July 31, 1928. 1,678,906

K. HOWIE

NEEDLE SELECTOR MECHANISM FOR KNITTING MACHINES

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Fig. 1.

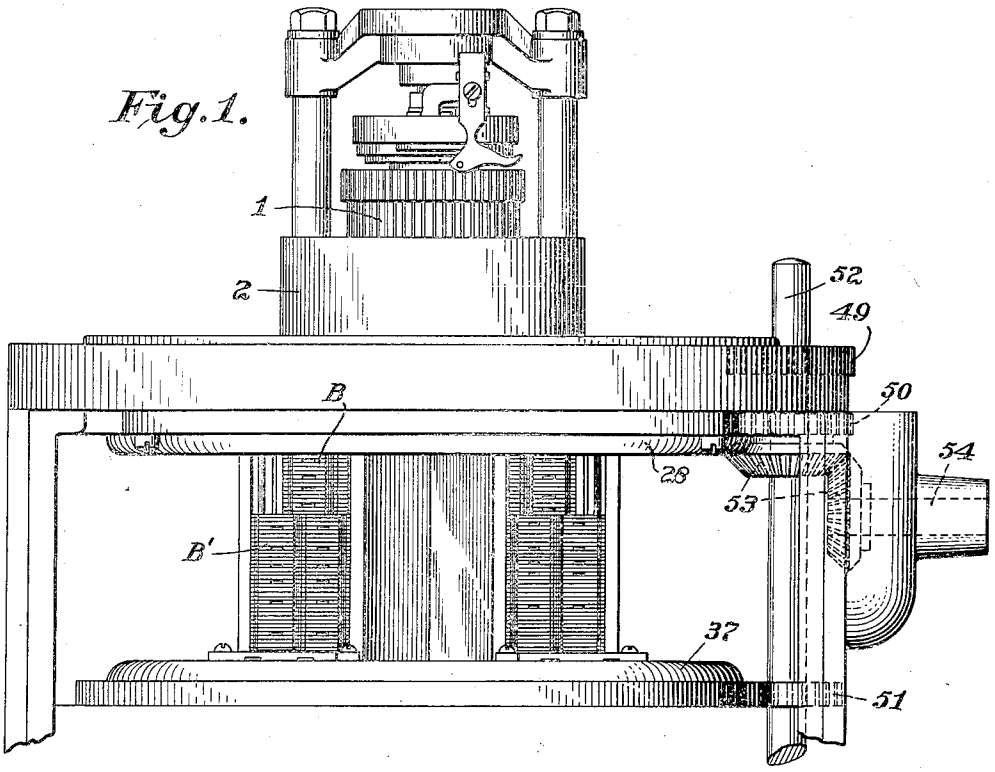


Fig. 2.

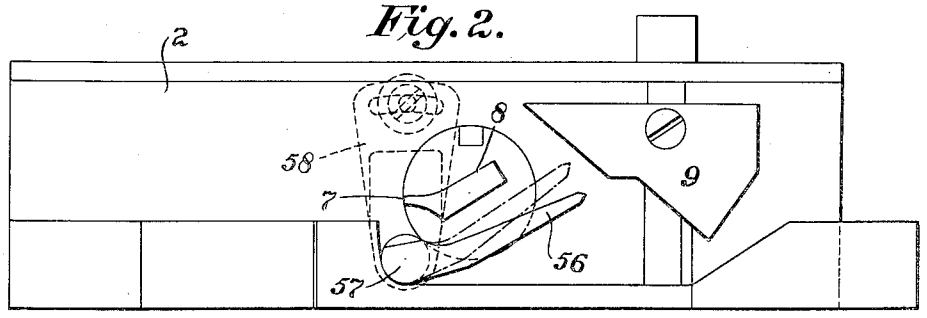
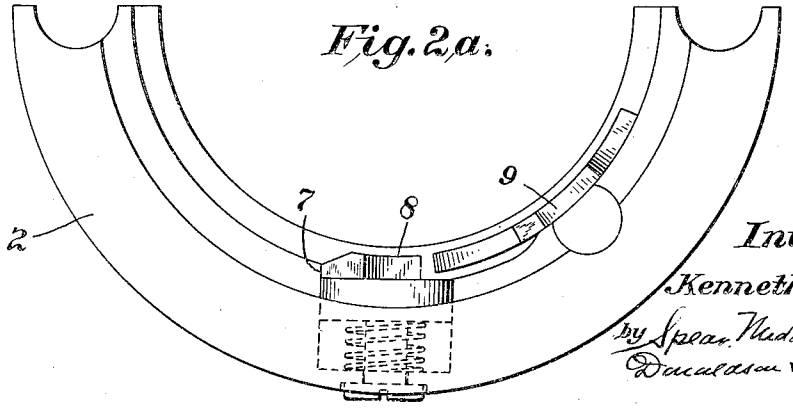


Fig. 2a.



Inventor:
Kenneth Howie,
by Spear, Middleton
Donaldson & Hall
Attys.

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K. HOWIE

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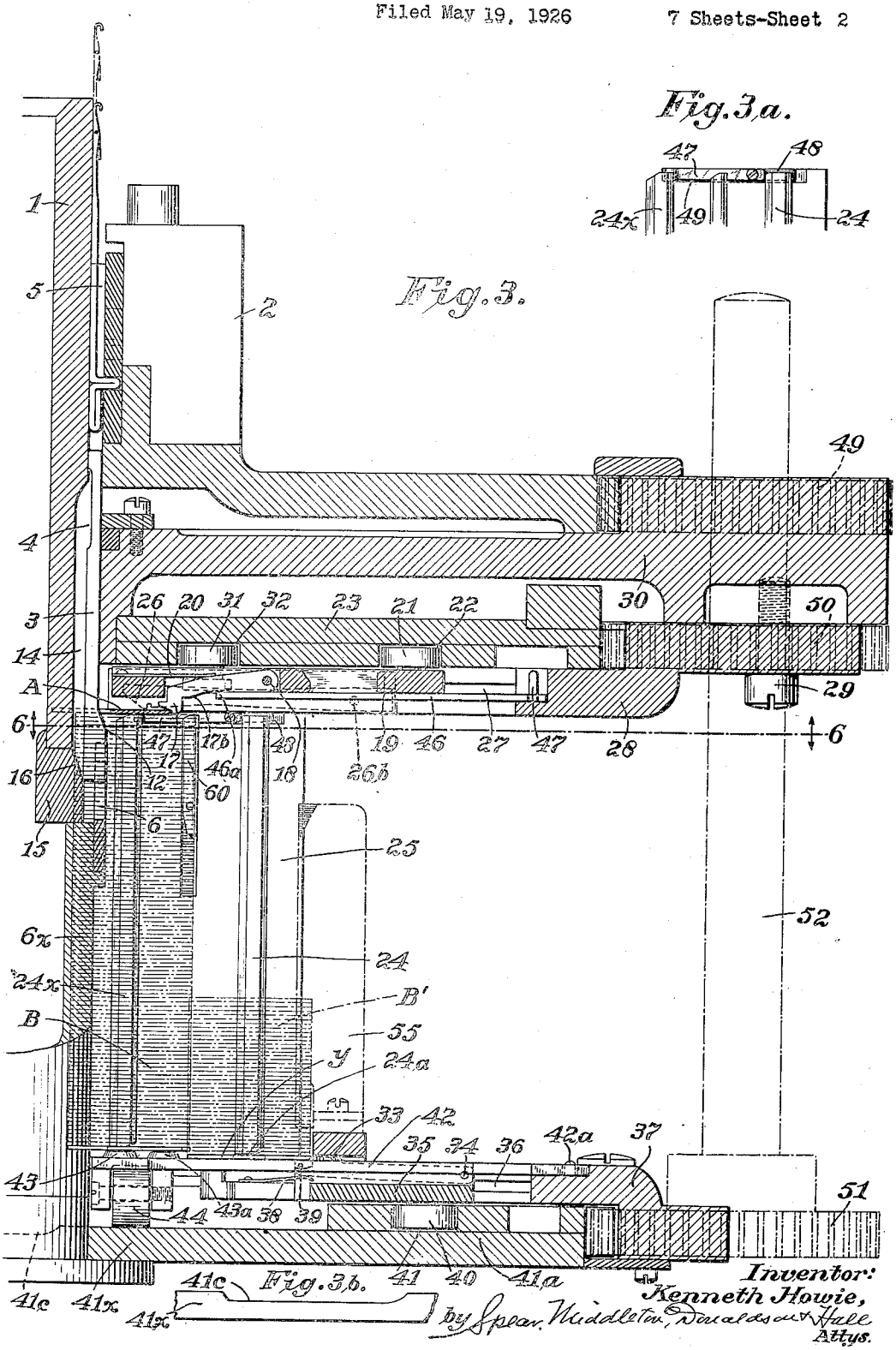


Fig. 3.

