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Fig. 1.

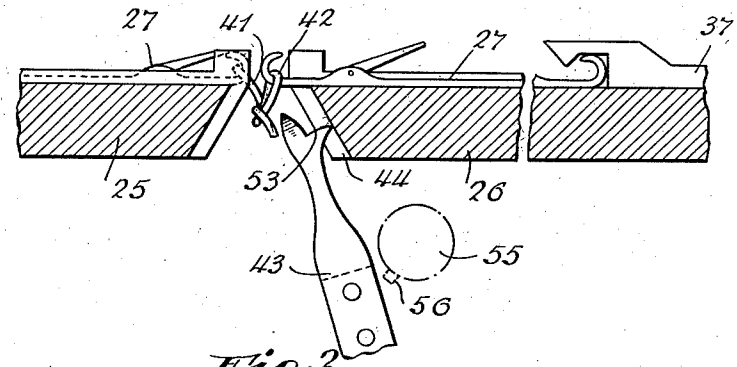


Fig. 2.

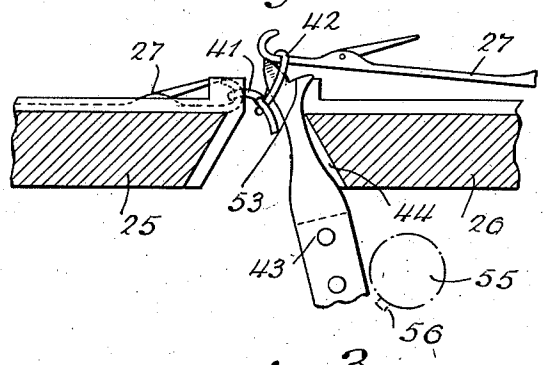


Fig. 8.

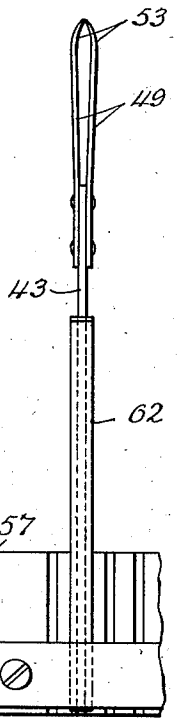


Fig. 7.

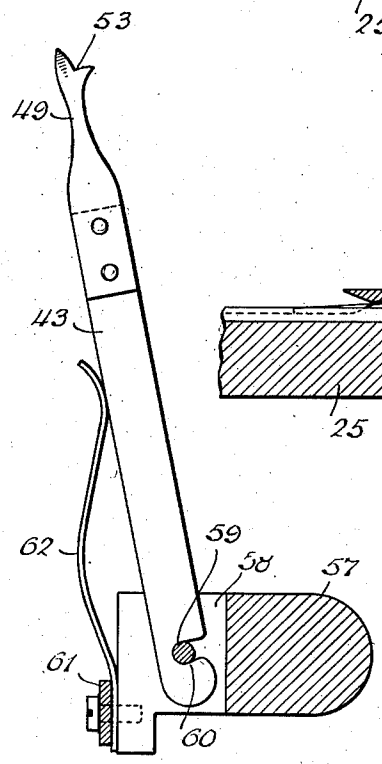
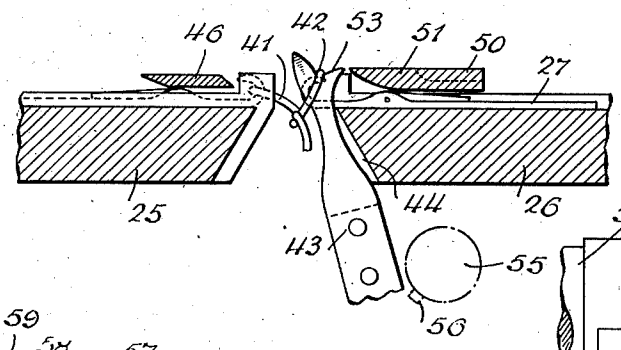


Fig. 3.



INVENTORS
MICHAEL ZIMIC
ANTON MISKOVSKY
BY
Mueller & Ruhl
ATTORNEYS

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Fig. 4.

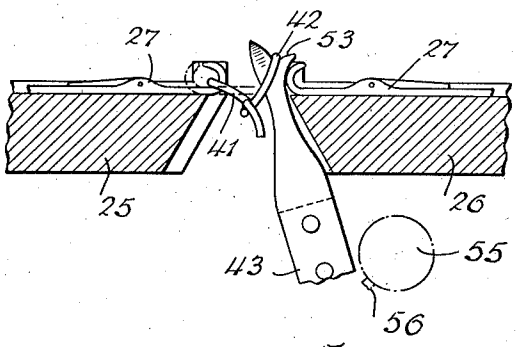


Fig. 5.

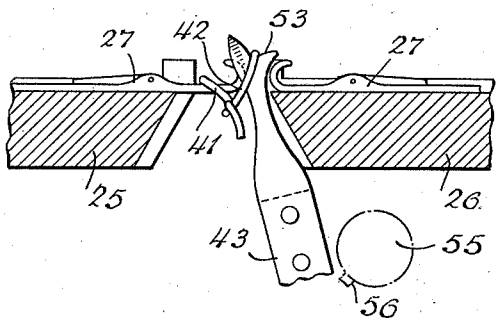
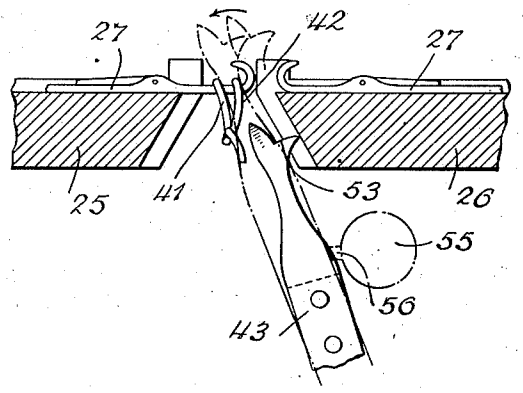


Fig. 6.



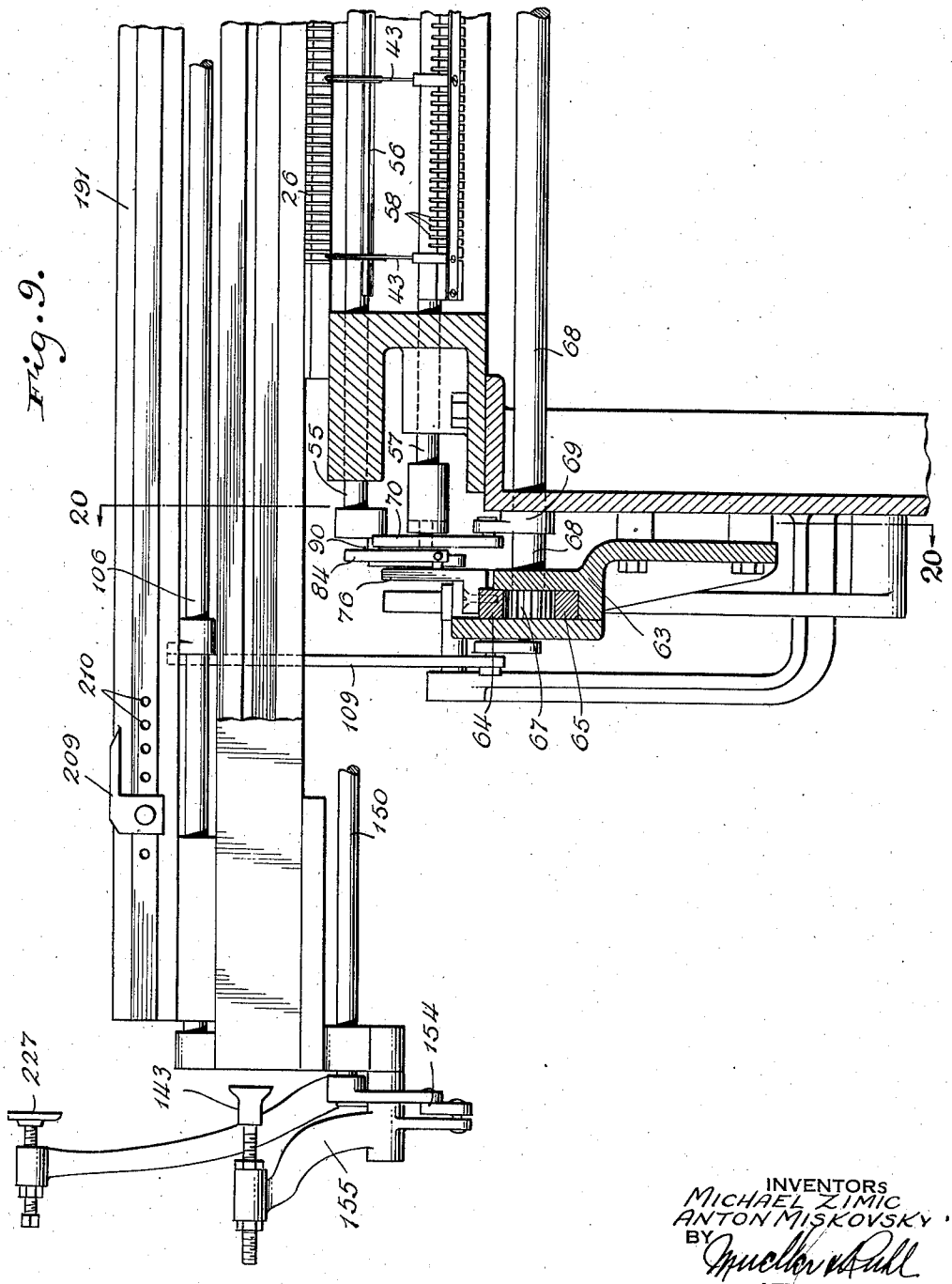
INVENTORS
MICHAEL ZIMIC
ANTON MISKOVSKY
BY
Mueller & Rubl
ATTORNEYS

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Fig. 9.



INVENTORS
MICHAEL ZIMIC
ANTON MISKOVSKY
BY
ATTORNEYS

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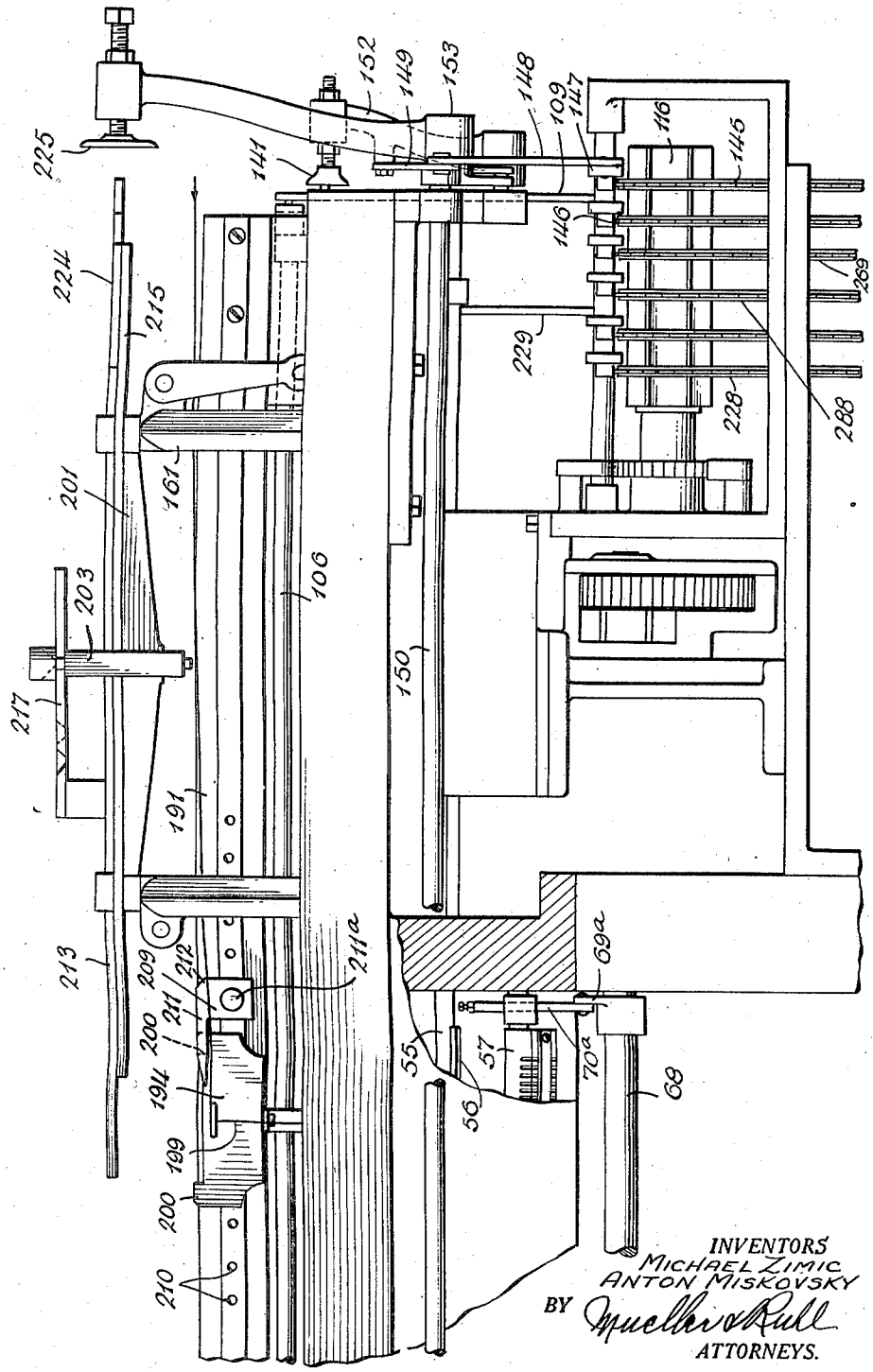


Fig. 10.

