Nov. 26, 1935. W. HUG 2,022,468

FLAT KNITTING MACHINE

Filed Nov. 15, 1933 4 Sheets-Sheet 1

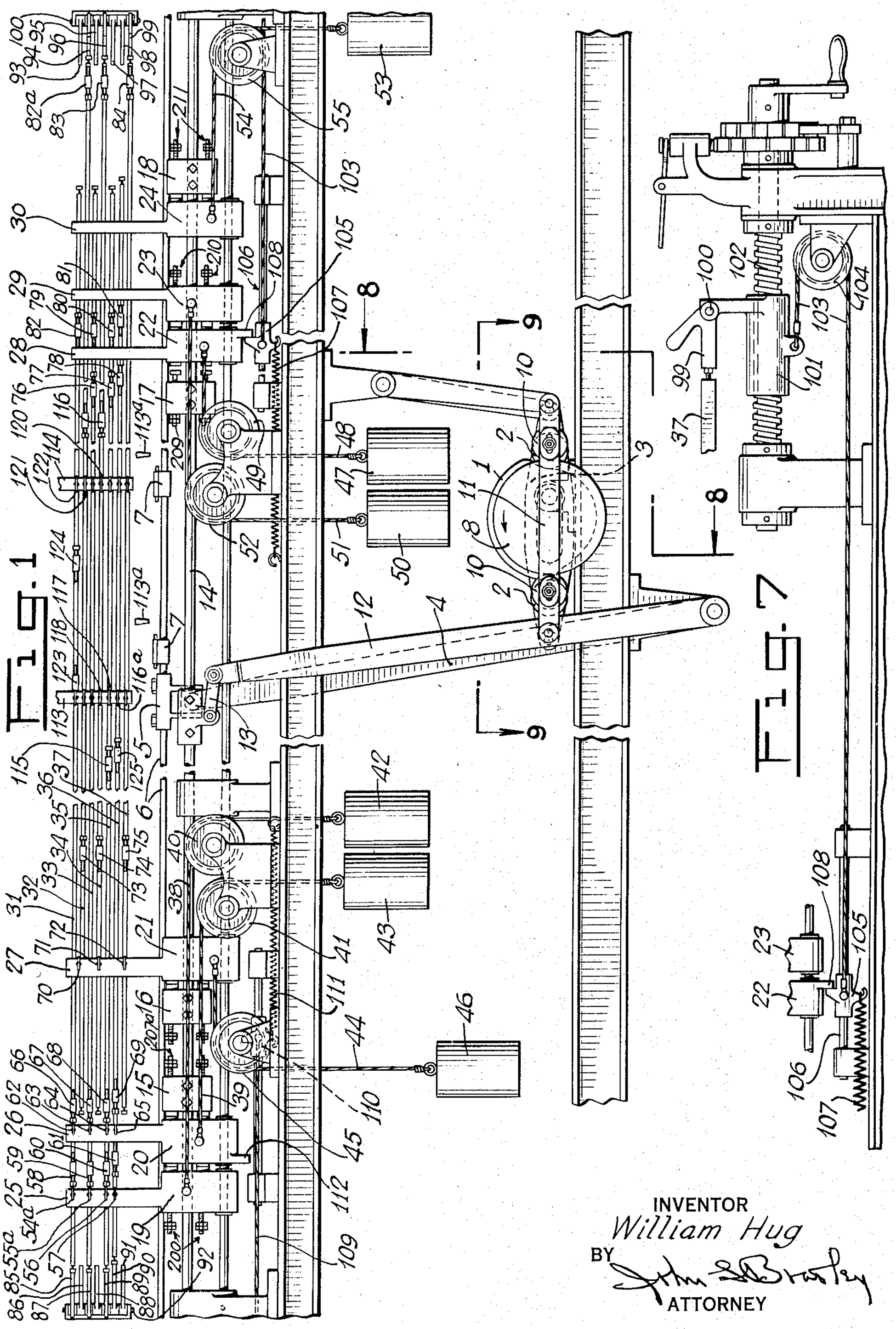

FIG. 1

FIG. 7

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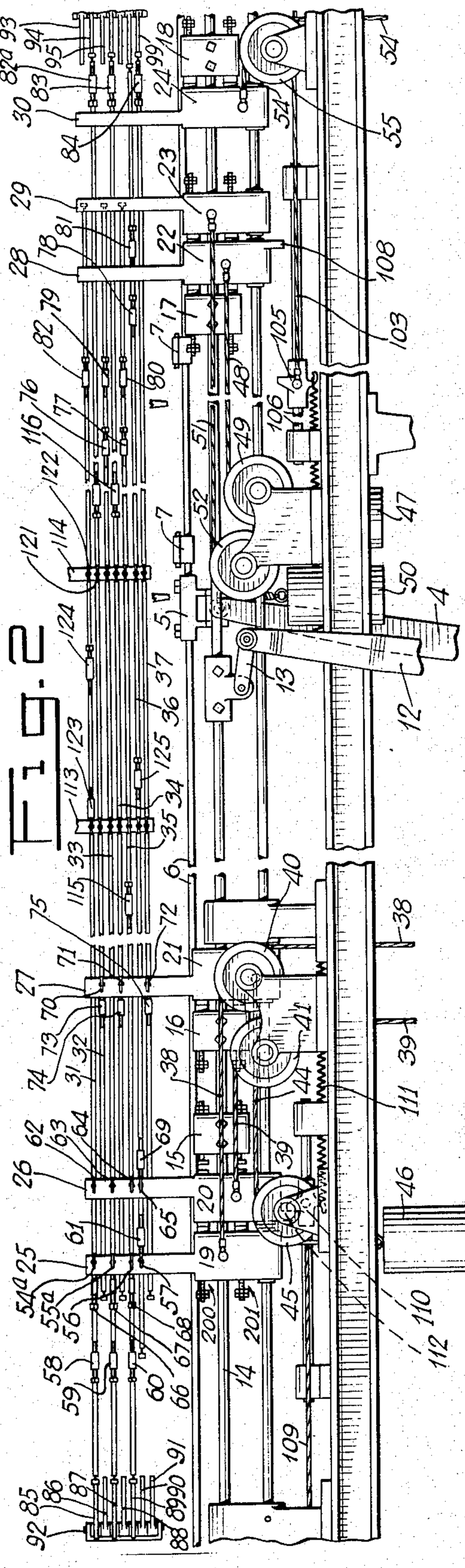

