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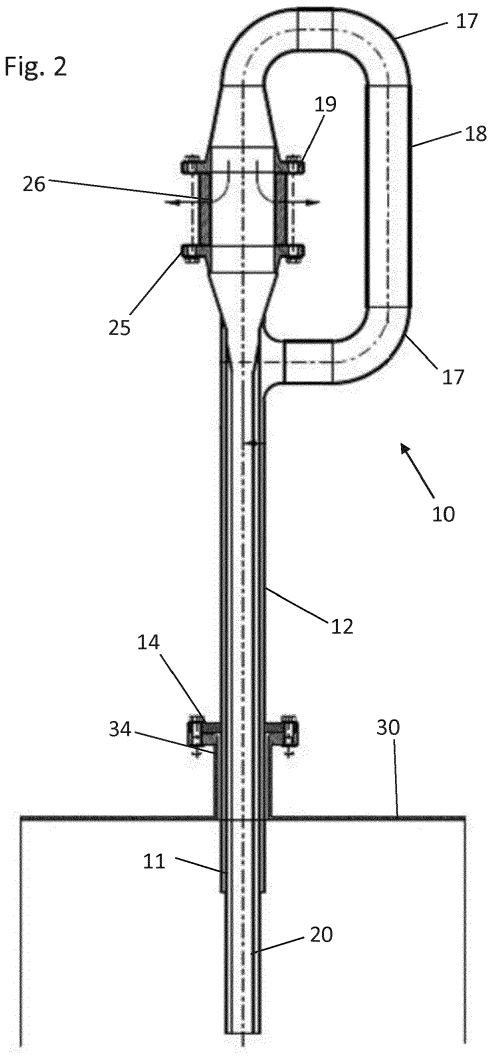
(54) **PRESSURE RELIEF VALVE, CONTAINER**

(57) The invention relates to a pressure relief valve for external floating roofs for containers storing liquids, comprising a down pipe for guiding liquid into the container and a riser pipe through which fluids can enter the pressure relief valve, wherein a deflection pipe that is connected to the riser pipe and the down pipe and guides fluids rising in the riser pipe to the down pipe, wherein the down pipe extends further downwards than the riser pipe, wherein the pressure relief valve further comprises a flame arrester device through which gas escapes into the environment.

Fig. 2



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Description

Field of Invention

[0001] The invention refers to a pressure relief valve and more particularly to a pressure relief valve for for external floating roofs for huge containers storing liquids.

Prior Art

[0002] External floating roofs are used in big containers for storing flammable liquids such as oil. Such floating roofs are moveably supported on the container so that they can move up and down corresponding to the amount of liquid that is stored within the container and they are sealed so that neither gas nor liquid can escape through the contact region of the floating roof and the container. The floating roofs are further supported by hollow legs, which are usually distributed along the outer circumferential portion of the floating roof. These external floating roofs are designed to retain vapor beneath the single skin of the centre deck. However, solar radiation heats the surface of the floating roof and the container causing the liquid beneath to boil and, thus, increasing the vapor beneath in the container. The diurnal effect of the sun (cold at night hot during the day) further increases the stresses on the welds of a floating roof which can lead to weld cracking. Moreover, the composition of the stored liquid also influences the production of the gas within the container. For instance, unsterilized crude oil or large quantities of butane in gasoline releases large quantities of vapor. Furthermore, the height above sea level of the tank farm also increases the effect of gas in such a container since the higher the elevation of the tank farm the less barometric pressure is available to contain the vapor in the stored liquid.

