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

(11) Publication number: **0 252 285**
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **87107957.0**

(51) Int. Cl.4: **H01H 1/20**

(22) Date of filing: **02.06.87**

(30) Priority: **03.06.86 DK 2608/86**

(43) Date of publication of application:
13.01.88 Bulletin 88/02

(84) Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

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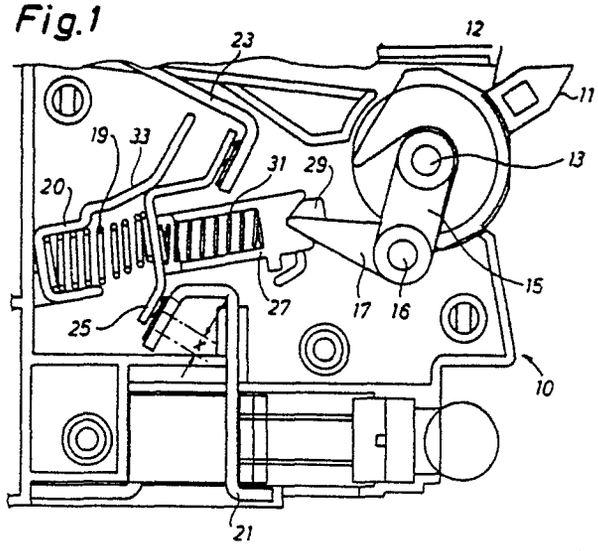
(54) Electric circuit breaker.

(57) The circuit breaker comprises a housing in which a pair of fixed contact members (21, 23) and a movable contact member (25) are mounted, said movable contact member being displaceable for establishing a connection between the two fixed contact members (21, 23). The movement of the movable contact member away from an outer position is always performed against the force of a spring (19), and the contact member is associated with a slider (27) slidable in guide tracks (29) provided for this purpose. When subjected to a pressure-transferring mechanism (15, 16, 17) activated by the control handle (11) of the circuit breaker, the movable contact member is pressed into an open position. The two fixed contact members (21, 23) and the movable contact member (25) comprise mutually parallel contact surfaces forming an angle with the displacement direction of the slider in the guide track (29), whereby said angle is substantially different from 90° and preferably is between 30-60°, especially approx. 50°. The spring (19) influences the movable contact member (25) in the displacement direction of the slider towards the closed position. Thus the movement of the movable contact member from the open to the closed position takes place in two steps, the latter step including a displacement of the movable contact member parallel to the contact surfaces (21, 23, 25) in such a manner that the movable contact surfaces touch the fixed contact members and consequently clean the contact points.

Fig.1



EP 0 252 285 A1

ELECTRIC CIRCUIT BREAKER

The present invention relates to an electric circuit breaker with a housing comprising a pair of fixed contact members or contact rails and a movable contact member with a first and a second, substantially parallel contact surface, said movable contact member being displaceable for establishing a connection between the two fixed contact members and with spring means for pressing the movable contact member against the fixed contact members in a closed position and where the movable contact member is attached to a slider movable on a guide track provided for this purpose and aligned with the spring means, said slider pressing the movable contact member into the open position when subjected to a pressure-transferring mechanism activated by the control handle of the circuit breaker and where the contact surfaces and the displacement direction of the guide track of the slider form an angle different from 90°.

Keeping contacts clean is a constant problem in connection with the making and breaking of electric pathways. Several different types of self-cleaning contacts are known, where movable or fixed contacts wipe each other clean by means of one or other form of rolling or displacement (e.g. EP application 0 105 817). Furthermore, the German Offenlegungsschrift nr. 2 817 815 describes a circuit breaker, where the contact surfaces and the displacement direction of a rod form an angle of only approx. 10-15°. The cleaning effect is not satisfactory with circuit breakers of the above type, especially with high currents, exceeding e.g. approx. 10 A.

