Dec. 9, 1947. F. LAMBACH 2,432,110

METHOD FOR THE AUTOMATIC CLAMPING AND CUTTING OF YARN IN A FLAT OR FULL-FASHIONED KNITTING MACHINE AND AN AUTOMATIC MECHANISM FOR CARRYING OUT SAID METHOD

Original Filed Oct. 4, 1939 9 Sheets-Sheet 1

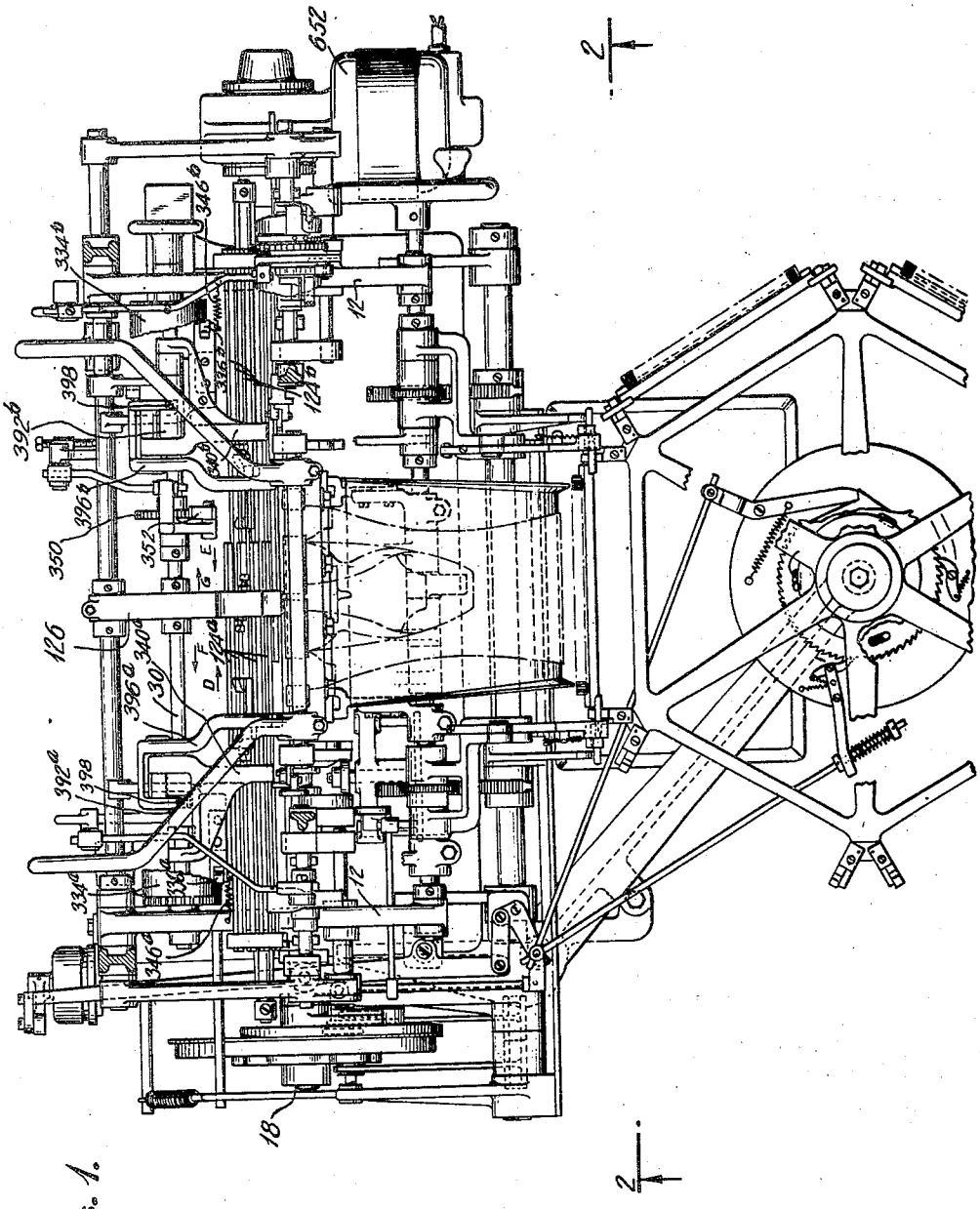


Fig. 1.

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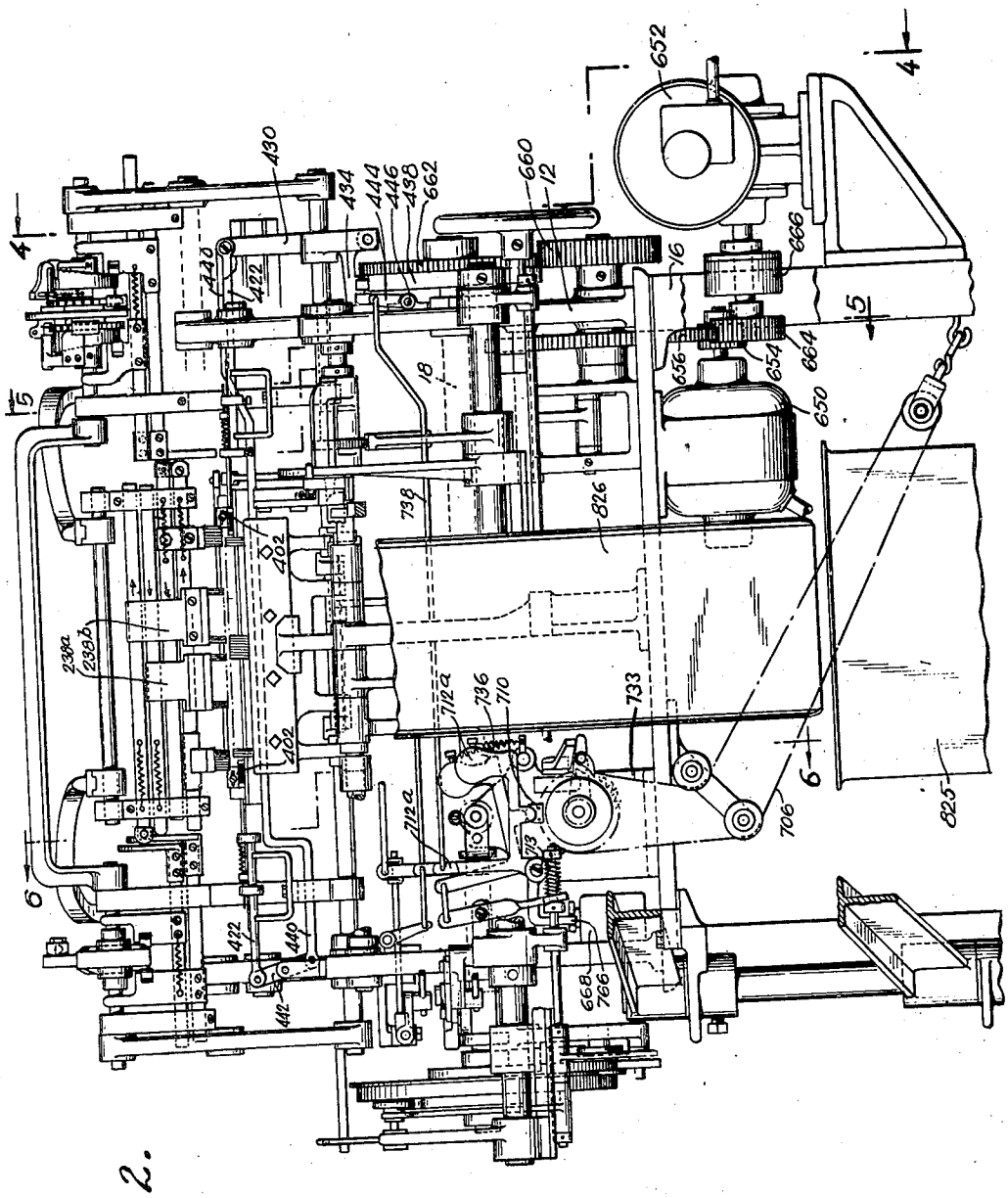


Fig. 2.

