PATENT SPECIFICATION (11) 1 589 373

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(21) Application No. 42687/77 (22) Filed 13 Oct. 1977

(31) Convention Application No. 2 646 410 (32) Filed 14 Oct. 1976 in

(33) Fed. Rep. of Germany (DE)

(44) Complete Specification published 13 May 1981

(51) INT. CL.³ D04B 15/78

(52) Index at acceptance D1C 1B

(54) IMPROVEMENTS IN OR RELATING TO PATTERN MECHANISMS FOR KNITTING MACHINES

(71) We, UNIVERSAL MASCHINENFABRIK DR. RUDOLF SCHIEBER KG, of Postfach 20, 7081 Westhausen, Germany, a German Kommanditgesellschaft do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

The invention relates to a flat bed knitting machine.

In known pattern mechanisms for such knitting machines, needle control means are provided comprising needle jacks, which can be lowered into and raised from a needle bed or which can be moved in the direction of movement of the needles by means of pattern jacks. The feet of the pattern jacks, or of the needle jacks movable in the direction of the needles, are in staggered formation. The pattern jacks, at each passage of a selection point on a cam, may be lowered to the needle bed and held either in, or half in, or fully out, in accordance with the particular pattern by control members, and the movement of the needle jacks in the direction of the needles is controlled by cams.

In known pattern mechanisms, pattern selection proceeds by arranging a pattern jack to be pivoted so that the foot of the needle jack which slides on the pattern jack, either disappears or projects, whereby it can be caught by the cam means at different heights so that the needles selectively form meshes or loops or do not operate. The size of the pattern repeat depends upon the number of needle jacks or pattern jacks, which are in mutually adjacent staggered formation. The number of feet in different positions staggered transverse to the needle bed is then limited by the width of the needle bed in flat knitting machine.

A similar dependence of the number of feet on the size of the pattern repeat exists also in pattern mechanisms for knitting machines in which the pattern selection takes place by location behind the needles of needle jacks with staggered feet, which are movable with the needle in the direction of movement thereof, and thus in a common plane.

In a second type of known knitting machine pattern mechanism, which operates with needle jacks, cam elements are introduced by means of magnets between the feet of the needle jacks or pattern jacks arranged successively at the same level in the direction of cam movement. In that case also the knitting speed depends *inter alia* upon the number of the feet arranged in staggered formation.

In flat knitting machines in which the selection points in both travel directions of the carriage are situated at various positions on the cam carriage, it is necessary to provide, for each travel direction of the carriage, corresponding cam parts with associated electromagnets, which means doubling the number of the cam members and electromagnets. Finally, all the known pattern mechanisms have the disadvantage that there must be provided for transfer cams individual selection points with associated actuating devices.

According to the present invention, there is provided a flat bed knitting machine comprising a plurality of needle jacks arranged in side by side relation and being movable in the direction of movement of associated needles upon engagement with cam means movable transversely of the needle, jacks, and pattern jacks engaging the needle jacks, butt means on each of the pattern jacks and arranged in groups with the adjacent butt means of each group being in staggered formation, a plurality of pattern jack control members, each control member being movable towards the pattern jacks for engagement with and displacement of a respective one of the butt means to position the associated one of the needle jacks in a desired one of predetermined positions of the needle jacks relative to the cam means in accordance with a particular pattern, mechanical means arranged to move each of the control members towards the pattern jacks, means for retaining each of the control members in a selected one of positions corresponding respectively to said predetermined positions

of the needle jacks, means grouping the plurality of control members into a plurality of sets each associated with a respective one of the cam means and each corresponding in number to the number of the butt means in a said group thereof and means for displacing the sets of control members together to selection positions of the cam means in the direction of movement of the cam means.

In a flat bed knitting machine, such sets of control members are advantageously movable in common with respect to the particular selection points in the direction of the cam movement. If the flat bed knitting machine includes transfer devices, the sets of control members are appropriately separately mounted and selectively displaceable to different selection points in the direction of cam movement.

Said means for retaining the control members may each comprise a double electromagnet or two electromagnets arranged one beside the other, preferably controlled by electronic circuit means.

Preferably, the control members are comprised in levers having displacement members mounted thereon at two respective spacings from the needle bed, the displacement members having displacement inclines at a first spacing for the selection of tuck stitch knitting located to be operative later than displacement inclines at a second spacing for the selection of knit stitch knitting.

Preferably, the levers comprise double armed levers having the control members mounted at one end thereof, and preferably also there are spring means urging the double armed levers to move the control members away from the pattern jacks, and means incorporated in said levers for causing movement of said control members towards the pattern jacks, by engagement of said movement causing means with the butt means.

The present invention is further explained below with reference to illustrative embodiment thereof shown in the accompanying drawings, in which:

Fig. 1 is a cross section through the needle bed, the needle jack bed and the pattern jack bed of a pattern mechanism with the pattern jack in the basic position,

Fig. 2 is a cross section corresponding to fig. 1 with the pattern jacks in the half position,

Fig. 3 is a cross-section corresponding to fig. 1 with the pattern jacks in the non-operating position,

Fig. 4 is a plan view of a portion of a pattern jack bed with the butt means of the inserted pattern jacks in diagonally staggered formation,

Fig. 5 is a schematic diagram showing fixed wipers, which press the pattern jacks into the pattern jack bed,

Fig. 6 is a plan view of two control member sets in their arrangement with relation to two knitting cam systems when knitting from right to left,

Fig. 7 is a plan view corresponding to fig. 6 when knitting from left to right,

Fig. 8 is a plan view corresponding to fig. 6 when performing transfer operations and knitting with a following cam system from right to left,

Fig. 9 is a schematic side elevation of a control strip depressed by a controlling eccentric,

Fig. 10 is a schematic side elevation of a control strip released by the eccentric and lifted up by a spring,

Fig. 11 is a schematic side elevation of a control strip released by the eccentric and held in the half position by a double electromagnet,