INVENTORS
MICHAEL ZIMIC
ANTON MISKOVSKY
BY Mueller & Rull
ATTORNEYS.

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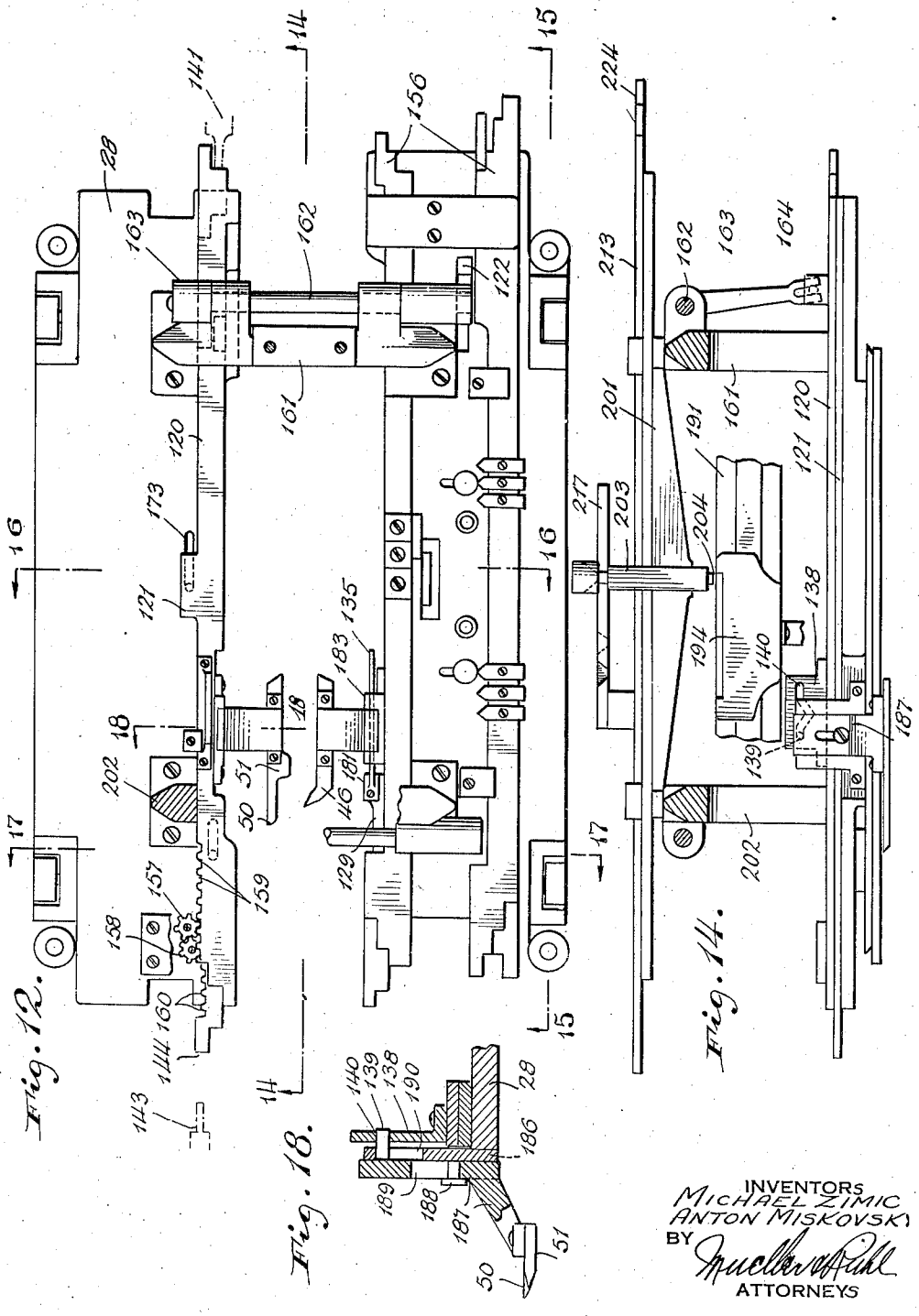


Fig. 12.

Fig. 18.

Fig. 14.

INVENTORS
MICHAEL ZIMIC
ANTON MISKOVSKI
BY Mueller & Hall
ATTORNEYS

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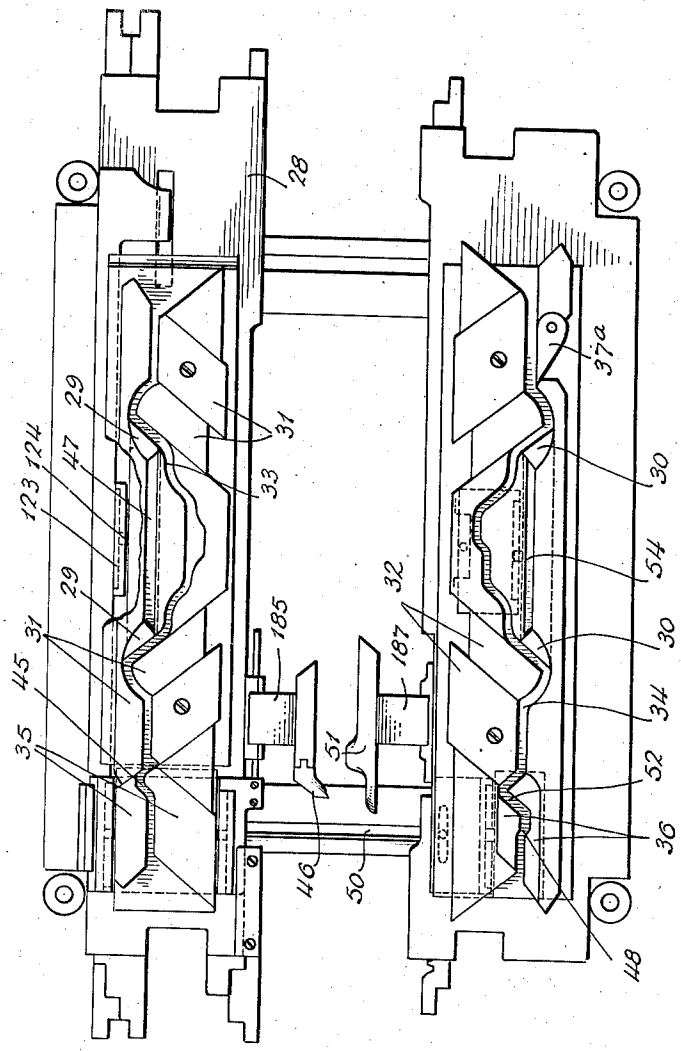


Fig. 13.

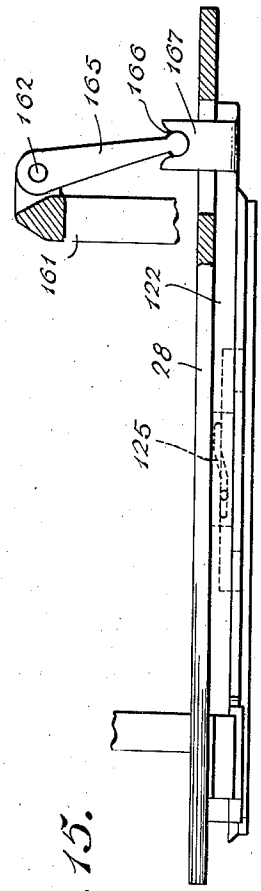


Fig. 15.

INVENTORS
MICHAEL ZIMIC
ANTON MISKOVSKY
BY Mueller & Rudd
ATTORNEYS

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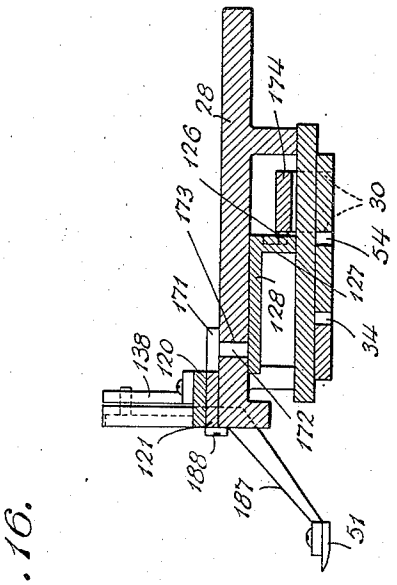


Fig. 16.

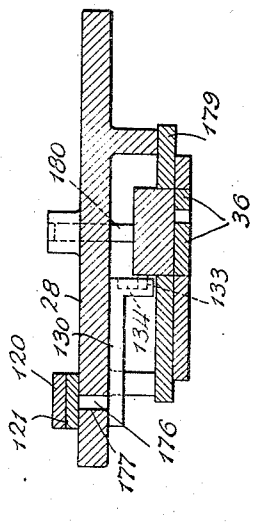


Fig. 17.

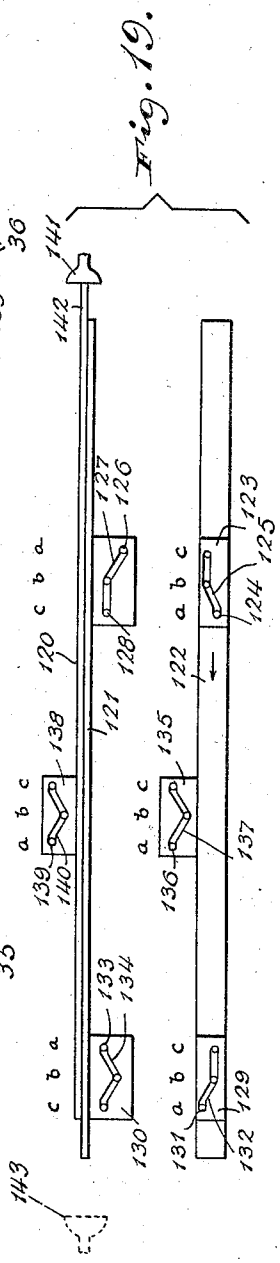


Fig. 19.

INVENTORS
MICHAEL ZIMIC
ANTON MISKOVSKY
BY Pruellen & Ruhl
ATTORNEYS

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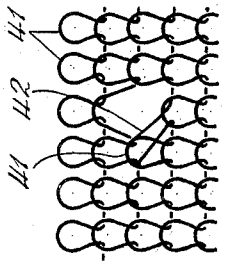


Fig. 29.

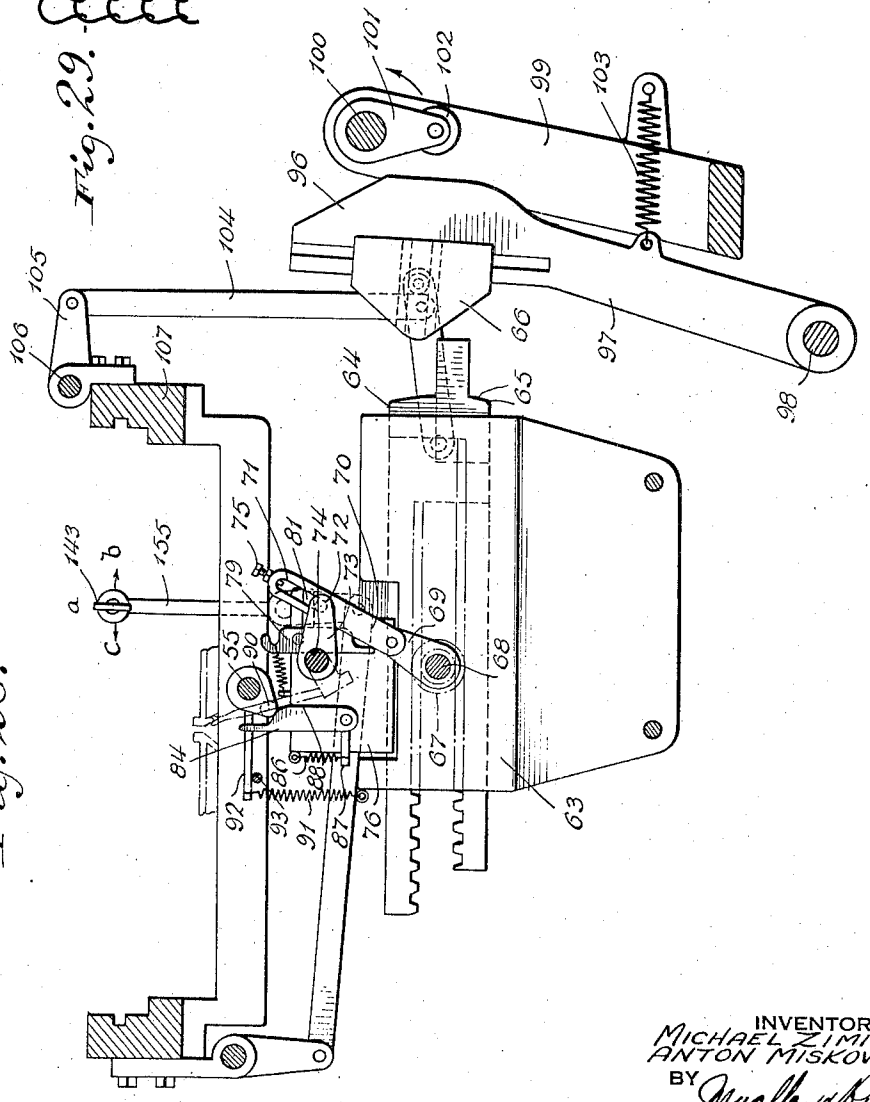


Fig. 20.

