May 9, 1967 S. A. MONK ETAL 3,318,110

FLAT BED KNITTING MACHINES

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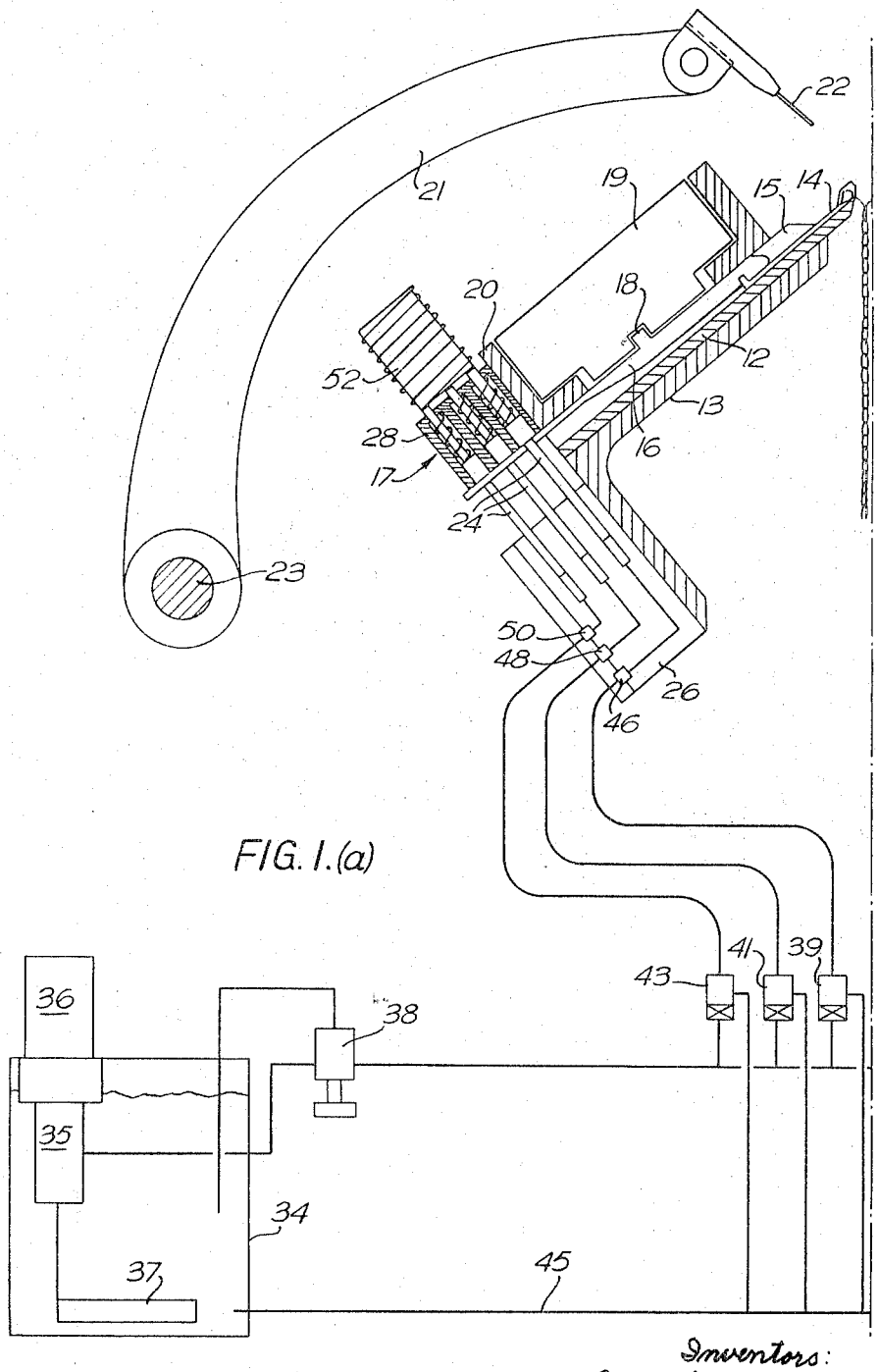


FIG. 1.(a)

Inventors:
Samuel Anthony Monk
and
Brian Arthur Monk
BY Baldwin & Wright
Attorneys

FLAT BED KNITTING MACHINES

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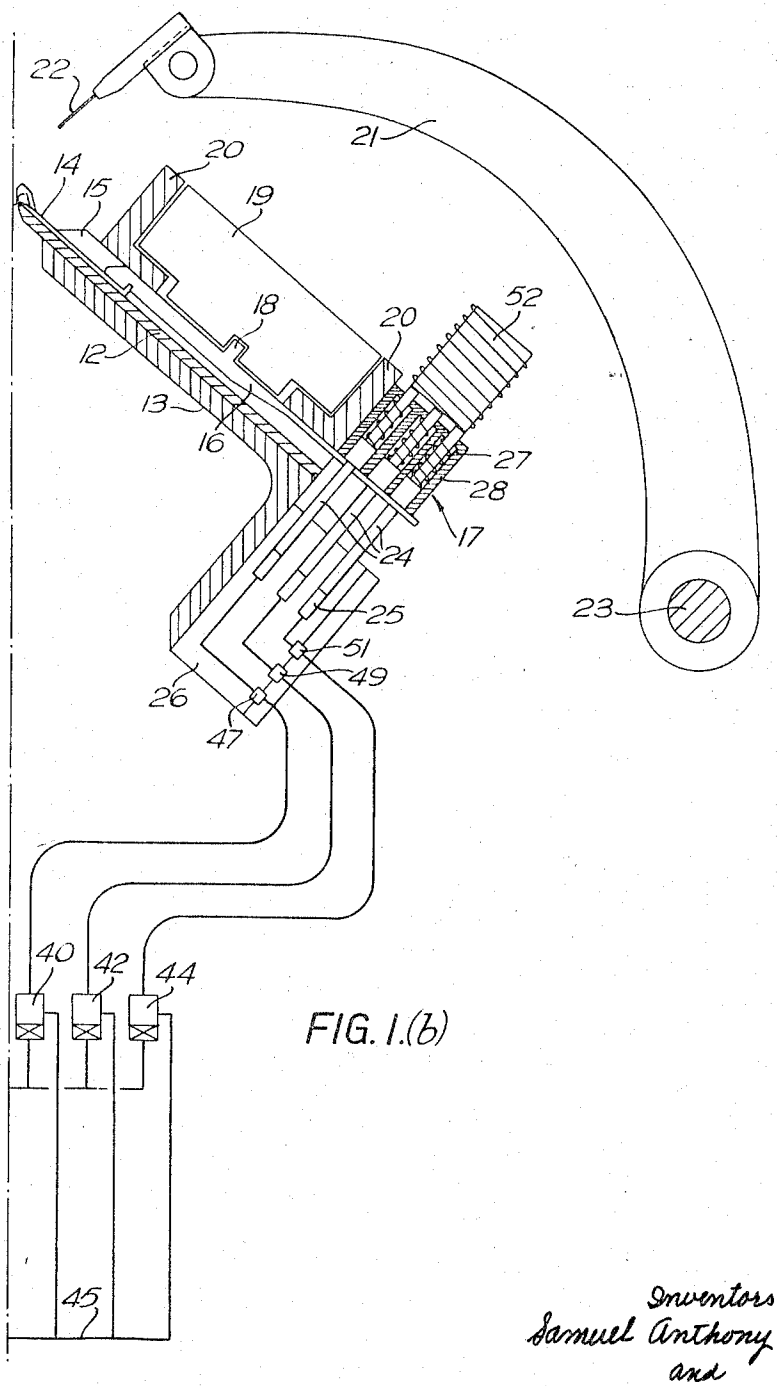


FIG. 1.(b)

Inventors:
Samuel Anthony Monk
and
Brian Arthur Monk
BY Baldwin & Wright
Attorneys

