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CARRIER ROD OPERATING MECHANISM FOR FLAT KNITTING MACHINES

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Fig. 1

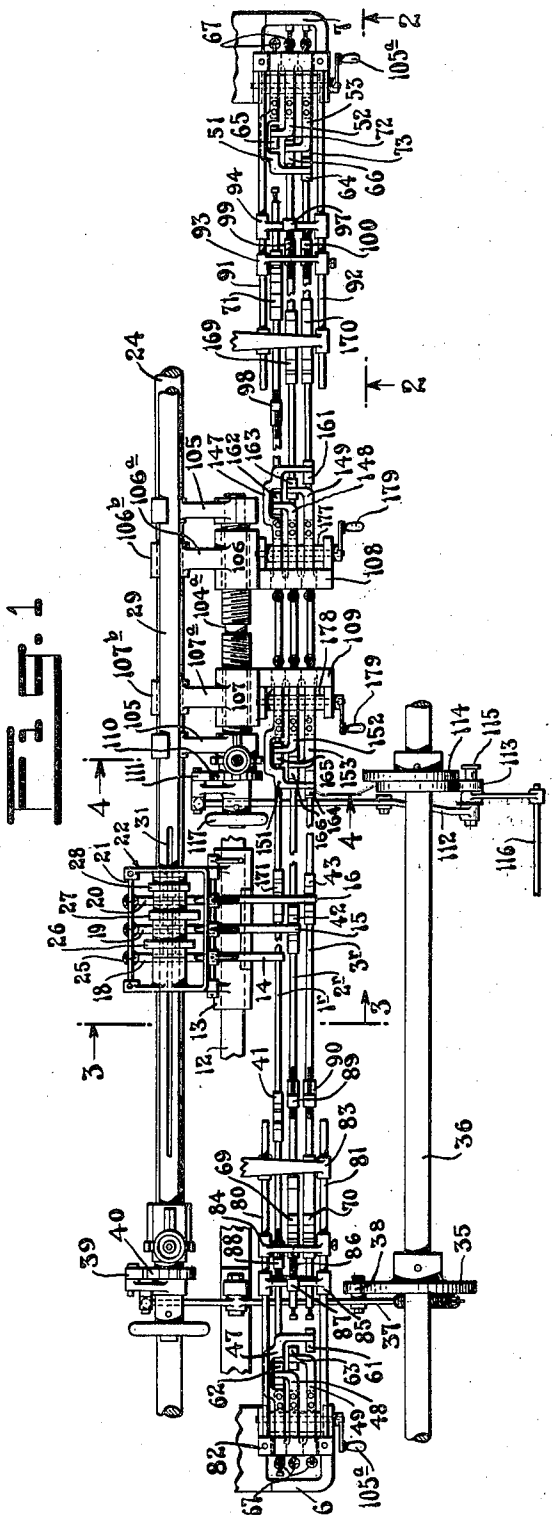
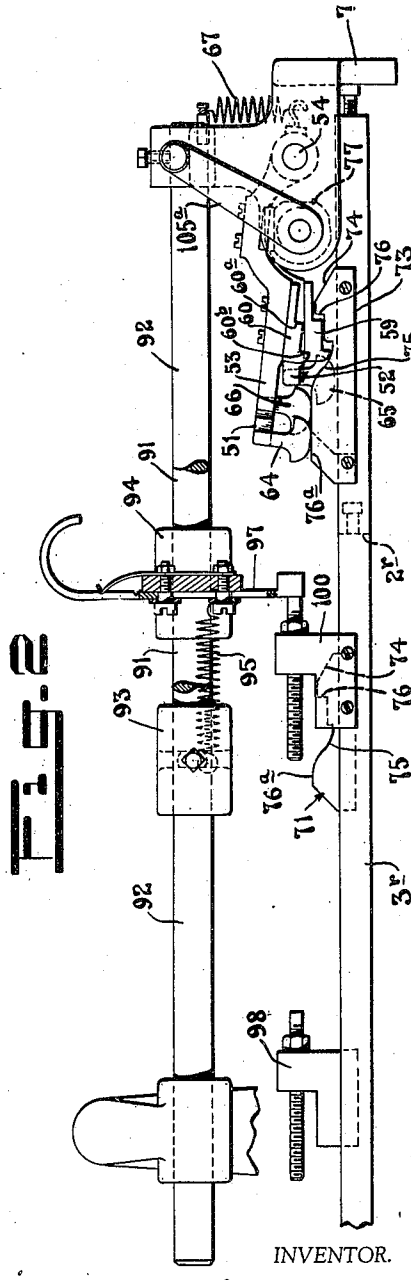


Fig. 2



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CARRIER ROD OPERATING MECHANISM FOR FLAT KNITTING MACHINES

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Fig. 4

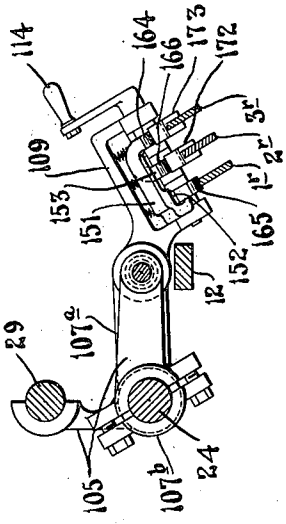


Fig. 6

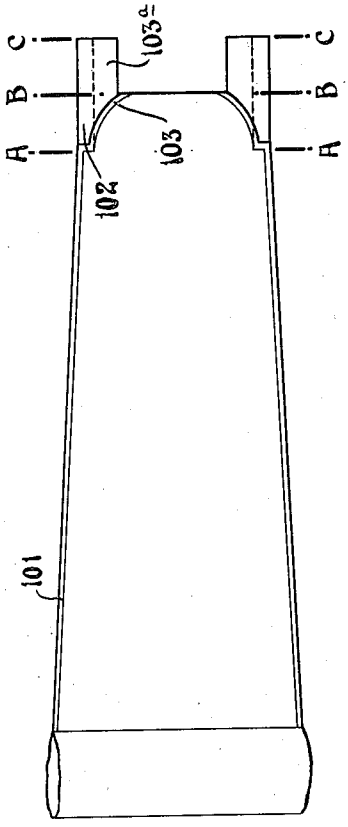


Fig. 3

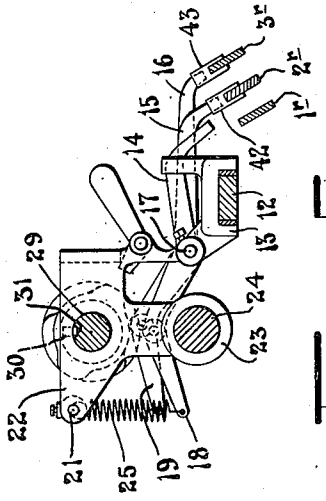
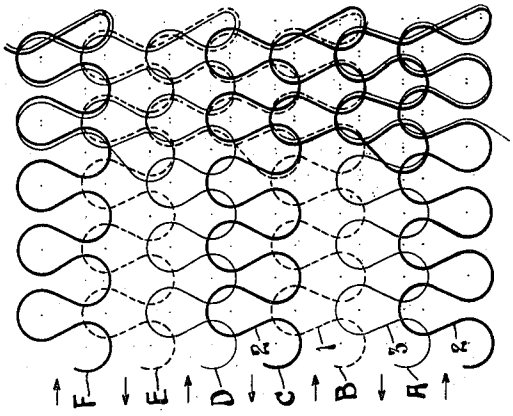


