Aug. 13, 1946. F. LAMBACH 2,405,583

KNITTING MACHINE

Original Filed Oct. 4, 1939 14 Sheets-Sheet 1

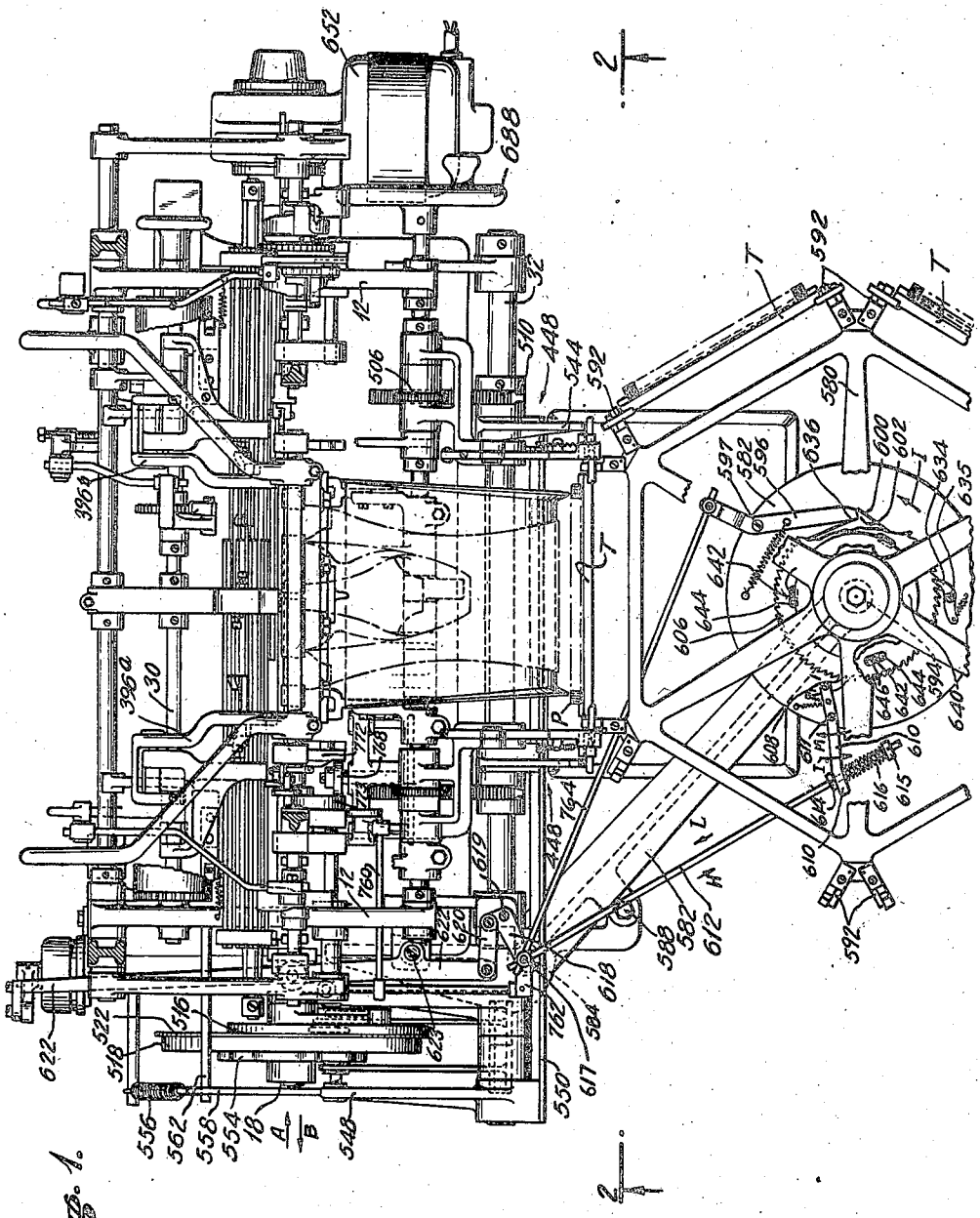


Fig. 1.

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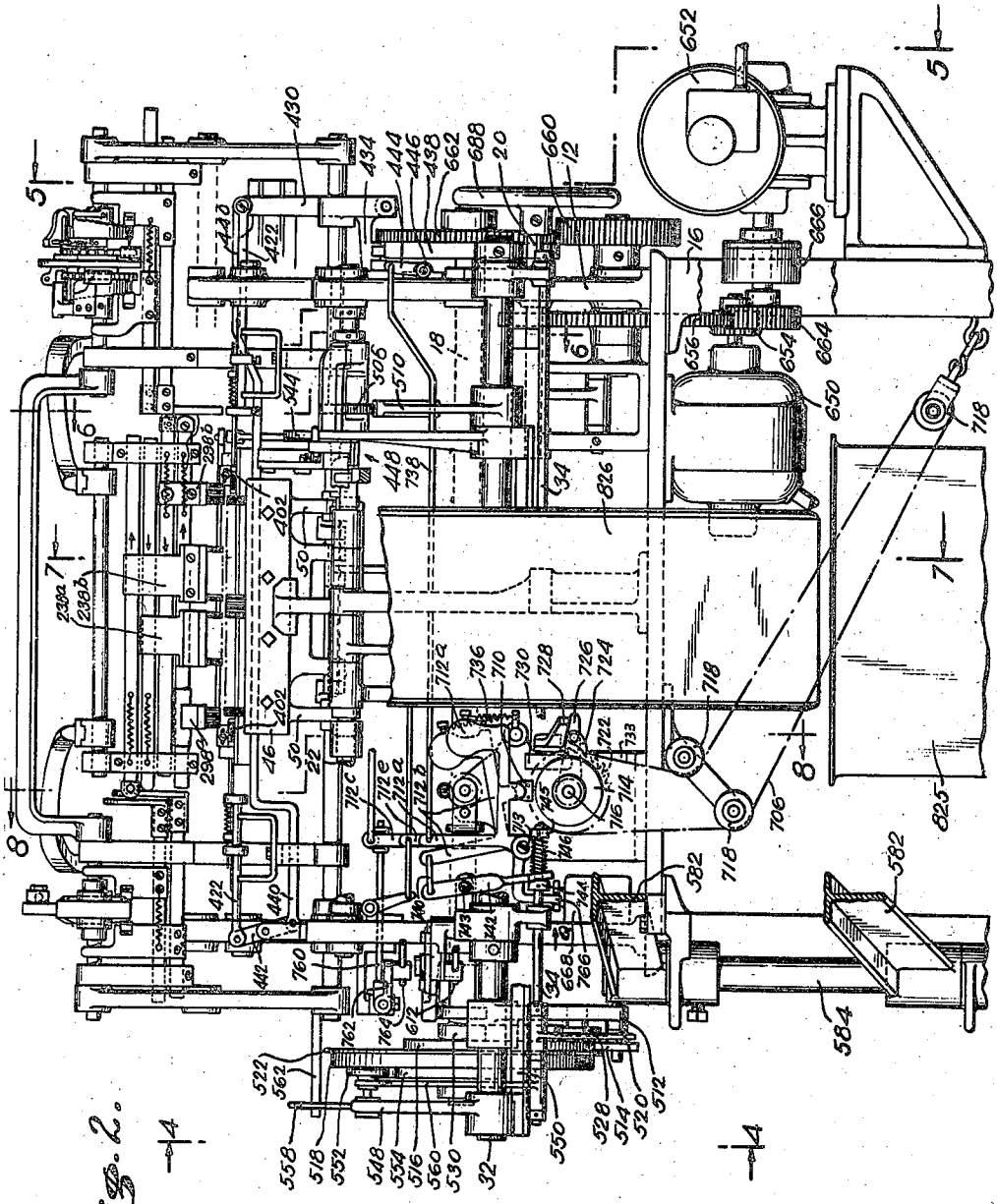


Fig. 2.

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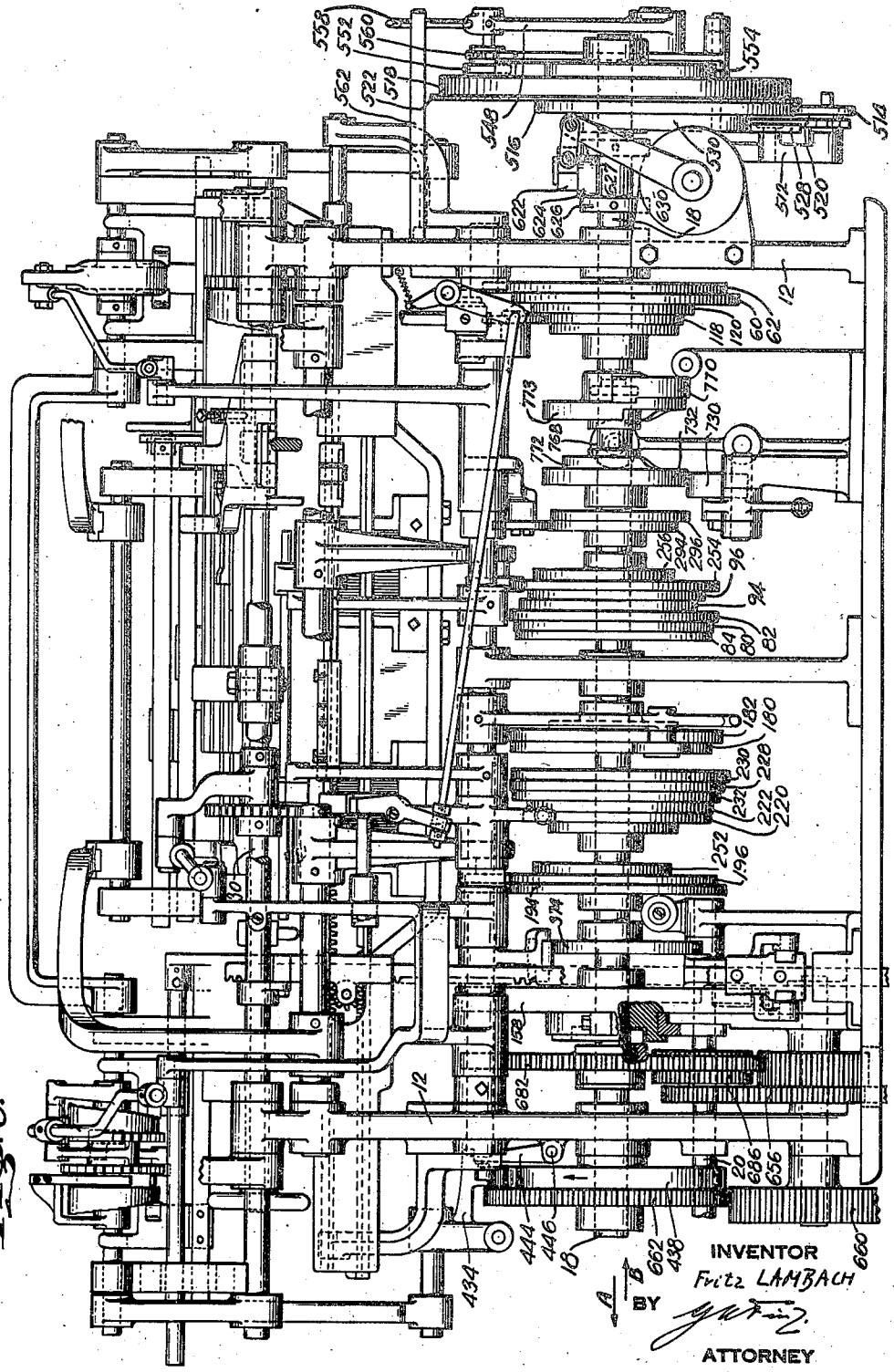


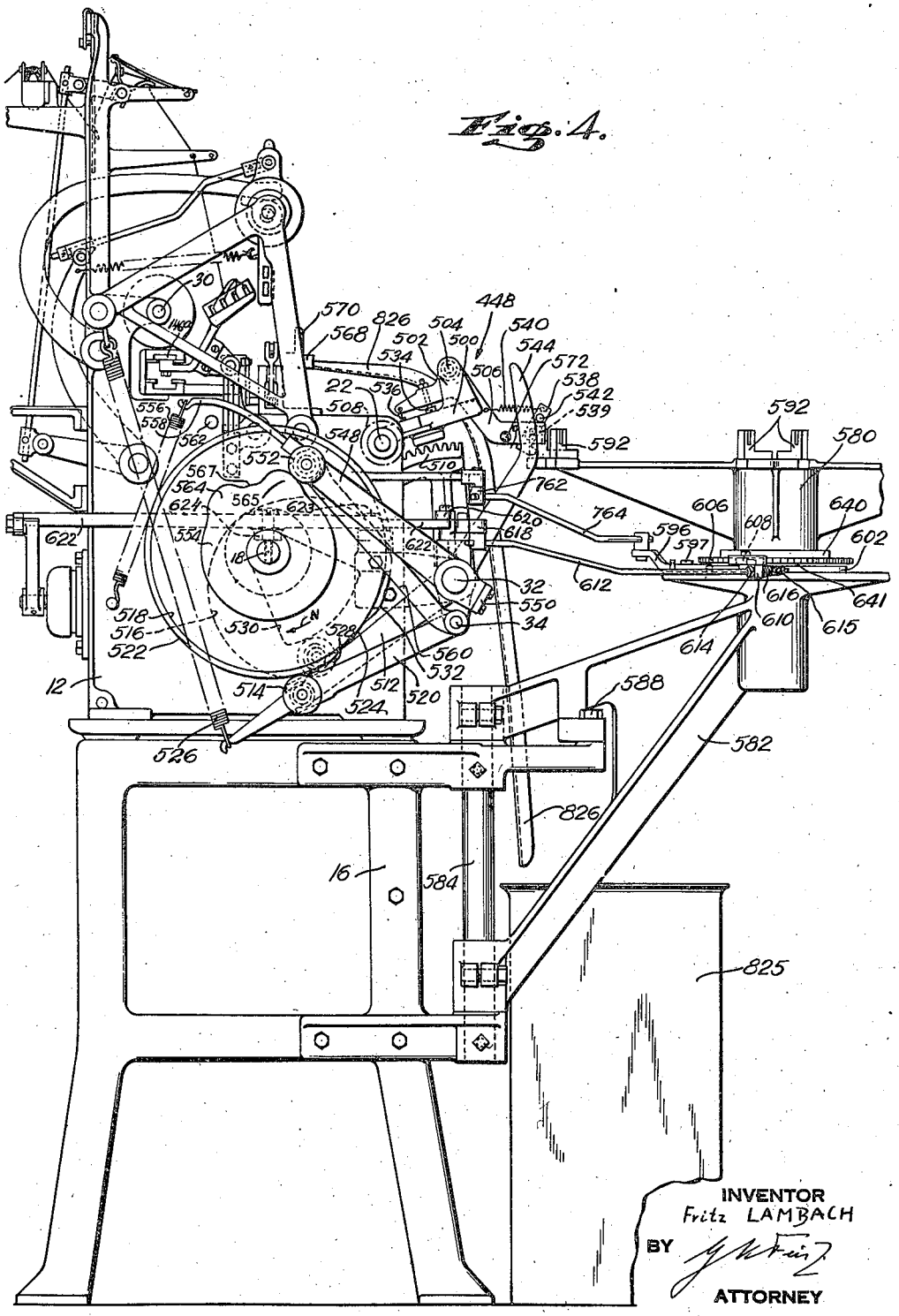
Fig. 3.

