UNDERWATER PIPELINE-RISER CLAMPS FOR USE ON OIL AND GAS PIPELINES

Hilbert J. Savoie, Jr., P.O. Box 98, Boutte, La. 70070
Filed Aug. 28, 1970, Ser. No. 67,864
Int. Cl. F16G 3/10

3,664,621

United States Patent Office
Patented May 23, 1972

ABSTRACT OF THE DISCLOSURE

The invention consists of double clamp assemblies which have segments pivoted relative to each other for attaching gas and oil vertical pipelines to platforms located offshore. The clamps allow swiveling adjustment of a pipe relative to the leg member of a platform to which it is to be attached. The clamps may include screw-adjusted link means for regulating the relative orientation of the clamping segments.

This invention relates to clamping devices, and more particularly to clamping devices for clamping pipes to adjacent supports.

A main object of the invention is to provide a novel and improved clamping assembly especially adapted for clamping gas and oil vertical pipelines to platforms located offshore, the clamping devices being relatively simple in construction, being easy to install, and having segments which are adjustable relative to each other.

A further object of the invention is to provide an improved clamping assembly for attaching gas and oil vertical pipelines, and similar conduits, to adjacent supports, such as leg elements of platforms located offshore, the clamps being relatively easy to manipulate so that they can be readily installed by divers, being durable in construction, and being inexpensive to fabricate.

A still further object of the invention is to provide an improved clamp assembly especially suitable for attaching gas and oil vertical pipelines to platforms located offshore, the clamp assemblies involving relatively few parts, having a high degree of adjustability so that they allow pipes to be secured to their associated supports even when the pipes are skewed relative to the supports, the clamp assemblies being relatively compact in size, being relatively light in weight, and having means for easily and efficiently adjusting the relative orientations of their various segments.

Further objects and advantages of the invention will be apparent from the following description and claims, and from the accompanying drawings, wherein:

FIG. 1 is a top plan view of an improved multiple-segment type clamping assembly constructed in accordance with the present invention.

FIG. 2 is a vertical cross-sectional view taken substantially on the line 2—2 of FIG. 1.

FIG. 3 is a perspective view of one of the sinuously curved body elements of the clamping assembly of FIGS. 1 and 2.

FIG. 4 is a fragmentary top-plan view of one end portion of a modified form of clamping assembly according to the present invention.

FIG. 5 is a vertical cross-sectional view taken substantially on the line 5—5 of FIG. 4.

FIG. 6 is a top-plan view of another modification of a multiple-clamp assembly according to the present invention.

FIG. 7 is a vertical cross-sectional view taken substantially on the line 7—7 of FIG. 6.

FIG. 8 is a top-plan view of still another modified form of a multiple-clamp assembly according to the present invention.

FIG. 9 is a vertical cross-sectional view taken substantially on the line 9—9 of FIG. 8.

FIG. 10 is a top-plan view of still another form of multiple-clamp assembly according to the present invention, said form being somewhat similar to that shown in FIG. 10, but without the swiveling feature.

FIG. 11 is a top-plan view of another form of multiple-clamp assembly according to the present invention, employing screw-adjustment means for regulating the spacing between the clamp assembly sections.

FIG. 13 is a front elevational view of the clamp assembly of FIG. 12.

FIG. 14 is a top-plan view of another form of multiple-clamp assembly according to the present invention, employing screw-adjustment means for regulating the spacing between the clamping segments of the assembly.

FIG. 15 is a top plan view of still another form of multiple-clamp assembly according to the present invention, wherein the clamping segments are angularly adjustable relative to each other.

FIG. 16 is a vertical cross-sectional view taken substantially on line 16—16 of FIG. 15.

FIG. 17 is a vertical cross-sectional view taken substantially on line 17—17 of FIG. 16.

FIG. 18 is an enlarged vertical cross-sectional detail view taken substantially on line 18—18 of FIG. 16.

A prime purpose of the present invention is to provide clamps intended to be utilized under water to attach gas and oil vertical pipelines (also called "risers") to platforms located offshore.

Oil and gas platforms located offshore are usually connected together with pipelines of varying sizes. These pipelines are usually laid under the surface of the water below the mud line. When the pipelines are brought from the mud line to the top of the platforms it is necessary to attach them to the platforms with some form of bracing or clamps. The pipeline sections from the mud line to the top of the platform are called "risers." These "risers" are usually attached to the platforms by using clamping devices which attach to the "risers" and usually to the main leg members of the platform.