Fig. 12 is a schematic side elevation of a control strip released by the eccentric and held in the out position by the double electromagnet,

Fig. 13 is a cross section through the needle bed, needle jack bed and pattern jack bed similar to fig. 1 showing a set of eccentrics and the drive therefor,

Fig. 14 is a cross section according to fig. 13 with one of the control strips in the pressed condition,

Fig. 15 is a cross section corresponding to fig. 13 showing a depressed control strip released by the eccentric but retained by an electromagnet,

Fig. 16 is a schematic side elevation of a control strip mounted upon a double armed lever and controlled by actuating cams,

Fig. 17 is a plan view of the actuating cams according to fig. 16, which show schematically the position of the actuating cams with reference to the diagonally staggered butt means of the pattern jacks,

Fig. 18 is a side elevation corresponding to fig. 16 with a control lever released by the operating cam and retained in the out position by a double magnet,

Fig. 19 is a side elevation corresponding to fig. 16 showing an elevated control strip,

Fig. 20 is a schematic side elevation of a control strip arranged at the free end of a single armed lever, and which is pressed by a spring against the surface of the needle bed,

Fig. 21 is a side elevation of a spring lever clamped at one end, and at the free end a control strip, which is elevated by the butt means of a pattern jack,

Fig. 22 is a side elevation corresponding to fig. 21 with a control strip retained in the depressed position by an electromagnet,

Fig. 23 is a cross section through a needle bed with pattern jacks movable in the direction of the needles and having butt means in staggered formation,

Fig. 24 is a plan view of a portion of a needle bed according to fig. 23 and shows in section a displacement member travelling in one row of butt means,

Fig. 25 shows a side elevation of a double armed lever with displacement members mounted at one end thereof, which are pressed towards the surface of the needle bed by an adjacent butt means of another pattern jack through the agency of the double armed lever, and retained in that position by an electromagnet,

Fig. 26 is a side elevation corresponding to fig. 25 after release of the jack by the adjacent butt means of the other pattern jack and its retention in the half position by another electromagnet,

Fig. 27 is a side elevation corresponding to fig. 25 after the release of the jack by the adjacent butt means of the other pattern jack and after release of the displacement member by the first electromagnet,

Fig. 28 is a plan view on a knitting cam system, an appertaining pattern cam and a displacement member displaced with respect to the advancing selection point, the displacement member being in the full position for the selection of needles to knit, together with an arrangement according to fig. 25,

Fig. 29 is a plan view corresponding to fig. 28, in which a displacement member is brought into the half position for the formation of tuck loops.

In the figures 1 to 15 there is shown a pattern mechanism for flat knitting machines with pattern jacks and eccentric operated single armed levers with control strips secured thereto. In a needle bed 1, needles 2 are displaceably disposed and, by means of a cover rail 3, are so retained in the needle bed that they are unable to move upwardly from the plane of the needle bed. Needle jacks 4 also have their shafts 5 displaceable in the needle bed 1 and are also mounted in a needle jack bed 6, from which the feet 7 of the needle jacks 4 project in their normal position.

Inside the needle jack bed 6 the needle jacks 4 lie upon pattern jacks 8, which limit the downward movement of the needle jacks in the bed 6. The pattern jacks 8 are pivotally mounted in the bed 6 and are provided with stops 9 at the upper edges of their shafts, whereby the movement of the needle jacks 4 to the rear of the needles 2 is limited. The rearward half of the pattern lever 8 is pivotally guided in a pattern lever bed 10. In this rearward region each pattern jack 8 is also provided with butt means in the form of a foot 11.

The feet 11 of the pattern jacks 8 arranged in adjacent relationship in the direction of cam travel, are so staggered in respect of their distance from the edge of the needle jack bed 6 that, of the total number of feet 11, 11a, 11b, 11c, 11d .... 11p which are provided, the foot 11 is farthest away and the foot 11p is closest to the edge of the bed 6, as is evident from figures 3 and 4.

The needle jacks 4 and the pattern jacks 8 are retained in the sinker bed 6 by rails 12 and 13 extending lengthwise of the bed 6. They are pressed against the rails 12 and 13 by springs 14.

Upon the carriage of the machine there are provided control strips 16, 16a .... 16p for the feet 11, 11a .... 11p, and wipers 15 are also provided. In the course of the passage of the carriage the wipers 15 press the pattern jacks 8 into the pattern jack bed 10. When the appertaining control strips 16, 16a .... 16p are in their lowest positions with respect to the pattern jack bed 10 and over the particular corresponding foot 11 of the pattern jack 8, these control strips prevent the spring 14 from lifting the corresponding pattern jack 8 out of the pattern jack bed 10, so that the jack remains depressed in the pattern jack bed 10. Furthermore there is provided upon the carriage a wiper 17, which before each selection point in the cam presses all of the needle jacks 4 into the bed 6, so that the feet 7 of the needle jack also remain out of engagement with the cam parts. Fig. 5 shows successive wipers 15, 15a, 15b for the pattern jacks 8.

The figures 6 to 8 show the assembly of control strips 16 .... 16p into two sets 18 and 19. In flat knitting machines, the sets 18 and 19 of control strips 16 have their position variable in the direction of carriage movement in such a manner that the actuating surfaces 20 of the control strips 16, which are clearly shown in figs. 9-12, are respectively located on the particular leading selection points 21 and 22 of two cams when the carriage runs from right to left, as is seen in fig. 6. When the carriage runs from left to right these actuating surfaces 20 are then located upon the leading selection points 23 and 24 as is shown in fig. 7.

In the case of flat knitting machines having transfer devices, the sets 18 and 19 are individually mounted and differently adjustable so that, for example, as shown in fig. 8, the actuating surfaces 20 of the set 18 are situated at a selection point 25 of a transfer cam system and the actuating surfaces 20 of the set 19 are situated at the selection point 22 of the following knitting cam system.