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Fig. 4.



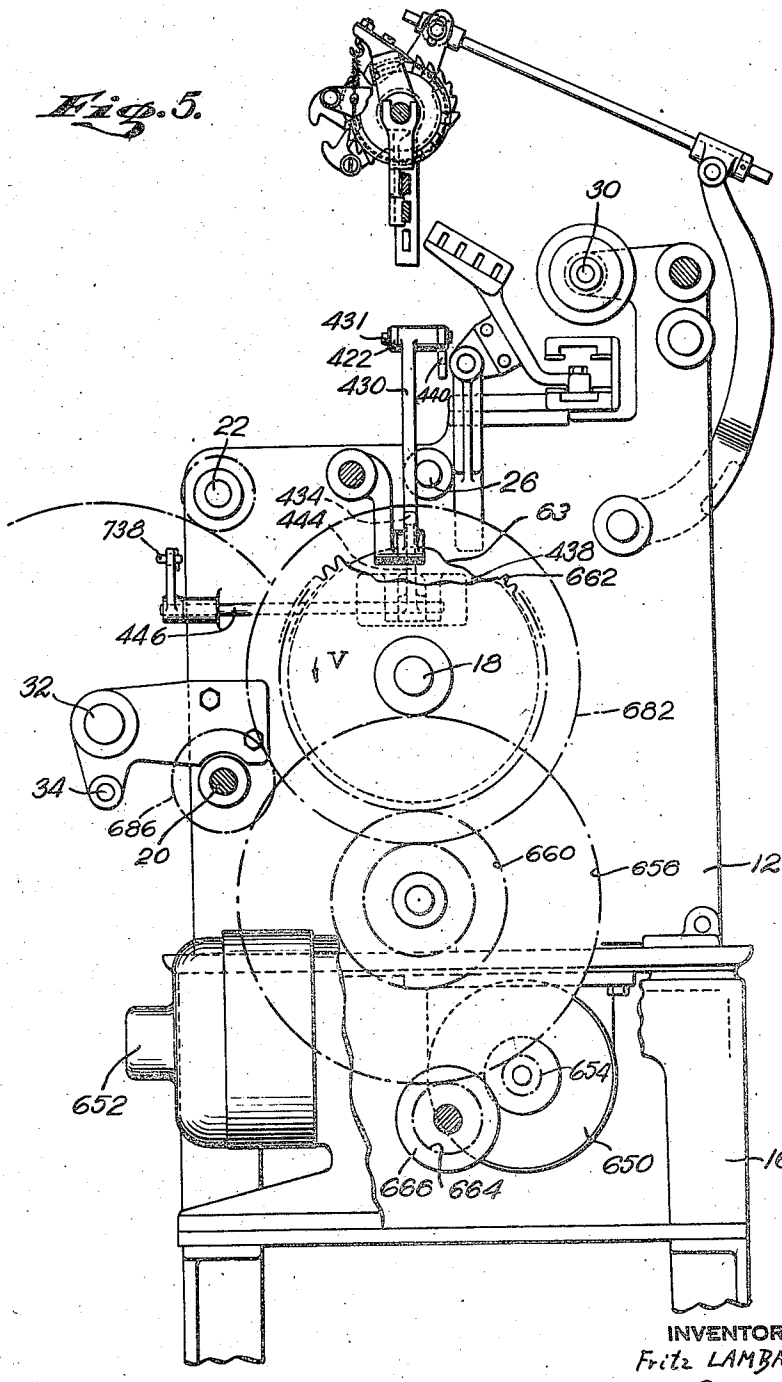
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Fig. 5.



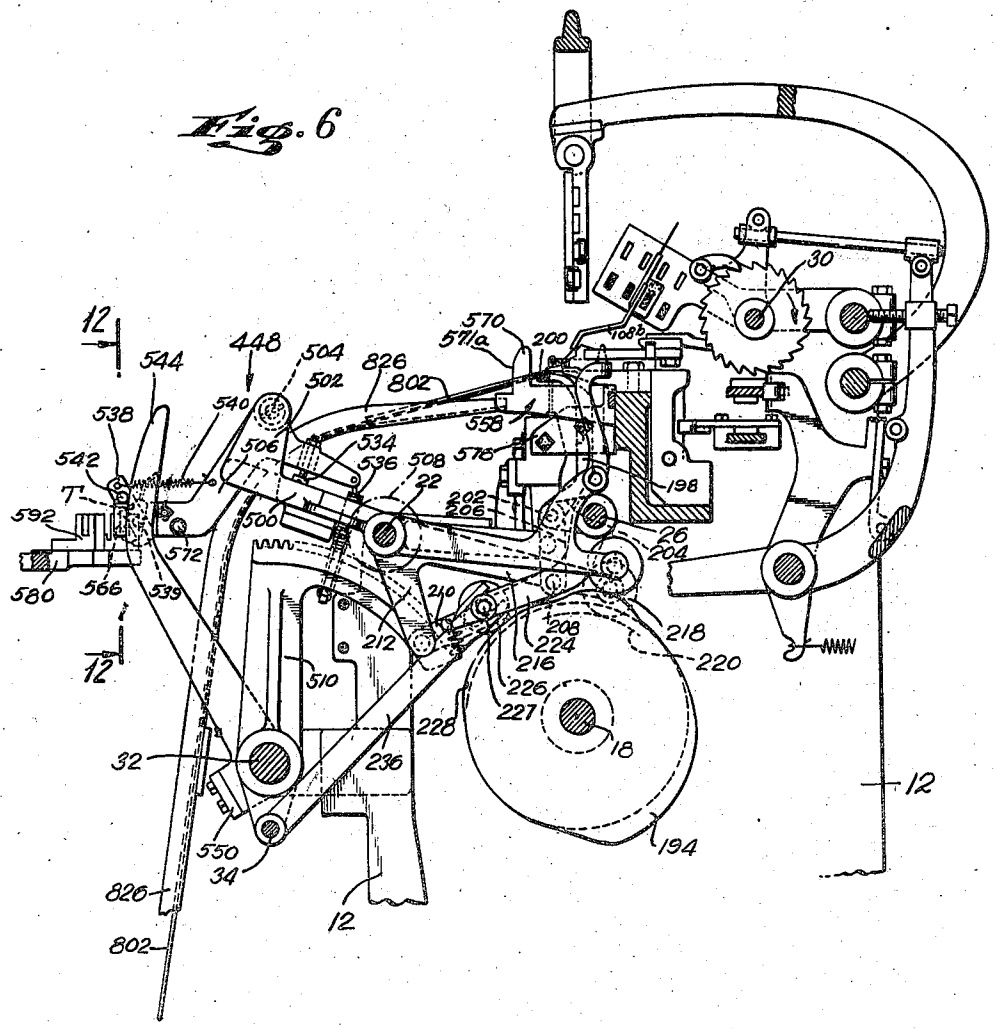
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Fig. 6



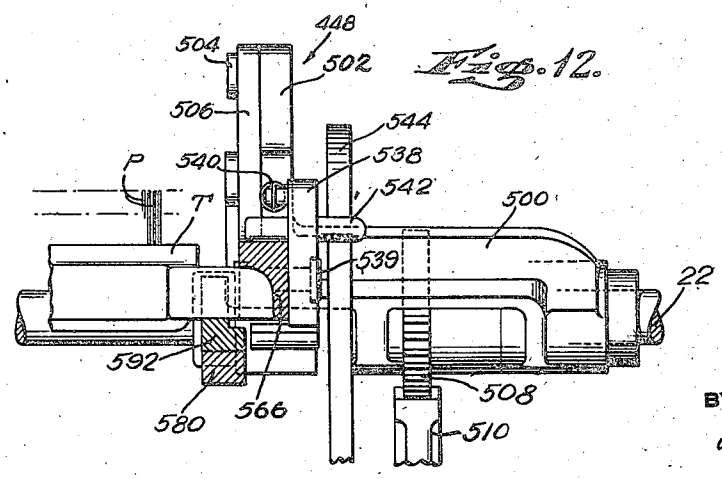


Fig. 12.

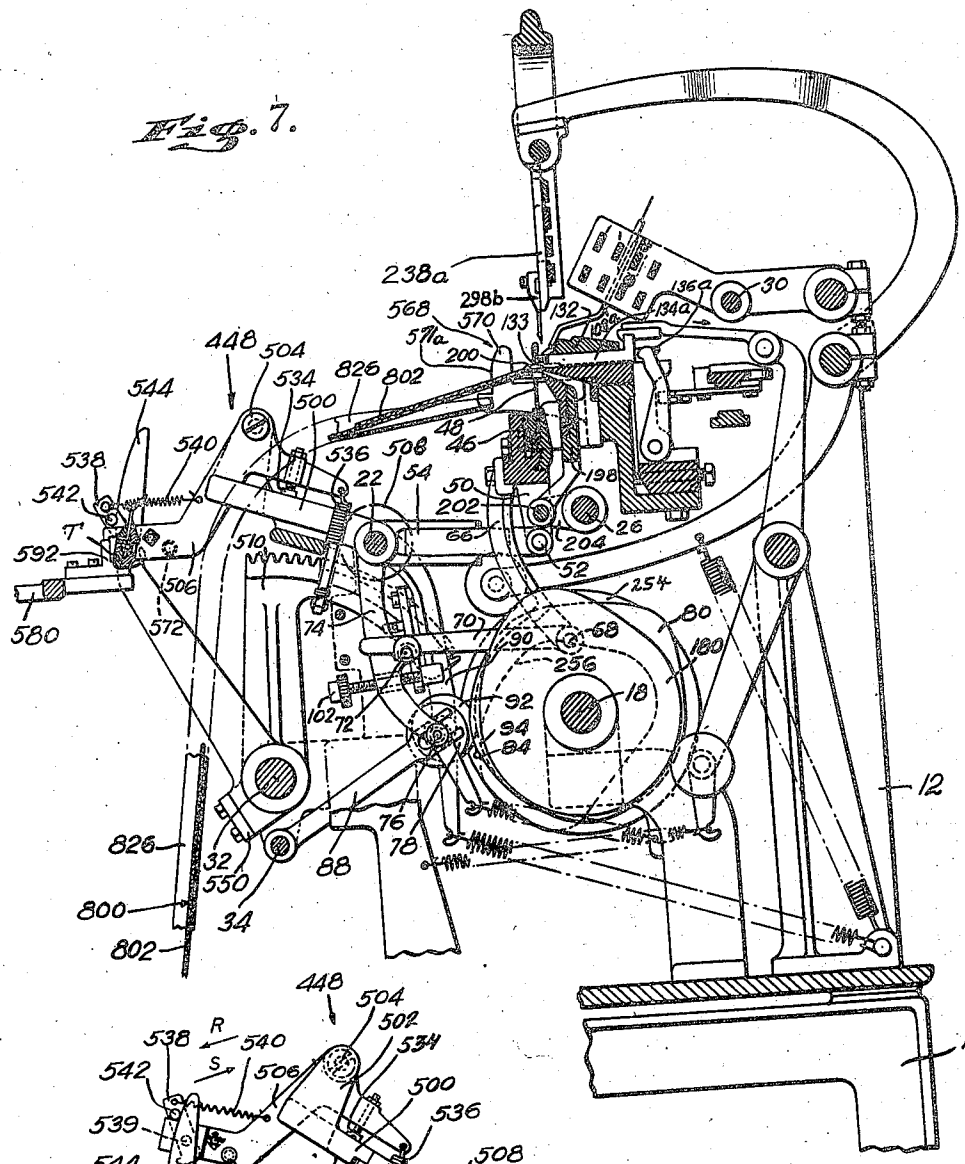
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Fig. 7.



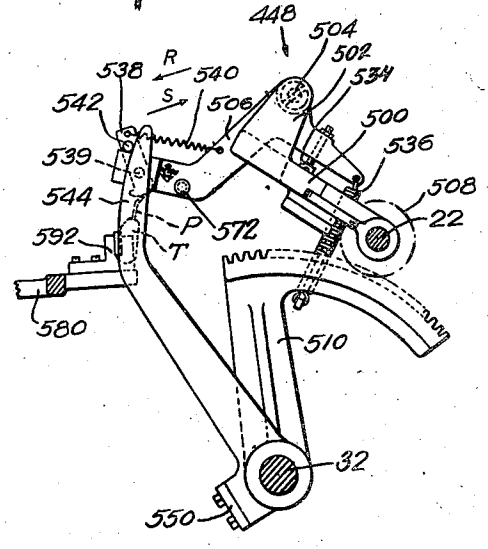


Fig. 11.

