In a pattern selecting device for a knitting machine of a circular or flat or straight bar type there is provided a selection mechanism for cooperating with pattern butts to engage or miss the butts to determine a pattern cycle. The selection mechanism according to the invention includes one or more selectors in the form of an arm having a butt engaging face movable between butt-missing and butt-engageing positions, and an actuating part of magnetisable material movable between a pair of pole faces of or associated with a permanent magnet. The permanent magnet is located within an electromagnetic coil for magnetising the actuating part to attract it to one pole face and repel it from the other.

1 Claim, 17 Drawing Figures
PATTERN-SELECTING DEVICES FOR KNITTING MACHINES

This invention relates to pattern selecting devices for knitting machines.

While the invention is described hereafter with particular reference to circular knitting machines, it is to be understood that it is also applicable to knitting machines of the flat and straight bar type.

Knitting machines comprise a plurality of needles which are associated with patterning butts, which may be on the needles themselves but are more usually on lifting jacks for the needles or on operating presser elements for the jacks. The pattern butts are arranged so as to co-operate with selectors controlled by a pattern control mechanism so as to engage or miss the successive pattern butts to influence the action or non-action of the successive needles to form a pattern.

In one particular form of patterning mechanisms, the needles are lifted by jacks having lifting butts sprung, preferably by the inherent springiness of the jack, into a path for engagement with a jack raising cam at each feed station, and retractable from that position by a rocking presser which is rocked outwards to cause retraction of the associated jack and held in the outward position by a permanent magnet. The rocking pressers have, or are associated with, patterning butts which cooperate with selectors of a patterning device which either miss the butts or engage them whereby release of the presser from engagement with the permanent magnet is effected with the consequent release of its associated spring jack, a butt portion of which returns to the path of the jack raising cam.

It will be appreciated that such an arrangement is applicable to machines with stationary or movable cam boxes.

The selectors are generally operated by some sort of electromagnetic arrangement. It is also usual to have the pattern butts arranged in staggered sets with a separate selector at each feed station associated with corresponding members of the sets. Thus, if there are six pattern butts in a set, each selector will control every sixth pattern butt. The selectors at each feed station have to be stacked into a compact form, so that the bulk of the electromagnetic actuating mechanism has to be kept as small as possible, while ensuring that the action is fast and reliable.

It has now been discovered that a very effective form of selector is provided if a magnetisable moving part of the selector operates between pole faces of a permanent magnet, when the pole faces themselves are surrounded by an electromagnetic coil for actuating the moving part to one or other of the pole faces.

The present invention accordingly consists in a pattern selecting device for a knitting machine comprising a selector arm movable between a butt engaging position in which a face of the arm is engageable with pattern butts on or associated with needles movable relative to the pattern selecting device, and a butt missing position in which the said face does not engage the pattern butts, the said selector arm further including an actuating part of magnetisable material movable between opposed pole faces of or associated with a permanent magnet, the pole faces being surrounded by at least one electromagnetic coil arranged to magnetise the said actuating part for attraction towards a selected one of the pole faces and repulsion from the other.

Is a simple coil is used, when a current is caused to pass through the coil in one direction the said movable actuating portion of the arm becomes polarised in one sense and is attracted a first of said pole faces and repelled from the other of said pole faces and further, when a current is passed through the coil in the opposite direction, the said movable actuating portion of the arm becomes oppositely polarised whereby it is repelled from said first pole face and attracted towards said second pole face thus to be moved between positions in which the butt engaging face of said arm lies in a butt engaging path or clear of said path. It can be seen that the permanent magnet holds the actuating part in either position when there is no current flowing. A separate coil may be used for each direction of magnetisation if desired.

The selector coils are preferably arranged in a stack forming a patterning unit, and the coils may be staggered for compactness of the stack. The coils may be shielded from each other by shelves so that stray fields do not affect the operation of the selectors.

The pole faces may be formed on pole pieces extending from the permanent magnet and straddling the actuating part.

In order to provide a compact coil with adequate turns for the operation of the actuating part, the coil may be long enough to embrace the whole assembly of permanent magnet and pole pieces.

The selector may be conveniently arranged so that the arm rocks about an axis parallel with the axis of the associated coil.

The selector may be such that the arm is pivotable about one end.

Alternatively, the selectors may be such that the arm is pivotable intermediate its ends.

Some of the selectors in a stack may differ from others in the mode of operation in order to provide the same stroke of the face from a similar but differently located, i.e., staggered actuating part and coil.