FIG. 2

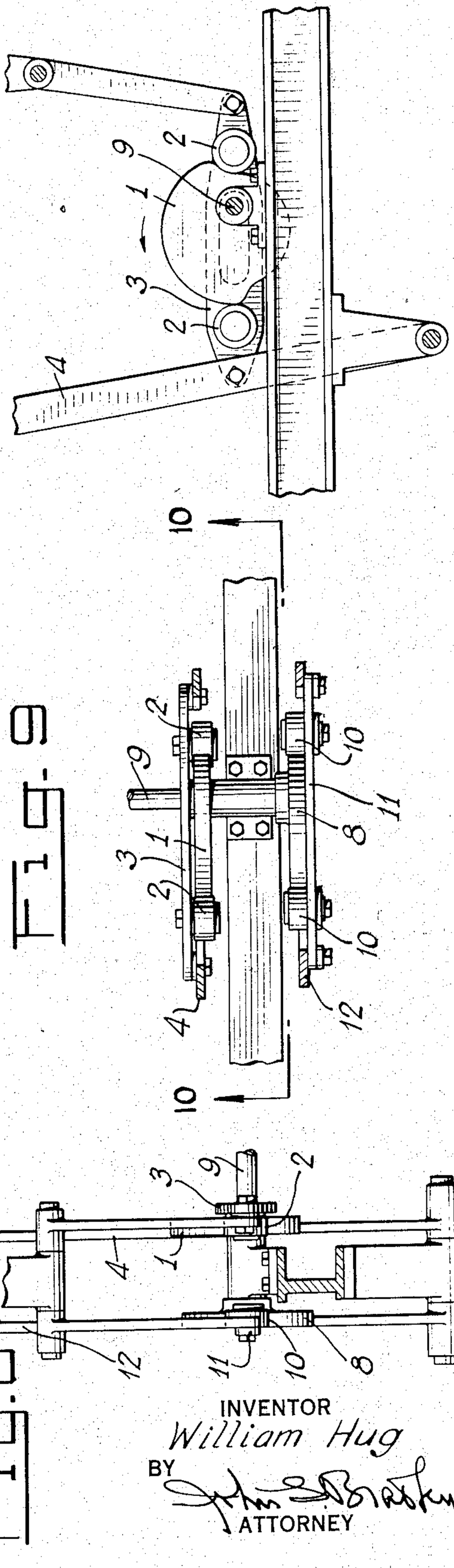

FIG. 1

FIG. 6

FIG. 8

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Fig. 3

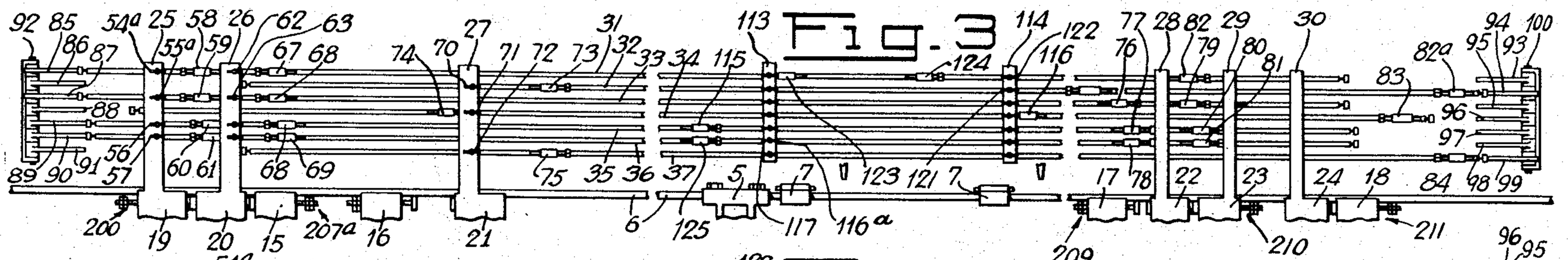


Fig. 4

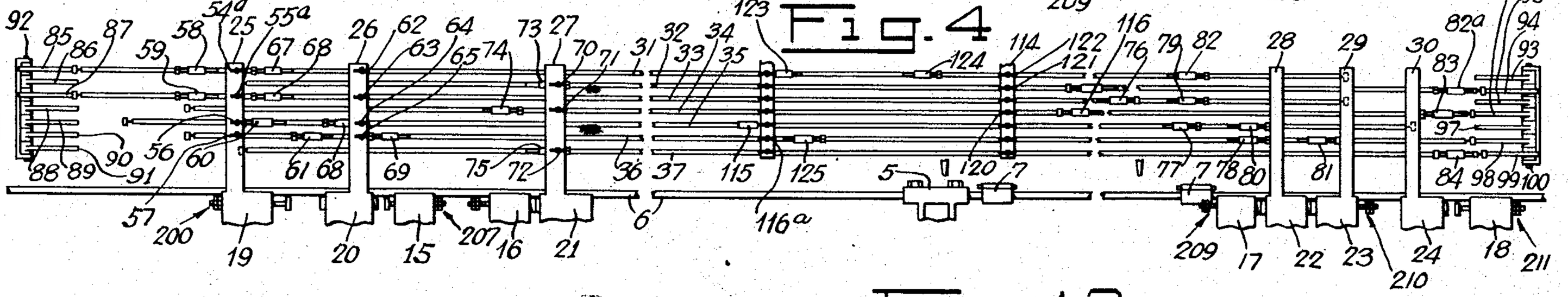


Fig. 12

