Sept. 22, 1942. T. TINKER 2,296,620

CLOSURE FOR PRESSURE VESSELS

Filed May 11, 1939 2 Sheets-Sheet 1

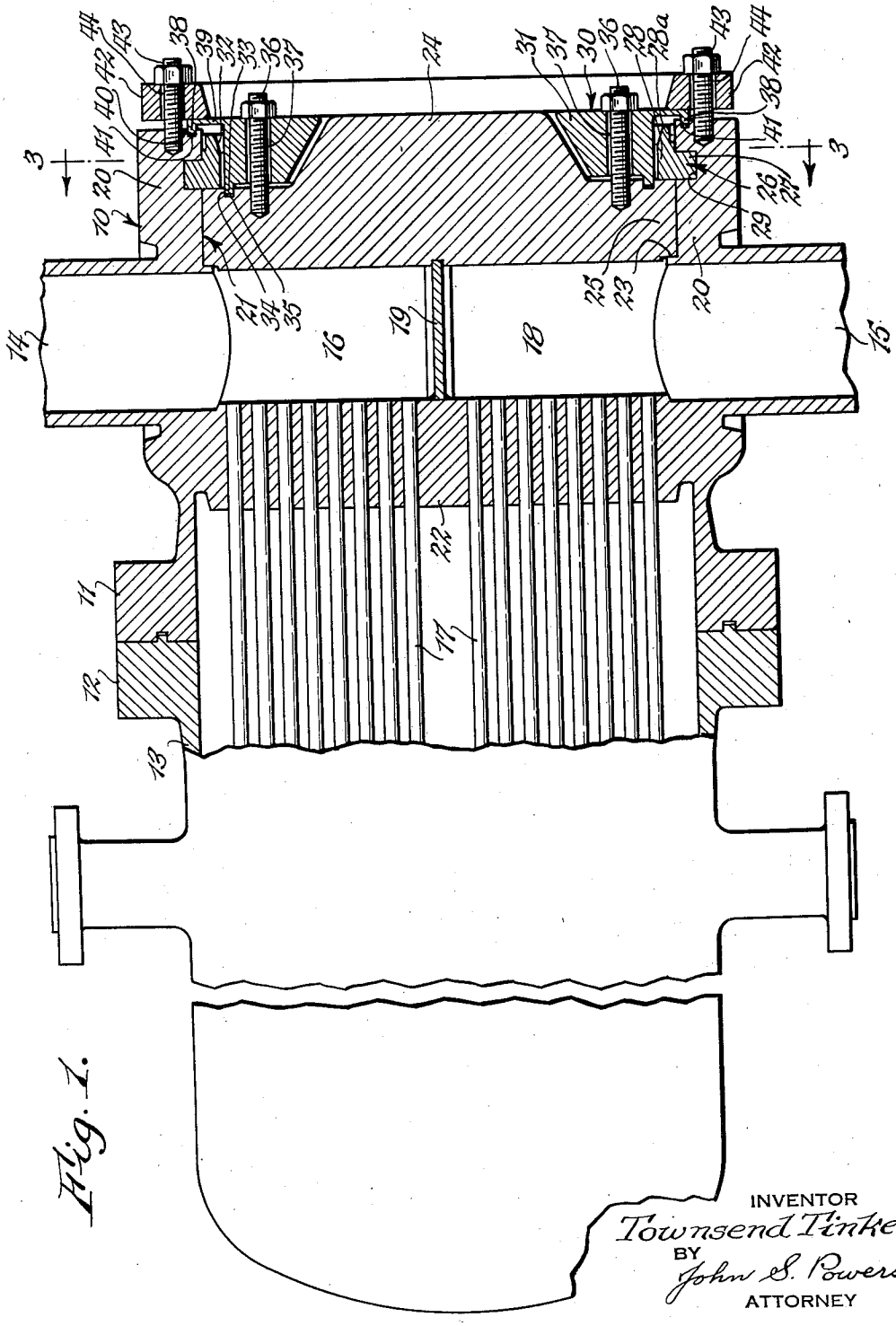

Fig. 1.

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Fig. 2.

