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(54) Highly versatile circular knitting machine for hosiery and the like with multiple drops or feeds

(57) A circular knitting machine for hosiery and the like with multiple drops or feeds comprising a needle cylinder and a needle actuation cam apron (1) which faces the lateral surface of said needle cylinder. Upstream of at least one feed or drop (60) of the machine along the direction of rotation of the needle cylinder with respect to the cam apron (1) there are: a first cam (21), which can be engaged by a heel (16) of the sub-needles (13) and is adapted to raise the needles (12) to the tuck-stitch position, and a second cam (22), which is located downstream of the first cam (21) and can be engaged by the heel (16) of the sub-needles (13) in order to lift the needles (12) to the drop-stitch position. A first auxiliary cam (23) is arranged above the first cam (21), can be actuated on command and can engage a heel (18) of the sub-needles (13) that engage the first cam (21) for the further lifting of the corresponding needles (12) to the drop-stitch position. A first selection device is provided upstream of the first cam (21) and acts on the sub-needles (13) for their engagement or nonengagement with the first cam (21); a second selection device is arranged between the first cam (21) and the second cam (22) and acts on the sub-needles (13) for their engagement or nonengagement with the second cam (22).

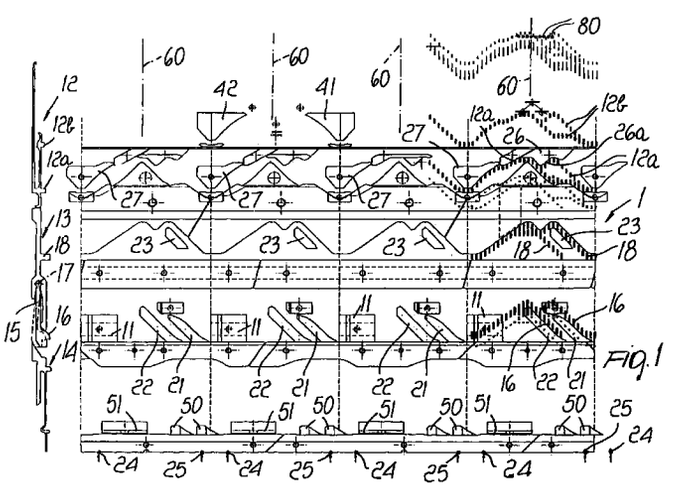

FIG. 1

EP 0 962 569 A2

Description

[0001] The present invention relates to a highly versatile circular knitting machine for hosiery and the like with multiple drops or feeds.

[0002] It is known that in knitting machines for hosiery and the like with multiple drops or feeds some kinds of knitting require a significant reduction of the productivity of the machine.

[0003] For example, in a four-drop circular machine, when one wishes to form knitting composed of one elastic thread and two colored yarns it is necessary to use one drop to supply the elastic yarn and two separate drops to supply the two colored yams; accordingly, it is possible to form only one row of knitting for each turn of the needle cylinder about its own axis. Moreover, with four-drop circular machines it is possible to form patterning with no more than four colored yams knitted separately in addition to the base yarn for each row of knitting.

[0004] Substantially, in conventional multiple-drop machines there is first of all a reduction in production when forming rows composed of a plurality of yarns to be knitted-in separately from each other, and there is also a limitation in the number of colors usable for each row of knitting when forming patterning.

[0005] The aim of the present invention is to solve the above described problem by providing a circular knitting machine for hosiery and the like with multiple drops or feeds which, for an equal number of feeds, can form patterning with a larger number of separately knitted-in colored yarns per row of knitting than allowed by conventional machines.

[0006] Within the scope of this aim, an object of the invention is to provide a machine which, for an equal number of usable yams, can form a higher number of rows for each turn of the needle cylinder.

[0007] Another object of the invention is to provide a circular knitting machine for hosiery which allows to produce a wide range of knitting types.

[0008] This aim, these objects and others which will become apparent hereinafter are achieved by a circular knitting machine for hosiery and the like with multiple drops or feeds, comprising a needle cylinder and a needle actuation cam apron which faces the lateral surface of said needle cylinder; said needle cylinder having, on its lateral surface, a plurality of axial slots, each of which accommodates a sub-needle and a needle which have heels which protrude radially from the needle cylinder and can engage paths formed by cams of said cam apron for the movement of the needles along the corresponding slot of the needle cylinder following the actuation of the needle cylinder with a rotary motion about its own axis with respect to said cam apron, characterized in that it comprises, upstream of at least one feed or drop along the direction of rotation of the needle cylinder with respect to the cam apron: a first cam, which can be engaged by a heel of the sub-needles and is adapted to raise the needles to the tuck-stitch position, and a second cam, which is located after said first cam and can be engaged by a heel of the sub-needles, said second cam being adapted to lift the needles to the drop-stitch position; a first auxiliary cam being arranged above said first cam, being activatable on command and being able to engage a heel of the sub-needles that engage said first cam for the further lifting of the corresponding needles to the drop-stitch position; a first selection device being provided upstream of said first cam, said device acting on said sub-needles for their engagement or nonengagement with said first cam; a second selection device being arranged between said first cam and said second cam, said second device acting on said sub-needles for their engagement or nonengagement with said second cam.

[0009] Further characteristics and advantages of the invention will become apparent from the following detailed description of a preferred but not exclusive embodiment of the machine according to the invention, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

Figure 1 is a flat projection view of the cam apron of a circular knitting machine for hosiery with four drops according to the invention, with an assembly constituted by a needle, a sub-needle and a selector arranged adjacent thereto;

Figures 2 to 8 are views of a portion of the cam apron at a feed of the machine during the execution of some kinds of knitting.

[0010] With reference to the above Figures, the machine according to the invention comprises, in a per se known manner, a needle cylinder which has a vertical axis and around which there is a cam apron generally designated by the reference numeral 1. The needle cylinder can be actuated so as to rotate about its own axis with respect to the cam apron 1. The needle cylinder 10 has, in a per se known manner, on its lateral surface, a plurality of slots, each of which accommodates a needle 12 and, below said needle, a sub-needle 13. A selector 14 is arranged below the sub-needle 13 and is actuated by adapted selection devices, arranged around the needle cylinder, upstream of each feed or drop of the machine, as will become apparent hereinafter.