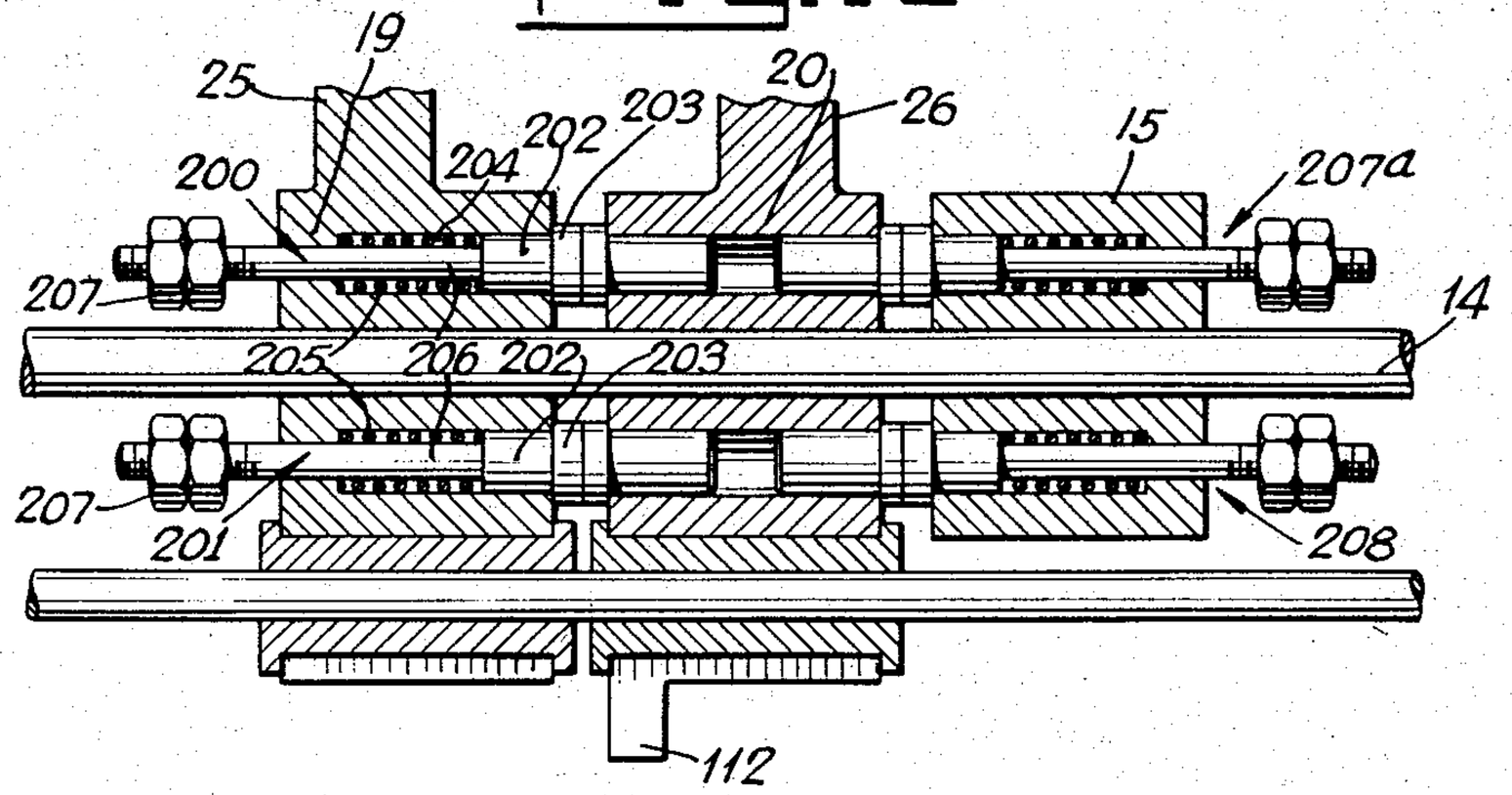
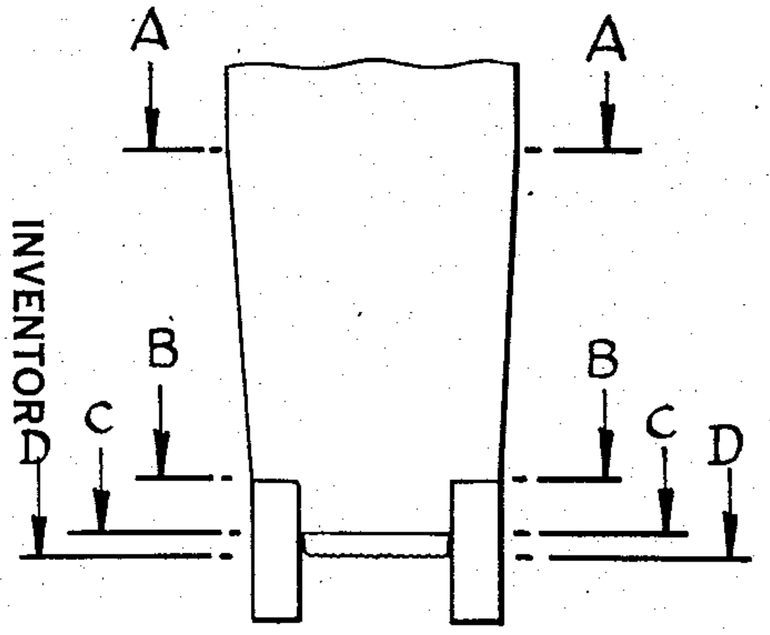


Fig. 11



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FLAT KNITTING MACHINE

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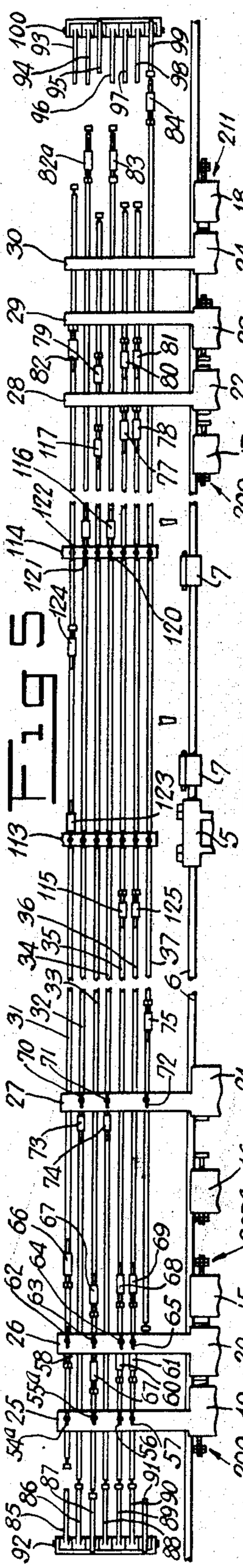

