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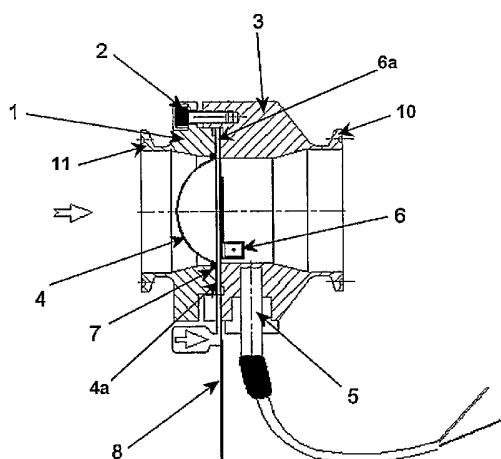
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(54) Title: BURSTING DISC DEVICE



(57) Abstract: A bursting disc type over-pressure detector for hygienic and aseptic application has a bursting disc (4) clamped at its flange (4a) between inlet and outlet pipe members (1, 3) with an O-ring seal (7) at the inlet side. At the vent side a magnet (6) is mounted, and its movement is sensed by a non-invasive sensor (5). The device is compact, avoids crevices and leak paths, and isolates the sensor (5) from the flow passage.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

BURSTING DISC DEVICE

FIELD OF THE INVENTION

5 This invention relates to an over-pressure detector in the form of a bursting disc device, and more particularly to such a device for use under the aseptic or hygienic conditions required for certain applications of bursting discs.

BACKGROUND OF THE INVENTION

10 Current practice for aseptic or hygienic applications is to utilise a bursting disc 11 as shown in Fig. 1 fitted directly between hygienic ferrules 12, 13 with gaskets to obtain a pressure seal in conjunction with a peripheral clamp. A detection device 14 is installed downstream at another pipe
15 joint 15, 16 and is typically a membrane type with a printed circuit having a cable connector 17, passing a small current to give a normally closed circuit. On disc rupture, the flow of the released process medium breaks the circuit on the downstream membrane giving an open circuit signal.

20 In both cases, an intermediate piece of pipe work is required to act as a spacer between the bursting disc and the detection device. This intermediate pipe work increases the volume of the combined installation and introduces potential new leak paths and crevices which reduce the suitability for
25 hygienic application.

Also, a section of the electrical circuit of the detector is exposed within the process pipe work on rupture which can give rise to electrical hazards. Additionally, the membrane has to be manufactured from a thin material to ensure that it
30 bursts when pressurised by the process fluid, making it prone to damage in normal use. Typically false alarm signals are generated requiring maintenance attention and increasing management time and costs associated with this system. The membrane is not reusable.

35

SUMMARY OF THE INVENTION

The present invention seeks to overcome these problems and provides, especially for aseptic or hygienic applications, e.g. food, beverage or pharmaceutical production, a bursting disc system not only of hygienic design, but also
5 incorporating a holder, bursting disc and a detection system, which is robust and non-invasive, in a single unit.

The present invention provides an over-pressure detector comprising a bursting disc having a bursting region and a
10 flange extending from the periphery of the bursting region;
an inlet pipe member and an outlet pipe member, rigidly fixed together and clamping the flange between them, the pipes forming a passage across which the disc spans;
a magnet disposed in the channel, adjacent to the
15 bursting disc and on the outlet side of the bursting disc; and
a sensor outside said passage for sensing displacement of said magnet;
wherein rupturing of said bursting disc displaces the
magnet.

20 In this detector the magnet is adjacent the disc and the sensor is outside the passage, minimising space occupied by the device, and enabling elimination of interspace pipe work, thereby simplifying construction and avoiding electrical risks associated with the sensor. The number of pipe components may
25 be reduced. The magnet and sensor may be re-usable.

Preferably there is a sealing member at the inner face of the inlet pipe member sealing between the bursting disc and the inlet pipe member. This avoids a crevice and possible
leak path.

30 Preferably the magnet is mounted on a member fixed to the disc and/or also clamped between the inlet and outlet pipe members, which provides simplification of construction.

In one alternative the inlet and outlet pipe members are fixed together by welding; while this reduces re-usability, it
35 increases leak-tightness.

The invention also provides an apparatus, such as a production plant, e.g. food, beverage or pharmaceutical production plant, having an aseptic or sterile interior space and an over-pressure detector of the invention connected to the space and sterilised. The invention also provides a method of installing the detector wherein the interior is sterilised after installation.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will now be described by way of non-limitative example, with reference to the drawings, in which:

Fig. 1 is a sectional view of a known bursting disc device described above.

Fig. 2 is a sectional view of a first bursting disc device embodying the invention.

Fig. 3 is a sectional view of a second bursting disc device embodying the invention.

