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(54) Tufting needle

(57) In the case of a tufting needle, as an individual needle and as an element of a needle module incorporating several such needles, with an eye (4) provided in the area of its tip (3) and a thread-guiding groove (5) on one side of the needle, starting from the eye (4) and running along the needle stem (2), the invention provides for a thread-feeding element (10; 12; 15; 21; 31; 37; 43; 46; 50; 59; 78) to be incorporated in the upper area of the stem of the thread-guiding groove (5), to introduce the thread into this groove. In particular, the thread-feeding element can take the form of a hook or a hole. It collects the thread in the upper area of the needle stem and supplies it to the thread-guiding groove, which conveys the thread under cover to the eye.
This process of feeding in the thread along the length of the needle lowers the load on the needle and thread and reduces the frictional forces which occur during movement of the needle in the backing material.

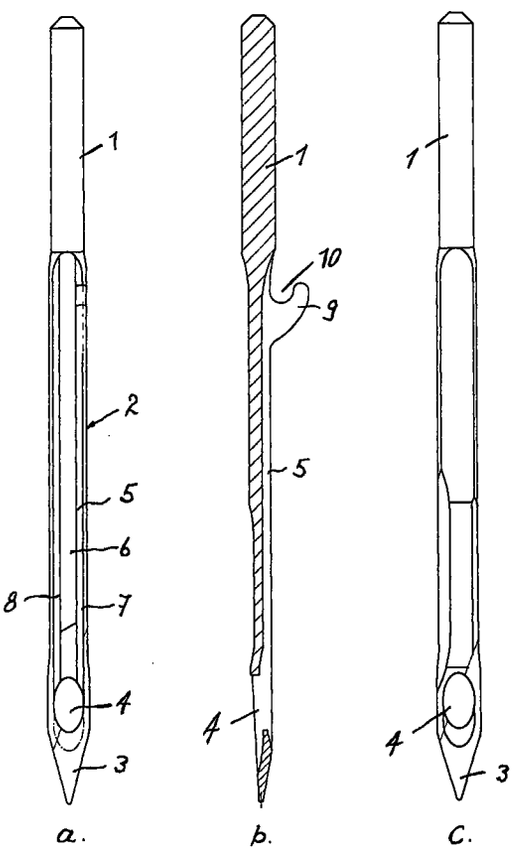

Fig. 1

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Description

The invention concerns a tufting needle as an individual needle and as an element of a needle module incorporating several such needles, with an eye provided in the area of its tip and a thread-guiding groove on one side of the needle, starting from the eye and running along the needle stem, together with a module for such needles.

In the conventional system, the yarn is at an angle to the axis of the needle prior to entry into the backing. As the needle penetrates the backing, the angle of the yarn to the needle axis increases in proportion to the depth of penetration. The yarn tension will tend to increase with the increase in this angle. The effects of this are as follows:

1. Friction between the yarn and the backing fabric causes an increase in yarn tension which in turn causes the yarn to stretch temporarily changing its physical nature, i.e. it may flatten, be drawn down, loosely bound short fibres, effect materials such as neps, or fibre ends may become loosened or protrude from the yarn structure, and the chances of yarn breakage at weak points or joints may be increased.

2. The increased yarn tension also resists the needle insertion process, increasing the load on the drive motor which in turn draws higher current and increases running costs. Increased motor load also affects the power factor which in some countries incurs extra penalty charges.

3. Increased yarn tension also often causes „robbing back" of pile yarn from the previous tuft. In the case of loop pile carpets this results in an uneven surface. In the case of cut pile carpets this results in different lengths of the two legs of the tuft, or „J-tufting" as it is commonly called.

4. Friction between the yarn and the backing changes the surfaces of the yarn. Loosened fibre ends are brushed out of the surface resulting in an unwanted hairy appearance. This problem will be more pronounced for staple yarns.

5. Loosened short fibres are released as „fly" which may contaminate the carpet surface and become a safety hazard as they collect around the machine. In extreme cases the count of the yarn could be changed. Loosened effect material can detract from the appearance of the carpet. If the effect material is loosened to the extent that they drop out of the structure the desired appearance of the carpet will not be achieved.

6. The friction between the yarn and the backing fabric, combined with the increased yarn tension will cause the insertion hole to elongate which can promote distortion of the tuft lines. It may also result in difficulties in obtaining acceptable tuft anchorage.

Furthermore, one of the funtions of the thread groove, which is also called the yarn protection groove, is to protect the yarn in its passage through the backing. However, in conventional tufting this function is not realised on both strokes of the needle, only on the upward stroke. On the downward stroke the yarn has to pass between the backing fabric and the cheeks of the groove before entering the groove. The relatively sharp contours of the cheeks, compared to the smooth circular shape of the rear of the needle, create increased resistance to the yarn passage.

The object of the present invention is to attain a substantial reduction in the stated loads on tufting needles in particular.

In order to attain this objective, the invention provides for a tufting needle of the type mentioned at the beginning of this description to be allocated a thread-feeding element in the upper area of the stem of the thread-guiding groove, to introduce the thread into this groove.

According to the invention the yarn is guided into the thread guiding groove near the top of the needle with the result that the contact between the yarn and the backing fabric is greatly reduced. The primary effects of this ar as follows:

1. After initial penetration of the needle into the backing fabric the contact area will be different for different yarns, but for one particular yarn will be essentially constant throughout both the downward and upward stroke as will the frictional effects between the yarn and the backing fabric.

2. After initial penetration a slight increase in yarn tension will occur after which it will become constant. Changes in the physical nature of the yarn due to stretching will be reduced.

3. Increased load on the drive motor during the time the needle is penetrating the backing fabric will be constant and minimal resulting in energy savings. Up to 30 % reduction in energy demands have been measured. Power factor changes are also minimised.

4. Needle insertion forces are greatly reduced, up to 70 % reductions have been measured depending on yarn count.

5. The lower yarn tension, coupled with the fact that a significant area of the surface of the yarn is in contact with the smooth surface of the thread guid-

ing groove (especially for finer count yarns), means that the yarn flows easily from the supply creel/beam through the needle throughout the stroke rather than „robbing back" from the previous stitch creating a more even surface with greater tuft shape regularity.

6. Yarn hairiness effects are minimised.

7. Fly at the needles is reduced and effect material is less likely to be loosened.

8. Elongation of the (needle) insertion hole due to yarn tension and yarn feed angle are eliminated resulting in more regular tuft lines and less likelihood of problems with tuft anchorage.

Particularly expedient embodiments of the object of this invention are specified in the sub-aims and in the following description:

Fig. 1a shows a front view of an initial embodiment of a tufting needle in accordance with the present invention;
Fig. 1b shows a side view (sectional) of the needle in accordance with Fig. 1a;
Fig. 1c shows a rear view of the needle in accordance with Fig. 1a;
Fig. 2a shows a front view of a further embodiment of a tufting needle in accordance with the present invention;
Fig. 2b shows a side view (sectional) of the needle in accordance with Fig. 2a;
Fig. 2c shows a rear view of the needle in accordance with Fig. 2a;
Fig. 3a shows a front view of a further embodiment of a tufting needle in accordance with the present invention;
Fig. 3b shows a side view (sectional) of the needle in accordance with Fig. 3a;
Fig. 3c shows a rear view of the needle in accordance with Fig. 3a;
Fig. 4a shows a rear view of a further embodiment of a tufting needle in accordance with the present invention;
Fig. 4b shows a side view (sectional) of the needle in accordance with Fig. 4a;
Fig. 4c shows a front view of the needle in accordance with Fig. 4a;
Fig. 5a shows a front view of a further embodiment of a tufting needle in accordance with the present invention;
Fig. 5b shows a side view (sectional) of the needle in accordance with Fig. 5a;
Fig. 5c shows a rear view of the needle in accordance with Fig. 5a;
Fig. 6a shows a rear view of a further embodiment of a tufting needle in accordance with the present invention;
Fig. 6b shows a side view of the needle in accordance with Fig. 6a;
Fig. 6c shows a front view of the needle in accordance with Fig. 6a;
Fig. 7a shows a front view of a further embodiment of a tufting needle in accordance with the present invention;
Fig. 7b shows a side view of the needle in accordance with Fig. 7a;
Fig. 7c shows a rear view of the needle in accordance with Fig. 7a;
Fig. 8a shows a front view of a further embodiment of a tufting needle in accordance with the present invention;
Fig. 8b shows a side view (sectional) of the needle in accordance with Fig. 8a;
Fig. 8c shows a rear view of the needle in accordance with Fig. 8a;
Fig. 8d shows a section along line A-A in Fig. 8a
Fig. 9a shows a front view of a further embodiment of a tufting needle in accordance with the present invention;
Fig. 9b shows a side view (sectional) of the needle in accordance with Fig. 9a;
Fig. 9c shows a rear view of the needle in accordance with Fig. 9a;
Fig. 10a shows a front view of a further embodiment of a tufting needle in accordance with the present invention;
Fig. 10b shows a side view (sectional) of the needle in accordance with Fig. 10a;
Fig. 10 c shows a rear view of the needle in accordance with Fig. 10a;
Fig. 11a shows a frontal view of a needle module in accordance with the present invention with tufting needles and mounted perforated plate;
Fig. 11b shows a side view of the needle module in accordance with Fig. 11a;
Fig. 12a shows a frontal view of a further embodiment of the needle module in accordance with the present invention with tufting needles and spring-loaded perforated plate;
Fig. 12b shows a side view of the needle module in accordance with Fig. 12a;
Fig. 13a shows a further embodiment of the invention, whereby the tufting needles are inserted directly in a needle bar which is connected to the perforated plate;
Fig. 13b shows a side view of the configuration according to Fig. 13a;
Fig. 14a shows a front view of a further embodiment of a tufting needle in accordance with the present invention;
Fig. 14b shows a side view of the needle in accordance with Fig. 14a, and
Fig. 14c shows a rear view of the needle in accord-

ance with Fig. 14a

Figs. 1, 2 show a tufting needle in accordance with the present invention, with a shank, 1, a stem, 2, a tip, 3, and an eye, 4, located close to the tip, 3. The shank, 1, can be fitted separately in the needle bar of a tufting machine. Alternatively, it can also be embedded in a module body, which holds several identical needles and can then be assigned as a unit to a needle bar.

