

Title of Invention: Rupture disc with a means for limiting an opening angle

[0001] The present invention relates to a means for limiting the opening angle of a rupture disc, in particular a rupture disc made of sheet metal, with edge areas with which the rupture disc can be attached to an opening of a container or a pipe, and with a central area with which the opening can be closed up to a rupture pressure, and with predetermined breaking lines along which the rupture disc tears open when the rupture pressure is reached, so that the central area opens completely or in parts.

[0002] Such a rupture disc is known from document EP 4 477 925 A1. The rupture disc known from the document is angular, in particular rectangular, and has a fold in the edge areas, which comprises a first folded part of the sheet metal and a second part of the sheet metal to which the folded part is parallel or predominantly parallel.

[0003] Document EP 2 532 933 B1 discloses a device for limiting the opening angle of the rupture disc, which can be attached together with a rupture disc to an opening of a container or a pipe.

[0004] Rupture discs seal an opening in a wall, floor, or ceiling during normal operation of a technical facility that needs to be protected. In the event of overpressure, particularly as a result of an explosion or negative pressure, the rupture disc ruptures and can thus ensure pressure equalization between the cavity in the technical facility to be protected and the area surrounding this technical facility without destroying the technical facility itself. The advantage of rupture discs is that

they provide pressure relief at a specific position in the protected technical equipment, namely at the position where the rupture disc is installed. At the position where the rupture disc is installed, a pressure wave and/or flame can escape from the protected equipment. It must therefore be ensured that the area in front of the rupture disc is clear so that the pressure wave and/or flame cannot cause damage to objects or persons. The rupture disc must therefore be installed at a position on the protected equipment where the pressure wave and/or flame can spread unhindered into the surrounding area. This means that the selection of positions on the technical equipment where a rupture disc can be installed is restricted, for example, by the build out in the surrounding area. Similarly, if the equipment protected by the rupture disc is already in place, the layout of the surrounding area cannot be carried out without taking the existing rupture disc into account.

[0005] A device or means for limiting the opening angle of a rupture disc can provide a remedy. By limiting the opening angle of the rupture disc, the direction of propagation of a pressure wave and/or flame can be influenced. The device can be used to ensure that, in the event of relief, the rupture disc does not swivel up to 180° from its starting point as usual, but rather swivels at smaller angles. This allows the rupture disc to direct the pressure wave and/or flame in a preferred direction. This makes it possible to choose the position where the rupture disc is installed more freely and to lay out the surrounding area of the protected technical equipment more freely.

[0006] Devices for limiting the opening angle of a rupture disc are known from various documents and also from practice, for example, the devices from documents US 6 192 914 B2, DE 202 15 501 U1, and EP 2 532 933 B1, or the TARGO-VENT product of the applicant, or the VIGISPACE product from STIF - Société de Tôlerie Industrielle Française.

[0007] The device known from document US 6 192 914 B2 is used on a rupture disc in a pipe and is formed by a catcher bar. This catcher bar supports a hinge area of the rupture disc when the rupture disc flips over and tears open, and brakes the movement of the central area ("blow-out portion") of the rupture disc when it bends into the free interior of a pipe socket. The supporting of the hinge area and the braking of the central area of the rupture disc by means of the catcher bar prevents the central area from being separated or torn off from the rest of the rupture disc. The function of the catcher bar is therefore also to prevent the central area of the rupture disc from being separated or torn off. When the rupture disc known from document US 6 192 914 B2 is folded out and torn open, the central area strikes the catcher bar. The opening angle of the rupture disc is always limited to 90° by the catcher bar. This may be sufficient for relieving excess pressure in a pipeline. However, this is not sufficient for applications in which the pressure is relieved into the surrounding area of the device to be protected.

[0008] The device for limiting the opening angle known from document DE 202 15 501 U1 is formed by triangular pieces attached to the side of the rupture disc, referred to as bellows in the utility model specification, which are made of a flexible material not specified in detail in the utility model specification. One side of triangular pieces are

attached with one edge of the opening closed off by the rupture disc. Another side is attached to one edge of the rupture disc. The device known from document DE 202 15 501 U1 has not become established in practice.