In instances, a "riser" when of a small enough size, can be attached to a horizontal bracing member of the platform by a clamping device.

"Risers" in modern use vary in size from a diameter of several inches to a diameter of two or three feet. It is especially difficult to attach the larger "risers" to the platforms because of the necessity for installation under water by divers. Furthermore, it is virtually impossible to compute, prior to installation, the exact distance that the vertical riser will be from the main leg of the platform to which it is to be attached.

In the oil and gas industry, clamps in current use are relatively bulky and are difficult to install. Also, the clamps currently in use must be fabricated to exact specifications for successful attachment of the vertical risers to the main leg members of the platforms. These requirements create further difficulties in the installation of the risers, as will be presently described.

Further evidence for the need for improved clamp assemblies are the following:

(1) Most of the clamps are installed under water, and therefore it is necessary to utilize marine divers; the cost of marine divers is great and the cost increases proportionately with the depth of the water in which the clamp
is to be installed. Additionally, large amounts of expensive equipment are necessary to assist the diver in installation of the clamps.

The time involved from the start to the finish in installing a vertical pipeline or riser adjacent to an existing platform is critical in that the most significant items of expense are the salaries and rental fees paid to divers and owners of marine equipment, such as derrick barges, tugboats, crew boats, supply barges, and engineering and fabricating equipment, and the cost for the installation of the installation of the abovementioned apparatus.

It is therefore apparent that improved clamps which will save time in installation will also save the petroleum companies and installation contractors concerned, considerable money.

The diver installing the clamps connecting the vertical risers to the adjacent platform usually works alone. The clamps in current use are of considerable size, sometimes weighing hundreds of pounds. The size of the clamp to be utilized is usually determined by the size of the vertical riser and the size of the main leg member of the platform to which the riser is to be attached. Main leg members of platforms usually range in diameter from 36 inches to 60 inches. As previously mentioned, the vertical pipelines or risers may range in size from a few inches to as large as two to three feet in diameter, and in some instances exceed three feet in diameter.

The clamps utilized to attach the vertical riser to the platform main leg member are placed at intervals starting at the bottom near the mud line, and are placed as required along the vertical pipeline or risers so that the riser is firmly attached to the main leg member of the platform. The depth of the water surrounding the oil or gas platform and the size of the vertical riser will usually determine the size and number of clamps to be installed. The time involved in installing the clamps will vary, depending upon the depth of the water to be worked in and the size of the clamps to be utilized.

The clamps forming the present invention will allow a diver to install all of the necessary clamps on a riser in one dive in water as deep as 200 feet. The various forms of the clamps of the present invention will now be described in detail, with reference to the accompanying drawings.

Referring now to FIGS. 1, 2 and 3, 20 generally designates a typical riser clamp assembly according to the present invention. The assembly 20 comprises two parts each having a generally S-shaped configuration which are pivotally connected together in interleaved relationship at their center portions to define pairs of opposing generally semi-circular jaws. Thus, the first generally S-shaped jaw member comprises a pair of sinuously curved flat bar elements 21, 21, each having the shape shown in FIG. 3, which are rigidly secured together in parallel spaced relationship, as by means of a spacer block 22 rigidly connected between their respective semi-circular jaw portions 24, 24. The cooperating generally S-shaped jaw member comprises similarly curved flat bar elements 25, 25 having the respective generally semi-circular jaw portions 28, 28 which respectively oppose semi-circular jaw portions 24, 24, as shown in FIG. 1. Generally semi-circular jaw elements 28 are rigidly connected together by blocks 22' similar to those employed for the jaw elements 24. The pairs of members 21, 21 and 25, 25 are interlaced and are pivotally connected at their center portions by a pivot bolt 26, as shown in FIG. 2, and suitable spacer washers 27, 27 surround the bolt 26 and are located between the crossing portions of the sinuous members, as illustrated in FIG. 2. The bolt 26 is provided with a fastening nut 35. Each flat sinuously curved member is provided at its end with an outwardly extending notched lug 31. Hinged at 32 to the pairs of semi-circular jaw elements 28, 28 is a bracket 33 to which is secured a bolt 34 engageable between the lugs 31, 31 of the jaws 24, 24 and being provided with a nut 35. The bolt 34 is provided with a rectangular bridging washer 36 which is receivable in the notches of the lugs 31 carried by the jaws 28, 28, and a similar bridging washer 37 is provided beneath the nut 35 and is receivable in the notches of the lugs 31 of jaws 24. Thus, the jaws 28 and 24 may be clamped around a leg member associated with an offshore platform, as above described, with the opposite pairs of opposing jaws 24' and 28' engaged around a vertical riser. Said members 28' and 24' are provided with similar locking structure consisting of notched lugs 31 and a hinged bracket 33' carrying a clamping bolt 34' provided with a securing nut 35' and having the bridging washers 36 and 37' engageable in the notches of the lugs 31 in the manner illustrated in FIG. 1.