Fig. 3a.

Fig. 3b.

Inventor:
Kenneth Howie,
by Spear, Middleton, Douglas & Hall
Attys.

July 31, 1928. 1,678,906

K. HOWIE

NEEDLE SELECTOR MECHANISM FOR KNITTING MACHINES

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Fig.6.

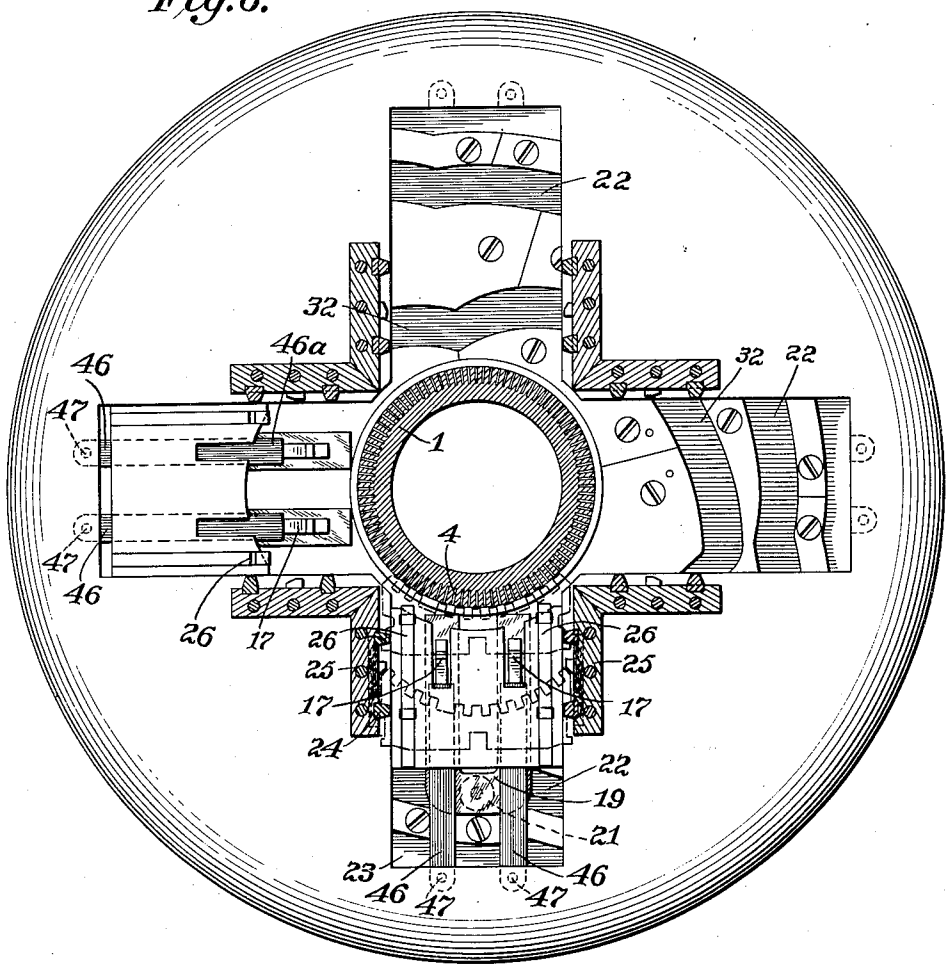


Fig.4.

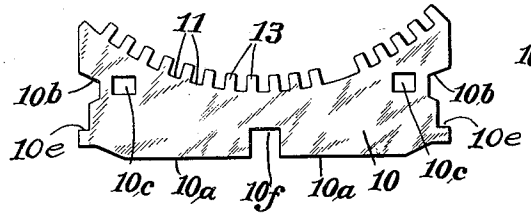
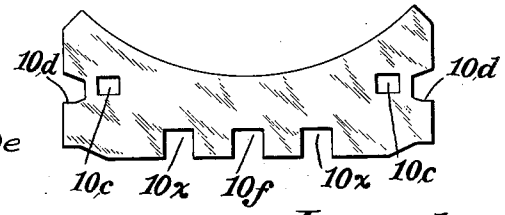


Fig.5.



Inventor:

Kenneth Howie,

by Spear, Middleton, Donaldson & Hall
Attys.

July 31, 1928. 1,678,906

K. HOWIE

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Fig.7.

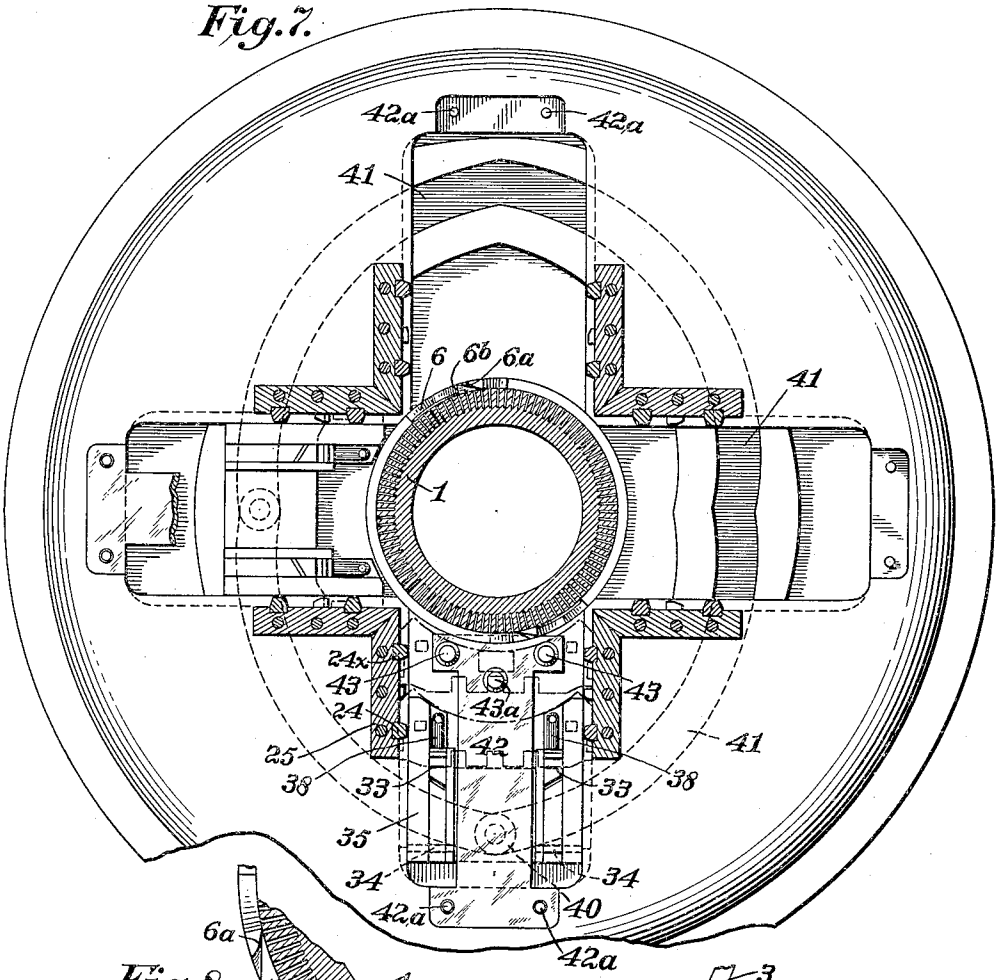
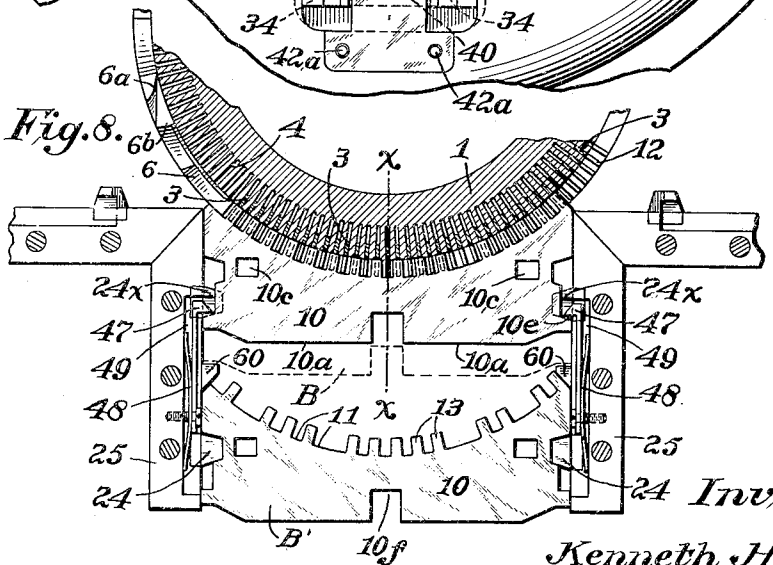


Fig.8.