In order to make it possible to select each individual needle at various operations, it is necessary for the control strips 16 to be selectable over a length of path *a*, shown in fig. 4, between the associated feet 11 adjacently situated in the travel direction of the carriage. In the practical example here

described, this selection is effected by arranging that gauge-dependent angularly staggered eccentrics 26 run in synchronism with the carriage movement over the needle bed, which eccentrics press the control strips 16 carrying the actuating surfaces 20 towards the pattern jack bed 10 as is represented in fig. 9. At the same position all of the pattern jacks 8 are depressed into the pattern jack bed by the appertaining wipers 15. A spring 27 is provided to return the control strip 16 against the action of the eccentrics 26.

When the eccentric 26 is rotated so far as to bring the lowest part of its periphery to bear against the control strip 16, the spring 27 has returned the control strip 16 into its basic position as is shown in fig. 10.

Above the control strip 16 there is mounted a double electromagnet 29 with an armature 28 capable of being brought into three positions. When the armature 28 is in the centre position as is shown in figs. 9 and 10, it can move into a groove 30 at the top of the control strip 16 as shown in fig. 10. When the control strip 16 moves over to the position shown in fig. 10, the pattern jack 8 remains in the basic position and brings the foot of the appertaining pattern jack fully in engagement with the following cam.

Fig. 11 shows the case, in which the armature 28 of the double magnet 29 is drawn to the right. In this case the armature 28 is received in a groove 31 of the control strip 16, whereby the control strip 16 is retained in the half position. The actuating surface 20 of the control strip 16 now allows the foot 11 of the pattern jack 8 to project only half way out of the pattern jack bed 10, whereby also the foot 7 of the needle jack 4 can only project half way out of the bed 6. This allows the foot 7 of the needle jack 4 to be engaged only by quite high parts of the cam system.

If now the double electromagnet 29 draws its armature towards the left, the latter moves into a further groove 32 in the control strip 16 as is shown in fig. 12. The control strip 16 is thereby so retained that its actuating surface 20 holds the foot 11 of the pattern jack 8 in position, into which it has been brought by the wiper 15. Accordingly the pattern jack 8 cannot move out of the pattern jack bed 10. The foot 7 of the needle jack 4 likewise remains sunk in the bed 6 and cannot be engaged by any part of the cam.

As shown in figs. 13 to 15, the eccentrics 26, 26a .... 26p are mounted upon the shaft 34, at the end of which remote from the needle bed 1 there is mounted a pinion 33. The pinion 33 meshes with a rack secured to the machine frame so that the shaft 34 is driven synchronously with the carriage movement. The pinion 33 and the rack 35 are designed to suit the fineness of gauge of the machine.

Fig. 13 shows all of the eccentrics 26 and the control strips 16 in the rest position, whilst in fig. 14 the eccentric 26, the control strip 16 together with the appertaining foot 11 are depressed into the half position. In fig. 15 a control strip 16 and the foot 11 have been completely depressed and retained.

Fig. 16 to 19 show the pattern mechanism with pattern jacks, wherein the lever carrying the control strip 16 is designed as a double armed lever, which is pivotably mounted about a pivot 36. Upon the lever arm 37 remote from the control strip 16 there is carried a roller 38. Between the diagonally staggered rows of feet 11 .... 11p of the pattern jacks 8 there are likewise arranged diagonally directed switching cams 39. When, in the passage of the cam and the carriage, the roller 38 encounters a switch cam 39, then the control strip 16 is tilted downwardly, the spring 27 is tensioned and the actuating surface 20 of the control strip 16 is guided towards the needle bed. The retention of the control strip 16 in its particular operating position is effected by means of a double electromagnet 29 in the same way as the previously described example.

Fig. 20 shows a further practical form of a single armed lever for the control strip 16. By means of a spring 69 the lever is continuously pressed against the surface of the needle bed and the control strip is raised, for example by the feet 11 of the pattern jacks 8, into its operating position determined by the armature 28 of the double electromagnet 29.

A further practical form of a single armed lever for the control strip 16 is shown in figs. 21 and 22. The shaft 40 of the lever is self sprung and at one of its ends 41 is clamped securely in a bearing 42 in such a manner that the actuating surface 20 of the control strip 16 slides closely above the needle bed. By means of a stop 43 the control strip is held in a lightly stressed condition at the necessary spacing from the needle bed. The spring force of the shaft 40 is substantially smaller than the spring force of the spring 14 of the pattern jack 8. If now during the travel of the carriage the actuating surface 20 of the control strip 16 encounters a foot 11 of the pattern jack 8, then the control strip 16 is pressed upwardly as is shown in fig. 21. The foot 11 projects fully out of the pattern lever bed 10, which position is suitable for knit-stitch formation.

Above the control strips there are provided electromagnets 44 and 46. If the electromagnet 44 attracts its armature 45 before the strip 16 encounters a foot 11, the control strip 16 is retained in its basic position and

the pattern jack 8 cannot move out of its basic position in the pattern jack bed 10. It therefore remains sunk in the pattern jack bed 10, whereby also the foot 7 of the needle jack remains sunk in the bed 6 in the position "not knitting". By switching in only the electromagnet 46 the control strip 16 may be held in the half position, i.e. the tuck position, as may be likewise seen from fig. 22.

In the figures 23 to 29 there is shown a further pattern mechanism with appertaining parts, wherein pattern jacks 47, which are movable in the direction of the needles, are selected and control the needles 2. For this purpose a wider needle bed 48 is necessary, which, however, has the advantage that the needle channels are not so deep. As is seen in fig. 23, in this needle bed 48 the needles 2 are displaceably mounted and are covered by a cover rail 3. In accordance with the pattern, an intermediate needle jack 49, acting upon the foot of the needle, displaces it to the desired selection point in a needle cam system, which is shown in more detail in figs. 28 and 29.

