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A device for monitoring leaks from metal-clad high
tension equipment

DESCRIPTION

5 The invention relates to a device for monitoring leaks
from high-tension metal-clad electrical gear under
dielectric gas pressure.

Metal-clad electrical gear which is insulated by
gas such as sulfur hexafluoride under pressure must remain
very well sealed for periods of months or even years
10 without being topped up with gas. For example, from French
published patent specification No. 992 862 it is known to
place two sealing rings in series on the leak path, and to
provide the flange with a hole which opens out firstly to
the outside and secondly to the zone situated between the
15 two sealing rings. Further, it is also known to monitor
effective sealing of the sealing ring which is located
further in by measuring leaks into the volume situated
between the two sealing rings by measuring traces of gas
leaving via said hole. The outwardly-directed orifice is
20 normally closed in a sealed manner by a bolt which
compresses a sealing ring.

As can be seen in accompanying Figure 1, which is
a section through assembled flanges with an insulator
interposed between the flanges together with a prior art
25 device for monitoring leaks from high-tension metal-clad
gear, these holes may be closed by a screw 12 and a
sealing ring 13, but this requires the hole to be tapped
which is an expensive operation in foundry work. It
would thus be desirable to be able to close this hole
30 without machining it, i.e. without tapping it.

French published patent specification No. 1 370 643
describes a device suitable for closing a smooth hole in
a sealed manner. The device comprises two parts, namely
a hollow stopper and a conical peg. The peg is coaxially
35 inserted inside the stopper after the stopper has been
placed in the hole. When the peg is pushed home, the
stopper expands and develops a radial force for holding

the stopper in place. Special tools are used to extract the device, which tools cooperate with inside threads on the peg and on the stopper.

The aim of the invention is to provide a device for
5 monitoring leaks between flanges for assembling the shells of electrical gear under a metal envelope which is filled with compressed gas, by means of two sealing rings disposed concentrically in series on the assembly faces of the shells, the internal volume lying between the two sealing
10 rings being in communication with the outside via a hole capable of being closed by a stopper, characterized by the fact that, said hole being smooth, the stopper comprises a screw which is threaded only at its end, a nut, and a tubular resilient sealing member, which member is
15 capable of being compressed between the screw and the nut and thereby close the hole. Reference is made to the subclaims for advantageous modes of implementing the invention.

The invention is described below in greater detail
20 by means of several embodiments, and with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic view in section through a portion of assembled flanges including a prior art monitoring device;

25 Figure 2 is a diagrammatic section view through a portion of assembled flanges including a monitoring device in accordance with the invention;

Figure 3 is a diagrammatic section view through a portion of assembled flanges including a variant embodiment of the monitoring device in accordance with the in-
30 vention;

Figure 4 is a variant embodiment on Figure 3 in which a notched resilient sealing member is used;

Figure 5 is a perspective view of the notched
35 sealing member shown in Figure 4.

Figure 6 is a variant of the Figure 3 device in which the smooth hole is provided with a notch;

Figure 7 is a front view of the notched hole of Figure 6;

Figure 8 is a section through a tool for detecting which of the sealing rings is leaking; and

5 Figure 9 is a perspective view of a component part of the Figure 8 tool.

The prior art assembly shown in Figure 1 comprises shells 1 and 3 each having a corresponding fixing flange 2 and 4. A disk or cone-shaped insulator 5 is inter-
10 posed between the two flanges 2 and 4 which are assembled by means of bolts (not shown) passing through bores through their peripheries. The insulator 5 itself constitutes an intermediate shell between the flanges of the shells 1 and 3. The flanges 2 and 4 are sealed by two O-rings 6, 7 and
15 8, 9 which are placed concentrically in series between the inside and the outside of the shells and which are received in grooves 26, 27 and 28, 29 provided in the assembly faces of the flanges 2 and 4. The two grooves such as 26 and 27 on the same flange are in communication with each
20 other thereby creating a volume such as 10 between the inner sealing ring 6 and the outer sealing ring 7.