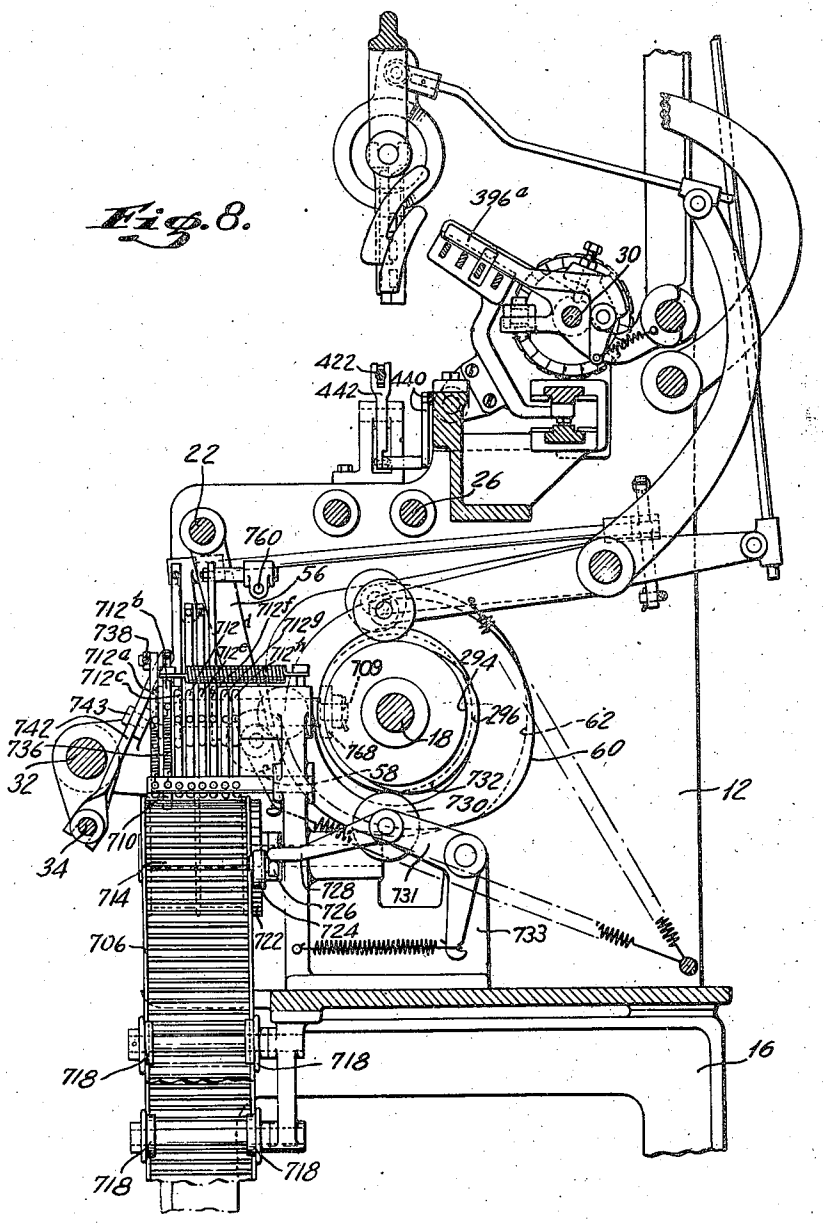
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Fig. 8.



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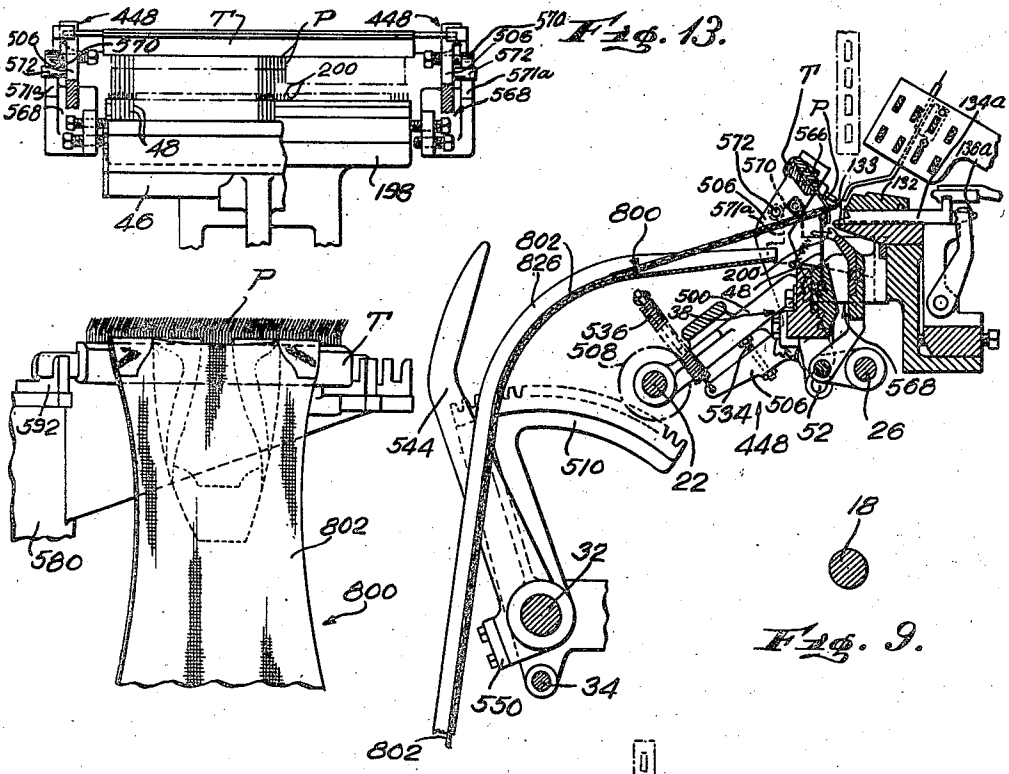


Fig. 13.

Fig. 9.

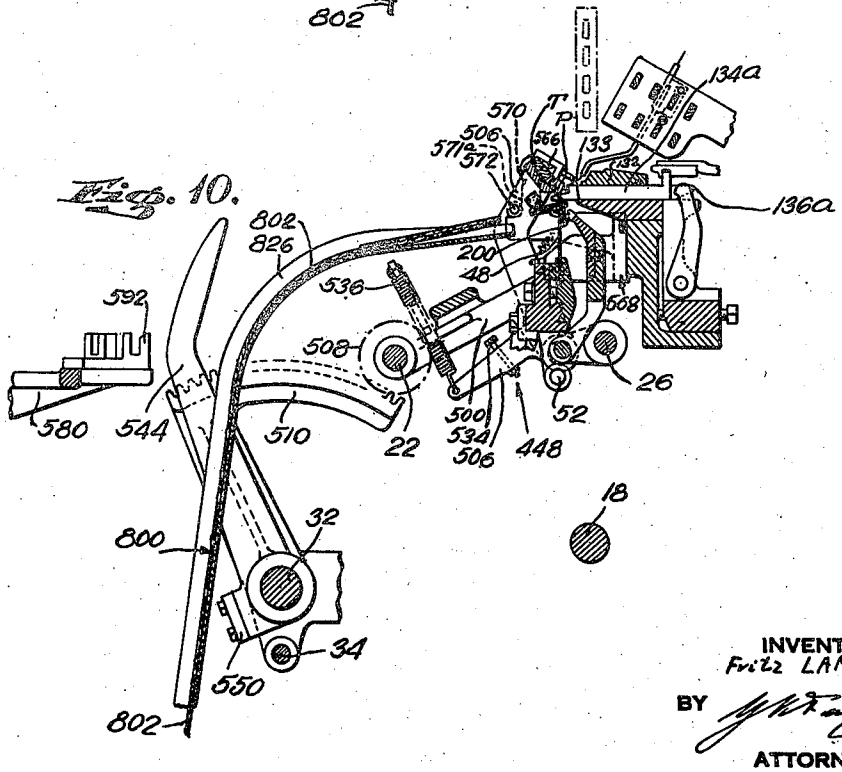


Fig. 10.

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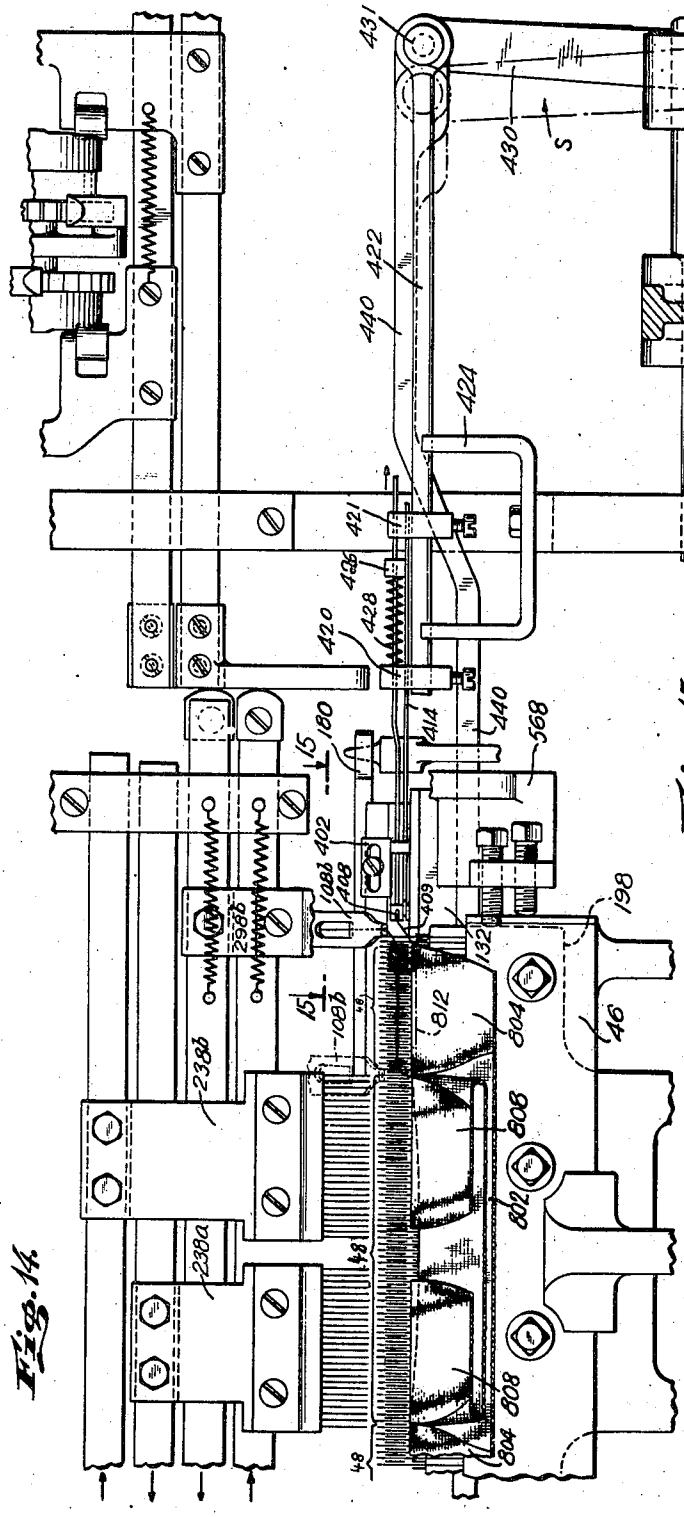


Fig. 14.

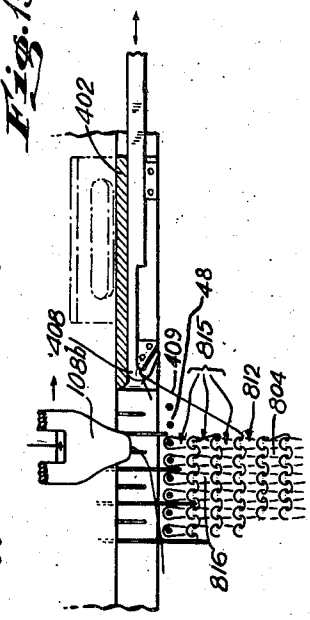


Fig. 15.

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Fig. 21.

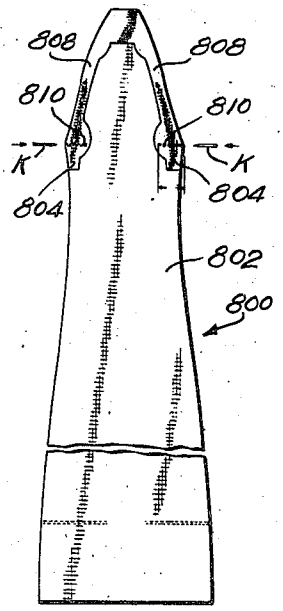


Fig. 22.

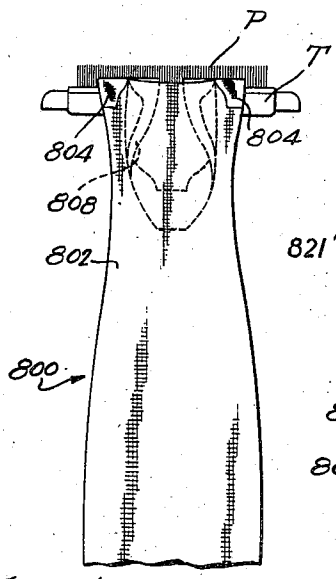


Fig. 23.

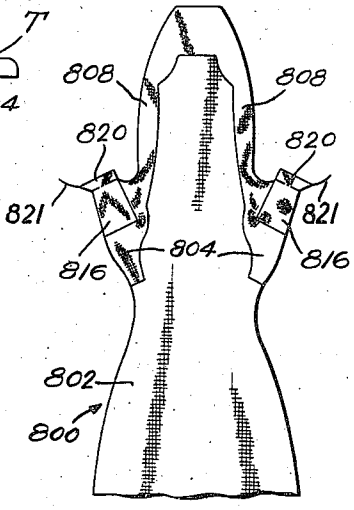


Fig. 16.

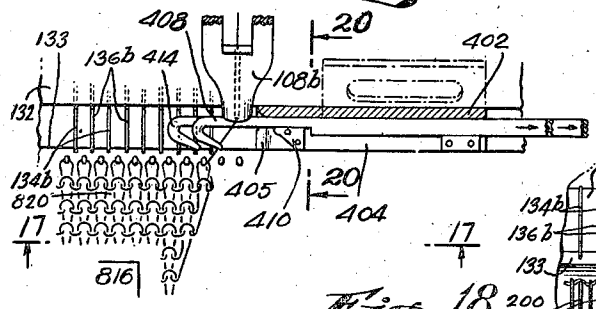


Fig. 17.

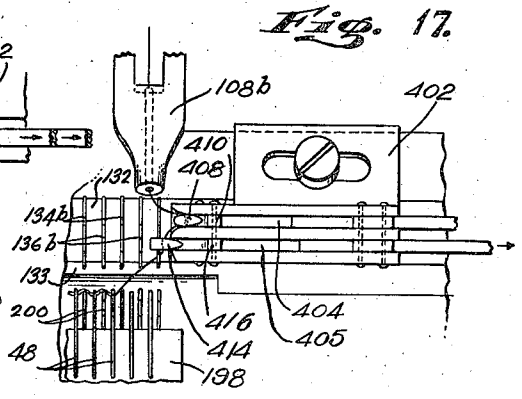


Fig. 18

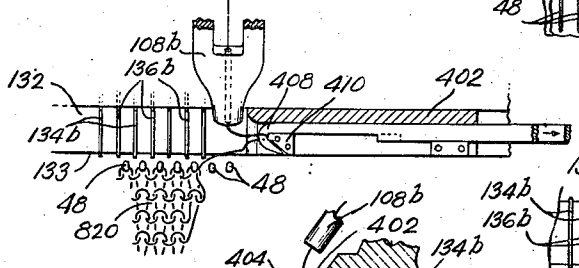


Fig. 19.