[0011] The sub-needle 13 is preferably of the oscillating type, i.e., it has, proximate to its lower end, a portion 15 which is provided with a heel 16 directed toward the outside of the needle cylinder. The portion 15 can oscillate about an oscillation axis 17 with respect to the remaining part of the sub-needle 13 in order to move the corresponding heel 16 from an inactive position, in which it is recessed within the corresponding slot of the needle cylinder so as to not interfere with the cams of the cam apron 1, to an active position, in which it protrudes from the corresponding slot of the needle cylin-

der toward the apron 1 in order to engage the cams of said apron. The selector 14 is movable, in a per se known manner, along the corresponding slot of the needle cylinder in order to produce the transfer of the portion 15 from the inactive position to the active position. Moreover, in the cam apron 1, upstream of each feed or drop of the machine, there are resetting cams 11 which act on the heel 16 so as to produce the transfer of the portion 15 from the active position to the inactive position. The selector 14 is actuated by the selection devices and is moved along the corresponding slot of the needle cylinder by adapted cams 50. Resetting cams 51 are provided for the selectors 14 as well.

[0012] The cam apron 1 comprises, upstream of at least one feed or drop of the machine, designated by the line 60, along the direction in which the needle cylinder rotates with respect to the cam apron 1: a first cam 21, which can be engaged by the heel 16 of the sub-needles 13 and is adapted to lift the needles 12 to the tuck-stitch position, and a second cam 22, which is located downstream of the first cam 21 and can be engaged by the heel 16 of the sub-needles 13 in order to lift the needles 12 to the drop-stitch position.

[0013] Above the first cam 21 there is a first auxiliary cam 23 which is actuatable on command and can engage another heel 18 of the sub-needles 18 that have engaged the first cam 21 in order to produce a further rise of the corresponding needles 12 to the drop-stitch position.

[0014] Upstream of the first cam 21 there is a first selection device which acts on the selectors 14 at a point 24 and, by means of said selectors, on the sub-needles 13 for their engagement or nonengagement with the first cam 21, and between the first cam 21 and the second cam 22 there is a second selection device which acts on the selectors 14 at the point 25 and, by means of said selectors, on the sub-needles 13 in order to cause their engagement or nonengagement with the second cam 22.

[0015] Conveniently, the cam apron comprises a second auxiliary cam 26 which is arranged above the first cam 21 and the second cam 22. The second auxiliary cam 26 has a descending portion 26a which is arranged between the first cam 21 and the second cam 22 and can be engaged by a heel 12a of the needles 12 in order to lower the needles 12 that engage said descending portion 26a to a lower level than the needles 12 raised by the second cam 22.

[0016] The first auxiliary cam 23 is movable on command, in a per se known manner, radially with respect to the needle cylinder from an active position, in which it is close to the needle cylinder so as to interfere with the heel 18 of the sub-needles 13 raised by the first cam 21, to an inactive position, in which it is spaced from the needle cylinders, with respect to the active position, so as to not interfere with the heels 18 of the sub-needles 13 lifted by the first cam 21, or viceversa.

[0017] Likewise, the second auxiliary cam 26 is movable on command, in a per se known manner, radially to the needle cylinder from an active position, in which it is close to the needle cylinder in order to interfere with the heel 12a of the needles 12 raised by the first cam 21, to an inactive position, in which it is spaced from the needle cylinder, with respect to the active position, so as to not interfere with the heels 12a of the needles 12 raised by the first cam 21, or viceversa.

[0018] Furthermore, at at least one feed of the machine there is a conventional lowering cam 27 which is movable on command radially to the needle cylinder from an active position, in which it is close to the needle cylinder in order to interfere with the heel 12a of the needles 12 raised by the first cam 21 or by the second cam 22, to an inactive position, in which it is spaced from the needle cylinder, with respect to the active position, so as to not interfere with the heels 12a of the needles 12.

[0019] Preferably, the machine according to the invention comprises at least four feeds or drops 60.

[0020] The first cam 21, the second cam 22, the first auxiliary cam 23 and the second auxiliary cam 26 can be provided at each feed of the machine or only at some of the feeds of the machine, according to the requirements.

[0021] For the sake of completeness in description, it is noted that the cam apron comprises lowering cams 41 and 42 at a feed or drop 60 for actuating the needles 12 during the alternating motion of the needle cylinder about its own axis. Conveniently, the paths traced by these lowering cams 41 and 42 are separate from those traced by the cams that actuate the needles in the continuous rotary motion of the needle cylinder and can be engaged by another heel 12b of the needles 12 located above the heel 12a.

[0022] The other cams of the cam apron that cooperate with the above described cams to form paths for the heels of the needles 12, of the sub-needles 13 and of the selectors 14 and are of a conventional type are not described further for the sake of brevity.

[0023] Figures 2 to 8 illustrate some kinds of knitting that can be produced with the machine according to the invention.

[0024] Figure 2 illustrates a first kind of knitting, for which the first auxiliary cam 23 is in the active position while the second auxiliary cam 26 is in the inactive position and is not shown for the sake of clarity. The selection device that acts at the point 24, i.e., directly upstream of the first cam 21, acts by means of the selectors 14 on preset sub-needles 13, causing their portion 15 to pass from the inactive position to the active position, so that their heel 16 engages the first cam 21. The corresponding needles 12 are thus raised initially by the first cam 21 and are then raised further following the engagement of the heel 18 of the sub-needles 13 with the first auxiliary cam 23 and are raised to a drop-stitch position. In this position, the raised needles 12 can take up the yarn or yarns supplied at the feed being

considered, producing drop stitches. This operating condition can be used for example in the formation of plain knitting, with the possibility to use all the yarn fingers 80 of a drop to feed the active needles 12.

[0025] Figure 3 illustrates an operating condition in which the first auxiliary cam 23 and the second auxiliary cam 26 are in the inactive position and are not shown for the sake of clarity. In this case, the second selection device is used, acting at the point 25 and causing preset sub-needles 13 to engage the second cam 22 with their heel 16. The corresponding needles 12 are thus raised to the drop-stitch position and can take up the yarns dispensed at the feed being considered. It should be noted that the number of yarns available for the needles 12 raised by the second cam 22 is smaller than the number of yarns available for the needles 12 raised by the first cam 21 in the kind of knitting described earlier with reference to Figure 2.

[0026] In the operating condition shown in Figure 4, the first auxiliary cam 23 is in the inactive position and therefore is not shown, while the second auxiliary cam 26 is in the active position. The first selection device, which acts at the point 24, causes preset sub-needles 13 to engage the first cam 21 with their heel 16. The corresponding needles 12 are raised to the held-stitch position, consequently forming held stitches. This operating condition can be used for example in the laying-in of the elastic of hosiery. In practice, the elastic yarn is taken up by the needles 12 raised into the held-stitch position without dropping the loop formed previously due to the feeding of the yarn to said needles 12 at a preceding feed.

