March 5, 1935. H. M. ZIPPEL 1,992,982

KNITTING MACHINE

Filed Sept. 14, 1931 8 Sheets-Sheet 1

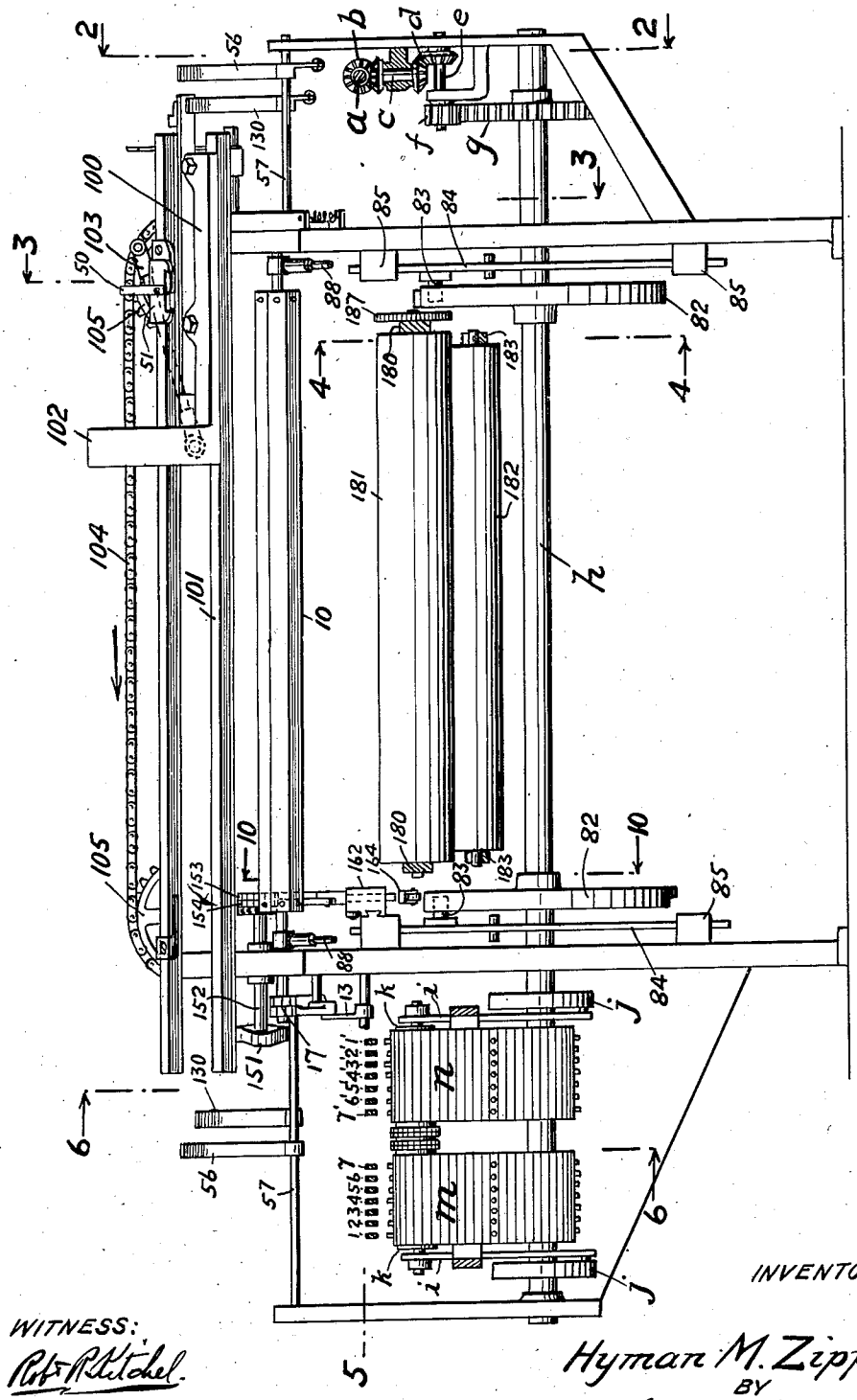


FIG. 1.

WITNESS:
Robt. R. Mitchell

INVENTOR
Hyman M. Zippel
BY
Busser and Harding
ATTORNEYS.

March 5, 1935. H. M. ZIPPEL 1,992,982

KNITTING MACHINE

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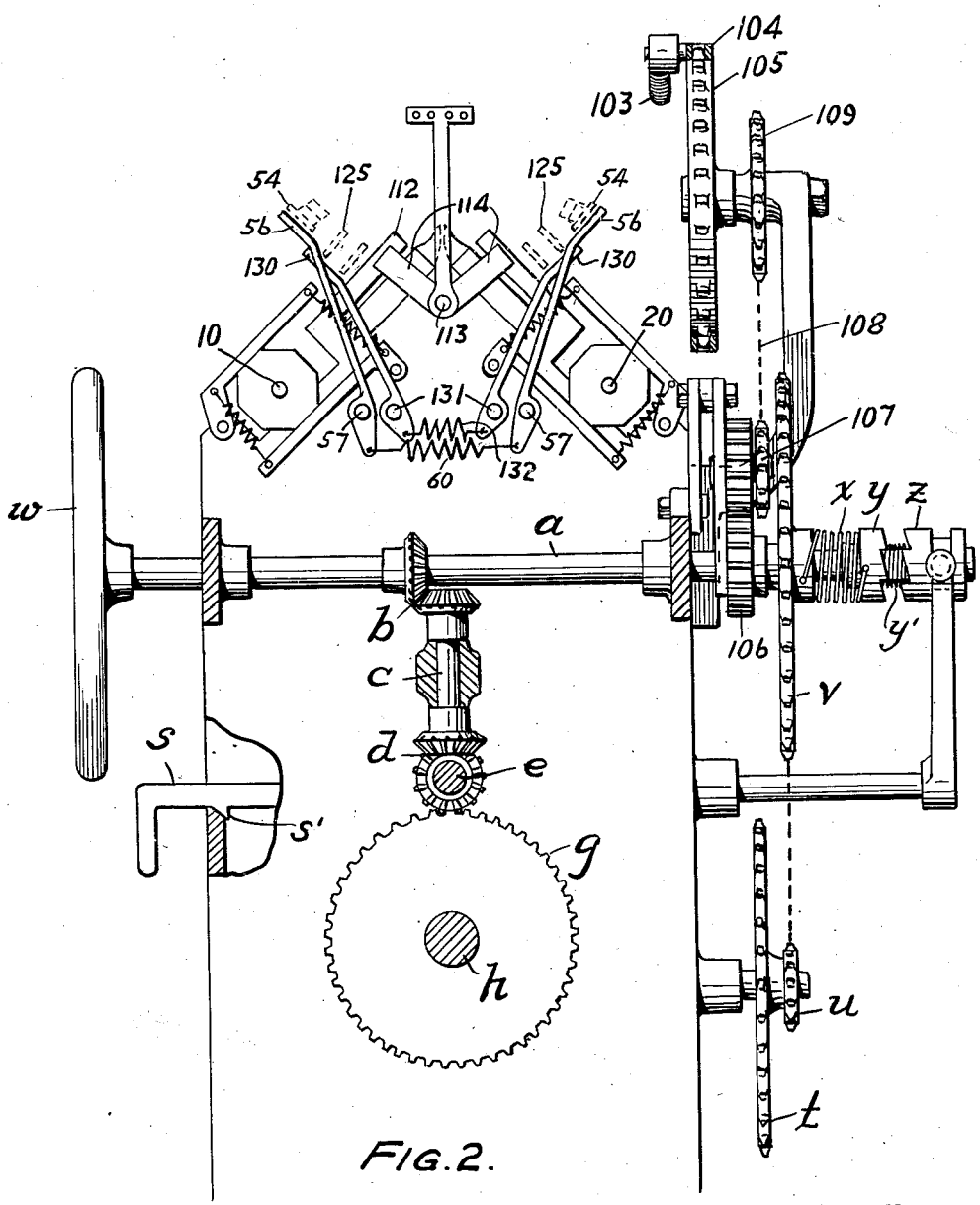


FIG. 2.

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March 5, 1935. H. M. ZIPPEL 1,992,982

