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De Cerjat et al.

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[45] **Feb. 4, 1975**

[54] **ELECTRO-MAGNETIC SELECTION DEVICE FOR THE NEEDLES OF A KNITTING MACHINE**

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[21] Appl. No.: **248,749**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 10,138, Feb. 10, 1970, abandoned, which is a continuation-in-part of Ser. No. 823,536, May 6, 1969, abandoned.

[52] **U.S. Cl.** ..... **66/50 R**

[51] **Int. Cl.** **D04b 15/78**

[58] **Field of Search** ..... 66/50 R, 50 B, 75, 25, 66/50 A

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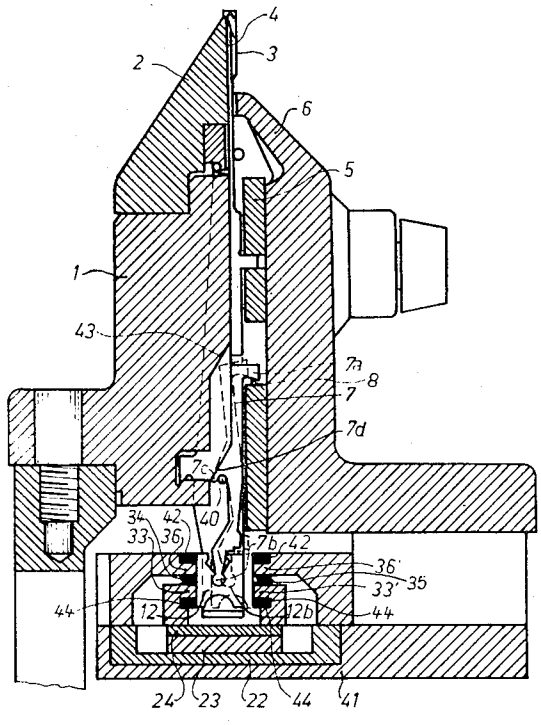
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Primary Examiner—Wm. Carter Reynolds
Attorney, Agent, or Firm—Robert E. Burns; Emmanuel J. Lobato; Bruce L. Adams

[57] **ABSTRACT**

In a knitting machine having individually operable needles, needle selection is made electromagnetically by means of selectors, one for each needle which travels in a channel having a constricted portion forming a throat followed by a diverging portion as they pass through the throat, the selectors are selectively drawn electromagnetically to one or the other side of the channel and they are thereafter held against the selected side of the channel, as they pass through the diverging portion, by means of a single permanent magnet having pole pieces at opposite sides of the diverging portion of the channel. Sufficient lateral movement of the selectors is thereby effected to make the desired needle selection.

