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(71) Applicant
Aktiebolaget Bofors (Sweden),
S-691 80 Bofors, Sweden

(72) Inventor
Johnny Ohlson

(74) Agent and/or Address for Service
Lloyd Wise Tregear & Co.,
Norman House, 105-109 Strand, London WC2R 0AE

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(54) **Linning for detonation chamber**

(57) The present invention relates to a readily replaceable liner for a detonation chamber (1) intended to protect the inside of the chamber from damage when the detonation chamber is used for test firings of fragment-producing charges. The liner consists of a plurality of readily replaceable parts or sections. In the case of cylindrical detonation chambers (1), use is made primarily for protection of the mantle wall of the chamber of rectangular plates or cassettes (20) slightly cupped in one direction, which are held together by a special fitting (29) to form mantle rings covering the inside of the detonation chamber wall (10).

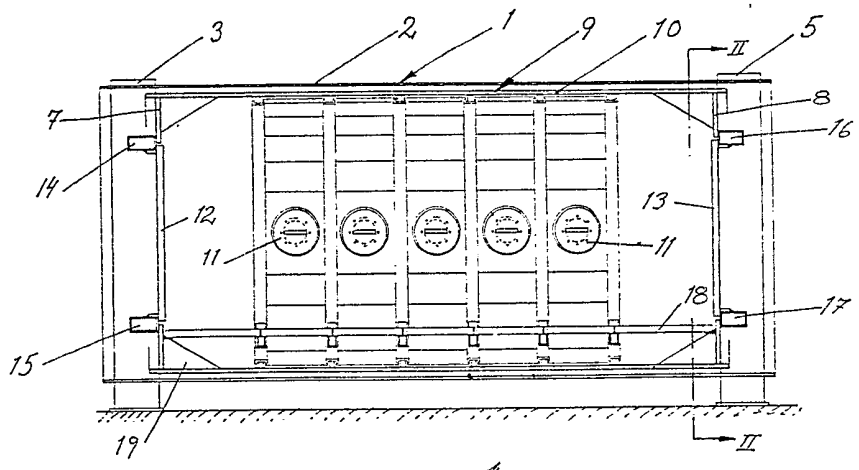

Fig. 1

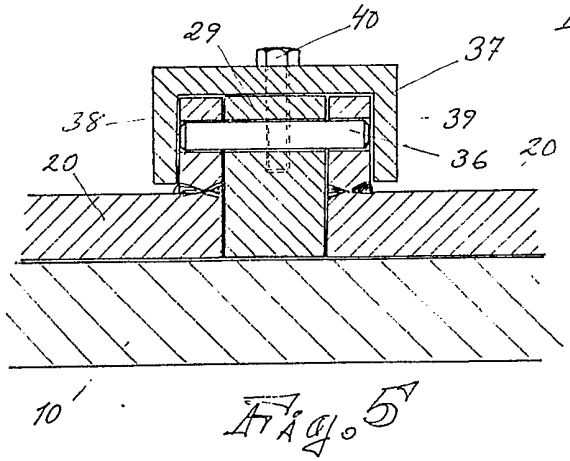

Fig. 5

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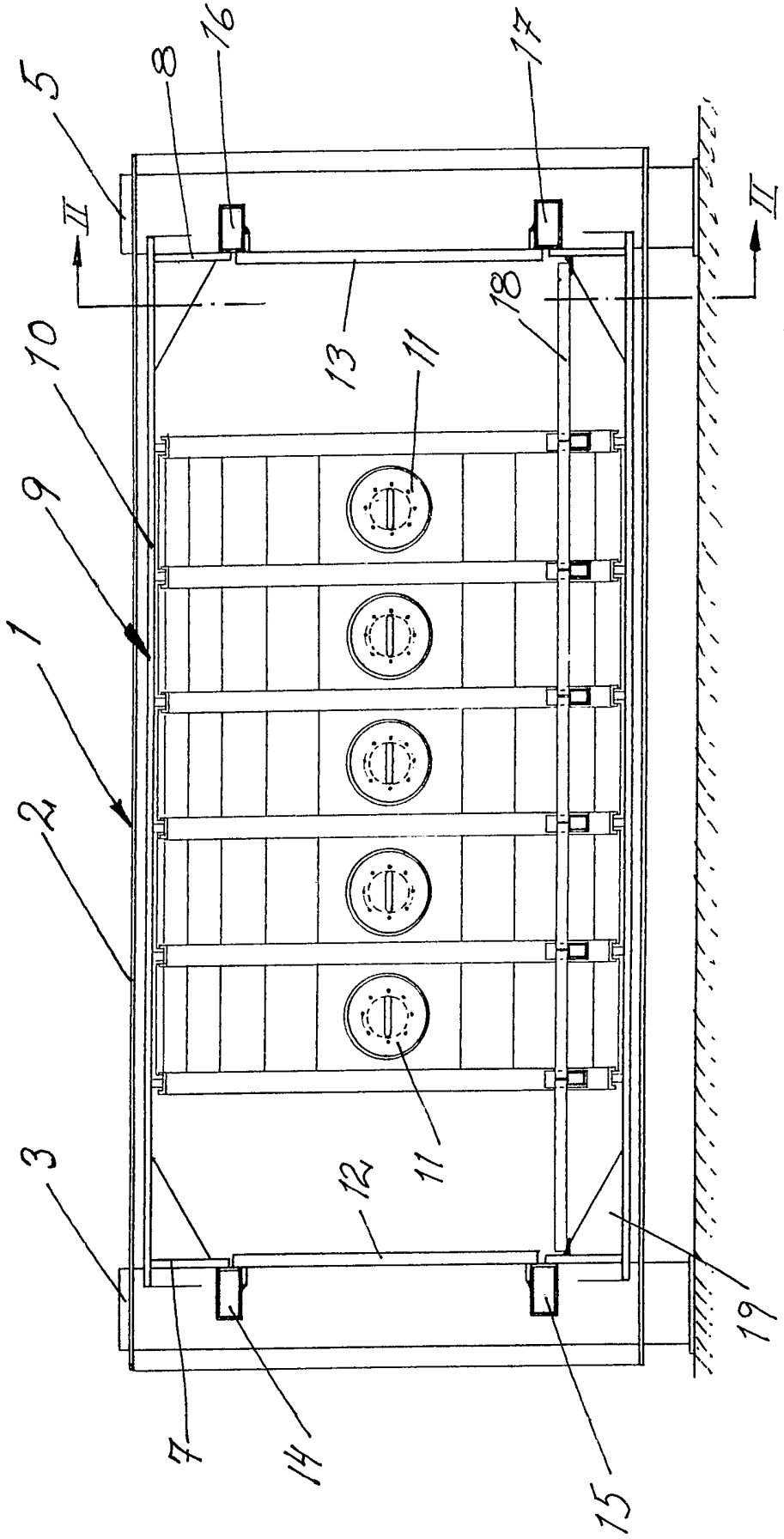