Thus, the assembly 20 may be used by first swining the opposing generally S-shaped members thereof to open positions, such as shown in dotted view in FIG. 1, and then engaging the sets of opposing jaws respectively around the vertical platform leg member and the vertical riser to be clamped thereto, after which the generally S-shaped members are swung together in scissor fashion and are fastened by their clamping bolts. The bolts 34, 34' may be swung into clamping positions between the sets of notched lugs 31 after the jaws have been swung inwardly to embrace the platform leg member and vertical riser, respectively. Due to the two-piece construction of this assembly, which enables the parts to be pivoted in scissor fashion, this design allows the use of horizontally acting power means to close the clamp segments, for example, allows the use of a hydraulic cylinder suitably engaged with the sets of notched lugs of one set of opposing jaws to close the jaws while the diver secures the bolts on the ends of the opposite jaws. The use of hydraulic power allows the clamp to be closed in the event there is a slight variation in distance between the leg member and the riser as compared with the nominal distance between sets of the opposing pairs of jaws. After the jaws at one have been bolted, the hydraulic cylinder device may be removed and the adjacent hinged bolt may be employed to clamp the jaws previously engaged by the hydraulic cylinder device.

FIGS. 4 and 5 illustrate a variation in structure as compared with FIGS. 1, 2 and 3, wherein the interleaved ends of one set of jaws may be apertured to receive a wedge 38, instead of employing the notched lugs 31 and the hinged bolts. Thus, this enables the diver to secure the clamping assembly closed after it has been closed by the hydraulic cylinder, whereby he can remove the hydraulic cylinder and complete the securing at that end with the hinged bolt and nut arrangement described in connection with FIGS. 1, 2 and 3. For example, the jaws 24, 24 and 28, 28 may be provided at their ends with registrable apertures 39 adapted to receive the wedge 38, whereas the jaw elements 28' and 24' may be provided with the structure shown in FIG. 1, including the notched lugs 31 and the hinged bracket 33' carrying the bolt 34'. With such an arrangement, the hydraulic cylinder device is employed to close the jaws at the ends of the elements 28' and 24', after which the wedge 38 is inserted through the apertures 39 to hold the clamping device closed. The hydraulic cylinder device may then be removed and the securing of the clamp may be then completed by using the hinged bolt 34' and the parts associated therewith to lock the jaw elements 28' and 24' together in the manner previously described.

FIGS. 6 and 7 illustrate another form of the invention designated generally as 40. The clamping assembly 40 comprises a first pair of generally C-shaped jaws 41 and 42 and a pair of additional generally C-shaped jaws 43 and 44, the jaws being pivotally connected together by a pivot bolt 45 defining a pivotal junction of the jaws. Thus, the generally C-shaped jaw assembly 41 comprises a pair of generally semi-circular flat bar elements 46 and 47, rigidly secured in spaced parallel relationship by being
connected to a spacer block 48 secured between their intermediate portions. The opposing generally C-shaped jaw 41, 42, and 43, 44 are similarly formed, but is provided with an upstanding bracket plate 49 to which is journaled a peripherally grooved pulley 50 adapted to be employed with a suspension cable, not shown, to facilitate handling the assembly. The upper generally semi-circular bar member 46 of the opposing jaw assembly 41 is provided with an upstanding loop 51 adapted to be employed with a cable, or the like, for handling the assembly. The generally C-shaped jaw assemblies are provided at their free ends with notched lugs, shown at 52, similar to those provided in the previously described forms of the invention, to be employed with pivotal securing bolts 34 and 34', carried by hinged bracket members 33 and 33', utilized in the same manner as in the embodiment of FIGS. 1, 2 and 3.

