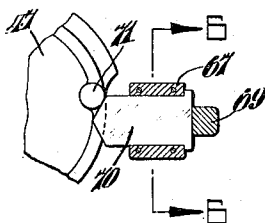
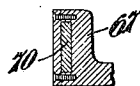


FIG. 6.



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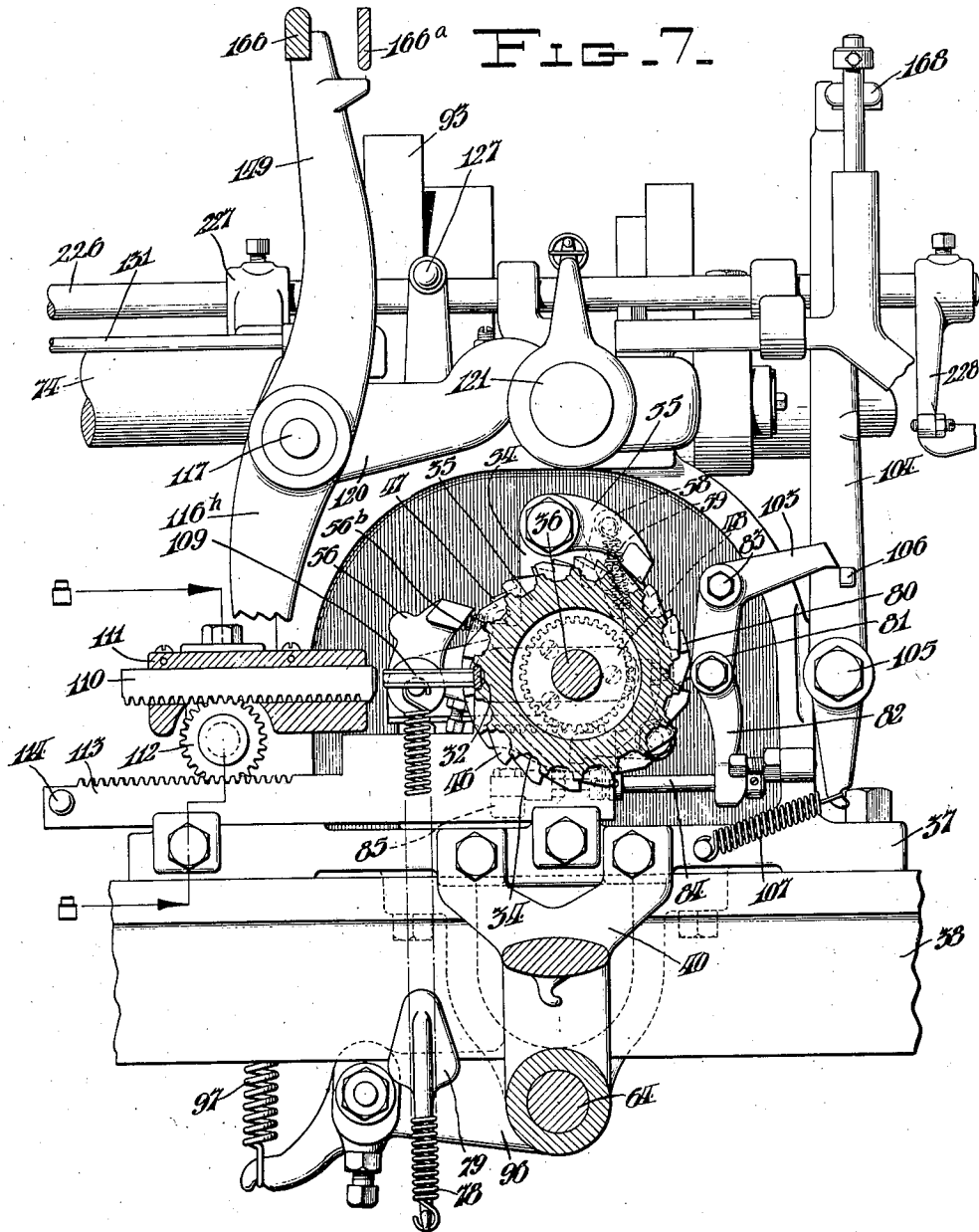
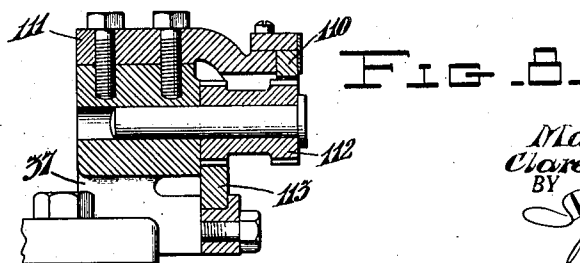
Aug. 15, 1939.

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STRAIGHT KNITTING MACHINE

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INVENTORS:
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Aug. 15, 1939.

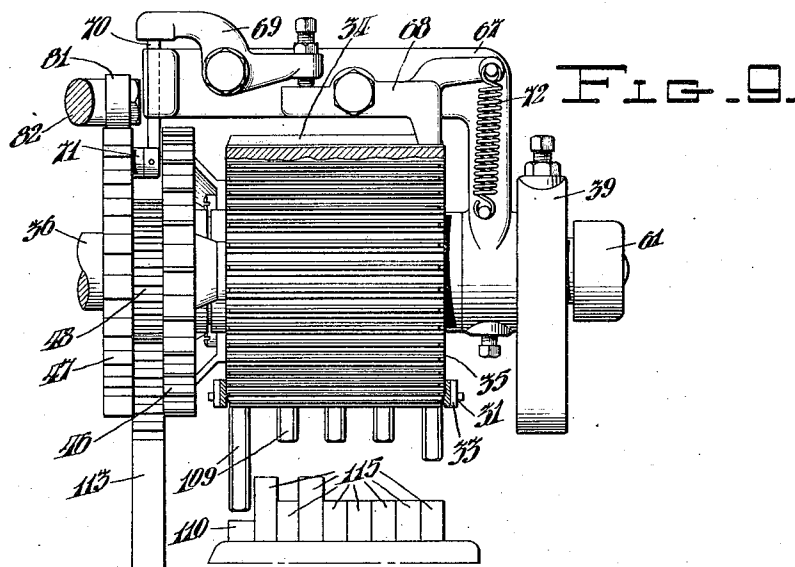
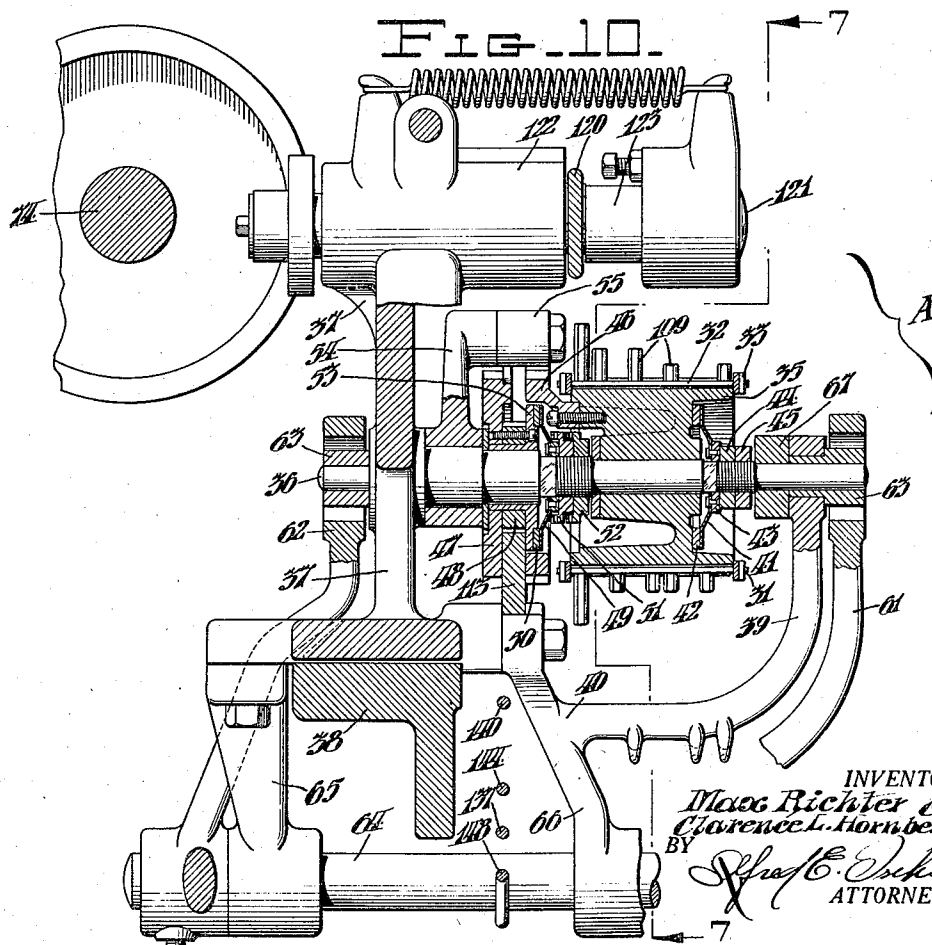
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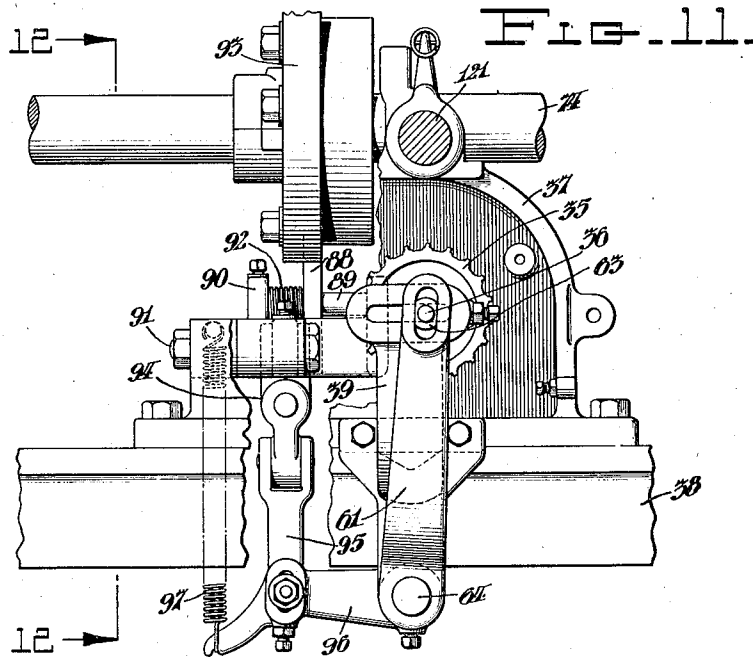
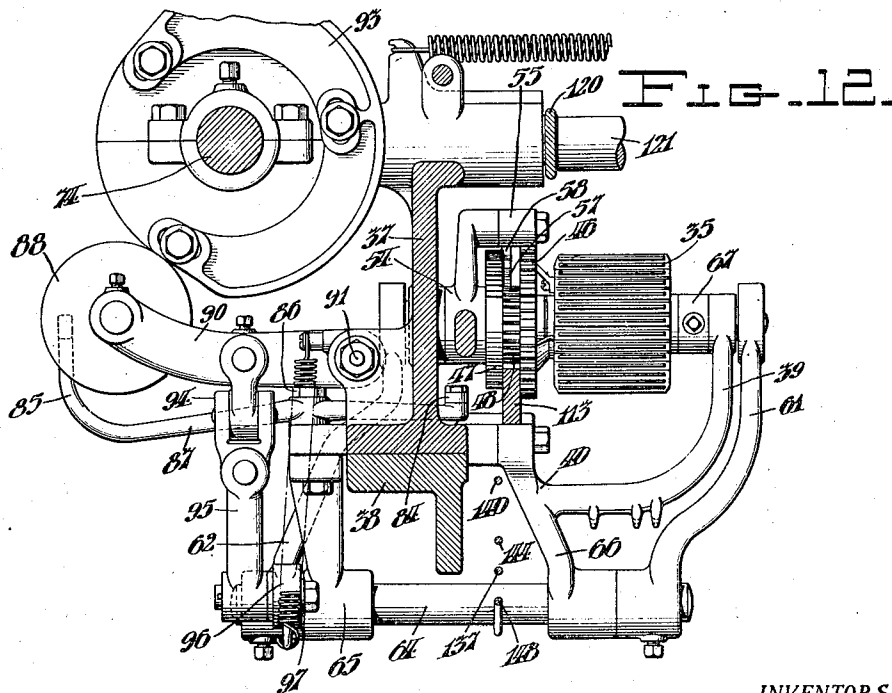
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STRAIGHT KNITTING MACHINE

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INVENTORS:
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FIG. 13.

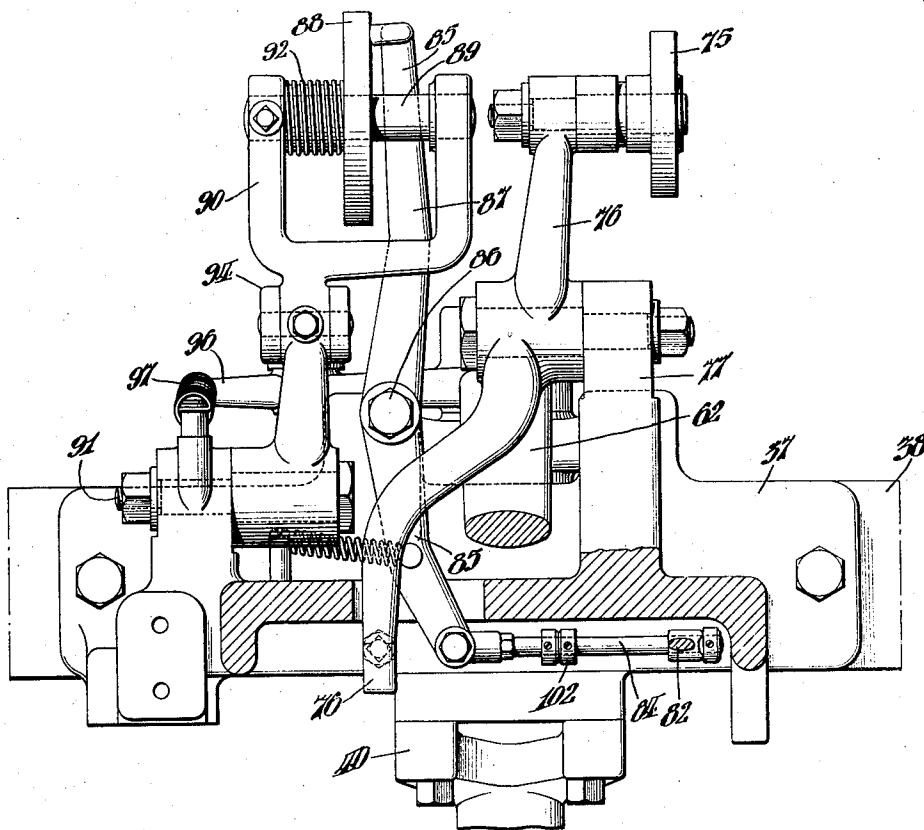
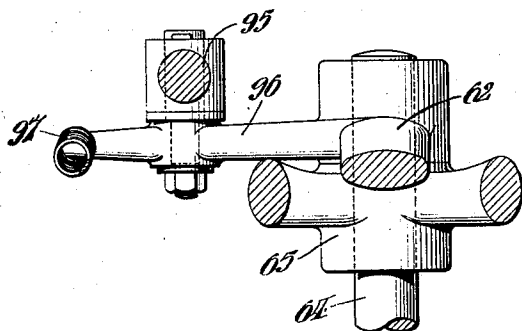


FIG. 14.

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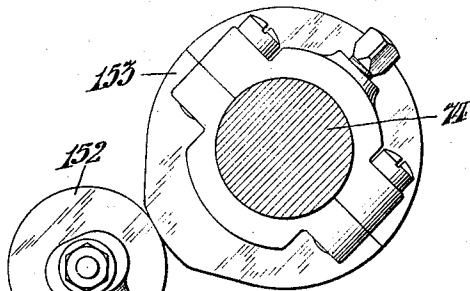
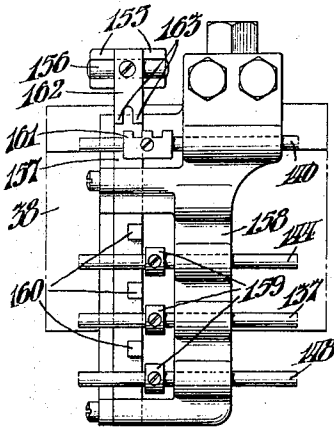
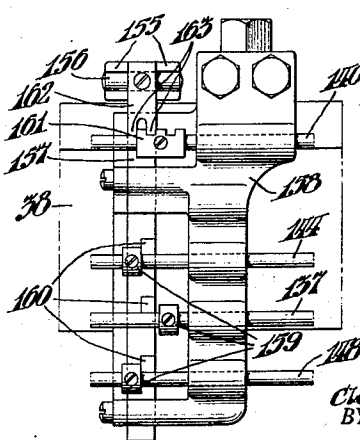
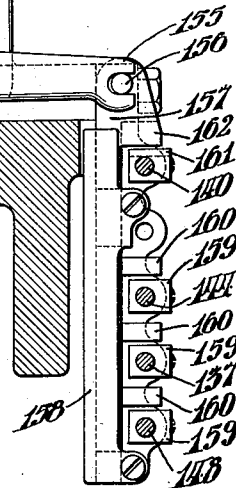


FIG. 19.

FIG. 20.

FIG. 21.



