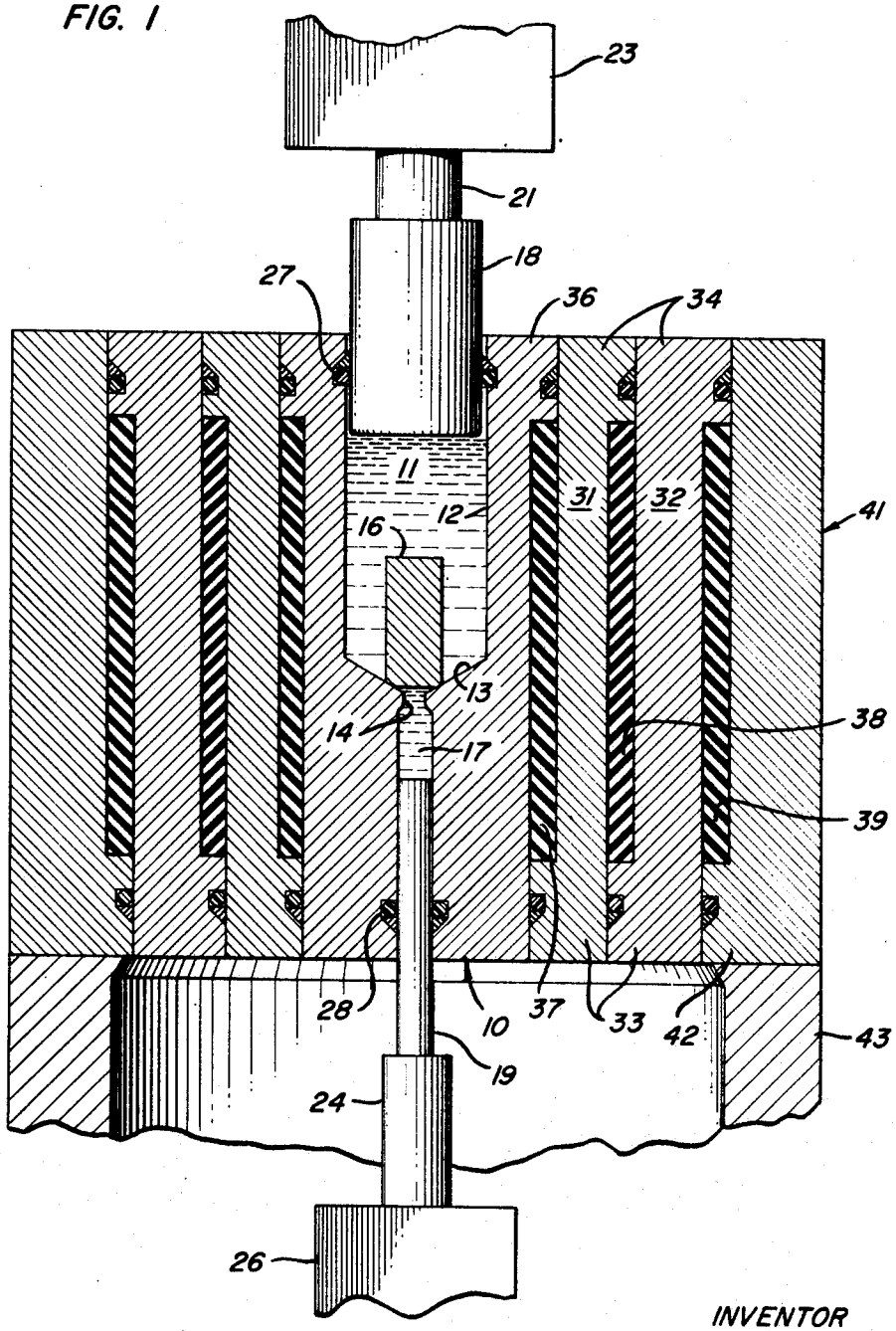
July 23, 1968 F. J. FUCHS, JR 3,393,820

MULTI-WALL HIGH PRESSURE CHAMBERS

Filed Feb. 3, 1966 3 Sheets-Sheet 1

FIG. 1

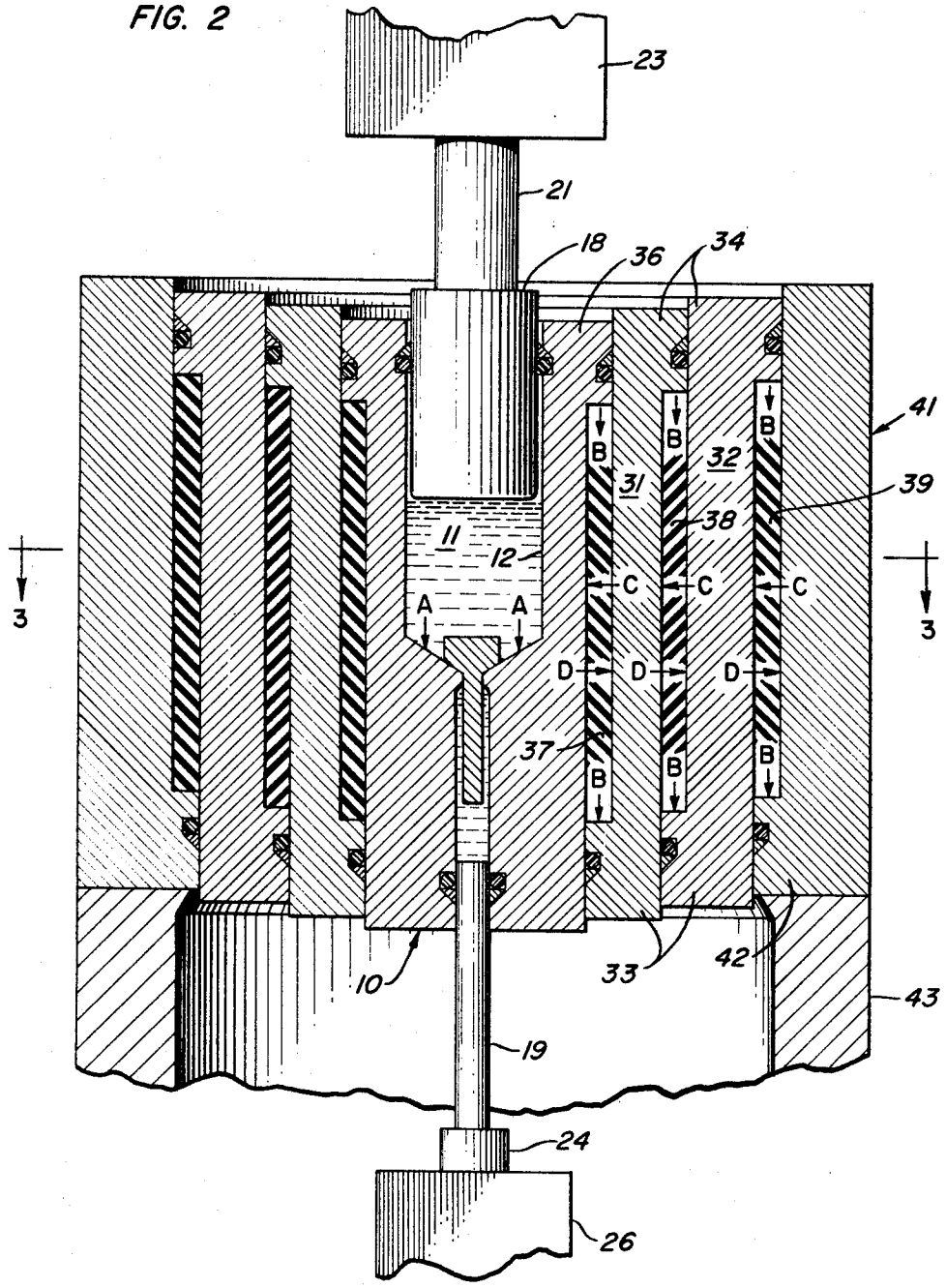


INVENTOR
F. J. FUCHS, JR.
BY R. P. Miller
ATTORNEY

MULTI-WALL HIGH PRESSURE CHAMBERS

Filed Feb. 3, 1966 3 Sheets-Sheet 2

FIG. 2

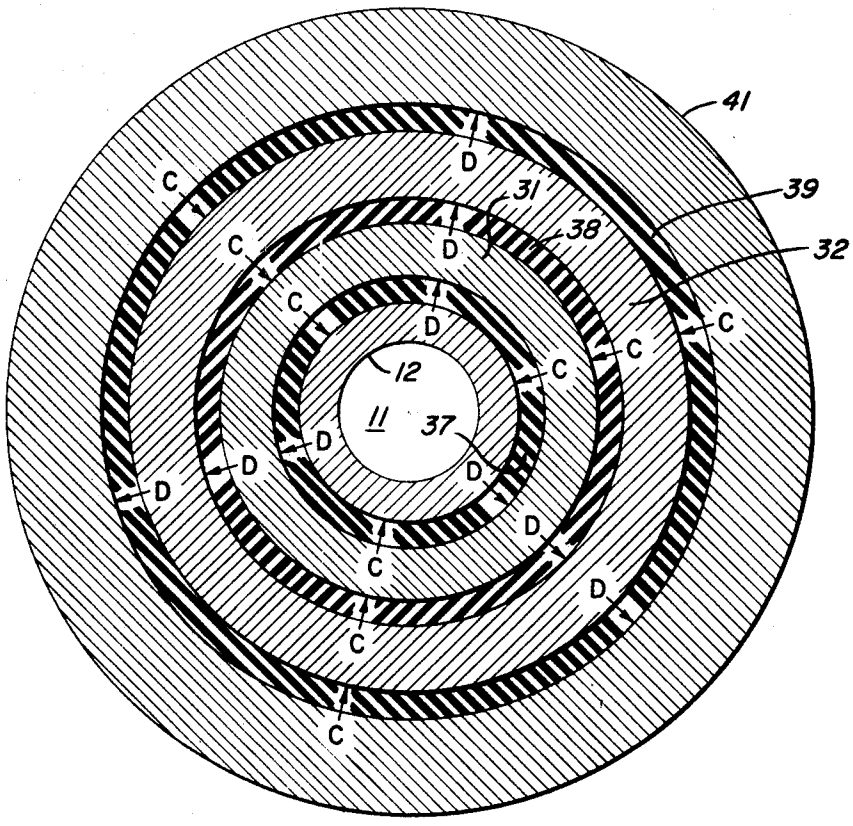


July 23, 1968 F. J. FUCHS, JR 3,393,820

MULTI-WALL HIGH PRESSURE CHAMBERS

Filed Feb. 3, 1966 3 Sheets-Sheet 3

FIG. 3



United States Patent Office 3,393,820 Patented July 23, 1968

3,393,820

MULTI-WALL HIGH PRESSURE CHAMBERS

Francis J. Fuchs, Jr., Princeton Junction, N.J., assignor to Western Electric Company, Incorporated, New York, N.Y., a corporation of New York

Filed Feb. 3, 1966, Ser. No. 524,739
7 Claims. (Cl. 220—3)

This invention relates to multi-wall high pressure chambers and more particularly to an array of concentric chambers wherein axial force components of pressures developed within an inner chamber are converted by facilities positioned between the other chambers to radial forces opposing radial forces generated within the inner chamber.

In many high pressure metal forming operations, it is imperative that forming chambers be provided having special wall construction to either dissipate or counteract the detrimental effects of radial expansion forces. If a solid wall construction is used, the required wall thickness is of such size as to require the utilization of excessive masses of metal. Further, with such a thick wall construction, detrimental stress concentrations are encountered due to stress gradients developed across the thickness of the wall.