FIG. 5

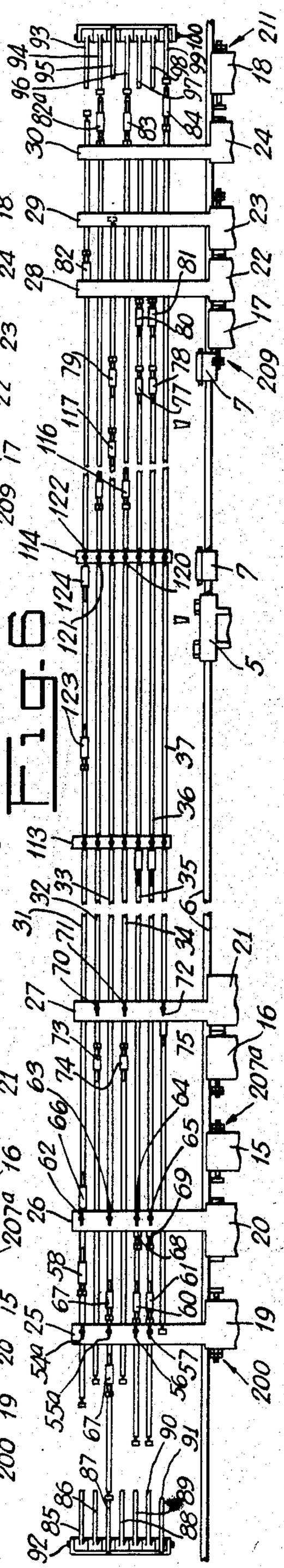

FIG. 6

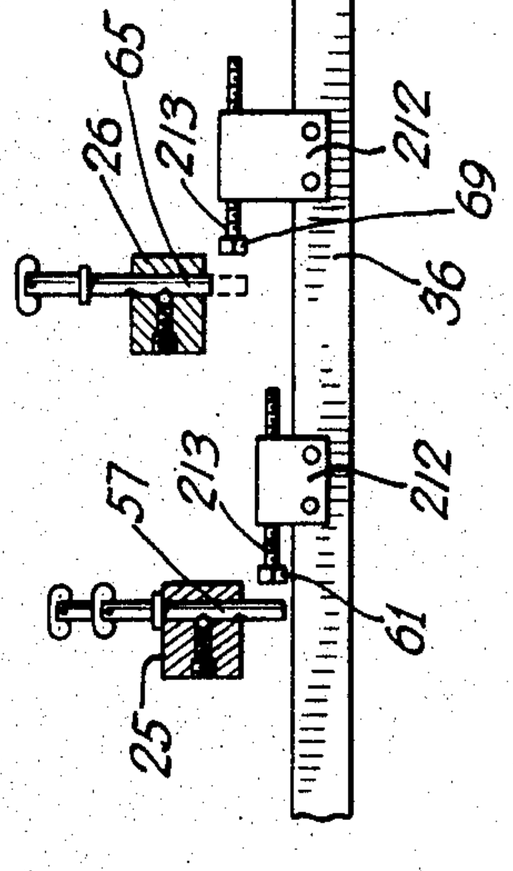

FIG. 14

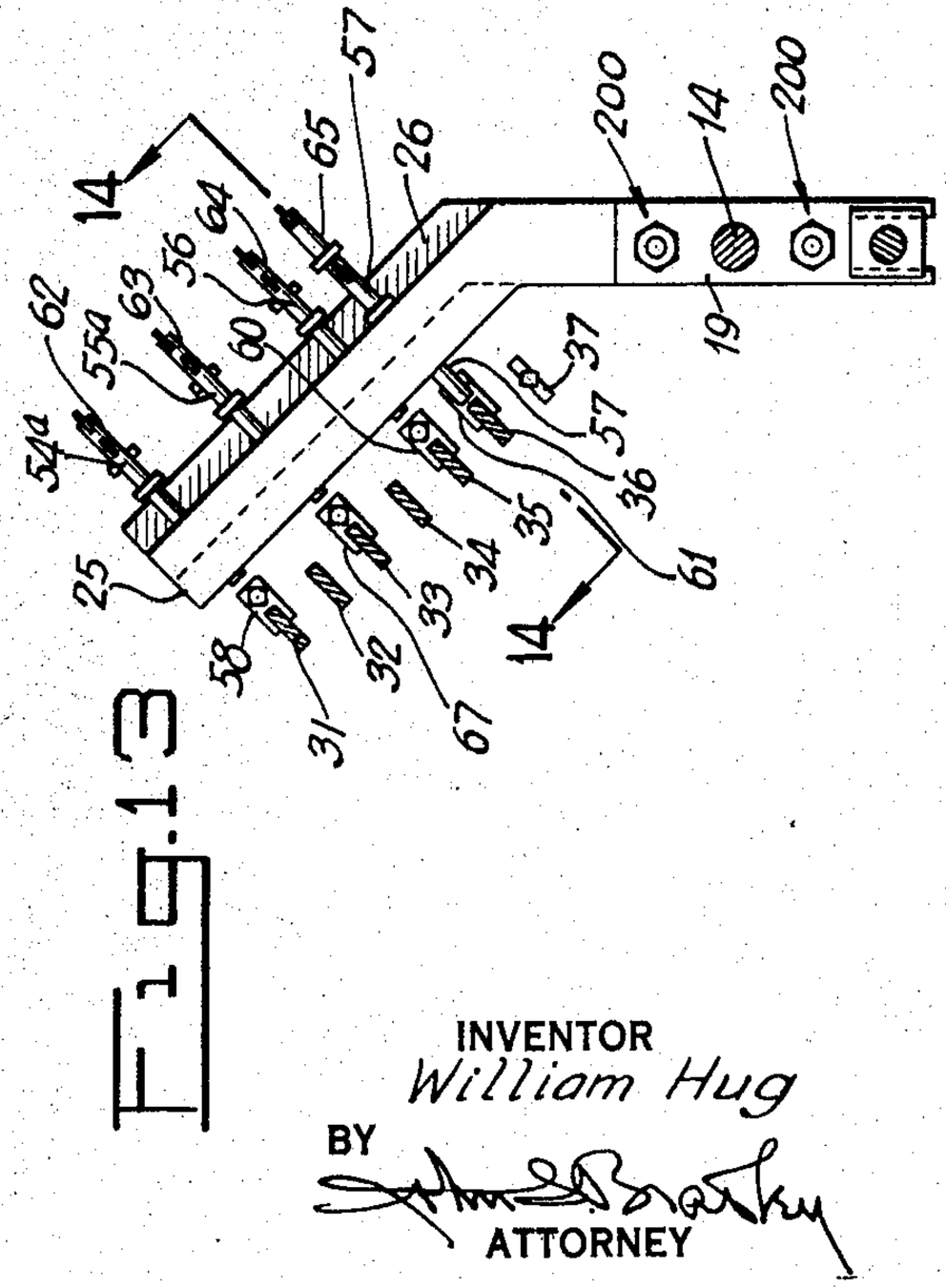

FIG. 13

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UNITED STATES PATENT OFFICE

2,022,468

FLAT KNITTING MACHINE

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Application November 15, 1933, Serial No. 698,080

12 Claims. (Cl. 66—126)

This invention relates to a new and useful improvement in flat knitting machines and specifically to the operating and control mechanisms for the thread carriers and slur cocks.

Among its advantages are the following: The coulier cam is employed to operate the slur cocks only and not both the slur cocks and thread carriers as in the present practice. The thread carriers are operated by a separate cam and separate operating levers which permit of independent regulation and control of either of these mechanisms without affecting the operation of the other. This makes it possible to maintain between carriers and sinkers the very desirable condition of a uniform lead of any desired amount, irrespective of the fact that the slur cocks necessarily travel an unvarying distance, whereas the travel of the thread carriers necessarily varies in knitting different parts of the stockings.

The thread carriers are positively driven, the usual friction drive being eliminated. This greatly reduces the strain upon the machine, reduces vibration, and decreases the power required to operate it. Also the usual shock absorbers and safety levers are unnecessary, all excessive shock and likelihood of rebounding of the carrier rods being prevented by this invention. Plating may be done without a plating attachment through the regular thread carrier mechanism provided. The thread carriers when at rest are accurately held between the sinkers thus reducing needle breakage and defective fabric. Manual movement of the thread carriers is largely eliminated, the new mechanism being automatic to a much greater extent than present mechanisms. The devices which control the travel of the carrier rods are concentrated in one part of the machine instead of being distributed over the entire length of the machine which greatly facilitates adjustment, reduces the danger of error and thus assists greatly in maintaining maximum production and quality of fabric.

These and other advantages are derived from this invention, one form of which is described herein. This form has been selected for purposes of illustration only and not with the intention of limiting the invention thereto. It is illustrated in the drawings, of which

Figures 1 to 6 are diagrammatic views from the rear of the slur cock and thread carrier mechanisms of this invention showing the positions of the various parts at different points of the knitting;

Fig. 7 is a diagrammatic view of a portion of the narrowing head and mechanisms controlled thereby;

Fig. 8 is an end view of the operating cam mechanism of Fig. 1 looking in the direction of the arrow 8;

Fig. 9 is a view of the same mechanism in section on the line 9—9 of Fig. 1;

Fig. 10 is a view of the coulier cam and associated parts from the front of the machine taken on the line 10—10 in Fig. 9;

Fig. 11 is a diagrammatic illustration of a part of a stocking blank;

Fig. 12 is a detailed view of the drive blocks and two associated carrier rod blocks of Fig. 1 located at the left end of Fig. 1;

Fig. 13 is a detailed view partly in section of a carrier rod block and finger; and

Fig. 14 is a detailed sectional view of two carrier rod fingers with their adjustable stops and of a section of a carrier rod with its stop along the line 14—14 of Fig. 13.

The slur cock motion is not affected by this invention with the exception that its separation from the thread carrier motion permits of altering the outline of the coulier cam so that the slur cocks may be caused to approach the jacks at less speed thus reducing the shock and wear upon them. As will be seen the machine is provided with the usual coulier cam 1 which, with rollers 2, operates the usual pitman 3, lever 4 and crosshead 5 to cause slur cock bar 6 and slur cocks 7 to reciprocate over an unvarying distance sufficient to cause the slur cocks to operate properly upon all the jacks.