In order to monitor possible leakage past the sealing ring 6 which would cause the pressure to rise in the volume 10, use is made of a radial hole 11 through the
25 flange 2 having a substantially perpendicular leak-receiving hole 30 opening out therein and putting the volume 10 into communication with the outside. In normal service, the hole 11 is closed in sealed manner by a sealing washer 13 located under the head of a screw 12 which is screwed into
30 tapping in the hole 11.

In order to monitor sealing, the screw 11 is unscrewed. Whistling then indicates a leak of gas from the volume 10 and thus past the sealing ring 6; the operation is repeated by unscrewing the other screw.

35 In Figure 2, which corresponds to a device in accordance with the invention, the screw 12 and the sealing washer 13

a of Figure 1 have been replaced by a self-anchoring type of stopper 15 which does not require the hole 11 to be tapped. The stopper 15 is constituted by a screw 16, a sealing washer 17, a tubular resilient seal 18 and a nut 19. The screw 16 which has a head of some kind has a threaded portion only at its end, whereas the portion of the screw close to the head is smooth in order to provide sealing with the tubular seal 18 through which it is engaged. The tubular seal 18 has an outside diameter which is slightly less than the inside diameter of hole 11 and is compressed between the washer 17 and the nut 19.

In order to close the hole 11, and thus the volume 10 situated between the two sealing rings 6 and 7, the stopper assembly 15 is inserted into the hole 11 and the screw 16 is then tightened. The sealing member 18 which may be made of rubber for example and which is compressed between the nut 19 and the washer 17 then provides sealing.

Rotation of the nut 19 may be avoided by glueing it to the seal member 18, for example. Tightening the nut 19 provides sufficient friction between the sealing member 18 and the wall of the hole to keep the assembly in place even if a major leak sets up a pressure of several bars behind the nut 19.

In order to monitor sealing, the screw 16 is unscrewed. A whistling sound while unscrewing then indicates that there is a leak of gas from the volume 10 and thus past the sealing ring 6. In comparison with the prior art, such a device no longer requires tapping to be performed in a bulky flange.

The variant embodiment of Figure 3 makes use of the conventional presence of an insulator 5 interposed between the flanges.

The flanges 13 no longer include the grooves shown in Figures 1 and 2. However, since the insulator 5 is made of moulded synthetic material, arrangements are made to enable the grooves 20, 21, 22 and 23 together with the volume 10 and 10' to be directly obtained from the moulding operation. A metal core having a slight taper makes it

possible to obtain a radial hole 24 likewise directly from the moulding. All that is then required is to drill two small-diameter holes 25 and 25' which meet the radial hole 24 perpendicularly in order to put the volumes 10 and 10' into communication with the hole 24. A stopper 15 analogous to that described with reference to Figure 2 serves to close the hole 24.

In this embodiment, there is no need to machine radial holes in the flanges. These holes are replaced by a single radial hole together with grooves which are obtained as part of the insulator casting, so that machining is limited to the leak-receiving holes 25 and 25'.

If there is a major leak past a defective sealing ring, the pressure behind the nut 19 may rise to several bars, and there is a risk of the stopper being violently expelled from its orifice while the screw is being loosened, which could be dangerous for the operator.

In order to avoid this danger, a leak is created in order to reduce the pressure before completely removing the resilient sealing member.

To this end, the tubular resilient sealing member has a notch 31 extending along a portion of its length (see Figures 4 and 5).

In a variant, the smooth hole has a notch 32 close to its end opening out to the outside (see Figures 6 and 7).

The embodiment shown in Figure 4 is identical to that shown in Figure 3 except that the sealing member 18 includes a notch 31 at its end which is in contact with the nut 19.

By way of example, if the sealing member is 10 to 15 mm long, the notch should be about 5 mm long. More generally, the length of the notch should lie between one-half and one-third of the length of the sealing member before compression. When the screw 16 is tightened the sealing member is compressed and the notch is closed. As the screw 16 is loosened, the notch starts to open with its lips

(16)

moving apart and the pressure behind the stopper 15 presses thereagainst. However, after the stopper has moved axially, the sharp end of the notch leaves the hole 24 and the gas can escape, thereby reducing the pressure before the stopper has left the hole, which stopper is thus not expelled outwardly.

The sealing member which is shown in perspective in Figure 5, may be obtained by moulding, and the notch is conical or pyramidal in shape in order to facilitate compression of the sealing member without excessive stress, the pyramid having only two faces.