[0027] Figure 5 illustrates an operating condition in which the needles 12 are selected both at the point 24 and at the point 25, using the two selection devices, In this operating condition, the first auxiliary cam 23 is in the inactive position and is therefore not shown, and the second auxiliary cam 26 also is in the inactive position and is likewise not shown. Following the selection performed at the point 24, some sub-needles 13 engage the first cam 21 with their heel 16, while other sub-needles 13, following the selection performed at the point 25, engage the cam 22 with their heel 16. In practice, the needles 12 that correspond to the sub-needles 13 that engage the first cam 21 form held stitches, while the needles 12 that correspond to the sub-needles 13 that engage the second cam 22 form drop stitches. This operating condition can be used to obtain a plastic effect in the knitting.

[0028] In the operating condition shown in Figure 6, the first auxiliary cam 23 is in the active position, while the second auxiliary cam 26 is in the inactive position and is therefore not shown. Some sub-needles 13 are selected at the point 24 and engage the first cam 21 with their heel 16, while other sub-needles 13 are selected at the point 25 and engage the second cam 22 with their heel 16. Owing to the fact that the first auxiliary cam 23 is in the active position, both the needles 12 that correspond to the sub-needles 13 that engage the first cam 21 and the needles 12 that correspond to the sub-needles 13 that engage the second cam 22 form drop stitches. The needles 12 that correspond to the sub-needles that engage the first cam 21 have available, and can therefore take up, the yarn that is dispensed from a larger number of yarn fingers 80 than available for the needles 12 that correspond to the sub-needles 13 that have engaged the second cam 22. This operating condition can be used for example to form reinforced portions of knitting.

[0029] In the operating condition shown in Figure 7, both the auxiliary cam 23 and the second auxiliary cam 26 are in the active position and the sub-needles 13 are selected both at the point 24 and at the point 25. In this way, some sub-needles 13 engage the first cam 21 with their heel 16, while other sub-needles 13 engage the second cam 22 with their heel 16.

[0030] The needles 12 that correspond to the sub-needles 13 that have engaged the first cam 21 and then the first auxiliary cam 23 are raised to a level which corresponds to a drop stitch, so as to take up one or more yarns supplied at the feed being considered, and are then lowered, following the engagement of the heel 12a of the needles 12 with the second auxiliary cam 26, so as to not take up the yarn at the yarn fingers 80 that follow.

[0031] The needles 12 that correspond to the sub-needles 13 that have engaged the second cam 22 with their heel 16 form drop stitches. This operating condition can be used in the formation of patterning with a plurality of colored yarns, since the needles 12 that correspond to the sub-needles 13 raised by the first cam 21 can take up a colored yarn, while the needles 12 that correspond to the sub-needles 13 that have engaged the second cam 22 can take up another colored yarn. In this manner it is possible to have loops of knitting of different colors on a same row of knitting and by passing through a single drop.

[0032] In the operating condition shown in Figure 8, the first auxiliary cam 23 and the second auxiliary cam 26 are in the active position, while the lowering cam 27 is in the inactive position and is therefore not shown. By virtue of the selection performed at the points 24 and 25, some sub-needles 13 engage the first cam 21 with their heel 16, while other sub-needles 13 engage the second cam 22 with their heel 16. The needles 12 that correspond to the sub-needles 13 that have engaged the first cam 21 are raised to the drop-stitch position and can take up a yarn supplied at the feed being considered, subsequently lowering in order to avoid taking up the yarn supplied by the subsequent yarn fingers 80 at the same feed. The needles 12 that correspond to the sub-needles 13 that have engaged the second cam 22 are raised and can take up the yarn at the yarn fingers 80, at which the needles 12 that correspond to the sub-needles 13 engaged with the first cam 21 were excluded from taking up the yarn. Since the lowering

cam 27 is in the inactive position, only yarn takeup occurs, without forming loops; said loops will be formed only at subsequent feeds.

[0033] It has been observed in practice that the machine according to the invention fully achieves the intended aim, since it allows to form patterning with a larger number of colored yarns knitted in separately from each other for each row or, for an equal number of knitted yarns, it achieves higher productivity than conventional types of machine for equal feeds.

[0034] The machine according to the invention, if provided with four feeds, is in fact capable of forming patterning by separately knitting seven yarns of different colors in addition to the base yarn or, as an alternative, can form two rows per turn, separately knitting in four yarns.

[0035] The machine thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept; all the details may furthermore be replaced with other technically equivalent elements.

[0036] In practice, the materials employed, as well as the dimensions, may be any according to requirements and to the state of the art.

[0037] The disclosures in Italian Patent Application No. MI98A001232 from which this application claims priority are incorporated herein by reference.

[0038] 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 interpretation of each element identified by way of example by such reference signs.

Claims

1. A circular knitting machine for hosiery and the like with multiple drops or feeds, comprising a needle cylinder and a needle actuation cam apron (1) which faces the lateral surface of said needle cylinder; said needle cylinder having, on its lateral surface, a plurality of axial slots, each of which accommodates a sub-needle (13) and a needle (12) which have heels (12a,12b,16,18) which protrude radially from the needle cylinder and can engage paths formed by cams of said cam apron (1) for the movement of the needles (12) along the corresponding slot of the needle cylinder following the actuation of the needle cylinder with a rotary motion about its own axis with respect to said cam apron (1), characterized in that it comprises, upstream of at least one feed or drop (60) along the direction of rotation of the needle cylinder with respect to the cam apron (1): a first cam (21), which can be engaged by a heel (16) of the sub-needles (13) and is adapted to raise the needles (12) to the tuck-stitch position, and a second cam (22), which is located downstream of said first cam (21) and can be engaged by the heel (16) of the sub-needles, said second cam (22) being adapted to lift the needles (12) to the drop-stitch position; a first auxiliary cam (23) being arranged above said first cam (21), being actuatable on command and being able to engage a heel (18) of the sub-needles (13) that engage said first cam (21) for the further lifting of the corresponding needles (12) to the drop-stitch position; a first selection device being provided upstream of said first cam (21), said device acting on said sub-needles (13) for their engagement or nonengagement with said first cam (21); a second selection device being arranged between said first cam (21) and said second cam (22), said second device acting on said sub-needles (13) for their engagement or nonengagement with said second cam (22).

2. The machine according to claim 1, characterized in that it comprises a second auxiliary cam (26) which is arranged above said first cam (21) and said second cam (22); said second auxiliary cam (26) being actuatable on command and having a descending portion (26a) which is located between said first cam (21) and said second cam (22) and can be engaged by a heel (12a) of the needles (12) raised by said first cam (21) in order to lower them to a level which is lower than the level of the needles (12) raised by said second cam (22).

