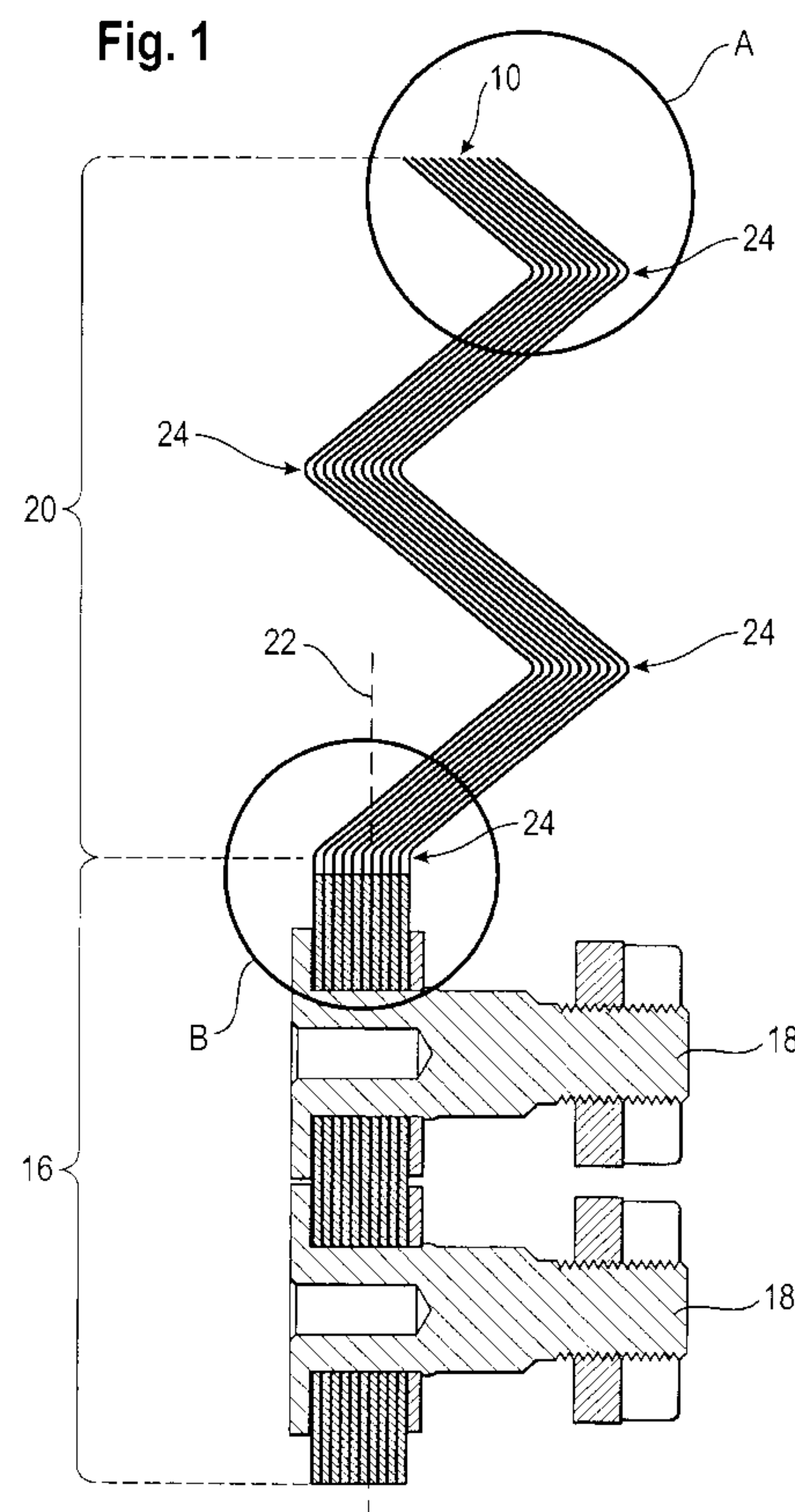




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(54) Titre : RESSORT DE CONTACT
(54) Title: CONTACT SPRING



(57) **Abrégé/Abstract:**

The invention relates to a contact spring having a free contact end (10) for producing an electrical contact between the free contact end (10) and a contact surface, the contact spring being formed from N contact spring metal sheets (12) and N-1 spacer elements

(57) **Abrégé(suite)/Abstract(continued):**

(14), N being ≥ 2 . The contact spring metal sheets (12) are fixed in a clamping region (16) with a spacer element (14) between two adjacent contact spring metal sheets (12), are at a distance from each other in a spring region (20) around the thickness of the spacer elements (14), extend parallel to each other up to the free contact end (10) in a freely elastic manner, and end in a common plane on the free contact end (10). The arrangement is such that, in the spring region (20), the contact spring metal sheets (12) have at least one bend (24) with a pre-determined angle (26, 28) between the longitudinal axis (22, 23) of the contact spring metal sheets (12) before the bend (24) and the longitudinal axis (23) of the contact spring metal sheets (12) after the bend (24).

