United States Patent

[111] 3,620,405

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[21] Appl. No. **41,860**
[22] Filed **June 1, 1970**
[45] Patented **Nov. 16, 1971**

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[32] Priority **June 3, 1969**
[33] **Germany**
[31] **P 19 28 169.7**

[54] **CLOSURE SYSTEM FOR HIGH-PRESSURE VESSELS**
5 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **220/40,** 220/39, 220/46, 220/3, 220/29
[51] **Int. Cl.** **B65d 41/06**
[50] **Field of Search** 220/39, 40, 46, 29, 3; 18/16

[56] **References Cited**
UNITED STATES PATENTS

3,315,836	4/1967	Boon	220/46
3,537,611	11/1970	Lohrenger	220/40

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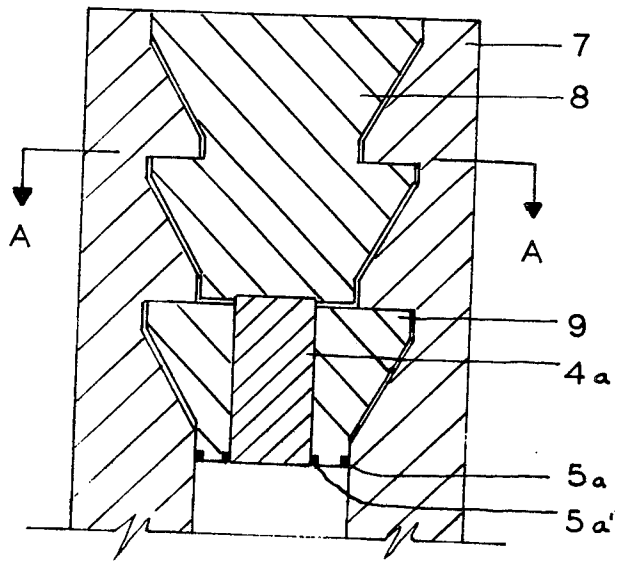
ABSTRACT: A closure for the open end of a high-pressure vessel is formed of two or more plugs, in the nature of pistons that cooperate to seal the end of the vessel, each of which is supported by engagement with a portion of the wall of the vessel different from the portion or portions supporting the other plug or plugs. The plugs may be in the form of a cylindrical piston, and encircling annular pistons or a series of plugs with varying effective areas. The plugs themselves or through intermediate members are individually supported from axially spaced portions of the vessel wall.



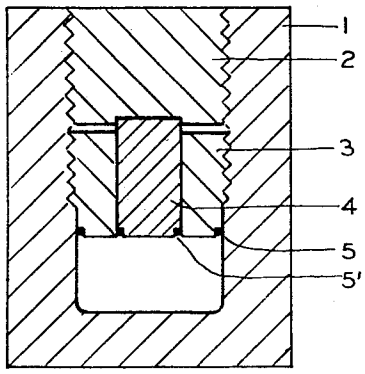


FIG. 1

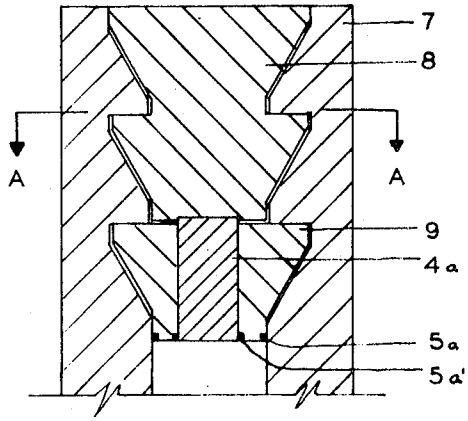


FIG. 2

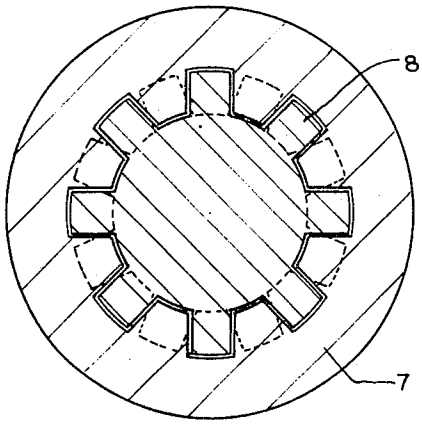


FIG. 3

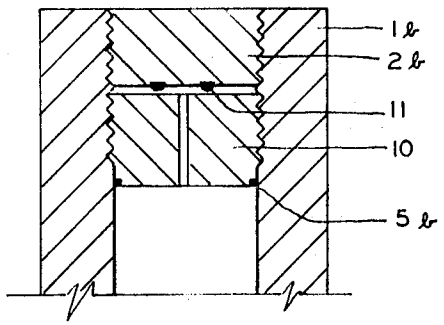


FIG. 4

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CLOSURE SYSTEM FOR HIGH-PRESSURE VESSELS

BACKGROUND OF THE INVENTION

For high-pressure vessels closed by a plug on the front end, it is necessary to achieve optimum distribution of the stresses occurring in the contact areas of plug and vessel wall in order to avoid local stress concentrations and to reduce the risk of breaking.

It is known that standard or special threadings of continuous or interrupted design are used to obtain the force transmission coupling between the high-pressure vessel and plug, particularly for self-sealing or partly self-sealing closure systems. Bayonet-type plugs are also used.