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FLAT BED KNITTING MACHINES

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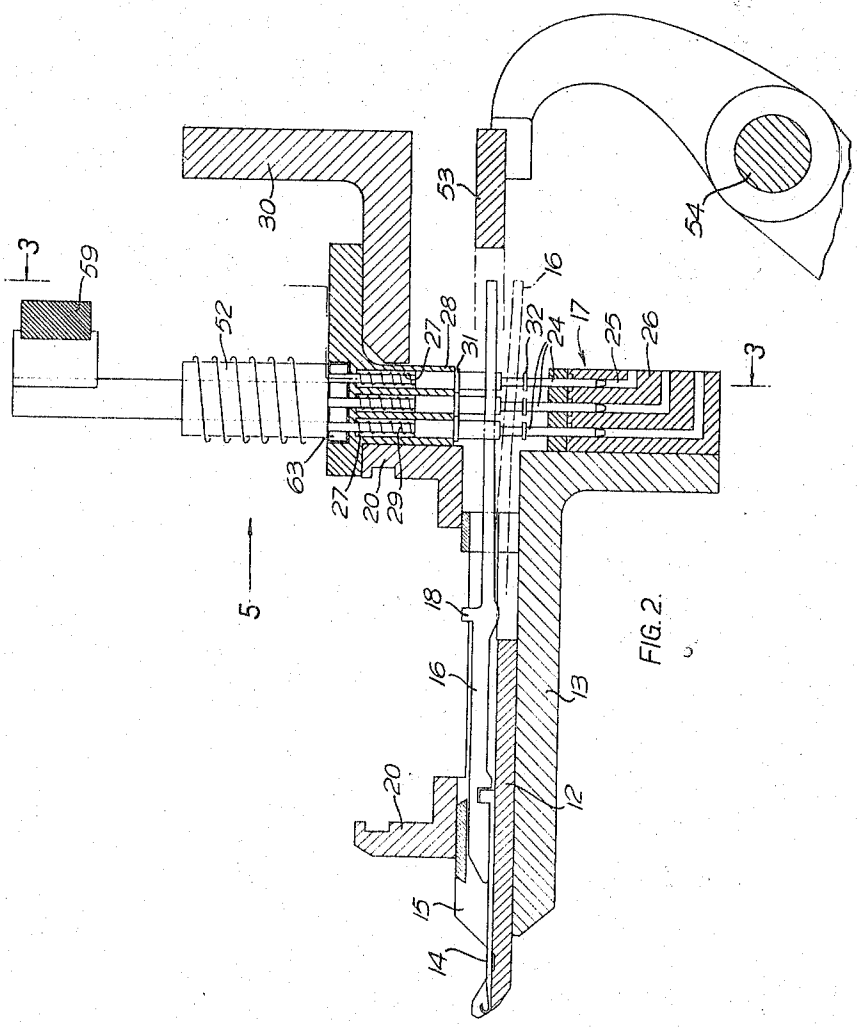


FIG. 2.

Inventors:
Samuel Anthony Monk
and
Brian Arthur Monk
BY Baldwin & Wight
Attorneys

May 9, 1967 S. A. MONK ETAL 3,318,110

FLAT BED KNITTING MACHINES

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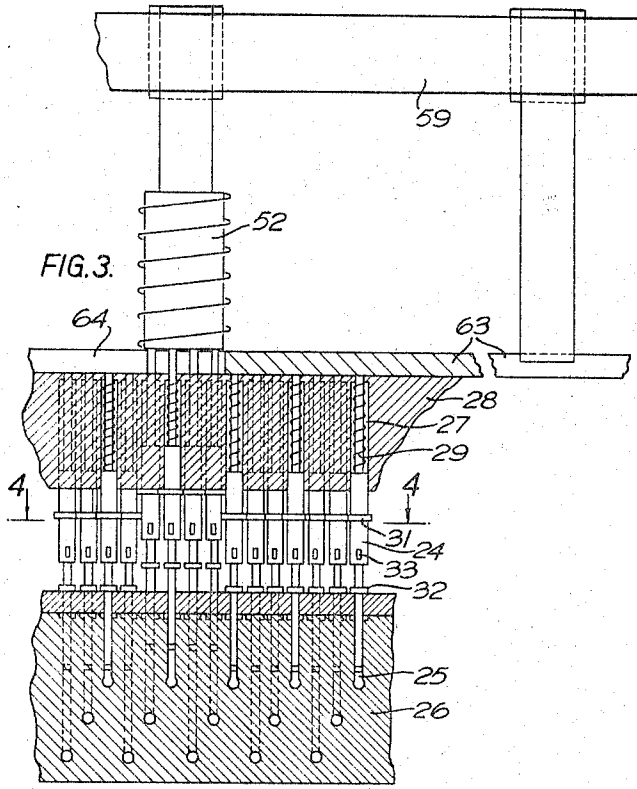


FIG. 3.

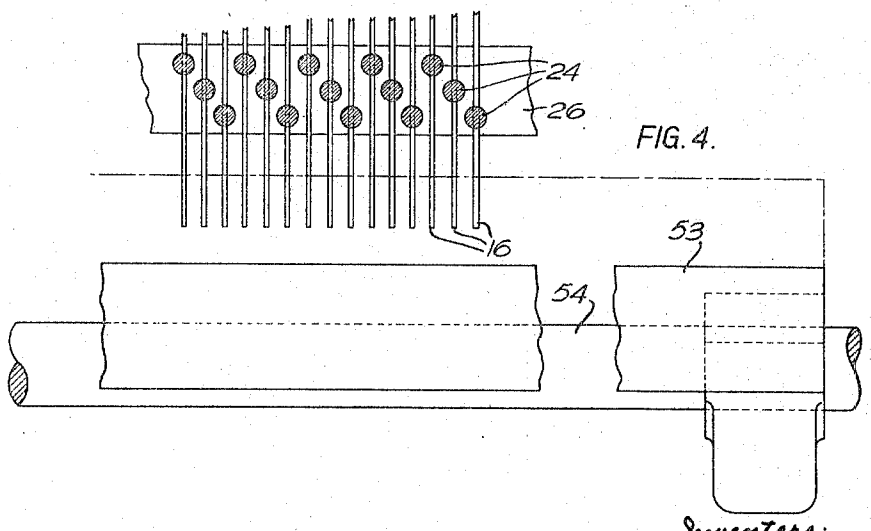


FIG. 4.

Inventors:
Samuel Anthony Monk
and
Brian Arthur Monk
BY Baldwin & Wright
Attorneys

FLAT BED KNITTING MACHINES

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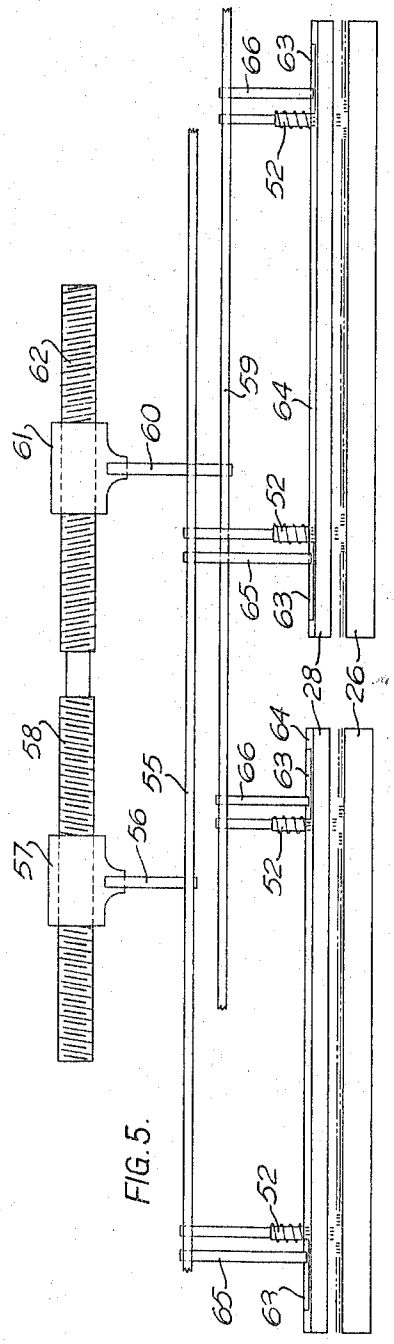


FIG. 5.

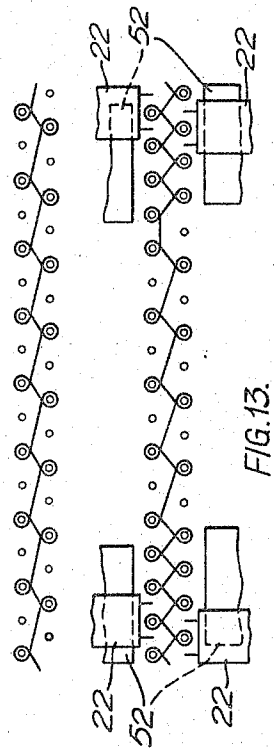


FIG. 12.

FIG. 13.

