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(11)

EP 1 433 884 A1

(12)

EUROPEAN PATENT APPLICATION
published in accordance with Art. 158(3) EPC

(43) Date of publication:

30.06.2004 Bulletin 2004/27

(51) Int Cl.7: **D04B 15/78**

(21) Application number: **02772412.9**

(86) International application number:
PCT/ES2002/000418

(22) Date of filing: **05.09.2002**

(87) International publication number:
WO 2003/021022 (13.03.2003 Gazette 2003/11)

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
IE IT LI LU MC NL PT SE SK TR**
Designated Extension States:
AL LT LV MK RO SI

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(30) Priority: **05.09.2001 ES 200102008**

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(54) **DEVICE FOR SELECTING NEEDLES IN CIRCULAR KNITTING MACHINES**

(57) The invention relates to a device that is used for selecting needles in circular knitting machines. The inventive device makes use of three basic polar systems, namely: a preparative magnetic retention system, an electromagnetic system which makes the selection

and a retention system for the mechanical selection. Said selection is based on the opposing forces produced between the magnetic attraction forces of the three polar systems on one face of the jack and a spring associated with said jack.

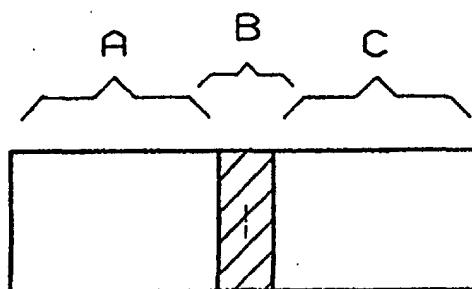


FIG.1

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Description

[0001] The present invention relates to a device for selecting needles in circular knitting machines, by means of which characteristics that are novel and advantageous in comparison with the prior art are obtained.

[0002] As is known, there are basically two types of selection system: multi-level systems and single-level systems. In multilevel systems, the actuator has a plurality of selection systems which act on the elements to be selected in a stepped manner so that, for a given actuation time for each of the systems, the speed of the machine is thus increased by increasing the number of levels. In single-level systems the elements to be selected are actuated directly. Naturally, single-level systems have the advantage of being inexpensive in comparison with multi-level systems. They also have advantages in application since they take up much less space. The main disadvantage of single-level systems lies in the greater general precision of the system upon the actuation of each of the elements. It is particularly difficult to synchronize the actuation signal with the position of the actuator relative to the element to be selected.

[0003] The present invention is intended to disclose a selecting device which has operating advantages due to optimization of the magnetic forces in the selection discrimination region by means of a multi-pole arrangement and by automatic control of the position of synchronism of the electromagnet relative to the element to be selected.

[0004] The present invention therefore relates to a device for transmitting data relating to the pattern to be knitted to the needles of a circular knitting machine by the actuation of so-called jacks which drive the needles.

[0005] The device comprises three basic pole systems, that is, a preparatory magnetic retaining system, an electromagnetic system for performing the selection, and a retaining system for the mechanical selection.

[0006] The selection capability of the device is based on the opposition of forces which is brought about between the magnetic attraction force which the three pole systems exert on a face of the jack, and a spring associated with the jack.

[0007] For a better understanding, some drawings relating to the device of the present invention are appended by way of non-limiting example.

Figure 1 shows schematically the arrangement of the pole systems with the electromagnetic system intercalated.

Figure 2 shows schematically the pole systems with the electromagnetic system intercalated but out of alignment with the retaining systems.

Figure 3 shows schematically the position of an end of a jack relative to the pole systems.

Figures 4 and 5 show schematically the path described by a selected jack, with different starting points of the movement of the jack.

Figures 6 and 7 show schematically the construction of the pole masses with different magnet arrangements.

Figure 8 shows schematically characteristic curves of a two-pole embodiment and two multi-pole embodiments.

Figure 9 shows an arrangement applicable to a straight knitting machine.

Figure 10 is a view, perpendicular to the pole faces, showing the electromagnetic system,

Figure 11 is a side view of the separated electromagnetic system.

Figure 12 shows a jack at the moment at which it enters the electromagnetic system.

[0008] Figures 1 and 2 show schematically the three pole systems A, B and C with two different configurations: in Figure 1 the electromagnetic system is intercalated and aligned with the retaining systems; in Figure 2 the electromagnetic system is intercalated but out of alignment with the retaining systems.