9 Claims, 8 Drawing Figures



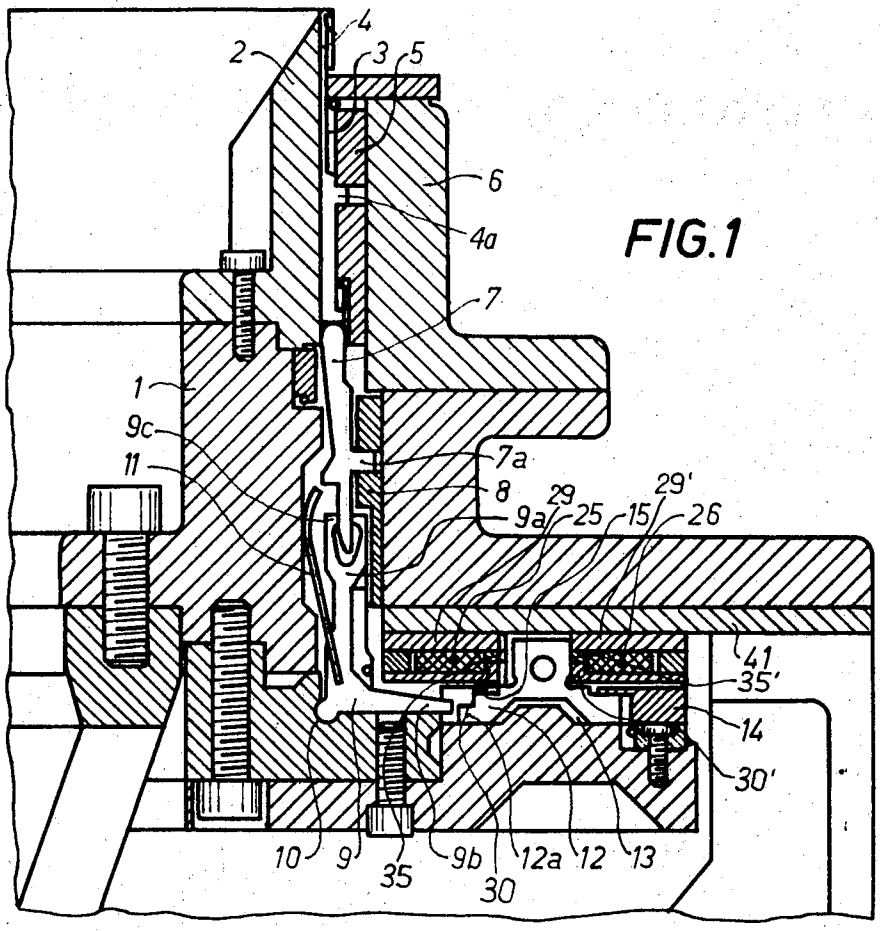

4
2
3
5
6
4a
7
1
9c
11
7a
8
29
29'
9a
25
15
26
41
35'
14
30'
10
9
35
9b
30
12a
12
13

FIG.1

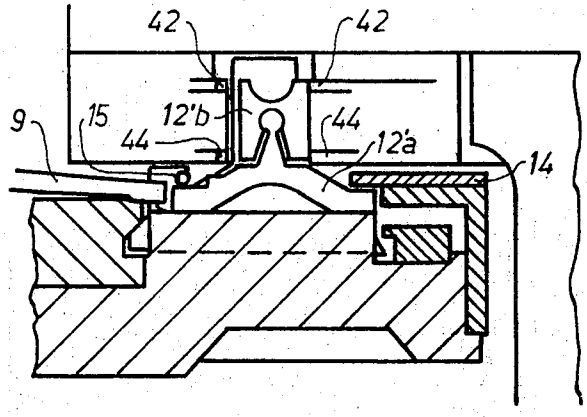
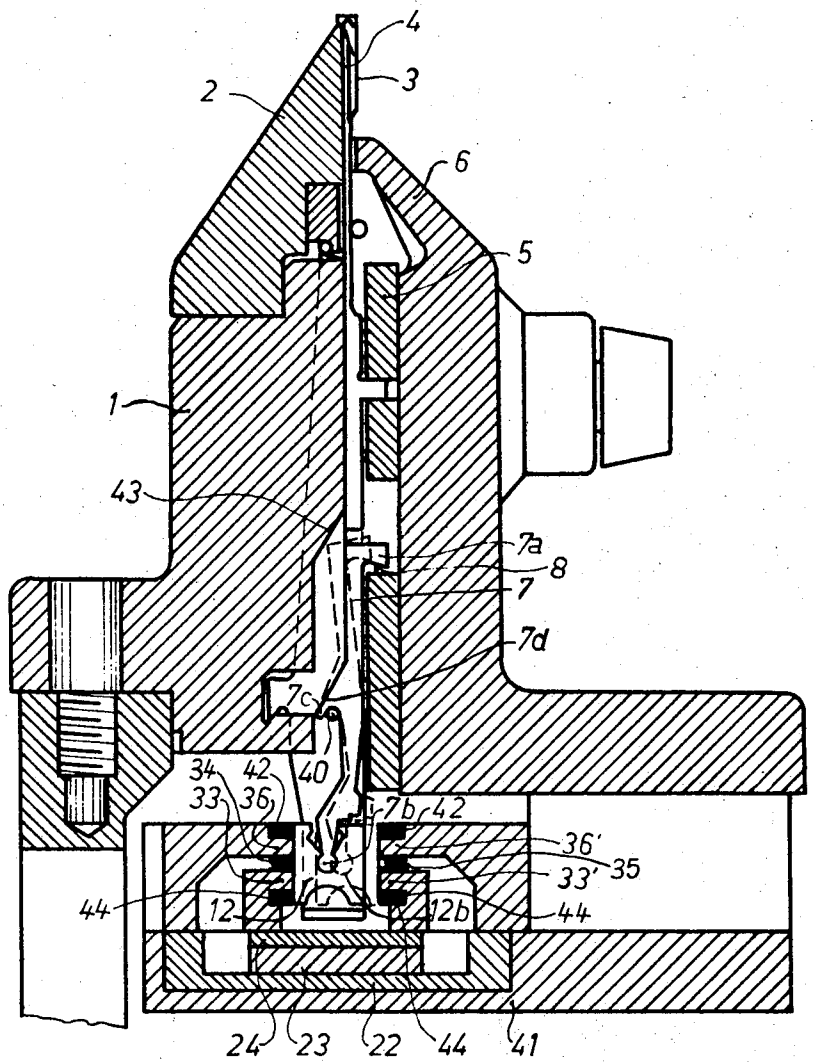

42
42
9
15
12'b
44
44
12'a
14

FIG. 5

FIG. 2


4
3
2
6
5
1
43
7a
8
7
7d
7c
34
42
40
33
36
7b
42
36'
35
33'
44
12
12b
44
24
23
22
44
41