Fig. 1

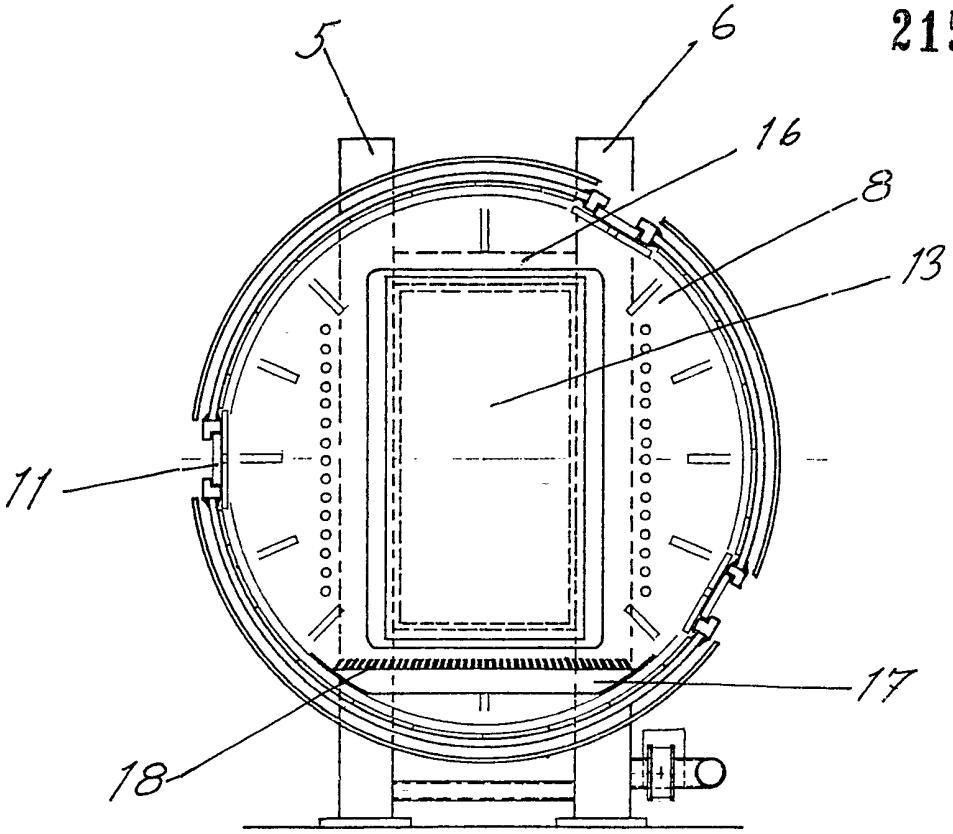

Fig. 2

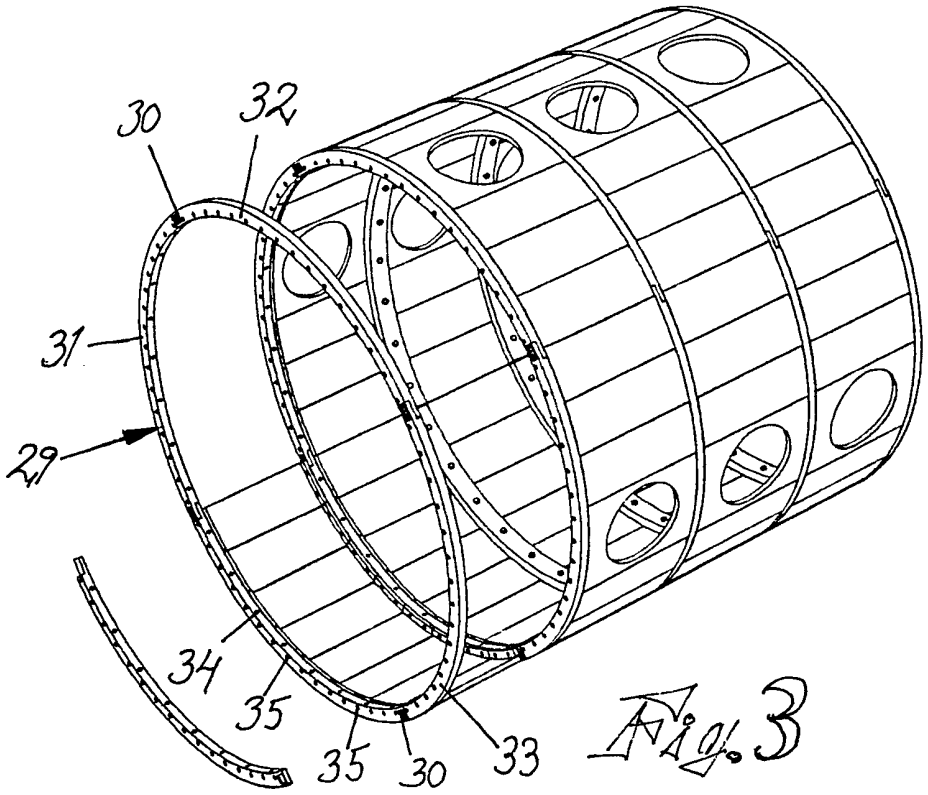

Fig. 3

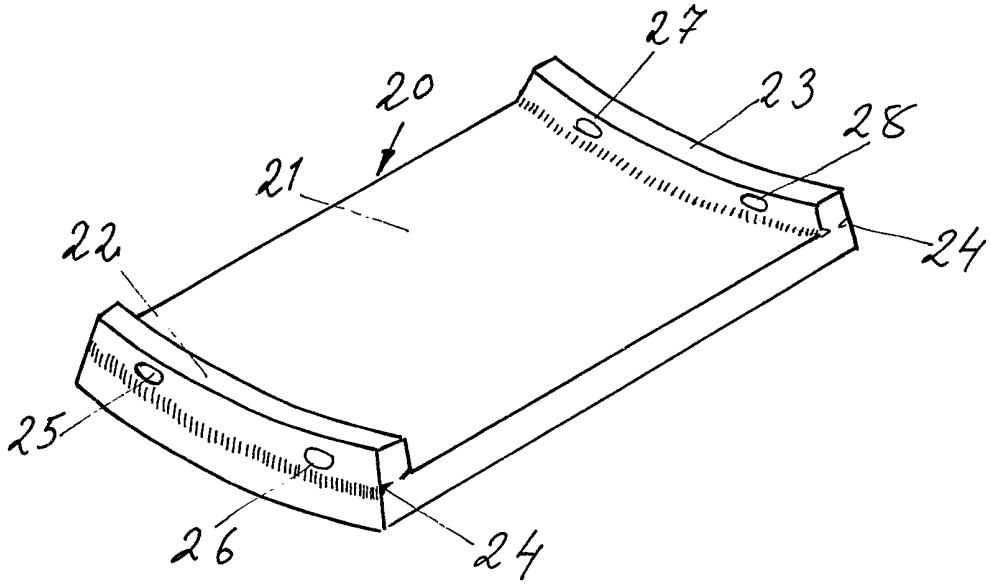

Fig. 4

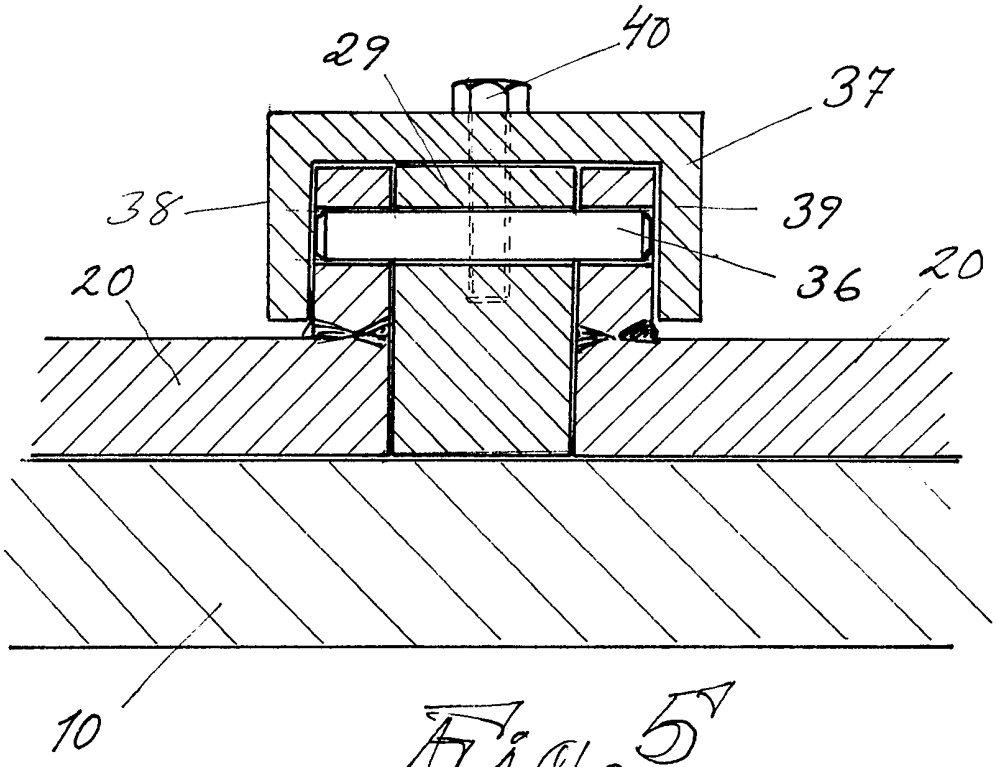

Fig. 5

SPECIFICATION

Detonation chamber

The present invention relates to a container or chamber capable of containing pressure and fragments produced by an explosion such as a detonation or a deflagration.

Containers of this type are commonly known as detonation chambers. They are used, for example, to protect the surroundings by containment of critical manufacturing stages in the production of explosive substances, as test bunkers in test detonations of such substances and for testing of fragmentation weapons, and for storage of explosive goods in general.

The detonation chamber designs available hitherto have virtually always consisted of solid concrete bunkers dug down into the ground. Certain essentially spherical, thick-walled steel structures are also previously known. The lack of lighter detonation chamber constructions is attributable to some extent to the difficulties in producing reliable strength calculation models. During the last few years, however, modern computer technology has enabled calculation programs to be compiled which make it possible to calculate the strength of multi-walled spherical and cylindrical bodies with a very high degree of accuracy. These calculation programs have opened up the possibilities for manufacturing light-weight detonation chamber designs whose strength is known.

