ABSTRACT OF THE DISCLOSURE

An improved arrangement of quick closure mechanisms of the automatic pressure-tight sealing of the air passages of shelters from the action of pressure or pressure surges. The arrangement is particularly useful in protecting the interior of a protective shelter against the pressure effects of atomic explosions. Automatically operating quick closure mechanisms are mounted in a carrier and result in a uniform distribution of the pressure surges upon the carrier. The carrier defines a geometric body having a regular base.

The present invention has reference to an improved arrangement of quick closure mechanisms for the automatic pressure-tight sealing of the aeration openings or air passages of shelters from the action or pressure surges, and which are especially protective against atomic explosions.

It is to be understood that the terms "pressure" or "pressure surges," or any equivalent expression, as employed herein is intended to cover both the shock or pressure wave and subsequent suction wave which appear when an explosion occurs.

During the construction of ventilating systems for protective shelters or similar structures two requirements should be fulfilled which, in principle, contradict one another. On the one hand, the pressure drop through the entire ventilation system should be maintained as small as possible to reduce power requirements, this necessitating sufficiently large channel cross-sections. On the other hand, the channel cross-sections should be held small so as not to excessively impair the strength of the wall broken through by the air channels in order that such a wall can effectively absorb the forces acting upon the quick closure mechanisms.

In prior art arrangements of quick closure mechanisms, known in quite different physical constructions, they are either arranged in a portion or section of the air channel or frontally at one end thereof. Appropriately large channel cross-sections are provided for large air quantities. The disadvantage of such arrangement is that the wall of the shelter broken through by the air channel is considerably weakened due to the larger channel cross-section, that larger forces have to be absorbed by the wall because of the larger channel cross-section, therefore requiring stronger reinforcement of the wall, and the production costs for larger channels correspondingly increase. Furthermore, due to the breaking-through of the walls of the shelter there is an increased incidence of radioactivity. Increasing the quantity of air in this known arrangement and with a given channel cross-section results in a greater pressure drop and, therefore, a correspondingly increased energy consumption for conveying the air. This becomes of importance during emergency conditions when there might be used manual power or internal combustion engines.

Accordingly, a primary object of the present invention is to provide an improved arrangement of quick closure mechanisms for protective shelters and similar structures which effectively overcomes the drawbacks of the prior art structures.

Another, more specific object of the invention is directed to an improved arrangement of quick closure mechanisms for the air passage openings of a shelter or the like, wherein air can effectively reach the shelter interior, the protective quick closure mechanisms respond reliably and rapidly in the presence of pressure surges, and wherein the power requirements and pressure drop through the system are minimized.

Still another considerable object of this invention is to provide an improved arrangement of quick closure mechanisms for the air passage opening or openings of protective shelters wherein forces acting upon the carrier for the quick closure mechanisms and brought about by the pressure surges following an explosion are taken up by such carrier and these forces tend to cancel one another.

The inventive arrangement of quick closure mechanisms is generally characterized by the features that the quick closure mechanisms are arranged at a carrier or support and for the purpose of uniformly distributing and taking up pressure forces or surges acting upon them are located at the surface of a geometric body having a regular base and defined by the carrier, wherein the longitudinal axis of the geometric body is disposed perpendicular to the plane containing the base, and the generatrix of the geometric body extends substantially parallel to the aforesaid longitudinal axis or passes through a point thereof.

Under the term "geometric body," or any equivalent expression as used herein, there is to be understood a surface which is formed by moving in space a flat generator curve or line. A large number of geometric bodies possess a longitudinal axis and are capable of being developed. The latter are also known as passable bodies or surfaces and constitute preferred embodiments.

The advantage of the inventive arrangement resides in the fact that with a given passage cross-section through the shelter wall and a given pressure drop which is to be maintained, it is possible to feed the arrangement with a multiple of the previously used air quantity, for instance eight times a much, or in the case of a given air quantity and a given pressure drop which is to be maintained, a considerably smaller wall through-passage area is required without having to considerably increasingly load the shelter wall punctured by the air channel and without intensifying the radiation load at the shelter. The inventive apparatus is particularly advantageous with large air quantities, one hundred thousand cubic meters per hour for instance.