As shown in FIG. 7, the flat generally semi-circular bar elements of the jaws have interlaced end lugs 54 which are apertured to receive the pivot bolt 45', being thus pivotally connected together by said pivot bolt. The apertured pivot lugs 54 at the ends of the bars thus cooperate with each other to maintain the flat bars in parallel planes. As in the previously described form of the invention, the pivot bolt 45 is provided with a nut 29 having a handle loop 30. This bolt 45 is designed for the purpose of connecting the vertical main leg member of a platform to a vertical riser. Thus, the jaws 42 and 41 are engageable with the platform vertical leg member and the jaws 43 and 44 are similarly engageable with a vertical riser to be clamped adjacent to the platform vertical leg member. The sets of jaws 41 and 42 can be manipulated independently of the jaws 43 and 44, so that the two sections of the clamp can be securely attached either to the riser or the main leg of the platform independently of each other.

It will thus be seen that the jaws 41 and 42 may be connected to the vertical leg of a platform, shown at 57 in FIG. 7, and the jaws 43 and 44 may be attached to a vertical riser, shown at 58 in FIG. 7, in any desired sequence of operations, because the respective pairs of jaws can be independently manipulated.

FIGS. 8 and 9 illustrate a modified form of the clamp assembly shown in FIGS. 6 and 7 wherein the respective pairs of jaws 41, 42 and 43, 44 are connected together by link bars to define a variable distance stand-off arrangement to allow the assembly to be used to connect a riser to a vertical platform leg member when the exact distance between the riser and the leg member cannot be accurately determined prior to the installation of the clamp assembly. Thus, a plurality of identical flat link bars 59 are interlaced with the apertured end lugs 54 of the clamp bars, respective pivot bolts 60, 60' being employed to connect respective sets of opposing jaws to the ends of the link bars. The uppermost link bar 59 may be provided with an upstanding handle loop 61, as shown in FIGS. 8 and 9.

The clamp assembly of FIGS. 8 and 9 is especially designed for use as a first clamp assembly at the mud line. As previously discussed, when pipelines are installed under the mud line, that portion of the pipeline from the mud line to the top of the platform is called "the vertical riser." When installing the pipelines of vertical risers, it is impossible to compute the exact distance the vertical riser will be from the main leg of the platform to which the riser is to be attached. The distance between the vertical riser and the main leg of the platform at the mud line is determined to three feet, and in some instances beyond three feet, along the length of the riser. Because of the above-mentioned variations, and because of the size of the risers, some of which have a diameter from two to three feet, and furthermore, because of the great depths at which the vertical riser is installed in some instances, it is nearly impossible to predetermine and pre-fabricate the size of the clamp necessary to connect the riser to the main leg at the mud line. According to the practice heretofore employed, numerous dives are necessary in order to connect the vertical risers to the main leg of the platform, using the clamps of the prior art. Thus, when using such prior art clamps, the diver must measure the distance between the riser and the main leg at the point of installation and send this information to the clamp fabricator. After the fabrication of the clamp the diver must then proceed to install the clamp on the riser and the main platform leg. If the clamp is not properly fitted and has no means for adjustment, a new measurement must be made and the clamp must be returned to the manufacturer. For these reasons the process must be continued until the clamps are properly fitted.

The above-mentioned problems are corrected by employing a double pivot clamp assembly of FIGS. 8 and 9. The double pivot assembly allows the clamp to be maneuvered so that it may be fitted to the riser and main leg of the adjacent platform with ample allowance for variation in distance between the riser and the main leg. Thus, the respective sets of jaws 41, 42 and 43, 44 may be maneuvered as required and then be locked in place by their fastening bolts 34, 34'.

The embodiment illustrated in FIG. 10 is generally similar to that of FIGS. 8 and 9 except that the link bars 59 are replaced by a swivel assembly to permit the cooperating jaw assembly 41, 42 to be swiveled with respect to the other cooperating jaw assembly 43', 44'. The cooperating jaw assembly 41, 42 may be similar to that shown in FIGS. 8 and 9 and is pivotally connected by the pivot bolt 60 to a bracket 62 which may be of general U-shape having a transverse bight portion 63 which is pivotally connected by a swivel bolt 64 to an end wall 65 of a box-like member 66. The member 66 is received between the generally semi-circular top arm 67 and the generally semi-circular bottom arm 68 of the jaw assembly 43'. As shown in FIG. 10, the generally semi-circular top arm 69 and the generally semi-circular bottom arm 70 of the jaw assembly 43' are respectively located above and below the arms 67 and 68, with the inner end portions of the upper arms 67 and 69 superimposed on the top wall of the box-like member 66 and the inner portions of the lower arms 68 and 70 superimposed on the sides of the box wall of box member 66. The connecting pin element 60 extends through said superimposed inner end portions of the arm, as well as the top and bottom walls of the box-like member 66 to define a pivotal connection for the jaw assembly 43', 44'. As is clearly shown in FIG. 10, the pivotal axis of the swivel bolt 64 extends perpendicular to both the left pivot pin element 60 and the right pivot pin element 60'. Thus, the jaw assembly 43', 44' may rotate relative to the jaw assembly 41, 42, which therefore allows the clamp assembly to be utilized to secure a vertical riser to a brace member running at any angle.