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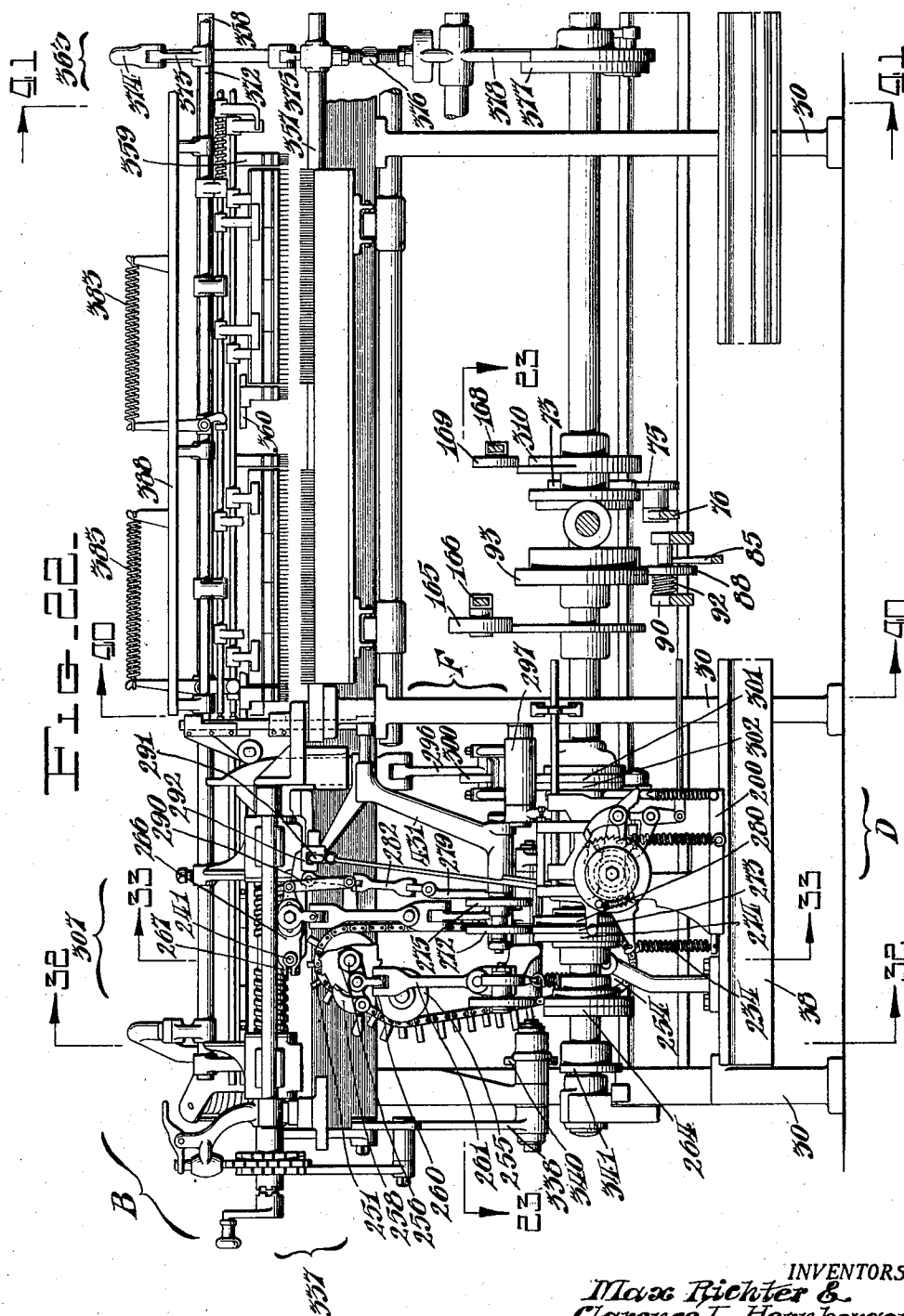
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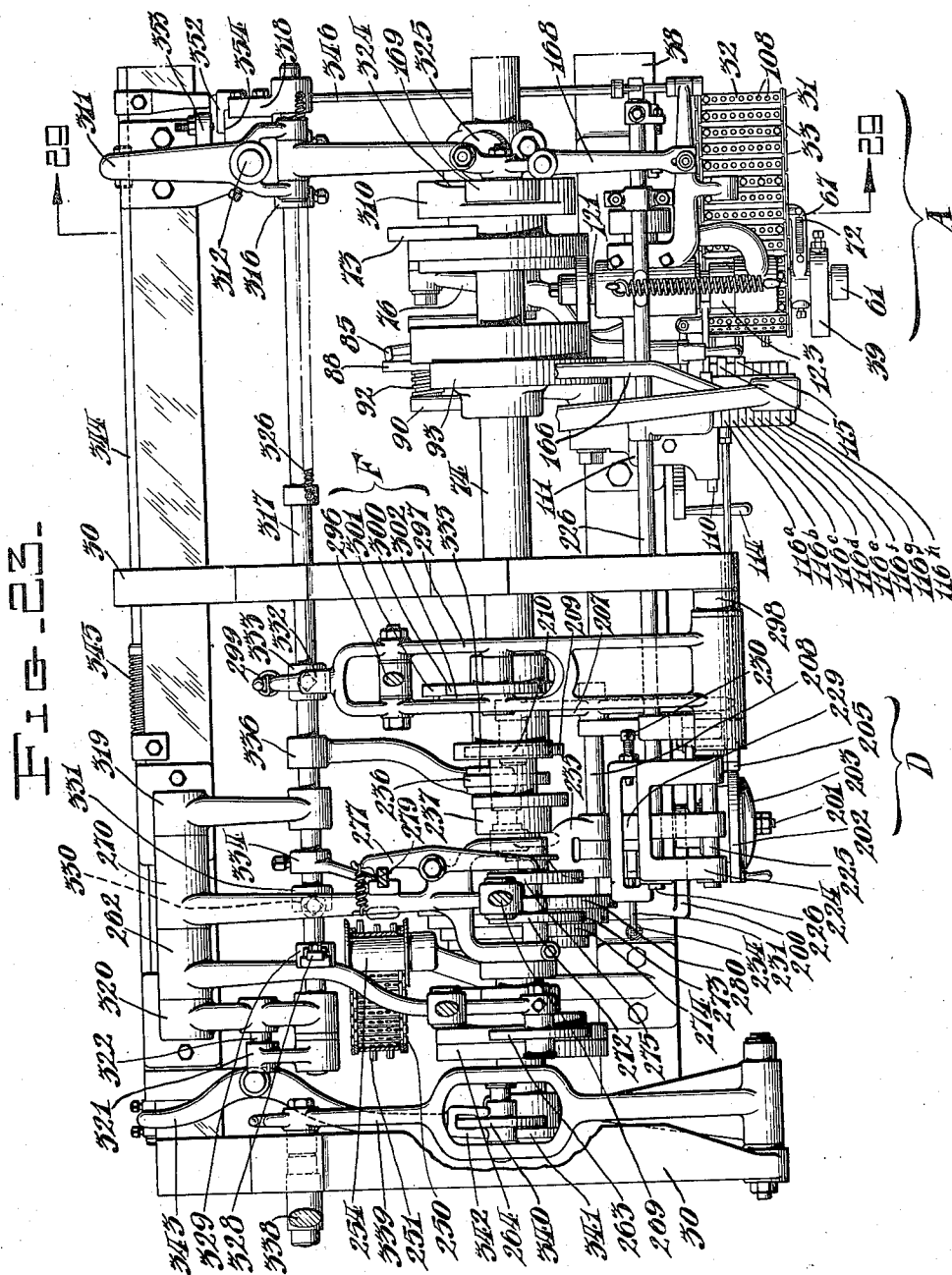
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STRAIGHT KNITTING MACHINE

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INVENTORS:
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FIG. 24.

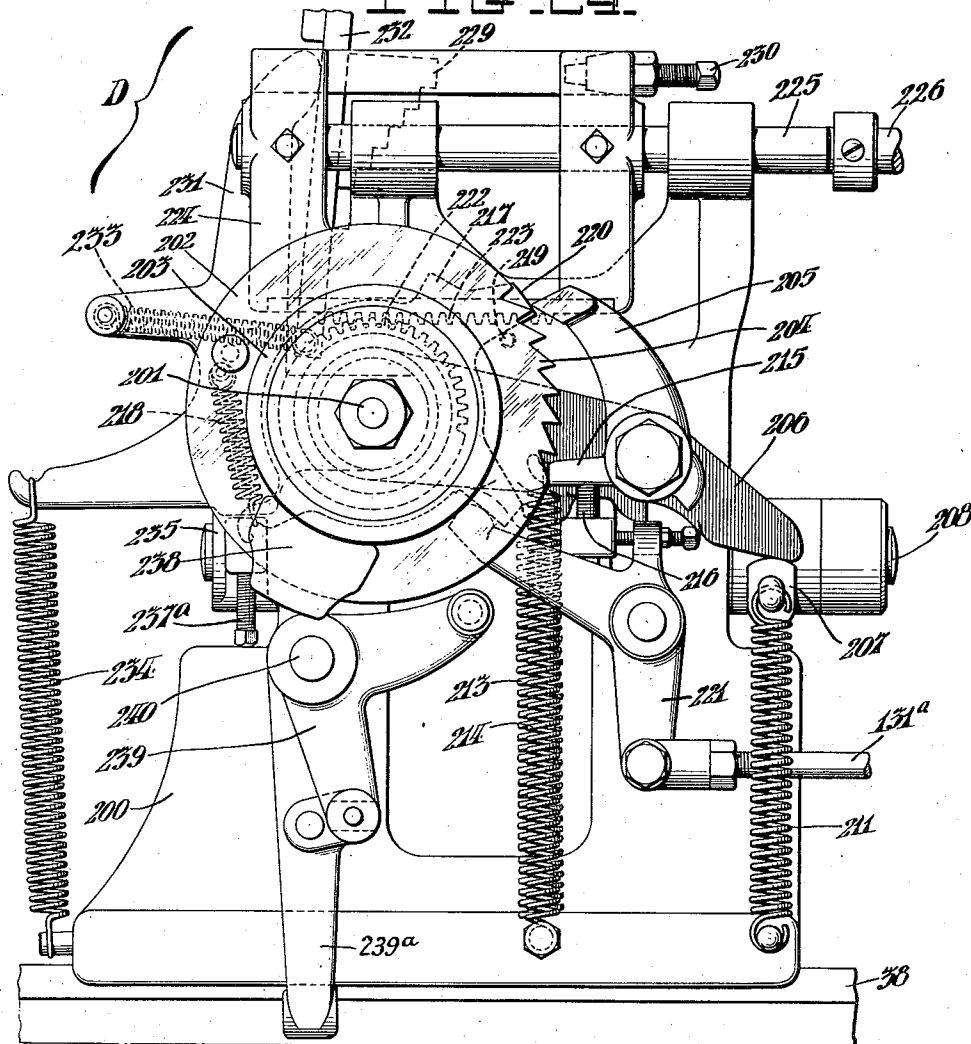
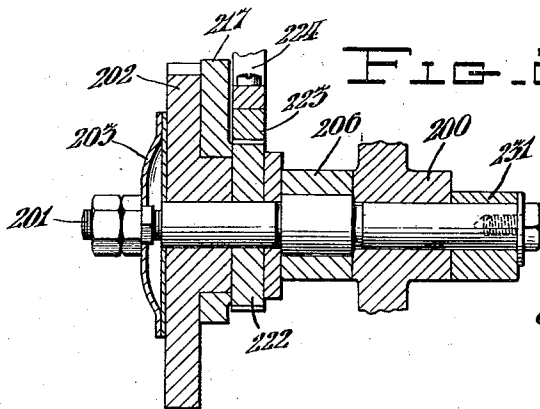


FIG. 25.



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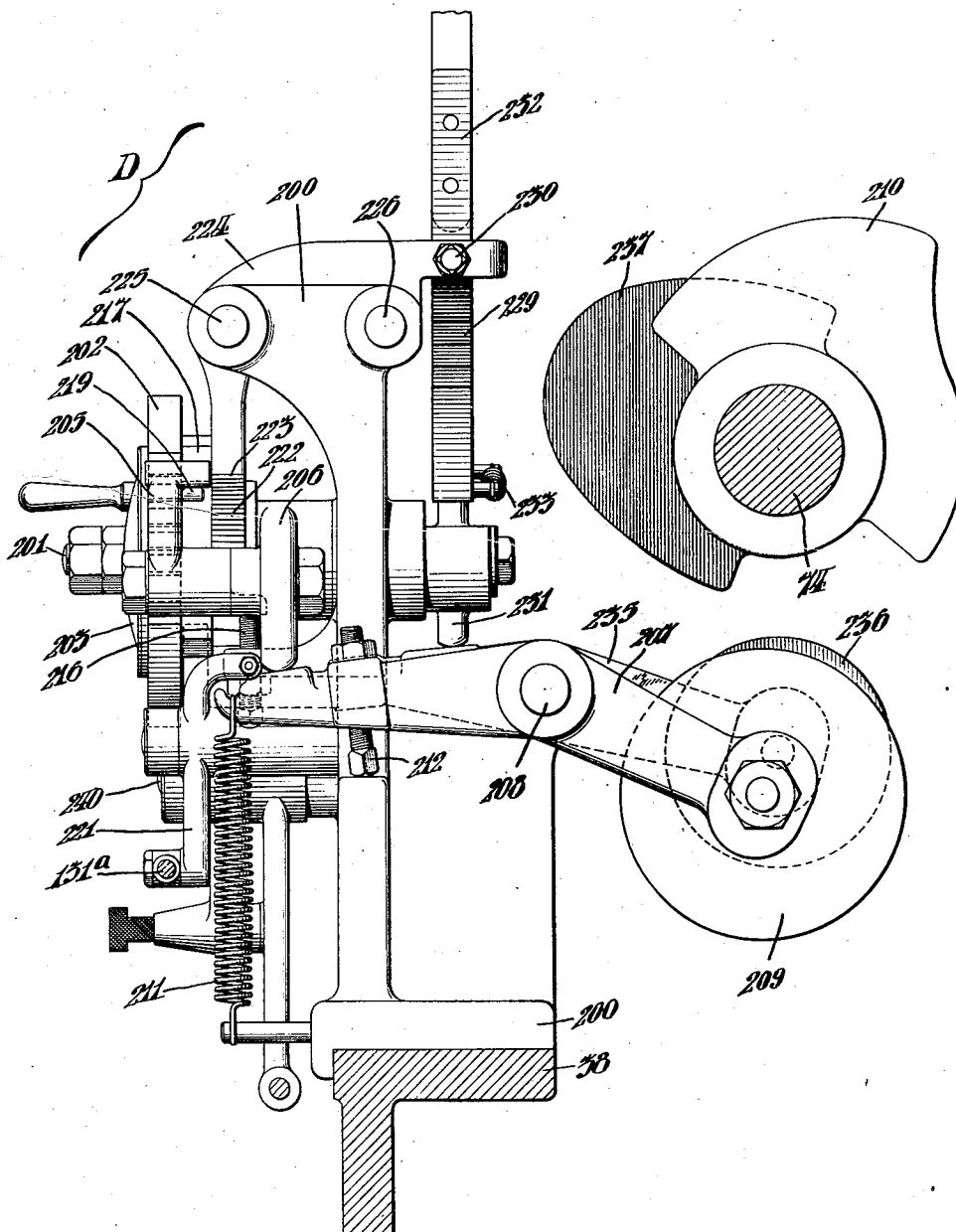
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FIG. 25.



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FIG. 27.

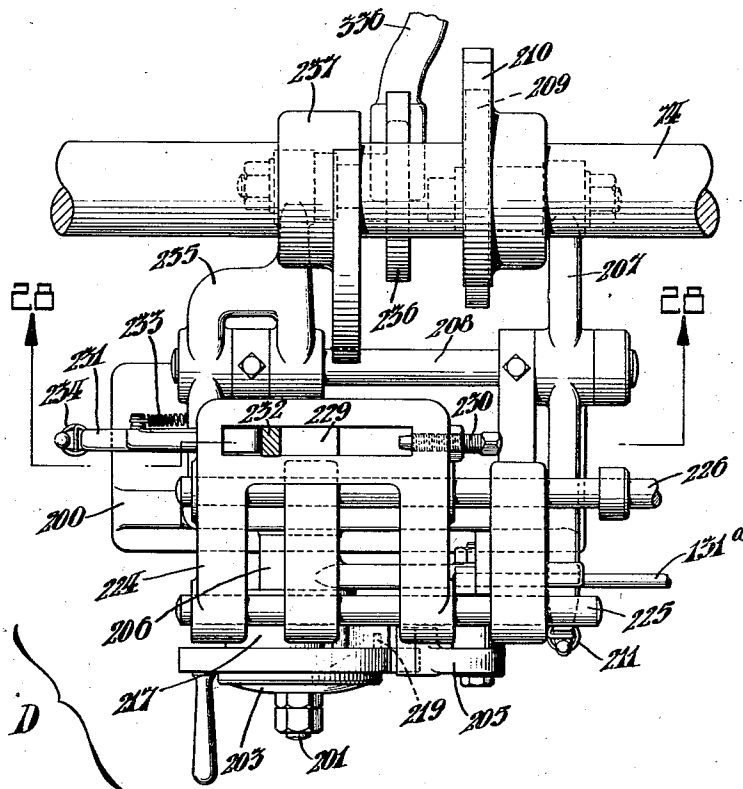
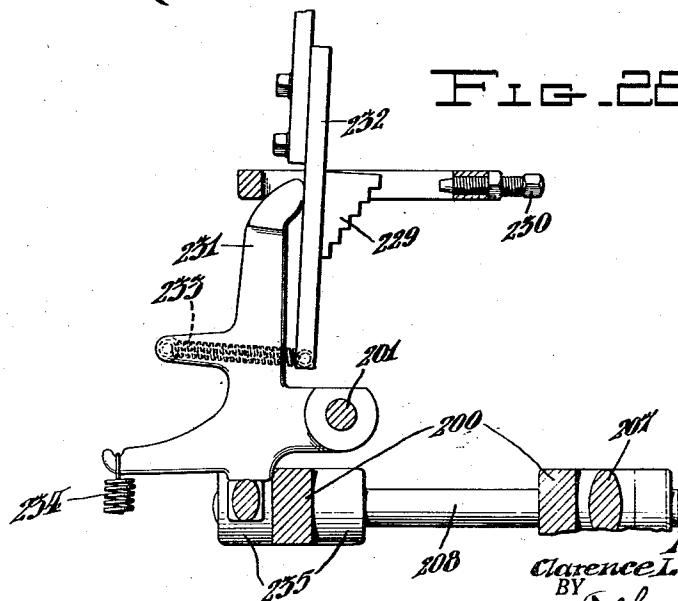


FIG. 28.