Fig. 4 is an enlarged sectional view of a portion of the devices of Figs. 2 and 3.

Fig. 5 is a perspective view of a portion of the magnet holder and magnet of the devices of Figs. 2 and 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figs. 2, 4 and 5 show a compact over-pressure detector of the invention, having inlet and outlet pipe elements 1, 3 fixed together by bolts 2. Clamped between them is a flange 4a of a domed bursting disc 4 of conventional design. Such bursting discs are well known, and need not be described in detail here. Clamped between the members 1, 3 alongside the disc 4 is a flat ring 6a having a cross-member 6b extending across the flow passage and carrying a magnet 6 which is thus held close to the vent (downstream) side of the disc 4.

Located just downstream of the disc 4 in the wall of the pipe member 3 is a sensor 5 for displacement of the magnet 6, in the form for example of a reed switch operated by the

magnetic field of the magnet on movement of the magnet 6 caused by operation (rupture) of the disc 4. Normally the switch 5 is open circuit, being closed by the close proximity of the magnet. The recess in the pipe member 3 containing the switch 5 is closed from the interior of the pipe member 3.

To provide sealing at the interior face of the inlet member 1, i.e. at the surface of the passage, an O-ring 7 is held in a rebate of the member 1 and seals against the flange 4a of the disc. The disc has a conventional identification tag 8.

Fig. 4 shows the clamped portions of the disc 4 and the support ring 6a in more detail. The disc 4 and the ring 6a, with the tag 8, may be joined together, to be installed and removed as a single unit.

Fig. 5 shows a portion of the ring 6a, carrying the magnet 6 on the cross-member 6b. The magnet 6 is attached through a welded strip 6c. At the junction between the cross-member 6b and the annular portion of the ring 6a, there is a thin frangible element 6d, which breaks to ensure movement of the magnet when the disc 4 operates. The tag 8 is welded to the ring 6a.

The embodiment of Fig. 3 is generally similar to that of Figs. 2, 4 and 5 and will not be described in detail. The same reference numerals are used for corresponding parts. The pipe members 1, 3 are in this device permanently joined by a continuous peripheral leak-proof weld 9.

This alternative design joins the hygienic holder inlet and outlet pipe members 1, 3 by a welding operation rather than releasable mechanical fixings as in Fig. 2. The welded device includes the non-invasive detection system and the disc as a single disposable unit which would have to be changed in its entirety after the disc had burst. It does however, by nature of the welded joint, provide for a higher seal integrity between the process and the outside world. In some cases, this integrity improvement is advantageous over the benefits of disassembly and disc-only replacement.

Both designs include hygienic ferrule connectors 10, 11 at inlet and outlet to permit simple mating with industry standard connectors.

The invention is applicable to forward or reverse acting bursting discs although the drawings illustrate only the reverse acting disc version.

Features of the invention as illustrated are:

A two part holder (1, 3) is designed such that:

- The mating interface is suitable to firmly hold the bursting disc.
- The mating interface includes an O-ring seal 7 on the inlet (upstream) side to eliminate crevices, prevent build-up of dirt or product and aid cleaning.
- Either: The number and size of bolts is sufficient to carry any loads generated by the internal pressure.
Or: The welded joint is of sufficient penetration to carry any loads generated by internal pressure
- The inlet and outlet connections 10, 11 fit directly to industry standard hygienic ferrules (e.g. (but not exclusively) those complying to ISO 2852).
- The internal surface finish, internal radii etc may be to known hygienic design standards e.g. (but not exclusively) ASME BPE 2002.

The O-ring 7 is produced from materials approved for use in aseptic/hygienic applications e.g. (but not exclusively) by the US FDA. The seal is produced inside the device by the use of the O-ring against the flat flange area of the bursting disc.

The bursting disc is produced such that:

- The disc membrane (thickness and shape etc) are selected to provide the correct bursting pressure.

- The inlet surface of the bursting disc is of appropriately high surface finish, crevice free and clear from marking/scoring etc.
- The disc carries the magnet 6 on its downstream (non-process contact) side which is arranged to be adjacent to the reed switch detector 5 located in the pipe member 3.

When the magnet is of sufficient size and strength and the pipe member 3 is manufactured from a suitable, low iron content material, the magnetic field from the magnet is sufficient to operate the reed switch and produce a closed circuit. This is achievable without the reed switch detector penetrating through the wall of the outlet (downstream) pipe member 3 and is therefore non-invasive. However, when the disc bursts, the magnet will be moved away from the reed switch by the disc membrane which can be designed to open in a non-fragmenting petal and pivot away from the reed switch. Thus the disc burst event can be reliably signalled to process operators/control equipment.