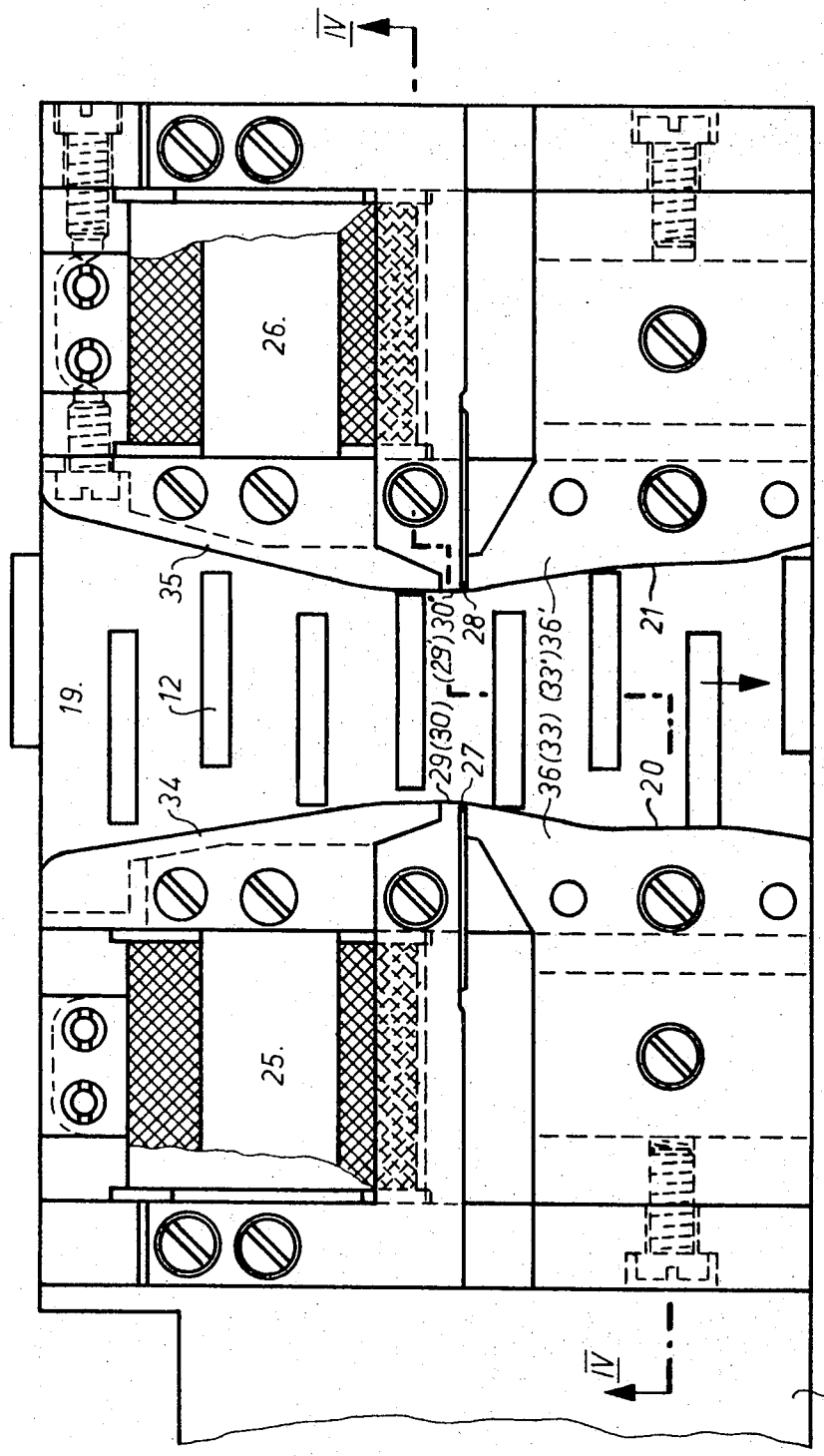


FIG. 3