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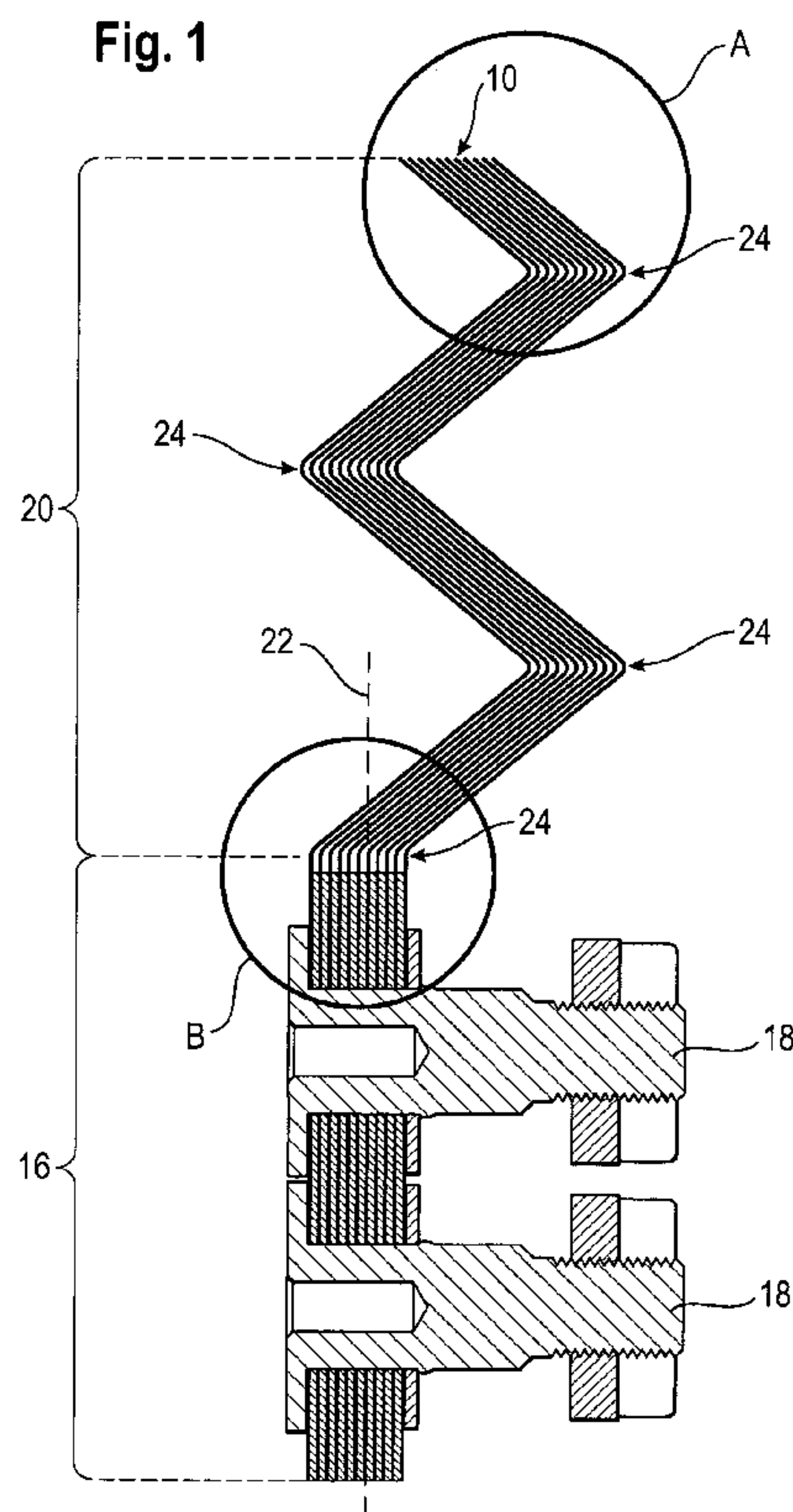
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(54) Title: CONTACT SPRING

(54) Bezeichnung: KONTAKTFEDER



(57) Abstract: The invention relates to a contact spring having a free contact end (10) for producing an electrical contact between the free contact end (10) and a contact surface, the contact spring being formed from N contact spring metal sheets (12) and N-1 spacer elements (14), N being ≥ 2 . The contact spring metal sheets (12) are fixed in a clamping region (16) with a spacer element (14) between two adjacent contact spring metal sheets (12), are at a distance from each other in a spring region (20) around the thickness of the spacer elements (14), extend parallel to each other up to the free contact end (10) in a freely elastic manner, and end in a common plane on the free contact end (10). The arrangement is such that, in the spring region (20), the contact spring metal sheets (12) have at least one bend (24) with a pre-determined angle (26, 28) between the longitudinal axis (22, 23) of the contact spring metal sheets (12) before the bend (24) and the longitudinal axis (23) of the contact spring metal sheets (12) after the bend (24).

(57) Zusammenfassung: Bei einer Kontaktfeder mit einem freien Kontaktende (10) zum Herstellen eines elektrischen Kontaktes zwischen dem freien Kontaktende (10) und einer Kontaktfläche, wobei die Kontaktfeder aus N Kontaktfederblechen (12) und N-1 Abstandselementen (14) mit $N \geq 2$ ausgebildet ist, wobei die Kontaktfederbleche (12) in einem Klemmbereich (16) mit je einem Abstandselement (14) zwischen zwei benachbarten Kontaktfederblechen (12) fixiert gehalten sind, in einem Federbereich (20) um die Dicke der Abstandselemente (14) voneinander beabstandet sind, frei federnd parallel zueinander

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bis zum freien Kontaktende (10) verlaufen und am freien Kontaktende (10) in einer gemeinsamen Ebene enden, ist die Anordnung derart getroffen, dass die Kontaktfederbleche (12) in dem Federbereich (20) wenigstens einen Knick (24) mit jeweils einem vorbestimmten Winkel (26, 28) zwischen der Längsachse (22, 23) der Kontaktfederbleche (12) vor dem Knick (24) und der Längsachse (23) der Kontaktfederbleche (12) nach dem Knick (24) aufweisen.

Contact spring

The present invention relates to a contact spring
5 having a free contacting end for making electric contact
between this free contacting end and a contact surface, the
contact spring being formed by N metal contact-spring
lamellae and N-1 spacer elements where $N \geq 2$, the metal
contact-spring lamellae being held fixed in a clamped
10 region with one spacer element between each two adjacent
metal contact-spring lamellae, being spaced apart from one
another in a resilient region, extending parallel to one
another in a freely and resiliently flexing manner to the
free contacting end, and ending in a common plane at the
15 free contacting end, the metal contact-spring lamellae
having, in the resilient region, at least one bend at each
of which there is a predetermined angle between the
longitudinal axis which the metal contact-spring lamellae
have upstream of the bend and the longitudinal axis which
20 the metal contact-spring lamellae have downstream of the
bend, as specified in the preamble to claim 1.