In present flat knitting machines the same coulier cam and levers are also employed to operate the thread carrier rods. In this invention the thread carrier rods are manipulated by a separate carrier cam 8 on the coulier cam shaft 9. This cam operates through separate rollers 10, pitman 11, and levers 12 and 13 to reciprocate rod 14 ordinarily employed to drive the frictions.

In present machines rod 14 like the slur cock bar 6 travels a uniform distance at each reciprocation, whereas the travel of the carrier rods driven thereby varies considerably. To make this possible the machine is provided with stops adapted to limit the travel of the carrier rods as required, and the carrier rods are connected to the friction rod through the well known friction boxes. Such a friction drive not only places a heavy strain upon the machine and driving mechanism, particularly when several carrier rods are in simultaneous operation, but it also tends to twist the carrier rods so that the thread

carriers are improperly spaced from the needles and sinkers. In addition, if oil or moisture happens to accumulate upon the friction rod, the amount of friction will vary and the inevitable wear of either rod or friction or both produces the same result.

This friction drive has been completely eliminated by this invention and a wholly different and more positive drive employed. On rod 14 are rigidly mounted driving blocks 15, 16, 17, and 18. Slidably mounted on rod 14 are carrier rod blocks 19, 20, 21, 22, 23, and 24 provided with a finger 25, 26, 27, 28, 29, and 30 respectively, overlying the carrier rods 31, 32, 33, 34, 35, 36, and 37. Carrier rod blocks 19 and 20 are positioned adjacent each other on rod 14 and to the left of fixed driving block 15. Carrier rod block 21 is positioned to the right of fixed driving block 16. Attached to carrier rod blocks 19 and 20 are cables 38 and 39 respectively, which pass over pulleys 40 and 41 and terminate in weights 42 and 43. A cable 44 is similarly attached to carrier rod block 21 and passes over a pulley 45 to a weight 46. Thus carrier rod blocks 19 and 20 will normally be urged to the right against fixed block 15 under the influence of weights 42 and 43 and carrier rod block 21 will be urged to the left under the influence of weight 46. It will be evident therefore that when rod 14 is reciprocated blocks 15 and 16 fixed thereto will move with it and carrier rod blocks 19, 20 and 21 will normally follow suit either being driven ahead of a fixed block or following a fixed block through the action of a weight.

Similarly on the other side of the machine are found fixed driving blocks 17 and 18 rigidly attached to rod 14 and another set of three slidable carrier rod blocks 22, 23 and 24 of which block 22 is normally urged to the left against fixed block 17 through the effect of a weight 47 attached thereto by a cable 48 passing over a pulley 49. Carrier block 23 is also urged to the left against carrier block 22 under the urge of weight 50 connected thereto by a cable 51 passing over a pulley 52 and carrier block 24 is normally urged to the right against fixed block 18 under the urge of a weight 53 acting through cable 54 which passes over a pulley 55. Therefore when rod 14 reciprocates the carrier blocks 22, 23, and 24 will also reciprocate correspondingly either being driven ahead of fixed blocks 17 or 18 or caused to follow by weights 47, 50 or 53. It will also be evident that if a finger, 25 for example, is in some way connected to a carrier rod the carrier rod will also be reciprocated carrying with it the thread carrier (not shown).

A suitable driving connection between these parts is provided as follows. Each finger is equipped with a number of adjustable stop pins, best shown in Figs. 13 and 14 overlying certain of the carrier rods and adapted to be slid into the path of stops fixed on the carrier rods. For example, in Fig. 1 finger 25 is provided with four such stop pins 54ª, 55ª, 56, and 57 overlying carrier rods 31, 33, 35, and 36 respectively, and these carrier rods are equipped with corresponding stops 58, 59, 60, and 61 positioned to the right of the finger 25. Similarly finger 26 is provided with four stop pins 62, 63, 64, and 65 overlying the same rods and adapted to engage, respectively, with stops 66, 67, 68, and 69. Finger 27 is provided with three stop pins 70, 71, and 72 engageable, respectively, with stops 73, 74, and 75 on the other three carrier rods 32, 34, and 37. Since each pin may be engaged or disengaged at will any of the four carrier rods 31, 33, 35, and 36 may be engaged with a stop pin on finger 25 or 26, or both, and any of the other thread carrier rods 32, 34, and 37 may be engaged with a stop pin on finger 27.

Fingers 28, 29, and 30 at the other end of the machine require no stop pins for reasons which will become apparent. They are so positioned, however, that finger 28 is engageable with stops 76, 77, and 78 on rods 33, 35 and 36 respectively, finger 29 with stops 79, 80 and 81 on the same rods and also with stop 82 on rod 31, and finger 30 with stops 82ª, 83 and 84 on rods 32, 34 and 37. By means of the carrier rod stops and stop pins described above the six fingers 25, 26, 27, 28, 29, and 30 move the carrier rods back and forth in the manner required for laying the thread during the knitting of the various parts of the stocking.

In order that carrier rod stops 58, 59, 60, and 61 may pass under carrier finger 26 as is required at certain points in the knitting, finger 26 is in a higher position than finger 25 so that stops 58—61 will pass freely thereunder even though stop pins 62—65 are down in operative position. Carrier rod stops 66—69 are also higher than stops 58—61 so that they can engage with the stop pins 62—65 of higher finger 26. See Fig. 14.

Similarly finger 28 is in a higher position than finger 29 so that carrier rod stops 79—82 may pass thereunder without striking finger 28, and carrier rod stops 76—78 are also higher than stops 79—82 so that they can engage with finger 28.

The extreme movement of the carrier rods is limited, as in present machines by stop levers 85, 86, 87, 88, 89, 90, and 91 pivotally mounted upon a shaft 92 at one end of the machine and stop levers 93, 94, 95, 96, 97, 98, and 99 pivotally mounted upon a shaft 100 at the other end. Thus any one or any number of them may be swung out of the way and the corresponding thread carriers moved by hand completely out of the field of operation by manually sliding the end of the carrier rod into the space vacated by the stop lever. Stop levers 85—91 and 93—99, as is well known, are carried by the narrowing heads at each end of the machine, the shaft upon which they pivot being mounted upon an internally threaded nut or block 101 (Fig. 7) which engages with a threaded spindle 102. By rotating spindle 102 the stop levers may be moved inwardly or outwardly and the travel of the thread carriers correspondingly limited. During the narrowing operation the stop levers 85—91 and 93—99 are automatically moved inwardly by mechanism linked to the narrowing mechanism at a rate corresponding to the decreasing width of the fabric and the distance of travel of the thread carriers involved progressively lessened.