Inventor:

Kenneth Howie,

by Spear, Middleton, Donnelly & Hall

Attys.

July 31, 1928. 1,678,906

K. HOWIE

NEEDLE SELECTOR MECHANISM FOR KNITTING MACHINES

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Fig.9.

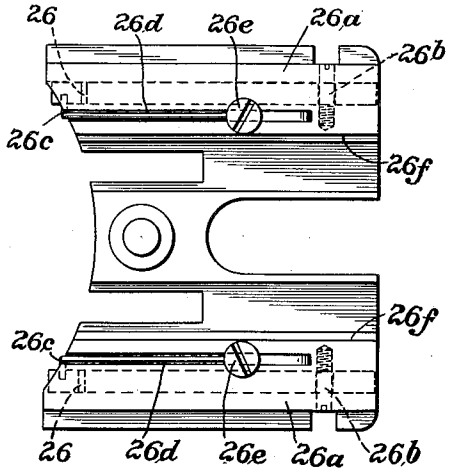


Fig.11.

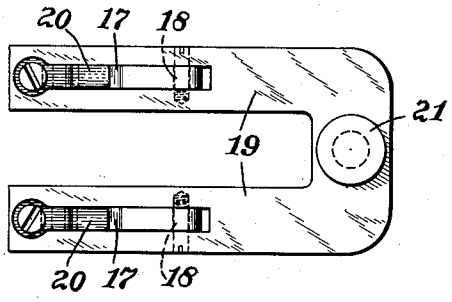


Fig.10.

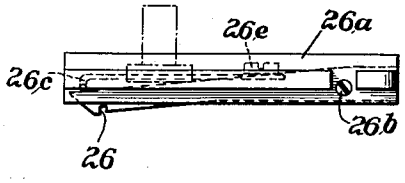


Fig.12.

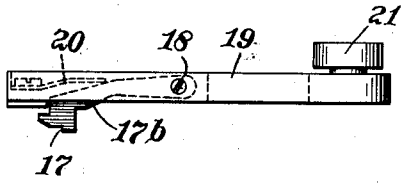


Fig.13.

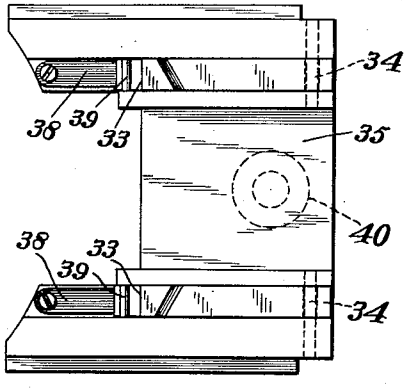
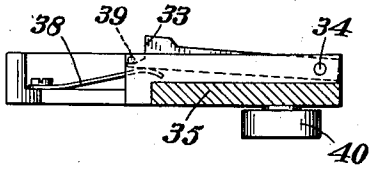


Fig.14.



Inventor:

Kenneth Howie,

by Spear, Middleton, Donaldson & Hall

Attys.

July 31, 1928. 1,678,906

K. HOWIE

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Fig. 15.

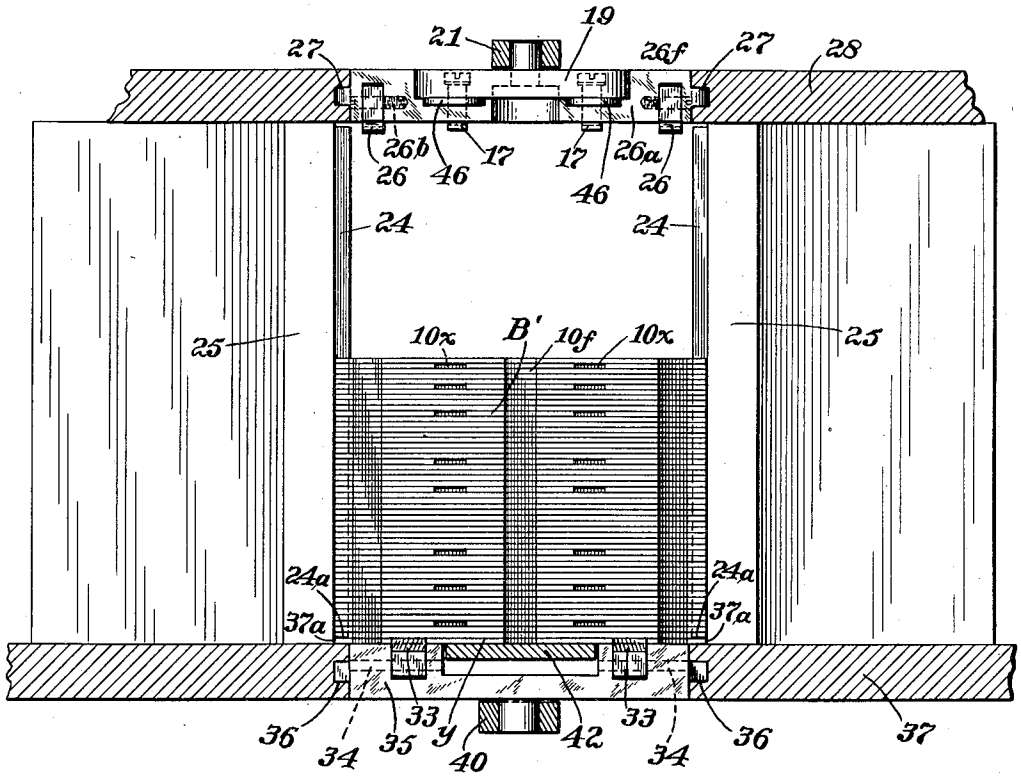
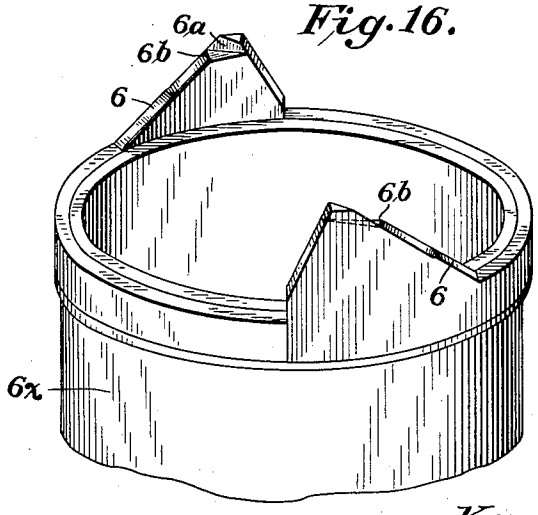


Fig. 16.



Inventor:

Kenneth Howie,

by Spear, Middleton, Donaldson & Hull

Attys.

July 31, 1928. 1,678,906

K. HOWIE

NEEDLE SELECTOR MECHANISM FOR KNITTING MACHINES

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Fig.17.