Known from DE 886616 B is an electrical contact in
which a contact part is brought into contact with a
plurality of contact springs in leaf form. There are
25 provided in this case sets of springs comprising a
plurality of individual springs arranged parallel to one
another which are fastened in place in a mounting. This
arrangement requires a blade contact which is inserted
perpendicularly to the sets of springs and which deflects
30 the individual springs in the sets of springs
perpendicularly to a longitudinal axis of the individual
springs. The contact arrangement is therefore not suitable

for making contact with a contact surface on a printed circuit board.

DE 100 24 165 A1, which is the generic text, relates to a contact-making system having a first contact member and a second contact member which are made from a material which flexes resiliently and is at the same time conductive. The contact members each comprise an insertable part, a resilient arm connected thereto and a contacting tip connected thereto, the resilient arm having the contacting tip at one end and the insertable part at the other end. The resilient arm is angled relative to the associated insertable part at an angle of approximately 80°. Similarly, the contacting tips are angled relative to the given resilient arm at an angle of approximately 120°. In conjunction with the resilient arm, the contacting tips serve to make contact with an electrical connection belonging to an electronic component. The two insertable parts of the contact members are arranged in a holding device with a printed circuit arranged between them. The resilient arms are spaced apart from one another in a region between the insertable parts and the contacting tips, the spacing in question being substantially less than the thickness of the printed circuit board which spaces the two insertable parts of the contact members apart from one another. This has the disadvantage that only a very small resilient travel is obtained for the resilient arms.

Known from DE 323 187 C is a fan-like electrical contact for electrical overload circuit-breakers. The fan-like contact comprises copper lamellae with highly elastic metal springs arranged between adjoining copper lamellae. These metal springs press the copper lamellae against a contact surface with a pressure which is always the same. The set of copper lamellae and metal springs is held in a

central region by a clamping action. From this central region, the copper lamellae, with the springs situated between them, extend to a contacting plane with a bend and at an increasing spacing from one another.

5 The object underlying the invention is to improve a contact spring of the above-mentioned kind in respect of contact resistance and current transmitting capacity.

 This object is achieved in accordance with the invention by a contact spring of the above-mentioned kind
10 which has the features characterised in claim 1. Advantageous embodiments of the invention are described in the other claims.

 In a contact spring of the above-mentioned kind, provision is made in accordance with the invention for the
15 metal contact-spring lamellae to be spaced apart from one another by the thickness of the spacer elements in the resilient region and for at least one of the metal contact-spring lamellae to have at least one slot starting from the free contacting end.

20 This has the advantage that the contact spring available is one which is able to flex in resiliently in a direction parallel to a longitudinal axis which the metal contact-spring lamellae and the spacer elements have in the clamped region, with all the metal contact-spring lamellae
25 being able to flex in resiliently simultaneously and independently of one another due to the spacing between the metal contact-spring lamellae in the resilient region. In this way, there are at least a number of points or spots of contact between the free contacting end of the contact
30 spring and the contact surface which corresponds to the number of metal contact-spring lamellae, even if the contact surface is uneven. The advantage is also obtained that one, or a plurality in parallel, of electrical

contacts of good quality can be made repeatedly (large numbers of cycles of 10,000 to 20,000 or more) with contact surfaces which are uneven and/or yielding, on printed circuit boards for example.

5 In a preferred embodiment, the common plane of the free contacting end is arranged to be perpendicular to a longitudinal axis which the metal contact-spring lamellae and the spacer elements have in the clamped region.

10 The metal contact-spring lamellae usefully have two, three or four bends in the resilient region.

By giving all of the metal contact-spring lamellae at least one slot in the resilient region, starting from the free contacting end, there are produced adjacent to the slot contact tongues which flex resiliently independently
15 of one another and the contact members which flex freely and resiliently at the free contacting end are multiplied, and the points of contact are thus multiplied in the same way. The at least one slot extends beyond at least one bend in the metal contact-spring lamellae in this case and
20 preferably extends parallel to a longitudinal axis of the metal contact-spring lamellae.

The metal contact-spring lamellae and the spacer elements are for example riveted and/or screwed together in the clamped region.

25 The spacer elements usefully extend for part of the clamped region or the entire length of the clamped region.

In a preferred embodiment, the predetermined angle between the longitudinal axis which the metal contact-spring lamellae have upstream of the bend and the
30 longitudinal axis which the metal contact-spring lamellae have downstream of the bend is the same for all the bends.

A substantially zigzag form for the resilient region is achieved by, starting from the clamped region and

looking in the direction of the contacting end, making the predetermined angle between the longitudinal axis which the metal contact-spring lamellae have upstream of the bend and the longitudinal axis which the metal contact-spring lamellae have downstream of the bend more than 90° for a first bend and equal to or less than 90° for each further bend in the resilient region.

The sum of the angles 28 of two successive bends 24 is usefully equal to or more than 180° .

10 The invention will be explained in detail in what follows by reference to the drawings. In the drawings:

Fig. 1 is a view in section of a preferred embodiment of contact spring according to the invention.

15 Fig. 2 is a plan view of the preferred embodiment of contact spring according to the invention which is shown in Fig. 1.

Fig. 3 is an enlarged view of detail B in Fig. 1.

Fig. 4 is an enlarged view of detail A in Fig. 1.

20 Fig. 5 is a view from below of a contact-making member having a plurality of contact springs according to the invention.

Fig. 6 is a partly cut-away view from the side of the contact-making member shown in Fig. 5.