As an alternative to pivoting, the arm may have a flexible zone so that one end may be fixed while allowing the movable actuating part to operate between the pole faces. The flexible zone may be formed by a beryllium-copper leaf spring.

In a further alternative, the arm may be guided for sliding as the movable actuating parts moves between the pole faces. For example, the gap between the pole faces may be bridged by a non-magnetic element having guides therein for the movable actuating part of the arm.

The selecting device may be used in conjunction with a patterning mechanism including the rocking pressers referred to above, but it will be appreciated that it is also more widely applicable.

The invention will be further described with reference to the accompanying drawings, which show a preferred embodiment of the invention and modifications thereof, as applied to a circular knitting machine of the rotating needle cylinder type, although it will be understood that the invention is more widely applicable.

In the drawings:

FIG. 1 is a perspective view with parts broken away showing the general arrangement of a stack of pattern selecting devices according to one form of the invention;

FIG. 2 is a section through a cylinder of a knitting machine showing a stack of selecting devices in situ;
FIG. 3 is a diagrammatic view of a selecting device of the stack and its relation to a coil would round a permanent magnet associated therewith;

FIG. 4 is a diagrammatic perspective view of a selecting device and pattern butts of the rocking pressure members in needle tricks of the machine.

FIG. 5 is a plan view generally in the direction of arrow 'V' in FIG. 2;

FIG. 6 shows a modified selector device with the stack of selecting devices differently located in relation to the machine axis;

FIG. 7 shows a modified form of selecting devices;

FIG. 8 shows a further modified form of selecting device;

FIG. 9 is a section taken along the line IX—IX of FIG. 8;

FIG. 10 is a front elevation of a further modified form of stack of selecting devices;

FIG. 11 is a diagrammatic perspective view of two selecting devices as shown in FIG. 10;

FIG. 12 is a front elevation of a still further modified form of stack of selecting devices;

FIG. 13 is a view corresponding to FIG. 3 and showing a further modified selecting device of a stack;

FIG. 14 is an elevational view of the structure of FIG. 13.

FIG. 15 is a perspective view, partly exploded, of part of a modified form of stack of selecting devices;

FIG. 16 is an elevation on the arrow XVI of FIG. 15, and FIG. 17 is a plan view, partly in section, of a further embodiment of the invention.

The invention pattern selecting device is suitable for use in a knitting machine of the circular, flat or straight bar type and will hereinafter be described in its application to a circular knitting machine of the rotating cylinder type.

The illustrated machine comprises a cylinder 1, see Figs. 2 and 5, in which needles 2 are supported in needle tricks 3 provided in the wall of the cylinder 1. Also mounted in the needle tricks 3 are needle jacks 4 which are each provided with a spring tail portion 5 having a lifting butt 6 arranged, when in an operative position, to engage a jack raising cam 7 when the needle 2 associated therewith is to effect a knitting operation.

The illustrative machine also comprises, associated with each jack 4, a rocking presser member 8 normally held in an inoperative position by the spring-tail portion 5 of the associated jack 4. Each rocking presser 8 has a pattern butt 9 and the pattern butts of each of the six successive rocking pressers are disposed in butt paths which lie one above the other, as may be seen in FIG. 4. The rocking pressers 8 each also comprise an upper end portion 21 arranged to engage a placer cam 23 in advance of a feed of the machine whereby successive rocking pressers are pivoted to cause their end portions 21 to move outwardly (FIG. 2) into engagement with a permanent magnet 24. Movement of the end portions 21 into engagement with the magnet 24 is also effective, through a tail portion 25, thereof, to cause the butts 6 of the jacks 4 associated therewith to move clear of the jack raising cam 7 into the needle trick 3 whereby actuation of the needle 2 is not effected, unless the butt 6 is allowed to spring out from the trick by the presser being knocked off the magnet 24 as a result of selection by a pattern unit 10 associated with the feed.

Each pattern unit 10, see Figs. 1, 3, 4 and 5 comprises six butt selecting members 11 or cams pivotally mounted by a spindle 13 in bearings 13a provided in a support housing of the device 10, each member 11 having a butt engaging portion 12, the members 11 being arranged for pivotal movement, when the machine is in use, between positions in which the butt engaging portions 12 thereof lie in respective ones of the butt paths or clear of such paths.

Each butt selector member 11 is pivotally mounted about a horizontal axis in an associated bearing 13a in such a manner that the butt engaging portions 12 of each device lie one over the other (see Figs. 1 and 5), and movement thereof between said positions is along a path substantially at right angles to the said path of movement of an associated pattern butt 9.