KNITTING MACHINE

Filed Sept. 14, 1931 8 Sheets-Sheet 3

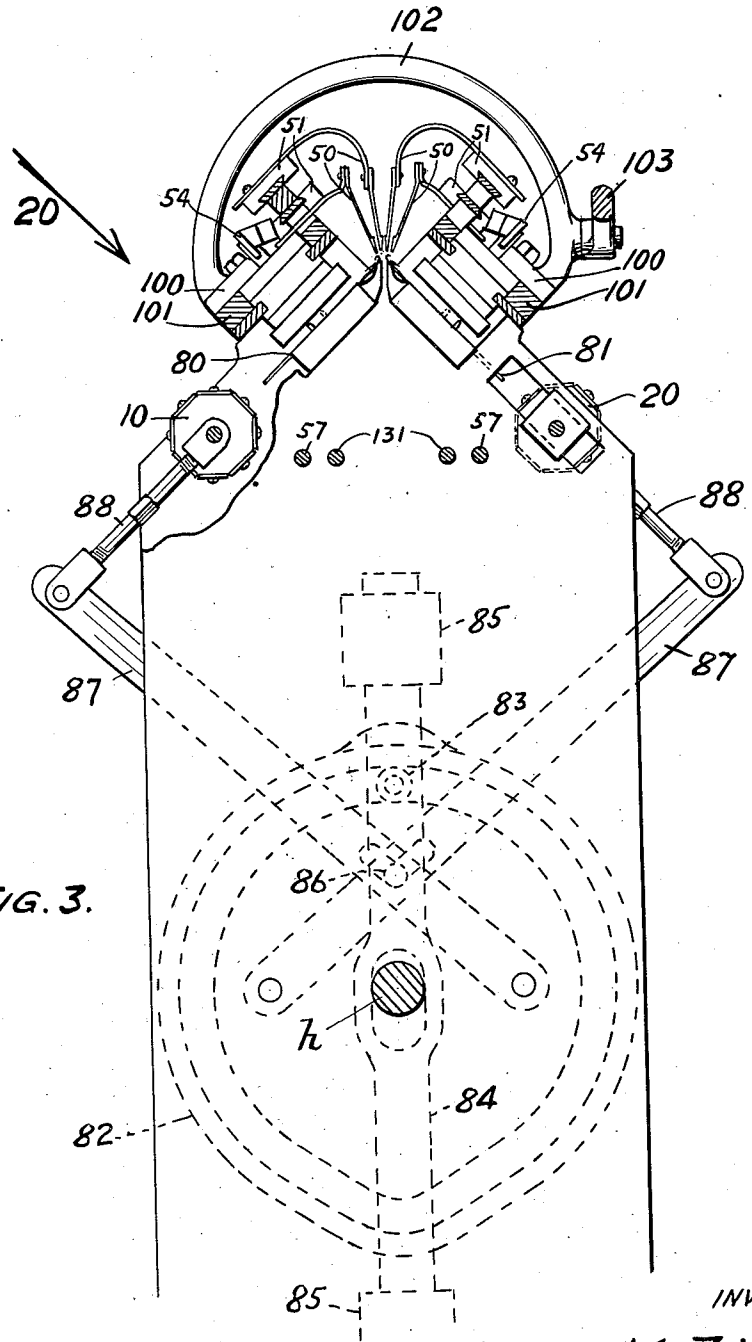


FIG. 3.

INVENTOR

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WITNESS:

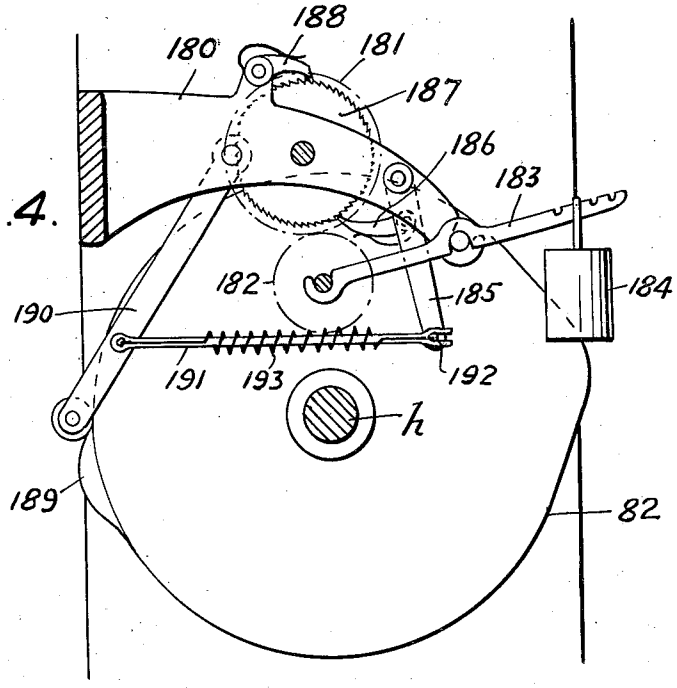
Robt R. Stickel

March 5, 1935. H. M. ZIPPEL 1,992,982

KNITTING MACHINE

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FIG. 4.



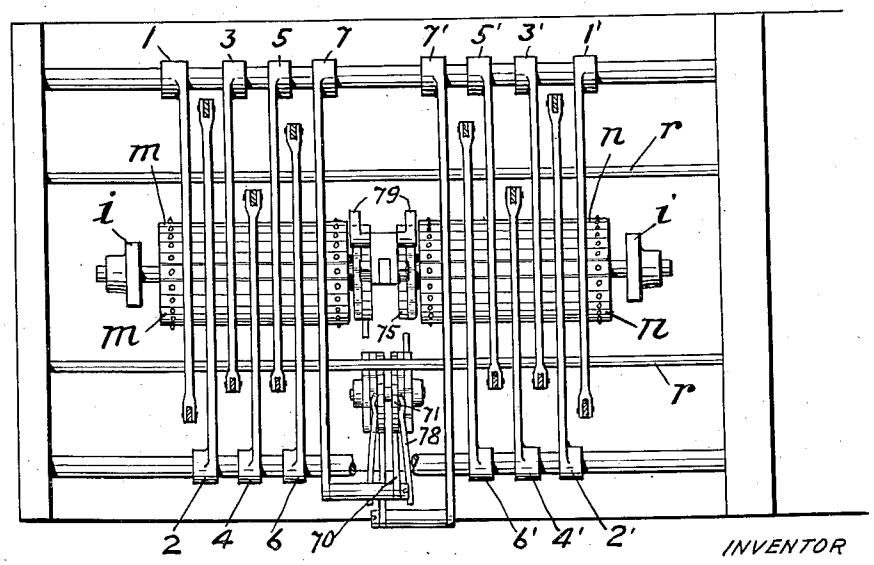


FIG. 5.

INVENTOR

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March 5, 1935. H. M. ZIPPEL 1,992,982

KNITTING MACHINE

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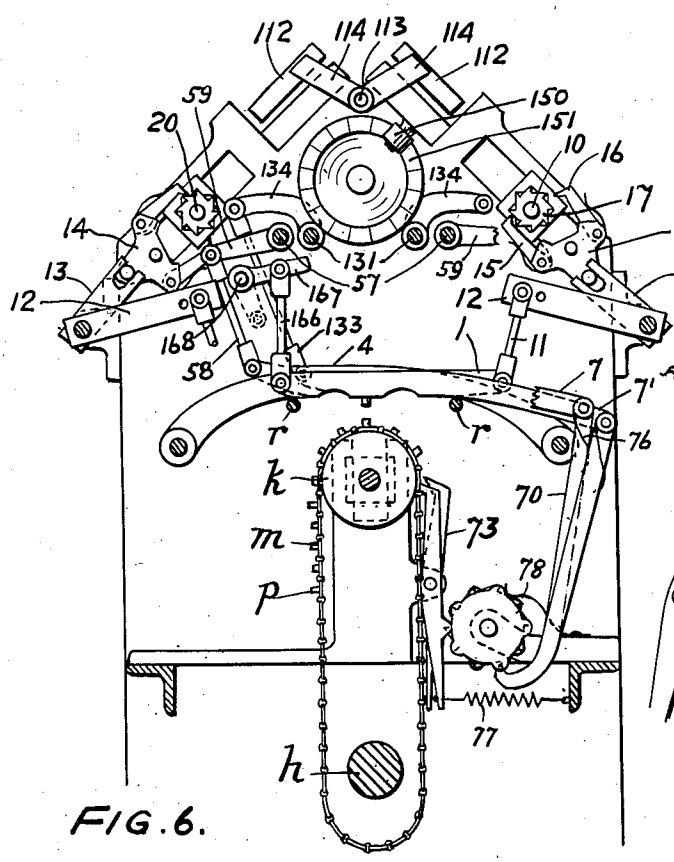


FIG. 6.

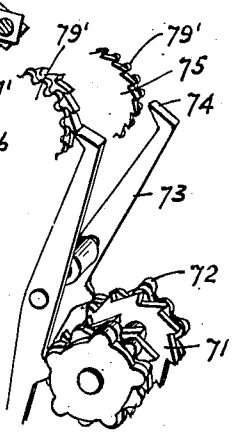


FIG. 7.

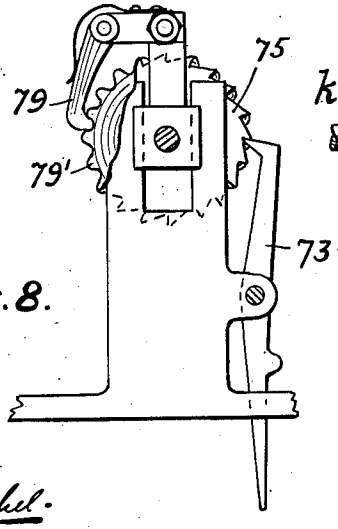


FIG. 8.

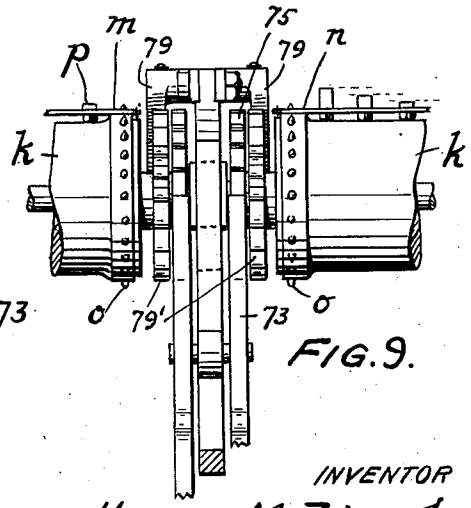


FIG. 9.

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March 5, 1935. H. M. ZIPPEL 1,992,982

KNITTING MACHINE

Filed Sept. 14, 1931 8 Sheets-Sheet 6

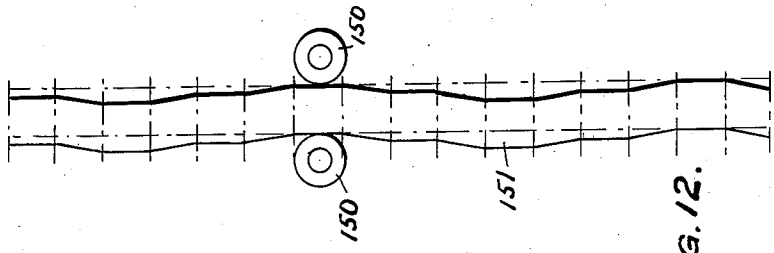


FIG. 12.