This invention provides many advantages as follows:

- Burst detection is provided for a hygienic system without penetrating the pipe wall.
- The bursting disc (or the welded assembly) may be easily replaced for one of another burst pressure to accommodate batch to batch variations in processing pressures.
- The pipe members and disc may be dismantled (or the complete assembly may be removed from the process) for periodic manual or intensive cleaning operations as may be required.
- The disc may be replaced after burst without requiring a new burst detector or disturbing any of the detector wiring.
- The detector system may be readily tested (without disturbing pipe work) by simply unscrewing and

removing the detector thus for example weakening the magnetic field sufficiently to cause the reed switch to go open circuit.

- The integrated detection eliminates an extra burst detector device, the intermediate pipe work and the extra seals (potential leak paths) thus greatly simplifying the system installation.

The bursting disc may be produced with an identification tag as per traditional disc designs. This tag is visible from the outside of the pipeline/holder thereby indicating rated burst pressure, flow direction, plant number etc) and also provides for a key to correctly orientate the magnet into position adjacent to the detector.

The device of the invention typically combines the use of forward acting (scored) or reverse acting (scored) discs into a holder housing arrangement, which is machined to fit directly onto hygienic ferrules, typically IS02852 but not exclusively, and an integral non-invasive burst detection means (magnet and reed switch) fitted to the vent side of the disc, in which the reed switch is re-useable. This arrangement reduces the possibility of burst detector damage on installation, as the disc element is not handled. It is encapsulated into the housing, which affords complete dome protection.

The device of Fig. 3 is typically electron beam welded around its periphery at the junction of the inlet, disc and outlet, which ensures a leak tightness of 1×10^{-8} std cc/sec, mechanical integrity of the device, and correct axial orientation of the disc, magnet and reed switch.

The magnet, which is mounted on the downstream side of the disc, maintains a closed circuit with the reed switch, mounted in the holder downstream side. It is non-invasive to the bore, and, on disc functioning (burst), can be unscrewed and re-fitted to a replacement disc device, which negates the need for rewiring after the disc has burst. The surface finish of the component parts and the use of a disc of a solid

metal non fragmenting design, means it is suitable for Sterilisation in Place (S.I.P.) and Clean in Place (C.I.P) duties, which are typically found on pharmaceutical applications.

5 The disc design can be one which will withstand vacuum without the need for an additional support.

 While the invention has been described in conjunction with the exemplary embodiments described above, many equivalent modifications and variations will be apparent to those skilled in the art when given this disclosure.
10 Accordingly, the exemplary embodiments of the invention set forth above are considered to be illustrative and not limiting. Various changes to the described embodiments may be made without departing from the spirit and scope of the
15 invention.

CLAIMS:

1. An over-pressure detector comprising a bursting disc having a bursting region and a flange extending from the periphery of said bursting region;
5 an inlet pipe member and an outlet pipe member rigidly fixed together and clamping said flange between them, said pipes forming a passage across which said disc spans;
a magnet disposed in the channel, adjacent said bursting disc and on the outlet side of the bursting disc; and
10 a sensor outside said passage for sensing displacement of said magnet;
wherein rupturing of said bursting disc displaces said magnet.
- 15
2. An over-pressure detector according to claim 1, having a sealing member at the inner face of the inlet pipe member sealing between the bursting disc and the inlet pipe member.
- 20
3. An over-pressure detector according to claim 2, wherein:
the inner face of the inlet pipe member adjacent the disc has a recess for receiving said seal which is an O-ring; and
the O-ring is compressed against the flange of the bursting disc, thereby forming the seal.
- 25
4. An over-pressure detector according to claim 1, 2 or 3, wherein the magnet is mounted on a member joined to said disc and/or also clamped between said inlet and outlet pipe members.
- 30
5. An over-pressure detector according to claim 4, wherein the member mounting the magnet is a ring, wherein the magnet is carried on a cross-piece of said ring in said passage.

6. An over-pressure detector according to any one of the preceding claims, wherein said inlet and outlet pipe members are fixed together by welding.
- 5 7. Apparatus having an aseptic or sterile interior space and an over-pressure detector according to any one of the preceding claims, connected to said space and sterilised at its interior.
- 10 8. A method of installing an over-pressure detector according to any one of the preceding claims, including sterilising the interior of the detector after its installation.