[0009] The device for limiting the opening angle known from document EP 2 532 933 B1 comprises a plate with a central area that can be bulged and/or deflected under force perpendicular to the plane of the plate, wherein the plate comprises edge areas on opposite sides of the central area with which the plate can be fastened, and wherein edge areas of the rupture disc and the edge areas of the plate lie on top of each other. In the event of the tearing open of the rupture disc, the central area of the rupture disc presses on the central area of the plate and bulges it out. This allows the rupture disc to open, but not to flip over completely. The opening angle is limited.

[0010] The TARGOVENT of the applicant is a technical implementation of the teaching of document EP 2 532 933 B1. A flexible material is used as the plate in the TARGOVENT.

[0011] The VIGISPACE from STIF is a catch basket that catches the central area of the rupture disc.

[0012] In contrast to the VIGSPACE, the means or devices for limiting the opening angle known from document DE 202 15 501 U1 and document EP 2 532 933 B1 and the TARGOVENT do not protrude significantly beyond the rupture disc. The means or devices take up hardly any additional space. In particular, the devices do not protrude into traffic routes that pass by the rupture discs. Likewise, the rupture discs with the means or devices for

limiting the opening angle can also be used on mobile installations, the dimensions of which are then not increased by protruding parts of the means or devices for limiting the opening angle.

[0013] The TARGOVENT of the applicant has therefore developed into a successful product that is particularly suitable for retrofitting rupture discs. At the same time, the TARGOVENT is also a complex product, in particular also due to the possibility of retrofitting rupture discs with it.

[0014] This is where the present invention comes into play.

[0015] The present invention is based on the task of proposing a means that is less complex than the TARGOVENT, but at the same time has the advantage of the small dimensions of the TARGOVENT.

[0016] According to the invention, this task is solved by a means having the features of claim 1 and a rupture disc with such a means.

[0017] Accordingly, a means according to the invention for limiting the opening angle of a rupture disc has a plate which

- a. comprises a first area that can be bulged and/or deflected under the action of a force perpendicular to the plane of the plate, and
- b. comprises a second area with which the plate can be fastened,
- c. wherein the second area is provided at a first edge of the plate and

- d. wherein the plate comprises two second edges that are substantially perpendicular to said first edge.

[0018] In addition, the means according to the invention may comprise a band extending between the second edges and overlapping the same, wherein

- a. a first end of the band and a second end of the band are each connected to a fastening element or each have a fastening element with which the band can be fastened, and
- b. the band elements comprise the band elements or the band is at least partially formed from a material by means of which the length or alternatively the one length of the band is extendable to a limited extent.

[0019] This means according to the invention can be attached to the outside of a rupture disc, which in particular is a rectangular one. For this purpose, the second area is attached to a first edge area of the rupture disc, along which the central area of the rupture disc swivels when pressure is released. Arranged perpendicular to this first edge area, the rupture disc comprises two second edge areas opposite each other. One or more predetermined breaking lines are provided between the second edge areas and the central area of the rupture disc. At least one further predetermined breaking line is provided on a third edge area of the rupture disc, which is opposite the first edge area of the rupture disc. The rupture disc tears open along these predetermined breaking lines in the event of pressure relief.

[0020] Just as the central area of the rupture disc swivels about this first edge area of the rupture disc when the rupture disc opens,

the first area of the plate of the means according to the invention swivels about the second area of the plate. Depending on how rigid the plate is, particularly in the swiveling area, the movement of the central area of the rupture disc is braked and/or dampened. By selecting the properties of the plate, for example, the thickness of the plate, it is possible to adapt the dampening of the movement, wherein the opening angle of the rupture disc is limited.

[0021] The fastening elements at the ends of the band of the means according to the invention are attached to second edge areas of the rupture disc. When opening, the swiveling first area of the plate presses on the band, the ends of which remain held at the second edge areas of the rupture disc. Inasmuch as the band is extendible, the first area of the plate and the central area of the rupture disc can bulge and/or deflect. This enables the swiveling of the central area of the rupture disc and of the first area of the plate of the means according to the invention.