25 The preferred embodiment of contact spring according to the invention which is shown in Figs. 1 to 4 comprises a free contacting end 10 for making electrical contact with a more or less even contact surface (not shown). The contact spring is formed by $N = 11$ metal contact-spring lamellae 12 and $N-1 = 10$ spacer elements 14. The metal contact-spring lamellae 12 are held fixed in a clamped region 16 with one
30 spacer element 14 between each two adjacent metal contact-spring lamellae 12. For this purpose, a stack or set of metal contact-spring lamellae 12 and spacer elements 14

placed alternately one on top of the other are riveted together by means of rivets 18. The spacer elements 14 only extend across the clamped region 16. The metal contact-spring lamellae 12 extend beyond the clamped region 16 and
5 form, between the clamped region 16 and the contacting end 10, a resilient region 20. In this resilient region 20 the metal contact-spring lamellae 12 are spaced apart from one another by the thickness of the spacer elements 14 and thus flex freely, resiliently and independently of one another
10 provided they do not butt against one another due to the resilient travel. The metal contact-spring lamellae 12 are also so formed that they extend parallel to one another for the full length of the resilient region 20 between the contacting end 10 and the clamped region 16. At the free
15 contacting end 10, the metal contact-spring lamellae 12 end in a common plane which is aligned perpendicularly to a longitudinal axis 22 which the metal contact-spring lamellae 12 have in the clamped region 16.

In the resilient region 20, the space between the
20 metal contact-spring lamellae 12 is empty, i.e. a spacer element 14 is not provided there, as can be seen in particular from Figs. 3 and 4. This free space allows the contact spring to flex resiliently in the direction of the longitudinal axis 22.

25 In accordance with the invention, the metal contact-spring lamellae 12 have, in the resilient region 20, at least one bend 24 at each of which there is a predetermined angle 26, 28 between the longitudinal axis 22 or 23 which the metal contact-spring lamellae 12 have upstream of the
30 bend 24 and the longitudinal axis 23 which the metal contact-spring lamellae 12 have downstream of the bend 24. All the longitudinal axes downstream of a bend 24 are identified by the reference numeral 23 in this case.

Between two longitudinal axes 23, what is meant by the term "angle" is whichever of the two complementary angles is smaller at a bend 24, as shown in Figs. 3 and 4.

Starting from the contacting end 10, the metal
5 contact-spring lamellae 12 are each provided with a slot 30. The resilient travel of the contact spring according to the invention is set by the thickness of the spacer elements 14. The constant of the spring is set by the thickness and width of the metal contact-spring lamellae 12
10 and by the number of metal contact-spring lamellae 12. The number $N = 11$ of metal contact-spring lamellae 12 which are shown in the embodiment is merely illustrative. A number N smaller or larger than 11 is also possible and in particular 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16,
15 17, 18, 19, 20.

The high-current contact spring according to the invention is characterised by a very low contact resistance if the cross-section of the material is sufficiently large and by a low spring constant. The contact spring is
20 preferably suitable for meeting (making contact with) even, i.e. plane surfaces such for example as pads or contact surfaces of printed circuit boards.

The contact spring which is shown by way of example in the drawings has eleven metal contact-spring lamellae 12
25 and ten spacer elements or metal inserts 14. Because of the central slot 30, the left and right halves of the contact spring which are produced by the slot 30 are able to flex resiliently independently of one another. Because of this, both halves of a spring make secure contact with the
30 contact surface. However, the contact spring still remains stable in the lateral direction. Two, three or more slots 30 may be provided to suit the application, which produces a corresponding tripling, quadrupling or in other words

multiplication of the halves of the contact spring which flex resiliently independently of one another.

By the placing in line of a plurality of thin contact springs it is possible to obtain low forces for resilient
5 flexing and a large resilient travel even when the cross-section of the material is large. The spacer elements or metal inserts 14 provide the mobility required at the time of flexing in by ensuring that there is a sufficiently large gap 32 between the metal contact-spring lamellae 12.

10 The many independently flexing points of contact form the basis for a low contact resistance, because the contact-making pressure is consistently high at each point of contact.

The contact spring according to the invention
15 comprises a block of metal contact-spring lamellae or individual springs 12 which are curved in an S-shape, with the resiliently flexing geometry being the same for all the metal contact-spring lamellae or individual springs 12 in the block. It is however possible for individual metal
20 contact-spring lamellae 12 also to have additions to their cross-section (attachments). There is obtained, in an advantageous way, a low contact resistance, a contact which is stiff in bending perpendicularly to the plane of operation and contact-making and a soft spring the cross-
25 section of whose material is large and whose overall dimensions are compact. The spring constant is determined in essence by the thickness of the material and the number of metal contact-spring lamellae or individual springs 12.

Figs. 5 and 6 show a contact-making member 34 which
30 has a plurality of contact springs according to the invention to enable a plurality of mutually separate electrical contacts to be made in parallel.

Claims

1. Contact spring having a free contacting end (10) for making electric contact between this free contacting end (10) and a contact surface, the contact spring being
5 formed by N metal contact-spring lamellae (12) and N-1 spacer elements (14) where $N \geq 2$, the metal contact-spring lamellae (12) being held fixed in a clamped region (16) with one spacer element (14) between each two adjacent
10 metal contact-spring lamellae (12), being spaced apart from one another in a resilient region (20), extending parallel to one another in a freely and resiliently flexing manner to the free contacting end (10), and ending in a common plane at the free contacting end (10), the metal contact-
15 spring lamellae (12) having, in the resilient region (20), at least one bend (24) at each of which there is a predetermined angle (26, 28) between the longitudinal axis (22, 23) which the metal contact-spring lamellae (12) have upstream of the bend (24) and the longitudinal axis (23)
20 which the metal contact-spring lamellae (12) have downstream of the bend (24), characterised in that the metal contact-spring lamellae (12) are spaced apart from one another by the thickness of the spacer elements (14) in the resilient region (20) and at least one of the metal
25 contact-spring lamellae (12) has at least one slot (30) starting from the free contacting end (10).