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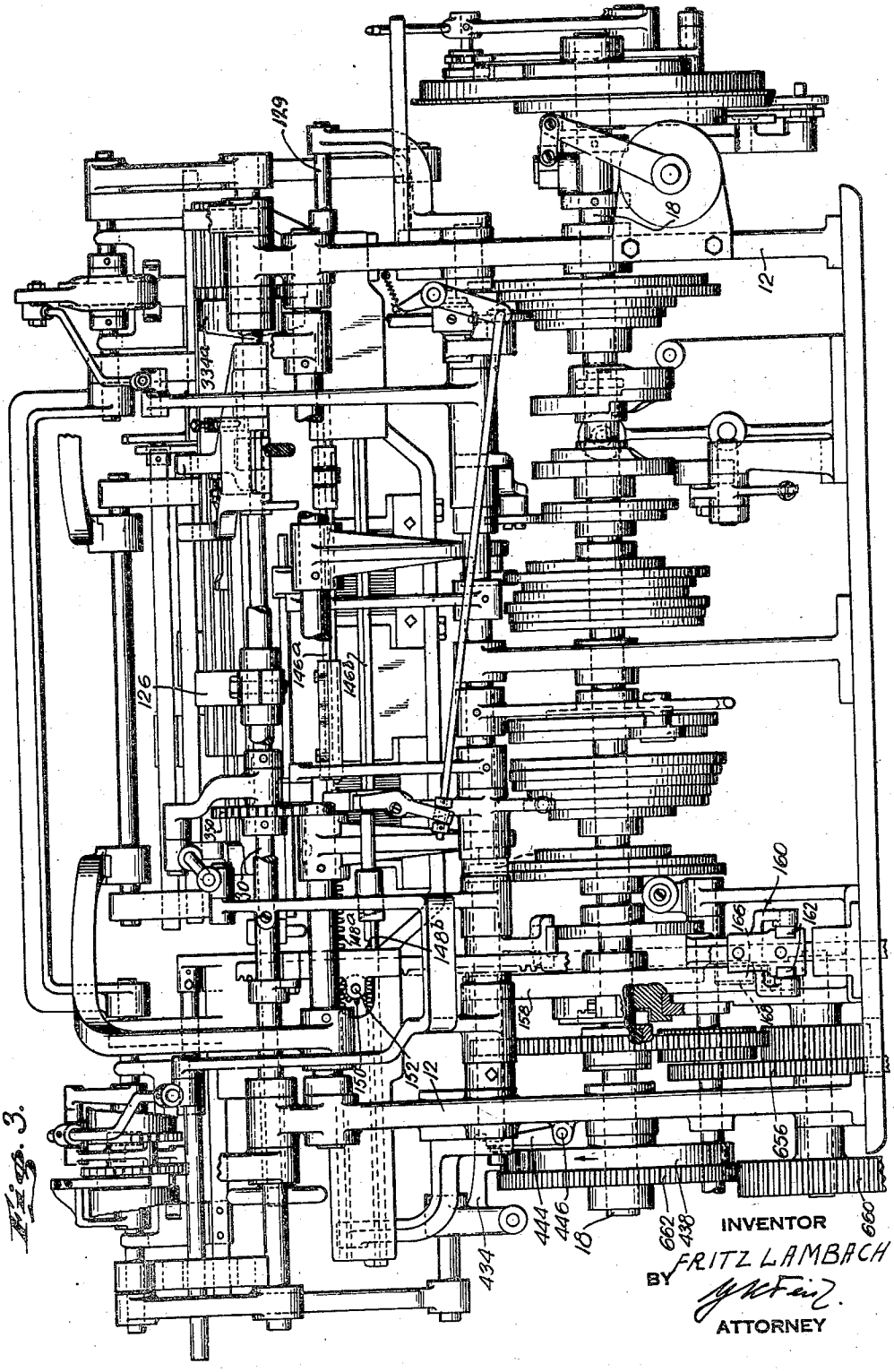


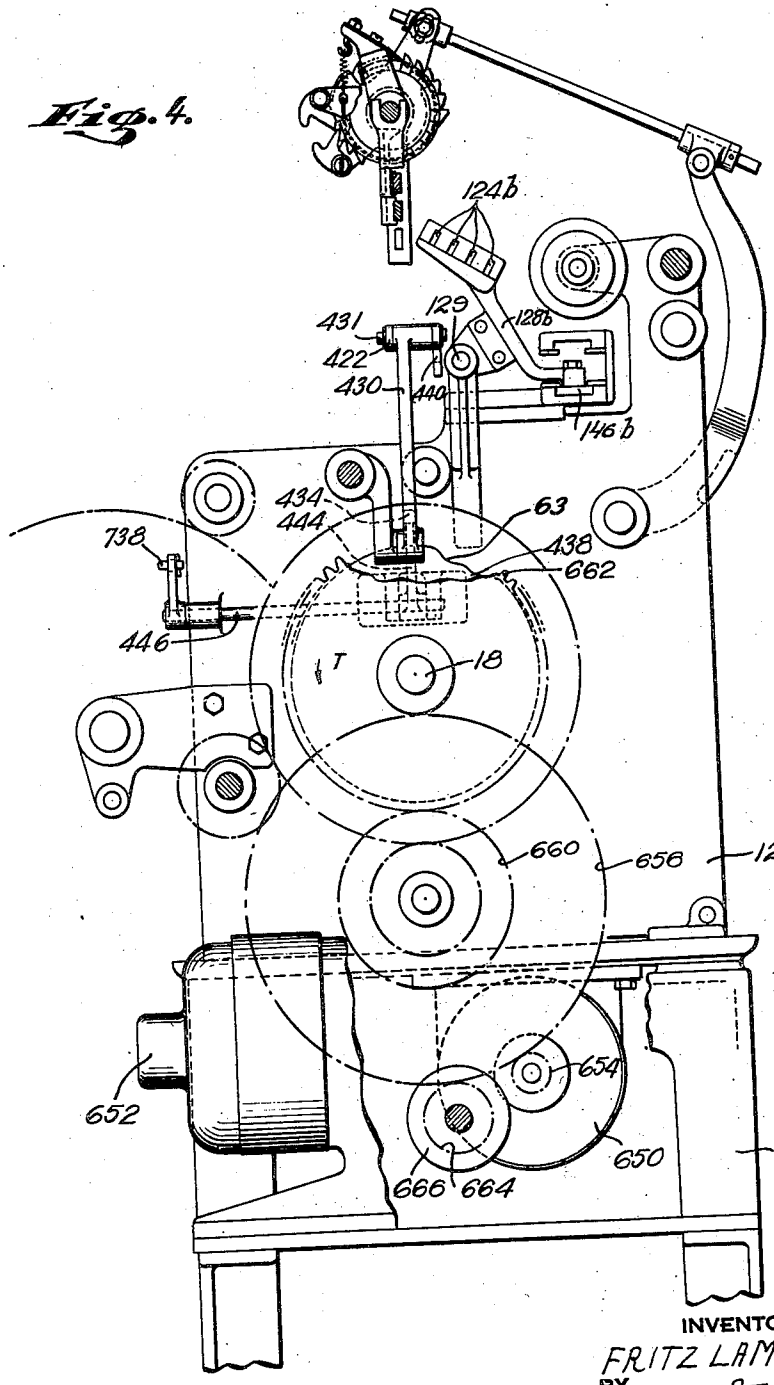
Fig. 3.

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Fig. 4.



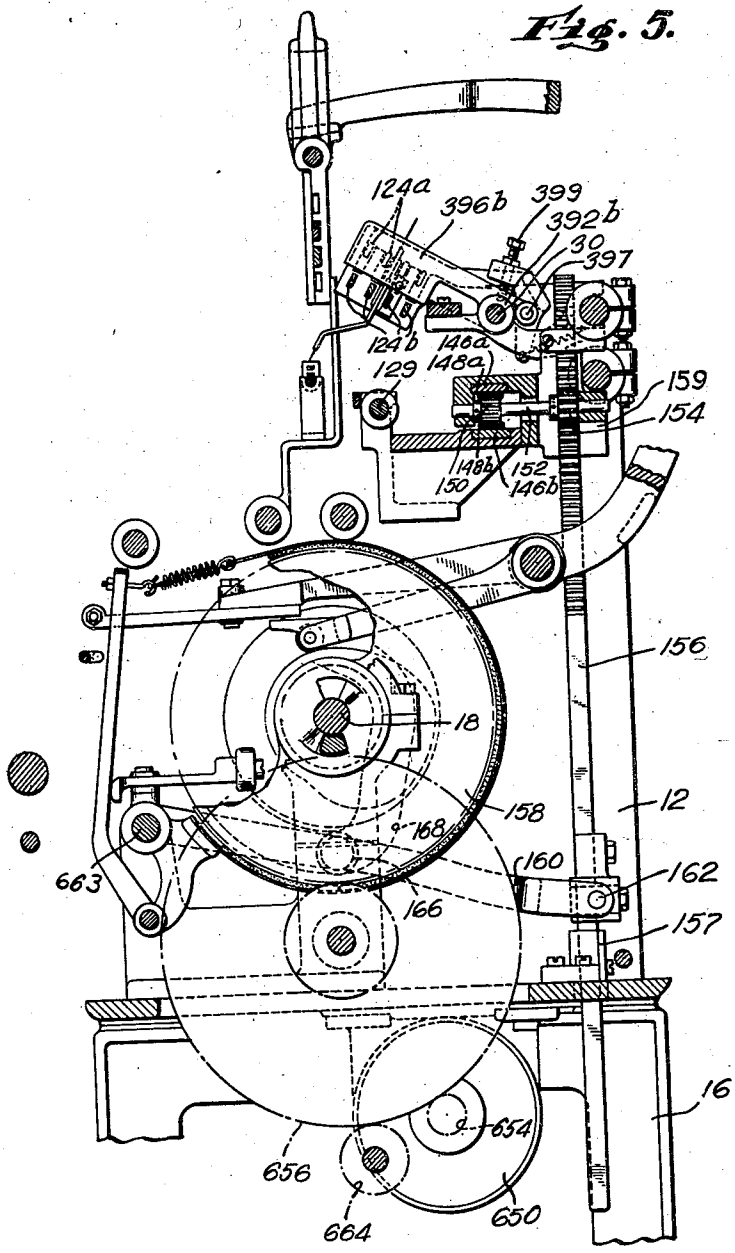
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Fig. 5.