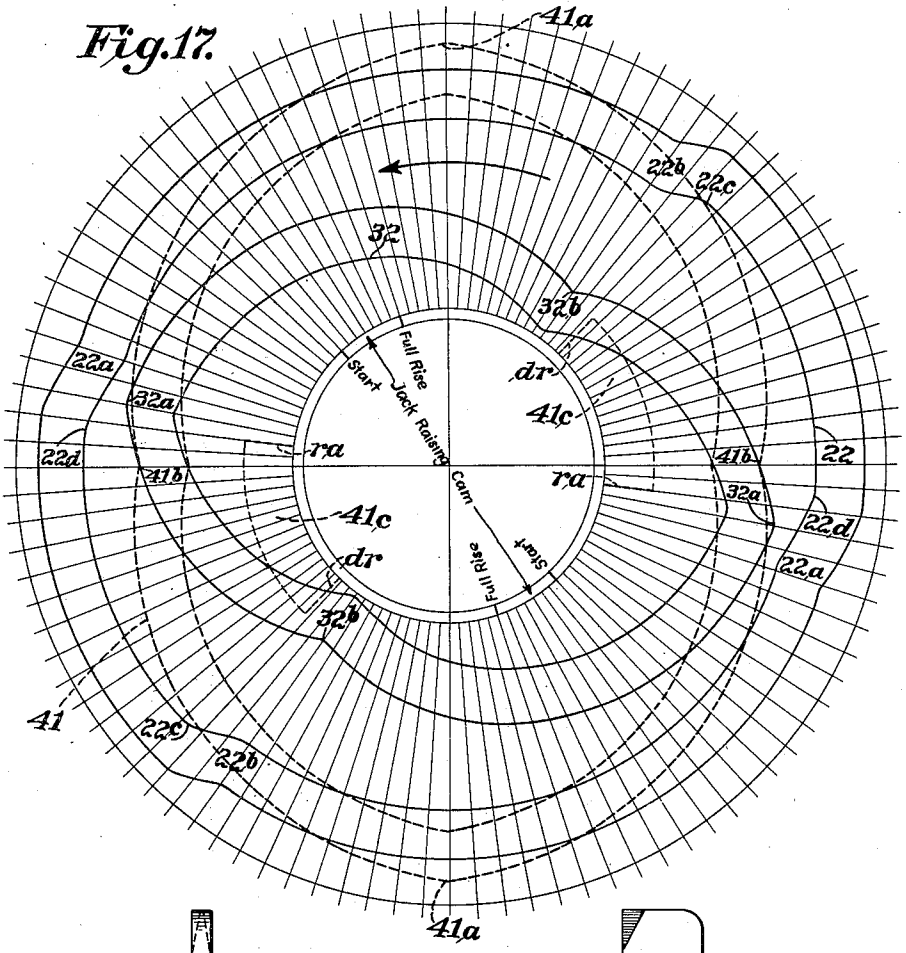
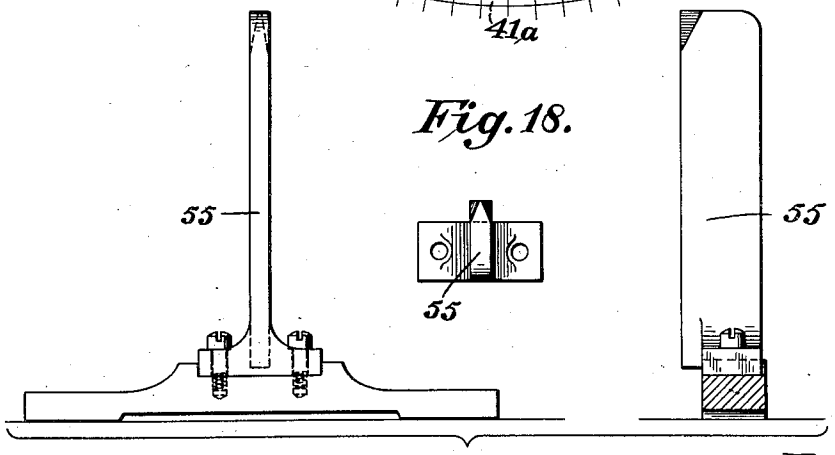


Fig. 18.



Inventor:

Kenneth Howie,

by Spear, Middleton, Donaldson & Hall

Attys.

Patented July 31, 1928. 1,678,906

UNITED STATES PATENT OFFICE.

KENNETH HOWIE, OF NORRISTOWN, PENNSYLVANIA, ASSIGNOR TO WILDMAN MFG. CO., OF NORRISTOWN, PENNSYLVANIA, A CORPORATOION OF PENNSYLVANIA.

NEEDLE-SELECTOR MECHANISM FOR KNITTING MACHINES.

Application filed May 19, 1926. Serial No. 110,184.

The invention concerns needle selector mechanism for knitting machines, by which the needles are controlled to knit, tuck or miss the yarn entirely according to the pattern desired, the mechanism being of such a character that, if desired, each needle throughout the needle circle is susceptible of control to produce a great variety of patterns.

In carrying out my invention one object has been to avoid the use of a pattern band or strip or a chain of attached pattern cards but instead to employ a stack of needle selector plates arranged in order or sequence to give the desired pattern, said plates being arranged to act directly upon the needles or needle jacks for their selection without the interposition of any levers or other devices between the plates and needles.

Other objects of the invention will appear from the following description.

In the accompanying drawings:

Fig. 1 is a front elevation of a portion of the head of a circular knitting machine with my improvement attached thereto.

Fig. 2 is a relatively enlarged view of one set of needles operating cams, looking from the inside of the cam ring outwardly.

Fig. 2[a] is a bottom plan view of one of the sections of the cam box, with one cam omitted.

Fig. 3 is a central vertical section along one wall of the needle cylinder with a series of needle selector plates adapted to control the operation of the needles by cooperating directly with the jacks thereof.

Fig. 3[a] shows a detail of a detent.

Fig. 3[b] is an edge view of a cam.

Fig. 4 illustrates one of the needle selector plates.

Fig. 5 illustrates one of the plain or filler plates which are inserted in the series or set of selector plates at those points where all the needles, within the zone or segment of the needle circle controlled by said series of plates, are desired to knit.

Fig. 6 is a bottom plan view of upper slides for moving the needle selector plates to and from the needle cylinder, this view being substantially along the plane of the line 6—6 of Fig. 3 looking upwardly.

Fig. 7 is a plan view of the lower slide or plate carrier in its relation to the needle cylinder, the view being substantially on line 6—6 looking downwardly.

Fig. 8 is a plan view of a part of the needle cylinder in section, and with one of the needle selector plates in its advanced position adjacent the needle cylinder and with another plate which has been withdrawn from the cylinder and is now the upper plate of the outer stack.

Fig. 9 is a plan view of the upper pawl slide or retracting carrier for the selector plates.

Fig. 10 is a side elevation of the upper pawl slide of Fig. 9.

Fig. 11 is a plan view of the upper push pawl slide or carrier.

Fig. 12 is a side elevation of the upper push pawl carrier or slide.

Fig. 13 is a plan view of the lower push pawl slide.

Fig. 14 is a sectional elevation of the lower push pawl slide.

Fig. 15 is a front view of the upper and lower pawl slides or carriers with the adjacent frame members, partly in section, and illustrating also the stack of plates.

Fig. 16 is a perspective view of cam means for operating the needles or rather their jacks.

Fig. 17 is a diagram of the cams for operating the needle selector plates through the pawl slides or carriers, the view being a top plan.

Fig. 18 shows a guide post for the plates.

In these drawings 1 indicates the needle cylinder, only a portion of which is shown in Fig. 3. In the present illustration showing one example of the invention, this needle cylinder is stationary, but it will be understood that instead of this the needle cylinder with the needle-selecting mechanism may rotate around the vertical axis of the machine, and the cam box 2 carrying the needle operating cams and certain other cams may be stationary instead of revolving.

The invention is shown as embodied in a two feed machine, but it is not limited as to this number of feeds. It is also shown in connection with a latch needle machine,

but may be used with a spring needle, and instead of the machine being for the production of plain fabric, it may be a rib machine.

The needles are operated by jacks 3 slidable in extensions 4 of the needle grooves 5 of the cylinder. When a jack is raised for a full stroke by the rotary cam 6, the highest lifting point of which is at 6^b, Fig. 16, it raises the corresponding needle so that its butt will be above the level of the forward end 7 of the needle advancing cam 8 so that said raising cam will raise the needle to take yarn and will be drawn down to knit by the stitch cam 9, said latter cams being carried by the rotary cam box 2. If, however, the jack is not elevated for its full stroke but moves only part way up, then the needle butt will not be acted on by the inclined upper side 8 of the needle advancing cam, but will pass below said advancing cam to tucking position, i. e., with its loop on its latch. This needle, however, will take yarn and subsequently two loops will be cast from it to make a tuck stitch.

For determining whether the jack shall perform its full upward movement to allow the needle to knit, or shall move only part way up to cause the needle to tuck, I employ the needle selecting plates, one of which is shown in Fig. 4 at 10. This needle selector plate is formed of thin sheet metal. One edge is curved to substantially fit the needle cylinder, though it is not allowed to contact therewith. This curved edge is provided with certain recesses at 11 of a width to receive certain of the jacks, while the teeth 13 between the recesses are to be contacted by the inclines 12 on those jacks which correspond in position to the tooth projections or intact portions 13 of the plates when these plates are positioned up to the needles.

The recesses are cut according to the pattern desired and consequently each needle selecting plate by its direct action, in association with the jacks, selects those jacks which, throughout the segment of the needle circle covered by the plate, are to cause the corresponding needles to knit and those which are to tuck.

In the present illustration the machine is intended to knit a design or pattern throughout the circumference of the tubular fabric or any part thereof, and there are therefore provided a plurality of stacks of these plates disposed at different points about the needle circle, each of which takes care of the needles throughout one-fourth of the needle row.

