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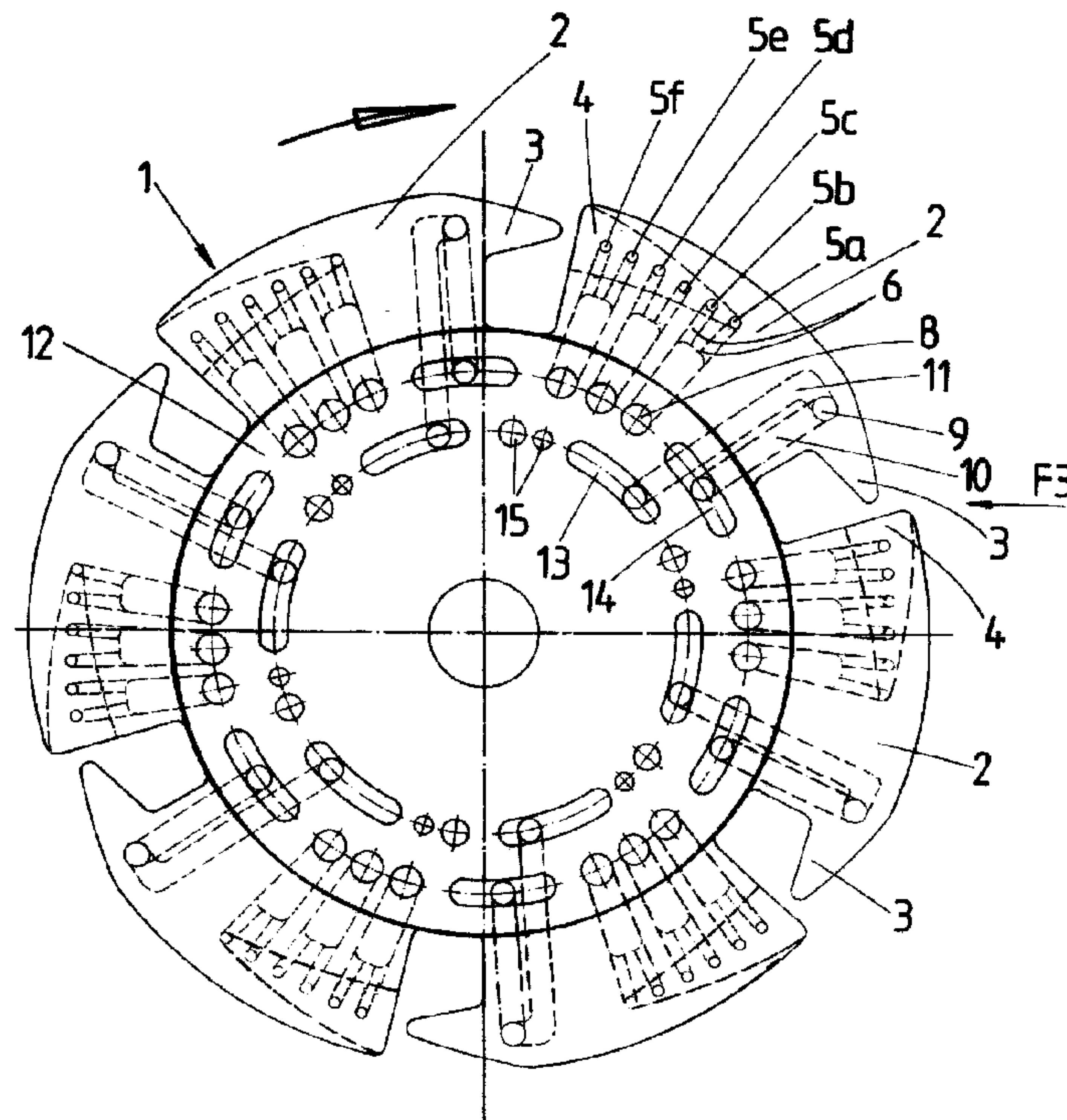
(72) Inventeur/Inventor:
SAUER, HARTMUT KARL, DE

(73) Propriétaire/Owner:
DE LA RUE GIORI S.A., CH

(74) Agent: FETHERSTONHAUGH & CO.

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(54) Title: COUNTING DISK OF SHEET COUNTER



(57) Abrégé/Abstract:

The counting disk (1) has circumferential sections (2) arranged on its border, and each circumferential section has a suction hollow (4) in which suction openings (5a to 5f) located one behind the other are arranged. Upon rotation of the counting disk, said suction openings are connected intermittently to a suction-air source, with the result that the corners of a sheet stack, one after the other, are subjected to suction, deformed, separated from the rest of the sheets and, by virtue of a pneumatic counting pulse being produced, counted. The suction air is supplied to the suction openings (5a to 5f) via a duct (6, 7) whose section (7), which opens into the suction openings, is directed perpendicularly with respect to the plane of the counting disk. Moreover, the suction openings (5a to 5f) are located in the center of the suction hollow (4).

ABSTRACT

The counting disk (1) has circumferential sections (2) arranged on its border, and each circumferential section has a suction hollow (4) in which suction openings (5a to 5f) located one behind the other are arranged. Upon rotation of the counting disk, said suction openings are connected intermittently to a suction-air source, with the result that the corners of a sheet stack, one after the other, are subjected to suction, deformed, separated from the rest of the sheets and, by virtue of a pneumatic counting pulse being produced, counted. The suction air is supplied to the suction openings (5a to 5f) via a duct (6, 7) whose section (7), which opens into the suction openings, is directed perpendicularly with respect to the plane of the counting disk. Moreover, the suction openings (5a to 5f) are located in the center of the suction hollow (4).

(Figures 2 and 5)

DE LA RUE GIORI S.A.

LAUSANNE/SWITZERLAND

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Counting disk of a sheet counter

FIELD OF THE INVENTION

10 The invention relates to a counting disk of a sheet counter for sheets arranged in stack form, in particular notes of value.