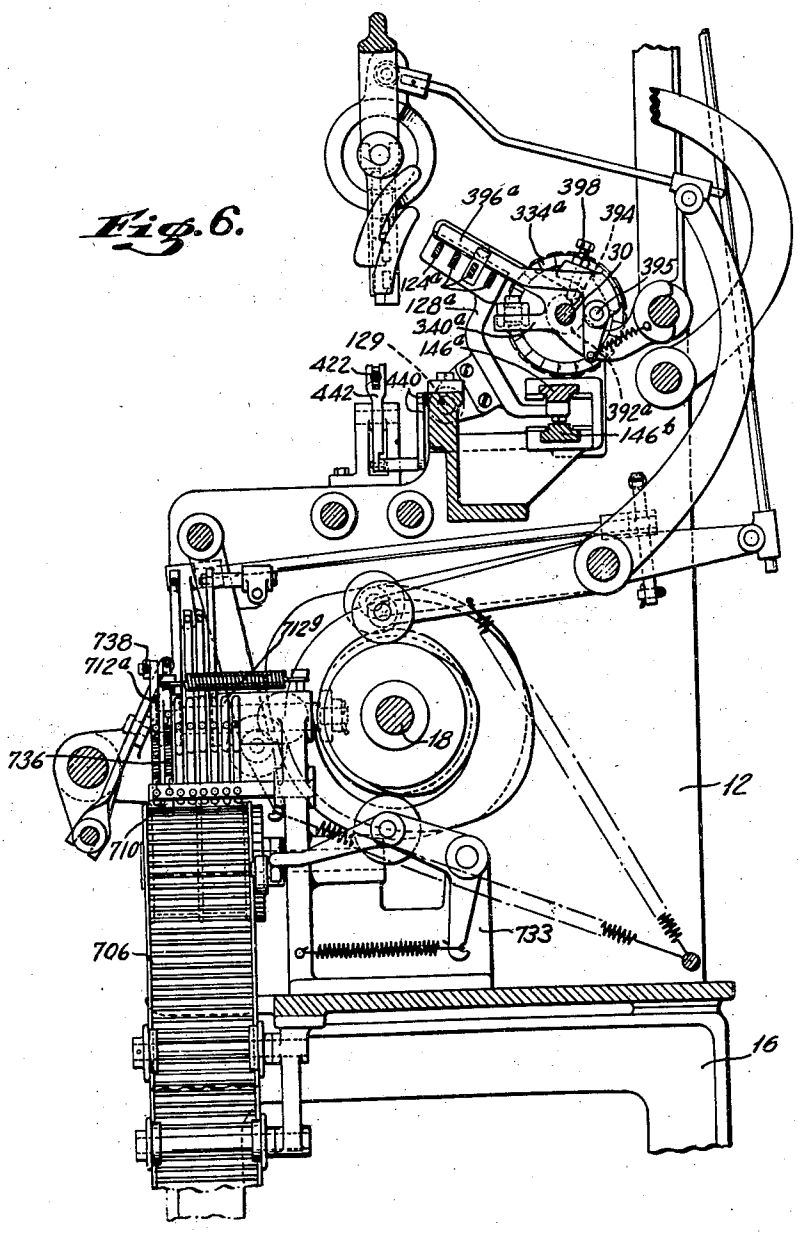
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Fig. 6.



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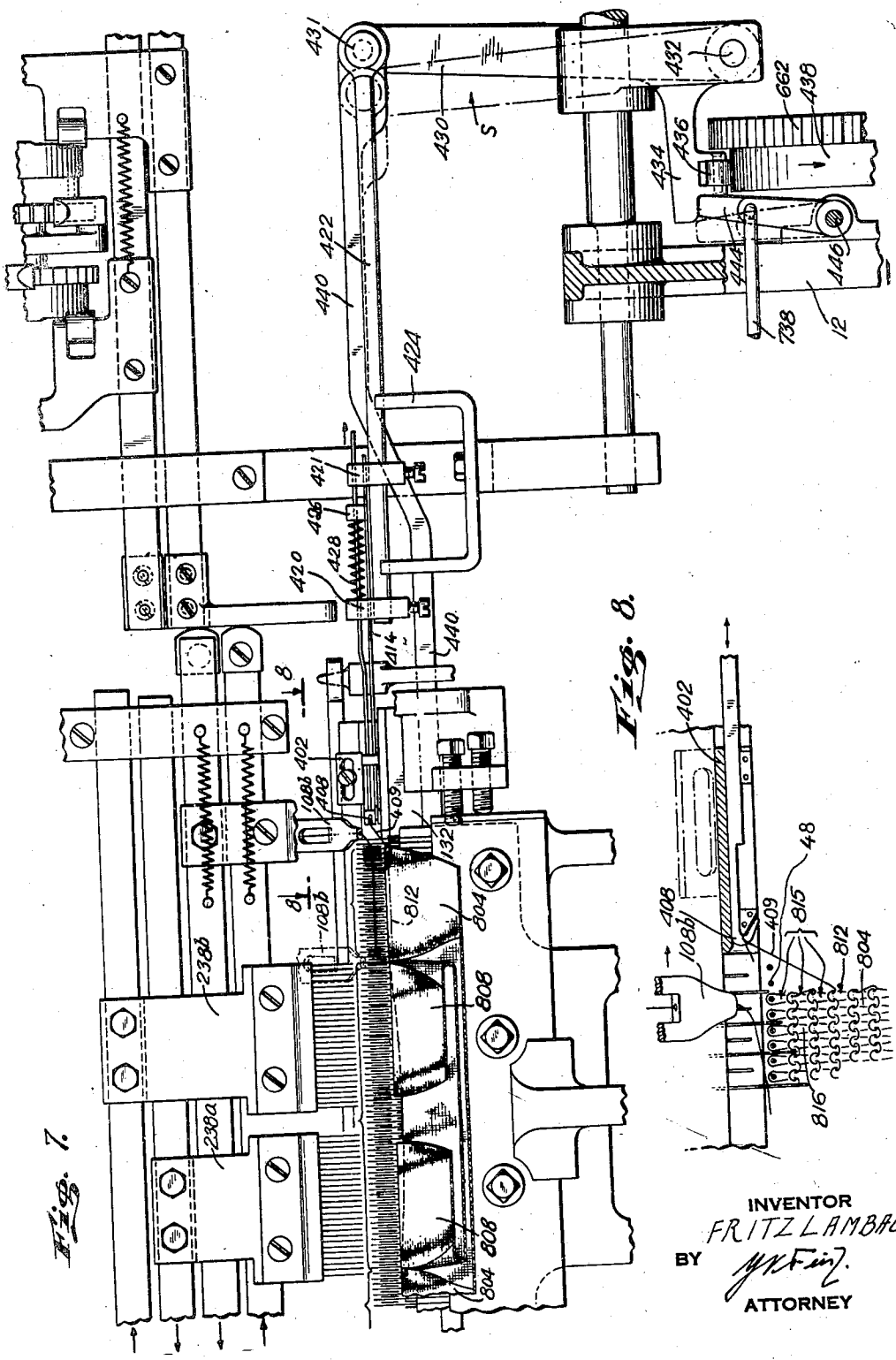


Fig. 7.

Fig. 8.

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Fig. 14.

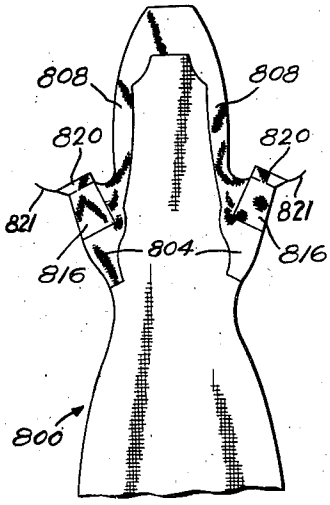


Fig. 9.

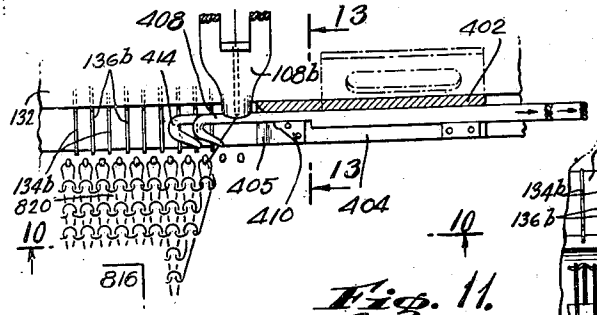


Fig. 10.