In addition to the considerable advantages of essentially smaller wall penetration or break-through, less radiation incidence and a considerable decrease in production costs, the inventive apparatus also provides the further advantage that entry of air into a protective structure, which always constitutes one of its weak points, becomes considerably less perceivable, this being of importance with regard to military installations.

Other features, objects and advantages of the invention will become apparent by reference to the following detailed description and drawings in which:

FIGURE 1 is a schematic longitudinal cross-sectional view of a first embodiment of inventive blast closure apparatus having valve elements arranged in substantially polygonal configuration, and viewed along the line I—I of FIGURE 2;

FIGURE 2 is a partial cross-sectional view of the embodiment of apparatus depicted in FIGURE 1, substantially as seen when viewed along the line II—II thereof;

FIGURE 3 is a perspective view of a portion of the
valve unit or block employed in the arrangement of FIGURE 1; FIGURE 4 shows details of the valve elements forming the valve block depicted in FIGURE 3; FIGURE 5 shows the assembly of a valve block or unit formed from the valve elements depicted in FIGURES 3 and 4; FIGURE 6 is a fragmentary, cross-sectional view showing a detail of the valve block of FIGURES 3 to 5; FIGURE 7 is a longitudinal cross-sectional view of a modified embodiment of inventive apparatus; FIGURE 8 is a cross-sectional view of the arrangement of FIGURE 7, substantially taken along the line VIII—VIII thereof; FIGURE 9 shows a detail of the arrangement of FIGURES 7 and 8; FIGURE 10 schematically depicts a further embodiment of inventive arrangement of the quick closure mechanisms; FIGURE 11 is a longitudinal cross-sectional view, taken along line XI—XI of FIGURE 12, of another embodiment of inventive apparatus, here provided with a perforated cylinder jacket as the carrier or cage and which at the same time forms the valve body; and FIGURE 12 is a cross-sectional view of the arrangement of FIGURE 11, taken along the line XII—XII thereof.

Describing now the drawings, and initially directing attention to the embodiment of inventive apparatus depicted in FIGURES 1 and 2, it will be recognized that the entire arrangement of blast closure device depicted therein is designated by reference character 8. This blast closure device 8 is secured, for instance, to a vertical inner wall 90 of a protective shelter or similar structure. A cylindrical air channel or duct 1 piercingly extends through this wall 90 and communicates with the surrounding air. Air channel 1 has a lining in the form of a pipe 2 possessing a flange 3 at its end facing towards the compartment of the shelter. This flange 3 is anchored to the inner wall 90 by means of eight sleeves 6 each provided with an inner or internal threading 4 and an anchoring ring 5. The pipe or tube 2 with the flange 3 and the anchoring sleeves 6 are embedded in concrete at the inner wall 90 during erection of the shelter. A tie or tension rod 7 is threaded into the internal threading of each anchoring sleeve 6.

The exemplary inventive embodiment of blast closure device 8 possesses an essentially cylindrical-shaped carrier body or cage 10 having a horizontal longitudinal axis 91. This carrier body or cage 10 is disposed in axial direction at the side of the shelter by means of an arched cover member 12. The latter has a flange 25 provided with bores 26 and is connected with the carrier body or cage 10 by means of nuts 27 screwed onto the free ends of the tension rods 7, so that said carrier body 10 is held fixed at the inner wall 90 of the protective shelter. Moreover, such carrier body or cage 10 is formed of three annular or ring members 13, 14, 15 axially spaced from one another and coaxially arranged with respect to the longitudinal axis 91. Each of these rings 13, 14 and 15 advantageously have the same inner diameter. Cage or carrier 10 is further composed of eight respective straight webs or crosspieces 19 and 20 and eight respective segment pieces 16, 17 and 18.

