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

(11) **EP 1 926 116 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
28.05.2008 Bulletin 2008/22

(51) Int Cl.:
H01H 33/90 *(2006.01)*

(21) Application number: **06405498.4**

(22) Date of filing: **27.11.2006**

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

(71) Applicant: **ABB Technology AG**
8050 Zurich (CH)

(72) Inventors:
- **Heiermeier, Helmut**
  79793 Wutöschingen (DE)
- **Kammerl, Kurt**
  79771 Griessen (DE)
- **Kehr, Timo**
  5244 Birrhard (CH)
- **Frisk, Johan**
  77134 Ludvika (SE)

(74) Representative: **Ingold, Mathias**
ABB Patent Attorneys
ABB Schweiz AG
Intellectual Property (CH-LC/IP)
Brown Boveri Strasse 6
5400 Baden (CH)

(54) Puffer circuit breaker with reduced puffer volume pressure

(57) A circuit breaker comprises a puffer volume (9) and at least one filling valve (16) adapted to allow a flow of gas into the puffer volume (9) upon expansion of the same. The closing member (18) is biased in a direction against the flow of gas exiting from the puffer volume (9) such that the filling valve (16) remains open while the pressure build-up within the puffer volume (9) remains below a given threshold. This allows to keep the pressure in the puffer volume (9) low under low current switching conditions, thereby decreasing the tendency for supersonic flow in the insulating nozzle. It also allows to increase the switching speed and/or to decrease the required drive operating energy.

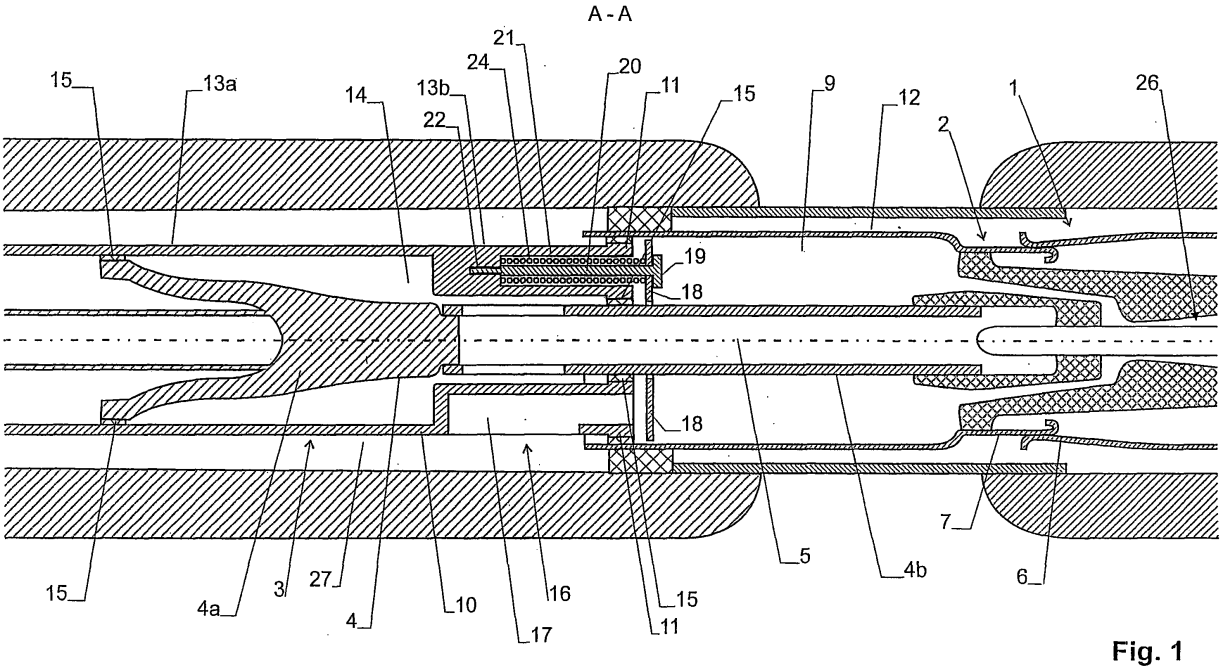


Fig. 1

EP 1 926 116 A1

Description

Technical field

[0001] The invention relates to puffer circuit breakers having filling valves.