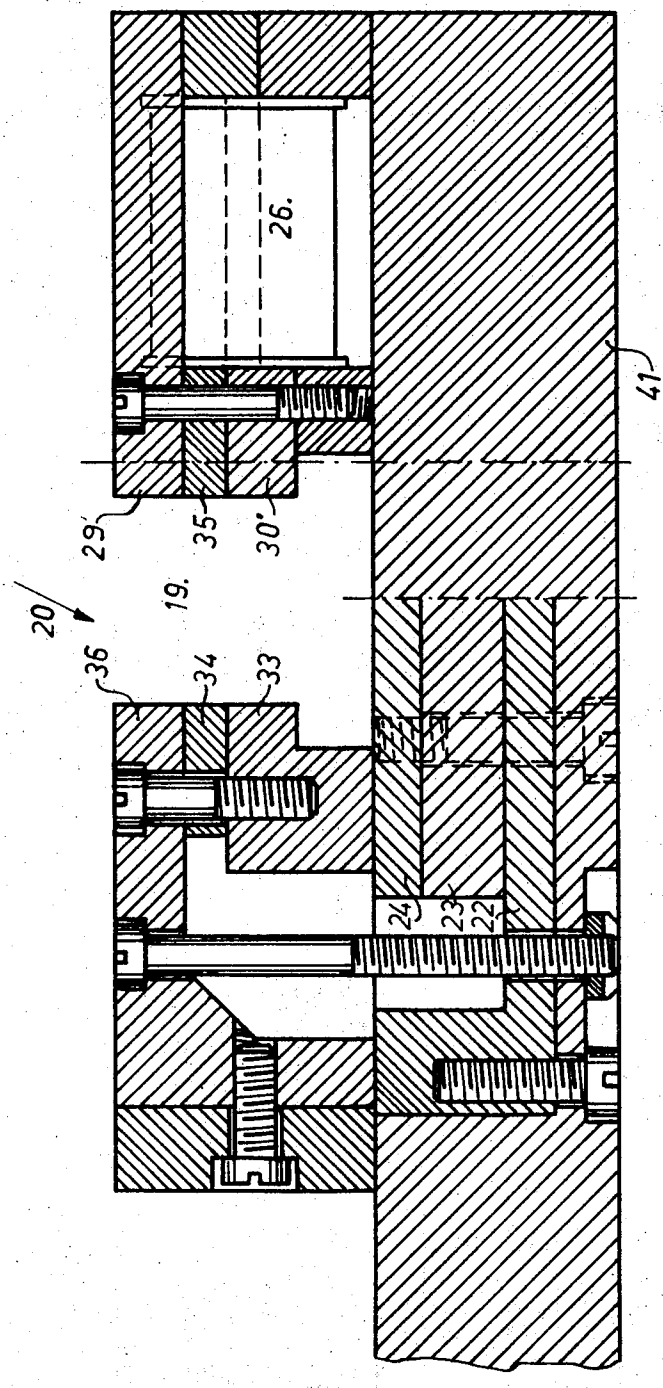
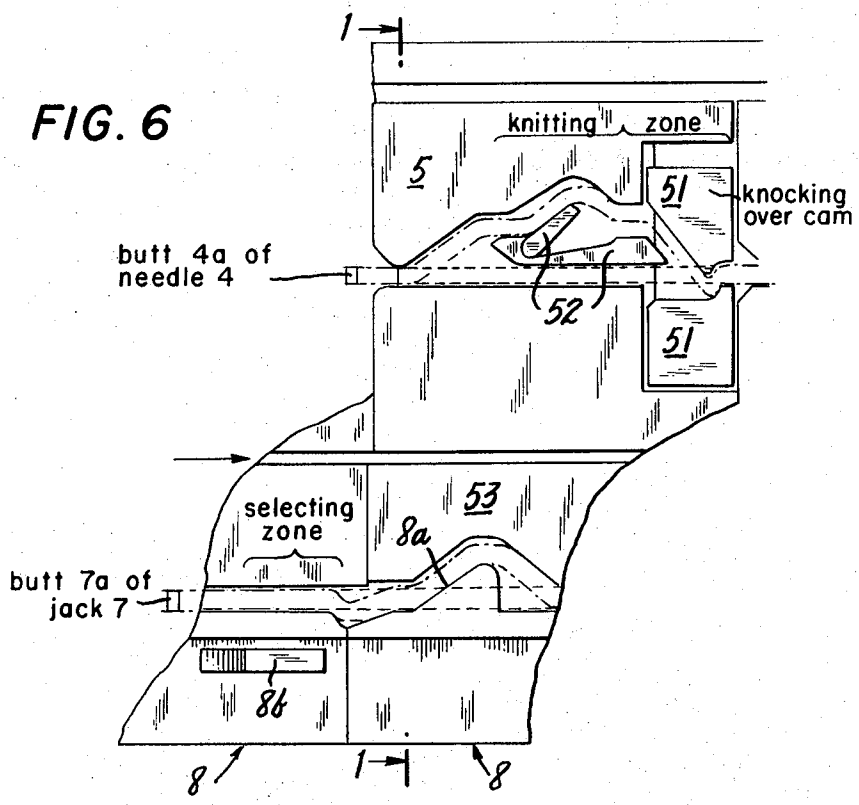