In order to obviate these difficulties, resort has been made to multi-thin wall construction wherein the stress gradients across each wall thickness are maintained fairly uniform during the generation of the high forming pressures. If each wall abuts the next succeeding wall, the inner wall is still subjected to excessive pressures inasmuch as this inner wall must absorb the total forming pressure before the pressure is transferred to the next succeeding wall section. This difficulty is also encountered in wall constructions of successive convolutions of a single band. A further expedient to obviate the difficulty of working with high pressures includes a wall construction consisting of a plurality of concentric wall members spaced apart so that pressurized fluid may be introduced between the wall sections to counteract the effects of radial expansion; e.g. see applicant's co-pending application Serial No. 436,128, filed March 1, 1965. Still another solution to the problem of counteracting the detrimental effects of high pressures is to provide a chamber surrounded by a series of concentric walls together with successively effective facilities to transfer the counteraction of the radial forces from one wall section to the next, e.g. see applicant's co-pending application Ser. No. 512,641 filed Dec. 9, 1965.

An object of this invention resides in a new and improved multi-wall high pressure chamber.

An additional object of the invention is the provision of a multi-wall high pressure forming chamber wherein axial forces generated within an inner wall are utilized to impress axial forces on the other walls while simultaneously transforming components of these forces into radial forces which oppose the radial expansion of the respective walls.

A further object of the invention resides in the telescopic arrangement of the wall sections with facilities between each pair of wall sections for converting forces tending to slide one wall over another into forces acting in a transverse direction to oppose forces acting against an interior wall section.

With these and other objects in view, the present invention contemplates a high pressure chamber having telescoping wall sections together with facilities. interposed between the wall sections, responding to axial forces within an inner wall section for converting components of these forces into radial forces which oppose the expansion of the inner wall section. Each wall section has spaced inwardly and outwardly extending projections which cooperate to support each other and the interposed facilities. These facilities may comprise ring-like members constructed of resilient material. Upon impression of high pressures to a workpiece within an inner wall section, axial force components are transferred to each succeeding wall section whereupon these wall sections are urged to move in axial directions to compress the resilient material and thus generate force components which oppose the expansion of each preceding wall section.

