(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 455 373 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
08.09.2004 Bulletin 2004/37

(51) Int Cl.[7]: **H01H 50/58**

(21) Application number: **04003663.4**

(22) Date of filing: **18.02.2004**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR
Designated Extension States:
AL LT LV MK

(30) Priority: **05.03.2003 DE 10309596**

(71) Applicant: **Matsushita Electric Works (Europe) Aktiengesellschaft**
83601 Holzkirchen (DE)

(72) Inventor: **Elsinger, Herbert**
82008 Unterhaching (DE)

(74) Representative: **Strehl Schübel-Hopf & Partner**
Maximilianstrasse 54
80538 München (DE)

(54) Relay contact assembly

(57) A relay contact assembly having a contact spring **13** and an actuator **11** comprises at least one rib **23** which extends towards the contact spring **13** and which restricts the freedom of motion of the contact spring **13** in the open contact state in case of spring breakage. Thereby, the contact spring **13** is held in a safety distance from the counter contact **16** and/or the spring terminal **14**.

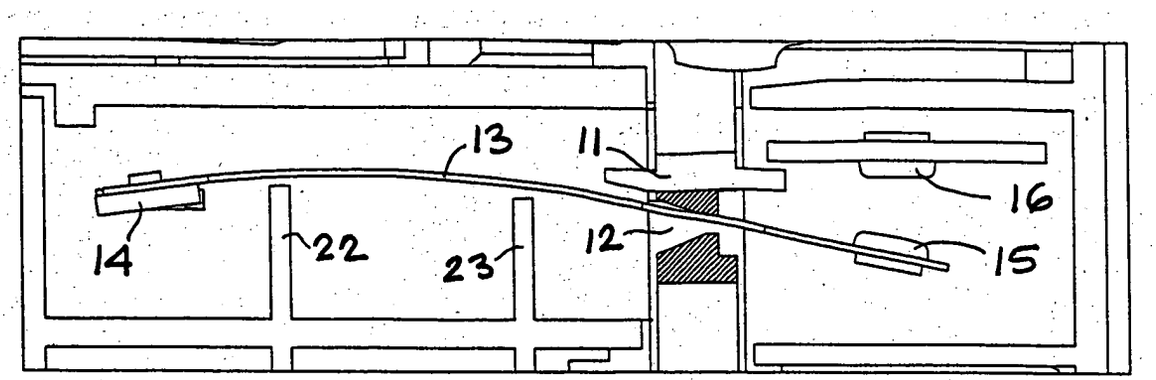

Fig. 1A

EP 1 455 373 A1

(Cont. next page)

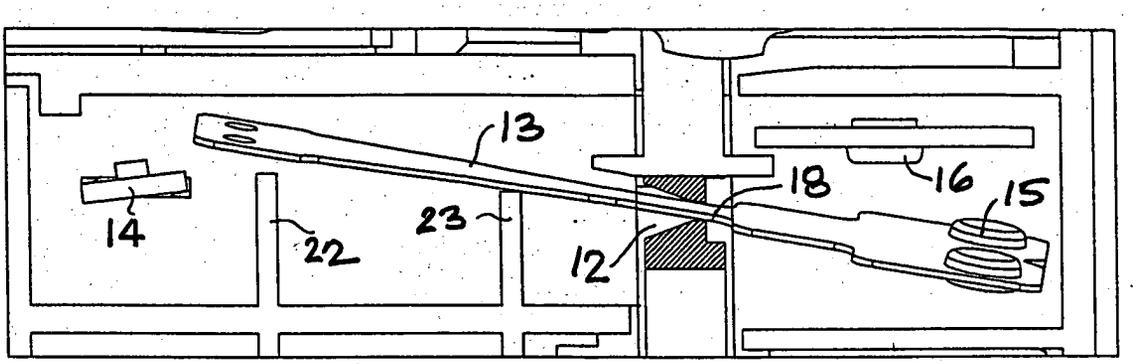

Fig. 1B

Description

[0001] In a safety relay it must be ensured that normally closed (NC) and normally open (NO) contacts cannot be closed at the same time, even in case of an abnormal incident, such as a breakage of the contact spring. According to EN 50205, the contact spacing for a single interruption has to be at least 0.5 mm, and for a double interruption at least 0.3 mm.