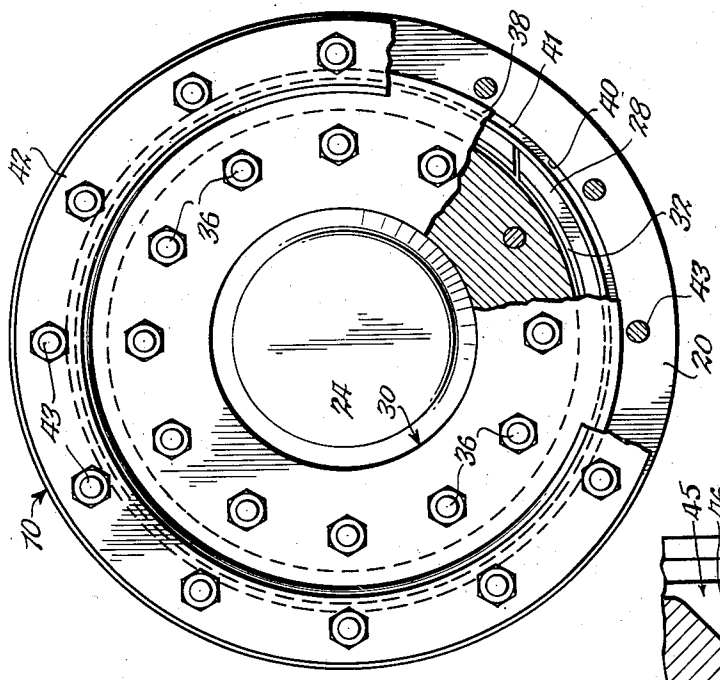


Fig. 3.

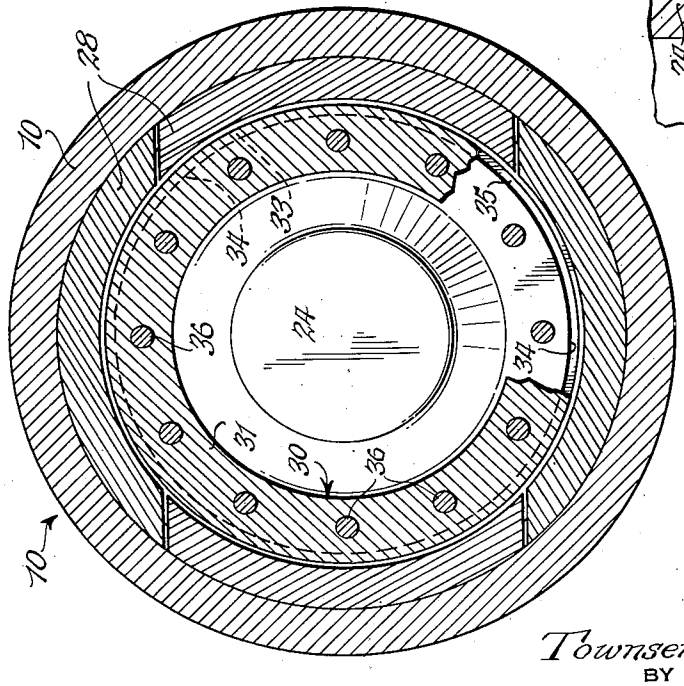
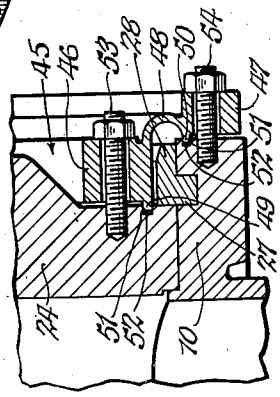


Fig. 4.



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2,296,620

CLOSURE FOR PRESSURE VESSELS

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2 Claims. (Cl. 220—46)

This invention relates to closures for pressure vessels such as heat exchangers, for example, and more particularly is concerned with improvements in closures of the so-called high pressure type which include a removable cover adapted to take up the greater part of the total hydrostatic thrust and an independently secured sealing member associated with the cover in such a manner as to be subjected to only a small part of such thrust.

One object of the invention is to provide a novel design and arrangement of the parts of the closure, whereby to attain simplicity, compactness and economy in construction and facilitate assembling and dismantling operations.