The modification illustrated in FIG. 11 is also generally similar to that shown in FIGS. 8 and 9 except that the cooperating pairs of opposing jaw portions are arranged with their jaw axes perpendicular to each other so as to secure a vertical riser to a horizontal brace member. Thus, in FIG. 11, the cooperating generally semi-circular jaws 41, 42, and 43, 44, similar to those of FIGS. 8, 9 and 10, are pivotally connected by the pivot bolt 60 to a rigid box-like member 66', the box-like member 66' being received between the inner end portions of the innermost semi-circular flat bar elements of the jaws 41, 42 with the pivot bolt 60 extending through the superimposed inner end portions of said flat bar elements as well as the inner semi-circular walls of the box-like member 66'. The opposite end portion of the box-like member 66' is received between the members 67 and 68 of jaw portion 44', as in FIG. 10, and the inner end portions of the jaw members 43', 44' are pivotally connected to the box-like member 66' by a pivot bolt 60' extending perpendicular to the pivot bolt 60. The box-
like member 66' may be provided with an outwardly projecting handle loop 72.

In the embodiments of FIGS. 10 and 11, the outer end portions of the jaw members may be provided with angle brackets 73 rigidly connected between the outer ends of the flat sides of the parallel bar members thereof to receive the clamping bolts 74.

Although not shown in FIGS. 10 and 11, the clamping bolts 74 may be mounted on swinging arms hinged to the jaws in the same manner as disclosed, for example, in FIGS. 8 and 9.

FIGS. 12 and 13 illustrate an embodiment of the invention adapted to be used to connect a vertical riser to a vertical platform leg with provision for adjusting the distance between the clamping members in accordance with the distance between the vertical riser and the platform leg to which it is to be clamped. Thus, the assembly, shown at 80 in FIGS. 12 and 13 is generally similar to that of FIGS. 6 and 7 in that it employs a pair of cooperating jaw portions 41' and 42' generally similar to the jaw portions 41 and 42 in FIG. 6 and adapted to be clamping secured to a platform vertical leg.

The cooperating jaw assembly adapted to be clamping secured to a vertical riser comprises the opposed jaw portions 41' and 42' generally curving arcuate support arm portions whose inner ends are pivotally connected to the inner ends of the other pair of cooperating jaw portions 41, 42' by the pivot bolt 45. As shown in FIG. 13, the arms 81 and 82 of the jaw portion 43' receive therebetween the top and bottom arms 83 and 84 of the cooperating jaw portions 44'. The arms 81 and 82 have arcually curved support portions 85 and 86 and the arms 83 and 84 of the jaw 44' have arcually curved support portions 87 and 88 received between the support portions 85 and 86, the inner ends of the support portions being pivotally connected to the other cooperating jawings 41, 42' by the pivot bolt 45. The assembly is provided with adjustable tie means connecting the arcuate support members 85, 86 to the jaw portion 41' of the opposite Cooperating pair of jaws. Thus, an arcually curved yoke member 89 has its arms pivotally connected at 90, 91 to intermediate portions of support elements 85, 86, and a threaded shaft element 91 is rigidly secured to the upper portion of yoke member 89. A pivot lug member 92 is rigidly secured to and projects outwardly from the intermediate portion of the jaw 41' and a sleeve member 93 is pivotally connected thereto at 94. The shank element 91 extends through the sleeve member 93 and is provided with respective nuts 95 and 96 located at the opposite ends of the sleeve 93 for locking the shaft element 91 in an adjusted position with respect to sleeve 93. This allows the distance between the clamping axes of the cooperating jaw elements 41', 42' and the jaw elements 43', 44' to be adjusted in accordance with the distance between the riser pipe and the platform leg element to which it is to be clamped.