According to the present invention a circuit breaker is proposed, which is characterised by the movable contact member comprising a first and a second midpart between, said first and second contact surfaces said first midpart being substantially perpendicular to the displacement direction of the slider and said second midpart being substantially parallel to the displacement direction of the slider.

Thus it is achieved that the movement of the movable contact member from the open to the closed position consists of two movements: First, the movable contact member is pressed by a spring in the displacement direction of the slider, said spring or springs being arranged perpendicular to the contact member, until the movable contact surfaces touch the fixed contact surfaces. Then the reaction forces of the fixed contact members oppose part of the spring pressure, resulting in a displacement force parallel to the contact surfaces. The resulting displacement force is proportional to the cosine of the angle between the contact surfaces and the direction of the spring forces and causes a displacement of the movable contact member parallel to the fixed contact surfaces, such that possible dirt is wiped off. Thus a self-cleaning effect is achieved.

In a preferred embodiment the guide track in the housing is arranged in such a way that the angle between the track and the bottom of the normally horizontally installed housing is approx. 10°, and such that the end of the slider actuating the movable contact member is closer to the bottom of the housing than the slider end subjected to the pressure-transferring mechanism, and the fixed and the movable contact surfaces form an angle of approx. 60° with said bottom. This is proposed with regard to the fact that the corresponding known circuit breaker without self-cleaning contacts comprises a guide track, which is usually horizontal in the installation position, while contact surfaces and rails are normally vertical to this position. By turning the guide track as well as the contact surfaces against each other so that the angle between them is approx. 50°, the compact form of the circuit breaker is retained. The new circuit breaker with self-cleaning contacts does thus not need more space than the common circuit breaker without self-cleaning contacts.

Preferably the circuit breaker housing furthermore comprises a retainer surface arranged such that a bend connecting the first and the second planar midparts of the contact member abuts the retainer surface in the closed position of the circuit breaker and when the breaker is opened, the bend or "knee" is guided back to its start position by the retainer surface. Thus the retainer surface has two effects: First, the retainer surface stops the displacement of the movable contact member during the closing operation and thus defines its final position, second, the retainer surface is a guide surface for the movable contact member, when the latter is returned to its open position.

Besides the main advantage of the circuit breaker, i.e. its self-cleaning, a reduced contact bounce time is achieved, probably due to damping caused by the special form of the movable contact member with its three curves and especially because of the position of the bend against the retainer surface. By choosing a suitable angle between the first and the second midpart of the contact member the bounce time can be considerably reduced. The exact angle depends, however, on the materials used as well as their dimensions

and has to be experimentally determined in each individual case. An angle of approx. 80° is found to be especially advantageous with contact members made of brass.

The invention will be described in greater details below with reference to the accompanying drawings, in which

Figure 1 shows a preferred embodiment of a main circuit breaker according to the present invention in closed position,

Figure 2 shows the same in open position,

Figure 3 a vector diagram,

Figure 4 an embodiment of a contact member, and

Figure 5 an enlarged section of the circuit breaker.

The circuit breaker is shown in its preferred embodiment and comprises a housing 10, wherein a pair of fixed contacts 21 and 23 is mounted, which can be connected by a movable contact member 25. The movable contact member 25 is fastened between a strong spring 19, in the following referred to as toggle spring, and a somewhat weaker spring 31 inside a slider 27 sliding along a track 29 supported by guide points and guide grooves in the housing. Figure 1 shows furthermore that the toggle spring 19 is aligned with a track 29 and is at its base end guided and supported by a retainer wall 20.