[0003] This gas causes the floating roof to balloon, i.e. the pressure of the gas bubble within the container pushes the floating roof upwards. Since the floating roof is heavier and supported at the outer edge, the gas bubble starts to grow in the centre of the roof, thereby pushing the centre upwards causing the roof to bend into a convex shape. Over time, the gas bubble increases and wanders outwards to the supporting legs. This phenomenon is called "ballooning". The first indication of ballooning is when an excess of vapor has built up on top of the stored liquid beneath the single skin of the centre deck, causing discoloration of the paint on the centre deck legs caused by vapor escaping from the leg pin holes. However, in more severe cases of ballooning, the gas bubble extends to the hollow supporting legs which are fixed to the floating roof and, therefore, are rising together with the roof. When the bottom end of such a hollow leg is lifted out of the liquid in the container, the gas will be pressed out through the leg into the environment, thereby relieving the pressure within the tank. That causes the floating roof and the hollow supporting leg to fall back down onto the liquid in the container and liquid will be pressed through the hollow leg out and will splash onto the outside of the container and the floating roof. One serious consequence is that liquid thrown onto the roof can enter the roof drain system.

Summary of the Invention

[0004] Object of the invention is to provide a floating roof that is resistant to ballooning and, thus, can reliably avoid splashing liquid onto the container. The object is solved by a pressure relief valve according to independent claim 1. Further preferred embodiments are depicted in the dependent claims.

[0005] According to the invention, pressure relief valve for external floating roofs for containers storing liquids, comprising a down pipe for guiding liquid into the container, a riser pipe, preferably arranged adjacent to the down pipe, through which fluids can enter the pressure relief valve and a deflection pipe that is connected to the riser pipe and the down pipe and guides fluids rising in the riser pipe to the down pipe, wherein the down pipe extends further downwards than the riser pipe, wherein the pressure relief valve further comprises a flame arrester device through which gas escapes into the environment. By this construction, the gas in the container will escape earlier when the down pipe is still within the liquid, thus weakening the falling force of the floating roof when the pressure is relieved. Additionally, since the flow of the fluids (gas and oil) will travel through the riser pipe and come down via the down pipe, the deflection pipe slows down the fluids and decrease the pressure of the fluids flowing through the pressure relief valve. And finally, the flame arrester device avoids the occurrence of a flame backlash when gas released by the pressure relief valve into the environment catches fire somehow.

[0006] The flame arrester device is preferably formed as a cage with a porous filler material or is formed as a sieve. Furthermore, the pores of the flame arrester device preferably have a size of at least 1mm, more preferable 1.5mm or 2mm and have a size of at most 5mm, more preferable 3mm, 2.5mm or 2mm. With such a construction, ignited gas on the outside of the flame arrester device will not be able to enter the pressure relief valve.

[0007] In one embodiment, the flame arrester device comprises a flange. This is a simple way of fixing the flame arrester device reliably on the pressure relief valve while simultaneously enabling a very easy mounting and de-mounting operation. Another easy to use fixation of the flame arrester device is by clamping it by means of a flange of the deflection pipe and the down pipe. In this way, the flame arrester device is simply clamped between the deflection pipe and the down pipe and can be constructed very simple.

[0008] Preferably, the flame arrester device is arranged between the deflection pipe and the down pipe. It can also be part of the deflection pipe or the down pipe, but the ideal spot for the gas release is at the end of the deflection pipe, when the fluids are slowed down and

start entering the down pipe.

[0009] Preferably, the down pipe comprises a tapered portion, in particular at its uppermost portion, where the fluids are entering the down pipe. This eases the introduction of the fluids into the down pipe.

[0010] In one embodiment, the riser pipe encloses the downpipe, so that between the down pipe and the riser pipe is a circumferential gap. This provides a compact and tight construction for saving space. Furthermore, it is easy to adjust the gap size of the riser pipe by choosing different thicknesses for the down pipe. This can also be done by using a further separation pipe between the riser pipe and the down pipe, in particular one that is connected to the down pipe.

[0011] One use of the invention is a container for storing flammable liquids that comprising a floating roof having one or more gas relief valves according to one or more of the preceding claims. These gas relief valves are preferably provided in a centre region of the floating roof. Since the gas bubble will travel towards the centre, this is the ideal place for the valve to be placed.