The plate shown at A in Fig. 3 is the one which has been advanced from the top of the stack of plates indicated generally at B, Figs. 3 and 8, which plate is now exerting control upon the segment of jacks corresponding to the length (circumferentially) of this plate, or in the present instance, one-fourth of the needle circle. The jack here represented when raised by the rotary cam 6 will pass freely up through the notch in the plate and the corresponding needle will be lifted to proper level to be acted on by the needle raising cam. Suppose, however, that instead of a recess or notch appearing at this point the plate had presented an intact portion or projection, such as indicated at 13 in Fig. 4, the result would be that as the jack rises under the action of its cam 6 the inclined edge 12 of said jack contacting with the tooth of the needle selector plate will force the lower end of the jack radially inward towards the center of the cylinder, or in other words, the lower end of the jack will bury itself in the groove or recess 14 and in this movement it will free itself from the jack raising cam 6, before it contacts with and lifts the needle from its normal position and therefore the needle will pass below raising cam 8 and will be lifted by cam 56, Fig. 2, only to its tuck position, with its loop on its latch. It will be noted that the lower ring or base 15 of the needle cylinder within the recesses 14 is inclined at 16, conforming substantially to the incline 12 of the jack so that the leftward or inward displacement of the lower end of the jack can take place, but yet an inclined surface (16) is provided so that when the needle is moved down by the stitch cam and pushes its jack down with it, said jack will ride down the incline 16 and will be restored to normal position in line with its rotary cam 6 ready for its next action. When said plate is all the way advanced, or in other words, in the position shown in Fig. 3, its tooth will be just at the top of the incline or cam edge of the jack. The lower edge of the jack is inclined upwardly and inwardly slightly and the edge of the cam 6 is formed to correspond, in order to exert better control upon the jack as it is moved up by the cam.

It will be noticed that the teeth of the selector plate are disposed on radii corresponding to the radii of the needle cylinder. The plate is guided to move along its center line x—x, Fig. 8, which is radial to the needle cylinder, hence the plate could not be retracted along this center line, due to the needles or jacks which lie in its radial notches or recesses, unless means are provided for disengaging the jacks from these notches of the plate when the jack reaches its upper limit, at which time its lower end would still be lying in the radial notch of the plate. This means of disengagement consists in the cam surface 6^a on the inner side of the revolving cam 6 which by engaging with the lower portion of the raised jacks moves said jack inward radially of the needle cylinder and thus removes it from the

notch in the selector plate so that said plate can be withdrawn and its place taken by a new plate. The jack thus withdrawn has reached its upper limit for causing its needle to knit, i. e., it has lifted the needle with its butt above the level of the needle advancing cam 8 so that this cam can take it and knit. As the needle moves down to draw the stitch it depresses its jack so that this rides down the incline 16 and it is thus restored to normal position ready for its next action.

The plate shown at A in Fig. 3 is in the position to which it was moved from the top of the stack of plates B, see also Figs. 1 and 8, radially inward by a pair of pusher pawls 17 which engage the outer intact edge 10^a of the plate shown in Fig. 4. These pawls are pivoted at 18 to a carrier or slide 19. They are pressed downwardly by springs 20 carried by the slide or carrier 19. The slide is operated by a roller 21 thereon engaging a cam groove 22 in a rotary cam plate 23 which revolves around the needle cylinder in unison with the needle cam box 2. After the selector plate has remained in the position A sufficiently long to perform its function in connection with the segment of needle jacks it is to serve, it is retracted from this position A by pull pawls 26, so that its side notches 10^b, Fig. 4, will align with the vertical guides 24 formed with or attached to the inner sides of the walls 25 forming the magazines for holding the stacks of plates. On reaching this outward position the plate will fall by gravity onto the top of the section B′ of the stack of plates, see Figs. 1, 3 and 8. In this falling action the plate will be guided by the vertical rails or guides 24 with which the side notches 10^b of the plates engage. The plates are provided with openings 10^c with which the pull or retracting pawls engage to withdraw them from the position A to the position over B′.

The pull pawls, there being two for each magazine or stack B, are pivotally mounted at 26^b in the carrier or slide 26^a, and they are pressed downwardly by springs 26^c held in grooves 26^d of the carrier by screws 26^e. This carrier slides in guide ways 27 of the fixed frame plate 28 which is secured by screws 29, Fig. 3, to the fixed base plate or ring 30 of the machine. The carrier or slide 26^a receives and guides the push pawl carrier 19, for which purpose said carrier 26^a has a guide way 26^f in which the push pawl carrier slides. The pull pawl carrier is moved by a roller 31 thereon operated upon by a cam groove 32 in the rotary cam plate 23.

The plates are moved from the bottom of stack section B′ into position under the bottom of stack section B by push pawls 33, there being a pair of these in each magazine compartment, where the stacks B, B′ are located.

These push pawls are pivotally mounted at 34 to a carrier or slide 35 guided in ways 36 of the lower fixed frame plate 37. These pawls are pressed normally upward by springs 38, and their positions are limited by stop pins 39. The carrier 35 is moved by a roller 40 working in the groove 41 of a rotary cam 41^a which moves in unison with the other rotary cams above described. The selector plates are supported on the upper side of the plate 37 which at 37^a, Fig. 15, form guide ways for the plates in cooperation with the inner faces of the walls 25 of the magazines. These walls also serve to connect the lower plate 37 with the upper fixed plate 28. As the plate at the bottom of the stack B′ is pushed forward by the push pawls 34 it slides on the guide 37^a and passes through the gate 24^a at the bottom of the vertical guide 24, and it passes below the stack section B to now become the bottom plate of said stack.

In order that this action may be performed the stack B has been lifted just before the arrival of the new plate so that the lowermost plate of the stack is just above the level of the plane of movement of the oncoming new plate, which is about to be introduced beneath the stack. For this raising of the stack B a lifter 42 is provided mounted at its outer end on pins 42^a with sufficient play to have limited up and down movement. The lifter plate has three projections or buttons, two of which are marked 43 and the third 43^a, upon which the lowermost needle selector plate of the stock B rests. The lifter plate has upward and downward movement due to the roll 44 which is journalled in ears on the lower side thereof running upon a cam track of the cam plate 41^x. This lifter is shown in Fig. 3 in its uppermost position with the stack raised and with the new needle selector plate y about to be inserted beneath the stack B. The lifter plate drops just before the throat of the plate y gets to the button 43^a, which is the one arranged centrally of the lifter plate in advance of the other two. When the new plate y has been inserted so far beneath the stack that its throat at its center is about to strike the first button 43^a, it will have reached such a position that its points are so far under the stack that the plate will serve to support the stack, it being itself supported on the guide ways 37^a. At this moment the lifter plate is allowed to drop and this is permitted by the drop or depression 41^c in the cam track upon which the roller 44 runs. The dropping of the lifter plate removes its button 43^a from the onward path of the selector plate which now continues its way to position under the stack B and with its side notches in line with the vertical guides 24^x thereof, so that as the plates move up step by step as other plates

are introduced at the bottom of the pile, they will be guided by the rails or guides 24^x engaging the side notches of the plates.

The raising of the stack by the lifter 41 brings the topmost plate of the stack B into position to be fed forward by the upper push pawls 17 to the position A, Fig. 3, and as just stated, this lifting of the stack permits the new plate *y* to be inserted beneath this lifted stack, the lifter plate 41 falling down as soon as the new plate has been inserted far enough under the stack to afford a support therefor.

In retracting a selector plate from the advanced position A to the position over guides 24 after it has performed its selecting function, the pull pawls 26 move outwardly at the proper time. In order to allow this plate to be retracted it is necessary to raise the push pawls 17 high enough to prevent them from interfering with the outward movement of the selector plate. For this purpose I provide arms 46 held on pins 47 extending up from the fixed frame plate 28. The forward ends 46^a of these arms are in such position that as the pawls 17 move outwardly the inclines 17^b on the under side of the pawls will ride up on the ends 46^a of the arms 46 and thus the push pawls will be raised out of the way for the outward unobstructed movement of the selector plate which has just been used and which must be restored to the stack section B′.

From the above it will be seen that the plates are arranged in stacks and the topmost plate of the inner stack is moved radially inward into position to perform its needle selecting function, after which it is moved outwardly past the inner stack B to the outer stack B′ upon which it falls, and as the plates of the stack are transferred to the bottom of the inner stack the plate whose movement we are following will be finally transferred to the bottom of the inner stack and will rise step by step in this stack until it reaches the top thereof, whereupon it will be again thrust radially inward to the needle circle to select the needles, after which it will be withdrawn to fall upon the top of the outer stack, and so on throughout the same circuit again, as just described.

Each plate represents in the present example of my invention, say a course of knitting. They may be numbered serially so that their position in the series or stack may be assured in assembling. Some of the plates may be plain, i. e., formed without the recesses and teeth 11, 13. These plain plates are inserted in the series at the points where all the needles throuhgout the segment of the needle circle served by the plate are to knit and not to tuck. These plates therefore need not be advanced from the top of the stack B up to the needle cylinder. This plain plate, as shown in Fig. 5, is provided with openings 10^x in its rear edge so that the push pawls 17 on their forward strokes will enter these openings and will therefore perform an idle stroke when one of these plain plates is at the top of the pile B, thus allowing the plain plate to rest at the top of the pile B when it will exert no selecting function upon the needles or jacks. All of the plates both toothed and plain may be of the same general outline, that is, their throats may be formed on the same curve, the plain plates having this curved edge intact throughout.

