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A. D. HERMAN ET AL

2,801,116

BAND CLAMP WITH MULTIPLE V-RESTRAINER MEANS

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fig. 1.

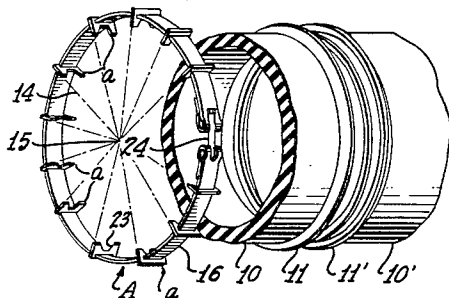


fig. 2.

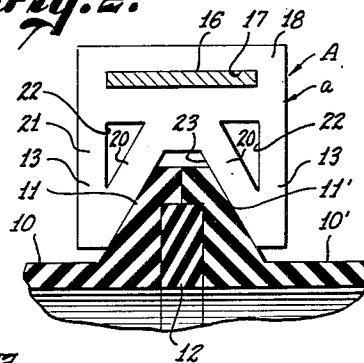


fig. 3.

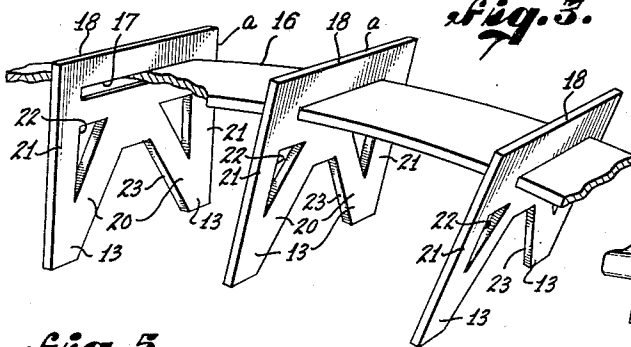


fig. 4.

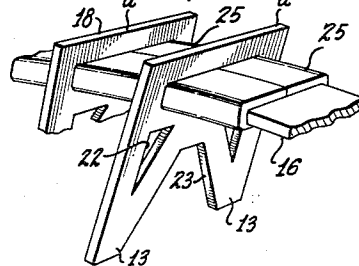


fig. 5.

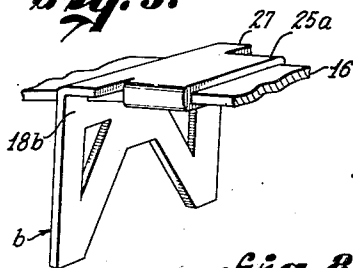


fig. 6.

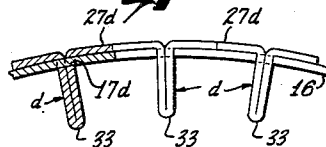


fig. 8.

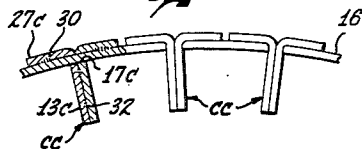


fig. 9.

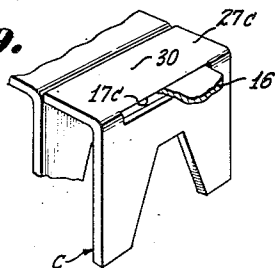
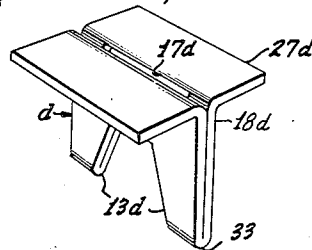


fig. 7.