INVENTORS
MICHAEL ZIMIC
ANTON MISKOVSKY
BY Mueller & Aubl
ATTORNEYS

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Fig. 21.

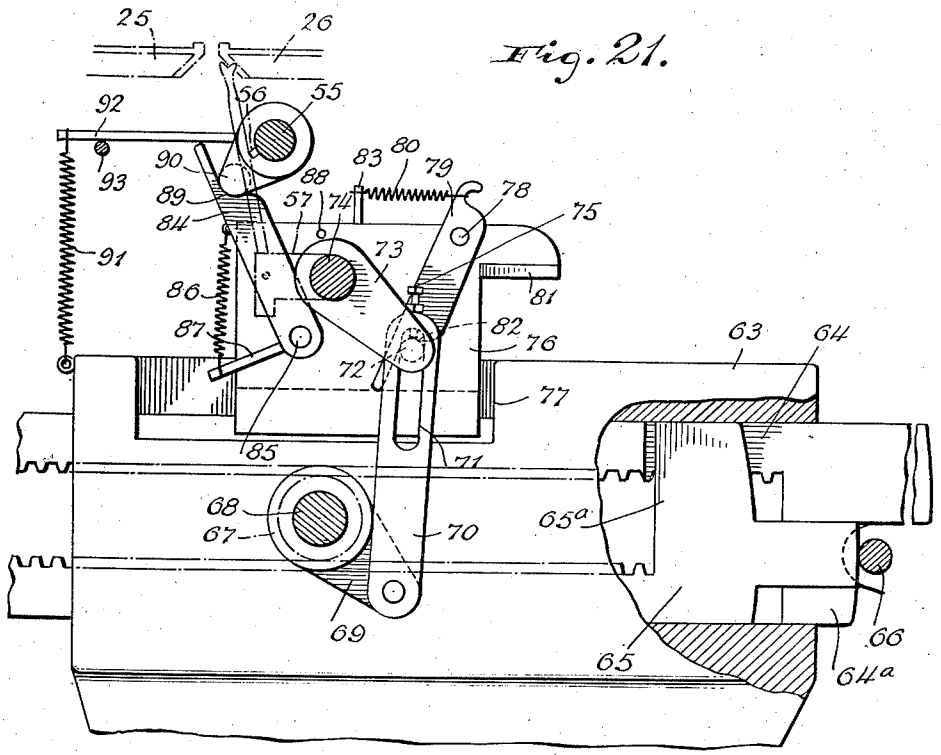
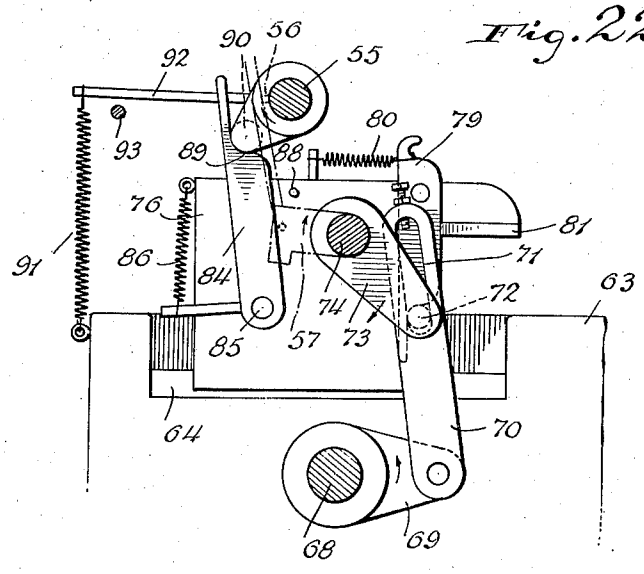


Fig. 22.



INVENTORS
MICHAEL ZIMIC
ANTON MISKOVSKY
BY Mueller & Rull
ATTORNEYS

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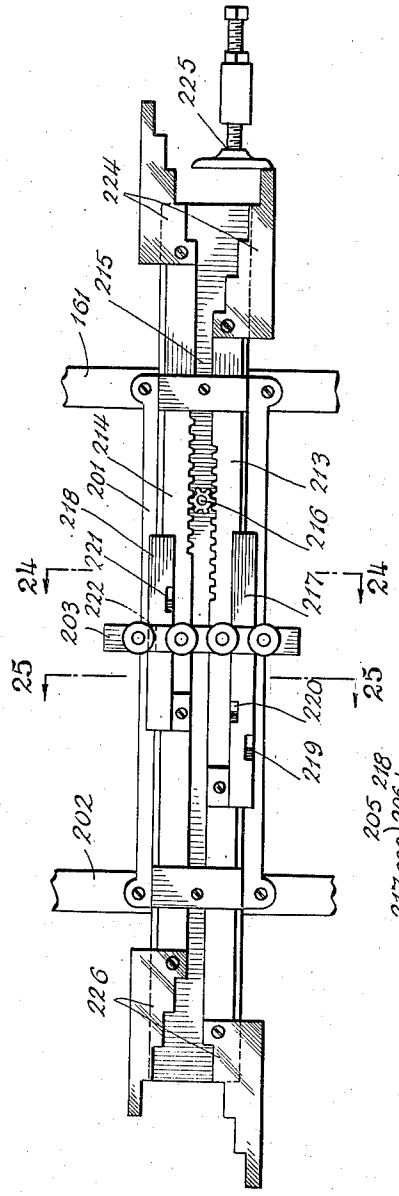


Fig. 23.

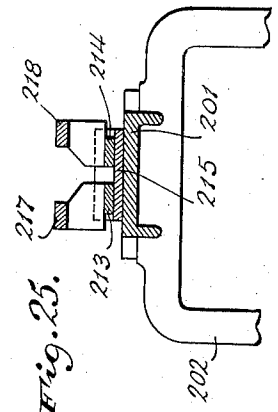


Fig. 25.

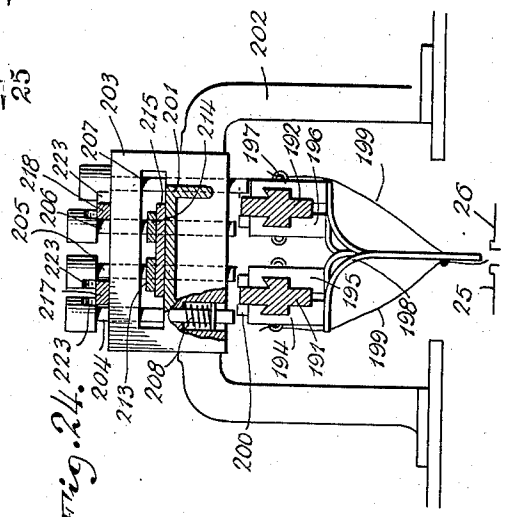
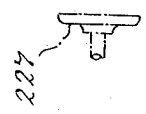


Fig. 24.



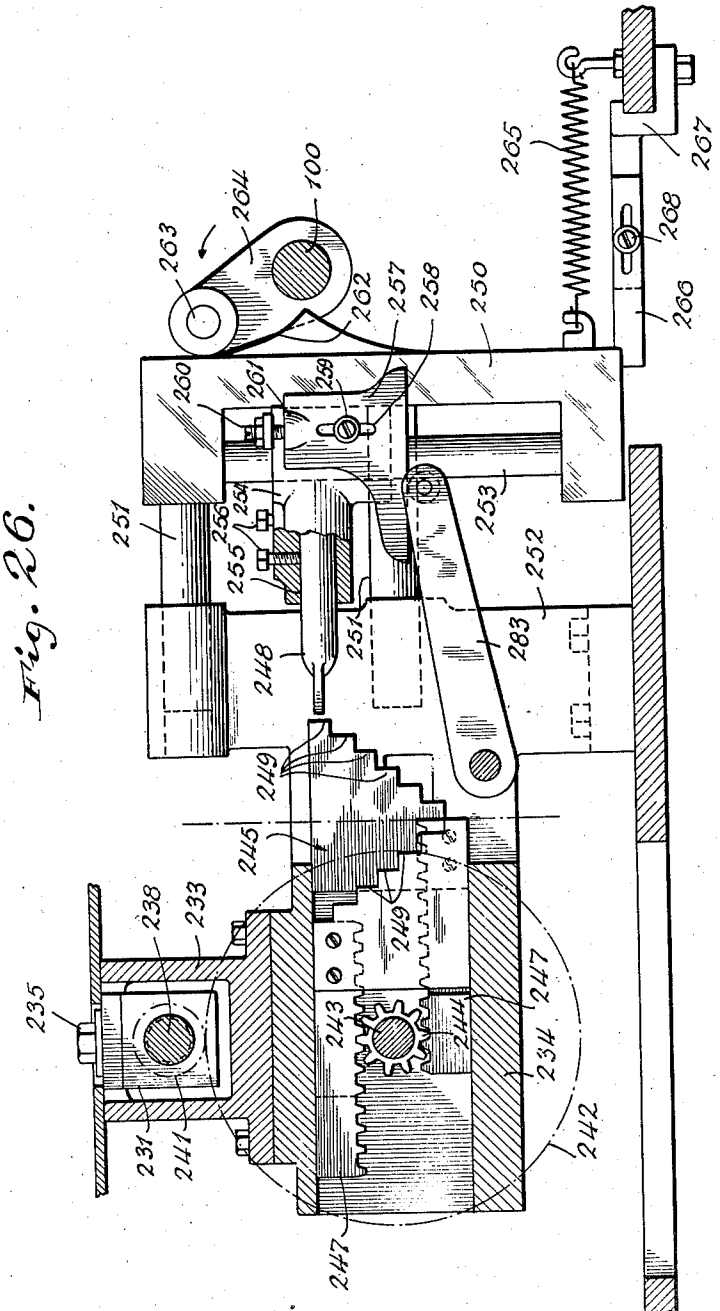
INVENTORS
MICHAEL ZIMIC
ANTON MISKOVSKY
BY Mueller & Ruhl
ATTORNEYS.

June 27, 1939. M. ZIMIC ET AL 2,164,170

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Fig. 26.



INVENTORS
MICHAEL ZIMIC
ANTON MISKOVSKY
BY Mueller & Rudl
ATTORNEYS.

June 27, 1939. M. ZIMIC ET AL 2,164,170

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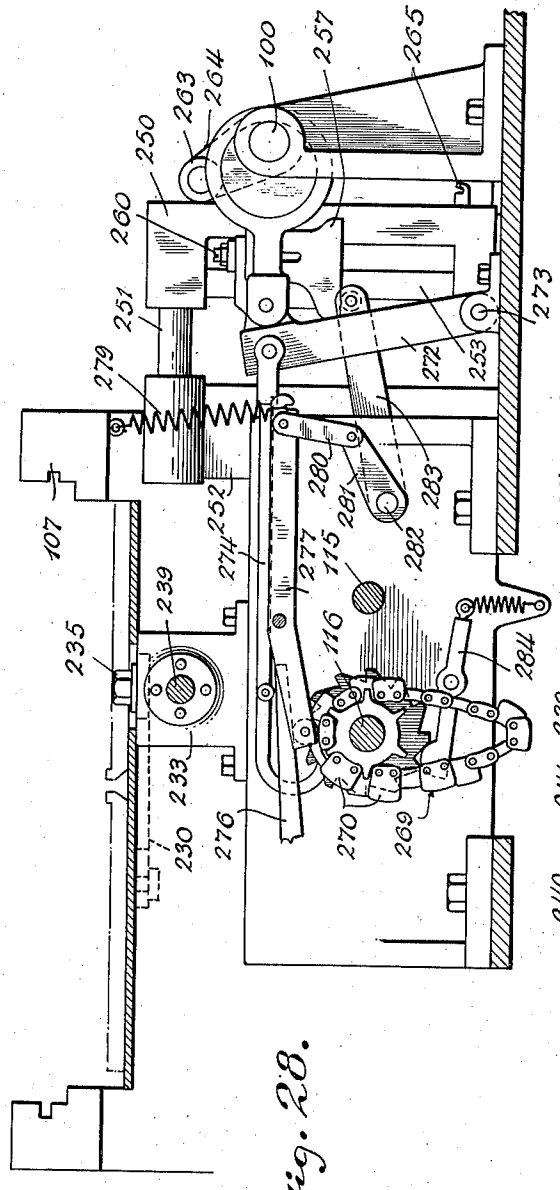


Fig. 28.