Each member 11 further comprises associated therewith (see FIG. 3) a permanent magnet 14 provided with upper and lower pole pieces 15 and 16, which magnet 14, together with the pole pieces 15 and 16, is arranged with a coil 17.

The coils and magnets are arranged in staggered relationship see Figs. 1 and 7 to maintain the stray flux effect between each magnet at a minimum and to provide for compactness of the arrangement. Shelves 17a of magnetic material are also provided to support and shield adjacent coils for extraneous electromagnetic field effects.

The butt selector members 11 are each further provided with actuating parts formed of magnetisable material, herein referred to as magnetisable actuation portions 18, which extend between the pole pieces 15 and 16 of their associated magnets 14 in such a manner that, when on the one hand, the selector is in an inoperative position the portion 18 is held in engagement with the lower pole piece 16 of the magnet 14 and thus the butt engaging portion 12 thereof lies below a path of movement of its associated butt 9, and when, on the other hand, the selector is in an operative position and a current is passed through the coil 17 in one direction the actuating portion 18 becomes polarised and is repelled from the pole piece 16 and attracted towards the pole piece 15 thus to cause movement of its associated butt engaging portion 12 upwardly into a butt engaging path whereby a cam surface 20 of said portion 12 is engageable by the butt 9. Engagement of the butt 9 with the surface 20 is effective to cause rocking movement of the presser member 8 associated therewith whereby the end portion 21 thereof is moved away from the engagement 24 and consequently the spring tail portion 5 of the jack 4 moves the butt 6 into a path of engagement with the jack raising cam 7 whereby an actuation of the associated needle 2 is carried out.

The actuating portions of the selector members, although being shown as extending between the pole pieces 15 and 16 for a short distance see FIG. 3, may be of such length that they extend wholly into the end space between the pole pieces 15 and 16.

The pivoted butt selector members 11 are arranged in such a manner because of the staggered relationship of the magnet and coil arrangements, that angular movement of the longer ones thereof compared to the shorter ones thereof is compensated for by making the actuating portions 18 of the shorter ones thicker compared to the actuating portions of the longer butt selecting members. Thus movement of the respective butts engaging portions is maintained substantially the
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The same effect could be obtained by varying the distance between the pole pieces 15 and 16 of the permanent magnets.

The magnet and coil arrangement has been found to operate most advantageously, compared with hitherto proposed arrangements, with the flux pattern concentrated around the actuating portion 18 and the permanent magnet 14 in such a manner that the problem of stray flux effect on butt engaging members of other closely situated magnet and coil arrangements is reduced. Further, the concentration of the flux is such that a rapid action of the actuating member is obtained.

In a first modified arrangement, the pattern unit 10a see FIG. 6, is displaced by substantially a right angle, as compared with the device of FIGS. 1 and 2, and the butt selector members 11a thereof extend substantially radially of the machine cylinder. The butt engaging members each comprise a portion 12a arranged for movement between positions in which it lies in the part of one level of butts 9a or clear of said path. The function of the magnet and coil arrangement is substantially as heretofore described with reference to the illustrative selecting device. In both cases, the pivot axis of the selector is parallel with the axis of the coil.

In a second modified arrangement, see FIG. 7, the butt engaging members are not pivot but include a clamped spring member 30 of beryllium-copper having an iron actuating piece (not shown) and a butt engaging portion 32.

In a third modified arrangement see FIGS. 8 and 9, the butt selector members may be arranged as slide members 35 located in slides 36 of non-magnetic material wherein, when on the one hand the member 35 is attracted towards one pole piece 37, of its associated magnet, it is in an operative condition in which a butt engaging portion is placed into a butt path, and when on the other hand the member 35 is attracted toward the opposite pole piece 38, of its associated magnet, it is moved clear of said path.

In a fourth modified arrangement (see FIGS. 10 and 11) the butt selector members are arranged with alternate cones thereof as single armed members 40 or double armed members 41, so as to maintain the distance movement by the butt engaging portions thereof at substantially the same distance despite the staggering of the coils.

In a fifth modified arrangement (see FIG. 12) the butt selector members 42 are of equal effective length and are arranged in a stack with alternate selectors pivoted on opposite sides of the selecting device.

In a sixth modified arrangement (see FIGS. 13 and 14) each butt selecting member 44 is located in an associated slot 5 formed in a block 46 of the arrangement, said slot 45 facing the magnet and coil associated with the butt selecting member 44 and acting as a pivotal location for the member 44, a longitudinal pivotal edge portion 47 of the member 44 being freely received within the slot 45.