Inventors:
Samuel Anthony Monk
and
Brian Arthur Monk
By Baldwin & Wight
Attorneys

May 9, 1967 S. A. MONK ETAL 3,318,110

FLAT BED KNITTING MACHINES

Filed Feb. 11, 1965 10 Sheets-Sheet 6

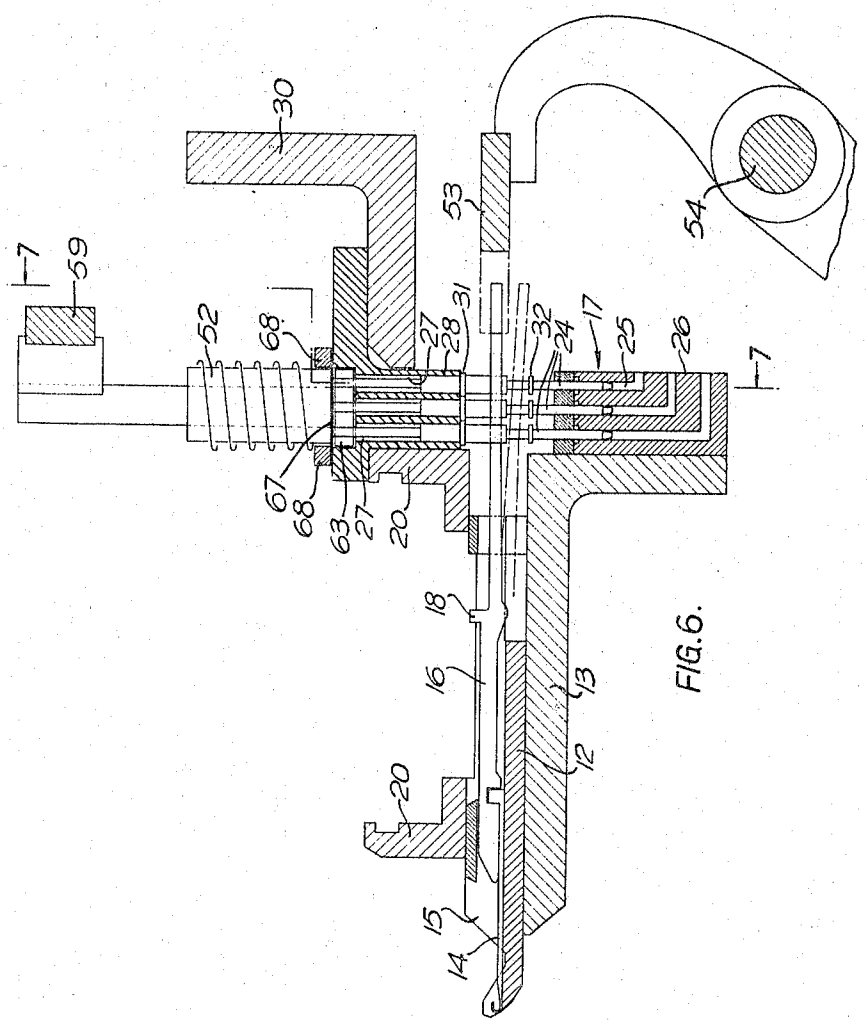


FIG. 6.

Inventors:
Samuel Anthony Monk
and
Brian Arthur Monk
By Baldwin & Wright
Attorneys

May 9, 1967 S. A. MONK ETAL 3,318,110

FLAT BED KNITTING MACHINES

Filed Feb. 11, 1965 10 Sheets-Sheet 7

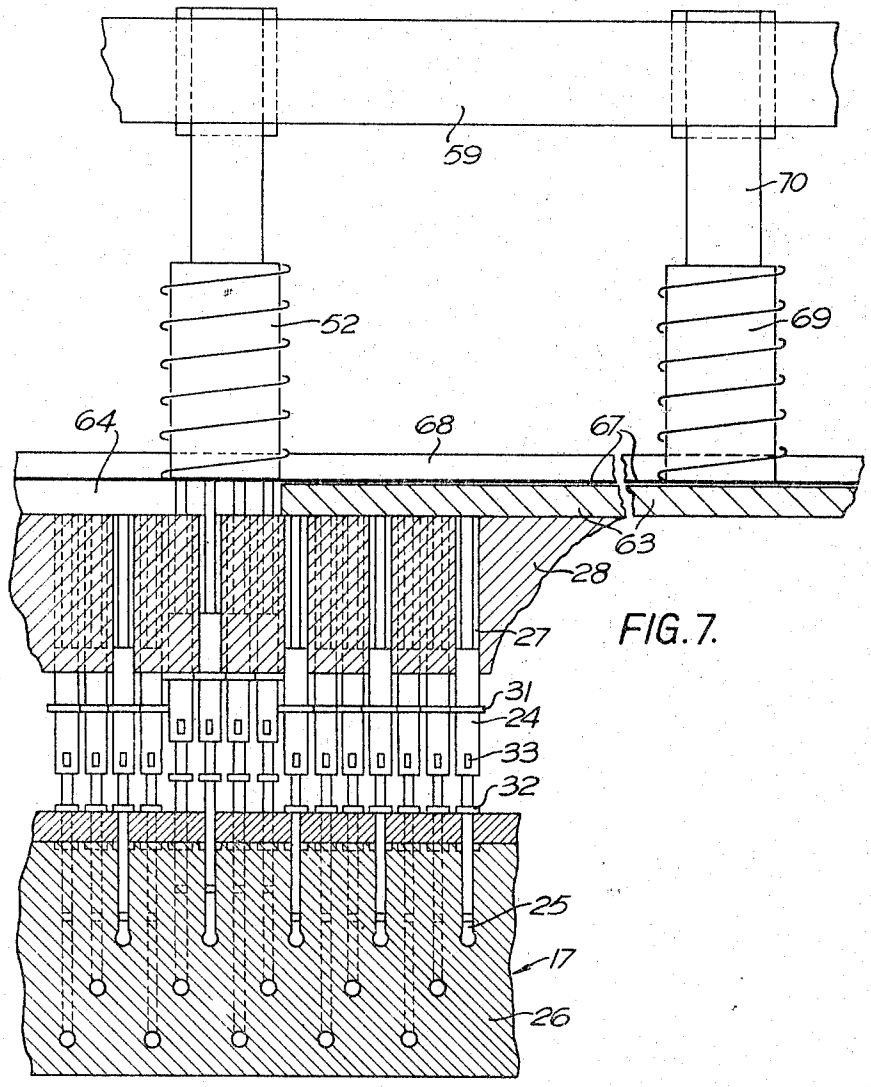


FIG. 7.

Inventors:
Samuel Anthony Monk
and
Brian Arthur Monk
BY Baldwin & Wight
Attorneys

May 9, 1967 S. A. MONK ETAL 3,318,110

FLAT BED KNITTING MACHINES

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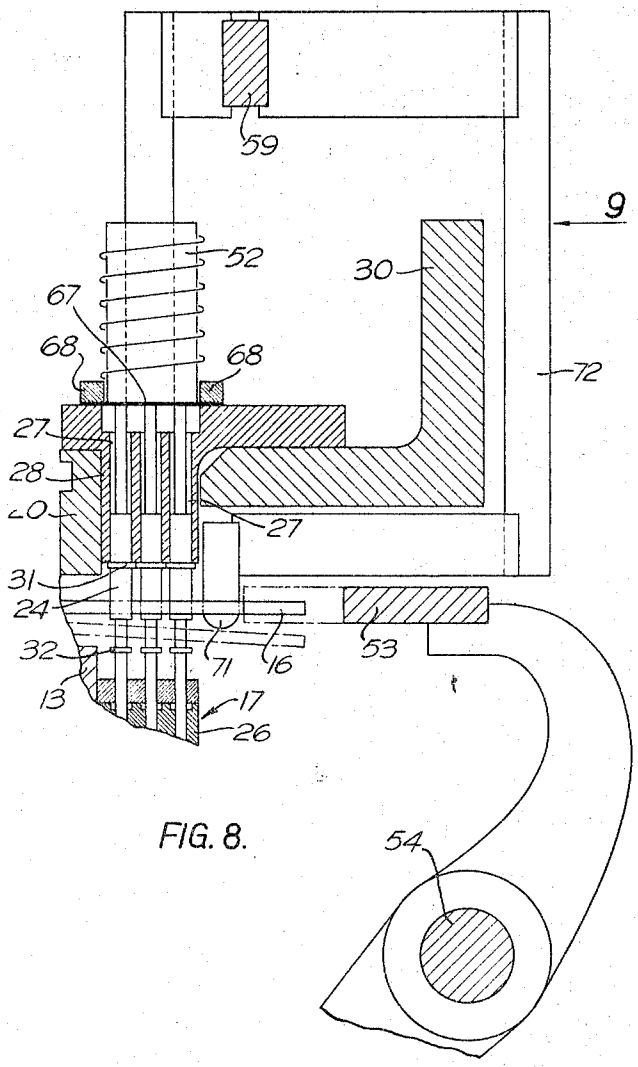


FIG. 8.