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FIG. 29.

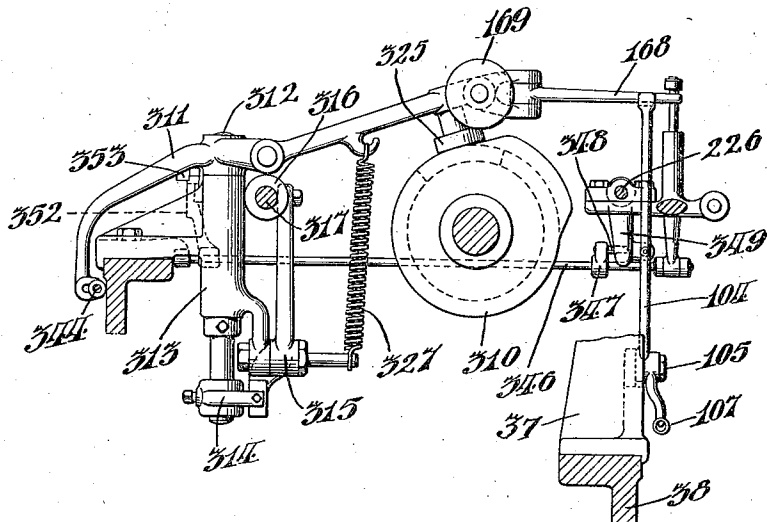
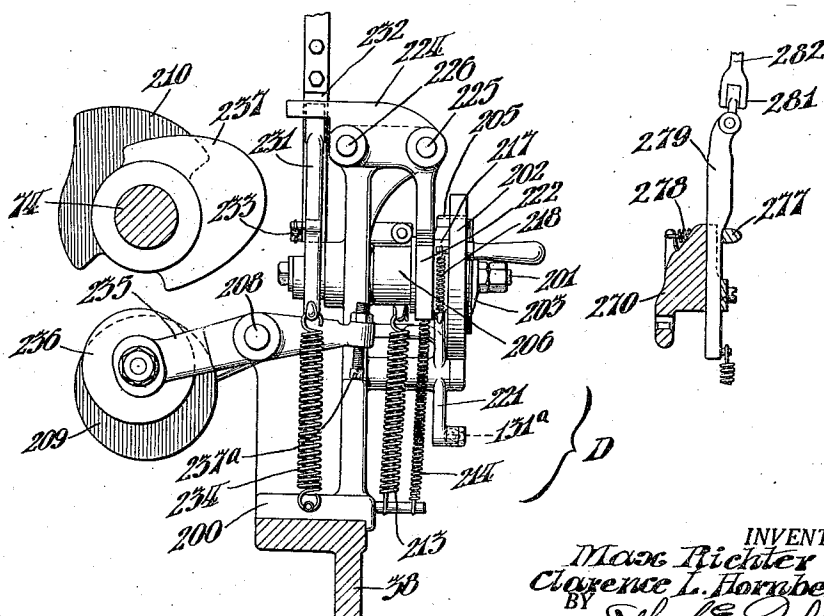


FIG. 30.

FIG. 31.



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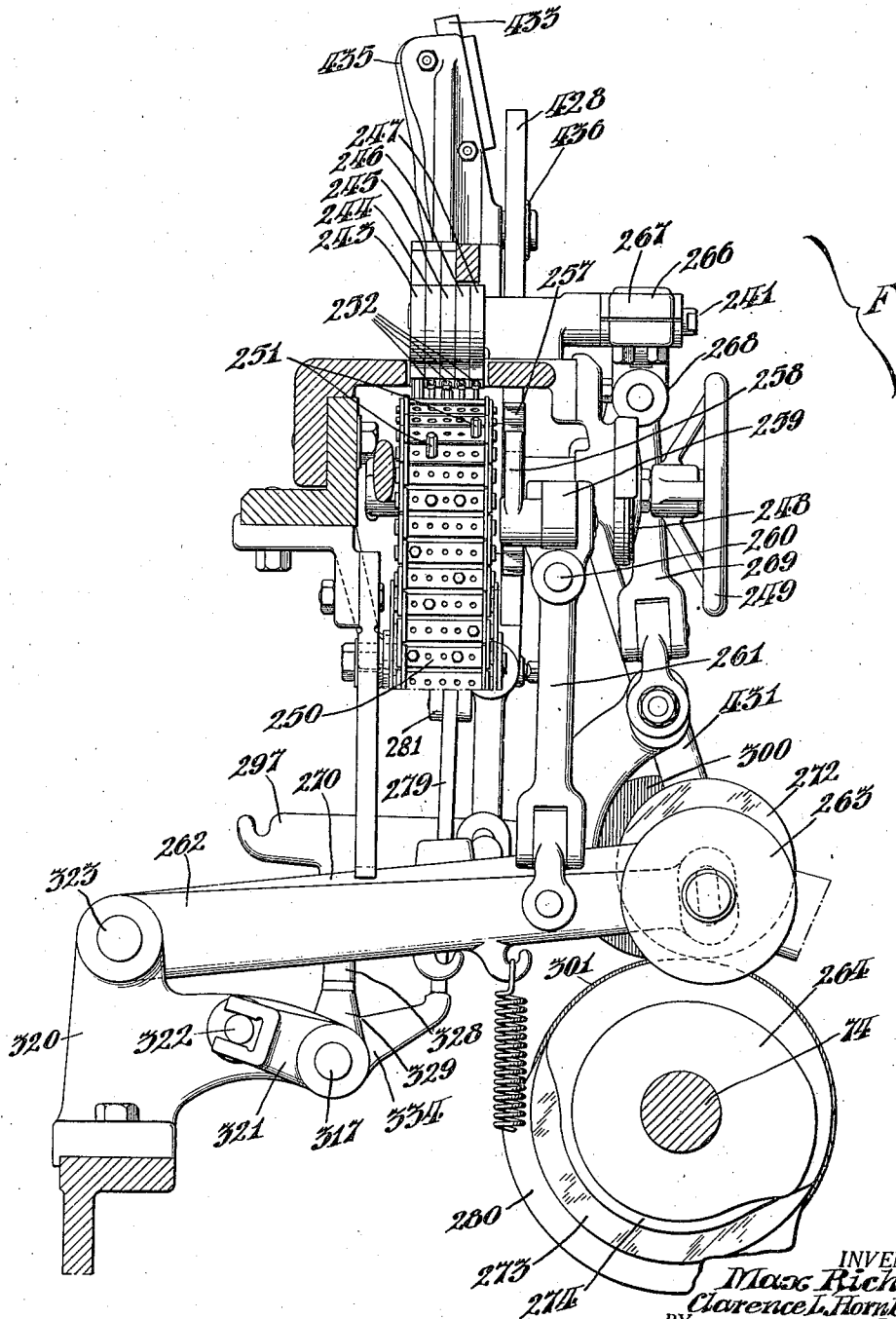
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Fig. 32.



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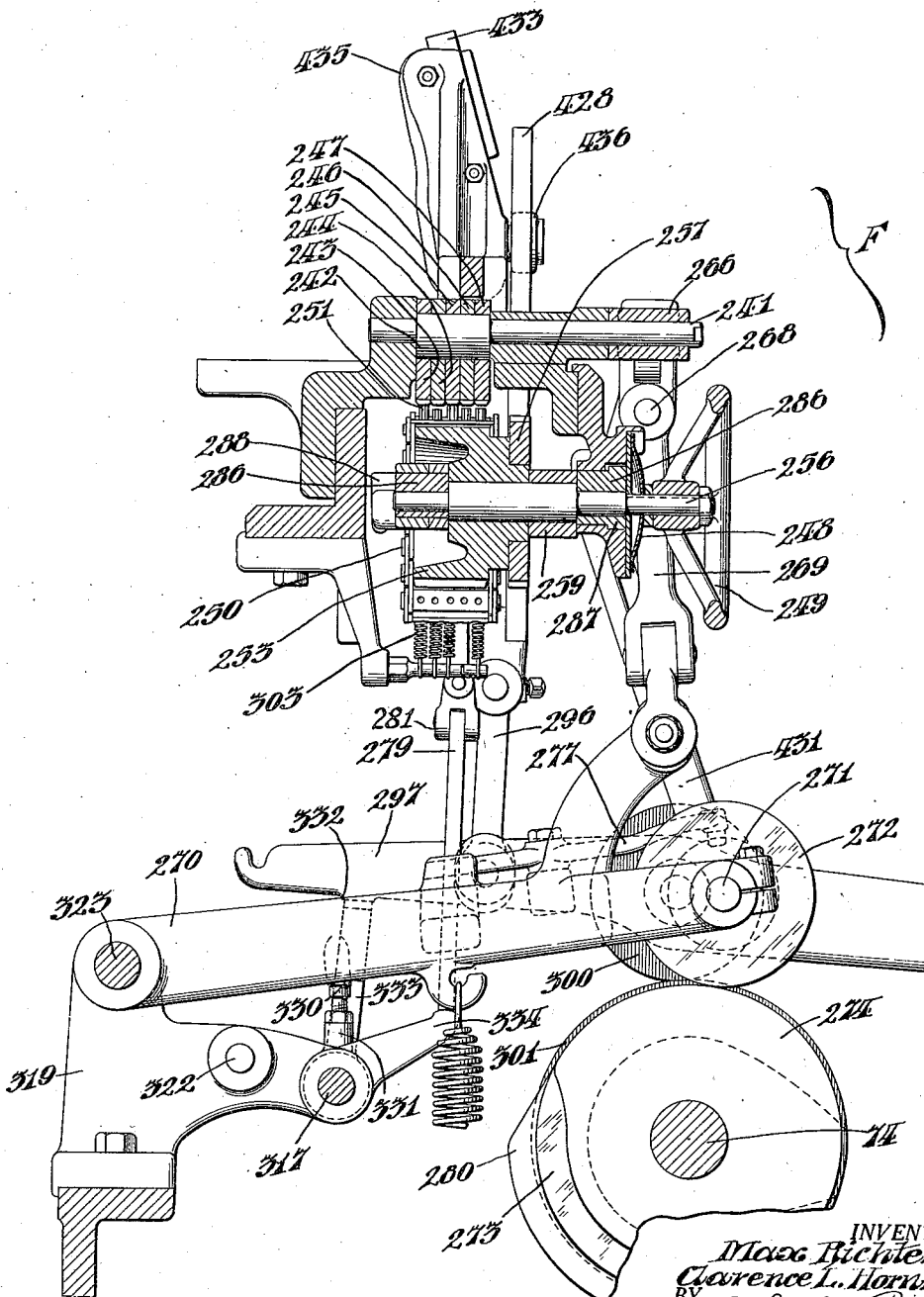
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FIG. 33.



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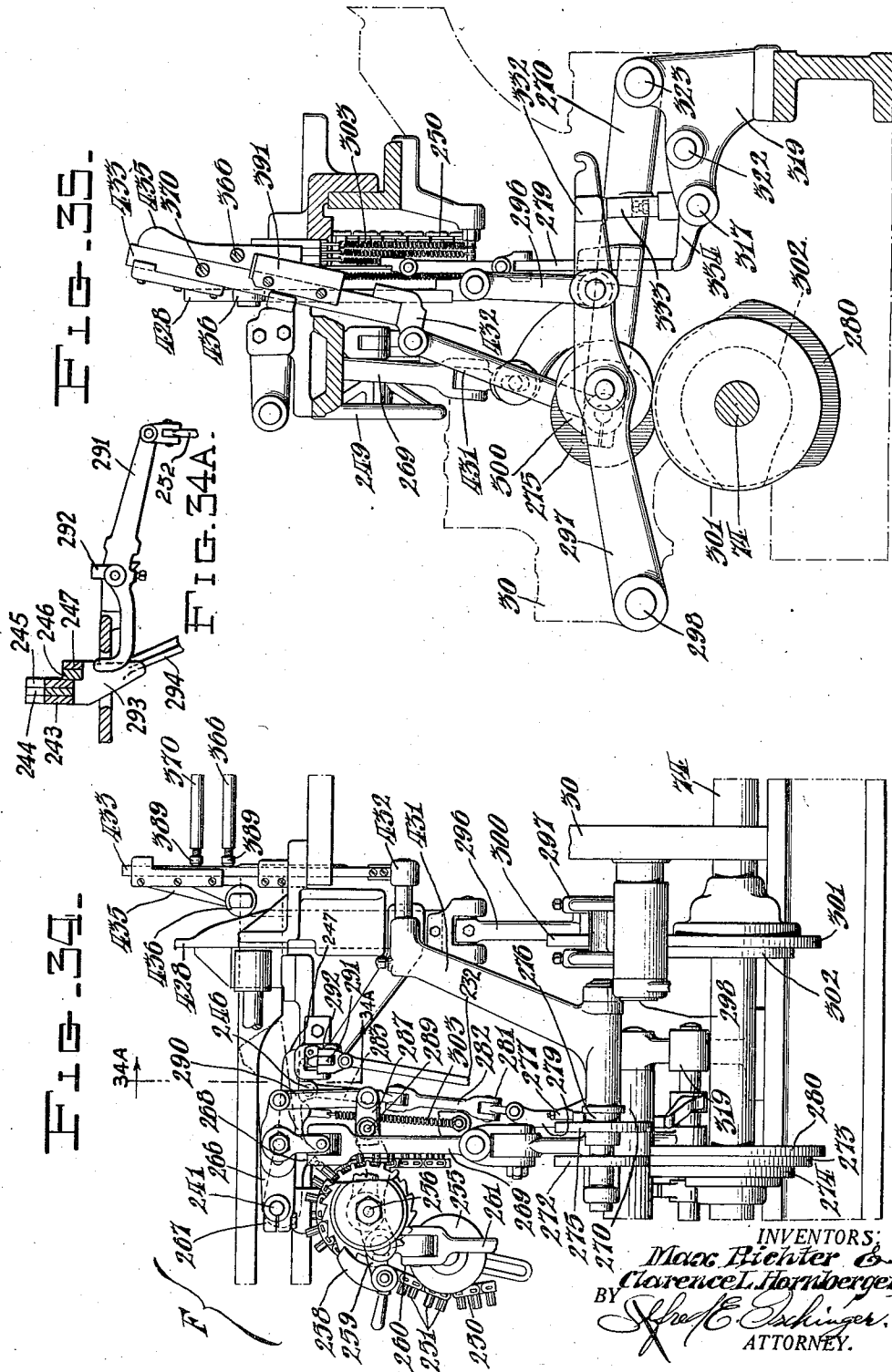
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FIG. 35.

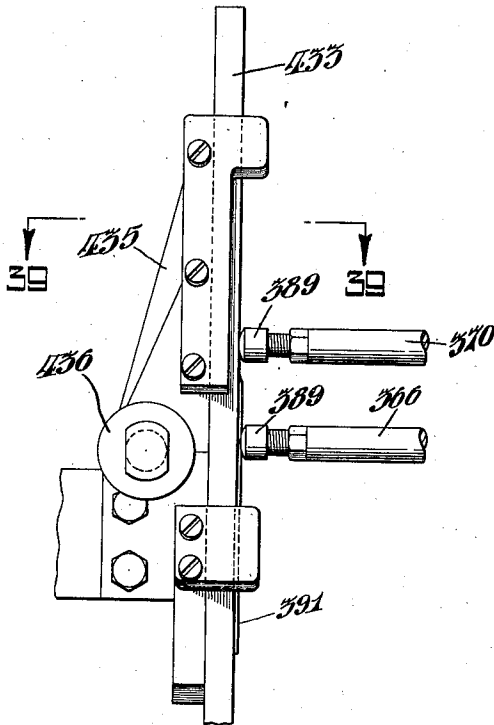


FIG. 37.

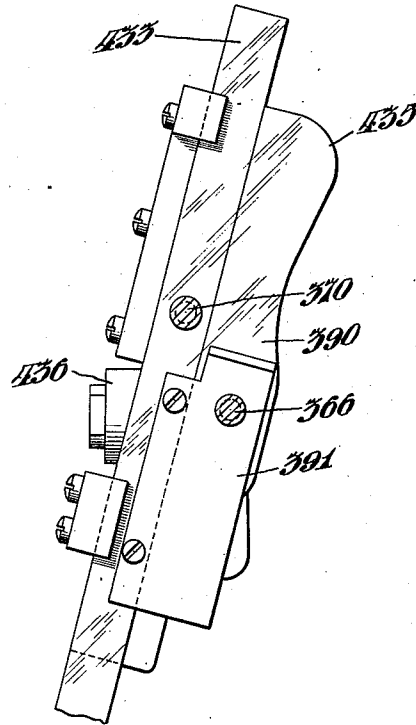


FIG. 38.

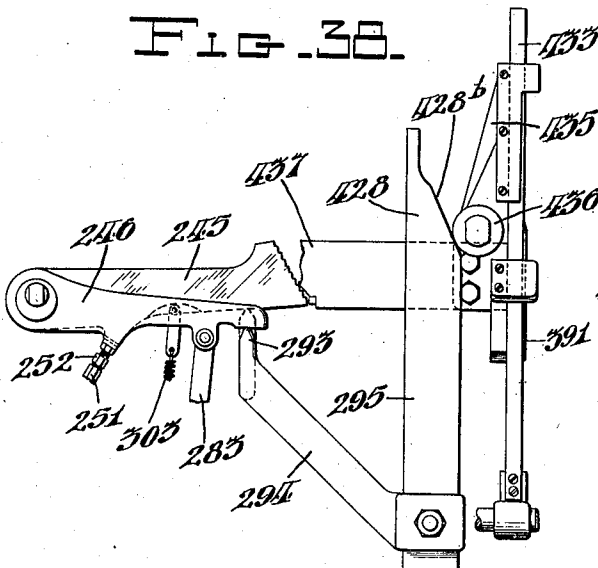
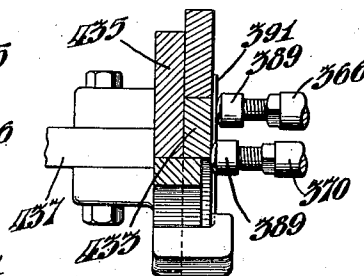


FIG. 39.



