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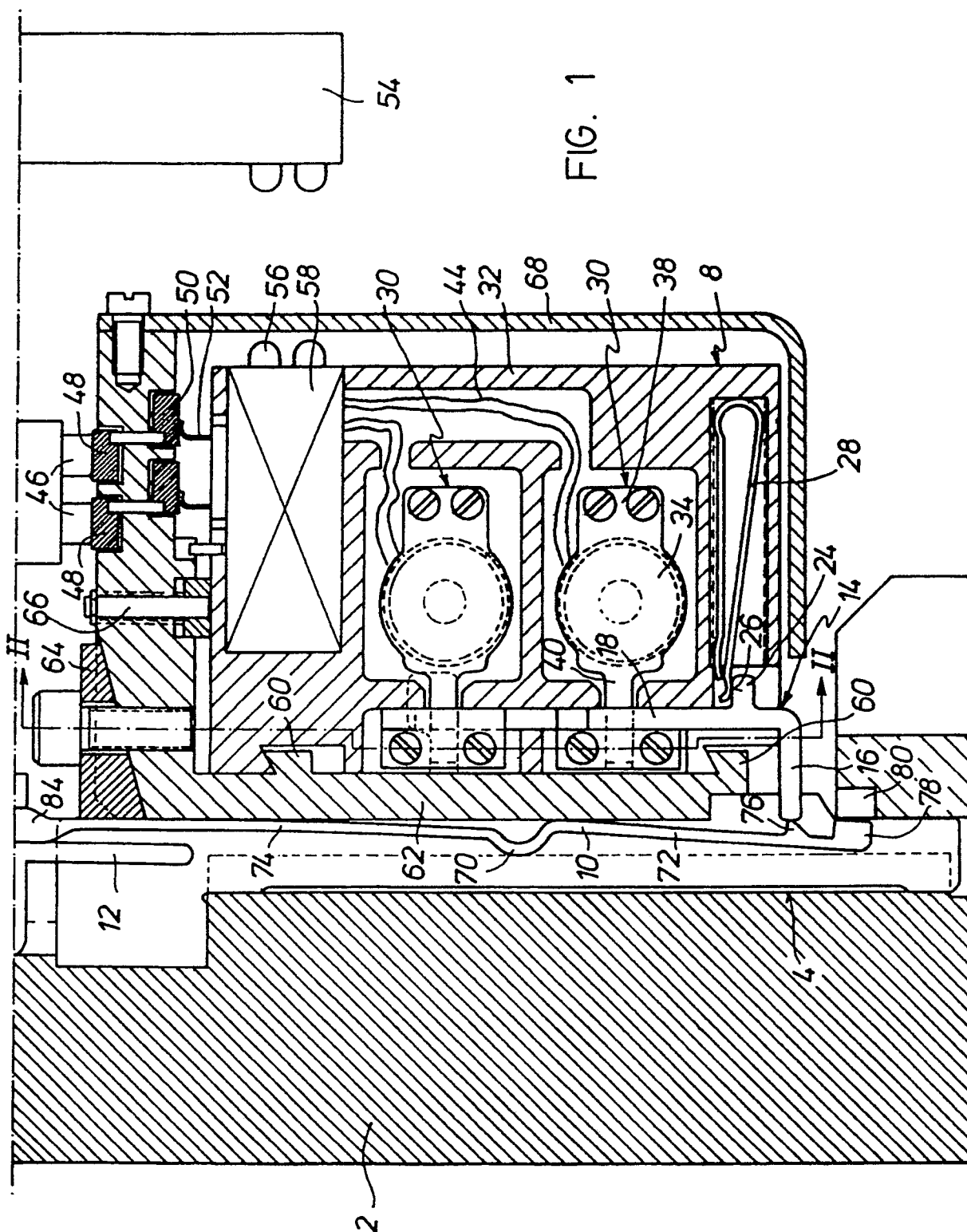
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Needle selection system in a knitting machine.

The selection system is based on the existence of a selector device (8) for each needle (6) which is provided with a selector slide member (14) moveable between two positions, in one of which it engages and moves a cancellation jack (10), determining in this way the selection of the corresponding needle (6). External means cyclically return the slide member (14) to the same position. The moving armature (38) of an electromagnet (30) either retains the slide member (14) in one position or releases it, depending on whether the electromagnet is energised by electronic control means.



NEEDLE SELECTION SYSTEM IN A KNITTING MACHINE

This invention relates to a needle selection system in a knitting machine which comprises : a needle bed provided with tricks for receiving needles ; selector devices ; a plurality of association members to associate the needles with the selector devices ; cams adapted to engage said association members and said needles and provided with movement relative to said association members and needles ; and electronic control means.

It is becoming increasingly important in the textile industry to have high speed knitting machines, which obviously improves their performance, but it is also very important that, further to the high speed, the machine should have short downtimes. The association of both factors means high machine productivity.

To achieve the high running speed, it is necessary to remove the barriers thereto : yarn feed, improved cams, faster responding selection means. This invention improves the last named aspect on providing an individual selection system for each needle. Furthermore, unlike other embodiments, the present arrangement allows a longer time to be made available for the selection operations, both for actuating the electromagnets retaining the selectors and for the movement of the latter, since they are prepared for selection thereof within the period in which the needle is knitting.

To reduce downtimes, the present invention affords great advantages, since with the selection being individual for each needle, it allows the source of any fault to be easily located and with the availability of compact sets grouping the selection electromagnets and the selectors corresponding to a group of needles together, it allows for ready replacement with a new set, reducing the downtimes, as stated above.

It is an object of the present invention to provide a selection system representing an outstanding breakthrough with regard to the abovementioned demands.

This object is attained with a selector system of the type first mentioned above and wherein there is a selector device for each needle, each selector device being fixed relative to said association members and needles and comprising : selector slide member moveable between a first position and a second position ; a spring urging said slide member to said first position ; an electromagnet in which there is a coil, a fixed armature and a moving armature moveable between a position close to said fixed armature when the coil is energised and a normal spaced apart position, said moving armature forming a retaining member which in one of said positions retains said selector slide member and in the other of said positions releases said selector slide member ; and electrical

connection means for said coil, associated with said electronic control means ; there being furthermore external actuating means for moving said selector slide member cyclically from said first position to said second position.

In a preferred embodiment, each selector slide member is vertically moveable and is provided with a projection directed towards said needle bed and a vertical portion in which there is a first portion having a thickness different from the thickness of the immediately adjacent portions and a second portion defining a support surface orientated transversally to the vertical direction ; said retaining member interlocks with said first portion to retain the selector slide member ; and said spring engages said support surface, urging said selector slide member to the first position thereof.

Alternatively according to the invention, said first portion is a recess in which said retaining member enters to retain the selector slide member or it is a projection, one of the flanks of which is engaged by said retaining member to retain the selector slide member.

In a further alternative of the invention, said support surface is a surface of a shoulder forming said second portion or it is a recess forming said second portion.

