

PATENT SPECIFICATION

(11)

1 452 914

1 452 914

- (21) Application No. 51506/73 (22) Filed 6 Nov. 1973
(31) Convention Application No. 307 419 (32) Filed 17 Nov. 1972 in
(33) United States of America (US)
(44) Complete Specification published 20 Oct. 1976
(51) INT. CL.² F16B 2/12
(52) Index at acceptance
E2B 5AU
F2G 9A 9B

(19)



(54) STRAIN LIMITED CLAMPING DEVICES

(71) We, CATERPILLAR TRACTOR Co., a corporation organised and existing under the laws of the State of California, United States of America, of 100 N.E. Adams Street, Peoria, State of Illinois 61602, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention concerns strain limited clamping devices.

Circular flange connectors have been in wide use for coupling tubular pipes or hoses equipped with shouldered heads to a housing, manifold or the like. Unfortunately, flange distortion and failures have been experienced due to overtightening of the retaining bolts which imposes excessive strain on the outermost portion of the flanged section between the bolt holes and which distorts the section in a wave-like manner. In some cases, a thicker flange section can be used to minimize such distortion with accompanying additional expense, while in other cases the thicker section will actually increase the encountered strain at the most severely stressed point.

Materials of greater strength can also be used to avoid the above-mentioned flange distortion problem, but adapting more sophisticated metals normally increases unit costs. Therefore, it is recognized that it would be desirable to limit the encountered maximum strain internally of the body of the flange even when the attaching bolts are overtightened because of using improperly adjusted, torque-limited impact wrenches or the like. Consequently, more economical materials and/or manufacturing steps can be adopted because of the increased reliability provided.

According to the invention we provide a strain-limited clamping device, for releas-

ably holding a removable object in tightly clamped relation against a support member, comprising, a body which may be clamped to the support member including gripping means for engagement with the removable object, and stops on the body in spaced relation to said gripping means for engagement with said support member only after deformation of said body during clamping of the body to the support member subsequent to engagement of said gripping means with the removable object, said stops being operative to limit deformation of said body.

The body may comprise a flange or may alternatively comprise one or more arcuate flange sections.

Other advantages of the present invention will become apparent upon reference to the accompanying drawings and following description of exemplary embodiments of the invention.

Fig. 1 is a plan view of the strain-limiting clamping device of the present invention connecting a removable relatively high pressure fluid conduit to a housing with portions thereof broken away for illustrative clarity.

Fig. 2 is a diametrical cross section taken along line II-II of Fig. 1 showing the clamping device in an initial pretightened position on the housing.

Fig. 3 is a sectional view similar to Fig. 2 but illustrating the clamping device in its fully tightened or maximum loaded position on the housing.

Fig. 4 is a bottom view of an alternative embodiment of the strain-limited clamping device of the present invention.

With reference to Figs. 1 and 2, a strain-limited clamping device 10 embodying the present invention is associated with a support structure or housing 12 such as a fluid manifold, valve body or the like. The housing has an outwardly opening passage 14 extended through an outer surface 16 on 90

which the clamping device is supported. A plurality of threaded bolt holes 18 are provided in the housing in a generally encircling relation to the passage.

- 5 A tubular member 20, such as a relatively high pressure hydraulic fluid conduit or the like having a shouldered head 22 and an internal passage 24, is axially aligned with the passage 14 to permit fluid transfer there-
10 between in a well known manner. The shouldered head comprises a shoulder having a bearing surface 26 facing away from the housing 12 and a surface 28 that is continuously associated with the surface 16 of the housing. A suitable seal 29 is preferably
15 disposed in a counterbore 30 in the shouldered head, and is loadably compressed against the surface 16 of the housing to prevent fluid leakage radially outwardly
20 from the passages 14 and 24.