Inventors:
Samuel Anthony Monk
and
Brian Arthur Monk
BY Baldwin & Wight
Attorneys

FLAT BED KNITTING MACHINES

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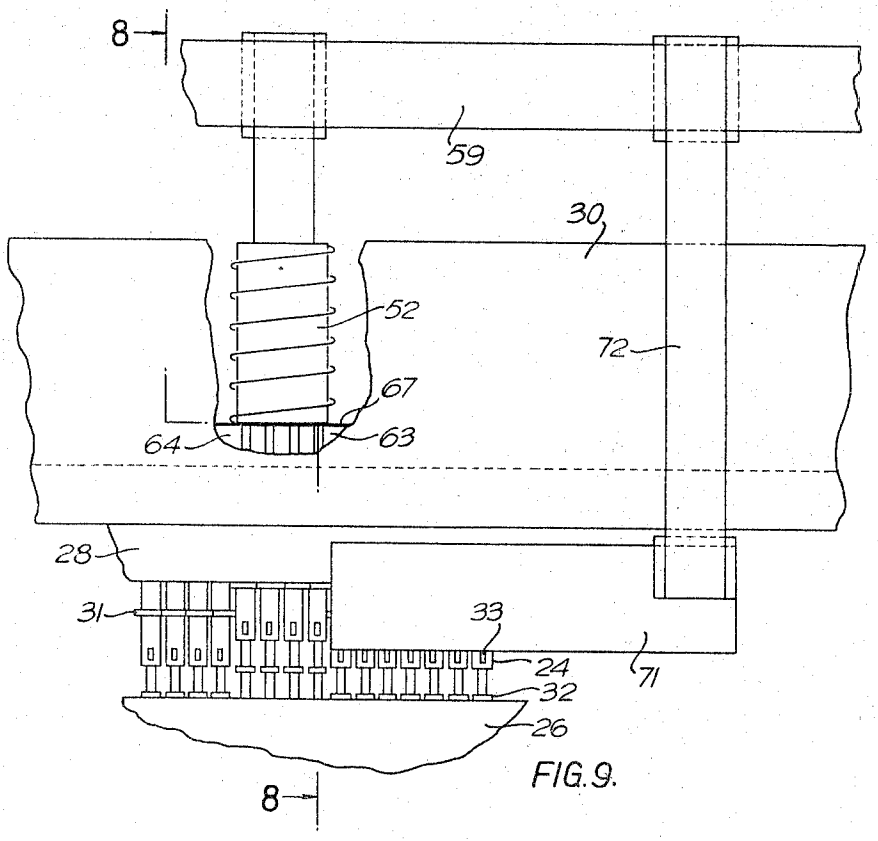


FIG. 9.

Inventors:
Samuel Anthony Monk
and
Brian Arthur Monk
BY Baldwin & Wight
Attorneys

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FLAT BED KNITTING MACHINES

Filed Feb. 11, 1965 10 Sheets-Sheet 10

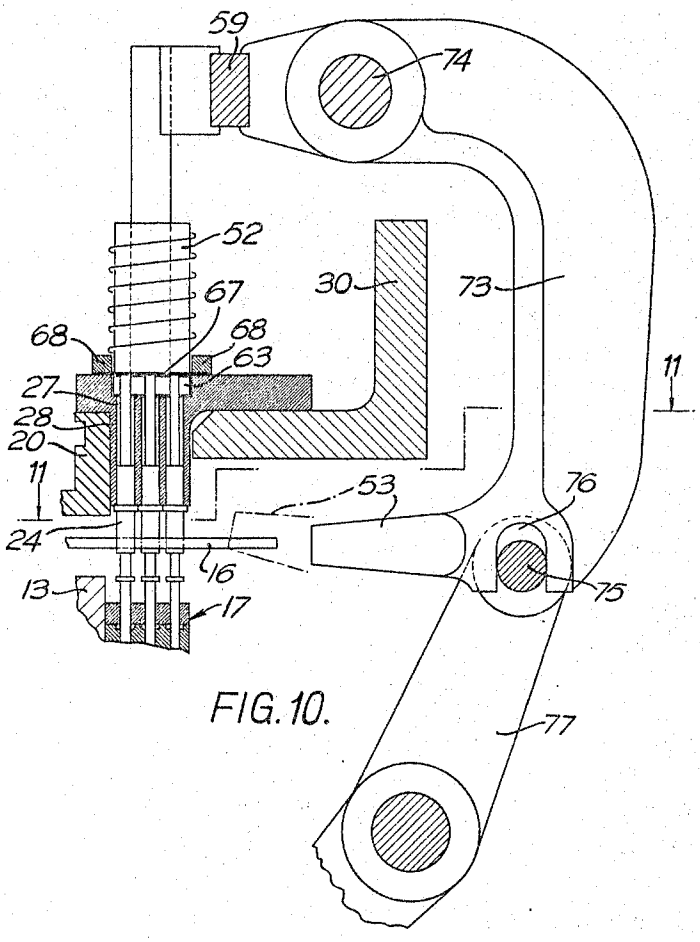


FIG. 10.

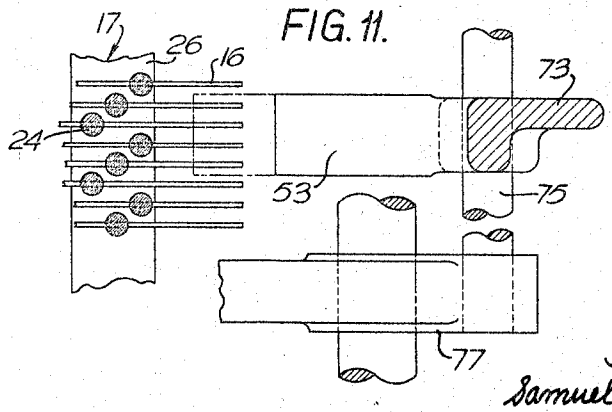


FIG. 11.

Inventors:
Samuel Anthony Monk
and
Brian Arthur Monk
BY Baldwin & Wright
Attorneys

United States Patent Office 3,318,110
Patented May 9, 1967

3,318,110

FLAT BED KNITTING MACHINES

Samuel Anthony Monk, Fish Pool, and Brian Arthur Monk, Mansfield, England, assignors of one-third to S. A. Monk (Sutton-in-Ashfield) Limited, Sutton-in-Ashfield, England, a corporation of the United Kingdom

Filed Feb. 11, 1965, Ser. No. 431,803
Claims priority, application Great Britain, Feb. 14, 1964, 6,260/64; July 29, 1964, 30,085/64
18 Claims. (Cl. 66—70)

This invention relates to a flat bed knitting machines of the kind (hereinafter referred to as the kind described) having a pair of co-operating needle beds arranged at an angle to one another, each needle bed having a series of latched needles which are movable individually in tricks formed therein by means of a cam box arranged to be traversed lengthwise over the needle bed.

Such machines usually include, for the purpose of effecting patterned work, needle selection means and it is among the objects of the present invention to provide new and improved needle selection means, particularly for machines of the kind described, in which each needle has hingedly connected thereto a needle actuator in the form of a needle arm having a butt for engagement by the cams of the cam box, needle selection being carried out by causing pivotal movement of the needle arm in a plane perpendicular to the needle bed so that its butt is either in, or out of, the path of the cams; or in which each needle has connected thereto a needle actuator in the form of a clavette having a butt for engagement by the cams of the cam box, needle selection being carried out by a single selector member, or one of a plurality of selector members, the selector member being arranged to move its co-acting clavette in an axial direction so that the butt thereof, which is normally in an inoperative position, is moved into the path of the cams.

According to the present invention, there is provided a knitting machine of the kind described having needle selection means in which each needle, or a plurality of needles, has or have operatively associated therewith, via a needle actuator formed with a butt for engagement by the cams of the cam box, a fluid operated piston or plunger, and in which means are provided for selectively moving the pistons or plungers between an operative position where the butts of the needle actuators are in the path of the cam box, and an inoperative position where the butts of the needle actuators are out of the path of the cam box.

The needle actuators may be in the form of needle arms, in which case the pistons or plungers are arranged in positions which are perpendicular, or substantially perpendicular, to the needle arms and to the needle bed. Alternatively, the needle actuators may be in the form of clavettes, in which case the pistons or plungers are arranged in axial alignment, or substantially in axial alignment, with the clavettes.

Operation of the pistons or plungers is effected by hydraulic or pneumatic pressure.

