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London W8 5BU(GB)(54) **Electromagnetic needle selection device for circular knitting machine.**

(57) Each yarn feeding and knitting station of the knitting machine is provided with an electromagnetic needle selection device so that the selection of knitting, tucking or welting of the needles is provided at each yarn feeding and knitting station thereby permitting the full range of pattern knitting at each yarn feeding and knitting station. A needle cylinder (1) is provided with grooves supporting knitting needles (2) and a rocking jack supporting cylinder (9) supporting first and second sets of rocking jacks (13, 14) is positioned beneath and in coaxial relationship with the needle cylinder (1). The rocking jack supporting cylinder (9) is of larger diameter than the needle cylinder and a right angle control lever (10) is positioned for rocking movement at the juncture of the smaller needle cylinder (1) and the larger rocking jack supporting cylinder (9). A spring jack (3) is retained below each needle (2) and includes a selecting butt for movement into and out of engagement with spring jack cams (6). First and second electromagnetic needle selection units (A and B) are positioned at each of the yarn feeding and knitting stations and adjacent the rocking jack supporting cylinder (9) and are operable for selectively imparting swinging movements to the rocking jacks (13, 14) so that the corresponding needles (2) may be selected for knitting, tucking or welting at each yarn

feeding and knitting station.

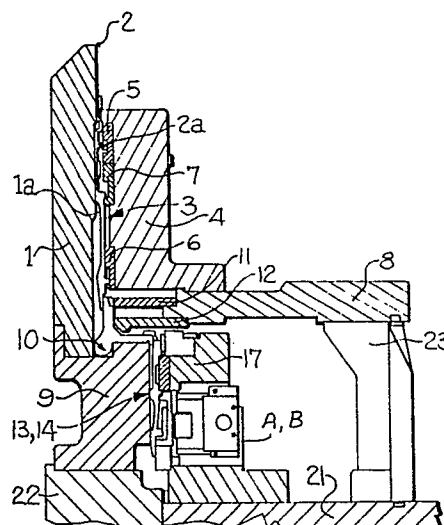


Fig. 1

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ELECTROMAGNETIC NEEDLE SELECTION DEVICE FOR CIRCULAR KNITTING MACHINE

This invention relates generally to an electromagnetic needle selection device for circular knitting machines of the type including closely spaced yarn feeding and knitting stations, and more particularly to an electromagnetic needle selection device which permits the selection of knitting, tucking or welting at each yarn feeding and knitting station.

Electromagnetic needle selection devices for circular knitting machines are generally well known and these known devices may be utilized in pattern knitting for permitting the needles to be selected to knit, tuck or welt. In these known needle selection devices, a rocking jack is positioned beneath each of the needles and permanent magnets are provided to act upon the upper and lower ends of the rocking jack for balancing the jack around the center by magnetic force while needle selection is performed by means of control electromagnets adapted to act on the rocking jack in response to signals provided by a pattern program so that the balanced condition of the rocking jack is overcome. According to these known devices, the upper permanent magnet attracts the upper part of the jack so that the jack engages a raising cam when the control electromagnet is not actuated. The lower permanent magnet attracts and draws out the lower end of the rocking jack which is further drawn out by the control electromagnet and kept in position until the jack is completely disengaged from the raising cam. The control electromagnets are disposed between the lower permanent magnet and the rocking fulcrum of the rocking jack and are aligned in a vertical direction. Rocking jacks are provided with armatures at two different vertical levels and these jacks are alternately positioned in the cylinder grooves. In this known selection device needles which are to perform knitting and welting operations are selected at the needle selection device of a first yarn feeding and knitting station while the needles to be selected for tucking and welting operations are selected at the needle selection device of a second yarn feeding and knitting station. In this type of selection device, it is necessary to have electromagnetic needle selection devices positioned at a pair of adjacent yarn feeding and knitting stations in order to provide the full needle selection of knitting, tucking and welting so that only half of the available yarn knitting and feeding stations are available to produce fabric when full pattern knitting takes place.

In order to overcome this problem, it would appear that the space required for the electromagnetic selection devices could be reduced so that each of the yarn feeding and knitting stations could

be utilized in pattern knitting. However, if the width of each electromagnetic selection device is reduced to this extent, the amount of electromagnetic force created may not be sufficient to carry out the required needle selection. Also, because of the direct actuation of the knitting needle by the rocking jack, a stroke of the cam for vertically moving the rocking jack must be at least 12 mm. This vertical stroke of the needle must be reduced by reducing the control range of the cam so that the distance between yarn feeding and knitting stations can be reduced. However, this reduction of the vertical stroke of the jack is difficult to attain with the known types of electromagnetic needle selection devices.

With the foregoing in mind, it is an object of the present invention to provide an electromagnetic needle selection device by which the control range or vertical stroke of the control cam is reduced and first and second needle selection units, each including sets of control electromagnets, are positioned at each yarn feeding and knitting station to provide for the selection of knitting, tucking or welting at each yarn feeding and knitting station, thereby permitting the full range of pattern knitting at each yarn feeding and knitting station.