FIG. 4

FIG. 6



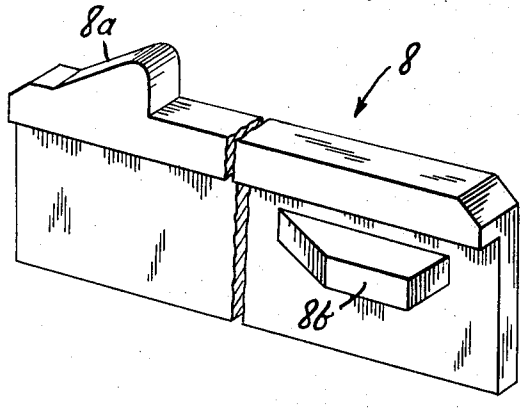


FIG. 7

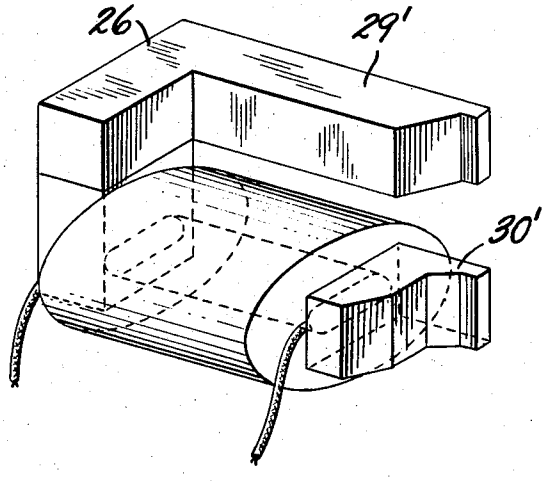


FIG. 8

ELECTRO-MAGNETIC SELECTION DEVICE FOR THE NEEDLES OF A KNITTING MACHINE

This application is a continuation in-part of my co-pending application Ser. No. 10,138 filed Feb. 10, 1970 which is a continuation-in-part of my application Ser. No. 823,536 filed May 6, 1969, both now abandoned.

The present invention relates to knitting machines having individually operable needles and particularly to an electromagnetic selection device for making a needle selection to produce desired fabric patterns. The needles are slidably arranged in tricks in a needle bed and are operated by means of cams engaging butts on needle jacks. Selection is effected by means of selectors, one for each jack, which are actuated magnetically for moving the jacks in a direction tranverse to their direction of travel relative to the cams so as to bring the butts of the jacks either into or out of position for engagement by the needle-operating cams. The selectors travel in a channel having a constricted portion forming a throat followed by a diverging portion. As they pass through the throat of the channel, the selectors are drawn electromagnetically to one or the other side of the channel according to the needle selection to be made. As the selectors then pass through the diverging portion of the channel, they are held against the side of the channel to which they have been selectively drawn by means of a single permanent magnet having pole pieces at opposite sides of the diverging portion of the channel. Sufficient movement of the selectors is thereby effected to move the respective jacks into or out of position for engagement with the needle operating cams. Strips of hard, nonmagnetic material are preferably provided in association with the pole pieces at the opposite sides of the channel in order to protect the pole pieces from wear.

As the selectors pass through the diverging portion of the channel, all of the selectors may be at one or the other side of the channel or some selectors may be at each side depending on the selection that has been made. If all or most of the selectors are at the moment at one side of the channel, the flux of the single permanent magnet is largely channeled to that side of the channel so that the magnetic stray field at the opposite side of the channel is relatively small. If, on the other hand, there are selectors on both sides of the channel, the total mean stray field will always be substantially the same and have a low value. Reliable operation of the selecting system is thereby assured.

The characteristics and advantages of the electromagnet selecting system in accordance with the present invention will be more fully understood from the following description in conjunction with the accompanying drawings in which:

FIG. 1 shows a cross-sectional view on the line 1—1 of FIG. 6 through a selector device of a circular knitting machine in a first embodiment of the invention;

FIG. 2 shows a similar view through a selector device of a circular knitting machine in a second embodiment of the invention;

FIG. 3 shows a plan view of the selecting magnets as used in the embodiments of FIG. 1 and FIG. 2;

FIG. 4 shows a cross-section taken along the line IV—IV of FIG. 3, and;

FIG. 5 shows a modified detail of the embodiment shown in FIG. 1.

FIG. 6 is a schematic view of a portion of the cam track of a knitting machine in accordance with the invention.

FIG. 7 is a persepective view of a cam for raising selected jacks.

FIG. 8 is a perspective view of an electromagnet for drawing selectors to one side or the other of the channel through which they pass.