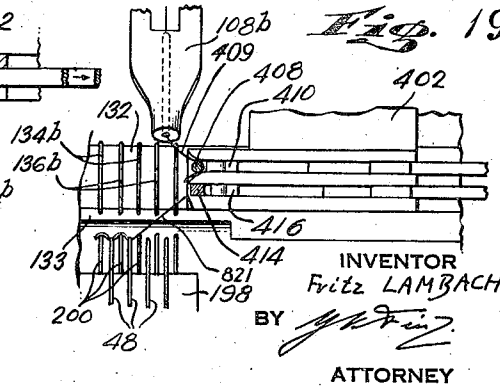
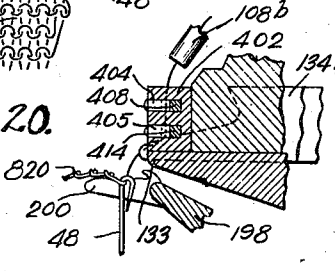


Fig. 20.



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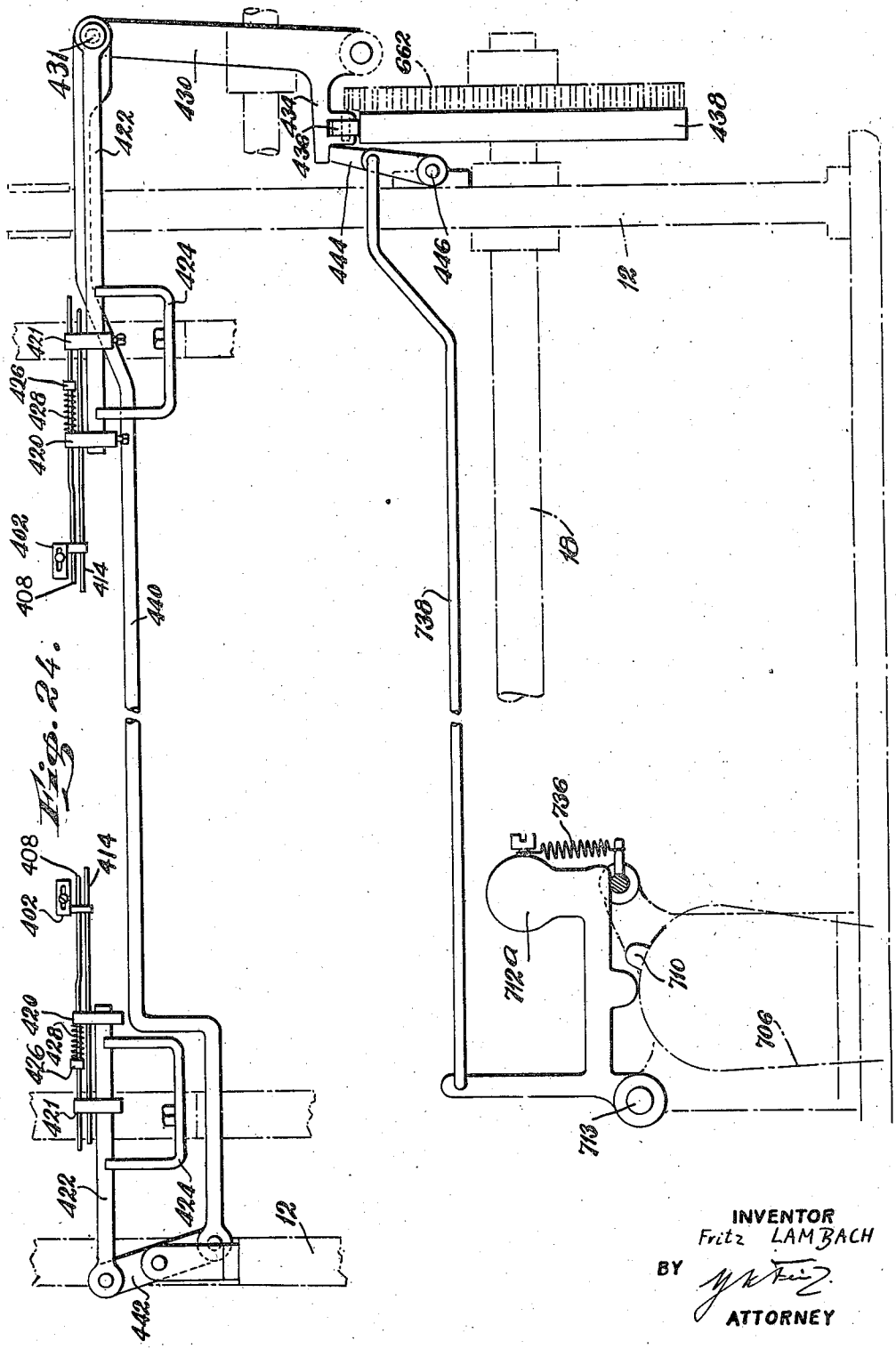


Fig. 24.

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Fig. 25.

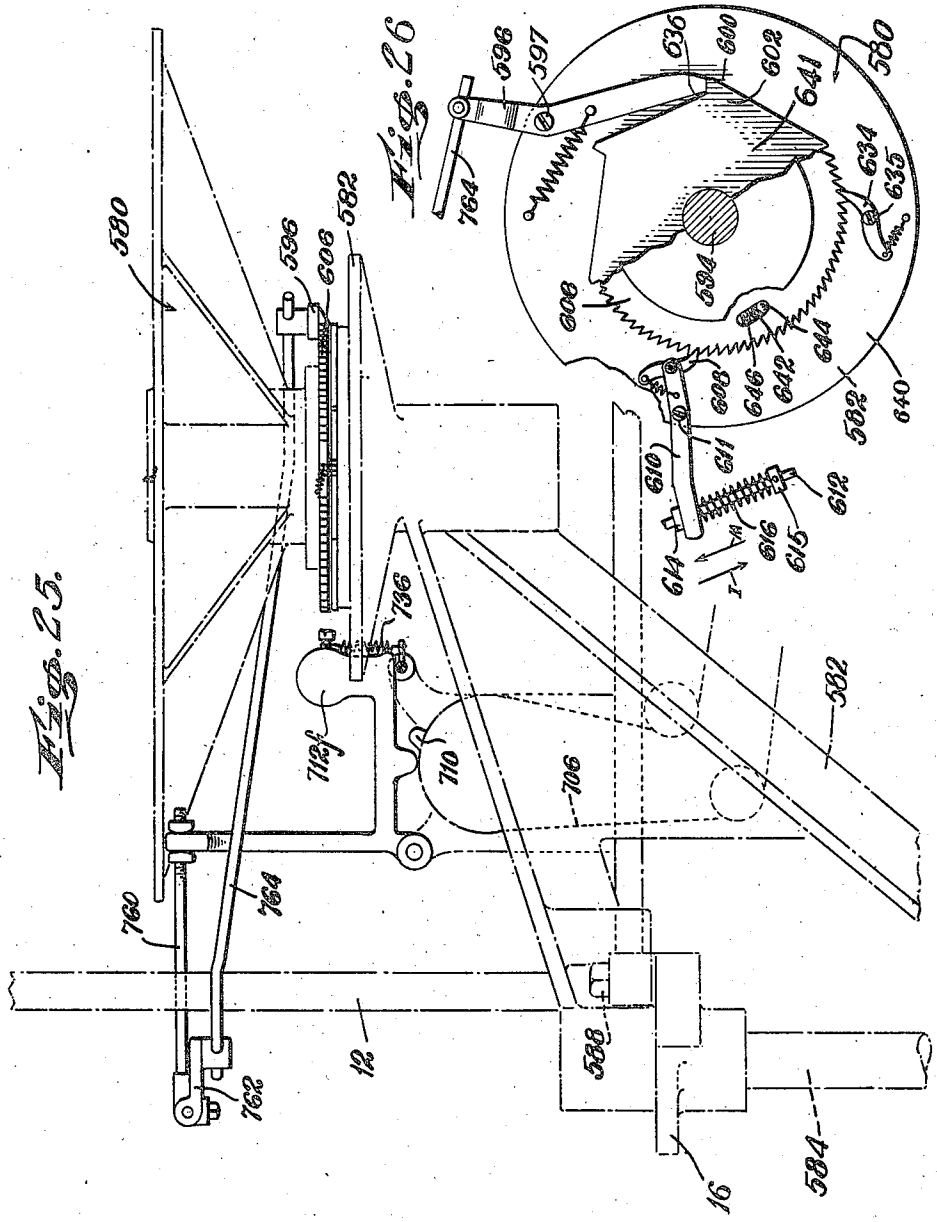


Fig. 26.

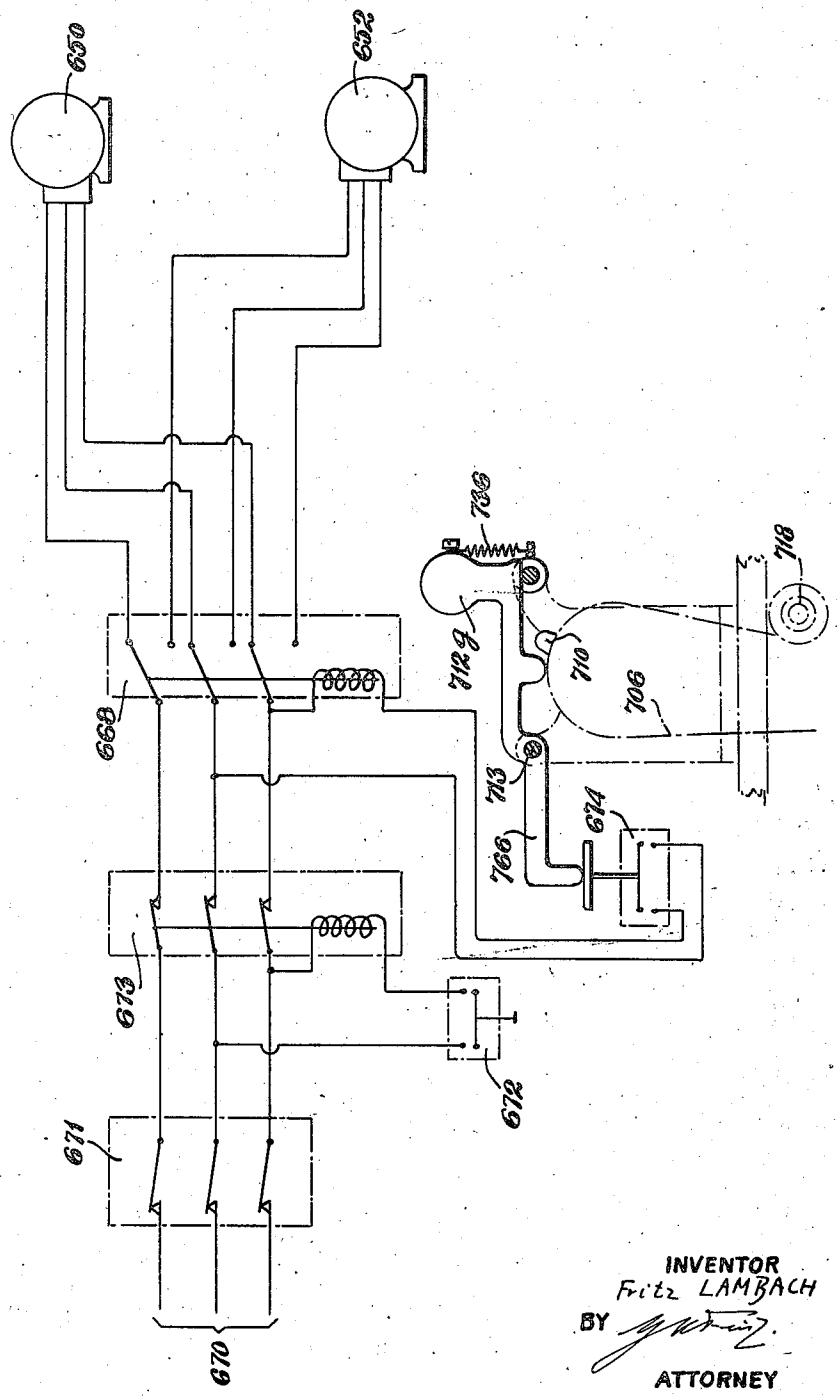
INVENTOR
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Fig. 27.



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Patented Aug. 13, 1946

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UNITED STATES PATENT OFFICE

2,405,583

KNITTING MACHINE

Fritz Lambach, Tenafly, N. J., assignor to Robert Reiner, Incorporated, Weehawken, N. J.

Original application October 4, 1939, Serial No. 297,829, now Patent No. 2,363,008, dated November 21, 1944. Divided and this application August 2, 1944, Serial No. 547,765. In Germany March 6, 1939.

9 Claims. (Cl. 66—82)

1

This application is a divisional application divided out of my patent application Serial #279,829 filed October 4, 1939, for Art of knitting fabric onto prefabricated fabric blanks, now Patent No. 2,363,008.

This invention relates to knitting machines, and more particularly to the motor drive of knitting machines.

An object of my invention is to provide a knitting machine, the operation of which may be automatically changed from a low speed operation to a high speed operation and vice versa, as the performance of certain operations during the manufacture of a fabric or a plurality of fabrics may require.

Another object of my invention is the construction of a knitting machine equipped with an automatic transfer device for transferring prefabricated fabric blanks from a supply of such prefabricated fabric blanks onto the needles of the knitting machine and/or equipped with an automatic thread clamping- and cutting device for cutting threads, which knitting machine may be automatically operated at low speed during the transferring and/or clamping and cutting operations and at high speed during the knitting of the fabric or fabrics.

A further object of my invention is to improve upon the construction of knitting machines as now ordinarily made.

My invention consists in certain novel featurs of construction of my improvements as will be hereinafter fully described.

Further objects and advantages of my invention will be apparent from the following disclosure of an illustrative embodiment thereof.

The accompanying drawings illustrate the application of the invention to a so-called "heeler" or heeling machine of the flat knitting machine type, which is intended to knit heel tabs as continuations of the high heel portions of a combination leg and foot full-fashioned stocking blank, and to interknit said blank with the heel tabs. It is, however, to be understood that the invention is in no way limited to such a heeler or heeling machine.