More precisely, the notch results from the intersection of the cylindrical sealing member with a cone or a pyramid whose axis lies outside the cylindrical section of the sealing member.

The same result is obtained with the variant shown in Figures 6 and 7: the sealing member 18 is cylindrical and a notch 32 is cut in the outer end of the hole 24. When the screw 16 is tightened, the sealing member is compressed and deforms to partially or completely occupy the notch 32. When the screw 16 is loosened, friction between the sealing member and the walls is insufficient to retain the pressure; the stopper leaves its housing, but when the bottom of the sealing member reaches the inside end of the notch 32 the gas escapes via the notch while a portion of the sealing member is still pressed against the walls 24, and thus the stopper is not ejected from the orifice.

The notch, whose length lies between one-half and one-third of the length of the sealing member prior to compression may be obtained by milling or drilling obliquely relative to the assembly plane; the edges of the notch are rounded to avoid tearing the sealing member; a conical cutter may be used having a small apex angle with the axis of the cutter lying inside the cross-section of the hole 24, thereby leading to an obtuse angle with its intersection with the hole 24.

The device described above in several embodiments

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may be used during assembly at a factory or on site to monitor sealing cheaply, or to detect the presence of a leak; to do this, the screw 16 is tightened fully, and then loosened by a few turns in order to ensure sealing while reducing friction between the sealing member 18 and the walls. If there is a leak, the pressure rises inside the hole 24 and pushes out the stopper 15 until the hole 24 communicates with the atmosphere, so that a projecting stopper marks the presence of a leak. No special tooling is required such as a water manometer in order to detect leaks.

Naturally, the invention is applicable to the case where the grooves receiving the sealing rings 6, 7, 8, and 9 are made in the flanges 2 and 3 as described with reference to the Figure 2 embodiment rather than in the insulator 5.

If a single stopper device is used for detecting leaks past the sealing rings 6 or 8, the exit of a stopper marks the presence of a leak, but in order to avoid disassembling the shells 2 and 4, a special tool may be used to determine the origin of the leak. Figure 8, which is similar to Figures 4 or 6 on a larger scale, shows this tool in place in the hole 24.

The tool comprises a tube 35 having a rectilinear portion 36 and a rounded portion 37. At the end of the rectilinear portion 36 and adjacent to the rounded portion 37 there is a hollow screw which is fixed by brazing, for example, and which has a thread directed towards the portion 36 and a head having flats or knurling.

At the open end of the portion 36 a cylindrical sleeve 38 (see Figure 9) is applied and held in place by a pin 40. The cylindrical sleeve 38 has a sloping face 44 and a flat 45 on the opposite side to the sloping face. The slope is at an angle of about 40° with the axis of the tube. A channel 46 puts the flange 45 into communication with the inside of the tube 35.

In the Figure, the sleeve is positioned so that the

flat looks towards the hole 25 and the sloping face towards the hole 25'.

A flexible tubular rubber seal 39, whose inside diameter is very slightly less than the outside diameter of the tube 35 and whose outside diameter is slightly less than the diameter of the hole 24 has a sloping face identical to the sloping face of the sleeve and is fitted round the tube so as to be adjacent to the sleeve.

Finally, a tube 41 slides freely over the tube 36 and is rotated by a knurled nut 42 in order to compress the seal when screwed onto the hollow screw 43. It serves to compress the seal 39.

The flat portion 45 of the sleeve 38 faces in the direction pointed to by the bend 37 in the tube 35, thus making it easy to determine the position of the flat in hole 24, and thus whether the seal 39 is engaging the hole 25 or 25'.

Once a leak has been detected by the stopper 15 leaving the hole, which leak could be past the seal between 2 and 5 and/or past the seal between 4 and 5, the origin of the leak must be looked for. In order to do this, the stopper 15 is completely removed from the hole and the rectilinear portion of the above-described tool is inserted in the empty hole, with the knurled nut 42 being screwed to free the seal 39. The tool is held in abutment against the bottom of the hole 24 and the bent portion 37 is directed towards the shell whose sealing is to be checked. Loosening the nut 42 moves the tube 41 from right to left thereby compressing the seal 39 which closes the hole 25' and seals it relative to the outside so that the only gas capable of passing along the tube 35 from the free space left by the flat 45 must come from the hole 25. The output 37 is then connected to a water manometer (not shown) to monitor whether the leak is past the seal 6.