Brief Description of the Figures

[0012]

Fig. 1 shows a floating roof in the top of a container;

Fig. 2 shows a pressure relief valve according to the invention;

Fig. 3a shows a flame arrester device in a axial section; and

Fig. 3b shows the flame arrester device of Fig. 3a in a cross section.

Preferred embodiments of the Invention

[0013] In the following, the terms "up", "down", "left" and "right" are used in relation to Figure 2 if not otherwise mentioned. Furthermore, the terms "axially", "radially" and "circumferentially" refer to the respective pipe it is used for. "Axially" is a direction along the pipe, "radially" a direction perpendicular to it and "circumferentially" is around the pipe.

[0014] Figure 1 shows a floating roof 30 supported on the top of a container 40 storing liquid 42. Several supporting legs 32 are distributed around the circumferential edge portion of the floating roof 30. These supporting legs 32 serve to support the roof when the liquid level in the container 40 is low. Then they are standing on the bottom of the container 40 and carry the weight of the floating roof 30. The supporting legs 32 are usually built hollow. A pressure relief valve is arranged in the centre of the floating roof 30 where the gas 44 will gather at first. Generally, the valve can be provided anywhere in the floating roof, possibly even in the container 40 itself if there is a suitable place, but the best location is in the centre portion of the floating roof 30.

[0015] The pressure relief valve 10 is shown in Figure 2. Basically, the valve 10 comprises a, a riser pipe 12 deflection pipe 18, a down pipe 20 and a flame arrester device 26. The floating roof is merely shown schematically in Figure 2. The riser pipe 12 extends a shorter way into the container 40 than the down pipe. In this way, since the gas bubble 44 generated in the container 40 is always floating on top of the liquid 42, it will automatically escape through the riser pipe 12 and never through the down pipe 20. The down pipe 20 and the riser pipe 12 can be arranged in any way on the floating roof 30. However, when the riser pipe and the down pipe are not arranged adjacent to each other, the length of the two pipes must be adjusted accordingly so that the gas always enters the riser pipe 12 first. The main condition is that the riser pipe is provided in a way that the gas in the tank will preferably they are arranged at least adjacent to each other. The most preferred arrangement is shown in Figure 2, in which the riser pipe 12 is encompassing the down pipe 20 coaxially.

[0016] The riser pipe 12 and the down pipe 20 are connected via a deflection pipe 18. The deflection pipes 18 main purpose is to slow down the speed with which the fluids (gas and liquid) that are flowing through the pressure relief valve 10. When the fluids are slowed down, the gas can escape via a flame arrester device 26 and the liquid enters the down pipe 20 and flows back into the container 40.

[0017] The flame arrester device 26 is shown in Figures 3a and 3b. In the present embodiment, it is a mere sleeve in which the circumferential wall can be formed as a mesh or a sieve. Other embodiments of such a flame arrester device can be a cage that is filled with metal chips or other material that leaves small holes within the circumferential wall of the flame arrester device 26. The pores in the flame arrester device 26 preferably have a size of at least 1mm, more preferable 1.5mm or 2mm and have a size of at most 5mm, more preferable 3mm, 2.5mm or 2mm. The wall of the flame arrester device has a thickness between 20 and 30 mm.

[0018] In Figure 2, the flame arrester device 26 is located between the end of the deflection pipe 18 and the beginning of the down pipe 20. The flame arrester device can be fixed by welding, but the preferred means of fixing it via a flange. The flange can be part of the flame arrester device 26 itself and it is then screwed onto the end flange 19 of the deflection device 18 and the upper flange 25 of the down pipe 20. In a simpler version, the end flange 19 and the upper flange 25 are screwed together and fix the flame arrester device 26 by pressure. Furthermore, at least one of the end flange 19 and the upper flange 25 can have a stopper in form of a step that is formed in at least a part of its circumference so that the flame arrester device is secured against a radial displacement.

