



US012103247B2

(12) **United States Patent**
Montgomery

(10) **Patent No.:** **US 12,103,247 B2**

(45) **Date of Patent:** **Oct. 1, 2024**

(54) **ASSEMBLY AND METHOD OF COUPLING PIPES**

(71) Applicant: **ISCO Industries, Inc.**, Louisville, KY (US)

(72) Inventor: **Michael John Montgomery**, Hazel Green, AL (US)

(73) Assignee: **ISCO Industries, Inc.**, Louisville, KY (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **16/951,803**

(22) Filed: **Nov. 18, 2020**

(65) **Prior Publication Data**

US 2021/0078260 A1 Mar. 18, 2021

Related U.S. Application Data

(63) Continuation-in-part of application No. 17/021,424, filed on Sep. 15, 2020, now Pat. No. 11,813,804, (Continued)

(51) **Int. Cl.**
B29C 65/02 (2006.01)
B23K 31/02 (2006.01)

(Continued)

(52) **U.S. Cl.**
CPC **B29C 65/7835** (2013.01); **B23K 31/02** (2013.01); **B23K 37/0533** (2013.01); (Continued)

(58) **Field of Classification Search**
CPC B21D 3/14; B23K 31/02; B23K 37/0533; B23P 19/04; B25B 5/147; B29C 65/02;

B29C 65/34; B29C 65/3404; B29C 65/342; B29C 65/3424; B29C 65/3432; B29C 65/3468; B29C 65/565; B29C 65/58; B29C 65/7802; B29C 65/7835; B29C 65/7841; B29C 66/1122; B29C 66/1142; B29C 66/1222; B29C 66/1224; B29C 66/12241; B29C 66/30321; B29C 66/30325;

(Continued)

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,632,417 A 3/1953 Smith
2,768,567 A 10/1956 Tinkess

(Continued)

FOREIGN PATENT DOCUMENTS

CA 2934317 10/2018
CA 3007568 10/2020

(Continued)

OTHER PUBLICATIONS

Canadian Patent Application No. 2,934,317 entered National Stage on Jun. 16, 2016.

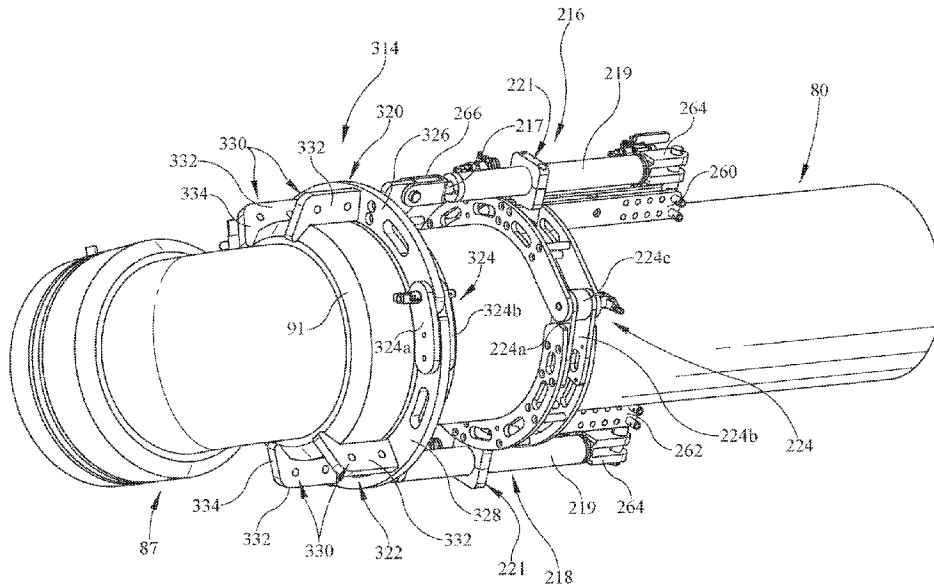
(Continued)

Primary Examiner — Michael A Tolin
(74) *Attorney, Agent, or Firm* — Dinsmore & Shohl LLP

(57) **ABSTRACT**

A jig assembly and method of use are provided for positioning and re-rounding pipes for welding. The jig assembly comprises a first jaw assembly and a second jaw assembly which position and move a coupling onto one pipe then the second pipe for subsequent welding.

10 Claims, 17 Drawing Sheets



Related U.S. Application Data

which is a continuation of application No. 15/207,004, filed on Jul. 11, 2016, now Pat. No. 10,780,649, which is a continuation of application No. 14/132,700, filed on Dec. 18, 2013, now Pat. No. 9,415,542.

(51) **Int. Cl.**

B23K 37/053 (2006.01)
B23P 19/04 (2006.01)
B29C 65/00 (2006.01)
B29C 65/34 (2006.01)
B29C 65/56 (2006.01)
B29C 65/58 (2006.01)
B29C 65/78 (2006.01)
F16L 1/09 (2006.01)
F16L 1/10 (2006.01)
F16L 47/03 (2006.01)
B29L 23/00 (2006.01)

(52) **U.S. Cl.**

CPC **B23P 19/04** (2013.01); **B29C 65/02** (2013.01); **B29C 65/342** (2013.01); **B29C 65/342A** (2013.01); **B29C 65/3468** (2013.01); **B29C 65/565** (2013.01); **B29C 65/58** (2013.01); **B29C 65/7802** (2013.01); **B29C 65/7841** (2013.01); **B29C 66/1122** (2013.01); **B29C 66/1142** (2013.01); **B29C 66/1222** (2013.01); **B29C 66/1224** (2013.01); **B29C 66/1224I** (2013.01); **B29C 66/5221** (2013.01); **B29C 66/5229** (2013.01); **F16L 1/09** (2013.01); **F16L 1/10** (2013.01); **F16L 47/03** (2013.01); **B29C 66/71** (2013.01); **B29L 2023/22** (2013.01); **Y10T 29/49902** (2015.01); **Y10T 29/5367** (2015.01)

(58) **Field of Classification Search**

CPC B29C 66/5221; B29C 66/52231; B29C 66/5229; B29C 66/71; B29C 66/73921; B29C 66/8242; B29C 66/8414; B29K 2023/06; B29K 2023/0633; B29K 2023/065; B29K 2023/12; B29K 2027/16; B29K 2055/02; B29L 2023/22; F16L 1/09; F16L 1/10; F16L 47/02; F16L 47/03; F16L 47/06; Y10T 29/49902; Y10T 29/5367

See application file for complete search history.

(56)

References Cited

U.S. PATENT DOCUMENTS

2,958,125 A * 11/1960 Nichols F16L 1/09 D8/51
 3,467,295 A 9/1969 Watson
 3,729,360 A 4/1973 McElroy
 3,846,208 A 11/1974 McElroy
 3,882,299 A 5/1975 Sciaky
 3,920,232 A 11/1975 Clark
 3,952,936 A 4/1976 Dearman
 4,008,118 A 2/1977 Wesebaum et al.
 4,315,702 A 2/1982 Moe et al.
 4,457,647 A 7/1984 Dusette et al.
 4,523,779 A 6/1985 Knox
 4,779,902 A 10/1988 Lee
 5,464,496 A 11/1995 Wilson et al.
 5,527,406 A 6/1996 Brath
 5,770,006 A 6/1998 Andrew et al.
 5,830,312 A 11/1998 Weimer et al.
 5,843,271 A 12/1998 Andrew et al.
 6,325,277 B1 12/2001 Collie
 6,406,063 B1 6/2002 Pfeiffer