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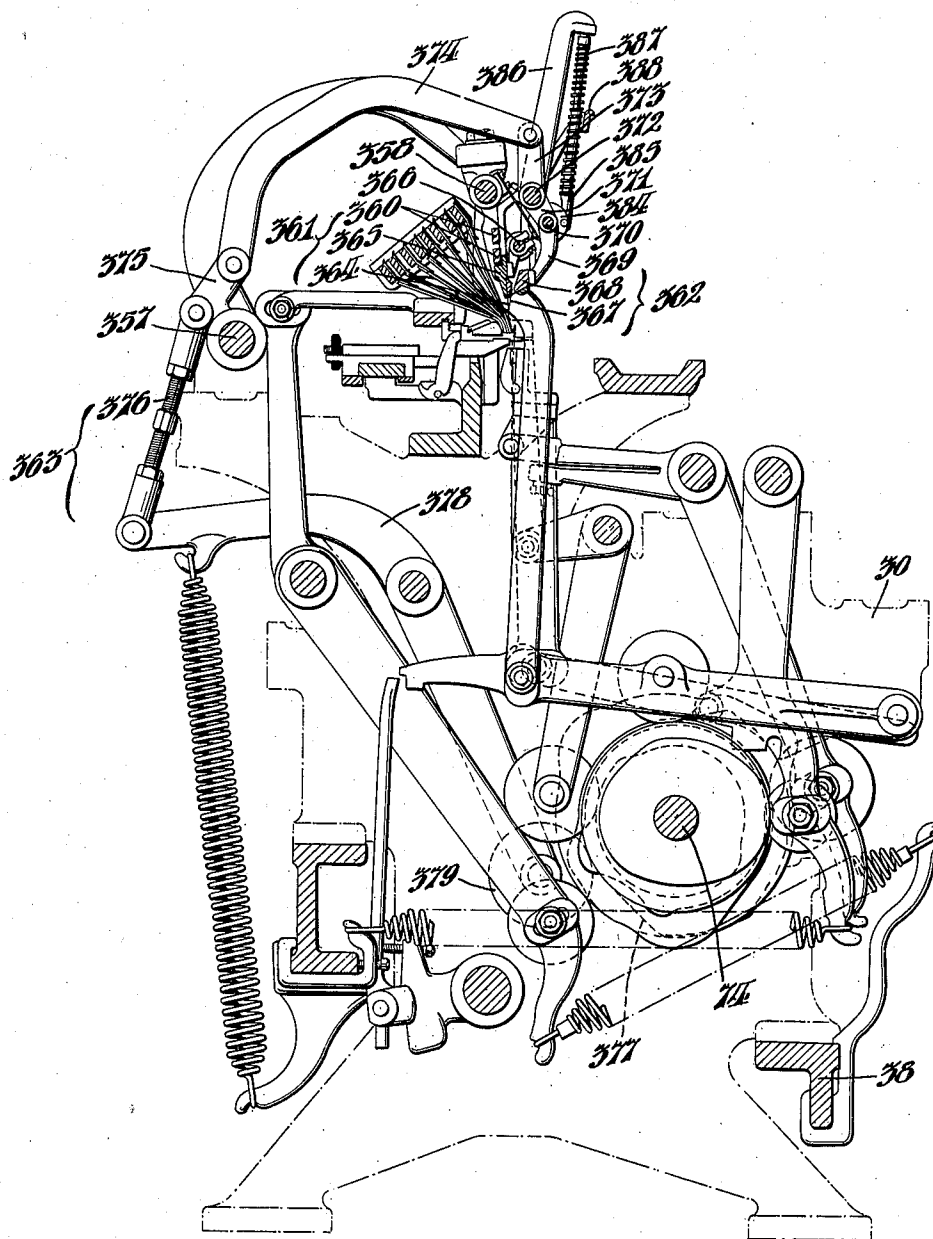
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Fig. 40.



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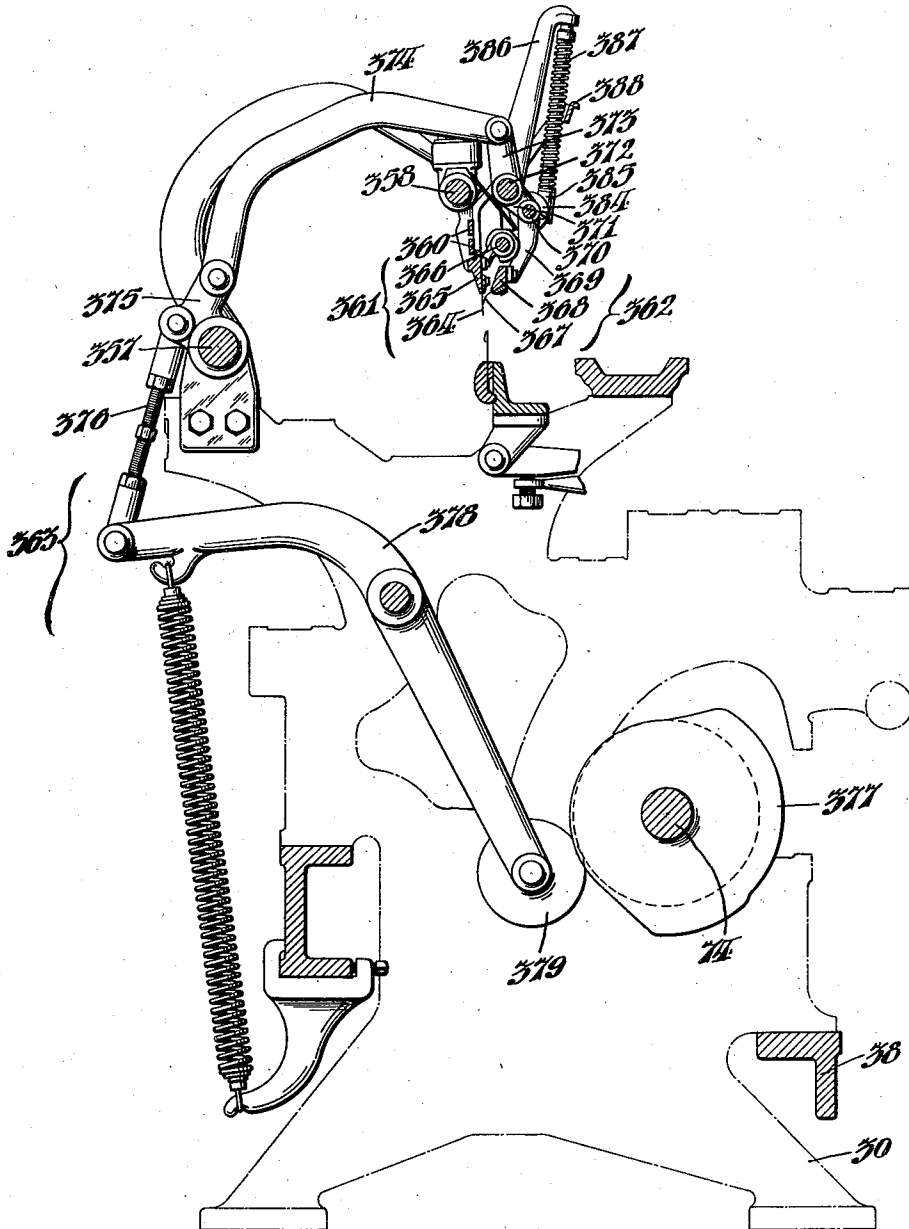
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STRAIGHT KNITTING MACHINE

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FIG. 41.



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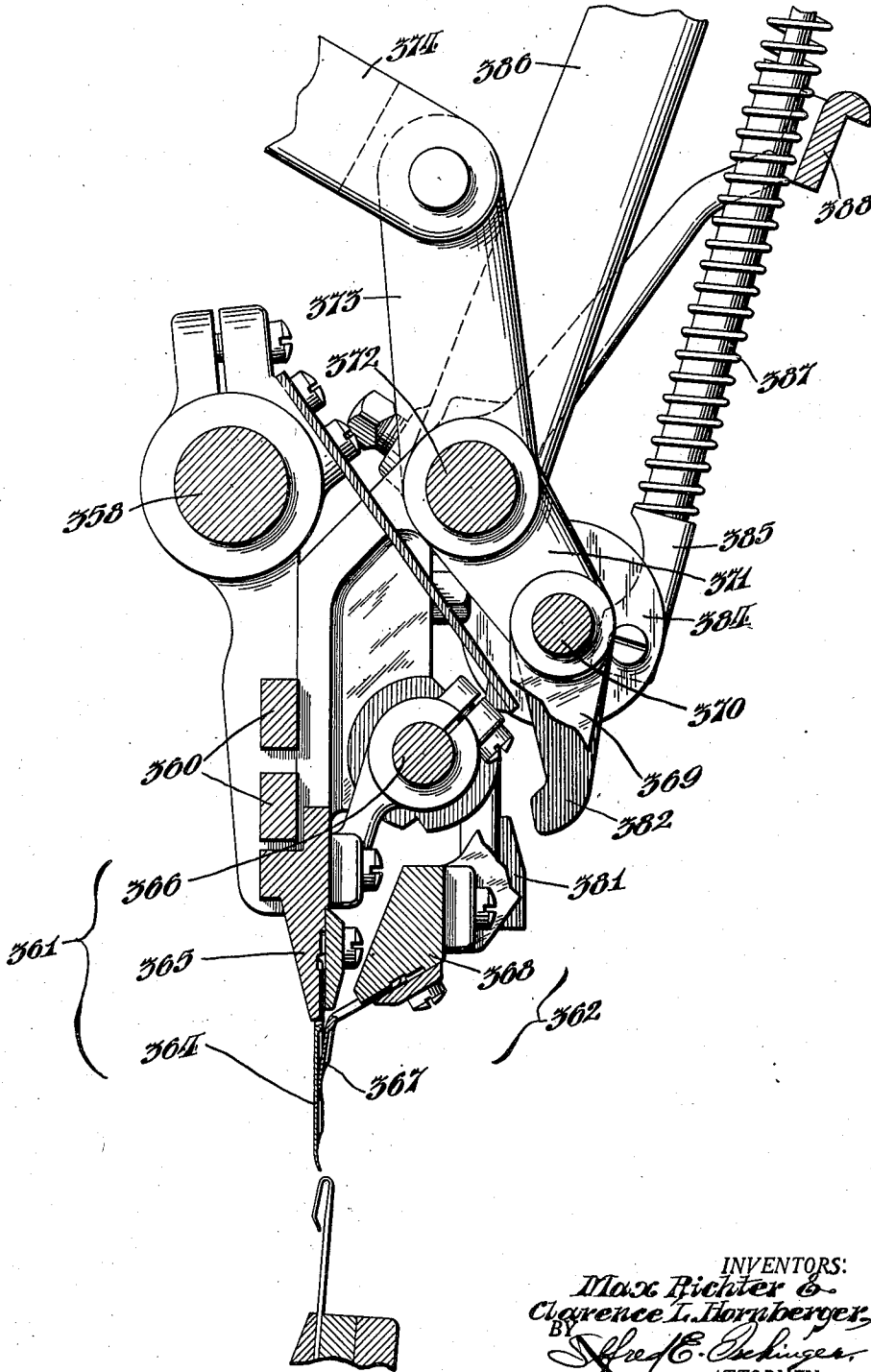
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Fig. 42.



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UNITED STATES PATENT OFFICE

2,169,979

STRAIGHT KNITTING MACHINE

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Application December 11, 1936, Serial No. 115,290

54 Claims. (Cl. 66—96)

This invention relates to improvements in knitting machines, and is particularly directed to improvements in pattern chain control apparatus adapted for use with straight or full fashioned knitting machines.

Pattern chains employed on machines of this type have a separate link for each course, and utilize buttons clamped to appropriate links for controlling the actuation of the various mechanisms at predetermined stages in the knitting operation. This was accomplished by providing control members having contact terminals adjacent the path of the chain buttons and having a rocking engagement therewith, necessarily resulting in considerable wear, and requiring relatively large buttons. Consequently the number of buttons that could be located in a given space was sharply limited, and relatively wide chains, or more than one chain, were required on many machines. Moreover, since a separate link was required for each course, long pattern chains were necessary, which were cumbersome, subject to inaccuracies in racking, and which made it difficult to locate accurately the position of buttons controlling particular mechanisms.

An object of this invention is to provide a more compact pattern chain control apparatus, with a shorter chain adapted to control the same number of courses as the prior long chain. This is accomplished in general by utilizing a single link to control a plurality of courses. A specific feature is the use of means on each link to determine the number of courses controlled by said link.

A further object of the invention is to improve the construction, arrangement and effectiveness of the buttons. These improvements are made possible by imparting to the buttons a direct movement toward the contact terminals of the control members to actuate said members, instead of employing the wiping or cam engagement heretofore in use. This method of operation permits the use of buttons of a different type. They may be narrower, permitting the location of a larger number in a given space. They may vary in height to an extent that is impractical where a wiping engagement is employed, and such extensive variations in height may be utilized to produce with each button a much wider variety of operations.

In the preferred embodiment the number of courses knitting during the period when each link is effective is determined by a button on said link. This may conveniently be accomplished by the use of buttons varying in height, each

height corresponding to a certain number of courses; and the number of courses that will be knitted between given points on the chain can readily be determined by adding up the corresponding numbers of all of the course-controlling buttons between such points. This arrangement facilitates the ready determination of the exact location of buttons controlling auxiliary mechanism.

Still another object of the invention is to provide apparatus for the control of transfer points generally referred to as lace mechanism which is adapted to cooperate with the pattern control apparatus to permit a wide variety of automatic operations. A particular feature is likewise the incorporation of a regulating device which may be interposed between the pattern control and the point actuating mechanism for automatically providing a selected number of plain courses between lace courses and otherwise providing a wider range of control and possible operations.

Another feature of this invention comprises the movement of the buttons toward the control members in a plurality of stages, which makes it possible to design such members so that they will produce successive operations in predetermined timed relation in accordance with the corresponding timed actuating movements of said buttons.

Other objects and advantages of the invention will appear from the following description, considered in connection with the accompanying drawings, in which:

Figure 1 is a front elevation of an end portion of a full fashioned knitting machine frame with a preferred embodiment of the invention mounted thereon, together with various auxiliary mechanisms, parts being broken away;

Fig. 2 is an enlarged detail front elevation of the improved pattern chain mechanism and associated parts shown in Fig. 1;

Fig. 3 is an elevational view taken from the left of Fig. 2;

Fig. 4 is a plan view of the mechanism shown in Fig. 2, with the parts overlying the chain and adjacent mechanism broken away;

Fig. 5 is a detail section on line 5—5 of Fig. 4 showing the device actuating the sprocket drum lock release;

Fig. 6 is a fragmentary section on line 6—6 of Fig. 5;

Fig. 7 is a vertical section on line 7—7 of Fig. 10, with parts broken away, showing the drum racking mechanism;

Fig. 8 is a detail section on line 8—8 of Fig. 7;

Fig. 9 is a top plan view of the sprocket drum and associated structure with parts broken away;

Fig. 10 is a transverse vertical section on line 10—10 of Fig. 2, parts being broken away;

5 Fig. 11 is a front elevation showing the sprocket drum shifting mechanism, with parts broken away;

Fig. 12 is a transverse section on line 12—12 of Fig. 11;

10 Fig. 13 is a plan view of the cam followers and associated lever systems;

Fig. 14 is a detail fragmentary plan view of certain arms and pivots in the subjacent part of the structure shown in Fig. 13;

15 Fig. 15 is a fragmentary vertical longitudinal section through the sprocket drum and associated parts, similar to a portion of Fig. 7 but showing the drum locking bracket and with the drum in shifted position to the left, parts being broken away;

20 Fig. 16 is a view similar to Fig. 15 but with the sprocket drum in normal position to the right, and with the pawls advanced;

Fig. 17 is a fragmentary view of the course-counting pawl in inactive position;

25 Fig. 18 is a view similar to Fig. 17 with the pawl in advanced position;

Fig. 19 is a fragmentary transverse sectional view on line 19—19 of Fig. 1 illustrating a rod-locking device;

30 Fig. 20 is a view of the locking mechanism shown in Fig. 19 looking from the right of said figure, with the parts in unlocked position;

Fig. 21 is a view similar to Fig. 20 with the parts in locked position;

35 Fig. 22 is a front elevation similar to Fig. 1, showing the lace clock apparatus, the lace course regulator and associated parts, the pattern control mechanism being broken away to show the cam arrangement;

40 Fig. 23 is a sectional plan view on line 23—23 of Fig. 22 showing the cam shaft and associated actuating mechanisms with parts broken away;

Fig. 24 is an enlarged front elevation of the lace course regulator unit;

45 Fig. 25 is a fragmentary section through the lace course regulator spindle;

Fig. 26 is a side elevation of the regulator unit taken from the right of Fig. 24;

50 Fig. 27 is a plan view of the regulator unit as shown in Fig. 24;

Fig. 28 is a fragmentary vertical section on line 28—28 of Fig. 27 showing the setting mechanism for said unit;

55 Fig. 29 is a fragmentary vertical section on line 29—29 of Fig. 23, showing the point control release shifting mechanism;

Fig. 30 is a side elevation of the regulator unit taken from the left of Fig. 24;

60 Fig. 31 is a detail vertical section showing the follower-shifting slide;

Fig. 32 is a fragmentary vertical section on line 32—32 of Fig. 22 showing the lace pattern chain mechanism in side elevation;

65 Fig. 33 is a fragmentary vertical section on line 33—33 of Fig. 22 passing through the lace pattern chain spindle and the point control eccentric spindle;

70 Fig. 34 is a fragmentary front elevation of the point positioning and shifting mechanism;

Fig. 34A is a fragmentary detail in sectional elevation, taken substantially on the line 34A—34A of Fig. 34, looking in the direction of the arrows;

Fig. 35 is a fragmentary side elevation of said mechanism taken from the right of Fig. 34;

Fig. 36 is a fragmentary front elevation of a portion of the point rod shifting slide of Fig. 34, parts being shown in a different position;

Fig. 37 is a side view of the same slide portion taken from the right of Fig. 36;

Fig. 38 is a detail front view of the point rod shifting slide with the cooperating shifting and positioning apparatus;

Fig. 39 is a fragmentary section on line 39—39 of Fig. 36;

Fig. 40 is a vertical section on line 40—40 of Fig. 22, omitting the main pattern chain apparatus and including a general showing of the point rod dipping mechanism and associated parts of the standard knitting machine structure;

Fig. 41 is a sectional view taken on line 41—41 of Fig. 22 showing the mechanism for vertical manipulation of the auxiliary points; and

Fig. 42 is a fragmentary enlarged view of the point supporting and manipulating parts on the same plane as Fig. 41.