FIG. 14 illustrates a further embodiment similar to that of FIGS. 12 and 13, wherein the lug member 92' rigidly secured to the jaw 41' projects outwardly in the same manner as in FIG. 12, but a similar lug structure is provided for the support arms of the jaw 43'. Thus, the arcually curved support arm portions of jaw 43' may be provided with outwardly projecting lugs 96' and a sleeve member 97 may be pivotally connected between their top ends, as viewed in FIG. 4, by a transverse pivot pin 98. One end of a threaded shaft member 91' is rigidly secured to the support member 93' pivotally to the lug structure 92' by transverse pivot pin 94', the threaded shaft 91' extending through the sleeve member 97 and being provided with the fastening nuts 95 and 96 similar to those employed in the embodiment of FIGS. 12 and 13.

In the embodiment illustrated in FIGS. 15 to 18, an arrangement is provided wherein a riser can be clamped to a leg or brace portion of a platform regardless of non-parallelism of the riser with respect to the element to which it is to be clamped. Thus, the assembly designated generally at 100 comprises a pair of generally V-shaped trunnion segments 101 and 102, the segment 101 having the arcually curved outwardly extending opposite trunnion arms 103 and 104 and the trunnion segment 102 having the corresponding arcually curved outwardly extending trunnion arms 105 and 106. The arms 103 and 105 have aligned trunnion pins 108 and 109 at their ends, projecting inwardly and having secured thereto the webs 110 and 111 of respectively general semi-circular opposing clamping jaws 112 and 113. Thus, as shown in FIG. 7, the clamping jaws are of generally ⅔-shaped cross-sectional shape and are secured to the trunnion pins at their mid-portions. The arms 104 and 106 likewise support respective generally semi-circular opposing clamping members 114 and 115 and are similar to the members 112 and 113. The respective clamping elements 112, 113, 114 and 115 are thereby freely pivoted.

The generally V-shaped trunnion segments each comprises a pair of parallel top and bottom plate members of identical shape rigidly connected by spacer blocks 120 and 121 located at the intermediate portions of the arcuate trunnion arms of the segments, as shown in FIG. 15. Top and bottom abutment plates 121, 122 are secured in the vertices of the arretral trunnion arms 103, 101, 105 and 107 being rigidly connected by an apertura vertical abutment plate 123. An aperture abutment block 124 is provided in the vertex of the opposing trunnion segment 102. A threaded clamping shaft 125 extends through the block 124 and the plate 123. The shaft 125 is provided with an enlarged outer portion 126 defining an abutment shoulder 127 engaged against the block 124, and a nut 128 is provided on the threaded shaft 125 outwardly adjacent the plate 123, the nut non-rotatorily fitting between the top and bottom plates 121 and 122, as shown in FIG. 18, whereby rotation of the shaft 125 in one direction causes clamping force to be exerted between the trunnion segments 101 and 102. The end of the enlarged shaft portion 126 may be provided with a hand wheel 129, and the hand wheel may be provided with loops 130 at its periphery which may be employed in conjunction with a suitable cable connected to a power source for providing external torque on the shaft 125 when required.

Thus, the respective pairs of jaw elements 112, 113 and 114, 115 may be respectively engaged around a fixed platform brace member and a riser pipe to be clamped thereon, to which the shaft 125 may be secured by any means of handwheel 129, and perhaps with the assistance of an externally powered cable attached to loops 130, to tighten the assembly so as to cause the members 112, 113 and 114, 115 to tightly clamp a platform brace member and a riser pipe, respectively. When the tightening procedure is completed, the diver removes the cable by detaching it from the loops 130.

For remote installation, the threaded shaft 125 may be operated by hydraulic, pneumatic or other mechanical means, and any suitable means may be employed for supervising the setting of the clamp assembly, for example, by the use of underwater television for viewing the assembly as it is operated by such mechanical means.

It will be noted that because of the swivel cooperation between the jaw elements 112, 113 and the arms 103, 105 and between the jaw elements 114, 115 and the arms 104, 106, once the clamp has been installed, the riser may be raised or lowered without the necessity of loosening or tightening of the assembly or of making any adjustments thereto.