PRIOR ART

15 Sheet counters with vacuum-operated counting disks are known and serve, in particular, to count bank notes which are either already bundled together with a banderole or located loosely on upon the other without a banderole. In particular, a counter with the counting
20 disk described in the preamble of claim 1 is known under the SHEETMASTER tradename and is sold by the British company DE LA RUE SYSTEMS Limited, which has also already developed other vacuum-operated sheet counters, as are described, for example, in US-PS 4,350,331. Furthermore,
25 a counter with a counting disk having only one suction and counting section is known, for example, from GB-PS 744 957.

 The intermittent connection of the counting opening and the suction openings to the negative-pressure source
30 takes place by means of a fixed transfer block which rests against the counting disk and has openings which are in connection with the negative-pressure source and are arranged such that,

upon rotation of the counting disk, they temporarily overlap the inlet openings of the suction ducts provided in the counting disk. Said fixed transfer block thus acts as a valve plate.

5 In the case of the abovementioned known counting disk, the suction ducts opening in the suction hollow of a circumferential section run obliquely with respect to the disk plane and terminate, outside the center of the suction hollow, in the lateral hollow region facing the
10 center point of the disk, with the result that the suction-air direction is oriented obliquely with respect to the disk plane, and thus with respect to the plane of the sheet to be counted, essentially tangentially with respect to the curved hollow wall. Consequently, a
15 comparatively high negative pressure has to be used in order that the suction openings are sealed satisfactorily by the paper sheet, this entailing a correspondingly high consumption of air and a stronger suction force than would actually be necessary for raising up a sheet corner
20 from the sheet stack located behind it. In addition, the known counting disk only has three suction openings in each suction hollow.

SUMMARY OF THE INVENTION

25 As embodied and broadly described herein, the present invention provides a counting disk of a sheet counter for sheets arranged in stack form, in particular notes of value, said rotatable counting disk having circumferential sections arranged at regular intervals on
30 a border of said disk, each circumferential sections having (i) a protrusion projecting in the direction of rotation of the disk, (ii) a counting opening, a pneumatic counting pulse being triggered when said opening is covered by a sheet, (iii) a suction hollow,

whose width and depth increase in the direction counter
to the direction of rotation of said disk, and (iv) a
group of suction openings located one behind the other,
arranged in said suction hollow and can be connected
5 intermittently, via suction ducts, to a negative-pressure
source, such that, during operation, said circumferential
sections leaf through all sheet corners of a sheet stack
one after the other, separate these from one another in
the process, under the action of suction and deformation,
10 and cause each sheet to be counted, wherein said suction
openings are centrally located in said suction hollow and
wherein said suction ducts comprise duct sections that
open into said suction openings and that are directed
essentially perpendicularly with respect to the disk
15 plane and with respect to the base of the suction hollow,
and wherein the suction force thus acts centrally on said
suction hollow and perpendicularly with respect to the
base of said suction hollow.

20 Since the suction air is directed

perpendicularly with respect to the plane of the sheet corner to be raised up and since said suction air acts centrally on the hollow, the sheet corner is reliably sucked into the hollow and is positioned in a positively locking manner on the suction openings, with the result that good sealing is ensured. Consequently, a lower negative pressure, and correspondingly lower consumption of air, may be used than has been common hitherto, which eliminates the risk of two sheets which rest against one another being subjected to suction simultaneously. Moreover, the suction force can be set precisely in dependence on the paper quality.

In addition, the shape of said suction hollow and the suction forces are preferably such that a first sheet along which a suction hollow is sliding will be curved into said hollow, whereas a second sheet lying underneath said first sheet will be pulled at the most until half of said hollow and, because of its inherent stability, will not undergo any further deformation.

Preferably, five to seven suction openings, in particular six suction openings, are provided for each suction hollow.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is explained in more detail by way of an exemplary embodiment and with reference to the drawings, in which:

Figure 1 shows a side view of a counting disk with fixed transfer block and a holding-down device for the raised-up sheets,

Figure 2 shows, on an enlarged scale, a plan view of the front side of the counting disk according to Figure 1,

Figure 3 shows a partial view, in section, of the circumferential sections of the counting disk in the direction of arrow F3 according to Figure 2,

Figure 4 shows a plan view of the transfer block, and

Figures 5 to 10 show sections through the six

suction ducts which open in a suction hollow of a circumferential section of a disk according to Figure 2, said sections being directed parallel to the disk axis and running along a disk radius.

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DESCRIPTION OF THE PREFERRED EMBODIMENT

The counting disk 1 represented in Figures 1 and 2 belongs to a counter of a type known per se and has the general configuration of the abovementioned known counting disk. Provided at regular intervals along the border of the counting disk 1, the direction of rotation of which is indicated by a bent arrow, are circumferential sections 2, six circumferential sections in the example in question, which have a protrusion 3 projecting in the direction of rotation of the disk. Each circumferential section 2 has a suction hollow 4 in its rear region, in relation to the direction of rotation of the disk, which suction hollow 4 is formed on the underside of the disk in the representation according to Figures 2 and 3.

Provided at intervals one behind the other in said suction hollow 4 are six suction openings 5a to 5f, which form the apertures of suction ducts 6, 7. These ducts run in the interior of the circumferential sections 2 and of the inner disk body and extend radially as far as an opening 8 in the disk body, which opening, as Figure 2 shows, opens on the front side of the counting disk.

At its front end, the suction hollow 4 is of a width which is virtually only as large as the diameter of the suction opening 5a. Continuing from this front end, the suction hollow 4 becomes deeper and wider counter to the direction of rotation of the disk, as is represented in Figures 2 and 5 to 10, and reaches as far as the rear edge of the relevant circumferential section 2.