Fig. 5



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CARRIER ROD OPERATING MECHANISM FOR FLAT KNITTING MACHINES

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Fig. 7

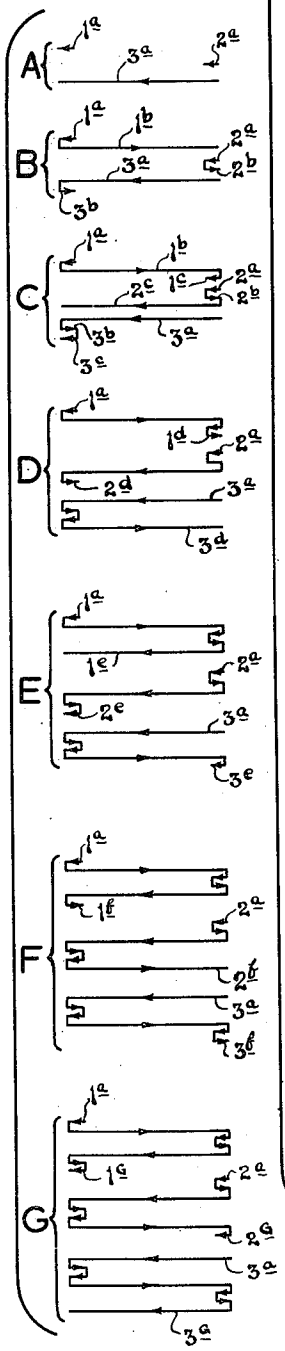
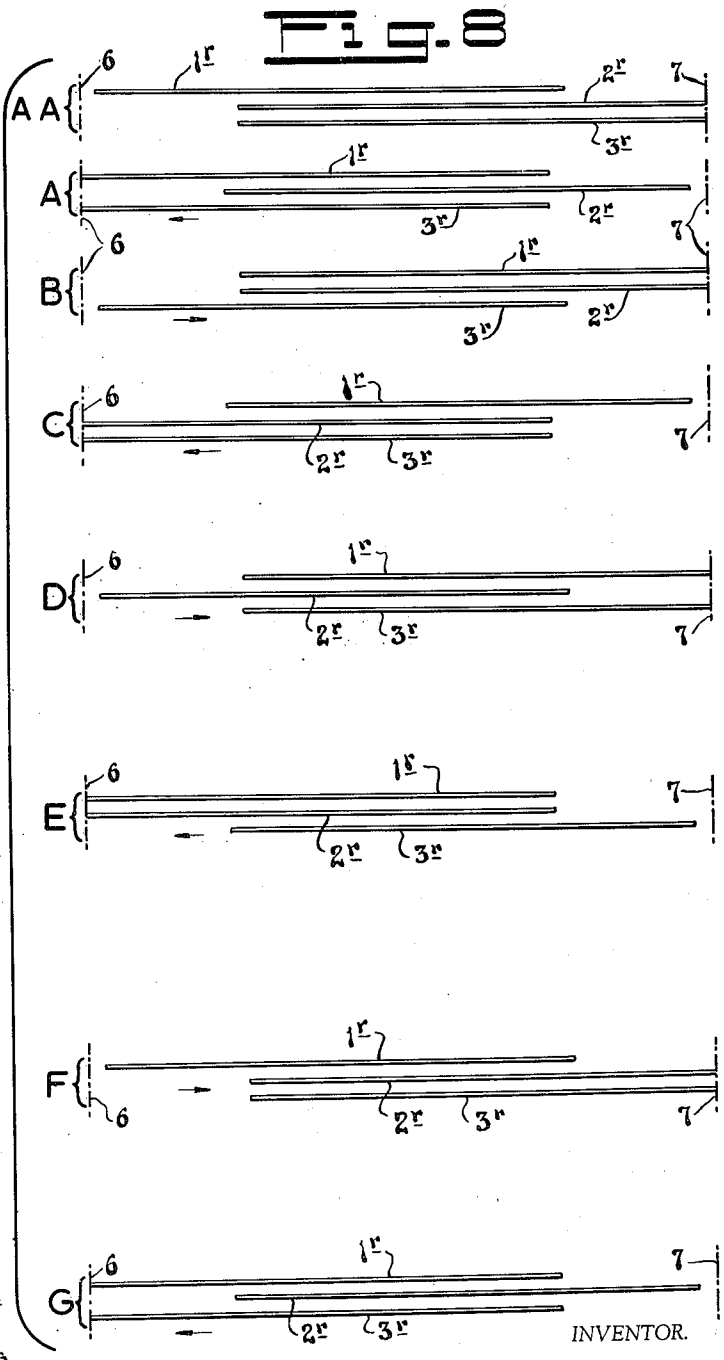


Fig. 8



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CARRIER ROD OPERATING MECHANISM FOR FLAT KNITTING MACHINES

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Fig. 9

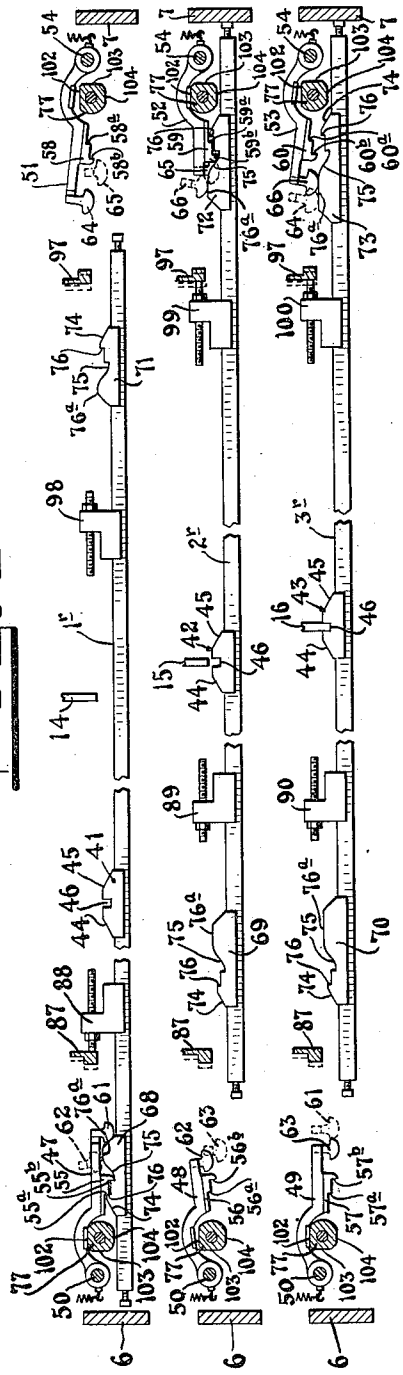
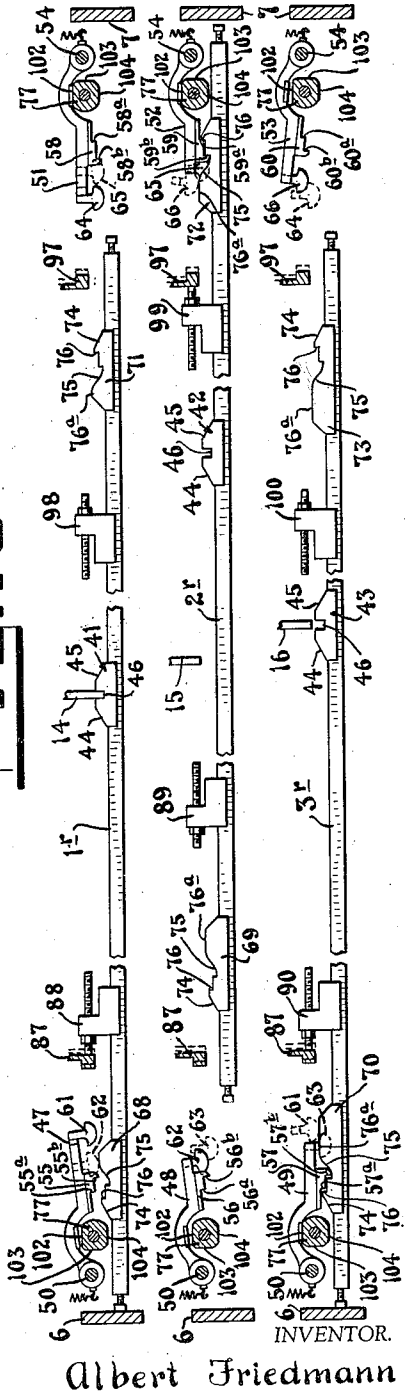