In a development of the invention, the association members for associating the needles with the selector devices comprise a cancellation jack and a pulling jack, said cancellation jack being adapted to undergo a first vertical movement between a high position and a low position and having an upper portion and a lower portion, both being adapted to rock resiliently and independently between a first position of approach to the needle bed and a second position spaced apart therefrom, while said pulling jack is adapted to undergo a vertical translation movement between an upper position and a lower position and rocks simultaneously with said upper portion of the cancellation jack between a first position of approach to the needle bed and a second position spaced apart therefrom.

In yet a further development of the invention, the lower portion of the cancellation jack is provided with a rocking butt and a raising butt and the upper portion is provided with a thrust butt, such that :

- a) the rocking butt is adapted to be engaged by said projection of the selector slide member, whereby the lower portion is retained in said first position and passes to the second position on release from said engagement ;
- b) the raising butt is adapted to engage a raising cam capable of moving the cancellation jack from the low position to the high position, when the lower portion is in said second position ; and
- c) the thrust butt is adapted to engage a thrust

cam capable of moving the upper portion to said first position when the cancellation jack is in the high position ; there being also a drawdown cam capable of moving the cancellation jack from the high position to the low position.

According to a further preferred feature of the invention, said pulling jack is provided with a lifting butt, which is adapted to engage a lifting cam capable of moving the pulling jack from the lower position to the upper position, when the pulling jack is in said second position ; there being also a depressing cam capable of moving the pulling jack from the upper position to the lower position.

Further advantages and features of the invention will be appreciated from the following description in which a preferred embodiment of the invention is described, with reference to the accompanying drawings, without any limiting nature. In the drawings :

Figure 1 is a cross section view of a selector device on an axial plane.

Figure 2 is a cross section view on the line II-II of Figure 1.

Figure 3 is partial schematic view of the selector slide member and of the retaining member in the retained position.

Figure 4 is a view similar to the previous one in the released position.

Figure 5 is a cross section view on the line V-V of Figure 2.

Figure 5a is a similar view to the previous one with the fixed armatures, being independent parts of the bodies.

Figure 5b is a detail on a larger scale of part of one of said bodies housing a fixed armature having a central orifice.

Figure 6 is a schematic perspective view of needles with the corresponding association members and cams.

Figure 7 is a cross section view on an axial plane comprising the upper portion of the needle bed, a selector device, a needle and the association members between the needle and the device, corresponding to a preferred embodiment, all with the selector slide member in the second position, the cancellation jack in the low position thereof and the lower portion of the same jack in the first position thereof close to the needle bed.

Figure 8 is a cross section view similar to that of Figure 7, with the selector slide member in the first position, the cancellation jack still in the low position and the lower portion in the second position thereof.

Figure 9 is a cross section view similar to the previous two, with the selector slide member in the second position again and the cancellation jack in the high position, both portions in the jack being in the second position thereof.

Figure 10 is a cross section view similar to the previous ones, with the selector slide member in the

second position, the cancellation jack in the high position and the upper portion of the jack in the first position thereof close to the needle bed.

The needle selection system of the invention relates to both circular and to flat bed knitting machines, although the examples described and illustrated herein correspond to circular machines.

Insofar as the invention is concerned, it is stated that the machines comprise a needle bed 2 (particularly, a needle cylinder in circular machines) having tricks 4 for receiving needles 6 and a selector device 8 for each needle. There are, furthermore, association members between each needle 6 and the corresponding selection element. These association members are cancellation jacks 10, pulling jacks 12 and others to which reference will be made hereinafter.

Each selector device 8 comprises a selector slide member 14 which preferably comprises a projecting portion 16, directed towards the needle bed 2, fixedly attached to a vertical portion 18 in which there is a first portion 20 (Figures 3 and 4) having a thickness different from the thickness of the immediately adjacent portions. Portion 20 is shown in the Figures to be thinner, whereby it forms a recess 22, although the invention also contemplates that the portion 20 be thicker, whereby it would form a shoulder. The slide member 14 is provided, further, with a second portion 24 (preferably formed by a shoulder, as shown) defining a support surface 26, although this second portion may also be formed by a recess also defining a support surface. Further reference will be made to said portions 20 and 24 hereinafter.

The selector slide member 14 is adapted to move between a first position, such as shown in Figure 8, and a second position such as shown in Figures 1, 7, 9 and 10. There is a spring 28 urging the slide member to the first position. Furthermore, there is an electromagnet 30 for each slide member 14. It should be noted that two electromagnets 30 have been shown in Figures 1 and 7 to 10, since two slide members 14 are partially superimposed in said figures.

The electromagnets are housed in bodies 32 and comprise a coil 34, a fixed armature 36 and a moving armature 38 which is moveable between a position close to the fixed armature and a normal position spaced apart therefrom. The moving armature is in the close position when the coil 34 is energised. In Figures 5 and 5a, the normal spaced apart position is shown by the moving armature 38a and the close up position (which may even be contact) is shown with the moving armature 38b.

The bodies 32 (Figures 5a and 5b) are preferably formed of non-magnetic material and in each of them there is housed at least one electromagnet 30. The fixed armature 36 of each electromagnet is an independent part housed in the body 32. Thus there is avoided the appearance of possible magnetic influences between the electromagnets which are moun-

ted in one same body 32 or those which are mounted in contiguous bodies. The existence of a central orifice 37 in the fixed armature 36 is contemplated.

When the slide member 14 is in the second position, the first portion 20 (and, as the case may be, the recess 22) are facing the moving armature 38 and, preferably, an extension 40 thereof. In this situation, if the electromagnet 30 is not energised, the moving armature 38 and the extension 40 thereof move apart from the fixed armature 36, whereby the extension 40 is inserted in the recess 22 and thus becomes a retaining member for the slide member in said second position. Obviously, if the electromagnet is energised, the moving armature 38 will cease to act as retaining member and, urged by the spring, the slide member 14 passes to the first position thereof.

In Figure 2 there are to be seen six packages 42, each of which comprises a pair of selector devices housed in a body 32 prepared for the selection of each pair of consecutive needles 6.

The coils 34 of the electromagnets 30 may be supplied directly by conductor leads 44 in the machines where an electronic control having no relative movement with the packages 42 of selector devices 8 may be provided. This may occur in machines having a fixed needle bed and fixed controller.

Where the packages 42 move relative to the controller (for example, in the case of rotating needle beds and a fixed controller), an electrical conducting system by way of brushes 46 and slip rings 48, in communication with distributor rings 50 to which the plug pins 52 of each package 42 of selectors 8 are connected may be provided.

The electricity received through said pins 52 is fed at the right time to the coils 34 following a trigger signal sent from the machine's electronic control (not shown) through optical signal transmission means. There are transmitters 54 disposed around the machine in each working set and receivers 56 disposed on each package 42 of selectors 8. The signal received through said means is processed by electronic components 58 so that the required electrical signal is allowed to reach the coils 34 to energise the electromagnets 30, thereby acting on the selector devices 8 according to a preset programme.