There are certain differences, however, in detail between the plain plates and the toothed selector plates. One detail has been mentioned above, i. e., that the plain plates have the recesses 10^x to prevent the push pawls 17 from advancing them to the needle cylinder. Another difference is in the form of the side notches which are to engage the guide rails 24, 24^x. In the plain plates these side notches, as shown in Fig. 5, have edges at 10^d which are at right angles to the transverse middle line of the plate so that detents 47, Fig. 8, by engaging these edges, will hold the plates against displacement from the top of the stack, inwardly towards the needle circle. If these detents were not provided and were the notches at 10^d not formed to be engaged by the detents for restraining these plain plates, they would be liable to inward displacement by the pulling pawls 26 when these move inward to get into position for engaging the openings 10^e of the selector plates, when in advanced position at A, it being understood that the pulling pawls have a regular stroke of one length without regard to whether the topmost plate of the stack B is a plain plate or one having its throat toothed. The forward ends of the pawls 26 are bevelled and being mounted to yield upwardly, they will pass over the plates on their forward stroke in getting into position to engage the openings 10^e for retracting said plates. In order to permit forward movement of the toothed plates to take place the side notches of these plates are of the form shown at 10^b; that is, they are elongated in respect to the shape of the side notches in the plain plate of Fig. 5, so that the detents 47 will not interfere with the advance or inward movement of the toothed plates up to position adjacent the needle circle. These notches, however, have the square or straight edges 10^e so disposed that the detents will arrest the inward or advance movement of the toothed plates just before they would otherwise contact with the needle cylinder, so that there is slight clearance between the toothed plate and the needle cylinder.

In thus preventing actual contact of the advanced selector plate with the cylinder, scoring of said cylinder and the formation

of burrs along the edges of the needle grooves is avoided.

The detent 47 has a bevelled end and is yieldingly mounted, it being pressed by the spring 48 so that it may recede into the recess 49 in which it is housed when the plates are pulled outwardly away from the needle cylinder.

The jacks are not restrained in their grooves but work freely therein. After they have risen and performed their function they may drop down to normal position again or be pushed down by the needles in drawing their stitch.

The cam 6 is carried by a plain cylindrical member 6^x arranged coaxially with and below the needle cylinder. This cylinder in the present example of my invention rotates and for this purpose it is connected with or seated in the cam ring or plate 41^a. Rotary movement is imparted to the cam box 2 and the cam plates 23 and 41^a by gears 49, 50 and 51, respectively, on a vertical shaft 52, said gears meshing with teeth on the parts mentioned. The shaft 52 is driven through bevel gearing at 53 from a horizontal drive shaft 54. In Fig. 3 I have shown this shaft and gearing in dotted lines, for convenience of illustration, though it will be understood that these parts do not in practice occupy this position, but are located at another point around the machine.

All the plates may be provided with a central opening 10^f, at their rear edges, which receive a vertical post 55 suitably supported on the fixed base of the machine adjacent the outer section B′ of the stack so that the plates as they fall on to the outer section of this stack will be guided downwardly.

If a plate in falling tends to assume an inclined position, such as would free it from the guides of the magazine, it will be prevented from doing so by the central post. If the plate assume such a position that it hangs on this post, it will be dislodged to fall onto the stack when the weight of the next plate comes upon it.

In the needle cam set I provide the adjustable cam 56 by which the action of the needle selecting plates may be neutralized. This cam is pivotally supported at 57 and it has means of adjustment on the outer side of the cam box shown in dotted lines at 58 by which the cam can be adjusted and held in either its full line position or in its dotted line position. In its full line position it will allow those needles which are to tuck to pass in this position, but if this cam 56 is adjusted to its dotted line position then the needles which have been selected by the toothed plates to tuck will be raised by this cam to knit.

Referring to Fig. 17, which shows diagrammatically the relation between the cam grooves 22, 32 and 41 for operating respectively the carriers of the upper push pawls 17, the plate retracting pawls 26 and the lower push pawls 33, the cams rotate in the direction of the arrow. The upper push pawls 17 are in their advance position to hold the plate up to the needle cylinder while the roller 21 of their slide is being acted on by the portion of the cam groove from 22^a to 22^b, this portion of the groove being concentric with the vertical axis of the machine. From 22^b to 22^c the upper pusher pawl is retracting and it remains in this retracted position until the point 22^d is reached. The machine being two feed, the lay out of each cam groove is repeated; hence I have marked 22^a a second time on the cam groove and from 22^d to this second point marked 22^a the upper pawl slide is advanced again to feed a new plate up to the needle cylinder.

Referring to the cam groove 32 for operating the slide of the pull pawl 26, the outermost point of this is at 32^a. This represents the retracted position of the pull pawls, from which point they advance or move inwardly towards the needle circle until the point 32^b is reached, at which time the pull pawls will be in their full advanced positions ready to retract and thus withdraw the selector plate, which now has performed its function of selecting the needles which are to knit and those which are to tuck.

During this advance or inward movement of the pull pawls the push pawls are being held by the concentric portion of the groove 22^a—22^b in their advanced or innermost positions, holding the selector plate in position to perform its function. Points 32^b and 22^b are substantially radially in line so that both the upper push pawls 17 and the pull pawls 26 begin to recede from the needle circle at substantially the same time. The recession of the push pawls, however, ceases when the point 22^c is reached, but the recession of the pull pawls continues, as their longer stroke outwardly to the point 32^a is necessary in order to carry the selector plate far enough to register with the outer vertical guides 24 to deliver the plate on top of the outer section B′ of the supply of plates in the magazine.

In thus retracting the plate it passes over guards 60, the tops of which form guides for the plate, and prevent it from dropping down.

The relation of the cam groove for operating the carrier of the lower push pawl is shown in dotted lines, the outermost and innermost points of this groove being indicated at 41^a and 41^b respectively.

The depression 41^e which cooperates with the roller 44 for controlling the stack lifter is also indicated in the Figure 17, the point

where the roller 44 drops to allow the new plate to assume its position at the bottom of the stack B being indicated at *dr*, and the point where the stack lifter raises to lift the stack for initiating the insertion of the forward ends beneath the stack being shown at *ra*.

It will be appreciated that with the plates as disclosed herein it is possible to make designs in fabric of fine gauges. With jacquard paper strips or cards having perforations, the gauge must necessarily be coarse, owing to the necessity of maintaining sufficient material between the holes in the paper or card to preserve the integrity of the paper strip or card. When the plates are made of metal, permanency of the selector teeth and finest of gauge is secured. The selector mechanism herein disclosed is applicable to both types of machine, i. e., the revolving cam type or the revolving needle cylinder type. Where paper strips or a series of cards are attached in an endless band and this band depends from a drum, it is impracticable to revolve the jacquard about the vertical axis of the machine. In the selector mechanism herein shown the stacks of plates are held close to the cylinder and consequently to the vertical axis of the machine, there being no devices such as bars, levers or other elements between these plates and the needles which would render it necessary to set the stacks of plates at a distance from the vertical axis about which the mechanism as a body must be carried in the revolution of the machine. The mechanism not only occupies little space radially of the machine but it is located below the upper deck and between the upper and lower decks, leaving the upper deck entirely free and the mechanism itself is in a protected position. A larger rate of production can be attained with this selector mechanism because it imposes no material limitation upon the speed of the machine owing to the fact that it is free from mechanism interposed between the plates and the needles and employs no feelers or interlocking mechanism, all of which are more or less subject to vibration and require a moderate speed of the machine. The mechanism readily can be enclosed against access of lint. A pattern of maximum length can be obtained in proportion to the space occupied, as the plates are thin and are stacked one directly against the other flatwise. Each series of plates may be divided into two stacks, each of which may be of the full length of the magazine.

The jacks being substantially extensions of the needles, it will be understood that where herein the needles are referred to as acted upon by the selector mechanism, said reference is made in a generic sense to mean either the needles or jacks.

It will be understood that with machines of comparatively small diameter it is not desirable to employ the selector plates by a direct action intended to push the jack or needle radially inward to cause it to tuck and not to knit, as in such case the tendency would be to push the needle sidewise relative to the radial slot in which it works, the result being that the needle or jack would be pushed against the side wall of its slot. To avoid such undesirable action the operation hereinbefore described is performed by which the selector plate is set in selecting position close to the needle cylinder and the cam incline 12 on the needle or jack by working against the tooth of the plate will be moved radially inward as described. It will be understood, however, that where the invention is used in connection with a machine having a substantially straight needle row, as for instance in a large diameter circular machine, I do not limit myself to the use of the selector plates in the precise way disclosed herein, as other ways of employing the selector plates may be used for causing the needles to knit at times and at other times to tuck. That is, the selector plates may be employed to push against the needles or jacks by direct action for their control, this being within the broad scope of my invention, it being understood also that the jacks having the idle movement disclosed and their cam inclines can be used in machines other than circular machines of small diameter.