The nut 42 is then rotated to free the seal which returns to its original place, and the tool is free to

turn through 180°. The tube 37 is pointed towards the shell 4, and the seal 39 is compressed to close the hole 25 and seal it relative to the outside while putting the hole 25' into communication with the water manometer, 5 thereby monitoring whether the leak is past the seal 8 between 4 and 5.

This tool is used solely for determining the origin of the leak.

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CLAIMS

- 1/ A device for monitoring leaks between the assembly flanges of the shells of electrical gear under metal cladding filled with compressed gas, by means of two
5 sealing rings disposed concentrically in series on the assembly faces of the shells, the inside volume (10) lying between the two sealing rings (6, 7) being in communication with the outside via a hole capable of being closed by a stopper, the device being characterized by the
10 fact that, said hole being smooth, the stopper comprises a screw (16) which is threaded only at its end, a nut (19), and a tubular resilient sealing member (18) capable of being compressed between the screw and the nut, thereby closing the hole.
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- 2/ A device according to claim 1, characterized in that the smooth hole (11) is provided through the periphery of one of the flanges (2).
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- 3/ A device according to claim 1, including an insulator (5) interposed between the flanges (2, 4), the device being characterized in that a smooth hole (24) is provided in the periphery of the insulator to provide communication between
25 the outside and the internal volumes (10 and 10') extending between the seals of the faces by which the flanges are assembled to the insulator.
- 4/ A device according to claim 3, characterized in that the
30 smooth hole (24) of the insulator (5) is obtained by means of a moulding core being present when the insulator is cast.
- 5/ A device according to claim 3 or 4, characterized in that the sealing rings (6, 7, 8, 9) of the assembly
35 faces are disposed in grooves (20, 21, 22, 23) provided in the insulator (5).
- 6/ A leak monitoring device according to claim 1,



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characterized by the fact that at least one of the items from the group constituted by the smooth hole (11, 24) and the resilient sealing member (18) includes a notch (31, 32) for creating a leak when the screw (16) is unscrewed.

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7/ A device according to claim 6, characterized by the fact that the notch (31) is provided in the member (18) at its end adjacent to the inside volume (10).

10 8/ A device according to claim 7, characterized by the fact that the notch (31) has the shape of a portion of a cone.

9/ A device according to claim 7, characterized by the fact that the notch (31) has the shape of a portion of a

15 pyramid.

10/ A device according to claim 7, characterized by the fact that the notch (31) of the sealing member (18) has a length lying between one-third and one-half of the length of the sealing member (18) prior to compression.

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11/ A device according to claim 6, characterized by the fact that the notch (32) is made in the end of the hole (24) situated adjacent to the outside of the metal cladding.

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12/ A device according to claim 11, characterized by the fact that the notch (32) is obtained by milling using a cylindrical cutter at an angle, with the edges between the notch and the hole being smoothed over.

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13/ A device according to claim 11, characterized by the fact that the notch (32) is obtained by milling using a conical cutter.

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14/ A device according to claim 11, characterized by the fact that the notch has a length lying between one-half and one-third of the length of the sealing member (18)



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prior to compression thereof.

15/ A leak monitoring device according to claim 3, enabling the origin of a leak to be determined, characterized by the
5 fact that it includes a device (35) for putting a selected one of the holes (10, 10') in communication with a pressure measuring apparatus, the device (35) including means (39, 42) for closing the other channel.

10 16/ A device according to claim 15, characterized by the fact that the measuring apparatus communicates with the said volume via a tube (35), said closure means comprising a resilient tubular seal (39) placed over the tube and associated with a seal compression member (42).

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17/ A device according to claim 16, characterized by the fact that the seal (39) has a sloping end face which is pressed against a face of a sleeve (38) placed over the tube (35) and having a corresponding slope.

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18/ A device according to claim 16, characterized by the fact that the sleeve (38) has a flat (45) provided with a channel (46) for communication with the inside of the (35).

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