A further object is to facilitate access to the sealing surfaces to enable their inspection, adjustment and replacement as occasion may demand without the necessity of removing the cover or any other heavy or unwieldy parts, this object contemplating a construction wherein the sealing member and the securing means therefor are both exteriorly located.

A still further object is to provide a closure which is adapted to provide a highly effective seal without the necessity of accurately fitting the parts and despite an initial failure of the co-operating sealing surfaces to firmly engage one another throughout their entire extent.

The invention is illustrated in the accompanying drawings in which:

Figure 1 is a view partially in elevation and partially in section of a heat exchanger having a closure embodying the features of the invention.

Figure 2 is an end view thereof, portions of the closure being shown in section.

Figure 3 is a section taken along line 3—3 of Figure 1.

Figure 4 is a fragmentary sectional view of a modified form of closure.

The invention is illustrated, by way of example, in connection with a heat exchanger. The latter includes a header 10 which is provided with a flange 11 for connection to the co-operating flange 12 of the shell 13 and which is formed with inlet and outlet connections 14 and 15, respectively. The fluid medium under high pressure is introduced into the exchanger through the connection 14. It enters a chamber 16 and is conducted through the shell by tubes 17 to a second chamber 18 from which it is discharged through the connection 15, the chambers 16 and 18 being separated by a pass partition 19. At the outer end of the header 10 the annular wall 20 thereof defines an opening 21 through which access may be had to the chambers 16 and 18 and the tube sheet 22 to enable cleaning, repairing and replacement of the tubes at the required intervals. The construction of the shell is conventional and is not involved, hence requires no description.

In accordance with the invention the opening 21 is countersunk to form a narrow annular ledge 23. The latter provides a seat for a cover 24 which fits loosely in the opening and which co-operates with the partition 19 to prevent communication between the chambers 16 and 18 except by way of the tubes 17. As illustrated, the cover 24 is formed with a relatively thick central portion and a rim 25 of reduced thickness. It is secured in the opening 21 against the hydrostatic thrust of the fluid medium passing through the chambers 16 and 18 by a key 26. The latter is in the form of a ring and comprises a plurality of segments each of which is angular in cross-section, having a flange portion 27 and a hub portion 28. The flange portions of the key segments fit in an annular keyway 29 formed in the wall 20 while the hub portions overlie the rim of the cover. The thrust against the latter, therefore, is transmitted by the key segments to the wall 20. Preferably the outer edges of the hub portions of the key segments are formed with notches 28a (Figure 1) in which a suitable tool may be inserted to facilitate withdrawal of the segments from the keyway when it is desired to remove the cover.

A sealing member 30 is associated with the cover 24. The said member is in the shape of a ring and is formed with a substantially rigid body 31 which fits in the annular recess delimited by the hub portions of the key sections and the raised portion of the cover, the inner wall of the body 31 being undercut to conform to the shape of the cover while the outer wall is arranged in close proximity to the hub portions of the keys. The body of the sealing member, therefore, serves to hold the key segments in the keyway, the upper inner edges of the hub portions of the key segments preferably being beveled as indicated at 32 to facilitate arrangement of the sealing member in the position described during assembling operations. The body of the sealing member is formed with a flange 33 which fits into a shallow groove 34 formed in the rim of the cover and in which a gasket 35 is preferably arranged. The said flange is urged against the gasket by bolts 36. The latter are in the form of studs and are arranged

in a circular series; they are carried by the rim of the cover; and they extend through openings 37 formed in the body 31. The sealing member is provided with a second flange 38. The latter is connected to the body 31 by a flat web-like bridge 39 and fits in a shallow groove 40 which is formed in the end of the wall 20 and in which a gasket 41 is preferably arranged. The flange 38 is urged against the said gasket by a ring 42 and a circular series of bolts 43. The latter are in the form of studs; they are carried by the wall 20 and they extend through openings 44 formed in the ring, the inner edge of the ring preferably terminating short of the point of juncture of the bridge and the body of the sealing member. In this connection it will be noted that the bridge 39 is thin with respect to the body 31. The bridge is so designed that, although of a strength greater than required to resist the fluid pressure to which it is subjected, it will bend when the bolts 36 and 43 are tightened, whereby to effect relative movement between the flanges 33 and 38 to a degree which will insure proper coaction with their respective seats.