- The strain-limited clamping device 10 in accordance with the present invention, provides a connecting body of a hard yet deformable material, such as a ferrous metal,
25 and is generally indicated by the reference numeral 32. The body is split so that a pair of similar arcuate flange sections 34 and 36 are formed. The arcuate sections have semi-circular recesses together defining
30 a central circular aperture 38 and a counterbore 40 and forming a ledge or bearing surface 42. The ledge faces inwardly toward the housing 12 in abutting relation to the bearing surface 26, so that the connecting
35 body can urge the shouldered head 22 in tightly clamped relation against the housing. The arcuate sections individually have an outer face 44 and an inner face 46, the latter of which is axially spaced some distance
40 away from the housing surface 16 when the bearing surfaces 26 and 42 are in abutting engagement. A plurality of bolt holes 48 in the flange sections permit insertion of a like number of fastening
45 attachment bolts 50 therethrough into the threaded holes 18 of the housing.

- The clamping device is provided with stops shown generally at 54 preferably extending toward the housing 16 from the
50 marginal outer edge of the inner face 46 of each arcuate section 34 and 36. Such stops are peripherally spaced in a predetermined pattern, as best shown in broken lines in Fig. 1, and provide two relatively
55 long lips 56 and two relatively short lips 58. These lips are disposed essentially radially outwardly of the bolts 50 on each of the arcuate sections. As shown in Fig. 2 the lips 56 and 58 individually have a surface
60 60 with a height "h" as measured from the face 46 toward the housing 12. Such height "h" provides a predetermined initial clearance "d" between the stop 54 and housing surface 16 with the pretightened
65 condition of the bolts 50 corresponding to

the maximum axial distortion permitted the body 32 at the outer periphery thereof.

While the operation of the present invention is believed clearly apparent from the foregoing description, further amplification
70 will subsequently be made in the following brief summary of such operation.

As previously described, excessive
75 tightening of the fastener bolts of conventional flange connectors results in a wave-like bridging effect or undulating distortion of the periphery of the flanges. This causes excessive strain, particularly in the outer face thereof between the bolts. Even if the
80 flange connector does not crack or otherwise fail due to such overloading, the undulating distortion results in less uniform loading which could be detrimental to effective sealing of the hydraulic circuitry.

On the other hand, the strain-limited
85 clamping device 10 of the subject invention avoids the overloading condition mentioned above as may be noted by a comparison of the pretightened and fully tightened bolt
90 condition represented in Figs. 2 and 3. The predetermined clearance "d", shown in Fig. 2, observed when the connector body 32 initially grippingly engages the tubular member 20 and holds the surfaces 16 and
95 28 in intimate contact, decreases as the bolts 50 are individually threadably tightened. When the bolts are tightened to a predetermined recommended torque value, the lip surface 60 of each stop 54 contacts
100 the surface 16 as shown in Fig. 3. Even though the bolts are tightened inadvertently beyond such value, the positive contact between each face 60 and the surface 16 of the housing 12 as well as the bearing surfaces
105 26 and 42 substantially form a substantially rigid bridge spaceably spanning each bolt which serves to limit excessive distortion of the connector body.

The subject embodiment also has the advantage of a larger axial clearance radially
110 inwardly of the stops between the faces 46 and housing surface 16 so that surface irregularities therebetween can be bridged, rather than interfering with the desired resilient clamping action, thus assuring positive
115 sealing of relatively high pressure fluid in the passages 14 and 24.

Although the split connector body shown in Figs. 1 through 3 incorporates arcuate
120 sections 34 and 36 individually having one long lip 56 and one short lip 58, the invention can be incorporated in other forms of segmented circular flanges such as shown in Fig. 4. Such an alternative embodiment
125 comprises a pair of arcuate flange sections 62 and 64 individually having a face 66 and a pair of lips 68 of similar intermediate length. The lips 68 also have a height "h" similar to the preferred embodiment as
130 measured from the face 66 and are disposed

substantially radially outwardly of a plurality of bolt holes 70 defined in the flange sections to provide the bridging distortion-limiting feature of the subject invention.

Further, while marginally disposed elongated lips are preferred for more positive manufacturing reasons, it should also be appreciated that other forms of protrusions can be utilized to limit distortion of the circular flange in the manner set forth above.

