

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number:

0 310 845
A2

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: 88115285.4

(51) Int. Cl. 4: D04B 15/32

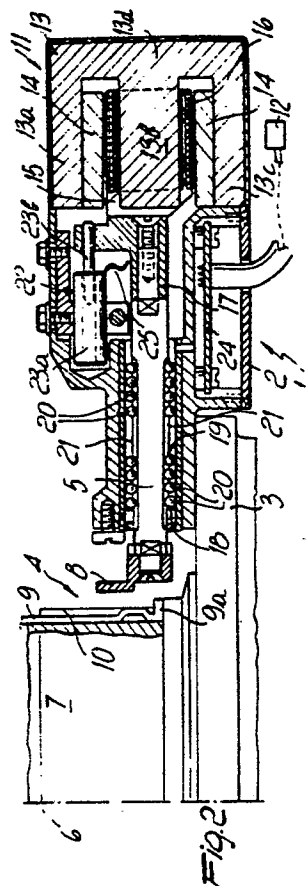
(22) Date of filing: 16.09.88

(30) Priority: 06.10.87 IT 2216387

(43) Date of publication of application:
12.04.89 Bulletin 89/15(84) Designated Contracting States:
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(54) **Device for inserting knitting cams during operation in circular knitting machines for stockings, knitwear and the like.**

(57) The device (1) for inserting knitting cams (8) during operation in circular knitting machines for stockings, knitwear and the like, comprises at least one slider (5) arranged laterally facing the needle cylinder (7) of the machine and movable in a direction substantially perpendicular to the axis (6) of the needle cylinder (7). The slider (5) is rigidly associated with a knitting cam (8) which is selectively engageable, upon movement of the slider (5), with needle actuation elements (9). The device (1) also comprises a linear motor (11) which acts on the slider (5) and is actuated by an electronic machine control element (12) to impart to the knitting cams (8) preset movements relatively to the needle cylinder (7).



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DEVICE FOR INSERTING KNITTING CAMS DURING OPERATION IN CIRCULAR KNITTING MACHINES FOR STOCKINGS, KNITWEAR AND THE LIKE

The present invention relates to a device for inserting knitting cams during operation in circular knitting machines for stockings, knitwear and the like.

As is known, in knitting machines and in particular in circular knitting machines for stockings it is possible to perform various types of knitting by varying the active needles and by varying the path followed by the needle butts inside the cam assemblies of the needle cylinder. To obtain these variations, knitting cams are provided which can be inserted or extracted, according to requirements, in the grooves of the needle cylinder so as to vary the paths followed by the needle butts. These knitting cams can generally have two insertion positions, and some of the needles are provided with long butts and others with short butts, so that by varying the insertion position of the cams it is possible to put to work only the needles having long butts or all the needles.

Generally, the knitting cams are inserted into or expelled from the cam assemblies of the needle cylinder with a movement in a direction substantially perpendicular to the axis of the needle cylinder by means of levers which are actuated by a main drum which has the function of a machine programming element. Said main drum has, on its surface, a certain number of raised portions or control cams which, upon rotation of the main drum about its axis, actuate, by means of mechanical connections, the levers which in turn act on the knitting cams, causing their insertion or expulsion.

Such known types of device have the disadvantage of a complicated mechanical structure which compulsorily requires continuous checks and adjustments to ensure an adequate operational reliability of the machine. The main drum furthermore allows the execution of a limited number of knittings patterns, which must be chosen by the purchaser and can be varied, after purchase, only by changing the control cams mounted on the main drum.

In the U.S. patent No. 4.708.002 in the name of the same Applicant, a device for the operative insertion of knitting cams is disclosed which uses a step motor actuated by an electronic control element which controls the various operations of the machine. By means of the use of a step motor, which is actuated by an electronic control element, all the disadvantages described in conventional machines are overcome, obtaining a greater flexibility of use of the machine and considerably reducing machine adjustment and tuning operations.