From the foregoing it will be apparent that of the total hydrostatic load to which the closure is subjected the greater part is taken up by the cover, and hence is transmitted to the wall 20, while only a small part of such load is taken up by the sealing member. The bolts 36 and 43, therefore, are only under moderate stress and as their primary function is to maintain the gaskets 35 and 41 under the proper sealing pressure, the joints to be sealed may be easily maintained leak-proof with relatively small bolts. In this connection it will be noted that the flanges 33 and 38 are located exteriorly of the cover, as are the bolts 36 and 43. Hence if a leak should develop its location can be determined by inspection and if it is caused by improper tightening of the bolts the leak may be stopped without removing any of the closure parts. If, on the other hand, a leak should occur as a result of a defective gasket it is necessary to enable replacement of the latter to remove only the sealing member. The grooves 34 and 40 and gaskets will thereby be fully exposed to view. Thus in this case also the necessity of removing any of the heavy or unwieldy parts of the closure is avoided. The exterior location of the sealing member and bolts has the further advantage that it enables the sizes of the various parts of the closure to be predetermined with respect to their individual loads. The use of large amounts of metal operating under low stresses is thus avoided and the reduction which is thereby achieved in the sizes of the parts, together with the arrangement of the latter in the manner described, insures a construction which is not only simple and economical but which is also compact.

A modified form of the invention is illustrated in Figure 4. In this embodiment the sealing member, indicated at 45, is in one piece and includes a body 46, a ring flange 47, both relatively rigid, and a web-like bridge 48 which is in the form of an arch and which is deformable in the manner and for the purpose described in connection with the embodiment illustrated in Figure 1. The body and ring flange are provided with flanges 49 and 50, respectively, the rim of the cover being formed with a shallow groove 51 to accommodate the flange 49 while the end wall of the header is formed with a similar groove to accommodate the flange 50. Gaskets 52 are preferably arranged in the grooves 51, there being a series of bolts 53 carried by the cover which are tightened to force the flange 49 against one of the gaskets and a second series of bolts 54 carried by the wall of the header which are tightened to force the flange 50 against the other gasket. It will thus be apparent that the present embodiment differs from that shown in Figure 1 only in the respects that the sealing member is in one piece instead of two and that the deformable bridge is arched instead of flat. In other respects the two closures illustrated and described are generally similar; their parts function in substantially the same manner; and their use enables the attainment of the advantages heretofore noted. It is to be understood that the use of grooves and gaskets in connection with the sealing member is intended by way of example only and that the cooperating sealing surfaces may be provided, if desired, without the use of either.

I claim as my invention:

1. A pressure vessel having a wall which defines an opening and which is formed with an annular keyway and a seat, a cover which fits in said opening and which is formed to provide a second seat, a key for transmitting to said wall the pressure exerted against said cover, said key comprising a plurality of sections, each of which is formed with a hub portion, fits in said keyway and overlies the marginal edge of said cover, said hub portions extending outwardly beyond said keyway and being formed in their outer faces with notches in which a tool may be inserted to effect withdrawal of the key sections from said keyway, a sealing member which is arranged over said key, which prevents displacement of the sections of the latter from said keyway, and which fits against both of said seats and means for forcing said sealing member against said seats with a pressure adequate to seal the joints thus provided.

2. A pressure vessel having an end wall which defines an opening and which is formed with an annular keyway and a seat, a cover which fits in said opening and which is formed to provide a second seat, an annular sectional key in said keyway for transmitting to said end wall the pressure exerted against said cover, each of said key sections having a hub portion which extends outwardly from said keyway in close proximity to said wall, a seal which is engageable with both of said seats, said seal comprising inner and outer, non-deformable, annular flanges and a connecting deformable bridge, said inner flange being located within the area delimited by said key and in such relation to the sections thereof as to prevent their displacement from said keyway and two series of bolts, one series for attaching said inner flange to said cover in the position described and the other series for attaching said outer flange to said end wall, the inner faces of the hub portions of said key sections being beveled to facilitate entry of said inner flange into said area and the outer faces being formed with notches in which a tool may be inserted, after detachment of said flanges, to effect removal of said key sections from said keyway.

TOWNSEND TINKER.