The electromagnetic needle selection device of the present invention includes a needle cylinder with knitting needles slidably retained for vertical movement within grooves surrounding the needle cylinder, and a rocking jack supporting cylinder positioned below the needle cylinder and in coaxial relationship therewith, the rocking jack supporting cylinder being larger in diameter than the needle cylinder and rotating therewith. Control cams surround the needle cylinder and resilient spring jacks are disposed below each of the needles. Selection cams are also positioned around the needle cylinder to be selectively engaged by the spring jacks. Rocking jacks are retained in the grooves of the larger rocking jack supporting cylinder and have armatures extending outwardly at two different vertical levels. Two sets of electromagnetic control devices are positioned at each yarn feeding and knitting stations with the electromagnets in each set being vertically spaced along a vertical line. Upper permanent magnets are positioned adjacent the upper ends of the rocking jacks and lower permanent magnets are disposed adjacent the lower ends of the rocking jacks for balancing the magnetic force acting on the rocking jacks. A right angle lever having a vertical arm and a horizontal arm is disposed at the juncture of the needle cylinder and the larger rocking jack supporting cylinder. The vertical arm is disposed in the groove

of the needle cylinder to control the position of the spring jack. The horizontal arm extends outwardly above the groove in the larger rocking jack supporting cylinder and is provided with a depending lug. The depending lug of the horizontal arm of the right angle lever may move into the groove behind the upper end of the rocking jack or be positioned on top of the rocking jack to impart the desired movement to the lower end of the spring jack in the needle cylinder.

The first needle selection unit at each yarn feeding and knitting station is provided to select certain needles to carry out a welting operation by disengaging the lower part of the spring jack from the selection cam or for selecting other needles to carry out a knitting or tucking operation by engaging the lower part of the spring jack with the selection cam for raising the spring jack up to a position where the spring jack can be selected for knitting or tucking. The second needle selection unit at each yarn feeding and knitting station operates to move the lower part of the spring jack of certain of the selected other needles out of engagement with the selection cam to maintain the spring jack at the tucking level. The lower part of the spring jack of the remaining of the selected other needles is maintained in engagement with the selection cam so that the corresponding spring jack is raised to a knitting position. The lever ratio between the vertical arm and the horizontal arm of the right angle lever is within the range of from 1:1 to 1:2, and preferably the lever ratio is 1:1. The combination of the small needle cylinder and the large rocking jack supporting cylinder enables the electromagnetic needle selecting device to operate preferably in the range of a 32 gauge or greater gauge knitting machine.

When the electromagnets of the first and second needle selection units are not actuated, the upper ends of the rocking jacks are held outwardly by the upper permanent magnet, while the depending lug of the horizontal arm of the right angle control lever is moved downwardly and is positioned behind the rocking jack so that the lower part of the spring jack is engaged with the selection cam and causes the needle to be raised so that it can be selected for knitting or tucking. When the electromagnets of both the first and second needle selection units are actuated, selecting of the needles for welting is performed by the first electromagnetic needle selection device while the upper end of the vertical arm of the right angle control lever is pushed inwardly by the cancelling cam. The armature of the rocking jack corresponding to the horizontal arm is attracted, with the upset of balance of magnetic force of the upper and lower permanent magnets, so that the horizontal arm of the right angle control lever abuts on the top

of the rocking jack after the depending lug is withdrawn from the back of the rocking jack by resilience of the spring jack. This causes the lower part of the spring jack to be disengaged from the selection cam and selection of needles to tuck is carried out by the second needle selection unit.

As pointed out above, the conventional type of electromagnetic needle selection device selects the needles for knitting, tucking or welting at two adjacent yarn feeding and knitting stations while the device of the present invention enables selection of these three positions of the needles for knitting, tucking or welting at one yarn feeding and knitting station. The provision of the right angle control lever between the rocking jacks and the spring jacks permits this selection of the needles for knitting, tucking or welting at one yarn feeding and knitting station.

In order that the present invention may be more readily understood, reference will now be made to the accompanying drawings, in which:-

Figure 1 is a fragmentary vertical sectional view through the knitting machine and illustrating the coaxial alignment of the smaller needle cylinder and the larger rocking jack supporting cylinder positioned therebeneath;

Figure 2A is an enlarged vertical sectional view showing the positional relationship of the knitting needle, the spring jack, the right angle control lever, and the rocking jack;

Figure 2B is a developed elevational view of the control cams and the first and second needle selection units at each of the yarn feeding and knitting stations;

Figure 3 is a sectional plan view illustrating the profile of the cancelling cams;

Figure 4 is a fragmentary sectional plan view showing the manner in which the lower permanent magnet operates on the lower end portions of the rocking jacks;

Figure 5 is an enlarged vertical sectional view illustrating the manner in which the electromagnetic selection devices cooperate with the armatures on the rocking jacks; and

Figures 6-10 are vertical sectional views through the knitting machine and illustrating the manner in which the needles are selected for knitting, tucking or welting operations.