3. The machine according to claim 1, characterized in that said first auxiliary cam (23) can move on command radially with respect to the needle cylinder from an active position, in which it is close to the needle cylinder in order to interfere with the heel (18) of the sub-needles (13) raised by said first cam (21), to an inactive position, in which it is spaced from the needle cylinder with respect to said active position, so as to not interfere with the heels (18) of the sub-needles (13) raised by said first cam (21), or viceversa.

4. The machine according to one or more of the preceding claims, characterized in that said second auxiliary cam (26) is movable on command radially with respect to the needle cylinder from an active position, in which it is close to the needle cylinder in order to interfere with a heel (12a) of the needles (12) raised by said first cam (21), to an inactive position, in which it is spaced from the needle cylinder with respect to said active position, so as to not interfere with the heels (12a) of the needles (12) raised by said first cam (21), or viceversa.

5. The machine according to one or more of the preceding claims, characterized in that at said at least one feed or drop (60) there is a lowering cam (27)

which is movable move on command, radially with respect to the needle cylinder, from an active position, in which it is close to the needle cylinder in order to interfere with the heel (12a) of the needles (12) raised by said first cam (21) or by said second cam (22), to an inactive position, in which it is spaced from the needle cylinder with respect to said active position in order to not interfere with the heels (12a) of the needles (12).

6. The machine according to one or more of the preceding claims, characterized in that it comprises at least four feeds or drops (60).

7. The machine according to one or more of the preceding claims, characterized in that said sub-needle (13) has, proximate to its lower end, a portion (15) which is provided with a heel (16) and is movable on command with respect to the remaining part of the sub-needle (13), thanks to the action of said selection devices, from an active position, in which its heel (16) protrudes from the corresponding slot of the needle cylinder in order to engage said first cam (21) or said second cam (22), to an inactive position, in which it is embedded with its heel (16) in the corresponding slot of the needle cylinder in order to not engage said first cam (21) or said second cam (22).

8. The machine according to one or more of the preceding claims, characterized in that it comprises cams (41,42) which form paths which can be engaged by a heel (12b) of the needles (12) in the alternating rotary motion of the needle cylinder about its own axis; said paths engageable in the alternating motion of the needle cylinder being separate from the paths formed by the cams that actuate the needles in the continuous rotary motion of the needle cylinder about its own axis.