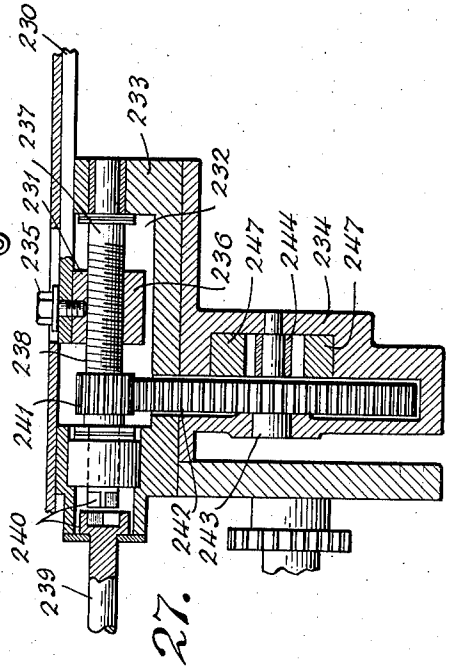


Fig. 27.

INVENTORS
MICHAEL ZIMIC
ANTON MISKOVSKY
BY Mueller & Rudd
ATTORNEYS.

Patented June 27, 1939 2,164,170

UNITED STATES PATENT OFFICE

2,164,170

KNITTING MACHINE AND METHOD

Michael Zimic, Forest Hills West, Long Island, and Anton Miskovsky, Astoria, Long Island, N. Y.; said Miskovsky assignor to said Zimic

Application May 21, 1937, Serial No. 143,964

20 Claims. (Cl. 66—63)

This invention relates to improvements in knitting machines and has particular reference to a full automatic, links and links machine, and the method of knitting thereby.

In the manufacture of knitted fabrics, the formation of open-work designing has heretofore been accomplished by the transfer of a loop from one wale of the fabric being knitted to an adjacent wale to thereby form an opening in the first wale. So far as known in the use of links and links machines, this transfer operation has been attained only through the medium of hand operated apparatus by a manual shifting of a loop from one needle to another during intervals when the reciprocating movements of the carriage of the machine are stopped. As a consequence of such manual operation and its attending difficulties including the time consumed in effecting the same, the cost of production of the fabric is greatly increased and its output consequently limited.

According to the present invention, it is proposed to accomplish the transfer of a formed loop from one needle to another in a links and links machine by a completely automatic operation. To this end, the invention contemplates the automatic control of instrumentalities, hereinafter generically referred to as transfer jacks, for effecting the loop transferring operation. These jacks are each automatically controlled, at predetermined intervals during the operation of the machine, to remove a loop from one needle upon which it has been formed and thereafter transfer said loop onto a different needle carrying another loop, so that the latter needle will then have two loops thereon which are automatically cast therefrom in the regular knitting operation with the result that both loops will be included in one wale of the fabric with an open space formed in an adjacent wale.

The inventive idea involved is capable of receiving a variety of expressions one of which, for purposes of illustration, is shown in the accompanying drawings; but it will be expressly understood that said drawings are used merely for the purpose of facilitating the description of the invention as a whole, and not to define the limits thereof, reference being had to the appended claims for this purpose.

In the drawings:—

Figures 1 to 6 inclusive are fragmentary transverse sectional views through the needle beds of the machine, illustrating the progressive operations of the transfer jacks and needles during a loop transfer operation.

Figure 7 is an elevation, partly in section, of a transfer jack and its support, the jack being shown in one of its operated positions.

Figure 8 is a fragmentary elevation of a jack and its support.

Figure 9 is a fragmentary front elevation, partly in section, of the left hand end of the knitting machine.

Figure 10 is a similar view of the right hand end of the machine.

Figure 11 is an end elevation of the right hand end of the machine, showing such mechanism as is utilized in a loop transfer operation.

Figure 12 is a top plan view, partly in section, of the reciprocating carriage of the machine.

Figure 13 is a bottom plan view thereof illustrating the lock mechanism mounted upon the bottom of the carriage for controlling the stitching and loop transfer operations.

Figure 14 is a longitudinal section on the line 14—14 of Figure 12.

Figure 15 is a similar section on the line 15—15 of Figure 12.

Figure 16 is a transverse section on the line 16—16 of Figure 12.

Figure 17 is a similar section on the line 17—17 of Figure 12.

Figure 18 is a section on the line 18—18 of Figure 12.

Figure 19 is a diagrammatic view showing the controls for the stitch and transfer cams of the lock mechanism, the needle latch opener for the front needles, and the depressor for the rear or transfer needles, all of which enter into the loop transfer operation.

Figure 20 is an elevation, partly in section, of the left hand end of the machine, illustrating the normal position of the mechanism for controlling the operations of the transfer jacks.

Figure 21 is a view similar to Figure 20 showing the position of the parts after the first operation of the transfer jacks.

Figure 22 shows the positions of the parts during the second operation of the transfer jacks and just before the same are returned to normal or inoperative positions.

Figure 23 is a fragmentary plan view of the reciprocating carriage illustrating the yarn control mechanism by which a number of yarns may be selectively fed to the needles of the machine, and also by which feed of all of the yarns may be discontinued during a loop transfer operation.

Figure 24 is a transverse section on the line 24—24 of Figure 23.

until the carriage has completed a reciprocation from its right hand position. Third, a transfer jack **43** associated with each of the transfer needles now in the rear bed of the machine is raised to the position in Figure 2, being guided in this movement by engagement of the upper end of the jack in a groove **44** formed in the front longitudinal edge of the bed **26**. As the jack **43** is raised its upper closed extremity contacts the then projecting end of its transfer needle and lifts the same partially out of its groove in the bed **26**.

The carriage **28** is now ready to start its return movement from right to left. With the transfer cams **35** now in operative position, the butts of the front jacks enter the groove formed by said cams and the first operation that occurs thereafter is that the portion **45** of said groove retracts each front needle slightly from the position of Figure 2 to that of Figure 3 to enable the latch opener **46** on the carriage, which opener has been lowered simultaneously with the lowering of the transfer cams, to engage and fully open the latch of said needle. Immediately following this retraction and opening of the latch, the front needle is again advanced to the position of Figure 4 and the butt of the jack associated with said needle then enters the groove **33**. The switch cams **29** now being raised, the butt will enter the by-pass groove **47** instead of being advanced into the central portion of the groove **33** by said cams. Substantially at the same time that the front needle is being controlled as just described, the rear transfer cams **36** engage the butt of the jack **37** associated with the transfer needle and at the point **48** of the groove formed by said cams **36** said needle is retracted slightly and immediately thereafter advanced. The retracting movement enables the hook of the needle carrying the loop **42** to engage between the spaced portions of the spring arms or fingers **49** of the head of the transfer jack **43** when the needle is depressed from the position in Figure 2 to that of Figure 3. At the moment of said retraction the forward extremity of the latch opener **50** supported by the carriage **28**, and which has also been lowered simultaneously with the cams **36**, engages the latch of the transfer needle to fully open the same. Said latch opener **50** is increased in thickness and width from its forward extremity to provide a needle depressing portion **51** which engages the transfer needle, as the carriage advances to the left, and forces said needle down into its groove as shown in Figure 3, with the hook of said needle entering the space between the arms **49**. As the needle is so depressed it is, at the same time, advanced by the portion **52** of the groove of the transfer cams **36** so as to free the loop **42** from the needle hook and deposit it upon the supporting shoulders **53** adjacent the upper ends of arms **49** of the transfer jack **43**. Thereafter, the transfer needle is retracted by the cams **36** to the position of Figure 4, leaving the loop **42** upon the shoulders **53** of the transfer jack. The butt of the needle jack **37** now enters the groove **34** and, by reason of the fact that the stitch cams **30** are now lifted out of operation, said butt will enter the by-pass groove **54** and from thence pass outwardly from the groove **34** as the carriage approaches its left hand position. When this position is reached, each transfer needle is in the position shown in Figure 4. As the carriage nears said position and before it starts the return movement to the right, two operations take place. The transfer cams **36** on the rear of the carriage, the latch opener **46** and the needle depressor **51**, are raised; and the front needle bed **25** is racked one or more needles in either direction, depending upon the size of the opening desired in the fabric. This racking of the bed is accomplished by the mechanism shown in Figures 26 to 28 which, aside from the transfer operation, may also be utilized to rack the needle bed variously when rack stitches are desired in the standard links and links operation. The result of the racking in the transfer operation is to shift the front needle from the position of Figure 3, wherein it is longitudinally offset from the transfer needle, to the position of Figure 4 in which the two needles are directly opposed to each other.

After the above operations have been effected, the carriage moves to the right to start its second reciprocation of the transfer operation. With the stitch cams **30** and the transfer cams **36** in the rear portion of the carriage in raised or inoperative positions, the jack butts of the transfer needles pass through the grooves **34** and **54** without material effect upon said needles. The stitch cams **29** in the front of the carriage being raised, and the front transfer cams **35** being lowered, the jack butts of the front needles will pass through the by-pass groove **47** and finally enter the groove between the cams **35** as the carriage moves to the right, so that the front needles will be advanced and remain in the position of Figure 5 after the carriage has passed thereover and reached its right hand position. This advancement of racked front needles projects the hooks thereof carrying the hoops **41** into the knitting area between the two needle beds and between the spring arms **49** of the transfer jacks associated with those front needles which are ultimately to receive the loops **42** now resting upon the jacks. The front needles are thus placed in position to receive the loops **42** when the transfer jacks are operated, as indicated in Figure 6, at the end of the right hand movement of the carriage. As the carriage reaches its right hand position, each of the transfer jacks **43**, which was initially raised to the position in Figure 2 at the end of the first right hand movement of the carriage and has remained in such position until this time, is now further raised to the right hand dotted line position in Figure 6, then swung forwardly to the left hand dotted line position, and finally lowered to its full line or normal position in said figure. The forward swinging of the upper end of the transfer jack is accomplished by an oscillatory rod **55** carrying a longitudinally extending key **56**. Said rod is turned to contact the key **56** with each of the transfer jacks at the instant that the latter is raised from the position in Figure 5 so as to impart a simultaneous forward swinging movement to the jack and thereby position the loop **42** directly over the shank of the associated front needle adjacent its hook. As the transfer jack moves downwardly toward its normal position the shank of the front needle passes between the upper extremities of the spring arms **49** of the jack, which arms spread to permit the needle to pass through; and as a consequence of this movement the loop **42** is deposited upon the front needle which already has the loop **41** thereon. The oscillatory rod **55** is immediately restored to normal position after it has swung the transfer jack forwardly to accomplish the operation just described.

A second operation which occurs at the end of the right hand movement of the carriage is the adjustment of the transfer cams **35** to their raised or inoperative positions and the lowering of the stitch cams **29**, **30** to their operative positions for regular knitting operations. Also, the yarn control mechanism is again thrown into operation so that when the carriage moves to the left to complete its second reciprocation a yarn will be fed to the needles. Further, the bed **25** is racked to its original position so that in the next regular knitting operation to follow upon the return of the carriage to the left, the loops on the various needles, including those needles now having two loops **41** and **42**, will be cast in the usual way with the result that said two loops will be knitted into the same wale in the fabric, as shown in Figure 29.

The carriage now moves to the left to complete its second reciprocation of the transfer action and in so doing the needles in the rear bed from which the loops **42** have been removed and transferred on to the front needles, may be released in the usual manner by their jacks and actuated by the regular stitch cams so as to be returned to the front bed from which they were originally projected at the beginning of the transfer operation; and during the passage of the carriage over the needles the regular knitting operation is again performed with the result that the formed loops are cast, as above described, and the new yarn is fed to the needles for subsequent knitting operations. The mentioned transfer of the needles in the rear bed to the front bed is done under the assumption that knitting of plain stitches is being accomplished. However, if a links and links operation is desired, the jacks in the rear bed may be so controlled as to retain some or all of the transfer needles in the rear bed in the usual manner for such operation.

The mechanisms by which the various above related steps in the operation are attained, will now be described in detail:

Mounting for transfer jacks

In Figures 7 and 8 there is shown an oscillatory jack-supporting member **57** which is in the form of a bar that extends the length of the needle bed **26** and is provided in the forward edge thereof with a plurality of slots **58** through which extends the supporting rod **59**. Each of the slots **58** is adapted to receive the lower end of one of the transfer jacks **43** and said lower end is provided with a notch or recess **60** in which the rod **59** engages to thus provide a pivotal mounting for the jack from which the latter may be detached. Along the forward edge of the member **57** the same has secured thereto, by means of a clamping plate **61**, a plurality of leaf springs **62** each aligned with one of the slots **58** so that the free end of the spring will bear against the forward edge of a jack **43** mounted in the recess and thus yieldably maintain the jack in association with the rear bed **25** during the entire operation of the jack except when the same is swung forwardly to deposit a loop **42** on a front needle, as described in connection with Figure 6. In Figure 7 the jack is shown in its first operated position where it has been partially elevated to remove the loop **42** from the transfer needle, and after said jack has been swung forwardly to deposit a removed loop onto the front needle, and has then started its downward movement, as will subsequently be described, the spring **62** acts to restore the jack **43** to its normally inclined position relative to the needle bed.