The intermediate needle jack 49, the foot of which passes through a pattern cam system, likewise shown in more detail in figs. 28 and 29, is itself selected by the pattern jack 47 lying behind it in the needle bed 48. The pattern jacks 47 are provided with feet 54a, 54b, 54c, ... 54o, which in succeeding pattern jacks 47 are staggered into different positions. Between each two successive corresponding feet positioned in the length of the needle bed, there is a free path *a* as shown in fig. 24, in which, upon passage of the carriage, there is moved a displacement member 55 having displacement inclines 56, 57 and 56', 57'.

The movement of the displacement member 55, may be seen from figs. 25 to 27. A double armed lever 58 is pivotally mounted upon the carriage. By means of a spring 59 the lever is biased always into a basic position in such a manner that its lever arm 60, to which the member 55 is secured, always holds the latter out of engagement with the feet 54 as shown in fig. 27. Upon the other lever arm 62 there is provided an incline 61. Upon passage of the carriage, this second lever arm 62 is lifted by cooperation of the incline 61 with, for example, an adjacent foot 54a, whereby the lever 58 stresses the spring 59. According to the height of the foot 54a the lever arm 60 is tilted so far downwardly that the displacement member 55 is brought into position close to the surface of the needle bed 48.

If now the lever 58 is retained in this position by the armature 45 of the electromagnet 44, then the subsequent feet 54a are engaged by the displacement inclines 56 or 56' of the member 55 and, by means of the pattern jack 47, push the foot 53 of the intermediate needle jack 49 into a channel 63 of the pattern cam system 52 shown in figs. 28 and 29. Thereby the intermediate needle jack 49 brings the foot 50 of the needle 2 into a channel 64 of a needle cam system shown in figs. 28 and 29, and is driven by a needle lifter 65 to form knit stitches.

If now, by means of an armature 66 of a further electromagnet 46, or by time delay effected by the control of the armature 45 of the electromagnet 44, the lever arm 60 is arrested in the next stage or half position, as is shown in fig. 26, then the feet 54a are engaged by the deeper and further inwardly situated displacement inclines 57 or 57' of the member 55. The particular pattern jack 47 then pushes the foot 53 of the intermediate needle jack 49 into a channel 67 of the pattern cam system 52. The intermediate needle jack 49 thereby brings the needle 2 having the foot 50 underneath the needle lifter 65, and the foot 50 will then only be engaged by a tucking bridge 68 for tuck-stitch formation, as is represented in fig. 29. The tucking bridge 68 is so controlled that it follows on during the cycle of the machine.

In flat knitting machines the sets 18 and 19 of control members, which in this case are fitted with levers 58, are in each case allocated to the leading selection point, as represented in figs. 6 and 7. In this way, as already explained, the required number of selection elements and of the members controlling them, for example the electromagnets, is reduced by one half as compared with non-displaceable sets. The long axis of the lever 58 is directed substantially in the direction of carriage movement. At the end of the lever arm 62, the feet 54 of the pattern jacks 47 form switching cams for moving the lever 58 into a position, in which the feet 54 of other pattern jacks 47, which are spaced away at a distance of at least twice the length of the free path *a*, can be engaged by the displacement member 55.

The electromagnets 29, 44, 46 situated upon the carriage can be controlled by an electronic control arrangement, either on-line or off-line, by means of a connecting cable or other transmitting means.

WHAT WE CLAIM IS:

1. A flat bed knitting machine comprising a plurality of needle jacks arranged in side by side relation and being movable in the direction of movement of associated needles upon engagement with cam means movable transversely of the needle jacks, and pattern jacks engaging the needle jacks, butt means on each of the pattern jacks and arranged in groups with the adjacent butt means of each group being in staggered formation, a plurality of pattern jack control members, each control member being movable towards the pattern jacks for engage-

ment with and displacement of a respective one of the butt means to position the associated one of the needle jacks in a desired one of predetermined positions of the needle jacks relative to the cam means in accordance with a particular pattern, mechanical means arranged to move the control members towards the pattern jacks, means for retaining each of the control members in a selected one of positions corresponding respectively to said predetermined positions of the needle jacks, means grouping the plurality of control members into a plurality of sets each associated with a respective one of the cam means and each corresponding in number to the number of the butt means in said group thereof, and means for displacing the sets of control members together to selection positions of the cam means in the direction of movement of the cam means.

2. A flat bed knitting machine as claimed in claim 1, having means for selectively moving the sets of control members separately to selection positions in the direction of cam movement.

3. A flat bed knitting machine as claimed in claim 1 or 2, wherein said means for retaining the lifting control members each comprises two electromagnets arranged one beside the other.

4. A flat bed knitting machine as claimed in claim 1 or 2, wherein said means for retaining the control members each comprises a double electromagnet.

5. A flat bed knitting machine as claimed in any one of claims 1 to 4, wherein the control members are comprised in levers having displacement members mounted thereon at two respective spacings from pattern jacks, the displacement members having displacement inclines at a first spacing for the selection of tuck stitch knitting located to be operative later than displacement inclines at a second spacing for the selection of knit stitch knitting.

6. A flat bed knitting machine as claimed in claim 5, wherein the levers comprise double armed levers having the control members mounted at one end thereof.

7. A flat bed knitting machine as claimed in claim 6, having spring means urging the double armed levers to move the control members away from the pattern jacks and means incorporated in said levers for causing movement of said control members towards the pattern jacks by engagement of said movement causing means with the butt means.

8. A flat bed knitting machine substantially as herein described with reference to figures 1 to 15, figures 16 to 19, figure 20, figures 21 and 22 or figures 23 to 29 of the accompanying drawings.