[0022] Inasmuch as the extension of the band is limited, the swiveling movement stops when the maximum length of the band is reached. The opening angle of the rupture disc is thereby limited. A flow discharged from the container secured with the rupture disc is thus directed in a desired direction by the opening angle of the rupture disc.

[0023] A material that allows a limited extension of the band could be a flexible or stretchable material.

[0024] It could also be that the band is corrugated or has a zigzag pattern and is pulled smooth when the limited extension

occurs. Such a corrugated or zigzag band could be made of steel or a composite material.

[0025] If elements for limited extension of the band are provided, the band may be made of a rigid material that is not stretchable or only slightly stretchable, such as steel or a composite material, in particular a fiber composite material such as carbon fiber reinforced plastic.

[0026] It is possible that the elements for the limited extension of the band are only provided in an area between the first and second band ends. In particular, they may also be arranged only in a central area of the band.

[0027] The extendibility of the band can be realized easily if the band is divided into two parts and comprises a first band section and a second band section. In particular, the first band section can comprise the first band end and the second band section can comprise the second band end. In particular, the first band section could comprise some of the elements for limited extension and the second band section could comprise some of the elements for limited extension.

[0028] Both the first band section as well as the second band section can be connected to each other in a displaceable manner by means of the elements for limited extension, wherein the displaceability of the two band sections relative to each other is limited to a predetermined path.

[0029] Guide elements and stop elements may belong to the elements for limited extension of a means according to the invention.

[0030] It is thus possible for both the first band section as well as also the second band section respectively to have at least one guide element, wherein the at least one guide element of the first band section and the at least one guide element of the second band section together form a guide that enables the extension.

[0031] Both the first band section as well as also the second band section of a means according to the invention may respectively comprise at least one stop element. The at least one stop element of the first band section and the at least one stop element of the second band section may form stops for each other, which is to say, they may strike against each other. The stops may limit the extension of the band.

[0032] The first band section and the second band section may each have a first area, wherein the first area of the second band section is wider than the first area of the first band section and the first area of the first band section is wider than a second area of the second band section.

[0033] Then, the first area of the first band section can have a slot as the guide element or one of the guide elements of the first band section. The second area of the second band section can be displaceably guided as the guide element or one of the guide elements of the second band section.

[0034] Alternatively or additionally, the first area of the second band section may have edges lying in the direction of

displacement. These edges may be bent about edges of the first area of the first band section lying in the direction of displacement. In this way, these edges of the two band sections may form the guide elements or one of the plurality of guide elements of the band sections.

[0035] A limitation or edge of the slot in the first area of the first band section may form the stop element or one of the plurality of stop elements of the first band section. Then, a shoulder or projection on the second band section, in particular a shoulder between the first area of the second band section and the second area of the second band section, can form the stop element or one of the plurality of stop elements of the second band section.

[0036] In the plate of a means according to the invention, two first recesses may be provided in the first area at a distance from each other. The band may be guided from a first side to a second side of the plate through these first recesses.

[0037] The plate of a means according to the invention may comprise a second recess in the first area. The center of the band may be arranged in this recess. This second recess may be an indentation in the first area of the plate, extending from the edge of the first area that is opposite to the second area of the plate toward the second area.

[0038] The problem underlying the invention is also solved by a rupture disc made of sheet metal, which has edge areas with which the rupture disc can be attached to an opening of a container or a pipe, which

has a central area with which the opening of the container or the pipe is closed until reaching a rupture pressure, and which has predetermined breaking lines along which the rupture disc ruptures when the rupture pressure is reached, so that the central area opens completely or in parts, wherein the rupture disc has a means according to the invention for limiting the opening angle of the rupture disc.

[0039] In the rupture disc according to the invention, at least one of the edge areas or the central area of the rupture disc and the plate of the means for limiting the opening angle of the rupture disc may consist of a single piece.