[0009] Figure 3 shows an end of the jack 1 circulating above the system in the direction indicated by the arrow at a speed v (the speed of the machine). There are two opposed forces acting on the jack: F_a is the magnetic force of the pole A; F_m is the force of the spring. The same drawing shows the two curves of forces which are exerted on the jack as functions of its position. The straight line 2 is the value of the force of the spring. The curve 3 is U-shaped since, in the central region 4, there are no pole faces and, as a result, there is a reduction in magnetic field.

[0010] The lower portion of Figure 3 shows the curve 5 of forces which the electromagnetic system B exerts on the jack. The sum of the forces of the curves 3 and 5 is greater than the force of the spring across the whole system so that, in one of the states of the electromagnetic system, the jack remains adhering thereto.

[0011] The operating sequence is as follows:

[0012] The jack is placed near the pole system A by mechanical means and adheres thereto since $F_a > F_m$. When the jack reaches the region B, the electromagnetic system keeps it adhering since $F_s > F_m$. The jack follows and remains adhering to the system C. If the electromagnetic system B has cancelled out the value F_s to a sufficient extent, F_m separates the jack from the assembly and it moves away from the system C. The system B transmits the pattern data to each of the jacks in a manner such that, above the system C, there may be

jacks that are adhering and jacks that are separated. From these two mechanical positions, a system of levers can transport the needles along two distinct paths.

[0013] The basic operating parameters are as follows:

[0014] Figure 4 shows the path described by a jack if it has been selected (system Fs cancelled). The point 6 at which the straight line 2 and the curve 3 cross is where the spring starts to be effective in order to accelerate the jack and where the path 7 starts. On the ordinate 8, where the retaining system C starts, there are magnetic forces which brake the movement of the jack in the direction perpendicular to the pole. Figure 4 shows another curve 9 which the jack will describe, if the jack is circulating at a greater speed v. The separation H reached on the ordinate 8 is less at greater speed. The curve 10 represents the path of a jack which has not reached the sufficient distance H and has been attracted again by the pole. The relationship between the force of attraction of the pole on a jack and the distance of the jack from the pole face will be referred to as the range of the pole. The efficiency of the system and the speed which can be reached by the machine depend to a large extent on this parameter.

[0015] Figure 5 shows a similar sequence but with the difference that the starting point of the movement of the jack is delayed relative to the coordinate 6 of the upper figure. This delay will exist if the electrical signal for cancelling the force Fs arrives with a delay. The effect which is produced on the path is equivalent to reducing the level H for a given speed of the system. The precision with which the electrical signal is transmitted to the system C, establishing the relationship between the physical position of the jack and the system C, is therefore another important parameter of the system.

[0016] The pole systems and the electromagnetic system will be described in greater detail below.

Pole systems:

[0017] The retaining system is formed by an even number of adjacent permanent magnets 11 each having one of its pole faces facing the jack 1 and the other facing a common ferromagnetic base 12. Figure 7 shows the arrangement of poles of an embodiment with four magnets in which it can be seen that each magnet is inverted with respect to its neighbours. Figure 6 shows the two retaining systems A and C with the resulting pole arrangements. In the gap 4 which exists between pole systems, the considerable reduction in retaining force is due to the preferential directionality of the magnetic fields of the magnets since, for each magnet, the nearest opposite-pole face in the lower and upper magnet of its own system is facing the face of the adjacent magnet of the other system that has the same polarity.

[0018] Figure 8 shows the characteristic curves of the "range" parameter of a two-pole embodiment 13 and two multi-pole embodiments 14 and 15. For a particular height w, the force of attraction on the jack when it is

adhering to the pole system is practically the same in all of the embodiments since the magnetic area is the same. However, as the separation between the jack and the magnets increases, the force of attraction decreases more rapidly in the arrangement 15 than in the arrangement 13, as shown in the curves F-x which, with an embodiment of this type, enables higher selection speeds to be reached in the arrangement 15 than in the arrangement 13. For a separation H of the jack reached along the path shown in Figure 3, the multi-pole system exerts a considerably lower force on the jack than the two-pole system.