The circuit breaker is in Figure 1 shown in its closed position. When the current is to be cut off, a lever arm turning around a pivot 13 is actuated. The lever arm 11 is part of a partially circular holder 12 with a toggle arm 15, which can turn around the pivot 13 together with the lever arm 11. The toggle arm 15 is by means of a rotating joint 16 attached to one end of another arm 17, which is tapered being flat but rounded at the other end and is referred to in the following as toggle member 17. The toggle arm 15, the pivot 16 and the toggle member 17 constitute the pressure-transferring mechanism referred to in the introduction. These are well-known means and can be realized in several ways. The toggle member 17 protrudes into a V-shaped recess at one end of the slider 27, which moves in the track 29. The other end of the slider is provided with a track or groove, receiving the movable contact member 25. When the lever arm 11 is turned to the open position shown in Figure 2, the toggle arm 15 is also turned and at a certain moment during this turning the toggle arm 15 and the toggle member 17 are aligned with each other. At this moment the toggle spring 19 is maximally compressed. The presence of the toggle spring ensures in a manner known per se that the last part of the movement is executed in such a way that the circuit breaker is either completely closed or completely open. In the open position shown in Figure 2 the spring is slightly compressed and the contact member 25 lies in its groove at the end of the slider fastened between the two springs 19 and 31 and at some distance to the two fixed contact rails 21 and 23.

When the lever arm is moved from the open to the closed position shown in Figure 1, the toggle spring 19 is compressed slightly more and the movable contact member is pressed further away from the contacts. During the last part of the movement the toggle spring 19 tries to straighten itself and thus the movable contact member is pressed against the fixed contacts 21 and 23, while the slider 27 is pressed back. At the same time the toggle member 17 is moved back during the rotation of the lever arm. The comparatively weak spring 31 ensures that the slider is pressed back (i.e. to the right in Figure 1) in such a way that its V-shaped bottom follows the toggle member 17. Since the angle between the spring force of the toggle spring 19 and the reaction forces from the fixed contacts is approx. 130°, as shown in the vector diagram in Figure 3, the resulting force presses the contact member upwards and sidewards along the contact surfaces. Thus a cleaning of the contact surfaces is achieved by the sliding movement of the movable contact member along the contact surfaces, and possible dirt is wiped off.

Preferably the movable contact member 25 is bent as shown in Figure 4 so that the contact member has two contact surfaces 25a and 25 e at each end and a first planar midpart 25b, approx. perpendicular to the other midpart 25d with the two midparts meeting at the bend 25c. The angle between the contact surface 25a and the first midpart 25b is between 130° and 150°, preferably 140°.

The first midpart 25b is, when mounted in the circuit breaker, approx. perpendicular to the slider and is guided in a track at the end surface of the slider. The movable contact member can be displaced in this track during the last part of the closing engagement, when the self-cleaning takes place. The first midpart 25b is provided with a cam 38, which supports the adjacent end of the spring 19 so that the spring and the contact member 25 slip simultaneously, cleaning the contact surfaces. The bend 25c abuts a retainer surface 33, which, as shown in the drawing, can be a continuation of the retainer wall 20. During the closing operation the retainer surface 33 stops the movable contact member and thus limits the travel x. The retainer surface 33 is preferably situated so that the angle between the retainer surface and the displacement direction of the slider defined by the track 29 is approx. 20°.

During the opening operation the retainer surface 33 acts as a guiding surface for the bend 25 c when the movable contact member is pressed back into its start position.

The movement of the movable contact member is thus triangular, as shown in Figure 5, where the first part of the closing operation is shown by the rectilinear movement 34 and the last part of the closing operation, i.e. the self-cleaning, is shown by the vector 35 with the length x. During the opening operation the movement follows the vector 36 defined by the retainer surface 33.

The described embodiment of the circuit breaker possesses the additional advantage of a surprisingly short bounce time, which is presumably due to the sliding engagement combined with a dampening effect in the retainer wall and the contact member.

An angle of approx. 80° between the first and the second midparts 25b and 25d of the contact member is found to be especially advantageous for achieving a short bounce time.

The proposed new circuit breaker thus enables a controlled, well-defined travel exactly as long as is necessary for achieving a suitable cleaning of the contacts.