6,550,514 B1 4/2003 Andrew
 6,775,890 B2 8/2004 Kolarik
 7,191,686 B1 3/2007 Angelle et al.
 7,371,305 B2 5/2008 Sano et al.
 7,926,534 B2 4/2011 Temple
 8,128,853 B2 3/2012 St. Onge et al.
 8,746,747 B2 6/2014 McPherson
 9,415,542 B2 8/2016 Montgomery
 10,780,649 B2 9/2020 Montgomery
 2002/0101017 A1 8/2002 Kolarik
 2007/0256288 A1 11/2007 Vermaat
 2010/0090453 A1 4/2010 Bortoli
 2013/0008881 A1 1/2013 Berbakov
 2015/0075722 A1 * 3/2015 Lawrence B29C 66/86521 156/502
 2015/0165672 A1 * 6/2015 Montgomery B23P 19/04 156/391
 2015/0174706 A1 * 6/2015 McClure B23K 37/0533 269/45
 2018/0058614 A1 * 3/2018 Anderson F16L 21/06
 2021/0001565 A1 1/2021 Montgomery

FOREIGN PATENT DOCUMENTS

DE 2433946 A1 2/1976
 DE 102011012198 9/2011
 EP 1306169 A1 * 5/2003 B25B 1/2452
 JP 11267888 10/1999
 KR 100850688 8/2008
 WO 2015095374 6/2015

OTHER PUBLICATIONS

Canadian Patent Application No. 2,934,317 Office Action dated Mar. 27, 2017.
 Transmittal Letter of Related Cases.
 Self-aligning hydraulic butt fusion machine, suitable for welding underpipe fusion machine pressure pipes for water, gas and other fluids; <http://www.rjmcompany.com/pipe-fusion-machines/HDPE-fusion-machine.htm> Sep. 10, 2013.
 Hiram; Used for Re-Rounding Large Diameter PE pipe prior to use with electrofusion couplers; <http://www.hiram.com/toolprint.php?id=9> Sep. 10, 2013.
 Integrity; HDPE Pipe, especially in larger sizes, has a tendency to oval, usually as result of excessive heat from the sun coupled with loading pressures; <http://www.integrityfusion.com/rerounding-clamps> Sep. 10, 2013.
 ISCO Industries, Snap-Tite Culvert Lining System, catalog, pp. 1-6, ISCO Industries, Louisville, Kentucky, Dec. 1, 2013.
 SnapTite, Ease of Installation, SnapTite Design Guide, pp. 36-38, www.culvert-rehab.com Jan. 9, 2014.
 Korean Intellectual Property Office, Written Opinion of the International Searching Authority for PCT/US2014/070924, pp. 1-11, Metropolitan City, Republic of Korea Apr. 15, 2015.
 Large Diameter HDPE ElectroFusion Couplers IPF—Plasson. www.youtube.com/watch?v=0mBVA_VTz4, Aug. 15, 2013.
 Central Plastics Company. Electrofusion Installation Procedure Manual. www.centralplastics.com/content/dam/gfps_country_US/Content/gfcp_assets/downloads/products/technical/EF%20Installation%20Booklet.pdf, May 2003.
 A guide on how to install a 800mm Friatec Electrofusion Coupling. www.youtube.com/watch?v=IZWME7XZ7BY, Jul. 25, 2013.
 Canadian Intellectual Property Office, Notice of Allowance for Patent Application No. 2,934,317 dated Aug. 15, 2018.
 Canadian Divisional Patent Application No. 3,007,568 filed Jun. 7, 2018.
 Canadian Intellectual Property Office, Office Action U.S. Pat. No. 3,007,568 dated May 24, 2019.
 "A Guide on How to Install a 800mm Friatec Electrofusion Coupling", www.youtube.com/watch?v=IZWME7XZ7BY, Jul. 25, 2013. (Year: 2013).

(56)

References Cited

OTHER PUBLICATIONS

US Patent and Trademark Office, Non-Final Office Action issued in
U.S. Appl. No. 17/021,424 issued Jan. 18, 2022.