[0002] Possible incidents to be analysed are the breakage of the contact spring and its loosening from the rivet. It is assumed that a potential breakage of the spring occurs at the position of highest material stress, that is essentially at the clamping site or at the location where the contact spring is riveted or welded to a terminal or spring support. Breakage at other sites is prevented by systematic and careful design and placement of the contact spring.

[0003] It has to be prevented that a spring which is vagabonding after a breakage at the predestined site exceeds the prescribed safety distance to the counter contact in the open contact state.

[0004] The problem arises in conventional contact assemblies and will be explained referring to Figs. 5A to 6.

[0005] In the position shown in Fig. 5A, the actuator **11** holds the contact spring **13** extending through the actuator slit **12** in an open state, in which the contact piece **15** located at the free end of the contact spring **13** is held in a distance from the counter contact **16.** The contact spring **13** is a mechanically biased flat spring, the foot of which is riveted, or fixed otherwise, to a terminal **14.**

[0006] In contact assemblies of this type, there is the danger that a loose contact spring **13** comes in the open state too close to the counter contact. The loosening of the contact spring **13** is particularly dangerous, since in this case the contact spring **13** persists in its complete length so that the danger that a spacing below the prescribed minimum or even a contact is reached, becomes particularly high.

[0007] Fig. 5B illustrates such an incident. The loose and relaxed contact spring **13** has moved to the other face of the terminal **14** and is contacting there. This means a single interruption in the contact region for which the required minimum distance of 0.5 mm to the counter contact **16** is not observed, as indicated by **17**.

[0008] Fig. 5C shows a case in which the loose contact spring **13** is displaced in its longitudinal direction. Again, the foot of the spring **13** has contact to the terminal **14.** In this position, a recess **18** of the contact spring **13** is located within the actuator slit **12** and the contact spring **13** can rotate about its longitudinal axis such that the required minimum distance to the counter contact **16** is again not observed at the sites **19**.

[0009] A known measure to avoid the case described with reference to Fig. 5C is shown in Fig. 6. Therein, the freedom of motion of the spring is restricted by a mushroom-shaped spacer **20** opposite to the free end of the spring. The spacer **20** prevents the recess **18** of the contact spring **13** from reaching the region of the actuator **11**, i.e. the position which allows a maximum rotation of the contact spring **13**.

[0010] The presence of such a spacer **20** close to the counter contact **16** has, however, the drawback of metallic deposit on the spacer **20** resulting from contact wear. Consequently, the electric characteristic of the relay is deteriorated and the electric lifetime may be shortened.

[0011] EP-B-1 121 701 discloses a relay in which the actuator comprises a window for the contact spring and a blocking wall, which effect that in case of a breakage, the spring is caught by the actuator. This avoids the danger of a short circuit potentially produced when the broken spring falls into the neighbouring chamber.

[0012] The present invention has the general object to avoid at least partially the drawbacks of conventional contact assemblies, and particularly to provide a relay contact assembly which ensures a safety contact spacing in case of a spring breakage without impairing the lifetime. It is further desired to keep the constructive and manufacturing expenditure as small as possible.

[0013] The object is met by the invention defined in claim 1 according to which the freedom of motion of a vagabonding contact spring is restricted in such a way that it cannot exceed the prescribed safety spacings. The subclaims relate to advantageous modifications of the invention.

[0014] According to claim 2, the element restricting the freedom of motion of the broken or loose contact spring has the form of a rib positioned to tilt the loose spring in such a way that it moves away from the counter contact.

[0015] The modification of the invention according to claim 3 relates to the case that the contact spring is operated by the actuator in a slit and hence from two sides. The actuator slit and the rib cooperate to restrict the freedom of motion of the broken or loose contact spring in the intended manner.

[0016] The modifications of the invention according to claims 4 and 5 provide ribs on both sides of the contact spring which further restrict the freedom of motion with respect to rotations about the spring's longitudinal axis.

[0017] According to claim 6, the rib extends transversely to the contact spring and across the complete width thereof such that the contact spring cannot evade.

[0018] The modification of the invention according to claims 7 and 8 relate to a contact assembly in which the contact spring is operated by the actuator only from one side.