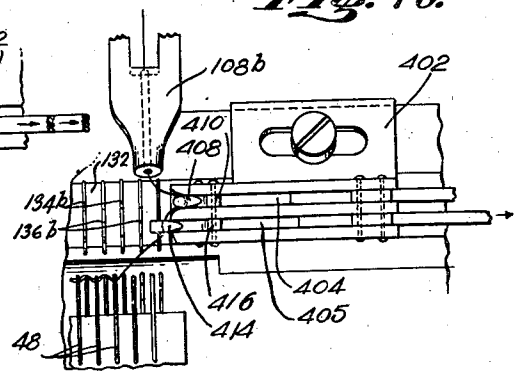


Fig. 11.

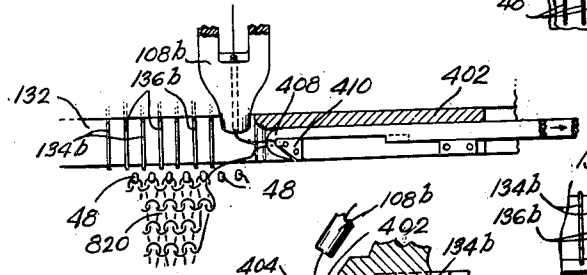


Fig. 12.

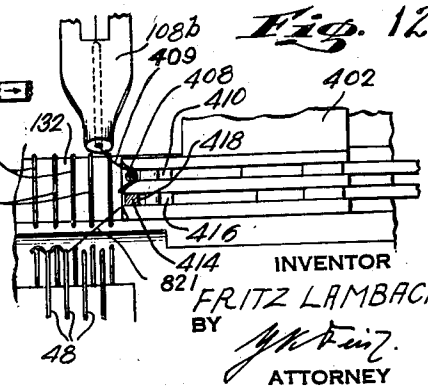
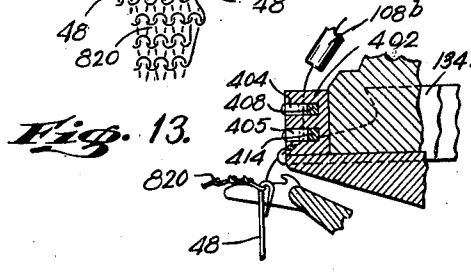


Fig. 13.

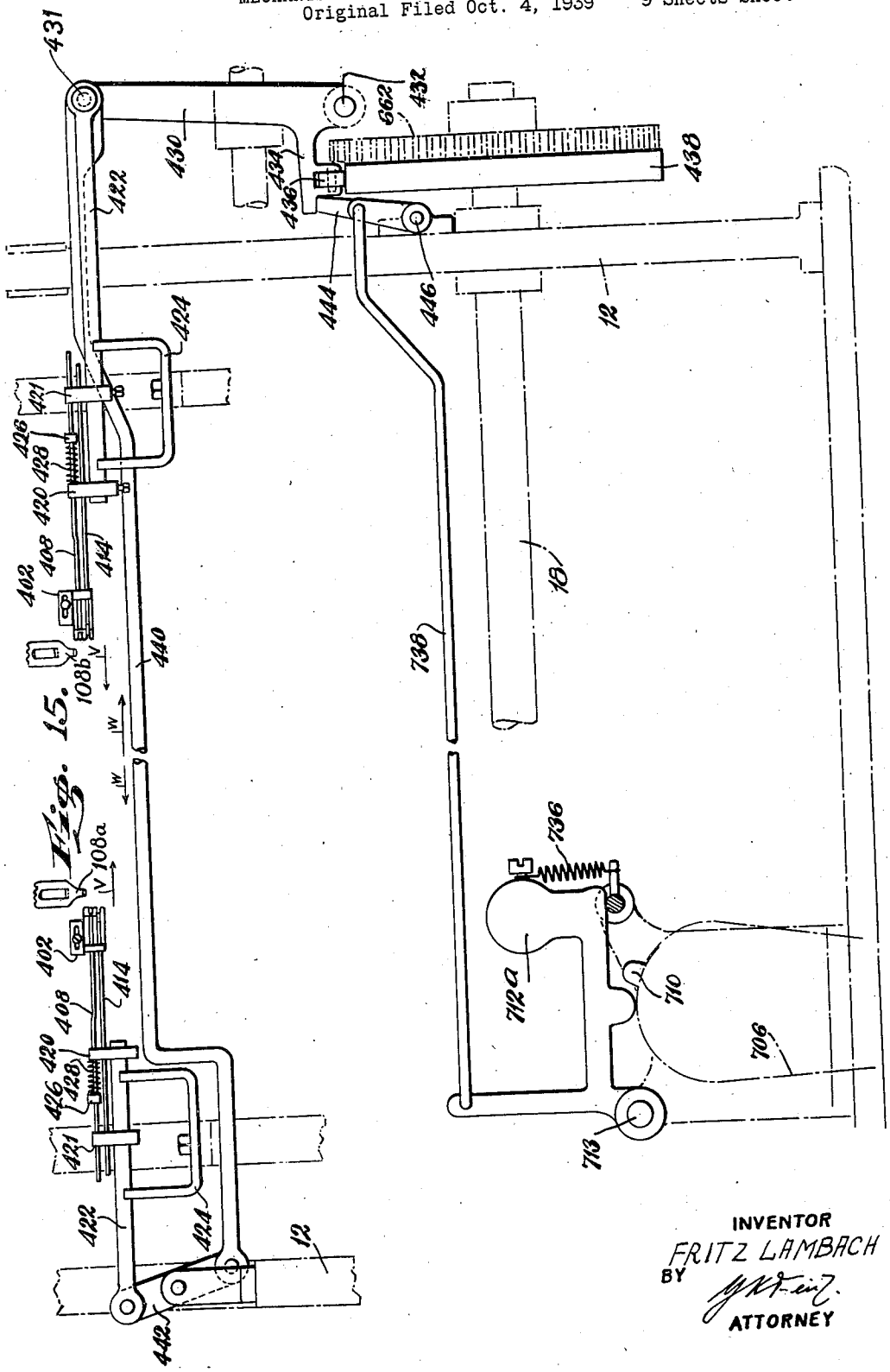


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Original Filed Oct. 4, 1939 9 Sheets-Sheet 9



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Patented Dec. 9, 1947 2,432,110

UNITED STATES PATENT OFFICE

2,432,110

METHOD FOR THE AUTOMATIC CLAMPING AND CUTTING OF YARN IN A FLAT OR FULL-FASHIONED KNITTING MACHINE AND AN AUTOMATIC MECHANISM FOR CARRYING OUT SAID METHOD

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Original application October 4, 1939, Serial No. 297,829, now Patent No. 2,363,008, dated November 21, 1944. Divided and this application August 16, 1944, Serial No. 549,734. In Germany March 6, 1939

42 Claims. (Cl. 66—145)

1

This application is a divisional application divided out of my patent application Ser. #297,829, filed October 4, 1939, for Art of knitting fabric onto prefabricated fabric blanks, now Patent No. 2,363,008.

This invention relates to a method for the automatic clamping and cutting of yarn in a flat or full-fashioned knitting machine and a mechanism for carrying out said method.

An object of the present invention is to provide a method and a mechanism, by means of which the yarn or yarns extending from the yarn carrier or yarn carriers to the fabric may be automatically clamped and cut after the completion of the fabric.

Another object of the invention is to provide a method and a mechanism, by means of which the end or ends of the yarn or yarns extending from the yarn carrier or yarn carriers may be automatically held by clamping means until the knitting of a new fabric has been started.

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 features 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 or full-fashioned 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, and that the automatic clamping and cutting mechanism may be applied to knitting machines of different types as well.

In the drawings:

Fig. 1 is a top plan view of a flat knitting machine equipped with the clamping and cutting mechanism according to the invention, some parts being broken away,

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 a section taken on line 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 an enlarged detail of a part of the knitting section of the flat knitting machine, illustrating the needle bar and the yarn clamping and cutting mechanism,

Fig. 8 is a section taken on line 8—8 of Fig. 7,

Fig. 9 is a view similar to Fig. 8 with the parts in another position,

Fig. 10 is a face elevation of the parts shown in Fig. 9 in the direction of line 10—10 with the parts in another position,

Fig. 11 is a view similar to Figs. 8 and 9 with the parts in still another position,

Fig. 12 is a view similar to Fig. 10 with certain parts in section to illustrate a construction thereof,

Fig. 13 is a section taken on line 13—13 of Fig. 9,

Fig. 14 is a diagrammatic illustration of a combination leg and foot blank with the heel tabs knitted therein, and

Fig. 15 is an enlarged detail of the yarn clamping and cutting mechanism.

In the embodiment shown in the drawings, the automatic clamping and cutting mechanism is arranged on a heel-knitting machine of the flat or full-fashioned knitting machine type, by means of which heel tabs 816 (see Fig. 14) are knitted on to the high heel portions 804 of a prefabricated stocking blank 800 and are at the same time interknitted with the sole portions 808 of said stocking blank.