As illustrated in Figure 1, the knitting machine includes a rotatable needle cylinder 1 having vertically extending grooves 1a in which vertically slidable knitting needles 2 are mounted and each needle is provided with at least one operating butt 2a. A spring jack, broadly indicated at 3, is supported for vertical movement in the grooves 1a and beneath each of the needles 2.

As illustrated in Figure 2A, each spring jack 3 is provided with a shoulder 3a, a vertically extend-

ing outer edge portion 3b, a stem 3c, a selecting butt 3d on the lower end portion thereof, a lowering butt 3e on the medial portion, and a vertically extending lower extension 3f. The shoulder 3a of the spring jack 3 engages the bottom of the needle 2 to push the needle 2 upwardly when the spring jack 3 is raised, in a manner to be presently described. The vertical outer edge 3b pushes the back or inner edge of the needle 2 outwardly while the lower end portion with the butt 3d is normally urged outwardly because of the resilient nature of the spring jack 3. The stem 3c is comparatively thin and provides the resilience to the spring jack 3 to normally return the butt 3d to the outermost position, unless pushed inwardly, by means to be presently described.

A cam holder bracket 4 surrounds the needle cylinder 1 and is provided with needle control cams 5 for controlling the vertical movement of the knitting needles 2. Spring jack selection cams 6 are also supported by the cam holder bracket 4 to be selectively engaged with the selection butt 3d of the spring jack 3. A spring jack lowering cam 7 is also supported by the cam holder bracket 4 for engagement with the butt 3e and the shoulder 3a for lowering the spring jack 3. The lower end portion of the cam holder bracket 4 is suitably mounted on the upper surface of an upper cam ring 8 surrounding the lower portion of the needle cylinder 1.

A right angle control lever, broadly indicated at 10, is supported for rocking movement (Figure 2A) beneath each of the spring jacks 3. The right angle control lever 10 includes a vertical arm 10a and a horizontal arm 10b extending outwardly therefrom and having a downwardly depending projection or lug 10c at the outer end thereof. A circular fulcrum 10d is provided at the inner juncture of the vertical arm 10a and the horizontal arm 10b. The lever ratio of the vertical arm 10a to the horizontal arm 10b is preferably from 1:1 to 1:2, and preferably 1:1. The vertical arm 10a, when pushed inwardly by a cancelling cam 11, is adapted to push the lower end portion 3f of the spring jack 3 inwardly, as illustrated in Figures 9 and 10. The horizontal arm 10b may be moved downwardly, as illustrated in Figures 6-8, so that the depending lug 10c is inserted into a space behind the upper inner portions of rocking jacks 13, 14, to be presently described in detail.

When the right angle lever 10 is moved in a counterclockwise direction, against the resilience of the lower portion of the spring jack 3, the depending lug 10c is raised to a position above the tops of the rocking jacks 13, 14, as shown in Figures 9 and 10. The juncture of the vertical leg 10a and the horizontal leg 10b of the right angle lever 10 includes an arcuate portion 10e (Figure 2A) which is

constantly in contact with a cam ring 12 to maintain the circular fulcrum 10d in a pivoting or rocking position adjacent the lower end of the needle cylinder 1 so that rocking movement may be imparted to the right angle control lever 10.

As best illustrated in Figure 3, the cancelling cam 11 includes an inwardly projecting cam portion, broadly indicated at 11a, and a relatively long arcuate portion 11b which is illustrated as being straight in the drawings but which actually curves. The projecting cam part 11a includes a short straight part 11c and an inclining cam surface 11d. The cancelling cam 11 and the cam ring 12 are each fixed at their outer portions to the upper cam ring 8, as illustrated in Figure 1.

A rocking jack supporting cylinder 9 is fixed at its upper end to the lower end of the needle cylinder 1 and in coaxial relationship therewith for rotation and the rocking jack supporting cylinder 9 is larger in diameter than the needle cylinder 1. The grooves in the rocking jack supporting cylinder 9 are aligned with the grooves 1a in the needle cylinder 1 and alternately contain two kinds of rocking jacks 13, 14 alternately positioned therein. The difference between the rocking jacks 13 and 14 is that the rocking jacks are provided with respective armatures or butts 13a, 14a which are positioned at different levels on the lower portions of the rocking jacks, as illustrated in Figure 2A. The rocking jacks 13, 14 do not move vertically but are freely rockable around the approximate centers thereof, as indicated by the fulcrums 13b, 14b so that the upper and lower ends thereof are swingable in the radial direction of the rocking jack supporting cylinder 9.