[0019] The specific embodiment of Figure 2 is now described in more detail. The riser pipe 12 is fixed to the

floating roof via a flange 14 and the roof flange 34. The riser pipe 12 is encompassing the down pipe 20 which is placed in particular coaxially within the riser pipe. A tapered portion 28 is formed on the top portion of the down pipe 20 to ease the flow of the liquid into the down pipe 20. The down pipe 20 can be formed thicker, for example 5 mm - 15mm to tighten the gap between the riser pipe and the down pipe. Another way to reduce the area through which the fluids can escape through the riser pipe is an additional middle pipe 16 that can be welded or otherwise being fixed to the top part of the down pipe 20, in particular to the tapered portion 28. The fixing is not carried out gapless, so that gas and/or liquid caught in between the down pipe and the middle pipe can escape.

[0020] The deflection pipe 18 comprises several bent portions 17 by which the fluid in the riser pipe 18 is slowed down since it loses energy by being deflected on the pipe walls. Here, there are three bent portions 17 with a deflection angle of about 90° degree. The first deflection is carried out by guiding the fluids into the deflection pipe that is arranged in a radial direction of the riser pipe 12. The deflection pipe 18 can simply be plugged onto a respective pipe extension 15 of the riser pipe, but can also be welded to or screwed onto the riser pipe.

[0021] In action, the pressure relief valve is fixed in the centre portion of the floating roof 30. The riser pipe 12 and the down pipe 20 are extending into the liquid 42. Then, the gas appears and starts to build a gas bubble until the bottom end 11 of the riser pipe 12 is raised into the gas bubble. The gas will suddenly escape through the riser pipe 12 and the floating roof will relax and fall down onto the liquid 42, thereby pressing also liquid into the riser pipe 12. The fluid (gas and liquid) will be pushed upwards through the riser pipe 12 and will be deflected into the deflection pipe 18. By repeated reflection in the bent portions 17, the fluid slows down and eventually enters the flame arrester device. Since the speed of the gas and the liquid is now low enough, the gas will escape through the pores of the flame arrester device 26, while the liquid is too heavy, falls down into the tapered portion of the down pipe 20 and is guided back into the container 40. In this way, none of the liquid pressed into the pressure relief valve can escape the container 40 and pollute the floating roof 30 on the outside.

Reference signs

[0022]

pressure relief valve 10
riser pipe bottom end 11
riser pipe 12
flange 14
pipe extension 15
middle pipe 16
deflection pipe 18
bent portions 17
flange 19
down pipe 20
upper flange 25
flame arrester device 26
tapered portion 28
floating roof 30
supporting legs 32
roof flange 34
container 40
liquid 42
gas 44

Claims

1. A pressure relief valve (10) for external floating roofs (30) for containers storing liquids, comprising
a down pipe (20) for guiding liquid into the container; and
a riser pipe (12) through which fluids can enter the pressure relief valve;
characterized in that
a deflection pipe (18) that is connected to the riser pipe (12) and the down pipe (20) and guides fluids rising in the riser pipe (12) to the down pipe (20), wherein the down pipe (20) extends further downwards than the riser pipe (12), wherein the pressure relief valve further comprises a flame arrester device (26) through which gas escapes into the environment.

2. A pressure relief valve (10) according to claim 1, wherein the flame arrester device (26) is formed as a cage with a porous filler material or is formed as a sieve.

3. A pressure relief valve (10) according to one or more of the preceding claims, wherein the flame arrester device (26) comprises a flange.

4. A pressure relief valve (10) according to one or more of the preceding claims, wherein the flame arrester device (26) is arranged between the deflection pipe (18) and the down pipe (20).

5. A pressure relief valve (10) according to one or more of the preceding claims, wherein the flame arrester is clamped by means of a flange (19) of the deflection pipe (18) and the down pipe (20).

6. A pressure relief valve (10) according to one or more of the preceding claims, wherein the down pipe (20) comprises a tapered portion.

7. A pressure relief valve (10) according to one or more of the preceding claims, wherein the pores of the flame arrester device (26) have a size of at least 1mm.