The knitting machine shown in the drawings comprises a motor 650 (Figs. 1, 2 and 4) for the normal high-speed operation of the knitting machine and a motor 652 for occasional low-speed operation of the knitting machine. Said motors 650 and 652 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 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. Fur-

thermore, a change-over switch 668 (see left half of Fig. 2) controlled by the pattern chain 706 of the knitting machine in a suitable manner is mounted on the frame of the knitting machine. 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. Of course, a manual switch, not shown in the drawings, is provided, by means of which the flow of current to the change-over switch 668 may be interrupted, in order to arrest the knitting machine, if necessary.

Now, the mechanism for clamping and cutting yarn and its controlling mechanism shall be described.

Figs. 2 and 15 show two clamping and cutting devices, one on each side of the needle section, while Fig. 7 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 (see Fig. 13) of the knitting machine 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. 9, 10 and 13) arranged above each other. In each of these horizontal tracks an abutment 410 and 416 respectively is arranged. The hook-like member 408 of the clamping means is slidably arranged in the track 404 for cooperation with the clamping abutment 410, while the hook-like element 414 of the cutting means is slidably arranged in the track 405 for cooperation with the cutting abutment 416. When according to Fig. 9, the hook-like clamping member or clamp 408 and the hook-like cutting element or knife 414 are in a position projecting from the block 402 into the working field of the yarn carrier 108b for catching a thread, the knife projects further toward the center of the section, so that upon return movement of the yarn clamp and the knife in the direction of the arrows shown in Fig. 9, at first the clamp 408 grips the yarn and clamps same against the abutment 410 whereupon the knife 414 grips the thus clamped yarn and severs same. As shown in Fig. 12, all parts of the yarn clamp 408 are round in order to prevent a cutting of the yarn by the clamp, whereas the knife 414 has sharp edges. According to Fig. 7, 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 mounted on the knitting machine and is hinged to a lever 430 at 431. The lever 430 is swingably mounted on the knitting machine at 432. The rod-like end of the yarn 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 yarn 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. 7 by dash and dot lines, the hook-like member 408 of the clamping means is nearer to the block 402 than the hook-like element 414 of the cutting means as already described and shown in Fig. 9. Now, when the lever 430 is swung in the direction of the arrow S in a manner to be described hereinafter, at first the hook-like member 408 of the clamping means abuts against its clamping abutment 410 (Figs. 10 and 11), whereby the yarn gripped by the clamping hook is clamped. Now, the yarn clamping hook is arrested, and a relative movement occurs between the link 422 and the yarn clamping hook 408 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 yarn is tightly held in the clamp. During the continuation of the movement of the lever 430 the hook-like element 414 of the cutting means is also drawn into the block 402, whereby the element 414 grips the yarn and severs same near the sinkers 134b and the dividers 136b of the knitting machine as shown in Fig. 12. The movements of the lever 430 are transmitted to the yarn cutting and yarn clamping device on the opposite side of the section by means of the linkage 440, 442, 422 (Figs. 2, 4, 7 and 15) 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. 12 and 15, in which the hook-like member 408 of the clamping means and the hook-like element 414 of the cutting means are in their normal withdrawn position outside the working field of the yarn carrier 108b.

The drawings illustrate an automatic heel knitting machine equipped with means for an automatic transfer of prefabricated stocking blanks 800 (see Fig. 7) onto the needles 48 of the knitting machine after the termination of a cycle of operations. Such a transfer mechanism is described in detail in my co-pending patent application Ser. #297,829 filed October 4, 1939, now Patent #2,363,008 and my co-pending patent application Ser. #547,765 filed August 2, 1944, now Patent #2,405,583. When according to Fig. 7, a prefabricated stocking blank 800 has been transferred to the needles 48; the yarn clamp 408 still holds the end of the yarn used in the previous cycle of operation, said end now being the beginning portion 409 of the yarn. The dash and dot line 812 shown in Fig. 7 in the high heel 804 shall represent the last course 812 of a high heel portion as shown in full lines in Fig. 8, which, during the transfer by the transfer device of the knitting machine, has been transferred to the needles 48 with the first course of the adjacent sole portion 808 (see Fig. 3). Several courses, for example three, namely the courses 815 of the heel tab 816 (see Fig. 7), are knitted onto this last high heel course 812, while the beginning portion 409 of the yarn 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 tab, as described in detail in my co-pending patent application Ser. #297,829 filed October 4, 1939. As shown in Figs. 7 and 8, the yarn clamp still holds the beginning portion of the yarn during the knitting of the first courses. Now, when after the knitting of the first courses, the yarn carrier has been moved by its driving mechanism from its outer working end position as shown in full lines in Fig. 7 into a position remote from said outer working end position as indicated by dash and dot lines in said Fig. 7, a button 710 on the control chain or pattern chain 706 (Figs. 2 and 15) of the knitting machine, which is intermittently advanced during the operation of the knitting machine in a manner known per se, is engaged with the narrowing jack lever 712a and swings same about the rod 713 carried by the narrowing jack 733 against the action of a spring 736 stretched between the narrowing jack lever 712a and a stationary part of the knitting machine. An arm of the narrowing jack lever 712a is connected with the stop latch 444 by means of a connecting rod 738, so that the above described swinging movement of the narrowing jack lever 712a results in a swinging movement of the stop latch 444 about the pivot 446 from the position shown in Fig. 7 by solid lines into the position shown in the same figure by dash and dot lines. Thus, a roller 436 arranged on the extension 434 of the lever 430 may engage the surface of a control cam 438 (Figs. 2, 4, 7 and 15 keyed to the main cam shaft 18 of the knitting machine. According to Fig. 4, 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 T is continued, the roller 436 comes in engagement with the recess 63 of the cam 438, so that the lever 430 (Fig. 7) is swung into the position shown by dash and dot lines in said figure and the hook-like member 408 of the clamping means is moved toward the center. Thus, the beginning portion of the yarn 409 is released and is disengaged from the clamp. The hook-like element 414 of the cutting means is also moved toward the center, but it cannot catch a yarn, as the yarn carrier is in its innermost end position, as shown by dash and dot lines in Fig. 7. As soon as the roller 436, during the further rotation of the cam 438 through an angle of less than 45°, is disengaged from the recess 63 and cooperates with the adjoining round portion of the cam 438, the hook-like member 408 of the clamping means and the hook-like element 414 of the cutting means are again withdrawn into their position outside the working field of the yarn carrier, without, however, cutting a yarn. Thereupon, when the cam 438 is again in the position shown in Fig. 4, the pattern chain 706 is advanced, so that the button 710 is disengaged from the narrowing jack lever 712a and the latter is returned into its normal position shown in Fig. 15 by the spring 736, whereby the latch 444 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 in Fig. 7. Now, the knitting of the heel tab 816 and the interknitting of the sole portion 810 with the heel tab may be carried out in any suitable manner, for example as described in my co-pending application Ser. #297,829 filed October 4, 1939. As soon as the ravel courses 820 (Fig. 14) are finished, the yarn carriers 108a, 108b (in the embodiment shown in the drawings, the knitting machine has two yarn carriers, one for each half of the needle section) are arrested in the position shown by solid lines in Figs. 7 and 15. This arresting of the yarn carriers is carried out by suitable means controlled by the pattern chain 706 of the knitting machine, for example by stop levers 396a and 396b as set forth hereinafter and as described in detail in my co-pending patent application Ser. #297,829 filed October 4, 1939. Furthermore, approximately at the time of the arresting of the yarn carriers by the stop levers, the narrowing jack lever 712a is again swung about the rod 713 by means of a button on the pattern chain, so that the latch 444 is again brought into the position shown in Fig. 7 by dash and dot lines and the clamping hook 408 and the cutting hook 414 are again moved into the position shown in Fig. 9. Now, however, the hooks 408 and 414 may catch the yarn, as now, on both sides of the section, the yarn carriers 108a, 108b are directly in front of them, depending on the relationship between the actuation of the stop levers 396a, 396b and the latch 444 by the pattern chain 706, said movement of the hooks 408 and 414 taking place, while the yarn carriers are still in their working field or while the yarn carriers are in or near their normal outer working end position. Now, when the hook 408 and the hook 414 are again withdrawn in the direction of the arrows shown in Fig. 9, at first the clamping hook 408 clamps the yarn against the clamping abutment 410 as shown in Figs. 10 and 11, whereupon, according to Fig. 12, the cutting hook 414 severs the yarn at a point between the clamping means and the finished fabric simultaneously with or substantially simultaneously with the stopping of the yarn carriers. Thus, the fabric is automatically pressed off and falls from the trough 826 (Figs. 1 and 2) into the container 825; the fabric has the form shown in Fig. 14, the short ends 821 of the yarn hanging on the ravel courses. On each side of the section the yarn clamp 408 still clamps the end 409 of the yarn protruding from the respective yarn 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 810, as mentioned above, the end of the yarn which is now the beginning portion 409 of the yarn, being not released by the clamp 408. The releasing of the beginning portion of the yarn takes place only after the knitting of these first loop course, as described above. If desired, however, the beginning portion 409 of the yarn could be released already after only one loop course has been knitted or even after only a few new loops have been sunk.

