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

(11) Publication number : **0 518 837 A1**

# (12) EUROPEAN PATENT APPLICATION

(21) Application number : **92850135.2**

(51) Int. Cl.[5] : **H01H 33/70**

(22) Date of filing : **10.06.92**

(30) Priority : **12.06.91 NO 912265**

(43) Date of publication of application :
**16.12.92 Bulletin 92/51**

(84) Designated Contracting States :
**CH DE DK ES FR IT LI SE**

(71) Applicant : **ABB DISTRIBUSJON AS**
**Amtm. Aallsgt. 73**
**N-3700 Skien (NO)**

(72) Inventor : **Dyngeseth, Harald**
**Enggravlia 27**
**N-3712 Skien (NO)**
Inventor : **Daalder, Jaap**
**Havundvn. 141**
**N-3751 Skien (NO)**
Inventor : **Lund, Arne Morten**
**Nybergkrysset 21**
**N-3737 Skien (NO)**

(74) Representative : **Delmar, John-Ake**
**P.O. Box 26 133**
**S-100 41 Stockholm (SE)**

## (54) An arrangement in an SF6 insulated, high voltage on-load switch.

(57) An arrangement in an SF6 gas insulated electrical high voltage on-load switch, wherein the number of rotatable switch knives (13, 14 ; 15, 16 ; 17, 18) in the switch are arranged at evenly spaced intervals, projecting from a common revolving shaft (22), there being provided on each side of each of said knives a fan blade (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12) which is freely rotatable, with the actual switch housing serving as the rotation chamber, and that said fan blades project from and are secured to said revolving shaft at an angle relative to the rotational axis (CL) of the revolving shaft. On rotation of the revolving shaft, turbulent gas flows are created around the switch contaces (20, 21) cooperating with the knife sets in a switch housing (19) in order to extinguish the electrice arcs around these switch contacts.

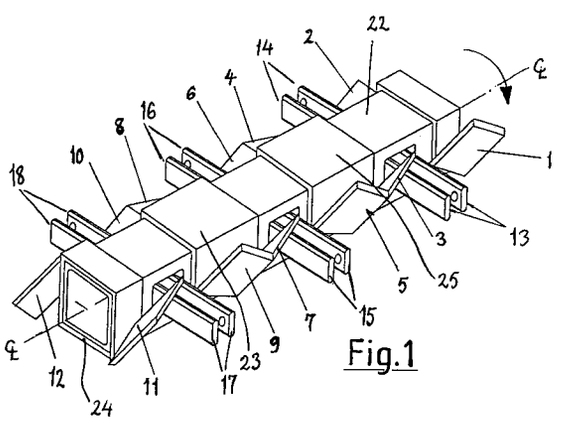


Fig.1

EP 0 518 837 A1

The present invention relates to an arrangement in an SF6 gas insulated electrical high voltage on-load switch, wherein the number of rotatable switch knives in the switch are arranged at evenly spaced intervals, projecting from a common revolving shaft.

In recent years there have been developed encapsulated, SF6 gas Insulated on-load switches for voltages from 12 kV and upwards. The purpose of using SF6 gas in such switches is to achieve a compact structural form combined with high breaking capacity on the basis of the high electrical insulation strength of the SF6 gas.

For on-load switches of this type, the SF6 gas is also used as an extinguisher or arc-control means for the electric arc caused by switching.

Various method are described in the literature for electric arc extinguishing in SF6 gas. We can refer to, among others, an article entitled "Forskning på SF6-effektbrytere", published in ABB (Asea Brown Boweri) Tidning no. 2/89. The most common form of arc extinguishing in circuit breakers with SF6 gas is to compress the gas in cylindrical switch chambers and to conduct a relatively powerful gas flow along the arc caused by switching.

In German Offenlegungsschrift DE 3514853-A1 is described an extinguishing principle embodied in a compression chamber in which the SF6 gas is compressed and conducted to discharge through a form of nozzle surrounding the one fixed switch contact per phase. The gas thus flows along the side of the switch contacts and continues approximately along the switch arc.