The invention is illustrated by way of example in the accompanying drawings in which,

FIGURES 1(*a*) and (*b*) each show a cross-section through a machine showing a general arrangement of the selector means of the invention and an hydraulic circuit therefor, the irrelevant parts of the machine having been omitted for the sake of clarity,

FIGURE 2 is a section, on an enlarged scale, corresponding to part of FIGURE 1,

FIGURE 3 is a part section one the line 3—3 of FIGURE 2,

FIGURE 4 is a section on the line 4—4 of FIGURE 3,

FIGURE 5 is a scrap view in the direction of the

arrow 5 of FIGURE 2 showing the knitting width and selvedge control means as applied to two adjacent knitting divisions of a multi-head machine,

FIGURE 6 is a section corresponding to that of FIGURE 2 showing a modification to adapt the selector means for pneumatic operation,

FIGURE 7 is a part section on the line 7—7 of FIGURE 6,

FIGURE 8 is a section on the line 8—8 of FIGURE 9 showing an alternative form of knitting width control,

FIGURE 9 is a view in part in the direction of the arrow 9 of FIGURE 8,

FIGURE 10 is a section corresponding in part to FIGURE 6 showing a further modification,

FIGURE 11 is a section in part on the line 11—11 of FIGURE 10, and

FIGURES 12 and 13 show respectively a course of loops with the usual selvedge and a course of loops with an improved selvedge.

Referring particularly to FIGURE 1 of the drawings, there is shown a full fashioned knitting machine comprising a pair of co-operating needle beds **12** arranged at an angle to one another and supported on longitudinally disposed angle brackets **13**, each needle bed having a series of latched needles **14** mounted for sliding axial movement in tricks **15** arranged in spaced relation along the length of the needle bed **12**, a series, corresponding in number to the number of needles, of needle arms **16** hingedly attached to, and slidable with, the needles **14**, and needle selection means **17** which are arranged to cause pivotal movement of the, or selected, needle arms **16** so that butts **18** of the needle arms, or certain of the needle arms **16** will be moved out of the path of the cams of a cam box **19** arranged to be traversed in guides **20** over the needle bed, so that only selected needles will carry out a knitting operation.

The needle arms **16**, which are shown in an operative position (i.e. pivoted upwardly) in FIGURE 1, are biased into an inoperative position by spring means which are hereinafter described and the cam boxes **19** are reciprocated over the needle beds **12** in known manner.

The machine also includes a pair of fashioning mechanisms **21** associated with each needle bed **12**, the fashioning points **22** thereof being arranged to co-operate with the needles **24** to effect narrowing of a fabric in well known manner. The fashioning mechanisms **21** are movable lengthwise of the machine on shafts **23** under the control of fashioning screws and are rocked about the shafts **23** under the action of the main cam shaft of the machine via suitable known linkages. The known means referred to above can be seen in, for example, British patent specification No. 958,074.

Referring now more particularly to FIGURES 2 to 4, the needle selection means **17** comprise a series of pistons or plungers **24** corresponding in number to the number of needles **14** and needle arms **16** so that each needle arm is acted upon by its co-acting piston or plunger. The pistons or plungers **24** are arranged adjacent the lower end of each needle bed **12** so that their longitudinal axes are perpendicular to, or substantially perpendicular to, the needle arms **16** and the needle bed **12**.

The lower ends of the pistons or plungers **24** are mounted for axial movement in bores **25** formed in a cylinder block **26**, which is fixed to the bracket **13** and may be constructed in one piece or in any number of sections. The upper ends of the pistons or plungers are slidable in bores **27** formed in a manifold **28** fixed to a support bracket **30** and may be in one or more sections. The manifold is arranged in spaced relationship with the cylinder block **26**. To provide the necessary space for the pistons or plungers **24**, they may be arranged in

staggered rows, for example in three staggered rows as shown in FIGURE 4.

Within the bores 27 of the piston manifold 28 are arranged compression springs 29 which serve to bias the pistons or plungers 24 into an inoperative position, as indicated in chain dot lines in FIGURE 2, where the butts 18 of the needle arms 16 are out of the path of the cams of the cam boxes 19.

The extent of axial movement of the pistons or plungers 24 in one direction is limited by stops 31 formed thereon, and the extent of movement in the opposite direction by stops 32.

The free ends of the needle arms 16 are slidably connected to their co-acting pistons or plungers 24 at a position between the cylinder block 26 and the manifold 28, and for this purpose, the pistons or plungers 24 are each formed with a slot or recess 33. In this respect, it will be understood that the pistons or plungers 24 are provided in two sections which are arranged in end to end relationship, the joint between the two sections being at a position between the cylinder block 26 and the manifold 28 so that any misalignment of the bores 25 or 27 therein will not result in damage to, or inaccurate operation of, the pistons or plungers. In this respect, the slots or recesses 33 for receiving the needle arms 16 will be provided in the upper section of the pistons or plungers i.e. that section which extends into the manifold 28. However, in an alternative arrangement (not illustrated) the pistons or plungers are in the form of a single member which extends both into the cylinder block 26 and into the manifold 28.

In operation, in order to effect pattern work on the machine, hydraulic fluid or air under pressure is supplied to the cylinder bores 25 corresponding to selected needles to cause the co-acting pistons or plungers 24 to move upwardly so that the corresponding needle arms 16 are pivoted to move the butts 18 thereof into the path of the cams of the cam box 19, which is of conventional design, and is such as to cause the needles to knit or to form tuck stitches. The return stroke of the pistons or plungers 24 to move the butts 18 of the needle arms 16 into an inoperative position is effected by cutting off the supply of hydraulic fluid or air to the cylinder bores 25 so that movement is effected by the action of the compression springs 29.

Furthermore, since a pattern in a garment is generally repetitive across the knitting width, it is obvious that it is not essential that each needle should be capable of individual selection. In this respect, it is convenient to divide the series of needles into, for example series of six, or multiples of six, and in practice, therefore, it is only necessary to provide one basic selection combination or combinations for six needles since each additional series of six needles throughout the needle bed will be the same. Thus, in accordance with the example given, the first needles of each series of six are controlled by a first valve, the second needles of each series of six are controlled by a second valve, and so on. In order to knit a given pattern, means are provided to actuate the six valves in any desired sequence or combination. Such means may comprise a six-track jacquard mechanism or any other convenient selection means. Thus, it will be appreciated that it is not necessary to utilize the usual steel bands which are expensive as they can be replaced by the cheaper paper bands.

Referring again to FIGURES 1(*a*) and 1(*b*) of the drawings, there is shown an hydraulic circuit for effecting needle selection in the manner set out above, it being understood that during operation the needles 14 of both needle beds 12 act together and thus form a single row of needles so that, in a series of six needles, the first, third and fifth needles are in one bed and the second, fourth and sixth needles are in the other bed.

As shown, the hydraulic circuit comprises a reservoir

34, a pump 35 driven by a motor 36 which pump passes fluid, via a filter 37 and a pressure regulator 38, to six control valves 39 to 44. The control valves are of the three way solenoid operated type and are each additionally connected to the reservoir 34 through a return or exhaust line 45.

Valve 39 is connected to a gallery 46 provided in the cylinder block 26, the gallery 46 in turn being connected to the bore 25 of the piston or plunger 24 corresponding to the first needle in each series of six; valve 40 is connected to a gallery 47 in the other cylinder block 26, the gallery 47 in turn being connected to the bore 25 of the piston or plunger 24 corresponding to the second needle in each series of six; and the valves 41, 42, 43 and 44 are connected respectively to galleries 48, 49, 50 and 51 which are similarly connected respectively to the third, fourth, fifth and sixth needles in each series of six.

Thus, in operation, if for example the solenoid of the valve 39 is energised, fluid under pressure will pass into the gallery 46 and thence into all the bores 25 common to the gallery 46. This will cause the co-acting pistons or plungers 24 to move upwardly against the action of the springs 29 to pivot the butts 18 of the corresponding needle arms 16 into the path of the cam box 19. The cam box will then be traversed over the needle bed to actuate the selected needles, after which the solenoid is de-energised to open the exhaust line and allow the pistons or plungers 24 to move downwards under the action of the springs 29. The solenoids of the control valves are energised and de-energised at the end of each stroke of the cam box according to the pattern required.

Although series of six needles have been described and shown in the drawings, it will be understood that there may be any convenient number of needles in each series. Thus, the number of control valves and co-acting galleries may be varied according to requirements. It has been found preferable for patterning purposes to have twelve needles in each series.

As is usual in full fashioned machines, in order to widen the knitting piece, the knitting width control means are operated to bring more needles into operation. In order to effect narrowing of the knitting piece, however, it is necessary to provide means for transferring the loops on the outer needles to the needles forming he new width. For this purpose the fashioning points 22, which are operated via fashioning screws from the main cam shaft of the machine, are provided.

The fashioning mechanism and a fashioning operation will now be described with reference to the knitting of a plain rib fabric using for example six needles in the fashioning operation.

Assuming that all the needle arms 16 of all the needles 14 throughout the knitting width are in an operative position and hydraulic fluid or air is, therefore, being supplied to all the pistons or plungers 24 in the cylinder block 26. The cam shaft is brought into operation by any suitable control means and causes the cam box 19 to stop at the end of its stroke. At this point, all the needle arms except the outer eight are returned, under the action of the springs 29, to their inoperative positions by passing the fluid pressure to exhaust. The outer eight needles, or at least their needle arms, are held in an operative position by electro-magnets 52 which are provided to co-operate with the upper ends of the pistons or plungers 24.