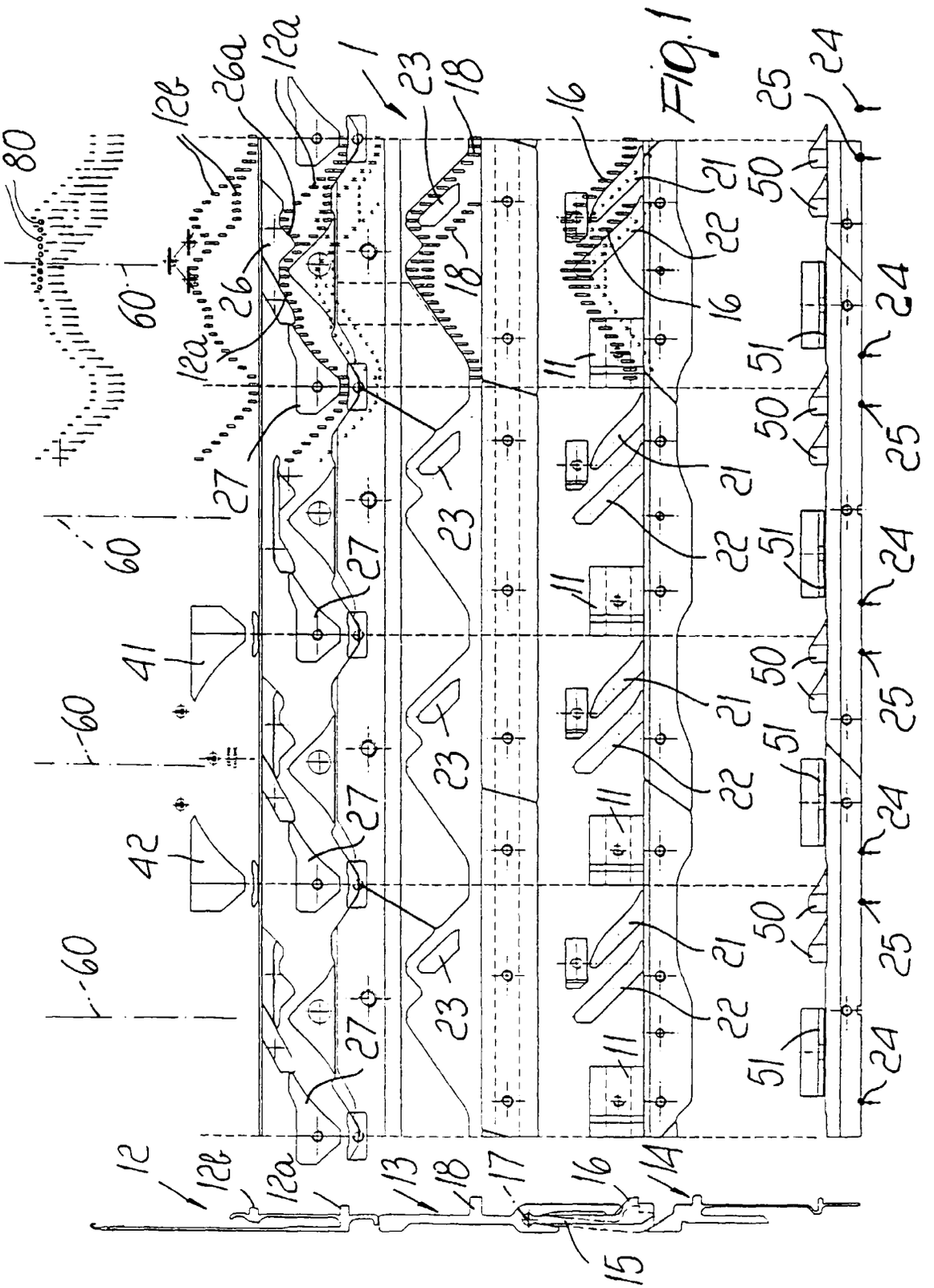

Fig. 1

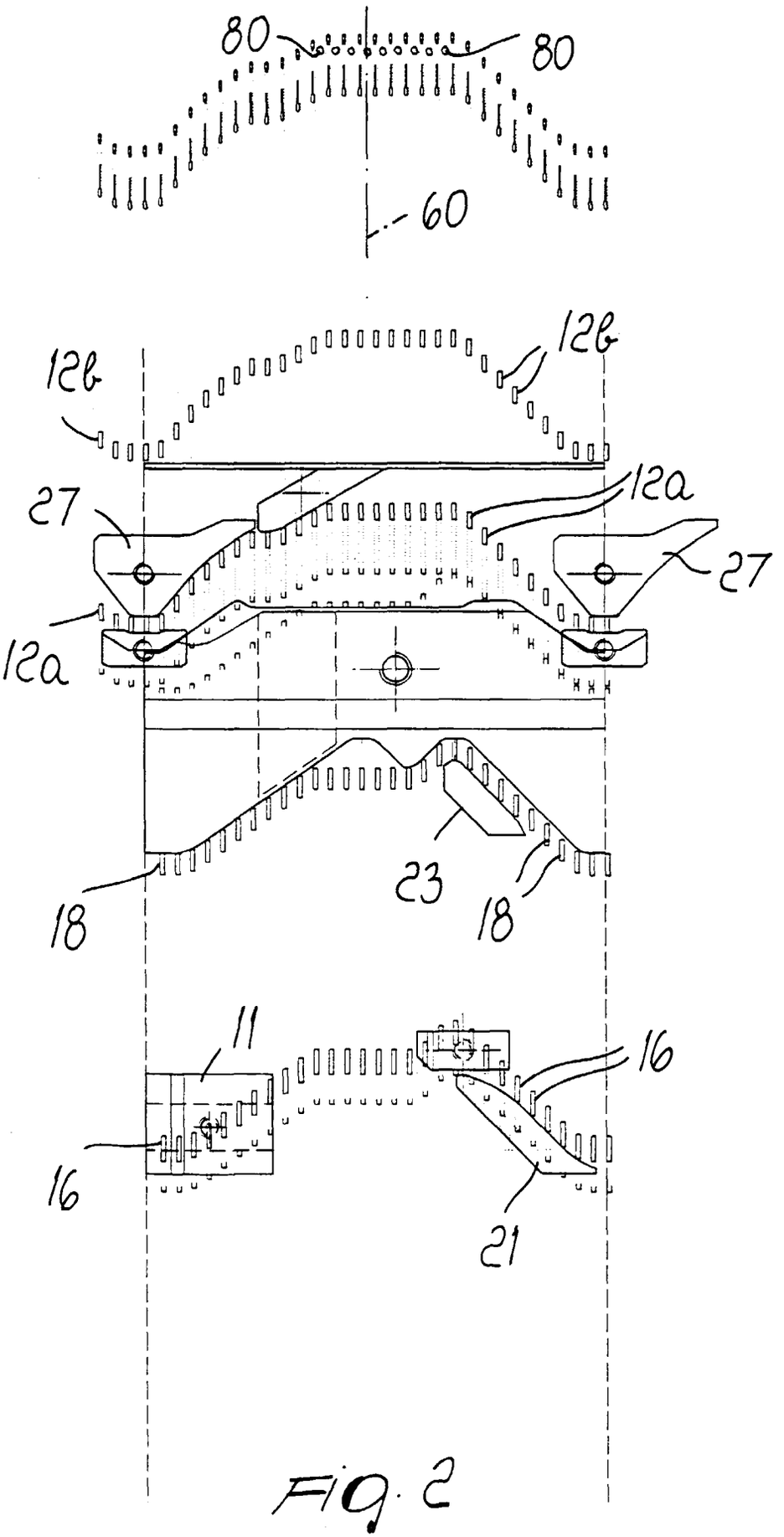

Fig. 2