The packages 42 are seen to be easily removable, since they are fixed in flanges 60 of a ring 62, which is fixedly attached to the needle bed 2 by a locking system 64. The packages 42 are attached to the ring 62 by conventional fastening means 66. The packages are protected by the screen 68 whereby the interior thereof is practically inaccessible to dust, yarn and/or fabric fly and other impurities.

Hereinafter there is described the relationship between the mechanism described and the needle selection as such. The description is given of a preferred embodiment, although there are various embodi-

ments.

Prior reference has been made to the needle bed 2, tricks 4, needles 6, cancellation jacks 10 and pulling jacks 12. In the embodiment described, each cancellation jack 10 is resilient and is provided with a bulge 70 forming a lower portion 72 and an upper portion 74 of the cancellation jack, each of which may rock resiliently from the bulge 70 independently of the other portion.

The lower portion 72 is provided with a rocking butt 76 and a raising butt 78. When the selector slide member 14 is in the second position thereof, the projection 16 thereof is engaged with the rocking butt 76, whereby the lower portion 72 of the cancellation jack rocks to a first position close to the needle bed 2, as shown in Figure 1. As a result of the rocking, the raising butt 78 is disengaged from a raising cam 80, whereby, while the projection 16 is engaged with the butt 76, the cancellation jack 10 is not moved vertically. See Figures 1 and 7 and cancellation jacks 10a and 10c in Figure 6.

When the corresponding electromagnet 30 is energised, the moving armature 38 approaches the fixed armature 36, whereby said moving armature 38 is spaced apart from the recess 22 of the selector slide member 14 and releases it. In this way the force of spring 28 urges the selector slide member 14 to move to the first position, with disengagement of the projection 16 from the rocking butt 76.

Therefore, the lower portion 72 of the rocking jack moves to the second position removed from the needle bed (see Figure 8 and cancellation jacks 10b in Figure 6) and consequently the raising butt 78 engages the raising cam 80. When the cancellation jack engages a protuberance 82 of the cam 80, the jack is raised vertically from the low position thereof (jack 10b) to the high position thereof (jack 10d).

In turn, the upper portion 74 of the cancellation jack 10 is provided with a thrust butt 84. When the jack is in the low position thereof, the thrust butt is withdrawn from engagement with the thrust cam 86. Nevertheless, when it moves to the high position thereof (Figure 9) and engages a first cam surface 88 of the cam 86 (Figure 10 and jack 10d), the upper portion 74 of the jack moves to the first position thereof close to the needle bed. The cam has a second cam surface 89 which is also adapted to cause the cancellation jack to rock, in turn, to the first close-up position thereof. There is also a drawdown cam 91 which engages the thrust butt 84 to drive the cancellation jack 10 from the high position to the low position.

The pulling jack 12 is in constant engagement with the upper portion 74 of the corresponding cancellation jack 10, whereby it accompanies this upper portion in the rocking movement thereof to the close-up position to the needle bed. A spring 90 urges the pulling jack to the position removed from the needle bed. The pulling jack is provided also with a lifting butt 92,

so that in the close-up position to the needle bed, butt 92 is disengaged from the lifting cam 94 and, on the other hand, in the removed position the lifting butt 92 engages said cam 94, so that when the butt 92 engages a first slope 96, the jack 12 is lifted.

The pulling jack 12 may be lifted for a second time by engagement with the second slope 98, although, for this purpose, it is necessary for the corresponding cancellation jack (jack 10e in Figure 6) to be in the low position thereof, since otherwise, the thrust jack 84e would have engaged the second cam surface 89 and the pulling jack 12e would have rocked towards the needle bed, whereby the lifting jack 92e would have become disengaged from said second slope 98.

Furthermore, the selector slide member 14 is seen in Figure 6 to be in the first position, whereby it has allowed the lower portion 72 of the cancellation jack 10b to rock to the second position thereof. This jack will duly be pushed upwards by the protuberance 82, whereby it will occupy the position corresponding to jack 10d which, in the upward movement thereof, has pulled the selector slide member 14d which, in turn, is immobilised in this position by the aforesaid action of the electromagnet 30 and its moving armature 38. Consequently, when the cancellation jack (jack 10f) has been drawn down by the drawdown cam 91, the projection 16 reengages the rocking jack 76. Therefore, the cancellation jack 10 is an external means to the selector device 8 which cyclically moves the selector slide member 14 from the first position to the second position.

Figure 6 also shows needles 6 having a lower butt 100 and an intermediate butt 102, as well as a first cam track 104 and a second cam track 106. The first cam track 104 is traversed by the upper jack 108 of the pulling jack 12, provided that the lifting butt 92 of the same jack 12 has previously traversed the first and second slopes 96 and 98. This cam track defines a depressing cam for moving the pulling jack from the upper position to the lower position.

The second cam track 106 is traversed in turn by the intermediate butt 102 of each needle 6 and the needle will be lifted if the corresponding pulling jack 12 has been previously been lifted. By suitably combining the selection of the selector slide members 14 by means of appropriate energisation of the electromagnets 30, the needles may be moved alternatively to the welting track 110, the tucking track 112 or to the knitting level 114.

2 needle bed

4 trick

6 needle

8 selector device

10 cancellation jacks

12 pulling jacks

14 selector slide member

16 projection

18 vertical portion

20 first portion

22 recess

5 24 second portion

26 support surface

28 spring

30 electromagnet

32 body

10 34 coil

36 fixed armature

37 central orifice

38 moving armature

40 extension

15 42 packages

44 conductor leads

46 brush

48 slip rings

50 distributor rings

20 52 plug pins

54 transmitters

56 receivers

58 electronic components

60 flanges

25 62 ring

64 locking system

66 attachment means

68 screen

70 bulge

30 72 lower portion

74 upper portion

76 rocking butt

78 raising butt

80 raising cam

35 82 protuberance

84 thrust butt

86 thrust cam

88 first cam surface

89 second cam surface

40 90 spring

91 drawdown cam

92 lifting butt

94 lifting cam

96 first slope

45 98 second slope

100 lower but

102 intermediate butt

104 first cam track

106 second cam track

50 108 upper butt

110 welting track

112 tucking track

114 knitting level

55

Claims

1. - A needle selection system in a knitting machine, the machine comprising : a needle bed (2) provided with tricks (4) for receiving needles (6) ;

selector devices (8) ; a plurality of association members to associate the needles with the selector devices (8) ; cams adapted to engage said association members and said needles (6) and provided with movement relative to said association members and needles (6) ; and electronic control means, wherein there is a selector device (8) for each needle (6), each selector device (8) being fixed relative to said association members and needles (6) and comprising : a selector slide member (14) moveable between a first position and a second position ; a spring (28) urging said slide member (14) to said first position ; an electromagnet (30) in which there is a coil (34), a fixed armature (36) and a moving armature (38) moveable between a position close to said fixed armature (36) when the coil (34) is energised, and a normal spaced apart position, said moving armature (38) forming a retaining member which in one of said positions retains said selector slide member (14) and in the other of said positions releases said selector slide member (14) ; and electrical connection means for said coil, associated with said electronic control means ; and wherein there is external actuating means for moving said selector slide member (14) cyclically from said first position to said second position.