The webs 19 and 20 which are here formed as angle irons enclosing an obtuse angle for instance, are arranged in the proximities and externally of the tension rods 7, and are equally spaced from one another about the circumferences of the rings 13, 14 and 15. Webs 19 and 20 interconnect each two neighboring rings 13 and 14 and 15 respectively, substantially parallel to the longitudinal axis 91. The segment pieces 16, 17 and 18 are located transverse to the longitudinal axis 91 and interconnect each two neighboring webs with one another, and further, are secured to the inner side of the rings 13, 14 and 15 respectively. These segment pieces 16, 17 and 18 and the webs 19, 20 in this instance define a regular prism, wherein its eight-sided base is situated at the plane of the wall of the shelter. The longitudinal axis 91 of the carrier or cage 10 here extends at a right angle or perpendicular to the plane of the aforementioned base of the polygon or prism. The generatrix of the geometric body defined by the carrier 10, the webs 19, 20, extend parallel to the longitudinal axis 91. Neighboring webs 19 or 20 which are located at the same circumferential portion form together with the interconnecting segment pieces 16 and 17 or 17 and 18 respectively, rectangular windows at which valve blocks or units are to form an individual valve element or quick closure mechanism. It will also be appreciated that windows situated behind one another in the direction of the longitudinal axis 91 form the side wall of the eight-sided prism.

Considering now details of the physical structure of the valve blocks or units 11, such are assembled from quick closure mechanisms or valve elements 28, best shown in FIGURES 3 to 6 and which will be discussed in greater detail hereinafter. These valve elements or quick closure mechanisms 28 are here disposed parallel to the lengthwise or longitudinal axis 91 and form in their entirety the surface of a double row prismatic rim or crown. The valve blocks 11 can be assembled in optional length in the circumferential direction of the carrier or cage 10 from the valve elements 28, whereby the diameter of the cage is enlarged, however, exhibit a constant spread or expanses in axial direction and are somewhat larger than the associated window, whereby the projecting portions are situated in one plane and serve as the support surfaces for attachment at the carrier or cage 10. However, the valve elements 28 could also be arranged transverse to the longitudinal axis 91, as will be further considered in greater detail hereinafter. Furthermore, these valve blocks or units 11 are fixed at the carrier or cage 10 by means of screws 23 or any other suitable fastening expedients.

By now referring specifically to FIGURES 3 to 6 there will become evident the physical structure of the valve elements or quick closure mechanisms 28 from which there is formed the valve block or units 11. A single quick closure mechanism or valve element 28 comprises two valve webs or bodies 34, two spacer pieces 21 and a plate-like valve spring or closure member 32. The valve spring 32 is mounted freely for movement in the cutouts or notches 30 of the spacer pieces 21 and acts as an elastic valve flap which is flexed and lifted somewhat in axial direction relative to these notches 30, by a pressure difference, towards the side of the manifold pressure, and thus, by means of their lateral edges bear at the concave seating surfaces 33 of the valve webs or bodies 34 to thereby shut off the flow of air in the relevant direction. It will be understood that these valve elements 28 operate both in the presence of overpressures as well as suction. The closure for complete valve block or unit 11 is formed by closure plates 29, as best shown in FIGURES 4 and 5. A similar type of quick closure mechanism or valve element is shown and described in the copending, commonly assigned, United States Patent No. 3,301,168 of Fried Schindler and Karl Sauter, issued Jan. 31, 1967 and entitled "Quick Closure Mechanism for the Air Passage Openings of Shelters and the Like." The valve webs or bodies 34 of concave form are, for example, formed of cast light metal or forgings and possess a cross section best depicted in FIGURE 6. However, they could also be formed of any other suitable material.

Furthermore, by referring to FIGURES 3 to 6 there will be recognized that there are provided means for assembling the valve webs or bodies 34 to the other members to form an individual valve element or quick closure mechanism 28 and then to form the latter into a valve
block 11. To this end, both the valve bodies 34 as well as the distance pieces or spacers 21 possess bores 35 of the same diameter which align in the assembled condition and receive a respective tension screw 36 having two thread-forming points (FIGURE 5). Also both of the cover or closure plates 29 of a valve block or assembly 11 have bores 38 corresponding to the bores 35, however with cylindrical countersinkings 39 for the receipt of circular nuts 40, by means of which the valve blocks 11 are threadably fastened together. To perfect sealing, the rubber seats 41 and 42 are adhesively affixed, at the portions of the valve block which bear against the edges of the window-shaped openings of the carrier or cage 10, as best shown in FIGURE 4.