[0040] Further features and advantages of one embodiment of the invention are described below with reference to the drawings. Wherein:

Fig. 1 shows a perspective view of a rupture disc according to the invention with a means according to the invention for limiting the opening angle of the rupture disc,

Fig. 2 shows a top view of this rupture disc,

Fig. 3 shows a top view of the rupture disc without a band of the means for limiting the opening angle,

Fig. 4 shows a top view of the band of the means for limiting the opening angle,

Fig. 5 shows a detailed view of the center of the band of the means for limiting the opening angle,

Fig. 6 shows a detail of a first band section in perspective view,

Fig. 7 shows a detail of a second band section of the band in perspective view, and

Fig. 8 shows a band of a variant of the rupture disc according to Fig. 1 through Fig. 7.

[0041] It is not necessary for a rupture disc B according to the invention or a means according to the invention to comprise all of the features described below. It is also possible for a device according to the invention to have only certain features of the embodiment described below.

[0042] The rupture disc according to the invention is made from three pieces of sheet metal 1, 2, 3. The largest piece of sheet metal 1 forms the edge areas 11, 12, 13 of the rupture disc B, a central area 14 of the rupture disc B, and the plate 15 of a means for limiting the opening angle of the rupture disc B, which is part of the rupture disc B.

[0043] The two other, smaller sheet metal pieces 2, 3 respectively form a first or alternatively a second band section 2, 3, which together form a band 2, 3 of the means for limiting the opening angle of the rupture disc B.

[0044] The central area 14 of the largest sheet metal piece or alternatively the rupture disc B is rectangular. The central area 14 is adjoined on each side by an edge area 11, 12, 13. The central area 14 swivels along a line between a first of the edge areas 11, 12, 13 and the central area 14 of the rupture disc when the rupture disc B opens. Second edge areas 12 are provided opposite one to the other on edges of the central area 14 perpendicular thereto. These are separated from the central area 14 by predetermined breaking lines. A third edge area 14 is located opposite the first edge area 11. This too is also separated from the central area 14 by a predetermined breaking line.

[0045] The largest sheet metal piece 1 has a fold in the second and third edge areas 12, 13. This fold has a first folded part of sheet metal piece 1 and a second part of sheet metal piece 1, to which the folded part is parallel or predominantly parallel and which is connected to the central area 14. The first, folded part of the sheet metal piece 1 extends to the central area 14 or even overlaps slightly with the central area 14, which is to say, it

protrudes beyond the predetermined breaking line between the second, non-folded part and the central area 14.

[0046] The largest sheet metal piece 1 also comprises a fold in the first edge area 11. This fold also has a first folded part 15 of the sheet metal and a second part of the sheet metal to which the folded part is parallel or predominantly parallel and which is substantially formed by the central area 14. The first folded part 15 of the sheet metal is, however, significantly longer than the first folded parts of the folds of the other edge areas 12, 13. This protrudes, in part, significantly beyond the center between the first edge area 11 and the third edge area 13. This first folded part 15 of the fold in the first edge area of the rupture disc forms the plate 15 of the means for limiting the opening angle of the rupture disc B. Of this, the part of the plate 15 overlapping the central area 14 of the rupture disc B forms the first part 151 of the plate 15, which is bulged out and/or deflected when the plate 15 is opened under the action of the force acting perpendicular to the plane of the plate 15 when the rupture disc B is opened. The second area 152 of the plate is formed by the first, folded part of the fold in the first edge area 11.

[0047] Holes 16 are provided in the edge areas 11, 12, 13, through which screws can be inserted to attach the rupture disc B to the container or pipe to be protected.

[0048] The two smaller sheet metal pieces 2, 3 of the rupture disc B, which form the first or alternatively second band pieces 2, 3 of the band 2, 3, each comprise a fastening element 23, 33 at one outer end. These fastening elements 23, 33 each comprise two holes that are aligned with two holes in the second edge areas 12. The

band sections 2, 3, together with the largest sheet metal piece 1 of the rupture disc, can thus be screwed to the container or pipe to be secured.