2. - The system of claim 1, having bodies (2) formed from non-magnetic material, on each of which there is housed at least one electromagnet (30) and said fixed armature (36) of each electromagnet is an independent part received in a body (32).

3. - The system of claim 1, wherein each selector slide member (14) is vertically moveable and is provided with a projection (16) directed towards said needle bed (2) and a vertical portion (18) having a first portion (20) of a different thickness than the immediate portions and a second portion (24) defining a support surface (26) orientated transversally to the vertical direction ; wherein said retaining member (38) is interlocked with said first portion (20) to retain the selector slide member (14) ; and wherein said spring (28) engages said support surface (26), urging the selector slide member (14) to the first position thereof.

4. - The system of claim 3, wherein said first portion (20) is a recess in which said retaining member (38) is inserted to retain the selector slide member (14).

5. - The system of claim 3, wherein said first portion (20) is a projection, one of the flanks of which is engaged by said retaining member (38) to retain the selector slide member (14).

6. - The system of any one of claims 3 to 5, wherein said support surface (26) is a surface of a projection forming said second portion (24).

7. - The system of any one of claims 3 to 5, wherein said support surface (26) is a surface of a recess forming said second portion (24).

8. - The system of any one of the foregoing

claims, wherein the selector devices (8) of several consecutive needles (6) are grouped together forming a unit.

9. - The system of any one of the foregoing claims, wherein the association members for associating the needles (6) with the selector devices (14) comprise a cancellation jack (10) and a pulling jack (12), said cancellation jack (10) being adapted to undergo a first vertical movement between a high position and a low position and having an upper portion (74) and a lower portion (72), both being adapted to rock resiliently and independently between a first position of approach to the needle bed (2) and a second position spaced apart therefrom, while said pulling jack (12) is adapted to undergo a vertical translation movement between an upper position and a lower position and rocks simultaneously with said upper portion (74) of the cancellation jack (10) between a first position of approach to the needle bed (2) and a second position spaced apart therefrom.

10. - The system of claim 9, wherein the lower portion (72) of the cancellation jack (10) is provided with a rocking butt (76) and a raising butt (78) and the upper portion (74) is provided with a thrust butt (84), such that :

a) the rocking butt (76) is adapted to be engaged by said projection (16) of the selector slide member (14), whereby the lower portion (72) is retained in said first position and passes to the second position on release from said engagement ;

b) the raising butt (78) is adapted to engage a raising cam (80) capable of moving the cancellation jack (10) from the low position to the high position, when the lower portion (72) is in said second position ; and

c) the thrust butt (84) is adapted to engage a thrust cam (86) capable of moving the upper portion (74) to said first position when the cancellation jack (10) is in the high position ; there being also a drawdown cam (91) capable of moving the cancellation jack (10) from the high position to the low position.

11. - The system of any one of the foregoing claims, wherein said external actuating means comprise the cancellation jack (10).

12. - The system of any one of claims 9 or 10, wherein said pulling jack (12) is provided with a lifting butt (92), which is adapted to engage a lifting cam (94) capable of moving the pulling jack (12) from the lower position to the upper position, when the pulling jack (12) is in said first position ; there being also a depressing cam capable of moving the pulling jack (12) from the upper position to the lower position.