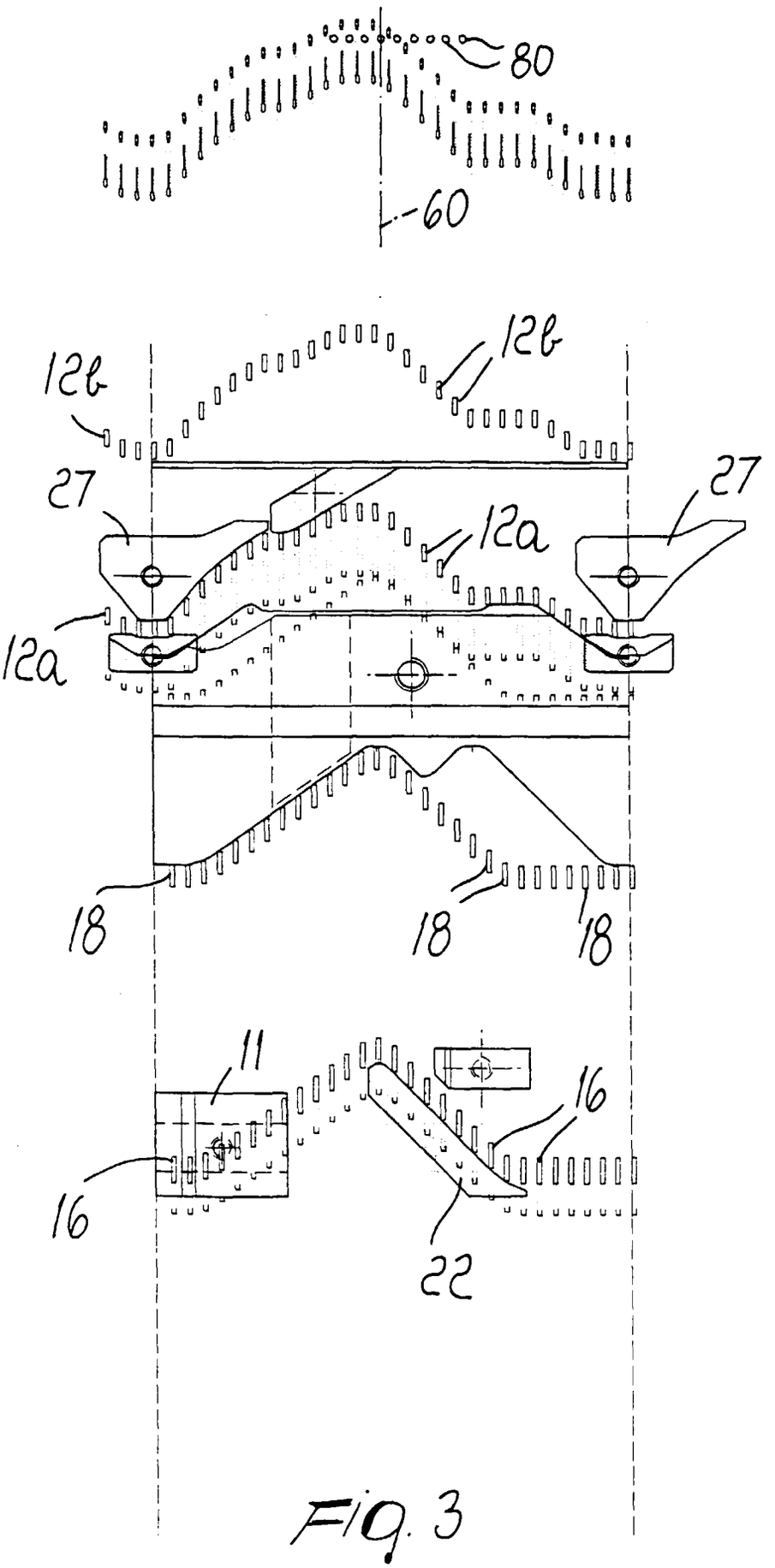

Fig. 3

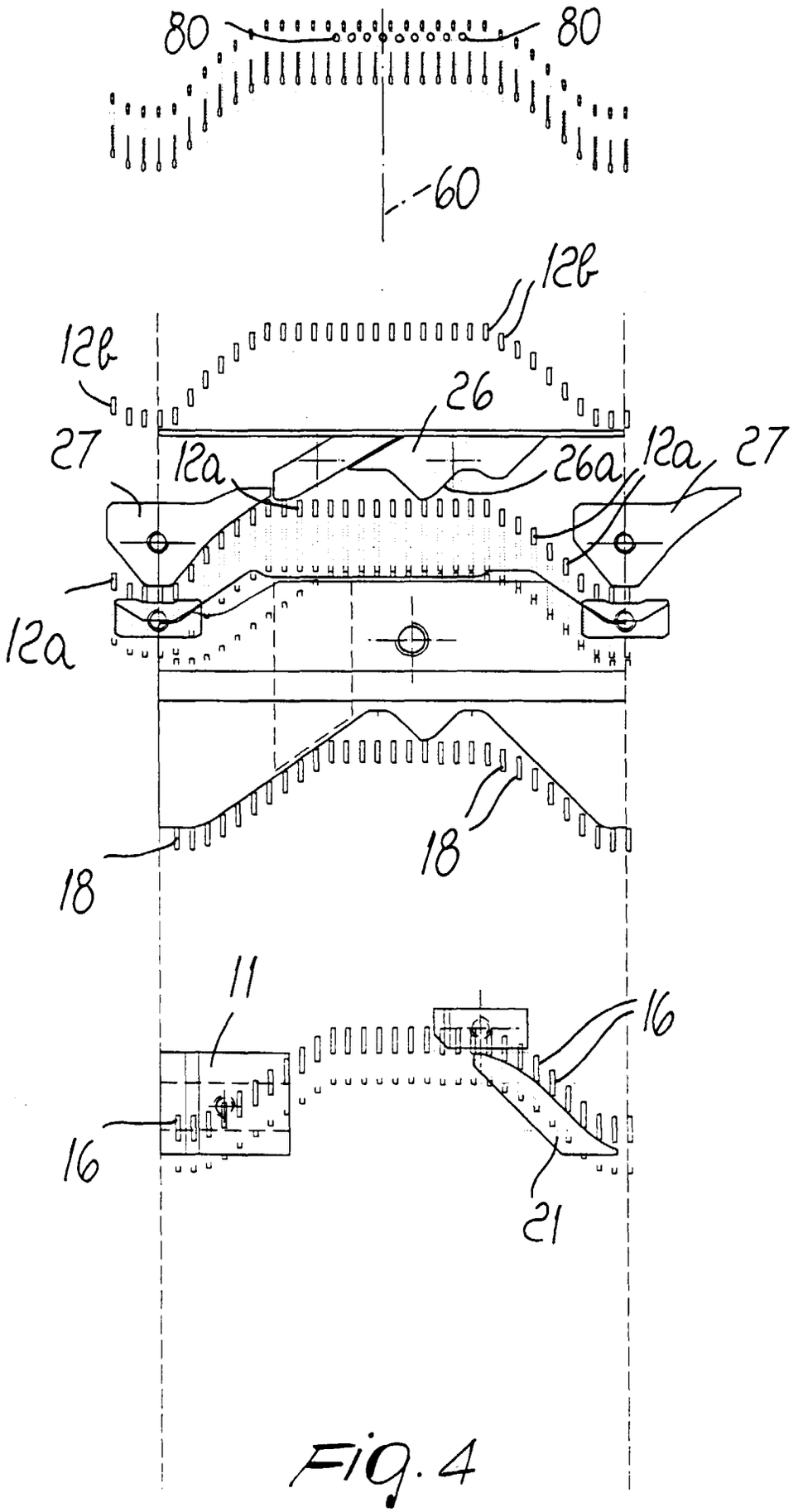

Fig. 4