As shown in FIG. 18, the vertex portions of the trunnion segments 101 and 102 are provided with centrally apertured bushing blocks 130' and 131 through which the threaded member 125 extends, said blocks serving as guides for said threaded member. An apertura resilient deformable plate 132 may be provided between the apex portions of said trunnion segments, as shown in FIG. 18,
serving as a yieldable cushioning filler between the trunnion segments. The threaded member 125 extends through the central aperture of said cushioning filler 132, as is clearly shown in FIG. 18.

As will be readily apparent, the assembly 100 of FIGS. 5 to 18 can be employed for substantially the same purposes as the clamps illustrated and described previously but may be employed with somewhat more flexibility and ease of installation. The assembly 100 can be maneuvered so as to compensate for variations in distance between the riser and the leg to which it is to be attached. The clamp assembly 100 can be installed at the maximum stand-off distance, whereby the ends of the assembly will be at the same level. When there is a lesser distance between the leg and the riser, the two ends of the clamp may be installed at different levels, the trunnion segments 101 and 102 being then angled relative to the two sets of opposing jaw members. It will also be apparent that in the event that the riser and the leg to which it is to be attached are not parallel to each other, the clamp assembly 100 can be installed and is adjustable for such non-parallelism.

As previously mentioned, the handwheel 129 may be manually operated by the diver, or alternatively, may be driven by an external power source by utilizing a cable attached to the loops 130. As above mentioned, when the tightening procedure is completed, the diver can remove the cable by disconnecting it from the loops 130.

The trunnion pins may be secured to the ends of the arms of the trunnion segments in any suitable manner, for example, may be rigidly secured between the arm bars employing vertical retaining plates 140, 140 welded between the bars on opposite sides of the pins. Furthermore, the pins are provided with retaining collars 141 which cooperate with the heads of the pins to retain them against axial movement.

While certain specific embodiments of improved clamp assemblies for connecting a riser to an adjacent stationary element of a platform or similar structure have been disclosed in the foregoing description, it will be understood that various modifications within the spirit of the invention may occur to those skilled in the art. Therefore, it is intended that no limitations be placed on the invention except as defined by the scope of the appended claims.

What is claimed is:

1. A clamp assembly comprising a plurality of body members having substantially semi-circular jaw portions, means pivotally connecting said body members together with said jaw portions in opposing relationship to define two sets of pairs of opposing jaw portions adapted to respectively engage around a fixed support member and an adjacent pipe, and means to secure said pairs of opposing jaw portions in cooperating clamping relationship, wherein said securing means includes at least one threaded member arranged to exert clamping force on at least one of the jaw portions and nut means threadedly engaged with said threaded member and arranged to exert clamping force on a jaw portion opposite said one jaw portion, and wherein said securing means comprises a coplanar pair of trunnion segments, each having a pair of trunnion arms and a connection therebetween, the threaded member extending through the junctions of the trunnion arms and being substantially in the planes of the trunnion segments, said semi-circular jaw portions being respectively pivoted to the ends of the trunnion arms.

2. The clamp assembly of claim 1, wherein the threaded member pivotally connects the body members together on a pivotal axis located between the two sets of pairs of opposing jaw portions.

3. The clamp assembly of claim 2, wherein said threaded member has an axis substantially parallel to the planes of the respective pairs of opposing jaw portions.

4. The clamp assembly of claim 1, and wherein said body members each comprises a plurality of parallel flat curved bar elements, and means to maintain the plurality of bar elements of each body member in spaced parallel relationship.

5. The clamp assembly of claim 1, and wherein said threaded member is provided with a hand wheel at one end thereof, said threaded member having shoulder means adjacent the hand wheel abutting the adjacent trunnion junction, the opposite trunnion junction being provided with non-rotatable nut means threadedly receiving said threaded member.

6. The clamp assembly of claim 1, and wherein said body members each comprises a pair of parallel flat curved bar elements, and means to maintain the bar elements in spaced parallel relationship.

7. The clamp assembly of claim 6, and wherein the threaded member extends between the respective flat curved bar elements of each pair and is substantially parallel to the planes thereof.

References Cited

UNITED STATES PATENTS

587,912 8/1897 Atwood 248—230
1,280,095 9/1918 Smith 248—230
1,852,363 4/1932 Parent 248—68 X
1,883,935 10/1932 Kelley 248—74 X
3,207,463 9/1965 Downey 248—68 X

FOREIGN PATENTS

23,395 5/1930 Australia 248—230

CHANCELLOR E. HARRIS, Primary Examiner

U.S. Cl. X.R.

24—81 CC; 248—221, 226 C