In view of the foregoing, it is readily apparent that the structure of the present invention provides an improved strain-limited connector of economical construction which controls distortion despite excessive loading of the attaching fasteners. Further, the distortion-limiting lips of the body of the present invention control the level of the maximum internal stress thereof even though the bolts are over-torqued. By controlling such stress and/or strain, the flange connector of the subject invention can be made of more economical, lower strength material.

WHAT WE CLAIM IS:—

1. A strain-limited clamping device, for releasably holding a removable object in tightly clamped relation against a support member, comprising, a body which may be clamped to the support member including gripping means for engagement with the removable object, and stops on the body in spaced relation to said gripping means for engagement with said support member only after deformation of said body during clamping of the body to the support mem-

ber subsequent to engagement of said gripping means with the removable object, said stops being operative to limit deformation of said body.

2. A strain-limited clamping device as claimed in claim 1, wherein said body is an arcuate flange section having a semi-cylindrical recess defining said gripping means in the form of a ledge grippingly engageable with a shouldered head of the removable object.

3. A strain-limited clamping device as claimed in claim 1, wherein said body is a flange defining a central circular aperture adapted to receive said object therethrough and a counterbore circumscribing said aperture and defining said gripping means in the form of a ledge.

4. A strain-limited clamping device as claimed in claim 3, wherein said flange comprises two arcuate flange sections of similar shape.

5. A strain-limited clamping device as claimed in any preceding claim, wherein said body is clamped to said support member in use by means of bolts, and wherein said body is provided with a plurality of bores into which bolts may be inserted for engagement in threaded bores provided in the support member.

6. Strain-limiting clamping devices substantially as described with reference to the accompanying drawings.

For the Applicants,
FRANK B. DEHN & CO.,
Imperial House,
15-19 Kingsway,
London WC2B 6UZ.

22 24
3

substantially radially outwardly of a plurality of bolt holes 70 defined in the flange sections to provide the bridging distortion-limiting feature of the subject invention.

Further, while marginally disposed elongated lips are preferred for more positive manufacturing reasons, it should also be appreciated that other forms of protrusions can be utilized to limit distortion of the circular flange in the manner set forth above.

In view of the foregoing, it is readily apparent that the structure of the present invention provides an improved strain-limited connector of economical construction which controls distortion despite excessive loading of the attaching fasteners. Further, the distortion-limiting lips of the body of the present invention control the level of the maximum internal stress thereof even though the bolts are over-torqued. By controlling such stress and/or strain, the flange connector of the subject invention can be made of more economical, lower strength material.

WHAT WE CLAIM IS:—

1. A strain-limited clamping device, for releasably holding a removable object in tightly clamped relation against a support member, comprising, a body which may be clamped to the support member including gripping means for engagement with the removable object, and stops on the body in spaced relation to said gripping means for engagement with said support member only after deformation of said body during clamping of the body to the support mem-

ber subsequent to engagement of said gripping means with the removable object, said stops being operative to limit deformation of said body.

2. A strain-limited clamping device as claimed in claim 1, wherein said body is an arcuate flange section having a semi-cylindrical recess defining said gripping means in the form of a ledge grippingly engageable with a shouldered head of the removable object.

3. A strain-limited clamping device as claimed in claim 1, wherein said body is a flange defining a central circular aperture adapted to receive said object therethrough and a counterbore circumscribing said aperture and defining said gripping means in the form of a ledge.

4. A strain-limited clamping device as claimed in claim 3, wherein said flange comprises two arcuate flange sections of similar shape.

5. A strain-limited clamping device as claimed in any preceding claim, wherein said body is clamped to said support member in use by means of bolts, and wherein said body is provided with a plurality of bores into which bolts may be inserted for engagement in threaded bores provided in the support member.

6. Strain-limiting clamping devices substantially as described with reference to the accompanying drawings.

For the Applicants,
FRANK B. DEHN & CO.,
Imperial House,
15-19 Kingsway,
London WC2B 6UZ.