In Norwegian patent application no. 891214 is described a similar blowing device for extinguishing the electric arc at a switch, but having the difference that the gas flow is directed across the arc and toward the points of intersection of the arc foot. These solutions have in common that the SF6 gas is compressed in a cylinder or in a fan chamber at exactly or approximately the same time as the switch contacts are opened and moved apart. In the solution according to Norwegian patent application no. 891214, the compressed gas is blown out through nozzle openings (apertures) placed on the side of the fan housing, thereby directing the gas flow against the switch arc. The fan blades or vanes which rotate in the fan housing are arranged such that, together with a rotating disc having openings that cooperate with said nozzle openings in the fixed fan housing, an opening for the gas discharge is periodically established during the rotational movement of the switch knives and blowing fans. One obtains thereby an intermittent or pulsating flow of gas directed toward the arc. This work is usually done by a manually operated spring mechanism. To achieve sufficient breaking speed the mechanism must have very powerful springs, which implies the disadvantage that the switch will be exceedingly heavy to operate manually.

It has been found through various laboratory experiments that it is sufficient to create a turbulence in the gas, which is a part of the electric arc zone, to extinguish the arc at the switch. In the present invention this idea is exploited, and an on-load switch is produced which requires considerably less mechanical switching energy than switches based on the known compression principles mentioned above.

According to the invention, the arrangement is characterized in that on each side of each of the aforementioned knives there is provided a fan blade which is freely rotatable, with the actual switch housing serving as the rotation chamber, and that said fan blades project from and are secured to said revolving shaft at an angle relative to the rotational axis of the revolving shaft, to create thereby, on rotation of the revolving shaft, turbulent gas flows around the switch contacts cooperating with the knife sets to extinguish the electric arcs thereabout.

According to a further embodiment of the arrangement in accordance with the invention, each fan blade is displaced at a first angle after a respective switch knife in the switch knife set. The angle is preferably between 20° and 45°.

According to a further embodiment of the arrangement in accordance with the invention, at least two sets of fan blades each form a substantially V-shaped cross-section, wherein each branch of said V forms a second angle with the axis of rotation of the revolving shaft.

Preferably, a pair of fan blades being adjacent to a switch knife In a switch knife set will be arranged such that the fan blades mutually form a third angle. This third angle may be in the range of 90° - 150°. The apex of the third angle will point in the direction of rotation for the revolving shaft.

The extinguishing principle according to the present invention is thus totally different from that of the devices according to the prior art. The fan blades according to the invention have a form more like a propeller, which brings the gas into more turbulent flows toward or in the arc zone. This requires, in contrast to the known solutions, exceedingly little switching energy, and has proven in laboratory experiments to-have surprisingly good properties.

The invention will now be described in more detail with reference to the enclosed drawings.

Fig. 1 illustrates the arrangement according to the invention, with a known per se rotating switch knife set, and with fan blades disposed adjacent to the switch knives.

Fig. 2 illustrates the mounting of the fan blades relative to the switch knives.

Fig. 3 illustrates the bevel angle of the switch knives in relation to the rotational axis of the device shown in Fig. 1.

Fig. 1 shows an SF6 insulated on-load switch based on an extinguishing system consisting of pro-

peller-like mounted fan blades 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12. These fan blades are placed on each side of known per se rotating switch knives 13, 14, 15, 16, 17, 18, said knives 13, 14 forming one knife set, said knives 15, 16 forming a second knife set and said knives 17, 18 forming a third knife set. The first knife set 13, 14 cooperates with fan blades 1, 2, 3, 4; the second knife set 15, 16 cooperates with fan blades 5, 6, 7, 8, and the third knife set 17, 18 cooperates with fan blades 9, 10, 11, 12.

The shape and placement of the fan blades relative to the switch knives is of considerable importance in creating the turbulent gas flows necessary for extinguishing the switch arcs.

Fig. 2 illustrates how the fan blades are displaced an angle A after the switch knives in the direction of rotation. Reference numeral 19 in Fig. 2 indicates the housing of the on-load switch, and reference numerals 20 and 21 indicate the switch contacts that will engage with a knife set, this being in the selected example knife set 17, 18 in Fig. 1. The fan blades, as seen for example in Fig. 2 with fan blades 9, 10, are formed as a unitary element, and are mounted on a revolving shaft 22. It is thus understood that fan blades 9, 10 (like the other fan blades) will rotate simultaneously with the knife sets 17, 18 (and the other knife sets). The fan blades may be joined together via a mid-section 23, as is apparent from Fig. 1 and 2, for example, with fan blades 9, 10.