As before stated the invention can be used in connection with either a plain fabric machine or a machine for producing rib fabric. In the latter case the needle selector mechanism would control the cylinder needles to make those which are not to knit remain at the welt position at which they would miss taking yarn. The cam 56, in this use of the machine, would be adjusted to a position below that shown in Fig. 2, so that the needles selected by the teeth of the plates would miss the yarn entirely.

In the appended claim I have stated that the needles are controlled to "knit" or "not to knit" and it will be understood that when I employ the negative expression it is done in a broad sense, to refer to tucking, or the production of welt.

I claim:

1. Needle selector mechanism for knitting machines for producing designs in the fabric comprising a series of needle selector plates stacked one upon another having edge teeth to control the needles, means for advancing said plates to select the needles and for withdrawing them after selecting the needles, and means for operating the needles, each of said toothed plates extending along a section of the needle bed to control a group of needles, substantially as described.

2. Needle selector mechanism for knitting machines for producing designs in the fabric comprising a series of needle selector plates horizontally disposed and stacked flatwise one upon another, said plates having toothed edges, means for advancing the plates individually from the top of the stack to select the needles and for withdrawing them and means cooperating with the said toothed plates for causing only a portion of said needles to knit, substantially as described.

3. Needle selector mechanism for knitting machines for producing designs in the fabric comprising flat plates having toothed edges, said plates being arranged in a stack, means for taking the plate at the top of the stack and advancing it to select the needles and for withdrawing the plate, means for directing the withdrawn plate to a position adjacent the bottom of the stack, and means for moving the said plate to position at the bottom of the stack, each plate in turn arriving at the top of the stack, and means cooperating with the toothed plates for causing certain needles to knit and others not to knit, substantially as described.

4. Needle selector mechanism for knitting machines for producing designs in the fabric comprising flat plates having toothed edges, said plates being arranged in a stack, means for taking the plate at the top of the stack and advancing it to select needles and for withdrawing the plate, means for directing the withdrawn plate to a position adjacent the bottom of the stack, and means for moving said plate to position at the bottom of the stack, each plate in turn arriving at the top of the stock to be moved to and from needle selecting position, and means cooperating with the toothed plates for causing certain needles to knit and others not to knit, and means for lifting the stack to permit the insertion of said plate at the bottom of the stack, substantially as described.

5. In combination with a needle bed, a series of toothed unattached plates to control the needles, means for holding the plates in a stack adjacent the needle bed, means for holding the plates at a point further removed from the needle bed, means for transferring the plate at the top of the inner stack to the needle bed to select the needles and thereafter transferring said plate to the outer holding means, means for transferring the plates individually from the bottom of the outer holding means to the bottom of the inner stack and means cooperating with the toothed plates for causing certain of the needles to knit and others not to knit, substantially as described.

6. In combination with the needle cylinder of a circular knitting machine for producing designs in the fabric, a series of unattached toothed plates, means for advancing said plates to select the needles and for withdrawing them, said movements being in a direction radially of the needle cylinder, and means cooperating with said plates for causing some of the needles to knit and others not to knit, substantially as described.

7. In combination with the needle cylinder of a circular knitting machine for producing designs in the fabric, a series of unattached toothed plates arranged horizontally in a stack, means for advancing the topmost plate of the stack to select needles, and for transferring said plate after it has performed its function to the bottom of the stack, each plate in turn arriving at the top of the stack, and means for operating the needles, the direction of movement of the said plates to and from the needles being radially of the needle cylinder, substantially as described.

8. In combination with the needles and needle bed of a knitting machine, a series of unattached toothed plates arranged in a stack, means for advancing the plates from the top of the stack to select needles to knit or not to knit and for thereafter transferring the said plates to position adjacent the bottom of the stack, means for advancing the plates from the latter position to a position at the bottom of the stack, a lifter for the stack with means for raising the same to lift the stack while the insertion of the plate at the bottom of the stack is initiated and for then lowering the lifter for the completion of the insertion of the plate at the bottom of the stack, substantially as described.

9. In a knitting machine according to claim 8, the said plates having their front edges curved to conform substantially to the curve of the segment of the needle circle served by the plate, the curved formation of said plate providing projecting end portions which are the first to enter below the stack, substantially as described.

10. In combination with a needle bed and needles, needle selector mechanism for producing designs in the fabric comprising plates toothed to control certain of the needles, said plates being arranged in a stack, push pawl means for moving the plates in succession and individually from the stack to select the needles, pull pawl means for retracting the plates, for their return to position adjacent the bottom of the stack, and push pawl means for moving the plates from said position to a position at the bottom of the stack and means for giving said pawl means reciprocating movement, substantially as described.

11. In combination with needles, and needle bed, a series of plates having teeth to control the needles, said plates having notches in their ends, vertical guides arranged in inner and outer sets for engaging the end notches for controlling the ver-

tical movement of said plates, said plates being stacked adjacent the needle bed, means for moving the plates from the top of the stack to select the needles and for retracting them to engage the outer set of guides, and means for moving the plates into position beneath the stack to be guided upwardly by the inner set of guides, substantially as described.

12. In combination with needles and a needle bed therefor, toothed flat plates to control the needles, said plates being matched and stacked one upon another and means for moving the plates in their own plane to and from the stack.

13. In combination with needles and a needle bed therefor, toothed plates to control the needles, push pawls for engaging the rear edges of the said plates to move the same to select the needles, pull pawls for retracting the plates away from the needles, said plates having openings therein to be engaged by the pull pawls.

14. In combination with needles and a needle bed therefor, toothed plates to control the needles, reciprocating push pawls for moving the plates to select the needles, reciprocating pull pawls for moving the plates away from the needles, and means for lifting the push pawls to permit the pull pawls to retract the plates, substantially as described.

15. In combination with needles and a needle bed therefor, toothed plates to control the needles, plain plates interspersed with the toothed plates in series, means for moving the toothed plates to select the needles, and for returning said plates into their place in the series, and means whereby the said means will move the plain plates throughout the course of the plates without moving them to needle selecting position, substantially as described.

16. In combination, a needle bed and needles, a stack of plates including plain plates and toothed plates, the former having recesses in their rear edges, push pawl means for moving the toothed plates from the top of the stack to select the needles, pull pawl means for retracting said toothed plates away from the needles and for their return to position adjacent the bottom of the stack, said push pawl means entering the openings of the plain plates when they reach the top of the pile for performing an idle movement whereby said plain plate is not advanced to the needles, said pull pawl means withdrawing said plain plates from the top of the stack to assume a position adjacent the bottom thereof and push pawl means for inserting the toothed and plain plates at the bottom of the stack, substantially as described.

17. In combination with a needle bed and its needles, a stack of needle selector plates, means for moving the plates from the top of the stack to select the needles and thence to position adjacent the bottom of the stack, means for inserting the plates at the bottom of the stack, lifting means for the stack and operating means for the lifting means comprising a cam having relative movement in respect to said lifter means, substantially as described.

18. In combination, a needle bed and needles, toothed needle selector plates, means for operating the needles, means for moving the selector plates to select the needles and detent means for limiting the advance movement of the toothed plates to prevent contact thereof with the needle bed, substantially as described.

19. In combination, a needle bed and needles, toothed needle selector plates, means for operating the needles, means for moving the selector plates to select the needles and detent means for limiting the advance movement of the toothed plates to prevent contact thereof with the needle bed, said toothed plates having notches in their ends, guides to engage said notches for directing the plates, said detent means engaging with a wall of an extension of said notch, substantially as described.

20. In combination, a needle bed and needles, toothed needle selector plates, means for operating the needles, means for moving the selector plates to select the needles and detent means for limiting the advance movement of the toothed plates to prevent contact thereof with the needle bed, plain plates interspersed with the toothed plates, both the toothed plates and the plain plates having end notches, guide rails engaging said notches, the notches in the toothed plates being elongated, detent means engaging the wall of the elongation of said notches to limit the advance movement of the toothed plate and prevent its contact with the needle bed, said detent means engaging the notches of the plain plates for preventing advance movement thereof from the top of the pile, push pawl means for engaging the toothed plates for advancing them, said plain plates having recesses in which said push pawls work idly, and pull pawl means for withdrawing the toothed plates from the needles and the plain plates from the top of the stack, substantially as described.

21. In combination with a circular knitting machine a needle cylinder having radial needle grooves, needles in said grooves, selector plates having teeth corresponding to certain of the needles to prevent them from producing regular knitting, and having the spaces between the teeth radially disposed relative to the needle cylinder and corresponding to other needles which are to perform regularly in knitting, a knitting cam set including a needle advancing cam and

a stitch cam, and means for raising the needles corresponding to the radial spaces of the plates into the plane of movement of the advancing cam, substantially as described.