A number of such light detonation chamber designs are described in our Swedish patent applications 80 06726-7, 81 05585-7 and 83 05758-8. Of these, the first describes a multi-shell construction with an outer and an inner shell of steel and an intermediate shell of a plastics material serving to prevent the two steel shells from vibrating in phase. This design has proved to completely fulfil everything it promised in terms of strength, but it is difficult to manufacture and even more difficult to repair and therefore relatively expensive. Its low weight, however, makes it suitable for mobile use, e.g. for disarming common terrorist bombs and for containment of critical process stages in otherwise harmless chemical process plants. In this latter field, it is in fact often a requirement that the detonation chamber be located at a height above ground level that is dictated by other process conditions.

The second of the aforesaid detonation chamber types is a cylindrical single shell construction with end pieces which have been strengthened in a special way. The third design is a partly double-shelled, preferably cylindrical, detonation chamber, the inner complete shell of which is clamped at its end pieces between powerful support beams which are anchored inside the end pieces of its cylindrical outer shell. This design is relatively easy to manufacture and is also relatively easy to repair. The cylindrical inner mantle of the chamber is in fact that part which will be damaged in the first instance and this part can be replaced after the outer shell of the chamber has been divided straight across and pulled apart. The repair is then concluded by welding the outer shell together. Although such a replacement of the inner shell is relatively simple in theory, it would nevertheless in practice be a rather expensive and time consuming procedure, partly in view of all the welding work involved.

The risk of damage to detonation chambers intended for test purposes originates primarily from firing of charges giving rise to fragments.

The present invention now relates to a sectioned, readily replaceable liner for a bursting chamber intended to receive the first jolt upon detonation of fragment-producing charges. More particularly, the present invention provides a detonation chamber capable of containing pressure and fragments produced by an explosion, comprising an outer single - or multi-shell casing for containing the pressure generated by the explosion and an inner shell disposed in said casing for containing fragments formed by the explosion, said inner shell being formed of a plurality of individual sections which are held in position so as to be readily replaceable if damaged.