This mechanism is standard in present day machines. It is employed in this invention not only for its original purpose as described above but also in connection with novel features. Attached to block 101 is a cable 103 which runs around a pulley 104 to a stop block 105 sliding upon a rod 106, longitudinally and rigidly mounted upon the machine frame. Cable 103 is held taut by a spring 107 attached to a stop block 105 and to the frame of the machine so that at any movement of block 101 through the rotation of spindle 102 stop block 105 will move a corresponding amount. However, because of the arrangement of cable 103 the motion of stop block

105 will be in the opposite direction to that of block 101. Hence when block 101 is racked inwardly while the machine is narrowing stop block 105 will be moved outwardly the same distance. As will be seen from Fig. 1 carrier rod block 22 is provided with a lug 108 engageable with stop block 105 so that the movement of carrier rod block 22 to the left may be limited by stop block 105. The purpose of this arrangement will be described later.

On the other end of the machine is a similar arrangement to that shown in Fig. 7 arranged to operate in the opposite direction. This narrowing head is not shown in the drawings nor the pulley corresponding to pulley 104 but the cable, sliding stop block, and restraining spring are shown in Fig. 1 at 109, 110, and 111 respectively. Carrier rod block 20 is provided with a lug 112 engageable with stop block 110 so that the inward travel of carrier rod block 20 may be limited by the position of stop block 110 in a manner similar to that in which stop block 105 at the other end of the machine may limit the travel of carrier rod block 22.

The function and operation of the parts described above can best be described in connection with the knitting of the various parts of a stocking such as that diagrammatically illustrated in Fig. 11.

In Fig. 1 the machine is shown arranged for the knitting of the leg. Since only one thread carrier is required for knitting this part of the stocking carrier rod 36 has been selected. Stop levers 85, 87, and 89 on the left are thrown up and the corresponding carrier rods 31, 33, and 35 are pushed to the left out of knitting position. Similarly on the right stop levers 94, 96, and 99 are thrown up and carrier rods 32, 34, and 37 pushed over to the right out of knitting position. Stops 90 and 98 are down in operative position and the left end of carrier rod 36 rests against stop 90 thus placing the corresponding thread carrier at the left end of its travel.

Coulier cam 1 and carrier cam 8 are in that position in which levers 4 and 12 are swung to the extreme left. This places slur cock bar 6, slur cocks 7, rod 14, drive blocks 15, 16, 17, and 18, carrier blocks 19, 20, 21, 22, 23, and 24, and the corresponding carrier fingers 25, 26, 27, 28, 29, and 30 at the extreme left of their travel also.

Stop pins 57 and 65 on carrier fingers 25 and 26 respectively, are in operative position to engage with stops 61 and 69 on carrier rod 36. All the other stop pins on carrier fingers 25, 26, and 27 are in their inoperative position. Stops 78 and 81 on the right end of carrier rod 36 are in engagement with the left side of carrier fingers 28 and 29. Thus carrier rod 36 is held between end stop 90 on the left and fingers 28 and 29 on the right. There is, however, a small clearance between carrier fingers 25 and 26 and the respective carrier rod stops 61 and 69. There is also the same clearance between carrier rod block 22 and drive block 17 due to the fact that stops 78 and 81 and stop block 105 have prevented finger 28 from following drive block 17 to its extreme left position. Thus the carrier rod is operatively separated by a small space from the coulier cam and its connecting mechanism and is, consequently, unaffected by any slight motion of those parts. This and the fact that the carrier rod is held between stops insures that the thread carrier will be maintained in proper relation to the sinkers at the end of each stroke and cannot possibly rebound or otherwise move out of correct position. The thread carriers on rod 36 are diagrammatically shown at 113a to the right of the corresponding slur cock 7. Since the slur cocks and thread carriers are operated by different cams and levers the timing and relation of their movements can be varied at will. For example, the slur cocks may be made to approach the end jacks at low speed thus obtaining a very desirable reduction in the wear upon these jacks and a smoother sinker movement and at the same time the thread carrier may be in faster motion under control of its separate operating mechanism so that when the slur cocks reach the jacks the desired lead between the slur cocks and thread carriers has been established after which this same lead may be maintained throughout the knitting stroke.

Assume now that the coulier and carrier cams 1 and 8 have made one-half revolution from the positions shown in Fig. 1 so that the slur cocks and carrier fingers have been transported to their extreme right position as shown in Fig. 2. Carrier rod 36 has also been shifted to the right carrying its thread carrier with it by carrier fingers 25 and 26, acting against carrier rod stops 61 and 69, but the carrier rod is securely held between end stop 98 and fingers 25 and 26. Also the original clearance between drive block 17 and carrier block 22 has been transferred to between drive block 15 and carrier block 20, the tendency of carrier block 20 to follow drive block 15 having been interrupted by stops 61 and 69 and block 110. Thus at this end of the carrier rod stroke also the carrier rod is isolated from the effect of any small movement of the cams and connections which might throw the thread carrier out of its correct position with respect to the sinkers. From the point of view of the following stroke the parts assume exactly the same relation. The next stroke will, of course, return the parts to the positions shown in Fig. 1 and so on until the leg of the stocking shown in Fig. 11 is completed as far as the broken line A—A where the narrowing is assumed to begin.

When narrowing, the narrowing heads function in their customary manner, stop levers 85 to 91 and 93 to 99 carried by nut 101 and the corresponding nut at the other end of the machine being racked inwardly step by step in time with the positioning of the narrowing points. This step by step inward movement produces an equivalent step by step outward movement of stop blocks 105 and 110 with the result that the travel of carrier fingers 26 and 28 will be correspondingly shortened. The relative positions of the parts remains as shown in Figs. 1 and 2 but the clearance between drive block 17 and carrier block 22 will be increased over that shown in Fig. 1 and the clearance between drive block 15 and carrier block 20 will be correspondingly increased when the parts are in the position shown in Fig. 2. This is evident from the fact that the distance of travel of the drive blocks is always the same, whereas the tendency of the fingers to follow the blocks under the urge of the weights attached thereto is arrested when lugs 112 and 108 engage stop blocks 110 and 105 respectively, this occurring at progressively earlier periods in the strokes of the carrier rod throughout the narrowing.

One of the important results of this is that the thread carriers instead of beginning to move when the slur cocks start do not move until the clearances between the carrier drive blocks have been closed so that the lead between the slur cocks

and thread carriers remains the same throughout. It is well known that the progressively increasing lead resulting from narrowing which cannot be avoided in present day machines is very undesirable and the cause of much imperfect knitting.

It will now be assumed that the stocking has been completed as far as the broken line B—B in Fig. 11 at which point the knitting of the heel tabs begins. From this point to that at which the knitting of the instep is discontinued (indicated by the broken line C—C in Fig. 11) three thread carriers are, of course, required, one which may be the original carrier upon rod **36** which will continue to lay the thread the full width of the narrowed stocking, and two others, one for each heel tab. These will be assumed to be attached to carrier rods **35** and **34**. See Figs. 3 and 4.

Carrier rod **36** and its driving mechanisms requires no readjustment of any sort. It continues to propel its thread carrier across the width of the narrowed fabric as described above. Rod **35** it will be assumed bears the auxiliary thread carrier for the right heel tab of Fig. 11 and rod **34** the auxiliary thread carrier for the left heel tab. Since in Figs. 1–6 the machine is being viewed from the rear the thread carrier mechanisms will appear in the reverse position in these figures, the thread carriers functioning on the right operating on the left heel tab and vice versa. This method of description which follows the custom of the trade should be borne in mind during the following discussion to avoid confusion.

