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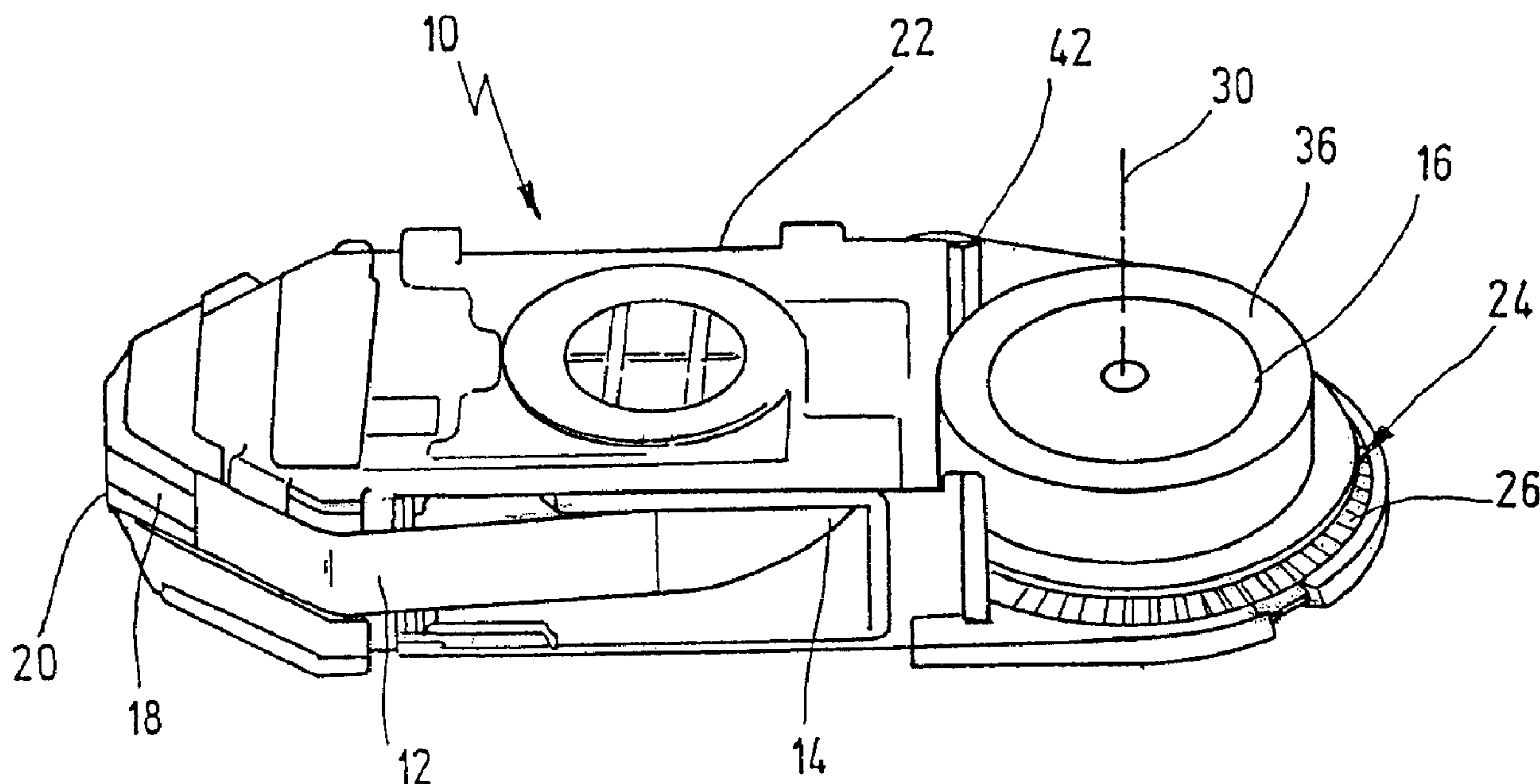
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(54) Titre : CASSETTE DE RUBAN DE DIAGNOSTIC, EN PARTICULIER POUR DES TESTS DE GLYCEMIE

(54) Title: DIAGNOSTIC TAPE CASSETTE, PARTICULARLY FOR BLOOD SUGAR TESTS



(57) Abrégé/Abstract:

A diagnostic tape cassette for blood sugar tests is described which includes an analytical test tape, a supply spool for winding off unused test tape and a take-up spool for winding used test tape, a housing for the spools and a rotational lock for the take-up spool at least against inadvertent unwinding of test tape. The rotational lock has a friction element attached to a housing surface which is brought into frictional engagement with a facing contact surface of the take-up spool when the take-up spool is moved axially out of a release position.

ABSTRACT

A diagnostic tape cassette for blood sugar tests is described which includes an analytical test tape, a supply spool for winding off unused test tape and a take-up spool for winding used test tape, a housing for the spools and a rotational lock for
5 the take-up spool at least against inadvertent unwinding of test tape. The rotational lock has a friction element attached to a housing surface which is brought into frictional engagement with a facing contact surface of the take-up spool when the take-up spool is moved axially out of a release position.

Diagnostic tape cassette, particularly for blood sugar tests**Description**

The invention concerns a diagnostic tape cassette particularly for blood sugar tests comprising an analytical test tape, a supply spool for winding off unused test tape
5 and a take-up spool for winding used test tape, a housing for the spools and a rotational lock for the take-up spool at least against inadvertent unwinding of test tape.

Previously individual test strips have been used in practice for the self-diagnosis of diabetics which are photometrically analysed after applying a small amount of
10 sample in order to determine the glucose content in the sample (blood or tissue fluid) as accurately and reliably as possible. In order to improve the user-friendliness it has already been suggested that a plurality of tests be provided on a test tape in the form of a tape cassette. It should be possible to insert such tape cassettes as a disposable part into compact hand-held devices in order to enable all
15 required analytical steps to be carried out automatically and rapidly.

In this connection a reversing lock against tape unwinding is disclosed in DE 10
2005 013 685 of the applicant which is still unpublished on the priority date of this application, in order to prevent unintentional winding out of used tape contaminated
with blood. In this document the lock in the form of a free wheel lock allows test
20 tape to be wound on whereas it should be secured against turning back in the opposite direction of rotation. In this connection it should be noted that diagnostic tape cassettes as consumable parts are mass-produced articles which it should be

- 2 -

possible to manufacture as simply as possible and should operate reliably with a high degree of user friendliness.

On this basis the object of the invention is to further improve the test tape systems proposed in the prior art and to achieve particular advantages for their use while
5 being simpler to manufacture.

In accordance with a first aspect of the present invention, there is provided a diagnostic tape cassette for blood sugar tests comprising an analytical test tape, a supply spool for winding off unused test tape and a take-up spool for winding used test tape, a housing for the spools and a rotational lock for the take-up spool at least
10 against inadvertent unwinding of test tape, wherein the rotational lock has locking teeth disposed on both opposing faces of the housing and the take-up spool, said teeth being shifted by an axial movement of the take-up spool between a mutually engaged position and a release position.

There is also provided, in accordance with another aspect of the present invention, a
15 diagnostic tape cassette for blood sugar tests comprising an analytical test tape, a supply spool for winding off unused test tape and a take-up spool for winding used test tape, a housing for the spools and a rotational lock for the take-up spool at least against inadvertent unwinding of test tape, wherein the rotational lock has a friction element attached to a housing surface which is brought into frictional engagement
20 with a facing contact surface of the take-up spool when the take-up spool is moved axially out of a release position.

A first concept of the invention is based on the idea of implementing an automatically switching mechanism instead of a lock controlled by the direction of rotation. Accordingly it is proposed that the rotational lock has locking teeth
25 disposed on both opposing faces of the housing and the take-up spool, said teeth being shifted by an axial movement of the take-up spool in its spool axis between a

- 3 -

mutually engaged position and a release position. In this manner it is possible to apply or override a locking action as the situation demands. In the engaged position used test tape is reliably prevented from becoming freely accessible by manipulation of the user. In the release position distracting noises are completely avoided and no
5 additional drive torque is required which is also advantageous with regard to energy supply when it is used in hand-held devices. Furthermore, the proposed solution works independently of the coil diameter of the wound test tape and the rotational lock can be manufactured using a few components without complicated free wheel mechanisms. At the same time the overall size can be kept small so that the
10 functional parts are not important for determining the cassette size.

The locking teeth are preferably in the engaged position when the tape cassette is handled independently of the device and are preferably in the release position when the tape cassette is used in a device preferably by inserting a drive spindle of the device into the take-up spool.

15 The axial movement of the locking teeth also enables the take-up spool to be freely rotated in both directions of rotation in the release position and locks the take-up spool in both directions of rotation in the engaged position.

A particularly advantageous embodiment for the construction provides that the take-up spool has a toothed disk with teeth on a front face as locking teeth, wherein the
20 toothed disk can be formed by a collar of a cylindrical spool body around which the test tape can be wound.

In order to achieve an automatic shift function, it is advantageous when the take-up spool is braced against the housing in the direction of the spool axis by means of a return spring. In this connection it is advantageous when the return spring is formed
25 on a wall of the housing as a leaf spring or spiral spring and when an annular space is kept free for the test tape between the wall and the locking teeth.

- 4 -

The housing preferably has a toothed ring flange as locking teeth.

In order to avoid an unintentional locking action during axial tilting due to high tape tension, it is advantageous when the locking teeth of the housing are formed on a ring segment facing away from a last deflecting point for the test tape to be wound
5 on and when the remaining ring segment has no teeth.