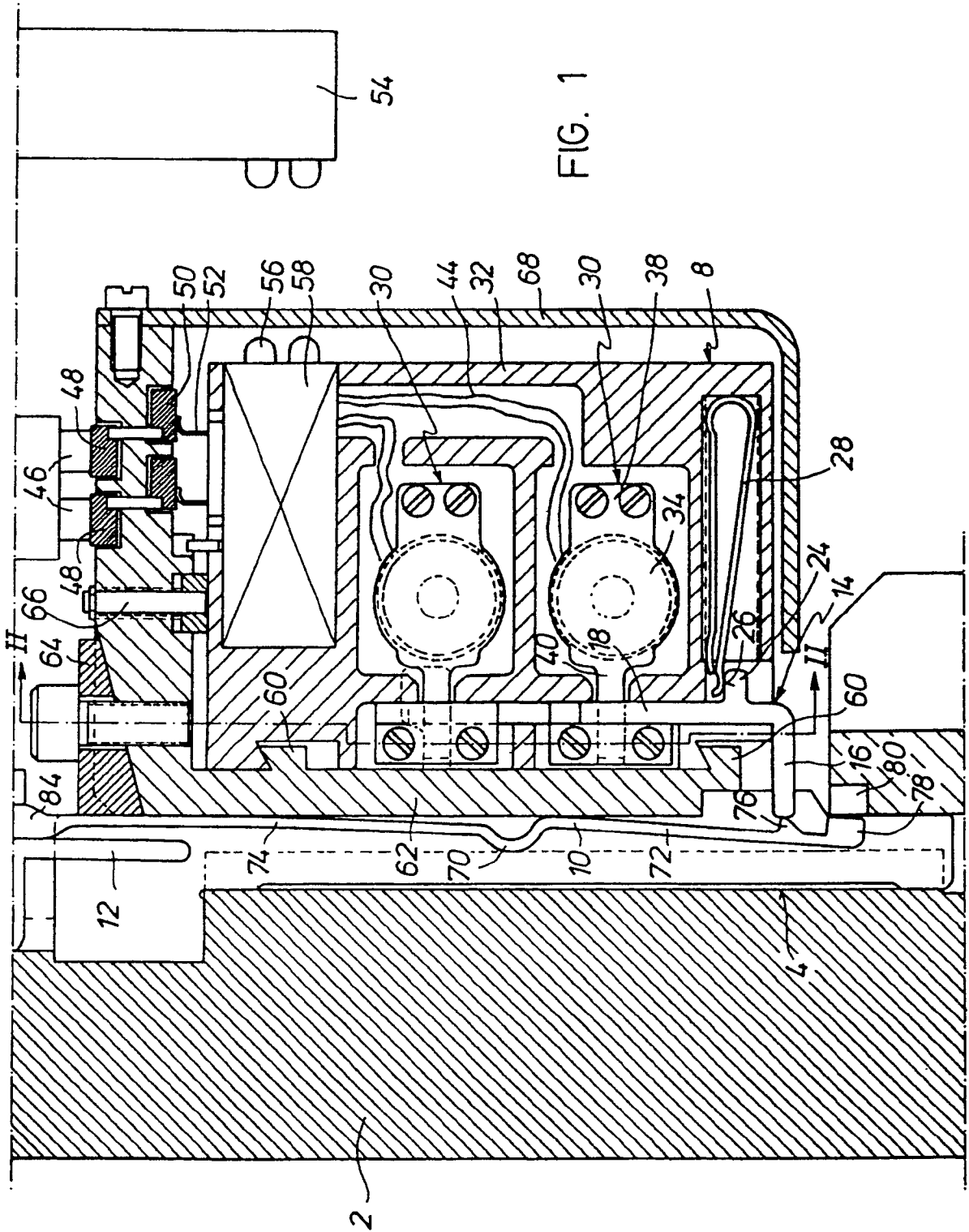
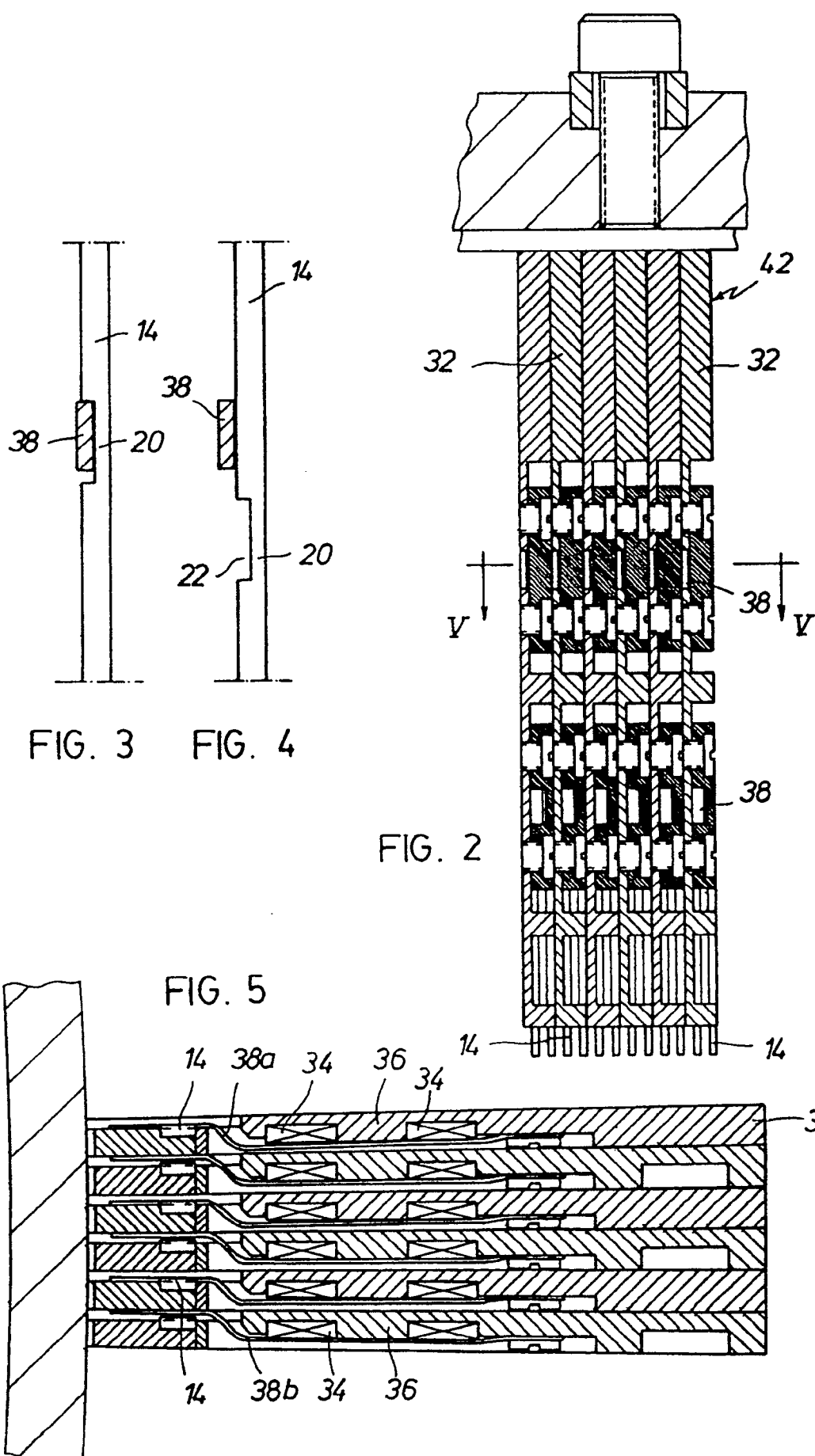
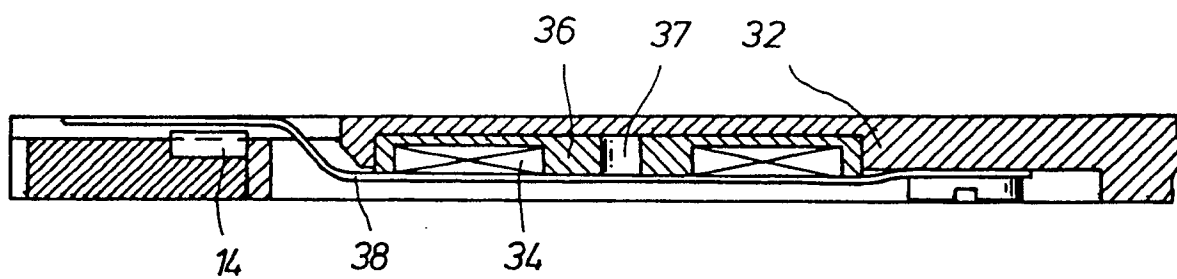
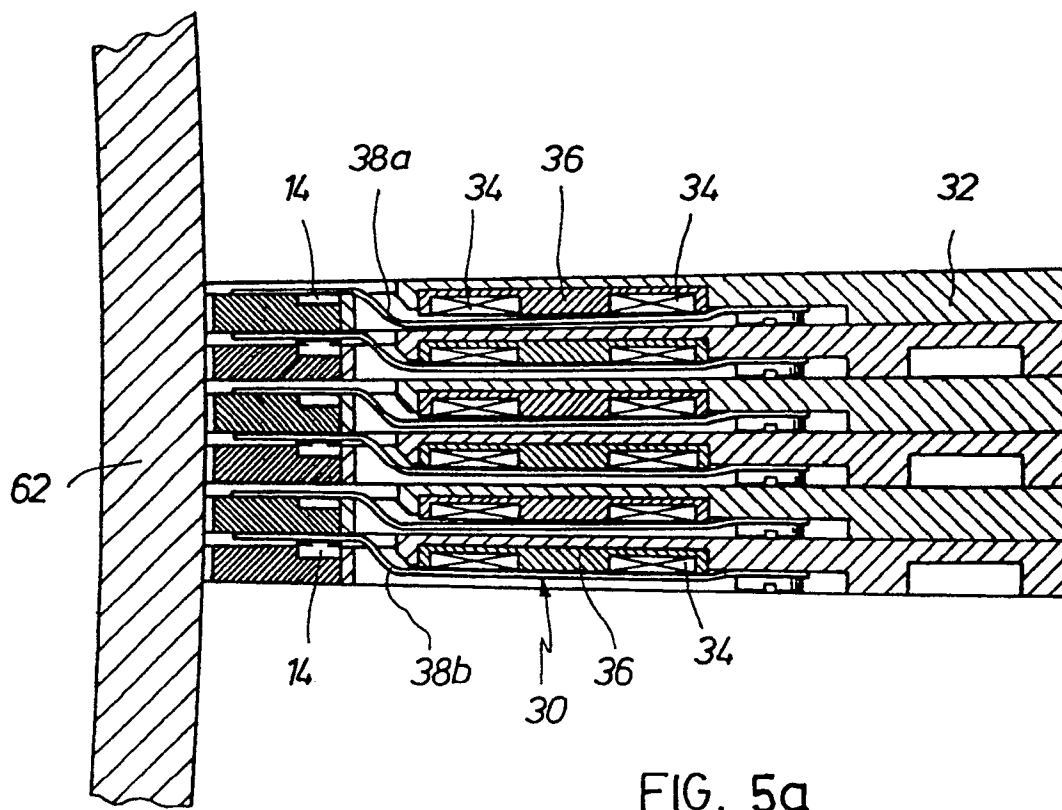