The stem, 2, incorporates a thread-guiding groove, 5, which has a flat base, 6. Two cheeks, 7, 8, run along the sides of the thread-guiding groove, 5. As shown in Figs. 1b, 2b, one of these cheeks is provided with a hook-shaped element, 9, which forms a thread support which is open in the direction of the shank, 1. The thread support, 10, extends into the area of the thread-guiding groove, 5, and may extend to the latter's base, 6 (Fig. 2).

The rear view of the tufting needle corresponds to an established configuration, as shown in Figs. 1c, 2c.

In the case of the needle in accordance with Fig. 1, therefore, the thread is not supplied to the eye, 4, at an angle to the needle's axis, but is inserted via the thread support, 10, directly into the thread-guiding groove, in which it is guided up to the eye, 4. This principle means that the thread is supplied to the needle in the vicinity of the shank, 1, and, subsequently, close to the point at which the tufting needle is mounted on the equipment concerned, that is, at a point at which the occurring forces can be easily discharged into the needle bar.

The embodiment of the invention in accordance with Fig. 3 also has a shank, 1, a stem, 2, a tip, 3, and an eye, 4. As Fig. 2b shows, in this embodiment the stem, 2, is joined to the shank, 1, via a transitional segment, 11. Shank, 1, and stem, 2, are offset in parallel with one another. An opening, 12, leads into the upper area of the thread-guiding groove, 5, forming a thread-feeding element. The stem, 2, possesses a thickened area, 13, around the opening, 12, which runs transversely to the longitudinal direction of the row of needles when the tufting needle is installed in a needle bar, i.e. it does not intrude into the space between neighbouring needles.

The embodiment of the invention in accordance with Fig. 14 also has a shank, 1, a stem, 2, a tip, 3, and an eye, 4. The stem, 2, is joined to the shank, 1, via a forwardly extending (i.e. away from the needle bar) transitional segment, 90. Shank, 1, and stem, 2, are offset in parallel with one another. In the transitional segment, 90, an upwardly and/or forwardly extending opening, 91, is provided which leads into the upper area of the thread guiding groove, 5.

This embodiment has the advantage that the yarn directly enters the yarn guiding groove = yarn protecting groove with minimal bending. As the yarn does not have to pass between the needles, the upper needle guide can be relatively large (i.e. the width of the needle or larger). Threading is also easier because the yarn can be pushed or pulled down through the upper needle guide into the needle groove toward the needle eye from the relatively clear space above the upper needle guide. Effectively the upper needle guide of this embodiment incorporates the last guide bar on the tufting machine in a similar orientation, but located directly at the top of the yarn protection groove. Accordingly all of the same space considerations and hole size considerations that apply to the guide bar also apply to the upper needle guide.

The embodiment of the tufting needle in accordance with the present invention shown in Fig. 4 differs from the previously described embodiments in that a transitional segment, 14, is provided between the shank, 1, and the stem, 2, with an opening, 15, which serves as a thread-feeding element. Here again, the shank, 1, and stem, 2, are offset in parallel with one another. The opening, 15, is followed by the thread-guiding groove, 5, on the stem, 2, whereby the straight continuation of the thread-guiding groove, 5, is aligned with the opening, 15.

In the embodiment of the tufting needle in accordance with the present invention which is shown in Fig. 5, shank, 1, and stem, 2, are coaxially aligned. Between these two segments of the needle there is a bend, 20, which lies on a plane parallel with the base, 6, of the thread-guiding groove. When this tufting needle is installed in a bar, this bend protrudes transversely to the row of needles, which means that it does not require any additional space between neighbouring tufting needles in the needle row.

The bend, 20, incorporates an opening, 21, which serves as a thread-feeding element. In relation to the longitudinal axis of the needle, the opening, 21, is twisted at an angle of 90° to the eye, 4. The upper end, 22, of the thread-guiding groove, 5, extends up to the opening, 21, in the area of the bend. After passing through the opening, 21, a thread which is fed in through the opening, 21, is thus positioned against a cheek, 23, of the thread-guiding groove, 5, at the upper end of which it continuously takes on the straight course of the thread-guiding groove, 5.

In the embodiment of the present invention shown in Fig. 6, the shank, 1, and stem, 2, are offset in parallel with one another. Between these segments there is a transitional segment, 30, incorporating an opening, 31, which serves as a thread-feeding element. This feeding element is flat, as a result of which the opening is inclined forwards when the row of needles is in installed state, thus simplifying the introduction and course of a thread in this opening. The opening, 31, is followed directly by a thread-guiding groove, 5, on the stem, 2.

In the embodiment of the invention shown in Fig. 7, a transitional segment, 35, of increased thickness is provided between the shank, 1, and the stem, 2, with an opening, 37, which serves as a thread-feeding element. As viewed from above in Fig. 7a, the transitional segment, 35, with the opening, 37, and the shank, 1, is

twisted in clockwise direction in relation to the stem of the needle. When needles are arranged in a row, the thickened area extends transversely to the course of such a row. One cheek, 36, of the thread-guiding groove, 5, partially covers the opening, 37, which leads into the upper area of the thread-guiding groove, 5. The described twist promotes contact of the thread with the base of the thread-guiding groove, 5.

The embodiment of the tufting needle in accordance with the present invention which is shown in Fig. 8 incorporates a thickened transitional segment, the thickened area of which extends in the direction of the row when tufting needles are arranged in a row. In the area of the transitional segment, 40, the depth of the base, 41, and the height of the cheeks, 42, of thread-guiding groove, 5, are increased. In the area of the transitional segment, 40, both cheeks, 42, incorporate an opening, 43, which serves as a thread-feeding element. The lowest point of the openings, 43, is in the plane of the base, 6, of the thread-guiding groove, 5. In this way, a thread which is inserted through an opening, 43, is guided so as to be brought directly into contact with the base, 6, of the thread-guiding groove, 5.

It is now possible to feed in one thread through each of the two openings, 43, or to choose from which side a thread is to be fed in, or to turn the needle by 180°.

As the thickened area in the region of the transitional segment, 40, affects the distance between two neighbouring needles arranged in a row, it is expedient to use such needles in two versions, involving different distances between the transitional segment, 40, and the needle tip, 3. When the difference in these distances is sufficient between the neighbouring needles, the minimum spacing required for these needles can be reduced.

The embodiment of the tufting needle in accordance with the present invention shown in Fig. 9 possesses a straight course between the shaft, 1, and the stem, 2. A sleeve, 45, is fitted on the stem, 2. This sleeve, 45, has two openings, 46, which serve as thread-feeding elements, and through which a thread can be fed into the thread-guiding groove, 5 - most expediently via an appropriate recess in one cheek of the thread-guiding groove. The sleeve, 45, can be fixed to the stem, 2, or produced with the stem, 2, as a single piece.

The embodiment in accordance with Fig. 10 also shows a straight course of the tufting needle between the shank, 1, and the stem, 2. A ring, 50, is mounted on the stem, 2, at a distance below the upper end of the thread-guiding groove, 5. The cheeks, 7, 8, of the thread-guiding groove, 5, are recessed above the ring, 50. A thread can now be inserted into the thread-guiding groove, 5, around the ring, 50. Instead of a closed ring, a web may suffice, which simply crosses the thread-guiding groove.

Fig. 11 shows an embodiment of the invention in which the thread-feeding elements are provided not directly on a thing needle, but in a perforated plate which closely adjoins the needle or needles. The tufting needles, 55, are firmly embedded in a row in a module body, 56, which, in turn, can be fixed to a needle bar (not shown).

Attached to the module body, 56, is a plate-type element, 57, the bottom part of which takes the form of a perforated plate, 58. This perforated plate, 58, is provided with openings, 59, which serve as thread-feeding elements, whereby one opening, 59, is provided for each tufting needle, 55, and a thread can be passed through these holes and thus conveyed into position in the direct vicinity of the upper area of the thread-guiding groove of the tufting needle concerned.

The perforated plate, 58, may also constitute a homogeneous element of the module body, 56.

The embodiment in accordance with Fig. 12 differs from that shown in Fig. 11 first of all in that a plate-type element, 65, is provided on the module body, 56, whereby the bottom part of this element takes the form of a perforated plate, 66. In Fig. 11b, the openings in this perforated plate are open to the bottom left (67), to facilitate the introduction of a thread. The plate-type element, 65, can be swivelled around a pin, 68. A spring, 69, presses it against the module body and consequently into the desired position in relation to the row of needles. The spring, 69, is stayed by a counterplate, 70, which is fixed to the module body, 56.

In the embodiment shown in Fig. 13, tufting needles, 75, are fixed individually in a needle bar, 76. Connected to the needle bar, 76, is a perforated plate, 77, each hole, 78, of which is positioned in relation to the thread-guiding groove of a tufting needle, 75, in such a manner as to enable a thread to be fed directly into this groove.

The thread guideways and guide elements are smoothed and rounded in all embodiments.

The tufting needles can be designed in accordance with previously common configurations in the area of the tip. The same applies with regard to the side of the needles facing the thread-guiding groove, which is referred to above as the rear side.

Claims

1. Tufting needle as an individual needle and as an element of a needle module incorporating several such needles, with an eye (4) provided in the area of its tip (3) and a thread-guiding groove (5) on one side of the needle, starting from the eye (4) and running along the needle stem (2),
characterised in that the thread-guiding groove (5) is provided with a thread-feeding element (10; 12; 15; 21; 31; 37; 43; 46; 50; 59; 78) in the upper area of the shank, to introduce the thread into this groove.