An improved form fit in the locking direction can be achieved by means of the fact that the teeth of the locking teeth have asymmetric tooth flanks where the tooth flanks which strike one another in the engaged position when backing the take-up spool, are steeper.

10 For an easy manufacture, it is advantageous when the take-up spool is inserted into a chamber of the housing that is free of a physical axis of rotation. The assembly can also be simplified if the take-up spool can be placed on the locking teeth of the housing in any rotational position.

In order to compensate for tolerances especially in the case of a separately mounted
15 rotary drive, it is advantageous when the take-up spool is float-mounted in the housing with transverse play with regard to its spool axis. In this case it should be ensured that the transverse play is greater than 0.2 mm and preferably 0.3 to 0.6 mm. An advantageous embodiment provides that the take-up spool has an annular extension which engages in an opening in the housing with transverse play
20 at least in the engaged position of the locking teeth.

According to a second inventive concept the rotational lock has a friction element attached to a housing surface which is brought into frictional engagement with a facing contact surface of the take-up spool when the take-up spool is moved axially out of a release position. As a result a locking function can be achieved in a

- 5 -

constructionally simple manner in any position of rotation and independently of the direction of rotation.

The friction element is advantageously formed by a friction ring arranged coaxially with respect to the take-up spool, can consist of an elastomer material, preferably
5 TPE and can be preferably formed on the housing surface by injection-moulding.

Another improvement is achieved in that the housing surface is formed by a ring flange defining an opening and that the friction element is arranged circumferentially on the ring flange preferably in the area of the rim of the opening. Correspondingly it is advantageous when the contact surface is formed by a collar of
10 a cylindrical spool body around which the test tape can be wound. The frictional force is therefore independent of the current diameter of the tape spool on the spool body.

In order to automatically ensure a frictional engagement when the cassette is not in use, it is advantageous when the take-up spool is braced against the housing in the
15 direction of the spool axis by means of a return spring such that the frictional engagement occurs under the restoring force of the return spring.

Another inventive concept is that the rotational lock has a catch spring attached to the housing and axially pretensioned against the take-up spool, which permanently meshes with free-wheel teeth arranged on the front of the take-up spool to prevent
20 unwinding of a tape loop. This not only increases protection against manipulation but can also always prevent an unintentional unwinding of a tape loop for example due to jolting and thus maintain a defined tape positioning at a sensor site.

- 6 -

The catch spring is advantageously formed on a wall of the housing preferably as a concentric ring structure or spiral spring where an inner member of the catch spring projecting from the wall carries the at least one latch.

5 In order to minimize the possible angle of backward movement with a given number of teeth, it is advantageous when the spring latch is designed as a multiple latch to subdivide the locked positions of the free-wheel teeth such that the individual latches are brought into a locking engagement which is displaced over the tooth pitch of the free-wheel teeth.

10 A particularly advantageous arrangement envisages that the free-wheel teeth are formed on an end wall of a spool body of the take-up spool which faces the catch spring, and that the spool body is supported on the housing by means of an annular collar and preferably by locking teeth.

15 In order to achieve a locking action which is dependent on the direction of rotation, it is advantageous when the free-wheel teeth are formed by a crown gear with an asymmetric tooth profile where the flatter tooth flanks form a slide slope for the spring latch during rotation in the winding direction and the steeper tooth flanks support the spring latch in a form-fitting manner during rotation in the unwinding direction.

20 In order to minimize friction it is advantageous when the teeth of the free-wheel teeth have a tooth height which decreases over their width thus shortening the engagement length of the spring latch.

The invention also concerns a test system comprising a test device and a diagnostic tape cassette inserted therein in particular for blood sugar tests where the tape cassette has an analytical test tape, a supply spool for winding off unused test tape

- 7 -

and a take-up spool for winding used test tape, a housing for the spools and a rotational lock for the take-up spool at least against inadvertent unwinding of test tape.

In such a system it is particularly advantageous when a drive spindle of the test
5 device engages in the take-up spool when the tape cassette is inserted and thereby lifts out the locking teeth or abolishes the frictional connection of the friction element into the release position. Another improvement can be achieved in that the drive spindle can be adjusted by a spring in the direction of a drive axis and engages in the take-up spool under spring displacement. In this connection it is advantageous
10 when the drive spindle in a driver bore of the take-up spool transfers a rotary movement by means of at least one driver.

The invention is further elucidated in the following on the basis of the embodiment examples shown schematically in the drawing.

Fig. 1 shows a tape cassette for blood sugar tests comprising an unwinding lock for
15 the test tape in a perspective view.

Fig. 2 shows a take-up spool of the tape cassette with locking teeth in an enlarged perspective view.

Fig. 3 shows a ring flange of the tape cassette with a counter-toothing in a top-view.

20 Figs. 4 and 5 show the take-up spool and the ring flange in an engaged position and a released position of the locking teeth in an axial section.

Fig. 6 shows a portable measuring device with a holder for the tape cassette in a perspective view.

Fig. 7 shows a drive spindle of the device according to fig. 6 in a side view.

- 8 -

Fig. 8 shows the housing cover with a locking spring that is formed thereon in a further embodiment of the tape cassette.

Fig. 9 shows a take-up spool provided with free wheel teeth on the front side in a side view.

5 Fig. 10 shows the locking spring according to fig. 8 engaged with the free wheel teeth according to fig. 9 for a permanent loop lock in a broken perspective view.

10 Figs. 11 to 13 show a further embodiment of the tape cassette with a take-up spool according to fig. 11 for a frictional engagement with a frictional ring on the housing according to fig. 12 or 13 in a perspective view.

The tape cassette shown in fig. 1 with the cover removed enables a plurality of glucose analyses to be carried out locally on blood samples collected by the patients themselves. For this purpose the tape cassette 10 comprises an analytical test tape 12 which can be pulled from a supply spool 14 and wound on to a take-up spool 16, 15 during which a test field 18 is deflected at an application tip 20 in order to allow body fluid (blood or tissue fluid) to be applied to the front side and a reflectometric measurement to be carried out on the rear side. The test fields 18 mounted on sections of the test tape 12 contain dry chemicals which respond to the analyte (glucose) in the applied blood fluid and lead to a measurable change in the light 20 radiated back when the rear side is illuminated.

The spools 14, 16 carrying the test tape 12 are inserted into a housing 22 of the cassette 10 in which housing only the application tip 20 is freely accessible when the cover is fitted. In order to prevent used test tape contaminated with blood from being unintentionally wound off during manipulations from outside, a rotational 25 lock 24 is provided between the take-up spool 16 and housing 22. Said lock is formed by locking teeth 26, 28 formed on the housing 22 and on the take-up spool

- 9 -

16 which can be shifted by an axial movement of the take-up spool along the spool axis 30 between a mutually engaged position and a release position.

As shown best in fig. 2, the take-up spool 16 has a toothed disk 32 with teeth on the front side which carries the locking teeth 28 in the fashion of a crown wheel. The toothed disk 32 is formed by a collar of a hollow-cylindrical spool body 34 around which the test tape 12 can be wound where the locking teeth 28 face away from the spool of test tape 36 (fig. 1). The take-up spool 16 has an annular extension 38 on the toothed side for a floating centring in the counter-toothed 26.

As shown in fig. 3 the housing 22 has a ring flange 40 which carries the locking teeth 26 on the housing side. Said teeth are formed on a ring segment 44 which faces away from the deflecting point 42 for the test tape 12 to be wound on which is last with regard to the tape transport direction whereas the remaining ring segment 46 has no teeth so that when it is tilted due to a strong tape tensile load of the take-up spool 16, unintentional locking is avoided. The ring flange 40 defines a housing opening 48 in which the annular extension 38 of the take-up spool 16 is pivoted in an engaged position with transverse play 49. This transverse play 49 is achieved by means of the fact that the circumference of the housing opening 48 has an approximately 0.5 mm larger diameter than the annular extension 38. Due to their radial extension the locking teeth 26, 28 can compensate for a corresponding lateral deflection of the take-up spool 16 which can thus compensate for positioning tolerances.

The locking teeth 26, 28 are thus formed in a ring shape on facing surfaces 44, 50 so that the take-up spool 16 can be placed in any rotational position on the ring flange 40. In order to improve the locking action against a reversal of rotation, the teeth of the locking teeth 26, 28 have asymmetric tooth flanks where the tooth flanks 52, 54 that strike each other in the engaged position when the take-up spool 16 is rotated backwards are steeper than the opposing tooth flanks 52, 54.

- 10 -

The shifting function of the rotational lock 24 is shown best in figs. 4 and 5. When the tape cassette 10 is stored or is handled independently of the device, the locking teeth 26, 28 are mutually engaged so that both directions of rotation are locked by form fitting (fig. 4). This is ensured by a return spring 56 which is clamped between the cover 58 of the housing 22 and the closed front face 60 of the spool body 34 and presses this against the ring flange 40. The return spring 56 is expediently formed on the cover 58 as a spiral spring. The take-up spool 16 can then be inserted into the housing chamber 62 where no physical pivot axle is required and the annular space 64 between the cover 58 and the rotational lock 24 is kept free in order to receive the test tape 12.