Other objects and advantages of the present invention will be apparent from the following detailed description when considered in conjunction with the accompanying drawings, wherein:

FIG. 1 is a side view partially in section, showing a high pressure forming chamber having a multi-wall construction embodying the principles of the present invention;

FIG. 2 is a side view similar to FIG. 1, particularly illustrating exaggerations of axial displacements of the walls during a high pressure forming operation; and

FIG. 3 is a cross sectional view taken along line 3—3 of FIG. 2 depicting force vectors acting on the walls during the forming operation.

Referring first to FIG. 1, there is shown an inner cylindrical forming block **10** having a cylindrical chamber **11**. Chamber **11** is defined by a wall section **12** converging at its lower extremity in a shoulder **13** which, in turn, terminates in an extrusion orifice **14**. A billet **16** may be positioned on the shoulder **13** and extruded through the orifice **14**, upon application of pressurized fluid to the chamber **11**. The extrusion orifice **14** flares out into a receiving chamber **17**.

In order to pressurize the fluid within chambers **11** and **17**, a pair of rams **18** and **19** are provided. Ram **18** is connected to a piston rod **21** extending into a high pressure fluid cylinder **23**. Ram **19** is connected to a piston rod **24** extending into a second high pressure cylinder **26**. Suitable seals **27** and **28** are provided to confine the fluid within the chambers **11** and **17**.

Considering now the facilities which are utilized to compensate for the radial expansion forces generated within the chamber **11**, there is provided a plurality of concentric bands **31** and **32** having inwardly projecting flanges **33** and outwardly projecting flanges **34**. The wall section **12** is provided with a flange **36** which engages the upper portion of a compressible or pressure transmitting member **37**. The lower portion of the compressible member **37** rests against the inner flange **33**. This compressible member **37** may be composed of a viscous liquid, neoprene, indium, or other materials which are fluid, elastic, or resilient under pressure. Similar members **38** and **39** are interposed between the other outwardly and inwardly projecting flanges **33** and **34**. Surrounding the outer member **39** is a ring or cylindrical band **41** having an inwardly projecting flange **42** for supporting the outer compressible member **39**. The outer and inner rims of the respective flanges abut the inner and outer walls of the forming block **10** and the concentric bands **31**, **32**, and **41**. The

outer cylinder **41** rests on a stationary support frame **43**. It may be thus appreciated that the support frame **43** supports the outer cylindrical band **41** and the interposed members **39**, **38**, and **37**, the concentric bands **32** and **31**, and the forming block **10**.

As illustrated in FIG. 3, the wall **12** and bands **31**, **32**, and **41** are shown in a cylindrical or circular configuration. It is to be understood that these members may be of other geometrical configuration such as, rectangles or squares.

In operation of the device, the ram **18** is withdrawn and a billet **16** positioned on the shoulder **13** over the extrusion orifice **14**. Fluids is introduced into the chambers **11** and **17** and the rams **18** and **19** move toward each other by operation of the fluid cylinders **23** and **26** to pressurize the fluid within the chambers. The fluid is pressurized to such an extent as to render the billet **16** ductile. The ram **19** is then withdrawn resulting in a pressure differential existing between the fluid in the chamber **11** and in the chamber **17**. The billet is thereupon extruded through the orifice **14**. Obviously, it may be appreciated that other metal forming operations may be performed in chamber **11** such as bending, shaping, etc. Further, it is to be understood that ductile materials, such as copper, may be formed by use of lower pressures.

The pressurized fluid in the chamber **11** has a force component acting in a longitudinal or axial direction as indicated by the vectors A (FIG. 2). These longitudinal forces are transferred through the block **10** to the flange **36** to act against the compressible member **37** as indicated by the force vectors B. Application of compression forces to member **37** result in the exertion of radial forces acting inwardly and outwardly as represented by the force vectors C and D. The pressurized fluid in the chamber **11** acts against the wall section **12** tending to expand this wall section, whereupon this expansion is counteracted by the force vectors C acting inwardly against the outer surface of the wall section. In a like manner, the axial force vectors B results in the application of similar forces to the flanges **33** and **34** which function to apply compression forces to the members **38** and **39** thereby transforming these axial forces into outwardly and inwardly forces which further act to oppose the expansion of the wall section **12**. As the members **37**, **38**, and **39** are compressed, the forming block **10** and the concentric members **31** and **32** will be urged to move in telescoping fashion to axial positions as shown in exaggeration in FIG. 2. Inasmuch as the outer cylindrical member **41** is resting on a stationary block **43**, this member will not move.