[0049] The band sections 2, 3 extend inward from the fastening elements 23, 33 to the respective opposite second edge area 12. They extend beyond the center between the second edge areas 12, and the ends are connected to each other in such a way that they can shift relative to each other. This allows the band 2, 3 to be extended and to follow any bulging and/or deflection of the first area 151 of the plate 15 or alternatively the central area 14 of the rupture disc B. However, the displacement of the ends of the two band sections 2, 3 is only possible to a limited extent. Stops 211, 34 at the ends of the band sections 2, 3 ensure that the ends of the band sections 2, 3 can only be displaced relative to each other by a certain distance.

[0050] Guide elements are provided at the ends of the two band sections 2, 3 to guide the ends. A stop element is provided at the ends of each band section to limit the displacement of the ends relative to each other and thus to limit the extension of the band.

[0051] The first band section 2 and the second band section 3 each comprise a first area 21, 31 which is located at the end of the first or alternatively second band section 2, 3 that is connected to the other band section 2, 3. A second area 22, 32 is provided between the first area 21, 31 and the fastening element 23, 33 for each of the two band sections 2, 3. The first area 21, 31 of the two band sections 2, 3 is wider than the second area 22, 32 of the same band section 2, 3.

[0052] In addition, the first area 31 of the second band section 3 is wider than the first area 21 of the first band section 2, and the first area 21 of the first band section 2 is wider than a second area 32 of the second band section 3.

[0053] The first area 21 of the first band section 2 has a slot 212 as the first of two guide elements of the first band section 2. The second area 32 of the second band section 3 is guided through this slot 212. This second area 32 is one of two guide elements of the second band section 3. The second area 32 is guided in a displaceable manner in the slot 212.

[0054] In addition, the first area 32 of the second band section 3 has edges 311 lying in the direction of displacement. These are wrapped around the edges 213 of the first area 21 of the first band section 2 that lie in the direction of displacement and thus enclose them. In this way, these edges 311, 213 of the two band sections 2, 3 each form second guide elements of the band sections 2, 3.

[0055] A limitation or edge 211 of slot 212 in the first area 21 of the first band section 2 forms the stop element of the first band section 2. A shoulder 34 between the first area 31 of the second band section 3 and the second area 32 of the second band section 3 forms the stop element of the second band section 2. In the event of a bulging or deflection of the first area 151 of the plate 15 or alternatively the central area 14 of the rupture disc B, the two stop elements strike each other and thereby limit the movement of the ends of the band sections 2, 3 relative to each other and the extension of the band 2, 3.

[0056] In order for the first area 151 to not slip under the extending band 2, 3 in the event of a bulging or deflection of the first area 151 of the plate 15 or alternatively of the central area 14 of the rupture disc B, two holes 16 are provided in the first area 151 of the plate 15, through which holes the band 2, 3 is guided from the front to the back of the plate 15. The second areas 22, 32 of the band sections 2, 3 are guided through the holes 16. The edge of the first area 151 of the plate 15 has an indentation 17 in the direction of the second area 152 of the plate 15. This indentation 17 releases the second areas of the band sections 2, 3, which can be displaceable relative to each other, and prevents the band sections from being pinched between the first area of the plate 15 and the central area 14 of the rupture disc B, which could impair the movement of the two band sections 2, 3 relative to each other.

[0057] The band shown in Fig. 8 could be part of a rupture disc according to the invention instead of the band shown in Fig. 1, Fig. 2, Fig. 4 through Fig. 7. The band has a zigzag shape. The force acting on the band when the rupture disc is opened stretches and smoothes the band. This allows a limited extension of the band.

Claims:

[Claim 1]

Means for limiting the opening angle of a rupture disc (B) with a plate (15) which

- comprises a first area (151) that can be bulged and/or deflected under the action of a force perpendicular to the plane of the plate (15) and
- comprises a second area (152) with which the plate (15) can be fastened,

characterized in

- that the second area (152) is provided at a first edge of the plate (15),
- that the plate (15) comprises two second edges that are substantially perpendicular to said first edge.

[Claim 2]

Means according to claim 1, characterized in

- that the means comprises a band (2, 3) extending between the second edges and overlapping the same,
- that a first end of the band (2, 3) and a second end of the band (2, 3) are each connected to a fastening element or each have a fastening element (23, 33) with which the band (2, 3) can be fastened,

- that the band (2, 3) comprises elements or alternatively that the band (2, 3) is at least partially formed from a material by means of which a length of the band (2, 3) is extendable to a limited extent.