2. Tufting needle in accordance with Claim 1, characterised in that the thread-feeding element is designed as a hook-shaped element (9) on one cheek (7) of the thread-guiding groove (5). (Fig. 1, 2)

3. Tufting needle in accordance with Claim 2, characterised in that the cheek (7) of the thread-guiding groove (5) which is provided with the hook-shaped element (9) is recessed down to the base (6) of the thread-guiding groove (5) in the area of the hook-shaped element. (Fig. 2)

4. Tufting needle in accordance with Claim 1, characterised in that its shank (1) is offset in relation to its stem (2) on the side of the thread-guiding groove (5) and that the thread-feeding element takes the form of an opening (15) in the transitional segment (14) between shank and stem. (Fig. 4)

5. Tufting needle in accordance with Claim 4, characterised in that the transitional segment provided with the opening (31) is flat, and the centre axis of the opening runs parallel with the base of the thread-guiding groove (5) and at an inclined angle in relation to the axis of the needle stem (1). (Fig. 6)

6. Tufting needle in accordance with Claim 4 or 5, characterised in that the base of the opening (31) is in alignment with the thread-guiding groove (5). (Figs. 4, 6)

7. Tufting needle in accordance with Claim 1, characterised in that its shank (1) is offset in relation to its stem (2) on the side of the thread-guiding groove (5) and that an opening (12) which penetrates the guide groove (5) and leads into the latter is provided in the shank. (Fig. 3)

8. Tufting needle in accordance with Claim 1, characterised in that it possesses a bend on a plane parallel with the base of the thread-guiding groove (5) in the transitional segment (20) between the shank (1) and the stem (2) which is in alignment with the shank (1), in which bend a thread-feeding element is provided in the form of a forward facing opening (21). (Fig. 5)

9. Tufting needle in accordance with Claim 8, characterised in that the upper end of the thread-guiding groove (5) extends into the area of the bend (20). (Fig. 5)

10. Tufting element in accordance with Claim 9, characterised in that the upper end of the thread-guiding groove (5) is partially covered in the area of the bend (20). (Fig. 5)

11. Tufting needle in accordance with Claim 1, characterised in that the transitional segment (35) with opening (37) and shank (1) is twisted in clockwise direction in relation to the stem (2) of the needle. (Fig. 7)

12. Tufting needle in accordance with Claim 1, characterised in that facing openings (43) are provided as thread-feeding elements in the cheeks (42) of the thread-guiding groove (5) in the upper area of this groove. (Fig. 8)

13. Tufting element in accordance with Claim 12, characterised in that the lowest point of each opening is aligned with the base of the thread-guiding groove (5). (Fig. 8)

14. Tufting needle in accordance with Claim 12 or 13, characterised in that it thickens in the area of the openings normal to the base of the thread-guiding groove (5). (Fig. 8)

15. Tufting needle in accordance with Claim 1, characterised in that its thread-guiding groove is covered in the form of a web at a distance from its upper end. (Fig. 10)

16. Tufting needle in accordance with Claim 15, characterised in that the web-type covering takes the form of a ring (50) on the stem (2) of the needle. (Fig. 10)

17. Tufting needle in accordance with Claim 1, characterised in that it is provided at a distance from its upper end with a sleeve (45) which covers the thread-guiding groove (5), said sleeve possessing at least one opening (46) as a thread-feeding element. (Fig. 9)

18. Tufting needle in accordance with Claim 1, characterised in that the stem (2) is forwardly offset to the shank (1) by a transitional segment (90) which has an upwardly and/or forwardly extending opening (91) being the thread feeding element. (Fig. 14)

19. Tufting needle in accordance with one of the preceding Claims, characterised in that the distances between the thickened area and the needle tip (3) differ for the needles provided with a thickened area in the plane of the thread-guiding groove (5) for the purpose of accommodating a thread-feeding element.

20. Tufting needle in accordance with Claim 1, characterised in that it operates in conjunction with a perforated plate (58, 66, 77) fixed to the needle bar of a tufting machine, said plate possessing holes corresponding to the upper end of the thread-guiding groove (5) of each needle. (Fig. 11, 12, 13).

21. Needle module with tufting needle in accordance with Claim 1, characterised in that the thread-feeding elements of the module's needles take the form of the holes of a perforated plate (58, 66, 77) which is located closely above the needles and each hole of which corresponds to the upper end of a thread-guiding groove (5). (Fig. 11, 12, 13)

22. Needle module in accordance with Claim 21, characterised in that the perforated plate is fixed to a module body.

23. Needle module in accordance with Claim 21, characterised in that the perforated plate on the module body is mounted in such a manner that it can be swung away from the needles.

24. Needle module in accordance with one of Claims 21 to 23, characterised in that the holes of the perforated plate are provided with slits to facilitate introduction of the thread.