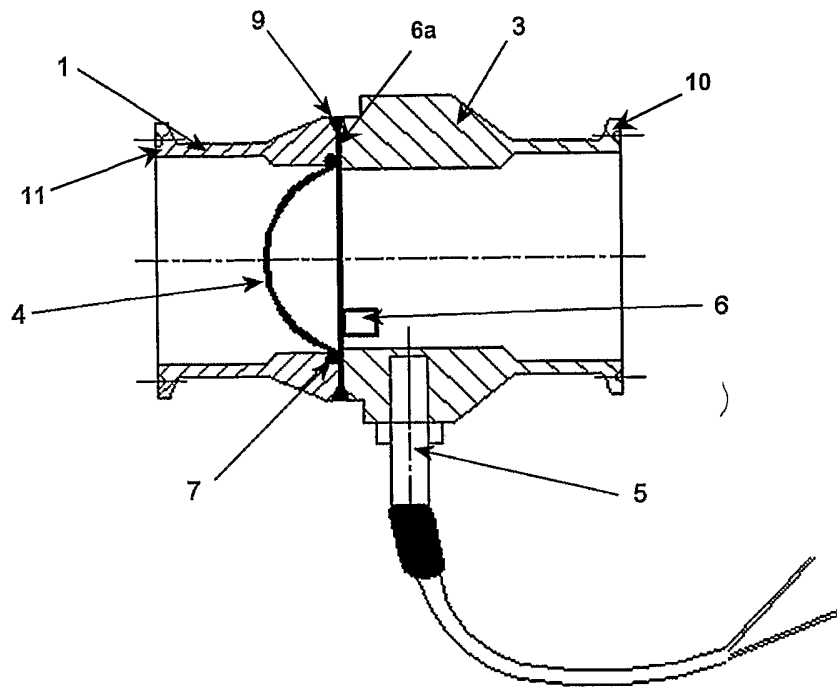


Fig. 3

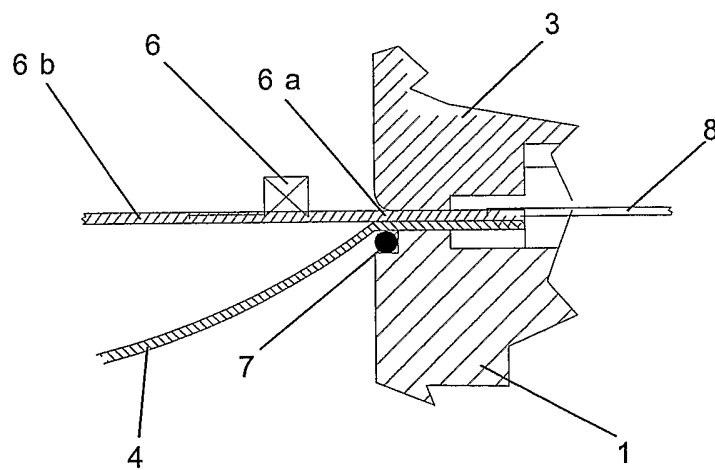


Fig. 4

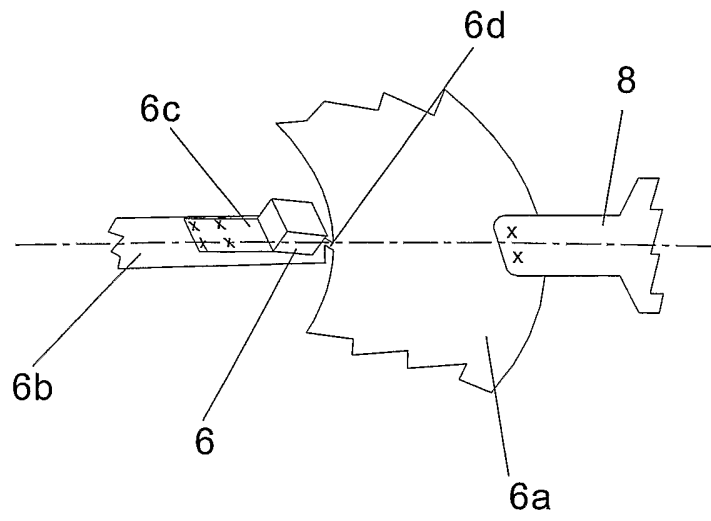


Fig. 5

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER IPC 7 F16K17/16 F16K37/00		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) IPC 7 F16K		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 224 077 A (BOOTS CO PLC) 25 April 1990 (1990-04-25) the whole document -----	1-4,6-8
A	US 6 321 771 B1 (NGUYEN JOHN ET AL) 27 November 2001 (2001-11-27) column 7, line 48 - line 59; figure 2 -----	1,7,8
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<input type="checkbox"/> Further documents are listed in the continuation of box C.		
<input checked="" type="checkbox"/> Patent family members are listed in annex.		
° Special categories of cited documents :		
A document defining the general state of the art which is not considered to be of particular relevance	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	
E earlier document but published on or after the international filing date	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	
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O document referring to an oral disclosure, use, exhibition or other means	*&* document member of the same patent family	
P document published prior to the international filing date but later than the priority date claimed		
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Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer <p style="text-align: center;">Lane1, F-B</p>	

INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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