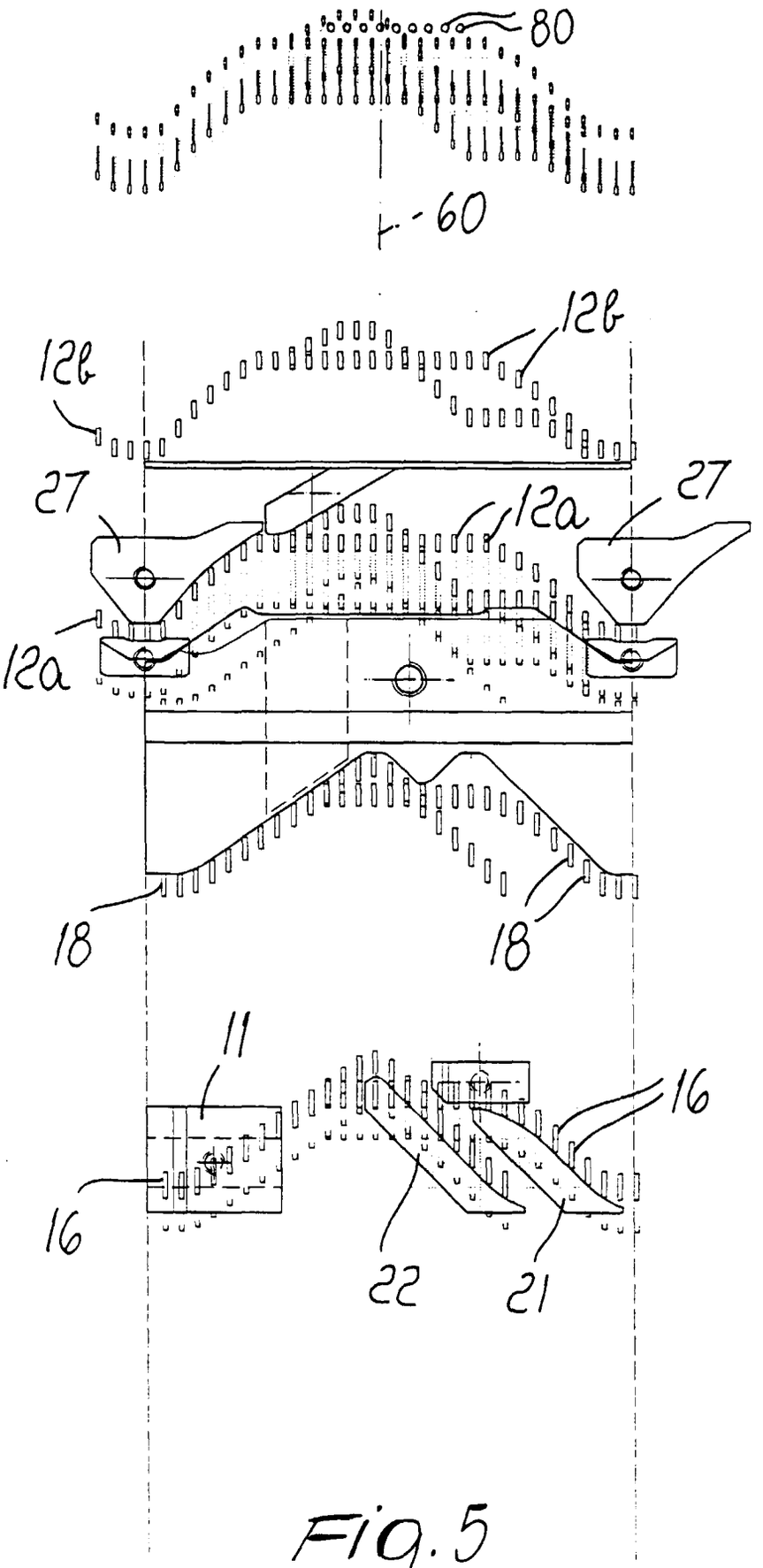

Fig. 5

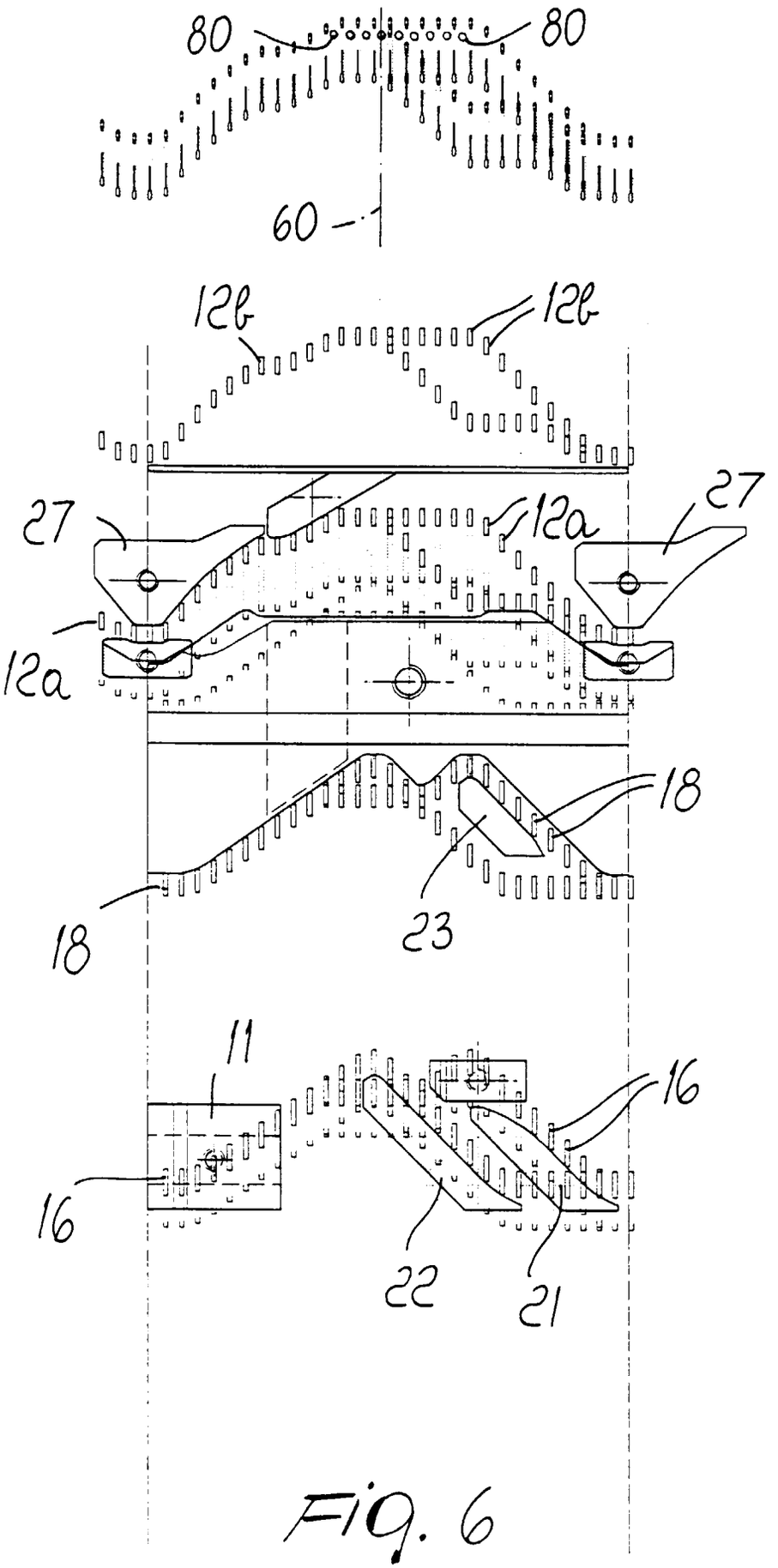

Fig. 6