In the embodiment shown in the drawings, the knitting machine is equipped with a mechanism, by means of which the yarn carrier operating in one half of the needle section and the yarn carrier operating in the other half of the needle section are driven in opposite directions. This mechanism is built up in the following manner:

As best shown in Figs. 3 and 5, a roller 166 carried by a lever 160 pivotally mounted at 663 is engaged with the cam path 168 of a draw cam 158 mounted on the main cam shaft 18. The free end of the lever 160 is forked and pivoted to a rack 156 at 162. Said rack 156 is slidably arranged in the bearings 157, 159. The upper end of said

rack, which is reciprocated by means of the lever 160 during the operation of the draw cam, meshes with a pinion 154 keyed to a shaft 152. A second pinion 150 keyed to said shaft 152 is in engagement with the rack 148a arranged on the upper slur cock bar 146a, and with the rack 148b arranged on the lower slur cock bar 146b, so that said two slur cock bars are reciprocated in opposite directions with respect to each other. Said slur cock bars cause a movement of the sinkers 134a and 134b during the operation of the knitting machine as described in my co-pending patent application Ser. #297,829 filed October 4, 1939.

According to Fig. 6, a bow 128a is secured to the upper slur cock bar 146a and is guided by a rod 129 firmly fixed to the machine frame. Said bow 128a follows the reciprocating movements of the upper slur cock bar 146a. The upper thread carrier rails 124a are secured to the upper end of the bow 128a and are guided by a stationary holder 126 arranged in the middle of the knitting machine. The upper yarn carrier rails follow the reciprocating movements of the bow 128a.

According to Fig. 4, a second bow 128b is fastened to the lower slur cock bar 146b and is likewise guided by the rod 129 during its reciprocating movements caused by the slur cock bar. On the upper end of the bow 128b the lower yarn carrier rails 124b are fastened, which likewise are guided by the stationary holder 126.

The yarn carriers 108a, 108b are mounted on the upper and lower yarn carrier rails 124a, 124b. Said yarn carriers 108a, 108b are shiftable on the yarn carrier rails, but they are held on the yarn carrier rails by means of springs in such a manner, that they follow the reciprocating movements of the yarn carrier rails and are only arrested when they abut against the holder 126 (Fig. 1) limiting the inner stroke or against stop elements 340a and 340b which limit the outer stroke and are adjustable by means of limiting dics 334a and 334b secured to the yarn carrier spindle 30, or when the stop levers 396a, 396b (Figs. 1 and 6) drop into the path of the yarn carriers, whereupon the yarn carrier rails are moved relatively to the arrested yarn carriers riding thereon.

As mentioned above, the two limiting discs 334a and 334b are secured to the yarn carrier spindle 30 (Figs. 1 and 6). These limiting discs cooperate with the spring actuated limiting elements 340a and 340b, which are slidably mounted on the yarn carrier spindle in longitudinal direction. These limiting elements carry rollers 336a and 336b, which are pressed against the steps of the limiting discs by the springs 346a and 346b. When, during the automatic feed motion of the yarn carrier spindle 30 by the pawl 352 cooperating with the ratchet wheel 350 as described in my co-pending patent application Ser. #297,829 filed October 4, 1939, the height of the respective steps of the limiting discs 334a and 334b contacting the limiting elements 340a and 340b becomes greater than the height of the preceding steps, the limiting elements 340a and 340b are shifted in the direction of the arrows D and E, whereby the stroke of the yarn carriers is reduced. When, during the knitting of the ravel courses and the continued feed motion of the yarn carrier spindle 30, the height of the respective steps of the limiting discs 334a and 334b contacting the limiting elements 340a and 340b becomes smaller than the height of the preceding steps, the spring actuated limiting elements 340a and 340b follow the steps in the direction of the arrows F and G, whereby finally the stroke of the yarn carriers is readjusted to the value at the beginning of the knitting operation as required for the knitting of a new heel tab in the next cycle of operation.

Furthermore, on each side of the knitting machine a sleeve 392a and 392b respectively (Figs. 1 and 6) is arranged on the yarn carrier spindle 30 by means of a slot and key connection between the two arms of the limiting element 340a and 340b respectively. Thus, each sleeve may be shifted on the yarn carrier spindle 30 in longitudinal direction but cannot be rotated thereon, so that a shifting of the limiting elements 340a and 340b respectively causes a shifting of the sleeves 392a and 392b on the yarn carrier spindle 30 and a feed motion of the yarn carrier spindle 30 results in an equal feed motion of the sleeves 392a and 392b. Each sleeve has a notch on one place of its periphery; for example, the sleeve 392a has a notch 394 as shown in Fig. 6. Furthermore, on each side of the knitting machine, a stop lever 396a or 396b respectively is loosely mounted on a pivot 395 or 397 (Figs. 5 and 6) attached to the limiting element 340a or 340b respectively. Each stop lever has an adjustable pin 398 or 399 respectively, the projecting end of which slides along the periphery of the sleeve 392a or 392b respectively when the yarn carrier spindle 30 is advanced. The sleeves are secured to the yarn carrier spindle 30 in such a way that upon the last feed motion of the yarn carrier spindle 30, after completion of the ravel courses, the pin falls into the notch, as shown for example in Fig. 6, wherein the pin 398 is engaged with the notch 394. Thus the stop levers 396a and 396b, which are outside the path of the yarn carriers 108a, 108b as long as the pin 398 or 399 respectively slides along the periphery of the sleeve 392a or 392b respectively during the knitting operations of the knitting machine, drop into the path of the yarn carriers and arrest same, as soon as the pin 398 and 399 come in engagement with the notch on the respective sleeve. When, later on, in a new cycle of operation, a new feed motion of the yarn carrier spindle 30 is started, the pins are automatically lifted out of the notches and the stop levers 396a and 396b are brought out of the path of the yarn carriers. The described automatic arresting of the yarn carriers in combination with the described automatic cutting of the yarns causes the automatic pressing off of the finished fabric and the dropping thereof into the container 825.

In the foregoing paragraphs, the mechanism is described, by means of which the yarn carrier 108a operating in one half of the needle section and the yarn carrier 108b operating in the other half of the needle section are driven in opposite directions. Accordingly, the yarn carriers 108a, 108b are moved in such a way, that, when laying yarns, they move either toward each other from the outside toward the center (see arrows V in Fig. 15) or away from each other from the center to the outside (see arrows W in Fig. 15). Therefore, at the end of a stroke, the yarn 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 yarns by means of the two cutting devices on both sides of the section.

As will be readily understood, the pattern control means of the knitting machine may be set in

such a manner, that the mechanism described in the foregoing paragraphs causes a reciprocating movement of the hook-like member 408 of the clamping means and of the hook-like element 414 of the cutting means into and away from the working field of the yarn carriers, when the yarn carriers are in or near their normal outer working end position as shown in Fig. 7, and when 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. 9.

As described above, the knitting machine has a motor 650 (Figs. 1, 2 and 4) for the normal high-speed operation of the main cam shaft 18 and a motor 652 for an occasional low-speed operation of the main cam shaft. Said motors are controlled by the change-over switch 668. Preferably, shortly before the actuation of the yarn clamping and cutting device to clamp and cover a yarn or yarns, the high-speed motor 650 is automatically switched off and the low-speed motor 652 is automatically switched on by the change-over switch 668, so that the cam shaft 18 driving the yarn clamping and cutting device through the cam 438 rotates at a comparatively low speed during the mechanical clamping and cutting operations. The change-over switch 668 is controlled by the pattern chain 706 through the medium of a narrowing jack lever 712g which is shown in Fig. 6 but cannot be seen in Fig. 2 owing to its arrangement in a plane behind the narrowing jack lever 712a, and which is connected with the change-over switch 668 by a suitable link connection 766 shown in Fig. 2. Preferably, the low-speed motor remains in operation until, after the transfer of a new prefabricated stocking blank, the first courses 815 (Fig. 8) of the new fabric (new heel tab) have been knitted on to the high heel portion and interknitted with the sole portion and the end of the yarn has been released by the yarn-clamp 408. Thereupon, the change-over switch 668 is again actuated by its narrowing jack lever controlled by the pattern chain, so that the low-speed motor 652 is switched off and the high-speed motor 650 is switched on again for the normal high speed operation of the knitting machine.

The drawings shown an automatic yarn cutting mechanism arranged on a knitting machine having only one needle section. Of course, a similar yarn cutting mechanism could also be used in combination with a knitting machine having several needle sections.

Whereas in the specification and drawings the yarn clamping and cutting mechanism has been described in connection with a heeling machine, of course, the yarn clamping and cutting mechanism may also be applied to different knitting machines, for example footing machines, and may also be used for the clamping and cutting of yarns extending from a yarn carrier or carriers to a fabric other than a stocking blank. The yarn clamping and cutting mechanism may be used in connection with any flat knitting machine for use in the severing of the finished fabric from the knitting machine and for the starting of a new fabric.