When the tape cassette 10 is used, a drive spindle 66 of an instrument drive which is only shown schematically in fig. 5 engages axially in the central driver bore 67 of the spool body 34 and thus under compression of the spring 56, results in it being lifted out into the release position. In this process the locking teeth 26, 28 are disengaged and the take-up spool 16 can thus be freely rotated. The drive spindle 66 then optionally adopts the locking function in the unwinding direction whereas the winding on of the test tape – in the example shown when rotated in a clockwise direction – is made possible by three drivers 68 divided in the direction of rotation. Due to the gap between the locking teeth 26, 28 distracting noises are thus avoided and no undesired braking torque occurs.

Fig. 6 shows a hand-held device 70 with a holder 72 into which the tape cassette 10 can be inserted in order to enable a substantially automated measuring process with the measuring system that is formed in this manner. The optical measuring system of the instrument 76 is positioned relative to the application tip 20 in the holder 72. In this connection the transverse play of the take-up spool 16 explained above allows a compensation of assembly and positioning tolerances of the drive spindle 66 specially mounted in the device housing.

- 11 -

The drive spindle 66 shown separately in fig. 7 has a driving pin 78 which penetrates the bottom of the holder 72 and is coupled via a gearing to a drive motor in the device 70 (not shown). A supporting disk 80 is seated on the pin 78 on which disk a coupling head 82 is supported by means of a helical compression spring 84
5 allowing axial movement relative to the pin 78. When the cassette 10 is inserted into the holder 72, the coupling head 82 plunges into the driver bore 67 of the take-up spool 16 and its circumferential cams 86 come into a form-fit with the drivers 68 under the force of the spring 84 so that a torque can be transferred.

In the embodiments described in the following the same reference numerals as
10 elucidated above are used for the same parts. The example according to figs. 8 to 10 differs essentially in that a locking spring 56 is provided on the housing cover 58 in combination with free-wheel teeth on the take-up spool 16 to permanently secure it against unintentional tape unwinding. As a result the unwinding of a tape loop is avoided in any state of use.

15 As shown in fig. 8 the locking spring 56 is punched out of the housing sheet 88 as a ring structure in which two coaxial rings 90 are connected together by bridges. Two ring segments 92 are formed on the inner ring and each has an end bent in each case towards the inside of the housing to form a latch 94 whereas the other piece of the segment is held in a plastic injection-moulded encapsulation covering the rear side
20 of the spring 56. The ring segments 92 and the rings 90 are axially displaced relative to one another such that they form an outwardly curved compression spring arrangement against the front face 60 of the inserted take-up spool 16 (cf. fig. 10).

Fig. 9 shows an appropriately adapted take-up spool 16 which in contrast to the design of fig. 2, is provided on its front side with free-wheel teeth 96. This is
25 formed by a crown gear with an asymmetric tooth profile where the flatter tooth flanks 98 form a slide slope for the spring latch 94 when it is rotated in the winding

- 12 -

direction and the steeper tooth flanks 100 lock the spring latch 94 in a form-fitting manner when rotated in the unwinding direction.

Fig. 10 illustrates the action of the spring engagement which is dependent on the direction of rotation. When the take-up spool 16 is inserted, the latches 94 that are bent downwards mesh under spring pretension such that in the position shown one latch butts against a steep tooth flank 100 whereas the other latch rests centrally on a flat tooth flank 98. In this manner the effective tooth pitch is halved such that a low angle of backward movement is nevertheless achieved until the locking action occurs with a continued and stable interlocking. In order to reduce friction, the teeth of the annular free wheel teeth 96 can have a tooth height which decreases over their width which shortens the engagement length of the spring latches 94.

In order to obtain an additional locking action in both directions of rotation when it is not in use, the collar 102 of the spool body 34 can be provided on its supporting side with circumferential locking teeth 28 which engage in counter-teeth 26 on the housing flange 40. This rotational lock 24 is released by the drive spindle 66 during insertion into the device 70 whereas the directionally-dependent locking action of the rotational lock 94, 96 is retained under higher spring pretension but at a lower engagement angle of the spring latches.

In the embodiment shown in figs. 11 to 13 a friction lock that is independent of the position of rotation and direction of rotation is provided instead of the locking teeth 26, 28. According to fig. 11, only the collar 102 of the take-up spool 16 remains in this case free of gear teeth. A frictional ring 104 is formed on the support surface of the ring flange 40 of the housing 22 for the frictional lock which either sits in the middle of the ring area (fig. 12) or at the side of the edge defining the flange opening 48 (fig. 13). The frictional ring 104 consists of a thermoplastic elastomer material (TPE) which is injection-moulded in the same manufacturing step together with sealing components on the housing 22 in an injection-moulding process. Also

- 13 -

in this case the frictional lock is supported by a return spring 56 according to fig. 4 formed on the housing 22 whereas when the drive spindle 66 engages according to fig. 5 the take-up spool 16 is lifted against the force of the spring and thus the frictional connection is released.