Considering the fact that research in this field is aimed at a continuous increase in the speed of rotation of the needle cylinder in order to increase production, the use of step motors has shown some limitations regarding the speed of operative insertion or expulsion of the cams at the high actuation speeds obtainable and regarding the precision of the movements imparted to the cams.

The aim of the present invention is to solve the above described problems by providing a device which allows the operative insertion and expulsion of the knitting cams in extremely short times, so as to be usable on machines with high operating speeds to fully employ the productive potential of modern knitting machines for stockings, knitwear and the like.

Within this aim, an object of the invention is to provide a device which achieves high precision and repeatability in the actuation of the knitting cams.

This aim, as well as this and other objects which will become apparent hereinafter, are achieved by a device for inserting knitting cams during operation in circular knitting machines for stockings, knitwear and the like, comprising at least one slider arranged laterally facing the needle cylinder of the machine and movable in a direction substantially perpendicular to the axis of the needle cylinder, said slider being rigidly associated with a knitting cam selectively engageable, upon movement of said slider, with needle control elements, characterized in that it comprises a linear motor acting on said slider and actuated by an electronic machine control element to impart to said knitting cam preset movements with respect to said needle cylinder.

Further characteristics and advantages of the invention will become apparent from the description of a preferred but not exclusive embodiment of the device according to the invention, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

figure 1 is a partially sectional top plan view of three devices according to the invention applied to a circular knitting machine for stockings;

figures 2 and 3 are sectional views of the device taken along a radial plane of the needle cylinder, illustrating the operation of the device according to the invention;

figure 4 is a sectional view of figure 3 taken along the axis IV-IV; and

figure 5 is a sectional view of figure 3 taken along the axis V-V.

With reference to the above described figures,

the device according to the invention, generally indicated by the reference numeral 1, comprises a frame 2 which is fixed to the supporting structure 3 of a circular knitting machine 4 for stockings and slideably supports a slider 5, movable in a direction substantially perpendicular to the axis 6 of the needle cylinder 7 of the machine. The end of the slider 5 is directed towards the needle cylinder 7 and is rigidly associated with a knitting cam 8 which, upon the movement of the slider 5 in a direction perpendicular to the axis 6 of the needle cylinder, is engageable with, or disengageable from, needle control elements 9. In the illustrated case said control elements are constituted by the butts 9a of the needles 9 which protrude radially from the grooves 10 defined in a known manner on the lateral surface of the needle cylinder 7.

According to the invention, the device comprises a linear motor 11 which acts on the slider 5 to obtain its movement in a radial direction with respect to the needle cylinder and is actuated by means of an electronic control element 12 which controls the various knitting operations of the machine.

More particularly, the linear motor 11 is constituted by a body 13 made of ferromagnetic material which has three expansions 13a, 13b, 13c joined by a crosspiece 13d which are substantially parallel to one another. Blocks 14 in permanent magnetic material are fixed on the two end expansions 13a and 13c, on the side directed towards the intermediate expansion 13b. An armature 15 is mounted on the intermediate expansion 13b and is movable along said expansion 13b. A winding 16 is arranged on the armature 15 and is supplied with direct current so as to generate an electromagnetic force which causes movement of the armature 15 with respect to the body 13 of the linear motor. The armature 15 is connected to a shaft 17 which constitutes the output shaft of the linear motor 11.

The linear motor 11 is arranged on the frame 2 so that its actuation direction is parallel to the direction of movement of the slider 5, and the shaft 17 of the linear motor is rigidly associated with the slider 5 so that the actuation of the linear motor directly causes the movement of the slider 5 along its direction of sliding relatively to the frame 2.

Advantageously, the slider 5 is slideably accommodated in a seat 18 which is defined in the frame in a direction perpendicular to the axis 6 of the needle cylinder 7, and between the slider 5 and the seat 18 coupling means 19 with low friction coefficient are interposed so that the actuation of the linear motor 11 requires a reduced amount of power. Said coupling means 19 are constituted by balls 20 which are accommodated in grooves 21 defined on the surfaces of the slider 5 and of the seat 18 which are arranged mutually facing.