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 flat knitting machine comprising: a knitting mechanism including at least one needle section and at least one yarn carrier, automatic means for reciprocating said yarn carrier between the end positions of its working field along needles of the needle section, at least one yarn clamping means, said yarn clamping means including a clamping abutment arranged adjacent the end of the needle section near the outer working end position of the yarn carrier and a reciprocable gripping element arranged for movement into and away from the working field of the yarn carrier for catching yarn and clamping same against said clamping abutment, and automatic means for reciprocating said gripping element at predetermined moments.

2. A flat knitting machine comprising: a knitting mechanism including at least one needle section and at least one yarn carrier, automatic means for reciprocating said yarn carrier between the end positions of its working field along needles of the needle section, at least one yarn clamping means, said yarn clamping means including a clamping abutment arranged adjacent the end of the needle section near the outer working end position of the yarn carrier and a reciprocable gripping element arranged for movement into and away from the working field of the yarn carrier for catching yarn and clamping same against said clamping abutment, at least one yarn cutting means arranged adjacent the end of the needle section for cutting yarn held by said clamping means, and automatic means for actuating said gripping element and said yarn cutting means at predetermined moments.

3. A flat knitting machine comprising: a knitting mechanism including at least one needle section and at least one yarn carrier, automatic means for reciprocating said yarn carrier between the end positions of its working field along needles of the needle section, at least one yarn clamping means, said yarn clamping means including a clamping abutment arranged adjacent the end of the needle section near the outer working end position of the yarn carrier and a reciprocable gripping element arranged for movement into and away from the working field of the yarn carrier for catching yarn and clamping same against said clamping abutment, at least one yarn cutting means, said yarn cutting means including a cutting abutment arranged adjacent the end of the needle section near the outer working end position of the yarn carrier and a reciprocable hook-like cutting element arranged for movement into and away from the working field of the yarn carrier for catching yarn extending between the gripping element and the fabric hanging on the needles and for cutting said yarn by cooperation with said cutting abutment, and automatic means for actuating said gripping element and said hook-like cutting element at predetermined movements.

4. In combination with a flat knitting machine as claimed in claim 3, adjusting means for setting the clamping abutment and the cutting abutment in a predetermined position relative to the end of the needle section.

5. A flat knitting machine comprising: a knitting mechanism including at least one needle section and at least two yarn carriers for each needle section, means for reciprocating said two yarn carriers simultaneously in opposite directions along the needles of said needle section, each yarn carrier being arranged for reciprocating between an outer and an inner working end position of its working field, two yarn clamping means for each needle section, one yarn clamping means being

arranged near each end of the needle section for gripping and clamping yarn extending from one of said yarn carriers, two yarn cutting means for each needle section, one yarn cutting means being arranged near each end of the needle section for cutting yarn held by the associated clamping means, a mechanism for a simultaneous actuation of the two yarn clamping means associated with a needle section, a mechanism for a simultaneous actuation of the two yarn cutting means associated with a needle section, and automatic means for actuating said mechanisms for the actuation of the yarn clamping means and the yarn cutting means at predetermined moments.

6. In a flat knitting machine as claimed in claim 5, each yarn clamping means including a clamping abutment arranged adjacent the end of the needle section near the outer working end position of the yarn carrier and a reciprocable gripping element arranged for movement into and away from the working field of the yarn carrier for catching yarn and clamping same against said clamping abutment, and each yarn cutting means including a cutting abutment arranged adjacent the end of the needle section near the outer working end position of the yarn carrier and a reciprocable hook-like cutting element arranged for movement into and away from the working field of the yarn carrier for catching yarn extending between the gripping element and the fabric hanging on the needles and for cutting said yarn by cooperation with said cutting abutment.

7. A flat knitting machine comprising: a knitting mechanism including at least one needle section and at least one reciprocable yarn carrier, at least one yarn clamping means, said yarn clamping means including a clamping abutment arranged near one end of the needle section and a reciprocable gripping element arranged for movement into and away from the working field of the yarn carrier, at least one yarn cutting means arranged near said end of the needle section for cutting yarn held by the clamping means, a rotatable main cam shaft, pattern control means operatively connected with said main cam shaft, said main cam shaft being arranged to actuate said knitting mechanism and said yarn clamping means in dependence on the control by said pattern control means, said pattern control means being capable of being set for causing a movement of said gripping element into the working field of the yarn carrier substantially at the end of the knitting of the fabric and for causing a subsequent movement of said gripping element away from said working field of the yarn carrier so as to catch yarn and clamp same against said clamping abutment, and actuating means associated with said yarn cutting means for actuating same so as to sever the yarn held by the clamping means.

8. A flat knitting machine comprising: a knitting mechanism including at least one needle section and at least one yarn carrier, at least one yarn clamping means arranged near one end of the needle section for gripping and clamping yarn extending from the yarn carrier, said clamping means including a clamping abutment arranged outside the working field of the yarn carrier and a reciprocable gripping element, means associated with said reciprocable gripping element for normally holding same outside the working field of the yarn carrier against said clamping abutment, at least one yarn cutting means arranged near said end of the needle section for cutting yarn held by the clamping means, a rotatable main cam shaft, pattern control means operatively connected with said main cam shaft, said main cam shaft being arranged to actuate said knitting mechanism and said reciprocable gripping element in dependence on the control by said pattern control means, said pattern control means being capable of being set for causing a reciprocation of the gripping element by the main cam shaft along the needles into the working field of the yarn carrier and away therefrom at predetermined moments, and actuating means associated with said cutting means for actuating same so as to sever yarn held between the gripping element and the clamping abutment.

9. In a flat knitting machine as claimed in claim 8, a cam mounted on said main cam shaft for driving said gripping element, said cam being shaped so as to cause a reciprocation of said gripping element during a rotation of said main cam shaft through an angle of less than 45°.

10. In a flat knitting machine as claimed in claim 8, said knitting mechanism including a plurality of sinkers and dividers, said pattern control means being capable of being set for causing said reciprocation of the gripping element when said sinkers and dividers controlled by the pattern control means are in their withdrawn position and the needles of the knitting mechanism are in their knocking-over position.

11. In a flat knitting machine as claimed in claim 8, said pattern control means being capable of being set for causing a reciprocation of the gripping element for catching and subsequently holding yarn against the clamping abutment substantially at the end of a knitting operation while the yarn carrier of the knitting mechanism controlled by the pattern control means is in its working field.

12. In a flat knitting machine as claimed in claim 8, said pattern control means being capable of being set for causing a reciprocation of the gripping element for catching and subsequently holding yarn against the clamping abutment substantially at the end of a knitting operation while the yarn carrier of the knitting mechanism controlled by the pattern control means is substantially in its outer working end position.

13. In a flat knitting machine as claimed in claim 8, said pattern control means being capable of being set for causing a reciprocation of the gripping element for releasing yarn after the start of a knitting operation when the yarn carrier of the knitting mechanism controlled by the pattern control means is remote from its outer normal working end position.

14. A flat knitting machine comprising: a knitting mechanism including at least one needle section and at least one reciprocable yarn carrier, at least one yarn clamping means, said yarn clamping means including a clamping abutment arranged near one end of the needle section and a reciprocable gripping element arranged for movement into and away from the working field of the yarn carrier, at least one yarn cutting means arranged near said end of the needle section for cutting yarn held by the clamping means, a rotatable main cam shaft, and pattern control means operatively connected with said main cam shaft, said main cam shaft being arranged to actuate said knitting mechanism said yarn clamping means and said yarn cutting means in dependence on the control by said pattern control means, and said pattern control means being capable of being set for causing a movement of said gripping element into the working field of the

yarn carrier substantially at the end of the knitting of the fabric and for causing a subsequent movement of said gripping element away from said working field of the yarn carrier so as to catch yarn and clamp same against said clamping abutment and for causing an actuation of the yarn cutting means so as to sever the yarn after being clamped by the clamping means.

15. A flat knitting machine comprising: a knitting mechanism including at least one needle section and at least one yarn carrier, at least one yarn clamping means arranged near one end of the needle section for gripping and clamping yarn extending from the yarn carrier, said clamping means including a clamping abutment arranged outside the working field of the yarn carrier and a reciprocable gripping element, means associated with said reciprocable gripping element for normally holding same outside the working field of the yarn carrier against said clamping abutment, at least one yarn cutting means arranged near said end of the needle section for cutting yarn held by the clamping means, said cutting means including a cutting abutment arranged outside the working field of the yarn carrier and a reciprocable hook-like cutting element capable of cooperation with said cutting abutment for severing a yarn, means associated with said reciprocable hook-like element for normally holding same outside the working field of the yarn carrier, a rotatable main cam shaft, and pattern control means operatively connected with said main cam shaft, said main cam shaft being arranged to actuate said knitting mechanism said gripping element and said hook-like element in dependence on the control by said pattern control means, and said pattern control means being capable of being set for causing a reciprocation of the gripping element and of the hook-like cutting element by the main cam shaft along the needles into the working field of the yarn carrier and away therefrom at predetermined moments.

16. In a flat knitting machine as claimed in claim 15, cam means mounted on said main cam shaft for driving said gripping element and said hook-like cutting element, said cam means being shaped so as to cause a reciprocation of said gripping element and of said hook-like cutting element during a rotation of said main cam shaft through an angle of less than 45°.