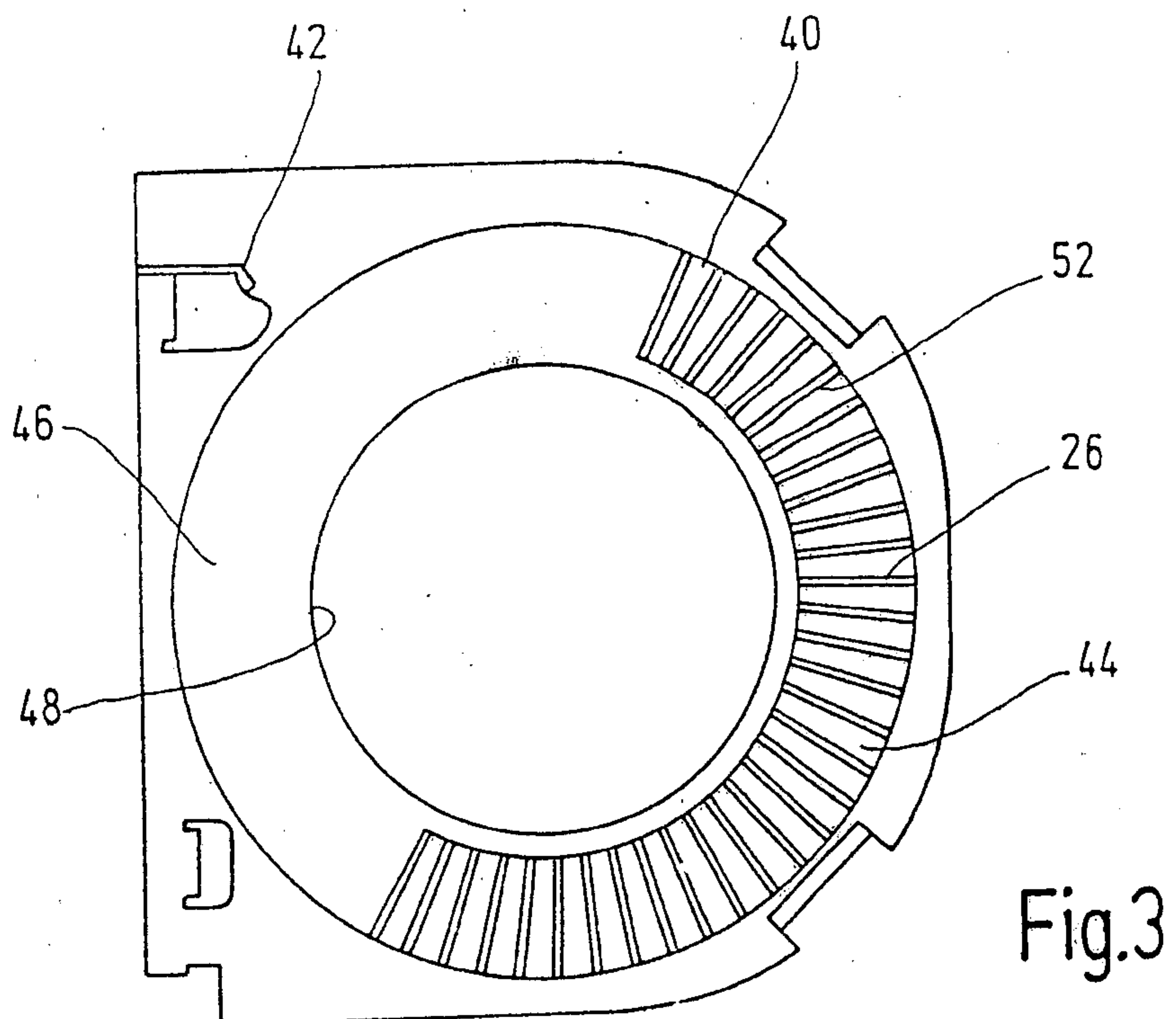
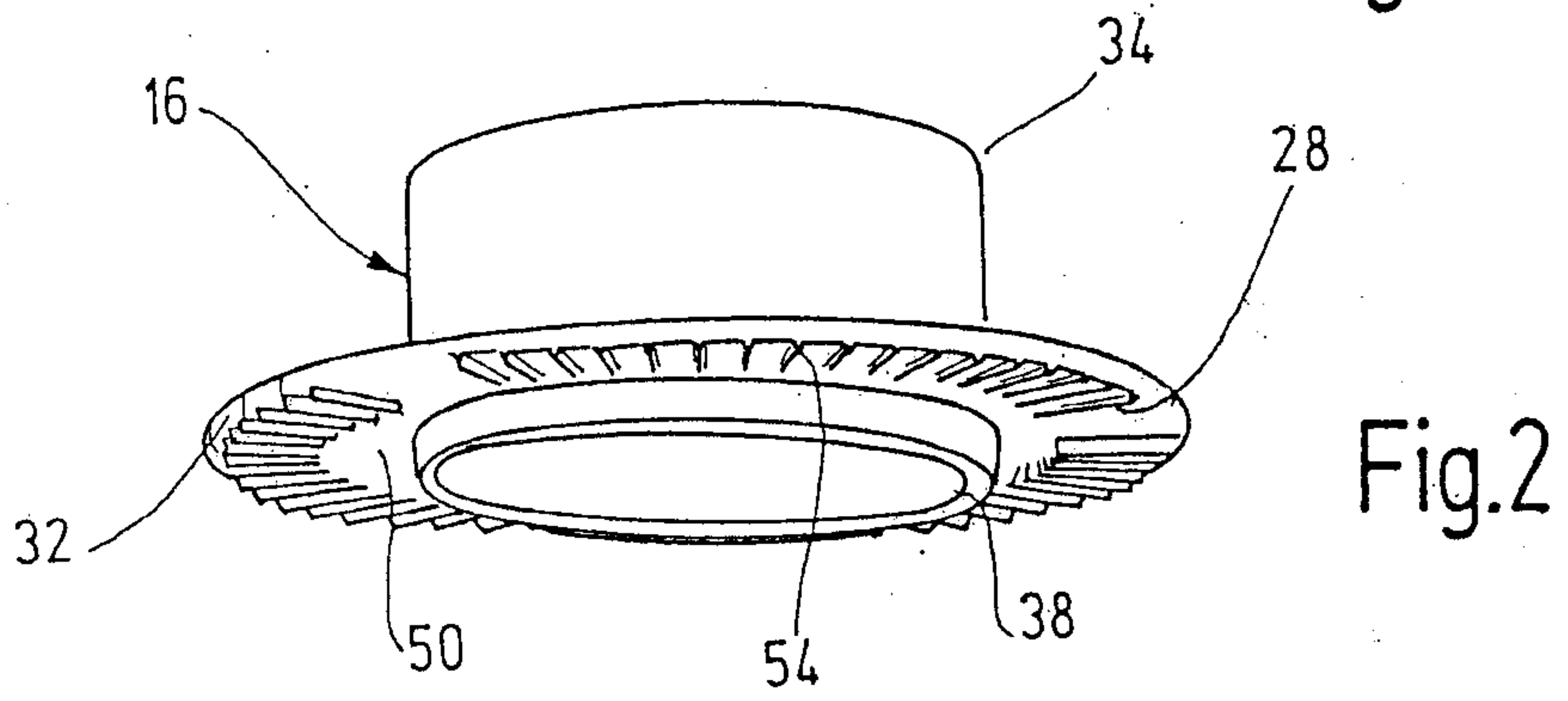
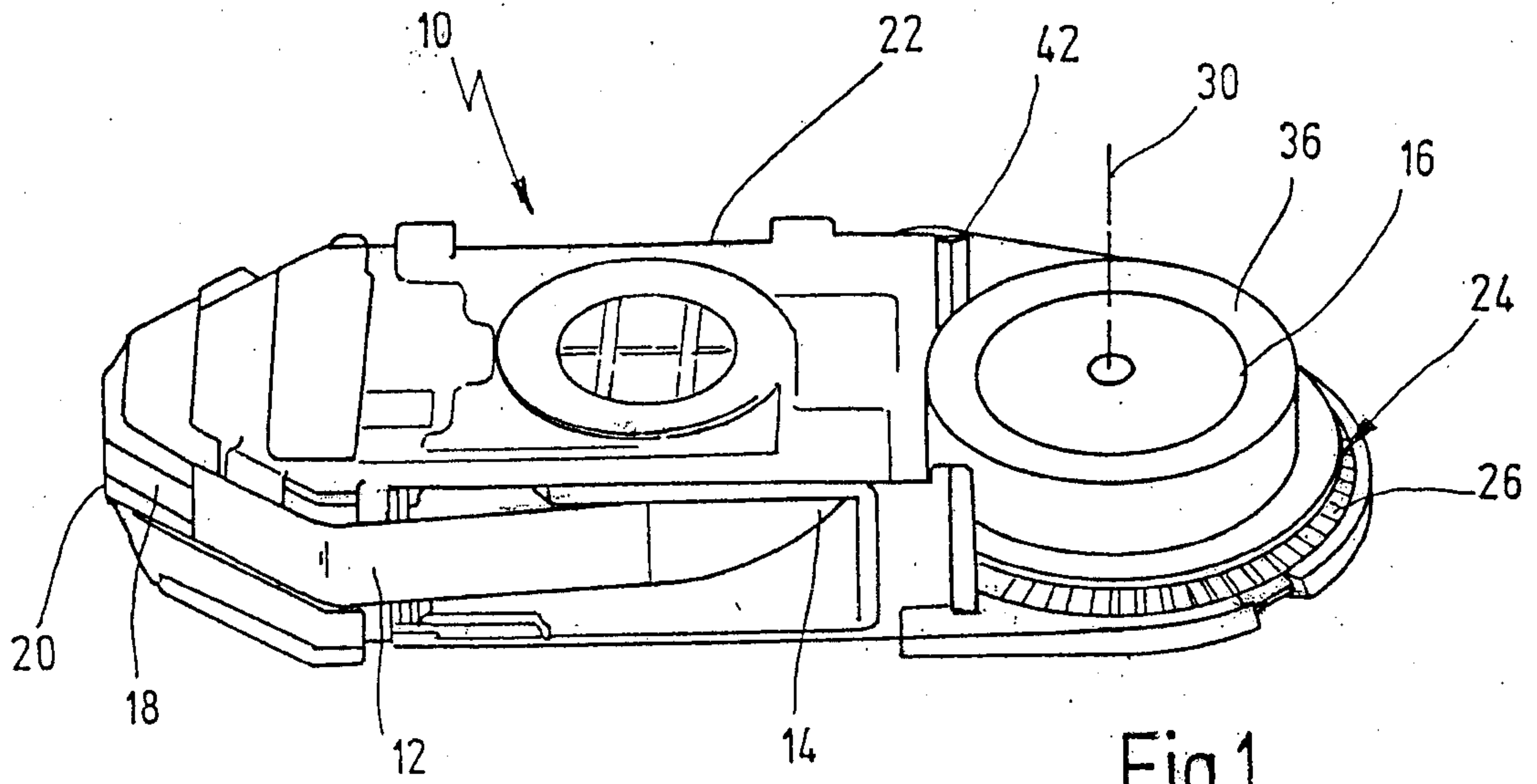
CLAIMS:

1. Diagnostic tape cassette for blood sugar tests comprising an analytical test tape, a supply spool for winding off unused test tape and a take-up spool for winding used test tape, a housing for the spools and a rotational lock for the take-up spool at least against inadvertent unwinding of test tape, wherein the rotational lock has a friction element attached to a housing surface which is brought into frictional engagement with a facing contact surface of the take-up spool when the take-up spool is moved axially out of a release position.
2. Tape cassette according to claim 1, wherein the friction element is formed by a friction ring arranged coaxially with respect to the take-up spool.
3. Tape cassette according to claim 1 or 2, wherein the friction element consists of an elastomer material.
4. Tape cassette according to claim 3, wherein the friction element consists of TPE.
5. Tape cassette according to any one of claims 1 to 4, wherein the friction element is formed on the housing surface by injection-moulding.
6. Tape cassette according to any one of claims 1 to 5, wherein the housing surface is formed by a ring flange defining an opening and that the friction element is arranged circumferentially on the ring flange in the area of the rim of the opening.

- 15 -

7. Tape cassette according to any one of claims 1 to 6, wherein the contact surface is formed by a collar of a cylindrical spool body around which the test tape can be wound.
8. Tape cassette according to any one of claims 1 to 7, wherein the take-up spool is braced against the housing in the direction of the spool axis by means of a return spring such that the frictional engagement occurs under the restoring force of the return spring.