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BAND CLAMP WITH MULTIPLE V-RESTRAINER MEANS

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6 Claims. (Cl. 285—365)

This invention relates to band clamps of the type used in coupling together a pair of flanged parts such as the sections of a tubing line. Such a clamp customarily embodies opposed jaw members for embracing engagement with flanges that are to be coupled together, a constrictor band encircling the jaw members, and connector parts for drawing the ends of the band together. Ordinarily, the jaw members embody opposed jaws that diverge toward the axis of the clamp, for exerting wedging action against the coupling flanges, whereby axial pressure may be applied to the flanges to seal them tightly against one another or against an interposed gasket or seal ring. In a common type of such band clamp, the jaw members are in the form of arcuately elongated channel sections, a common method of fabricating them being by yoder roll forming from ribbon metal and cutting the rolled coil into selected lengths.

A general object of the present invention is to provide a coupling clamp which does not require the use of the elongated arcuate channel sections, and which correspondingly dispenses with the necessity for rolling or other comparably difficult and expensive forming operation.

A specific object is to provide a coupling clamp embodying jaw elements which may be fabricated easily and inexpensively on a high speed punch press in a simple die-blanking operation.

A further object is to provide an improved method of fabricating a coupling clamp of the general type referred to above.

One of the problems encountered in coupling clamps is the load limit which can be endured by the opposed wedging jaws without spreading. In the common type of coupling clamp referred to above, the axial load limit is determined by the thickness of the ribbon metal from which the elongated jaw sections are fabricated. To adapt the manufacture of such clamps to a large number of varying load requirements, necessitates the selection and utilization of an equal number of thickness gages in the ribbon metal stock (other factors being the same) if maximum efficiency in the use of material for each load requirement, is to be attained. Since it is feasible from a manufacturing standpoint to stock and fabricate only a limited selection of combinations of material, width and thickness in the ribbon or sheet metal stock from which the couplings are fabricated, in actual practice there is dictated a compromise wherein a selected ribbon stock must serve a range of load requirements, and a coupling in the lower end of such range will thus utilize jaw sections that are thicker and heavier than actually required.

Where coupling clamps of the general type under consideration are utilized in aircraft, elimination of excess weight, even though in slight amounts, is quite an important consideration. One of the major objects of the present invention is to provide a coupling clamp of a novel construction such that the weight of the clamp can be adjusted to vary with load requirements so as to minimize weight over a very substantial range, without

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the multiplication of tooling or stock sizes. More specifically, the invention contemplates the provision of a coupling clamp utilizing jaw segments such that the weight of the clamp can be adjusted to load requirements simply by varying the number of segments utilized in the clamp, and yet wherein uniformity of circumferential spacing of the jaw segments (for uniform application of clamping pressure around the circumference of the clamp) is attained regardless of the number of segments utilized.

In the common form of coupling clamps utilizing the simple V-section channel, the resistance of the jaws to spreading is determined by the strength of the metal in the bends at the bottom of the channel, where the spreading couples are applied at maximum intensity. Improvements in the strength-weight ratio can be gained by trussing construction which, however, increases the expense of fabrication by complicating the rolling or other forming of the channel sections, and requiring welding for the most efficient trussing. An important object of the present invention is to provide a coupling clamp utilizing jaw segments of fully trussed, integral closed loop form, in a relatively inexpensive, easily fabricated part requiring no welding operation.

A still further object is to provide a coupling clamp utilizing jaw segments which, for the purpose of attaining maximum ratio of jaw strength to weight, can be processed to uniform hardness and toughness throughout, avoiding the problems of hardness and strength variations arising from work hardening which takes place in the forming of sheet metal.

Another object is to provide a coupling clamp wherein uniform distribution of radial and axial loads between jaw segments is attained by virtue of self alignment of the jaw segments with relation to the flanges being coupled, whereby all jaw segments are caused to operate at maximum efficiency, and whereby failures arising from overloading of one part of a coupling while another part is underloaded, are avoided.