[Claim 3]

Means according to claim 2, characterized in that the elements for limited extension of the band (2, 3) are provided in an area between the first and second band ends.

[Claim 4]

Means according to claim 2 or claim 3, characterized in that the band (2, 3) is divided into two parts and comprises a first band section (2) and a second band section (3).

[Claim 5]

Means according to claim 4, characterized in that the first band section (2) comprises the first band end and the second band section (3) comprises the second band end.

[Claim 6]

Means according to claim 5, characterized in that the first band section (2) comprises some of the elements for limited extension and the second band section (3) comprises some of the elements for limited extension.

[Claim 7]

Means according to claim 6, characterized in that the first band section (2) and the second band section (3) are, limited to a predetermined path, connected to each other in a displaceable manner by means of the elements for limited extension.

[Claim 8]

Means according to any one of claim 1 through claim 7, characterized in that guide elements and stop elements belong to the elements for limited extension.

[Claim 9]

Means according to claim 7 and claim 8, characterized in that the first band section (2) and the second band section (3) respectively have at least one guide element, wherein the at least one guide element of the first band section and the at least one guide element of the second band section together form a guide that enables the extension.

[Claim 10]

Means according to claim 8 or claim 9, characterized in that the first band section (2) and the second band section (3) respectively comprise at least one stop element, wherein the at least one stop element of the first band section and the at least one stop element of the second band section form stops for each other, which limit the extension of the band (2, 3).

[Claim 11]

Means according to any one of claim 2 through claim 10, characterized in that the first band section (2) and the second band section (3) each have a first area (21, 31), wherein the first area (31) of the second band section (3) is wider than the first area (21) of the first band section (2) and the first area (21) of the first band section is wider than a second area (32) of the second band section (3).

[Claim 12]

Means according to claim 9 and claim 11, characterized in that the first area (21) of the first band section (2) has a slot (212) as the guide element or one of the guide elements of the first band section, through which slot the second area (32) of the second band section (3) is displaceably guided as the guide element or one of the guide elements of the second band section (3).

[Claim 13]

Means according to claim 9 and claim 11 or claim 12, characterized in that the second area (32) of the second band section (3) has edges (311) lying in the direction of displacement, which edges are bent about edges (213) of the first area (21) of the first band section (2) lying in the direction of displacement, wherein these edges (213, 311) of the two band sections (2, 3) form the guide elements or one of the plurality of guide elements of the band sections (2, 3).

[Claim 14]

Means according to claim 10 and claim 11, characterized in that

- a limitation of the slot (211) in the first area (21) of the first band section (2) forms the stop element or one of the plurality of stop elements of the first band section (2), and
- a shoulder (34) between the first area (31) of the second band section (3) and the second area (32) of the second band section (3) forms the stop element or one of the plurality of stop elements of the second band sections (3).

[Claim 15]

Means according to any one of claim 2 through claim 14, characterized in that two first recesses (16) are provided in the plate (15) in the first area (151) at a distance from each other, through which first recesses the band (2, 3) is guided from a first side to a second side of the plate (15).

[Claim 16]

Means according to any one of claim 2 through claim 14, characterized in that the plate (15) comprises a second recess or indentation (17) in the first area (151), in which the center of the band (2, 3) is arranged.

[Claim 17]

Rupture disc (B) made of sheet metal, which has edge areas with which the rupture disc (B) can be attached to an opening of a container or a pipe, and which has a central area (14) with which the opening can be closed until reaching a rupture pressure, and which has predetermined breaking lines along which the rupture disc (B) ruptures when the rupture pressure is reached, so that the central area (14) opens completely or in parts,

characterized in that

the rupture disc (B) has a means for limiting an opening angle of a rupture disc according to any one of claim 1 through claim 16.

[Claim 18]

Rupture disc according to claim 17, characterized in that at least one of the edge areas (11, 12, 13) and/or the central area (14) of the rupture disc (B) and the plate (15) of the means for limiting the opening angle of the rupture disc consist of a single piece.