Background

[0002] When being operated, circuit breakers having a puffer chamber generate a pressure build-up in their puffer volume that depends on current, speed of operation, puffer volume and contact system dimension. The built-up pressure is required for quenching the arc under high current conditions, but it works against the drive and reduces the reachable speed. Additionally, it may create supersonic flow in the insulating nozzle, which may reduce the dielectric withstand capability between contacts due to a lower gas density in certain regions.

Summary of the invention

[0003] Hence, the object of the present invention is to provide a circuit breaker that addresses this problem. This object is achieved by the circuit breaker of claim 1.

[0004] The circuit breaker of the present invention uses a modified filling valve. The filling valve is available anyhow in circuit breakers of this type and conventionally serves to allow a flow of gas into the puffer volume upon expansion of the puffer volume. According to the invention, the closing member of the filling valve is biased in a direction against a flow of gas exiting from the puffer volume in such a manner that the filling valve remains open while the pressure build-up within the puffer volume remains below a given threshold. If the pressure build-up exceeds this threshold, which is the case when interrupting higher currents, the closing member closes the filling valve in order to allow the generation of a pressure and gas flow sufficient to extinguish a high power arc.

[0005] Hence, the invention allows to keep the pressure in the puffer volume low when opening the circuit breaker under low load conditions, thereby reducing the tendency of supersonic flow in the nozzle and reducing the energy required by the drive for the switching operation.

Brief description of the drawings

[0006] Further embodiments, advantages and applications of the invention are disclosed in the dependent claims as well as in the following description, which makes reference to the figures. These show in:

Fig. 1 a sectional view of a circuit breaker along line A-A of Fig. 2, and in

Fig. 2 a view of the support of the circuit breaker with the valve plate mounted thereon.

Embodiments of the invention

[0007] The circuit breaker of Figs. 1 and 2 is a high voltage circuit breaker designed for voltages of e.g. at least 72.5 kV. It comprises a first contact assembly 1 and a second contact assembly 2, at least one of which shall be movable. In the example shown, the first contact assembly 1 is stationary, but could be movable as well, and the second contact assembly 2 is movable. Movable contact assembly 2 is movably connected to a stationary support 3. A rod 4 comprising a base member 4a and a tube 4b is connected to movable contact assembly 2 for moving the contact assembly 2 along a direction of displacement that generally coincides with the longitudinal axis 5 of the circuit breaker.

[0008] Stationary contact assembly 1 comprises a series of first, stationary contacts 6 arranged to contact a mating second contact 7 of movable contact assembly 2. When the circuit breaker is operated, second contact 7 disengages from the first contacts 6 and an arc is formed in an arc volume. The pressure generated in arc volume feeds back, in part, into a puffer volume 9 (also called "buffer volume") formed between movable contact assembly 2 and support 3. Puffer volume 9 is formed between a front plate 11 of support 3 and a cylinder housing 12 of movable contact assembly 2. Front plate 11 is slideably arranged in cylinder housing 12.

[0009] Support 3 preferably comprises an integral tubular body 10 made from a single piece of cast metal. Body 10 is of tubular, approximately cylindrical shape and extends around rod 4. It forms front plate 11 at one end, a cylindrical base section 13a at the opposite end, and a valve section 13b located between front plate 11 and base section 13a. Rod 4 is located in an axial cavity 14 of body 10 and guided therein by frictional bearings 15.