In the drawings:

Fig. 1 is a top plan view of the knitting machine with certain parts removed for the sake of clarity,

Fig. 2 is a section taken on line 2—2 of Fig. 1,

Fig. 3 is an enlarged rear elevation of the knitting machine with certain parts removed for the sake of clarity,

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Fig. 4 is an end elevation of the machine looking in the direction of arrow 4—4 of Fig. 2,

Fig. 5 is a section taken on line 5—5 of Fig. 2,

Fig. 6 is a section taken on line 6—6 of Fig. 2,

Fig. 7 is a section taken on line 7—7 of Fig. 2,

Fig. 8 is a section taken on line 8—8 of Fig. 2,

Fig. 9 is a detail showing parts of Fig. 7 in one operative position,

Fig. 10 is a view similar to Fig. 9 with the parts in another operative position,

Fig. 11 is a side elevation of the transfer device showing the parts in neutral inoperative position,

Fig. 12 is a section taken on line 12—12 of Fig. 6,

Fig. 13 is a detail in front elevation illustrating the guiding means for the needle bar, knock-over comb, and transfer device,

Fig. 14 is an enlarged detail of a part of the knitting section of the knitting machine,

Fig. 15 is a section taken on line 15—15 of Fig. 14,

Fig. 16 is a view similar to Fig. 15 with the parts in another position,

Fig. 17 is a face elevation of the parts shown in Fig. 16 in the direction of line 17—17,

Fig. 18 is a view similar to Figs. 15 and 16 with the parts in still another position,

Fig. 19 is a view similar to Fig. 17 with certain parts in section to illustrate a construction thereof,

Fig. 20 is a section taken on line 20—20 of Fig. 16,

Fig. 21 is a diagrammatic illustration of a combination leg and foot blank,

Fig. 22 is a diagrammatic illustration of the stocking fabric in topped position on the transfer bar,

Fig. 23 is a diagrammatic illustration of the stocking blank with the heel tabs knitted therein,

Fig. 24 is an enlarged detail of the thread clamping and cutting mechanism,

Fig. 25 is a diagrammatic illustration of the turn-table locking control mechanism,

Fig. 26 is a detail in top plan of a portion of the mechanism illustrated in Fig. 25, with certain parts broken out, and

Fig. 27 is a diagrammatic illustration of the speed control mechanism.

Referring now to the drawings, a motor 650 (Fig. 2) for the normal high-speed operation of the machine and a motor 652 for the occasional low-speed operation of the machine are attached to the support 16 carrying the frame 12 of the knitting machine. The high speed motor 650 is

directly connected to the main cam shaft 18 of the knitting machine through the medium of a gearing 654, 656, 660 and 662 (Figs. 2, 3 and 5) for driving the main cam shaft 18. A free wheel coupling 666 is arranged between the low-speed motor 652 and the pinion 664 also meshing with the gear 656 of said gearing. Furthermore, a double pole magnetic switch or change-over switch 668 (see left half of Fig. 2) is mounted on the knitting machine frame. Said change-over switch is controlled by the pattern control mechanism of the knitting machine in a manner to be described later on. When the switch 668 is in such a position that the high-speed motor 650 is fed with current from the electric source, the high-speed motor drives the main cam shaft 18 through the medium of the gearing 654, 656, 660, 662, whereby the pinion 664 is also rotated by the gear 656; the low-speed motor 652, however, is not rotated, as the free wheel coupling 666 is arranged between the pinion 664 and the low-speed motor 652. When, on the other hand, the switch 668 is in such a position, that the low-speed motor 652 is fed with current from the electric source, the low-speed motor 652 drives the gearing 656, 660, 662 by means of the pinion 664, which now is positively rotated by the coupling 666, so that the main cam shaft 18 is revolved slowly. In this case, the gear 656 rotates the pinion 654 directly connected with the high-speed motor 650, so that the rotor of the high-speed motor 650 is also slowly rotated. Thus, during the operation of the knitting machine either the high-speed motor 650 or the low-speed motor 652 drives the main cam shaft 18 so that the latter constantly rotates. Fig. 27 diagrammatically shows an electrical circuit illustrating a possible way of selectively supplying current to the motors. The current from the feed lines 670 wherein a line switch 671 may be interposed, is controlled by means of a manually operable master switch 672 adapted, by the function of a single pole magnetic switch 673 associated therewith, to start and stop the machine. The line switch 671 and the single pole switch 673 being closed, the current may then flow to the high-speed motor 650, or to the low-speed motor 652. The pole of the change-over switch 668 may be reversed by actuation of a limit switch 674 under control of the pattern control mechanism, as will later appear.

Fig. 3 shows all the cams which are arranged on the main cam shaft 18 for driving the various mechanisms of the knitting machine. These cams as shown from left to right in Fig. 3 are enumerated as follows:

438 is the thread-cutting cam arranged on the gear 662 as a flange thereof;

158 is the draw cam which is loosely arranged on the main cam shaft 18;

374 is the push cam for advancing the thread carrier spindle and the narrowing mechanism producing the narrowing of the heel, said push cam is firmly secured to the main cam shaft like all the other cams except cam 158.

194 is the catch bar lifting cam;

196 is a round cam representing one of the two round cams for the narrowing machine during the working operations and also representing the round cam for the catch bar during the narrowing operations;

252 is one of the two narrowing machine cams;

220 is the forward knocking-over working cam;

222 is the forward knocking-over narrowing cam;

232 is the additional cam for high and low knocking over during the transfer of a prefabricated stocking blank from the transfer bar to the needles;

228 is the normal high and low knocking-over working cam;

230 is the high and low knocking-over narrowing cam;

180 is the catch bar working cam;

182 is the catch bar narrowing cam;

84 is the additional press cam for moving the needle bar during the transfer of a prefabricated stocking blank from the transfer bar to the needles.

80 is the press working cam;

82 is the press narrowing cam;

94 is the regulating working cam;

96 is the regulating narrowing cam;

254 is the second round cam for the narrowing machine during the working operations;

256 is the second narrowing machine cam;

294 is the round cam for the sole transfer mechanism;

296 is the working cam for the sole transfer mechanism for transferring the soles by one or two needles on to the needles knitting the heels;

732 is the push cam for the pattern chain;

772 is one of the two halves of the narrowing shifting cam;

773 is the other half of the narrowing shifting cam;

770 is the cam for shifting the shifting roller 768 cooperating with two halves of the narrowing shifting cam;

118 is the thread tension working cam;

120 is the thread tension narrowing cam;

60 is the needle bar working cam;

62 is the needle bar narrowing cam;

626 and 627 are collars for the feed motion of the turn table said collars being firmly mounted on the main cam shaft;

530 is an auxiliary cam cooperating with the mechanism of the transfer device;

516 is the working cam for the transfer device;

518 is the round cam for the transfer device;

554 is the working cam for the gripping latches of the transfer device.

Figs. 2 and 8 show the control chain or pattern chain 706 controlling the various mechanisms of the knitting machine. This pattern chain 706 is advanced by one link for every revolution of the main cam shaft 18. For this purpose the push cam 732 (Figs. 3 and 8) for the pattern chain or narrowing chain 706 cooperates with the roller 730 of the spring actuated push lever 731 swingably mounted on the narrowing jack 733 at 729. During every down stroke of the roller lever 731 caused by means of the push cam 732, the free end 728 of the roller lever 731 depresses the pawl arm 726, so that the pawl 724 (Figs. 2 and 8) attached to said arm 726 feeds by one tooth the gear 722 secured to the shaft 716 of the narrowing chain drum 714. Thus, the narrowing chain 706 guided by the rollers 718 is intermittently advanced. A row of spring actuated narrowing jack levers 712*a*, 712*b*, 712*c*, 712*d*, 712*e*, 712*f*, 712*g* and 712*h* (Figs. 2 and 8) is swingably arranged on a rod 713 carried by the narrowing jack 733. As often as one of the narrowing buttons 710 arranged in several rows and at certain distances on the narrowing chain 706 comes in engagement with the projecting extension of one of said narrowing jack levers, the respective narrowing jack lever is swung about the rod 713, whereby the respec-

tive mechanism in the knitting machine is controlled or released respectively. The narrowing jack levers operate the respective mechanisms by means of linkages. Now, the following controlling operations carried out by the narrowing jack levers are enumerated:

The narrowing jack lever 712*a* controls the thread-cutting device;

The narrowing jack lever 712*b* controls the transfer device and renders the additional press cam as well as the additional cam for high and low knocking-over active or inactive respectively;

The narrowing jack lever 712*c* controls the feed motion of the thread carrier spindle and the narrowing mechanism during the knitting of the heel;

The narrowing jack lever 712*d* controls the feed motion of the thread carrier spindle and the narrowing mechanism during the knitting of the ravel courses;

The narrowing jack lever 712*e* controls the loose-course intermediate lever for knitting a loose course;

The narrowing jack lever 712*f* controls the stopping device of the turntable carrying the prefabricated stocking blank;

The narrowing jack lever 712*g* controls the change-over switch for high and low speed operation of the knitting machine;

The narrowing jack lever 712*h* controls the transfer of the soles by one or two needles on to the needles knitting the heels.

The knitting mechanism and the narrowing mechanism are fully described in my co-pending parent patent application Ser. #297,829. Hereinafter only those mechanisms, and parts of the knitting machine will be described, which are necessary for the understanding of the invention described herein.

When the knitting machine is started and the main cam shaft 18 revolves, at certain periods, each time a transfer of the soles shall take place, the narrowing jack lever 712*h* is swung by means of buttons mounted on the narrowing chain 706, which is intermittently advanced. Each time the narrowing jack lever 712*h* is swung, a linkage (not shown) connected to said narrowing jack lever causes in a well-known manner a shifting of the narrowing roller 768 (Figs. 3 and 8) by means of the cam 770 in the direction of the axis of a shaft 709 carrying said narrowing roller 768, so that the narrowing roller comes into engagement with either one of the two halves of the narrowing shifting cam 772, 773. Fig. 3 shows the main cam shaft 18, which is rotatably and slidably arranged in the frame of the knitting machine and may be shifted in longitudinal direction, in the position which it occupies during the knitting operations of the knitting machine. When a narrowing operation controlled by the narrowing jack lever 712*h* takes place for transferring the soles by one or two needles on to the needles knitting the heels, the main cam shaft 18 is shifted in the direction of the arrow A to the left.

The drive of the knocking-over device is shown in Figs. 3, 6 and 7. The knocking-over bits 200 are mounted on the frame 198 rigidly secured to a shaft 202, the ends of which are rotatably mounted in two spaced small lever arms 204 (only one of same is shown in the drawings). The lever arms 204 are keyed to the knocking-over shaft 26, journalled in the machine frame. Furthermore, a link 206 is rigidly secured to the shaft 202 as best shown in Fig. 6. The free end

of said link 206 is pivoted to another link 210 at 208. The free end of this link 210 is pivoted to the arm 212 of a double-armed roller lever 216 loosely and rotatably arranged on the needle bar shaft 22. During the knitting operations the roller 218 of the lever 216 cooperates with the forward knocking-over working cam 220 (Figs. 3 and 6 and during the narrowing operations said roller 218 cooperates with the forward-knocking-over narrowing cam 222, whereby the forward and backward movement is imparted to the knocking-over bits.

The knocking-over bits must, however, also perform an up and down movement. For this purpose a lever 224 (Fig. 6) is keyed to the knocking-over shaft 26. For a purpose to be described later on, the roller 226 of said lever 224 is shiftably arranged on a pin 227 attached to the lever 224. The roller 226 can be shifted on the pin 227 by means of a fork lever 236 secured to a control rod 34 (Figs. 2 and 6), which is slidably arranged in the machine frame in longitudinal direction. The operation and control of this control rod 34 will be described later on. As long as the roller 226 is in its normal position, it cooperates, during the knitting operations, with the normal working cam 228 for high and low knocking-over (Figs. 3 and 6) and during the narrowing operations, with the high and low knocking-over narrowing cam 230, which imparts to the knocking-over bits the desired up and down movements.

Figs. 7 and 8 show the driving mechanism by means of which the needle bar 46 carrying the needles 48 is lifted and lowered. The needle bar 46 has two downward extensions 50 (Figs. 2 and 7) linked to the small needle bar arms 54 at 52. The small needle bar arms are keyed to the needle bar shaft 22 journalled in the machine frame. Furthermore, the roller lever 56 (Fig. 8) carrying the roller 58 is secured to the needle bar shaft 22. During the knitting operations the roller 58 cooperates with the needle bar working cam 60 (Figs. 3 and 8), and during the narrowing operations the roller 58 cooperates with the needle bar narrowing cam 62. The oscillations thus imparted to the roller lever 56 produce the lifting and lowering movements of the needle bar through the medium of the small needle bar arms 54.

Fig. 7 shows the driving mechanism by means of which the press movements are imparted to the needle bar 46. The press arm 74 is loosely and rotatably mounted on the needle bar shaft 22. One end of a connecting link 70 is linked to said press arm at 72, the other end of said link 70 is pivoted at 68 to the free end of the needle bar cross arm 66 secured to the needle bar. The press arm 74 carries at its lower end a pivot 76, on which a roller 78 is shiftably arranged. This roller 78 may be shifted by means of a fork lever 88, which, like the fork lever 236 (Fig. 6), is secured to the control rod 34 and performs the shifting of the roller in a manner and for a purpose to be described later on, when the control rod 34 is shifted as will be described later on. When the roller 78 is in its normal position, during the knitting operations of the machine, the roller 78 cooperates with the normal press working cam 80 (Figs. 3 and 7), and during the narrowing operations the roller 78 cooperates with the press narrowing cam 82, whereby the needles are moved against the press edge 133 or against the points of the transfer fingers 238*a*, and 238*b* and narrowing fingers 298*a*, and 298*b* respectively

as required during the knitting and narrowing. An adjusting screw 102 (Fig. 7) is adjustably arranged on the press arm 74. The end of the adjusting screw 102 abuts against the regulating arm 90 loosely and rotatably mounted on the needle bar shaft 22 and provided with a roller 92. During the knitting operations of the machine said roller 92 cooperates with the regulating working cam 94 (Figs. 3 and 7), and during the narrowing operations the roller 92 cooperates with the regulating narrowing cam 96. The regulating arm 90 serves to regulate the length of the loops.

In order to render possible the automatic transferring of prefabricated stocking blanks on the needles of the knitting machine, the knitting machine is provided with a rotatable supply table or turn table 580 and an automatic transfer device 448 (Figs 1, 4, 6, 7, 9–12, 25 and 26). The turn table 580 is rotatable about the vertical axle 594 mounted in the frame 582. This frame 582 is swingably arranged on the shaft 584 (Figs. 1, 4 and 36) arranged in the machine frame 16, and is held in its operative position shown in Fig. 1 by means of a conical lock screw 586. If for any reason the operater wishes to have access to the mechanism of the knitting machine, he may, after removal of the screw 586, swing the turn table 580 with its frame 582 about the shaft 584. The turn table 580 has a number of sections, for instance six. Said sections are provided with extensions 592 having slots in which the operator may insert transfer bars T as shown in the drawings. Fig. 21 shows a prefabricated stocking blank 800, in which between the high heel portions 804 and the sole portions 808 the separating courses 810 are still present. After, in a suitable device, the separating courses 810 have been removed by the knives K and the first course of sole loops has been brought in line with the last course of high heel loops by folding over, the prefabricated stocking blank 800 is topped on to the transfer bar T in the manner as shown in Fig. 22. Preferably, before the operation of the knitting machine is started, the operator inserts several transfer bars T having the prefabricated stocking blanks 800 topped thereon in above described manner into several sections of the turn table 580, whereupon during the feed motion of the turn table about its axis 594, which will be described later on, the supply on the turn table may continuously be renewed, so that an uninterrupted operation of the knitting machine is assured.