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Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1981. Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

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Sheet 1

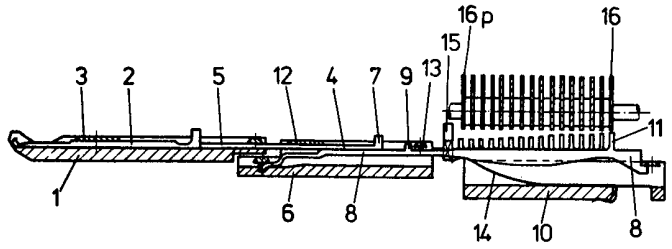

Fig. 1

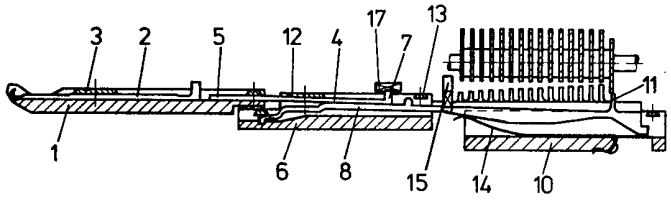

Fig. 2

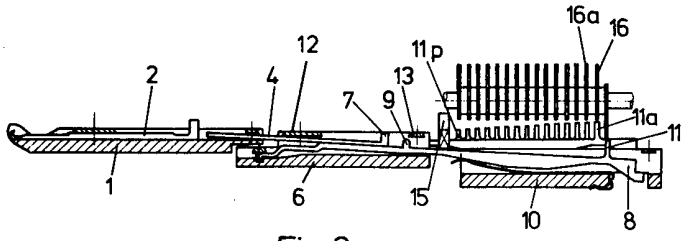

Fig.3

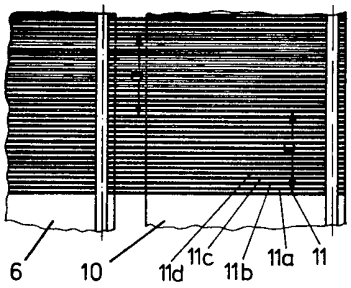

Fig.4

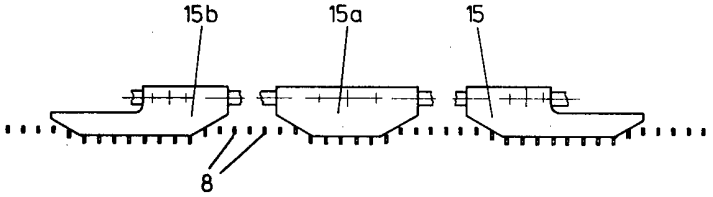

Fig.5

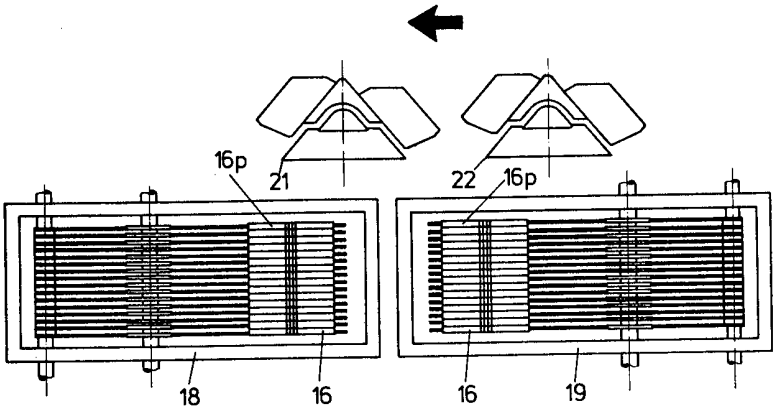

Fig. 6

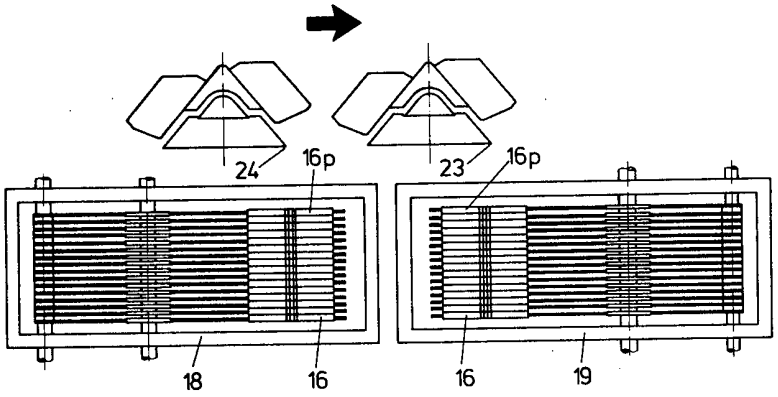

Fig. 7

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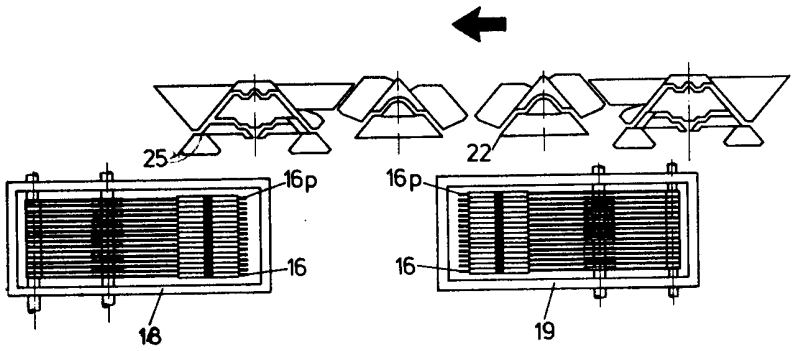

Fig. 8

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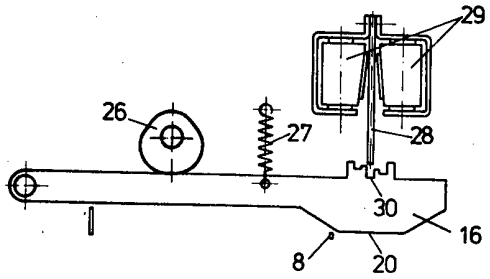