Claims

1. Electric circuit breaker with a housing comprising a pair of fixed contact members or contact rails (21, 23) and a movable contact member (25) with a first and a second, substantially parallel contact surface (25a, 25e), said movable contact member being displaceable for establishing a connection between the two fixed contact members (21, 23) and with spring means (19) for pressing the movable contact member (25) against the fixed contact members (21, 23) in a closed position and where the movable contact member is attached to a slider (27), movable on a guide track (29) provided for this purpose and aligned with the spring means (19), said slider pressing the movable contact member into the open position when subjected to a pressure-transferring mechanism (15, 16, 17) activated by the control handle of the circuit breaker (11), and where the contact surfaces (25a, 25e) and the displacement direction of the guide track (29) of the slider form an angle different from 90. **characterised** in that the angle is approx. 30°-60°, preferably approx. 50°, and that the movable contact member further comprises a first and a second midpart (25b, 25d) between said first and second contact surfaces (25a, 25e), said first midpart (25b) being substantially perpendicular to the displacement direction of the slider (27), and said second midpart (25 d) being substantially parallel to the displacement direction of the slider (27).

2. Electric circuit breaker according to claim 1, **characterised** in that the guide track (29) in the housing is arranged in such a way that the angle between the track (29) and the bottom of the normally horizontally installed housing is approx. 10°, and such that the end of the slider (27) actuating the movable contact member is closer to the bottom of the housing than the slider end subjected to the pressure-transferring mechanism (15, 16, 17), and that the fixed and the movable contact surfaces form an angle of approx. 60° with said bottom.

3. Electric circuit breaker according to claim 1 or 2, **characterised** in that the circuit breaker housing comprises a retainer surface (33) arranged such that a bend (25c) connecting the first (25b) and the second planar midpart (25d) of the movable contact member abuts the retainer surface (33) in the closed position of the circuit breaker and when the breaker is opened the bend (25 c) is guided back to its start position by the retainer surface.

4. Electric circuit breaker according to claim 3, **characterised** in that the angle between the retainer surface (33) and the displacement direction of the slider in the guide track (29) is approx. 20°, the top of the angle substantially coinciding with the basis of the spring (19).

5. Electric circuit breaker according to claim 1, 2, 3 or 4, **characterised** in that the angle between the first contact surface (25a) and the first midpart (25b) is between 130. and 150°, preferably 140°.

6. Electric circuit breaker according to claim 1, 2, 3, 4 or 5, **characterised** in that the angle between the first midpart (25b) and the second midpart (25d) is between 75° and 90°, preferably 80°.