1 / 5



2 / 5

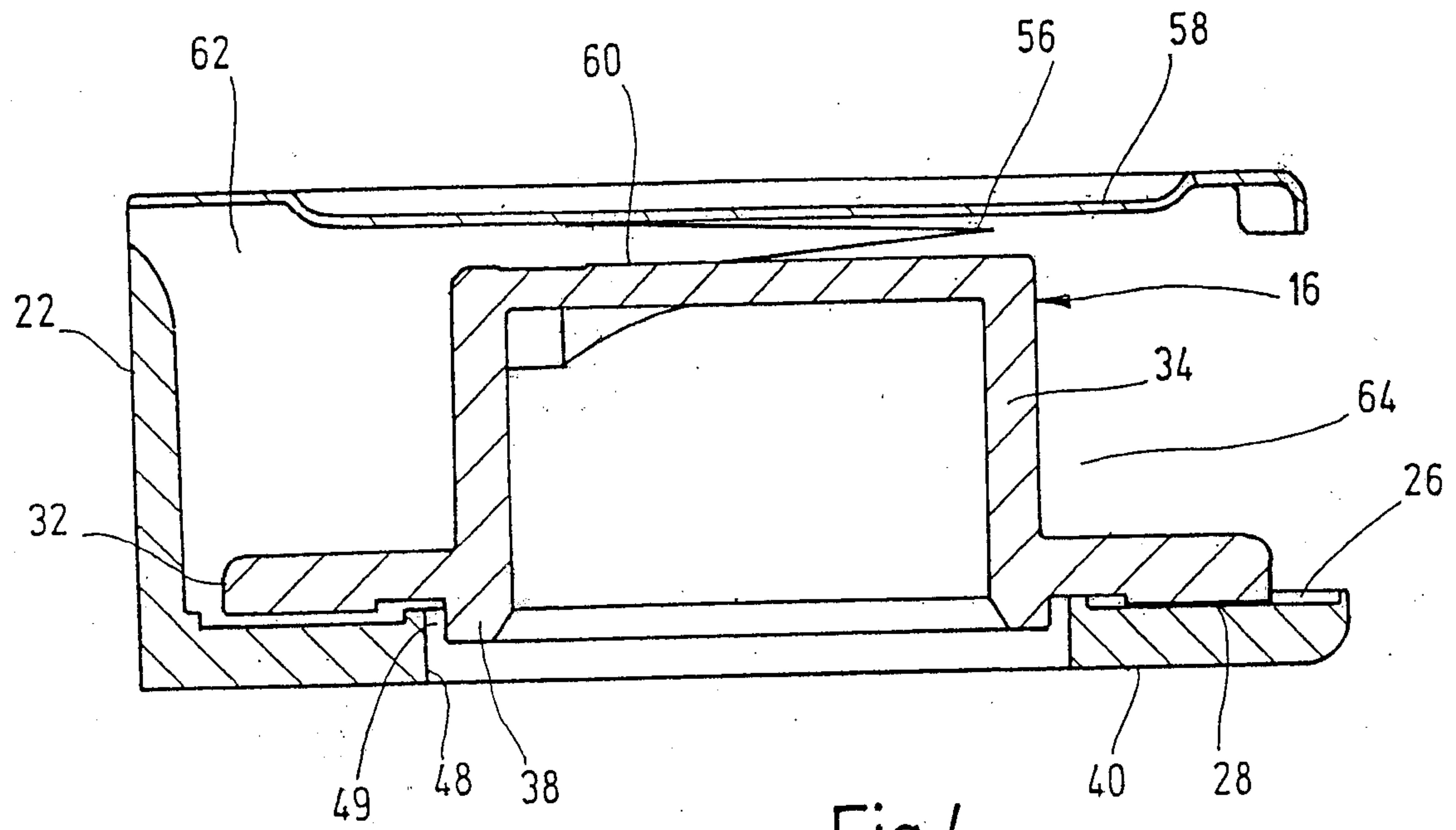


Fig.4

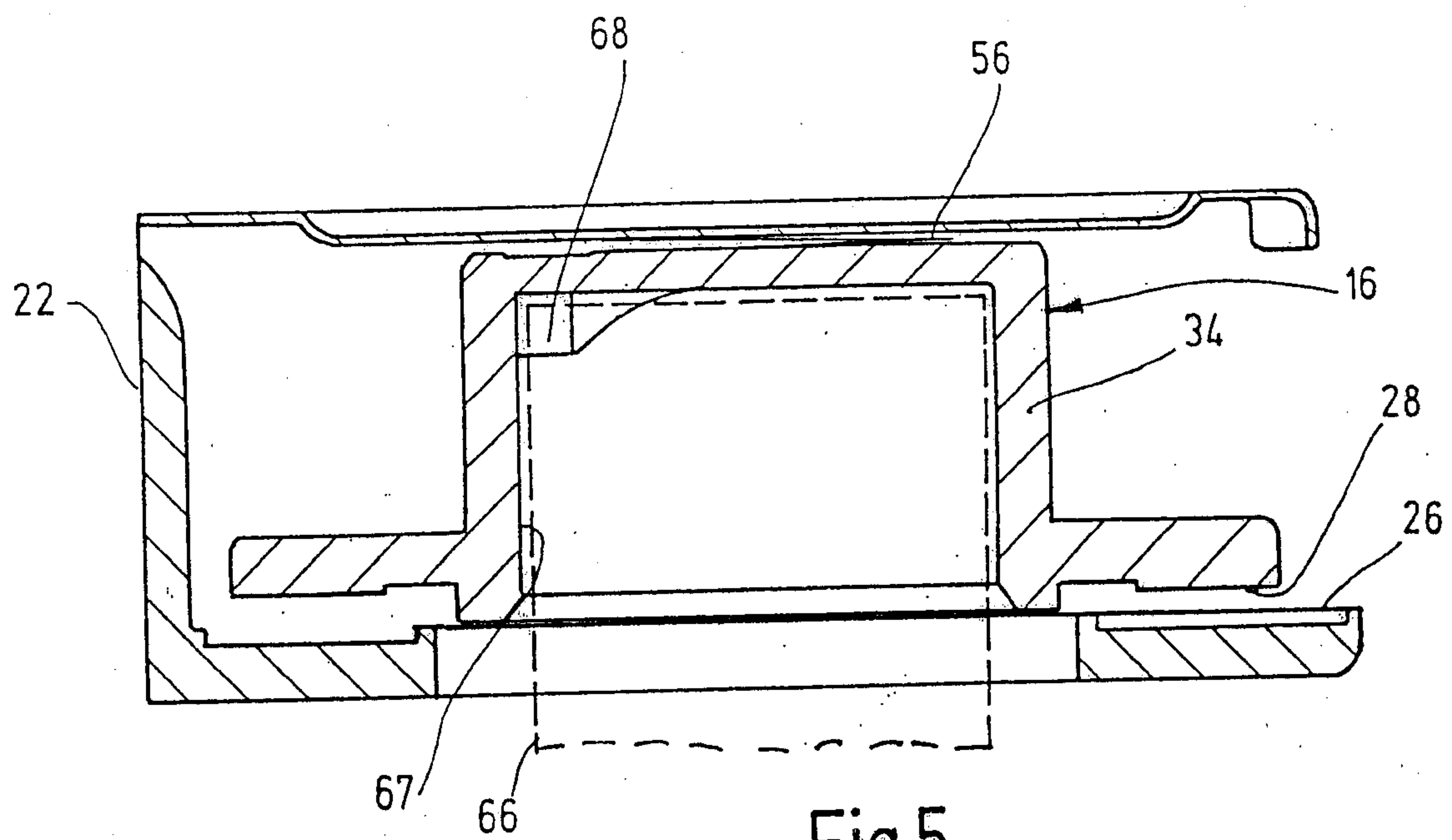


Fig.5

3 / 5