Other objects will become apparent in the ensuing specifications and appended drawing in which:

Fig. 1 is an exploded perspective view of a tubing joint including flanges, tube sections and a coupling clamp embodying my invention;

Fig. 2 is an axial sectional view through such joint;

Fig. 3 is a detail perspective view of a fragmentary portion of the clamp;

Fig. 4 is a fragmentary sectional view of a modified form of the clamp;

Fig. 5 is a fragmentary sectional view of another modified form of the clamp;

Fig. 6 is a side view of a portion of another modified form of the clamp;

Fig. 7 is a perspective view of the jaw segment of Fig. 6;

Fig. 8 is a side view of another modified form of the invention; and

Fig. 9 is a perspective view of the jaw segment of Fig. 8.

THE INVENTION AS DISCLOSED IN FIGS. 1-3

The preferred form

Referring now specifically to the form of the invention shown in Figs. 1, 2 and 3, I have illustrated therein, as an example of a preferred form in which the invention may be embodied, a coupling clamp, indicated generally at A, for coupling together a pair of adjoining tube flanges, indicated generally by the reference character B. Merely by way of illustration of what may be regarded as a conventional tube flange structure, we have shown in Fig. 2, tube sections 10 and 10' having respective flanges 11, 11' which are provided with spaced grooves to receive

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a gasket or seal ring 12 for establishing a fluid tight joint between the tube sections. The outer faces of flanges 11, 11' may be frusto-conical as shown, for cooperation with inclined wedging faces of the opposed jaws 13 of jaw segments *a*. The wedging faces of the series of segments collectively define opposed, approximately frusto conical faces of an interrupted channel corresponding generally in shape to the flange contours. It will be apparent that radially inward movement of jaw segments *a*, under pressure, will provide a wedging action against flanges 11, 11' which will force them against gasket 12 to establish a pressure seal as required.

The invention is particularly characterized by the fact jaw segments *a* are in the form of metal slabs, arranged with their minimum dimension (thickness) as their circumferential dimension and with their major dimensions (width and height), disposed in planes (indicated by the broken lines 14 in Fig. 1) which radiate from the axis 15 of the clamp. Jaw segments *a* are carried by a constrictor band 16 of flexible ribbon metal and are secured thereto with sufficient anchorage to be maintained in the aforesaid radiating axial plane. This may be accomplished by providing each segment with a transverse slot 17 in the head portion 18 of each segment, and assembling the segments on band 16 with the latter extending through and snugly fitted in the respective slots 17, and with the respective lips (longitudinal faces) of slots 17, either welded to or clamped against the band 16 under sufficient pressure to resist dislodgement of the segments relative to the band under the forces that are applied to the segments when the coupling clamp is drawn tightly around the flanges 11, 11'. For maximum anchorage, it is preferred to resistance weld the head 18 of the segments to the band 16 so that the segments become integrally united to the band along both lips of the slot 17.

The segments *a* are of slab form, i. e., in the form of flat, one-piece blanks die cut from sheet or plate metal of appropriate thickness such that the segments have adequate rigidity, sufficient width of anchorage to bands 16, and adequate strength in jaws 13 to resist spreading under the reactive loads developed by the wedging engagement against tube flanges 11, 11'. For maximum ratio of strength to weight, the jaws 13 are of truss form, including diagonal bars 20 the inner faces of which constitute the wedging faces of the jaws, and including trussing struts 21, which are parallel, normal to the edge of head 18, disposed so as to define the side margins of the segments, and integrally join the remote ends of jaw bars 20 to head 18. The near ends of bars 20 are integrally joined to the center of head 18. Triangular cut-out spaces 22 are defined between the bars 20, struts 21 and head 18. The elimination of metal from spacer 22 substantially lightens the segments without noticeably weakening them. With the above described construction, the overall contour of the segments may be generally that of a square with a central, truncated V-shaped notch 23 in one side, defined between bars 20.

The segments *a* are substantially uniformly spaced around the circumference of band 16, the extent of spacing and the number of segments being varied in accordance with the load requirement of the clamp. In general, the clamp embodies a fairly large number of segments, there being a multiple number of segments for each quadrant of the coupling, and, in the average clamp, these segments being spaced not over about 15° arcuate displacement apart. In the example shown, the spacing is approximately 10° angular separation. In some applications, the spacing might be considerably closer and in others, considerably farther apart, depending upon the loading requirement.