Furthermore, each circumferential section 2 has, behind the protrusion 3 and at a distance in front of the suction hollow 4, a counting opening 9 which

opens on the front side of the disk and is in connection with inner ducts 10 and 11, the duct 10 opening in a slit 14 which is curved concentrically with respect to the disk axis and is located on the front side of the disk, and the duct 11 opening in a slit 13 which is likewise curved concentrically with respect to the disk axis and is located on the front side of the disk. The curved slits 14 are located together with the openings 8 on a first circle concentric to the disk axis, while the curved slits 13 together with in each case two further openings 15, these being arranged in each case between two slits 13, are located on a second, inner circle.

The planar front side 12 of the inner disk body of the counting disk 1 bears on a fixed, disk-shaped transfer block 16 whose center point coincides with the axis of rotation of the counting disk 1 and whose planar side facing the counting disk is provided with two openings 17 and 18 in the angle region in which the counting takes place (Figure 4). The opening 17 is connected to a negative-pressure source and is located on the outer circle, concentric to the axis of rotation of the counting disk, on which the slits 14 and the openings 8 of the counting disk are situated. The other opening 18 leads to a vacuum gauge, a so-called transducer, and is located on that circle on which the slits 13 and the openings 15 of the counting disk 1 are situated. As is represented in Figure 4, the opening 17 is offset somewhat by an angle in the direction of rotation of the counting disk 1 with respect to the opening 18.

When the counting disk 1, which slides on the transfer block 16, rotates, then the slits 14 and the openings 8 temporarily overlap, one after the other, the opening 17 of the transfer block and are thus temporarily connected to the suction-air source, while the slits 13 and the openings 15 of the counting disk temporarily overlap, one after the other, the opening 18 of the transfer block, as a result of which, as is

further explained below, a counting pulse is triggered. The transfer block 16 thus functions as a valve plate.

As is shown in Figures 5 to 10, each suction duct comprises a duct section 6, which runs obliquely outward from the opening 8 and reaches to beyond the center of the suction hollow 4, and a short duct section 7 which is oriented perpendicularly with respect to the disk plane, and thus with respect to the plane of a sheet to be counted, and opens into the relevant suction opening 5a to 5f. In the example in question, as Figure 2 shows, two suction-duct sections 6 in each case are connected to one and the same opening 8.

The counting of a sheet stack, in particular of the individual notes of value of a bundle of such notes, by means of the abovedescribed counting disk takes place as follows:

The sheet stack is laid against the counting disk 1, rotating at a constant speed, such that the plane of a sheet is oriented essentially parallel to the plane of the counting disk and a corner of the sheet stack overlaps the circumferential sections 2 in the angle region of the counting disk where the openings 17 and 18 of the transfer block 16 are located. As soon as a circumferential section 2 slides along the corner of the first sheet, the openings 8 of the counting disk 1 pass the opening 17 of the transfer block 16 and, when the beginning of the suction hollow 4 reaches this sheet, the negative pressure which is produced in the suction openings 5a to 5f connected, via the transfer block and the ducts 6 and 7, one after the other to the negative-pressure source, causes the sheet corner to be sucked against said openings and deformed.

Figures 5 to 10, which represent sections through the suction openings 5a to 5f and their suction-air ducts 7, 6, show schematic illustrations of the individual stages of this suction and deformation of the sheet corner, which, in this manner, is raised

up from those sheets of the stack which are located behind it.

By virtue of the first suction opening 5a, the sheet corner is subjected to suction, and successive
5 contact with the following suction openings 5b to 5f effects further suction and, in the process, the increasing deformation of the sheet corner by the latter resting against the curved base of the deepening and widening suction hollow 4, and, finally, the sheet
10 is definitively raised up from the rest of the sheets and separated therefrom. Since, on account of the position of the suction-duct sections 7, the suction air takes effect (in accordance with the arrow in Figure 10) in the center of the suction hollow 4 and
15 perpendicularly with respect to the base thereof, and thus with respect to the sheet subjected to suction, for a given aspirating intensity, the sheet undergoes an optimal suction force, which then pulls the sheet into the suction hollow by deforming it against its
20 inherent stability or elasticity. A reliable suction, deformation and separation of the sheet corners is thus obtained without the necessity of producing an excessive negative pressure, it being possible, furthermore, for the negative pressure to be adapted in
25 a simple manner to the quality, in particular to the bending behavior, of the sheets.

In particular, the suction cavity and the suction force are chosen such that a second sheet, which is underneath the sucked sheet, will be pulled at
30 the most until half of the suction cavity 4, preferably at the most until the second suction hole 5b ; from this place, the force due to the inherent stability of the sheet will be stronger than the force due to the remaining suction air applied by the sheet which is
35 aspirated and maintained in the suction cavity, so that both sheets separate.

As soon as the circumferential section 2 subjecting the sheet to suction has passed the sheet corner, the protrusion 3 of the following circumferen-

tial section 2 passes beneath the deformed, curved up sheet corner and thus reaches beneath said sheet, as a result of which it is further separated from the following sheets and is guided over the counting opening 9 of said circumferential section 2. In order that said raised-up sheet remains in the immediate vicinity of the front side of the circumferential section 2 and can be subjected to suction by the negative pressure prevailing in the counting opening 9, the counting disk 1 has seated upon it a holding-down device 19 (Figures 1 and 3) which is connected firmly to said disk and rotates therewith and is in the form of a ring with blade-like attachments 20 reaching radially over the raised-up sheet.

While the counting opening 9 slides along beneath the raised-up sheet corner, the slit 14 of the counting disk passes the opening 17 of the transfer block 16 and, immediately thereafter, the slit 13 of the counting disk passes the opening 18 of the transfer block 16. Consequently, on the one hand, the counting opening 9 is connected to the negative-pressure source via the transfer block and the duct 10, as a result of which the sheet is sucked against the counting opening 9 and covers the latter, and, on the other hand, the closure of the counting opening 9 means that a negative pressure is produced in the duct 11, which is in connection with the duct 10, and in the opening 18, which is then in connection with said duct 11 via the slit 13.