Fig. 9

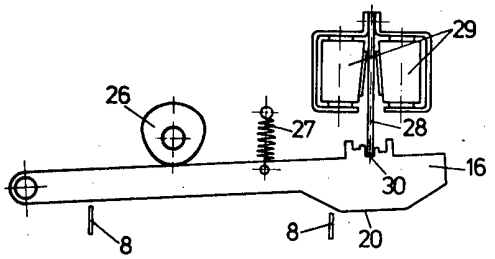

Fig. 10

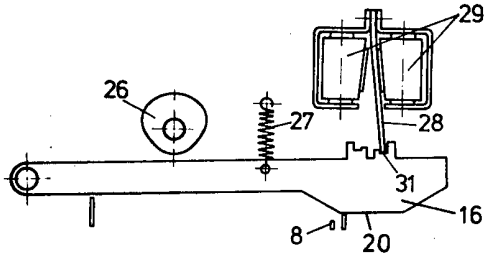

Fig. 11

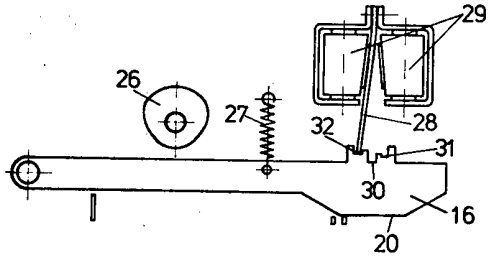

Fig. 12

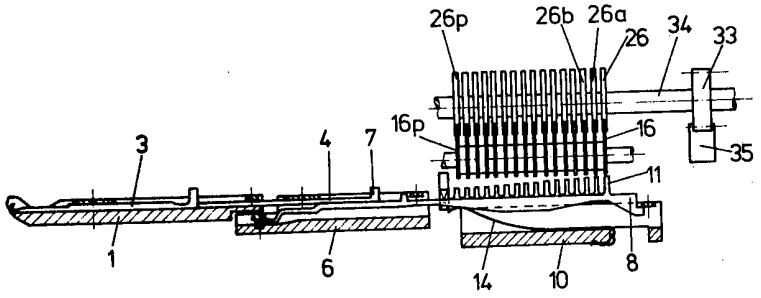

Fig. 13

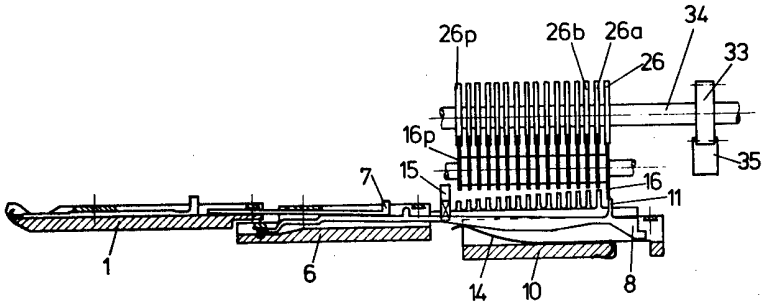

Fig. 14

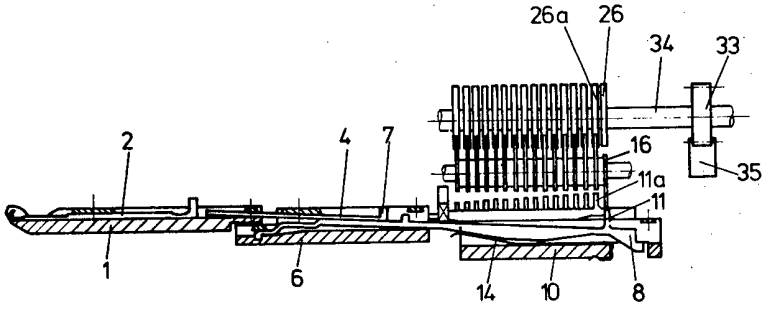

Fig. 15

Fig.16

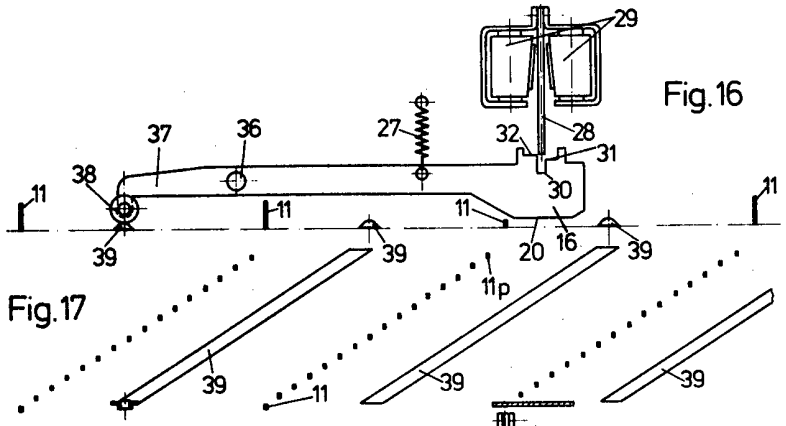

Fig.17

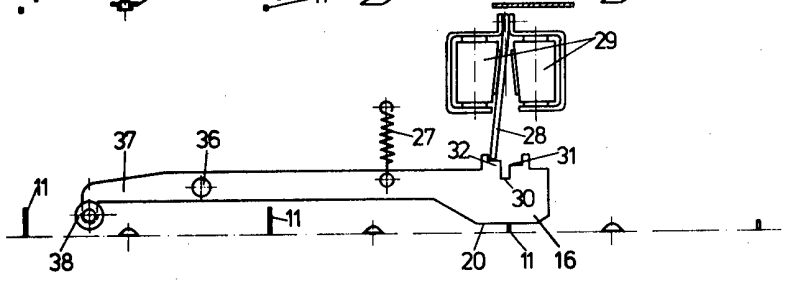