[0019] In the following, the invention will be explained in more detail with reference to the accompanying drawings, in which Figs. 1A to 4B show cross-sections through contact assemblies according to four embodiments.

[0020] The embodiment according to Figs. 1A to 2B corresponds in its general assembly to the state of the

art explained with reference to Figs. 5A to 5C, such that the description of corresponding parts is not repeated.

[0021] According to Figs. 1A and 1B, two ribs **22, 23** are provided in the region between the terminal **14** of the contact spring **13** and the actuator **11.** The ribs are located at the side which is not facing the counter contact **15** and extend towards the contact spring **13.** The ribs **22, 23** are preferably made of plastics and integrally formed with the relay base or the housing cap.

[0022] Fig. 1A shows an operative contact assembly in the open state. The ribs **22, 23** protrude towards the contact spring **13** but do not contact it in any moment of the switching movement.

[0023] Fig. 1B shows a contact assembly in the same actuator state which correspond to the open contact state in case of an abnormal incidence. The loose contact spring **13** is in a position which shows a double interruption. In this state, the ribs **22, 23** prevent the loose contact spring from reaching the other side of the terminal **14**.

[0024] Further, the rib **23** and the actuator slit **12** effect that the contact spring **13** is kept in a distance from the terminal **14** as well as from the counter contact 16. At each interruption site, the minimum distance of 0.3 mm is observed, even if the contact spring **13** is rotated about its longitudinal axis as indicated in Fig. 1B.

[0025] The embodiment according to Figs. 2A and 2B provides two further ribs **24**, **25** in addition to the ribs **22, 23** on the opposite side of the contact spring **13**. The ribs **24, 25** protrude towards the contact spring **13** without actually contacting it in any moment of the switching movement.

[0026] In Fig. 2A, the operative contact spring **13** is shown simultaneously in closed and open state without actuator so that the bending behaviour of the contact spring **13** is visible for both states. It is shown that the position of the contact spring **13** close to the terminal **14** hardly differs in the two states. Therefore, the spacing between ribs **22** and **24** can be made smaller than between ribs **23** and **25** which hinders a rotation of the contact spring **13** (as in Fig. 1B).

[0027] Fig. 2B shows a possible state of a loose contact spring **13** in an abnormal incidence with double interruption. As in Fig. 1B, the rib **23** and the actuator slit **12** effect that the minimum distance of 0.3 mm is observed between the foot of the contact spring **13** and the terminal **14** as well as between the contact piece **15** and the counter contact **16**.

[0028] The embodiment according to Figs. 3A and 3B shows that a single rib **23** located in the middle between the terminal **14** and the actuator **11** is sufficient for effectively keeping the relay in fail safe condition in case of a spring breakage.

[0029] In Fig. 3A a single rib **23** is positioned on the side of the contact spring **13** which is not facing the contact piece **15.** The upper part of Fig. 3B shows a possible state of a broken contact spring **13** in an abnormal incidence with single interruption. The rib **23** cooperates with the actuator **11** to ensure that the minimum distance of 0.5 mm is observed between the contact piece **15** and the counter contact **16,** while the broken end of the spring contacts the terminal **14.**

[0030] The lower part of Fig. 3B shows a contact assembly which is axially symmetric to the one in the upper part. The lower contact is in open state when the upper contact is in closed state and vice versa. It can be seen that the rib **23** does not affect the normal switching operation and has no influence on the contact spring **13** in the closed state.

[0031] The embodiment according to Figs. 4A and 4B relates to a relay contact assembly in which the contact spring **13** is forcibly operated by the actuator **11a** with the contact spring **13a** and by the actuator **11b** with the contact spring **13b,** as it is principally known from DE-C-101 01 751. Fig. 4A illustrates the open state and Fig. 4B the closed state of the relay.

[0032] It is shown that in the forced operation, the NC-contact spring **13** cannot be operated in a narrow actuator slit as this has been the case with the NO-contact springs **13a, 13b** or with the contact spring **13** in the assemblies according to Figs. 1A to 2B. Therefore, the freedom of motion of the contact spring **13** in longitudinal or rotational direction is not sufficiently restricted by the actuator **11a** and **11b**.