Control mechanism for the transfer jack

Reference is made to Figures 9, 10, 11, 20, 21 and 22 for a description of this mechanism and its operation. The parts of the mechanism shown in Figures 20 to 22 are located at the left hand end of the machine, as viewed in Figure 9, and the control for such mechanism is located at the right hand end of the machine, as viewed in Figure 11. Referring particularly to Figures 20 to 22 the jack control mechanism is shown as comprising a housing **63** suitably mounted upon the frame of the machine and having mounted therein for sliding movements in opposite directions the upper and lower rack bars **64** and **65**. These rack bars are alternately actuated by a vertically adjustable contact member **66**, the operation of which is later to be described in detail, which is adapted to strike against the projecting end of either of said bars, depending upon the position thereof and the vertical adjustment of said member **66**. At the time that the transfer jacks **43** are first elevated, which is at the termination of the first movement of the carriage **28** from left to right following the initiation of the loop transfer operation, the lower rack **65** is in its right hand position, as shown in Figure 20, and to start the initial raising of the transfer jack the contact member **66** is lowered so as to be in a position to strike against the projecting end of the rack **65** and drive the same to the left. When this action occurs the teeth of said rack rotate a pinion **67** in clock-wise direction so as to move the rack **64** to the right or in the operated position shown in Figure 21, this movement being limited by engagement of the extension **64***a* on the rack **64** with the contact **66**. The shaft **68** of the pinion **67** carries an arm **69** to which is connected one end of a link **70**. This link is provided with an elongated slot **71** therein to receive a pin **72** carried by an arm **73** which is fixed upon a shaft **74** carried by the adjacent end of the transfer jack-supporting bar **57**. The movement of the arm **69** from the position of Figure 20 to that in Figure 21 exerts a downward pull upon the link **70** which causes an adjustable set screw **75** at the upper end of the link to engage the pin **72** as said link approaches the extreme of its downward movement, and at the conclusion of said movement the set screw **75** will have forced the arm **73** from the normal position of Figure 20 to the operated position of Figure 21. As a consequence, the supporting bar **57** is swung upwardly to the position shown in Figure 7, thereby elevating all of the transfer jacks **43** to the positions shown in Figures 2 to 5 inclusive. In order that there will be no torsional twist to the bar **57** which extends the length of the needle beds, the other end of said bar (Fig. 10) also has an arm **73***a*, similar to the arm **73**. On the shaft **68**, which also extends to the other end of the machine, is another arm **69***a* connected to a link **70***a* which controls the arm **73***a* in the same manner described in connection with the arm **73**. The set screw **75** may be adjusted in the end of the link **70** in order to regulate the amount of throw of the arm **73** and consequently the degree of elevation of the transfer jacks. At the same time that the link **70** is pulled downwardly, the upper rack **64** is moved to the right by the pinion **67**, as previously mentioned, and said rack carries therewith a plate **76** movable in a recess **77** formed in the housing **63**. This plate has pivoted thereon at **78** a lever **79** which is maintained in the nor-

mal vertical position of Figure 20 by a spring 80 connected to the upper end of said lever and by contact of the latter with a laterally projecting stop flange 81 formed on the right end edge of the plate 76. The lower end of the lever 79 is reduced to form a curved shoulder 82. As the plate 76 moves to the right from its position in Figure 20 to that in Figure 21, and at the same time that the link 70 is being pulled downwardly and into its substantial vertical position in the later figure, the right edge of the lower portion of the lever 79 engages the pin 72, and this engagement causes the lever 79 to swing about its pivot against the tension of the spring 80 which is connected to a fixed part 83 on the machine. This swinging movement of the lever 79 continues until the right hand position of the plate 76 is reached, whereupon the shoulder 82 of the lever 79 will engage and rest upon the pin 72 and will remain in such position until the plate 76 is returned to its left hand or normal position. A second lever 84 is also pivoted at 85 to the plate 76 and is maintained in its normal vertical position (Figure 20) by a coil spring 86 connected to the arm 87 of said lever and by engagement of the latter with a stop pin 88 on the plate 76. As the plate 76 moves to the position in Figure 21 the upper reduced end of the lever 84 forming the shoulder 89 contacts a pin 90 carried by the adjacent end of the oscillatory rod 55, and the engagement of said pin with said shoulder 89 causes the lever 84 to swing to the inclined position in Figure 20 against the tension of the spring 86.

The apparatus has now been actuated to impart the first raising movements to the transfer jacks 43 by reason of the downward movement of the arm 73, and the adjustments of the levers 79 and 84 to the positions shown in Figure 21 are preparatory to the subsequent additional raising and forward swinging of the transfer jacks which occur at the termination of the second right hand movement of the carriage 28, as previously described. These latter movements of the transfer jacks are effected by the return of the plate 76 toward its left hand position, as shown in Figure 22, and said movement of the plate is obtained by a raising of the contact member 66 so as to align the same with the then projecting end of the upper rack 64 and when said rack is so contacted, it is moved to the left and the rack 65 is projected to the right by the pinion 67, this movement being limited by engagement of the extension 65a of the rack 65 with the contact 66. The rack 64 carries the plate 76 therewith and at the same time the link 70 moves upwardly from the position of Figure 21 to that of Figure 22, this being a free movement in which the pin 72 passes from the upper end of the slot 71 to a point adjacent the lower end thereof. As the plate 76 moves to the left, the pin 72, resting against the shoulder 82 of the lever 79, acts as a fulcrum for said lever and because of the fact that the latter is fixed at its pivot 78 to said plate the lever will have the effect of forcing the pin 72 further in a downward direction to impart a slight rocking movement to the shaft 74 in a clock-wise direction and thus impart a similar movement to the transfer jack-supporting member 57 to further elevate the transfer jacks to the right hand dotted position of Figure 6. At the same time that the member 57 is being moved from its position in Figure 21 to that in Figure 22 by the movement of the plate 76 toward its left hand position, the lever 84 is, by the latter movement, being swung toward its vertical position by reason of engagement of the shoulder 89 thereof with the pin 90. Again, as with the lever 79, the lever 84 being fixed at its pivot 85 to the plate 76 imparts a lifting action to the pin 90 as said lever moves toward its vertical position; and as a consequence of such lifting action the oscillatory rod 55 is turned in a clockwise direction to engage the key 56 with the transfer jacks 43 to swing the same forwardly through the left hand dotted line position of Figure 6 wherein the loop 42 is ready to be deposited upon the front needle as each transfer jack subsequently moves downwardly toward its normal or inoperative position. The turning movement of the rod 55 which effects the swinging movement of the transfer jacks as just described, is against the tension of a coil spring 91 connected at one end to the housing 63 and at its other end to an arm 92 carried by the rod 55 and normally resting on a stop pin 93. As the rod 55 is turned, the arm 92 is raised off of its stop pin 93 to the position in Figure 22. With the parts in the position of Figure 22, the plate 76 now continues moving to its extreme left hand position and in so doing the pin 72 is released from engagement with the shoulder 82 of the lever 79 by reason of the continued movement of the latter to the left, whereupon the lower end of the slot 71 engages said pin 72 and forces the arm 73 to turn counter-clockwise to swing the supporting member 57 downwardly, to the normal position of Figure 20, thus restoring the transfer jacks to their lowermost or normal positions. At the end of this movement the pin 72 contacts the stop flange 81 as in Figure 20. At the same time that the restoration of the member 57 is taking place, the lever 84 moves from its position in Figure 22 toward its normal vertical position against the stop pin 88 and in so doing the pin 90 will slide off of the shoulder 89 of said lever and, under the influence of the spring 91, the oscillatory rod 55 will be returned, with its key 56, to the normal position by reason of the downward pull of said spring 91 upon the rod 92.

To obtain the necessary vertical adjustments of the contact member 66 whereby the racks 64 and 65 are alternately operated, said member, is slidably mounted in the grooved head 96 of an arm 97 mounted for oscillation about the pivot 98. In a portion 99 of the frame of the machine there is journaled the power shaft 100 which is utilized to control several of the operations of the machine including that of the transfer mechanism and which rotates twice during each complete reciprocation of the carriage 28. The shaft 100 carries an arm 101 having upon its free end a roller 102 which is adapted to contact the rear of the head 96 and swing the arm 97 forwardly so that the member 66 will engage and propel the rack bar 64 or 65 with which it may be horizontally aligned. After its forward swinging movement and continued rotation of the roller 102 out of engagement with the head 96, the arm 97 is retracted by a spring 103 connecting said arm with the portion 99 of the frame. The vertical adjustments of the member 66 are accomplished through the medium of a link 104 pivoted to the member 66 and also to an arm 105 carried by a rock shaft 106 extending the length of the machine and mounted upon one side of the support 107 in which the carriage 28 reciprocates. At the opposite end of the machine from that at which the transfer jack-control mechanism is

located, the rock shaft 106 carries another arm 108 (Fig. 11) to which is connected one end of a link 109 the other end of which is similarly joined to one end of a rocking arm 110 pivoted on the frame at 111. The arm 110 is maintained in the position of Figure 11 in which the contact member 66 is in its raised position so as to engage the rack 64, by means of a coil spring 112 connected to said arm 110 and to the frame of the machine. The inner end of the arm 110 is interengaged with an adjacent end of another arm 113 the other end of which terminates and is pivotally mounted at 114 to the frame. Two sprocket shafts 115 and 116 of well known construction are utilized to initiate a number of the knitting operations by being stepped around, as will be seen in Figure 28, to rotate a number of chains, such as the chains 117 and 118, which are associated with the transfer jack mechanism. Each of these chains carries the necessary number of lugs 119 arranged at intervals about the chain and brought into contact with the arms 110 or 113 at the proper time to accomplish the desired operation. As shown in Figure 11, the shaft 106 may be, optionally, rocked by a lug on either of the chains 117, 118, depending upon the positions of the lugs 119 thereon. If a lug on the chain 117 is engaged with the arm 110 the latter is rocked about its pivot 111 independently of the arm 113. On the other hand, if a lug on the chain by reason of its interengagement with the arm 110 the latter will be actuated as by the chain 118 engages the arm 113, this arm is raised and, 117 to produce the same result. The rocking of said arm 110 against the tension of the spring 112 pulls the link 109 downwardly to rock the shaft 106 so that the link 104 will also move downwardly and thus adjust the contact member 66 in alignment with the rack 65 so that upon the next forward movement of the arm 97 under the control of the power shaft 100, will move said rack 65 in its housing to accomplish the operations previously described. When the contact 66 is ready to be raised to operate the rack 64, the chains 117 and 118 will be stepped around so that no lug 119 will engage either arm 110 or 113, whereupon the latter will be restored to the position of Figure 11 under the influence of the spring 112 and the contact 66 will thus be raised again to the position of Figure 20.

Carriage and lock mechanism control

This mechanism, which is movable with the carriage 28, includes the stitch cams 29, 30, the transfer cams 35, 36, the latch opener 46, the needle depressor 51 and the various instrumentalities for raising and lowering said elements.

Said mechanism is illustrated in Figures 12 to 19 inclusive and, by reference to the latter figure, the sequence of operation will be best understood. The mechanism comprises upper and lower superimposed sliders 120, 121 mounted on the rear portion of the carriage 28, and a single slider 122 on the front portion thereof movable in unison with the slider 120, as will later appear. These sliders are adapted to have longitudinal movements imparted thereto to three distinctive positions, with the sliders 120, 121 movable in opposite directions to each other and the slider 122 movable in the same direction as the slider 120. The three positions, indicated by the characters *a*, *b* and *c*, are those which the stitch cams 29, 30, the transfer cams 35, 36, the latch opener 46 and the needle depressor 51 assume during the loop transfer operation. Thus, in position *a*, the front stitch cams 29, controlled by the cam block 123 carried by the underside of the slider 122, are in the lower or operative position for regular knitting operations, this position being indicated by the pin 124 at the left hand end of the angular guide slot 125 in the block 123; the rear stitch cams 30 are also lowered by engagement of their control pin 126 in the right hand end of the angular slot 127 in the cam block 128 supported by the lower slider 121. Also in position *a*, the front and rear transfer cams 35, 36, controlled from the cam blocks 129, 130 on the sliders 122 and 121, are raised to their inoperative positions, the pin 131 for the cams 35 being in the left hand end of the slot 132 in the block 129 and the pin 133 for the cams 36 being in the right hand end of the slot 134 in the cam block 130. A cam block 135 on the slider 122 controls the latch opener 46, and in position *a* the control pin 136 therefor is in the left hand end of the slot 137. Finally, in position *a*, the cam block 138 on the slider 120, which controls the raising and lowering of the depressor 51, is located so that its control pin 139 to which said depressor is connected is at the left hand end of the slot 140.

As previously described, the first change in position of the various elements in a loop transfer operation occurs as the carriage 28 approaches its right hand position during its first reciprocation, at which time the stitch cams 29, 30 are raised, the transfer cams 35, 36 lowered and the opener 46 and depressor 51 also lowered to accomplish their respective operations on the return of the carriage to the left. This first change of parts to position *b* is attained by means of a control member 141 at the right hand end of the machine, associated with the sliders 120, 121 and adapted for adjustment, as will later appear, to engage different portions of the stepped ends of said sliders to accomplish various longitudinal adjustments thereof. Thus to obtain the *b* position, the member 141 is adjusted to align with the intermediate shoulder 142 on the upper slider 120 which is then projected beyond the adjacent end of the lower slider 121. As the carriage 28 approaches its right hand position, shoulder 142 contacts the member 141 and, as a result, the slider 120 is moved to the left and slider 121 to the right until the latter engages said member. The slider 122, being connected to slider 120, in a manner to later appear, moves therewith. Thus the pin 124 connected to the stitch cams 29 is raised to the indicated *b* position in slot 125 to thereby elevate said cams to their inoperative position and, likewise, the pin 126 is raised by the slot 127 to elevate the stitch cams 30. The pin 131 connected to the transfer cams 35 is lowered by the slot 132 to place said cams in operative position, and the cams 36 are similarly adjusted by the movement of the pin 133 to the *b* position. Also, the opener 46 and depressor 51 are lowered by the passage of the pins 136 and 139, respectively, to their *b* positions in the blocks 135 and 138. The carriage now moves to the left to effect the various operations previously described.