Fig.18

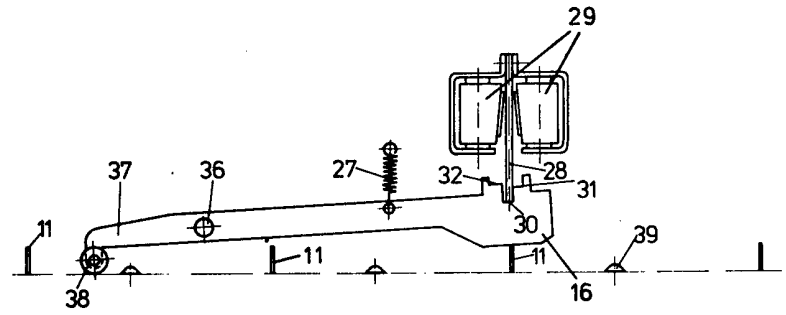

Fig. 19

1589373 COMPLETE SPECIFICATION
13 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 8

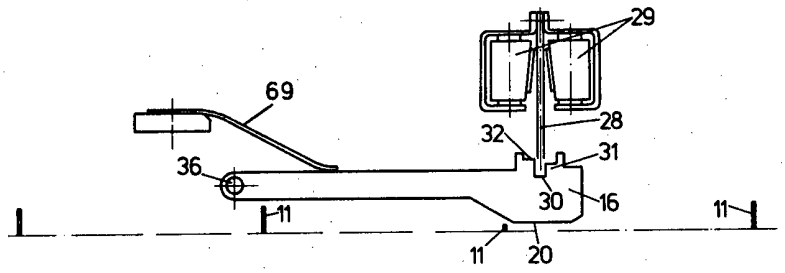

Fig. 20

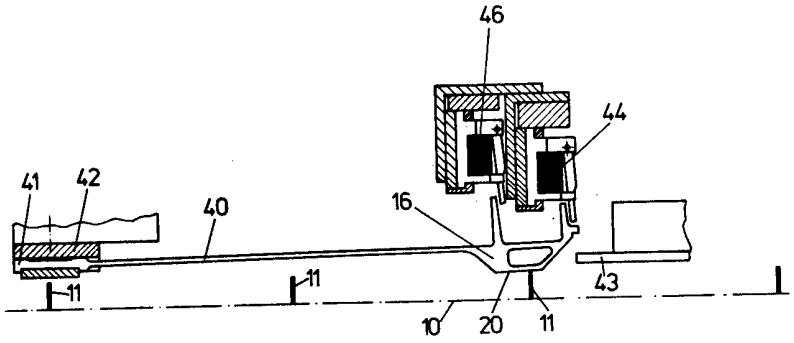
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Fig. 21

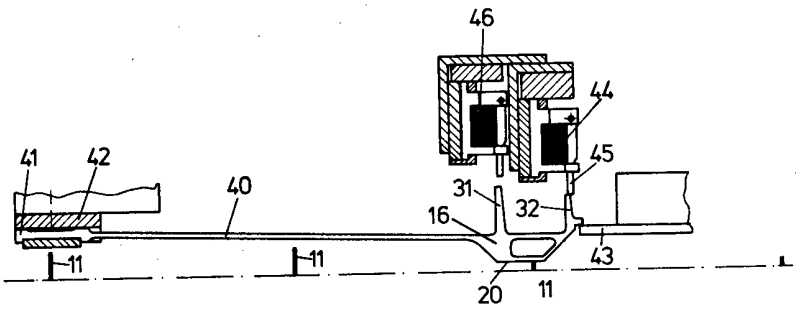
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Fig. 22