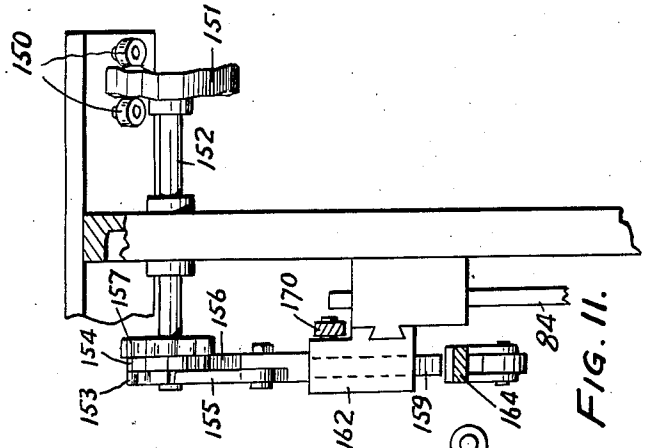


FIG. 11.

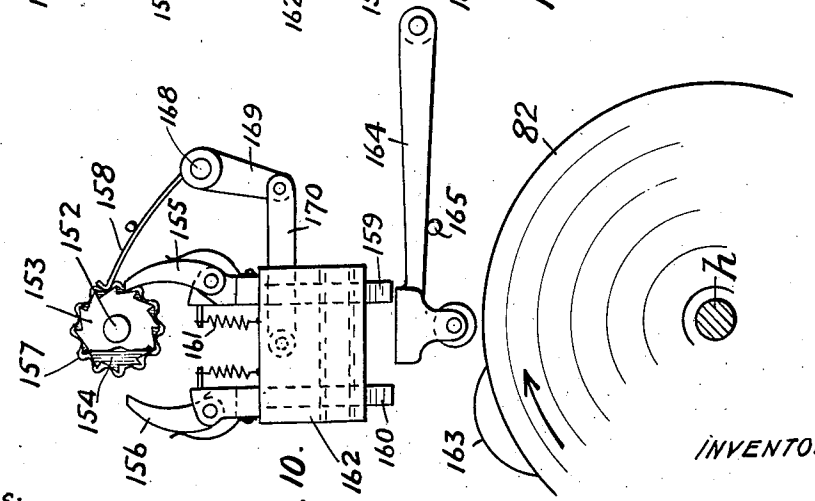


FIG. 10.

WITNESS:
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March 5, 1935. H. M. ZIPPEL 1,992,982

KNITTING MACHINE

Filed Sept. 14, 1931 8 Sheets-Sheet 7

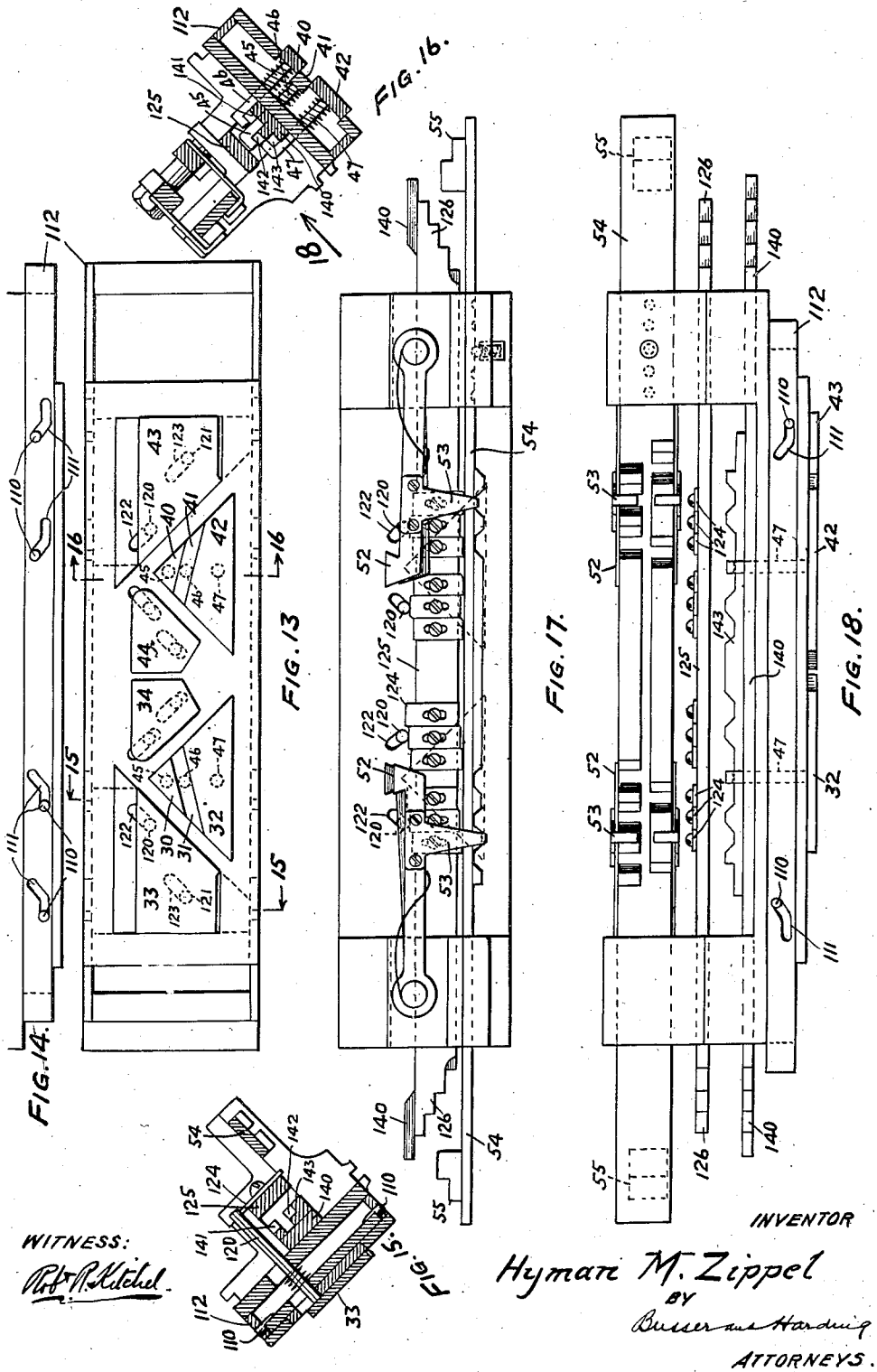


FIG. 14.

FIG. 13.

FIG. 16.

FIG. 15.

FIG. 17.

FIG. 18.

WITNESS:

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KNITTING MACHINE

Filed Sept. 14, 1931 8 Sheets-Sheet 8

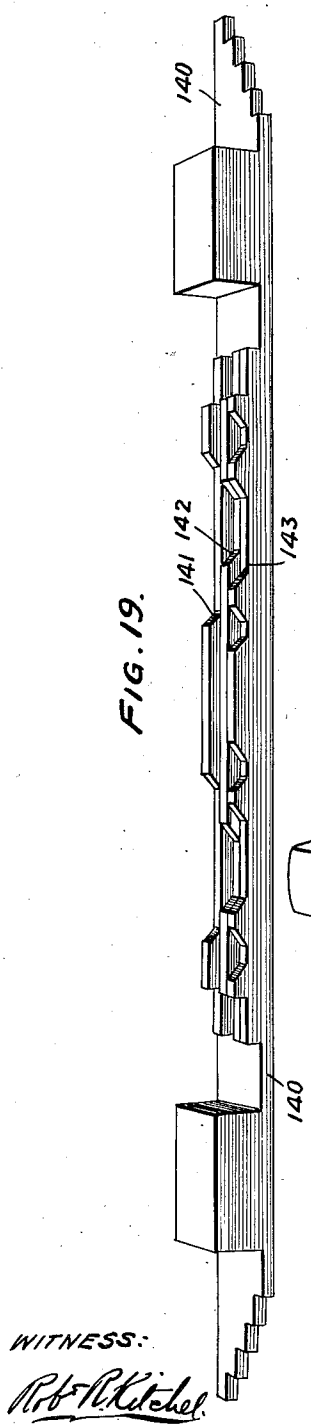


FIG. 19.

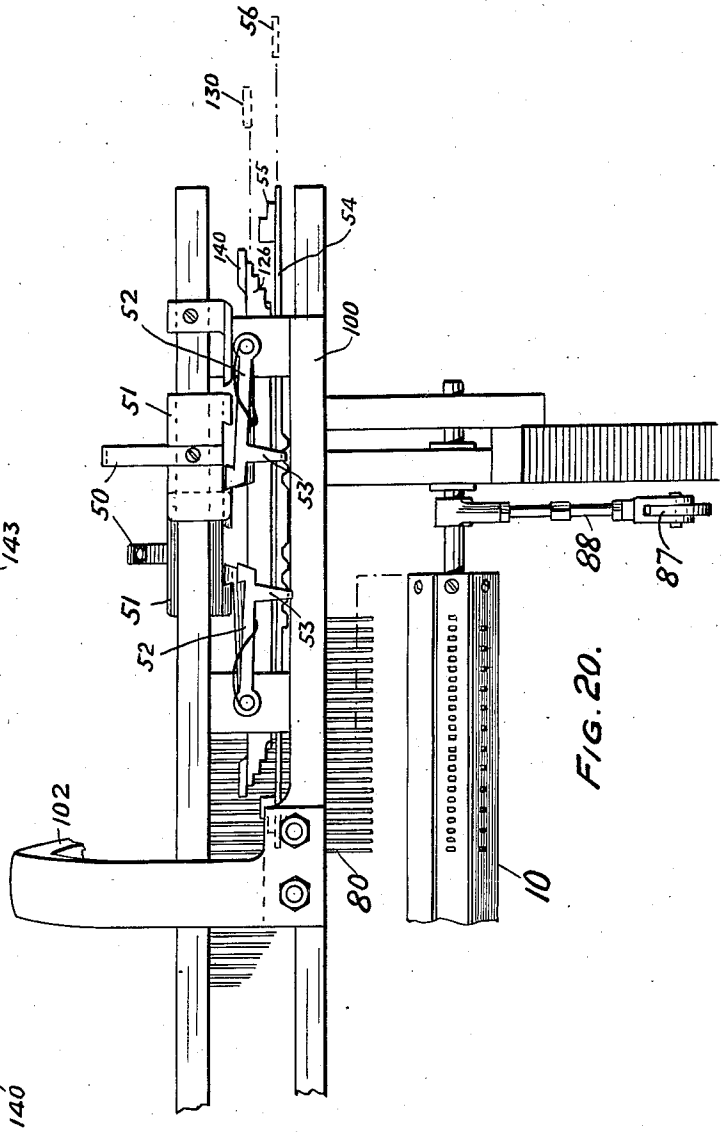


FIG. 20.