FIG. 1





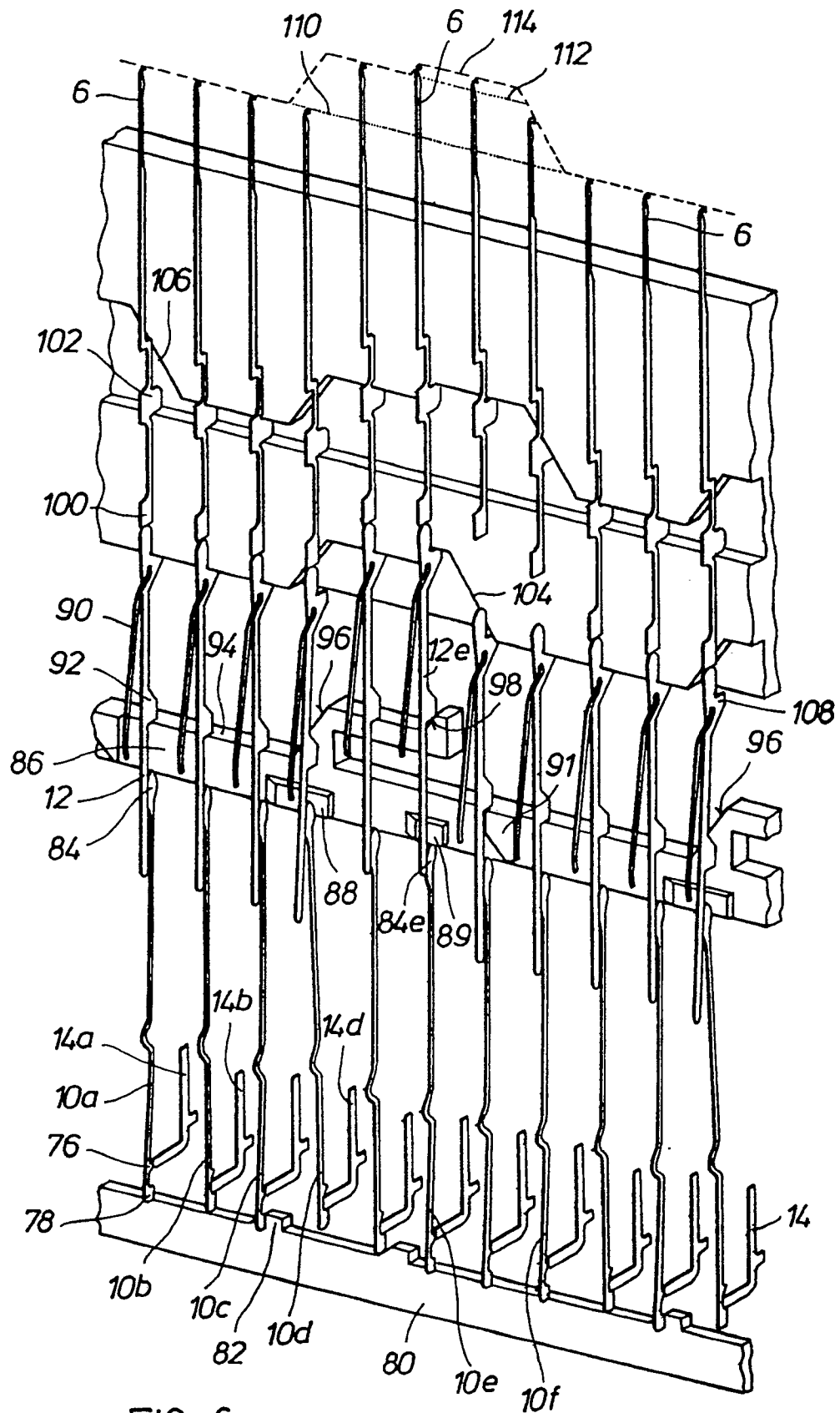
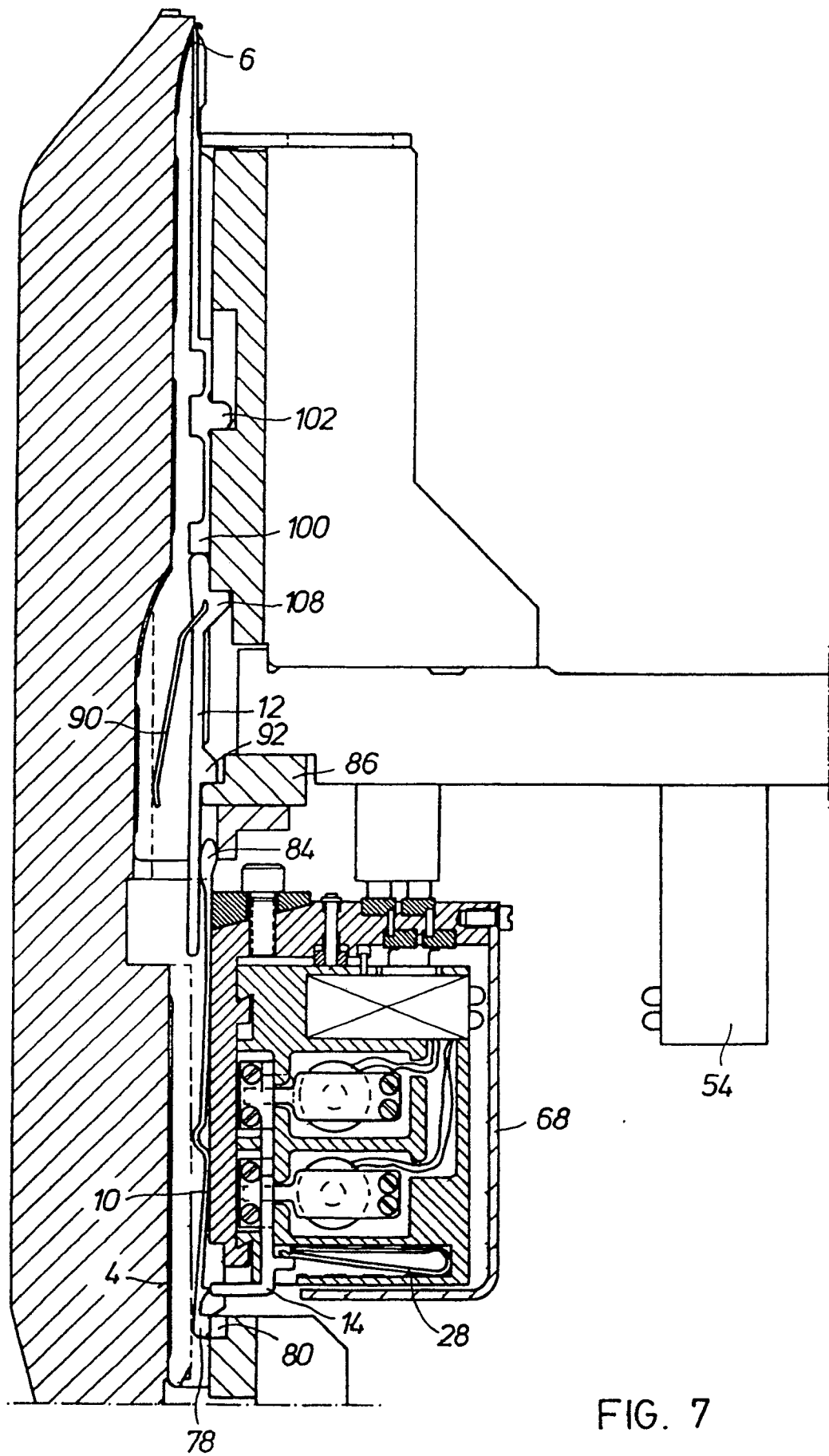