Only those parts of the knitting machine necessary for an understanding of the invention are shown in the drawings; the various other parts and mechanisms and their manner of operation are well known in the art, and are shown and described in detail in the "Reading" Full Fashioned Knitting Machine Catalogues, copyrighted 1920, 1929 and 1935 and published by the Textile Machine Works, Reading, Pennsylvania, and in a booklet entitled "Knitting Machine Lectures" published in 1935 by the Wyomissing Polytechnic Institute, Wyomissing, Pennsylvania.

Fig. 1 is a front view of one end of a full fashioned knitting machine of the type indicated, with various mechanisms mounted on a frame 30. These mechanisms include in addition to a pattern chain control mechanism A, a usual narrowing assembly B, a reinforced selvage attachment C, a lace course regulator unit D and an inside rocker unit E. An associated lace clock apparatus F is shown in Fig. 22 and succeeding figures.

Main pattern chain control A

A pattern chain 31 of the pattern chain control mechanism A is constructed with a plurality of transverse bars 32 connected at their ends by links 33, bars 32 being engaged by suitable depressions 34, Fig. 7, in the sprocket drum 35. Drum 35 is rotatably mounted on spindle 36 supported at its rear end by a frame bracket 37 mounted on front beam 38 of frame 30 (Fig. 10). The outer end of spindle 36 is supported by arm 39 of spindle bracket 40 bolted to the base of frame bracket 37.

Where reference is made herein to left, right or other directions, they are based on the position of the observer facing the front of the machine, as in Fig. 1.

A braking arrangement is provided for preventing accidental rotation of sprocket drum 35. This includes a concave spring disc 41 (Fig. 10) having a friction ring 42 bearing against the recessed outer end of drum 35. Disc 41 is mounted on a collar 43 which is mounted on the square portion of spindle 36 and is adjustably forced against drum 35 by pressure nut 44 on the spindle, held in position by lock nut 45, pressing the drum 35 against a suitable shoulder on spindle 36.

A chain-driving ratchet wheel 46 is mounted

on the opposite end of drum 35. An interval determining element or course-counting ratchet wheel 47 is mounted on the spindle adjacent ratchet wheel 46 and carries a pinion 48 on the face toward ratchet wheel 46, pinion 48 and wheel 47 being rotatable about spindle 36 and provided with a brake structure similar to that above described in connection with the sprocket drum 35. This brake arrangement includes a concave spring disc 49, friction ring 50, pressure nut 51 and lock nut 52, friction ring 50 engaging a flange on a collar 53 on which the course-counting ratchet wheel 47 and associated pinion 48 are mounted, a suitable shoulder on spindle 36 retaining collar 53 in position against the pressure of said brake.

Means is provided for racking the chain-driving ratchet wheel 46 and the course-counting ratchet wheel 47. In the form illustrated, a bell crank 54 (Fig. 7) rotatably mounted on spindle 36 carries at its upper end a pawl 55 positioned to engage the chain-driving ratchet wheel 46. The other arm of said bell crank 54 carries pawl 56 positioned to engage the course-counting ratchet wheel 47 (Figs. 15-18). In the arrangement shown, the chain driving ratchet wheel 46 is racked one step after the course-counting ratchet wheel 47 has been racked a predetermined number of times corresponding to the selected number of courses to be knitted during the dwell of the pattern chain. To accomplish this purpose the course-counting ratchet wheel 47 is provided near its periphery on the face adjacent ratchet wheel 46 with an arcuate flange 57 (Figs. 15 and 16) aligned with hold-out arm 58 mounted on pawl 55 and maintained in engagement with flange 57 by spring 59.

The parts are arranged so that the course-counting ratchet wheel 47 never makes a complete revolution, being provided with a terminal tooth 60. After said tooth has been actuated means is provided for rotating ratchet wheel 47 in a reverse direction for a distance corresponding to the number of courses to be knit during the dwell of the chain; and the mechanism is arranged so that a number of operations take place when the terminal tooth 60 is racked. One of these operations is the racking of the chain driving ratchet wheel 46; and to this end flange 57 terminates at a point such that the pawl 55 will be dropped into engagement with ratchet wheel 46 at the appropriate time to rack said wheel 46 simultaneously with the racking of terminal tooth 60 on wheel 47. The end of flanges 57 is cam-shaped so that the reverse movement of the course-counting ratchet wheel 47 will lift the hold-out stud 58 and pawl 55 and maintain the latter out of engagement until pawl 56 has again reached terminal tooth 60.

The spindle 36, together with sprocket drum 35 and all other parts mounted on said spindle, is given a periodic leftward and return movement. In the form illustrated this is accomplished by mounting the spindle in horizontal slots in the frame bracket 37 and spindle bracket 40 (Figs. 2 and 7) and engaging the ends of said spindle by arms 61 and 62 (Fig. 10) through crosshead sleeves 63 on spindle 36 working in vertical slots in the ends of arms 61 and 62. Said arms 61 and 62 are fixed to a rock shaft 64 journaled in bracket 65, mounted on the base of frame bracket 37 and in a depending arm 66 of spindle bracket 40.

An arrangement may be provided for locking the sprocket drum 35 in position at all times

except during the racking step. In the form illustrated, this includes a lock bracket 67 (Fig. 9) fixed on spindle 36 adjacent the slotted end of the arm 39, and extending across the face of said drum between the runs of the pattern chain 31. A locking detent 68 is pivotally mounted on lock bracket 67. One end of detent 68 is forced into locking position in depressions 34 of the sprocket drum 35. A releasing lever 69 pivotally mounted on bracket 67 has an arm bearing against the tail piece of detent 68, the other end of lever 69 being positioned for engagement by the end of slide 70 (Figs. 5 and 6) slidably mounted in a suitable channel in the end of lock bracket 67, and having an inclined inner end positioned to engage pin 71 on the side of the course-counting ratchet wheel 47 at the appropriate time immediately before the racking of the terminal tooth 60, the construction and arrangement being such that pin 71 will force slide 70 outward, swinging releasing lever 69 and withdrawing locking detent 68 from engagement with sprocket drum 35 immediately preceding the racking of terminal tooth 60 and the simultaneous racking of the chain-driving ratchet wheel 46. The reverse movement of course-counting ratchet wheel 47 will release slide 70 and detent 68 will return to locking position through the action of spring 72.

The means for actuating bell crank 54 to operate pawls 55 and 56 includes a racking cam 73 (Fig. 3) mounted on cam shaft 74, which is preferably the main cam shaft of the machine; and in the construction disclosed the cams employed in connection with the mechanism described herein are associated with the cams employed for shifting such cam shaft endwise in connection with the well known narrowing operation, though the latter arrangement forms no part of this invention and will not be described in detail. A cam follower 75 (Figs. 3 and 13) is mounted on the end of the rear arm of a racking lever 76 pivoted to an ear 77 on the frame bracket 37 and extending forwardly through a suitable opening in said frame bracket to a position beneath the arm of bell crank 54 carrying pawl 56. The periodic elevation of the front end of racking lever 76 when cam follower 75 engages racking cam 73 at each revolution of shaft 74 in normal position will rock bell crank 54 and operate pawls 55 and 56 in the manner indicated above. Bell crank 54 and racking lever 76 are maintained in operative relationship by spring 78 extending from the lower arm of bell crank 54 to a spring bracket 79 clamped to front beam 38 of the machine (Fig. 3).

In order to permit the reverse or setting movement of the course-counting ratchet wheel 47, and to assure the accurate racking of one tooth only at each oscillation of bell crank 54, an arrangement is provided for locating the pawl 56 in predetermined position out of engagement with ratchet wheel 47 at the beginning of each racking stroke. This arrangement, shown best in Figs. 17 and 18, includes an adjustable set screw 56a carried by said pawl and positioned to strike a suitable abutment, such as the face of a resetting rack 113, when pawl 56 is in lowermost position, maintaining the pawl out of engagement with ratchet wheel 47 and in appropriate racking position against the pull of a pawl spring 56b.

An arrangement is provided for imparting the above mentioned leftward and return movement to the sprocket drum 35 each time that the course-counting ratchet wheel 47 has completed

a cycle of operation by racking the terminal tooth 60. In the form illustrated, this is accomplished by forming a cam face 80 on the edge of the coarse-counting ratchet wheel 47, it being understood that with this arrangement the teeth of said wheel will not extend completely around the edge thereof. Cam face 80 is positioned so that when terminal tooth 60 is actuated, said cam face will engage a roller 81 on a vertical lever 82 (Fig. 7) pivotally mounted at 83 on the face of frame bracket 37. The lower end of vertical lever 82 engages a shift rod 84 pivoted at its opposite end to an end of cam-shifting lever 85 which extends rearwardly through frame bracket 37 (Fig. 13) and is pivotally mounted on a stud 86 carried by the base of said bracket. The rearward extension of lever 85 is in the form of a curved arm 87, and engages the side of a cam follower 88 rotatably mounted on a short shaft 89 carried by a forked lever 90 pivotally mounted on stud 91 on the base of frame bracket 37. A spring 92 on shaft 89 normally urges cam follower 88 to the right against arm 87. A drum-oscillating cam 93 (Fig. 3) is mounted on cam shaft 74 in position for engagement by cam follower 88 when shifted to the left by lever 85. Cam 93 may be shaped to impart a series of appropriate horizontal movements to spindle 36 and the structures mounted thereon. In the form shown, cam 93 is contoured to impart an initial movement of spindle 36 to the left, followed by a dwell, a final movement to the left, and a return movement. The length of shaft 89 and the throw of lever 85 is such that when cam follower 88 is in inactive position, it is shifted far enough so that it will not be engaged by cam 93 when cam shaft 74 is shogged in connection with the narrowing operation. Cam 93 however is preferably of sufficient width to engage follower 88 when shaft 74 is in either normal or narrowing position and follower 88 is in active position.

Forked lever 90 is connected by a universal joint 94 and a link 95 with the outer end of a rocking lever 96 (Figs. 11, 12 and 14) fixed on rock shaft 64; and a spring 97 extending from said lever to frame bracket 37 will maintain lever 96 normally in elevated position with the sprocket drum 35 in normal position and cam follower 88 at its upward limit.

Means are provided for retaining cam follower 88 in operative position relative to the drum-oscillating cam 93 for the necessary period. This is accomplished in the form illustrated by employing a locking lever 98 (Figs. 15 and 16) in the form of a bell crank mounted on pivot stud 99 on the face of frame bracket 37, the upper end of said bell crank lever 98 being positioned to bear against a portion of the structure mounted on spindle 36, such as the hub of bell crank 54, and may have an adjustable contact provided by set screw 100. The lower arm of locking lever 98 is provided with a shoulder 101 positioned to engage a collar 102 on shift rod 84 when the rod is shifted to the right by vertical lever 82. The lower end of locking lever 98 is however maintained out of contact with collar 102 when spindle 36 is in normal position, by reason of the contact between set screw 100 and the hub of bell crank 54. As soon as spindle 36 starts its shifting movement to the left, however, the lower end 101 of lever 98 will drop into engagement with collar 102 and prevent shift rod 84 from moving to the left, thereby maintaining cam follower 88 in position to engage cam 93 until the reciprocating movement of spindle 36 is completed.

Means may be provided independently of the pattern chain and ratchet structure for holding said structure in position for successive reciprocations of the spindle 36. This is accomplished in the arrangement shown by providing vertical lever 82 with a laterally extending arm 103, (Fig. 7), and a holding lever 104 rocking on pivot stud 105 on the frame bracket 37 and provided with a retaining lug 106 positioned relative to arm 103 so that when the holding lever 104 is swung to the left against the action of spring 107 the retaining lug 106 will pass beneath the end of arm 103 if lever 82 is in shifted position to the right, thereby retaining cam follower 88 in engagement with drum oscillating cam 93, irrespective of the action of the mechanism normally controlling said cam follower and cam, until holding lever 104 is again allowed to move to the right. While lever 104 is shown as automatically actuated by the lace course regulator unit D hereinafter described, it will be apparent that it may also be operated manually or otherwise.

The bars 32 of the pattern chain 31 are each provided with a series of sockets 108 in which the buttons 109 may be mounted. Each button is in the form of a rod, which may be relatively narrow since it is subjected only to thrusting stresses. One row of buttons is preferably employed for resetting the course-counting ratchet wheel 47, the height of said buttons determining the number of teeth set ahead of the pawl on said wheel, and therefore the number of courses knitted before the next actuation of chain driving ratchet wheel 46. This is accomplished by aligning the button 109 of this series carried by the bar 32 which is in operative position (Figs. 7 and 8), with the end of a sliding rack 110 carried in a suitable guideway in push rod bracket 111 mounted on the frame bracket 37. Push rod bracket 111 rotatably supports a duplex pinion 112 engaging rack 110 at one end of the pinion, the other end of which engages a resetting rack 113 slidably mounted in bearings in said bracket 111 and engaging the pinion 112 on course-counting ratchet wheel 47. Resetting rack 113 may be provided with a handle 114 for manual operation.

Chain-actuated mechanisms

Suitable means is employed for actuating various instrumentalities on the knitting machine in accordance with the position and height of the buttons in operative position on the sprocket drum 35, including means engaged by said buttons when the drum is shifted as described. Obviously, a substantial variety of operations may thus be controlled, and various means for utilizing the arrangement above set forth may be employed. In the form illustrated the buttons 109 engage push rods 115 slidably mounted in push rod bracket 111 with a rod 115 in alignment with each operative row of buttons 109. A bank of levers is mounted in position to be moved selectively by push rods 115, each lever controlling a separate device or operation. In the form illustrated the levers, indicated generally as 116, are mounted on stub shaft 117 carried by the frame bracket 37, and each lever is provided with a bearing face 118 normally held against the left end of a push rod 115, which end may be enlarged to retain the rod in position in bracket 111.

Various mechanisms and means of actuation are shown in connection with the different levers. For instance, the upper end of lever 116a (Fig. 3) is rigidly connected by a jumper to a collar 119 on stub shaft 117. Between said collar 119 and

lever 116a the usual narrowing motion latch lever 120 is loosely mounted on stub shaft 117 with its nose resting on the cam follower shaft 121 between the shaft bearing 122 and collar 123 on said shaft. This construction and arrangement is well known and will not be described in detail, except in connection with its actuation by the improved pattern chain mechanism. The latter operates when lever 116a is shifted to the left by a push rod 115 engaged by a button 109 in the appropriate row assigned to actuation of the cam shaft shifting mechanism for narrowing. The specific mechanism disclosed includes an extension 124 (Fig. 2) projecting up and to the right from collar 119 and positioned to engage one end of a rocking lever 125 pivoted on the frame bracket 37, the other end of lever 125 swinging upwardly against a lug 126 on the latch lever 120 when lever 116a is shifted and extension 124 engages an end of said rocking lever 125. A handle 127 on rocking lever 125 permits manual operation of the latch lever 120. Lever 116a is also connected to an end of rod 128 running to half speed switch 129, (Fig. 1), and the connection is arranged in relation to the release of latch lever 120 so that the initial movement of lever 116a will operate half speed switch 129, and subsequent movement of said lever will lift latch lever 120 and throw the narrowing mechanism into operation.

A convenient arrangement for this purpose utilizes a drum-oscillating cam 93 of the type illustrated herein, by which sprocket drum 35 is initially moved a predetermined distance to the left, during which movement the appropriate button engages a push rod 115 to move lever 116a a distance sufficient to throw half speed switch 129, the subsequent dwell of drum 35 permitting the machine to slow down to an extent sufficient to permit proper operation of the narrowing mechanism when the subsequent final shift of sprocket drum 35 to the left moves lever 116a a further distance sufficient to lift the narrowing motion latch lever 120.

In order to avoid confusion due to careless selection of buttons it may be convenient to employ on bars 32, in several or all positions other than those which actuate rack 110, buttons having the same height. When this arrangement is employed, appropriate levers 116 may be actuated during the initial shift of sprocket drum 35 by employing push rods 115 (Figs. 2 and 4) projecting sufficiently to the right of push rod bracket 111 to be engaged by appropriate buttons for actuation of corresponding levers 116 during such initial movement of sprocket drum 35. Where it is not desired to move a lever 116 during such initial shift of drum 35, the push rods 115 may be of such length that they will be engaged by co-operating buttons 109 only during the second shifting movement of said drum 35.