The device according to the invention furthermore advantageously comprises means 22 for detecting movement of the slider 5 with respect to the needle cylinder 7. The detector means 22 are constituted by a known linear transducer, which has a fixed part 23a rigidly associated with the frame 2 and by a movable part 23b rigidly associated with the shaft 17 of the linear motor 11. For the sake of greater clarity, the linear transducer may be of the type constituted by a solenoid winding which is fed with low-intensity current and is arranged in the fixed part 23a. The movable part 23b is constituted by a pin made of ferromagnetic material which, according to the movement of the slider 5, penetrates more or less into the solenoid along its axis. The insertion of the pin in the solenoid determines a variation of the potential difference across the ends of said solenoid which can be detected and is a function of the length of the pin present inside said solenoid. The linear transducer is connected to the electronic machine control element 12 which, according to a control program, checks the actual movement of the slider 5 and, according to what it detects, may act or not act on the linear motor 11 to correct said movement.

For the sake of descriptive completeness, it should be observed that the linear motor 11 is connected to the electronic machine control element 12 via a printed circuit 24 arranged inside the frame 2. The linear transducer 23 may also be connected to said printed circuit 24 via a connecting cable 25.

In the illustrated embodiment, the frame 2 is mounted on the supporting structure of the machine at a level corresponding to the lower end of the needles and the knitting cams act directly on the needle butts, but obviously the device, according to the invention, may be employed for the insertion of cams which actuate sliders or sub-needles.

The operation of the device according to the invention is evident from what has been described and illustrated, and in particular it is evident that the control element 12, according to the different knitting operations which the machine is to perform, moves the cam 8 to engage with or disengage from the butts 9a of the needles 9 by actuating the linear motor 11.

In practice it has been observed that the device according to the invention fully achieves the intended aim since, by having very high speeds of insertion and expulsion of the knitting cams, it can be successfully employed even on very fast machines without entailing a slowing of the machine during said operation of insertion or expulsion of the knitting cams.

Furthermore, the presence of a closed-loop

control of the movement of the cams ensures great precision and repeatability of said movement with equal precision for a great number of times, without requiring checking or adjustment interventions. By virtue of this greater precision it is possible to provide a plurality of insertion positions of each knitting cam, as opposed to the usual two insertion positions of conventional machines, and correspondingly provide needle butts having mutually different lengths so as to increase the types of knitting which the machine can carry out.

The device thus conceived is susceptible to numerous modifications and variations, all of which are within the scope of the inventive concept; furthermore all the details may be replaced with other technically equivalent elements.

In practice, the materials employed, so long as compatible with the specific use, as well as the dimensions, may be any according to the requirements and to the state of the art.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the scope of each element identified by way of example by such reference signs.

Claims

1. Device for inserting knitting cams during operation in circular knitting machines for stockings, knitwear and the like, comprising at least one slider (5) arranged laterally facing the needle cylinder (7) of the machine (4) and movable in a direction substantially perpendicular to the axis (6) of the needle cylinder (7), said slider (5) being rigidly associated with a knitting cam (8) selectively engageable, upon the movement of said slider (5), with needle control elements (9), characterized in that it comprises a linear motor (11) acting on said slider (5) and actuated by an electronic machine control element (12) to impart to said knitting cam (8) preset movements with respect to said needle cylinder (7).

2. Device according to claim 1, characterized in that said linear motor (11) has an output shaft (17) connected to said slider (5) and has an actuation direction substantially parallel to the direction of movement of said slider, said linear motor (11) being operatively connected to said electronic machine control element (12) and controllably activatable for a preset movement of said slider (5) relatively to said needle cylinder (7).