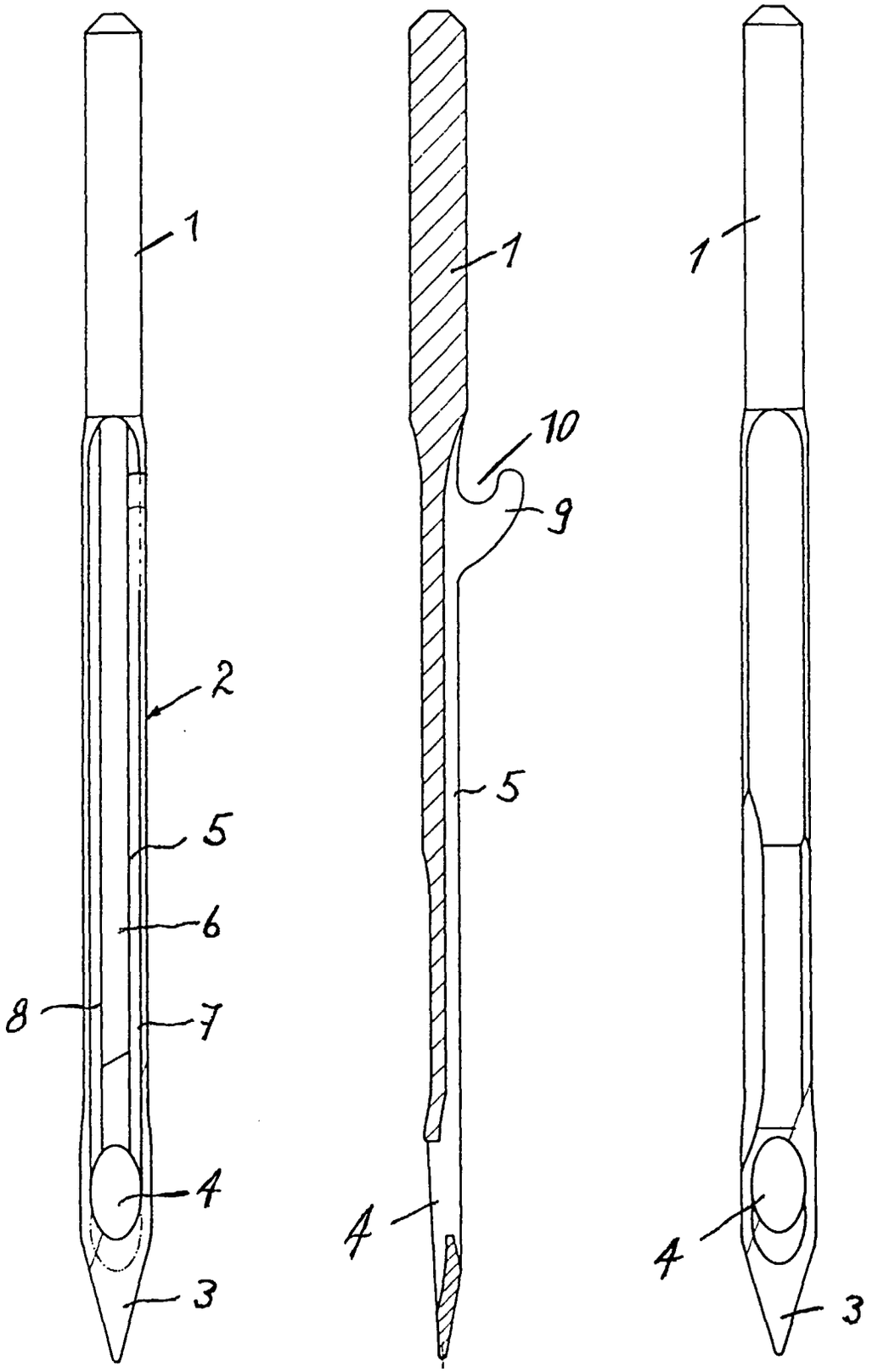

Fig. 1

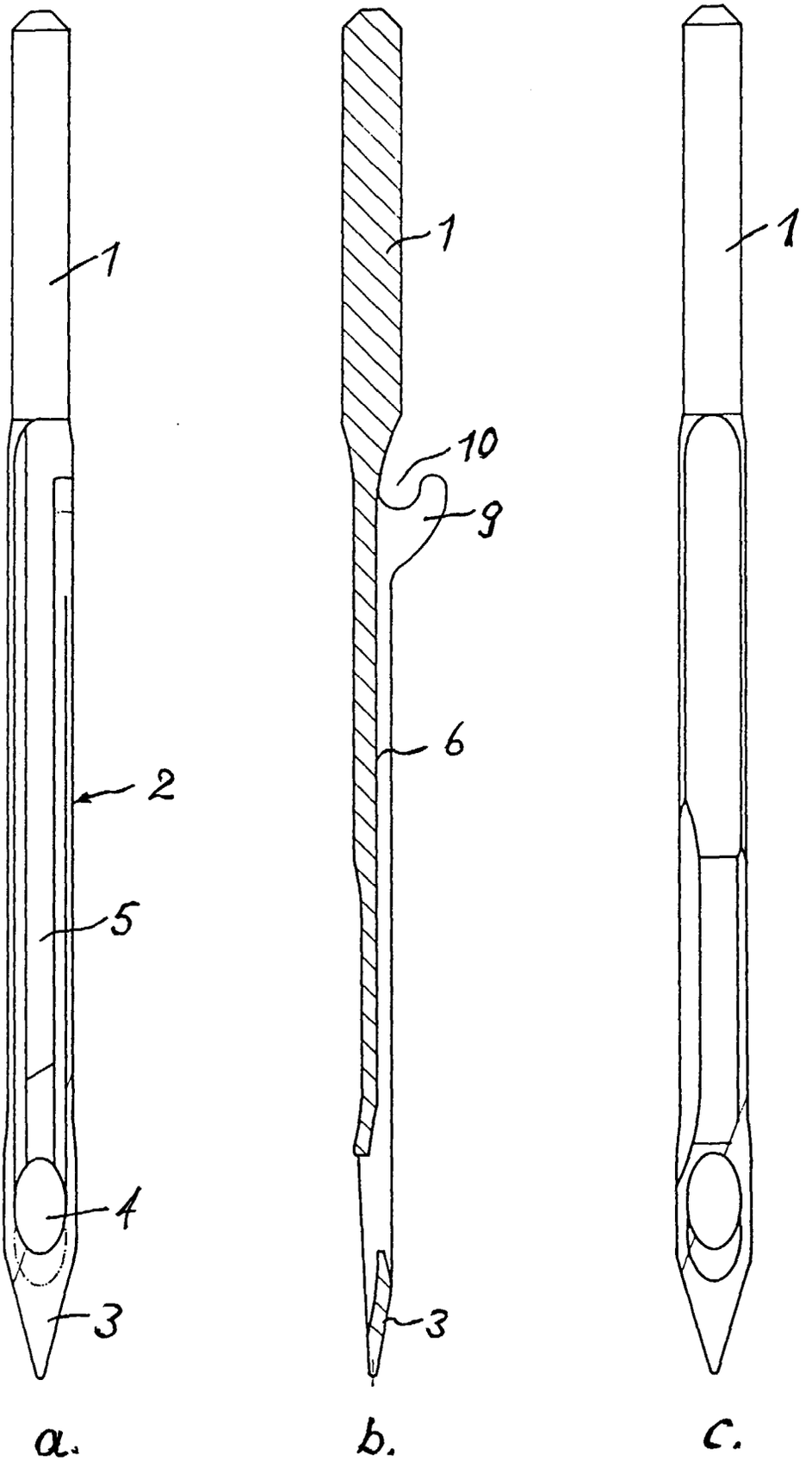

Fig. 2

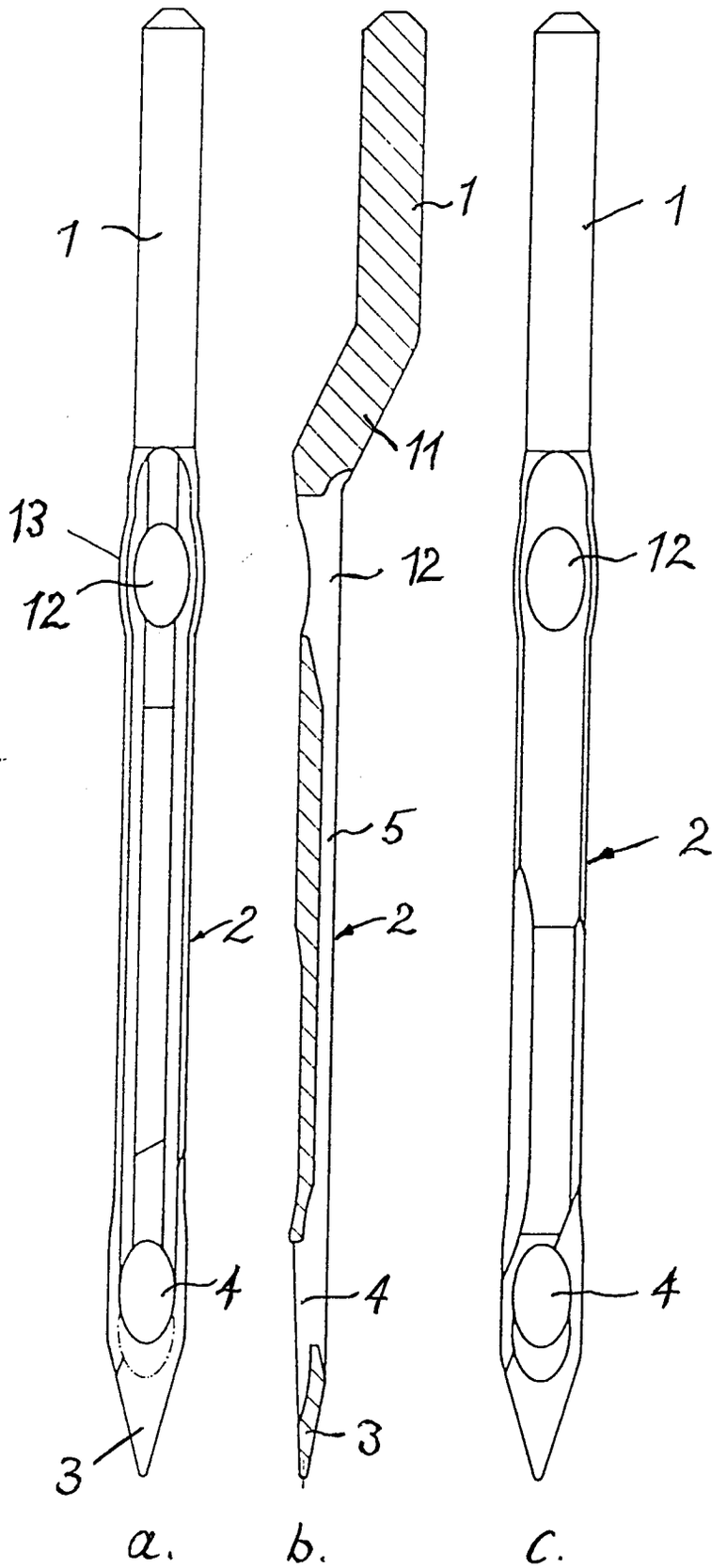

Fig. 3

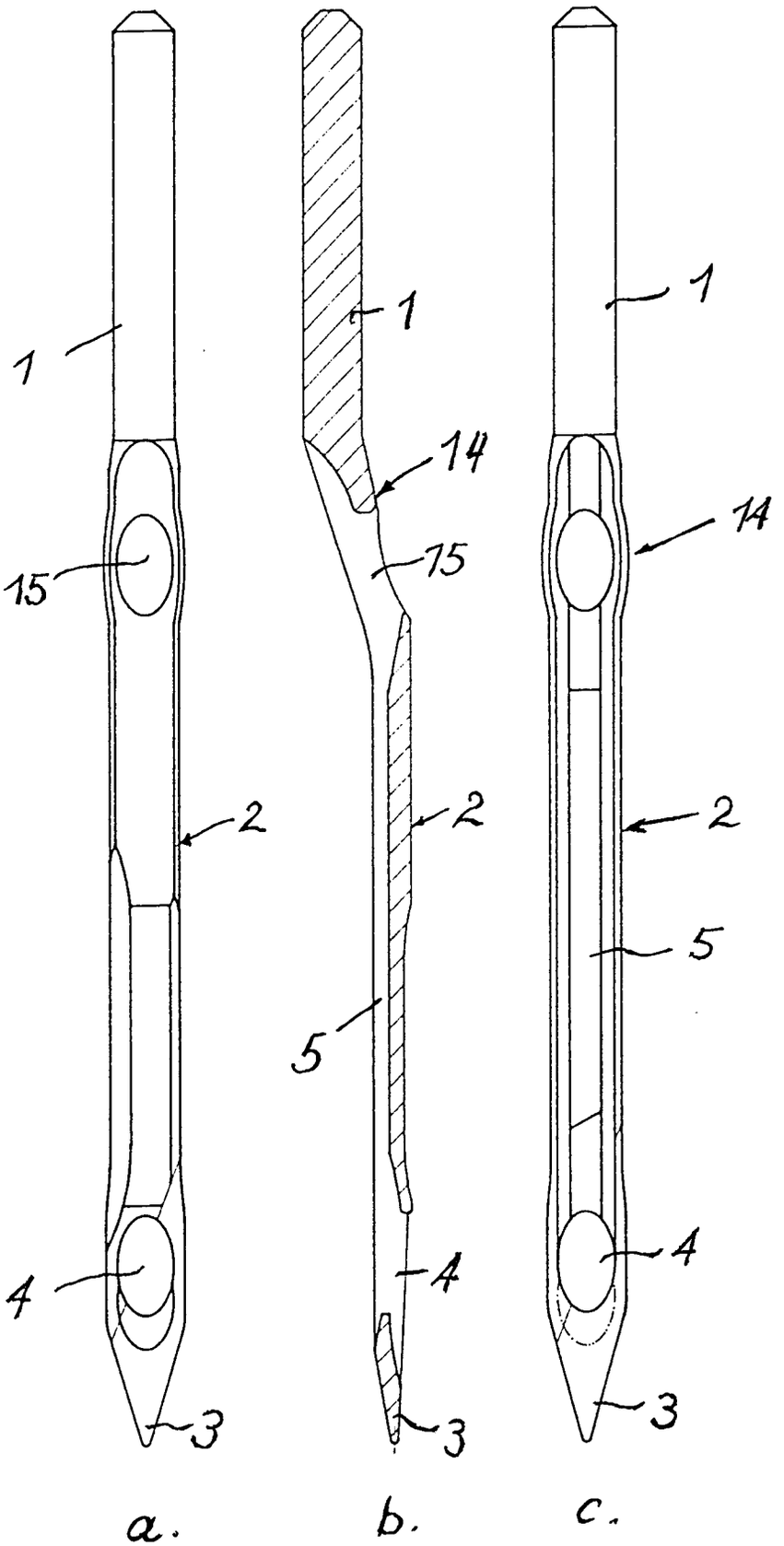

Fig. 4

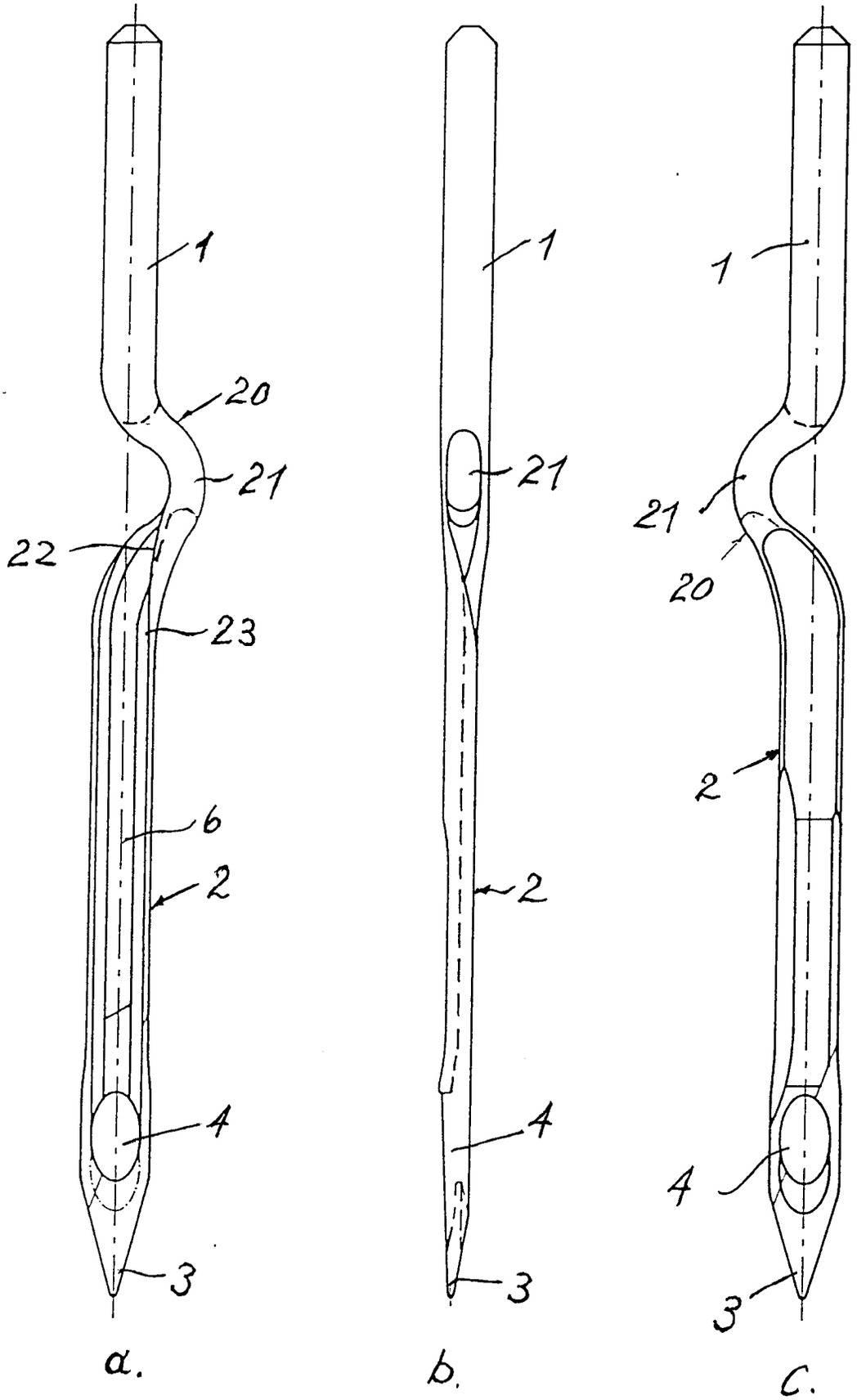

Fig. 5

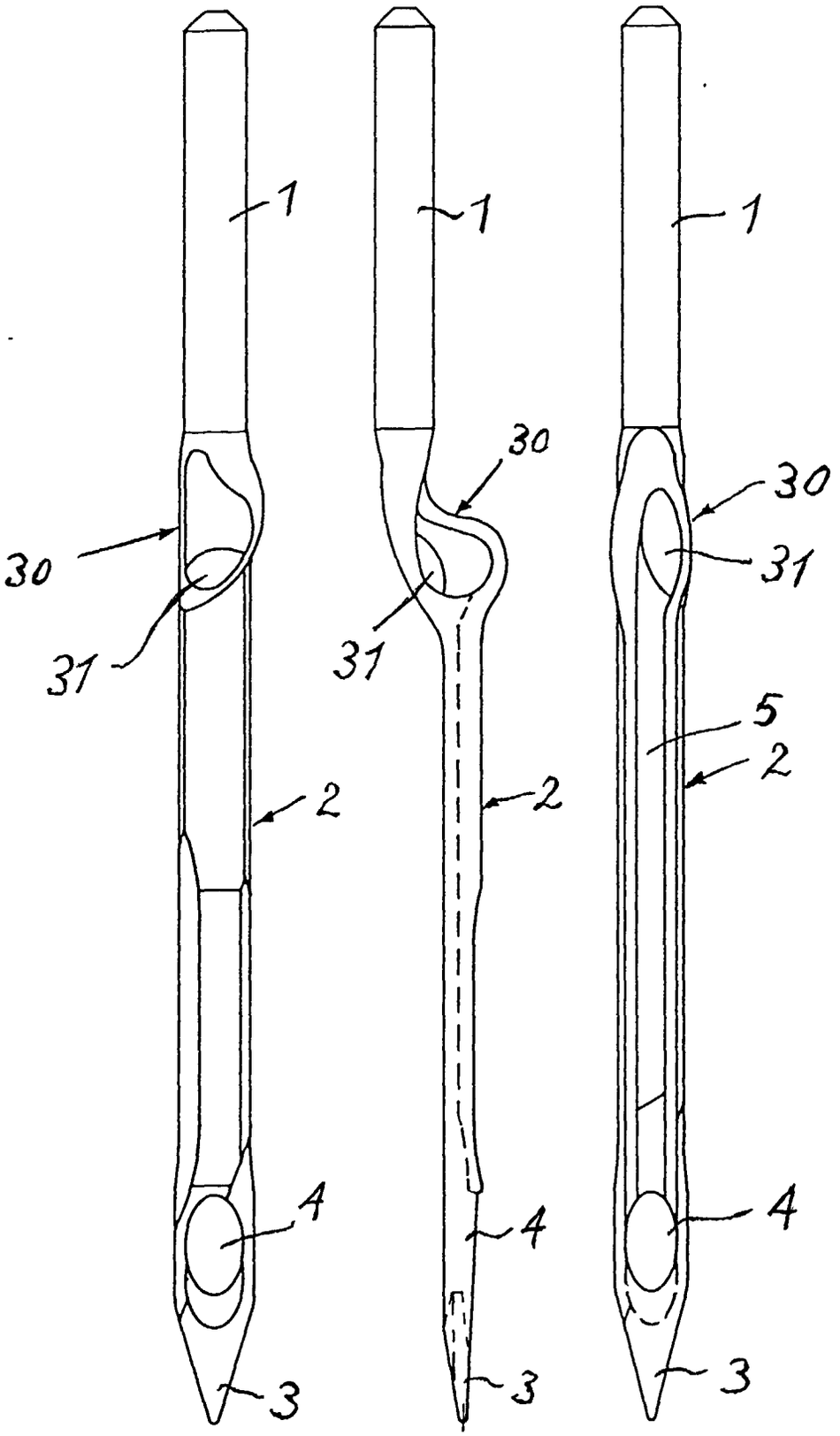