Fig. 10



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CARRIER ROD OPERATING MECHANISM FOR FLAT KNITTING MACHINES

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Fig. 11

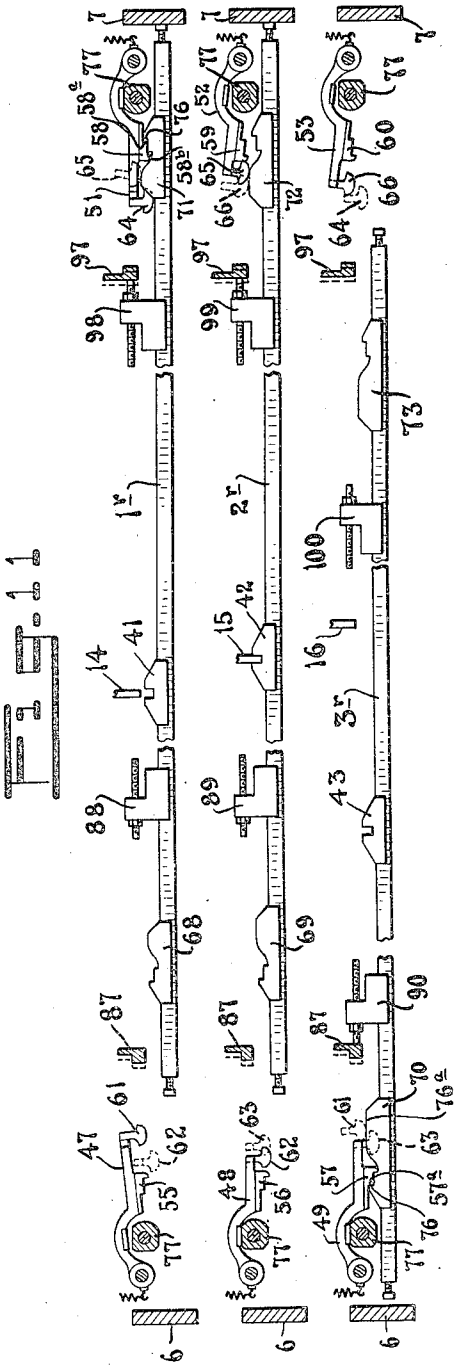
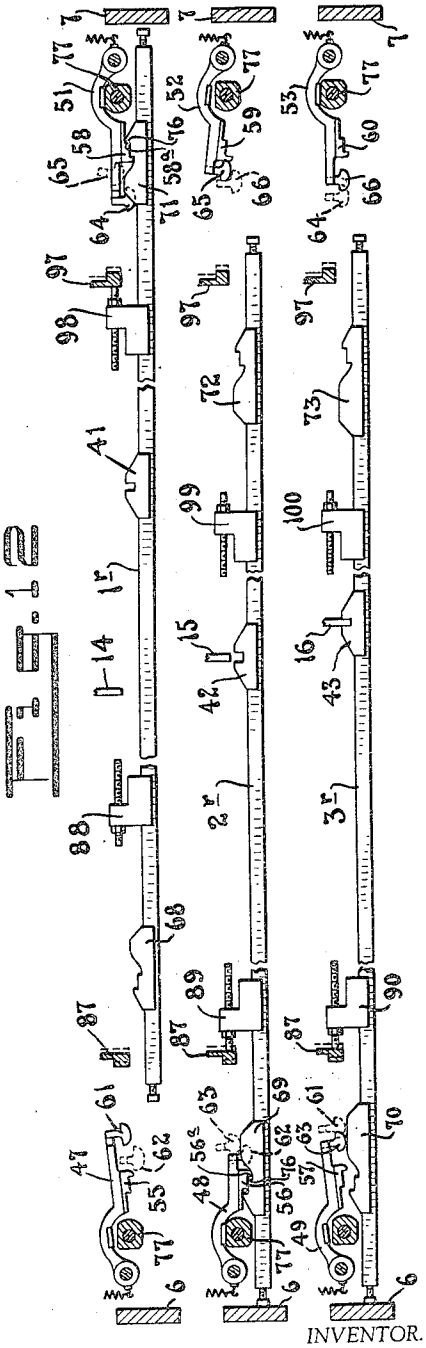


Fig. 12



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CARRIER ROD OPERATING MECHANISM FOR FLAT KNITTING MACHINES

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Fig. 13

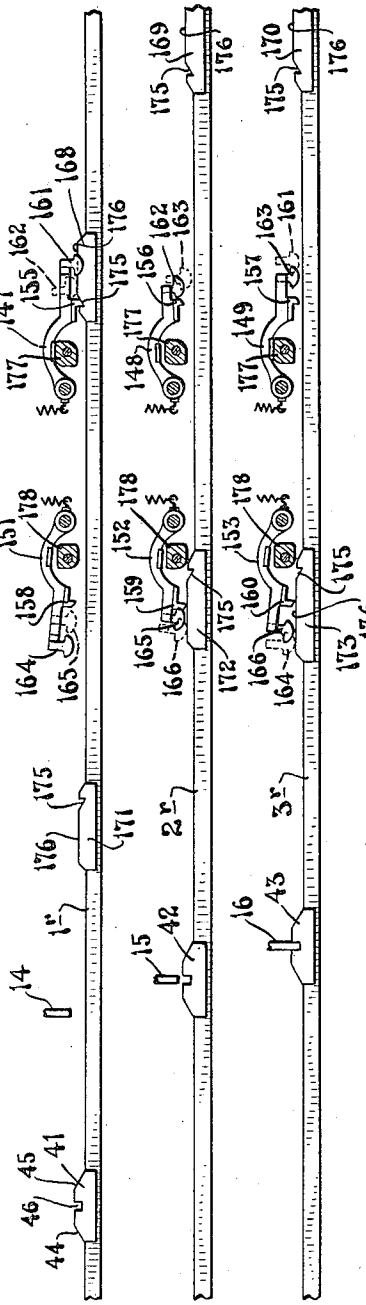
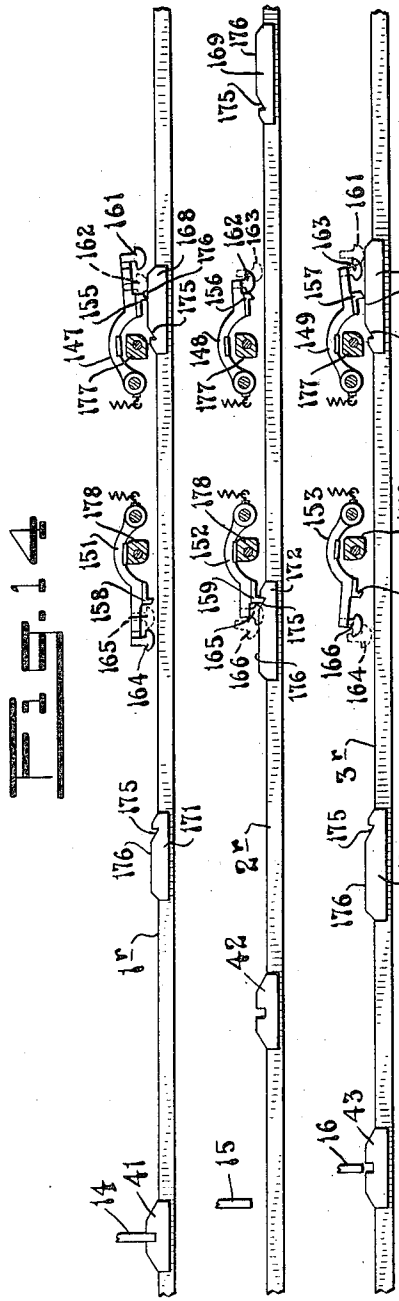


Fig. 14



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Patented Oct. 22, 1935 2,018,059

UNITED STATES PATENT OFFICE

2,018,059

CARRIER ROD OPERATING MECHANISM FOR FLAT KNITTING MACHINES

Albert Friedmann, Wyomissing, Pa., assignor to Louis Hirsch Textile Machines, Inc., New York, N. Y., a corporation of New York

Application December 28, 1934, Serial No. 759,524

21 Claims. (Cl. 66—127)

This invention relates to a new and useful improvement in flat knitting machines and specifically to the mechanisms for controlling the movements of the carrier rods.

While the invention may be utilized for other purposes it is of particular advantage in the knitting of "ringless" fabric of the type disclosed in my application No. 701,737 filed December 11, 1933, and for that reason the form shown in the drawings and described in the specification is that suitable for knitting this type of ringless fabric.

As is well known, the rings or stripes which frequently mar the appearance of sheer silk hosiery are caused primarily by lack of uniformity in the thread which, in spite of the greatest care in manufacture, varies in diameter in different parts and also because it has been the practice to knit such hosiery from a single thread. This brings such inequalities into adjacent courses, thereby accentuating them and producing the objectionable variations in thickness of the fabric commonly known as rings. The difficulty has been largely overcome by employing instead of one thread say three separate threads utilized in rotation in successive courses so that the same thread appears only in every third course.

While this method of knitting has substantially eliminated the objectionable rings it has introduced a serious defect at the extreme edge of the fabric. In fact, it is impossible to obtain a good edge for the reason that between the end of one course knit with a thread and the beginning of the next course knit with the same thread there is a loose or floating length of the thread lying across the ends of the two intervening courses. Since this is true of each of the threads, the fabric over its entire length is bordered by three such floating threads. These are sometimes caught by chance into the intervening courses, but usually hang loosely along the edges of the fabric where they may easily be cut or become entangled with the needles causing breakage and damaging the fabric. They also make neat seaming extremely difficult.

By the invention of this application although three carriers are used to lay three separate threads in successive courses a ringless fabric is produced in which there are no floating threads. To the contrary, each of the three threads is knit into each course, one forming the main full width course and the other two being knit into the respective selvages of the same course.