FIG. 6



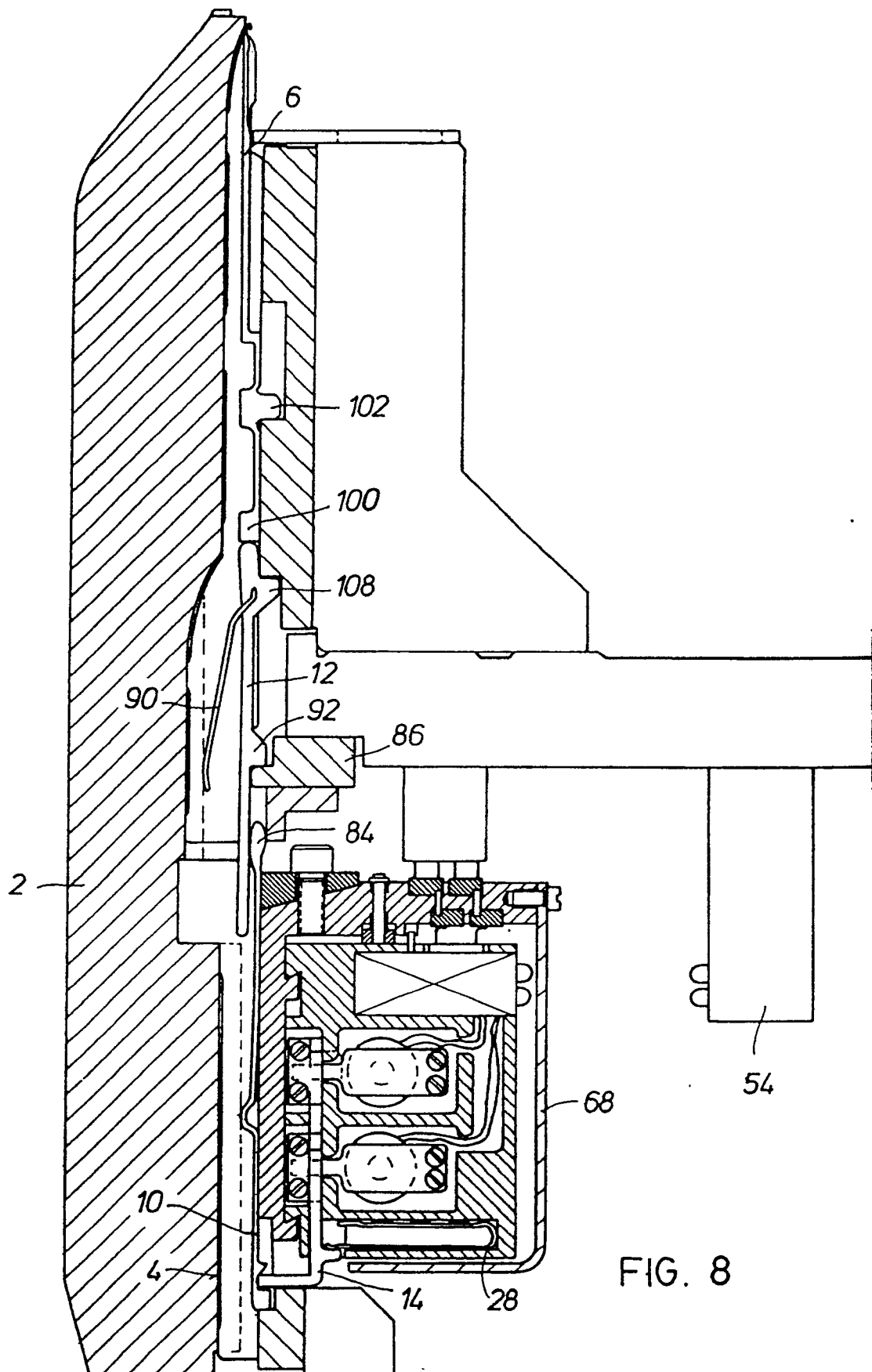
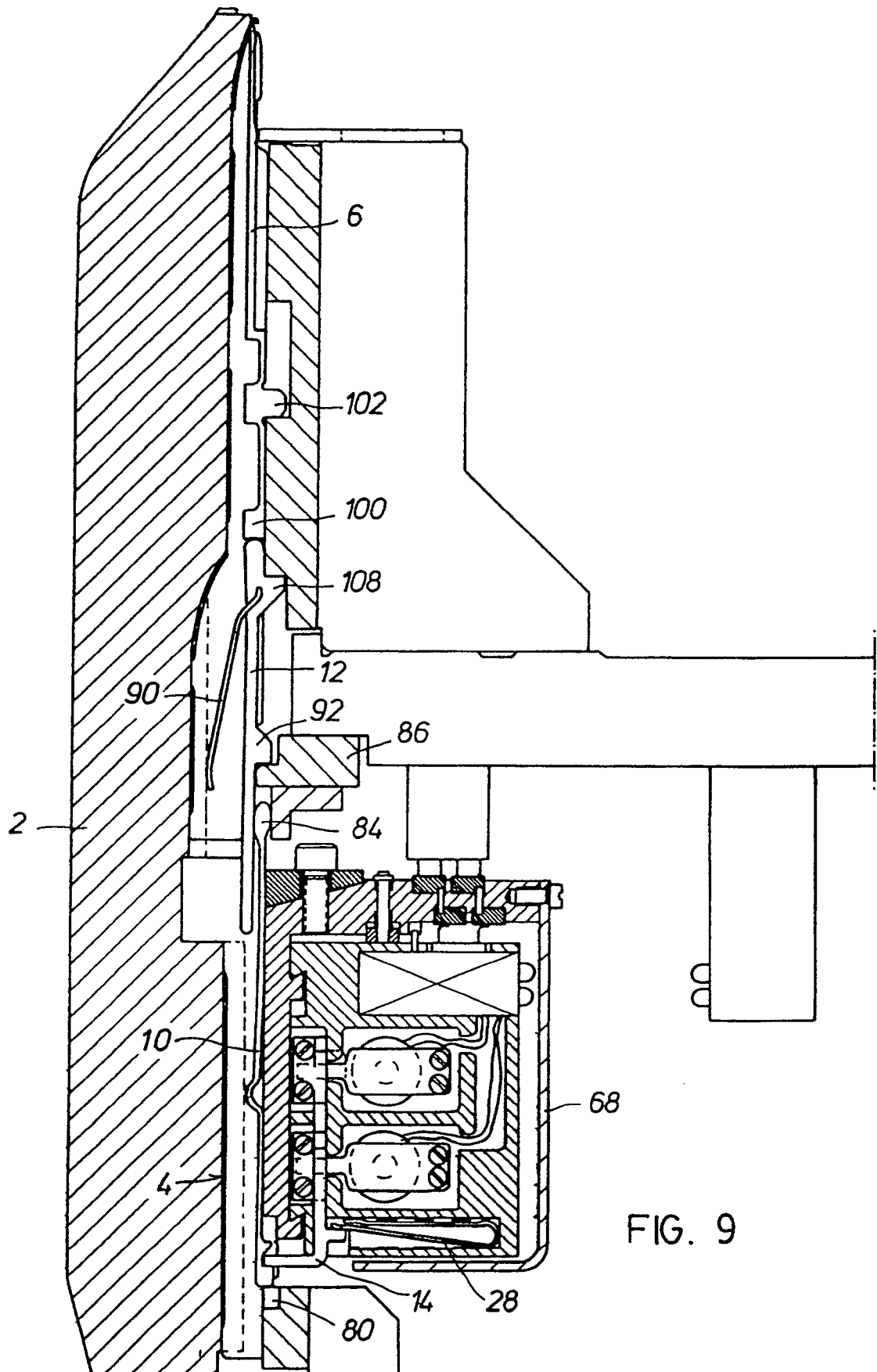