The travel of carrier rods **35** and **34** will, of course, be reduced to that sufficient to cause their thread carriers to traverse the width of the respective heel tabs only. To effect this carrier fingers **25** and **28** are utilized to drive rod **35** and fingers **27** and **30** to drive rod **34**. Also additional stop arms **113** and **114** are provided which are either automatically or manually controlled so that they may be positioned at any desired point longitudinal of the machine. Carrier rod **35** also bears an additional stop **115** so positioned that it will strike arm **113** when carrier rod **35** has completed its travel to the right. Carrier rod **34** is also provided with a similar stop **116** so positioned that it will strike arm **114** when rod **34** has traveled a similar distance to the left, the distance in each case being that traversed by the thread carrier in laying down the reenforcing thread for each heel tab. In Fig. 3 the thread carrier mechanism is shown at the end of its stroke to the left as in Fig. 1. However, in Fig. 3 since carrier rods **35** and **34** will be used in addition to carrier rod **36**, stop levers **88** and **89** at one end, and **96** and **97** at the other end have been thrown down into operating position, and rod **35** bears against end stop **89**. Stop pin **56** on carrier finger **25** has also been pushed down into operative position so as to be engageable with stop **60**. Carrier rod **34** has been moved to the left until stop **116** strikes arm **114** and stop **74** strikes stop pin **71** on finger **27**. Rods **36**, **35** and **34** are now in position to lay a course from left to right for the knitting on the upper portion of the heel tabs and the intermediate instep portion. When the carrier rod driving mechanism makes its stroke to the right towards the position shown in Fig. 4 carrier fingers **25** and **26** first move to close the gap between them and stops **61** and **60** and **69** and **68**, and then move rods **36** and **35** to the right, rod **36** being driven by stop pin **65** on finger **26** and rod **35** by stop pin **56** on finger **25**. Rod **35**, however, after its thread carrier has traversed the width of the right heel tab will strike, by means of its stop **115**, fixed stop **113**. Since this rod is driven by carrier finger **25** under the pull of weight **43** finger **25** will also stop, the other fingers **26** and **27** continuing on without it. Since the pull of weight **43** is constant upon finger **25** rod **35** will at the end of the stroke to the right be held between that finger and stop finger **113**.

During the same stroke to the right rod **34** has been driven to the right a similar distance until it strikes end stop lever **96**. This is accomplished by carrier finger **30** which after traversing the gap shown in Fig. 3 between it and stop **83** at the right end of rod **34** strikes stop **83** and by means of it carries the rod to the right until, as already stated, it hits end stop **96** against which it is held by finger **30** acting on stop **83**. At this point finger **30** also stops since it is not permitted to travel further by stop **83**, drive block **18** going on to the end of its stroke without it as shown in Fig. 4. Simultaneously, of course, the slur cocks have performed their travel to the right. The result of the operation as described above is shown in Fig. 5, rods **36**, **35**, **34** having traveled the required distances to the right for the laying of the threads and being positioned as shown in Fig. 4 ready for the return stroke. When this occurs rod **35** is driven back to the left by finger **28** which engages with stop **77**. Rod **34** is returned to the left by finger **27** which engages and propels stop **74**, and rod **36** is returned as already described, by carrier finger **29** operating upon stop **81**, the parts resuming at the end of the stroke the positions shown in Fig. 3. Through repeated strokes of this character the upper part of the heel tabs and intervening instep portion of the stocking are knit, that is to say, the section lying between broken lines B—B and C—C of Fig. 11. The lead between the slur cocks and thread carriers still remains the same for the reasons already stated.

There remains the completing of the heel tabs and the knitting of a number of raveling courses following the completion of the instep before the stocking is transferred from the legger to the footer. To carry out these operations five thread carriers are required, two for each heel tab, and one for the intermediate raveling courses. See Figs. 5 and 6. Rods **35** and **34** which are already working on the heel tabs will be continued and rod **36** which has already carried the thread of which the leg has been knit into the upper portion of each heel tab may be continued as the other carrier for one of the heel tabs, say the right heel tab. In addition another rod **32**, its carrier threaded with the same sort of thread as the carrier of rod **36** will be brought into play as the second carrier rod in knitting the remaining portion of the left heel tab. A fifth rod **31** will also be used for knitting the raveling courses which ordinarily follow the instep portion as indicated in Fig. 11 between the broken line C—C and D—D. Auxiliary stop arms **113** and **114** will remain in operating position. Carrier rod stops **123** and **124** will also function in the control of carrier rod **31** and also an additional stop **125** on carrier rod **36**. The end stops corresponding to the carrier rods in operation will, of course, also be thrown down into operative position.

The position of the carrier rods and related parts at the beginning of the stroke to the right

is shown in Fig. 5. Upon this stroke rod 36, now working upon the right heel tab is driven to the right by finger 25, acting upon stop 61 through stop pin 57 which is pushed down. Its companion rod 35 is also driven to the right the same distance by finger 25 by means of stop pin 56 and stop 60. Working upon the left heel tab rod 34 is driven to the right by finger 30 acting upon stop 83 until it is stopped by end stop 96. Rod 32 also working upon the left heel tab is driven to the right the same distance by finger 30 acting upon stop 82a. The distance traveled by each of these rods is only that required for the heel tabs. Rod 31, however, must travel the greater distance of the instep raveling courses and must lay the thread only between the inner edges of the heel tabs instead of entirely across the fabric as heretofore. For this reason stop 123 on rod 31 is so positioned that when the rod is positioned at the extreme left as shown in Fig. 5 finger 26 which will drive it through stop 66 will not make contact with stop 66 until rods 36, 35, 34 and 32 have completed their strokes. Then finger 26 continues to move until stop 124 on rod 31 strikes fixed stop 114. The distance between stops 113 and 114 is, of course, equal to the width of the instep.

The parts are now in the position shown in Fig. 6 and ready for the return stroke to the left. Rod 31 is the first to be moved. This is accomplished by finger 29 acting against stop 82 to drive the rod until stop 123 strikes fixed stop arm 113. This completes the instep raveling course. Meanwhile arm 27 has moved up to stops 73 and 74 on carrier rods 32 and 34 and arm 28 has moved up to stops 77 and 78 on rods 35 and 36 and these fingers continue on to drive these four rods back to their original positions against the end stops at the left shown in Fig. 5.

The three knitting movements described will be sufficient to make the method of operation of the invention clear to those skilled in the art. It will be understood that the arrangement of carrier rods selected for the various operations described may be varied to suit the desires and convenience of the knitter and that the arrangement of stops and stop pins shown may also be varied and added to as need arises.

It will be noted that the carrier rods are driven not by frictions but by simple direct pressure so that they can slide freely without any twisting strains; that the rods as they travel and particularly at their rest positions at the end of each stroke are held between stops and physically separated from their driving gear so that they cannot be jarred or otherwise moved out of correct position and cannot assume an incorrect position through the displacement of the driving mechanism, a common occurrence with the old friction drive; that the lead between thread carriers and slur cocks is maintained at a constant amount irrespective of the part of the fabric being knit and that the slur cock and thread carrier actions since they are independent, can each be made to operate to best advantage. This feature is of particular value at the beginning and end of the strokes since the speed of the slur cocks can be reduced to cause them to strike the end jacks with less violence while the speed of the thread carrier motion can be made great enough to establish the desired lead when the slur cocks reach the jacks.