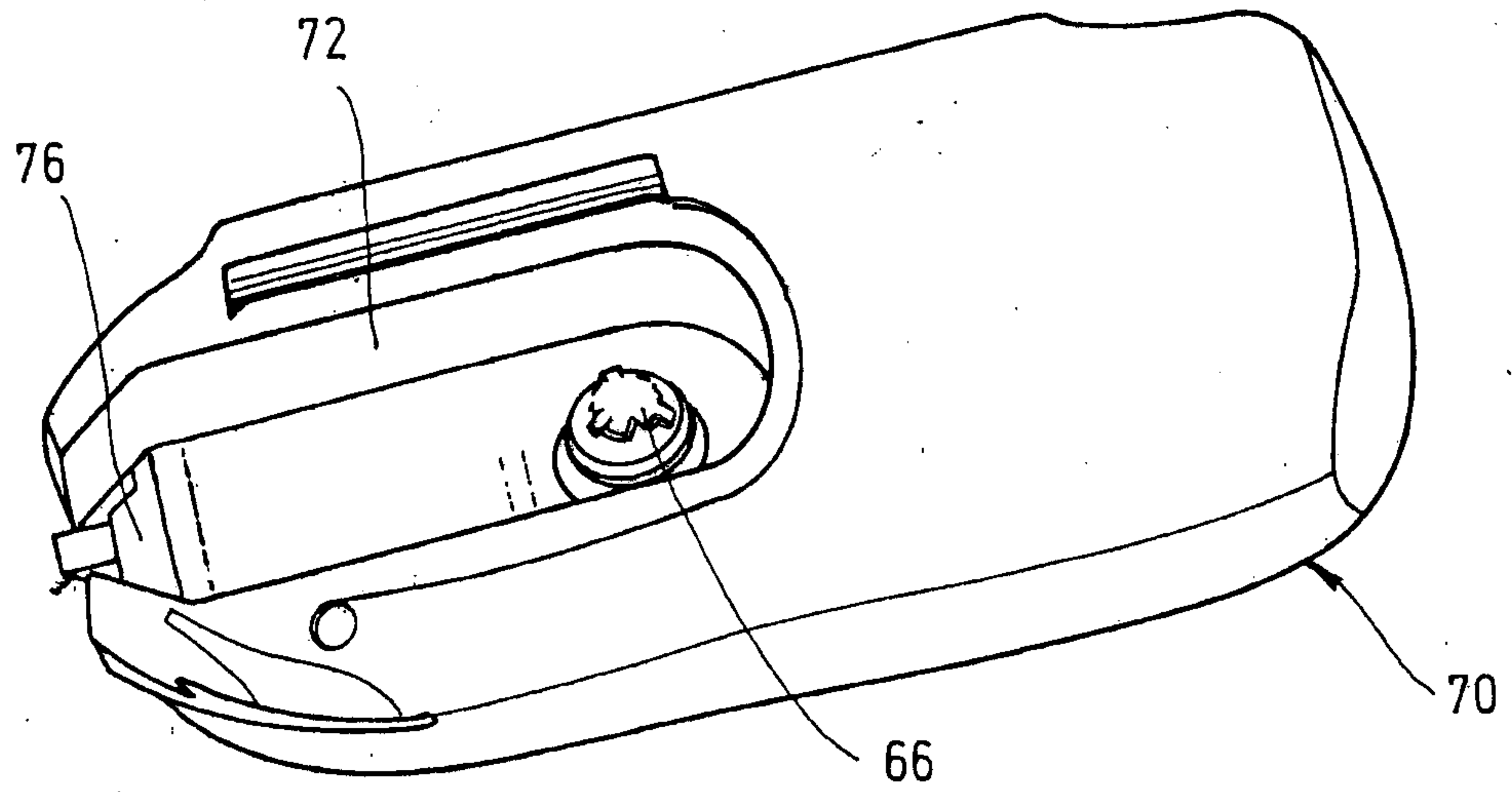


Fig.6

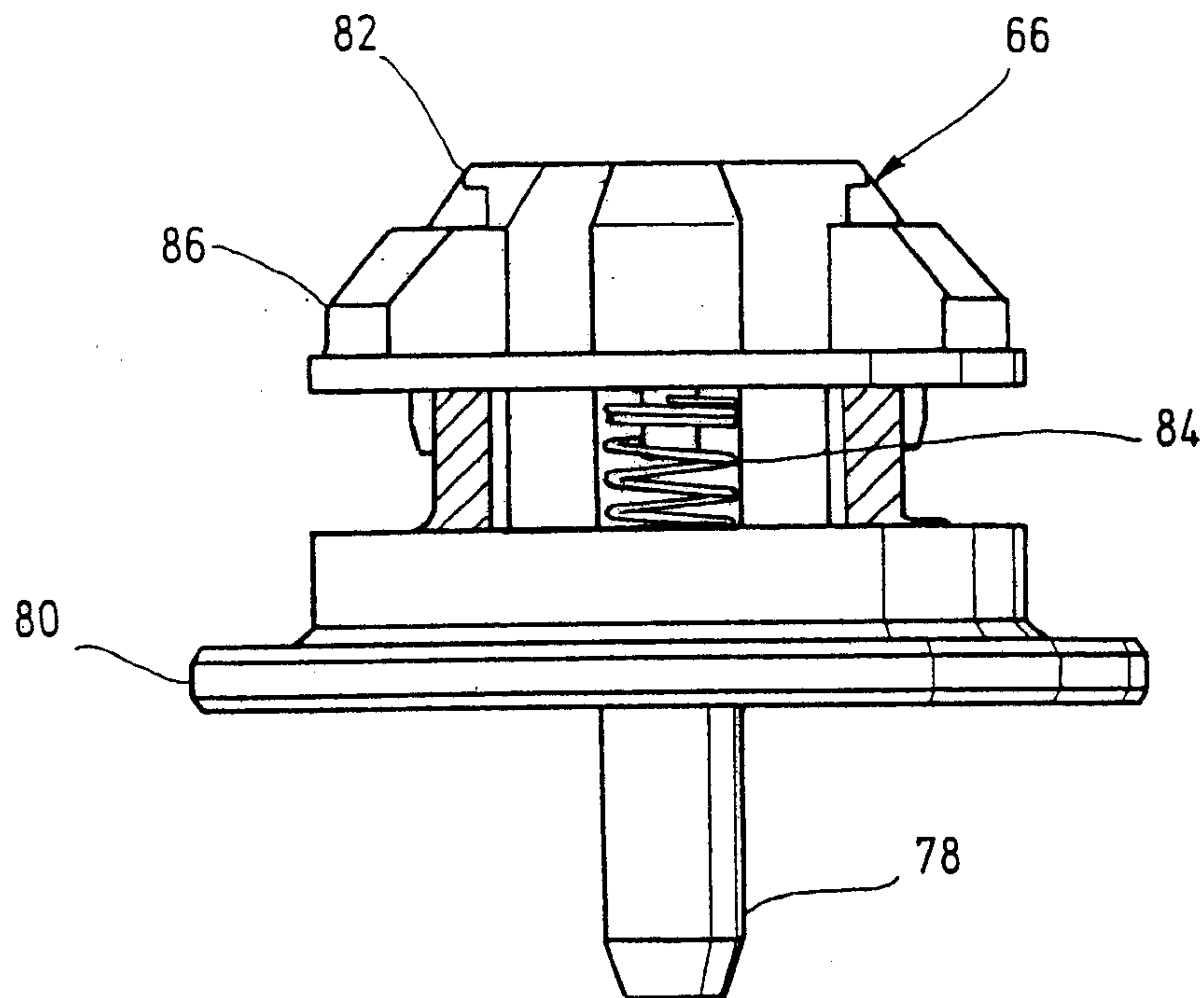


Fig.7

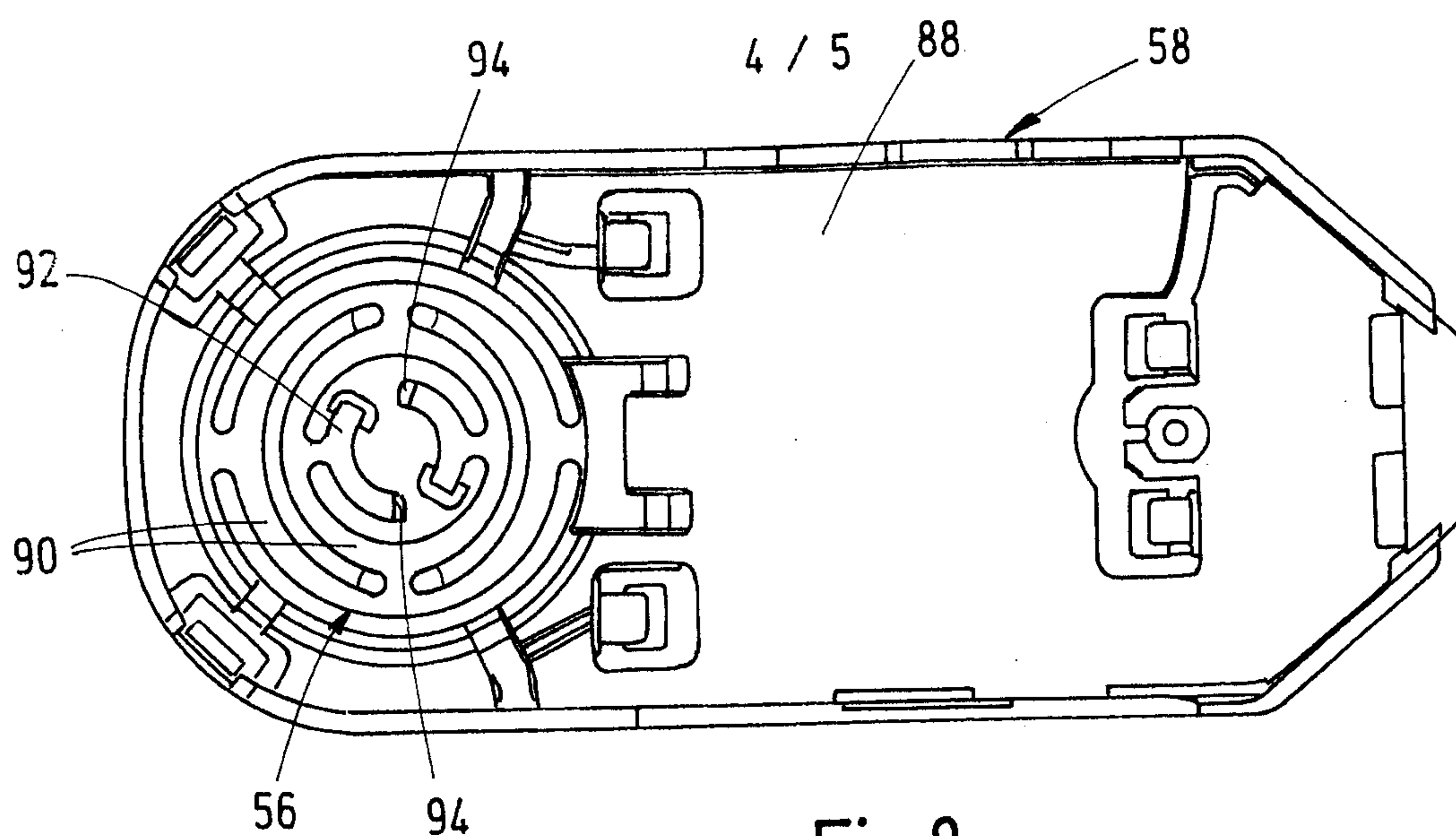