WITNESS:

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ATTORNEYS.

Patented Mar. 5, 1935 1,992,982

UNITED STATES PATENT OFFICE

1,992,982

KNITTING MACHINE

Hyman M. Zippel, Philadelphia, Pa.

Application September 14, 1931, Serial No. 562,652

33 Claims. (Cl. 66—75)

My invention relates to that type of knitting machine which comprises two longitudinally extending banks of needles, turnable jacquard drums for determining what needles shall be selectively raised, longitudinally reciprocating knitting cams and yarn feeders, and pattern mechanism for controlling the knitting operation.

The main object of the invention is to enlarge the pattern range of the machine while at the same time simplifying the construction.

The invention comprises various generic and specific structural features relating to the jacquard drums and the means for actuating and controlling them, to the means for longitudinally shifting one bank of needles relatively to the other bank so as to produce different varieties of conventional stitches, to the knitting cams and particularly to the means for moving them into different relative positions during the operation of the machine, to the yarn feeders and the means for actuating them and for moving them into and out of operative position, to the take-up mechanism, and to the pattern mechanism for controlling the adjustment and operation of the above specified parts during the operation of the machine. The adjustments and changes of operation, which it is the object of my invention to effect in order to broaden the range of the machine and to knit thereon any kind of fabric involving elaborate changes of pattern, are so numerous that no pattern chain, drum or disc of practicable size would be capable of effecting them. One important feature of the invention is the provision of two pattern chains, each controlling the same mechanism, and each adapted to control the operation of the other, so that now one pattern chain and now the other, and permissively both, are in operation, whereby two pattern chains of relatively short length are capable of effecting the same adjustments and changes of operation as could be theoretically effected by a single pattern chain of impracticably great length.

It is impracticable, however, to explicitly or fully set forth, even in a general way, the various features of the invention except by a description of the details of the machine. It will be, of course, understood that in describing the machine many details will be disclosed which are non-essential, these details constituting merely a preferred embodiment of the invention and not the specific form which the invention must necessarily take. The essential elements and new combinations which constitute the invention are recited in the appended claims.

In the drawings, which illustrate a machine embodying the invention which has been constructed and successfully operated—

Fig. 1 is a general elevation of front of machine.

Fig. 2 is an enlarged cross-section on line 2—2, Fig. 1.

Fig. 3 is a similar section on line 3—3, Fig. 1.

Fig. 4 is a similar section on line 4—4, Fig. 1.

Fig. 5 is a plan view of left end of machine taken on line 5, Fig. 1.

Fig. 6 is a cross-section through left end of machine on line 6—6, Fig. 1.

Fig. 7 is a perspective view of detail shown in Fig. 6.

Fig. 8 is an enlarged detail of a portion of Fig. 6.

Fig. 9 is a front view of parts shown in Fig. 8.

Fig. 10 is a sectional view on line 10—10, Fig. 1, showing means for moving front needle bar.

Fig. 11 is a side view of parts shown in Fig. 10.

Fig. 12 is a developed view of circular cam for endwise movement of needle bar.

Fig. 13 is an inside view of one of the two similar needle cam carriers.

Fig. 14 is a top view of same.

Figs. 15 and 16 are cross-sections taken on lines 15—15 and 16—16, Fig. 13.

Fig. 17 is an outside view of needle cam carrier, being the obverse view to Fig. 13.

Fig. 18 is a view looking up at Fig. 17 or at Fig. 16 in direction shown by arrow 18.

Fig. 19 is a perspective view of the slidable bar which throws the knitting cams out of action.

Fig. 20 is a view of knitting carriage at right end of the machine, looking in direction of arrow 20, Fig. 3.

Referring first to Figs. 1 and 2: From a motor not shown is driven a sprocket wheel *t* which, through speed reducing sprockets *u* and *v*, drives a shaft *a* which, for convenience, may be called the driving shaft. Preferably the sprocket *v* is not fixed on shaft *a*, but is loose on the shaft and is connected, by a spring *x* with a clutch member *y* which is adapted to engage and drive a clutch member *z* splined on shaft *a*. As shown in Fig. 2, the clutch members are disengaged, a spring *y'* forcing the clutch members apart, breaking the drive from the motor, so that shaft *a* can be turned only by the hand wheel *w*. Connected to the clutch member *z* is a hand operable clutch-engaging rod *s* which, when moved to the left, engages clutch member *z* with clutch member *y*, thereby rendering the motor drive operative. A projection *s'* on clutch rod *s* is engageable with the frame of the machine so as to hold the clutch-shifting rod *s* in its operative position.

Through bevel gears *b* on shaft *a* is driven a shaft *c* which, through bevel gears *d*, drives a shaft *e* carrying a pinion *f*, the latter meshing with a gear wheel *g* on a shaft *h*.

At the left-hand end of Fig. 1, and also in Figs. 5, 6 and 9, is shown a pair of endless pattern chains *m* and *n*. Pattern chain *m* controls the operation of a series of levers 1 to 6 inclusive. Pattern chain *n* controls the operation of a series of levers 1′ to 6′. The pattern chains are continuously reciprocated vertically and in their upward movement lift such of their corresponding levers as may be engaged by lugs on the chains and to heights dependent on the heights of the lugs. All the levers rest on cross-bars *r*, *r* (see Fig. 5) when they are not lifted by lugs on the pattern chain. For convenience, this position of a lever may be called its normal position.

The pattern chains are hung on drums *k*, *k*, which are supported by and turnable in vertically slidable bars *i*, *i*. These bars are continuously reciprocated vertically by means of cam wheels *j*, *j*, on the shaft *h*; each cam wheel having a cam groove engaging a pin on the lower end of the corresponding bar *i*. Thereby the pattern chains are continuously bodily reciprocated vertically.

Pattern chain *m* is also adapted, in its upward movement, to operate a lever 7, which is adapted to effect a step-by-step turning movement of the drum that supports chain *n*. Similarly, pattern chain *n* is adapted, in its upward movement, to operate a lever 7′, which is adapted to effect a step-by-step turning movement of the drum that supports chain *m*. Each pattern chain has perforations along its edges which are engaged by sprocket teeth *o* on the corresponding drum, and in each turning movement of the drum the pattern chain is advanced so as to bring the next succeeding transverse row of lugs *p* under the control levers. The mechanism whereby a lever, 7 or 7′, operated by one chain, effects a turning movement of the drum carrying the other chain, will now be described. See particularly Figs. 5 to 9 inclusive.

Pivoted between their ends on the machine frame are two pawl levers 73 (see Figs. 6 and 8) which may be swung into and out of operative relation with the respective ratchet wheels 75 on the respective drums carrying the respective pattern chains. When the upper end of either pawl lever 73 is swung in toward the corresponding ratchet wheel 75, the latter, in the downward movement of the corresponding drum *k*, engages the pawl lever and is turned thereby so as to advance the corresponding pattern chain a distance equal to the distance between adjacent rows of lugs on the pattern chain. When the upper end of pawl lever 73 is swung away from the corresponding ratchet wheel 75, the ratchet wheel does not engage the pawl lever in its descent and the pattern chain is not advanced.

Depending from a stud on the end of each of the levers 7 or 7′ is a hook 70 (see Fig. 6), which is adapted, when the lever is lifted above its normal position, to engage a tooth on one of the ratchet wheels 71 (see Fig. 7) and thereby turn the ratchet wheel. Secured to each ratchet wheel 71 is another wheel 72 having knobs or cams adapted, in the turning movement of wheel 72, to engage a projection on the corresponding pawl lever 73. It will be observed that the knobs on wheel 72 are spaced apart twice the distance between adjacent teeth on wheel 71. Consequently, at one ratcheting of wheel 71, the projection on pawl lever 73 will ride onto a knob of wheel 72, thereby moving the pawl out of operative position, while at the next ratcheting of wheel 71, the projection on pawl lever 73 will drop between adjacent knobs of wheel 72, thereby moving the pawl lever into operative position.

A spring 76 maintains hook 70 in such position that it will always engage ratchet 71 when the hook is raised by the lever, 7 or 7′, by which it is carried. A spring 77 holds lever 73 in operative engagement with wheel 72. A spring detent 78 holds wheels 71 and 72 in the position to which they are turned.

It will be understood, as shown in Fig. 5, that the lever 7 or 7′ which is in operative relation with one pattern chain controls the lever 73 in operative relative relation with the other pattern chain. Assume that the lever 73 corresponding to pattern chain *m* is in operative position (its projection resting between knobs on the corresponding wheel 72), and that the lever 73 corresponding to pattern chain *n* is out of operative position (its projection resting on one of the knobs on the corresponding wheel 72). In these positions of the levers 73, pattern chain *m* is turning and pattern chain *n* is not turning. Assume now that a lug on chain *m* underrides lever 7. The lifting of lever 7, through the mechanism described, moves into operative position the lever 73 corresponding to pattern chain *n*. At the next downward movement of the pattern drums, both pattern chains are turned. Assume now that a lug on chain *n* underrides lever 7′. This, through the mechanism described, moves out of operative position the lever 73 corresponding to pattern chain *m*. At the next reciprocation of the pattern drums, pattern chain *n* turns but pattern chain *m* does not turn.