The next change to position *c* takes place as the carriage approaches the left hand end of its travel during the first reciprocation, and this change is designed only to raise the elements 46 and 51 and adjust the rear transfer cams 36 to their raised or inoperative position preparatory to the next movement of the carriage to the right. To produce this change, the slider 120 is moved further to the left by a contact member

143 at the left hand end of the machine. This member is adjusted, in the same manner as the member 141, during the travel of the carriage to the left, to align with a shoulder 144 (Fig. 12) on the lower slider 121 so that as said shoulder engages the contact 143, said slider will be moved to the right as in the first operation and sliders 120 and 122 will consequently be again moved further to the left. Due to these movements, pins 124, 126 and 131 will pass from position *b* to position *c* but owing to the horizontal disposition of the portions of the respective slots 125, 127 and 132 in which the pins are now engaged, the stitch cams 29, 30 and front transfer cams 35 will neither be raised nor lowered in their *c* positions. However, due to the shape of the slots 134, 137 and 140, the further movement of the block 130 to the right and the blocks 135 and 138 to the left, causes the pins in said slots to be raised, with the result that the cams 36, the latch opener 46 and the depressor 51 will be adjusted to their inoperative positions. The carriage now again moves to the right to start its second reciprocation and during this movement the front transfer cams 35 advance the needles in the front bed 25 to the position of Figure 5 for the purpose previously described.

During the movement of the carriage to the right the contact member 141 at the right hand end of the machine is adjusted to a position so as to be engaged by the then projecting extremity of the lower slider 121. This engagement, which occurs near the end of the right hand movement of the carriage, now moves the lower slider to the left through its maximum range of movement and a similar adjustment of the sliders 120 and 122 to the right is thus effected. With the pins 124, 126, 131, 133, 136 and 139 all in their *c* positions prior to the final adjustment of the sliders, it will be apparent that said pins are now passed through the entire length of their respective slots and as a consequence the stitch and transfer cams, the latch opener and the needle depressor are restored to the *a* position for normal knitting operations.

The control of the contact members 141, 143 will now be described. This control is initiated by one or more chains 145 (Fig. 10) similar to chains 117, 118, mounted upon the sprocket shafts 115, 116, and said chain or chains 145, with lugs 146 of different heights thereon, is designed to variously rock the lever 147 (Fig. 11) in accordance with the desired position of the contact member 141 at the right hand end of the machine. The front end of the lever 147 has connected thereto the link 148 which is also joined to one extremity of the bell crank lever 149 mounted upon the rod 150 which extends the length of the machine. The other arm of the lever 149 has connected thereto one end of the link 151 the other end of which is pivoted to an intermediate portion of an oscillatory arm 152 pivotally mounted at 153. The upper end of said arm 152 carries the contact member 141 and, as indicated in Figure 11, the positions *a*, *b* and *c* of said member may be attained through the actuation of the lever 147 by the lugs 146 on the chain 145. At the left hand end of the machine (Fig. 9) the rod 150 is connected, through the link 154 to the arm 155 which carries the contact member 143 so that the latter is adjusted to the *a*, *b* and *c* positions in the same manner as the contact 141. In Figure 12, other sliders and associated elements, generally indicated by the numeral 156 and similar to the sliders which have been specifically described, are utilized on the machine for performing other well known knitting functions which are not included in the loop transfer operations herein described.

By further reference to Figure 12, it will be seen that the movements of the sliders 120 and 121 in opposite directions are attained by two pinions 157, 158 which mesh with each other and, respectively, with rack teeth 159, 160 on the upper and lower sliders. In order that the slider 122 may be moved in unison with the slider 120, the connecting arch 161 which joins the front and rear portions of the carriage 28, carries a rock shaft 162. At the rear end of said shaft (Fig. 14) the same is provided with an arm 163 the lower end of which is forked to engage a pin 164 on the slider 120 so that as the latter is moved the arm 163 will be swung to rock the shaft 162. At the forward end of this shaft (Fig. 15) it carries another arm 165 the lower end of which engages in a socket 166 formed in the block 167 on the slider 122. Thus, as shaft 162 is rocked, the arm 165 is swung in the same direction as the arm 163 and the two sliders 120 and 122 are moved together.

In Figure 16, the construction is shown by which the stitch cams 29 and 30 are raised and lowered. At the left of said figure, the slider 122 is shown extending below the carriage 28 and having the cam block 123 thereon. The pin 124, which is engaged in the slot 125 of said block, is carried by the bar 168 that connects the two stitch cams 29 and supports them for vertical movement in the cam plate 169 on the underside of the carriage 28. To guide the bar 168 in its vertical movements, it is provided intermediate its ends with a pin 170 which extends upwardly through an opening in said carriage. With this construction, as the slider 122 is moved back and forth the bar 168, and consequently the cams 29 are raised and lowered by engagement of the pin 124 in the slot 125. At the rear of the carriage, the lower slider 121 has an extension 171 depending from which is a pin 172 movable in a slot 173 in the carriage 28. Connected to the lower end of said pin 172 is the cam block 128 in which the slot 127 is formed for guiding the pin 126. A bar 174 carries said pin and connects the two stitch cams 30 to raise and lower the same in accordance with the movements of the slider 121.

The construction for operating the transfer cams 35, 36 is shown in Figure 17. At the left of said figure, the cam block 129, which is attached to the front slider 122, is provided with two portions 175 in each of which is formed one of the slots 132 for guiding the pins 131 carried by the two transfer cams 35 so that the latter may be raised and lowered. On the rear of the carriage, the lower slider 121 has a depending pin 176 which extends through a slot 177 in the carriage 28 and supports the cam block 138 having the slot 134 therein for guiding the pin 133. This pin projects from the support 178 which is vertically adjustable in the cam plate 179 and carries the two transfer cams 36, being guided in such vertical movements by the pin 180 extending through an opening in the carriage 28.

The means for accomplishing the vertical adjustments of the latch opener 46 will now be described. As shown in Figures 12 and 17, the block 129 is provided with an extension 181 that supports the block 135 which is in the form

of a vertically disposed plate movable in an opening or reduced portion 182 of the carriage 28. Said block 135 slides longitudinally in a housing 183 (Figs. 12 and 16) and has formed therein the slot 137 which receives the pin 136. Said pin is carried by the plate 184 which is moved vertically by said slot and from the lower end of which extends the arm 185 to which the latch opener 46 is attached.

The structure by which the needle depressor 51 is raised and lowered is best shown in Figure 18 wherein the upper slider 128 is shown as carrying the cam block 138 having the slot 140 therein. A supporting plate 186 secured to the carriage 28 is interposed between the block 138 and the depressor carrying plate 187 which is guided in its vertical movements by engagement of pin 188 on the plate 186 in the guide slot 189. Said plate 187 carries the pin 139 which extends through the slot 190 in the plate 186 and into the slot 140 in the cam block 138 so that as the latter is moved horizontally by the slider 128, the plate 187 together with the depressor 51 will be raised and lowered.

Yarn control mechanism

This mechanism, illustrated principally in Figures 23 to 25, is associated with the carriage 28 and, in addition to the selective feed of a plurality of yarns to the needle of the machine during the reciprocations of said carriage, in the angular knitting operations, it is also designed to automatically discontinue the feed of said yarn during stages of the loop transfer operation; such discontinuance occurring, as previously mentioned, at the end of the first movement of the carriage to the right after said transfer operation has been initiated, and the feed of the yarn being again started at the end of the second movement of said carriage to the right.

The control mechanism for the yarns comprises two stationary trackways 191 and 192 which are substantially coextensive with the length of movement of the carriage 28 and mounted upon blocks 193 (Figure 10) on the frame of the machine. Said trackways have the four yarn carriers 194, 195, 196 and 197 mounted thereon for sliding movements and the various guides 198 depending from the carriers feed the yarns 199 from the source of supply to the needles of the machine in the customary manner. Each of the carriers, as best shown in Figure 10, is provided at each end of its upper edge with an upstanding abutment 200 which are utilized to reciprocate the carrier on the trackway by a control mechanism now to be described.

The mechanism for selectively controlling the movements of any one of the yarn carriers so that its yarn 199 is fed to the needles, is mounted upon the carriage 28 by means of a beam 201 extending between the arches 161 and 202 which join the front and rear portions of said carriage. Said beam supports a frame 203 in which four pins 204, 205, 206 and 207 are vertically slidable, with a yieldable pressure in a downward direction exerted upon each of them by a coil spring 208. Said pins are associated, respectively, with the carriers 194 to 197 to propel the latter on their trackways when the pins are lowered to positions between the abutments 200 of the carriers. As shown in Figure 24, the right hand pin 207 is lowered to its operative position and hence the yarn leading to the carrier 197 will be the one that is fed to the needles as said carrier is reciprocated by the movements of the carriage 28 with which all of the pins travel, and the other yarn carriers will remain stationary on their trackways until the pin 207 is raised and one of the other pins lowered into operative relation with its carrier.

As each yarn carrier moves back and forth on its trackway under the influence of its propelling pin alternately engaging the abutments 200, the same is brought into cooperative relation with a pin elevating device, generally indicated by the numeral 209 (Figs. 9 and 10), located adjacent each end of the trackway upon which said carrier is mounted. These devices are customarily supported for longitudinal adjustment on their trackways by providing the latter with openings 210 to receive pins 211*a* carried by the devices. Each device is positioned at some preselected point along its trackway where it is desired to throw out of operation the yarn connected to the carrier on said trackway so that said yarn will no longer be fed to the needles until the carrier is again selected by the lowering of its associated propelling pin. As best shown in Figure 10, the device 209 associated with the carrier 194 is provided with a deflecting finger or cam 211 which, as the carrier moves to the right and approaches the device, comes into operative position alongside the right hand aubutment 200. Assuming for the moment that the pin 204 associated with the carrier 194 is lowered and consequently engaged with said abutment, the tapered end of said finger will be contacted by the lower end of said pin and the latter will be elevated against the tension of its spring 208. The carrier engaging the device 209, will come to rest; but the continued movement of the carriage 28 to the right, causes the pin 204 to ride over the upper surface of the finger 211 and pass off the same at the inclined right hand end 212 thereof. If the pin 204 should be still lowered by its spring upon the return of the carriage 28 to the left, said pin will engage said end 212 and be thus guided over the finger until the other end is reached, whereupon the pin will again be lowered by its spring so that said pin will come into contact with the left hand abutment 200 as the carriage 28 continues its movement to the left; and the yarn carrier will now be moved along with the carriage. If, on the other hand, the pin 204, after passing over the finger 211 during the right hand movement of the carriage, had been elevated and held in such position, as will appear hereinafter, it would pass over the yarn carrier during the movement of the carriage 28 to the left and said carrier would consequently remain in its stopped position and its yarn would therefore not be fed to the needles.

The operative and inoperative positions of the pins 204 to 207 are controlled by two sliders 213 and 214 arranged alongside of each other on a bed plate 215 and interconnected by a rack and gear arrangement 216 which causes said sliders to move in opposite longitudinal directions when either of them is propelled, as will presently appear. Said sliders carry, respectively, the cam blocks 217 and 218 the first of which is associated with the two pins 204 and 205, while the block 218 controls the positions of the pins 206 and 207. The block 217 is provided on opposite edges with two longitudinally spaced, tapered recesses 219 and 220 therein either of which may, by proper adjustment of the slider 213, be brought into vertical registration with its associated pin 204 or 205. Likewise, the block 218 has similarly

disposed recesses 221 and 222 therein associated, respectively, with the pins 206 and 207 so that when either of said recesses is brought into operative position relative to its pin, by a movement of the slider 214, said pin will be permitted to lower to its operative position. For this purpose, the head of each of the pins 204 to 207 is provided with a tapered portion 223 which fits into the corresponding recess 219, 220, 221 or 222. These recesses on the two cam blocks are so disposed that only one of them can be aligned with its pin in any position of the sliders 213, 214 and consequently only one yarn can be fed to the needles at a time. Thus, for the regular yarn feed, the sliders have four distinct positions to which they may be adjusted, depending upon which yarn is to be fed to the needles.

In addition to said four positions, the sliders have a fifth position in which none of the recesses are registered with the pins and it is in this fifth position that the feed of all the yarns is discontinued while performing the loop transfer operation. In this fifth position of the sliders the same are adjusted longitudinally so that the four pins 204 to 207 will rest upon the upper surfaces of the cam blocks 217, 218 out of alignment with the recesses 219 to 222 and consequently in their elevated or inoperative positions in which they will pass over their respective yarn carriers and not propel the same when the carriage 28 is reciprocated.