The relative diameters of the rocking jack supporting cylinder 9 and the needle cylinder 1 can vary. It has been found that satisfactory results can be obtained when the larger rocking jack supporting cylinder 9 corresponds to a 28 gauge knitting machine while the smaller needle cylinder 1 corresponds to a 32 gauge knitting machine. Therefore, the combination of a large rocking jack supporting cylinder 9 with a smaller diameter needle cylinder 1 enables the manufacture of an electronic pattern knitting machine of 32 gauge or more, which has been impossible in the known types of electronic needle selection devices.

First and second needle selection units A, B are supported in spaced relationship around the rocking jack supporting cylinder 9 and at each yarn feeding and knitting station in a cam holder bracket 17 (Figure 1). Each of the first and second needle selection units A, B includes upper control electromagnets 15 and lower control electromagnets 16 (Figure 5) which are structurally identical and are actuated from signals from a conventional type of pattern device, not shown. The cam holder bracket

17 is supported on the upper surface of a lower cam ring 21 (Figure 1). A driving gear 22 is fixed to the lower end of the rocking jack supporting cylinder 9. The driving gear 22 is driven by a driving mechanism of the knitting machine, not shown, so that both the needle cylinder 1 and the rocking jack supporting cylinder 9 are rotated thereby.

Spaced-apart support brackets 23 are fixed at their lower ends on the upper surface of the lower cam ring 21 and their upper ends are fixed to and support the upper ring 8. In addition to the armatures 13a, 14a, the rocking jacks 13, 14 are provided with lower extensions 13c, 14c (Figures 2A and 5) which may be pushed into the rocking jack supporting cylinder 9 by means of a setting cam 18. The inner central portions of the rocking jacks 13, 14 are provided with pivoting fulcrums 13a, 13b for permitting the inward and outward rocking movements of the upper and lower ends of the rocking jacks 13, 14. Upper outer edges 13f, 14f are provided on the outer surface of the upper ends of the rocking jacks 13, 14 to be magnetically attracted to upper permanent magnets 19, in a manner to be presently described. The setting cam 18 includes an outwardly inclining cam surface 18a, an inwardly inclining cam surface 18b, and a relatively straight part 18c, as illustrated in Figure 4.

The upper and lower control electromagnets 15, 16 are respectively provided with pole faces 15a, 16a arranged in vertical alignment, as shown in Figure 2B and Figure 5. The armatures 13a, 14a are horizontally aligned with the pole faces 15a, 16a so that they may be drawn outwardly into surface contact therewith, when the corresponding electromagnets 15, 16 are actuated. Coils of the electromagnets 15, 16 are connected to a suitable power source generating electrical pulse currents in accordance with a prerecorded program device, not shown. As illustrated in Figure 5, the upper permanent magnet 19 and a lower permanent magnet 20 are positioned adjacent the respective upper and lower ends of the rocking jacks 13, 14 and above and below the control electromagnets 15, 16. The upper edges 13f, 14f of the rocking jacks 13, 14 are magnetically attracted by the upper permanent magnet 19 while the lower extensions 13c, 14c are magnetically attracted by the lower permanent magnet 20.

The upper permanent magnet 19 is provided with magnetic pole plates 19a, 19b and a central cutout 19c (Figure 2B) for reducing the magnetic force at the center of the pole faces thereof. The lower permanent magnet 20 is provided with permanent magnets 20a, 20b (Figure 4) each having an acting surface in generally the same shape as that of the setting cam 18 and a central cutout 20c for reducing the magnetic force thereof. The cutout

20c is on the same vertical line passing through the cutout 19c of the upper permanent magnet 19.

When the control electromagnets 15, 16 are not actuated at the first needle selection unit A, the rocking jacks 13, 14 move from left to right, as indicated by the arrow in Figure 2B, and the control butts 13e, 14e move along a guide passageway 21 (Figure 2B). The spring jacks 3 also move from left to right in Figure 2B and in their lowermost position, as shown in Figure 2A, with the operating butt 3d moving along the spring jack selection cam 6. The lower end extensions 13c, 14c of the rocking jacks 13, 14 engage the inwardly inclining surface 18a of the setting cam 18, as shown in Figure 4, so that the upper outer edges 13f, 14f swing outwardly of the rocking jack supporting cylinder 9 and the lower end extensions 13c, 14c are gradually pushed into the grooves of the rocking jack supporting cylinder 9. As the rocking jacks 13, 14 reach the innermost portion of the cam surface 18a, the lower ends 13c, 14c are pushed into the deepest part of the rocking jack supporting cylinder grooves, while the rocking jacks 13, 14 are passing the vertical line A of the first needle selection unit and while the jacks 13, 14 are passing the cutouts 19c, 20c, whereby the magnetic force of the permanent magnets 19, 20 is temporarily reduced by the cutouts. At this time, the upper and lower armatures 13a, 14a are directly opposite the upper and lower control electromagnets 15, 16 but are not moved thereby since these electromagnets 15, 16 are not electrified.