* cited by examiner

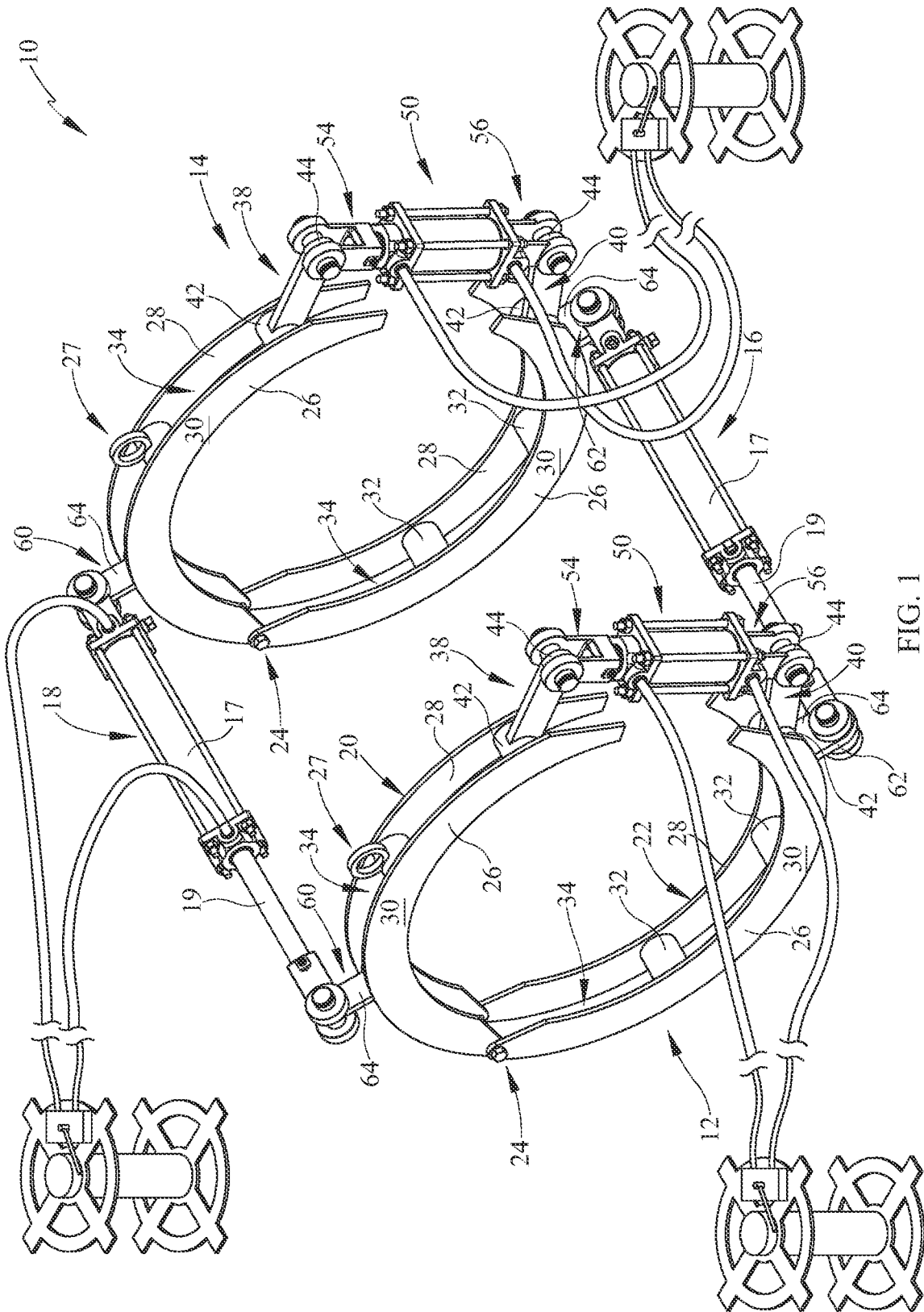


FIG. 1

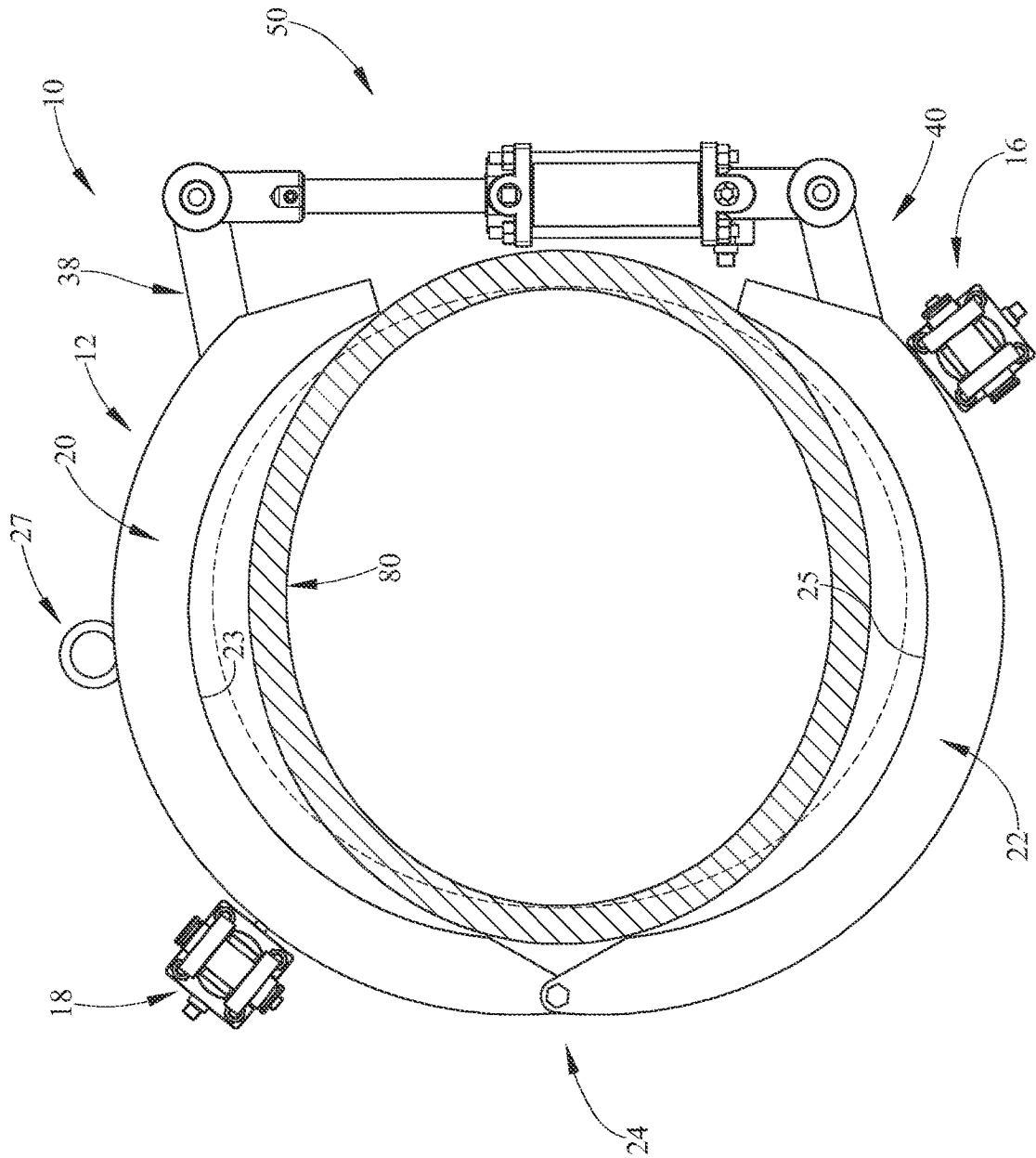


FIG. 2