[0010] Filling valves 16 are mounted in valve section 13b of body 10. In the present embodiment, a total of two such filling valves are provided, one of which can be seen in Fig. 1. The primary, conventional purpose of these valves is to allow the entry of gas into puffer volume 9 when it is expanded while closing the circuit breaker.

[0011] Each filling valve 16 comprises an opening 17 extending from the side of support 3 through front plate 11. The openings 17 of the filling valves 16 can be closed by means of a valve plate 18. Valve plate 18 is arranged in puffer volume 9 over at least one opening 17.

[0012] When the pressure difference over valve plate 18 is low or when the pressure in the openings 17 is higher than in buffer volume 9, valve plate 18 is in its "first" position shown in the figures, where it rests against four retainer members 19 arranged at a distance from front plate 11 of support 3. Each retainer member 19 is mounted to a rod member 20 that connects it to support 3. Each rod member 20 extends into a recess 21 in valve section 13b of support 3 and is screwed into a bore 22 at the bottom of the recess 21. Four spring members 24, preferably formed by helical springs 24, are extending around the rod members 20 from the bottom of each re-

cess 21 to valve plate 18. They push valve plate 18 away from support 3 and against the retainer members 19.

[0013] When the circuit breaker is opened under low load, the pressure build-up from the arc is in part released through the filling valves 16, because the pressure drop over valve plate 18 is not sufficient for closing the filling valves 16. This allows to keep the pressure in puffer volume 9 fairly low, e.g. at 4 bar, thereby avoiding undesired supersonic flows in nozzle region 26 of the circuit breaker and decreasing the force required from the drive.

[0014] If, however, the pressure build-up from the arc exceeds a given threshold, the gas flow through the filling valves 16 will generate a pressure drop over valve plate 18 that is sufficient to overcome the force of the springs 24, and valve plate 18 will be brought into its "second" position where it is pushed against the openings 17, thereby closing the filling valves 16. A subsequent further pressure build-up in puffer volume 9 will further increase the force by which the valve plate 18 is pushed against front plate 11 of support 3, thereby keeping the filling valves 16 safely closed, which allows to achieve a pressure sufficient for extinguishing a powerful arc. Preferably, the area of the valve plate 18 is designed to be larger than the area of the openings 17, here in the form of bananaholes 17, in order to achieve a certain hysteresis between opening and closing pressure, such that reopening takes place at much lower pressure than closing of the filling valve oder valves 16.

[0015] In the embodiment of Figs. 1 and 2, the openings 17 of all filling valves 16 can be closed by the same valve plate 18, which ensures that all valves 16 close at the same time. However, it is also possible to use an individual valve plate for each filling valve 16.

[0016] The valve plate 18 and springs 24 of the embodiment shown so far can also be replaced by other types of closing members 18 and spring members 24. For example, at each opening 17, a spring plate may be attached at a first end section thereof to front plate 11. If the pressure drop over the spring plate is small, the second end section of the spring plate is located over opening 17 at a distance from front plate 11. In the presence of a strong pressure build-up from the arc, the second end section is pushed against front plate 11 thereby closing opening 17.

[0017] The spring member(s) of the present invention must be designed such that closing member(s) is (are) biased in a direction shifted against the flow of gas exiting from the puffer volume 9, such that filling valve 16 remains open while the pressure build-up within puffer volume 9 remains below a given threshold. The threshold should be chosen such that the filling valves 16 close, if the pressure build-up corresponds to the one generated by an arc that could not be extinguished with the filling valves 16 being open. The exact level of the threshold depends on the circuit breaker design and can be found experimentally or by numerical simulations.

[0018] The design of the filling valve 16 shown here is simple and compact and similar to the design of conventional filling valves. Since it is an integral part of support 3, the costs for its assembly are low.

[0019] The use of the modified filling valve 16 described here increases the average speed of the circuit breaker. Together with the higher density in the arcing zone it increases the important capacitive voltage withstand capability. This gives the possibility to use drives with lower operating energy, and/or to increase switching capabilities with existing drives to higher ratings.