Referring now to FIG. 1 there is shown a cylinder 1 of a circular knitting machine having a needle bed 2 provided with tricks 3 in which are disposed needles 4. The needles 4 are movable in their tricks 3 in conventional manner by means of butts 4*a* engageable with a cam 5 provided in a block 6. A typical cam block for a knitting station is shown by way of example in FIG. 6 as including a needle lowering or knocking-over cam 51 and a needle raising cam 52. The needles are raised to their operating position by means of jacks 7 each having a butt 7*a* for cooperation with an incline 8*a* on a raise cam 8 which is shown in perspective view in FIG. 7. The cam block includes a cam 53 for lowering jacks after they have been raised by cam 8.

The selector device comprises, for each jack 7, a two armed lever 9 which is pivotable in a socket 10. One arm 9*a* of each lever 9 terminates in a fork 9*c* in which slides the lower extremity of the pertaining jack 7. The arm 9*a* also carries a spring 11 which bears against a fixed part of the cylinder 1 to bias the lever arm 9*a* and its pertaining jack 7 constantly towards a working position. The second arm 9*b* of each lever 9 is aligned with a sliding selector 12 which is lodged in a radial groove 13 and is restrained against vertical movement by parts 14 and 15.

A selector station is constituted by two opposed electromagnets 25 and 26, the poles of which define part of the walls of a channel 19 (FIG. 3) along which the selectors 12 pass during operation of the machine. The arrangment of such selector station will be described more fully later on with reference to FIGS. 3 and 4.

The action of the electromagnets is to move a selector passing therebetween either to the left or to the right as viewed in FIG. 1 depending on which electromagnet is energized.

The device operates in the following manner:

When a selector 12 reaches the proximity of the selector station, the lever 9 associated with that selector 12 is pivoted counter-clockwise against the action of the spring 11 by means of a ramp 8*b* on the raise cam 8. If the magnet 25 is energized the selector 12 will be moved to the left as viewed in FIG. 1 and consequently when the lever 9 is subsequently freed by the ramp 8*b* of cam 8 the extremity 12*a* of the selector 12 will remain in the path of movement of the arm 9*b* and thus the lever 9 will be prevented from returning to its position shown in FIG. 1 and its pertaining jack 7 will consequently be held in its inoperative position, that is where its butt 7*a* is out of contact with the raise cam 8. Hence the jack is not raised and the corresponding needle follows the lower needle path as illustrated in dotted lines in FIG. 6. If however the electromagnet 26 is energized then the selector 12 will be moved to the right as viewed in FIG. 1 in which as case its extremity 12*a* is removed from the path of movement of the lever arm 9*b*. Consequently when the lever 9 is subsequently released by the cam 8, the spring 11 will cause the lever 9 to return to its position shown in FIG. 1 and its pertaining jack 7 will be returned to its working position

in which its butt 7*a* engages cam 8 to raise the jack and the corresponding needle. The needle is thereby raised to a level at which the needle butt engages the needle raising cam 52 so to pass through a knitting nave as illustrated in dot-dash lines in FIG. 6.

The construction and operation of the selector station will be most readily apparent from FIGS. 3 and 4. FIG. 3 shows schematically several selectors 12 passing through the channel 19 of the selector station. The selectors arrive at the selector station in whatever position they have previously assumed. For example, some may be at one side of the channel and others at the other side as illustrated in FIG. 3. The entry end of the channel 19 narrows to a throat formed by the pole pieces 29, 30 and 29', 30' of the electromagnets 25, 26 respectively, one of which is shown in a perspective view in FIG. 8. The constricted throat approximately centers the selectors 12. The constricted throat portion is followed, in the direction of travel of the selectors 12, by a portion having diverging side walls 20 and 21 formed by pole pieces 36, 33 and 36', 33' respectively of a permanent magnet 23 (see FIG. 4).

The right hand half of FIG. 4 shows a cross-section taken at the location of the electromagnet 26, and it can be seen that the pole pieces 29', 30' of the electromagnet are separated by a strip 35 of hard metal sandwiched between said poles. The left hand half of FIG. 4 shows a section taken at the location of the permanent magnet 23, and it can be seen that at this location the base plate 41 supports a U-shaped member 22 of good magnetic permeability, for example soft iron, a permanent magnet 23 magnetized in the vertical direction, preferably of ferrite, and a plate 24 of the same material as the part 22. The pole pieces 36, 33 are preferably made of soft iron, and are of angular shape so that the pole piece 33 can be clamped to the plate 24 and the pole piece 36 can be clamped to the part 22 so that said pole pieces will be of opposite polarity. A strip 34 of hard metal is sandwiched between the pole pieces 36, 33. Also, as seen in FIG. 2, strips 42 and 44 of hard non-magnetic material are disposed on opposite sides of the pole pieces of each pair for engagement by the selectors to protect the pole pieces from wear. The arrangement of the pole pieces on the other sides of the channel 19 from those shown in FIG. 4 are of course identical. The purpose of the strips 34 and 35 is to prevent excessive frictional wear of the softer pole pieces.