[0019] Additional advantages which result from the symmetry of the system are the facility to select jacks in both directions of movement and the facility to instal several consecutive systems. Figure 9 shows a typical arrangement applicable to a straight knitting machine in which there are three pole systems A', A'' and A''' and two electromagnetic systems C' and C''. The selection of the jack 1' can be performed in two distinct places from which the levers can transport the needle to two different working positions.

Electromagnetic system:

[0020] The electromagnetic system is shown in Figures 10, 11 and 12.

[0021] Figure 10 is a view perpendicular to the pole faces in which, by way of orientation, the electromagnetic system appears between the retaining systems A and C.

[0022] Figure 11 is a side view of the separated electromagnetic system in which the pole pieces 16 and 17 of ferromagnetic material are shown separated by a permanent magnet 18. The two pole faces which define the elements 16, 17 at their ends 19 and 20 face the attraction surface of the jack.

[0023] Two windings or coils are wrapped around each of the pole pieces. The two coils 21 closest to the magnet 18 form part of an electrical supply circuit which can bring about the circulation of the electrical current that is necessary to counteract the magnetic flux which circulates through the pole pieces. The two coils 22 form part of an electronic circuit which can detect the electrical currents induced by the changes in magnetic flux which are produced in the pole pieces.

[0024] In the absence of a jack in front of the pole faces, the magnetic circuit is closed by the various regions of the air surrounding the system. When the jack is present, there is a considerable change in the reluctance of the circuit in the pole faces because of the ferromagnetic material of which the jack is made, and an increase in the flux which circulates inside the coils 21 and 22. A suitable electronic circuit can detect the electrical currents induced in the coils 22 and can correlate the value of these currents with the position of the jack relative to the electromagnetic system. Figure 12 shows a jack at the moment at which it "enters" the electromag-

netic system, in which position it can be detected by the circuit of the coils 22. Starting from this signal, the circuit of the coils 21 can be acted on in order to select or not to select the jack, according to the pattern. The electromagnetic system itself thus determines the optimal actuation position in order to achieve the greatest possible speed by the kinematic effects illustrated in Figure 5.

Claims

1. A device for selecting needles in circular knitting machines in order to transmit data relating to the pattern to be knitted to the needles of a knitting machine by the actuation of intermediate jacks which drive the needles, **characterized in that** it has three basic pole systems, that is, a preparatory magnetic retaining system, an electromagnetic system for performing the selection, and a retaining system for the mechanical selection, the selection being based on the opposition of forces which is brought about between the magnetic attraction force of the three pole systems on a face of the jack, and a spring associated with the jack.
2. A device for selecting needles in circular knitting machines according to Claim 1, **characterized in that** the jack is placed near the first pole system by mechanical means, adhering to the pole system if the force of attraction is greater than the force of an opposing spring, and remaining adhering thereto in the region of the electromagnetic selection system or being separated therefrom according to the progressively variable force of attraction of the electromagnetic system, permitting possible separation of the jack and movement away from the retaining pole system in order to despatch the needles, by means of a system of levers, along two distinct paths.
3. A device for selecting needles in circular knitting machines according to Claim 2, **characterized in that** the preparatory electromagnetic system transmits the data relating to the pattern to be knitted to each of the jacks, so that, above the retaining pole system, there may be jacks that are adhering and jacks that are separated.
4. A device for selecting needles in circular knitting machines according to Claim 1, **characterized in that** the arrangement of the pole systems is symmetrical with respect to the electromagnetic selection system.
5. A device for selecting needles in circular knitting machines according to Claim 1, **characterized in that** the retaining pole system is formed by an even number of permanent magnets each of which has

one of its faces facing the jack and the other facing a common ferromagnetic base.