17. In a flat knitting machine as claimed in claim 15, a reciprocable actuating mechanism operatively connected with said gripping element and said hook-like cutting element, and a cam mounted on the main cam shaft for engagement with said actuating mechanism, said gripping element and said hook-like cutting element being in such a relationship to each other that, at the end of their inward movements towards the center of the needle section, the hook-like cutting element is nearer to the center of the needle section than the gripping element whereby, during their subsequent outward movements, the clamping means grips and clamps the yarn before the cutting means severs same.

18. In a flat knitting machine as claimed in claim 15, said knitting mechanism including a plurality of sinkers and dividers, said pattern control means being capable of being set for causing the reciprocation of the gripping element and the hook-like cutting element when said sinkers and dividers controlled by the pattern control means are in their withdrawn position and the needles of the knitting mechanism are in their knocking-over position.

19. In a flat knitting machine as claimed in claim 15, said pattern control means being capable of being set for causing a reciprocation of the gripping element and of the hook-like cutting element substantially at the end of a knitting operation while the yarn carrier of the knitting mechanism controlled by the pattern control means is substantially in its outer working end position, and for causing a severing of the yarn by the yarn cutting means substantially simultaneously with the arresting of the yarn carrier.

20. In combination with a flat knitting machine as claimed in claim 14, said pattern control means being capable of being set for causing an uninterrupted clamping of the yarn against the clamping abutment after the cutting of the yarn until a new cycle of knitting operations for knitting a new fabric has been started.

21. In a flat knitting machine as claimed in claim 14, said pattern control means being capable of being set for continuing the clamping of the yarn against the clamping abutment after the cutting of the yarn and for causing a further reciprocation of the gripping element for releasing the yarn after the start of a new cycle of knitting operations.

22. In a flat knitting machine as claimed in claim 14, said pattern control means being capable of being set for causing a further reciprocation of the gripping element for releasing the yarn clamped upon the previous reciprocation of the gripping element when, after the start of a new cycle of knitting operations, the yarn carrier of the knitting mechanism controlled by the pattern control means is remote from its outer normal working end position.

23. A flat knitting machine comprising: a knitting mechanism including at least one needle section and at least two yarn carriers for each needle section, means for reciprocating said two yarn carriers simultaneously in opposite directions along the needles of said needle section, two yarn clamping means for each needle section, one yarn clamping means being arranged near each end of the needle section for gripping and clamping yarn extending from one of said yarn carriers, two yarn cutting means for each needle section, one yarn cutting means being arranged near each end of the needle section for cutting yarn held by the associated clamping means, a mechanism for a simultaneous actuation of the two yarn clamping means associated with a needle section, a mechanism for a simultaneous actuation of the two yarn cutting means associated with a needle section, a rotatable main cam shaft, and pattern control means operatively connected with said main cam shaft, said main cam shaft being arranged to actuate said knitting mechanism and said mechanisms for the actuation of the yarn clamping means and the yarn cutting means in dependence on the control by said pattern control means, and said pattern control means being capable of being set for causing a gripping and subsequent clamping of the yarns by the yarn clamping means substantially at the end of the knitting of the fabric and for causing an actuation of the yarn cutting means so as to sever the yarns after being clamped by the clamping means.

24. In combination with a flat knitting machine as claimed in claim 23, said pattern control means being capable of being set for causing an uninterrupted clamping of the yarns extending from the yarn carriers by the yarn clamping means after the cutting of the yarns until a new

cycle of knitting operations for knitting a new fabric has been started.

25. A method for the automatic clamping and cutting of yarn in a flat knitting machine equipped with an automatically operated knitting mechanism, comprising the steps of knitting a fabric, then, substantially at the end of the knitting of the fabric, gripping yarn between an active yarn carrier and the fabric by moving automatically operated means parallel to the needle series into and away from the working field of the yarn carrier for a subsequent clamping and cutting of the yarn in timed relationship to the operation of the knitting machine, clamping the yarn, cutting the yarn, and continuing the clamping of the end of the yarn extending from the yarn carrier until a new cycle of operation for the knitting of a new fabric has been started.

26. A method for the automatic clamping and cutting of yarn in a flat knitting machine as claimed in claim 25, wherein the gripping of yarn takes place while the yarn carrier is within in its working field.

27. A method for the automatic clamping and cutting of yarn in a flat knitting machine as claimed in claim 25, wherein the gripping of yarn takes place, when the yarn carrier is substantially in its normal outer working end position.

28. A method for the automatic clamping and cutting of yarn in a flat knitting machine equipped with an automatically operated knitting mechanism including a plurality of sinkers and dividers as claimed in claim 25, wherein the gripping of yarn takes place, when the sinkers and dividers are in their withdrawn position and the needles are in their knocking-over position.

29. A method for the automatic clamping and cutting of yarn in a flat knitting machine equipped with an automatically operated knitting mechanism including a plurality of sinkers and dividers as claimed in claim 25, wherein the gripping of yarn and the subsequent cutting thereof takes placing during a rotation of the main cam shaft of the knitting machine through an angle of less than 45°.

30. A method for the automatic clamping and cutting of yarn in a flat knitting machine as claimed in claim 25, wherein the cutting of yarn takes place substantially simultaneously with the arresting of the yarn carrier.

31. A method for the automatic clamping and cutting of yarn in a flat knitting machine as claimed in claim 25, wherein the clamping of the end of the yarn extending from the yarn carrier is continued until new loops of the new fabric have been sunk.

32. A method for the automatic clamping and cutting of yarn in a flat knitting machine as claimed in claim 25, wherein the clamping of the end of the yarn extending from the yarn carrier is continued until at least one loop course of the new fabric has been knitted.

33. A method for the automatic clamping and cutting of yarn in a flat knitting machine equipped with an automatically operated knitting mechanism including a main cam shaft as claimed in claim 25, wherein, after the start of a new cycle of operation of the knitting machine, the end of the yarn extending from the yarn carrier is released during a rotation of the main cam shaft of the knitting machine through an angle of less than 45° while the active yarn carrier is in a position remote from its outer normal working end position.

34. A method for the automatic clamping and cutting of yarn in a flat knitting machine equipped with an automatically operated knitting mechanism, comprising the steps of knitting a fabric, then, substantially at the end of the knitting of the fabric, gripping yarn between an active yarn carrier and the fabric by moving automatically operated means parallel to the needle series into and away from the working field of the yarn carrier for a subsequent clamping and cutting of the yarn in timed relationship to the operation of the knitting machine, clamping the yarn by engaging the clamping elements of automatically operated clamping means with each other, cutting the yarn, continuing the clamping of the end of the yarn extending from the yarn carrier by holding said clamping elements engaged with each other until a new cycle of operation for the knitting of a new fabric has been started, and, after the start of said new cycle of operation, releasing said end of the yarn by disengaging said clamping elements from each other.

35. A method for the automatic clamping and cutting of yarn in a flat knitting machine as claimed in claim 34, wherein the gripping of yarn takes place while the yarn carrier is within in its working field.

36. A method for the automatic clamping and cutting of yarn in a flat knitting machine as claimed in claim 34, wherein the gripping of yarn takes place, when the yarn carrier is substantially in its normal outer working end position.

37. A method for the automatic clamping and cutting of yarn in a flat knitting machine equipped with an automatically operated knitting mechanism including a plurality of sinkers and dividers as claimed in claim 34, wherein the gripping of yarn takes place, when the sinkers and dividers are in their withdrawn position and the needles are in their knocking-over position.

38. A method for the automatic clamping and cutting of yarn in a flat knitting machine equipped with an automatically operated knitting mechanism including a plurality of sinkers and dividers as claimed in claim 34, wherein the gripping of yarn and the subsequent cutting thereof takes place during a rotation of the main cam shaft of the knitting machine through an angle of less than 45°.

39. A method for the automatic clamping and cutting of yarn in a flat knitting machine as claimed in claim 34, wherein the cutting of yarn takes place substantially simultaneously with the arresting of the yarn carrier.

40. A method for the automatic clamping and cutting of yarn in a flat knitting machine as claimed in claim 34, wherein the release of the end of the yarn extending from the yarn carrier by disengaging the clamping elements from each other takes place after the sinking of new loops of the new fabric.

41. A method for the automatic clamping and cutting of yarn in a flat knitting machine as claimed in claim 34, wherein the release of the end of the yarn extending from the yarn carrier takes place after the knitting of at least one loop course of the new fabric.

42. A method for the automatic clamping and cutting of yarn in a flat knitting machine equipped with an automatically operated knitting mechanism including a main cam shaft as claimed in claim 34, wherein, after the start of a new cycle of operation of the knitting machine, the end of the yarn extending from the yarn carrier is released during a rotation of the main cam shaft

of the knitting machine through an angle of less than 45° while the active yarn carrier is in a position remote from its outer normal working end position.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,101,048	Ischinger	Dec. 7, 1937
15,435	Nesmith	July 29, 1856
229,709	Johnstone	July 6, 1880
1,261,050	Miller	Apr. 2, 1918
2,100,345	Miller	Nov. 30, 1937