It will thus be understood that while both pattern chains *m* and *n* are continuously reciprocated vertically, one chain or the other is, at each reciprocation, turned on the axis of its drum. If at any given reciprocation or series of reciprocations both levers 73 are in operative relation to ratchet 75, both chains are turned simultaneously. Thus, one or both chains are always ratcheted forward at each reciprocation of the chain-carrying drums *k*, *k*.

Suitable mechanism should be provided to insure that each chain-carrying drum *k*, *k*, will be turned a definite distance and be held in the position to which it is turned. This may be done by having a spring-pressed detent lever 79 engage a toothed wheel 79′ connected with each chain carrying drum. See Figs. 8 and 9.

Reference has heretofore been made to the series of levers 1–6 operable by chain *m* in its upward movement and to the series of levers 1′–6′ operable by chain *n* in its upward movement. It should be explained that levers 1 and 1′ operate upon the same mechanism, that levers 2 and 2′ operate upon the same mechanism, and that the same is true of levers 3 and 3′, 4 and 4′, 5 and 5′ and 6 and 6′.

Specifically, when either lever 1 or 1′ is in a given position, it determines what needles of the front bank shall be positioned to be actuated by the needle cams. When either lever 2 or 2′ is in a given position, it determines what needles of the rear bank shall be in position to be actuated by the needle cams. When lever 3 or 3′ is in a given position, it determines the positioning of the needle cams controlling the front bank of needles. When either lever 4 or 4′ is in a given position, it determines the positioning of

the rear needle cams. When either lever 5 or 5′ is in a given position, it determines that certain yarn feeders at the front of the machine shall be in operation. When either lever 6 or 6′ is in a given position, it determines the operation of the rear yarn feeders.

In other words, if, instead of the two pattern chains, there were substituted one impossibly long pattern chain, only one set of levers 1 to 6 inclusive would be required. The operation of the mechanism controlled by the two pattern chains is the same as if one impossibly long pattern chain were substituted for the two pattern chains. In order that the operation may be the same, the levers 1 to 6 inclusive must be duplicated.

In describing the machine, reference will first be made to the jacquard mechanism controlled by levers 1, 1′ and 2, 2′.

Slidable in guides on the frame of the machine are two octagonal jacquard drums 10, 20, one extending along the front bank of needles 80 and the other extending along the rear bank of needles 81 (see Fig. 3). Each jacquard drum is positioned below its needle bank and is reciprocated toward, and parallel with the direction of extension of, the needles. Each wall of the drum is provided with a flat plate or jacquard card containing perforations aligning with some or all of the needles. In the upward movement of a drum those needles which align with perforations in the jacquard card are not lifted and consequently will not be in a position to subsequently catch the yarn unless they are lifted by the needle raising cam hereinafter described. Those needles which do not align with perforations in the jacquard will be engaged thereby and be lifted into position to subsequently catch the yarn whether or not the needle raising cam is in position to so lift them.

The jacquard drums are reciprocated by the following mechanism (see Figs. 1 and 3). On the shaft *h* are cam wheels 82, 82, having cam grooves engaged by pins 83 on bars 84. Each bar 84 is slotted between its ends so as to be vertically slidable upon, and radially of, shaft *h*. Each bar 84 is maintained in a vertical position by having its ends slidable in guides 85 on the machine frame.

Pivoted on the frame of the machine on both sides of sliding bars 84 are two levers 87, 87, each of which is slotted, between its ends, to engage a pin 86 on the corresponding bar 84. The end of each lever 87 is connected to one end of a link 88, whose other end supports one end of the shaft on which one of the jacquard drums is turnable. By reference to Fig. 3 it will be understood how, in the turning movement of cam wheels 82, bars 84 are reciprocated up and down, and pins 86, sliding in the slots of levers 87, swing said levers on their pivots and thereby, through links 88, reciprocate the front and rear jacquard drums in unison.

The reciprocating movement of the jacquard drums is thus continuous, and entirely independent of the pattern chains. The turning movement of such drums is, however, effected by levers 1, 1′ and 2, 2′, respectively. It will suffice to describe the means by which the operation of lever 1 controls the turning of the front jacquard drum 10; it being understood that the operation of lever 1′ controls the turning of the front jacquard drum by the same means, and that levers 2 and 2′ effect the turning of the rear jacquard drum 20 by duplicate mechanism.

The movable end of lever 1 is connected, by a link 11 (see Fig. 6) with an arm 12 secured to a shaft to which is also secured an arm 13. The forked end of arm 13 engages a pin on one arm of a three-armed swingable block 14. The other two arms of this block carry pawls 15 and 16 respectively.

When arm 1 rests on the cross-bar *r*, as shown in Fig. 6, pawl 15 is in such position that, in the downward movement of jacquard drum 10, pawl 15 engages a double ratchet 17 on the jacquard drum shaft and turns it so as to bring a different face of the drum opposite the needles of the front bank. As long as lever 1 remains in this position, it will continue to turn the jacquard drum in this direction at each reciprocation of the latter. When lever 1 is lifted by what may be called a low lug on pattern chain *m*, block 14 is swung into a middle position, rendering both pawls 15 and 16 inoperative. As long as lever 1 remains in this position, the jacquard drum is not turned. When lever 1 is lifted by what might be called a high lug on pattern chain *m*, block 14 is swung into such position that, in the downward movement of the jacquard drum, pawl 16 engages ratchet 17 and thereby turns the jacquard drum in the opposite direction. As long as lever 1 remains in this high position, it will continue to turn the jacquard drum in this direction at each reciprocation of the latter.

Before describing the operation of levers 3, 3′, and 4, 4′, reference should be made to the knitting cams whose positioning these levers control. The cams controlling the operation of one bank of needles and their immediate positioning means are shown in Figs. 13 to 20 inclusive. By reference to Fig. 13 it will be observed that, for each bank of needles, there are two sets of cams. Each set of cams comprises a middle needle-raising cam (30, 31, 32 or 40, 41, 42) and stitch cams (33 and 34 or 43 and 44). By means of these two sets of cams the needles are actuated to produce two courses of knitting at each movement of the cams in one direction along the needles. For example, in the movement of the cams from right to left (Fig. 13), the middle cam 30, 31, 32 of one set of cams is adapted to lift the needles, which are then lowered by cam 34; following which the middle cam, 40, 41, 42 of the other set of cams is adapted to lift the needles, which are then lowered by cam 43. This general description applies, of course, to any ordinary knitting cams. The middle cam, however, is peculiarly constructed and is made in three independently withdrawable sections (30, 31 and 32 or 40, 41, 42) for purposes to be hereinafter described.

Each of the described sets of knitting cams is carried by a frame 100 (see Figs. 1 and 3). The two frames 100 which carry the front and rear knitting cams respectively are slidable on and guided by stationary bars 101. The two frames 100 are connected by a yoke 102, which is connected, by means of a connecting rod 103, with an endless chain 104 extending around sprocket wheels 105, 105. Shaft *a*, through spur gears 106 (see Fig. 2) sprocket wheel 107, sprocket chain 108, and sprocket wheel 109 on the shaft of one of the sprocket wheels 105, imparts a continuous travel to chain 104 and thereby, through the connections above described, reciprocates the cam carrying frames 100.

It is necessary, at the end of each stroke of a cam carrying frame, to withdraw one of the end cams 33 or 43 from operative position so that, at

the next stroke of the frame, such cam (which is the cam in advance on that stroke) will not engage the needles in order that the needles may engage the adjacent needle lifting cam. For this purpose each of the cams 33 and 43 is made laterally movable, into and out of the path of movement of the needle butts, by means of pins 110 thereon engaging angular slots 111 in a longitudinally movable frame 112 (see Fig. 14). A stud 113 at each end of the machine is provided with lateral arms 114 (see Fig. 2) which, at the end of each stroke of the carriage, engage the ends of frames 112. Each frame is thereby shifted longitudinally and thereby withdraws one of the end cams 33 or 43 from operative position and moves the other end cam 33 or 43 into operative position.

Each cam 33 and 43 is spring-held in normal lower position, but is also adjustable vertically. For this purpose each cam is provided with pins 120, 121, slidable in slots 122, 123, respectively. Pin 120 is positively actuated. Pin 121 has merely a guiding function. Pin 120 is movable into any one of three positions by means (see Figs. 17 and 18) of adjustable blocks 124, on a bar 125 carried by and longitudinally movable in the cam frame 100. Bar 125 is provided at each end with a stepped end abutment 126. An arm 130 (see Fig. 1) is adapted to engage one or other of the three steps of abutment 126 as the cams approach the end of a stroke. Dependent on which step is engaged by arm 130, one or the other of the three blocks 124 will engage the pin 120 and position the cam 33 or 43 accordingly.

There are, of course, four of these arms 130 on the machine, two at opposite ends of the machine for actuating the front cam-actuating bar 125 and two at opposite ends of the machine for actuating the corresponding rear cam-actuating bar. The two pairs of arms are carried on shafts 131, 131. See Figs. 2 and 6. The shafts are turnable on their axes by means of mechanism actuated by the levers 3, 3', and 4, 4', and spring-returned into inactive position. Levers 3, 3', control one shaft, and levers 4, 4' the other shaft. For example, lever 4 is connected, by means of a link 133, with an arm 134 on one of the shafts 131. Lever 4' is similarly connected with the same shaft. Levers 3 and 3' are similarly connected with the other shaft 131. Each arm 130 is normally held by a spring 132 (see Fig. 2) in one extreme position, in which position the corresponding lever 3 or 3', 4 or 4', rests on the bars *r*. In the upward movement of the corresponding pattern chain, the lever is not lifted unless it is struck by a high lug on the chain. If it is struck by a lug, it will be lifted to a greater or less height dependent on the height of the lug. For the purpose of actuating the cam-actuating bar 125, only two lugs of different height are required. This affords three positions for the arms 130, which is all that is required for shifting the bar 125 to any one of its three positions. As a matter of fact, however, each pattern chain is provided with lugs of four different heights in order that the arms 130 may be swung into any one of five different positions, for a purpose that will now be described.