The butt selecting member 44 is retained in the slot 45 by a pin 48 passing through an oversized hole 49 formed in a lug portion 50 of the member, a center line of the hole 49 being arranged coincident with an edge of the portion 47.

The pin 48 also serves to retain each of the other five of the six selecting members, of the sixth modified arrangement, in their respective slots 45.

Like the selecting members of the pattern unit 10 FIG. 1, the selecting members 44 each comprise a magnetisable actuation portion 52. However, in the sixth modified arrangement the portion 52 extends wholly into the air space between associated pole pieces 55 and 56 of a permanent magnet 54 which pole pieces and actuation portion are arranged within a coil 57 corresponding to the arrangement of FIG. 3.

Each selecting member 44 is also provided with a butt engaging portion 58 arranged to function in a similar manner to the member 11 of FIG. 3 with the exception that pivotal movement of the member 44 takes place about the edge portion 47 thereof located in the slot 45 as aforesaid.

FIGS. 15 and 16 show a modified form of the embodiment of FIGS 13 and 14. An end block 61 is shown spaced from the housing 62 it completes to facilitate the showing of the internal structure. The block 61 is shown as having two recesses 63 aligned with slots 64 in cooperating faces of the housing 62. Transverse grooves 65 are shown in the cut-away portion of the block 61.

The butt-selecting or selector members 66 are each in the form of a spindle 67 snugly and rotatably received in two lengths of groove or slot 65. Each spindle 67 carries a hub 68 of a magnetisable actuation portion or actuating part or rocker 69 axially located in one or the other of the recesses 63. One end of each spindle 67 protrudes out of the side of the housing to carry a selector cam or rocker 70 on a respective hub 71.

As previously, the selector cams 70, having butt-engaging prongs similar to the portions 12 described hereinafore, cooperate with pattern butts 72 in tricks 73 of a needle cylinder 74.

The operation is similar to that of the FIGS. 13 and 14 embodiment, except that the movement of the butt-selecting members 66 is more precise, by virtue of the cooperation between the spindles 67 and hubs 68 with the corresponding formations in the end blocks 61. Thus it can be seen that each selector member is in the form of a shaft freely mounted in a slot for rocking movement and carrying rockers forming the actuating part and butt-engaging portion.

FIG. 17 shows a further modification within the scope of the invention. Each selector is mechanically very similar to that shown in FIGS. 10 and 11 of our United Kingdom patent specification 1,187,911 and consists of an arm 81 shown in full lines in an operative position in the path of pattern butts 82 on a needle cylinder 83 rotating in the direction of the arrow 84. The inoperative position is shown dotted at 81a. The arm is rockable on a fixed pivot 85 by means of an actuating part 86 of magnetisable material extending between pole pieces 87 of a permanent magnet 88. The actuating part acts as an armature in an electromagnetic coil 89 surrounding the magnet 88 and pole pieces 87, so as to move between the pole pieces and to be retained by them in either end position.

Each of the foregoing selecting devices can be operated, to cause patterning to be effected on fabric produced on the machine, by signals from a tape controlled means which may be similar to that disclosed in the Specification of United Kingdom Patent No. 1,214,691 although any like suitable means may be used.

It will be appreciated that the spring jack system (using rocking pressers) for operating the knitting nee-
The electromagnetic selecting device according to the invention may be applied to other knitting systems e.g. where the patterning butts are formed on the spring jacks themselves or on needle jacks which are rockable within the needle tricks.

Various modifications may be made within the scope of the invention. For instance, instead of a single coil adapted to be selectively energized in one direction or the other, two separate coils e.g. wound together, could be used to magnetise the actuating portion.

We claim:

1. In a pattern selecting device for a knitting machine, comprising a stack of selector members each having a butt-engaging portion movable between a butt-engaging position in which it is engageable with pattern butts on or associated with needles movable in relation to said pattern selecting device, and a butt-missing position in which the butt-engaging portion does not engage said pattern butts; the improvement that each selector member comprises an actuating part formed of magnetisable material and that the selecting device further comprises, associated with each selector member, a permanent magnet, pole pieces on said permanent magnet, opposed pole faces on said pole pieces, and an electromagnetic coil surrounding said permanent magnet and pole pieces, said actuating part of each selector member being movable transversely of the coil between the associated pole faces and being magnetisable by the associated coil for attraction to a selected one of the pole faces and repulsion from the other of the pole faces, and in that each selector member comprises a spindle freely mounted in a slot for rotational movement, each spindle carrying a rocker forming the said actuating part and a rocker forming the butt-engaging portion each rocker angularly extending from the spindle in the direction in which the said mounting slot opens.

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