The operation of the sliders 213 and 214 is effected in the following manner. Said sliders are provided at their right hand ends (Figure 23) with the stepped plates 224 each having five shoulders thereon for the five positions to which the sliders may be adjusted. A movable contact member 225 is adjustable between the plates to align with the particular shoulder necessary to accomplish the desired movement of the sliders for any one of said five positions, and when the shoulder engages said contact member in the movement of the carriage 28 to the right, the sliders and their cam blocks are adjusted to the preselected position for either dropping one of the pins 204 to 207 to its operative position or preventing any of said pins from being lowered. As shown in Figure 23, the member 225 has been adjusted to contact the outermost shoulder of the slider 213 to obtain the fifth position in which no yarn will be fed to the needles. As the carriage 28 approaches its right hand position said contact is established and the slider 213 is moved to the left until the innermost shoulder on the slider 214, which is then moving to the right, engages said contact member to stop further movement of the sliders. At the beginning of such movement, the portion 223 of the head of the pin 207 which is then in lowered position, as shown in Figure 24, rides out of its recess 222 and onto the upper surface of the cam block 218 and the pin is thus elevated to its inoperative position. At the conclusion of said movement, the blocks 217, 218 are positioned so that none of the pins 204 to 207 can enter their recesses and the operation of all of the yarn carriers will thus be discontinued until the member 225 is again adjusted just prior to the carriage 28 reaching its right hand position during its second reciprocation of the loop transfer operation. At such time, the adjustment of the contact member is effected to engage one of the four inner shoulders of the slider 214 to move it to the left and thereby align one of the pins 204 to 207 with its associated recess so that the corresponding yarn will be fed to the needles upon the return of the carriage 28 to the left. In performing the same adjustments of the sliders as above described for regular knitting operations, the same may have plates 226 (similar to the plates 224) at the left hand ends thereof which are adapted to be engaged by a contact member 227 at the left hand end of the machine so that change-overs from one yarn to another may be effected as the carriage 28 approaches either end of its movement.

The adjustments of the contacts 225 to 227 are accomplished by the chain or chains 228 (Figure 10) on the shafts 115 or 116 through the usual linkage generally indicated at 229 which is similar to that controlled from the chain 145.

Needle bed racking mechanism

This mechanism, illustrated in Figures 26 to 28, is not only adaptable for the purpose of racking the needle bed 25 to the position shown in Figures 4 to 6 preparatory to the completion of the transfer of the loop 42 to the front needle, but may also be employed, in link and link operations, to selectively rack said bed from its normal or any racked position thereof to which the bed may have been previously adjusted, to any one of a plurality of other racking positions of different magnitudes within the racking range of the bed. It will, of course, be understood that insofar as the loop transfer operation is concerned, other racking mechanisms may be employed which are capable of racking the bed one or more needles, the present mechanism being shown only by way of example and because of its adaptability in making a large variety of rack stitches in the fabric being knitted.

As shown, the mechanism comprises a rack bar 230 which is connected to the front bed 25 so that the latter may be shifted longitudinally relative to the bed 26 to obtain the necessary racking operations of the needles in the front bed. At the end of the bar 230 remote from that to which the needle bed is connected, said arm carries a follower nut 231 movable in a longitudinal recess 232 formed in the upper section 233 of a housing 234. This nut 231 is secured to the bar 230 by a set screw 235 and is provided therethrough with a screw-threaded opening 236 engaged by the threads 237 of a rotatable shaft 238 capable of being driven in opposite directions and to various degrees so as to shift the nut 231 back and forth thereon and thereby transmit the desired racking movement to the needle bed through the bar 230. By the provision of the follower nut and screw-threaded shaft, the pitch of the threads of which is very low, it has been found in actual practice that no additional instrumentalities are needed to prevent any possible overthrow of the needle bed being racked relative to the other bed, which overthrow might otherwise result in serious damage to the machine and the needles by reason of non-registration of the needle grooves in the beds.

Should it be necessary to reset the needle bed, this may be accomplished manually by means of a resetting shaft 239. The inner end of said shaft and adjacent end of the shaft 238 are provided with cooperating clutching elements 240 normally out of engagement with each other but adapted to interengage when the shaft 239 is moved inwardly. When the clutch elements are so engaged, the shaft 239 may be rotated in either direction to transmit a similar motion to the shaft 238 and thereby adjust the follower nut 231 back and forth until the needle bed has been reset

to the proper position for a repetition of the racking sequence.

During the automatic operation of the machine, rotation is imparted to the shaft **238** in either direction through the medium of a pinion **241** on said shaft which meshes with a large gear **242** the major portion of which is disposed within the lower section of the housing **234** wherein said gear is mounted for rotation upon a trunnion **243**. This trunnion also carries a pinion **244** which constitutes a direct drive from the operating member of the racking mechanism to the shaft **238** through the gear **242** and pinion **241**.

The racking mechanism further comprises two plates **245** and **246** (Fig. 26) mounted for reciprocation in opposite directions in the lower section of the housing **234** and transversely relative to the shaft **238**. To accomplish the movements of the plates in opposite directions, each of them carries a rack bar **247** which meshes with the pinion **244** so that when one of the plates is operated by the driving member **248**, later to be described in detail, the rack bar **247** associated with said plate will turn the pinion **244** in one direction and thereby impart a linear movement to the other plate in the opposite direction through engagement of said pinion with the rack bar associated with said other plate. The plates **245** and **246**, which are arranged alongside of each other in the same horizontal plane, are designed to have different ranges of reciprocating movements imparted thereto by the driving member **248**, the changes in the magnitude of such movements depending upon the position of said driving member relative to said plates, said driving member being vertically adjustable as will later be described. To attain the variations in the magnitude of movements of said plates, and thereby control the amount of rotation of the shaft **238** and consequent racking movement of the needle bed, each of said plates has the end thereof adjacent the driving member provided with a stepped formation extending in opposite direction to the end of the other plate to form a series of contact surfaces or shoulders **249** equal in number to the various positions to which said plates may be moved by the driving member. The latter member also reciprocates and has a fixed degree of movement extending from the full-line position of Figure 26 to a point indicated by the vertical dot-and-dash line. Depending upon the relative positions of the plates **245** and **246** attained by previous operation thereof and also upon the vertical position of the driving member **248** in relation to said plates, one of the latter acts as an operating member for the pinion **244** while the other member acts as a stop which contacts said member **248** to limit the turning movement of the pinion **244** and thereby bring the needle bed to the desired racking position in which its needle grooves will properly align with the grooves of the other needle bed. As shown in Figure 26, the plate **245** has been advanced to a projected position relative to the plate **246** so that it will be first contacted by the driving member **248** when the latter is reciprocated, and will thus act as the operating member, with the plate **246** assuming the role of the stop member during the next racking operation. Thus, with the parts in the position of Figure 26 in which the driving member **248** has been elevated to align horizontally with the uppermost shoulders **249** of the plates **245** and **246**, in which the extreme or greatest racking movement of the needle bed will be attained, the reciprocating movement of the driving member **248** is started, in a manner to later appear, and at the beginning of such movement it contacts the shoulder **249** of the plate **245** and moves said plate to the left. At the same time, through the rack and pinion arrangement, the plate **246** is moved to the right and rotation is imparted to the shaft **238** in the desired direction. When the free end of the driving member **248** reaches the left hand extremity of its fixed movement, indicated by the vertical dot-and-dash line, the uppermost shoulder **249** of the plate **246**, which is now acting as the stop member, comes in contact with said driving member, and thus, through its rack and gear connection with the plate **245**, brings the latter to a stop and, aided by the screw thread **237** and follower nut **231**, prevents any overthrow of the needle bed. With the positions of the plates **245** and **246** thus reversed, all of the shoulders **249** of the plate **246** are now projected beyond the corresponding shoulders of the plate **245** in the direction of the driving member **248** and consequently should the latter member be lowered to any one of its other positions for a subsequent racking operation of a different magnitude, said driving member will, upon its next reciprocation, contact the shoulder of the plate **246** with which it is horizontally aligned, and in such instance the latter plate will then act as the operating member and the plate **245** will be the stop member. Thus, if the next racking operation, is to be accomplished during a loop transfer operation, the driving member would be adjusted, when racking the bed **25** one needle, from the position of Figure 26, for instance, to align with the second uppermost shoulder of the plate **246** so that the next forward movement of the member **248** will adjust said plate the one step necessary to rack the needle the necessary distance. There may be times during the operation of the machine when it is not desired to rack the needle plate. In such instance, no adjustment of the driving member **248** from its previous position need be made and the same will continue to reciprocate with no effect upon the plates **245**, **246** except to contact the shoulders thereof which are then aligned with said driving member.

The supporting means for the driving member **248** and the mechanism by which it is reciprocated through a fixed range of movement will now be described. Said means comprises a support or carriage **250**, having guide pins **251** extending laterally therefrom in a horizontal direction and each adapted to engage in the standard **252** fixed upon a convenient part of the machine frame. A vertically disposed guiding post **253** is carried by the support **250** and passes through an opening formed in the vertically adjustable carrier **254**. This carrier is provided with a recess **255** in which the inner end of the driving member **248** is adjustably mounted and secured in position by means of set screws **256**. On one side of the carrier **254** the same supports a plate **257** which is utilized in imparting vertical movement to said carrier when adjusting the driving member for various racking operations. The plate **257** may be adjustable in a vertical direction on the carrier and for this purpose said plate is provided with a longitudinal slot **258** through which a set screw **259** extends into the carrier to tighten said plate in its adjusted positions. A set screw **260** at the top of the carrier engages an enlargement **261** on the plate **257** to effect the necessary adjustments after said set screw **259** has been loosened sufficiently, following which

the latter may be tightened as previously described. The support 250 is horizontally reciprocated to impart a similar motion to the driving member 248 and for this purpose the rear face of said support is provided with a cam 262 adapted to be engaged by a roller 263 carried by the crank arm 264 which rotates in the direction of the arrow in Figure 26. This crank arm is mounted upon the power shaft 100 which, as before stated, is rotated two revolutions during each complete reciprocation of the carriage 28, so that a racking operation may be effected at the end of each course that the carriage travels. Thus, as the carriage approaches either one of the extremities of its movement the roller 263 will be brought into the position shown in Figure 26, and during the time that it takes for said carriage to reach said extremity of movement and start its return movement, said roller will pass over the cam surface 262 and thus force the support 250 to move to the left as viewed in said figure. The driving member 248, having previously been vertically adjusted to the desired position, will now advance and engage one of the plates 245 or 246 as previously described. The operation of said plates and the consequent racking of the needle bed, as when making a transfer operation, is accomplished at the end of the first reciprocation of the carriage 28 as previously mentioned, and after the roller 263 has disengaged from the cam 262 the support 250 is returned to its starting point under the influence of a retractile spring 265 connected to said support. This return movement by said spring is limited by a stop 266 carried by a bracket 267 on which said stop is adjustable by means of a set screw 268.

The selective adjustment of the driving member 248 whereby the same may be positioned at any point within the racking range, or in a neutral position in which the member will not contact either of the plates 245, 246 is best illustrated in Figure 28. This adjustment is under the primary control of a pattern chain, generally indicated by the numeral 269, mounted on the sprocket shaft 115, and consisting of a plurality of links 270 of different heights, there being at least one link for each position of adjustment of the driving member. The lowest link on the chain accomplishes the adjustment of the driving member of its uppermost position, in alignment with the top shoulder of one of plates 245, 246, while the highest link will cause said driving member to be moved to its lowest position, the links of intermediate heights operating to adjust the driving member in horizontal alignment with the remaining shoulders 249 of said plates.

A step-by-step motion imparted to the sprocket shafts 115 and 116 successively brings the various links or lugs of the different chains into operative position with respect to their associated elements and this motion is transmitted to said shafts by means of a pitman connection 271 driven from the power shaft 100 and connected to an oscillatory lever 272 pivoted at 273 to the frame of the machine. An operating pawl 274 has one end connected to the upper end of the lever 272 and its other end engageable with a rachet 275 carried by the shaft 115. When it is desired that the pawl 274 be controlled so that it will not engage the ratchet 275, as during intervals when the described operations are not to be performed, a well-known mechanism which includes a lever 276 may be periodically operated to raise the pawl 274 so that its stroke will be ineffective to step the ratchet 275 around.

When a link 270 has been brought to its operative position at the top of the pattern chain, it engages one end of a lever 277 pivoted at 278 to cause a rocking movement of said lever. If it be a lower link such as would be necessary to raise the driving member to the position shown in Figure 26, for instance, a spring 279 connected to the opposite end of the lever 277 from that which engages the link of the chain, becomes effective to draw said opposite end upwardly with the result that an upward pull is exerted upon a link 280 having one end connected to said lever 277. The other end of said link is pivoted to a crank arm 281 mounted upon a shaft 282 which has fixed thereon one end of the plate-operating arm 283. The other end of said arm engages the undersurface of the plate 257 and as said end is raised in response to the operation just described, the carrier 254 is also raised to adjust the driving member 248 to the proper height in accordance with the link on the pattern chain which contacted the lever 277. From the foregoing description it will be obvious that when a succeeding higher link engages the lever 277, a reverse operation takes place in which the end of said lever connected to the spring 279 is lowered against the tension of said spring and the arm 283 is also lowered to the proper point determined by the higher chain link. This lowering of the arm 283 permits the carrier 254 to drop by gravity and its downward movement is limited by contact of the plate 257 with said arm 283. A spring controlled pawl 284 may be associated with the ratchet 275 to prevent any overthrow of said ratchet when the same is operated by the pawl 274.