The invention, in addition to providing simple and efficient means for imparting to the carrier rods the motion required for laying the threads in this manner, also insures that the carrier rods involved are positively positioned against their limiting stops at the end of each stroke and that they are not dragged out of position through interference between the different carriers. This is accomplished without utilizing the latches which have been considered necessary to hold the carrier rods against their end stops. Also the burden upon the friction rod is greatly reduced so that less power is required and smoother operation secured.

In addition, the invention permits of the knitting of a "triple heel" or "heel within a heel" by means of five carriers instead of the usual minimum of seven, thus freeing two carriers for other uses. In spite of the continual demand for more and more carriers manufacturers of flat knitting machines have been unable to equip their machines with more than eight and, generally, with not more than seven. This invention which, in effect, increases the number of carriers by two, is of great practical importance, particularly since it can be applied without difficulty to old machines having a more limited number of carriers.

A form of this invention suitable for knitting the type of ringless fabric described is shown in the drawings, in which

Figure 1 is a plan view of a part of a flat knitting machine equipped with this invention;

Fig. 2 is a front elevation of the right end of Fig. 1 viewed from the line 2—2 in the direction indicated by the arrows;

Fig. 3 is an end elevation of a part of the carrier rod driving mechanism shown in Fig. 1 viewed from the line 3—3 in the direction of the arrows;

Fig. 4 is an end elevation of the adjustable carrier rod stop mechanism shown in Fig. 1 viewed from the line 4—4 in the direction of the arrows;

Fig. 5 is a diagrammatic illustration of the loop arrangement of the ringless fabric which can be knit by this invention;

Fig. 6 is a diagrammatic illustration of a stocking leg blank knit in this manner;

Fig. 7 illustrates diagrammatically the manner in which the courses of the fabric of Fig. 5 are laid;

Fig. 8 is a diagrammatic illustration of the movement of the carrier rods during the laying of these courses;

Figs. 9, 10, 11 and 12 illustrate diagrammatically the positions assumed by the carrier rod operating and controlling devices during the knitting of this fabric; and

Figs. 13 and 14 illustrate diagrammatically the operation of other carrier rod operating and controlling devices.

As an aid to understanding the form of the invention selected for description herein a more detailed explanation of the peculiar type of ringless fabric knit by it and the manner in which the threads are laid will be of value. As already generally stated the outstanding characteristics of this fabric is that it is ringless and possesses neat reinforced selvages formed of the same threads as the full width courses and without floating threads. These selvages may be very narrow so that they disappear in the seam or as much wider as desired.

To produce three thread ringless fabric of this character three thread carriers work simultaneously upon each course, one laying a thread across the entire width of the fabric and the other two laying other threads across the respective selvages. Fig. 7 illustrates diagrammatically the threads as they are laid in six consecutive courses. As shown in diagram A of Fig. 7, when thread **3** is laid from right to left across the full width of the fabric as shown at 3^a, thread **2** is laid across the right selvage as shown at 2^a, and thread **1** across the left selvage as shown at 1^a. When the course is knit a fabric with a reinforced selvage is produced and all three threads are contained therein.

Diagram B of Fig. 7 illustrates the first course described above and also the second course. In this second course the carriers have traveled from left to right. Thread **3** which during the first course was laid across the full width of the fabric is now laid in this second course across the left selvage only (3^b). Thread **2** is again laid across the right selvage in the direction opposite to that of the first course (2^b). Thread **1** is laid across the full width of the fabric (1^b), completing the laying of the three threads for the second course which, when knit, will have the same characteristics as the first course, all three threads being incorporated therein.

The laying of the third course is illustrated in Diagram C of Fig. 7. In this the threads are laid from right to left, thread **3** being laid back across the left selvage again (3^c), thread **2** across the full width of the fabric (2^c) and thread **1** across the right selvage (1^c).

For the next course (Diagram D of Fig. 7) thread **3** is laid across the full width of the fabric for the second time (3^d) but from left to right, thread **2** is laid across the left selvage from left to right (2^d) and thread **1** is laid back across the right selvage also from left to right (1^d).

This method is continued as shown in Diagrams E, F and G of Fig. 7, each thread being laid across the full width of the fabric in every third course and across one selvage or the other in each of the two intervening courses. The new course in each of these diagrams is indicated as in the earlier diagram by the numeral **1**, **2** and **3** followed by letters corresponding to the identifying letter of the diagram. Each course contains all three threads and there are no loose or floating threads at the edges or elsewhere, although each thread in the main body portion of the fabric between the reinforced selvages is separated by two other threads to carry out the "ringless' structure.

The fabric may be narrowed as desired without interfering with this method of knitting the usual narrowing attachment being employed. The expression "full width of the fabric" as used herein refers, of course, to the fabric from one edge to the other, irrespective of whether it is of its greatest width or less as the result of narrowing.

The structure of the fabric produced in this way is diagrammatically shown in Fig. 5 which shows one selvage and a fragment of the body and how the courses numbered A—F, corresponding with the similarly numbered diagrams of Fig. 7, are incorporated. Only two threads appear in the selvage of Fig. 5, the other thread being found, of course, in the other selvage which is not shown but which has the same loop arrangement. The completely and symmetrically looped, reinforced edges of the selvages without floating threads is clearly shown.

The movements of the carrier rods required to carry out the above described thread laying operations are diagrammatically illustrated in Fig. 8. In Diagram AA of this figure the three rods 1^r, 2^r and 3^r are shown in their positions for the beginning of the first thread laying operation already described and shown in Diagram A of Fig. 7. Each of the following diagrams of Fig. 8 are lettered to correspond with the equivalently lettered diagram of Fig. 7. The vertical lines **6** and **7** represent the usual end stops carried by the narrowing heads.

In Diagram AA of Fig. 8 carrior rod 1^r is positioned so that its carrier is over the inner edge of the left selvage and rods 2^r and 3^r rest against their right end stops **7**. To lay the course represented by Diagram A of Fig. 7 all of the rods move to the left rod 1^r laying thread **1** across the left selvage, rod 2^r laying thread **2** across the right selvage, and rod 3^r laying thread **3** across the full width of the fabric. At the end of this operation the carrier rods assume the positions shown in Diagram A of Fig. 8.

To lay the following course represented by Diagram B of Fig. 7 the carrier rods move to the right, as shown in Diagram B of Fig. 8, rod 1^r laying thread **1** across the full width of the fabric and rods 2^r and 3^r laying threads **2** and **3** respectively, across the respective right and left selvages. In the following course (Diagram C of Figure 7) the rods all move back to the left again, rod 1^r transporting its carrier and laying thread **1** across the right selvage, rod 2^r laying thread **2** across the full width of the fabric, and rod 3^r laying thread **3** back again across the left selvage, as shown in Diagram C of Fig. 8.

In laying the next course (Diagram D of Fig. 7) the rods move as shown in Diagram D of Fig. 8, rod 1^r moving back to its end stop **7** to lay thread **1** back across the right selvage, rod 2^r traversing the width of the left selvage to lay thread **2** across that selvage, and rod 3^r making its second complete traverse to lay yarn **3** for its second full width course.

The succeeding carrier rod movements will be understood readily from Diagrams E, F and G of Fig. 8 in conjunction with the corresponding thread laying diagrams of Fig. 7. It will be noted that each carrier rod performs a three course cycle, laying a thread the full width of the fabric in one course, across a selvage in the next course and again across the same selvage in the third course after which it again lays a full width course in the opposite direction followed by two

courses in the opposite selvage but otherwise similar to those described above. It will also be noted that the above cycle for each rod begins one course after that of another rod so that each rod is in continuous operation and the capacity of the machine is not reduced by the relatively complex character of the knitting as compared with plain fabric. It will also be noted that at the end of each course two carrier rods rest against end stop 6 or 7, whereas the third rod has stopped with its carrier over the inner edge of a selvage and, therefore, is not in contact with either end stop.

To operate the carrier rods in the manner described is the primary object of this invention. A form of mechanism for this purpose is shown in Figs. 1–4 and 9–12, and a modified form in Figs. 13 and 14.

The knitting machine, as a whole, may be of the standard flat type. In Fig. 1 all carrier rods are omitted for the sake of clarity, except the three rods 1^r, 2^r and 3^r required for knitting the fabric. Corresponding end stops are diagrammatically indicated at 6 and 7 on the usual narrowing heads 8 and 9. The standard reciprocable friction rod 12 is also utilized upon which is mounted a friction box 13 provided with the usual frictional devices. Upon friction box 12 are pivotally mounted fingers 14, 15 and 16, the respective lengths of which are such that their ends overlie carrier rods 1^r, 2^r and 3^r respectively. All three fingers are mounted on a common shaft 17 in such a way that they may be individually rocked in a vertical plane.