Reference has heretofore been made to the fact that the middle or needle lifting cam of each set of knitting cams is made in three sections 30, 31 and 32, or 40, 41 and 42. Each of these sections is spring-held in active position to engage needle butts, and is movable laterally to move it out of operative position. For so laterally moving these cam sections, three separate pins are secured to the respective cam sections of each needle lifting cam. As shown in Fig. 16, these pins, which are therein marked 45, 46 and 47, have hooked ends overlying the respective cam sections. To withdraw any cam section from operative position, the corresponding pin is moved in against the pressure of its actuating spring. It is desired that these cam sections shall assume a variety of different relative positions, thus necessitating the operation of the pins in a corresponding variety of ways. To effect this purpose there is provided a longitudinally extending cam bar (shown in detail in Fig. 19) which is longitudinally slidable in the cam frame and is provided with three parallel longitudinally extending rows of cams 141, 142 and 143, all integral with the bar 140. The cams 141, 142 and 143 are so formed and so relatively arranged that in different positions of the cam bar as many different combinations of pins 45, 46 and 47 may be operated. For example, the cam bar 140 may be movable into nine different positions, namely, a normal or central position, four positions to the left of the central position and four positions to the right of the central position.

To effect these movements, the bar 140 may be provided, at each end, with a five-stepped abutment. As hereinbefore stated, the arms 130, which actuate the stitch cam adjusting bars 125, are movable into five different angular positions. These arms 130 may also be utilized to actuate the bar 140. An arm 130 at the right-hand end of the machine may thus, dependent on which right-hand end abutment of the corresponding bar 140 engages it, shift the bar either into a median position or into any one of four positions to the left of the median position. Similarly, an arm 130 at the left-hand end of the machine may, dependent on which left-hand end abutment of the corresponding bar 140 engages it, shift the bar either into a median position or into any one of four positions to the right of the median position.

It has been hereinbefore pointed out that the lifting of the needles by the jacquard drums 10, 20, was for the purpose of enabling the raised needles to engage the cams 30 or 40 to be lifted thereby to catch the yarn whether or not the needle raising cam was in position to so lift them. One of the most important features of my machine is that the jacquard drums and the needle raising cams act in conjunction to greatly enlarge the capacity of the machine while at the same time simplifying the construction. It is important, in this connection, to note that, in most operations, none of the needle-raising cams is rendered inactive when the jacquard mechanism is rendered active, but that the jacquard mechanism and the needle raising cams act cooperatively, as will be presently explained. In ordinary knitting machines equipped with jacquard drums, the regular needle raising cam is rendered inoperative when the jacquard is rendered operative, and the jacquard then acts to lift jacks, and a special cam acts upon the jacks to lift the corresponding needles. In my machine the jacquard preferably directly lifts the needles to the height required to enable the needles to catch the yarn but not high enough to cast the yarn. The needle raising cam may or may not be rendered operative to lift the same needles high enough to cast the yarn. At the same time the needle-raising cam may be rendered operative to lift the needles not raised by the jacquard, to the same

height as the needles raised by the jacquard, or to lift the needles high enough to catch but not cast off the yarn while the needles raised by the jacquard are lifted high enough to both catch and cast off yarn, or to escape engagement with the needles not lifted by the jacquard so that such needles will not knit at all.

In order that the cooperative action between the jacquard and the knitting cams may be fully understood, it is desirable to explain in detail a number of different examples of cam adjustments and cam section withdrawals to produce different operative combinations and to then explain the way in which, in each operative combination, the jacquard-lifted needles and the needles not so lifted are operated.

In considering these various combinations it should be understood that the jacquard functions cooperatively with only the first acting of the two needle raising cams at each reciprocation of the cams; that is, with the left-hand needle raising cam when the cams are moving from right to left and with the right-hand needle raising cam when the cams are moving from left to right. In the following description it will be assumed, for simplification, that the knitting cams are moving from right to left. The operation when the cams are moving in the opposite direction, assuming that, preparatory thereto, the jacquard drum again lifts the same needles, will be the same if the two needle raising cams are adjusted in the same way. If they are differently adjusted, the different operation will be apparent after all the operations in the cam movement from right to left have been explained.

It should, of course, be understood that the provision of precisely nine combinations of needle lifting cam sections is not required. The combinations may be fewer, or they may be more numerous. The combinations which I use, however, are sufficiently great to secure a very great variety of stitches, as the following description will make clear.

The normal combination may be assumed to be that in which all the cam sections of both sets of knitting cams are moved out into operative position. Every needle, whether or not it has been lifted by the jacquard, will then lift high enough to catch the yarn and cast the stitch at each of the two courses of knitting.

In position 2, only cam section 31 is moved in out of line of the butts of needles. The needles which the jacquard has lifted engage the upper cam section 30 and are thereby lifted high enough to take yarn and cast off. The needles which the jacquard has not lifted will be engaged only by the lower cam section 32 and will thereby be lifted high enough to take yarn but not to cast off. All the needles will be lifted by the cam 40, 41, 42 to take and cast off yarn.

In position 3 the middle and lower cam sections, 31 and 32, 41 and 42, of both needle raising cams are moved in. The needles lifted by the jacquard drum will engage cam section 30 and take and cast yarn. The needles not lifted by the jacquard will not operate. None of the needles will be operated by the right-hand needle lifting cam.

In position 4 the cam sections 30, 31 and 40, 41 are moved in. All the needles are moved up by both needle lifting cams high enough to take yarn in both courses of knitting but not high enough to cast off in either course of knitting. In position 4, the jacquard, although it has lifted certain needles, is functionless to affect the knitting. It is one of the advantages of my invention that the stitches may be varied as desired while the jacquard drums remain stationary.

In position 5 all the cam sections of both needle lifting cams are moved in. None of the needles will be operated. During this adjustment the yarn carriers will be thrown out of action as hereinafter described.

In position 6 the cam sections 30 and 31 are moved in. The left-hand needle lifting cam will lift the needles which have not been lifted by the jacquard high enough to take yarn but not high enough to cast off. Any needles that may have been lifted by the jacquard will operate in the same way. The right-hand needle lifting cam will lift all the needles high enough to take yarn and cast off.

In position 7, the cam sections 31 and 32 are moved in. Those needles which the jacquard drum has raised will be lifted high enough to take and cast off yarn, the other needles not being operated. The right-hand needle lifting cam will lift all the needles to take and cast yarn.

In position 8 all the cam sections of the left-hand needle lifting cam are moved out, while all the cam sections of the right-hand needle lifting cam are pulled in. In one course of knitting all the needles will be lifted to take and cast off yarn. In the other course of knitting none of the needles will operate.

In position 9 the middle cam sections 31 and 41 of both needle raising cams are moved in. The needles that have been lifted by the jacquard drum will be lifted by cam section 30 to take and cast stitches, while the needles that have not been lifted by the jacquard drum will form tuck stitches. All the needles will be operated by the right-hand needle raising cam to form tuck stitches.

It is obvious, without further explanation, how it is possible to shape the cams 141, 142 and 143 of the cam bar 140 to simultaneously withdraw, at different longitudinal positions of the cam bar, the various combinations of cam sections hereinbefore described, or any other combinations of cam sections that may be desired.

In describing the means for actuating and positioning the yarn feeders, reference will be made to Figures 1, 2, 3, 6, 16, 17 and 20. There are two yarn feeders 50, 50 for the front bank of needles and two similar yarn feeders for the rear bank of needles. One yarn feeder of a pair feeds yarn to the needles when they are in proper position relative to the left-hand set of knitting cams and the other yarn feeder of the same pair feeds yarn to the needles when they are in proper position relative to the right-hand set of knitting cams. It will suffice to describe the means for actuating and positioning one pair of yarn feeders, such means being merely duplicated for the other pair of feeders. The yarn feeders 50, 50 are carried by sliding blocks 51, 51 which have dovetail engagement with a fixed longitudinal bar and are slidable thereon (see Figures 3 and 20).

The reciprocating frames or carriage 100 operable, as hereinbefore described, by the endless pattern chain 104 and connecting rod 103, carries hooked levers 52, 52, each of which is normally spring-pressed into a recess formed between end projections on a sliding block 51. The block is pushed by the lever in the latter's longitudinal movement in one direction and is pulled by the lever in the latter's longitudinal movement in the other direction. The lever has considerable

play in the block recess so that the block will be shifted longitudinally at the end of each reciprocation so as to properly position its yarn carrier relative to the corresponding set of knitting cams.

It is desired to provide means for withdrawing from operation either of the yarn carriers. This is effected by means of a cam bar 54 (see Figures 17 and 20) movable with, but slidable longitudinally of, the carriage 100. This cam bar is provided with projections or cams which are adapted to underride the hooked end of an arm 53 on a lever 52 thereby drawing the hooked end of lever 52 out of the recess in block 51, so that, in the reciprocation of frame 100 and lever 52 it will not engage the block, whereby the corresponding yarn carrier will not be reciprocated and will therefore not feed yarn to the needles.

It is desired to sometimes have both yarn carriers of a pair in action and sometimes to have either yarn carrier in action and the other out of action. These three possible conditions are established by having both levers 52, 52 of a pair in operative position or either one of them in operative position and the other out of operative position. The cam projections on bar 54 are so arranged that the bar, when shifted into one position, will not operate upon either lever 52, and when shifted into a second position will withdraw one lever 52 from operative position, and when shifted into a third position will withdraw the other lever 52 from operative position.

To enable the bar 54 to be shifted to these three positions it is provided, at each end, with a three-stepped abutment 55. Any one of these steps is adapted, at the end of a reciprocating movement of the frame 100 and bar 54, to be engaged by an arm 56 (see Figures 1 and 2) on a shaft 57, dependent on the position to which the arm is swung by the shaft. The shaft is operable by the corresponding levers 5, 5′ or 6, 6′ for the corresponding needle bank (see Figure 6), each lever of a pair being connected, by means of a link 58, with an arm 59 on shaft 57. Each arm 56 is normally held in one of its operative positions by a spring 60. In this position the corresponding levers 5, 5′ or 6, 6′ rest on the bars *r*.