Jacquard control mechanism

As shown in Figure 11, the jacquard 38 is mounted upon an arm 285, pivoted to the frame of the machine for swinging movement toward and away from the rear needle bed 26. This movement is effected by a contact 286 rotatable with the power shaft 100 to periodically engage the arm 285 to move the same forwardly. In order to step the jacquard chain around to align various pattern lugs 39 thereon with different needles in the rear bed, a pawl 287 is operated by the usual type of linkage controlled from a chain 288 on one or both of the shafts 115, 116. In order to control the jacquard 38 so that it will not be impelled forwardly, should such be desired, a chain or chains 289, similar to the chain 288, is utilized to control the position of a striker plate 290 pivoted on the arm 285 to move the same out of the path of the contact 286.

What is claimed is:

1. The method of knitting with a full automatic links and links machine which comprises utilizing a reciprocating carriage to shift certain needles from one needle bed to an opposing bed and to form loops on needles in both beds, removing the loops from the shifted needles, and transferring the removed loops to other needles.

2. The method of knitting with a full automatic links and links machine which comprises utilizing a reciprocating carriage to shift certain needles from one needle bed to an opposed bed and to form loops on needles in both beds of the machine, removing the loops from the shifted needles, racking one of said beds relative to the other, and transferring the removed loops to other needles in the racked bed.

3. The method of knitting with a full automatic links and links machine which comprises utilizing a reciprocating carriage to shift certain needles from one needle bed to an opposed bed and to form loops on needles in both beds of the machine, removing the loops from the shifted needles by first raising and then lowering the latter relative to their bed, and transferring the removed loops to other needles.

4. The method of knitting with a full automatic links and links machine which comprises utilizing a reciprocating carriage to shift certain needles from one needle bed to an opposed bed and to form loops on needles in both beds of the machine, removing the loops from the shifted needles by first raising and then lowering the latter relative to their bed, racking one of said beds relative to the other, and transferring the removed loops to needles in the racked bed.

5. The method of knitting with a links and links machine which comprises continuously operating the drive of a lock mechanism over opposed beds of the machine to initially shift certain needles from one of said beds to the other and to control the formation of loops on needles in both beds and, while so operating said drive, transferring loops from the shifted needles in one bed to needles in the other bed.

6. The method of knitting with a links and links machine which comprises continuously operating the drive of a reciprocating lock mechanism over opposed beds of the machine to initially shift certain needles from one of said beds to the other and to control the formation of loops in both beds, controlling a transfer jack during one of the movements of said lock mechanism to remove the loop from a shifted needle on to said jack, and operating said jack, during a subsequent movement over said lock mechanism, to deposit its loop upon a needle in the first named bed.

7. The method of knitting with a links and links machine which comprises continuously operating the drive of a reciprocating lock mechanism over opposed beds of the machine to initially shift certain needles from one of said beds to the other to control the formation of loops on needles in both beds, controlling a transfer jack during one of the movements of said lock mechanism to remove the loop from a shifted needle on to said jack, racking one of said beds relative to the other during a different movement of said lock mechanism, and operating said jack, during still another of the movements of said mechanism, to transfer its loop to a needle in the racked bed.

8. The method of knitting with a links and links machine which comprises continuously operating the drive of a lock mechanism over opposed beds of the machine to initially shift certain needles from one of said beds to the other and to control the feed of a yarn to needles in both beds and form loops on said needles and, while so operating said drive, suspending the feed of said yarn, and transferring loops on the shifted needles to others in the first named bed while the feed of said yarn is suspended.

9. The method of knitting with a links and links machine which comprises continuously operating the drive of a lock mechanism over opposed beds of the machine to initially shift certain needles from one of said beds to the other and to control the feed of a yarn to needles in both beds and form loops on said needles and, while so operating said drive, suspending the feed of said yarn, racking the first named bed, operating transfer jacks to remove loops from the shifted needles to other needles in the racked bed, and thereafter resuming the feed of said yarn.

10. The method of knitting with a links and links machine which comprises continuously operating the drive of a lock mechanism over opposed beds of the machine to initially shift one of said needles from one bed to the other and to control the feed of a yarn to needles in both beds and form loops on said needles and, while so operating said drive, suspending the feed of said yarn controlling a transfer jack to disengage the loop from each of the shifted needles, racking one of said beds, again operating said transfer jack to deposit the disengaged loop onto a needle in the racked bed, and finally resuming the feed of said yarn.

11. The method of knitting with a links and links machine which comprises forming loops on a series of needles by the reciprocation of a lock mechanism over opposed needle beds of the machine, shifting certain of said needles from one needle bed to another, removing the loop from the latter needles following one movement of said mechanism, adjusting other needles to positions to receive the removed loops during another movement of said lock mechanism, and transferring said removed loops to the last named needles before said lock mechanism is again moved.

12. In a links and links knitting machine, cooperating needle beds, a plurality of needles in said beds, a reciprocating lock mechanism movable over said beds and controlling said needles in the formation of loops, means actuated after the passage of said mechanism over said beds in one direction to remove the loops from certain of said needles by temporarily raising the latter from their bed, means thereafter operable to rack one of said beds, and means to actuate said removing means, after another movement of said lock mechanism, to transfer the removed loops to other needles in the racked bed.

13. In a links and links knitting machine, cooperating needle beds, a plurality of needles in said beds, a lock mechanism movable relative to said beds and controlling said needles in the formation of loops, a transfer jack operable between said beds, after one movement of said lock mechanism, to initiate the removel of a formed loop from one of said needles by raising the latter from its bed, means to thereafter rack one of said beds, and operating means for said transfer jack effective, following another movement of said lock mechanism, to actuate said jack to remove the loop from the raised needle and transfer the same to a needle in the racked bed.

14. Loop transfer mechanism for links and links knitting machines comprising, in combination, a transfer jack-supporting member, a plurality of transfer jacks supported thereby, a plurality of needles on which loops are formed and from certain of which the formed loops are to be transferred by said jacks to other needles, means to form said loops, a reciprocating control element for said supporting member having separate movements, and lever connections between said control element and supporting member operable to actuate the latter and said jacks to certain positions during one movement of said control element to remove the loops from said certain needles and to further actuate said member and jacks to a different position during another movement of said control element to transfer said removed loops to other needles of the machine.

15. A loop transfer mechanism for links and links knitting machines comprising, in combination, a transfer jack supporting member, a plurality of transfer jacks supported thereby, a plurality of needles on which loops are formed and from certain of which the formed loops are to be transferred by said jacks to other needles, means to form said loops, a control element for said supporting member having separate movements, lever connections between said control element and supporting member operable to actuate the latter and said jacks to certain positions during one movement of said control element to raise said certain needles relative to their bed and further actuate said member and jacks to other positions during another movement of said element to remove the loops from said certain needles, and means operated by said control element for further actuating said jacks to transfer said removed loops to other needles of the machine.

16. A loop transfer mechanism for links and links knitting machines comprising, in combination, a transfer jack-supporting member, a plurality of transfer jacks supported thereby, a plurality of needles on which loops are formed and from certain of which the formed loops are to be transferred by said jacks to other needles, means to form said loops, a sliding control element for said supporting member having separate movements, and connections between said control element and supporting member operable by the former to impart movements to said jacks during sliding movements of said control element to successively remove loops from certain of said needles and transfer said loops to other needles.

17. A loop transfer mechanism for links and links knitting machines comprising, in combination, a transfer jack supporting member, a plurality of transfer jacks pivoted thereto, a plurality of needles on which loops are formed and from certain of which the formed loops are to be transferred by said jacks to other needles, means to form said loops, a control element for said supporting member having separate movements, connections between said control element and supporting member operable by the former to move said jacks in a linear direction during one movement of said control element to remove loops from said certain needles, and means also actuated by said control element to impart a combined linear and oscillatory movement to said jacks during another of the movements of said control element to transfer the removed loops to other needles.

18. A loop transfer mechanism for links and links knitting machines comprising, in combination, an oscillatory jack supporting member, a plurality of transfer jacks pivoted thereto, a plurality of needles on which loops are formed and from certain of which the formed loops are to be transferred by said jacks to other needles, means to form said loops, a reciprocating control element for said supporting member, connections between said control element and supporting member actuated by movement of the former in one direction to impart a linear movement of said jacks to one position of operation to raise certain of said needles from their bed, and to impart a combined linear and pivotal movement to said jacks upon movement of said control element in an opposite direction to remove loops from said certain needles and transfer them to other needles of the machine, and means to reciprocate said control element.

19. In a links and links knitting machine, cooperating needle beds, a plurality of needles in said beds, means movable over said beds to operate said needles to form rows of loops in a fabric being knitted, a jacquard mechanism cooperating with said means to shift certain of said needles with their loops from one bed to another, loop transferring means thereupon operable to remove the loops from the shifted needles, means to rack one of said beds, and means thereafter operable to actuate said transferring means to transfer the removed loops onto needles which are moved into opposition to the shifted needles by the racking of said bed.

20. A loop transfer mechanism for links and links knitting machines comprising, in combination, an oscillatory jack-supporting member, a plurality of transfer jacks pivoted thereto, a reciprocatory control element for said supporting member, and connections between said control element and supporting member actuated by movement of the former in one direction to impart a linear movement of said jacks to one position of operation, and to impart a similar movement to said jacks to a second operative position upon movement of said control element in an opposite direction.

MICHAEL ZIMIC.
ANTON MISKOVSKY.

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HYDRAULIC PUMP OR MOTOR

Filed Oct. 16, 1935 4 Sheets-Sheet 1

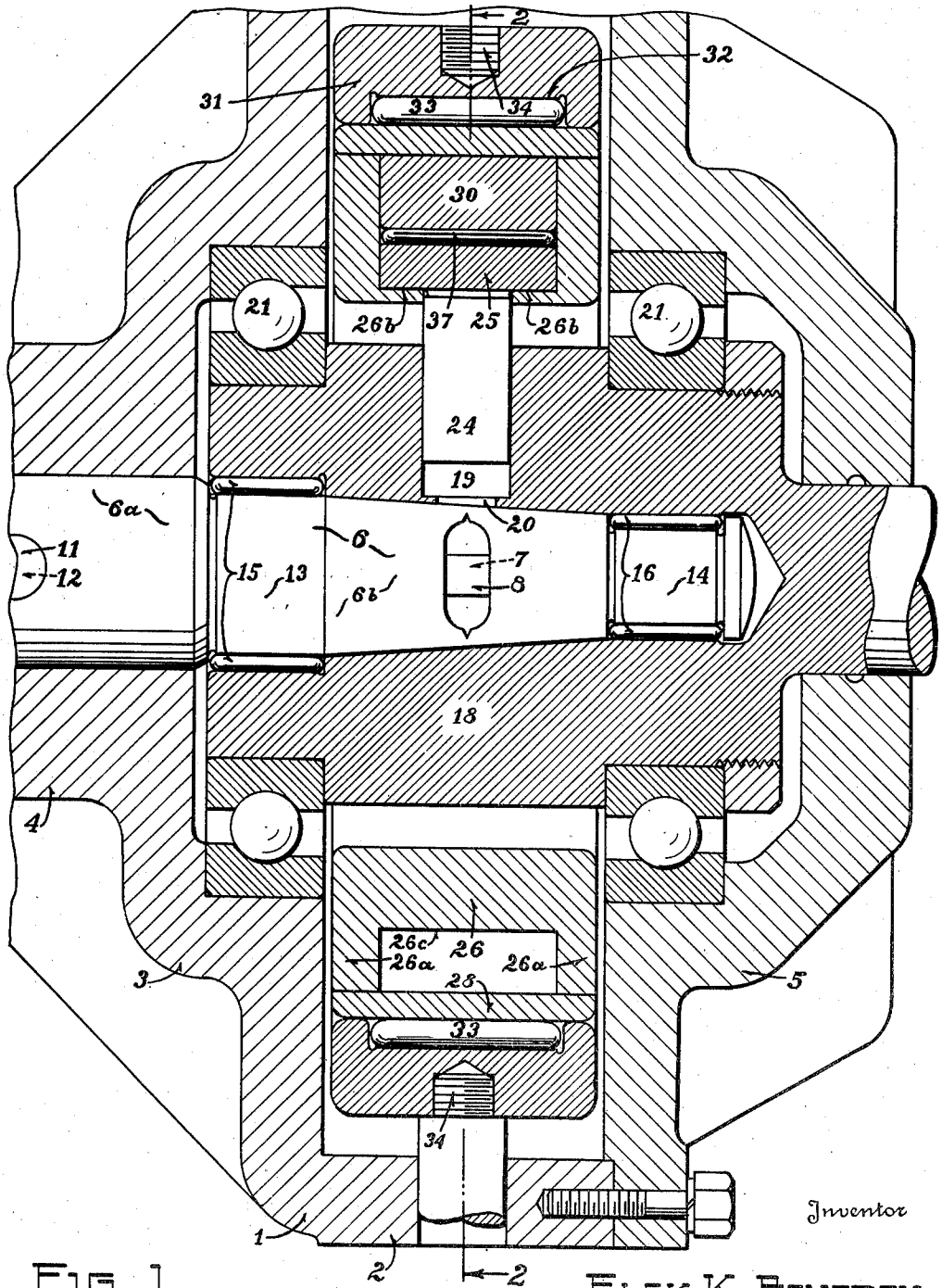


FIG. 1.

Inventor

ELEK K. BENEDEK,

By J. Harvey Howard,

his Attorney