[0033] To obtain nevertheless the required distance with respect to the counter contact **16** in the energised relay state (Fig. 4B), a shoulder **26** is integrally formed with the basis of the relay. In this case, the shoulder **26** practically replaces the missing side of the actuator slit.

[0034] The shoulder **26** and the actuator **11a** confine the position of the potentially loose contact spring **13** to avoid any undesired contact closure by the loose spring. A rib **23** integrally formed with the housing cap may enhance the safety in the way known from Figures 1B, 2B and 3B.

[0035] The shown assembly of the shoulder **26** provides the additional advantage that a vagabonding contact spring **13** faces the rib **23** with a broad portion even if the spring is displaced in the direction of the counter contact **16**, with the effect that the rotation about the longitudinal axis is further restricted.

List of reference characters

[0036]

11	actuator
12	slit
13	contact spring
14	terminal
15	contact piece
16	counter contact
17	distance
18	recess
19	distances
20	spacer

22 ... **25** ribs
26 shoulder

Claims

1. A relay contact assembly comprising:

a contact spring (**13**) which is mounted with its foot to a terminal (**14**) and which comprises a contact piece (**15**) close to its free end which cooperates with a fixed counter contact (**16**);
an actuator (**11**) acting on the contact spring (**13**) between the terminal (**14**) and the contact piece (**15**); and
at least one element (**23**; **26**) fixedly mounted with respect to the counter contact **(16)** and positioned in immediate proximity to the contact spring **(13)** in the region between the terminal **(14)** and the spring end in the open contact state without contacting the contact spring **(13),**

characterised in that the actuator (**11**) and the element (**23; 26**) restrict the freedom of motion of a broken or loose contact spring (**13**) in such a way that the spring is held in a security distance from the counter contact (**16**) and/or the terminal (**14**).

2. The contact assembly of claim 1, wherein the element is a rib (**23**) which is integrally formed with the base or a housing cap of the relay.

3. The contact assembly of claim 1 or 2, wherein the contact spring **(13)** is operated in a slit **(12)** of the actuator **(11),** and the rib **(23)** is positioned on the side of the contact spring (**13**) which is not facing the contact piece **(15).**

4. The contact assembly of claim 2 or 3, wherein one further rib (**24, 25**) is provided on the side of the contact spring (**13**) which is opposite to the rib (**23**).

5. The contact assembly of claim 4, wherein two ribs (**22, 23; 24, 25**) are provided on each side of the contact spring (**13**).

6. The contact assembly of any of claims 2 to 5, wherein the rib extends essentially transversal to the contact spring **(13)** across the full width of the spring.

7. The contact assembly of claim 1 or 2, wherein the contact spring (**13**) is operated by the actuator **(11a, 11b)** only on one side, the element **(23)** is positioned on the opposite side of the contact spring **(13),** and a further element **(26)** is provided, which is fixedly mounted with respect to the counter contact (**16**), restricts the freedom of movement of a broken or loose contact spring (**13**) and is located in immediate proximity to the contact spring (**13**) in the region of the actuator (**11a, 11b**) in the open contact state.

8. The contact assembly of claim 7, wherein the further element is a shoulder (**26**) integrally formed on the relay base.