After the rocking jacks 13, 14 pass the cutout grooves 19c, 20c at the first needle selection unit A, the vertical arm 10a of the right angle control lever 10 is pushed inwardly by the cam surface 11d of the cancelling cam 11 so that the outer end of the horizontal arm 10b is raised upwardly, as illustrated in Figures 9 and 10. At this time, the depending lug 10c on the outer end of the horizontal arm 10b is raised upwardly above the level of the upper ends of the rocking racks 13, 14 so that the lower end of the spring jack 3 is pushed inwardly of the needle cylinder 1 and the butt 3d is temporarily disengaged from the selection cam 6. Immediately after the rocking jacks 13, 14 pass the straight part 11c of the cancelling cam 11, the depending lug 10c of the right angle control lever 10 is moved downwardly behind the top portions of the rocking jacks 13, 14 as the horizontal arm 10b moves downwardly because of resilience of the spring jack 3. The movement of the right angle control lever 10 in the clockwise direction permits the selection butt 3d to move outwardly into engagement with the selection cam 6 and the spring jack 3 and the corresponding needle 3 is raised from the lower welting position shown in Figure 6 to the intermediate tucking position shown in Fig-

ure 7.

As the rocking jacks 13, 14 reach the second needle selection unit B, the upper and lower armatures 13a, 14a are not influenced by the upper control electromagnet 15 or the lower control electromagnet 16, unless these two electromagnets are electrified, so that the knitting needle 2 is further raised by the selection cam 6 to the latch clearing or knitting position, as shown in Figure 8.

When the rocking jacks 13, 14 reach the second needle selection unit B and pass the cutouts 19c, 20c and one of the upper and lower control magnets 15, 16 is electrified, a pole face 15a or 16a overcomes the attractive force of the pole face of the permanent magnet 19 and magnetically attracts the corresponding armature 13a, 14a of the rocking jacks 13, 14, respectively. Thus, the lower extensions 13c, 14c of the rocking jacks 13, 14 are drawn outwardly and the upper ends of the jacks are pushed into the grooves of the rocking jack supporting cylinder 9. While the rocking jacks 13, 14 are passing the second needle selection unit B, the lower end portion 3f of the spring jack 3 is pushed inwardly by inward movement of the vertical arm 10a of the right angle control lever 10 as it is pushed into the cylinder. Thus, the selection butt 3d of the spring jack 3 is disengaged from the selection cam 6 and passes in front of the higher portion of the cam 6 so that the spring jack is maintained at the tucking level, as shown in Figure 9, and is not raised to the knitting level. The spring jack 3 is then lowered by a downwardly inclining part 7a of the lowering cam 7 (Figure 2B) after the selection butt 3d is again engaged with the selection cam 7 by resilience of the spring jack 3. At the same time, the knitting needle 2 is lowered back to the lowest or welting position, shown in Figure 10, by the stitch cam 5a.

In accordance with the present invention, it is not necessary to incorporate a control cam for raising and lowering rocking jacks because the rocking jacks 13, 14 of the present invention do not move vertically in the larger diameter rocking jack supporting cylinder 9. The elimination of the need for raising and lowering the rocking jacks 13, 14 is provided by the right angle control lever 10 positioned between the spring jacks 3 and the rocking jacks 13, 14 so that the only function of the rocking jacks 13, 14 is to swing in the radial direction of the cylinder 9. With this arrangement the distance between needle selection points can be made much shorter than that in the conventional selection device in which three positions for knitting, tucking or welting are selected at two yarn feeding and knitting stations. Thus, the selection of three positions for knitting, tucking or welting at each yarn feeding and knitting station is possible and the number of yarn feeding and knitting stations surrounding the

needle cylinder of a circular knitting machine can be increased. Also, since the rocking jacks 13, 14 perform only a radial swinging motion and are not required to be raised and lowered, the supporting cylinder has a longer life and increased durability.

In the drawings and specification there has been set forth the best mode presently contemplated for the practice of the present invention, and although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being defined in the claims.

Claims

1. An electromagnetic needle selection device for a circular knitting machine including closely spaced yarn feeding and knitting stations providing for the selection of knitting, tucking or welting at each yarn feeding and knitting station, and a needle cylinder (1) having a plurality of grooves (1a) on the outer periphery thereof and knitting needles (2) slidably retained within said grooves, said electromagnetic needle selection device being characterized by a rocking jack supporting cylinder (9) having a plurality of grooves on the outer periphery thereof, said rocking jack supporting cylinder (9) being larger than said needle cylinder (1) and positioned below said smaller needle cylinder (1) in coaxial relationship therewith, needle control cam means (5) engageable with said needles (2) for guiding and controlling the raising and lowering of said needles, a spring jack (3) retained below each needle (2) and having an upper end portion engageable with a corresponding needle (2) and a pivotally movable lower end portion, each of said spring jacks (3) including a selecting butt (3d), spring jack cam means (6) positioned to be engageable by said selecting butt (3d) on the lower end portion of said spring jack (3) for selectively raising and lowering said spring jacks, first and second sets of rocking jacks (13, 14) retained in the grooves of said rocking jack supporting cylinder (9), each rocking jack (13, 14) in each set including a pivotally movable lower extension (13c, 14c) and an upper end (13f, 14f), said first set of rocking jacks (13) having an armature (13a) positioned at a first predetermined vertical location along the length of said rocking jack (13), said second set of rocking jacks (14) having an armature (14a) positioned at a second predetermined vertical location along the length of said rocking jack (14) different from said first vertical location, a right angle control lever (10) positioned for rocking movement at the juncture of said smaller needle cylinder (1) and said larger rocking jack supporting cylinder (9), each control lever (10) having a verti-