Fig.1

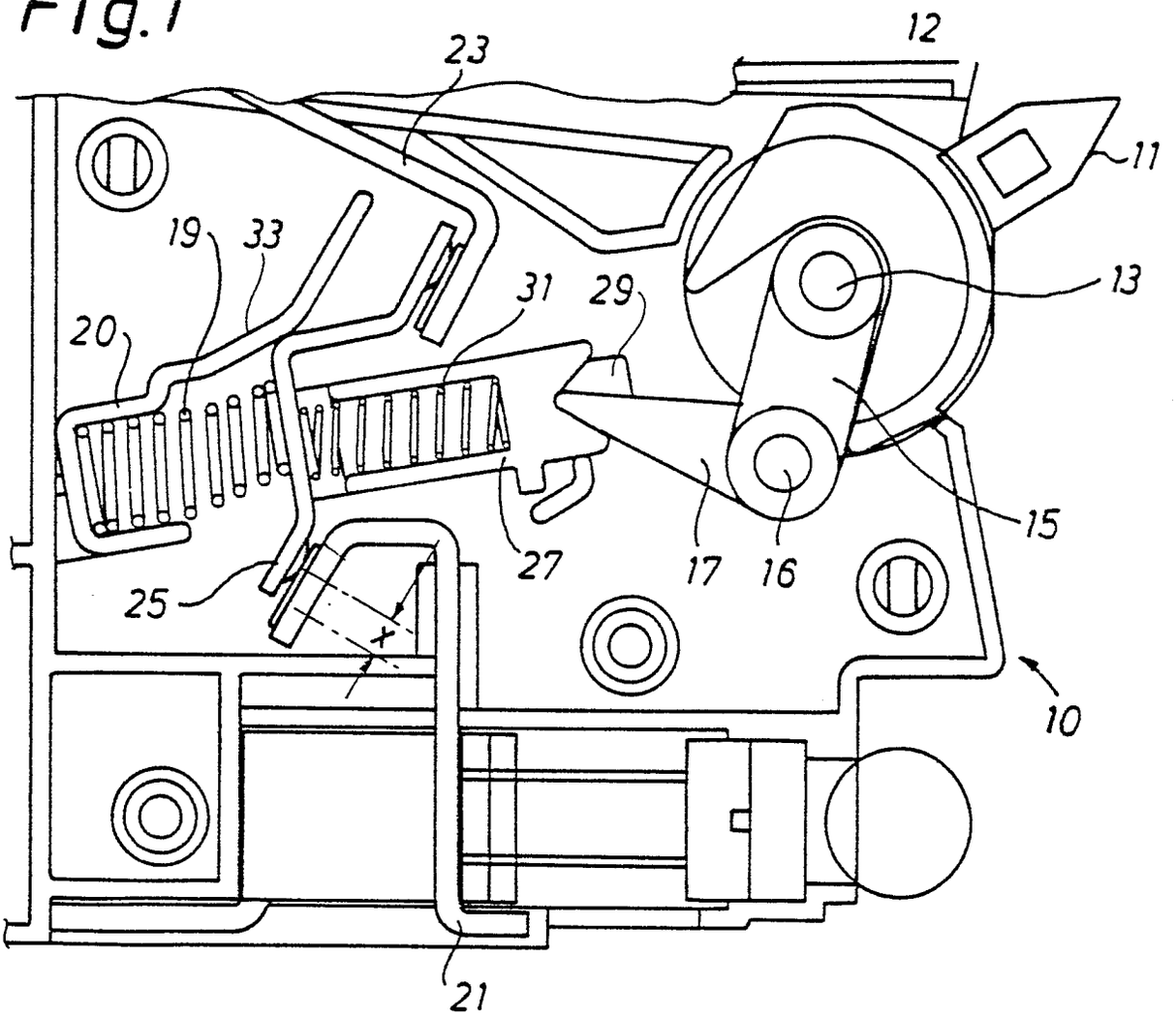

23
12
11
19
33
13
31
29
20
15
27
17
16
25
X
10
21

Fig.2

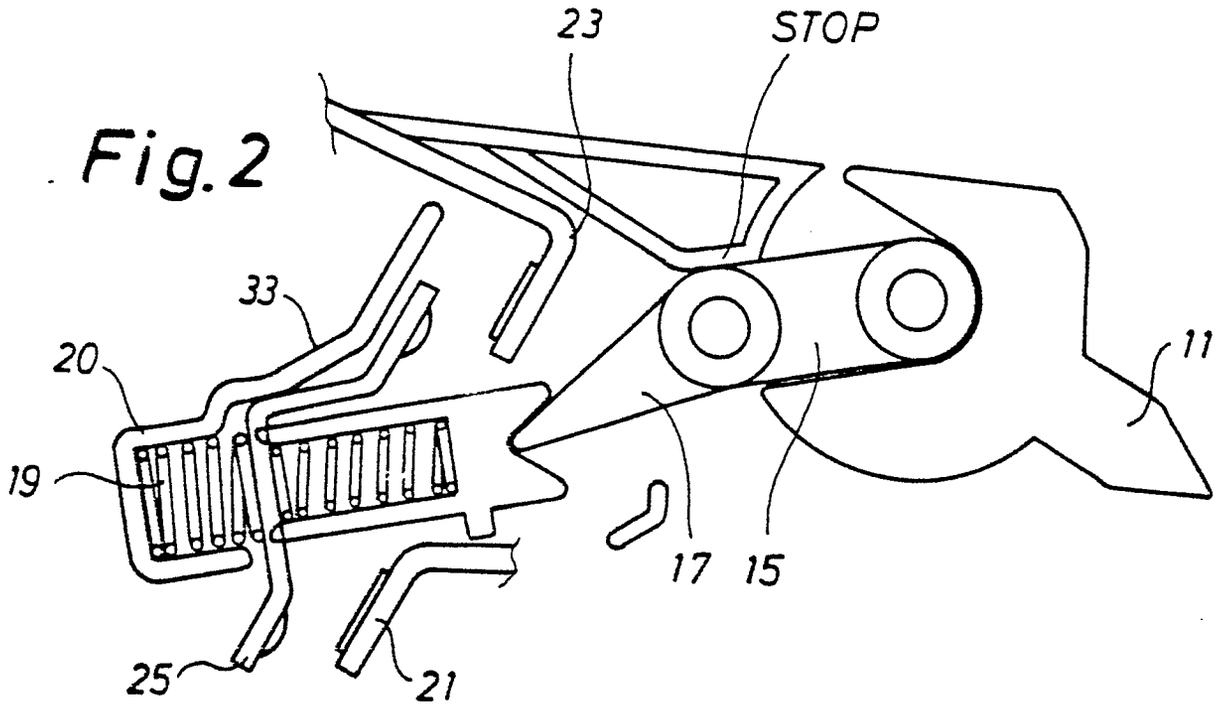

23
STOP
33
11
20
19
17
15
25
21

Fig.3

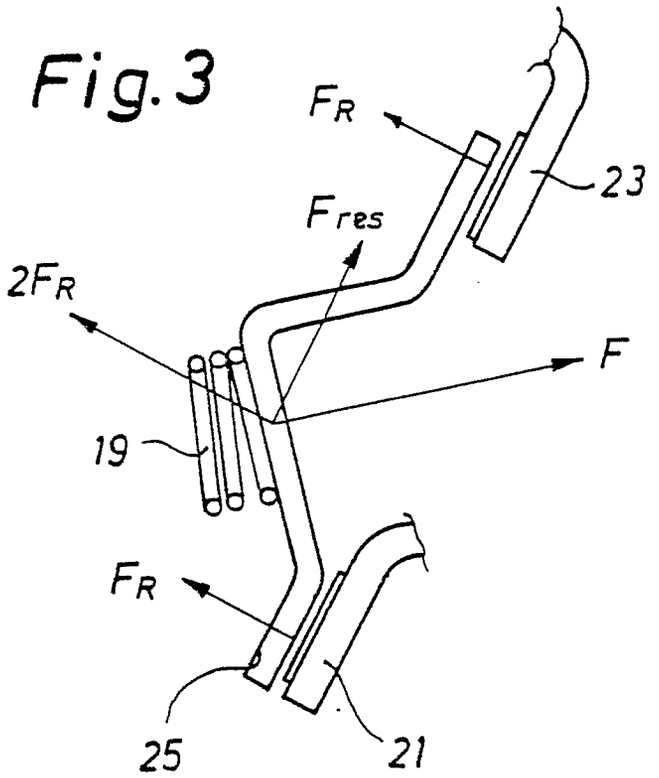


Fig.4

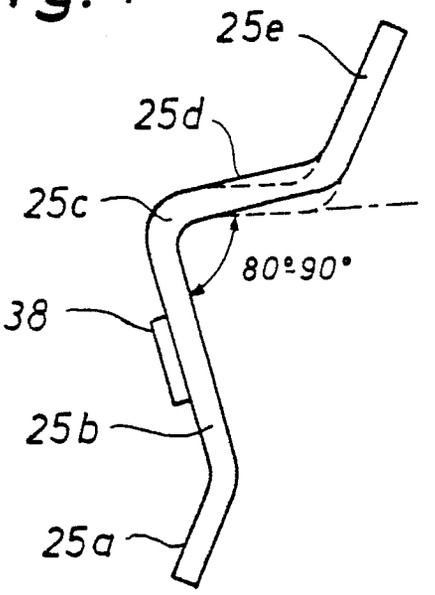
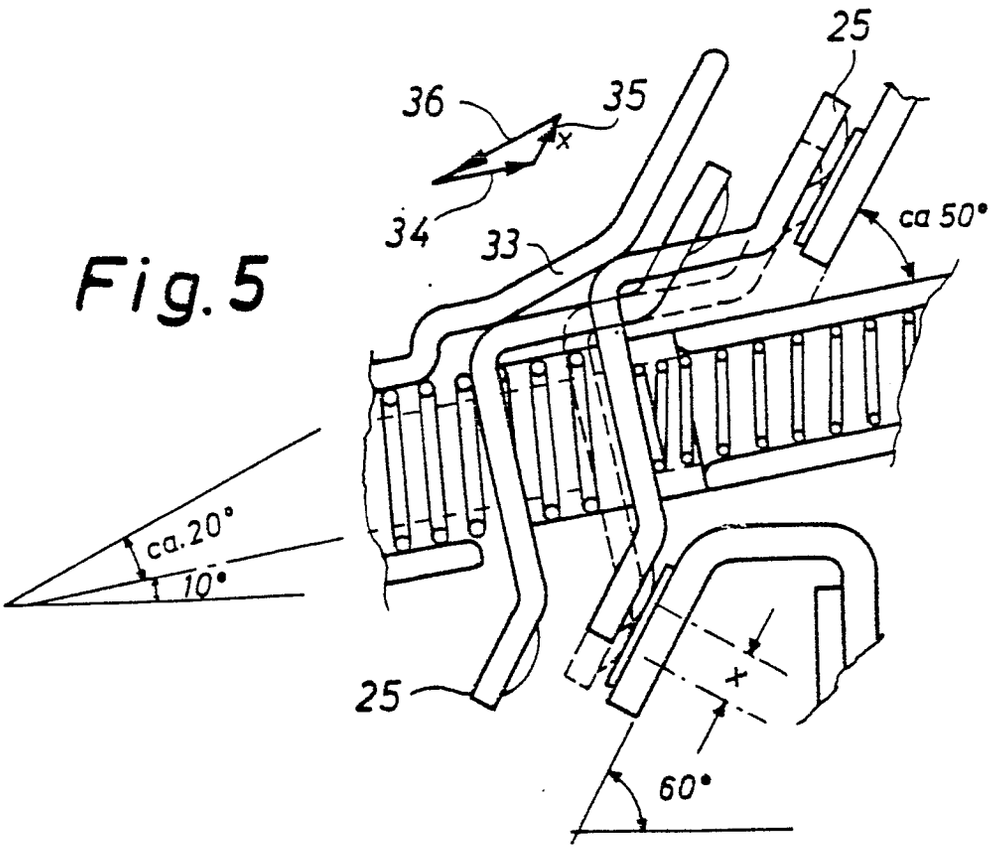


Fig.5



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EUROPEAN SEARCH REPORT

Application number
87107957.0

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.4)
A,D	DE-A1-2 817 815 (SCHALTBAU GESELLSCHAFT GMBH) *Page 6, lines 18-31; page 7, lines 1-20; fig 3*	1	H 01 H 1/20
A	DE-A1-2 132 658 (J & J MARQUARDT)	1	
A	DE-A1-2 525 467 (CALOR-EMAG ELEKTRIZITÄTS-AKTIENGESELLSCHAFT)	1	
A	EP-A1-0 011 413 (BONNELLA SWITCHES, LIMITED)	1	
A,D	EP-A1-0 105 817 (MANUFACTURE DES ALPES FRANCAISES)	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

H 01 H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
STOCKHOLM	22-09-1987	B. NORDENBERG

CATEGORY OF CITED DOCUMENTS

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