The electro-magnets 52 preferably comprise a single coil winding within which is arranged a core or a plurality of, for example four, cores separated, if necessary, by brass or other separator members. The magnetic cores are of plate-like construction and are of such width as to span the three rows of staggered pistons or plungers. Provision may be made where it is desired to fashion on a different number of needles to enable one or more cores of each magnet to be moved upwardly so that their

magnetic fields are no longer capable of attracting their co-acting piston or plunger.

The outer eight needle arms **16** held in the operative position by the electro-magnets **52** are then moved forward in the needle bed tricks **15** by means of a pusher bar **53** which is pivotally mounted on a shaft **54**, movement of the pusher bar, which may be effected by the main cam shaft, being sufficient to open the latches of the needles associated with the said needle arms. The fashioning points **22** are then operated in known manner so as to transfer the six loops from the outer six needles to the fashioning points and the emptied needles are left just below their knock-over height. The pusher bar **53** again operates to level the needles.

The electro-magnets **52** are then switched off so that the six pistons or plungers **24** drop down and their co-operating needle arms **16** are returned, under the action of the springs **29**, to their inoperative positions. Thus, the six outer loops are now held by the fashioning points **22**. Fluid pressure is again supplied to all the pistons or plungers **24** and the six outer loops are transferred from the fashioning points **22** to their new needles in known manner. The electro-magnets **52** are again switched on in readiness for the next fashioning operation, and the cam box **19** is set into operation to continue knitting. At the same time the cam shaft having completed its cycle of operation comes to rest. From the foregoing description, it will be appreciated that in order to ensure that the latches of the needles which are to receive loops from the fashioning points are open at the relevant time, the number of needle arms held by the electro-magnets **52** must be greater than the number of points in the fashioning mechanisms.

As shown particularly in FIGURE 5, the electro-magnets **52** arranged to operate on the left-hand side of each needle bed are supported on a common operating rod **55** which is connected, via a bracket **56**, to a nut housing **57** movable on the left-hand fashioning screw **58** of the machine. Similarly, the electro-magnets **52** arranged to operate on the right-hand side of each needle bed are supported on a common operating rod **59** which is connected, via a bracket **60**, to a nut housing **61** movable on the right-hand fashioning screw **62** of the machine. Thus, it will be seen that operation of the fashioning screws **58** and **62**, which control the positioning of the fashioning mechanisms **21**, will also be effective to maintain the electro-magnets **52** in a correct position relative to the selvedge of the knitting piece.

The overall knitting width control means referred to above comprise, on each side of each needle bed, a metal bar **63** which is slidably mounted in a recess **64** formed in the manifold **28**. The bar **63**, which is movable lengthwise of the recess **64**, serves to prevent axial movement of those pistons or plungers **24** outside the desired knitting width. As shown in FIGURE 5, the left-hand bars **63** are supported, via brackets **65**, on the common operating rod **55** and the right-hand bars **63** are supported, via brackets **66**, on the common operating rod **59**. Thus, it will be seen that the knitting width control bars **63** are moved in unison with the electro-magnets **52**.

It will be clear from the above description that, during a narrowing operation, the electro-magnets **52** will be operating more or less continuously whereas, during a widening operation, the electro-magnets are inoperative since it is only necessary to add needles by outwardly moving the bars **63** and simultaneously increasing the stroke of the yarn feeder guides of the machine.

It will further be understood that, in the embodiment described above, hydraulic or pneumatic fluid may be used to actuate the pistons or plungers **24**.

There will now be described with reference generally to FIGURES 6 to 11 embodiments where pneumatic fluid only can be used for actuating the pistons or plungers **24**.

Referring to FIGURES 6 and 7, it will be seen that the return springs **29** are dispensed with, that the recess **64** housing the bars **63** is closed by a strip **67** of brass or nylon foil held in position by retaining bars **68**, and that the bores **27** in manifold **28** are in direct communication with the recess **64**. The purpose of this is to utilise the recess **64** as an air chamber which serves to apply pressure to the pistons or plungers **24** to effect the return movement thereof.

In practice, movement of the pistons or plungers **24** into an operative position is effected by feeding, through control valves, air under pressure to the bores **25**, and the return movement is effected by releasing the air pressure and applying air pressure to the opposite ends of the pistons or plungers via the recess **64**. The air pressure supplied via the recess **64** is preferably constant so that it provides in effect an air spring. Thus, movement of the pistons or plungers is dependent upon the pressure differential between the two air supplies.

The electro-magnets **52** are supported and operate in the same manner as that hereinbefore described and it will be appreciated that, since the recess **64** is closed, the electro-magnets are not in direct contact with the pistons or plungers **24** but are effective to operate through the strip **67**.

In the case of the knitting width control means, since the recess **64** is closed, it is not possible, as described with reference to FIGURE 5, to have the bars **63** rigidly connected to the operating rods **55** and **59**. It is, therefore, proposed that the bars **63** should be freely disposed in the recess **64** and that their movement be effected by electro or permanent magnets **69** which operate through the strip **67** and are supported by brackets **70** on the respective operating rods **55** and **59**. Thus, the operation of the knitting width control means will effectively be substantially the same as that hereinbefore described.

Referring now to FIGURES 8 and 9, there is shown a modification of the knitting width control means hereinfore described. In this embodiment co-operating bars **71** are arranged to operate on opposite sides of the needle beds in positions external to the manifold **28**. As shown, the bars **71** are arranged so that they enter into engagement with the needle bars **16** of the needles which are outside the desired knitting width and thus prevent operation of the associated pistons or plungers **24**. In this case the bars **71** are supported respectively on the operating rods **55** and **59** by means of U-shaped brackets **72** and are operated in the manner hereinbefore described with reference to bars **63**.

It will of course be appreciated that this modification can also be applied to the embodiment shown specifically in FIGURES 2 to 4. However, in such a case, the recess **64** could be dispensed with as indicated in FIGURE 1.

A further modification is shown in FIGURES 10 and **11** where the pusher bars **53** are supported on, and are movable with, the common operating rods **55** and **59**. As shown, the pusher bars **53** are attached to brackets **73** which are hingedly secured at **74** to the respective rods **55** and **59**. The means for moving the bars **53** into and out of an operative position comprise a common spindle **75** which is arranged to engage a recess **76** formed in each bracket **73**, the spindle **75** being supported on, and actuated by, a linkage **77** which is coupled to the main cam shaft of the machine.

It will be appreciated that, in the embodiments of FIGURES 2 to 9, the pusher bar **53** consists of a single bar which extends the full width of each needle bed, whereas, in the embodiment of FIGURES 10 and 11, the pusher bar is in two separate parts which are associated respectively with the electro-magnets **52** and the knitting width control means, the width of each bar being equivalent to that of for example six needles.

In an alternative embodiment of the invention, as applied to a machine having clavettes, the piston or plunger manifold **28** is dispensed with and the pistons or plungers **24** mounted in the cylinder block **26** are arranged in align-

ment with the clavettes, or their selector member or members, so that the latter are moved into an operative position directly by the pistons or plungers. In this case, the return movement of the pistons or plungers, after the hydraulic fluid or air to the cylinder block has been switched off, is effected by the cams in the cam box.

The remainder of the construction and operation of this embodiment is substantially the same as that hereinbefore described.

Although the invention has been described specifically with reference to knitting a plain rib fabric, it will be understood that the sequence described is substantially the same when knitting patterned fabric where even further advantages become apparent. In this respect, when knitting patterns where certain needles are out of action, the outer needles, for example the outer four needles, which are influenced by the electro-magnets **52** are always made to knit irrespective of the pattern dictated by the controlled fluid supply. This has the advantage that there are always loops present on the outer needles which are used to open the latches prior to each fashioning operation, and the advantage that needles which, due to the pattern formation, may not have been knitting are made to knit after receiving a loop from the fashioning points.

The effect of this advantage is illustrated in FIGURES 12 and 13 of the drawings, FIGURE 12 showing a course of loops where the electro-magnets **52** have not been used and FIGURE 13 showing a course where the magnets **52** have been used to ensure that the outer needles always carry out a knitting operation. In this illustration it will be seen that the electro-magnets **52** each operate on four needles whereas the fashioning points **22** only operate on two needles thus positioning the necessary number of needles to receive the loops transferred by the fashioning points.