It will be evident from this arrangement that by employing buttons 109 and push rods 115 of suitable length in relation to the shifting movement of drum 35, and by providing a certain timed relation between the movement of drum 35 through successive zones of effective engagement between buttons 109 and push rods 115, successive actuating movements may be given to selected levers 116 in predetermined timed relation.

For example, in the arrangement illustrated the push rod 115 which engages lever 116a is shown as projecting to the right in position for engagement with the corresponding button 109 during the first movement of drum 35 to the left,

thereby shifting lever 116a a distance sufficient to operate half speed switch 129, but not sufficient to lift the latch lever 120; and the contour of cam 93 is such that nearly half a revolution of cam shaft 74 takes place before drum 35 is again shifted to the left to lift latch lever 120 and set the narrowing mechanism in operation, the period between such shifts being sufficient to permit the mechanism to slow down to the appropriate speed.

The next adjacent lever 116b on stub shaft 117 carries an upward extension 130 engaging the end of rod 131, which in Fig. 1 is shown as connected to the machine stop switch 132, actuating the switch to stop the machine when lever 116b is shifted by operation of an appropriate button 109.

The succeeding lever 116c on stub shaft 117 is connected to an end of rod 131a of the lace course regulator unit D which is operated when lever 116c is shifted by a button 109; and it will be noted that push rod 115 which engages lever 116c projects to the right in position for engagement or operation during the first shift of sprocket drum 35.

The lever 116d on stub shaft 117 engages at its lower end the lower portion of a short arm 133 pivoted on lower stub shaft 134, mounted on frame bracket 37 and having a reinforcing tie plate 135 (Fig. 3) engaging the outer ends of stub shaft 134 and push rod bracket 111. The short arm 133 is rigidly connected by a jumper to a depending shift arm 136 likewise pivoted at its upper end on the lower stub shaft 134 and engaging a control rod 137, the construction and arrangement being such that when the lever 116d is shifted by the action of a button 109 it will swing arm 133 and shift arm 136 connected thereto, moving control rod 137 to the left to operate in known manner the inside rocker unit E.

Lever 116e, the next in line on stub shaft 117, engages similarly a short arm 138 connected by a jumper to the upper end of depending shift arm 139, the lower end of arm 139 engaging a rod 140 and shifting said rod to the left when lever 116e is actuated. The next lever 116f on stub shaft 117 similarly engages the lower end of short arm 141 connected by a jumper 142 to shift arm 143 engaging rod 144. The succeeding arm 116g on stub shaft 117 operates similarly on short arm 145 connected by a jumper 146 with shift arm 147 whose lower end engages rod 148. All of said short arms and shift arms are pivotally mounted on the lower stub shaft 134.

The outermost lever 116h on stub shaft 117 has an arm 149 extending upwardly, adapted to actuate selected mechanism, such as the reinforced selvage attachment C, by lateral movement of the upper end of said arm 149 when lever 116h is shifted by a button 109.

Control rod lock

An arrangement may be provided for locking the control rods 137, 140, 144 and 148 in longitudinally shifted position, and for releasing the locking means in synchronism with the operation of the chain pattern mechanism when a shift of one or more of said rods may occur. A suitable arrangement is illustrated in Figs. 19, 20 and 21 and includes a bell crank 150 pivoted on a bracket 151 mounted on front beam 38 of the machine and having at its upper end a cam follower 152 engaging a rod release cam 153 on cam shaft 74, said follower and cam being main-

tained in engagement by spring 154. The lower arm of bell crank 150 is provided with a forked yoke 155 engaging the ends of pin 156 on the upper end of locking slide 157 mounted for vertical reciprocation in slide bracket 158 carried by mounting bracket 151. Slide bracket 158 is provided with a plurality of guide openings for maintaining said rods 137, 140, 144 and 148 in alignment. The three lowermost rods, 148, 137 and 144, are each provided with a lock collar 159; and locking slide 157 carries locking lugs 160 so positioned relative to locking collars 159 that when slide 157 descends after the rods have been shifted from the positions shown in Fig. 20 to the positions shown in Fig. 1, lugs 160 will abut one face of each of said lock collars 159, and maintain all of said rods in shifted position until locking slide 157 is raised by the action of rod release cam 153. A slightly different arrangement is illustrated for locking the uppermost rod 140, which carries a locking collar 161 having a plurality of notches in its upper face; and a locking form 162 is mounted on the upper end of locking slide 157 with locking tongues 163 positioned to engage appropriate notches in the locking collar 161 when locking slide 157 descends, this arrangement permitting the locking of rod 140 in various adjusted positions.

Controlled auxiliary apparatus

The various rods and levers actuated by the chain pattern mechanism may be utilized in numerous ways to control different mechanisms and attachments on the knitting machine, and a number of such mechanisms are illustrated in Fig. 1. The narrowing assembly B is operated in the usual manner when the cam shaft 74 of the machine is shifted lengthwise, a step that results from the lifting of the latch lever 120 and operation of half speed switch 132 in the manner already set forth. The reinforced selvage attachment C is actuated in known manner by the reciprocation of the ratchet rod 164 operated by movements of cam follower 165 carried by arm 166 in well known manner; and arm 166, normally held out of operating position by engagement with the upper end of arm 149 on lever 116h, is released to permit cam follower 165 to engage its cam and operate ratchet rod 164 when said lever 116h is shifted by the appropriate button 109 on the pattern chain in the manner already set forth.

The construction and arrangement of the reinforced selvage attachment C is well known, and has been shown in various publications, such as United States Patent to Müller and Richter 1,971,725, issued August 28, 1934. This attachment is arranged so that it may shift the stops either to the right or to the left, the direction being determined by mechanism operated by lever 116h through engagement with an arm 166a (Fig. 2) positioned adjacent the upper end of arm 149 so that it will be engaged thereby if lever 116h is moved a sufficient distance. As such distance will vary in accordance with the height of the buttons 109 positioned to operate said lever 116h, the operation of said reinforced selvage attachment can be controlled by employing a button 109 of the proper height, a long button serving a shift lever 116h and arm 149 a distance sufficient not only to release arm 166 and throw cam follower 165 into operation, but also to engage and actuate arm 166a to set the reinforced selvage attachment C for operation in one direction; while a short button 109 similarly posi-

tioned will release bar 166 but will not affect lever 166a, permitting attachment C to operate in the opposite direction.

The mechanisms controlled by the rods at the bottom of the machine in general are not indicated, said rods being typical of those used on knitting machines, and particularly "Reading" machines. The connection of rod 137 however is shown, the right hand end thereof engaging the lower end of lever 170 operating the inside rocker unit E. Springs are employed at suitable points, whether in connection with each of said rods or at other points, to maintain the various levers 116 in operative position in known manner.

The lace course regulator unit D is thrown into operation by actuation of lever 116c and rod 131a. The lace clock apparatus F is placed in operation by tripping the holding lever 104, which in the form disclosed is accomplished by the regulator unit D. In view of the interrelationship between the regulator unit D, the lace clock apparatus F and the pattern control apparatus A, these auxiliary mechanisms will be described more in detail.

Lace course regulator unit

The purpose of this unit is to provide a selected movement of plain courses between successive actuations of the lace clock apparatus F. Referring particularly to Figs. 24 to 28, the regulator unit is mounted on a bracket 200 mounted on the front beam 38 of the machine. A spindle 201 journaled in the bracket 200 carries adjacent its front end a ratchet disc 202 rotatable on spindle 201 and held in place by convex spring friction disc 203 on the forward end of spindle 201. Ratchet disc 202 is provided with a predetermined number of teeth 204 extending along its periphery in position for engagement by pawl 205 pivotally mounted on pawl arm 206 rotatably mounted at its inner end on spindle 201 and bearing at its outer end against racking lever 207 pivoted on stud 208 on bracket 200 and carrying follower 209 engaging racking cam 210 on cam shaft 74. Racking lever 207 is held by spring 211 in depressed position adjustable by means of screw stud 212 bearing on abutment of the bracket 200. Pawl arm 206 is held downwardly against arm 207 by spring 213 whose strength is sufficient to pull pawl 205 away from teeth 204 against the pull of spring 214 on lug 215 fixed to pawl 205 and bearing against adjustable stud 216 on bracket 200.

Pawl 205 may be held out of engagement with teeth 204 by suitable means tripped by the pattern chain for throwing the unit into operation. In the form shown this comprises a hold-out plate 217 pivotally mounted on spindle 201 adjacent disc 202, the pawl 205 being sufficiently broad to engage both said disc and plate. Hold-out plate 217 is normally impelled in a clockwise direction by spring 218 holding against pin 219 on ratchet disc 202, the extension 220 of hold-out plate 217 engaging pawl 205. Hold-out plate 217 is shifted by bell crank 221 operated through rod 131a by the pattern chain, permitting pawl 205 to rack disc 202, the initial movement of rod 131a operating to shift plate 217 and permit pawl 205 to draw into engagement with the end tooth 204, so that the pawl may be actuated through racking cam 210 during a later part of the same rotation of cam shaft 74 to rack disc 202 one notch. This movement through the engagement of pin 219 with hold-out plate 217 will remove extension 220 beyond the travel of pawl 205 so that the pawl

will continue to engage ratchet disc 202 until the latter is shifted in a clockwise direction to the position shown in Fig. 24 by mechanism hereafter described.

Spindle 201 carries a pinion 222 engaging rack 223 carried by slide frame 224 slidably mounted on guide rod 225 on bracket 200. Frame 224 carries a lace trip rod 226 slidable in bracket 200 and extending above the pattern chain and provided with a narrowing trip arm 227 (Fig. 2) positioned to engage a lug on narrowing latch lever 120, and a holding lever trip arm 228 positioned to engage lever 104. Racking of disc 202 will draw the lace trip rod 226 to the left until the racking of the final tooth 204 will trip the narrowing latch lever 120 and throw holding lever 104 to the left, serving to operate the narrowing cams and to hold the pattern drum in oscillating position. Reverse movement of disc 202 will shift trip rod 226 to the right, permitting the cam shaft to return to normal position and throwing the lace mechanism F out of operation.

Means is provided for rotating disc 202 clockwise for this purpose, the number of teeth 204 which are moved past pawl 205 and are thereafter actuated determining the number of courses during which the lace mechanism F is out of operation. This is accomplished in the form shown by a stepped shift plate 229 movable in a slot in slide frame 224 to engage an adjustable stud 230 and shift frame 224 and trip rod 226 to the right a distance corresponding to the step on plate 229 which is in alignment with stud 230. Plate 229 is shifted through rocking bell crank lever 231 pivoted on bracket 200 and having one arm held in engagement with shifting plate rod 232 by spring 233. The other arm of lever 231 is maintained by spring 234 in engagement with actuating lever 235 pivotally mounted on bracket 200 and carrying follower 236 engaging regulator shift cam 237 on cam shaft 74. Lever 235 is adjustably held in idle position by threaded stud 237a abutting bracket 200 (Fig. 30).

The rotation of ratchet disc 202 may be utilized to actuate other mechanisms. For this purpose a cam plate 238 attached to disc 202 is moved by the racking of the disc into engagement with the end of bell crank 239 pivoted on stud 240 and adjustably engaging at its opposite end a shift arm 239a also pivoted on stud 240 and adapted to carry a shift rod or other device for actuating suitable mechanism, such as a loose course regulator of standard type.

The vertical setting of shift plate 229 is controlled by the pattern mechanism of the lace clock apparatus which will now be described.

Lace clock apparatus

While this mechanism is referred to by its usual name, it is to be understood that its utility is not limited to the production of lace or the insertion of clocks. Its function is generally to control the action of transfer points to produce any of the various loop structures which are capable of manufacture by manipulating points, including the different varieties of lock stitches, transferred loops and spread loops.

Many features of this mechanism have heretofore been known and used, and are disclosed not only in the above mentioned catalogue but also in Gastrich Patent No. 1,977,676 and Richter No. 2,034,990; therefore only so much of the mechanism will be set forth as is necessary to understand the invention in conjunction with that previously known.

The lace clock apparatus F includes means for positioning transfer points in register with selected needles; means for imparting a uniform shift to a plurality of transfer rods, and means for imparting a divisional shift between such rods. Referring principally to Figs. 22 and 32-34, the principal operating mechanism is mounted on brackets adjacent the narrowing head, and includes a spindle 241 (Fig. 33) carrying an eccentric 242. A series of control levers are pivotally mounted on eccentric 242, and in the form illustrated include three stepped stop levers 243, 244 and 245; a slide control lever 246 and a regulator setting lever 247.

The levers on eccentric 242 are selectively positioned by pattern means to produce various knitting operations and conditions. In the form shown the pattern means comprises a lace pattern chain 250 provided with studs 251 positioned to contact suitable lugs 252 on the lower faces of levers 243-247 (Figs. 32 and 38). Chain 250 is supported by an upper drive drum 253, a lower drum 254 and a guide drum 255 for spacing the chain runs from contiguous parts. The drive drum 253 is rotatably mounted on spindle 256 and carries a ratchet wheel 257 operated through pawl 258 (Fig. 34) on pawl arm 259 pivoted on spindle 256 and oscillated through universal joint 260 and link 261 by lace racking lever 262 carrying follower 263 aligned with cam 264 when the cam shaft 74 is in narrowing position. Drive drum 253 may be maintained against undesired rotation by spring brake disc 248, and may be turned by hand through hand wheel 249 fixed on the end of spindle 256.

For reasons that will hereafter be apparent, including primarily the uniform shifting of the lace point rods, eccentric 242 may be given a periodic oscillatory movement in either direction to shift said levers either to the right or to the left. This may be accomplished through oscillating lever 266 fixed to the end of eccentric spindle 241, preferably by a split clamp 267 (Fig. 34), and adjustably connected through universal joint 268 and link 269 with eccentric shifting lever 270 (Fig. 33) having a forked end carrying a short shaft 271 on which follower 272 is mounted in registry with neutral cam 273 and with left shift cam 274 when the cam shaft 74 is in narrowing position.

The short shaft 271 also carries a slidably mounted follower 275 having a channeled shoulder 276 engaged by the end of shifting lever 277 pivoted on eccentric shifting lever 270 and maintained by spring 278 in engagement with right shift slide 279 (Fig. 31) vertically slidable in suitable channels in shifting lever 270 and follower shifting lever 277. Follower 275 is positioned so that it will be immediately adjacent right shift cam 280 when cam shaft 74 is in narrowing position and slide 279 is raised, so that the lowering of slide 279 will shift follower 275 into alignment with right shift cam 280. Although follower 272 will likewise be in alignment with left shift cam 274, the latter is a low cam which drops eccentric shifting lever 270 below the position of neutral cam 273, whereas right shift cam 280 has a high portion which raises the shifting lever 270 above neutral cam 273; consequently cam 280 will control lever 270 when follower 275 is in operating position. This arrangement provides a means for oscillating eccentric 242 in either direction in accordance with the position of slide 279; and when the eccentric is normally positioned as shown in Figs.

33 and 38 with its plane of eccentricity substantially vertical, the direction of oscillation will determine the direction in which the points are shifted. Right shift slide 279 is suitably controlled, being shown as connected through universal joint 281 and links 282, 283 with slide control lever 246, so that the position of slide 279 is controlled by appropriate studs 251 on chain 250 engaging lever 246.

The lateral shifting of levers 243—247 will tend to move them relative to chain studs 251. In order to avoid such relative movement the drive drum 253 may be provided with means for imparting a corresponding movement thereto. This may include eccentric bearings 286 having drum eccentric arms 287 and 288 joined by tie pin 289 and connected by link 290 to oscillating lever 266. With this arrangement and by properly proportioning and positioning eccentrics 286 the drum 253 and levers 243—247 will have the same lateral movement when oscillating lever 266 is actuated.

The shift plate rod 232, carrying shift plate 229 whose vertical position determines the period of operation of the regulator unit D, is connected to the outer end of a rearwardly extending rocking lever 291 (Figs. 34 and 34a) pivoted on a bracket 292 and having its rear end bearing against the lower face of regulator setting lever 247, so that the position of the latter lever as determined by its cooperating pattern stud will position the stepped shift plate 229 for the appropriate setting of the lace course regulator.

Means is provided for moving the levers 243—247 to a neutral position above the path of the highest stud on lace pattern chain 250 to permit shifting of the chain, and the lowering of said levers into engagement with the newly aligned studs 251. In the arrangement illustrated this is accomplished by a lifting bar 293 (Fig. 38) extending across and in position to engage with the lower faces of levers 243—247. Bar 293 is mounted on upper end of lever resetting arm 294 mounted on vertical slide 295 connected through link 296 with double frame lever 297 (Figs. 23 and 35) having at one end a pivotal mounting 298 at the front of the frame 30 and biased downwardly at the other end by spring 299. Resetting lever 297 carries a follower 300 aligned with neutral cam 301 when cam shaft 74 is in normal position and with resetting cam 302 when cam shaft 74 is in narrowing position. The levers 243—247 are biased downwardly by suitable spring means, such as springs 303.

Actuating mechanism

The lace clock apparatus F is driven from the cam shaft when the latter is in narrowing position; but is not operated during ordinary narrowing. Consequently special drive control and connections must be provided. In the form shown, these include means for inhibiting the actuation of the lace apparatus during narrowing, a release arrangement tripped to throw the lace clock mechanism into operation, and means for simultaneously preventing the narrowing operation, which is not necessary and in general is not desirable in connection with the manipulation of loops by said mechanism.

As has been indicated above, the tripping of the lace course regulator D and the consequent shift of lace trip rod 226 to the left will trip lever 120, shifting cam shaft 74 into narrowing position, and will simultaneously throw holding lever 104 to the left, permitting the lace release arm 168 to drop so that its follower 169 may come

into contact with lace release cam 310 (Figs. 23 and 29). Lever 168 is pivoted to a cross arm 311 fixed to the upper end of a vertical trip shaft 312 journaled in bracket 313 and carrying at its lower end a trip lug 314 bearing against the lower end of a rocking lever 315 pivoted on bracket 313. The upper end of lever 315 is located between shift collars 316 on lace release bar 317. Bar 317 is slidably mounted in brackets 318, 319 and 320 (Fig. 23) mounted on the frame of the machine, and is provided at one end with a fixed arm 321 slidable on a stud 322 fixed in the bracket 320 to prevent rotation of release bar 317. Brackets 319 and 320 also carry a pivot shaft 323 (Fig. 32) on which lace racking lever 262 and eccentric shifting lever 270 are mounted.