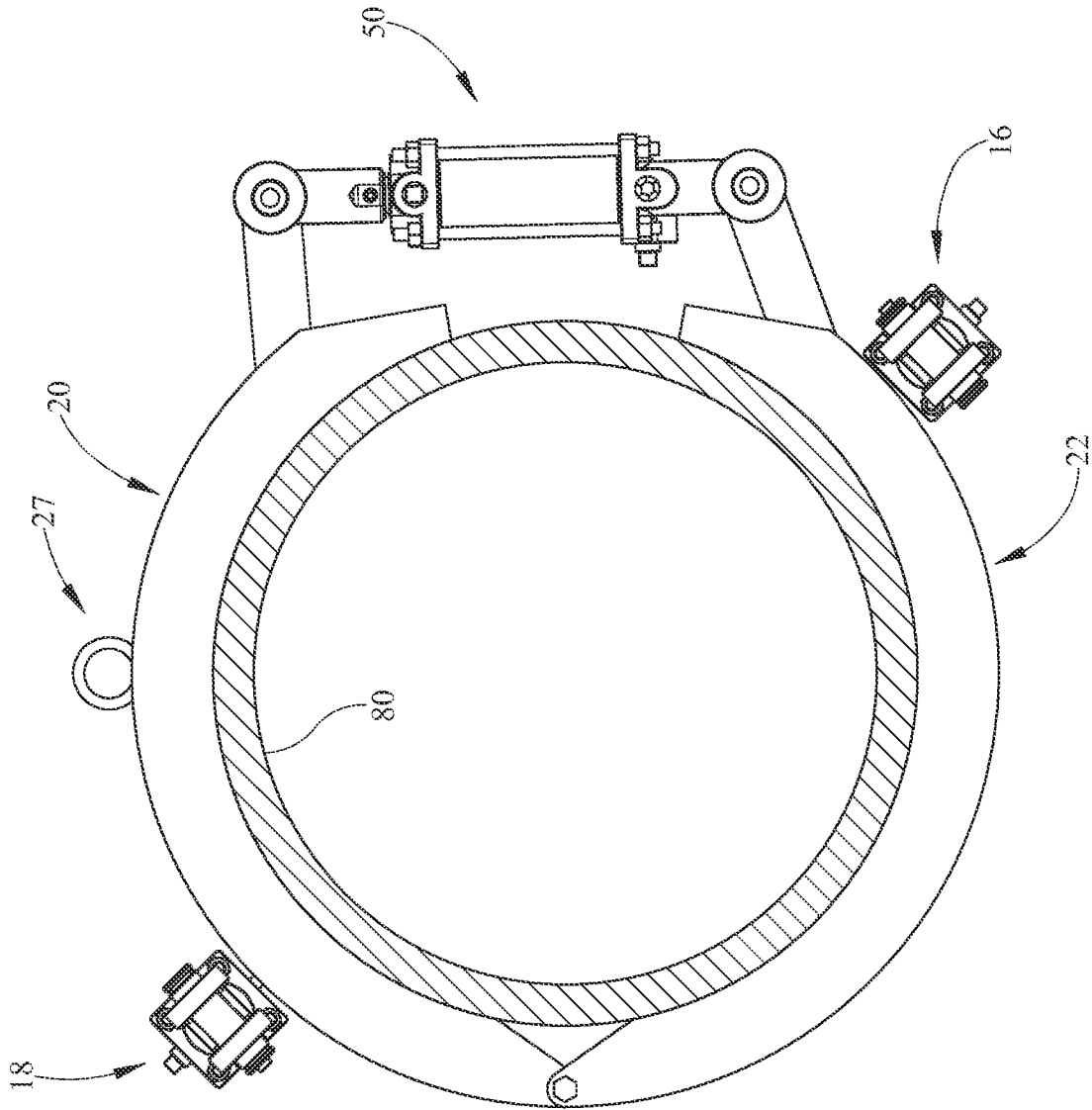


FIG. 3

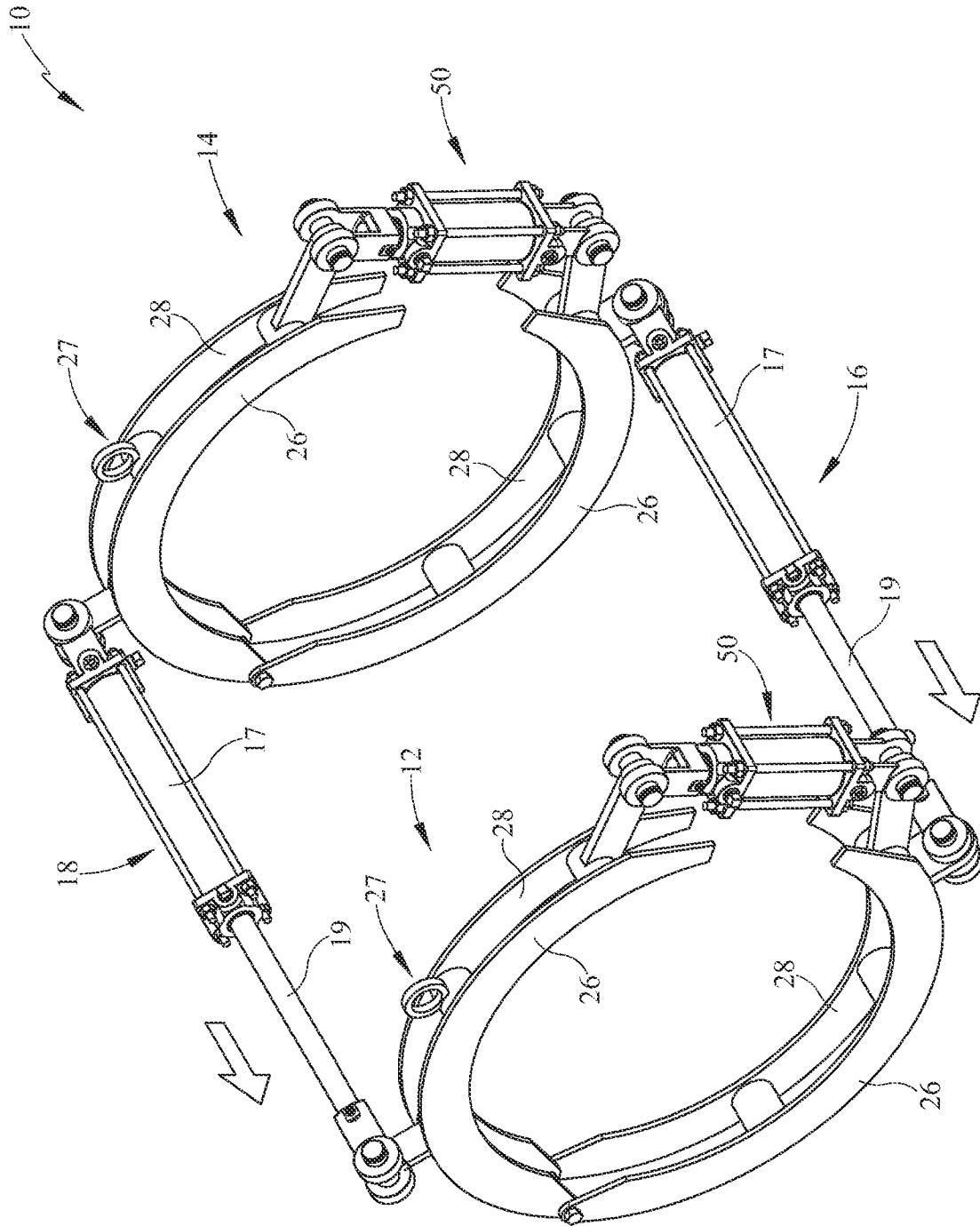


FIG. 4

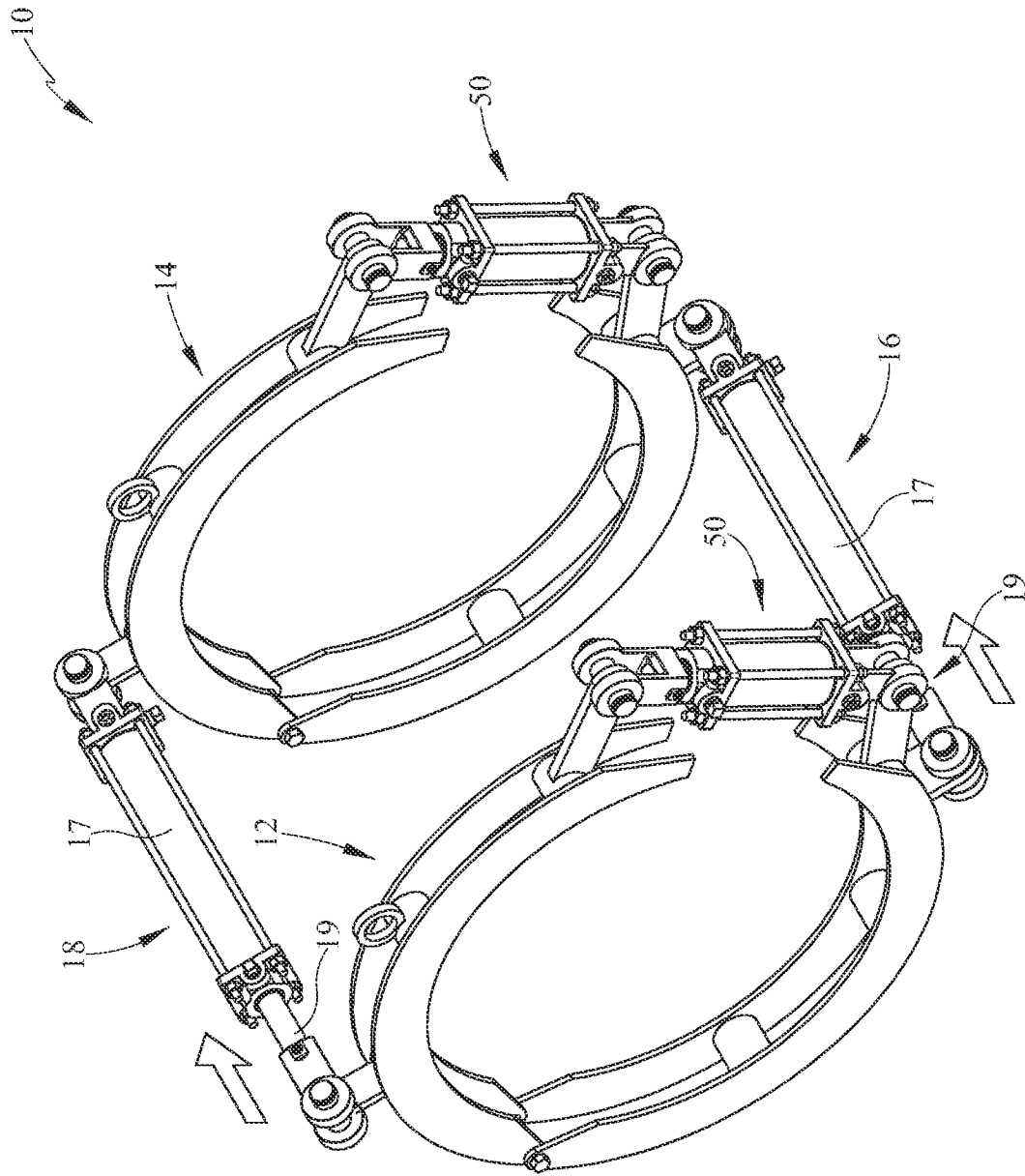