The disadvantage of these assemblies is the nonuniform distribution of the load over the length of the threaded coupling. It is known, for example, that the vessel is subject to particularly high-peak stresses in the area of the first load-bearing thread. A similar phenomenon is found in bayonet closures where the load is sustained primarily by the first cam ring or by the single cam ring. Owing to the high internal pressure, the load-bearing section of high-pressure vessels is subject to additional radial deformation with peak stresses occurring at the point of transition between vessel and plug. These stresses add to those present in the closure with consequent addition to excessive stress concentration. This stress concentration might rise to a value where the creep strength is substantially reduced, especially at a first load-bearing thread. This means a marked reduction in the safety of high-pressure vessels.

SUMMARY OF THE INVENTION

The object of the invention is to prevent stress concentrations in the closure system of high-pressure vessels in order to increase both operation safety and service life of such equipment, while permitting at the same time a less sturdy construction of the equipment.

According to the invention, the problem is solved by sectionalizing the closure into two or more closure pieces sustaining the fluid pressure, said pieces transferring the load proportionately to optimal areas of the vessel-closure wall section.

The forces are introduced into the vessel wall through a piston and an annular piston either mechanically or hydraulically. By dividing the closure into a pressure-bearing piston and annular piston it is possible to transfer given forces produced by the internal pressure, which forces can be exactly defined by the size of the piston and annular piston areas, into any sections of the coupling between the closure plugs and the wall of the high-pressure vessel in such a way as to avoid the disadvantage inherent in conventional designs. The distribution of the forces introduced into the vessel wall ensures that no plastic deformation will occur at any point of the closure system; in addition, it permits using a less sturdy construction while at the same time increasing the service life and operating safety.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal section of a high-pressure vessel having a closure constructed according to the invention.

FIG. 2 is a fragmentary longitudinal section of a high-pressure vessel employing a "bayonet-plug" coupling between the plugs and the vessel wall.

FIG. 3 is a transverse section taken along the line A—A of FIG. 2, showing the parts in disengageable or unlocked position.

FIG. 4 is a fragmentary longitudinal section of an alternative form of divided or sectionalized closure plug.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Examples of the improved closures are illustrated in FIGS. 1 to 4 inclusive. Referring to FIG. 1, the drawing illustrates a high-pressure vessel 1 having an opening that is closed by closure means including a threaded plug. The closure means inserted into the high-pressure vessel 1 comprises an outer-threaded plug 2, an inner annular-threaded plug 3 including a pressure-receiving face, a pressure-receiving element or piston 4, and gaskets 5 and 5'. The force of the internal pressure acting upon the face of the annular-threaded plug 3 is transferred, within the area of the plug threads, to the vessel wall. The force of the internal pressure acting upon piston 4 is transferred by the piston to the outer-threaded plug 2. Within the area of the threads of this plug, the resultant forces are transferred to the vessel wall.

Depending on the area selected for annular threaded plug 3 and piston 4 with respect to the total load-bearing area of the closure, the forces are introduced proportionately into the threaded sections of the high-pressure vessel.

Referring to FIG. 2, the drawing illustrates a high-pressure vessel closure with bayonet plug. The closure inserted into high-pressure vessel 7 comprises an outer bayonet plug 8, an inner bayonet plug 9 of annular shape, a piston 4*a*, and gaskets 5*a* and 5*a'*. Similar to the principle shown in FIG. 1, the use of piston 4*a* leads to a proportionate distribution of the sealing force upon the load-bearing areas of the outer and inner plugs 8 and 9, consequently, to the distribution of the forces over several areas of the vessel closure section. The sectional view, FIG. 3, shows that the bayonet closure is a quick-closing device that can be engaged by a fraction of a turn.

An equivalent interrupted thread closure, i.e. one in which the periphery of the plug and corresponding wall are divided into sections with the threads cut away in alternate sections to allow the plug to be inserted without rotation and then locked by a fraction of a turn, may be substituted for the bayonet structure.

Referring to FIG. 4, the drawing illustrates a high-pressure vessel closure with threaded plug. The closure inserted into high-pressure vessel 1*b* comprises an outer threaded plug 2*b*, an inner threaded plug 10 with a bore, and gaskets 5*b* and 11. Through the bore of threaded plug 10, the area of the outer threaded plug 2 bounded by gasket 11 is exposed to the fluid pressure, and threaded plug 10 is unloaded accordingly, i.e., the effective area of the plug 10 is equal to that annular area between the wall of the vessel and the gasket 11.

In this way again, the sealing force is distributed to two distinct areas of the high-pressure closure.

In a broader sense of the invention, the closure may be divided into more than two plugs with adequate pistons or with boreholes for the passage of the pressure fluid.

High-pressure vessels may be equipped with one or more closures as described above.

We claim:

1. In a high-pressure vessel arrangement, a closure means comprising a plurality of pressure-receiving elements, each element having an effective pressure-receiving area constituting a selected portion of the closure area and each element having support means engaging a separate portion of the vessel wall.

2. A high-pressure vessel closure arrangement according to claim 1 in which the pressure-receiving elements include at least one annular plug surrounding a piston, each being exposed to pressure in the vessel.

3. A high-pressure vessel closure arrangement according to claim 1 in which the support means for each element includes threaded means engaging threads in the wall of the vessel.

4. A high-pressure vessel closure arrangement according to claim 1 in which the support means includes a bayonet connection to the wall of the vessel.

5. A high-pressure vessel closure arrangement according to claim 1 in which at least one pressure-receiving element is exposed to pressure on opposite faces, the exposed effective area of one face being greater than the exposed effective area of the opposite face.

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