Fig. 6

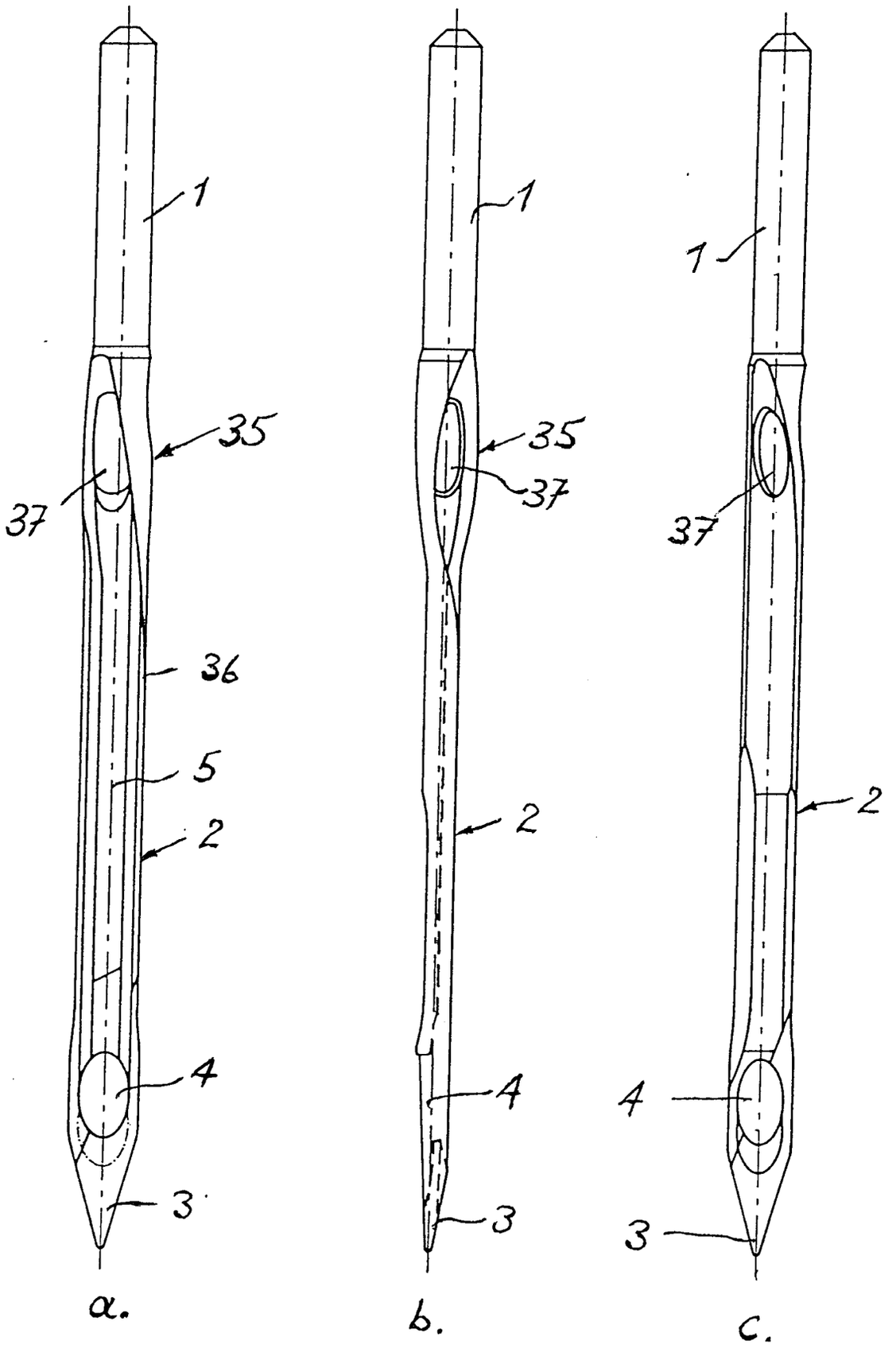

Fig. 7

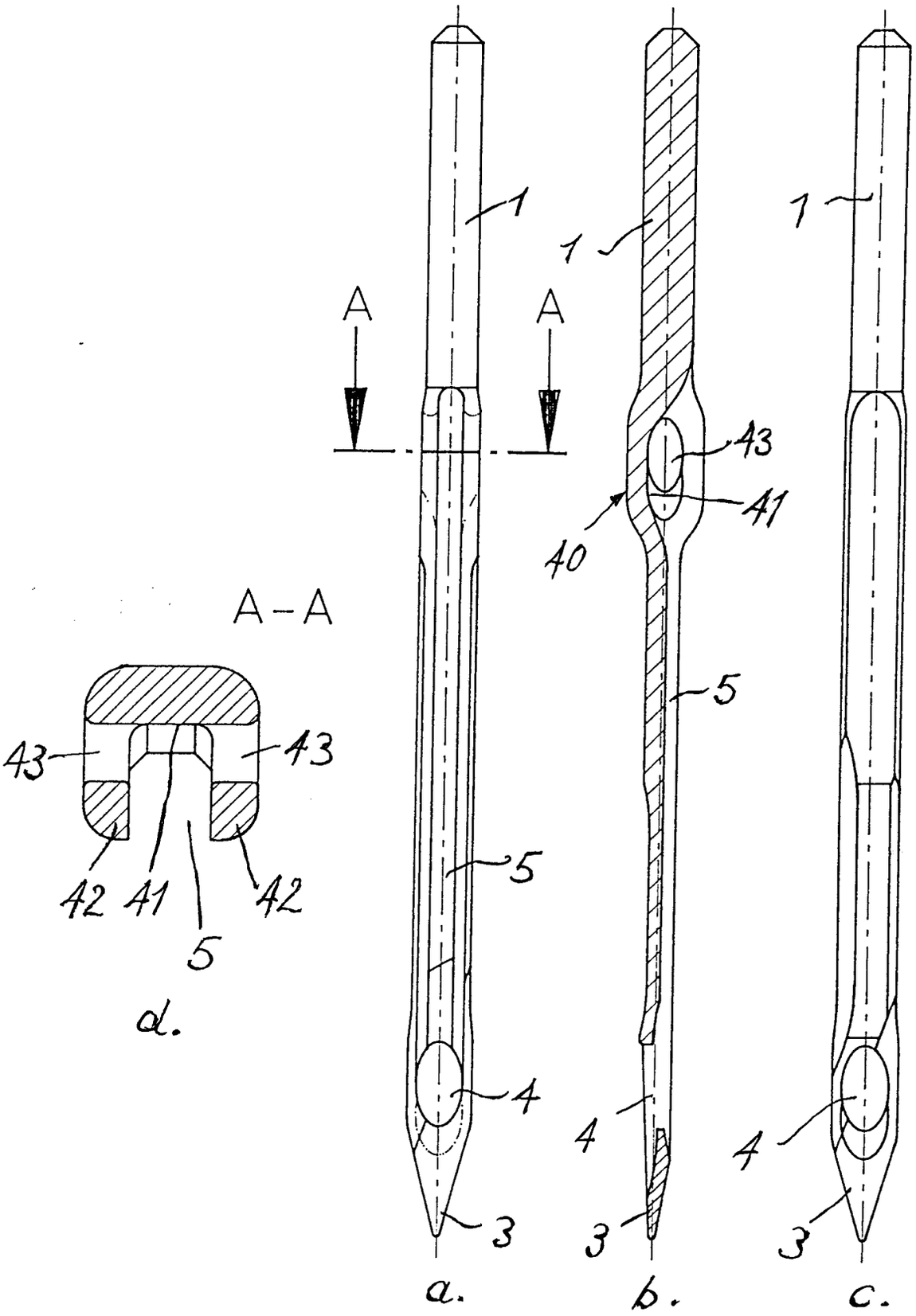

Fig. 8

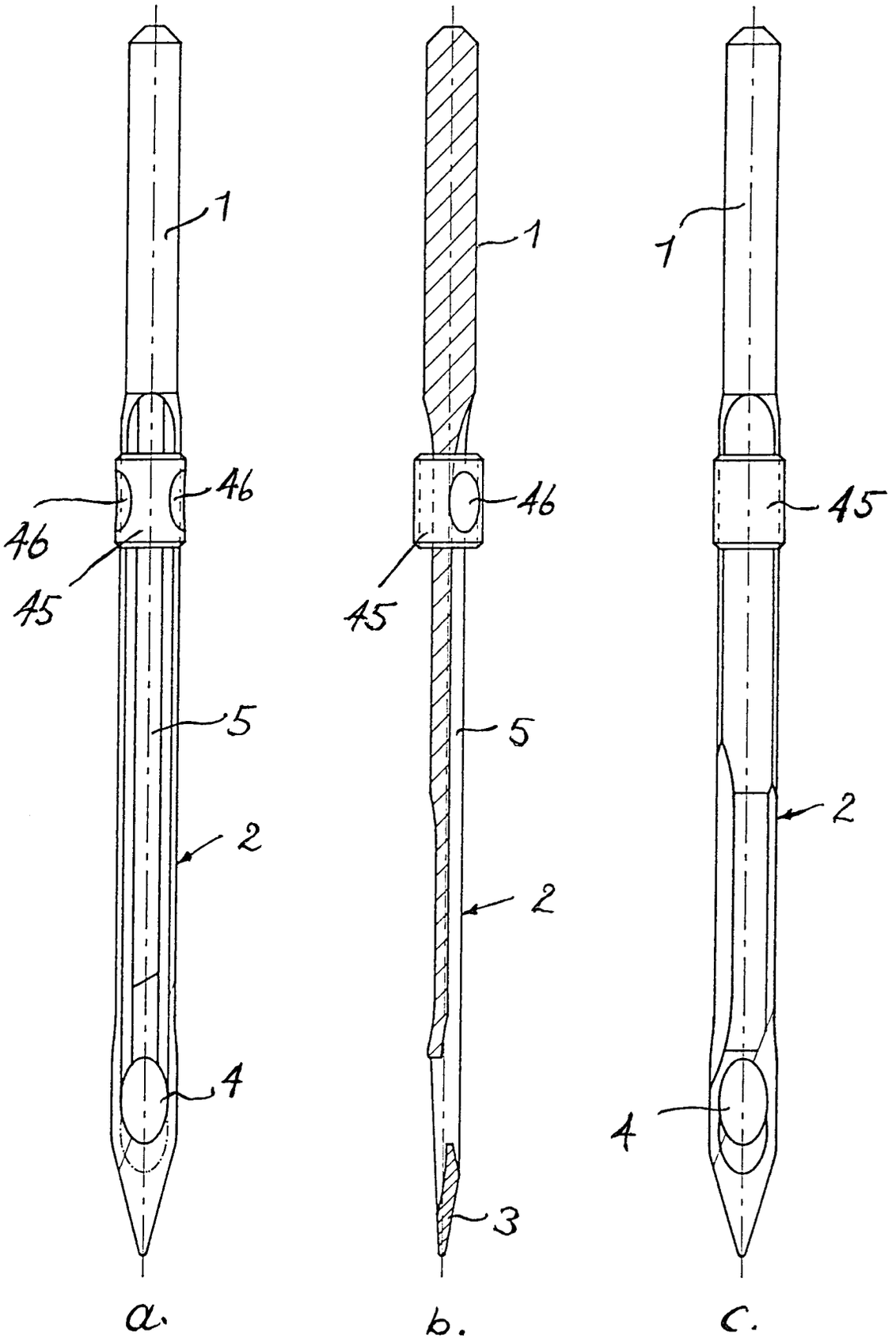

Fig. 9

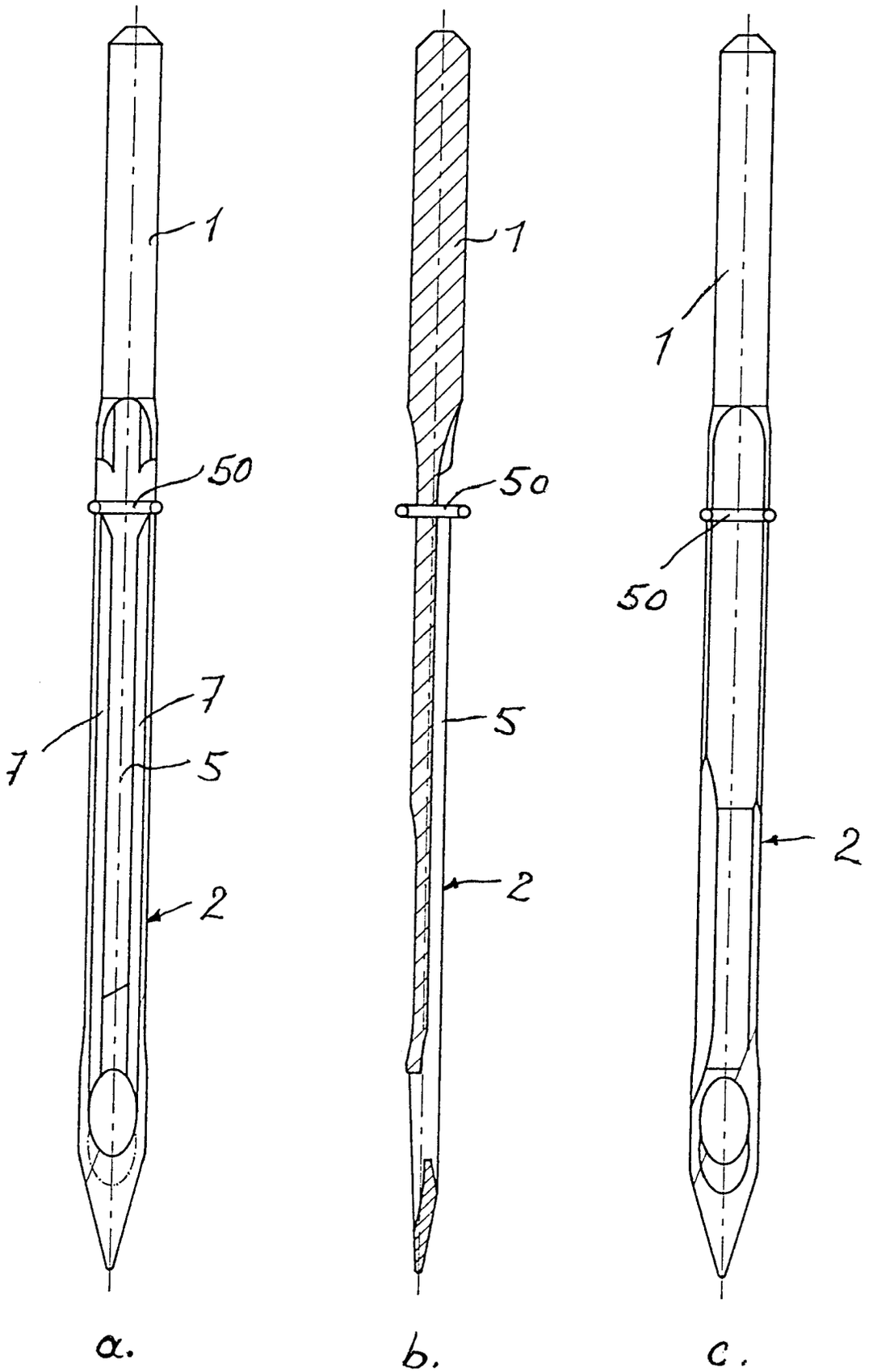

Fig. 10

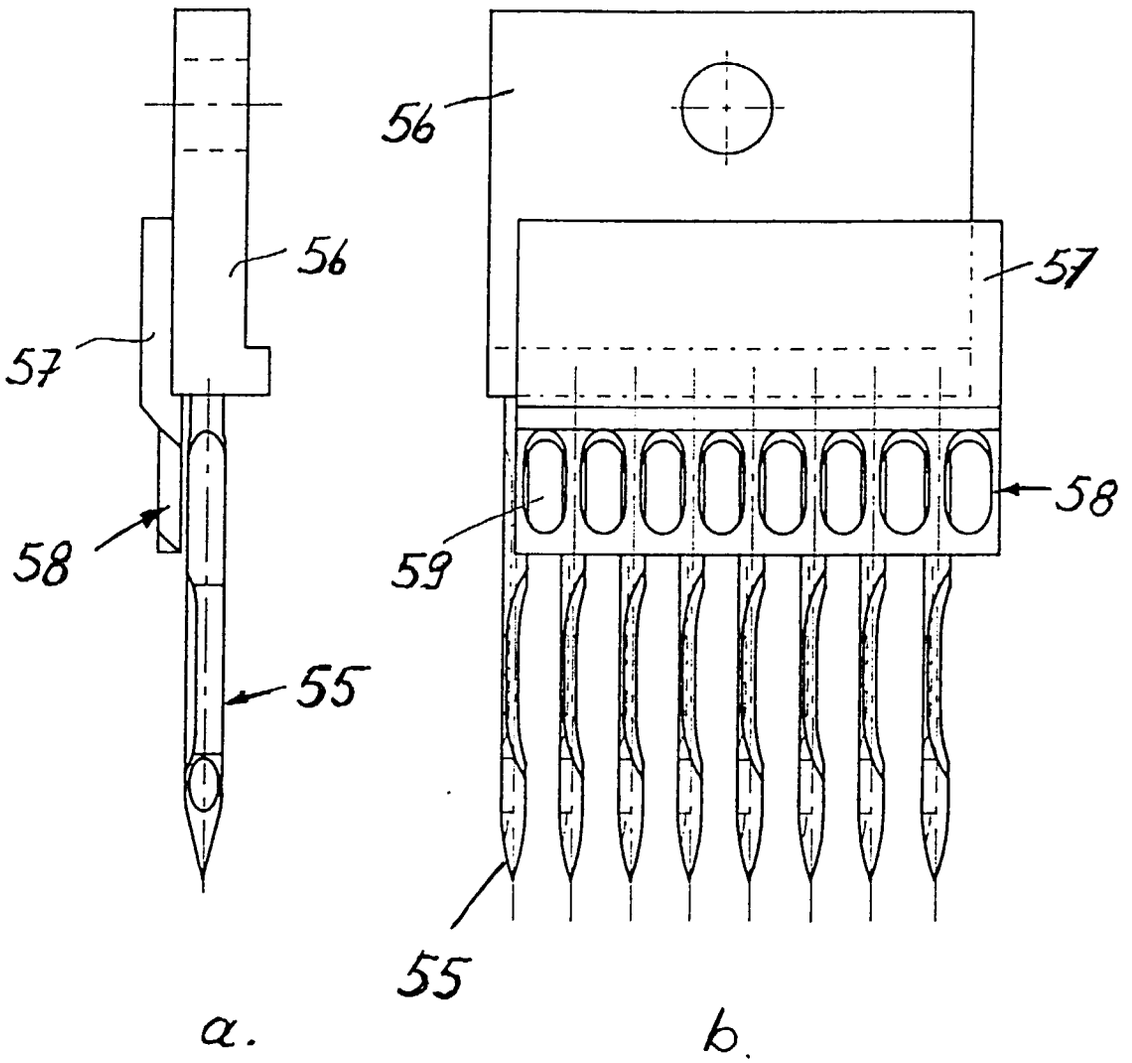

Fig. 11

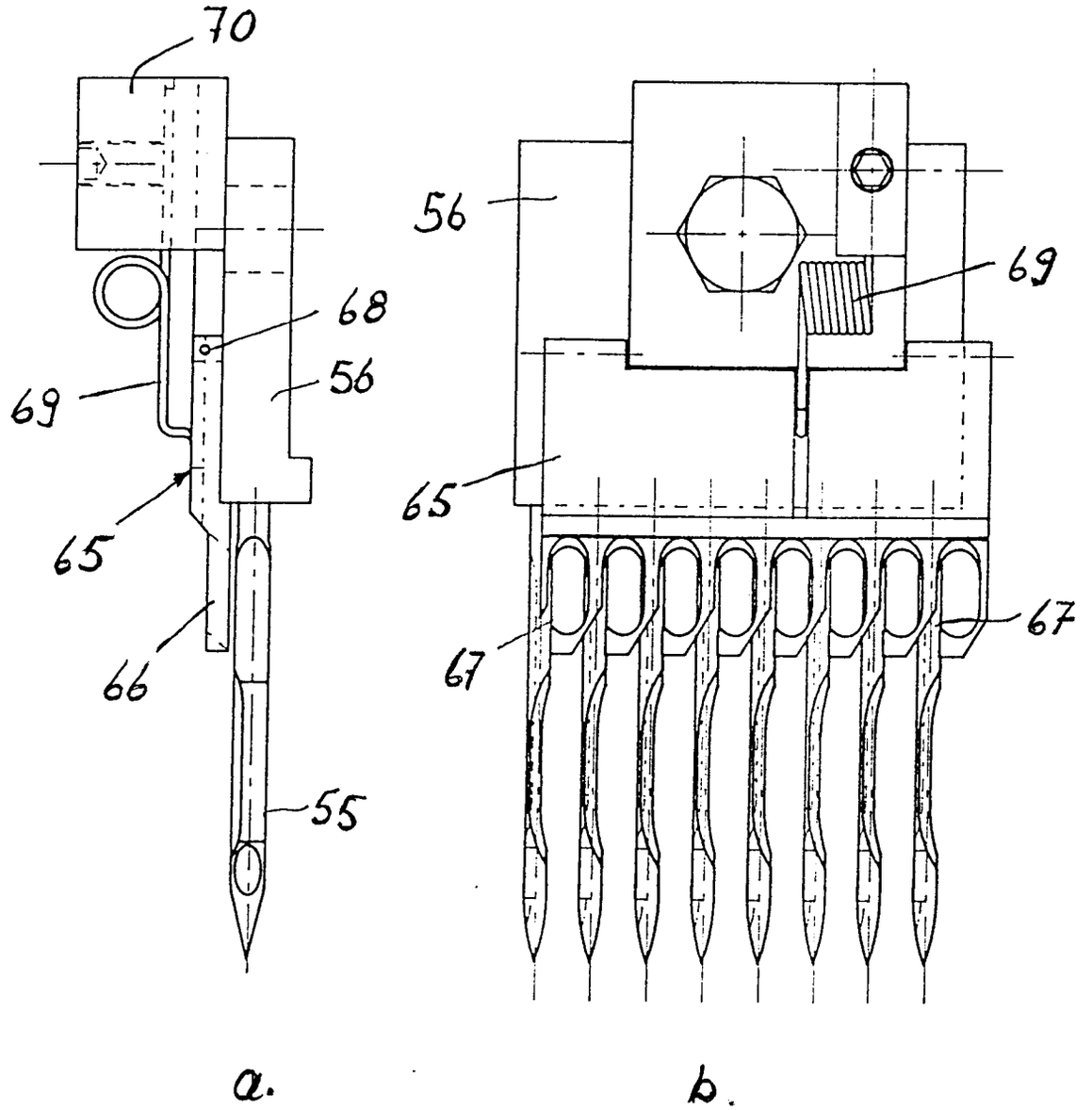