These fingers also extend rearwardly from their pivots as arms 18, 19 and 20 which terminate substantially beneath cross bar 21 of frame 22, which is also mounted upon or is an integral part of friction box 13. The sides of frame 22 are extended downwardly to form supports for a bearing 23 slidably surrounding a shaft 24 so that frame 22, although it can slide longitudinally, is rigidly braced against other movement insuring that the various parts of the device will be maintained in correct position with respect to the carrier rods. Each of the arms 18, 19 and 20 is connected to cross bar 21 of frame 22 by means of a spring 25. Thus, normally, the fingers will be maintained in "down" position with their ends slightly above their respective rods.

Rocking of fingers 14, 15 and 16 is automatically effected by cams 26, 27 and 28 respectively, mounted on a changing shaft 29 which is rotatably mounted in suitable bearings so that it overlies the rear end of arms 18, 19 and 20. Each of the cams 26, 27 and 28 is slidably mounted upon changing shaft 29, the hub of each being provided with one or more splines 30 which engage with corresponding spline slots 31 in changing shaft 29. Thus although cams 26, 27 and 28 are slidable upon changing shaft 29 any rotation of shaft 29 will impart a corresponding rotation to the cams.

Cams 26, 27 and 28 are mounted in proper position with respect to each other and to the arms 18, 19 and 20 by any suitable means and engage with those arms through the medium of a roller 32 on each arm. Thus when friction box 13 is reciprocated by friction rod 12 not only the fingers 14, 15 and 16 and arms 18, 19 and 20 but also rollers 32 and cams 26, 27 and 28 will reciprocate as a unit, the cams sliding along shaft 24 and maintaining their operative alignment with the arms. Each of cams 26, 27 and 28 is so shaped and its working surface so distributed about the shaft that the finger which it controls will be maintained in its raised and lowered positions at appropriate times during the knitting operation by suitable rotation of shaft 29.

Shaft 29 may be rotated by any suitable mechanism which will impart proper timing to the cams. The mechanism shown in Fig. 1 for rotating shaft 29 consists of a cam 35 upon the main cam shaft 36 which operates a rock lever 37 through roller 38. Lever 37 in turn rotates shaft 29 in a step by step manner through a pawl 39 and ratchet wheel 40. This form of drive is well known to those skilled in the art and can be designed by them to impart the required rotation to shaft 29 to harmonize its action with the knitting cycle.

The purpose of fingers 14, 15 and 16 and the associated mechanism described is to propel, in accordance with the requirements of the knitting, the two carrier rods whose thread laying strokes terminate at an end stop. The third rod is propelled by other means to be described although also under control of one of fingers 14, 15 or 16.

The driving connection between these fingers and the carrier rods may consist of drive blocks 41, 42 and 43 mounted upon rods 1^r, 2^r and 3^r respectively, and so positioned upon the rods as to be engageable with fingers 14, 15 or 16 respectively throughout a carrier rod stroke. Each drive block may consist of a metallic block attached to and projecting above its carrier rod and provided with sloping surfaces 44 and 45 leading up to a centrally positioned rectangular depression 46 of suitable size to receive the end of a finger (see Fig. 9 for example). It will be apparent that whatever during the reciprocation of the friction rod one of the fingers 14, 15 or 16 is engaged in the recess 46 of its corresponding drive block, a carrier rod will be reciprocated, provided it is not otherwise restrained.

Additional means for reciprocating the carrier rods is also provided. These are shown in Fig. 1 and one of them in Fig. 2. It consists of two rods 80 and 81 mounted in suitable brackets 82 and 83 on the left narrowing head and paralleling the carrier rods. Extending between rods 80 and 81 and adjustably attached to them is a yoke 84. Another similar yoke 85 also extends between rods 80 and 81 but is slidably mounted upon them between yoke 84 and the outer end of the narrowing head. Between yokes 84 and 85 is an expansion spring 86 which urges yoke 85 towards yoke 84.

Upon yoke 85 is mounted a drive plate 87 with its face lying above and across the carrier rods and slidable vertically so that it may be engaged with and disengaged from stops 88, 89 and 90 on carrier rods 1^r, 2^r and 3^r respectively. The object of plate 87 is to drive the carrier rod which is to lay a thread inwardly across the left selvage; rod 3^r of Diagram B, Fig. 8, for example. Consequently yoke 84 will be positioned upon rods 80 and 81 so as to maintain plate 87 in engagement with stops 88, 89 or 90, as the case may be, upon the carrier rod in question and under sufficient tension, through spring 86 acting through sliding yoke 85, to cause plate 87 to reciprocate the rod at the required speed inwardly across the selvage and to hold it securely in position at the termination of this movement.

A similar arrangement of yokes, plate and spring is positioned upon the right narrowing mechanism but designed to operate in the opposite direction. It is identified in Figs. 1 and 2 by rods 91 and 92, fixed yoke 93, sliding yoke 94, spring 95 and drive plate 97. The corresponding stops

on rods 1^r, 2^r and 3^r respectively are shown at 98, 99 and 100.

The description thus far has included two separate means for driving the three carrier rods, one the fingers 14, 15 and 16 for driving the rods in any stroke which is to terminate at an end stop and the other plates 87 and 97 and its associated yokes and springs for driving any of the rods inwardly across a selvage.

In the upper leg portion of the stocking as at 101 in Fig. 6 the reinforced selvage will ordinarily be, say, two needles in width so that it will disappear in the seam. Therefore, the inward travel of the carrier rods working upon the selvages must be limited to the required distance.

When the portion which includes the heel splice is knit, the knitting is continued without change with the exception that the selvage is widened to the equivalent of say sixteen needles to form the splice, as indicated at 102 in Fig. 6. For this purpose the inward travel of the carrier rods working upon the selvage must be increased.

Therefore, the means described for driving the carrier rods inwardly across the selvage must have a range of movement at least as great as, and preferably somewhat greater than, the maximum movement of the carrier rods. Specifically the space between yokes 93 and 94 (Fig. 2) and between yokes 84 and 85 must be greater than the greatest distance traversed by the carrier rods working upon the selvages.

The means shown in the drawings for limiting the travel of these carrier rods to the required distances consists of two sets of three latch stops, each mounted upon individual, vertically swingable levers. One set is carried by each narrowing head and one latch stop of each set controls the inward travel of a carrier rod across a selvage, as will be explained. The set of levers upon the left narrowing head are shown at 47, 48 and 49 in Fig. 1, hinged upon a shaft 50. The set of levers upon the right narrowing head is shown at 51, 52 and 53 in Fig. 1 hinged upon a shaft 54. They are also shown in greater detail in Fig. 2. Since the other set of levers 47, 48 and 49 is identical with the exception that they face in the opposite directions, as will be evident from Figs. 1, 9, 10, 11 and 12, the detailed showing of one set in Fig. 2, as clarified by Figs. 9–12, will suffice for both. Each of the levers is urged downwardly by a spring 67.

Levers 47, 48 and 49 are provided respectively with latch stops 55, 56 and 57. Levers 51, 52 and 53 respectively, are provided with similar latch stops 58, 59 and 60, the three stops of each set lying directly above the path of travel of carrier rods 1^r, 2^r and 3^r in the order named. Each stop is provided with two stop faces, facing towards the respective ends of the machine. These faces are numbered as follows—

Stop 55 Faces 55^a and 55^b
Stop 56 Faces 56^a and 56^b
Stop 57 Faces 57^a and 57^b
Stop 58 Faces 58^a and 58^b
Stop 59 Faces 59^a and 59^b
Stop 60 Faces 60^a and 60^b

Each lever is also provided at its free end with a downwardly depending shoe, those for levers 47, 48 and 49 being shown at 61, 62 and 63 in Figs. 9–12, and those for levers 51, 52 and 53 at 64, 65 and 66 and also in Fig. 2. Shoes 61 and 64 overlie the path of carrier rod 3^r, shoes 62 and 65 overlie the path of carrier rod 1^r, and shoes 63 and 66 overlie the path of carrier rod 2^r, all as shown in dotted lines in Figs. 9–12, the respective levers being suitably formed to make this possible as best shown in Fig. 1.