The pole pieces 29, 30 and 29', 30' of the electromagnets are separated from the pole pieces 36, 33 and 36', 33' respectively of the permanent magnet by means of copper inserts 27 and 28 the thickness of which is less than the thickness of a selector 12.

The operation of the selector station is as follows:

As a selector 12 enters the restricted throat of the channel 19, one or other of the electromagnets 25, 26 is energized according to the desired program and will displace the selector 12 radially to one or other of its two positions. The movement of the selector 12 at the constricted throat is limited to a small distance, by virtue of the constriction of the throat, so as to make possible rapid selection. The minute radial displacement of the selectors 12 is increased by the subsequent movement of each selector 12 along the appropriate wall 20 or 21 of the diverging portion of the channel 19. Since the walls 20 and 21 are formed by the pole pieces of a permanent magnet the selectors 12 are maintained against the appropriate one of the walls 20 or 21 by magnetic adherence thus increasing the reliability of the selection by ensuring that the selectors do not lose contact with the wall 20 or 21 due to vibration of the running machine.

The shape of the channel 19 has been developed to ensure the greatest possible reliability of selection. Thus, in the constricted throat portion the pole pieces 29, 30 are arranged parallel to the pole pieces 29', 30' so as to ensure the greatest possible area of contact with the matching straight sides of the selectors 12. Furthermore, to minimize the radial acceleration of the selectors 12 due to the passage from the parallel throat to the diverging portion of the channel 19 and thus to assist in preventing loss of contact of the selectors 12 with the wall 20 or 21, the constricted throat portion is connected to the sides 20 and 21 by walls which are curved for example in an arc of a circle.

In the embodiment shown in FIG. 2 it has been sought to simplify and reduce the bulk of the selector device without decreasing substantially the operating speed of the knitting machine. The embodiment shown in FIG. 2 again comprises a cylinder 1 of a circular knitting machine the needle bed 2 of which is provided with tricks 3 in which are located needles 4 for displacement in conventional manner by cams 5 of a lock 6. The needles 4 are raised into working position by jacks 7 each of which is provided with a butt 7*a* engaging a raise cam 8. In the embodiment shown in FIG. 2 each jack 7 has at its lower extremity a circular head 7*b* which engages in a corresponding circular opening 12*b* of a selector 12. Each selector 12 is a vertical plate substantially rectangular in shape and of a thickness substantially equal to the thickness of the jack 7. Consequently the jack 7 can pivot about its head 7*b* in the manner of a rod attached to a piston. The middle part of each jack 7 forms a pivot 7*c* providing a neck which is supported by and pivots on a transverse axis 40 supported by a relief machined in the wall of the trick. The slight shoulder 7*d* of the jack 7 improves its lateral guidance. A sloping face 43 formed in the cylinder 1 limits the displacement of the jack 7 during its pivotal movement about the axis 40.

It should by pointed out that whereas FIG. 1 shows the selector 12 positioned in the funnel zone just in advance of the constricted throat of the channel 19 where it is in the zone of influence of the electromagnets 25, 26, FIG. 2 shows the selector 12 in the diverging portion of the channel 19 and thus within the zone of influence of the permanent magnet 23.

The operation of the device shown in FIG. 2 is as follows:

Depending on whether the selector 12 has been influenced by the electromagnet 25 or the electromagnet 26 it will be positioned either in the solid line position or in the broken line position shown in FIG. 2.

Assuming the selector 12 to be in the solid line position shown in FIG. 2 it will be seen that the circular head 7*b* of the jack 7 will be moved to the left as viewed in the figure and consequently the jack 7 will pivot about its axis 40 so that the butt 7*a* is moved into a position to be influenced by the raise cam 8 during lifting of the jack 7 by the cam 8 the selector 12 will follow the jack in its upward movement and also the neck formed by the spigot 7*c* of the jack will leave the axis 40 but will again return into engagement with said axis 40 on the subsequent return movement of the jack after the selection of the needle has been effected.

If the selector 12 is in its broken line position shown in FIG. 2, it will be seen that the circular head 7*b* of the jack 7 will be swung to the right as viewed in the figure and consequently the jack 7 will be pivoted counterclockwise about the axis 40 so as to bring the butt 7*a* of the jack out of the zone of influence of the raise cam 8. Consequently during subsequent lifting movement of the raise cam 8 the jack 7 will remain inoperative.

Since the selectors are preselected by the electromagnets, the selectors do not have to be displaced very rapidly and consequently electromagnets of medium power can be used adequately. It will be noted that the device presents a very small bulk, the number of parts being reduced to a minimum while the need for a spring is eliminated.