The negative-pressure peak detected by the vacuum gauge mounted at the opening 18 of the transfer block 16 is converted, as a pneumatic counting pulse, into an electric counting signal. The negative pressure produced is eliminated again via the holes 15 of the counting disk which pass the opening 18 thereafter. If no sheet is guided over the counting opening 9 and the latter thus remains open, no negative pressure can be produced in the opening 18 and it is also not possible for any counting pulse to be produced.

As soon as the first suction opening 5a in the suction hollow 4 reaches the next sheet of the stack, the described suction and deformation operation is repeated for the second sheet, which, after being
5 raised up from the rest of the sheets, is counted upon passing the counting opening 9 in the next circumferential section 2, and so on. The circumferential sections 2 of the counting disk 1 thus, as it were, leaf through the corners of the sheet
10 stack, which, successively having the protrusions 3 passing beneath them, are counted when sucked against the counting opening 9, and pass from the rear side of the counting disk 1 to the front side thereof, until the entire sheet stack has been counted.

15 The invention is not restricted to the described embodiment of a counting disk, but, as regards the precise design of the circumferential sections and the suction-air supply means and the number of suction openings, permits a variety of
20 variants.

CLAIMS

1. A counting disk of a sheet counter for sheets arranged in stack form, in particular notes of value,
5 said rotatable counting disk having circumferential sections arranged at regular intervals on a border of said disk, each circumferential sections having (i) a protrusion projecting in the direction of rotation of the disk, (ii) a counting opening, a pneumatic counting pulse
10 being triggered when said opening is covered by a sheet, (iii) a suction hollow, whose width and depth increase in the direction counter to the direction of rotation of said disk, and (iv) a group of suction openings located one behind the other, arranged in said suction hollow and
15 can be connected intermittently, via suction ducts, to a negative-pressure source, such that, during operation, said circumferential sections leaf through all sheet corners of a sheet stack one after the other, separate these from one another in the process, under the action
20 of suction and deformation, and cause each sheet to be counted, wherein said suction openings are centrally located in said suction hollow and wherein said suction ducts comprise duct sections that open into said suction openings and that are directed essentially
25 perpendicularly with respect to the disk plane and with respect to the base of the suction hollow, and wherein the suction force thus acts centrally on said suction hollow and perpendicularly with respect to the base of said suction hollow.

30

2. The counting disk as claimed in claim 1, wherein the shape of said suction hollow and the suction forces are

such that a first sheet along which said suction hollow is sliding will be curved into said suction hollow whereas a second sheet lying underneath the first sheet will be pulled at the most until half of said suction
5 hollow and, because of its inherent stability, will not undergo any further deformation.

3. The counting disk as claimed in claim 1 or 2, wherein said group of suction openings on each
10 circumferential section comprises five to seven suction openings.

4. The counting disk as claimed in claim 1 or 2, wherein said group of suction openings on each
15 circumferential section comprises six suction openings.

5. The counting disc as claimed in claim 2, wherein the second sheet will be pulled at the most until a second suction opening.