In that the inner shell or linear is divided into a plurality of readily exchangeable sections which can be of a few different standardized forms, any sections damaged by fragments can easily be replaced. Assembled on site, the various liner sections together form a connected lining which is cylindrical detonation chambers should completely cover at least the inside of the mantle surface of the detonation chamber, since it is the inside of the mantle surface that can be expected to be exposed to severe so-called fragment damage. Since the function of the liner to protect the inside of the detonation chamber proper against damage by fragments, the liner sections can therefore be made of relatively inexpensive steel, although they must be given rather sturdy dimensions to stop all fragments. The pressure stresses to which the detonation chamber may be expected to be exposed are, in contrast, absorbed by the ordinary walls of the chamber. Since the liner is not designed to absorb any pressure stresses there is no need for the liner sections to be butt attached in the chamber. On the contrary, it is advantageous if the liner sections are able to rattle slightly in their mountings since by this means the occurrence of vibrations in the same phase as in the ordinary outer wall of the chamber an in the liner can be prevented.

In order to provide adequate protection against fragments, the individual liner sections must be given a fairly considerable thickness. At the same time, this implies that their extent in the sideways direction must be limited in order for the different pieces not to become impossible to handle without cranes or other lifting devices.

In what we have found to be particularly advantageous embodiment of the liner according to the invention, the liner consists, when it is adapted to protect the mantle surface of a cylindrical detonation chamber, of a plurality of rectangular parts or cassettes, slightly cupped in one direction, which placed side-by-side form mantle rings, the outside diameter of which is adapted to the inside diameter of the detonation chamber. The length of each mantle ring in the lengthwise direction of the

detonation chamber and the width of the cassettes and thus indirectly also their quantity in each mantle ring is determined by the thickness of the liner, since each cassette should desirably not be so heavy that it cannot be handled manually. To hold the various cassettes in place within each mantle ring, there is advantageously provided connecting rings or end piece irons to which the cassettes can be attached by means, for example, of pins or bolts. These connecting rings may in themselves be made of several parts joined together provided that they are able to function as a connected unit. The complete liner of the detonation chamber is thus formed by several lengthwise disposed mantle rings of cassettes separated by connecting rings or end piece irons.

For joining the cassettes and end piece irons together it may be appropriate to provide the cassettes with protruding end piece flanges. In order for the joint between the end piece irons and cassettes not to be deformed by fragments, and thus render removal of damaged cassettes more difficult, the joint between the end piece irons and cassettes can be protected by a protective section, such as a readily removable U-section which adjoins and is connected to the inside of the end piece iron.

A preferred embodiment of a detonation chamber according to the invention will now be described in greater detail and with reference to the accompanying drawings, in which:

Figure 1 shows a longitudinal section through the detonation chamber,

Figure 2 shows section II-II of Figure 1;

Figure 3 shows an inclined projection of a part of the sectioned inner shell of the detonation chamber;

Figure 4 shows an inclined projection on a larger scale of the cassettes of the inner shell; and

Figure 5 shows a section on a larger scale across the joint between two adjacent mantle rings of cassettes and interlying ring-shaped fittings.

Corresponding parts have been given the same reference designations in the different figures although they have been drawn to different scales.

The detonation chamber 1 shown in Figure 1 and 2 comprises a cylindrical outer shell (2) inside the ends of which there are four stout beams (3-6). Beam (4) is not shown in these figures. The detonation chamber also includes an inner chamber (9) which is closed towards its ends by means of end pieces (7) and (8), and which is clamped inside and between the beams (3-6). In addition to the end pieces (7) and (8) resting against the beams, this inner chamber includes a mantle wall (10) in which there are a plurality of observation apertures (11).

Provided in the end pieces are doors (12) and (13) respectively. These doors open inwards towards the chamber (9). They are supported by the beams (3-6) and cross beams (14-17). Welded in between the end pieces (7) and (8) and the mantle wall (10) are a plurality of triangular reinforcement plates (19). In addition the detonation chamber is provided with a latticed floor plate (18).

The sectioned inner shell which is provided according to the invention is disposed along the inside of the middle section of the shell wall (10) of the inner detonation chamber. This sectioned inner shell comprises rectangular plates or cassettes (20), slightly cupped in one direction, which disposed side-by-side form mantle rings which completely cover the inside of the mantle wall (10) along the part thereof where it is disposed.