FIG. 5

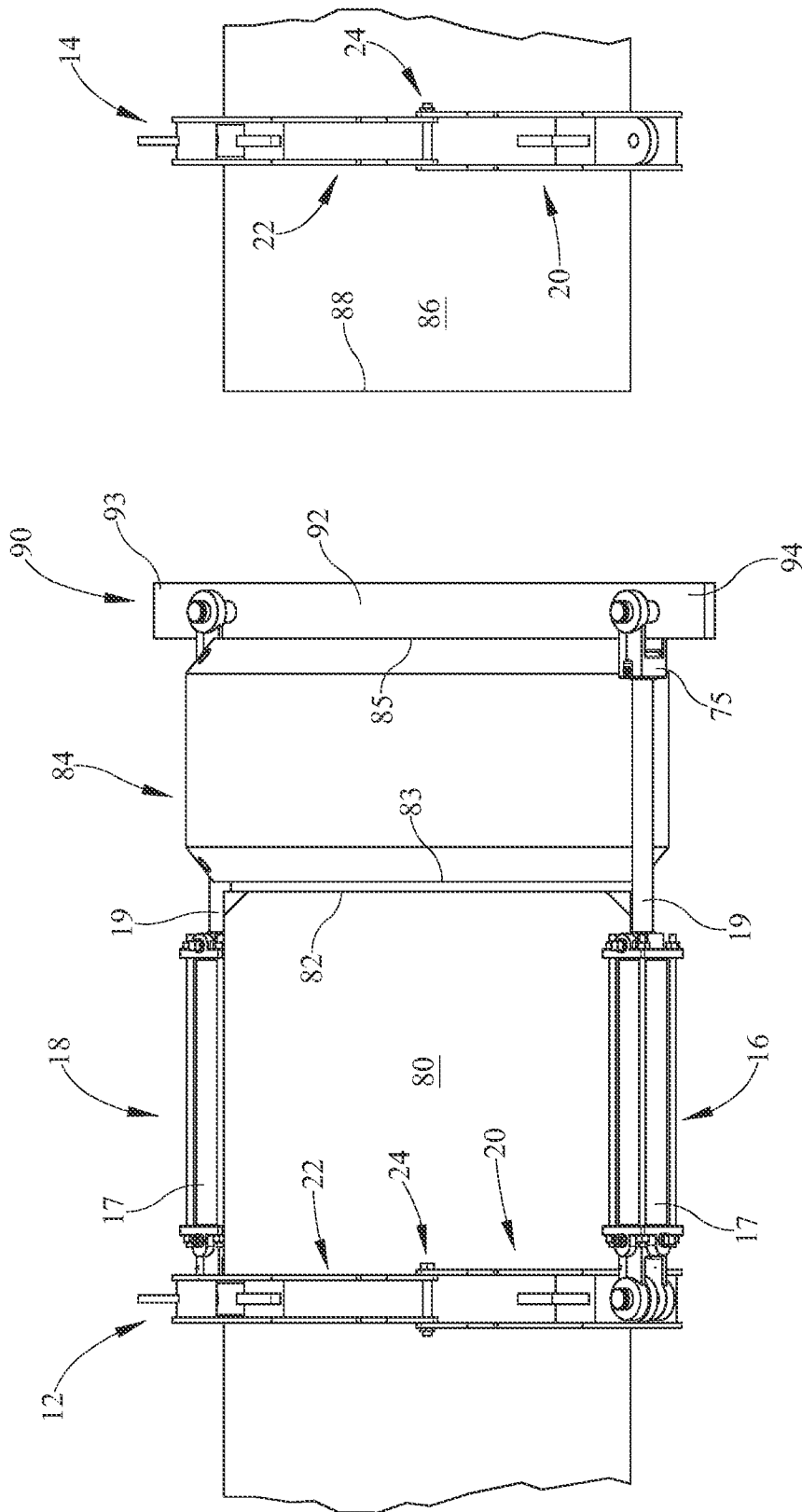


FIG. 6

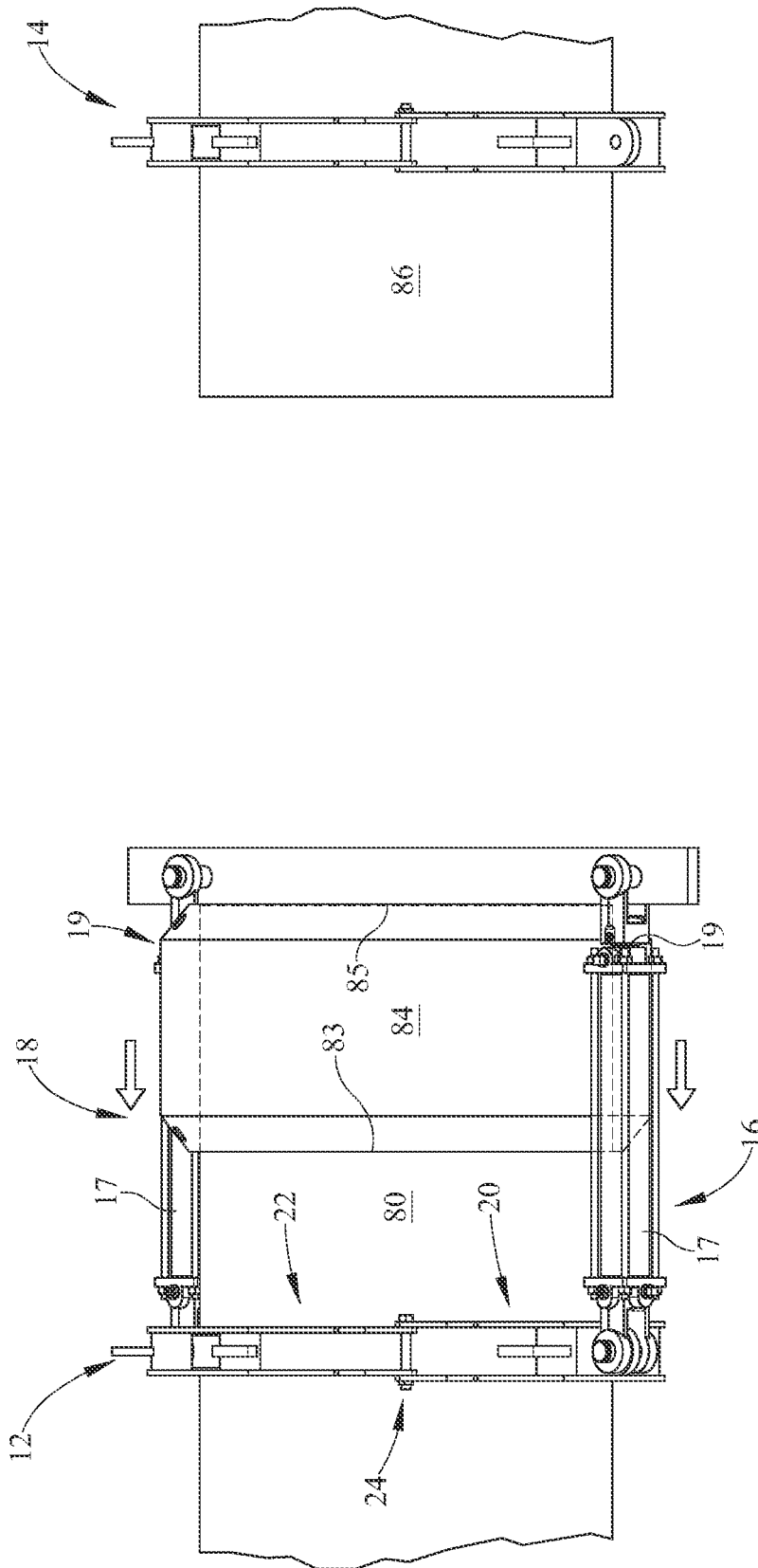