FIGURES 7, 8 and 9 depict a further embodiment of the inventive arrangement of quick closure mechanisms, wherein the individual valve bodies 43 are uniformly distributed about the circumference of a cylinder 10 and in their entirety form two cylindrical valve crowns or rings. The distance or spacer pieces 44 here employed, however, possess side surfaces 44a which are inclined with respect to one another, the wedge angle α of which is dependent upon the number of spacers 44 in which are included the sides of the cylindrical carrier or cage 10. In analogous manner as in the case of the valve structure shown in FIGURES 3 to 6, also here each of two neighboring valve web or bodies 43 together with the therebetween disposed distance pieces and an intermediate arranged leaf spring form a valve element.

As best shown in FIGURE 9, the spacers or distance pieces 44, at both wedge sides, possess four respective projections or lips 45 which engage in corresponding holes or bores 46 of the neighboring valve body 43. These distance pieces 44, when assembled, form a circumferential groove 47 in which is situated a bipartite tensioning ring 48 through the agency of non-illustrated screws or equivalent structure. Attachment of the valve crowns or rings at the wall of the shelter is undertaken by means of eight tension or tie rods 49 embedded into the shelter wall and with the aid of a ring flange 50 and nuts 51. A cover member 52 connected with the ring flange 50 closes the cage or ear body 10 at the side of the shelter.

FIGURE 10 illustrates a further variant of the invention. Just as in the case of the initially described embodiment here also the valve blocks 59, similar to the valve blocks 11, form the side walls of a regular, eight-sided prism. The carrier body or cage supporting these valve blocks 59. In this instance, consists of eight diagonally arranged full or solid walls 53 secured to a rod 54 located at the lengthwise or longitudinal axis of the prism, whereby the free ends of such solid or full walls bear against the edges of the regular, that is equal-sided prism. At these free ends, there are welded lengthwise extending webs 55, once again formed of angle irons enclosing an obtuse angle. These webs 55 in turn are welded to a ring flange 56 of a non-illustrated air channel jacket or sleeve. Four respective threaded sleeves 57 are welded at the frontal edge of the solid walls 53 at the side of the shelter compartment and they serve to attach a cover member 58, only half of which is shown, having a number of outlet gullets 60 to 63 with through-passing sleeves 64, by means of suitable screws 65.

In contrast to the embodiment previously described at the outset, here the valve elements 28 of the valve blocks 59 are situated at right angles or transverse to the lengthwise axis of the prism. These valve elements or quick closure mechanisms 28 are assembled into the valve block 59 by means of tension screws and countersunk circular nuts in the same manner as already explained with regard to the structure depicted in FIGURES 3 to 5, and by means of strips or ledges 66 are secured to the straight legs of the lengthwise webs 55. The ledge 66 are threadably affixed by means of a number of screws 67 to the legs of the longitudinal or lengthwise webs 55. A further row of screws 68 which are threaded into the thread- ing 22 (FIGURES 3, 4 and 5) of the spaces or distance pieces 21 fix the valve blocks 59 in the windows of the carrier or cage. In this construction the geometric body forming the cage is again a regular eight-sided prism.

In the embodiment according to FIGURE 10, the sides of the regular polygon or prism have a constant length independent of the number of prisms, and are defined by a respective link as already explained with regard to the structure depicted in FIGURES 3 to 5, and in the windows of the carrier or cage.

FIGURES 11 and 12 depict a further embodiment of the invention, wherein a perforated cylindrical sleeve or jacket 69 simultaneously serves as carrier body or cage. This cylindrical sleeve 69 is welded to a flange 70 mounted, by means of eight anchoring screws 82, at the inner wall of the shelter. Furthermore, this cylindrical sleeve 69 is obturated in axial direction towards the shelter by a cover member 71 threadably connected via a number of screws 72 with said cylindrical sleeve 69. Internally of such cylindrical sleeve 69 eight webs 74 in the form of T-profiles are welded at equal spacing from one another parallel to the longitudinal axis of the cylinder and at the inner surface of such sleeve. A perforated valve plate 75 is arranged between each two T-profiles 74, also parallel to the cylinder axis. These valve plates 75 are guided in the spaces or compartments 76 formed by the cylindrical jacket 69 and the T-profiles 74. The perforations 77 of the valve plates 75 are offset with respect to the perforations 78 of the cylindrical jacket or sleeve 69, so that the valve plates 75, when in their seating or bearing position, seal the sector of the cylindrical jacket located between each two neighboring T-profiles 74. Specifically, an explosion wave occurring in the direction of the arrow of FIGURE 11 presses the valve plates 75 against the cylindrical sleeve or jacket 69, thereby seals the shelter compartment against the overpressure prevailing outside of the aforesaid shelter compartment. Naturally, instead of the cylindrical sleeve 69 being an integral structure and forming the individual axially parallel surface sections between the profile irons 74, it could also be assembled from separate sheet metal wall sections interconnected along their longitudinal edges by such profile irons.

