Title: CORROSION REDUCING MINIMUM CONTACT CLAMP FOR SUPPORTING AND SECURING TUBING

Abstract: Tubing clamps having a minimum contact area between the tubes and the clamps supporting surfaces are provided for minimizing the collection and retaining of liquids at the supporting surfaces. A predetermined minimum spacing is maintained between the tubes supported by the tubing clamps while maintaining sufficient ventilation between the tubes and the clamps to permit drying of any liquids which contact the tubes and the clamps at the support points. This prevents electrolysis and corrosion caused by liquid retention and contact of dissimilar metals. Further, the tubing clamps are readily adapted to secure tubes of different outer diameters in a single row or multiple rows, such as in a stacked configuration. The clamps are provided with upper and lower supports, each having matching grooves that have chamfered edges forming the upper and lower tubing contact surfaces. The supports are secured together with fasteners to clamp the tubing therebetween.
FIELD OF THE INVENTION

The invention relates to the clamping and supporting of tubing used to transport fluids, chemicals, oils and gases in industries, such as oil and gas drilling; and production and refining, where tubing is commonly used. Other industries using tubing include shipping, military installations and equipment, food production installations, manufacturing sites, etc. In addition the invention is applicable in corrosive environments, such as marine environments, where minimum contact between tubing and the clamps that support the tubing is preferable in order to reduce the accumulation of moisture contacting the tubing at the support area which creates a risk of pitting and corrosion of the tubing.

DESCRIPTION OF RELATED ART

Clamping systems of the prior art include solutions for solving or reducing the problems associated with electrolysis and corrosion of tubing. However, the greater the contact area between the clamping supports and the tubing, the more the contact area is likely to collect and hold moisture. Vibration isolating and insulating materials are conventionally provided between the contact surfaces of the clamp supports and the tubing. However, such additional insulating materials hold moisture. Further, spacers, such as metallic spacers, are used with conventional clamping systems to space apart a series of tubes in a row. However, all such features constitute additional parts in the manufacture and assembly of the clamps. Accordingly, such designs are disadvantageous with respect to the economical and efficient
implementation of such clamps in clamping systems for tubing of various types of materials and sizes typically found in industrial installations existing in potentially corrosive environments.

BRIEF SUMMARY OF THE INVENTION

It is an object of the present invention to provide a clamp or an arrangement of clamps in a clamping system that provides minimum contact between the tubing support surfaces and the tubing to allow for ventilation that minimizes electrolysis and corrosion of the tubing while offering a compact clamping system permitting uniform configurations of a variety of tubes with equal or different diameters.

The clamping supports enable a number of tubes to be secured and supported within the same clamping system using one or more grooves of equal or unequal size (when supporting multiple tubes of the same OD) formed in the clamp support bodies in order to enable the tubes to seat properly with tubing engaging surfaces that are of a minimum contact area.

Embodiments of the present invention provide a corrosion reducing minimum contact clamp comprised of cylindrically shaped bodies made from a metallic, composite or plastic material for forming upper and lower clamping support bodies for securing an individual row of tubes or a rectangular array of tubes, including one or more spaced-apart tubing accommodating grooves of a shape having chamfered edges that form conical frustums. The grooves can be of equal or unequal size within the same clamp support bodies in order to enable tubes of different sizes or multiple tubes of the same size to be accommodated and properly seated side by side within the same tubing clamp.
BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A illustrates a side view of a cylindrical clamp support body according to an embodiment of the invention having one groove with chamfered edges that form contact areas with the tubing to be supported.

FIG. 1B illustrates an end view of the cylindrical clamp support body according to Fig. 1A.

FIG. 1C illustrates a side view of a cylindrical clamp support body according to an embodiment of the invention having multiple grooves of the same dimensions with chamfered edges that form contact areas supporting tubing of substantially the same outer diameters.

FIG. 1D illustrates an end view of the cylindrical clamp support body according to Fig. 1C.

FIG. 1E illustrates a side view of a cylindrical clamp support body according to an embodiment of the invention having multiple grooves of different dimensions with chamfered edges that form contact areas supporting tubing of respectively different outer diameters.

FIG. 1F illustrates an end view of the cylindrical clamp support body according to Fig. 1E.

FIG. 1G illustrates a side view of a clamp comprised of upper and lower clamp support bodies according to the embodiment of Fig. 1A having a tube clamped between them and supported by the groove with chamfered edges.
FIG. 1H illustrates a side view of a clamp comprised of upper and lower clamp support bodies according to the embodiment of Fig. 1C having tubes clamped between them and supported by the grooves with chamfered edges.