Certain details remain to be described.

Fig. 12 is an enlarged diagrammatic sectional view of drive block 15 and carrier rod blocks 19 and 20. As already explained drive block 15 is fastened to rod 14 whereas carrier rod blocks 19 and 20 are slidably mounted upon rod 14. Block 19 is provided with spring bumpers or shock absorbers 200 and 201. Each consists of a piston 202 slidably mounted in the block terminating in a head 203 which faces carrier block 20. Within a recess 204 in block 19 is a spring 205 surrounding the stem 206 of piston 202 which tends to urge head 203 to the right as far as permitted by nuts 207 on the other end of the stem. Similar shock absorbers 207a and 208 are provided for drive block 15 but acting against carrier block 20 in the opposite direction. Whenever during the knitting carrier block 20 is separated from block 19 or block 15 from block 20 contact is temporarily maintained between the heads of these shock absorbers so that the blocks are not abruptly pulled apart but the separation is effected gradually. Conversely when the blocks come together again contact is first made by the heads of the shock absorbers and actual contact of the blocks resisted somewhat by the springs so that the shock is greatly lessened. This greatly improves the smoothness of working of the thread carriers and lessens the wear upon the parts. Of course spring 205 of each shock absorber is of sufficiently less strength than the pull of the weights attached to blocks 19 and 20 so that the proper working of these blocks is not delayed excessively. The object is simply to relieve the initial and greatest shock but this is of great value. Similar shock absorbers 209, 211, and 210 are provided in drive blocks 17 and 18 and carrier rod block 23 respectively, so that these blocks and carrier rod blocks 22 and 23 are also protected against undue shock.

Emphasis has been placed upon the maintenance of an unvarying lead between the slur cocks and thread carriers. This, as is now evident, is made possible by the elastic coupling between the drive blocks and carrier rod blocks maintained by the weights which make is possible to time the starting and stopping of the carrier rods without regard to the status of the driving gear. However, it is necessary at times to change the amount of lead. For example, when plating the lead should be much shorter for the plating thread so that it will be held directly above the other thread when the loops are formed by the sinkers. This is easily accomplished by this invention. Each of the carrier rod stops, as will be seen from Fig. 14, consists of a block 212 fixed to the carrier rod and a screw 213 threaded therethrough, the head of which acts as the actual stop. By turning this screw in or out the position of the stop upon the rod is changed in one direction or the other. The effect of this is to move the thread carrier towards or away from its slur cock, in other words, to decrease or increase the lead.

It will be understood that the shapes, construction and arrangement of the machine and its parts shown herein may be varied greatly without exceeding the scope of this invention.

I claim:

1. In a flat knitting machine having slur cocks, carrier rods and an operating rod for the thread carrier rods; means for reciprocating said operating rod, a drive block fixed to said operating rod, means for reciprocating said carrier rods slidably mounted on said operating rod and means for yieldably holding said reciprocating means against said drive block.

2. In a flat knitting machine having slur cocks,

and an operating rod for reciprocating the thread carrier rods; means for reciprocating said operating rod, a drive block fixed to said operating rod, and means for operating said carrier rods slidably mounted on said operating rod, means for yieldably holding said operating means against said drive block, and means for separating said operating means from said drive block at any desired point of the reciprocation of said operating rod within the limits of variation of carrier rod travel provided for narrowing.

3. In a flat knitting machine having a slur cock bar, an operating rod; and carrier rods, means slidably mounted on said operating rod for operating said carrier rods, means for reciprocating said operating rod, means fixed to said operating rod for moving said carrier rod operating means in one direction, and means attached to said carrier rod operating means for moving it in the opposite direction.

4. In a flat knitting machine having thread carrier rods and a coulier cam shaft provided with a cam; carrier rod operating mechanism comprising a drive rod reciprocable by said cam, a block slidably mounted on said drive rod, a drive block fixed to said drive rod so as to drive said slidable block in one direction when said drive rod is moved in that direction, means attached to said slidable block to drive it in the other direction when said drive rod is moved in that direction, means for bringing said slidable block to rest during the reciprocation of said rod in the last mentioned direction, and means for moving said last mentioned means outwardly towards the end of the machine a predetermined amount between predetermined courses of the knitting.

5. In a flat knitting machine having carrier rods, carrier rod operating mechanism comprising a driving rod, driving blocks fixed thereon, driven blocks slidably mounted thereon, means attached to the driven blocks normally retaining them against said driving blocks, and a multiplicity of driving connections between said driven blocks and said carrier rods each of which is capable of driving a rod in one direction.

6. A flat knitting machine having thread carrier rods and a coulier cam shaft provided with a cam; carrier rod operating mechanisms according to claim 4 in which the means for bringing the slidable block to rest during the reciprocation of the drive rod consists of a stop adjustable longitudinally of the path of reciprocation of the slidable block and engageable with said slidable block.

7. In a flat knitting machine having thread carrier rods, narrowing mechanism and a coulier cam shaft provided with a cam; carrier rod operating mechanism comprising a drive rod reciprocable by said cam, a block slidably mounted on said drive rod, a drive block fixed to said drive rod so as to drive said slidable block in one direction when said drive rod is moved in that direction, means attached to said slidable block to drive it in the other direction when said drive rod is moved in that direction, means for bringing said slidable block to rest during the movement of said drive rod in the last mentioned direction, and means for moving said last mentioned means outwardly towards the end of the machine a predetermined amount between predetermined courses of the knitting and synchronously with and proportionately to the corresponding motion of the narrowing mechanism.

8. In a flat knitting machine having slur cocks, carrier rods and an operating rod for the thread carrier rods; means for reciprocating said operating rod, a drive block fixed to said operating rod, means for reciprocating said carrier rods slidably mounted on said operating rod, means for yieldably holding said reciprocating means against said drive block, and a shock absorber in said drive block.

9. In a flat knitting machine having slur cocks, carrier rods and an operating rod for the thread carrier rods; means for reciprocating said operating rod, a drive block fixed to said operating rod, means for reciprocating said carrier rods slidably mounted on said operating rod, means for yieldably holding said reciprocating means against said drive block, and a shock absorber in said reciprocating means.

10. In a flat knitting machine having a slur cock bar, a thread carrier operating rod, thread carrier rods operated therefrom provided with thread carriers, means for reciprocating said operating rod a fixed distance, means slidably mounted on said operating rod and connected to said carrier rods for moving said rods in one direction over varying distances as required for laying the thread for different courses by the thread carriers, similar and similarly mounted and connected reciprocating means for driving said carrier rods in the other direction for similar varying distances, a yielding non-frictional drive for propelling one of said carrier rod reciprocating means in one direction, a similar drive for propelling it in the other direction, and separate non-yielding means for propelling each of said carrier rod reciprocating means in the opposite direction.

11. A flat knitting machine according to claim 3 characterized in that the carrier rod reciprocating means is provided with means for selecting the carrier rod which it is to reciprocate.

12. A flat knitting machine according to claim 3 characterized in that the carrier rods are provided with stops and the carrier rod reciprocating means is also provided with stops, each of which is engageable with and disengageable from the stop on a different carrier rod.

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