To cooperate with these stops and shoes each carrier rod is equipped with two opposed but otherwise identical combination shoe lifter and stop blocks positioned adjacent the ends of the carrier rods so as to be engageable with the stops. The combination blocks for carrier rod 1^r are shown at 68 and 71, those for carrier rod 2^r at 69 and 72, and those for carrier rod 3^r at 70 and 73 (see Figs. 1, 9–12). Each block is provided with an inclined surface 74 and a depression 75 to receive the latch stop on the corresponding lever, the face 76 of the depression being adapted to engage with the stop faces of the latch stop, and a shoe lifter 76^a. The stop faces 55^a—60^a on stops 55—60 are so positioned with respect to to the stop face 76 of the corresponding combination stop blocks 68—73 on the carrier rod that when a rod is resting against its end stop there will be a space between the stop faces equal to the distance the carrier rod must travel to lay the thread inwardly across a selvage, such as 101 in Fig. 6, say a two needle selvage. Stop faces 55^b—60^b on the latch stops are so positioned that under similar conditions the space between them and the stop faces 76 of the carrier rod stop blocks is equal to the width of the wide selvage or high heel splice 102 (Fig. 6), say sixteen needles.

Means for swinging levers 47—49 and 51—53 to bring stop faces 55^a—60^a or stop faces 51^b—60^b into engageable position with the carrier rod stop blocks or to prevent such engagement is provided by a transverse cam 77 having low, medium and high lifts 102, 103 and 104 respectively. When low lift 102 is engaged with the levers they assume their lowermost position and stop faces 55^a—60^a are then engageable with the carrier rod stop blocks. When intermediate lift 103 engages the levers they are lifted sufficiently to cause stop faces 55^a—60^a to clear the carrier rod stop blocks and to permit stop faces 55^b—60^b to assume engaging position. When the high lift 104 engages with the levers they are lifted sufficiently to cause all of the stop faces to clear the carrier rod stop blocks. To rotate cam 77 as directed a manually operable handle 105 is provided.

The operation of the device will be best understood from Figs. 9–12. In Fig. 9 the carrier rods are in the same position as in Diagram A—A of Fig. 8. That is to say, they are ready to move to the left as shown in Diagram A of Fig. 8 to lay the three threads of the first course as illustrated by Diagram A of Fig. 7. As already described, rod 3^r which rests against its right end stop 7 will traverse the full width of the fabric. It will be driven by the friction rod 12 through finger 16 which has been permitted to enter depression 46 in drive block 43 on carrier rod 3^r by cam 28 on shaft 29. Drive plate 97 is in its extreme position to the right, as shown in full line, pressing against carrier rod stop 100. Latch stop 60 is lifted out of engageable position with carrier rod stop block 73 on carrier rod 3^r because shoe 66 rides upon shoe lifter 76^a on carrier rod 2^r which is also against right end stop 7. Therefore, carrier rod 3r, is free to move to the left over the full width of the fabric under the guidance of finger 16.

Carrier rod 2^r is also ready to move inwardly to the left across the right selvage. It is driven by drive plate 97 which presses against carrier

rod stop 99 as shown in full line. However, latch stop 59 rests in the depression 75 of carrier rod stop 72 with its stop face 59a in position to engage stop face 76 of the carrier rod stop 72 because with rod 1r in the position shown on the inner edge of the left selvage shoe 65 cannot engage with its shoe lifter 76a on stop block 71 on carrier rod 1r. Therefore, when carrier rod 2r moves it will be arrested by the carrier rod stop block 59 when its carrier reaches the inner edge of the right selvage. Carrier rod 2r cannot move until carrier rod 3r starts because as already stated drive plate 97 is restrained by a stop 100 on carrier rod 3r with which drive finger 16 is engaged. Finger 15 has been lifted by cam 27 out of engagement with drive block 42 on carrier rod 2r so that it has no operative effect upon that rod.

Carrier rod 1r rests above the inner edge of the left selvage, being maintained there by stop 55 whose face 55a engages with face 76 on carrier rod stop block 68 to resist the inward pressure of drive plate 87 acting against carrier rod stop 88. Carrier rod 1r is free to move, however, to the left across the left selvage whenever a driving force is applied since its stop block 71 is disengaged from latch stop 58. Drive finger 14 has been rocked up by cam 26 so that it is out of engaging position with drive block 41 on carrier rod 1r.

When the friction rod moves to the left carrier rod 3r will be driven along with it across the full width of the fabric, as shown in Fig. 10. Carrier rod 2r will be driven by drive plate 97 inwardly across the right selvage when it will be arrested by latch stop 59 as already explained. Carrier rod 1 remains motionless until finger 14, which at some point in the earlier part of the stroke has been allowed to drop into operating position by cam 26, strikes drive block 41, rides up sloping surface 45, snaps into recess 46 and then propels rod 1r outwardly across the left selvage until arrested by end stop 6.

The first course (Diagram A of Fig. 7) is now completed and the carrier rods are in the position shown in Fig. 10. The arrival of rod 3 at its end stop 6 has raised shoe 61 of latch stop lever 47 so that latch stop 55 is inoperative upon the carrier rod stop 68 of carrier rod 1. Drive plate 87 has been moved to the left by stop 88 and is prevented from reacting under the urge of spring 86 by drive finger 14 which remains engaged with drive block 41. Carrier rod 1r is, therefore, in condition to make a full traverse to the right to lay the next full course, as shown by Diagram B of Fig. 7.

Carrier rod 2r is ready to be driven to the right outwardly across the right selvage when a driving force is applied thereto through drive finger 15. Carrier rod 3 will operate inwardly across the left selvage under the drive of drive plate 86 acting upon stop 90 when the restraining effect of stop 88 on carrier rod 1 is removed.

When the friction rod reciprocation occurs carrier rod 1 will be propelled by drive finger 14 over the full width of the fabric. This will remove stop 88 from contact with drive plate 87 permitting drive plate 87 to propel carrier rod 3r inwardly over the left selvage until arrested by the engagement of stop face 57a on latch stop 57 with face 76 on carrier rod stop 70. This latch stop is operative since its shoe 63 is not engaged by shoe lifter 76a on carrier rod 2r.

While carrier rod 1r is in movement drive finger 15 is permitted to drop by cam 27 and will ultimately strike drive block 42 on carrier rod 2r, snap into recess 46 and then propel rod 2r across the right selvage until end stop 7 is contacted. The carrier rod movements for the second course (Diagram B Fig. 7) have now been completed, the carrier rods being in the positions shown in Fig. 11.

For the following course (Diagram C of Fig. 7) the mechanism operates as follows: Rod 2 will lay the full width course, being driven by drive finger 15. Latch stop 59 was disengaged from stop block 72 on this carrier rod by the lifting of its shoe 65 by shoe lifter 76a on carrier rod 1r at the termination of the last stroke so that rod 2r is free to move over the full course. When carrier rod 2r starts across the full course spring 95 will cause drive plate 97 to follow the receding stop 99. Drive plate 97 being also in engagement with carrier rod stop 98 on carrier rod 1r it will drive that rod inwardly across the next selvage until arrested by engagement of stop face 58a of latch stop 58 with face 76 of carrier rod stop 71. During the movement of carrier rod 2 finger 16 has been permitted to drop so as to be engageable with drive block 43 on carrier rod 3r when it passes across it to drive this rod outwardly across the left selvage, as already indicated.

The rods are now in the positions shown in Fig. 12. Each of them in succession has laid a full width course and has operated upon a selvage in each of the other courses. At the end of each stroke the rod which is to make the next full width course is engaged with a drive finger 14, 15 or 16 and, consequently, held securely against its end stop; the rod which is to traverse a selvage inwardly, has also been under the control of a finger 14, 15 or 16 until after the end of its previous stroke and, consequently, is also definitely positioned against its end stop. The rod which is to move outwardly across the other selvage is positively positioned with its carrier above the inner edge of the selvage by the latch stop and drive plate which act in opposition to each other. Therefore there is complete assurance that the rods will be correctly positioned at the beginning of each stroke.

Throughout the greater part of each stroke the friction rod is required to move only a single rod—that making the full traverse—so that the greater part of the driving effort usually required is eliminated. One rod is driven by an entirely separate drive, typified by drive plate 87 or 97 which also assists the friction rod in starting the rod making the full traverse, thus reducing the strain upon the friction rod and friction still more. The latch stops which arrest the inward movement of the salvage carrier rods are operated by the rods themselves, the rod just ending a full traverse raising the latch stop of the rod required for the following full width traverse without affecting the others. Therefore, the correct peformance of this operation is absolutely certain and imposes no appreciable additional burden upon the machine. In spite of the lengthy description required for full understanding, the invention is extremely simple and may be applied without difficulty to existing knitting machines.

To knit the high heel portions 102 (Fig. 6) cam 77 is rotated to engage intermediate lift 103 with levers 47—49 and 51—53 so that latch stop faces 55b—60b (instead of 55a—60a) will become engageable with carrier rod stops 68—73 respectively. This permits the inward travel of the carrier rods across the selvages to increase to the

required amount (assumed to be the equivalent of sixteen needles). Otherwise the adjustment and operation of the mechanism continue unaltered.