2. Contact spring according to claim 1, characterised in that the common plane of the free contacting end (10) is arranged to be perpendicular to a
30 longitudinal axis (22) which the metal contact-spring lamellae and the spacer elements have in the clamped region (16).

3. Contact spring according to claim 1 or 2, characterised in that the metal contact-spring lamellae (12) have two, three or four bends (24) in the resilient region (20).

5 4. Contact spring according to at least one of the preceding claims, characterised in that, starting from the free contacting end (10), all of the metal contact-spring lamellae (12) each have at least one slot (30).

10 5. Contact spring according to at least one of the preceding claims, characterised in that the at least one slot (30) extends beyond at least one bend (24) in the metal contact-spring lamellae (12).

15 6. Contact spring according to at least one of the preceding claims, characterised in that the at least one slot (30) extends parallel to a longitudinal axis (23) which the metal contact-spring lamellae (12) have in the resilient region (20).

20 7. Contact spring according to at least one of the preceding claims, characterised in that the metal contact-spring lamellae (12) and the spacer elements (14) are riveted and/or screwed together in the clamped region (16).

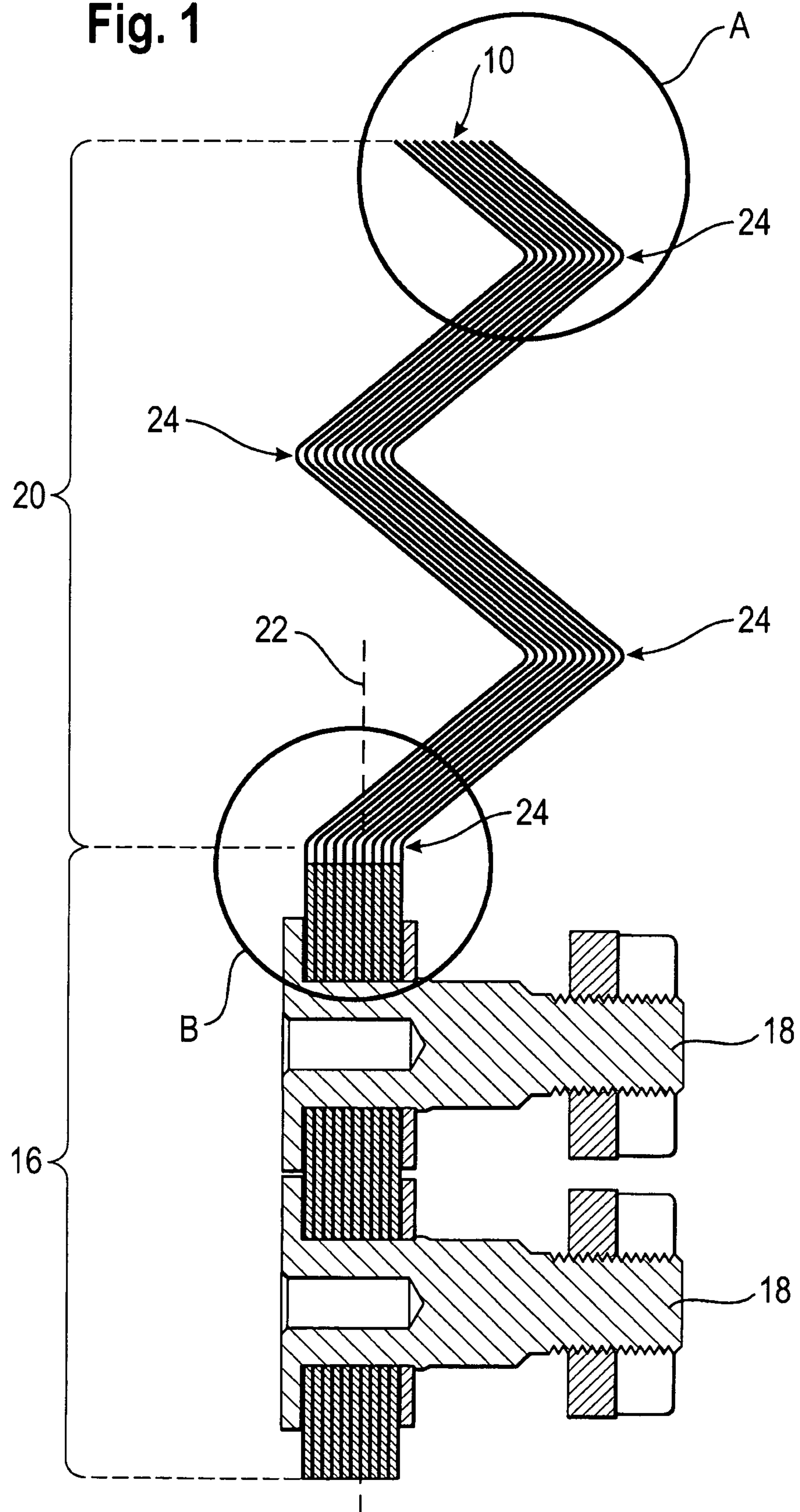
25 8. Contact spring according to at least one of the preceding claims, characterised in that the spacer elements (14) extend for part of the clamped region (16) or the entire length of the clamped region (16).

9. Contact spring according to at least one of the preceding claims, characterised in that the predetermined angle (26, 28) between the longitudinal axis (22, 23) which the metal contact-spring lamellae (12) have upstream of the bend (24) and the longitudinal axis (23) which the metal contact-spring lamellae (12) have downstream of the bend (24) is the same for all the bends (24).