- 5 6. A device for selecting needles in circular knitting machines, according to the preceding claims, **characterized in that** the device has the facility to select jacks in both directions of movement, and the facility for the installation of several consecutive systems.
- 10 7. A device for selecting needles in circular knitting machines according to Claim 1, **characterized in that** the electromagnetic system comprises pole pieces made of ferromagnetic material separated by a permanent magnet, the pole faces of the said pole pieces facing the attraction surface of the jack, at their ends.
- 15 8. A device for selecting needles in circular knitting machines according to Claim 6, **characterized in that** two windings or coils are wrapped around each of the pole pieces.
- 20 9. A device for selecting needles in circular knitting machines according to Claims 6 and 7, **characterized in that** the coils closest to the magnet form part of an electrical supply circuit capable of bringing about the circulation of an electrical current for counteracting the magnetic flux which circulates through the pole pieces.
- 25 10. A device for selecting needles in circular knitting machines according to the preceding claims, **characterized in that** two of the coils of the pole pieces of the electromagnetic system form part of an electronic circuit capable of detecting the electrical currents induced by the changes in magnetic flux in the pole pieces.
- 30 11. A device for selecting needles in circular knitting machines according to the preceding claims, **characterized by** the arrangement of an electronic circuit for detecting the electrical currents induced in the electrical detection coils, correlating the said currents with the position of the jack relative to the electromagnetic system.
- 35 40 45 50 55