With the construction illustrated in the drawing, it is possible to use relatively thin members for wall section **12** and the bands **31**, **32**, and **41**. With the thin wall construction, the pressure gradients across the respective wall members are relatively uniform, thus, avoiding the generation of detrimental stress concentrations on the inner surfaces of these members.

It is to be understood that the above-described arrangements of apparatus and construction of elemental parts are simply illustrative of the application of the principles of the invention and many other modifications may be made without departing from the invention.

What is claimed is:

1. A pressure vessel comprising:
an inner ring providing a pressure chamber;
an outer ring surrounding said inner ring;
said rings mounted for relative axial movement and provided with members defining a space therebetween; and
means provided in said space and for providing lateral support to said inner ring upon said pressure chamber containing a pressurized fluid medium under sufficient pressure to cause relative axial movement between said rings.

2. A pressure vessel comprising:
a pair of concentric cylinders mounted for relative axial movement, and the inner cylinder of said pair providing a pressure chamber;
the adjacent walls of said cylinders provided with members defining a space between said cylinders;
a compressible, pressure transmitting member provided in said space; and
upon said pressure chamber containing a pressurized medium under sufficient pressure to cause relative axial movement between said cylinders, said members movable toward each other to compress said compressible member to case said member to exert supporting pressure against said inner cylinder to assist said inner cylinder in containing said pressurized medium.

3. A pressure vessel comprising:
a plurality of concentric cylinders mounted for relative axial movement and the adjacent walls of said cylinders provided with flanges defining a closed space between adjacent cylinders;
each of said spaces containing a compressible, pressure transmitting medium; and
upon relative axial movement between said cylinders, said flanges for compressing said compressible pressure transmitting media to cause said media to develop and apply radial support force to the inner cylinders of said plurality.

4. A pressure vessel comprising:
concentric rings, spaced apart and relatively movable in axial directions;
a medium in said space between said rings; and
means confining said medium so that relative axial movement between said rings compresses the medium to develop radial support forces.

5. In a high pressure chamber,
an inner hollow cylinder having an inwardly extending shoulder and an outwardly extending flange, said shoulder being axially spaced from said flange,
a support means,
axially compressible and radially expandable means interposed between said support means and said outwardly extending flange for supporting said hollow cylinder, and
means for applying axial forces within said cylinder to act upon said shoulder to urge said cylinder to move relative to said support means and axially compress and radially expand said interposed means.

6. In a high pressure forming chamber,
a cylindrical chamber having an inwardly projecting circumferential section for receiving fluid, said chamber having a radially extending flange,
a plurality of concentric cylinders spaced apart and positioned about said chamber,
each cylinder having an inwardly projecting flange to abut the outer surface of the next succeeding inner cylinder, and an outwardly projecting flange to abut the inner surface of the next succeeding outer cylinder,
a compressible member positioned between each inwardly projecting flange and its associated outwardly projecting flange on the next succeeding inner cylinder, and
means for pressurizing the fluid within the cylindrical chamber to develop axial forces in each of said cylinders which act on said compressible members to impart radial forces on said cylindrical members.

7. In a high pressure chamber,
an inner hollow cylinder having a shoulder projecting into one end of said cylinder and a flange projecting from the outer surface at the opposite end of said cylinder,
a series of concentric bands positioned about and spaced from each other and said outer surface of said cylinder,
each of said bands having an inwardly projecting flange extending from one end of the inner surface thereof

and an outwardly projecting flange extending from the opposite end of the outer surface thereof, said flanges arranged so that the first inwardly projecting flange is spaced from the flange on the inner cylinder and each other outwardly extending flange is spaced from the inwardly extending flange on the next succeeding band,

means for supporting the outer band,

means interposed between each outwardly extending flange and each associated inwardly extending flange on the next succeeding band for supporting each succeeding inner band and the inner cylinder, and

means for applying forces to said shoulder which are successively transferred by the flanges and the interposed means to said supporting means while applying compression forces to said interposed means to exert inwardly directed forces against the outer walls of said cylinder and said inner bands.

References Cited

UNITED STATES PATENTS

667,525	2/1901	Huber	72—60
2,558,035	6/1951	Bridgman	72—60
3,243,985	4/1966	Green	72—260

RICHARD J. HERBST, *Primary Examiner.*

G. P. CROSBY, *Assistant Examiner.*