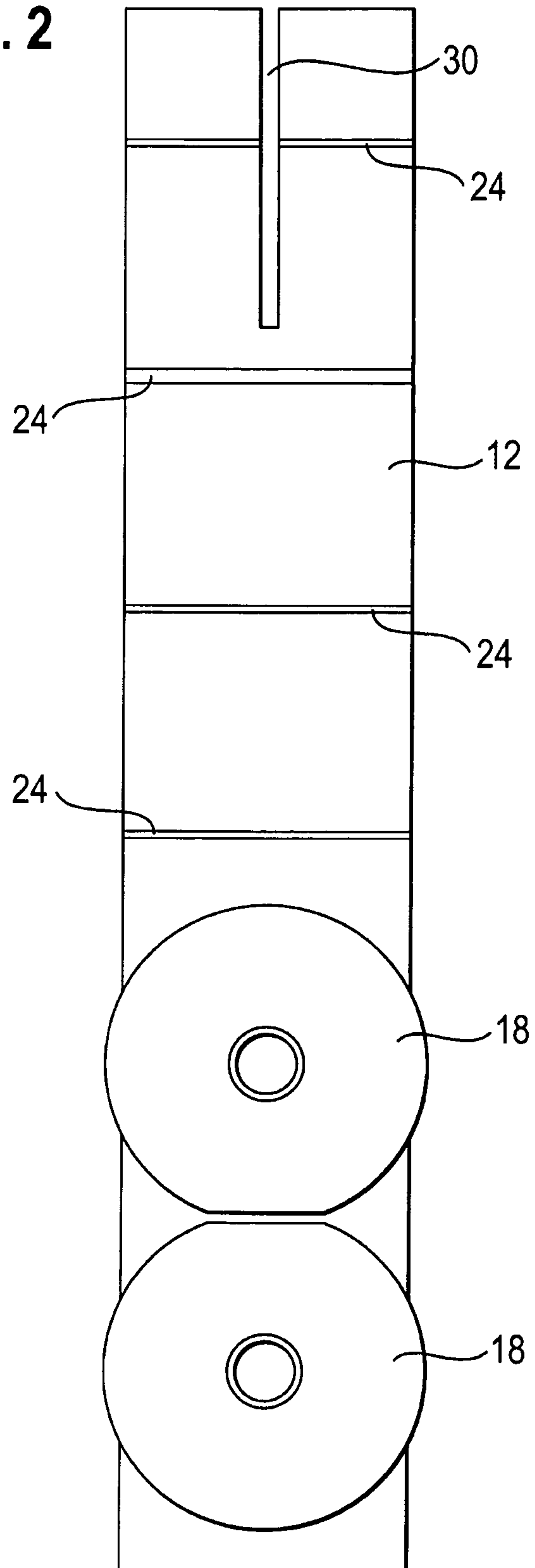
10. Contact spring according to at least one of the preceding claims, characterised in that, starting from the clamped region (16) and looking in the direction of the contacting end (30), the predetermined angle (26, 28) between the longitudinal axis (22, 23) which the metal contact-spring lamellae (12) have upstream of the bend (24) and the longitudinal axis (23) which the metal contact-spring lamellae (12) have downstream of the bend (24) is more than 90° for a first bend (24) and equal to or less than 90° for each further bend (24) in the resilient region (20).

11. Contact spring according to at least one of the preceding claims, characterised in that the sum of the angles (26, 28) of two successive bends (24) is equal to or more than 180° .

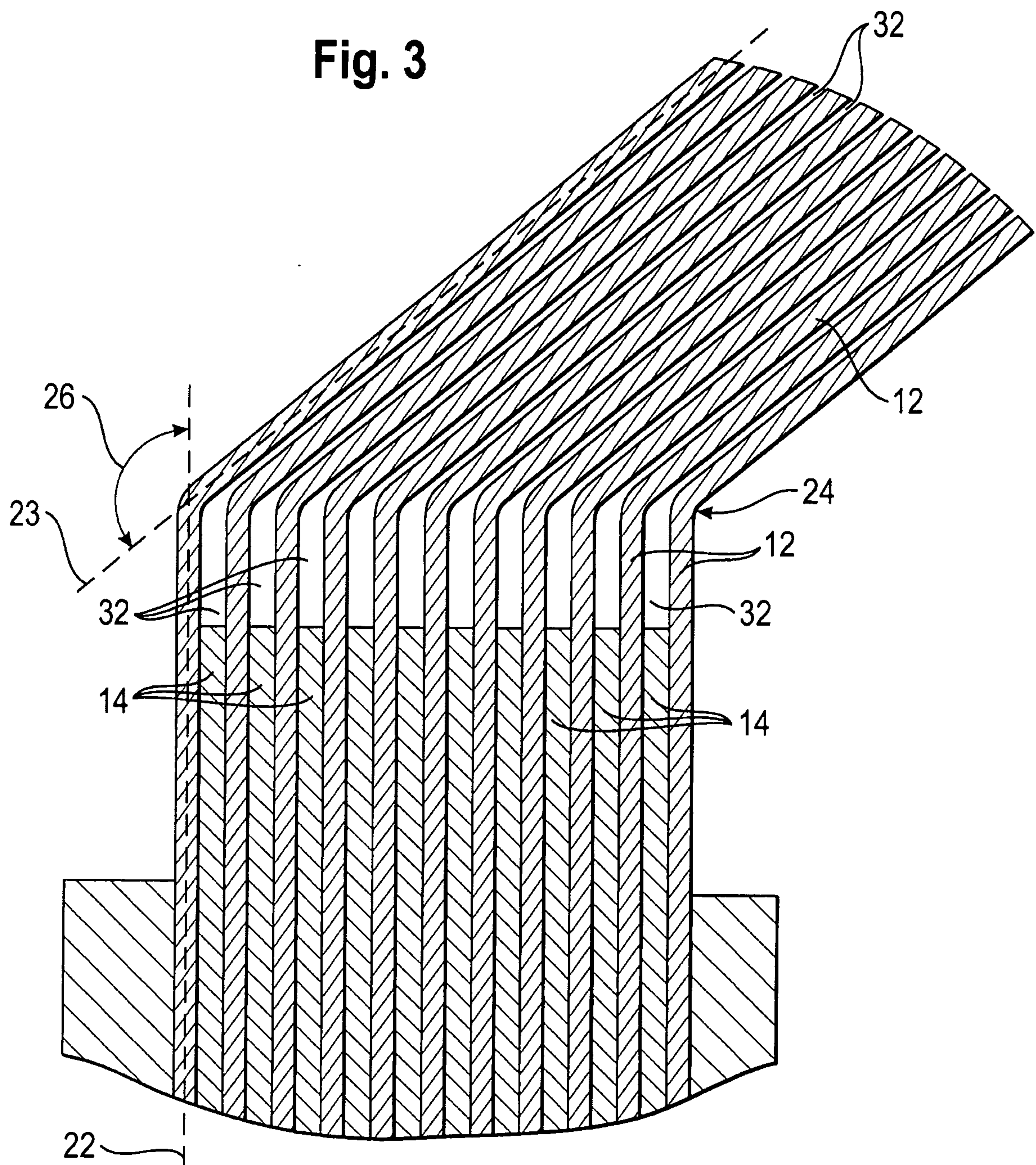
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Fig. 1