FIG. 11 illustrates a side view of a clamp comprised of upper and lower clamp support bodies according to the embodiment of Fig. 1E having tubes of respectively different diameters clamped between them and supported by the grooves with chamfered edges.

FIGs. 2A and 2B are detailed views of the cylindrical clamp support body according to the embodiment of the invention shown in Fig. 1E showing the base, chamfer angles and depth of grooves of the clamp body.

FIG. 3A illustrates a side view of a cylindrical clamp support body according to another embodiment of the invention having one groove with chamfered edges that form contact areas with the tubing to be supported.

FIG. 3B illustrates an end view of the cylindrical clamp support body according to Fig. 3A.

FIG. 3C illustrates a side view of a cylindrical clamp support body according to another embodiment of the invention having multiple grooves of different dimensions with chamfered edges that form contact areas supporting tubing of respectively different outer diameters.

FIG. 3D illustrates an end view of the cylindrical clamp support body according to Fig. 3C.

FIG. 3E illustrates a side view of a clamp comprised of upper and lower clamp support bodies according to the embodiment of Fig. 3C and a middle clamp support body of Fig. 1E respectively supporting rows of tubes with mixed outer diameters.
clamped between the clamp support bodies and supported by the respective
grooves with chamfered edges, secured by fasteners as part of a clamping assembly
or system.

FIG. 3F illustrates a side view of a clamp comprised of upper and lower clamp
support bodies according to the embodiment of Fig. 3A supporting a tube clamped
between the clamp support bodies and supported by the respective grooves with
chamfered edges and secured by fasteners.

FIG. 3G illustrates a side view of a clamp according to another embodiment of
the invention comprised of an upper clamp support body without any grooves and a
lower clamp support body of the embodiment of Fig. 3A having grooves supporting a
tube clamped between the upper and lower clamp support bodies, and secured by
fasteners.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In Figure 1, Fig. 1A shows a clamp support body of right circular cylindrical
shape 1 having a single circular groove 2 with features of a wedge and quadrilateral
shape and having chamfered edges 3 forming two mirrored right conical frustums 4.
The chamfered edges 3 form a wedge and are the contact points for tubing when
clamped. The wedge shape prevents the tubing from shifting to either side. The
conical frustums 4 formed by the chamfered edge 3 is a circular object that comes in
contact with the tubing which is also of circular shape resulting in a minimal contact
area of the clamp and tubing. Groove depth 5 provides a space between the surface
of the clamp and the tubing. This space is required to allow ventilation for drying any
liquids that might be present or accumulate as a result of the installation environment.
In one embodiment of the present invention, the distance from the axis of symmetry 8 to the depth of the groove 5 as shown in Fig. 1B is not less than .125 inch. Overall the length of the clamp 9 is not less than 1.25 inches, for example. The largest right conical frustum base 10 is shown having an equal circumference to that of the clamp and is the edge of the groove. In the following description, a tube is used as an exemplary application, however, the present invention may be used with any cylindrical type body, such as a pipe and the like.

FIGs. 1C and 1D show a clamp of right circular cylindrical shape 1' that is consistent with the features of the clamp shown in Fig. 1A, except for having multiple spaced-apart grooves 2 for clamping and supporting more than one tube of equal diameter.

FIGs. 1E and 1F show a clamp of right circular cylindrical shape 111 having multiple grooves of identical size and dimension in a first series 6 and in a second series 60 to form a multiple series of spaced-apart grooves 7. All the grooves have chamfered edges forming wedges 11 and have right conical frustums 4 in an alternating arrangement. In one embodiment of the present invention, the distance from the axis of symmetry 8 to the greatest depth of the grooves 5' is shown in the side view and is not less than .125 inch. The configuration of grooves shown in Figs. 1E and 1F allows for the clamping of multiple sized tubes in the same row and side by side.

FIG. 1G illustrates two clamp support bodies 1 with cylindrical shape having molded quadrilateral shape surfaces 1 held together by assembly hardware 12, such as bolts and nuts, and clamping a single tube 13 as part of a clamp assembly.
FIG. 1H illustrates two clamp support bodies as of right circular cylindrical shape \(1^1\) held together by assembly hardware 12, bolts and nuts, and clamping multiple tubes 13 of equal diameter.