Fig.8

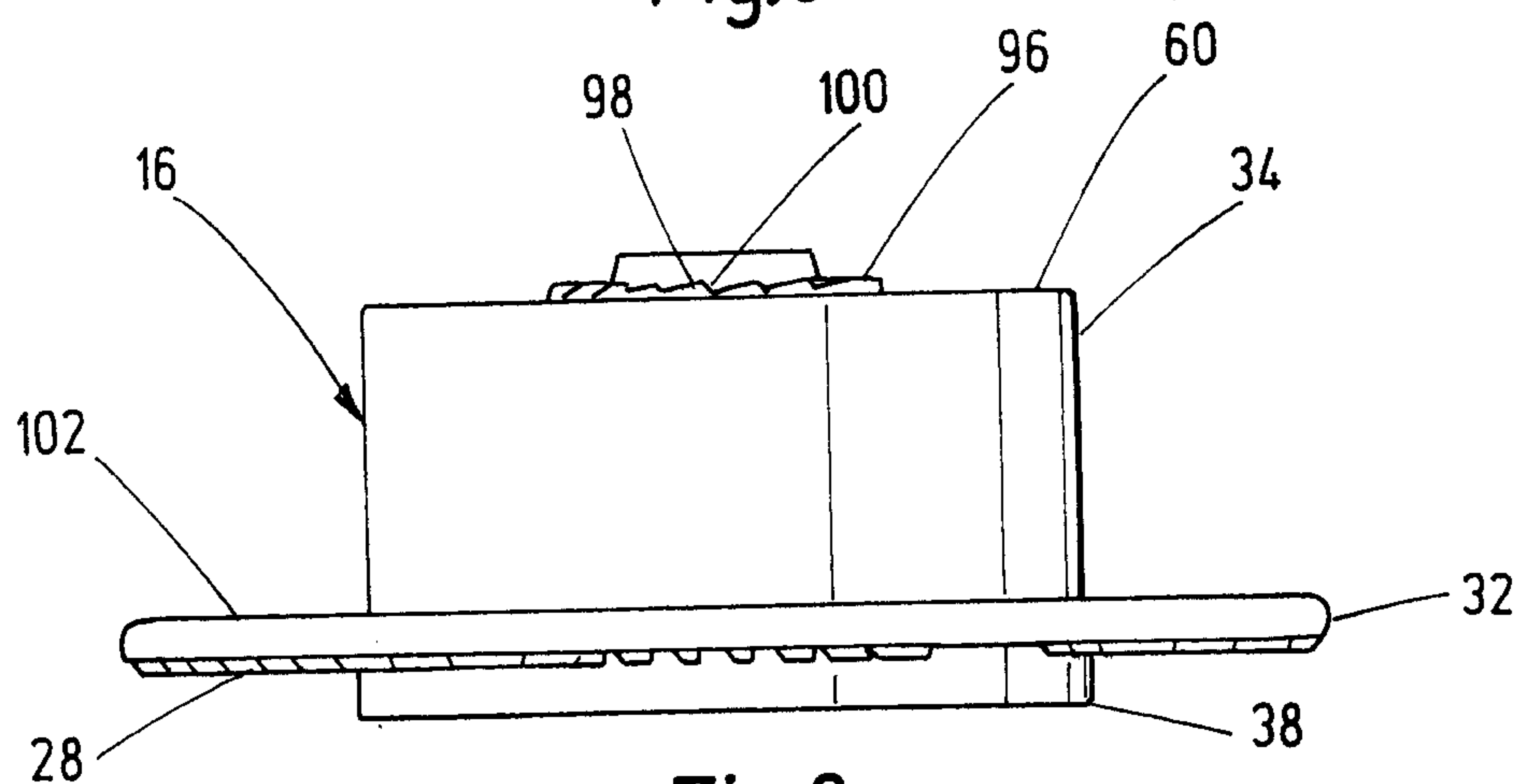


Fig.9

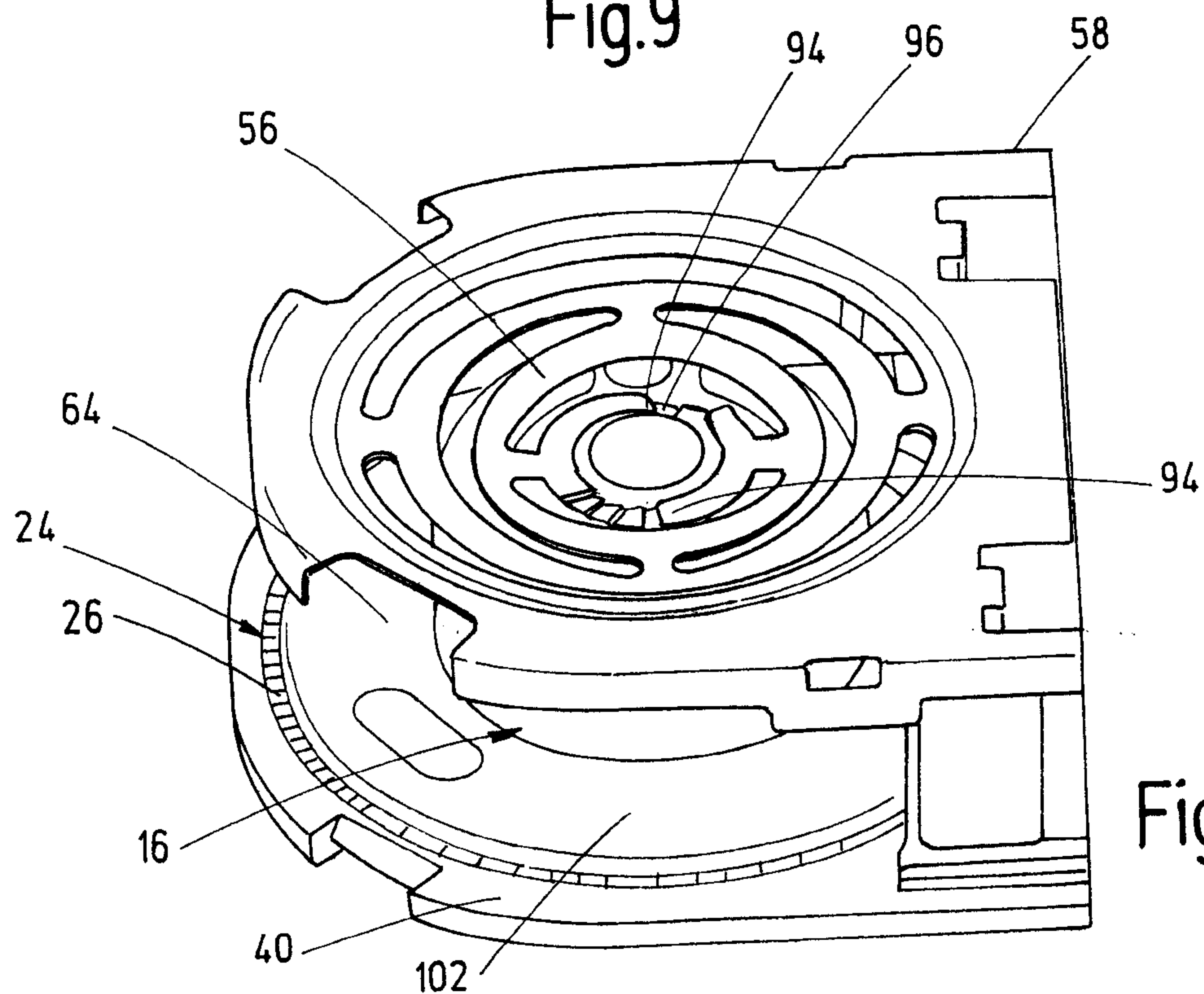


Fig.10

5 / 5