So that in this embodiment with a suction wave, working opposite the direction of the arrow of FIGURE 11, the air channel 1 is also closed, there can be provided internally of the cylinder sleeve 69, as shown in FIGURE 12, cylindrical, sector-shaped, dies or bow-like members 79 which are disposed symmetric to the surface of the cylindrical sleeve 69 with respect to the valve plates 77 against which the latter sealingly bear. Here again, the perforations 80 in the bow-like members 79 are offset with respect to those at the valve plates 77.

In all embodiments during normal ventilation the air flows through the air channel 1 in the direction of the arrow, in other words, in the direction of the longitudinal axis 91 (FIGURE 1) of the carrier body or cage 10 and into the blast closure device. Since the cover member 12 blocks the flow path in axial direction, the air will stream in centrifugal or radial direction through the closure mechanisms, i.e., valve blocks 11, and leaves the carrier body or cage 10. An occurring pressure wave presses the resilient elements 32 or 77 instantaneously against the corresponding seating portion 33 or 78, so that the quick closure mechanisms close in about one millisecond. When the resilient elements 32 or 77 press against the corresponding seating portions 33 or 78 to assume the closed position, the quick closure elements
form a jacket of a hood which serves to cover the air opening in the wall of the protective shelter. In so doing, the occurring pressure acting upon the inner surface of the quick closure elements is transmitted to the carrier body or cage and must be taken up by such.

However, it is a particular advantage of the present invention that only the pressure component acting upon the contract member 12 is transmitted via the tie rods 7 to the wall 90 and needs to be absorbed by the latter. The centrifugal forces acting upon the jacket or outer surface of the carrier body 10 have the same intensity or strength in all directions so that their vector sum is zero, whereby all these forces are absorbed by the carrier body itself or by its ring members 13, 14 and 15, or by the full walls 53 and the rod 54, or by the cylindrical jacket 69, without additionally loading the wall 90.

An essential condition to be observed for forming the vectorial sum of magnitude zero is that all of the elements of the carrier body surface must be spaced the same distance from its longitudinal axis 91, which is the case with regular polygons and circles defining the carrier body cross-section or base. Carrier bodies having a longitudinal axis disposed perpendicular to the wall of the shelter therefore constitute a preferred embodiment since the loading is uniform.

Moreover, the carrier or cage can also, with increased spacing from the shelter wall, exhibit changing cross-section, in other words, can be conical or pyramid-shaped, or taper to a point. Generally, the quick closure apparatus is secured to a wall of a shelter. However, it is also possible to mount such in a distribution chamber, from which branch off a number of air channels, located at the end of a main air shaft of optional cross-section.

The inventive quick closure mechanisms can, however, also be mounted at the end of an air channel at the side of the external surrounding air, whereby such is advantageously protected by suitable structural expedients, such as means for the lateral delivery of air, protective walls or otherwise, so as to safeguard against direct destruction by means of objects and the like. In any event, the apparatus should not project above the surface of the ground unprotected. In all of the embodiments according to FIGURES 1, 2, 7, 8, 11 and 12, the possibility exists of screwing away the cover member and using the air channel as an emergency exit. Moreover, instead of the longitudinal axis of the carrier being horizontal, the device could be mounted such that it is vertical.

What is shown and described above is a preferred embodiment of the invention, it is to be distinctly understood that the invention is not limited thereto, but may be otherwise variously embodied and practised within the scope of the following claims.

What is claimed is:

1. In combination with an air ventilation opening in the wall of a protective shelter, a quick closure device for automatic pressure-tight sealing of said air ventilation opening; particularly against the pressure effect of atomic bomb explosions, said device comprising a hood which serves to cover said air ventilation opening in said wall of said protective shelter, said hood comprising a plurality of movable closure elements normally in an open position, and a plurality of stationary sealing elements for said closure elements, each of said closure elements interacting in sealing fashion with said sealing elements to assume a closed position as a result of the pressure effect, said sealing elements comprising a jacket of said hood which is pressure-tight in said closed position of said closure element.