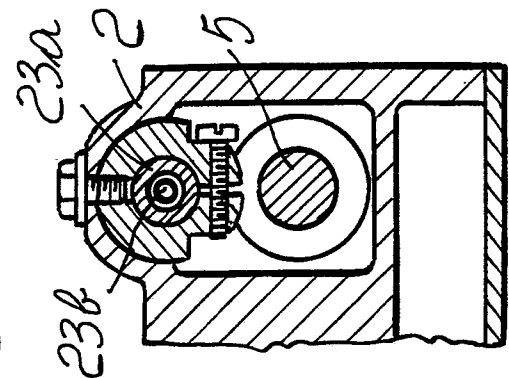
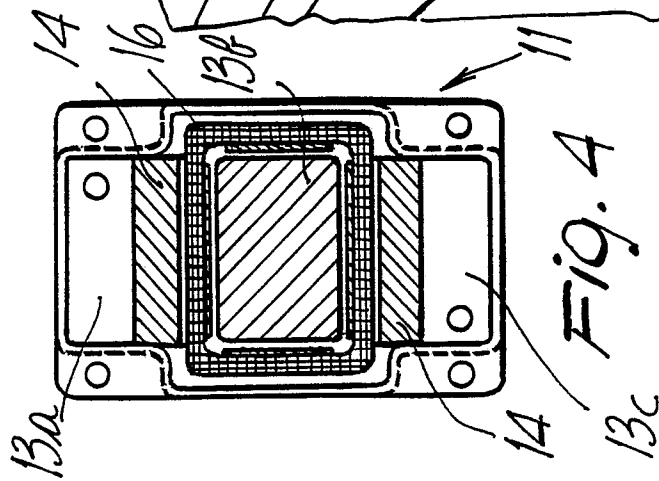
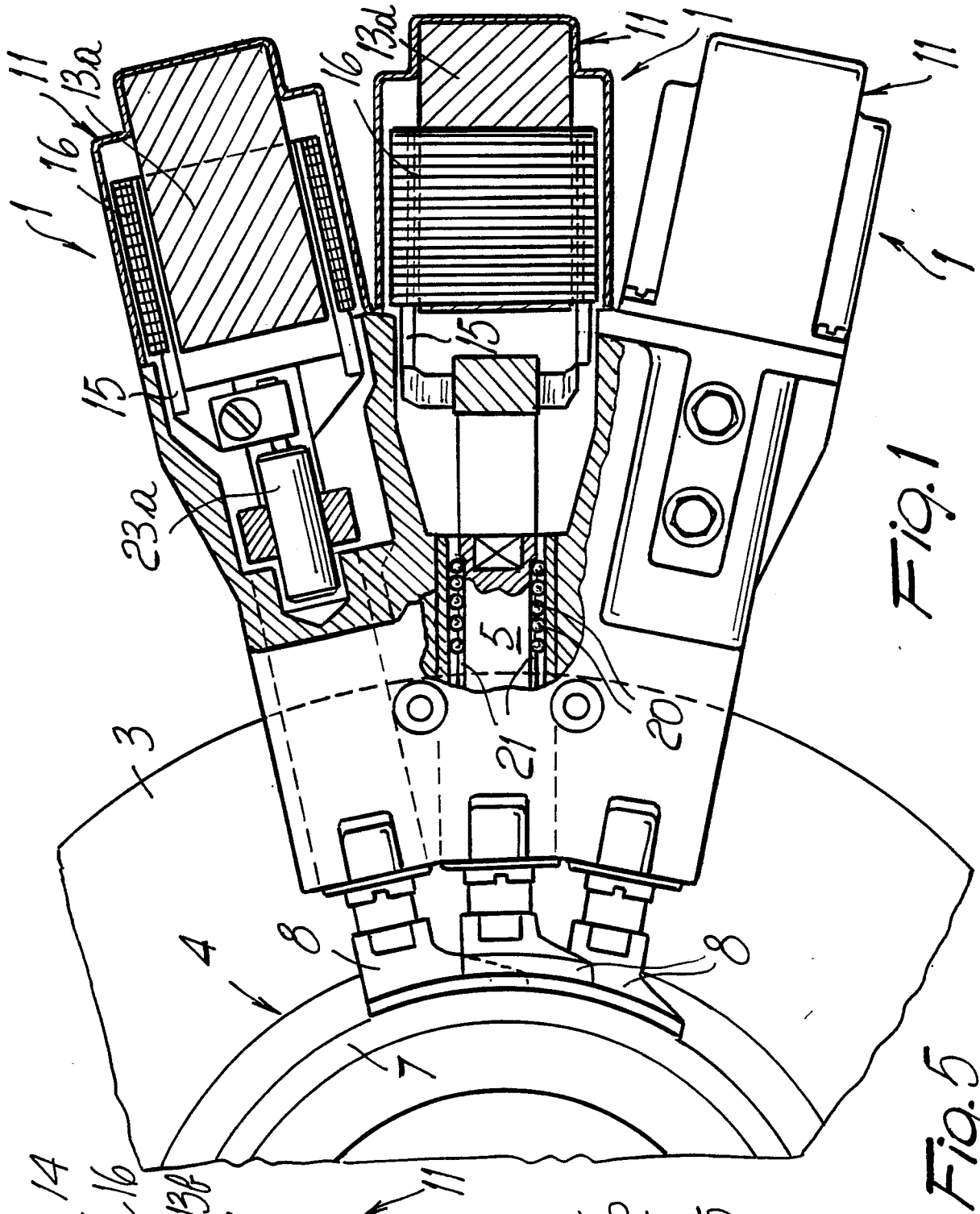
3. Device according to claim 1 or 2, characterized in that it comprises means (22) for detecting movement of said slider (5) relatively to said needle cylinder (7), said detector means (22) being operatively connected to said electronic machine control element (12).