FIG. 8



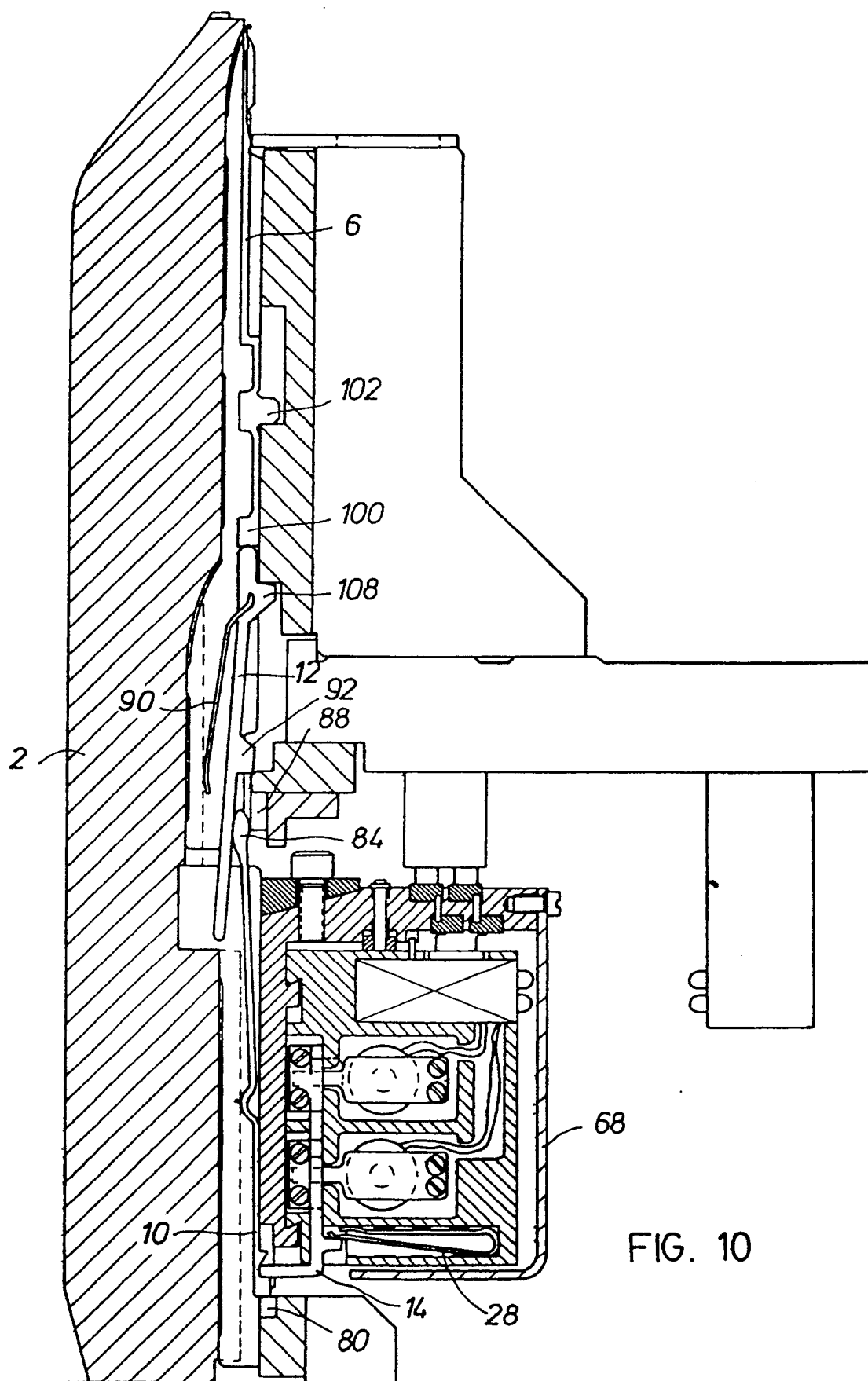


FIG. 10