For a clamp having segments of approximately 1½" width, the thickness may be approximately ⅛".

It will be evident that by varying the spacing of the segments to meet load requirements, the same identical segments may be used in the fabrication of a large variety

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of clamps, differing from one another by the addition or subtraction of one segment, whereby a fairly exact fitting of the clamp to each load requirement within a range of only moderately varying requirement figures, may be simply and easily attained without in any way complicating the tooling or fabricating requirement. For filling quantity orders, it may be desirable to provide separate tooling for each particular clamp, in the form of a jig for locating the segments accurately in their uniformly spaced relation, in accordance with requirements of the particular clamp. Such a jig, however, is not expensive and does not add a great deal to the overall tooling expense.

THE MODIFIED FORM OF THE INVENTION SHOWN IN FIG. 4

As shown in Fig. 4, the spacing of the segments may be determined by spacers 25 in the form of split ring clips of flat ring form, encircling the sections of band 16 between successive segments *a*. The side edges of such clips are disposed in planes normal to the circumferential axis of band 16, whereby, as the band is tightened, any tendency of the segments to tilt with reference to the band will be resisted by the snug abutment of the side faces of the segments against these radial edges of the clip 25. Stated somewhat differently, the clips 25 may function to block the segments apart in uniformly spaced positions and to simultaneously block them against tilting.

Operation

In the operation of the clamp, it is wrapped around the flanges 11, 11', like a necklace, and its ends are brought together and connected by a conventional latching take-up connector 24 of any suitable known type, through which circumferential tension may be applied to the clamp by drawing the ends thereof toward one another. As the segments become tightened against flanges 11, 11' their legs 13 will exert a wedging action thereagainst to draw the flanges into sealing engagement with gasket 12. At the same time, the circumferential shortening of the clamp will necessitate some sliding of the segments circumferentially against flanges 11, 11'. The anchorage of the segments to the band 16 must be sufficiently secure to resist the tendency to tilt away from respective radiating planes, in response to the drag created as an incident to said shortening.

Should the frusto-conical outer faces of flanges 11, 11' vary from true frusto-conical form the segments *a* will automatically conform to the irregularities, the slight displacements of the segments from their normal positions being readily accommodated by twisting of band 16. Through the same self-aligning action, the jaws will shift from their approximately frusto-conical channel array in the unstressed clamp to conformity with the frusto-conical flange faces as the clamp is tightened.

Fig. 1 shows approximately a minimum number of segments, such as would be suitable for joining the sections of a low-pressure fluid line. As progressively greater loads are encountered, an increasing number of segments may be added, until, for extremely high loads, the number of segments might be trebled or quadrupled over the number shown in Fig. 1. Thus a wide variety of load conditions can be satisfactorily met with a coupling having just enough segments to handle the load in each case, and therefore having minimum weight for the given requirements. Yet the segments may be identical in each instance, and tooling costs are not multiplied with the multiplication of segment combinations.

THE INVENTION AS DISCLOSED IN FIG. 5

Fig. 5 illustrates how a spacer collar 25b may be formed integrally with a jaw segment *b*, by partially detaching a pair of tabs from a portion 27 of segment head 18b, which portion 27 is bent to define, with the body of segment *b*, a right dihedral angle. The collar

25a may be clamped tightly against band 16, without welding, to securely position the segment circumferentially of the band, and provides leverage to resist the load couples tending to tilt the segment when the coupling is being drawn tightly around a pair of flanges. Alternatively, the collar 25a or head portion 27 may be spot welded or riveted to band 16.