FIG. 1

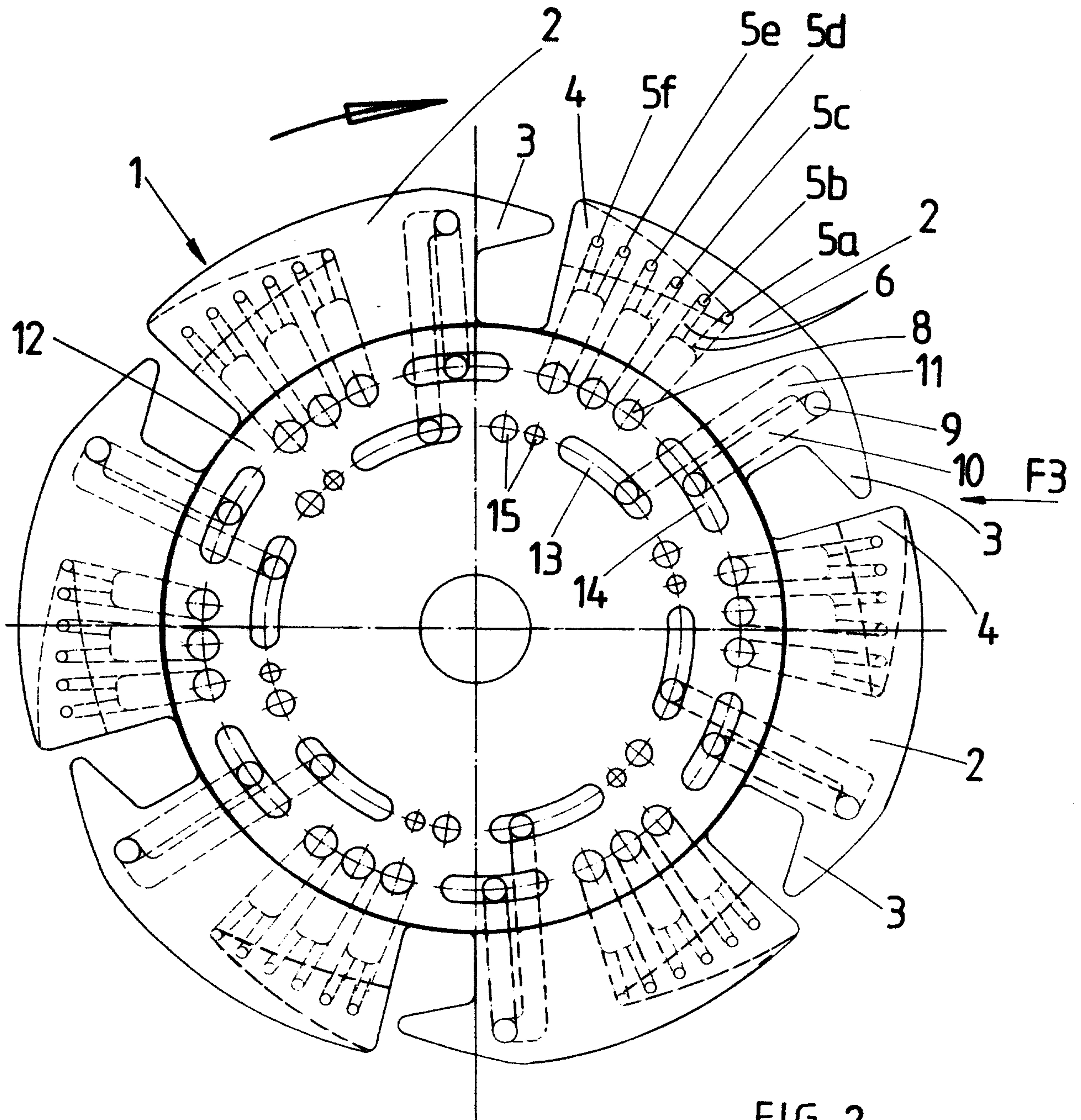
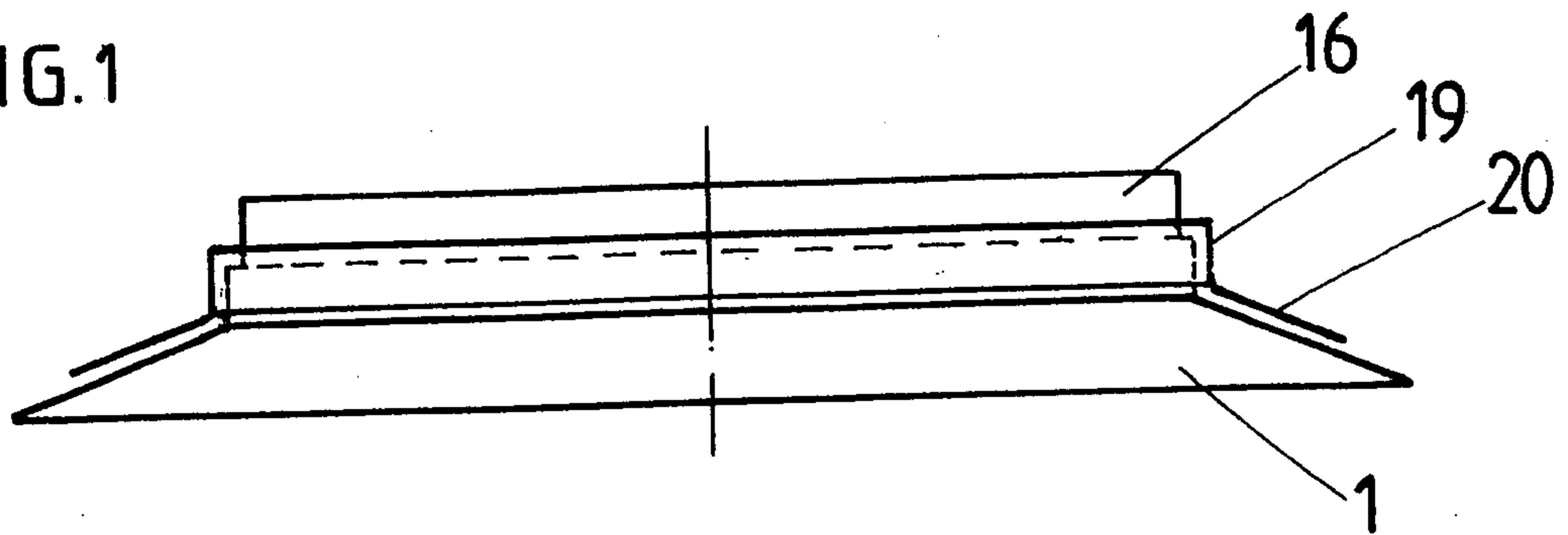