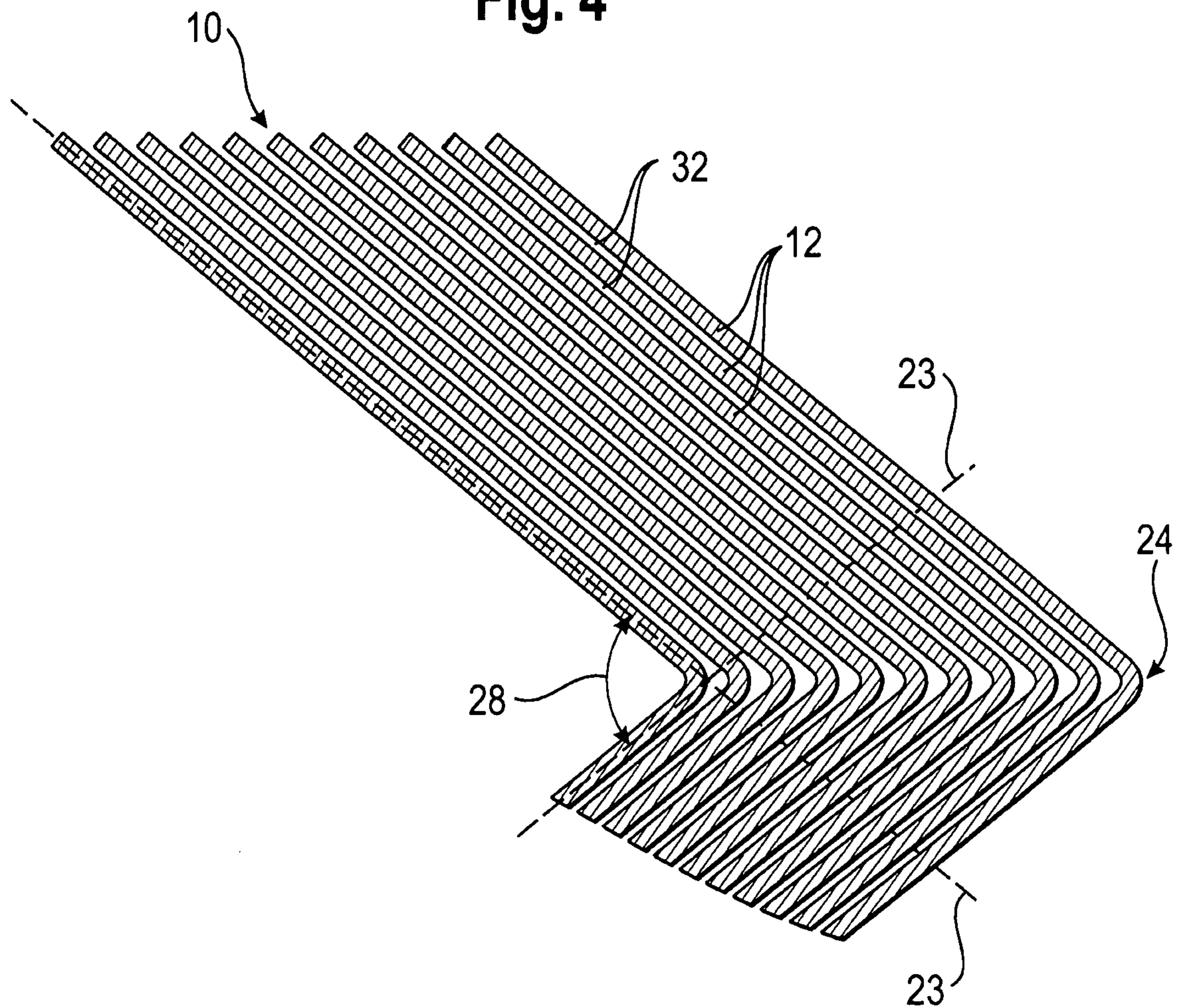
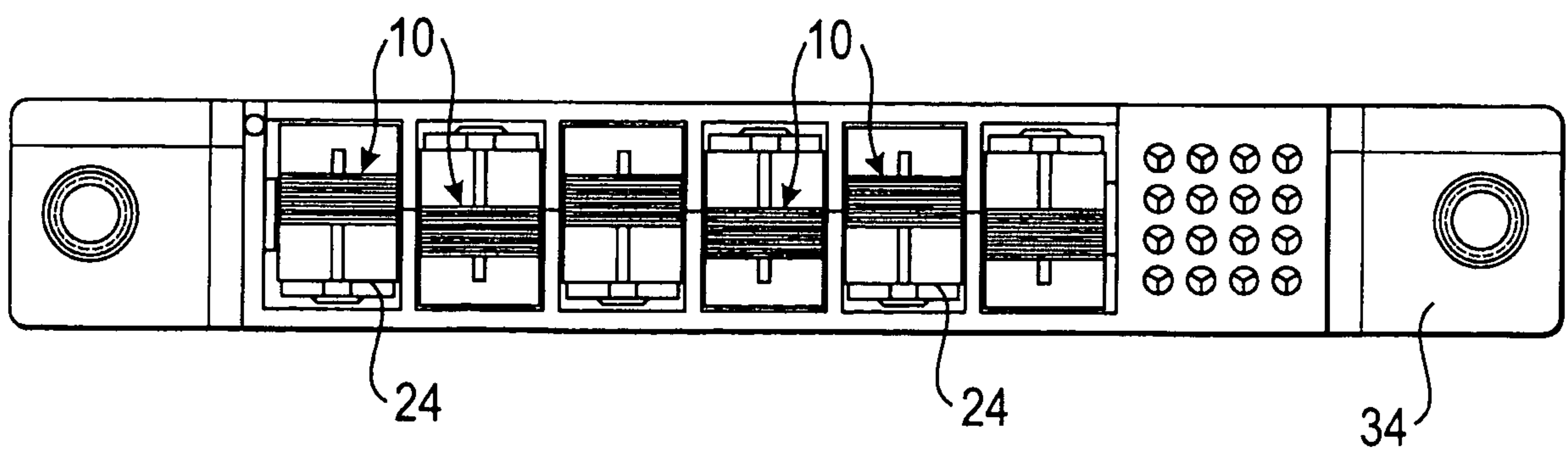
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Fig. 2