FIG. 5 shows a modification of the device shown in FIG. 1. In this modification each selector 12 is composed of two parts, namely its extremity 12'*a*, which as previously described either prevents or allows movement of the lever arm 9*b*, and a second part 12'*b* which constitutes the actual selector.

The parts 12'*a* and 12'*b* are connected together by means of an articulated joint formed by a circular extremity of part 12'*a* which engages in a corresponding circular opening in the part 12'*b*. The provision of the articulated joint enables the selector part 12'*b* to accommodate itself to any possible irregularities in the side walls of the channel 19 so that the maximum area of contact between the selector 12'*b* and the pole pieces forming the walls of the channel 19 can be maintained without placing undue strain and friction on the selector part 12'*a*. Also the provision of the articulated joint means that the guiding members 14 and 15 can be constructed with a lower degree of accuracy than the similar parts in the embodiment shown in FIG. 1.

Similarly to the embodiment shown in FIG. 2 the embodiment shown in FIG. 5 also comprises hard metal inserts 42 and 44 provided in the pole pieces of the magnet so as to prevent excessive frictional wear of the softer pole pieces.

Although the device has been described above by way of example in its application to a circular knitting machine, it can obviously also be applied to a flat bed machine in which the electromagnets could travel on a carriage.

It will of course be understood that since each of the walls 20, 21 of the diverging portion of the channel 19 is formed by both poles of the same permanent magnet, and since the number of selectors 12 in the diverging portion of the channel 19 is always constant at any instant, the selectors will provide a substantially constant flux path between said opposite pole pieces of the single permanent magnet irrespective of the number of selectors drawn to each wall.

What we claim and desire to secure by Letters Patent is:

1. Electromagnetic selection device for the needles of a knitting machine, comprising jacks for raising the needles, cam means for moving the jacks upward when in selected position, a selector for each said jack movable laterally of the direction of travel of the needles to position said jack in or out of selected position, channel means guiding said selectors and comprising successively in the direction of movement of said selectors a portion with converging side walls, a throat and a portion with diverging side walls, an electromagnetic selection system at said throat of said channel means, said electromagnetic selection system comprising opposite pairs of pole pieces disposed at the side walls of said channel means for drawing said selectors selectively to one or the other side of said channel means, and a permanent magnet system in the portion of said channel means with diverging side walls for maintaining said selectors at the side of said channel means to which they have been drawn by said electromagnetic selection system, said permanent magnet system comprising a single permanent magnet disposed transversely of and beneath said channel means portion with diverging side walls, said permanent magnet being vertically magnetized and having an upper face of one polarity and a lower face of the opposite polarity, a pair of spaced superposed pole pieces of opposite polarity at each of the diverging side walls of said diverging portion of said channel means, and two soft iron yoke systems, one of said yoke systems being connected to one pole piece of one polarity of each of said pair of pole pieces of said permanent magnet system and having a portion contiguous to the upper face of said permanent magnet, the other of said yoke systems being connected the other pole piece of opposite polarity of each of said pair of pole pieces of said permanent magnet system and having a portion contiguous to the lower face of said permanent magnet, whereby the total flux of said single permanent magnet is distributed between the pairs of pole pieces at opposite sides of said portion of said channel means with diverging side walls according to the distribution of said selectors at one or the other side wall.

2. Electromagnetic selection device according to claim 1, in which said pole pieces of said electromagnetic selection system are separated from said pole pieces of said permanent magnet system on each of said side walls by a spacer of non-magnetic material having a thickness less than that of said selectors.

3. Electromagnetic selection device according to claim 1, in which a strip of hard non-magnetic material is disposed between the pole pieces of each said pair of pole pieces of said permanent magnet system for engagement by said selectors to protect said pole pieces from wear.

4. Electromagnetic selection device according to claim 1, in which strips of hard non-magnetic material are disposed on opposite sides of each of said pole pieces of each said pair of pole pieces of said permanent magnet system for engagement by said selectors to protect said pole pieces from wear.

5. Electromagnetic selection device according to claim 1, in which each of said jacks is pivoted to rock in and out of selected position and in which each said selector is pivotally connected with the lower end of the respective jack to swing said jack between selected and non-selected position by said lateral movement of the selectors.

6. Electromagnetic selection device according to claim 5, in which each said selector has an upwardly opening socket and each said jack has a pivot end received in the socket of the respective selector.

7. Electromagnetic selection device according to claim 1, comprising a two armed lever interconnecting each said selector with a respective jack.

8. Electromagnetic selection device according to claim 7, in which said lever has one arm pivotally connected with the respective jack and a second arm engageable by the respective selector to determine the position of said lever and thereby determine the position of said jack.

9. Electromagnetic selection means according to claim 8, comprising spring means for biasing each said lever to a position in which the respective jack is in selected position.

* * * * *