Fig. 3 shows how a typical fan blade may be designed, the configuration also being consistent with what is shown in Fig. 2. Although the fan blade set could be shaped as shown, for example, with reference numerals 11, 12 and 24 in Fig. 1, the example in Fig. 3 is more closely related to the configuration of fan blade sets 3, 4 and 5, 6, see Fig. 1. The fan blade set here is provided with a mid-section 25 adapted to engage with the revolving shaft 22, as is shown in connection with Fig. 2. At the right in Fig. 3 is shown how two fan blades 4, 6 form an approximate V-shape, where fan blades 4, 6 form a respective angle B with the center line axis CL through revolving shaft 22 in Fig. 1 and 2. Between said branches 4, 6 of said V is a mutual angle C. The angle A in Fig. 2 is preferably in the range of 20°-45°, the angle B in Fig. 3 is in the range of 15°-45°, while angle C is in the range of 90°-150°.

It will be immediately understood that the angle between, for example, fan blades 9 and 11 will also be equal to angle C.

It has proven very important to optimize said angles with respect to the creation of vortexes (turbulent gas flows) which contribute toward removing or displacing the ionized gases formed in the arc. Further, it is also of considerable importance that fresh, cool gas is brought into the arc zone as long as the arc is burning, in order to cool down and deionizing the arc gasses. In the present invention it has proven possible to achieve arc extinction within 1-2 half cycles of the electric current time at 50 Hz, i.e., from less than 10 milliseconds to a maximum of up to 20 milliseconds, which is a fully acceptable arc time for this type of on-load switch.

This very simple system for arc control in an SF6 insulated high voltage on-load switch requires little movement energy from the operating mechanism, which is a considerable improvement in relation to all other known switch principles which make use of gas blowing based on compression of the gas in a cylinder or in a fan chamber.

## Claims

1. An arrangement in an SF6 gas insulted electrical high voltage on-load switch, wherein the number of rotatable switch knives in the switch are arranged at evenly spaced intervals, projecting from a common revolving shaft,
**characterised in** that on each side of each of said knives there is provided a fan blade which is freely rotatable, with the actual switch housing serving as the rotation chamber, and that said fan blades project from and are secured to said revolving shaft at an angle relative to the rotational axis of the revolving shaft, to create thereby, on rotation of the revolving shaft, turbulent gas flows around the switch contacts cooperating with the knife sets to extinguish the electric arcs thereabout.

2. An arrangement as disclosed in claim 1,
**characterised in** that each of said fan blades is displaced an angle (A) after a respective switch knife in the switch knife set, seen in the direction of rotation of the revolving shaft.

3. An arrangement as disclosed in claim 1,
**characterised in** that each angle is between 20° and 45°.

4. An arrangement as disclosed in claim 1 or 2,
**characterised in** that at least two sets of fan blades each form a substantially V-shaped cross-section, wherein each branch of said V forms an angle (B) with an axis through said revolving shaft.

5. An arrangement as disclosed in claim 1,
**characterized in** that a pair of fan blades adjacent a switch knife in a switch knife set is mounted such that the fan blades mutually form a third angle (C).

6. An arrangement as disclosed in claim 5,
**characterised in** that said third angle is in the

range of 90°-150°.

7. An arrangement as disclosed in claim 5 or 6, **characterised in** that the apex of the third angle points in the direction of rotation of the revolving shaft.