cal arm (10a) engageable with said spring jack (3) and a horizontal arm (10b) engageable with said rocking jacks (13, 14), spring jack cancelling cam means (11) engageable with said vertical arm (10a) of said control lever (10) and adapted to push the same inwardly to cause said butt (3d) of said spring jack (3) to move out of engagement with said spring jack cam means (6), and first and second electromagnetic needle selection units (A and B) positioned at each of said yarn feeding and knitting stations and adjacent said rocking jack supporting cylinder (9), said first and second electromagnetic needle selection units being operable for selectively imparting outward swinging movements to certain of said rocking jacks (13, 14) so that the corresponding needles (2) may be selected for knitting, tucking or welting at each yarn feeding and knitting station.

2. An electromagnetic needle selection device according to Claim 1 and being further characterized in that said horizontal arm (10b) of said right angle control lever (10) includes an outer free end portion with a depending lug (10c) extending downwardly therefrom and adapted to move into and out of the grooves of said rocking jack supporting cylinder (9).

3. An electromagnetic needle selection device according to Claim 1 and being further characterized in that the lever ratio between said vertical arm (10a) and said horizontal arm (10b) of said right angle control lever (10) is within the range of from 1:1 to 1:2.

4. An electromagnetic needle selection device according to Claim 1, and being further characterized in that said first and second electromagnetic needle selection units (A and B) each includes upper permanent magnets (19) and lower permanent magnets (20).

5. An electromagnetic needle selection device according to Claim 1, and being further characterized in that each of said first and second electromagnetic needle selection units (A and B) includes two sets of electromagnets (15, 16) disposed in vertical alignment with each other.

6. An electromagnetic needle selection device according to Claim 1 and being further characterized in that said right angle control lever (10) includes a circular fulcrum (10d) positioned at the inner junction of said vertical arm (10a) and said horizontal arm (10b), and wherein said circular fulcrum (10d) is supported in a rocking position adjacent the lower end of said needle cylinder (1) and at the upper end of said rocking jack supporting cylinder (9) so that rocking movement may be imparted to said right angle control lever (10).