FIG. 7

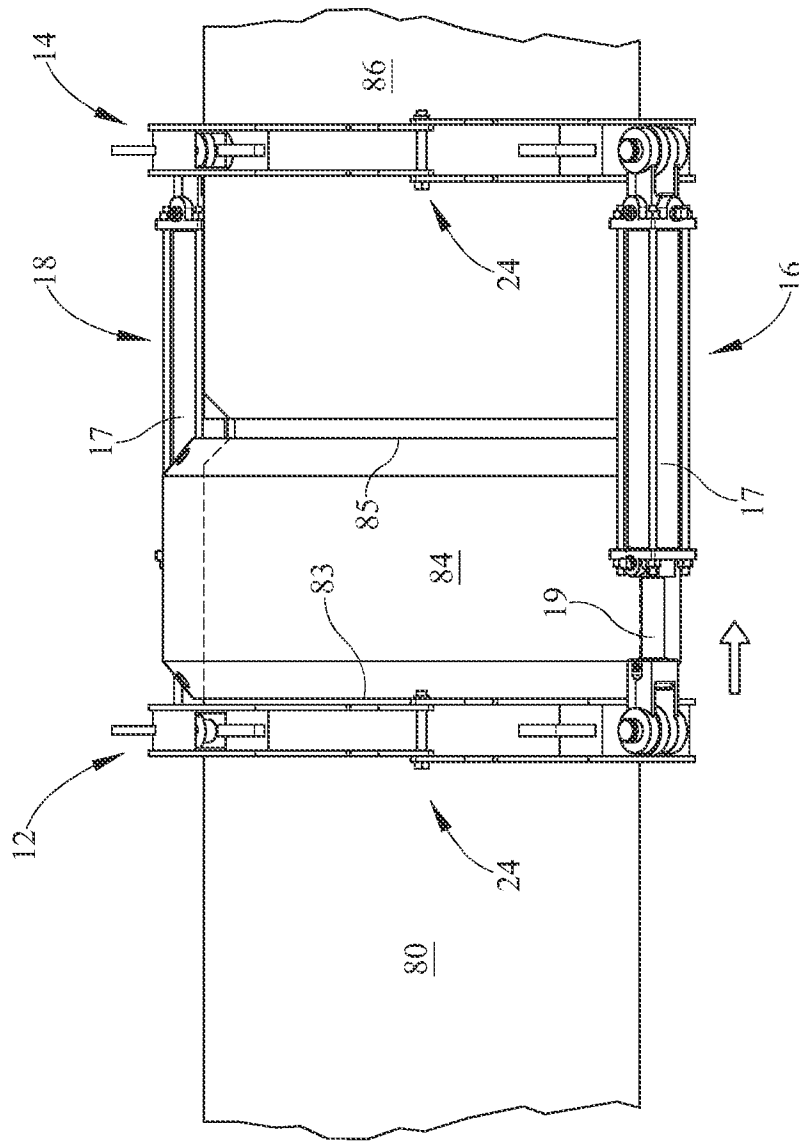


FIG. 8

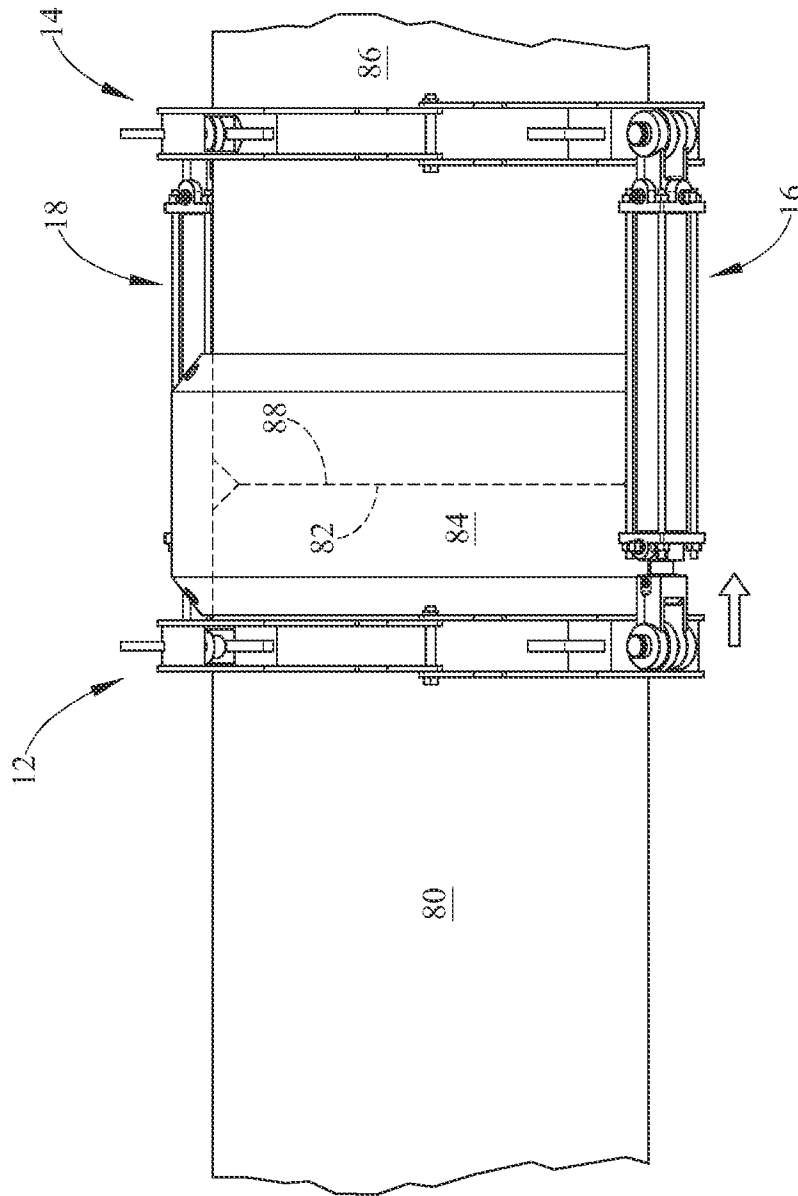


FIG. 9