THE INVENTION AS DISCLOSED IN FIG. 9

Fig. 9 illustrates a segment *c* similar to that of Fig. 5, but somewhat simpler in that it omits the collar 25a and has a bent head portion 27c of plain rectangular form which may be spot welded, as at 30, or riveted to a band 16, extending through a slot 17c the upper margin of which lies in the plane of the under face of head portion 27c. A series of the segments *c* may be arranged with their head portions all projecting in the same direction, as indicated in Fig. 9. The head portions 27c thus function as spacers.

THE INVENTION AS DISCLOSED IN FIG. 8

As shown in Fig. 8, two of the segments *c* may be attached, back-to-back to form double segments *cc*. To this end, the legs 13c may be spot-welded together, as indicated at 32, and the head portions 27c, projecting circumferentially in opposite directions, may be spot welded to band 16 at 30, the band projecting through the registering slots 17c. Alternatively, the head portions may be abutted as in Fig. 6, to restrain the segments from circumferential slippage on the band, thus eliminating the need for the welded connections 30.

THE INVENTION AS DISCLOSED IN FIGS. 6 AND 7

Fig. 7 discloses a jaw segment similar to the double segment *cc* of Fig. 8, but made from a single blank of sheet metal, with the ends of legs 13d connected by integral folds 33. Head portions 27d, bent in opposite directions into a common plane at substantially right angles to the plane of the segment body, are adapted to lie flatly against the outer face of a band 16, extending through slots 17d in the respective head portions 18d of the segment. The head portions may be bent somewhat beyond a right angle bend so as to define a dihedral angle of somewhat less than 90°, and, when the segments are assembled on the band and the band is placed under tension, will be deflected outwardly and thereby tension-loaded so as to bear tightly against the band. The extremities of adjoining head portions 27d may be abutted as shown in Fig. 6, so as to brace the segments one against another, locking them in circumferentially fixed positions without requiring any welded or riveted connection between the segments and the band. Likewise, no welded or riveted connection between the halves of a segment body, is required. The double bracing action of the oppositely projecting head portions of a segment, against the outer face of band 16, coupled with the engagement of the inner margins of slots 17d against the

inner face of the band, thoroughly braces the segments against tilting in response to couples set up in the drawing of the coupling tightly around a pair of flanges.

We claim:

1. In a coupling clamp: a constrictor band of ribbon metal; connector means for drawing the ends of the band together; and a plurality of jaw segments of stamped sheet metal attached to said band in circumferentially spaced succession, each segment being of L-form, including a body yoke disposed in a plane of the coupling axis and extending radially inwardly from said band and a head projecting circumferentially from said yoke and bearing against the outer face of said band, said body yoke comprising axially opposed flange-embracing jaws and a web bridging said jaws, said jaw segment having a slot defined between said web and said head and snugly receiving said band, and said segment including right-angle bends at respective ends of said slot, joining said head integrally to said web.

2. A coupling clamp as defined in claim 1, including a series of said segments arranged with said heads projecting in a common direction circumferentially, each head at its end engaging the bends of the adjacent segment and thereby functioning as a spacer.

3. A clamp as defined in claim 1, wherein said head has integral tabs bent around the side margins of the band and engaged beneath the band.

4. A clamp as defined in claim 1, wherein said head is welded to the outer face of the band.

5. A clamp as defined in claim 1, wherein the segments are arranged in pairs with the yokes of each pair being in back-to-back abutting engagement with the heads of the pair projecting circumferentially in opposite directions therefrom, whereby the yokes of the pair will brace one another against tilting under circumferential drag developed in drawings the coupling tight around a pair of tube flanges.

6. A clamp as defined in claim 1, wherein the segments are arranged in pairs with the yokes of each pair being in back-to-back abutting engagement and with the heads of the pair projecting circumferentially in opposite directions therefrom, and including return bends whereby the inner ends of the abutting jaws of a pair of segments are integrally joined to one another, whereby the yokes of the pair will brace one another against tilting under circumferential drag developed in drawing the coupling tight around a pair of flanges.

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