An alternate or supplementary form of the mechanism is included in Fig. 1 and is also shown in Figs. 4, 13 and 14. Although this modification is quite capable of doing everything that can be done by the form already described, and certain additional things, both forms may be employed together to advantage.

A limitation inherent in the device heretofore described is that it is incapable of making a selvage reinforcement the inner edge of which is not parallel to the outer edge. This necessarily results from the mounting of the latch stops upon the narrowing heads so that any variations in selvage width other than provided for by multiple latch stop faces such as 55a—60a and 55b—60b can be obtained only by a similar variation at the outer edge of the fabric.

Other variations in the selvages and, particularly, in the high heel, are sometimes desired. For example, an attractive type of high heel is shown at 103 in Fig. 6, in which the heel splice is progressively widened the inner edge appearing as a graceful curve. To provide for such knitting a different means of controlling the selvage carrier rods is dequired so that the inward travel of these rods can be progressively increased without affecting the outer edge.

The only modification required is the transfer of the latch stops and supporting levers from the narrowing heads to supports which can be moved inwardly and outwardly as much and whenever desired, independently of the end stops on the narrowing heads, and providing on each carrier rod a pair of stop blocks to cooperate with the latch stops in arresting the inward travel of selvage carriers in the manner already described. Since this drive, when it is in operation, performs all of the required functions latch stops 55—60 are rendered inoperative by engaging the high lift of cam 77 with levers 47—49 and 51—53.

As shown in Figs. 1 and 4 this alternative or supplementary device consists of a spindle 104a having oppositely threaded halves rotatably mounted in suitable brackets, such as brackets 105 attached to shaft 24 and also engaging with shaft 29 so that the spindle is rigidly held in correct position. Upon the threaded halves of spindle 104a are internally threaded nuts 106 and 107 from which arms 108 and 109 respectively extend across the carrier rods. Nuts 106 and 107 are prevented from turning about spindle 104a by extensions 106a and 107a which terminate in bearings 106b and 107b slidable upon shaft 24. Therefore, arms 108 and 109 are also securely held against rotation about spindle 104a but can move with nuts 106 and 107.

Means for rotating spindle 104a so that nuts 106 and 107 and arms 108 and 109 may be moved away from each other is provided by the ratchet wheel 110, pawl 111, rock lever 112, cam roller 113 and operating cam 114 on main cam shaft 36. Roller 113 is slidable upon its shaft 115 into and out of engagement with cam 114 so that spindle 104a will be rotated only when desired. Control of roller 113 may be effected through the usual linkage to a pattery chain which is too well known to require showing or explanation and hence is merely indicated at 116.

A similar means may be utilized to move nuts 106 and 107 toward each other but in order to simplify the drawings the means for this purpose is shown as a hand wheel 117. This wheel may also be used to move the nuts outwardly whenever desired.

Arms 108 and 109 act as supports for two sets of hinged latch stop bearing levers identical in all material respects with levers 47—49 and 51—53 described. Levers 147—149 correspond to levers 47—49 and levers 151—153 correspond to levers 51—53, both in essential structure and function. Levers 147—149 are provided with latch stops 155—157 respectively, overlying carrier rods 1^r, 2^r and 3^r respectively, and levers 151—153 are provided with latch stops 158—160 respectively, overlying carrier rods 1^r, 2^r and 3^r respectively. Levers 147 and 151 are also provided with shoes 161 and 164 respectively, overlying carrier rod 3^r. Levers 148 and 152 are provided with shoes 162 and 165 respectively, overlying carrier rod 1^r, and levers 149 and 153 are provided with shoes 163 and 166 respectively, overlying carrier rod 2^r.

Carrier rods 1^r, 2^r and 3^r are each provided with a pair of combination shoe lifter and stop blocks engageable with the stops and shoe lifters, those on rod 1^r being shown at 168 and 171, those on rod 2^r at 169 and 162, and those on rod 3^r at 170 and 173. Each stop has a notch 175 with which the related latch stop can engage and a shoe lifter 176.

It will be noted that the levers, latch stops, shoes and carrier rod stop blocks and shoe lifters are essentially identical with those already described in connection with the first form of the device. The only difference of importance is in the mounting of the levers upon movable nuts 106 and 107 instead of the narrowing heads. This difference in mounting permits of adjustment of the latch stops longitudinally of the carrier rods independently of the end stops upon the narrowing heads so that the distance traveled by the carrier rods inwardly across the selvages may be independently varied, as desired over a relatively wide range. A transverse rotatable cam is also provided for each set of levers so that they may be swung up out of operating position when not in use. These cams are shown at 177 and 178. They may be operated manually by handle 179.

Since latch stops 155—160 cooperate with carrier rod stops 168—173 to perform exactly the same functions in the same way as latch stops 55—60 and carrier rod stops 68—73 which have been fully explained, no extended description of their mode of operation is required here. Fig. 13 shows these parts in the positions assumed when the rods are in readiness to lay the first course, as shown in diagram A—A of Fig. 8. It is, therefore, directly comparable with Fig. 9 and it will be noted that the equivalent levers, latch stops, carrier rod stops, etc. are in exactly the same relative positions. That is to say, rod 3^r is free to make as full traverse to the left because latch stop 160 (the equivalent of latch stop 60) is disengaged from carrier rod stop 173 (the equivalent of stop 73) and finger 16 is engaged with drive block 43. Carrier rod 2^r will be driven inwardly across the right selvage by drive plate 97 acting against stop 99 and carrier rod 1^r will be driven across the left selvage by finger 14 which engages with drive block 41 at the proper time as already fully described. Meanwhile, carrier rod 1^r is securely held with its carrier over the inner edge of the left selvage by latch stop 155 which engages with notch 175 on stop 168 and

drive plate 87 which engages with stop 88 on the carrier rod.

Fig. 14 which illustrates the positions of that parts under discussion at the end of this first traverse is directly comparable with Fig. 10 and will demonstrate that the equivalent levers, latch stops, etc., have functioned in exactly the same way. In short, the mechanisms carried by nuts 106 and 107 take the place of the similar devices upon the narrowing heads whenever it is desired to form inner selvage margins which are not parallel to the outer margins although they may be utilized for parallel margins, if desired, in which case the equivalent devices upon the narrowing heads will not be used at all or may be omitted from the machine if desired.

The knitting of the "triple heel" or heel within a heel, shown at 103a in Fig. 6, may be performed by this invention in so far as the main fabric layer and one layer of reinforcement is concerned by following the method already described. The additional reinforcement may be added by utilizing two additional carrier rods operated by ordinary frictions, each carrier moving back and forth across one selvage in the well known manner. For this purpose only five carrier rods are required, it will be noted, instead of the usual seven, so that two carrier rods are freed for other uses—a very important consideration as already stated.

The heel tabs may be knit by the usual methods, there being no advantage in having the ringless type of fabric in these parts. The ringless fabric should, however, be continued into the foot since the instep and upper foot portion of the stocking are very conspicuous. If a single unit machine is employed the three carrier rods and controlling drives heretofore described are adequate for the performance of this work, the travel of the carrier rods working upon the selvages being lengthened sufficiently to lay the threads for the sole reinforcement. The arrangement which includes the spindle 104a is best adapted for the purpose because of the wide range of movement which it provides for the latch stops which determine the inward limits of travel of the reinforcement carrier rods. If a footer is employed it also should, of course, be similarly equipped with the invention.

I claim:

1. In a flat knitting machine having a multiplicity of carrier rods and means for reciprocating them; means equal in number to said carrier rods, each of which is adapted to arrest the inward traverse of a different carrier rod at a point intermediate its full traverse without affecting the traverse of the other carrier rods, and means on each carrier rod for rendering inoperative the said arresting means for another carrier rod when each carrier rod approaches an end stop.

2. In a flat knitting machine having a multiplicity of carrier rods and means for reciprocating them; means equal in number to said carrier rods, each of which is adapted to arrest the inward traverse of a different carrier rod at a point intermediate its full traverse without affecting the traverse of the other carrier rods, and means on each carrier rod for rendering inoperative the said arresting means for another carrier rod, when each carrier rod approaches an end stop, all of said arresting means being carried by a narrowing head.

3. In a flat knitting machine having a multiplicity of carrier rods and means for reciprocating them; means equal in number to said carrier rods, each of which is adapted to arrest the inward traverse of a different carrier rod at a point intermediate its full traverse without affecting the traverse of the other carrier rods, means on each carrier rod for rendering inoperative the said arresting means for another carrier rod when each carrier rod approaches an end stop, all of said arresting means being mounted upon a nut engaged with a threaded, rotatable spindle, and means for rotating said spindle to alter the longitudinal position of said arresting means with respect to the carrier rods.