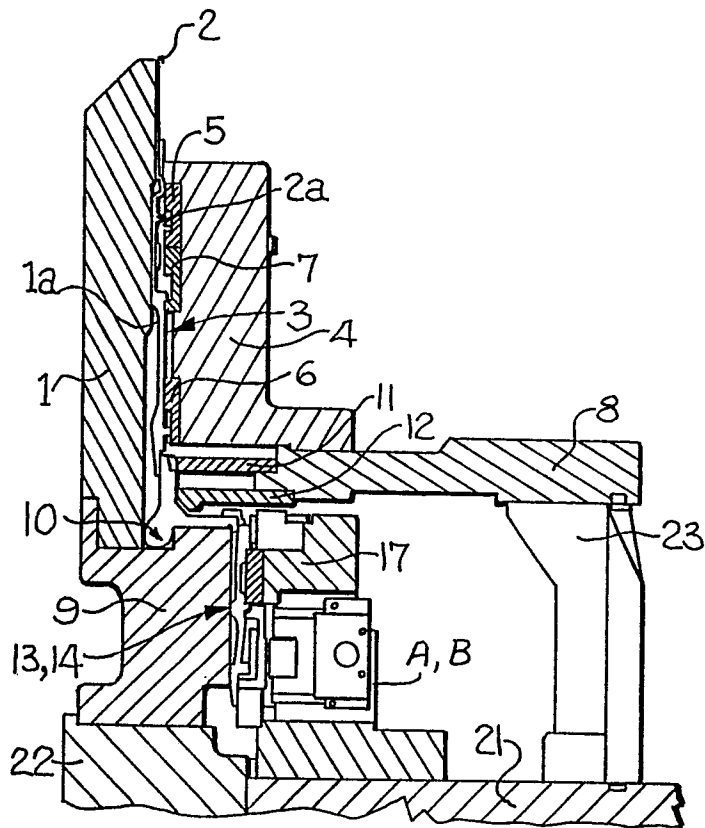


Fig- 1



Fig- 3

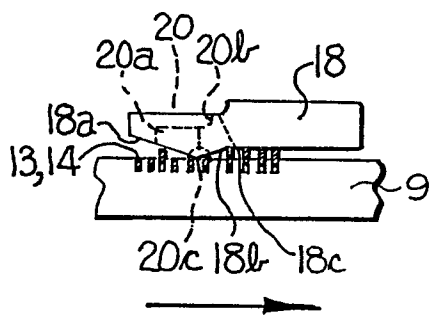


Fig- 4

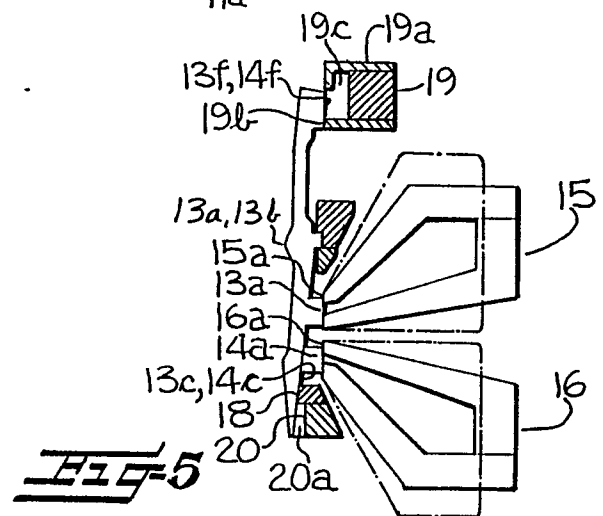


Fig- 5

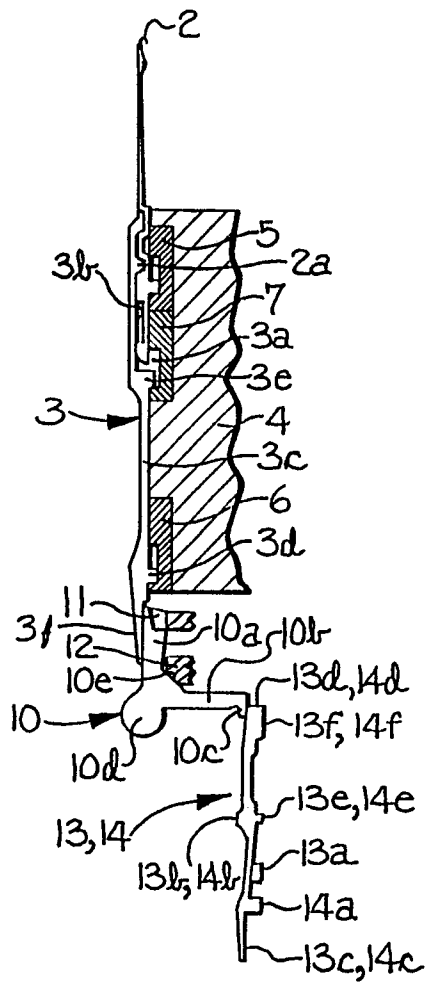


Fig-2A

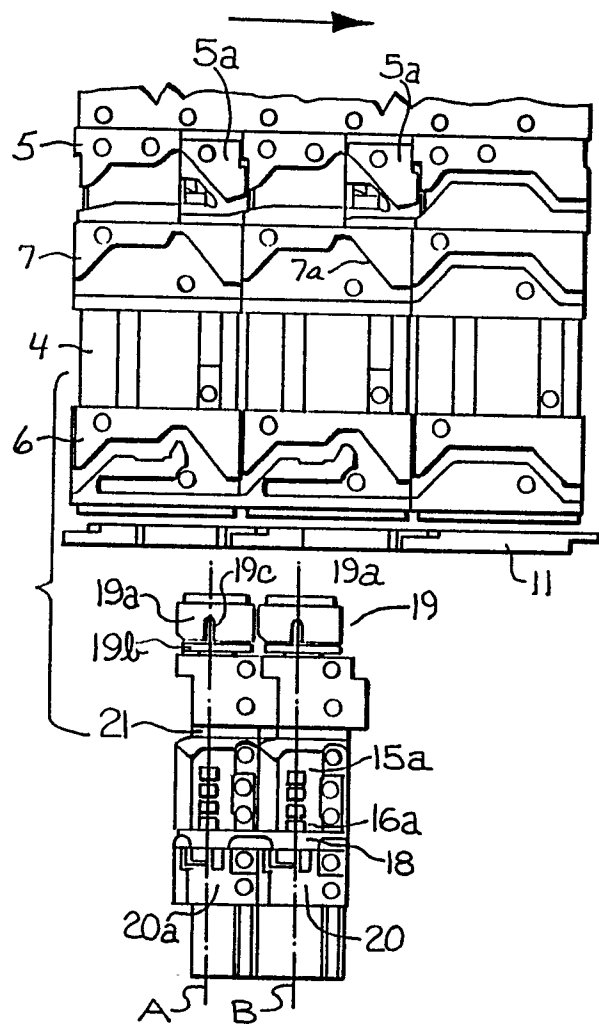