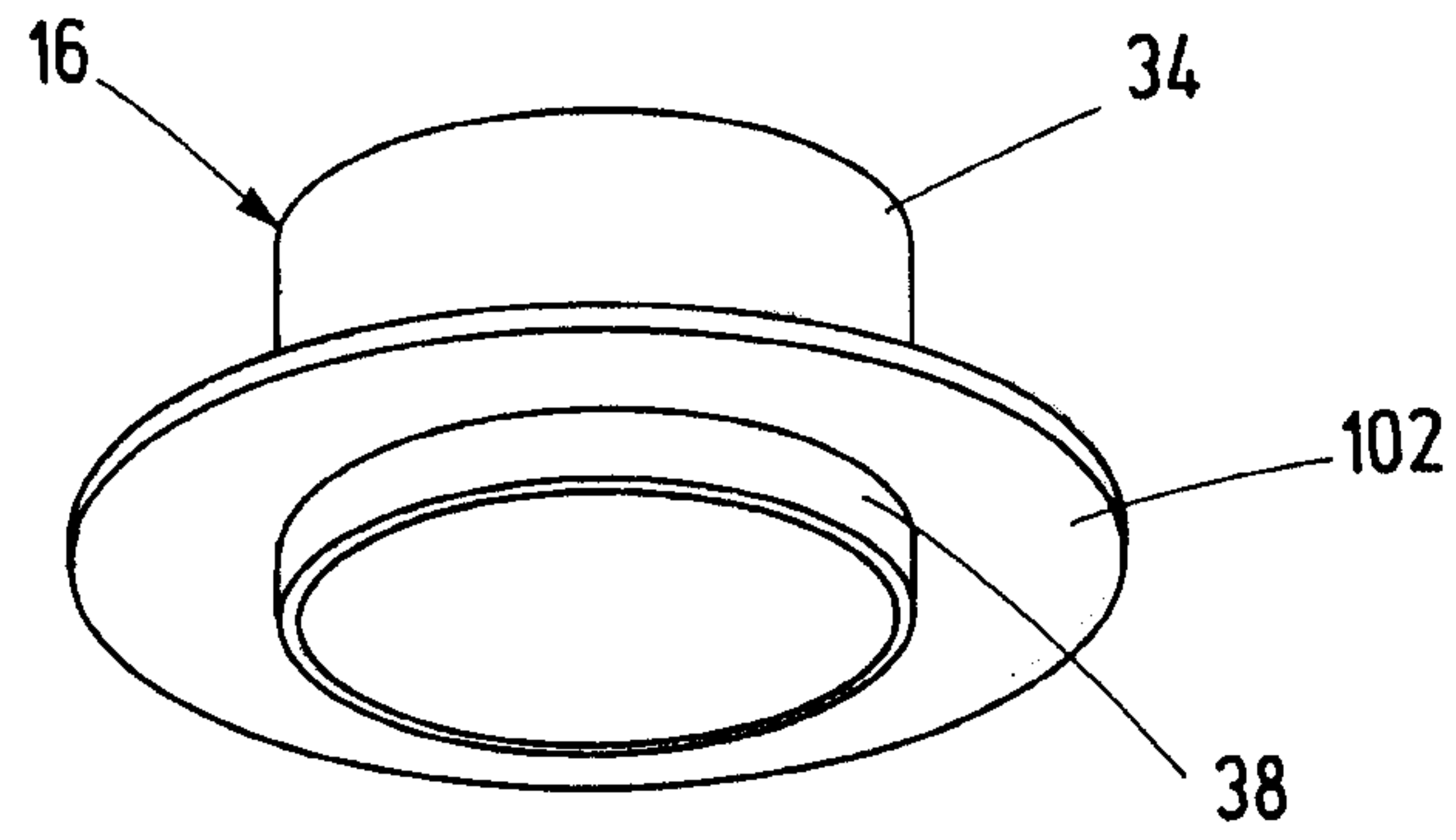


Fig.11

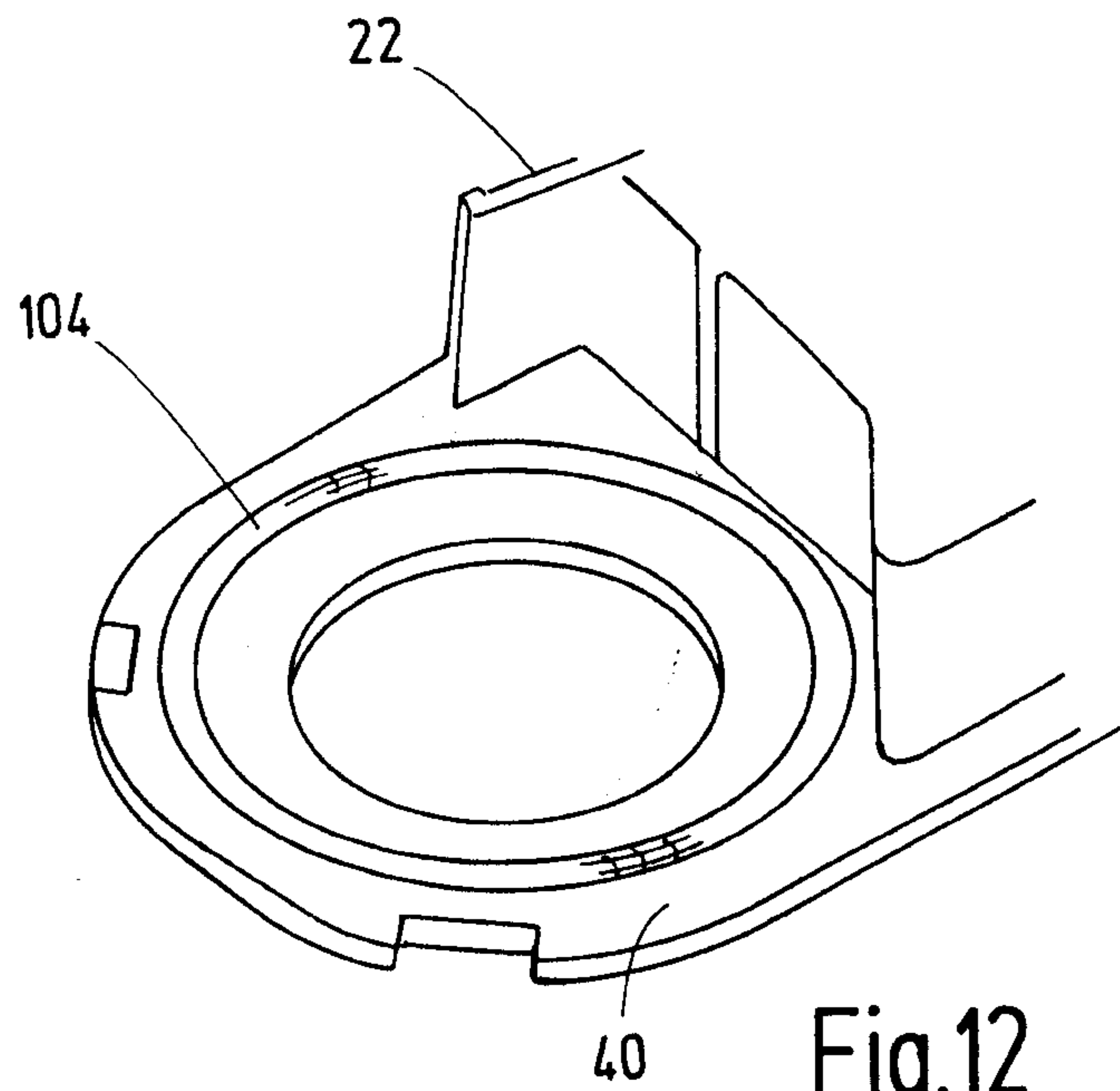


Fig.12

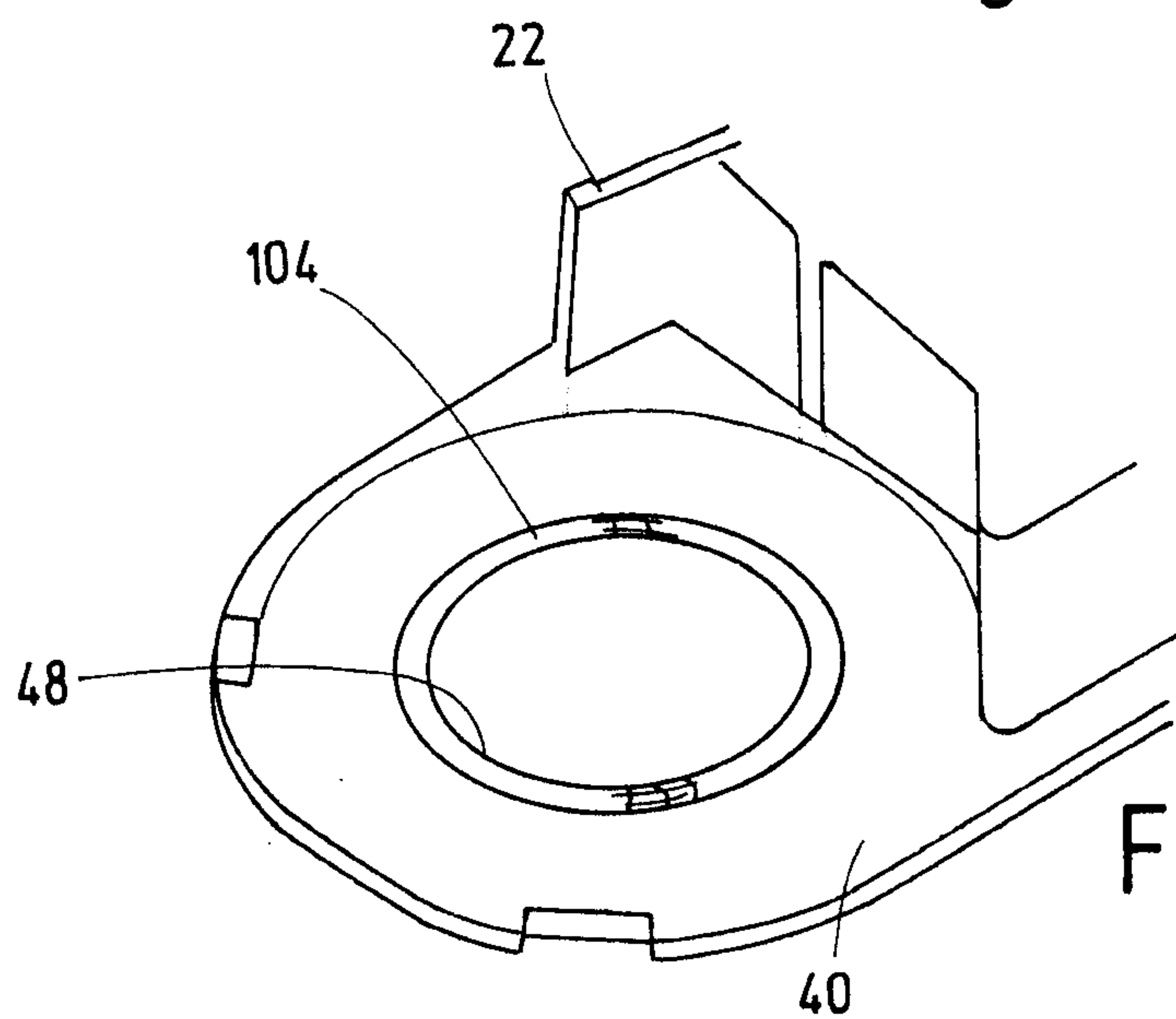


Fig.13