22. In combination with a circular knitting machine a cylinder having radial grooves, needles in said grooves, selector plates having teeth corresponding to certain of the needles to prevent them from producing regular knitting, and having the spaces between the teeth radially disposed relative to the needle cylinder and corresponding to other needles which are to perform regularly in knitting, a knitting cam set including an advancing cam and a stitch cam, and means for raising the needles corresponding to the radial spaces of the plate into the plane of movement of the advancing cam, said means including jacks and a raising cam therefor, and cam means for withdrawing the jacks radially from the spaces between the teeth, substantially as described.

23. In combination a needle bed, needles, needle jacks, needle selector plates having teeth to engage certain of the jacks and spaces between the teeth to receive the other jacks, a cam set for operating the needles including an advancing cam and a stitch cam, and cam means for giving movement to the jacks relative to the toothed plate, said jacks being selected by the said plates as a result of said movement, substantially as described.

24. In combination a needle bed, needles, needle jacks, needle selector plates having teeth to engage certain of the jacks and spaces between the teeth to receive the other jacks, a cam set for operating the needles including an advancing cam and a stitch cam, and cam means for operating the jacks relative to the toothed plate, said jacks having inclined edges which engage the teeth of the plate which are radially in line therewith for the deflection of said jack as it rises to prevent it from operating the corresponding needle, substantially as described.

25. In combination a needle cylinder, needles and jacks disposed in the radial grooves thereof, plates having teeth on radii corresponding to the radii of the needles and with spaces between the teeth also on radii corresponding to the radii on which the jacks are located, means for presenting the toothed plates to the jacks with the teeth in front of certain jacks and the spaces between the teeth opposite the other jacks, a set of cams including an advancing cam and a stitch cam for operating the jacks, said jacks having inclines, cam means to elevate the needles, those needles which are in radial line with the teeth being deflected by their inclines working against the teeth, to prevent them from rising high enough to be operated by the advancing cam and those jacks which are radially in line with the spaces between the teeth being elevated to be operated by the advancing cam for making regular stitches, and cam means for withdrawing the jacks from the recesses of the plates after being lifted, substantially as described.

26. A circular knitting machine according to claim 25 in which the cam means for withdrawing the jacks from the recesses in the plates consists of an extension at the top of the cam means which elevates the jacks substantially as described.

27. In combination in a knitting machine a needle bed having grooves, needles and jacks in the grooves, said grooves having an outward and downward incline at the lower end of each jack in the grooves having outward and downward inclines at their lower ends, a cam set for operating the needles to form stitches, including a needle advancing cam and a stitch cam, a cam for elevating jacks and therefor the needles to be acted on by the cam set, plates having teeth and recesses between the teeth to correspond with the spacing of the jacks, the inclines of the jacks in line with the teeth contacting therewith to bury the said jacks in the grooves as they are elevated and thereby limit their elevation to allow the needles to pass below the advancing cam, and means for presenting the plates to and withdrawing them from the jacks substantially as described.

28. In a knitting machine the combination of a needle bed, needles, stacked needle selector plates, means for advancing the plates individually and successively from the top of the stack to select the needles, and for withdrawing the plates after selecting the needles, to return to position adjacent the bottom of the stack, and means for guiding and controlling the plates in their return movement, substantially as described.

29. In a knitting machine in accordance with the features of claim 28, said plates having each an opening intermediate of its ends, said guiding and controlling means consisting of a post engaging said opening.

30. In a knitting machine in accordance with the features of claim 28, said plates each having a notch at each end, and an opening intermediate of its ends, and guides engaging said notches and recess to direct the plates in their downward movement, substantially as described.

31. In combination in a knitting machine, needles, needle jacks, a cam set including an advancing cam and a stitch cam, a cam for elevating the jacks, needle selector plates having teeth and recesses between the teeth cooperating with said jacks and said elevating cam, to determine which needles are to

be engaged by the advancing cam and which needles are to pass below said advancing cam, and an adjustable cam between the advancing cam and the stitch cam to allow the needles to proceed at the low level below the advancing cam or cause said needles to be elevated to shed their loops below their latches, take new yarn and be operated by the stitch cam to form stitches, substantially as described.

32. In combination in a circular knitting machine a head, a cam box, a deck at the lower part of the cam box outside of and surrounding the same, a lower plate spaced apart from said deck and extending about the axis of the needle cylinder, needle selector mechanism for selecting the needles which are to knit and those which are not to knit, said selector mechanism being outside of the needle circle and below the said deck and between said deck and the spaced apart lower plate, substantially as described.

33. In combination in a circular knitting machine, a needle cylinder, needles, cams for operating the needles, a cam box therefor, a deck or base plate, needle selector mechanism surrounding the needle circle below the said deck, including stacked plates, upper and lower cams spaced apart and arranged respectively adjacent the upper and lower ends of the stack, and means operated by the said cams for moving the plates, substantially as described.

34. In combination in a knitting machine, a needle bed, needles, needle jacks, flat plates having edge teeth extending in the plane of the plate to act on certain of the jacks and recesses between the teeth to receive other jacks for controlling the operation of the needles, and means for feeding the plates, substantially as described.

35. In a knitting machine according to claim 34, providing the jacks with inclines to work against the teeth whereby the jacks will perform a part only of their upward movement to allow the needles to tuck, those jacks which work in the recesses between the teeth performing a full upward movement to cause the needles to be acted on by their raising cam to knit, a needle cam set, and a cam for moving the jacks upwardly and means for feeding the plates, substantially as described.

36. In a knitting machine and in combination, a needle bed, needles, needle jacks for moving the needles upwardly, a needle cam set including a needle raising cam and a stitch cam, said needle raising cam having a path beneath it for the needles, means for causing the needles which traverse said path not to knit, a jack elevating cam and plates having teeth to act on certain jacks and spaces between the teeth to cooperate with other jacks, the jacks which contact with the teeth performing an idle upward movement to allow the needles not to knit, while the jacks which operate in the spaces between the teeth act to elevate their needles to be taken by their raising cam to knit, substantially as described.

37. In combination in a knitting machine, a needle bed, needles, a cam set including a stitch cam, and a needle raising cam, the latter having a pathway below it to receive those needles which are left in normal position, jacks for raising the needles from normal position to be taken by their raising cam for knitting, a cam for elevating the jacks, plates having teeth to act on the jacks for eliminating their raising action on the needles, while the spaces between the teeth permit other jacks to perform their full elevating movement to raise their needles to be taken by their raising cam for knitting on said needles, and means for feeding the plates to cooperate with the needles, substantially as described.

38. In combination in a knitting machine, a needle bed, needles, a cam set including a stitch cam and a needle raising cam, the latter having a pathway below it to receive certain needles from their normal position, a tucking cam for acting upon said needles, jacks for raising the needles from normal position to be taken by their raising cam for knitting, a cam for elevating the jacks, said jacks having cam inclines, plates having teeth against which the cam inclines of the jacks work whereby said jacks are disengaged from their elevating cam at a point intermediate their full stroke to eliminate their action on their needles, the spaces between the teeth permitting other jacks to perform their full elevating stroke under the action of their cam to raise their needles from normal plane to be taken by the needle raising cam for knitting, and means for feeding the plates to cooperate with the jacks.

39. In a knitting machine and in combination, a needle bed, needles, needle jacks for moving the needles upwardly, plates having teeth to act on certain of the jacks and recesses between the teeth to cooperate with other jacks for controlling the operation of the needles, said jacks having inclines to work against the teeth whereby said jacks will perform only a part of their upward movement, those jacks which work in the recesses performing a full upward movement to cause their needles to knit, a needle cam set and a cam for moving the jacks upwardly and means for feeding the plates.

40. In combination in a knitting machine, a needle bed, needle jacks, flat plates having edge teeth, which on one plate are differently disposed in respect to those on another plate according to pattern, said plates being un-

attached in respect to each other and arranged in a stack, means for feeding the plates to the jacks for controlling them, which jacks in turn control the operation of the needles, substantially as described.

41. A knitting machine according to claim 40 in which the toothed selector plates move in a plane towards and from the jacks substantially at right angles to said jacks, substantially as described.

42. A knitting machine according to claim 40 in which the toothed plates are unattached in respect to each other, and means for moving the said plates individually and in prescribed order to and from the jacks, substantially as described.

43. In combination with the needles and needle bed, a series of unattached toothed plates arranged in a stack, means for moving the plates seriatim from the stack to position for controlling the needles and for restoring the plates to the stack in prescribed order, and a lifter for the stack with operating means therefor, substantially as described.

In testimony whereof I affix my signature.

KENNETH HOWIE.