8. A pressure relief valve (10) according to one or more of the preceding claims, wherein the riser pipe (12) encloses the downpipe, so that between the down pipe (20) and the riser pipe (12) is a circumferential gap.

9. A pressure relief valve (10) according to claim 8, wherein between the riser pipe (12) and the down pipe (20) is provided a further separation pipe, in particular connected to the down pipe (20).

10. A container (40) for storing flammable liquids, comprising a floating roof (30) having one or more pressure relief valves (10) according to one or more of the preceding claims.

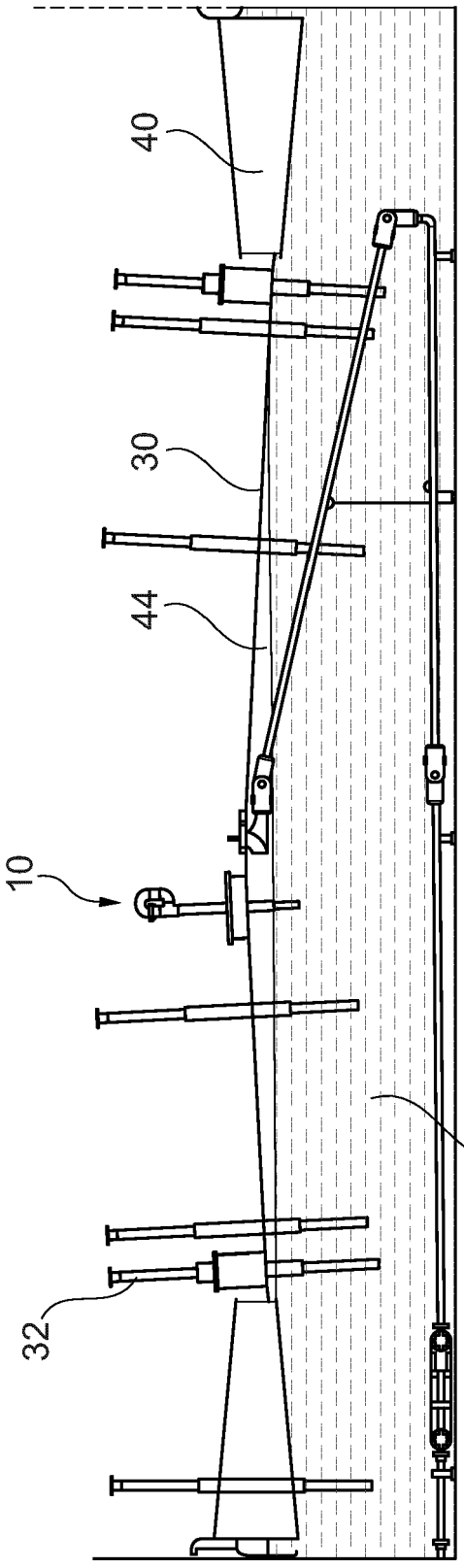

Fig. 1

Fig. 2

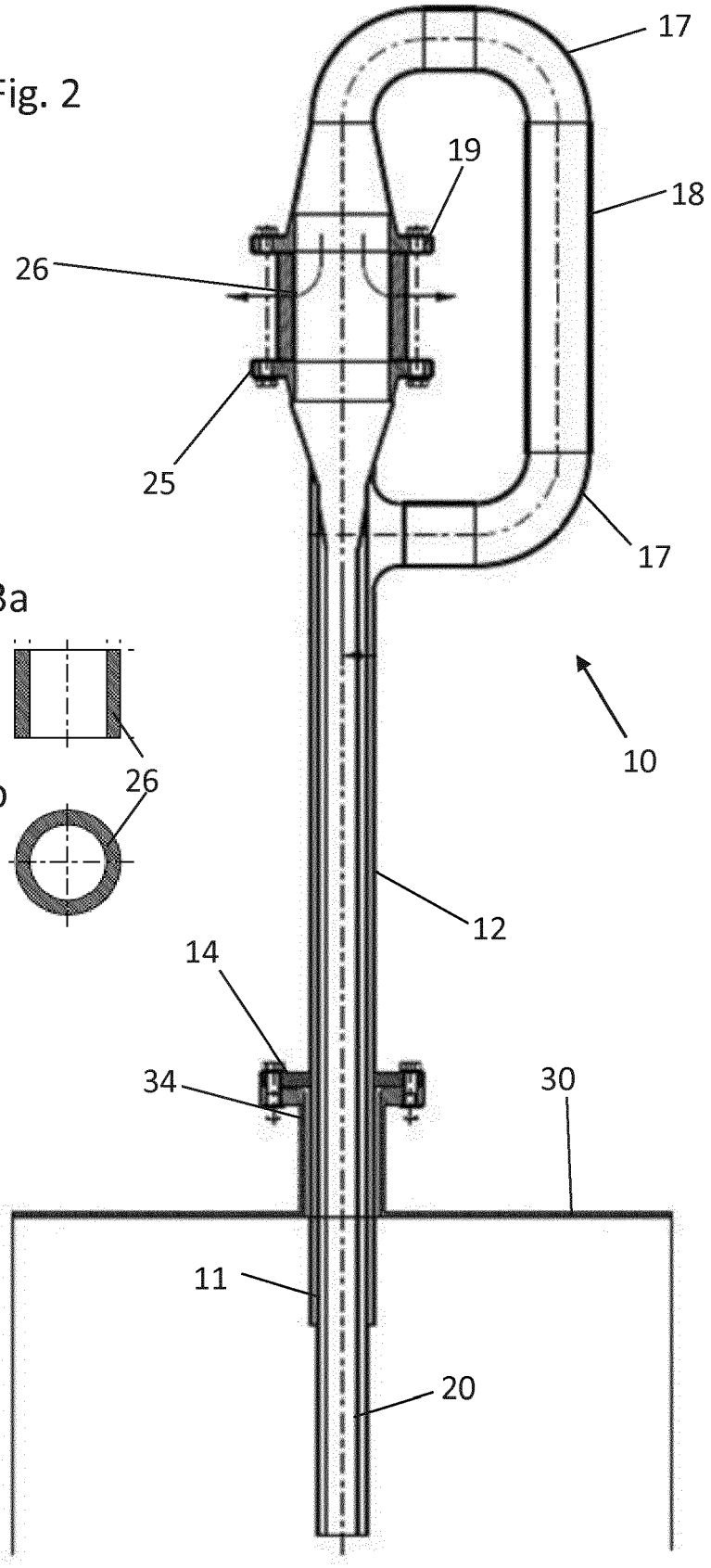

Fig. 3a

Fig. 3b

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EUROPEAN SEARCH REPORT

Application Number
EP 19 16 6873

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	US 1 904 339 A (WIGGINS JOHN H) 18 April 1933 (1933-04-18) * page 2, line 46 - page 3, line 57; figures 1,2 *	1-10	INV. B65D88/34 B65D90/34
A	US 3 120 902 A (SOUTHWORTH ALFRED M ET AL) 11 February 1964 (1964-02-11) * column 2, line 32 - column 6, line 35; figures 1-12 *	1-10	
A	GB 878 158 A (BRITISH PETROLEUM CO; GEORGE BRUCE MARRIOTT ET AL.) 27 September 1961 (1961-09-27) * page 6, line 6 - page 8, line 55; figures 1-8 *	1-10	
A	US 2 461 537 A (FELLD ALEXANDER S) 15 February 1949 (1949-02-15) * column 2, line 35 - column 8, line 58; figures 1-4 *	1-10	
			TECHNICAL FIELDS SEARCHED (IPC) B65D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 May 2019	Lämmel, Gunnar

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 19 16 6873

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
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28-05-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 1904339 A	18-04-1933	NONE	
US 3120902 A	11-02-1964	NONE	
GB 878158 A	27-09-1961	NONE	
US 2461537 A	15-02-1949	NONE	

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