1589373 COMPLETE SPECIFICATION

13 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 10

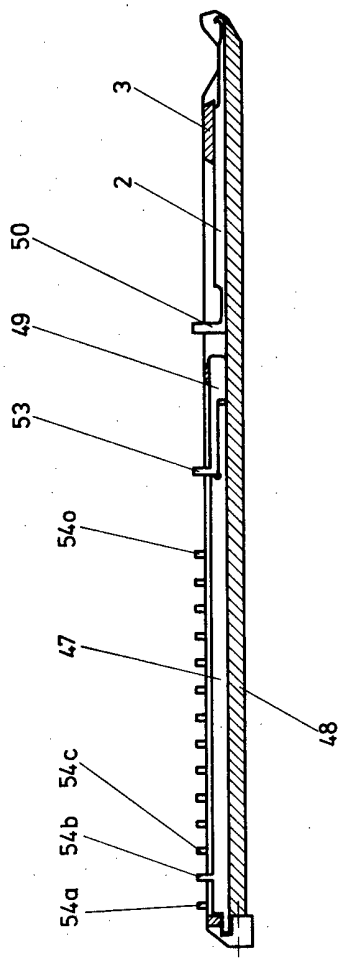


Fig. 23

1589373 COMPLETE SPECIFICATION
13 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 11

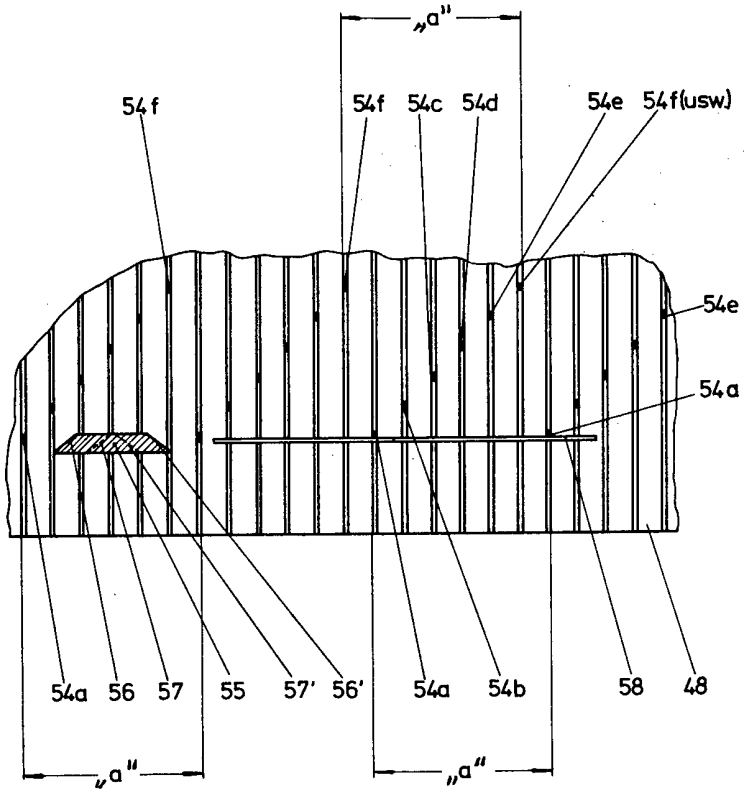


Fig. 24

Fig. 25

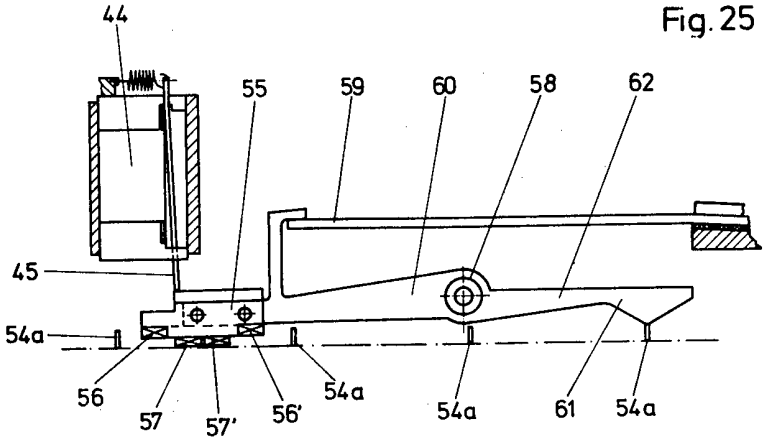


Fig. 26

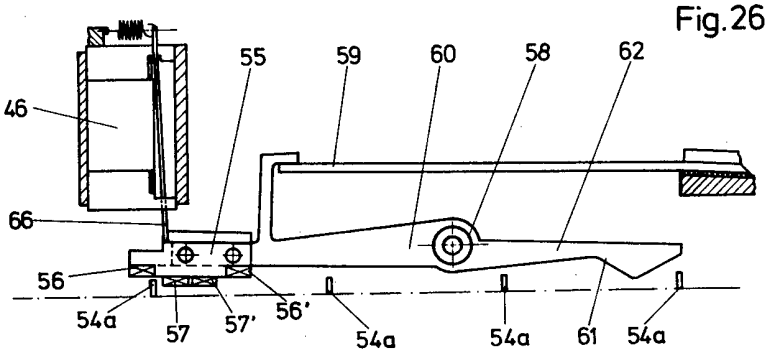
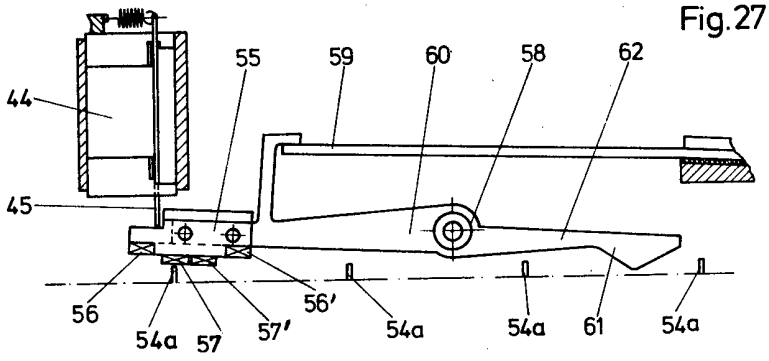


Fig. 27



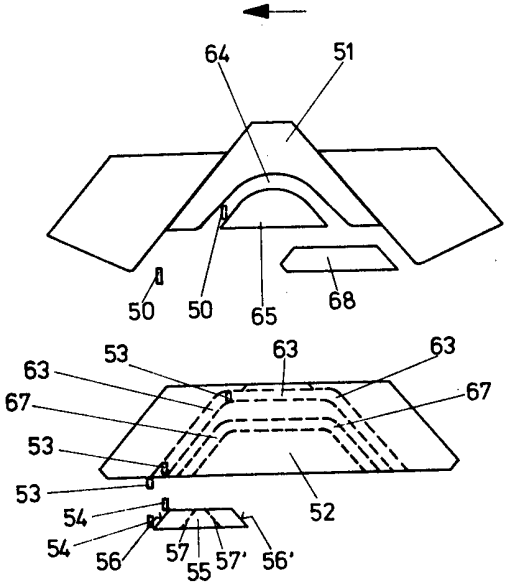

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Fig. 28

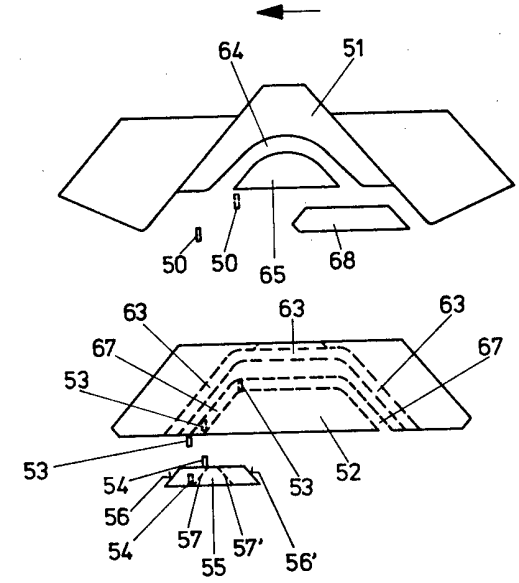
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Fig. 29