FIG. 2

Fig.3

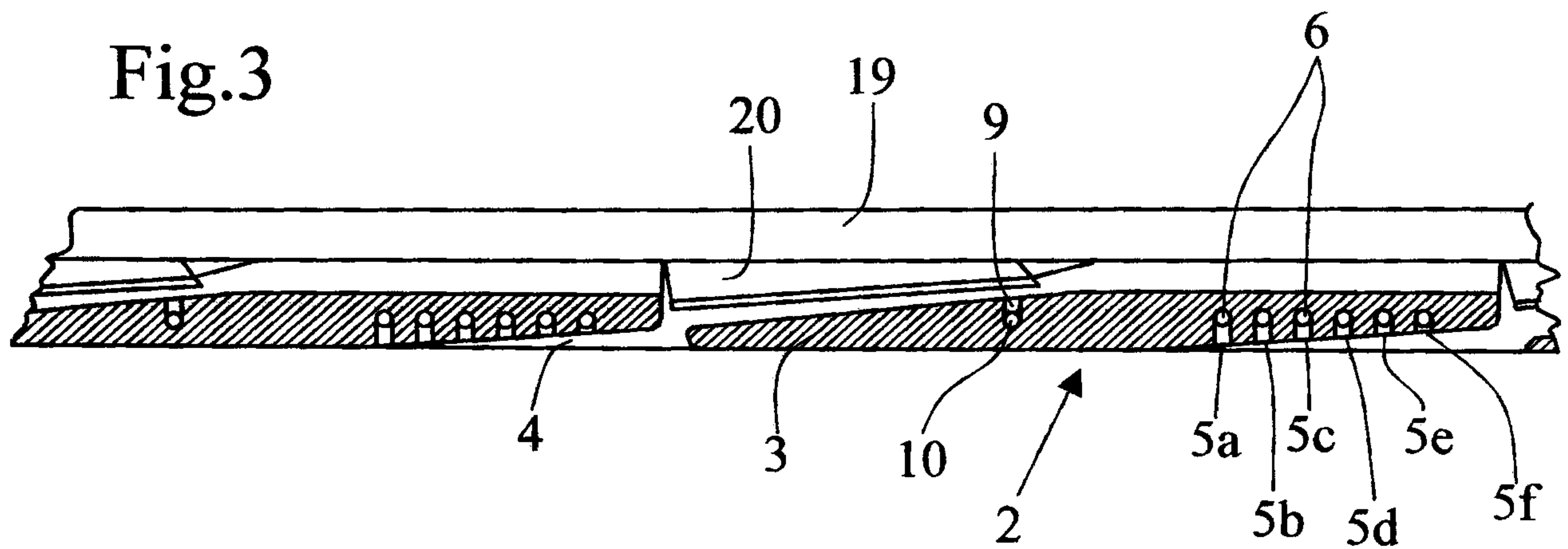


FIG. 4

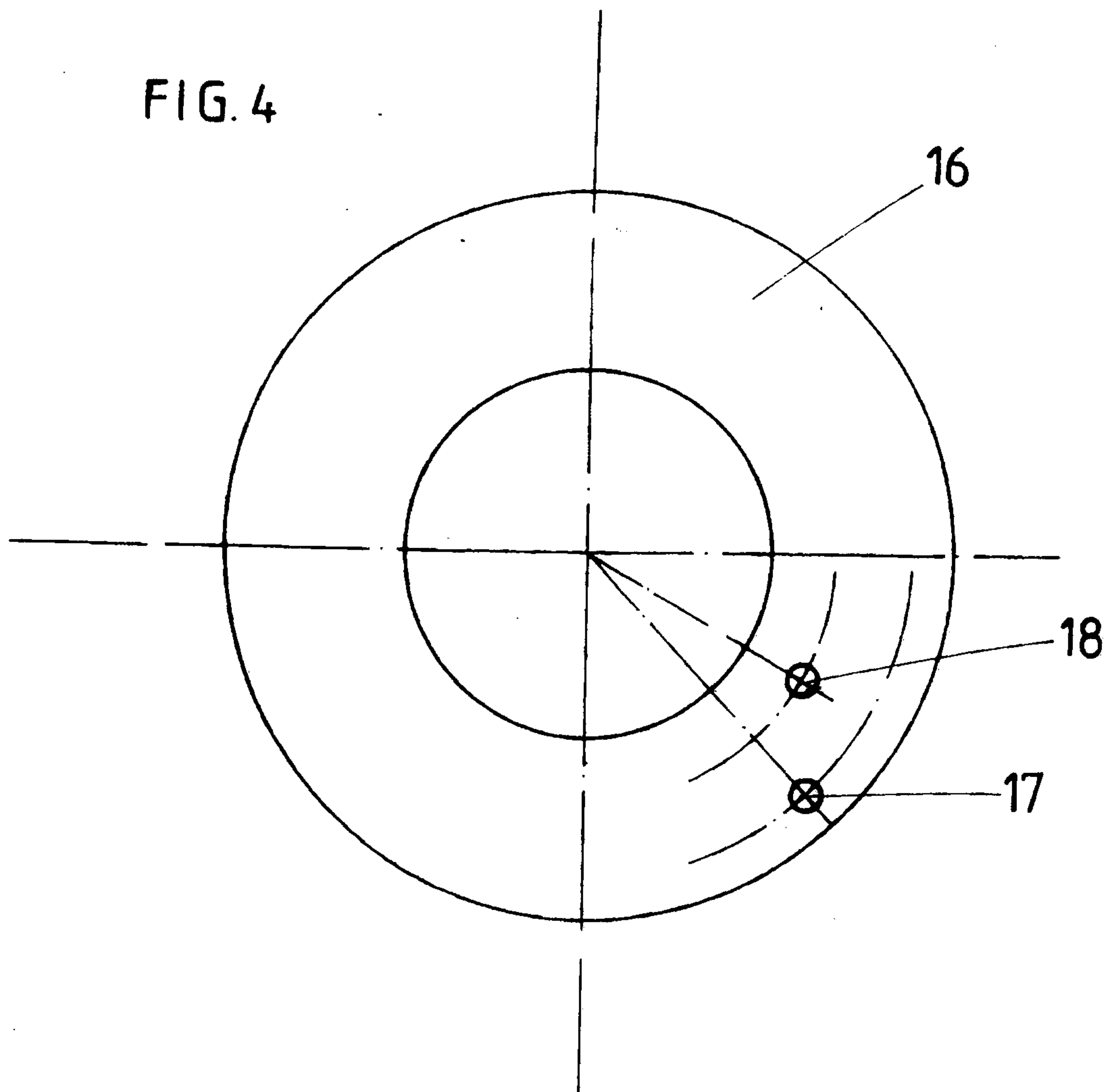


Fig.5