Lace release cam 310 is provided with a lateral cam face 324 engaged by lateral cam follower 325 on lace release arm 168, controlling an appropriate shift of the arm 168 to the right producing a shift of lace release bar 317 to the left against spring 326 at the proper point in the cycle of operation. Arm 168 is biased downwardly by spring 327.

The longitudinal shift of release bar 317 is utilized to place the various elements of the lace clock apparatus into operation. For this purpose the lace racking lever 262 is provided with a lug 328 normally resting on a trip arm 329 fixed to release bar 317. Similarly, eccentric shifting lever 270 has a lug 330 (Fig. 33) resting on a trip arm 331 fixed to release bar 317; and resetting lever 297 is formed with a lug 332 normally resting on trip arm 333 rigid with release bar 317. Trip arm 334 (Fig. 33) fixed to release bar 317 normally holds right shift slide 279 in upper position and prevents the sliding follower 275 from engaging right shift cam 280 during ordinary narrowing. Follower 236 which operates rocking lever 231 engaging stepped shift plate 229 is slidably mounted on lever 235 out of position for engagement by cam 237 when the cam shaft is in narrowing position; and the follower 236 is shifted to engage cam 237 in said position by fork 335 on shift arm 336 (Fig. 23) fixed to lace release bar 317.

During ordinary narrowing the narrowing head 307 is shifted by a well known racking mechanism indicated generally at 337 and operated by a lever 338 (Figs. 22 and 23) vertically reciprocated by connection to arm 339 carrying a slidably mounted follower 340 cooperating with narrowing cam 341 on the cam shaft 74. Follower 340 is normally positioned to be engaged by cam 341 when the cam shaft 74 is shifted to narrowing position; but to prevent racking of the narrowing head during the operation of the lace clock apparatus, follower 340 is engaged by a fork 342 on shift lever 343 pivoted to the frame and engaging control rod 344 slidably mounted at the rear of the frame and connected to an end of cross arm 311. Spring 345 normally forces rod 344 to the right, maintaining follower 340 in position for engagement by cam 341 during narrowing, and also biasing arm 168 toward the left for appropriate cooperation of lateral cam face 324 and follower 325.

Means may be provided to prevent the lace release arm 168 and the parts controlled thereby from shifting at every rotation of the cam shaft 74 during operation of the lace clock apparatus F. A convenient construction for this purpose is illustrated in Figs. 23 and 29, comprising a locking rod 346 suitably journaled for oscillation and provided near its front end with a collar 347 car-

rying a pin 348 engaged by a tongue 349 on rod 226, positioned so that pin 348 will be held in upper position by tongue 349 except when rod 226 is at the extreme left in position for setting the lace clock apparatus F in operation. Near the other end of the rod 346 a locking plate 352 is mounted on the rod in alignment with the space between an abutment 353 on cross arm 311 and a face 354 on bracket 318 normally engaged by abutment 353. Locking plate 352 is normally biased to the left by spring means not shown, so that when cross arm 311 is shifted to the left locking plate 352 will slide between abutment 353 and face 354, maintaining the lace release arm 168 and associated parts in position for operation of the lace clock apparatus F until the return of the lace trip rod to the right will shift locking plate 352 in the same direction through engagement of tongue 349 with pin 348, permitting arm 168 and its associated parts to return to normal position coincident with the shogging of the cam shaft 74 back to its normal location.

Transfer point structure

The control apparatus already described may be utilized in connection with a variety of point structures and connections to produce the different types of spread, transferred, elongated or otherwise distorted loops employed in different types of knitting for producing lace, clocks, lock stitches and for other purposes. One mechanism of this type is illustrated herein, and corresponds in general to the arrangement set forth in the Richter Patent 2,034,990. This mechanism will therefore be described generally, except for certain variations from the Richter disclosure.

This embodiment includes, in addition to the usual narrowing point structure, an arrangement of lace points including in the specific form illustrated herein a set of main lace points and a set of auxiliary lace points, though the auxiliary points are necessary only for certain types of work such as the production of spread loops in the manner disclosed by Richter. The mechanism includes means for locating the lace point structures in register with any desired needles within a predetermined range by shifting such structures to a neutral position and then returning them against stepped stops or the like. It also includes means for imparting to the lace points a general movement in either direction, and in addition means for moving one group of lace points relative to another, as in the production of spread loops.

In addition to the usual narrowing combs 359 carried by narrowing rods 360 controlled by the narrowing head 307 in the usual way, the disclosed structure is provided with a main point device 361, an auxiliary point device 362 and an actuating mechanism 363 therefor.

The main point device 361 consists of a main row of points 364 carried on a bar 365 fixed to a main point rod 366 supported by the front narrowing shaft 358. The auxiliary point device 362 is in the form of an auxiliary row of points 367 carried by a bar 368 supported by brackets 369 fixed to auxiliary point rod 370 rotatable in brackets 371 on manipulating shaft 372 connected through crank arm 373 and curved link 374 (Fig. 41) with bell crank lever 375 pivoted on rear narrowing shaft 357. Lever 375 is connected by adjustable link 376 with lever 378 carrying roller 379 coacting with auxiliary point cam 377 on cam shaft 74.

The main point rod 366 carries a cam element

381 engaging lug 382 fixed to rod 370. Coil spring 383 is provided for each rod arranged to bias the rods to the left of Fig. 22.

The oscillation of auxiliary point rod 370 is controlled through disc 384 (Fig. 42) pivotally connected to a telescoping rod 385 pivoted at its other end to spring arm 386 supported from shaft 372, rod 385 being biased downwardly by spring 387 to hold the auxiliary points 367 against the main points 364, and to maintain lug 382 in operative relation to cam element 381; and likewise serves when the auxiliary points 367 are swung vertically, to hold them against guard bar 388.

The dipping movement of the narrowing machine and the general arrangement, actuation and relationship thereof with the various knitting elements is standard and is disclosed in the above mentioned catalogue and specifically in the Richter patent, attention being directed to Fig. 3 thereof which corresponds generally to Fig. 40 herein.

Suitable mechanism is provided for longitudinally shifting the point rods 366 and 370. The embodiment illustrated is shown in detail in the Richter patent, and includes a resetting cam block 428 carried by the upper end of vertical slide 295. Offset arm 431 (Figs. 22, 34 and 35) is pivotally mounted on eccentric shifting lever 270 and is pivoted to a bracket 432 carrying vertical slide cam 433 mounted in the horizontally slidable stop frame 435 which carries a roller 436 engaging the cam surface 428b of cam block 428 for shifting the stop frame 435 horizontally.

The left ends of the point rods 366 and 370 (Figs. 36 and 39) are provided with followers 389 having sliding contact with frame 435. Said frame has a plane vertical surface 390, and slide cam 433 is provided with a cam surface 391 (Fig. 37), the rods 366 and 370 being jointly moved by cam block 428, and rod 366 being moved relative to rod 370 by vertical actuation of slide cam 433.

Stop frame 435 is provided with a tail piece 437 (Fig. 38) coacting with stepped stop levers 243-245, which may be constructed with graduated steps in well known manner to provide a substantial number of stop positions for tail piece 437, convenient arrangement providing ten steps on each of said levers arranged to furnish 30 needle-stop positions for tail piece 437, stop frame 435 and point rods 366 and 370, preferably spaced by one needle to provide a 30-needle working range.

Pattern control operation

The pattern chain 31 is prepared for operation by dividing the total courses of the pattern into successive series each employing certain mechanisms, and each series is provided with appropriate course counting buttons 109 and actuating buttons for said mechanisms. The setting is also coordinated with auxiliary devices such as the lace course regulator, which must be tripped a predetermined number of courses before the lace clock apparatus is set in operation; and also with auxiliary pattern devices such as that of lace clock apparatus, as will be indicated hereafter in connection with the operation of said apparatus.

The machine may be set for starting by locating the appropriate bar 32 in operative position in alignment with push rod 115, and setting the course-counting ratchet wheel 47 by means of rack 113 and handle 114 to knit the desired number of courses in the first series, ratchet wheel 47

being set by turning it against the friction of brake drum 49 and associated parts. When the machine is started the selected number of courses in said series is knitted; and when the course-counting ratchet wheel 47 is racked through engagement of the notch preceding terminal tooth 60, the sprocket drum locking detent 68 is released; and at the same time pawl 55 is dropped into operative position. When terminal tooth 60 is racked, pawl 55 rotates the ratchet wheel 47 and sprocket drum 35 to bring the next bar 32 into operative position. At the same time cam follower 88 will be brought into alignment with drum-oscillating cam 93 in the manner already set forth.

The rotation of cam 93 will depress forked lever 90 against the action of spring 97, rocking shaft 64 through link 95 and lever 96, thereby swinging to the left the arms 61 and 62 and sliding the spindle 36 to the left in the horizontal bearing slots in frame bracket 37 and bracket arm 39. The initial movement of spindle 36 to the left will drop locking lever 98 to lock rod 84 and hold drum-oscillating cam follower 88 in operative position until the spindle 36 and drum 35 return to normal position at the right, as already set forth. The chain may have sufficient slack to permit the drum to move the relatively short distance necessary for operation.

In the arrangement illustrated, cam 93 will initially shift spindle 36 to the left for a predetermined distance, and then retain it in said position for a substantial period; and selected levers 116 will be actuated during such initial movement where buttons 109 and push rods 115 are not only suitably juxtaposed, but are of the relative length necessary for engagement during said initial movement. It will be noted however that the arrangement is such that cam 93 is not necessarily restricted to a plurality of timed stages, nor even to successive movements of drum 35 in one direction, but may be contoured to produce any desired reciprocating movement of spindle 36 and the parts carried thereby, to produce any desired actuating movement of selected levers 116 during the period when cam 93 is effective.

Ratchet wheel 47 and pinion 48 attached thereto will move to the left with spindle 36; and the frictional engagement caused by spring disc 49 is sufficient to cause such movement of pinion 48 to slide the resetting rack 113 to the left, which through the action of pinion 112 will move rack 110 to the right until it meets either a button 109 or a bar 32 in case no button is positioned on the bar 32 that is in operation. After such engagement the further movement of spindle 36 to the left will reverse the movement of the rack structure, shifting rack 110 to the left, moving the resetting rack 113 to the right, rotating pinion 48 and ratchet wheel 47 against the friction exerted by spring disc 49 for a distance corresponding to the height of the engaging button 109, the construction preferably being such that when no button is in position the bar 32 will move ratchet wheel 47 a distance corresponding to one notch.

As soon as ratchet wheel 47 commences its resetting rotation, and while pawl 56 is maintained out of engagement in the manner already described, slide 70 will be released and detent 68 will return into locking engagement with sprocket drum 35. After the first tooth has been passed, flange 57 on ratchet wheel 47 will engage stud 58

and lift the chain driving pawl 55 out of operative position.

During the movement of spindle 36 to the left, buttons 109 will engage push rods 115 at appropriate stages as already set forth, and will actuate levers 116 and the mechanisms controlled thereby in appropriate timed relation and to the desired extent. The return movement of spindle 36 and the parts mounted thereon to normal position at the right will release locking lever 98 and allow cam follower 88 to be shifted by spring 92 out of register with cam 93, permitting the desired number of courses to be knit without further movement of spindle 36, unless holding lever 104 has been shifted to the left through the action of rod 167, locking said cam and follower in place and producing automatically the described reciprocation of spindle 36 with each revolution of cam shaft 74 until holding lever 104 is returned to normal position.

Following the reciprocating movement of spindle 36, the continuing rotation of the main cam shaft 74 will rack the course-counting ratchet wheel 47 one tooth for each rotation of said shaft. The pattern chain 31 will remain stationary during such racking, and during the operation of such mechanisms as may have been actuated by said reciprocating movement, until the racking of terminal tooth 60 marks the completion of the knitting of the predetermined number of courses constituting the series for which the particular bar 32 that is in operative position was set. The racking of said terminal tooth 60 will be accompanied by the racking of chain-driving ratchet wheel 46, thereby placing the next bar 32 in operative position, and the reciprocating movement of spindle 36 will again set the course-counting ratchet wheel 47 for knitting the desired number of courses in the next series, at the same time placing in operation any desired auxiliary mechanisms. This cycle of operations is repeated until the desired pattern is completed, at which time the machine is finally arrested by the action of an appropriate button shifting lever 116b to operate the stop switch.

The described method of operation suffices for auxiliary devices such as the cam shaft shogging device and the inside rocker unit, which may be thrown into and out of operation by a simple shift of a control rod, or by the movement of one or more rods in stages. It also includes the operation of devices such as the reinforced selvage attachment C in which the operation is affected by the extent of the shift, controlled by the button height or otherwise. The inter-relationship of the lace clock apparatus F, and regulator D with the pattern control involves different relationships and their operation will therefore be specifically described.

Operation of lace clock apparatus

During normal operation of the knitting machine the lace clock apparatus is idle, the actuating arms and levers carrying cam followers being held in elevated inactive position by engagement with the various trip arms or lace release bar 317, which also holds in inactive position the follower on actuating lever 235 which sets the lace course regulator D. Although pawl 205 of the lace course regulator D may be actuated at every rotation of cam shaft 74 in normal position, as shown, this has no effect on the regulator since the hold-out plate 217 prevents pawl 205 from functioning. This status of the lace clock apparatus actuating mechanism is not affected by

shogging of cam shaft 74 for ordinary narrowing, except that pawl 205 will not be operated.

When the lace course regulator is tripped by the main pattern chain in the manner already described the disc 202 is racked the full number of its teeth before it sets the apparatus F into operation; and therefore the stud 109 which trips rod 131a must be located an appropriate number of courses ahead of the course in which the apparatus F starts its operation.

When the lace trip rod 226 reaches its left hand limit, shogging cam shaft 74 and releasing arm 168; control rod 344 is shifted to the left, throwing follower 340 out of alignment with narrowing cam 341 to prevent narrowing; and locking plate 352 is rocked to the left to hold arm 168 and the associated parts in position. Lace release bar 317 is also moved to the left, withdrawing trip arms 329, 331, 333 and 334 from their corresponding abutments and slide 279, permitting the corresponding followers 263, 272 and 300 to engage their cams. Follower 236 is shifted into alignment with cam 237 for oscillating the regulator setting mechanism, while cam 210 is moved out of alignment with follower 209, halting the racking of the regulator. If the main pattern chain is appropriately set, the actuation of the lace clock apparatus F may coincide with the racking of the terminal tooth 60 on the course counting ratchet wheel 47, which will throw arm 103 on lever 82 into upper position where it will be held by retaining lug 106 on holding lever 104, thereby assuring an actuating forward movement of the pattern drum at every course and a corresponding actuation of mechanisms selected by studs 109 at each course until the operation of the lace course apparatus F is terminated by movement of lace trip rod 226 to the right. If however the main pattern chain 31 is set so that said terminal tooth 60 is not racked simultaneously with the shifting of holding lever 104, the shogging of cam shaft 74 will halt the racking of the ratchet wheel 47 until the shaft 74 returns to normal position, and main pattern chain 31 will be ineffective during the operation of lace course apparatus F.

When in operation the lace course apparatus F passes through a complete cycle of operations at every rotation of the cam shaft, including setting of the stop frame 435 followed by point rod shifting actuation. The setting steps are controlled by resetting cam 302, which forces vertical slide 295 vertically, operating through lifting bar 293 to raise the levers 243—47 above the path of travel of studs 251 on lace pattern chain 250, and at the same time functioning through resetting cam block 428 to shift the stop frame 435 to a neutral position at the right hand limit of motion beyond the zone of point activity. The lace pattern chain drive drum 253 is then racked by racking cam 264 actuating pawl 258 to bring a new set of studs 251 in alignment with lugs 252 on said levers 243—247. The descent of slide 295 will lower the latter levers upon studs 251, setting levers 243, 244 and 245 to halt the points rods with the point registering with predetermined needles. Slide control lever 246 will be arrested appropriately to position right shift slide either in upper inactive position or in lower active position, depending upon the direction of point rod shift that is selected. Regulator setting lever 247 will descend against the inner end of rocking lever 291 to position the proper step on the lace course regulator shift plate 229 in alignment with stud 230. The descent of slide

295 will also permit stop frame 435 to return to the left under the pull of springs 383 and spring means (not shown) directly associated with the tail piece 437, seating tail piece 437 against the registering step on lever 243, 244 or 245.

Following the setting of the parts, continued rotation of cam shaft 74 will operate the rod-shifting mechanism in conjunction with the usual narrowing machine dipping mechanism, not shown in detail herein, to manipulate the points for producing the desired type of distorted loops at the desired locations. Two types of mechanism for this purpose are shown in combination herein, but ordinarily would be employed separately. One arrangement is intended to shift the point rods simultaneously, and is applicable where only one set of lace points is employed. It includes the actuation of eccentric 242 through the operation either of left shift cam 274, which oscillates eccentric 242 clockwise as viewed in Fig. 38, or the actuation of right shift cam 280 to shift eccentric 242 in the opposite direction when follower 275 is shifted into operative position by the depression of slide 279 controlled by lever 246. This operation will shift all the levers 243—247 either to right or left, which through the corresponding movement of stop frame 435 will similarly shift the lace points on rods 366 and 370.

The shifting movement of eccentric shifting lever 270 will likewise operate through offset arm 431 to move vertical slide cam 433, which may be set to produce relative movement between point rods 366 and 370 in either direction. Frequently it is desirable to operate one of the point rod shifting devices without the other. For instance, when producing the spread locking loop construction specifically shown in the Richter patent, only the vertical slide cam 433 is employed, eccentric shifting lever 270 being disconnected from the eccentric 242, as by releasing the split clamp 267. Likewise, the vertical slide cam 433 may be put out of operation, as by disconnecting it from offset arm 431 or by removing the cam plate thereon.