Fig. 12

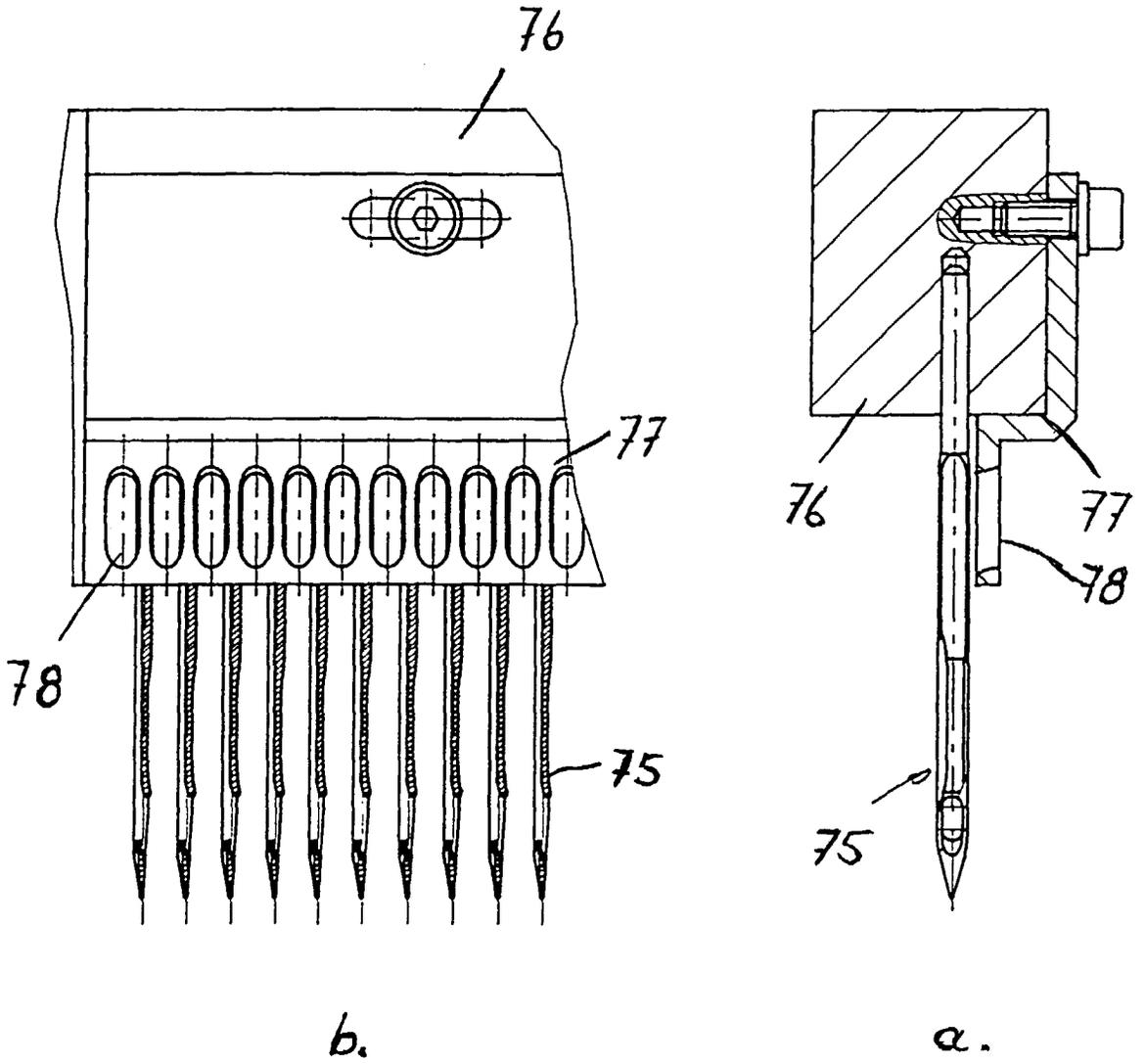

Fig. 13

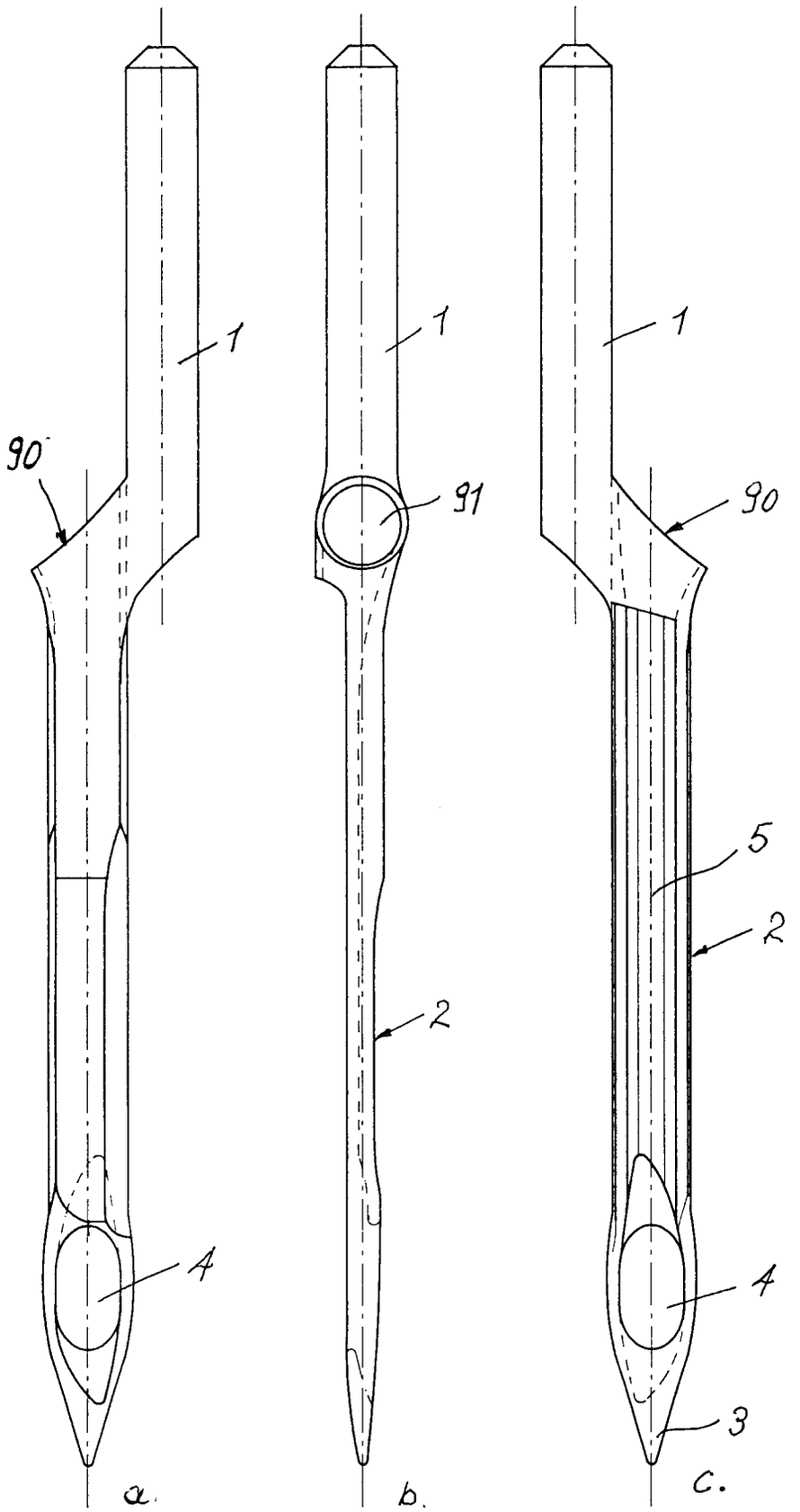

Fig. 14

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 10 8895

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X A	EP 0 187 925 A (FIRMA JOS. ZIMMERMANN) * page 11, line 4 - line 16; figures 8-14 * ---	1,19 12,15, 16,18	D05C15/20 D05C15/18
X	GB 1 601 812 A (C. FALK; A. JOHANSSON) * the whole document * ---	1,19	
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A	US 3 618 542 A (J. ZOCHER) * the whole document * ---	1,11	
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A	US 3 641 956 A (S.B. OWNBEY) -----		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

D05C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11 November 1997	D'Hulster, E

CATEGORY OF CITED DOCUMENTS

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