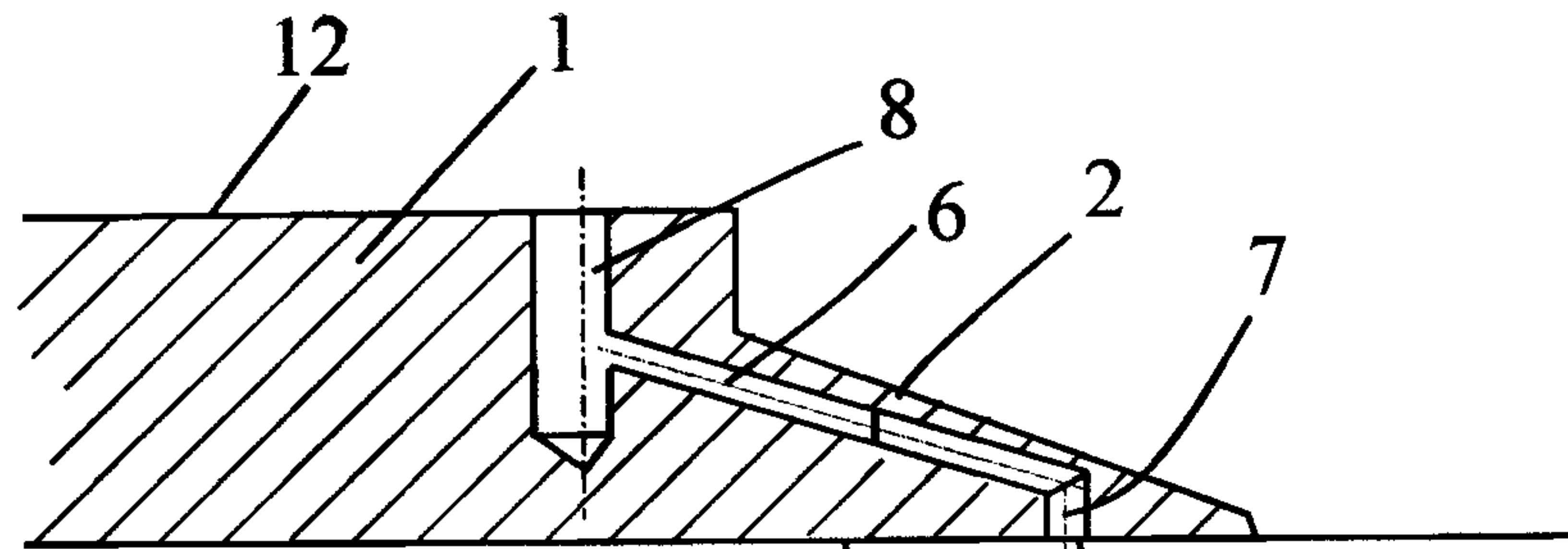


Fig.6

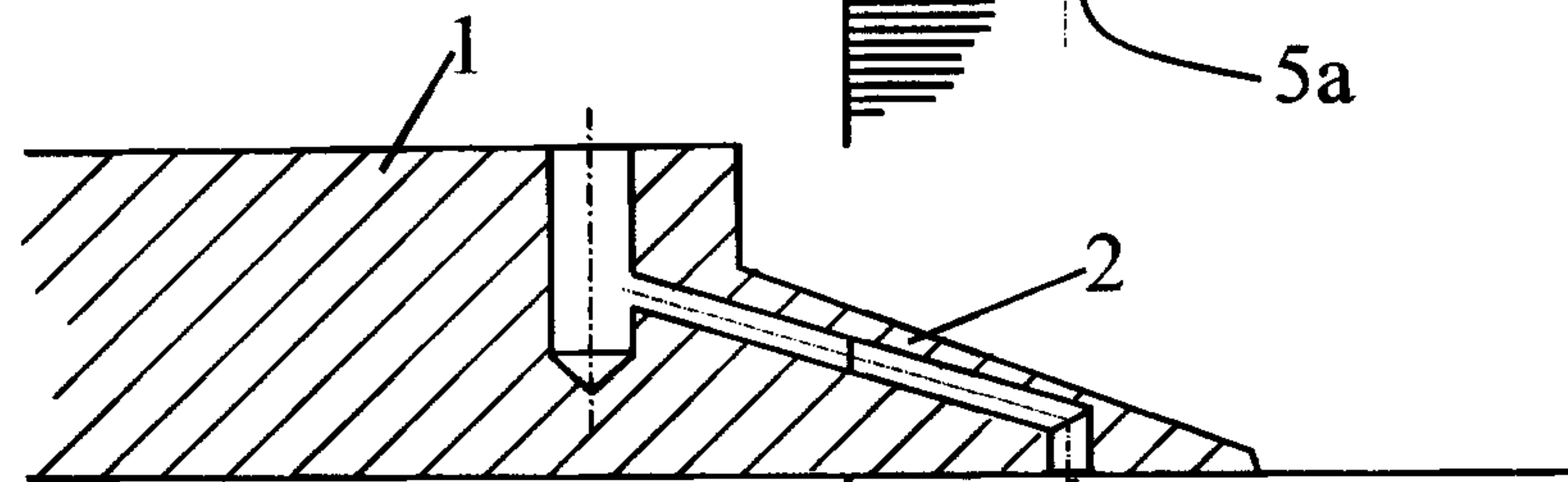


Fig.7

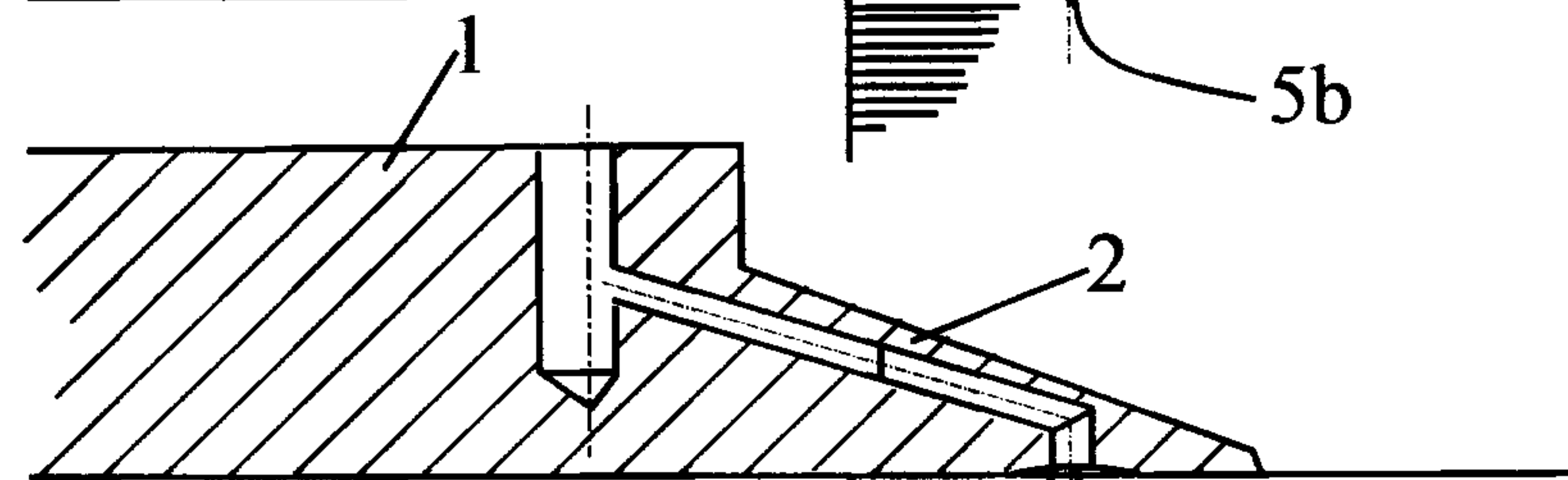