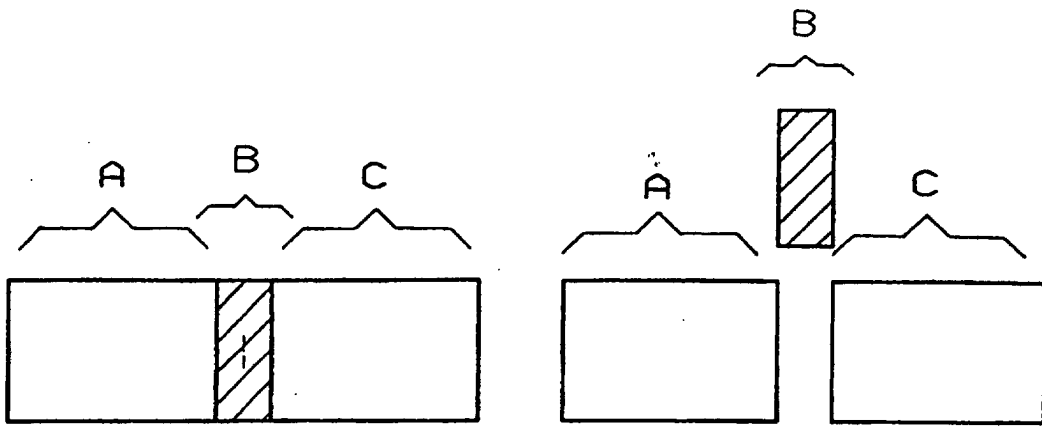


FIG. 1

FIG. 2

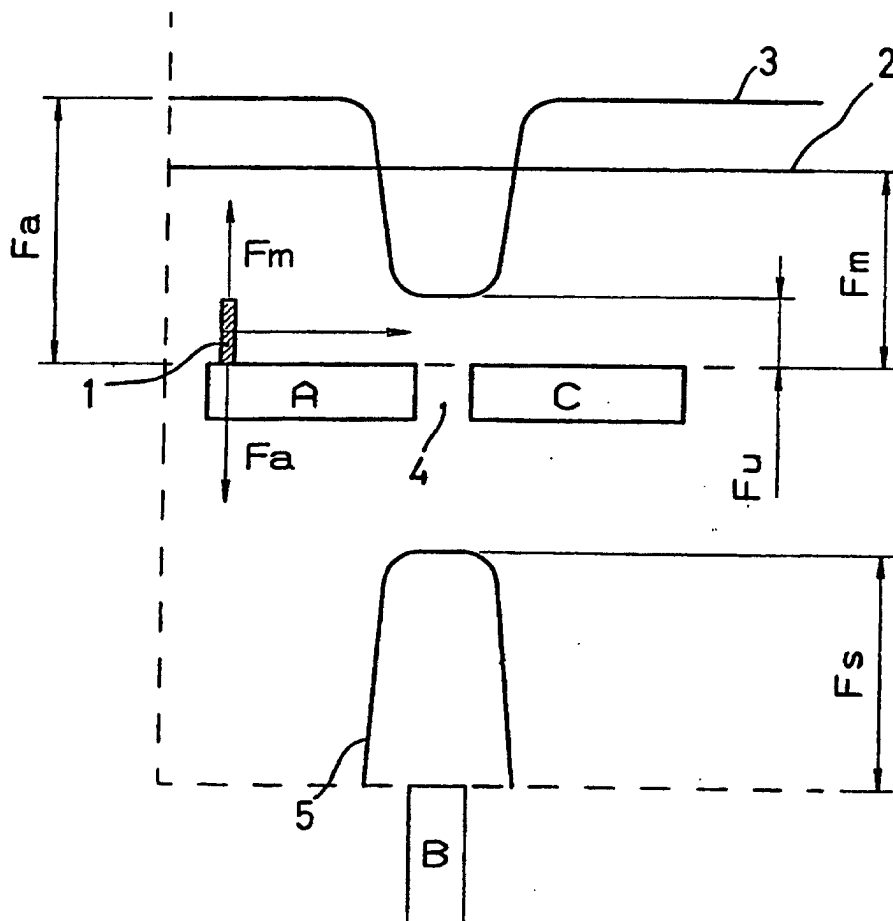
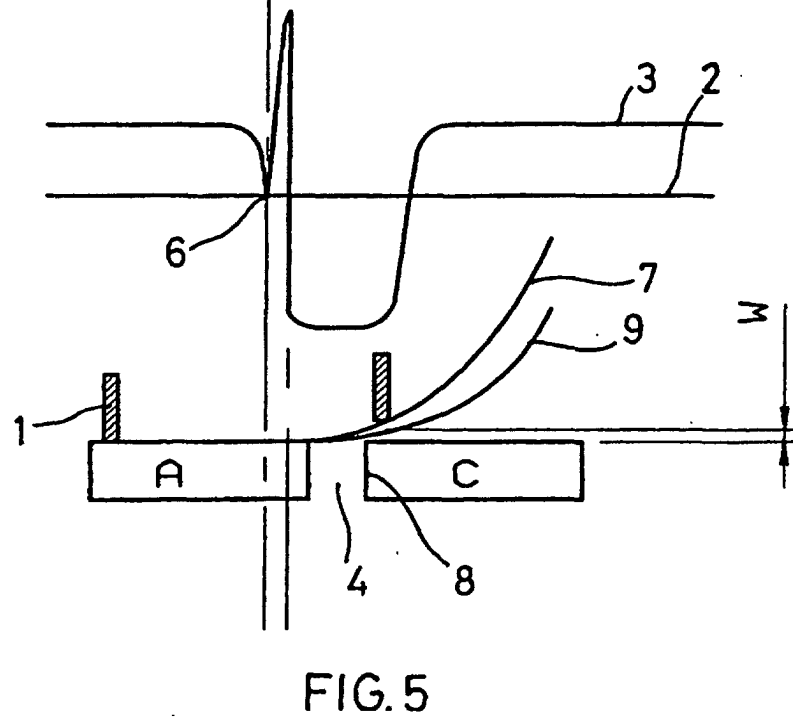
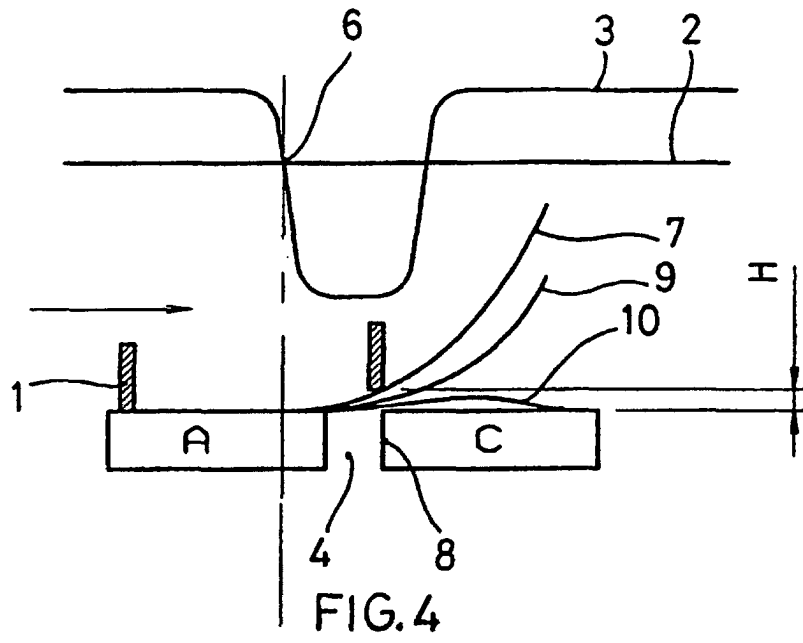