The turning of the shaft 57 and arm 56 into one of its other operative positions is effected by pins of different height on either pattern chain *m* or *n*.

It is necessary in knitting certain kinds of fabrics to longitudinally reciprocate one bank of needles relative to the other bank, so that, at alternate longitudinal reciprocations of the knitting mechanism, the needles of one bank will be shifted longitudinally relative to corresponding needles of the other bank. To effect this purpose the front needle bar is longitudinally movable and is provided, at one end, with rollers 150 (see Figures 1, 6 and 11) which engage opposite sides of a cam wheel 151, a developed view of which is shown in Figure 12, and determine the relative position of the needle bar.

On the short shaft 152, which carries cam wheel 151, are secured ratchet wheels 153 and 154 (see also Figure 10). Ratchet 153 is turnable by a spring-pressed pawl 155 so as to turn shaft 152 and cam wheel 151 in one direction. Ratchet 154 is turnable by a spring-pressed pawl 156 so as to turn shaft 152 and cam wheel 151 in the opposite direction. A holding spring-pawl 158 engages a knob wheel 157 on shaft 152 and holds it in the position to which it is ratcheted.

Pawls 155 and 156 are carried by bars 159 and 160, slidable vertically in a block 162, which is slidable laterally on the machine frame. Block 162 is slidable laterally into three positions, namely: one in which pawl 155 is in operative relation with ratchet 153, another in which pawl 156 is in operative relation with ratchet 154, and a third, middle, or neutral position in which neither pawl is in operative relation with its ratchet.

Secured to the periphery of one of the wheels 82 (which, as previously described, operate the jacquard drum reciprocating mechanism) is a projection or cam 163 which, once during each revolution of wheel 82, contacts with a roller on the free end of a lever 164. This lever is pivotally supported at its other end on the machine frame and rests, between its ends, on a fixed supporting pin 165. The free end of lever 164 aligns with one or the other of the vertically slidable bars 159 or 160, when the block 162 is in one or the other of its end positions and lifts said bar whenever the lever is raised by cam 163. When block 162 is in its intermediate position, lever 164, when lifted, engages neither of the bars. Whenever bar 159 or 160 is lifted, the pawl carried thereby engages the corresponding ratchet and turns the shaft 152 in one direction or the other, thereby moving cam wheel 151 into position to longitudinally shift the front bank of needles. As soon as cam 163 rides beyond lever 164, the lever drops and a spring 161 returns the lifted bar 159 or 160 to its lower position, at which it is operable by lever 164 in the next revolution of wheel 82, provided, in the meantime, block 162 has not been shifted laterally.

The shifting of block 162 laterally is controlled from levers 1 and 1′. Levers 1 and 1′ may occupy three different positions, as hereinbefore explained. Each lever is connected (see Figure 6) by means of a link 166, with an arm 167 on a shaft 168 (see also Figure 10). An arm 169 on this shaft is connected, by means of a link 170, with the slidable block 162. The position of lever 1 or 1′ will therefore determine the position of the slidable block 162, which will in turn determine whether the cam wheel 151 shall be stationary or shall be ratcheted in one direction or the other, whereby the longitudinal shifting of the front bank of needles is controlled as described.

The take-up mechanism for the knit goods is shown in Figure 4. One of the take-up rollers 181 turns in bearings on brackets 180 secured to the machine frame. The other take-up roller 182 is hung on the end of levers 183, which are pivotally supported between their ends on the ends of brackets 180. On the outer ends of levers 183 are supported adjustable weights 184. Pivotally supported on one of the brackets 180 is a lever 185 carrying a pawl 186 engaging a ratchet wheel 187 on the shaft of roller 181. Oscillation of lever 185 turns the roller 181 step by step. A pawl 188 on bracket 180 holds ratchet wheel 187 in the position to which it is turned by pawl 187.

On one of the cam wheels 82, hereinbefore described, is a cam 189 which, at each rotation of the cam wheel, oscillates a lever 190 pivoted on bracket 180. A link 191, pivoted at one end on lever 190 has on its other end a fork embracing a pin 192 on lever 185. A spring 193 is coiled around lever 191 and is secured at one end to lever 190 and at the other end to pin 192.

When cam 189 oscillates lever 190, it imposes sufficient tension on spring 193 to swing lever 185 and thereby cause pawl 186 to turn ratchet

187, thus turning the take-up rollers 181 and 182 and pulling the knitted fabric forward. If, however, the knitted fabric is already sufficiently taut to impose a substantial resistance to forward movement, the pull of spring 193 will not be strong enough to overcome the resistance and the spring will expand without actuating ratchet 187.

Having now fully described my invention, what I claim and desire to protect by Letters Patent is:

1. In a knitting machine, the combination with knitting mechanism including a longitudinally extending bank of needles and other elements cooperating with the needles, of a set of levers respectively controlling the operation of different knitting elements, another set of levers respectively controlling the same knitting elements, pattern chains controlling the respective sets of levers, and mechanism operable by each pattern chain and controlling the operation of the other pattern chain.

2. In a knitting machine, the combination with knitting mechanism including a longitudinally extending bank of needles and other elements cooperating with the needles, of a set of levers respectively controlling the operation of different knitting elements, another set of levers respectively controlling the same knitting elements, pattern chains controlling the respective sets of levers, a special lever operable by each pattern chain, and mechanism, controlled by such special lever, adapted to control the operation of other pattern chain.

3. In a knitting machine, the combination with knitting mechanism including front and rear longitudinally extending banks of needles and other elements cooperating with the needles, of a set of levers respectively controlling different knitting elements of both banks of needles, another set of levers respectively controlling the same knitting elements, patterns chains controlling the respective sets of levers, and mechanism operable by each pattern chain and controlling the operation of the other pattern chain.

4. In a knitting machine, the combination with knitting mechanism including a longitudinally extending bank of needles and other knitting elements cooperating with the needles, of a set of levers respectively controlling different knitting elements, another set of levers respectively controlling the same knitting elements, two drums, pattern chains carried by the respective drums and adapted to operate the respective sets of levers, means to bodily reciprocate the drums, means to turn each drum shaft step by step to advance the pattern chain carried thereby, and mechanism operable by each pattern chain and controlling the operation of the means for turning the drum carrying the other pattern chain.

5. In a knitting machine, the combination with knitting mechanism including front and rear longitudinally extending banks of needles and other elements cooperating with the needles, of a set of levers respectively controlling different knitting elements of both banks of needles, another set of levers respectively controlling the same knitting elements, two drums, pattern chains carried by the respective drums and adapted to operate the respective set of levers, means to bodily reciprocate the drums, means to turn each drum step by step to advance the pattern chain carried thereby, and mechanism operable by each pattern chain and controlling the operation of the means for turning the drum carrying the other pattern chain.

6. In a knitting machine, the combination with knitting mechanism including a longitudinally extending bank of needles and other knitting elements cooperating with the needles, of a set of levers respectively controlling different knitting elements, another set of levers respectively controlling the same knitting elements, two drums, pattern chains carried by the respective drums and adapted to operate the respective sets of levers, means to bodily reciprocate the drums, means operable in the bodily movement of each drum to turn such drum and advance the pattern chain carried thereby, a special lever operable by each pattern chain, and mechanism, controlled by the special lever operable by each pattern chain, adapted to control the operation of the means for turning the drum carried by the other pattern chain.

7. In a knitting machine, the combination with knitting mechanism including a longitudinally extending bank of needles and other knitting elements cooperating with the needles, of a set of levers respectively controlling different knitting elements, another set of levers respectively controlling the same knitting elements, two drums, pattern chains carried by the respective drums and adapted to operate the respective sets of levers, means to bodily reciprocate the drums, drum-turning levers, and mechanism, controlled by the pattern chain carried by each drum, adapted to render alternately operative and inoperative the lever for turning the other drum.

8. In a knitting machine, the combination with knitting mechanism including a longitudinally extending bank of needles and other knitting elements cooperating with the needles, of a set of levers respectively controlling different knitting elements, another set of levers respectively controlling the same knitting elements, two drums, pattern chains carried by the respective drums and adapted to operate the respective sets of levers, means to bodily reciprocate the drums, means operable in the bodily movement of each drum to turn such drum and advance the pattern chain carried thereby, a special lever operable by each pattern chain, and mechanism, controlled by the special lever operable by each pattern chain, adapted to render alternately operative and inoperative the means for turning the drum carried by the other pattern chain.

9. In a knitting machine, the combination with knitting mechanism including a longitudinally extending bank of needles and other knitting elements cooperating with the needles, of a set of levers respectively controlling different knitting elements, another set of levers respectively controlling the same knitting elements, two drums, pattern chains carried by the respective drums and adapted to operate the respective sets of levers, means to bodily reciprocate the drums, special levers operable by the respective pattern chains, ratchet wheels operable by the respective special levers, ratchet wheels adapted to turn the respective drums in their bodily movements, levers adapted to operate the respective second named ratchet wheels, and mechanism, operable by the first named ratchet wheel operable from each pattern chain, adapted to operate the lever for operating the ratchet wheel for operating the drum carrying the other pattern chain.

10. In a knitting machine, the combination with knitting mechanism including a longitudinally extending bank of needles and other knit-

ting elements cooperating with the needles, of a set of levers respectively controlling different knitting elements, another set of levers respectively controlling the same knitting elements, two drums, pattern chains carried by the respective drums and adapted to operate the respective sets of levers, means to bodily reciprocate the drums, special levers operable by the respective pattern chains, ratchet wheels operable by the respective special levers, ratchet wheels adapted to turn the respective drums in their bodily movements, levers adapted to operate the respective second named ratchet wheels, and a wheel operable by the ratchet wheel which is operable from each pattern chain, adapted to render alternately operative and inoperative the lever for operating the ratchet wheel for operating the drum carrying the other pattern chain.