4. Device according to one or more of the preceding claims, characterized in that said detector means (22) are constituted by a linear transducer (23a,23b).

5. Device according to one or more of the preceding claims, characterized in that it comprises a frame (2) supporting said linear motor (11) and said slider (5), said frame (2) being fixed to the supporting structure (3) of the machine (4) which rotatably supports said needle cylinder (7) about its axis (6), said detector means (22) being constituted by a fixed part (23a) rigidly associated with said frame (2) and by a movable part (23b) rigidly associated with the output shaft (17) of said linear motor (11).

6. Device according to one or more of the preceding claims, characterized in that a seat (18) is defined in said frame (2) and extends in a direction substantially perpendicular to the axis (6) of the needle cylinder (7) and slideably accommodates said slider (5) with the interposition of coupling means (19) having a low coefficient of friction.

7. Device according to claim 6, characterized in that said coupling means (19) with low coefficient of friction comprise balls (20) accommodated in grooves (21) extending in a direction substantially perpendicular to the axis (6) of said needle cylinder (7) and defined on the mutually facing surfaces of said slider (5) and of said seat (18).



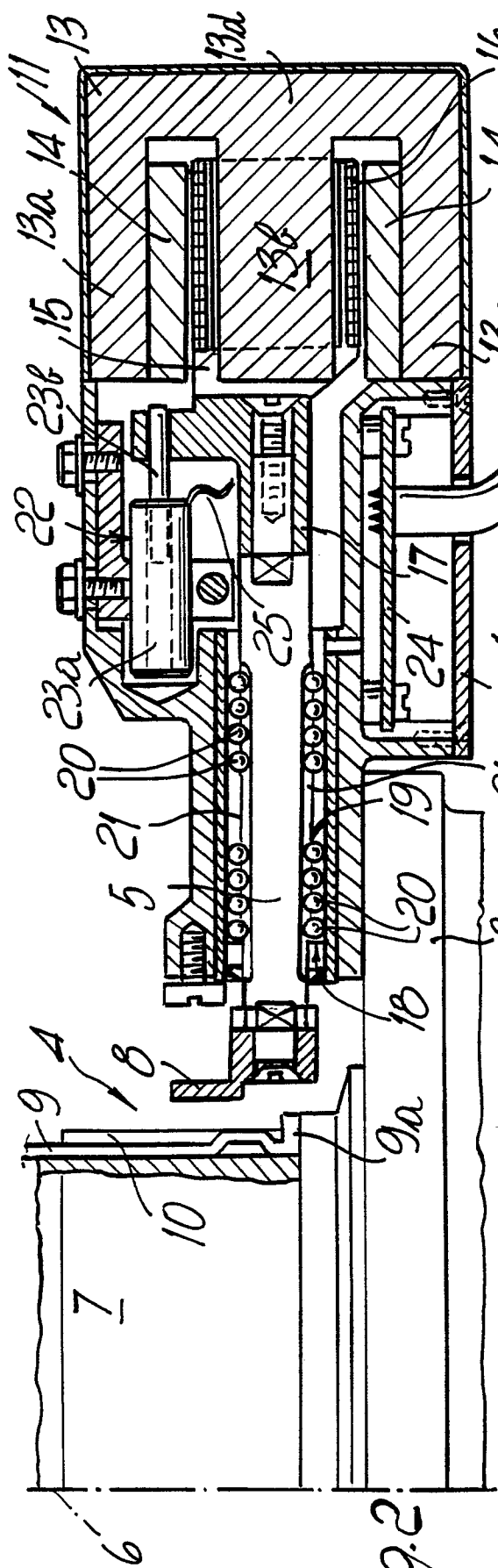


Fig. 2

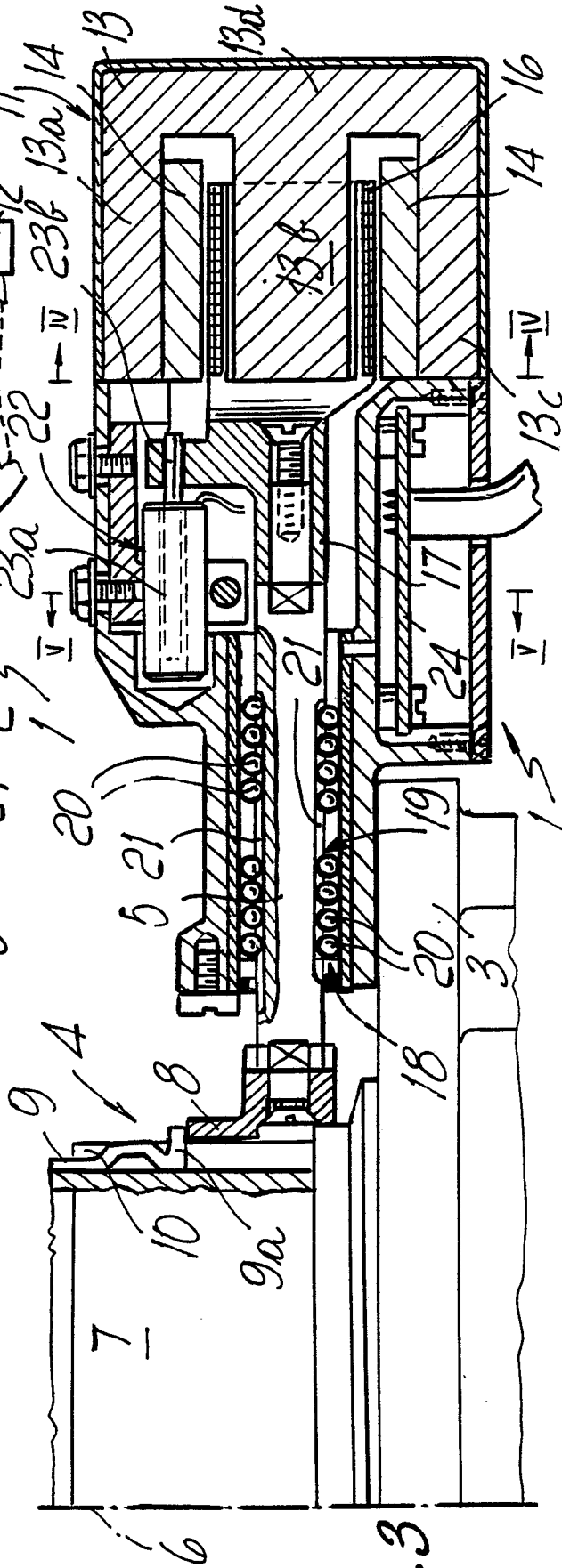


Fig. 3