FIG. 3



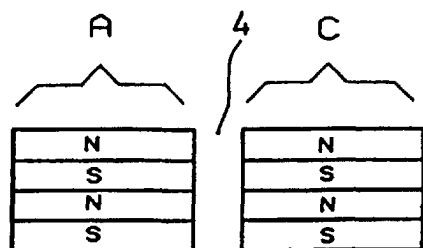


FIG. 6

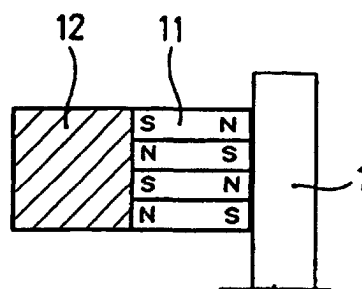


FIG. 7

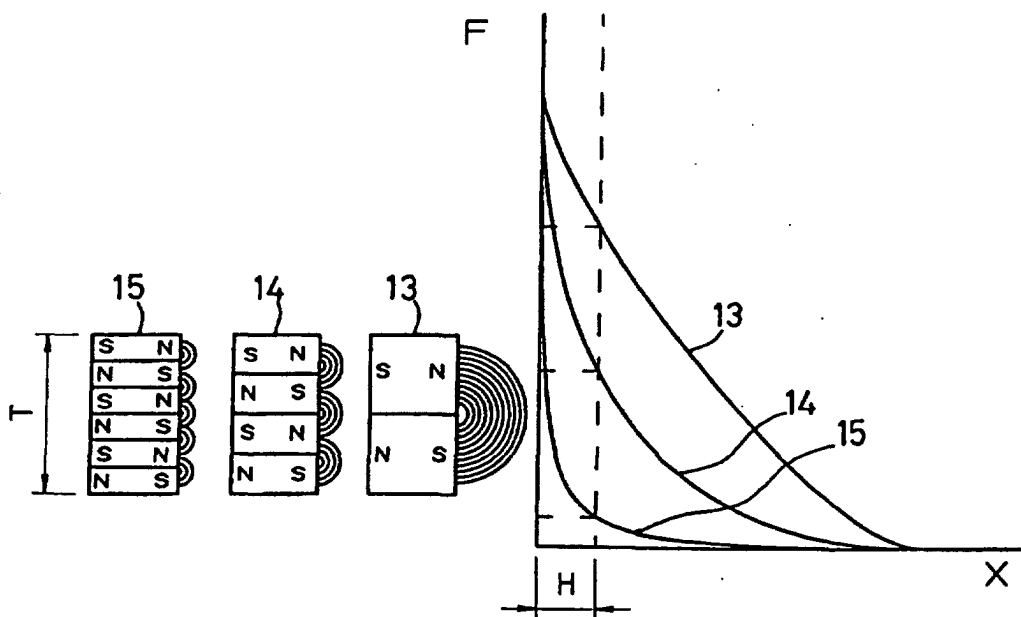


FIG. 8

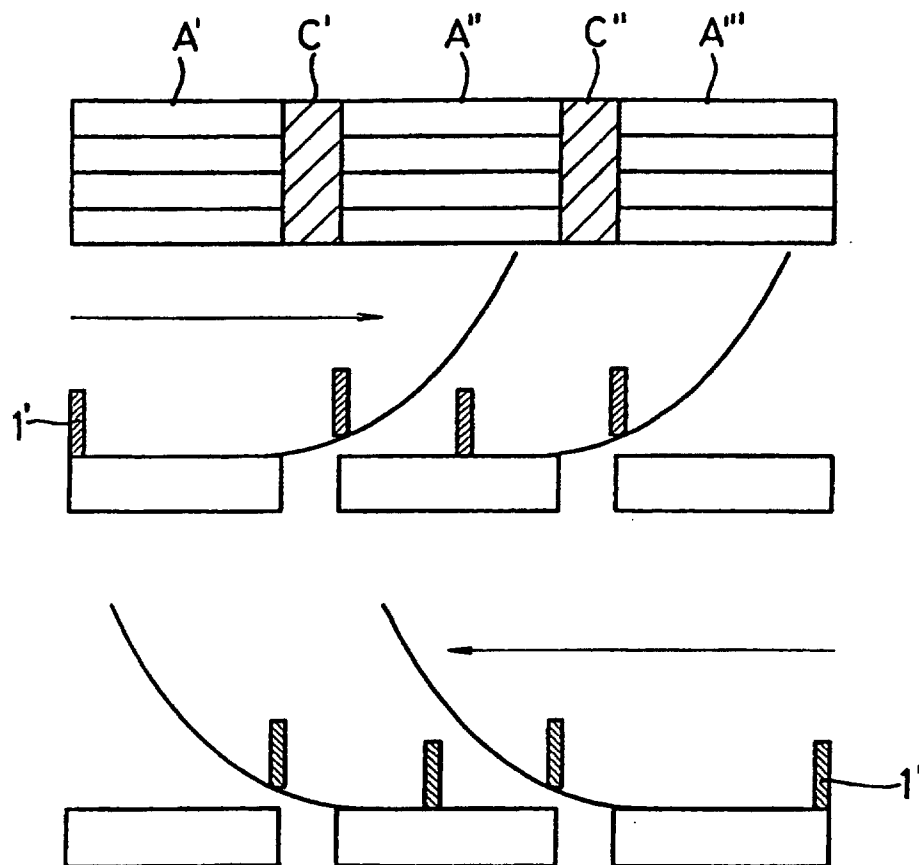


FIG.9

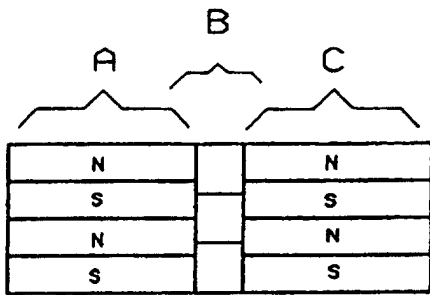


FIG. 10

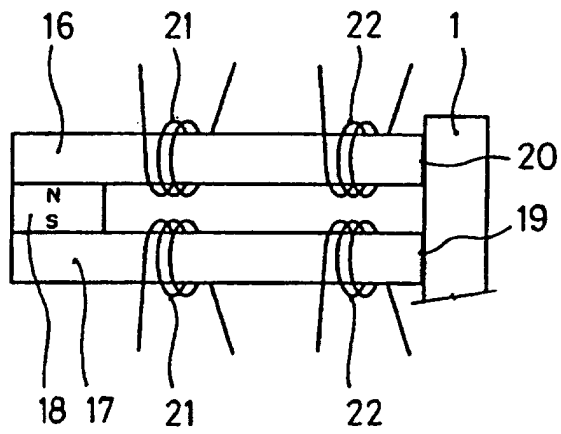


FIG. 11

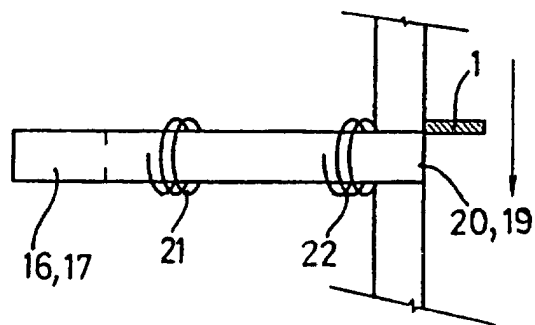


FIG. 12

INTERNATIONAL SEARCH REPORT

International application No.

PCT/ES02/00418

A. CLASSIFICATION OF SUBJECT MATTER		
IPC 7 D04B15/78		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
IPC 7 D04B15/78		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
EPODOC, WPI, PAJ, CIBEPAT		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP0474195 A (HARTING ELEKTRONIK GmbH) 11.03.1992 (resumen) [en línea]. Recuperado de : World Patent Index & EP0474195 A (HARTING ELEKTRONIK GmbH) 11.03.1992, all document	1- 3, 7-10
Y	US4715198 A (PLOPPA et al.) 29.12.1987, column 4, line 29-39; column 6, línea 58 – column 7, line 32.	1- 3, 7-10
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Y	ES2023283 B3 (SAVIO S.p.A.) 01.01.1992, column 1, line 10-33.	1-3
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26:december:2002		07.01.03
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Facsimile No.		Telephone No. +34 913493026

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/ ES02/00418

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Form PCT/ISA/210 (patent family annex) (July 1992)