What we claim is:

1. A flat bed knitting machine comprising a pair of cooperating needle beds arranged at an angle to one another, a series of latched needles disposed for axial movement in tricks formed in each of said needle beds, a cam box arranged to be traversed lengthwise of each of said needle beds to effect axial movement of said needles, and needle selection means associated with said needles in each of said needle beds, wherein said needle selection means comprise an actuator device arranged to provide an operative connection between each of said needles and cams provided in said cam boxes, a fluid operated plunger operatively associated with each of said actuator devices, pressure applying means for biasing said plungers into an inoperative position, and control means for selectively moving said plungers into an operative position so that actuation of selected needles can be effected by said cam boxes.

2. A flat bed knitting machine comprising a pair of co-operating needle beds arranged at an angle to one another, a series of latched needles disposed for axial movement in tricks formed in each of said needle beds, a cam box arranged to be traversed lengthwise of each of said needle beds to effect axial movement of said needles, and needle selection means associated with said needles in each of said needle beds, wherein said needle selection means comprise an actuator device arranged to provide an operative connection between each of said needles and cams provided in said cam boxes, a fluid operated plunger operatively associated with each of said actuator devices, pressure applying means for biasing said plungers into an inoperative position, and control means for selectively moving said plungers into an operative position so that actuation of selected needles can be effected by said cam boxes, each of said actuator devices consisting of a needle arm hingedly connected at one end to its coacting needle and slidably attached at its other end to its coacting plunger, said needle arm being formed with a butt which is arranged to be moved into the path of said cams of said cam box under the action of said plunger.

3. A flat bed knitting machine comprising a pair of co-operating needle beds arranged at an angle to one another, a series of latched needles disposed for axial movement in tricks formed in each of said needle beds, a cam box arranged to be traversed lengthwise of each of said needle beds to effect axial movement of said needles, and needle selection means associated with said needles in each of said needle beds, wherein said needle selection means comprise an actuator device arranged to provide an operative connection between each of said needles and cams provided in said cam boxes, a fluid operated plunger operatively associated with each of said actuator devices, a cylinder block associated with each of said needle beds to receive one end of each of said plungers, a manifold arranged in spaced relationship with each of said cylinder blocks to receive the other end of each of said plungers, pressure applying means for biasing said plungers into an inoperative position, and control means for selectively moving said plungers into an operative position so that actuation of selected needles can be effected by said cam boxes, each of said actuator devices consisting of a needle arm hingedly connected at one end to its coacting needle and slidably attached at its other end to its coacting plunger, said needle arm being formed with a butt which is arranged to be moved into the path of said cams of said cam box under the action of said plunger.

4. A flat bed knitting machine comprising a pair of co-operating needle beds arranged at an angle to one another, a series of latched needles disposed for axial movement in tricks formed in each of said needle beds, a cam box arranged to be traversed lengthwise of each of said needle beds to effect axial movement of said needles, and needle selection means associated with said needles in each of said needle beds, wherein said needle selection means comprise an actuator device arranged to provide an operative connection between each of said needles and cams provided in said cam boxes, a fluid operated plunger operatively associated with each of said actuator devices, a cylinder block associated with each of said needle beds to receive one end of each of said plungers, a manifold arranged in spaced relationship with each of said cylinder blocks to receive the other end of each of said plungers, pressure applying means for biasing said plungers into an inoperative position, a pair of co-operating axially movable knitting width control bars associated with each of said needle beds, and control means for selectively moving said plungers into an operative position so that actuation of selected needles can be effected by said cam boxes, each of said actuator devices consisting of a needle arm hingedly connected at one end to its coacting needle and slidably attached at its other end to its coacting plunger, said needle arm being formed with a butt which is arranged to be moved into the path of said cams of said cam box under the action of said plunger.

5. A flat bed knitting machine comprising a pair of co-operating needle beds arranged at an angle to one another, a series of latched needles disposed for axial movement in tricks formed in each of said needle beds, a cam box arranged to be traversed lengthwise of each of said needle beds to effect axial movement of said needles, and needle selection means associated with said needles in each of said needle beds, wherein said needle selection means comprise an actuator device arranged to provide an operative connection between each of said needles and cams provided in said cam boxes, a fluid operated plunger operatively associated with each of said actuator devices, a cylinder block associated with each of said needle beds to receive one end of each of said plungers, a manifold arranged in spaced relationship with each of said cylinder blocks to receive the other end of each of said plungers, compression springs arranged in bores in said manifold for biasing said plungers into an inoperative position, and control means for selectively moving said plungers into an operative position so that actuation of selected needles can be effected by said cam boxes, each of said actuator devices consisting of a needle arm hingedly connected at one end to its coacting needle

and slidably attached at its other end to its coacting plunger, said needle arm being formed with a butt which is arranged to be moved into the path of said cams of said cam box under the action of said plunger.

6. A flat bed knitting machine comprising a pair of co-operating needle beds arranged at an angle to one another, a series of latched needles disposed for axial movement in tricks formed in each of said needle beds, a cam box arranged to be traversed lengthwise of each of said needle beds to effect axial movement of said needles, and needle selection means associated with said needles in each of said needle beds, wherein said needle selection means comprise an actuator device arranged to provide an operative connection between each of said needles and cams provided in said cam boxes, a fluid operated plunger operatively associated with each of said actuator devices, a cylinder block associated with each of said needle beds to receive one end of each of said plungers, a manifold arranged in spaced relationship with each of said cylinder blocks to receive the other end of each of said plungers, compression springs arranged in bores in said manifold for biasing said plungers into an inoperative position, a pair of co-operating axially movable knitting width control bars arranged to engage those of said actuator devices which are outside a preselected knitting width, and control means for selectively moving said plungers into an operative position so that actuation of selected needles can be effected by said cam boxes.

7. A flat bed knitting machine comprising a pair of cooperating needle beds arranged at an angle to one another, a series of latched needles disposed for axial movement in tricks formed in each of said needle beds, a cam box arranged to be traversed lengthwise of each of said needle beds to effect axial movement of said needles, and needle selection means associated with said needles in each of said needle beds, wherein said needle selection means comprise an actuator device arranged to provide an operative connection between each of said needles and cams provided in said cam boxes, a fluid operated plunger operatively associated with each of said actuator devices, a cylinder block associated with each of said needle beds to receive one end of each of said plungers, a manifold arranged in spaced relationship with each of said cylinder blocks to receive the other end of each of said plungers, compression springs arranged in bores in said manifold for biasing said plungers into an inoperative position, a longitudinally disposed recess formed in said manifold, a pair of cooperating axially movable knitting width control bars arranged in said recess to engage those of said plungers which coact with those of said actuator devices which are outside a preselected knitting width, and control means for selectively moving said plungers into an operative position so that actuation of selected needles can be effected by said cam boxes.

8. A flat bed knitting machine comprising a pair of co-operating needle beds arranged at an angle to one another, a series of latched needles disposed for axial movement in tricks formed in each of said needle beds, a cam box arranged to be traversed lengthwise of each of said needle beds to effect axial movement of said needles, and needle selection means associated with said needles in each of said needle beds, wherein said needle selection means comprise an actuator device arranged to provide an operative connection between each of said needles and cams provided in said cam boxes, a fluid operated plunger operatively associated with each of said actuator devices, a cylinder block associated with each of said needle beds to receive one end of each of said plungers, a manifold arranged in spaced relationship with each of said cylinder blocks to receive the other end of each of said plungers, compression springs arranged in bores in said manifold for biasing said plungers into an inoperative position, a pair of co-operating axially movable knitting width control bars arranged to engage those of said actuator devices which are outside a preselected knitting width, a pair of adjustably mounted electromagnets associated with each of said needle beds, said electromagnets being arranged to co-operate with a predetermined number of selvedge needles to ensure that said selvedge needles always knit and to assist in a fashioning operation, and control means for selectively moving said plungers into an operative position so that actuation of selected needles can be effected by said cam boxes.

9. A flat bed knitting machine comprising a pair of co-operating needle beds arranged at an angle to one another, a series of latched needles disposed for axial movement in tricks formed in each of said needle beds, a cam box arranged to be traversed lengthwise of each of said needle beds to effect axial movement of said needles, and needle selection means associated with said needles in each of said needle beds, wherein said needle selection means comprise an actuator device arranged to provide an operative connection between each of said needles and cams provided in said cam boxes, a fluid operated plunger operatively associated with each of said actuator devices, a cylinder block associated with each of said needle beds to receive one end of each of said plungers, a manifold arranged in spaced relationship with each of said cylinder blocks to receive the other end of each of said plungers, compression springs arranged in bores in said manifold for biasing said plungers into an inoperative position, a longitudinally disposed recess formed in said manifold, a pair of co-operating axially movable knitting width control bars arranged in said recess to engage those of said plungers which coact with those of said actuator devices which are outside a preselected knitting width, a pair of adjustably mounted electro-magnets associated with each of said needle beds, said electro-magnets being arranged to co-operate with a predetermined number of selvedge needles to ensure that said selvedge needles always knit and to assist in a fashioning operation, and control means for selectively moving said plungers into an operative position so that actuation of selected needles can be effected by said cam boxes.