The turn table 580 must be advanced in such a manner that at the moment when a full transfer bar carrying a prefabricated stocking blank shall be gripped by the transfer device the turn table holds such a full transfer bar in front of the transfer device. Then, the turn table must remain in this position until the transfer device has returned the empty transfer bar, after transferring the prefabricated stocking blank on to the knitting needles, into the same section from which it previously removed the then full transfer bar. When this operation has been carried out, the turn table must be advanced during the knitting operations of the knitting machine, so that, before the transfer device may grip another full transfer bar of the turn table for a new cycle of operation, the turn table has again brought such a full transfer bar in front of the transfer device. The empty transfer bar, which has been moved away from the knitting machine by the feed motion of the turn table, may then be removed from the turn table by the operator, and at the proper time the operator may replace the empty transfer bar by a fresh, full transfer bar.

Figs. 1 and 26 show the turn table 580 in a position, in which a spring actuated stop pawl 596 pivoted to the frame 582 at 597 is in engagement with one of the six stops 602 arranged on the turn table, and holds the turn table in such a position that a full transfer bar T placed on the turn table may be gripped by the transfer device. The gripping of this full transfer bar by the transfer device and the return of the empty transfer bar by the transfer device will be described later on. When the empty transfer bar is returned into the respective section of the turn table and the transfer device has been returned into the neutral position with the gripping latches at a small distance above the turn table as will be described later on, then a button 710 of the pattern chain 706 (Figs. 2 and 8) actuates the narrowing jack lever 712f which, in turn, swings the latch 596 through the medium of a linkage 760, 762, 764, so that the stop pawl 596 is disengaged from the stop 602. Now the feed pawl 608 can become active and can advance the turn table 580 by means of the ratchet wheel 606 in the following manner. The spring actuated pawl 608 is pivoted to one end of a lever 610 swingably mounted on the frame 582 at 611. The other end of the lever 610 is in engagement with a push rod 612 having two set collars 614 and 615 secured thereto. A spring 616 is inserted between the set collar 615 and the lever 610 slidably engaged with the push rod 612. The rear end of the push rod 612 is pivoted to one end of a bell-crank lever 618 (Figs. 1 and 4) at 617. The other end of the bell-crank lever 618 swingably mounted at 619 is pivoted to one end of an intermediate link 620, the other end of which is being pivoted to a lever 622. This lever 622 is swingably mounted on the machine frame at the point 623 and carries, approximately at its center, a roller 624 (Figs. 3 and 4) which is in engagement with the two rings 626 and 627 keyed to the cam shaft 18. Thus, every narrowing shift movement of the cam shaft 18 in the direction of the arrows A, B causes an oscillation of the lever 622 about the pivot 623. This oscillation of the lever 622 produces a reciprocating movement of the push rod 612 by means of the intermediate lever 620 and the bell-crank lever 618. Thus, when the narrowing operation is initiated by means of the narrowing jack lever 712f as described above, the push rod 612 first is shifted in the direction of the arrow H, whereby the set collar 614 secured to the push rod 612 swings the lever 610 in the direction of the arrow I about the pivot 611 so that the spring actuated pawl 608 is moved back by one tooth and is engaged with another tooth of the ratchet wheel 606. When, at the end of the narrowing operation, the cam shaft is shifted in the direction of the arrow B and the push rod 612 is shifted in the direction of the arrow L, the lever 610 is swung in the direction of the arrow M by means of the collar 615 through the medium of the interposed spring 616 whereby the ratchet wheel 606 is advanced by one tooth. After this advancement of the ratchet wheel, the inclined edge 600 of the stop 602 comes in front of the edge 636 of the pawl 596, so that, upon the subsequent return movement of the narrowing jack lever 712f the spring actuated stop pawl 596 can not engage any more the front edge of this stop 602 and the ratchet wheel 606 can be

advanced by the feed pawl 608 without any obstruction during repeated feed motions. The various positions of the ratchet wheel 606 are locked by a small spring actuated lock pawl 634 rotatably mounted at 635. The ratchet wheel 606 is, however, not directly, but indirectly coupled with the turn table 580. As may be seen from Figs. 1, 4 and 26, the ratchet wheel 606 is loosely arranged in a recess of the turn table 580 between its flange 640 and its part 641 provided with the stops 602 and may be rotated relatively to the turntable; furthermore, the ratchet wheel has a plurality of elongated slots 642, which are in engagement with pins 644 secured to the upper side of the part 641. Small springs 646 are inserted between these pins and one end of the slots 642. Every feed motion of the ratchet wheel 606 is transmitted to the turn table 580 by means of the spring 646 and the pins 644. Now, when the turn table has been advanced by one tooth with every narrowing operation, after a certain number of feed motions the spring actuated stop pawl 596 comes in engagement with the next stop 602 of the part 641 being integral with the turn table 580, whereby the turn table 580 is arrested in such a position that the next section carrying a full transfer bar is in front of the transfer device. Now, when during further narrowing operations the push rod 612 is repeatedly reciprocated in the direction of the arrows H and L, at first the ratchet wheel 606 is advanced to a small extent by one or two teeth and is rotated relative to the turn table 580 held in its position by the stop pawl 596, as long as the small springs 646 may be compressed. Thereupon, when the small springs are compressed, the ratchet wheel 606 cannot be advanced further, so that, while the pawl 608 is moved back by one tooth and is engaged with another tooth of the ratchet wheel when the push rod 612 is moved in the direction of the arrow I, the pawl 608 and the lever 610 carrying same, however, remain in the new position when the push rod 612 is moved in the direction of the arrow L, and the shifting of the push rod results in a compression of the spring 616. Thus, during further narrowing operations, the reciprocating movements of the push rod 612 have no effect at all on the ratchet wheel 606, merely the spring 616 is expanded and compressed. Thereupon, as soon as the narrowing jack lever 712*f* swings the stop pawl 596 as described above, the turn table can again be advanced in the manner described by means of the push rod 612. The arrangement of the small springs 646, which, after the stopping of the turn table 580 by the engagement of a stop 602 with the stop pawl 596, are compressed, as described above, results in a firm pressing of the respective stop 602 against the stop pawl 596, so that the turn table 580, which is prevented from a return movement by the small stop pawl 634, cannot move to the slightest extent and assures a proper holding of the transfer bar, which is inserted in the respective section, in front of the transfer device in such an accurate position that the transfer device may surely grip the transfer bar.

Now, the transfer device 448 is to be described. This transfer device must be controlled in such a manner, that, during the knitting and narrowing operations, the transfer device is in a neutral position with its gripping latches at a small distance above the turn table 580, so that the latter can be advanced without obstruction at

the predetermined moments, as described above. Furthermore, it is necessary, that, after a finished stocking blank has been pressed off, the transfer device performs the following movements during a single revolution of the cam shaft: First the transfer device is swung against the turn table for the gripping of a full transfer bar, then the transfer device is swung against the needle bar for the transfer of the prefabricated stocking blank to the knitting needles, then the transfer device is again swung against the turn table for the deposing of the empty transfer bar on the turn table, and finally the transfer device is raised to a small degree into the neutral position. The transfer device and its driving mechanism to be described hereinafter carry out said operations.

According to Figs. 4, 6, 7 and 9–12 the supporting frame 500 of the transfer device 448 is loosely and rotatably mounted on the needle bar shaft 22. The support 500 is provided with lugs 502. Bell-crank levers 506 are pivoted to said lugs at 504. The rear end of these bell-crank levers is provided with an adjusting screw 534, which normally is pressed against the support 500 by means of a spring 536 stretched between the bell-crank lever 506 and the support, so that the bell-crank levers are normally held in a predetermined adjustable relative position with respect to the support 500. The gripping latches 538 (see particularly Figs. 11 and 12) are pivoted to the front end of the bell-crank levers at 539. The gripping latches are subjected to the action of a tension spring 540 which is stretched between the gripping latches and the arm 506 and tends to draw the gripping latches into closing position. Furthermore, on the side of each gripping latch a stud 542 is arranged, which cooperates with one of the two guiding finger levers 544. These guiding finger levers 544 are loosely arranged on the shaft 32 supported by the machine frame, and may carry out small swinging movements in a manner to be described later on. When, during such a swinging movement, the guiding finger 544 abuts against the stud 542, the latches are opened against the action of the spring 540. When, during such a swinging motion, the finger 544 is moved away from the stud 542, the gripping latches are brought into closing position by the action of the spring 540. When a transfer bar T has been gripped by the gripping latches, the latter press same into a recess 566 (Figs. 6 and 12) of the arms 506 owing to the action of the spring 540, so that the transfer bar T is held firmly in its position, when the gripping latches are in closing position, and cannot fall out of this position, when the transfer device having its support 500 loosely arranged on the needle bar 22 is swung about this needle bar. In order to make this swinging movement possible, gears 508 rigidly connected with the support 500 in a suitable manner are also loosely mounted on the needle bar shaft 22. Said gears 508 mesh with gear segments 510 keyed to the shaft 32. When an operation of the transfer device is required at a predetermined time, the gear segments 510 meshing with the gears 508 are oscillated by means of suitable movements of the shaft 32 as will be described later on.

The cam drive controlling the support 500 and the fingers 544 is best shown in Figs. 1–4. A roller lever 512 which is subjected to the action of the strong spring 526 and carries the two rollers 528 and 514, is keyed to the shaft 32 carrying the gear segments 510. The roller 528 is rotatably

but not shiftably arranged on the lever 512, while the roller 514 is rotatably and shiftably mounted on the lever 512. The roller 528 always cooperates with the auxiliary cam 530, irrespective of the fact whether or not the cam shaft 18 is shifted for a narowing operation, as the auxiliary cam 530 (see Fig. 3) is broader than the roller 528. The roller 514 cooperates either with the working cam 516 for the transfer device or with the round cam 518 for the transfer device and may be shifted from the round cam 518 to the cam 516 and vice versa by means of a forked lever 520 at moments controlled by the pattern chain in a manner to be described later on. When the roller 514 is in engagement with the working cam 516 actuating the transfer device, no narrowing operation takes place, i. e. the cam shaft 18 is not shifted. When the roller 514 cooperates with the round cam 518 holding the transfer device in neutral position, shifting movements of the cam shaft 18 for narrowing operations occur. Therefore, the round cam 518 is broader than the roller 514, so that the latter also remains in engagement with the round cam during narrowing operations. It is obvious that the swinging movements imparted to the roller lever 512 by the working cam 516 are transmitted to the gear segments 510 through the medium of the shaft 32. The forked lever 520 causing the shifting of the roller 514 from the round cam 518 to the working cam 516, is keyed to the control rod 34, which also carries, as described above, the forked lever 236 (Fig. 6) for the shifting of the roller 226 of the roller lever 224 causing the high and low knocking-over as well as the forked lever 88 (Fig. 7) for the shifting of the roller 78 of the press arm 74. As best shown in Figs. 1–4, a flange 522 is provided, which serves to render a shifting of the roller 514 from the round cam 518 to the working cam 516 and vice versa possible only at a certain predetermined moment. For this purpose the flange 522 has a recess only at one place 524 (Fig. 4), i. e. the place where the working cam 516 and the round cam 518 are of the same height and the shifting of the roller 514 by means of the forked lever 520 takes place in a manner to be described later on. Furthermore, at this place 524 the round cam 518 has a small indentation, by means of which the height of its circumference is reduced to a small degree, and at this place 524 the roller 528 cooperating with the auxiliary cam 530 becomes active, so that, when the roller 514 is opposite to the place 524, the roller 514 is spaced to a small degree from the round cam 518 or the cam 516 respectively. This space is necessary, in order to obtain an easy shifting of the roller 514 by means of the forked lever 520 and to prevent the roller 514 from becoming pressed against the round cam 518 or the cam 520 by the strong spring 526 during the shifting. Fig. 4 shows the roller 514 in contact with the highest point of the working cam 516 rotating in the direction of the arrow N. When the roller occupies this position, the gear segment 510 is swung to the furthest extent in counter-clockwise direction as seen in Fig. 4, so that the support 500 with its gripping latches 538 is in its lowermost position. The cam 516 has a second high point 532, in which again the gripping latches 538 are brought into the lowermost position. The position first mentioned, shown in Fig. 4, is the position in which the gripping latches 538 deposit an empty transfer bar on the turn table 580. The second position mentioned, in which the roller 514 contacts the point 532 of the cam 516, is the position in which the gripping latches remove a full transfer bar from the turn table. The radius of the round cam 518 is somewhat shorter than the distance between the above mentioned highest points of the working cam 516 and its center point, so that, when the roller 514 contacts the round cam 518, the support 500 with its gripping latches 538 is in a somewhat elevated position as shown in Fig. 11. In this position, which has been designated as the neutral position of the transfer device, the latches 538 are above the quills or transfer points P of the transfer bar T, so that the turn table 580 may be advanced without any obstruction.

The cam 554 mounted on the main cam shaft 18 actuates the fingers 544. The roller 552 rotatably and shiftably mounted on the roller lever 548 may be pressed against the projections 564 and 565 of the cam 554 by means of the tension spring 556 connected to the extension 558 of this roller lever. The lever 548 is loosely and rotatably mounted on the shaft 32 and is rigidly connected to the finger levers 544 by means of a connecting rod 550 (Figs. 1, 2, 4, 6, 7, 9, and 10). Thus, when the roller 552 comes in engagement with the projections 564 and 565, the fingers 544 are swung. The roller 552, however, cannot come in engagement with the round portion of the cam 554, because, when the strong spring 556 lowers the roller lever 548, its extension 558 at first abuts against a rod 562 attached to the machine frame. The space thus obtained between the round portion of the cam 554 and the roller 552 renders possible a shifting of the roller 552 by means of the forked lever 560 without any obstruction by the spring 556 at the predetermined moments. Like the forked lever 520 and the forked levers 236 and 88 (Figs. 6 and 7) the forked lever 560 is keyed to the control rod 34 already mentioned above.