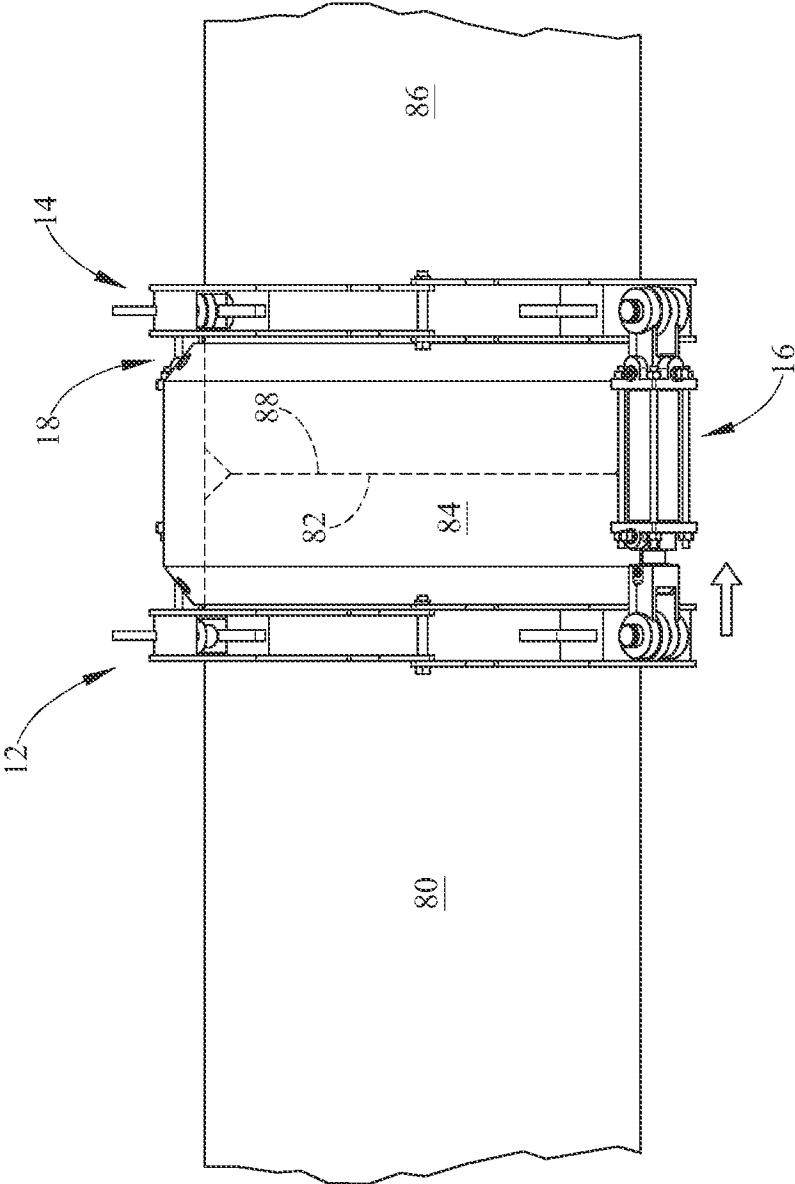


FIG. 10

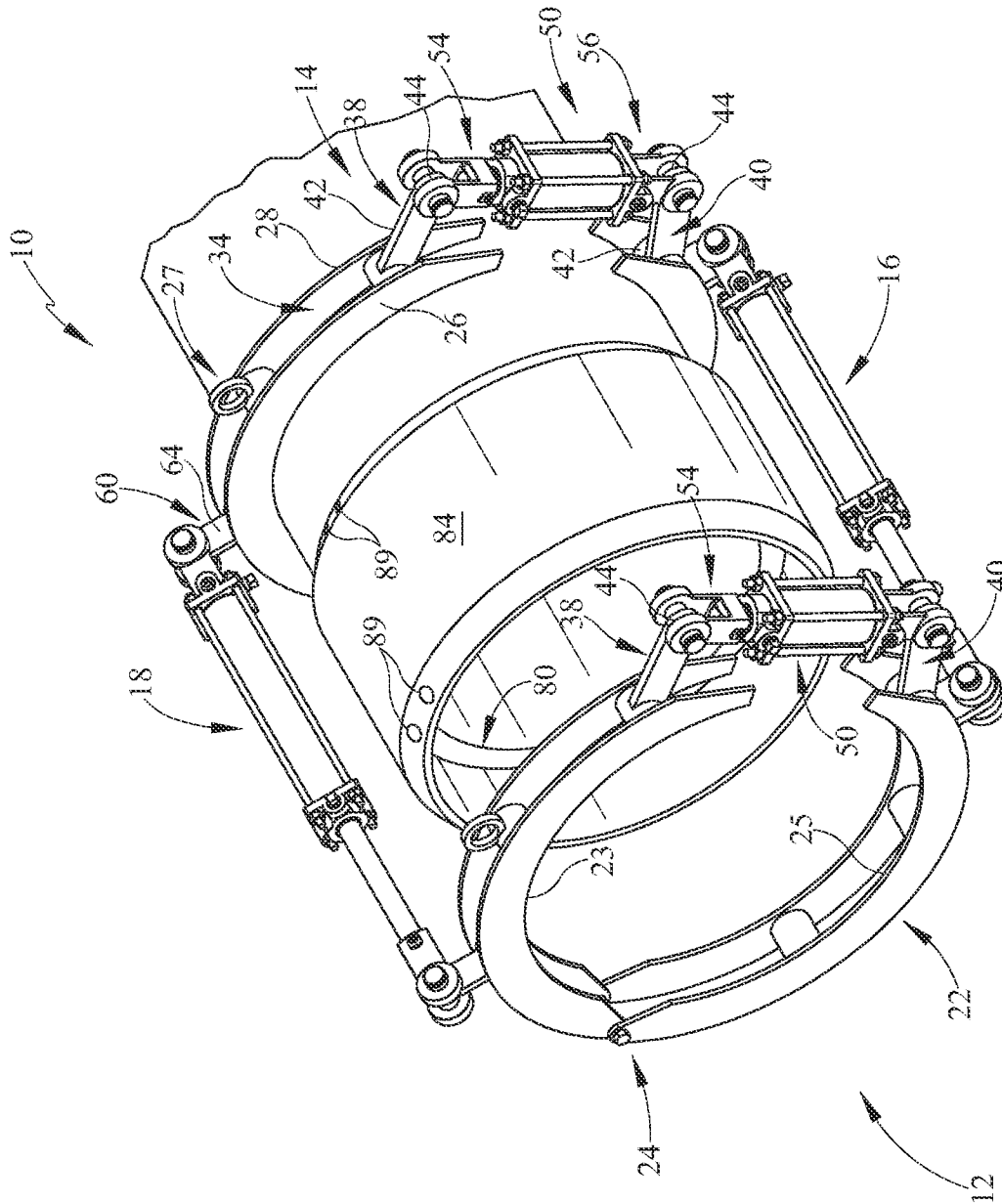


FIG. 11

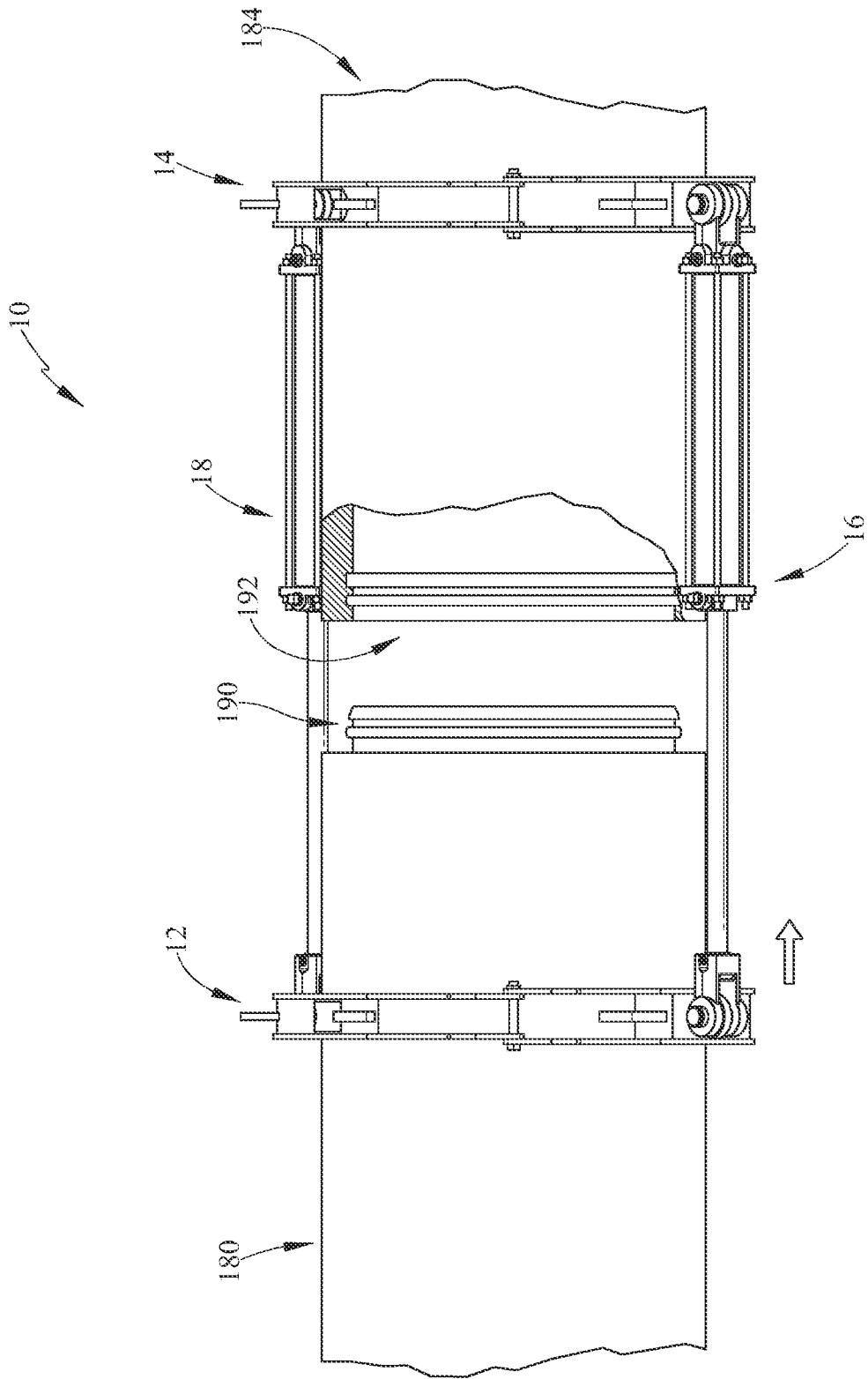