4. In a flat knitting machine provided with a reciprocable friction rod and at least three carrier rods; a friction device upon said friction rod engageable with two of said three carrier rods to drive said two rods during a traverse of the friction rod, means for driving the third carrier rod during the same traverse of the friction rod, means other than the friction rod for propelling said driving means for said third rod during said traverse of said friction rod, and means for arresting the traverse of the third rod only, at a point intermediate its full traverse.

5. In a flat knitting machine provided with a reciprocable friction rod and at least three carrier rods; a friction device upon said friction rod engageable with two of said three carrier rods to drive said two rods during a traverse of the friction rod, means for driving the third carrier rod during the same traverse of the friction rod, means other than the friction rod for propelling said driving means for said third rod during said traverse of said friction rod, and means for arresting the traverse of the third rod only, at a point intermediate its full traverse, all of said arresting means being carried by a narrowing head.

6. In a flat knitting machine provided with a reciprocable friction rod and at least three carrier rods; a friction device upon said friction rod engageable with two of said three carrier rods to drive said two rods during a traverse of the friction rod, means for driving the third carrier rod during the same traverse of the friction rod, means other than the friction rod for propelling said driving means for said third rod during said traverse of said friction rod, means for arresting the traverse of the third rod only, at a point intermediate its full traverse, all of said arresting means being mounted upon a nut engaged with a threaded rotatable sprindle, and means for rotating said spindle to alter the longitudinal position of said arresting means with respect to the carrier rods.

7. In a flat knitting machine provided with reciprocable friction rod and carrier rods; a carrier rod control mechanism comprising a friction drive on said friction rod for driving one carrier rod across the full width of the fabric and for driving another carrier rod outwardly across a selvage during a traverse of the friction rod, means for driving a third rod inwardly across the other selvage, and means other than the friction rod for propelling said third rod driving means during said traverse.

8. In a flat knitting machine provided with reciprocable friction rod and carrier rods; a carrier rod control mechanism comprising a friction device on said friction rod for driving one carrier rod across the full width of the fabric and for driving another carrier rod outwardly across a selvage during a traverse of the friction rod,

means for driving a third rod inwardly across the other selvage during said traverse of said friction rod, means other than the friction rod for propelling said third rod driving means during said traverse, and means carried by a narrowing head for arresting the traverse of the third rod at the inner edge of the selvage.

9. In a flat knitting machine provided with reciprocable friction rod and carrier rods; a carrier rod control mechanism comprising a friction device on said friction rod for driving one carrier rod across the full width of the fabric and for driving another carrier rod outwardly across a selvage during a traverse of the friction rod, means for driving a third rod inwardly across the other selvage during the same traverse of said friction rod, means other than said friction rod for propelling said third rod driving means during said traverse, and means for arresting the traverse of the third rod at the inner edge of the selvage, said arresting means being mounted upon a nut engaged with a threaded rotatable spindle, and means for rotating said spindle to alter the longitudinal position of said arresting means with respect to the carrier rods.

10. In a flat knitting machine provided with reciprocable friction rod and carrier rods; a carrier rod control mechanism comprising a friction device on the friction rod for driving one carrier rod across the full width of the fabric and for driving another carrier rod outwardly across a selvage during a traverse of said friction rod, means for driving a third rod inwardly across the other selvage during the same traverse of the friction rod, said last mentioned means consisting of a drive plate engageable with said third rod and slidable longitudinally of the carrier rod. and means other than the friction rod for moving said plate inwardly to drive the carrier rod during said traverse of said friction rod.

11. In a flat knitting machine provided with reciprocable friction rod and carrier rods; a carrier rod control mechanism comprising a friction device on said friction rod for driving one carrier rod across the full width of the fabric and for driving another carrier rod outwardly across a selvage during a traverse of said friction rod, means for driving a third rod inwardly across the other selvage during the same traverse of the friction rod, said last mentioned means consisting of a drive plate engageable with said third rod and slidable longitudinally of the carrier rod, means other than the friction rod for moving said plate inwardly to drive the carrier rod, and means for arresting the traverse of said third rod at the inner edge of the selvage.

12. In a flat knitting machine provided with reciprocable friction rod and carrier rods; a carrier rod control mechanism comprising a friction device on said friction rod for driving one carrier rod across the full width of the fabric and for driving another carrier rod outwardly across a selvage during a traverse of said friction rod, means for driving a third rod inwardly across the other selvage during said traverse of said friction rod, said last mentioned means consisting of a drive plate engageable with said third rod and slidable longitudinally of the carrier rod, means for moving said plate inwardly to drive the carrier rod, and means for arresting the traverse of said third rod at the inner edge of the selvage, said arresting means being carried by a narrowing head.

13. In a flat knitting machine provided with reciprocable friction rod and carrier rods; a carrier rod control mechanism comprising a friction device on said friction rod for driving one carrier rod across the full width of the fabric and for driving another carrier rod outwardly across a selvage during a traverse of said friction rod, means for driving a third rod inwardly across the other selvage, said last mentioned means consisting of a drive plate engageable with said third rod and slidable longitudinally of the carrier rod, means other than said friction rod for moving said plate inwardly to drive the carrier rod, means for arresting the traverse of said third rod at the inner edge of the selvage, said arresting means being mounted upon a nut engaged with a threaded rotatable spindle, and means for rotating said spindle to alter the longitudinal position of said arresting means with respect to the carrier rod.

14. In a flat knitting machine provided with a reciprocable friction rod and carrier rod, a carrier rod control mechanism consisting of a friction device frictionally engaged with said friction rod and provided with means for independently connecting it to each of said carrier rods for driving the same, means equal in number to said carrier rods each of which is adapted to arrest the movement of a different carrier rod at a point intermediate its full traverse, the operation of each of said arresting means being controlled by means on a carrier rod other than the one which it is adapted to arrest, each of said arresting means comprising a pivoted lever provided with a stop engageable with a stop on its respective carrier rod at the end of the partial stroke of said carrier rod and also provided with means engageable with other means on another carrier rod adapted to said lever sufficiently to release its stop from the stop on its respective carrier rod whenever both carrier rods approach the same end stop.

15. In a flat knitting machine provided with a reciprocable friction rod and carrier rods; a carrier rod control mechanism comprising a friction device on said friction rod for driving two carrier rods during each traverse of the friction rod, other means for driving a third rod in the same direction during the same traverse of the friction rod, and means other than the friction rod for propelling said third rod driving means during said traverse of said friction rod.

16. In a flat knitting machine provided with a reciprocable friction rod and carrier rods; a carrier rod control mechanism comprising means longitudinally reciprocable of the machine for driving two carrier rods during a traverse of said friction rod, other means for driving a third rod simultaneously with one of said two rods, means for propelling said third rod driving means only, during said traverse of said friction rod the return movement of said propelling means being effected by said friction rod during its return traverse.

17. A flat knitting machine according to claim 5 characterized in that the driving means for the third rod is also mounted upon a narrowing head.

18. A flat knitting machine according to claim 5 characterized in that the driving means for said third rod and the propelling means for said third rod driving means are mounted upon a narrowing head.

19. A flat knitting machine according to claim 5 characterized in that the driving means for the third carrier rod is mounted upon the same narrowing head as the arresting means.

20. In a flat knitting machine provided with

a reciprocable friction rod and at least three carrier rods; a friction device upon said friction rod engageable with two of said three carrier rods to drive said two rods during a traverse of the friction rod, means for driving the third carrier rod during the same traverse of the friction rod, means other than the friction rod for propelling said driving means for said third rod during said traverse of said friction rod, means for arresting the traverse of the third rod only, at a point intermediate its full traverse, said third rod driving means being carried by means which is longitudinally adjustable with and to the same extent as said arresting means.

21. In a flat knitting machine provided with at least three carrier rods; a friction device upon said friction rod engageable with two of said three carrier rods to drive said two rods during a traverse of the friction rod, spring driven means for driving the third carrier rod during the same traverse of the friction rod, and means for arresting the traverse of the third rod only, at a point intermediate its full traverse.

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DISCLAIMER

2,018,059.—*Albert Friedmann*, Wyomissing, Pa. CARRIER ROD OPERATING MECHANISM FOR FLAT KNITTING MACHINES. Patent dated October 22, 1935. Disclaimer filed August 25, 1937, by the assignee, *Louis Hirsch Textile Machines, Inc.*

Hereby enters this disclaimer to claim 1 of said patent.

[*Official Gazette September 21, 1937.*]