Fig-2B

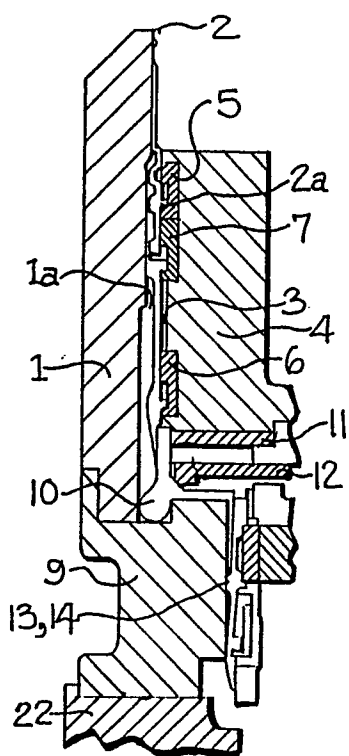


Fig-6

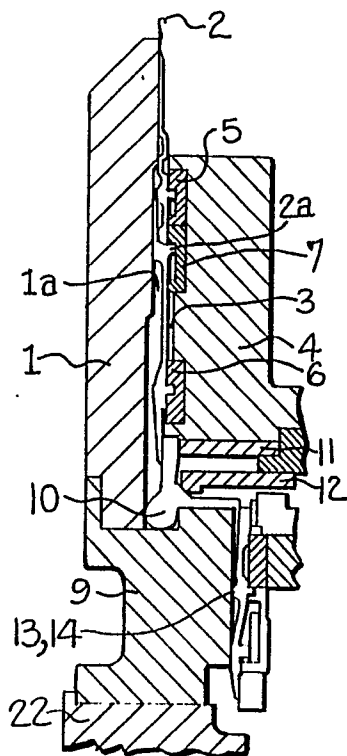


Fig-7

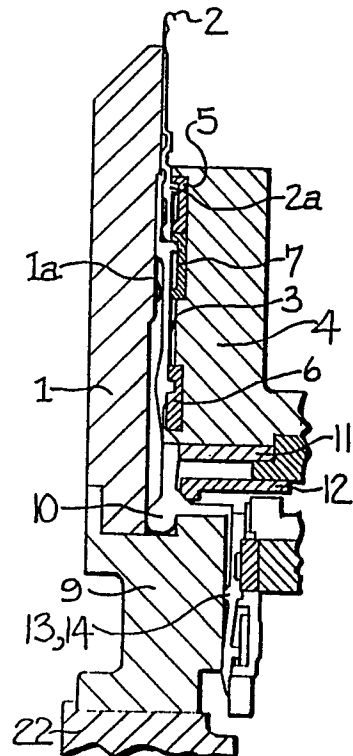


Fig-8

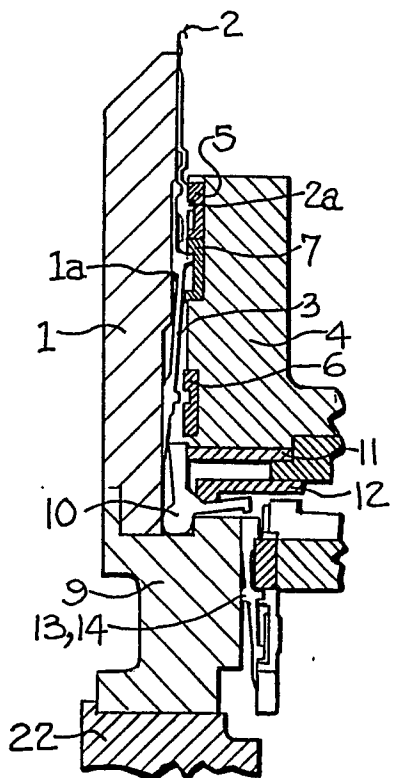


Fig-9

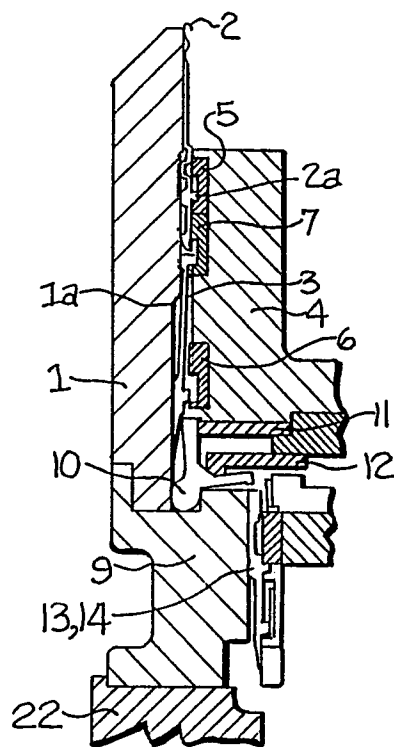


Fig-10