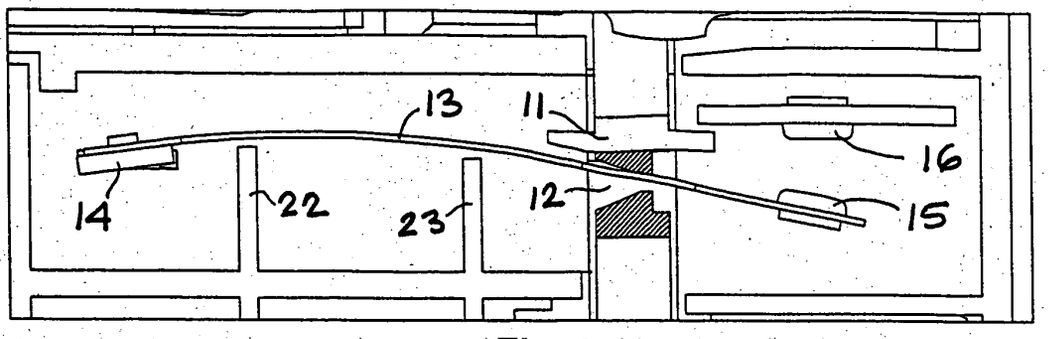

Fig. 1A

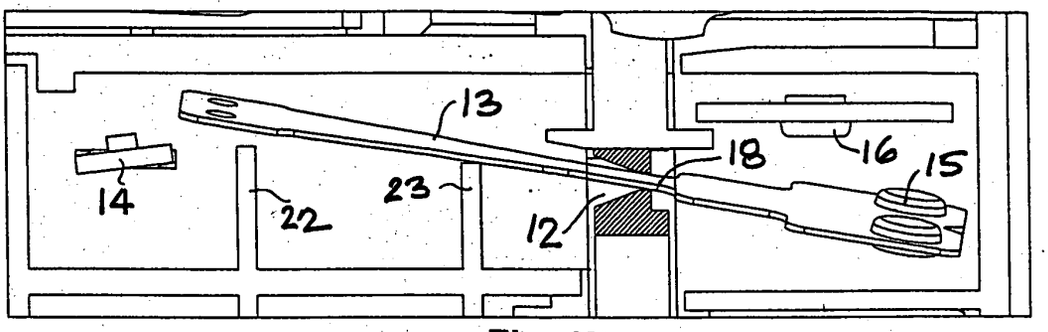

Fig. 1B

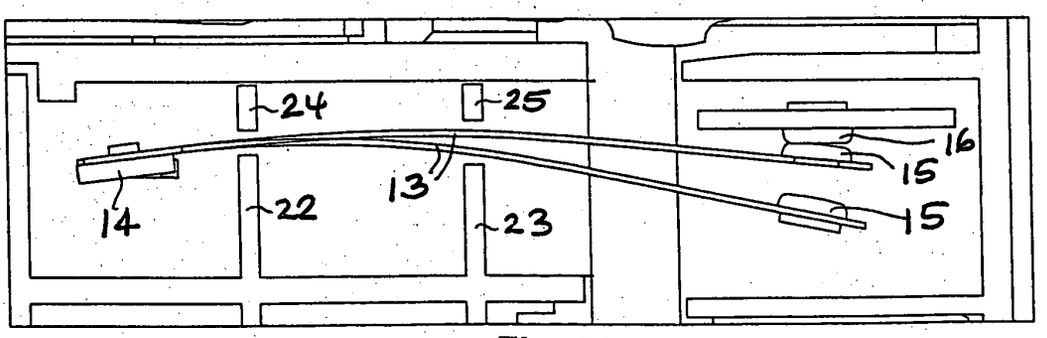

Fig. 2A

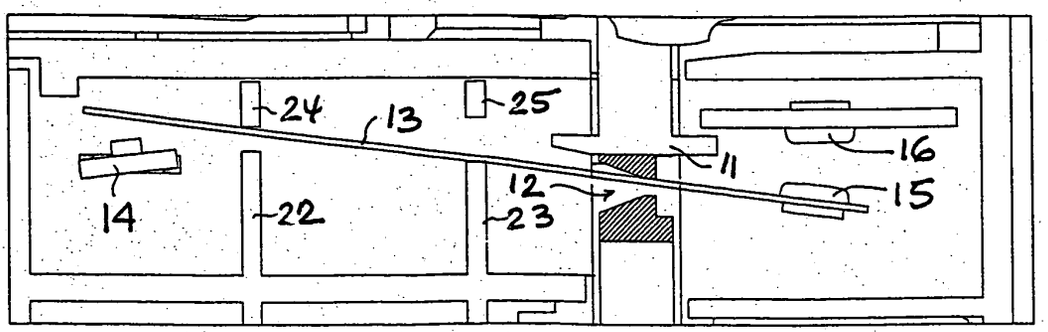

Fig. 2B

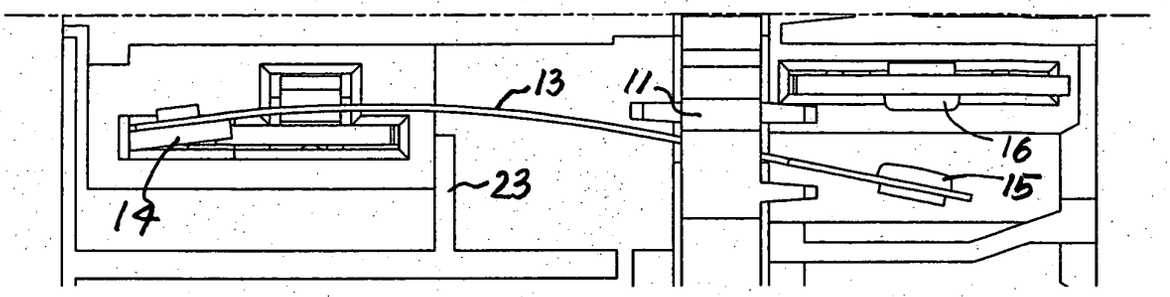

Fig. 3A

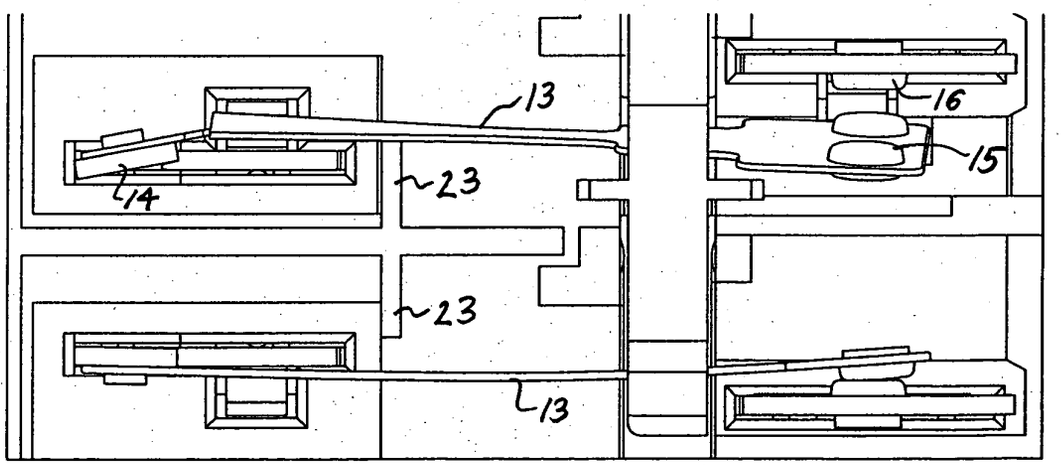

Fig. 3B

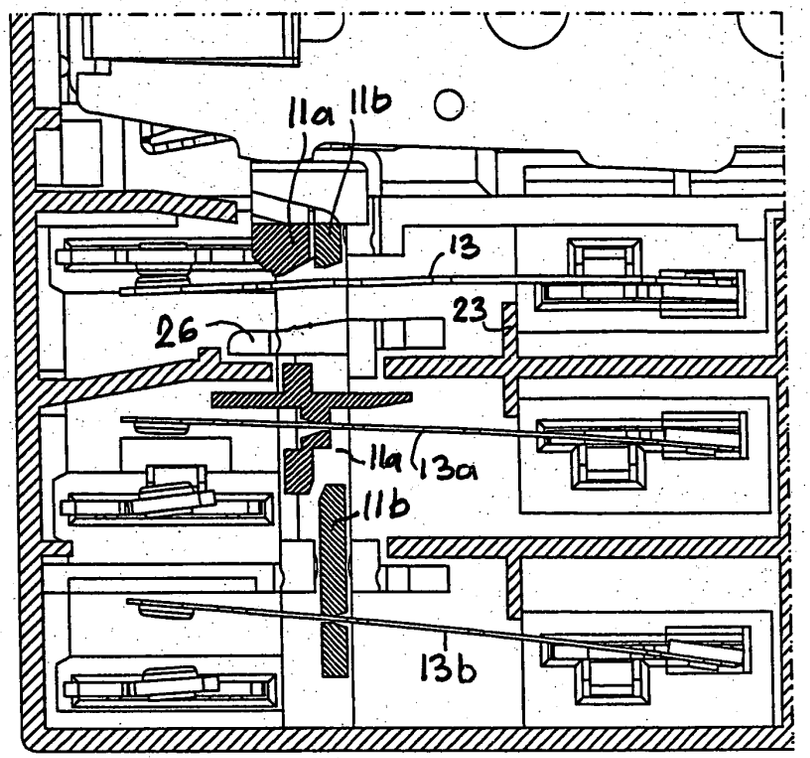
11a
11b
13
23
26
11a