Meanwhile rocking lever 231 of the lace course regulator mechanism will be swung to the right through regulator shift cam 237. If the lace course apparatus F is to function during the succeeding course, shift plate 229 will be set so that its actuation will not move slide frame 224 or lace trip rod 226 carried thereby. If however it is desired to interpose one or more courses in which the lace course apparatus F does not function, shift plate 229 is set to move slide frame 224 to the right, operating through rack 223 and pinion 222 to reset ratchet disc 202 with the number of teeth 204 ahead of pawl 205 corresponding to the desired number of plain courses.

The shift of lace trip rod 226 to the right will release the narrowing motion latch lever 120 and holding lever 104; and by rocking the locking rod 346 through the engagement of tongue 349 with pin 348, locking plate 352 is swung to the right, permitting spring 345 to shift arm 168 to the left at the appropriate time controlled by lateral cam face 324, which in conjunction with the lifting of arm 168 by lace release cam 310 and follower 169, will reposition arm 168 upon the upper end of holding lever 104. Cam shaft 74 will be shogged to normal position through the usual narrowing cam operation, and the machine will operate in normal position during a number of courses determined by the number of teeth 204 on lace course regulator ratchet disc 202 set

ahead of pawl 205. When the last tooth 204 is racked the lace trip rod 226 will again reach its tripped position at the left and will function in a manner already described to set the lace clock

5 apparatus F in operation.

It will be understood that while the lace course regulator D is in operation with cam shaft 74 in normal position, the course counting ratchet wheel 47 will be racked in the usual manner; and it will therefore be necessary to coordinate the

10 setting of the main pattern chain 31 with the setting of the lace pattern chain 250, since the latter controls the number of plain courses knit under control of the lace course regulator D.

15 When it is desired to throw the lace course apparatus F out of commission until again tripped by the main pattern chain 31, the lace pattern chain 250 is provided with a suitable stud engaging regulator setting lever 247 to position the

20 stepped shift plate 229 for maximum throw. When said plate is shifted ratchet disc 202 will be rotated in a clockwise direction to the position shown in Fig. 24, in which hold-out plate 217 will prevent pawl 205 from again becoming effective

25 until rod 131a is actuated by the main pattern chain 31.

Various combinations of instrumentalities disclosed herein, together with variations thereof and other mechanisms known in this art and

30 adapted for use in conjunction therewith, may be employed for producing a variety of knitting effects, as will appear to those familiar with this art; and the disclosure herein of specific constructions and instrumentalities is to be construed as illustrative of a preferred embodiment

35 of the invention rather than as limiting the scope thereof.

We claim:

1. A knitting machine comprising a pattern

40 device, mechanism for imparting an operating movement to the device, holdout means for holding the mechanism out of operation, means for shifting the holdout means through successive stages while in effective position and thereafter

45 into ineffective position, and means for determining the number of said stage movements including means automatically varying the length of time said holdout means is in operation at different points in knitting a given piece of fabric.

50 2. A knitting machine comprising a pattern device, means for imparting a pattern shifting movement to the device at intervals including an interval determining element, means for imparting an actuating movement to the pattern device,

55 and means for resetting the interval determining element during the actuating movement.

3. A knitting machine comprising a pattern device, means for imparting a pattern shifting movement to the device at intervals including an

60 interval determining element, means for imparting an actuating movement to the pattern device, and means operated by the actuating movement for resetting the interval determining element.

65 4. A knitting machine comprising a pattern device, mechanism for imparting at intervals an operating movement to the device, control means including a ratchet for determining said intervals, and means actuated by the operating movement of the pattern device for resetting the

70 ratchet.

75 5. A knitting machine comprising a pattern device, mechanism for imparting at intervals an operating movement to the device, control means including a rotary ratchet for determining said intervals, and a rack operated during said move-

ment of the pattern device for setting the rotary ratchet.

6. A knitting machine comprising a pattern device, control means for determining the intervals between successive operations of the pattern device and means for imparting a translatable movement to the pattern device and setting the control device to determine a succeeding interval.

7. A knitting machine comprising a pattern device, means for imparting a pattern-changing movement to the device, means for imparting an actuating movement to the device, and means for controlling the intervals between successive pattern shifting movements including a rotary ratchet, pattern elements carried by the pattern device, and means operated by said elements during the actuating movement of said device for resetting the rotary ratchet.

8. A knitting machine comprising a rotary pattern device, means for imparting rotary pattern shifting movements to the device, means for imparting translatable actuating movements to the device, and control means for determining the intervals between successive pattern shifting movements including a rotary ratchet, rack means for resetting the ratchet, pattern elements of variable height carried by the pattern device, and means operated by said elements during the translatable movement to actuate the rack means and set the ratchet in conformity with the height of the elements.

9. A knitting machine comprising a rotary pattern device, means for imparting successive operating movements to the device including a translatable movement, and control means for determining the intervals between successive operative movements including a ratchet, rack means for resetting the ratchet, a resetting member associated with a rack connected by pinion means to the resetting rack means, and means carried by the pattern device and operatively engaging the resetting member during said actuating movement of the device to reset the ratchet.

10. A knitting machine comprising a rotary pattern device, means for imparting rotary movement to the device at intervals, control means for determining said intervals including a rotary ratchet unit, means for imparting translatable movement to the pattern device and ratchet unit, a rack engaging the ratchet unit, a support having frictional engagement with the ratchet unit for shifting the rack in one direction during translatable movement of the ratchet unit, and resetting means connected to the rack and engaged by the pattern device during said translatable movement for shifting the rack in the opposite direction against said frictional engagement to reset the ratchet unit.

11. A knitting machine including a support, a rotary pattern device mounted on the support, means for imparting rotary pattern changing movement to the device at intervals, and control means for determining the intervals including a rotary ratchet mounted on the support, means for periodically shifting the support, and means actuated by said shift to reset the ratchet.

12. A knitting machine including a support, a rotary pattern device mounted on the support, means for imparting rotary pattern changing movement to the device at intervals, and control means for determining the intervals including a rotary ratchet mounted on the support, means for periodically shifting the support, and means actuated by the pattern device during said shift for resetting the ratchet.

13. A knitting machine comprising a shaft, a pattern device mounted for rotation on the shaft, means for imparting rotary pattern shifting movement to the device at intervals, and control means for determining the intervals including a ratchet unit mounted for rotation on the shaft, means for imparting translatory movement to the shaft, and means actuated by the pattern device during the translatory movement for re-setting the ratchet unit.

14. A knitting machine comprising a pattern device having a series of successively effective pattern units, means for imparting an actuating movement in stages to a unit when in effective position, means for transmitting movement during one of said stages from the unit in effective position to one or more elements of the machine, and means for transmitting motion from the unit in effective position to one or more elements of the machine other than said element or elements during another stage of the movement of the effective unit.

15. A knitting machine comprising a rotary pattern device having a series of successively effective pattern units, means for imparting to each unit when in effective position a series of actuating movements, means for transmitting motion to one or more elements of the machine from the unit which is in effective position during one of said series of actuating movements, and means for transmitting movement to one or more elements of the machine other than said element or elements from the unit in effective position during another of said series of actuating movements.

16. A knitting machine including a pattern device comprising a series of pattern units, means for imparting to each unit an actuating movement in stages, means operated by a unit during one stage of movement, and means operated by the same unit during a subsequent stage of movement.

17. A knitting machine including a plurality of mechanisms operating in predetermined sequence in timed relation, and means for effecting appropriate operation of said mechanisms including a pattern device having a series of pattern units, means for imparting to each unit an actuating movement, and means engaging said unit and operated thereby at appropriate stages of said movement for effecting the operation of said mechanisms in the proper sequence and relation.

18. A knitting machine including a rotary pattern device, means for imparting to the device a translatory movement in stages, means operatively engaged by the pattern device during a stage of movement, and means operatively engaged by the device during a successive movement.

19. A knitting machine comprising a pattern device, means for imparting a pattern shifting movement to the device, means for imparting an actuating movement to the device, and locking means maintained in locking engagement with the pattern device during the actuating movement and released during the pattern shifting movement.

20. A knitting machine comprising a pattern device, means for locking the device, means for imparting a pattern shifting movement to the device and releasing the locking means during such movement, and means for imparting an actuating movement to the pattern device and rendering the locking means effective during the actuating movement.

21. A knitting machine comprising a pattern device, means for locking the device, means for imparting a pattern shifting movement to the device and releasing the locking means during such movement, control mechanism for the movement imparting means, and means operative after said pattern shifting movement to reset the control mechanism and return the locking means to operative position.

22. A knitting machine comprising a rotary pattern device, means for locking the device against rotation, means for imparting a rotary pattern shifting movement to the device and releasing the locking means during such movement, and means for imparting a transaxial actuating movement to the device and positioning the locking means in operative engagement with the device during the actuating movement.

23. A knitting machine comprising a rotary pattern device, means for imparting a translatory movement to the pattern device including an actuating element rendered effective by rotation of the device, and a lock for said device maintaining it in operative position during said translatory movement.

24. A full fashioned knitting machine comprising a main cam shaft, mechanism for shogging the shaft, a pattern device, intermittently operable means for imparting an actuating movement to the pattern device, and control means for effecting the operation of the shaft-shogging mechanism and maintaining the movement-imparting means in operative position.

25. A full fashioned knitting machine comprising a main cam shaft, mechanism for shogging the shaft, a pattern device, intermittently operable means for imparting an actuating movement to the pattern device, control means for effecting the operation of the shaft-shogging mechanism and maintaining the movement imparting means in operative position, and mechanism set in operation by the pattern device for operating the control means after a predetermined number of rotations of the cam shaft.

26. A knitting machine comprising a pattern device, means for imparting a pattern shifting movement to the device at predetermined intervals, a drive shaft, control means operated by the shaft and moving the pattern shifting means by stages to operative position, means for effecting an actuating movement of the pattern device, and means for operatively connecting the movement-effecting means to the drive shaft when the pattern-shifting means is in operative position.

27. A knitting machine including a pattern device, a cam shaft having a normal position and a shogged position, a cam on the shaft, and means for imparting periodic movement to the pattern device including a follower normally out of alignment with both positions of the cam and movable into operative position in which the follower engages the cam when the shaft is in normal position and is out of engagement with the cam when the shaft is in shogged position.

28. A knitting machine including a pattern device, a cam shaft having a normal position and a shogged position, mechanism for imparting an actuating movement to the pattern device at intervals including a cam on the shaft, a cooperating follower normally out of engagement with the cam, and means for shifting the follower into actuating position in which the follower is in engagement with the cam when the shaft is in normal position and out of engagement with the

cam when the shaft is in shogged position; and control means for determining said intervals including a cam on the shaft and a cooperating follower engaging the cam in both positions of the shaft.

29. A knitting machine including a pattern device, a cam shaft having a normal position and a shogged position, a cam on said shaft, means for imparting periodic movement to the pattern device including a follower normally out of alignment with both positions of said cam and means for moving the follower into active position engaging the cam when the shaft is in normal position only, and means controlled by the pattern device for shogging the shaft.

30. A knitting machine including a cam shaft having a normal position and a shogged position, a pattern device, means operable by the cam shaft only when in normal position for imparting an actuating movement to the pattern device, means actuated by said movement of the pattern device for shogging the shaft, and means for returning the shaft to normal position.

31. A knitting machine including a cam shaft having a normal position and a shogged position, apparatus operable by the shaft in normal position, apparatus operable by the shaft in shogged position, a pattern device, means for imparting an actuating movement to the device including a cam on the shaft and a follower engageable with the cam only when the shaft is in normal position, means actuated by said movement of the pattern device for shogging the shaft, means actuated by said movement for operating selected apparatus, and apparatus operated by the shaft in shogged position for controlling the return of the shaft to normal position.

32. A knitting machine comprising a pattern device, means for imparting a pattern shifting movement to the device at predetermined intervals, control means for determining said intervals, a drive shaft, means operated by the shaft for imparting stage movement to the control means, mechanism for effecting an actuating movement of the pattern device, and means for operatively connecting said mechanism to the drive shaft when the control means has reached a predetermined stage.

33. A knitting machine including a pattern device, a drive shaft, mechanism operable by the drive shaft for imparting an actuating movement to the device at intervals and control means for determining said intervals including apparatus moved in successive stages by the drive shaft, means whereby said pattern device determines the number of said stages and means effective at the final one of said stages for effecting a pattern shifting movement of said device and operatively associating the drive shaft with said mechanism.

34. A knitting machine including a pattern device, a drive shaft, means operable by the drive shaft for imparting an actuating movement to the device at intervals, control means for determining said intervals including apparatus moved in successive stages by the drive shaft and means effective at the final stage of said movement for effecting a pattern shifting movement of said device and operatively connecting the drive shaft to said mechanism, and means operated by the actuating movement of the device for resetting said apparatus.

35. A knitting machine comprising a pattern device, mechanism for imparting an actuating movement to the device, means for imparting a pattern-changing movement to the device, a con-

trol device adapted to vary the intervals between successive pattern changing movements, and unitary means for effecting the operation of said means and mechanism.

36. A knitting machine comprising a pattern device, means for imparting a pattern shifting movement to the device at variable intervals, means for determining the intervals, and means for imparting an actuating movement to the device after said pattern shifting movement.

37. A knitting machine comprising a pattern device, means for imparting a pattern changing movement to the device, mechanism for imparting an actuating movement to the device at predetermined intervals, and means controlled by the pattern device for determining said intervals.

38. A knitting machine comprising a rotary pattern device, a series of successively effective pattern units supported by the device, a mechanism for imparting pattern shifting movement to the pattern device at predetermined intervals, pattern means for determining the intervals, and means for imparting to the pattern device a transitory actuating movement subsequent to the pattern shifting movement of the device.

39. A knitting machine comprising a pattern device, a plurality of rods operatively associated with said device and longitudinally movable in a common plane, means for locking the rods against longitudinal movement, and means synchronized with the pattern device for releasing the locking means.

40. A knitting machine comprising a pattern device, a plurality of coplanar rods longitudinally shifted by the pattern device at predetermined intervals, a locking slide movable transversely to the rods for engagement and disengagement therewith, and means for shifting the locking slide into disengaging position at the same intervals.

41. A knitting machine comprising a pattern device, means actuated by the pattern device, locking apparatus for said means, a cam shaft, and means associated with the cam shaft for actuating the pattern device and locking apparatus.

42. A knitting machine comprising a pattern device, mechanism for moving the device from normal position, drive means for said mechanism, means for rendering the drive means effective while the pattern device is in normal position, and means for maintaining the drive means in operative association with said mechanism when the pattern means is moved from normal position.

43. A knitting machine comprising a pattern device, a movable support therefor, mechanism for shifting the support to impart an actuating movement to the pattern device, drive means, means for operatively associating said mechanism and drive means including an element carried by the support and a cooperating element mounted independently of the support, and means for maintaining said mechanism and drive means in operative association when said elements are separated by movement of the support.

44. A knitting machine comprising a rotary pattern device, a ratchet for rotating the device, control means for maintaining the ratchet in inoperative position, movable by stages and effective in the final stage to set the ratchet in operative position, and means controlled by said device for varying the number of said stages.

45. A knitting machine including a spindle, a pattern device mounted for rotation thereon, control means including a ratchet rotatably mounted

on the spindle for determining the interval between rotary movements of the pattern device, means for imparting translatable movement to the spindle, means including an element engaging said ratchet and shifted by translatable movement thereof to reset the ratchet, and means providing a yieldable engagement between the ratchet and spindle.

46. A knitting machine comprising a pattern device, means for reducing the machine speed, auxiliary apparatus operative at said reduced speed, means for shifting the pattern device in stages, means actuated by said shift during one stage for operating the speed reducing device, and means actuated by said shift during a succeeding stage for placing said auxiliary apparatus in operation.

47. A knitting machine comprising a rotary pattern device, means for imparting a pattern shifting movement thereto, mechanism for imparting an actuating movement thereto, and means for continuously operating said mechanism in repeated cycles between successive operations of the pattern shifting means.

48. A knitting machine comprising a pattern device, means for imparting to the device a pattern changing movement at predetermined intervals, control means for determining said intervals, mechanism for imparting an actuating movement to the pattern device, and means for maintaining said mechanism in operative position and simultaneously holding the control means out of operation.

49. A knitting machine including a pattern device, means for imparting a pattern shifting movement thereto, mechanism for imparting an actuating movement to the device, and control means for operating said means and mechanism to produce a predetermined number of actuating movements to the device between successive pattern shifting movements thereof.

50. A pattern control unit for knitting machines provided with a cam shaft, including a bracket adapted to be mounted on the machine, a pattern

device mounted on the bracket and adapted to cooperate with control elements on the machine, means carried by the bracket for determining the intervals between successive operations of the pattern device, and actuating means extending from the bracket arranged for cooperation with said cam shaft to actuate the pattern device and control means.

51. A knitting machine including a pattern device, means for imparting an actuating movement to the device, and apparatus actuated by said movement, and means for variably determining the time of actuation, including a device located at a variable point in the path of the pattern device during the actuating movement thereof.

52. A knitting machine comprising a pattern device, means for operating the device at predetermined intervals, and control means for determining said intervals including a ratchet, a pawl therefor, and means for resetting the ratchet and maintaining the pawl out of operative engagement during resetting.

53. A knitting machine comprising a pattern device, mechanism for imparting an operating movement to the device, hold-out means for holding said mechanism out of operation, means for shifting the hold-out means through successive stages while in effective position and thereafter into ineffective position, and means whereby said pattern device determines the number of said stage movements.

54. A knitting machine comprising a pattern device, mechanism for imparting an operating movement to the device, holdout means for holding the mechanism out of operation, means for shifting the holdout means through successive stages while in effective position and thereafter into ineffective position, and means for determining the number of said stage movements including means for reversing the movement of said holdout means.

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