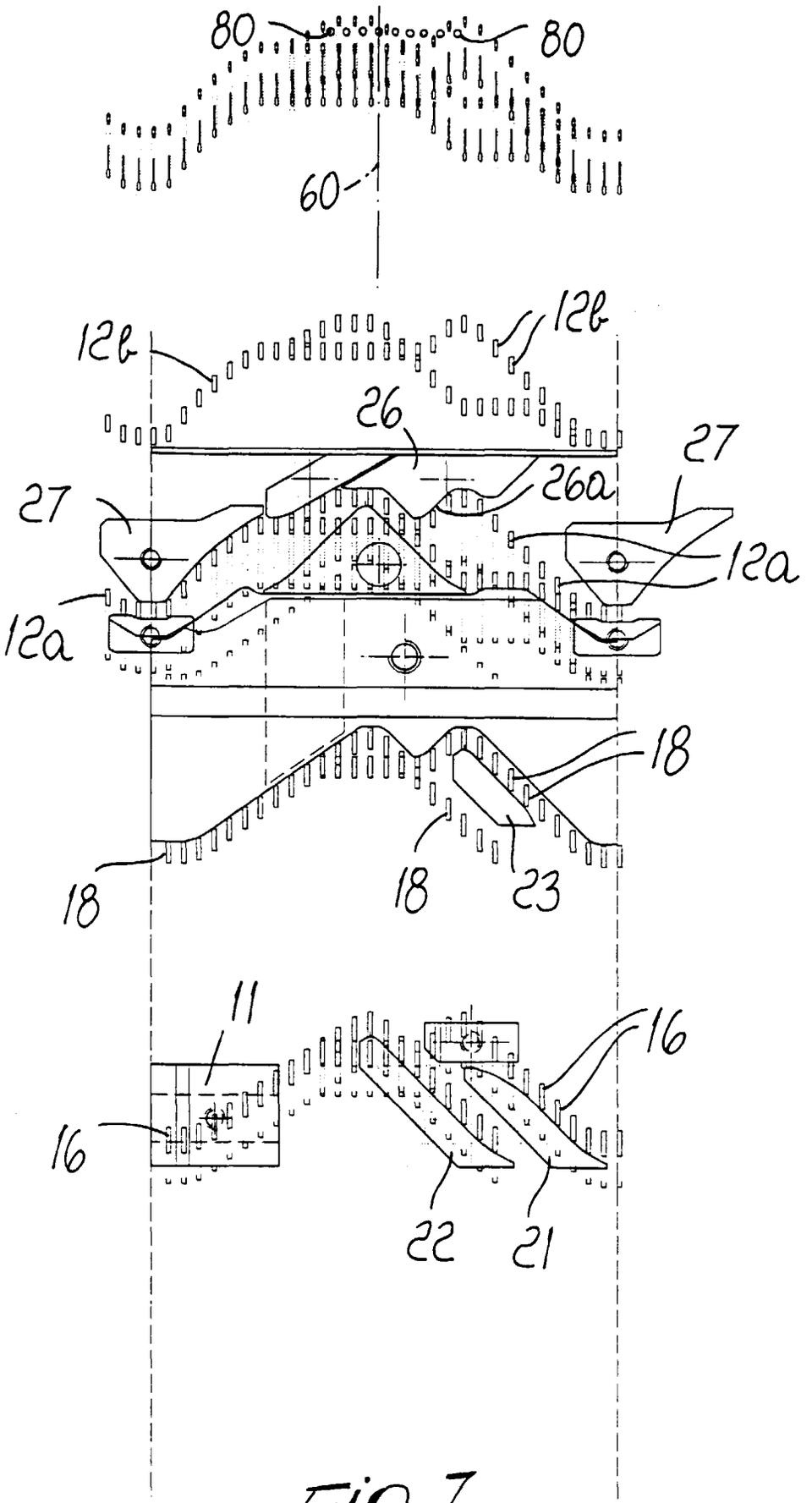

Fig. 7

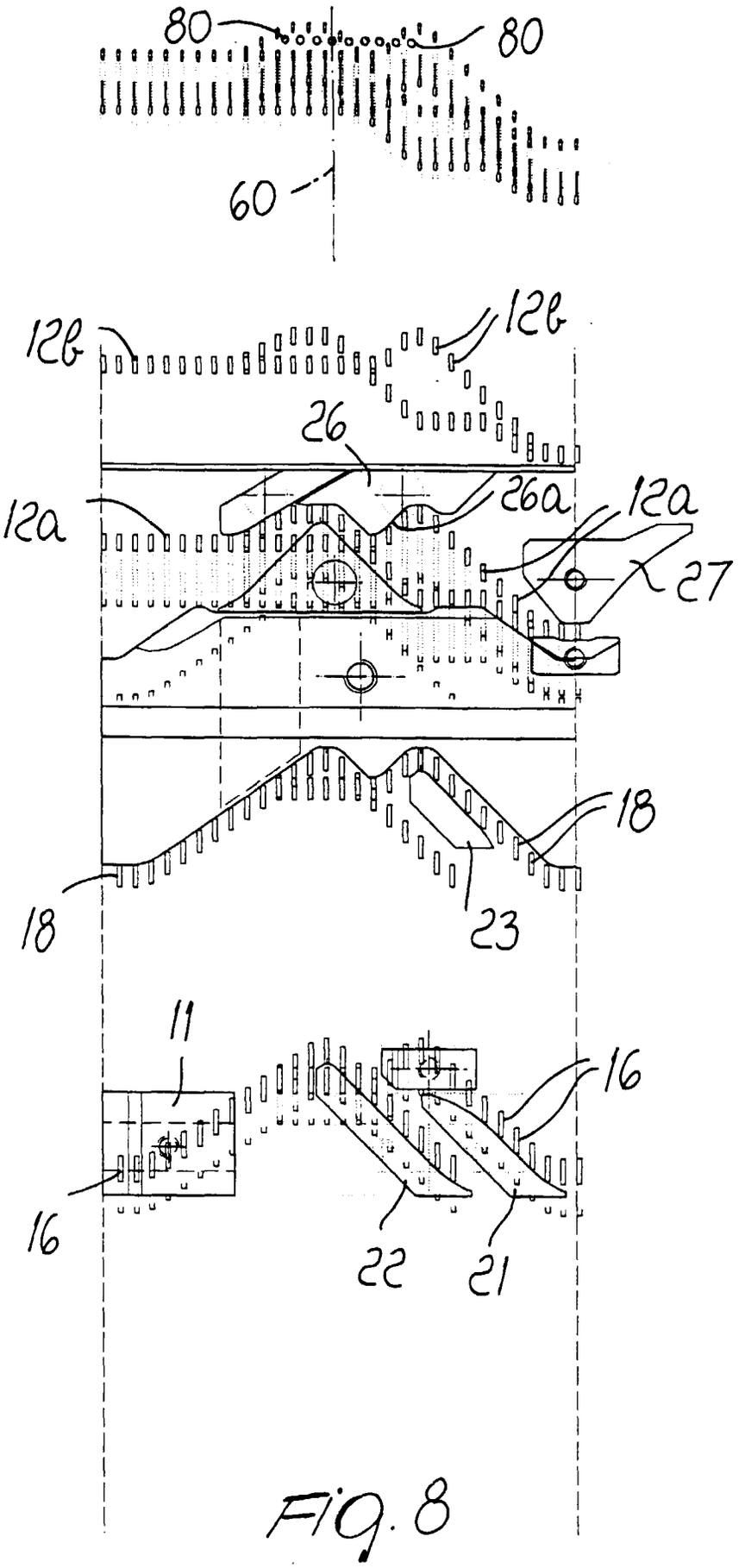

Fig. 8