As evident from Figure 4 each cassette has a rectangular bottom part (21), slightly cupped along one axis, and two protruding end pieces or flanges (22) and (23). The flanges follow the curvature of the bottom section. The simplest way of manufacturing these end pieces is to preshape them and weld them on site. Each flange has two or more through holes (25-28). The flanges are welded to the bottom sections throughout the length of the joint (24). The flanges (22, 23) of the cassette are applied to annular fittings (29) which are provided between adjacent mantle rings of cassettes. The fittings (29) may themselves consist, as evident from Figure 3, of a pluarlity of parts (31-34) joined together by bolts (30). In the fittings (29) are a plurality of apertures (35), the spacing between which corresponds to the spacing between the holes (25-28) in the flanges of the cassettes.

The cassettes (20) are joined together with the fittings (29) by means of smooth pins (36) (see Figure 5) which are inserted through their respective holes. In addition, the joint between adjacent cassettes and interlying fittings is covered by a U-shaped protective rail (37) which is attached to the inside of the fitting and which extends with its flanges (38,39) past the apertures concerned to prevent the pins from falling out. The protective rail (37) is attached to its respective fitting (29) by means of bolts (40) threaded into it.

When joining the parts of the inner shell together, no absolute fit is aspired to. On the contrary, it is an advantage if the parts are able to rattle in relation to each other in order to prevent vibrations in phase. The holes for pins and bolts can therefore be made slightly out of round. The protective rails (37) grip across the end pieces (22,23) of the cassettes (20), thus preventing these and the fittings (29) from sliding apart.

CLAIMS

1. A detonation chamber (1) capable of containing pressure and fragments produced by an explosion, characterized in that it comprises an outer single or multi-shell casing (2,9) for containing the pressure generated by the explosion, and a inner shell disposed in said casing for containing fragments formed by the explosion, said inner shell being formed of a plurality of individual sections which are held in position so as to be readily replaceable if damaged.

2. A detonation chamber according to Claim 1, characterized in that said outer casing (2,9) comprises a cylindrical mantle (10) screened off towards its ends by cross bulkheads (7,8) and in that the sectioned inner shell, which covers completely at least the middle section of the inside of the said mantle (10) is formed of substantially rectangular plates or cassettes (20) slightly cupped in one direction and held in position in side-by-side re-

lationship to form mantle rings located around the inside of said mantle (10).

3. A detonation chamber according to Claim 2, characterized in that the plates or cassettes (20) forming said mantle rings are held in side-by-side relationship by means of ring-shaped fittings (29) which follow the inside surface of said mantle (10) and to which said plates or cassettes are releasably attached at their ends.

4. A detonation chamber according to Claim 3, characterized in that each ring-shaped fitting (29) disposed at the ends of the plates or cassettes is itself composed of several sections (31-35) joined together.

5. A detonation chamber according to Claim 3 or Claim 4, characterized in that each plate or cassette (20) includes flanges (22, 23) along its cupped ends, provided with mounting means (36), for releasable attachment of said plate or cassette to said ring-shaped fittings (29).

6. A detonation chamber according to Claim 5, characterized in that protective means (37) are attached to the ring-shaped fittings (29) to protect the joint between said fittings and adjacent plates or cassettes (20) attached thereto.

7. A detonation chamber according to Claim 5 or Claim 6, characterized in that the ring-shaped fittings (29) and the plates or cassettes (20) are releasably attached together by means of locking pins (36) which are inserted through registering appertures in the flanges (22, 23) and the ring-shaped fittings, and in that the locking pins (36) are kept in place by said protective means (37) of the ring-shaped fittings (29), which are in the form of bent U-sections which extend past the apertures for the locking pins.

8. A detonation chamber according to any of the preceding claims, characterized in that the joints between the parts forming the inner shell permit a small amount of movement between the parts.

9. A detonation chamber substantially as hereinbefore described with reference to the accompanying drawings.

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