11. In a knitting machine, the combination with knitting mechanism including a longitudinally extending bank of needles and other elements cooperating therewith, of a set of levers respectively controlling different elements of the knitting mechanism, a turnable drum, a pattern chain carried thereby having studs of various heights thereon, means to bodily reciprocate the drum toward and from said levers, and means to turn the drum in its bodily movement to position the chain for selective actuation of the levers, the positioned chain being adapted to variably operate said levers in accordance with the heights of the studs in the bodily movement of the drum toward the levers and while the drum is not turning.

12. In a knitting machine, the combination with knitting mechanism including a longitudinally extending bank of needles and other knitting elements cooperating with the needles, of a set of levers respectively controlling different knitting elements, another set of levers respectively controlling the same knitting elements, two drums, pattern chains carried by the respective drums, means to bodily reciprocate the drums, means operable in the bodily movement of each drum to turn it step by step to advance the pattern chain carried thereby, the positioned chain being adapted to operate said levers in the bodily movement of the drum toward the levers and while the drum is not turning, and mechanism, operable by each pattern chain in the same bodily movement of the drum, controlling the operation of the means for turning the drum carrying the other pattern chain.

13. In a knitting machine, the combination with knitting elements including front and rear longitudinally extending banks of needles, knitting cams for each bank of needles, jacquard drums controlling the selective positioning of needles of the respective banks, and yarn feeders for each bank of needles, of two sets of levers, one lever of each set controlling the operation of the jacquard drum which controls the selective positioning of needles of the front bank, a second lever of such set controlling the jacquard drum which controls the selective positioning of needles of the rear bank, a third lever of each set controlling the knitting cams for the front bank of needles, a fourth lever of each set controlling the knitting cams for the rear bank of needles, a fifth lever of each set controlling the yarn feeders for the front bank of needles, a sixth lever of each set controlling the yarn feeders for the rear bank of needles, two pattern chains controlling respectively the two sets of levers, and mechanism operable by each pattern chain and controlling the operation of the other pattern chain.

14. In a knitting machine, the combination with a longitudinally extending bank of needles, of a turnable jacquard drum, means to impart to the jacquard drum a bodily reciprocating movement and thereby effect the selective actuation of needles, pattern chains, levers one operable by each pattern chain, jacquard drum turning means operable by either of said levers, and mechanism operable by each pattern chain and controlling the operation of the other pattern chain.

15. In a knitting machine, the combination with knitting elements including front and rear longitudinally extending banks of needles and knitting cams for each bank of needles, of means to adjust the cams for the needles of each bank, two pairs of levers, one lever of each pair controlling the operation of cam-adjusting means for the cams of the front bank of needles, the other lever of each pair controlling the operation of cam-adjusting means for the cams of the rear bank of needles, two pattern chains one controlling the operation of one pair of levers and the other controlling the operation of the other pair of levers, and mechanism operable by each pattern chain and controlling the operation of the other pattern chain.

16. In a knitting machine, the combination with a longitudinally extending bank of needles and knitting cams including a needle lowering cam, two pattern chains, duplicate levers each movable to different positions and operable by the respective pattern chains, means operable by either lever, dependent on the positions to which the lever is moved, adapted to move the needle lowering cam into different predetermined positions, and mechanism operable by each pattern chain and controlling the operation of the other pattern chain.

17. In a knitting machine, the combination with a longitudinally extending bank of needles and knitting cams including a needle lifting cam formed of sections independently movable into and out of operative position, two pattern chains, duplicate levers each movable to different positions and operable by the respective pattern chains, means operable by either lever, dependent on the positions to which the lever is moved, adapted to render inoperative different combinations of cam sections, and mechanism operable by each pattern chain and controlling the operation of the other pattern chain.

18. In a knitting machine, the combination with a longitudinally extending bank of needles and two yarn feeders, mechanism adapted to render both yarn feeders active or either yarn feeder active and the other inactive, two pattern chains, duplicate levers each movable to different positions and operable by the respective pattern chains, means operable by either lever, dependent on the positions to which the lever is moved, adapted to render said mechanism operable to effect a predetermined one of said three yarn feeder actuations, and mechanism operable by each pattern chain and controlling the operations of the other pattern chain.

19. In a knitting machine, the combination with two longitudinally extending needle bars of which one is shiftable longitudinally related to the other, means to shift the shiftable needle bar, two pattern chains, two levers operable by the respective pattern chains, mechanism operable by either of said levers and adapted to render

said shifting means operable to shift the shiftable needle bar, and mechanism operable by each pattern chain and controlling the operation of the other pattern chain.

20. In a knitting machine, the combinations with a longitudinally extending bank of needles, of a turnable jacquard drum, means to impart to the jacquard drum a bodily reciprocating movement and thereby effect the selective actuation of needles, ratchet wheels actuable to turn the jacquard drum in opposite directions, a frame movable into two positions for actuation of said ratchet wheels respectively and also movable into a third inoperative position, a pattern chain, and a lever operable by said pattern chain and adapted in three different positions to effect the movement of the frame into the three respective positions specified.

21. In a knitting machine, the combination with two longitudinally extending banks of needles, of two polygonally, bodily movable and step by step turnable jacquard drums, one for each bank of needles, a rotatable shaft, cams thereon, slidable bars, operable by said cams, pairs of levers, said pairs of levers having slidable connections with the respective bars, links connecting two corresponding levers of the two pairs of levers with one jacquard drum, and links connecting the other two corresponding levers of the two pairs of levers with the other jacquard drum, whereby the jacquard drums are reciprocated at regular intervals in the direction of extension of the needles of the corresponding bank.

22. In a knitting machine, the combination with a longitudinally extending bank of needles, of a jacquard adapted to selectively lift needles and a needle lifting cam adapted in a single course of knitting to operate upon both needles lifted by the jacquard and needles not so lifted.

23. In a knitting machine, the combination with a longitudinally extending bank of needles, of a needle lifting cam adapted to operate upon all the needles, a jacquard adapted to selectively lift needles, and means to adjust the needle lifting cam to enable it to differentially operate upon needles lifted by the jacquard and needles not so lifted.

24. In a knitting machine, the combination with a longitudinally extending bank of needles, of a sectional needle lifting cam, means to selectively move different combinations of cam sections into and out of needle operating position, and a jacquard adapted to selectively lift needles to enable the cam to differentially operate upon needles lifted by the jacquard and needles not so lifted.

25. In a knitting machine, the combination with a longitudinally extending bank of needles, of a yarn feeder, a jacquard adapted to selectively lift needles high enough to take yarn, and a needle lifting cam which is adjustable to engage the needles lifted by the jacquard and further lift them high enough to cast yarn.

26. In a knitting machine, the combination with a longitudinally extending bank of needles, of a yarn feeder, a sectional needle lifting cam, a jacquard adapted to selectively lift needles high enough to take yarn, and a needle lifting cam which is adjustable to further lift the needles lifted by the jacquard high enough to also cast yarn and to lift the needles not lifted by the jacquard high enough to take but not cast yarn and which is also adjustable to lift all the needles high enough to take and cast yarn.

27. In a knitting machine, the combination with a longitudinally extending bank of needles, of a needle lifting cam comprising an upper section, a lower section and a middle section, means adapted to move different combinations of cam sections into and out of operative position, only the lower section, when in operative position, being adapted to engage needles not preliminarily lifted, and a jacquard adapted to preliminarily selectively lift needles into position to engage the upper cam section when the same is moved into needle engaging position.

28. In a knitting machine, the combination with a longitudinally extending bank of needles, of a needle lifting cam comprising upper, lower and middle sections independently movable into and out of operative position, of three longitudinally extending cams adapted to control the movement of the respective cam sections into and out of needle lifting positions, said cams being shiftable into different longitudinal positions to render operative different combinations of cam sections, and pattern-controlled mechanism adapted to shift said cams into different longitudinal positions.

29. In a knitting machine, the combination with a longitudinally extending bank of needles, of a needle lifting cam reciprocable along the bank of needles and comprising sections independently movable into and out of operative position, a bar reciprocable with the cams and also shiftable longitudinally relatively thereto, longitudinally extending cams carried by the bar and adapted, in different shiftable positions of the bar, to render operative different combinations of cam sections, movable arms at opposite ends of the machines adapted, in different positions, to shift said bar to different positions, and pattern-controlled mechanism adapted to differentially position said arms.

30. In a knitting machine, the combination with a longitudinally extending bank of needles, of two sets of knitting cams reciprocable along the needle bank, each set comprising a central needle raising cam, an outer needle lowering cam and an inner needle lowering cam, longitudinally shiftable means connected with the two outer cams and adapted, when shifted in one direction, to move one outer cam into needle engaging position and the other outer cam out of needle engaging position, and adapted, when shifted in the opposite direction, to reverse the positions of the outer cams, and means at opposite ends of the machine adapted to shift said shiftable means in respectively opposite directions.

31. In a knitting machine, the combination with a longitudinally extending bank of needles, of a set of knitting cams comprising a needle lowering cam and a needle raising cam, longitudinally shiftable means connected with the needle lowering cam and adapted, when shifted into different positions, to move the needle lowering cam into different positions independently of the needle raising cam, and pattern-controlled mechanism adapted to shift said means into different predetermined longitudinal positions.

32. In a knitting machine, the combination with a longitudinally extending bank of needles, of knitting cams, comprising needle lowering cams, reciprocable along the bank of needles, a bar reciprocable with the cams and also shiftable longitudinally relatively thereto, means operable by the bar in different shiftable positions to move the needle lowering cams into different positions,

movable arms at opposite ends of the machine adapted, in different positions, to shift said bar to different positions, and pattern-controlled mechanism adapted to differentially position said arms.

33. In a knitting machine, the combination with a longitudinally extending bank of needles, of knitting cams, comprising needle lowering cams, reciprocable along the bank of needles, a bar reciprocable with the cams and also shiftable longitudinally relatively thereto, adjustable blocks carried by the bar, means operable by different blocks to shift the needle lowering arms into different positions, and pattern-controlled means adapted to shift said bar into different longitudinal positions and thereby render different blocks operative.

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