When, after the pressing off of a finished stocking blank, the operation of the transfer device shall be automatically started for the transfer of a new, prefabricated stocking blank on to the needles of the machine, the narrowing jack lever 712b (Figs. 2 and 8) is lifted by a button 710 arranged on the narrowing chain 706. The narrowing jack lever 712b is connected to one end of a link 740, the other end of which is connected to a lever 742 rotatably mounted on the pivot 743. The lever 742 has a forked end engaged with the control rod 34. Thus, the narrowing jack lever 712b tends to move the control rod 34 in the direction of the arrow Q (Fig. 2) when the narrowing jack lever is lifted. The narrowing jack lever 712b is, however, actuated at a moment in which the control rod should not yet be moved. The movement of the control rod must be timed in such a manner, that during the period in which the main cam shaft makes a full revolution the transfer device has sufficient time to bring the transfer bar from the supply table to the needles, to transfer the loops at the proper moment to the needles and to move the transfer bar away from the needles again. Therefore, means are provided by which, on one hand, the control rod 34 is moved in the direction of the arrow Q only at a moment, when the main cam shaft 18, after the actuation of the narrowing jack lever 712b, has been rotated through a certain angle of about 200 to 300 degrees, and, on the other hand, the control rod 34 is returned into its starting position in a direction opposite to the direction of the arrow Q only at a moment, when, after a

feed motion of the narrowing chain, the main cam shaft has been rotated through the same angle of about 200 to 300 degrees. For this purpose, two set collars 744 and 745 (Fig. 2) are secured to the control rod 34, and a spring 746 is interposed between the forked lever 742 and the set collar 745. Furthermore, the flange 522 is arranged between the round cam 518 and the cam 516, as pointed out above. Now, when the narrowing jack lever 712b causes a movement of the forked lever 742, in the first instance the spring 746 is compressed, as, at this instance, the flange 522 prevents the roller 514 engaging the lever 520 secured to the control rod 34 from being shifted, so that the control rod 34 is held in its position by the roller 514. The movement of the control rod into the position shown in Fig. 2 by the expansion of the spring 746 takes place only at a moment, when, after a further rotation of the cam shaft 18 through said certain angle, the place 524 of the round cam or cam 516 respectively (Fig. 4), has come opposite to the roller 514, so that the latter is no longer obstructed by the flange 522. At the same time also the place 567 of the cam 554 has been brought into a position opposite to the roller 552. Now, when the control rod 34 is moved by means of the spring 746, the rollers 514 and 552 come in engagement with their working cams 516 and 554 respectively. At the same time, however, the roller 226 (Fig. 6) is shifted by means of the forked lever 236, so that it does not cooperate any more with the normal working cam 228 (Figs. 3 and 6) but is engaged with the additional cam 232 for high and low knocking over. Furthermore, at the same time the roller 78 (Fig. 7) of the press arm 74 is shifted by means of the forked lever 88, so that it does not cooperate any more with the normal press working cam (Figs. 3 and 7) but is engaged with the additional press cam 84. The simultaneous engagement of these two additional cams 232 and 84 is necessary, because, during the transfer of a prefabricated stocking blank on to the needles, which will be described later on, on one hand the knocking-over bits must be brought into a position as low as possible, i. e. into a position lower than the lowermost position during normal knitting operations, and on the other hand the needles must perform a different press motion than during normal knitting and narrowing operations. Now, when the rollers 514 and 552 (Fig. 4) are engaged with their cams 516 and 554 respectively and the cam shaft 18 is rotated in the direction of the arrow N, at first the support 500 is swung by the high point 532 of the cam 516 from the neutral position shown in Fig. 11 in the direction of the arrow R against the turn table 580. The lowermost position of the support 500 corresponds to the position shown in Figs. 6 and 7. Incidentally it may be mentioned, that Figs. 6 and 7 do not illustrate the gripping of a full transfer bar, but the depositing of an empty transfer bar. During the swinging of the support 500 against the turn table 580, the fingers 544 are also swung in the direction of the arrow R (Figs. 11 and 6) by means of the cam portion 564 (Fig. 4) of the cam 554, whereby they cause a swinging of the gripping latches 538 about the pivot 539, so that the gripping latches engage a full transfer bar inserted in a section of the turn table 580. During the further rotation of the cam shaft 18, the support 500 is swung about the needle bar shaft 22 in the direction of the arrow S (Fig. 11), until the pins 572, which may be constructed as rollers and are attached to the bell-crank levers 506 swingably mounted at 504 abut against the two guiding lugs 570 in the position shown in Fig. 9. Said guiding lugs form a part of the guiding bodies 568 (Figs. 9 and 13) attached to the machine frame and provided with two projecting plates. In the position shown in Fig. 9, the quills or transfer points P of the transfer bar T carried by the arms 506 are behind the needles 48, The prefabricated stocking blank 800 still hangs on the quills P of the transfer bar, and its leg portion 802 rests on the trough 826. The needles 48 and the knocking-over bits 200 are in lifted position, the sinkers 134a are in a withdrawn position. In order to transfer the stocking blank from the transfer points of the transfer bar on to the needles, at first the needles and the transfer points must be moved downward, if possible without any mutual displacement. In order to render possible this common movement, both guiding lugs 570 are arranged in such a manner that, in that particular moment when the pin 572 abuts against the guiding lugs in the position shown in Fig. 9, the center point of the pivot 504 between the arms 506 and the support 500 is in line with the center point of the pivot 52 (Fig. 6) between the needle bar 46, 50 and the needle bar arms 54. Inasmuch as both the support 500 and the needle bar arms 54 are arranged on the needle bar shaft 22 this pivotal point 22 is common to the support and the needle bar arms. Thus, when, during the continued transfer operation, the support 500 is swung from the position shown in Fig. 9 into the position shown in Fig. 10 and at the same time the needle bar 46 is actuated by the needle bar arms 54, a common swinging movement of the pivot 504 and the pivot 52 about the pivotal point 22 is obtained by means of a suitable shape of the working cam 516 for the transfer device and the needle bar working cam 60, the pivot 504 and the pivot 52 remaining in alignment. Now, however, the needle bar 46 is also actuated by means of the press arm 74 cooperating with the additional press cam 84. In order to conform the movements of the transfer points of the transfer bar to the movements thus imparted to the needles 48 of the needle bar, the front faces 571a of the guide 570 have such a shape, that, during the swinging of the support 500 from the position shown in Fig. 9 into the position shown in Fig. 10, the pins 572 slide along the guides, whereby they cause a swinging of the arms 506 about the pivots 504 the spring 536 thus being put under tension. The downward movement of the pins 572 is limited by the shoulders 570 of the bodies 568, so that the transfer bar cannot be pulled further down than shown in Fig. 10. Owing to the downward movement of the transfer points of the transfer bar and the needles, the knocking-over bits 200 coming below the stocking blank must be brought into a position as low as possible, and this feature is carried out by means of the additional knocking-over cam 232, as pointed out above. Shortly before the relifting of the needles and transfer points of the transfer bar, the additional press cam presses the needles into the grooves of the transfer points. Furthermore, as may be seen from Fig. 10, the sinkers 134a, and 134b are brought into the advanced position above the stocking blank, so that during the subsequent parallel raising of the needles and transfer points of the transfer

bar, the stocking blank is cast off from the transfer points of the transfer bar onto the needles and the transfer bar T becomes empty. Thereupon, the support 500 is swung away from the needles about the needle bar shaft 22 and is brought into the position shown in Figs. 4, 6 and 7 for the deposit of the empty transfer bar on to the turn table. The gripping latches are again opened by the fingers 544 now actuated by the cam portion 565 (Fig. 4), and the support 500 is returned into the neutral position shown in Fig. 11 after the deposit of the empty transfer bar. Shortly before the return of the support into the neutral position the narrowing chain 706 has been advanced by one link, and the button 710 has been disengaged from the narrowing jack lever 712b. The spring 736 (Fig. 2) connected to the narrowing jack lever 712b, however, cannot return the control rod 34 at the moment, as the flange 522 prevents a shifting of the roller 514 engaging the lever 520 secured to the control rod 34. Only when, after a further rotation of the cam shaft 18 through a certain angle of about 200 to 300 degrees, the recess 524 comes in front of the roller 514, the spring 736 can return, through the medium of the linkage 712b, 740, 742, 744, the control rod 34 into its starting position in a direction opposite to the direction of the arrow Q. During this return movement, the control rod 34, by means of the forked levers 236, 88, 520 and 560 secured thereto, disengages the rollers 226 and 78 from the additional cams 232 and 84 and engages said rollers with the normal working cams 228 and 80, disengages the roller 514 from the working cam 516 and engages same with the round cam 518, and moves the roller 552 outside the zone of operation of the cam 554.

In the foregoing paragraphs the automatic transfer of a prefabricated stocking blank on to the needles of the knitting machine has been described. Now, the device will be described by means of which the automatic removal of the finished and pressed-off fabric may be carried out, thus rendering the uninterrupted operation of the knitting machine possible. In addition to the device for the automatic arresting of the thread carriers by means of the stop lever 396a (Fig. 8), (as fully described in my co-pending parent application Ser. #297,829 filed October 4, 1939) which results in a pressing off of the fabric, the knitting machine has also a device for clamping and cutting the threads, whereby the pressed off fabric is separated from the thread coming from the thread carrier. Figs. 2 and 24 show the two clamping and cutting devices, one on each side of the needle section, while Fig. 14 shows only the right hand cutting device in front view and enlarged. On each side of the needle section a block 402 is adjustably arranged on the sinker head 132 by means of an elongated slot and a screw in order to adjust the cutting device to the width of the fabric to be knitted. This block 402 has two tracks 404 and 405 (Figs. 16, 17 and 21) arranged above each other. In each of these tracks an abutment 410 and 415 respectively is arranged. The thread clamp 408 having a hook on its end is slidably arranged in the track 404, while the knife 414 provided with a hook is slidably arranged in longitudinal direction in the track 405. When according to Fig. 16 the thread clamp and the knife are in a position projecting from the block 402 for catching a thread, the knife projects further toward the center of the section, so that upon return movement of the thread clamp and the knife in the direction of the arrows shown in Fig. 16 at first the clamp grips the thread and clamps same against the abutment 410 and then the knife becomes active. As shown in Fig. 19, all parts of the thread clamp 408 are round in order to prevent a cutting of the thread by the clamp, whereas the knife 414 has sharp edges. According to Figs. 14 and 24, the rod-like end of the knife is adjustably attached to the link 422 by means of the clamping pieces 420 and 421. The link 422 is guided in the U-piece 424 and is pivoted to the lever 430 at 431. The lever 430 is swingably mounted on the knitting machine at 432. The rod-like end of the thread clamp 408 is, however, loosely and slidably arranged in suitable bores of the clamping pieces 420 and 421. A body 426 is secured to the thread clamp 408 between the two clamping pieces 420 and 421, and a spring 428 is interposed between this body 426 and the clamping piece 420. When the lever 430 is in the position shown in Fig. 14 by dash and dot lines, the hook of the thread clamp 408 is nearer to the block 402 than the hook of the knife 414 as already described above and shown in Fig. 16. Now, when the lever 430 is swung in the direction of the arrow S, at first the hook of the clamp 408 abuts against its abutment 410 (Figs. 17, 20 and 18), whereby the thread gripped by the clamp is clamped. Now the thread clamp is arrested, and a relative movement occurs between the lever 430 and the thread clamp sliding in the bores of the clamping pieces 420 and 421, when the movement of the lever 430 is continued, whereby the spring 428 is compressed, so that the thread is tightly held in the clamp. During the continuation of the movement of the lever 430 the hook of the knife 414 is also drawn into the block 402, whereby, as shown in Fig. 19, the thread is severed near the sinkers. The movements of the lever 430 are transmitted to the thread-cutting and thread-clamping device on the opposite side of the section by means of the linkage 440, 442 (Figs. 2, 5, 14 and 24) connected to the lever 430 at 431. A stop latch 444, which is secured to a shaft 446 journalled in the machine frame and is normally engaged with the lower side of an extension 434 of the lever 430, normally holds the lever 430 in the position shown in Figs. 14 and 24, in which the clamp and the knife are in withdrawn position.

When, according to Fig. 14, a prefabricated stocking blank has been transferred to the needles 48, the thread clamp 408 still holds the end of the thread used in the previous cycle of operation, said end now being the beginning portion 409 of the thread. The dash and dot line 812 shown in Fig. 14 in the high heel portion 804 shall represent the last course 812 of the high heel as shown in full lines in Fig. 15, which, during the transfer by the transfer device, has been transferred to the needles 48 with the first course of the sole. Several courses, for example the three courses 815 of the heel tab 816, are knitted onto this last high heel course 812, while the beginning portion 409 of the thread is held in the clamp, and, at the same time, the loops of the first sole course are transferred by means of the sole transfer fingers 238a and 238b by one or two needles toward the outside and are interknitted with the heel. As shown in Figs. 14 and 15, the thread clamp still holds the beginning portion of the thread during the knitting of the first courses. Now, when, after the knitting of the first courses, the thread carrier has been moved into the position shown by dash and dot

lines in Fig. 14, a button 710 on the pattern chain 706 (Figs. 2, 7 and 24) lifts the narrowing jack lever 712a, which swings the stop latch 444 by means of the rod 738 from the position shown in Fig. 14, by solid lines into the position shown by dash and dot lines. Thus, the roller 436 of the extension 434 may engage the thread-cutting cam 438 (Figs. 3, 5, 14 and 24). According to Fig. 5, at this moment the cam is in such a position that the roller 436 of the extension 434 engages the round portion of the cam 438. Now, when the rotation of the cam in the direction of the arrow V is continued, the roller 436 comes in engagement with the recess 63 of the cam 438, so that the lever 430 (Fig. 14) is swung into the position shown by dash and dot lines and the thread clamp 408 is moved toward the center. Thus, the beginning portion of the thread 409 is released and is disengaged from the clamp. The knife is also moved toward the center, but it cannot catch a thread, as each of the two thread carriers is in its innermost end position, as shown by the dash and dot lines. As soon as the roller 436, during the further rotation of the cam 438, is disengaged from the recess 63 and cooperates with the adjoining round portion of the cam 438, the clamp and the knife are again withdrawn without, however, cutting a thread. Thereupon, when the cam 438 is again in the position shown in Fig. 5, the latch 444 (Fig. 14) is again engaged with the lower side of the extension 434 by means of the rod 738 and locks the lever 430 in the position shown by solid lines. Now, the knitting of the heel tab 816 and the interknitting of the sole portion 808 with the heel tab may be carried out in usual manner. As soon as the ravel courses 820 (Fig. 23) are finished, the thread carriers 108a, 108b are arrested in the position shown in Fig. 16 by solid lines. This arresting of the thread carriers 108a, 108b is carried out by means of the stop levers 396a, 396b controlled by the narrowing jack lever 712d through the medium of the thread carrier spindle 30, as described in my co-pending parent application Ser. #297,829 filed Oct. 4, 1939. Furthermore, the narrowing jack lever 712a is again actuated so that the latch 444 is again brought into the position shown in Fig. 14 by dash and dot lines and the thread clamp 408 and the knife 414 are again moved into the position shown in Fig. 16. Now, however, the clamp and the knife may catch the thread, as now, on both sides of the section, the thread carriers 108a, 108b are directly in front of them. Now, when the clamp 408 and the knife 414 are again withdrawn in the direction of the arrows shown in Fig. 16, at first the clamp 408 clamps the thread against the abutment 410 as shown in Figs. 17 and 18, whereupon, according to Fig. 19, the knife severs the thread between the clamp and the finished fabric. Thus, the fabric is automatically pressed off and falls from the trough 826 (Figs. 2 and 4) into the container 825; the fabric has the form shown in Fig. 23, the short ends 821 of the thread hanging on the ravel courses. On each side of the section the thread clamp 408 still clamps the end 409 of the thread protruding from the respective thread carrier and is held in its clamping position by the latch 444 again contacting the lower side of the extension 434. As soon as a new prefabricated stocking blank has been transferred to the needles by the transfer device, at first several loop courses 815 are again knitted on to the high heel portion 804 and are simultaneously interknitted with the sole portion 808, as described above, the end of the thread which is now the beginning portion 409 of the thread, being not released by the clamp 408. The releasing of the beginning portion of the thread takes place only after the knitting of these first loop courses as described above. If desired, however, the beginning portion 409 of the thread could be released already after only one loop course has been knitted or even after only a few new loops have been formed.