10. A flat bed knitting machine comprising a pair of co-operating needle beds arranged at an angle to one another, a series of latched needles disposed for axial movement in tricks formed in each of said needle beds, a cam box arranged to be traversed lengthwise of each of said needle beds to effect axial movement of said needles, and needle selection means associated with said needles in each of said needle beds, wherein said needle selection means comprise an actuator device arranged to provide an operative connection between each of said needles and cams provided in said cam boxes, a fluid operated plunger operatively associated with each of said actuator devices, a cylinder block associated with each of said needle beds to receive one end of each of said plungers, a manifold arranged in spaced relationship with each of said cylinder blocks to receive the other ends of each of said plungers, compression springs arranged in bores in said manifold for biasing said plungers into an inoperative position, a pair of co-operating axially movable knitting width control bars arranged to engage those of said actuator devices which are outside a preselected knitting width, a pair of adjustably mounted electro-magnets associated with each of said needle beds, said electro-magnets being arranged to co-operate with a predetermined number of selvedge needles to ensure that said selvedge needles always knit and to assist in a fashioning operation, pusher bars operatively associated with the actuator devices of said selvedge needles, and control means for selectively moving said plungers into an operative position so that actuation of selected needles can be effected by said cam boxes.

11. A flat bed knitting machine comprising a pair of co-operating needle beds arranged at an angle to one another, a series of latched needles disposed for axial movement in tricks formed in each of said needle beds, a cam

box arranged to be traversed lengthwise of each of said needle beds to effect axial movement of said needles, and needle selection means associated with said needles in each of said needle beds, wherein said needle selection means comprise an actuator device arranged to provide an operative connection between each of said needles and cams provided in said cam boxes, a fluid operated plunger operatively associated with each of said actuator devices, a cylinder block associated with each of said needle beds to receive one end of each of said plungers, a manifold arranged in spaced relationship with each of said cylinder blocks to receive the other end of each of said plungers, compression springs arranged in bores in said manifold for biasing said plungers into an inoperative position, a longitudinally disposed recess formed in said manifold, a pair of co-operating axially movable knitting width control bars arranged in said recess to engage those of said plungers which coact with those of said actuator devices which are outside a preselected knitting width, a pair of adjustably mounted electromagnets associated with each of said needle beds, said electromagnets being arranged to co-operate with a predetermined number of selvedge needles to ensure that said selvedge needles always knit and to assist in a fastening operation, pusher bars operatively associated with the actuator devices of said selvedge needles, and control means for selectively moving said plungers into an operative position so that actuation of selected needles can be effected by said cam boxes.

12. A flat bed knitting machine comprising a pair of co-operating needle beds arranged at an angle to one another, a series of latched needles disposed for axial movement in tricks formed in each of said needle beds, a cam box arranged to be traversed lengthwise of each of said needle beds to effect axial movement of said needles, and needle selection means associated with said needles in each of said needle beds, wherein said needle selection means comprise an actuator device arranged to provide an operative connection between each of said needles and cams provided in said cam boxes, a fluid operated plunger operatively associated with each of said actuator devices, a cylinder block associated with each of said needle beds to receive one end of each of said plungers, a manifold arranged in spaced relationship with each of said cylinder blocks to receive the other end of each of said plungers, compression springs arranged in bores in said manifold for biasing said plungers into an inoperative position, a pair of co-operating axially movable knitting width control bars arranged to engage those of said actuator devices which are outside a preselected knitting width, a pair of adjustably mounted electro-magnets associated with each of said needle beds, said electro-magnets being arranged to co-operate with a predetermined number of selvedge needles to ensure that said selvedge needles always knit and to assist in a fashioning operation, pusher bars operatively associated with the actuator devices of said selvedge needle, and control means for selectively moving said plungers into an operative position so that actuation of selected needles can be effected by said cam boxes.

13. A flat bed knitting machine comprising a pair of coperating needle beds arranged at an angle to one another, a series of latched needles disposed for axial movement in tricks formed in each of said needle beds, a cam box arranged to be traversed lengthwise of each of said needle beds to effect axial movement of said needles, and needle selection means associated with said needles in each of said needle beds, wherein said needle selection means comprise an actuator device arranged to provide an operative connection between each of said needles and cams provided in said cam boxes, a fluid operated plunger operatively associated with each of said actuator devices, a cylinder block associated with each of said needle beds to receive one end of each of said plungers, a manifold arranged in spaced relationship with each of said cylinder blocks to receive the other end of each of said plungers, compression springs arranged in bores in said manifold for biasing said plungers into an inoperative position, a longitudinally disposed recess formed in said manifold, a pair of co-operating axially movable knitting width control bars arranged in said recess to engage those of said plungers which coact with those of said actuator devices which are outside a preselected knitting width, a pair of adjustably mounted electro-magnets associated with each of said needle beds, said electro-magnets being arranged to co-operate with a predetermined number of selvedge needles to ensure that said selvedge needles always knit and to assist in a fashioning operation, pusher bars operatively associated with the actuator devices of said selvedge needles, and control means for selectively moving said plungers into an operative position so that actuation of selected needles can be effected by said cam boxes.

14. A flat bed knitting machine comprising a pair of co-operating needle beds arranged at an angle to one another, a series of latched needles disposed for axial movement in tricks formed in each of said needle beds, a cam box arranged to be traversed lengthwise of each of said needle beds to effect axial movement of said needles, and needle selection means associated with said needles in each of said needle beds, wherein said needle selection means comprise an actuator device arranged to provide an operative connection between each of said needles and cams provided in said cam boxes, a pneumatically operated plunger operatively associated with each of said actuator devices, a cylinder block associated with each of said needle beds to receive one end of each of said plungers, a manifold arranged in spaced relationship with each of said cylinder blocks to receive the other end of each of said plungers, a closed duct longitudinally disposed in said manifold, means for applying pneumatic pressure to said duct for biasing said plungers into an inoperative position, a pair of co-operating axially movable knitting width control bars arranged in said duct to engage those of said plungers which coact with those of said actuator devices which are outside a preselected knitting width, a pair of adjustably mounted electro-magnets associated with each of said needle beds, said electro-magnets being arranged to co-operate with a predetermined number of selvedge needles to ensure that said selvedge needles always knit and to assist in a fashioning operation, and control means for selectively moving said plungers into and operative position so that actuation of selected needles can be effected by said cam boxes, each of said actuator devices consisting of a needle arm hingedly connected at one end to its coacting needle and slidably attached at its other end to its coacting plunger, said needle arm being formed with a butt which is arranged to be moved into the path of said cams of said cam box under the action of said plunger.

15. A flat bed knitting machine comprising a pair of co-operating needle beds arranged at an angle to one another, a series of latched needles disposed for axial movement in tricks formed in each of said needle beds, a cam box arranged to be traversed lengthwise of each of said needle beds to effect axial movement of said needles, and needle selection means associated with said needles in each of said needle beds, wherein said needle selection means comprise an actuator device arranged to provide an operative connection between each of said needles and cams provided in said cam boxes, a pneumatically operated plunger operatively associated with each of said actuator devices, a cylinder block associated with each of said needle beds to receive one end of the each of said plungers, a manifold arranged in spaced relationship with each of said cylinder blocks to receive the other end of each of said plungers, a closed duct longitudinally disposed in said manifold, means for applying pneumatic pressure to said duct for biasing said plungers into an inoperative position, a pair of co-operating axially movable knitting width control bars arranged in said duct to engage those of said plungers which coact with those of said actuator devices which are outside a preselected knitting width,

a pair of adjustably mounted electro-magnets associated with each of said needle beds and arranged to co-operate with a predetermined number of selvedge needles to ensure that said selvedge needles always knit and to assist in a fashioning operation, and control means for selectively moving said plungers into an operative position so that actuation of selected needles can be effected by said cam boxes.

16. A flat bed knitting machine as claimed in claim **15**, including pusher bars operatively associated with the actuator devices of said selvedge needles.

17. A flat bed knitting machine as claimed in claim **16**, in which said control means consist of a plurality of solenoid actuated valves each of which is operatively associated with a selected number of said plungers.

18. A flat bed knitting machine as claimed in claim **17**, including a pair of co-operating axially movable electromagnets for adjusting said knitting width control bars.

References Cited by the Examiner

UNITED STATES PATENTS

2,416,933	3/1947	Lynam et al.	66—154
2,442,822	6/1948	Monk	66—154 XR
3,089,322	5/1963	Bruce et al.	66—154
3,177,686	4/1965	Croucher	66—8

ROBERT R. MACKEY, *Acting Primary Examiner.*

R. FELDBAUM, *Assistant Examiner.*