Fig.8

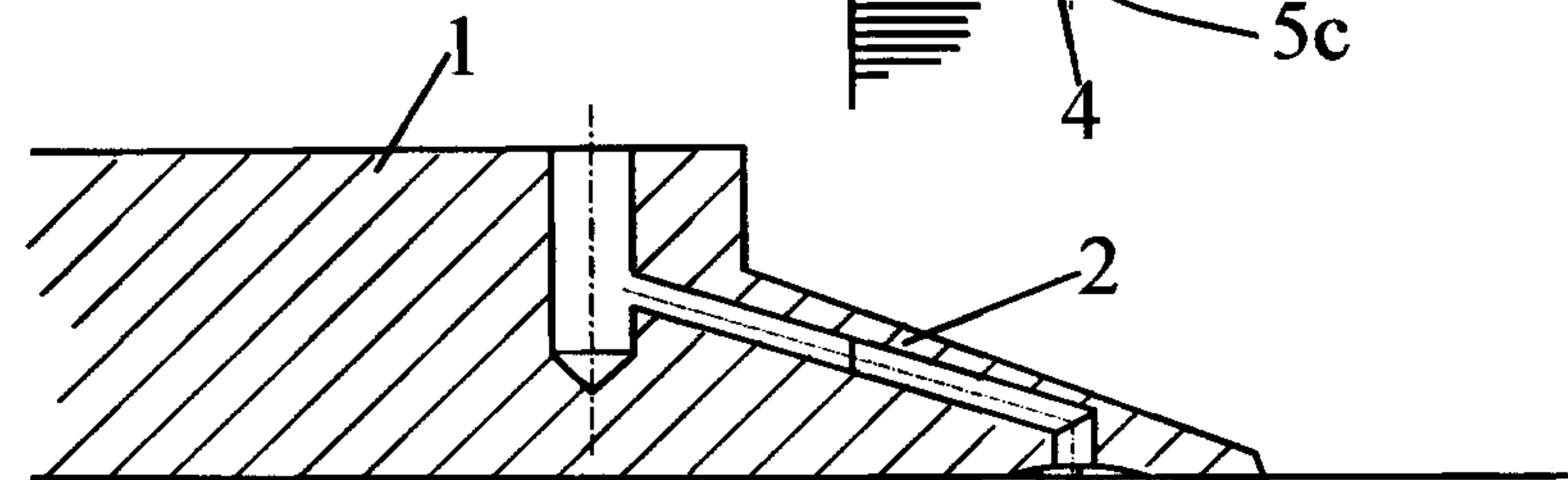


Fig.9

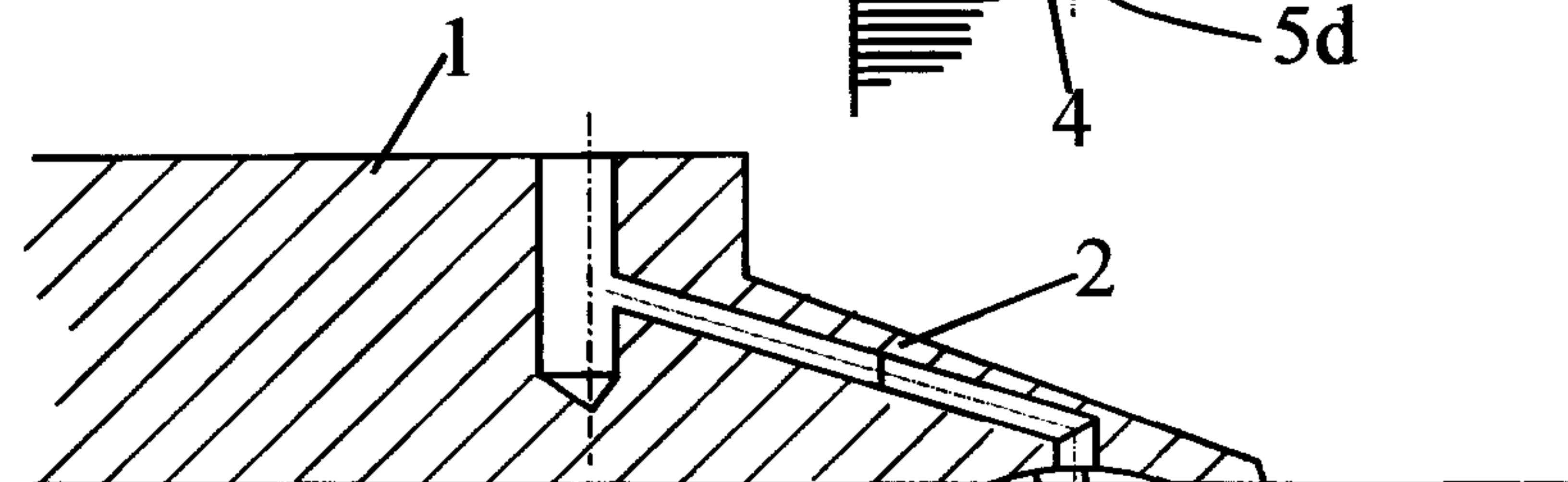


Fig.10