2. A quick closure device as defined in claim 1, wherein said jacket of said hood defines a circular cylinder.

3. A quick closure device as defined in claim 1 wherein said jacket of said hood defines a polygonal prism.

4. A quick closure device as defined in claim 1 wherein said hood is closed off by a removable lid detachably mounted upon said jacket, said lid providing an emergency exit.

5. In combination with an air ventilation opening in the wall of a protective shelter, a quick closure device for automatic pressure-tight sealing of said air ventilation opening particularly against the pressure effect of atomic bomb explosions, said device comprising a hood which serves to cover said air ventilation opening in said wall of said protective shelter, said hood comprising a plurality of movable closure elements, and a plurality of stationary sealing elements for said closure elements, each of said closure elements interacting in sealing fashion with said sealing elements to assume a closed position as a result of the pressure effect, said closure elements and said sealing elements providing air paths when in the open position, said plurality of movable closure elements cooperating with said plurality of stationary sealing elements to form a jacket of said hood which is pressure-tight in said closed position of said closure elements.

6. A quick closure device as defined in claim 5 wherein said sealing elements are arranged in the shape of a rim and maintained at their ends in spaced relation to each other by wedge-shaped spacer elements, said sealing elements together with said closure plates comprising said jacket of said hood.

7. A quick closure device as defined in claim 6 wherein the grouped sealing elements and closure plates comprise superimposed rims disposed in the axial direction of the hood.

8. A quick closure device as defined in claim 5 wherein said sealing elements are arranged in the shape of a rim and maintained at their ends in spaced relation to each other by wedge-shaped spacer elements, said sealing elements together with said closure plates comprising said jacket of said hood.

9. A quick closure device as defined in claim 8 wherein said jacket at each of its end regions is spanned by a reinforcement ring.

10. In combination with an air ventilation opening in the wall of a protective shelter, a quick closure device for automatic pressure-tight sealing of said air ventilation opening particularly against the pressure effect of atomic bomb explosions, said device comprising a hood which serves to cover said air ventilation opening in said wall of said protective shelter, said hood comprising a plurality of movable closure elements, and a plurality of stationary sealing elements for said closure elements, each of said closure elements interacting in sealing fashion with said sealing elements to assume a closed position as a result of the pressure effect, said closure elements and said sealing elements providing air paths when in the open position, said plurality of movable closure elements cooperating with said plurality of stationary sealing elements to form a jacket of said hood which is pressure-tight in said closed position of said closure elements, said closure elements and said sealing elements being perforated plates, said sealing elements forming axially parallel surface sections of a circular cylinder, the wall sections thus formed being connected along their longitudinal edges by profiled elements, said closure elements, said profiled elements when associated with said closure elements overlapping each surface section of the circular cylinder and together with said closure plates comprising said pressure-tight jacket of said hood.

11. A quick closure device as defined in claim 10 wherein at least the closure elements comprise superimposed rims in the axial direction of the hood.

12. In combination with an air ventilation opening in the wall of a protective shelter, a quick closure device
for automatic pressure-tight sealing of said air ventilation opening, particularly against the pressure effect of atomic bomb explosions, said device comprising a hood which serves to cover said air ventilation opening in said wall of said protective shelter, said hood comprising a plurality of movable closure elements, and a plurality of stationary seating elements for said closure elements, each of said closure elements interacting in sealing fashion with said seating elements to assume a closed position as a result of the pressure effect, said closure elements and said seating elements providing air paths when in the open position, said plurality of movable closure elements cooperating with said plurality of stationary seating elements to form a jacket of said hood which is pressure-tight in said closed position of said closure elements, said seating elements comprising a number of parallelly arranged and spaced web-shaped valve bodies each having a first valve seating surface and a second valve seating surface such that said movable closure element will seat against said first valve seating surface when the pressure effect thereon is produced by the pressure wave of an atomic explosion and said movable closure element will seat against said second valve seating surface when the pressure effect acting thereon is produced by the suction wave of an atomic explosion.

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