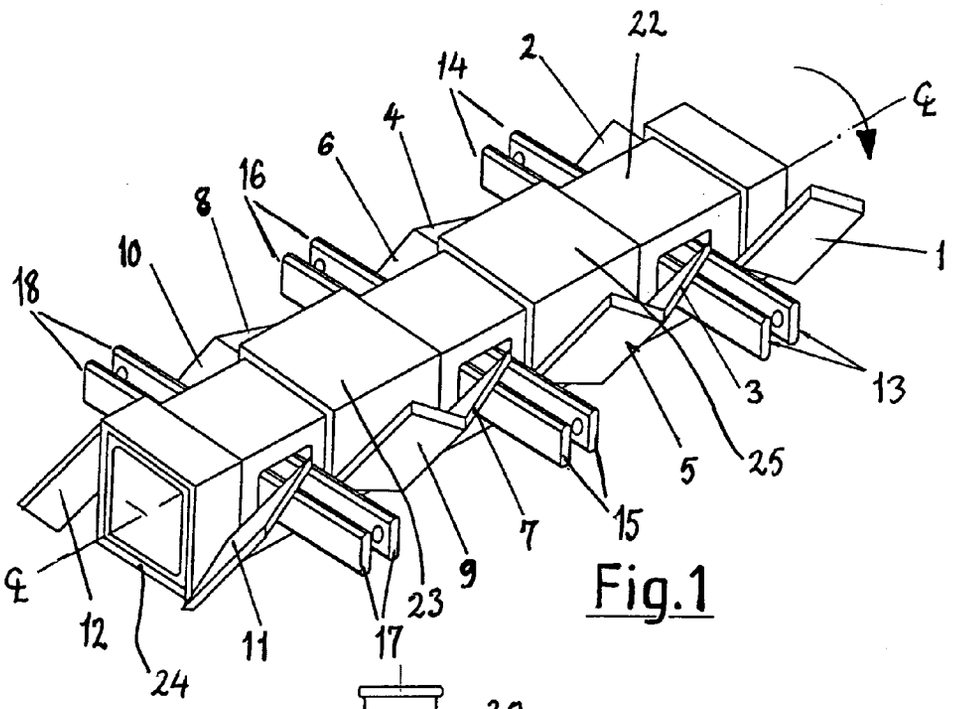


Fig.1

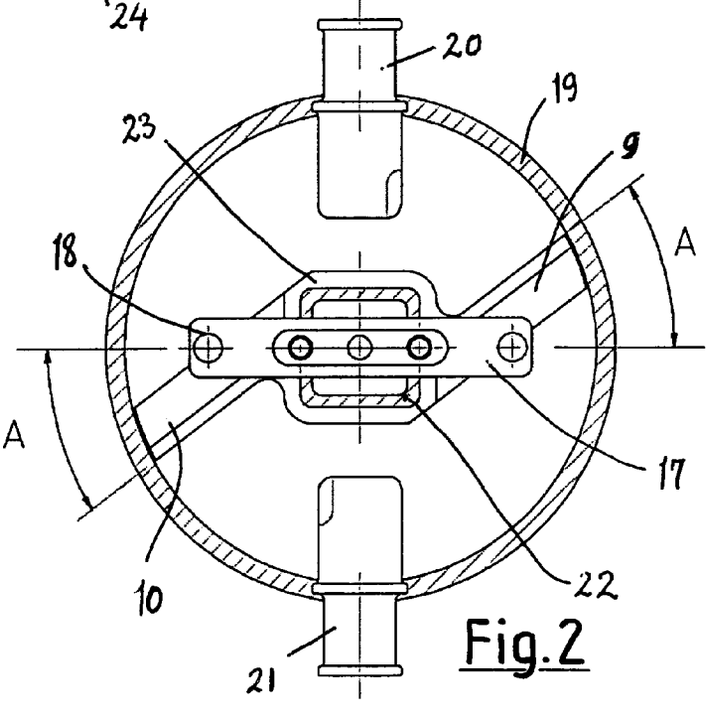


Fig.2

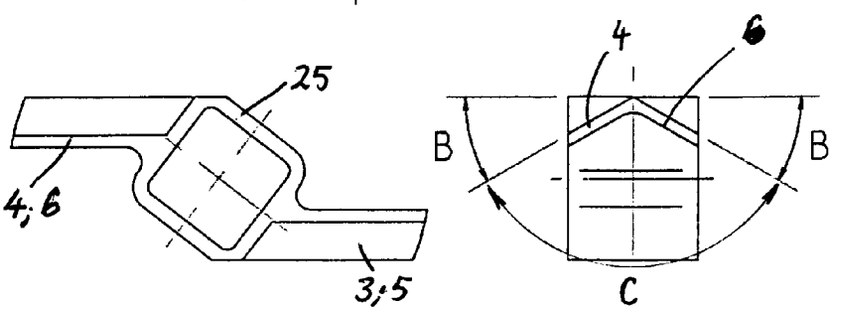


Fig.3

European Patent Office

# EUROPEAN SEARCH REPORT

Application Number

EP 92 85 0135

## 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.5) |
|---|---|---|---|
| A | DE-A-4 008 800 (EB DISTRIBUSJON) * the whole document *; & NO - A - 891214 (cat. D) --- | 1 | H 01 H 33/70 |
| A | DE-C- 613 359 (ALLGEMEINE ELEKTRICITÄTS-GESELLSCHAFT) * the whole document * --- | 1 | |
| A | EP-A-0 056 632 (MITSUBISHI) * page 4, lines 1-19; figures 2-5 * --- | 1 | |
| A | EP-A-0 199 248 (SIEMENS) * page 1, line 38 - page 3, line 26; figure *; & DE - A - 3514853 (cat. D) ----- | 1 | |

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H 01 H

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| BERLIN | 09-09-1992 | NIELSEN K G |

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 (P0401)