[0020] In a further aspect, the invention relates to a method for blowing an arc in a circuit breaker, the circuit breaker comprising a puffer chamber with at least one filling valve 16, the method being characterized by the steps of: during opening of the circuit breaker, keeping the filling valve 16 open while a built-up pressure within said puffer volume 9 remains below a given pressure threshold, and closing the filling valve 16 when the built-up pressure within said puffer volume 9 exceeds said given pressure threshold. In particular, the pressure threshold shall be chosen such that the filling valve 16 is being closed, if the built-up pressure equals or exceeds the minimal pressure which can be generated by an arc that is no more extinguishable with the filling valve 16 being open.

List of reference numbers

[0021]

1:	stationary contact assembly
2:	movable contact assembly
3:	support
4:	rod
4a:	base member
4b:	tube
5:	longitudinal axis
6:	first contacts
7:	second contacts
9:	puffer volume
10:	body
11:	front plate
12:	cylinder housing
13a:	base section
13b:	valve section
14:	axial cavity
15:	frictional bearings
16:	filling valves
17:	opening
18:	valve plate
19:	retainer members
20:	rod members
21:	recesses
22:	bores
24:	springs
26:	nozzle region

Claims

1. A circuit breaker comprising a puffer chamber, a first contact assembly (1) and a second contact assembly (2),
a support (3), wherein said second contact assembly (2) is movably connected to said support (3),
a puffer volume (9) is formed between said support (3) and said movable contact assembly (2),
at least one filling valve (16) is adapted to allow a flow of gas into said puffer volume (9) upon expansion of said puffer volume (9), wherein said filling valve (16) is closeable by means of at least one closing member (18),
characterized in that said closing member (18) is biased in a direction against a flow of gas exiting from said puffer volume (9) such that said filling valve (16) remains open while a pressure build-up within said puffer volume (9) remains below a given threshold.

2. The circuit breaker of claim 1, wherein said filling valve (16) comprises at least one spring member (24) exerting a force keeping said closing member (18) open against the flow of gas exiting from said puffer volume (9), wherein said spring member (24) is dimensioned such that said closing member (18) closes, if the pressure build-up exceeds the given threshold.

3. The circuit breaker of claim 2, wherein said closing member (18) is a plate (18) movable from a first position, in which said filling valve (16) is open, to a second position, in which said filling valve (16) is closed, wherein said spring member (24) urges said plate (18) into said first position.

4. The circuit breaker of claim 3, wherein said plate (18) is arranged in said puffer volume (9) over at least one opening (17) in said support (3).

5. The circuit breaker of claim 4, wherein said plate (18) has a larger area than the at least one opening (17) in order to achieve a hysteresis between an opening and closing pressure of the filling valve (16).

6. The circuit breaker of any of the claims 3-5, further comprising a retainer member (19) at a distance from said support (3), wherein said spring member (24) urges said plate (18) against said retainer member (19).

7. The circuit breaker of claim 6 wherein said spring member (24) comprises at least one helical spring (24) extending from a recess (21) of said support (3) to said plate (18) and pushing said plate (18) away from said support (3) against said retainer member (19).

8. The circuit breaker of claim 7 comprising a rod member (20) connecting said retainer member (19) to said support (3), wherein said rod member (20) extends into said recess (21) and said helical spring (24) extends around said rod member (20).

9. The circuit breaker of any of the claims 2 to 8, comprising at least two spring members (24) for each filling valve (16).

10. The circuit breaker of any of the preceding claims, comprising a rod (4) connected to said movable contact assembly (2) for actuating said movable contact assembly (2), wherein said rod (4) extends through said support (3).

11. The circuit breaker of any of the preceding claims, wherein said filling valve (16) is arranged at said support (3).

12. A method for blowing an arc in a circuit breaker, the circuit breaker comprising a puffer chamber with at least one filling valve (16), **characterized by** the steps of: during opening of the circuit breaker, keeping the filling valve (16) open while a pressure build-up within said puffer volume (9) remains below a given threshold, and closing the filling valve (16) when the pressure build-up within said puffer volume (9) exceeds said given threshold.