13a
11b
13b

Fig. 4A

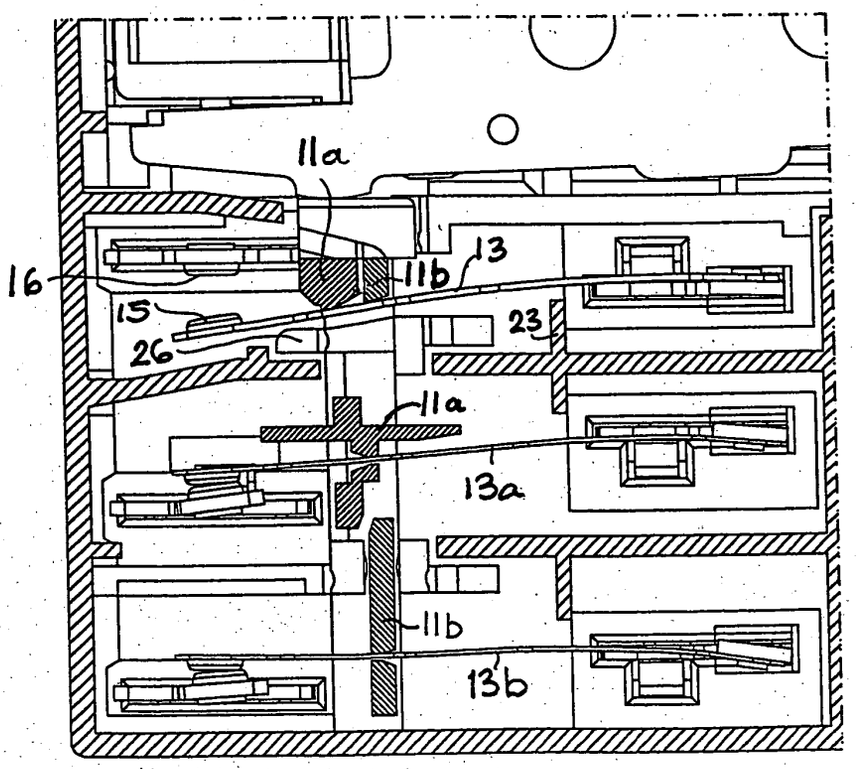
11a
16
11b
13
15
23
26
11a
13a
11b
13b

Fig. 4B

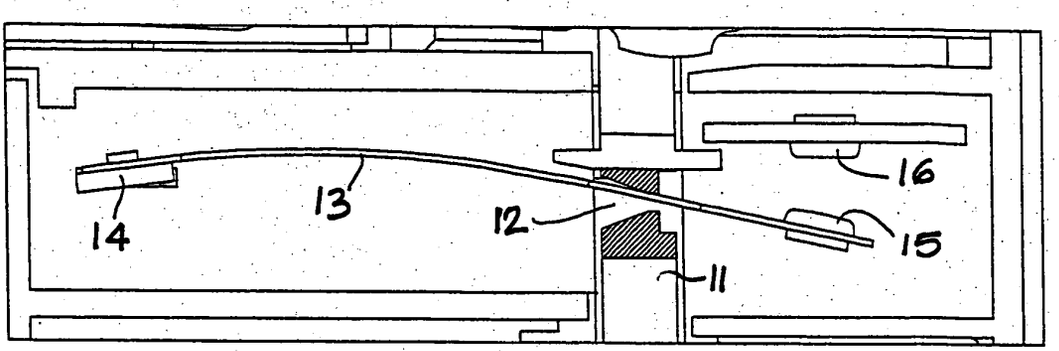

Fig. 5A

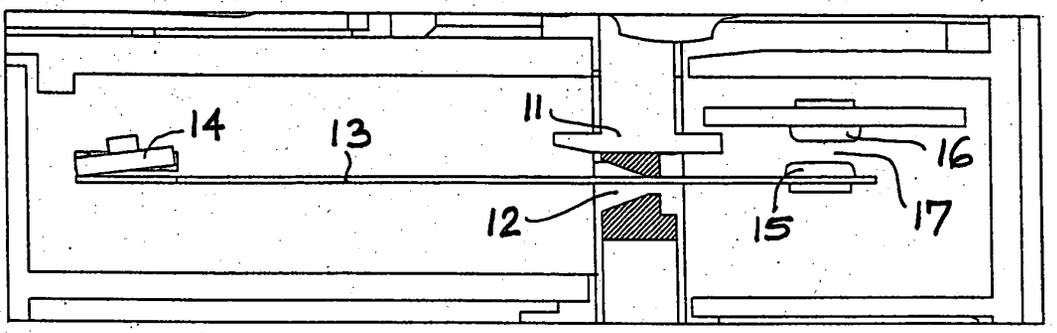

Fig. 5B

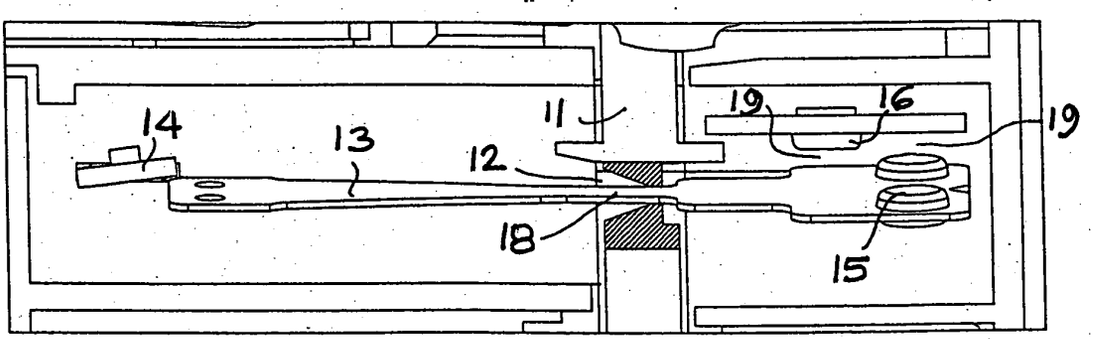

Fig. 5C

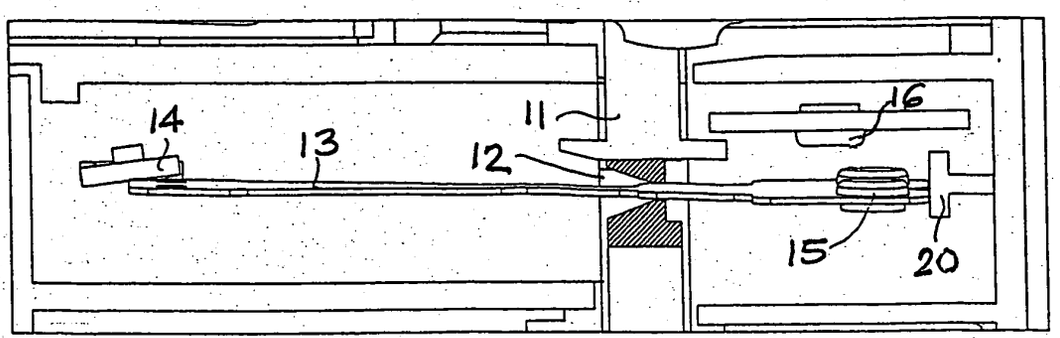

Fig. 6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 00 3663

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.7)
A,D	EP 1 121 701 A (TYCO ELECTRONICS GMBH) 8 August 2001 (2001-08-08) * page 7, lines 12-23 *	1-8	H01H50/58
A	DE 34 02 650 A (HENGSTLER GMBH) 1 August 1985 (1985-08-01) * abstract; figure 1 *	1-8	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 April 2004	Simonini, S

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 04 00 3663

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

28-04-2004

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1121701 A	08-08-2001	DE 59902225 D1	05-09-2002
		WO 0024020 A1	27-04-2000
		EP 1121701 A1	08-08-2001
DE 3402650 A	01-08-1985	DE 3402650 A1	01-08-1985

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82