As described in my co-pending parent application Ser. #297,829 filed Oct. 4, 1939, the thread carriers are moved in such a manner that, when laying threads, they move either toward each other from the outside toward the center or away from each other from the center to the outside. Therefore, at the end of a stroke, the thread carriers are either at the inner portion or at the outer portion of each half of the section. The feature, that the thread carriers in both halves of the section are at the same time at the outer portion thereof, renders possible a simultaneous cutting of the threads by means of the two cutting devices on both sides of the section. When the thread clamping devices and the thread cutting devices are actuated, the thread carriers are in their normal outer working end position, the sinkers 134a, 134b and the dividers 136a, 136b are in their withdrawn position, and the needles 48 are in the knocking-over position, as shown in Fig. 20.

As described above, the gripping of a full transfer bar, the transferring of the stocking blank to the needles and the returning of the empty transfer bar to the turn table by means of the transfer device, shall take place during a single revolution of the cam shaft 18. In consideration of the required exact guiding of the transfer points of the transfer bar and the needles, and in consideration of the large masses to be moved, it would be impractical to have the knitting machine operate, during the transferring, at the normal relatively high operating speed. Therefore, during this transferring, preferably, however, already shortly before the operation of the thread-cutting device, the above described high-speed motor 650 is disconnected from the electric circuit and the low-speed motor 652 is connected with the electric circuit by means of the double-pole magnetic switch or change-over switch 668 (Figs. 2 and 27). The change-over switch 668 is actuated by means of the narrowing jack lever 712g controlled by a button 710 on the pattern chain 706. When the jack lever 712g is lifted by a button 710, an arm 766 connected with the jack lever depresses the limit switch 674, so that the pole of the change-over switch 668 is reversed and, now, the electric current is supplied to the low-speed motor 652. Preferably, the low-speed motor remains in operation until, after the transfer of a new prefabricated stocking blank, the first courses 815 (Fig. 15) have been knitted on to the high heel and inter-knitted with the sole and the thread has been released by the thread clamp 408. Thereupon, the change-over switch 668 is again actuated by the narrowing jack lever 712g and limit switch 674, so that now, the electric current is supplied to the high-speed motor 650 and the knitting machine is driven at high speed for the knitting operation.

The operation of the knitting machine is as follows:

At first, if necessary, the pattern chain 706 which is advanced by the push cam 732 mounted

on the main cam shaft, may be brought into its proper starting position by means of the handwheel 688 (Figs. 1 and 2). The handwheel 688 is secured to the spindle 20 carrying the pinion 686 meshing with the gear 692 (Figs. 3 and 5), which, in turn, is operatively connected with the cam shaft 18. Furthermore, several transfer bars T carrying prefabricated stocking blanks are inserted into several sections of the turn table 580. The turn table is swung into the position shown in Fig. 1 and is held in its operative position by the screw 583 and is adjusted by hand in such a manner that the first transfer bar is in front of the transfer device. Then the operation of the knitting machine is started by means of the hand switch 672. The change-over switch 668 is in such a position, that the low-speed motor 652 is fed with current and drives the cam shaft 18. Now, the first button of the pattern chain 706 lifts the narrowing jack lever 712b, so that the control rod 34 engages the rollers 226 and 78 of the knocking-over roller lever 224 and the press arm 74 with the additional cams 232 and 84 and also starts the operation of the transfer device 448. Now, the transfer device transfers the prefabricated stocking blank on to the needles of the knitting machine. As soon as the stocking blank has been transferred on to the needles, the thread carriers are rendered active and are moved toward each other from the outside toward the center. Thus, the thread carriers lay the first thread, while at the same time the transfer device returns the now empty transfer bar into the respective section of the turn table. The transfer device returns into its neutral position, in which it remains, as, after the advancement of the pattern chain already carried out at this moment, the narrowing jack lever 712b is returned into its resting position and in turn returns the control rod 34. Thus, the rollers 226 and 78 have also been moved away from the additional cams 232 and 84, so that the operation of the knitting machine may take place in normal manner. The narrowing chain 706 is advanced after every completion of a loop course as well as after every narrowing operation, and when the first loop courses of the heel tabs have been knitted on to the high heel portions and interknitted with the sole portions, on one hand the thread clamps 408 are actuated by the narrowing jack lever 712a and are temporarily brought into opening position, and on the other hand the change-over switch 668 is actuated by the narrowing jack lever 712g, so that the low-speed motor 652 is switched off and the high-speed motor 650 is switched on for the performance of the knitting operations by the knitting machine. Already after the return of the transfer device into its neutral position, the narrowing jack lever 712f is actuated by a button of the narrowing chain, so that the stop pawl 596 is disengaged from the stop 602 of the turn table 580. Thereupon, the turn table is advanced at regular intervals until the next section with a full transfer bar has been brought into a position in front of the transfer device and stopped in this position. The operator may remove the empty transfer bar from the turn table and may insert a new, full transfer bar into an empty section of the turn table. The turn table is arrested prior to the termination of the knitting of the heel tabs. When the heel tabs are finished, a button on the narrowing chain actuates the narrowing jack lever 712e, which causes the knitting of a loose course. Now the ravel courses are knitted and, shortly before the knitting of the last rows of the ravel courses, the change-over switch 668 is reset by means of the narrowing jack lever 712g, so that the low-speed motor 652 is again started. After the last loop courses of the ravel courses have been knitted, the stop levers 396a, 396b are released upon the last advancement of the thread carrier spindle 30, so that the thread carriers are arrested. Furthermore, the thread cutting device is again actuated by the narrowing jack lever 712a, so that the thread clamp grips the thread and the knife severs the thread. Thus the fabric is automatically pressed off and falls into the container 825 by its own weight. The thread clamp holds the thread protruding from the thread carrier. Thereupon the transfer device is again operated and transfers a new, prefabricated stocking blank from the turn table to the needles, so that a new cycle of operation begins. The knitting machine, therefore, operates without interruption. Obviously, the knitting machine is automatically operated at low speed substantially during the transferring and clamping and cutting operations, and at high speed substantially during the knitting operations proper.

The drawings show a knitting machine having only one needle section, in which only one stocking blank is topped on to the needles for a cycle of operations. Of course, a knitting machine could be maufactured, which has several sections, on the needles of which several stocking blanks may be simultaneously topped on by means of one or more transfer devices.

Whereas in the description and drawings, the present invention has been described in connection with a heeling machine, of course, the invention may also be applied to different knitting machines and to the production of other fabrics than stockings. Furthermore, the application of the automatic means for changing the speed of operation of a knitting machine is not limited to knitting machines being equipped with both a transfer device and a thread clamping- and cutting device. The automatic speed changing means may also be arranged on knitting machines having only one of said two devices. Moreover, the automatic means for changing the speed of operation of a knitting machine may be applied to knitting machines of any type, which have neither a transfer device nor a thread clamping- and cutting device; knitting machines equipped with the automatic speed changing means according to this invention may be automatically operated at high speed or low speed in accordance with the requirements of certain operations to be performed by certain mechanisms of the knitting machine during the manufacture of a fabric or a plulrality of fabrics.

I have described a preferred embodiment of my invention but, of course, numerous changes and omissions may be made without departing from the spirit of my invention.

What I claim is:

1. A knitting machine comprising: a knitting mechanism for performing knitting operations, at least one additional mechanism for performing a special operation, a main cam shaft, pattern control means driven by said main cam shaft, said main cam shaft being arranged to drive said knitting mechanism and said additional mechanism during predetermined periods in dependence on the control by said pattern control means, a high-speed motor connected to rotate said main cam shaft at a relatively high speed, a low-speed motor connected to rotate said main cam shaft at a relatively low speed, a free wheel coupling ar-

ranged in the connections between the low-speed motor and the main cam shaft so that the low-speed motor may rotate the main cam shaft but may not be driven by the main cam shaft when the latter is rotated by the high-speed motor, and switching means controlled by said pattern control means, said switching means being arranged for causing alternate rotations of the main cam shaft by the high-speed motor and by the low-speed motor during predetermined periods in dependence on the control by said pattern control means, and said pattern control means being capable of being set for causing a rotation of the main cam shaft by the high-speed motor substantially during the period of the drive of the knitting mechanism by the main cam shaft, and for causing a rotation of the main cam shaft by the low-speed motor substantially during the period of the drive of the additional mechanism by the main cam shaft.

2. In a knitting machine as claimed in claim 1, said pattern control means being capable of being set for causing a rotation of the main cam shaft by the high-speed motor during the greatest portion of the period of the drive of the knitting mechanism by the main cam shaft, and for causing a rotation of the main cam shaft by the low-speed motor substantially during the period of the drive of the additional mechanism by the main cam shaft and at the beginning of the period of the drive of the knitting mechanism by the main cam shaft.

3. In a knitting machine as claimed in claim 1, said pattern control means being capable of being set for causing a rotation of the main cam shaft by the high-speed motor during the greatest portion of the period of the drive of the knitting mechanism by the main cam shaft, and for causing a rotation of the main cam shaft by the low-speed motor substantially during the period of the drive of the additional mechanism by the main cam shaft and at the end of the period of the drive of the knitting mechanism by the main cam shaft.

4. In a knitting machine as claimed in claim 1, said pattern control means being capable of being set for causing a rotation of the main cam shaft by the high-speed motor during the greatest portion of the period of the drive of the knitting mechanism by the main cam shaft, and for causing a rotation of the main cam shaft by the low-speed motor at the end of the period of the drive of the knitting mechanism by the main cam shaft, during the period of the drive of the additional mechanism by the main cam shaft, and at the beginning of the period of the drive of the knitting mechanism by the main cam shaft.

5. In a knitting machine as claimed in claim 1, said switching means being capable of a substantially simultaneous energizing of the high-speed motor and deenergizing of the low-speed motor for a rotation of the main cam shaft by the high-speed motor, and said switching means being capable of a substantially simultaneous energizing of the low-speed motor and deenergizing of the high-speed motor for a rotation of the main cam shaft by the low-speed motor.

6. In a knitting machine as claimed in claim 1, said switching means including a double-pole magnetic switch, and a limit switch, the poles of said double-pole magnetic switch being electrically connected with said high-speed motor and with said low-speed motor for connecting one of said motors with an electric source in a first position of said double-pole switch and for connecting the other motor with said electric source in a second position of said double-pole switch, said limit switch being controlled by the pattern control means and being electrically connected with said double-pole magnetic switch for an alternate movement of the latter into the first position and into the second position in dependence on the control of the limit switch by the pattern control means.

7. A knitting machine comprising: a knitting mechanism for performing knitting operations, a transfer device for transferring prefabricated fabric blanks onto the needles of the knitting machine, a main cam shaft, pattern control means driven by said main cam shaft, said main cam shaft being arranged to drive said knitting mechanism and said transfer device during predetermined periods in dependence on the control by said pattern control means, a high-speed motor connected to rotate said main cam shaft at a relatively high speed, a low-speed motor connected to rotate said main cam shaft at a relatively low speed, a free wheel coupling arranged in the connections between the low-speed motor and the main cam shaft so that the low-speed motor may rotate the main cam shaft but may not be driven by the main cam shaft when the latter is rotated by the high-speed motor, and switching means controlled by said pattern control means, said switching means being arranged for causing alternate rotations of the main cam shaft by the high-speed motor and by the low-speed motor during predetermined periods in dependence on the control by said pattern control means, and said pattern control means being capable of being set for causing a rotation of the main cam shaft by the high-speed motor substantially during the period of the drive of the knitting mechanism by the main cam shaft, and for causing a rotation of the main cam shaft by the low-speed motor substantially during the period of the drive of the transfer device by the main cam shaft.

8. A knitting machine comprising: a knitting mechanism for performing knitting operations, a thread clamping and cutting device for cutting threads, a main cam shaft, pattern control means driven by said main cam shaft, said main cam shaft being arranged to drive said knitting mechanism and said thread clamping and cutting device during predetermined periods in dependence on the control by said pattern control means, a high-speed motor connected to rotate said main cam shaft at a relatively high speed, a low-speed motor connected to rotate said main cam shaft at a relatively low speed, a free wheel coupling arranged in the connections between the low-speed motor and the main cam shaft so that the low-speed motor may rotate the main cam shaft but may not be driven by the main cam shaft when the latter is rotated by the high-speed motor, and switching means controlled by said pattern control means, said switching means being arranged for causing alternate rotations of the main cam shaft by the high-speed motor and by the low-speed motor during predetermined periods in dependence on the control by said pattern control means, and said pattern control means being capable of being set for causing a rotation of the main cam shaft by the high-speed motor substantially during the period of the drive of the knitting mechanism by the main cam shaft, and for causing a rotation of the main cam shaft by the low-speed motor substantially during the period of the drive of the thread clamping and cutting device by the main cam shaft.

9. A knitting machine comprising: a knitting mechanism for performing knitting operations, a transfer device for transferring prefabricated fabric blanks onto the needles of the knitting machine, a thread clamping and cutting device for cutting threads, a main cam shaft, pattern control means driven by said main cam shaft, said main cam shaft being arranged to drive said knitting mechanism and said transfer device and said thread clamping and cutting device during predetermined periods in dependence on the control by said pattern control means, a high-speed motor connected to rotate said main cam shaft at a relatively high speed, a low-speed motor connected to rotate said main cam shaft at a relatively low speed, a free wheel coupling arranged in the connections between the low-speed motor and the main cam shaft so that the low-speed motor may rotate the main cam shaft but may not

be driven by the main cam shaft when the latter is rotated by the high-speed motor, and switching means controlled by said pattern control means, said switching means being arranged for causing alternate rotations of the main cam shaft by the high-speed motor and by the low-speed motor during predetermined periods in dependence on the control by said pattern control means, and said pattern control means being capable of being set for causing a rotation of the main cam shaft by the high-speed motor substantially during the period of the drive of the knitting mechanism by the main cam shaft, and for causing a rotation of the main cam shaft by the low-speed motor substantially during the period of the drive of the transfer device and of the thread clamping and cutting device by the main cam shaft.

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