FIG. 11 illustrates three clamp support bodies of right circular cylindrical shape 111 held together by assembly hardware 12, such as bolts and nuts, and clamping multiple series of tubing 13 of unequal diameter in a same row and in a rectangular array as part of a clamp assembly or clamp system.

FIG. 2A illustrates the embodiment of the present invention shown in Fig. 1E in which the greatest width of each groove 23 measured from its chamfered edges connecting to the surface with the greatest circumference 4 of the clamp is not less than .177 inch. Proportionate spacing between grooves in a tightly spaced arrangement that allows for the tubing to be arranged as compact as possible while providing adequate spacing for ventilation between each tube.

FIG. 2B illustrates a clamp support body 111 of right circular cylindrical shape showing the grooves having bases 2 even and parallel with the axis of symmetry and circular in a cross section. The circular bases 2 of the groove provide more space between tubing and clamp surface as well as a stronger base design when required. In Fig. 2B, the grooves have chamfered edges which may range from 45 degrees to 85 degrees, for example, to accommodate multiple diameters of tubing.

FIGs. 3A and 3B illustrate a clamp support body of right circular cylindrical shape 1 bisymmetrically segmented by a single plane oriented in line with the cylinder's axis of symmetry 17 creating a quadrilateral surface with one symmetrical groove 2 having chamfered edges 3 forming two right conical frustums 4.
FIG. 3C and 3D illustrate a clamp support body of right circular cylindrical shape 111 segmented by a single plane 17 oriented parallel but offset from the cylinder's axis of symmetry to form a series of base supports 26. The plane 17 in Fig. 3C segments the clamp into unequal halves unlike the segmentation of the clamp in FIG 3A and leaves the surface of the clamp with the least circumference 20 as circular and the clamp is more rigid as a result.

In each of the clamp support bodies shown in Figs. 3A - 3D, the cylindrical segment shape of the clamp in enables for a more compact clamping system. The circumferential length of the grooves' chamfered edges and the clamps' greatest circumference 15 are equal. The right conical frustum 4 circumference of the largest base is equal to the clamp surface area having the greatest circumference of the clamp 6.

FIG. 3E illustrates a stack of clamp support bodies of right circular cylindrical shape with the top and bottom support bodies being segmented by a single plane oriented parallel to the cylinder's axis of symmetry and the middle clamp support body being un-segmented as, for example, shown in Figs. 2A - 2B. The three clamp support bodies arrange the tubing 19 in a rectangular array with assembly hardware 18 bringing them together. The number of tubes clamped in a rectangular array of tubing can be increased by adding one or more clamps on the top or bottom or by increasing the length of and number of grooves in the clamp bodies.

Optionally, also shown in Fig. 3E are top and bottom plates 21 engaging the fasteners and providing for added support. Optionally, the middle clamp support body may comprise two segmented clamp support bodies as shown in Fig. 3C and disposed back to back having a single backing plate 22 therebetween.
FIG. 3F illustrates two clamp support bodies of right circular cylindrical shape 1 segmented by a single plane oriented parallel to the cylinder's axis of symmetry and clamping a single tube 19 with assembly hardware 18.

FIG. 3G illustrates a side view of a clamp according to another embodiment of the invention in which an upper clamp support body without any grooves and a lower clamp support body having grooves as shown in the embodiment of Fig. 3A support a tube clamped therebetween. The upper clamp support body 30 without grooves is a cylindrical rod. The upper support plate 30 and the lower clamp support body are secured by fasteners 18. In this way, a three point support system is provided for supporting the tubing, i.e. using a clamp support body having grooves providing two support points and an upper cylindrical (rod) support body providing a third support point.

The tubing clamp assemblies of Figs. 1G, 1H, 1I and 3E can also be modified to include an upper or lower cylindrical clamp support body without grooves (30) in place of a clamp support body having grooves in order to provide the three point contact support shown in Fig. 3G, with or without the additional support plate(s) 21 as shown in Fig. 3E. Further, for applications in which there is different sized tubing being accommodated in the three point support configuration, the depth of the grooves may be adjusted on the grooved clamp support body to ensure that the top surface of each of the different OD tubes engages the upper clamp body in a straight line (substantially parallel to the axis of symmetry). Alternatively, the upper clamp support body may have a step profile where the stepped part accommodates the tubes having a different OD when tubes of different diameters are accommodated together in a row of a three point clamp configuration.
According to embodiments of the invention, the clamp support bodies are manufactured from metal or plastic cylindrical rods, for example of stainless steel, aluminum or synthetic resin, such as DELRIN (TM). Teflon or Teflon coatings are also suitable in the manufacture. Using a synthetic resin for the clamp support body prevents dissimilar material problems from arising. However, using a material for the clamp support body which matches that of the tubing also prevents dissimilar material problems from arising. In some embodiments, the clamp support bodies, support plates 21 and/or 30 are manufactured and the holes for accommodating the fasteners 12, 18 are drilled in the bodies during assembly of the clamp support bodies. The holes may also be pre-drilled at the time of manufacture of the clamp support bodies.
What is claimed is:

1. A corrosion reducing minimum contact clamp body for supporting and securing tubing in a tubing clamp, comprising:
   - said clamp support body being of a metallic or plastic material having one or more spaced-apart grooves; and
   - said grooves being of a wedge and quadrilateral shape, having chamfered edges forming conical frustums as tubing engaging support areas.

2. The clamp support body of claim 1, wherein the clamp support body is circular in cross section and said grooves include grooves of a first same spacing adjacent to at least one groove of a different second spacing.

3. The clamp support body of claim 1, wherein said clamp support body is perpendicular to an axis of symmetry of the clamp support body.

4. The tubing clamp of claim 1, wherein the chamfered edges of each groove presents a minimum contact area for supporting tubing and forms a wedge.

5. A corrosion reducing minimum tubing clamp for supporting and securing tubing, comprising:
   - a clamp support body being of a metallic or plastic material having one or more spaced-apart grooves, said grooves being of a wedge and quadrilateral shape, having chamfered edges forming conical frustums as tubing engaging support areas; and
fasteners for clamping at least two of said clamp support bodies together with
said grooves of each said clamp support bodies facing each other.

6. The tubing clamp of claim 5, wherein the chamfered edges of each groove
presents a minimum contact area for supporting tubing and forms a wedge.

7. A corrosion reducing minimum contact clamp for supporting and securing tubing
in a tubing clamp, comprising:
   partly cylindrical clamp support bodies of a metallic or plastic material having
   a flat surface and one or more spaced-apart grooves; and
   said grooves being of a wedge and quadrilateral shape, having chamfered
   edges forming conical frustums as tubing engaging support areas.

8. The clamp of claim 7, further comprising fasteners for clamping together two said
clamp support bodies with said grooves facing one another for supporting tubing
therebetween.

9. The tubing clamp of claim 7, further including upper and lower clamping plates
adjacent said flat surfaces wherein said fasteners clamp said clamp support bodies
between said support plates.

10. The tubing clamp of claim 7, further including a middle clamp support body
disposed between said two clamp support bodies of a metallic or plastic material
having one or more spaced-apart grooves of a wedge and quadrilateral shape and
having chamfered edges forming conical frustums, wherein said grooves of said
middle clamp support body include upper groove portions facing said grooves of said
upper one of said two clamp support bodies and lower groove portions facing said
grooves of a lower one of said two clamp support bodies to support tubing between
each of said facing grooves.

11. The tubing clamp of claim 7, wherein the chamfered edges of each groove
presents a minimum contact area for supporting tubing and forms a wedge.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IP (8) - F16L 3/22 (2014.01)
US PC - 248/68
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
IP (8) - F16L 3/22 (2014.01)
US PC - 91/508; 174/157; 248/59, 68, 74; 604/174,180

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC - F16L 3/223, F16L 55/035 (2014.07)

Electronic database consulted during the international search (name of data base and, where practicable, search terms used)
Orbit, Google Patents, Google Scholar

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<tr>
<td>X</td>
<td>EP 1 373 773 B1 (SHIBUYA) 05 July 2006 (05.07.2006) entire document</td>
<td>1, 3, 4, 7, 11</td>
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<tr>
<td>Y</td>
<td>US 6,783,101 B2 (KNOTTS) 31 August 2004 (31.08.2004) entire document</td>
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<td>Y</td>
<td>US 5,542,339 A (KACZMARCYK et al) 06 August 1996 (06.08.1996) entire document</td>
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Further documents are listed in the continuation of Box C.

* Special categories of cited documents:
  "A" document defining the general state of the art which is not considered to be of particular relevance
  "E" earlier application or patent but published on or after the international filing date
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Date of the actual completion of the international search
14 August 2014

Date of mailing of the international search report
05 SEP 2014

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