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Fig. 3

4 / 5

Fig. 4**Fig. 5**

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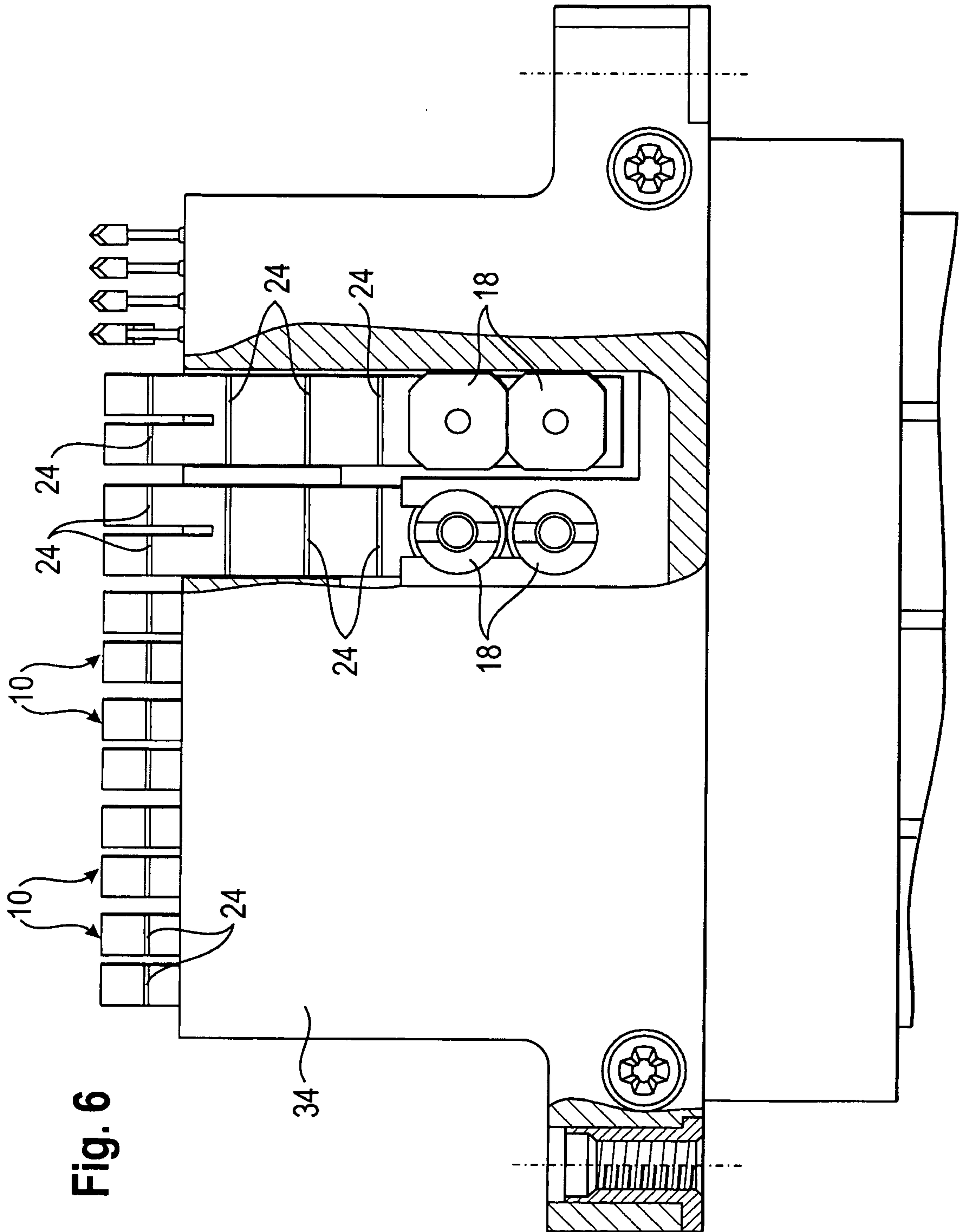


Fig. 1