13. The method of claim 12, **characterized by** the step of: choosing the threshold such that the filling valve (16) is closed, if the built-up pressure equals or exceeds the minimal pressure which can be generated by an arc that is no more extinguishable with the filling valve (16) being open.

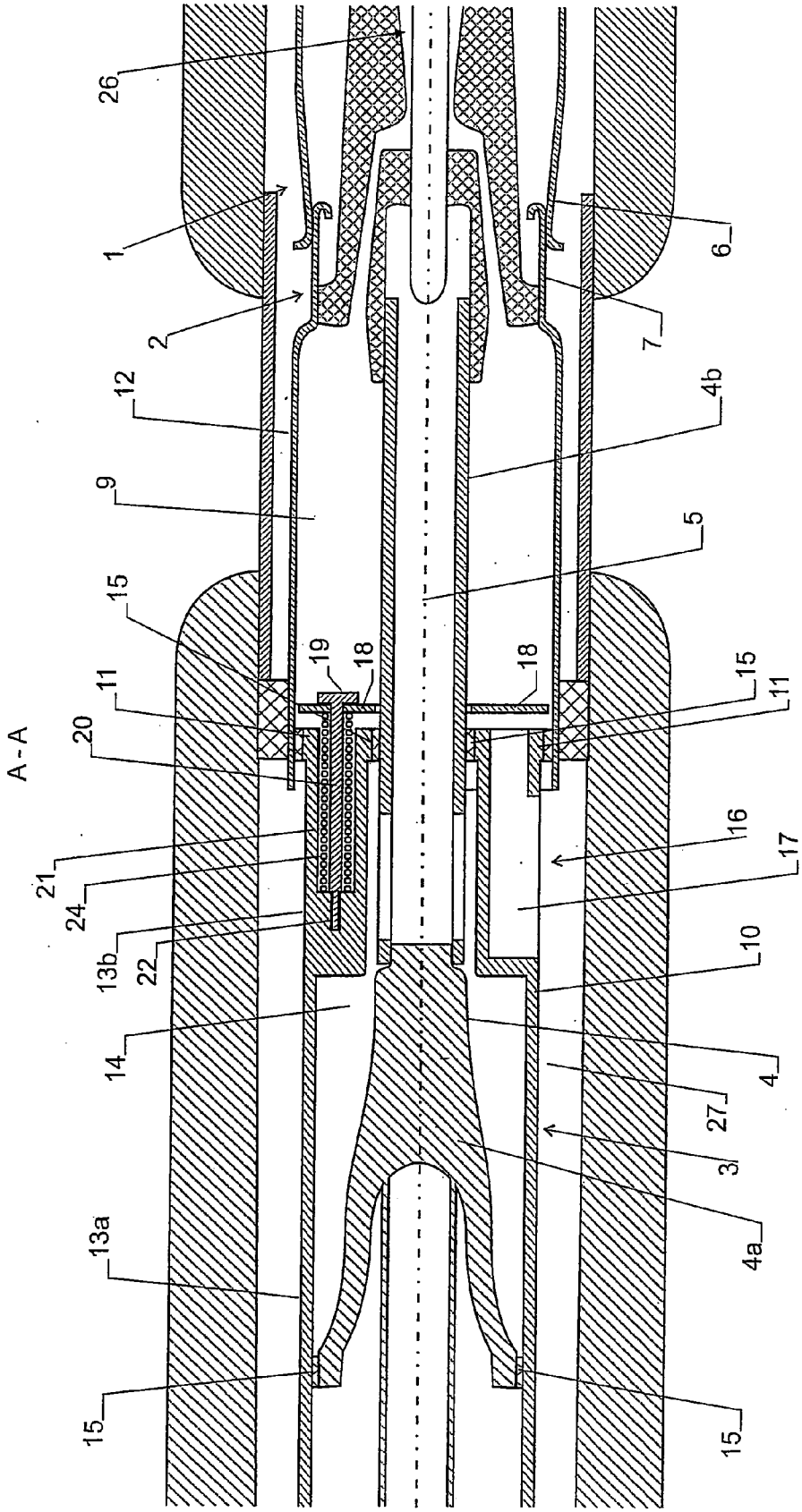

A - A
26
1
2
12
9
15
11
20
21
24
13b
22
14
13a
15
19
18
18
15
11
16
17
10
4
27
3
4a
15
6
7
4b
5

Fig. 1

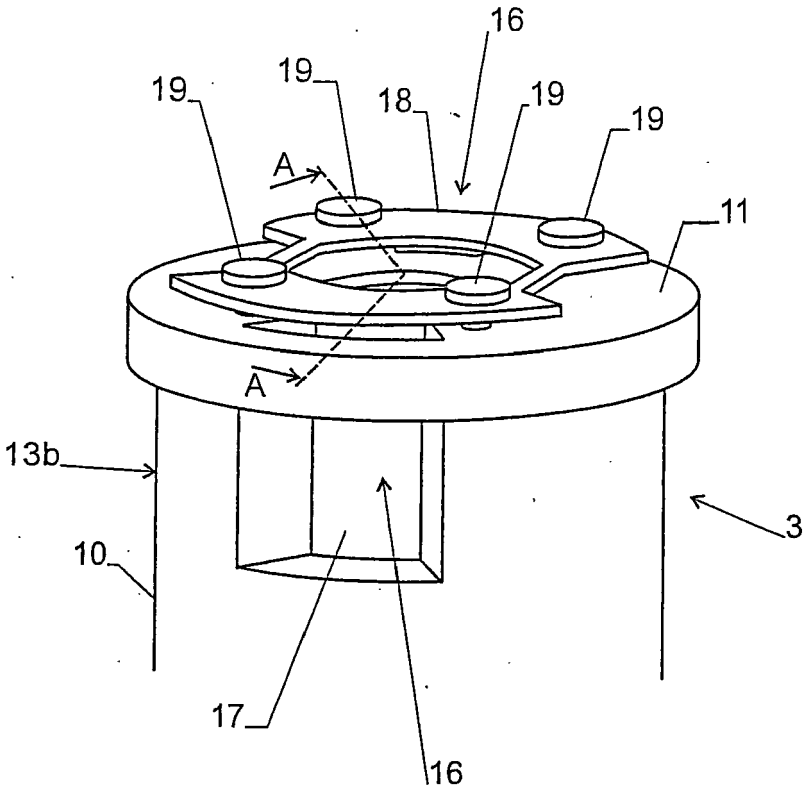


Fig. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 40 5498

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	EP 0 296 363 A2 (LICENTIA GMBH [DE]) 28 December 1988 (1988-12-28) * column 4, line 37 - column 5, line 41; figures 1,2,5,6 * -----	1-5,10, 12,13 6-9,11	INV. H01H33/90
Y	US 5 589 673 A (LEHMANN VOLKER [DE] ET AL) 31 December 1996 (1996-12-31) * column 2, lines 17-51; figure 2 * -----	6-9,11	
			TECHNICAL FIELDS SEARCHED (IPC) H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	18 April 2007	Findeli, Luc

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 06 40 5498

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.

18-04-2007

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0296363 A2	28-12-1988	DE 3720816 A1	05-01-1989
US 5589673 A	31-12-1996	CA 2133330 A1	01-10-1993
		DE 4211159 A1	07-10-1993
		WO 9320573 A1	14-10-1993
		DE 59302616 D1	20-06-1996
		EP 0634049 A1	18-01-1995

EPO FORM P0459

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