FIG. 12

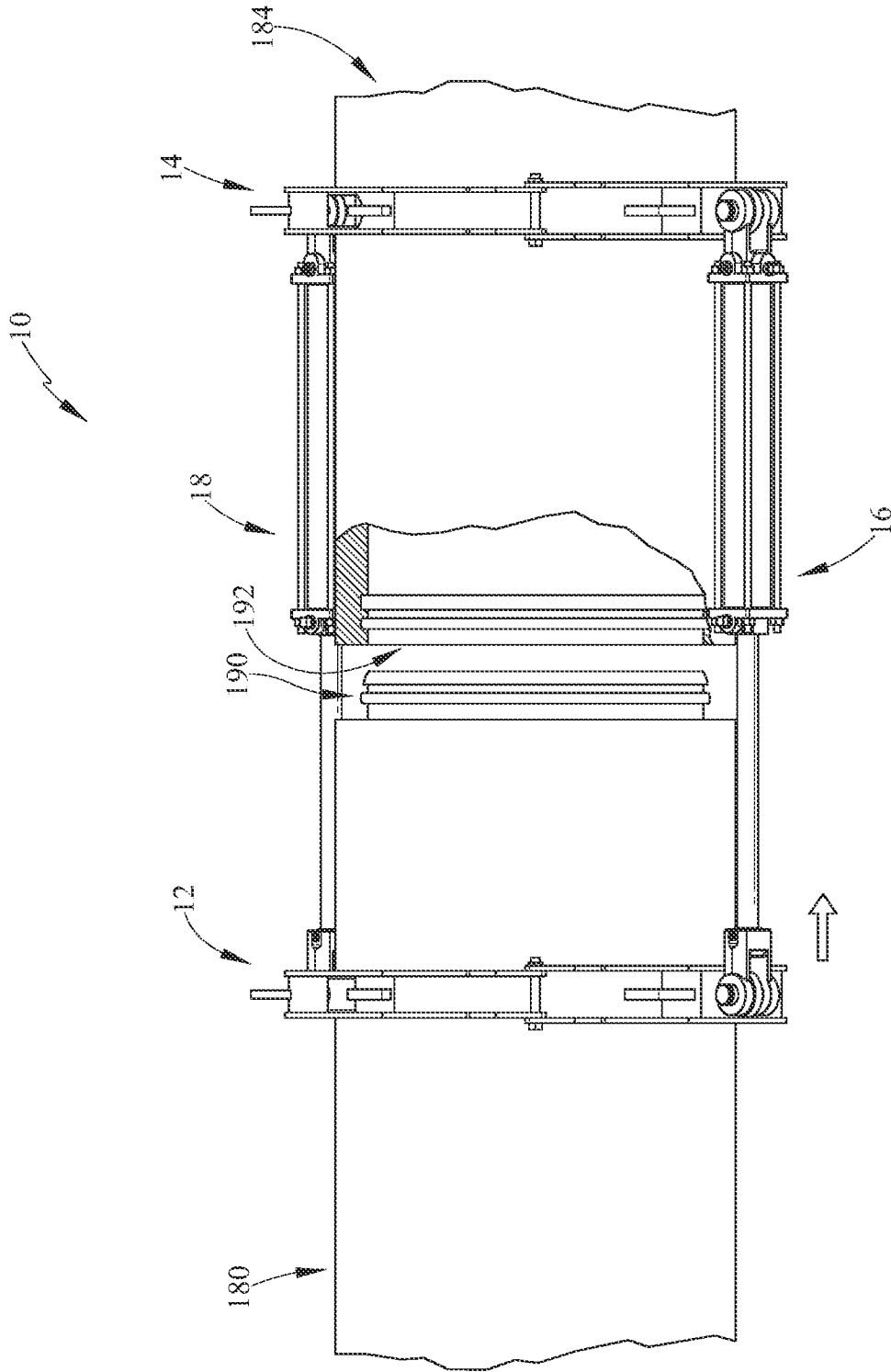


FIG. 13

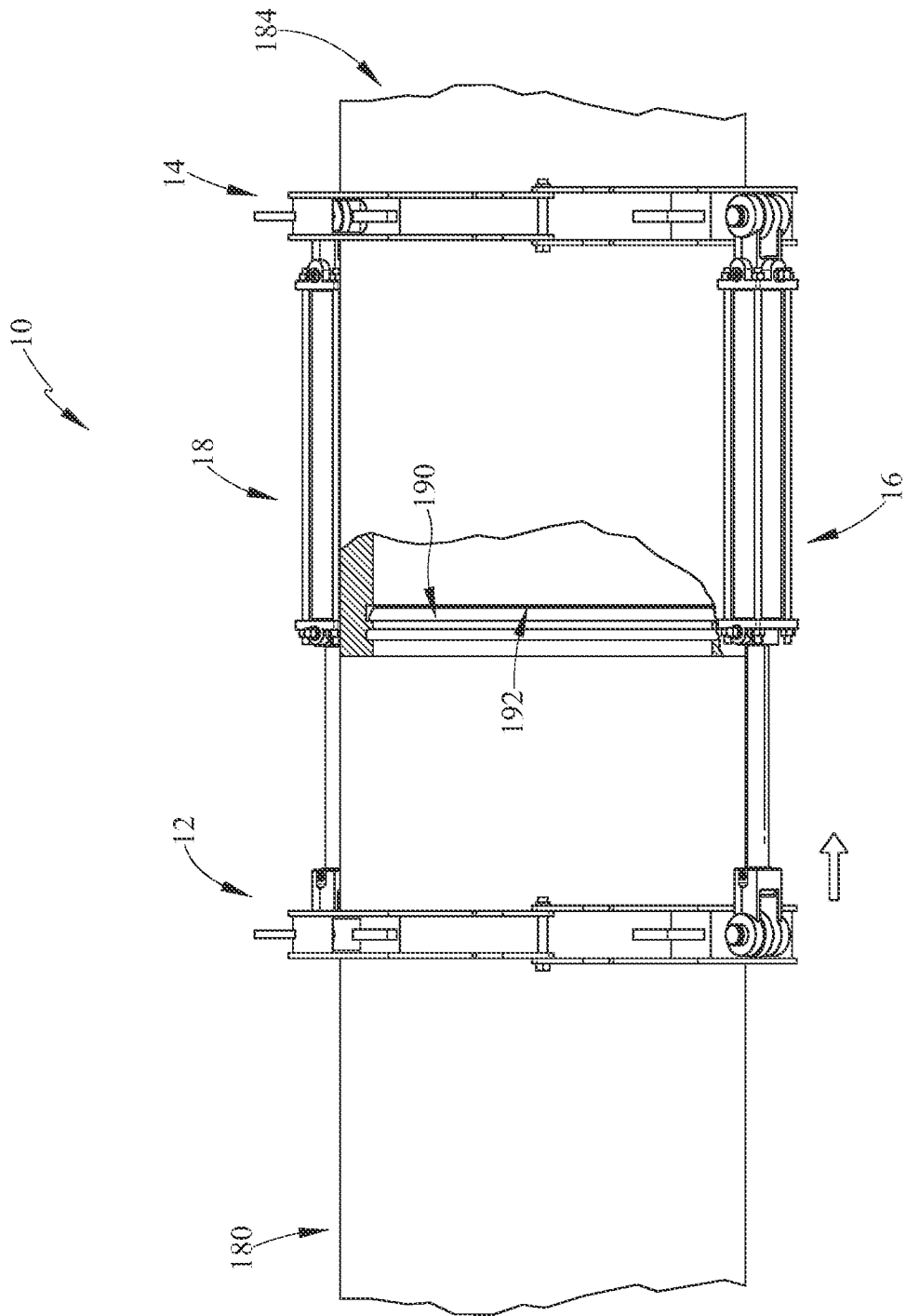


FIG. 14

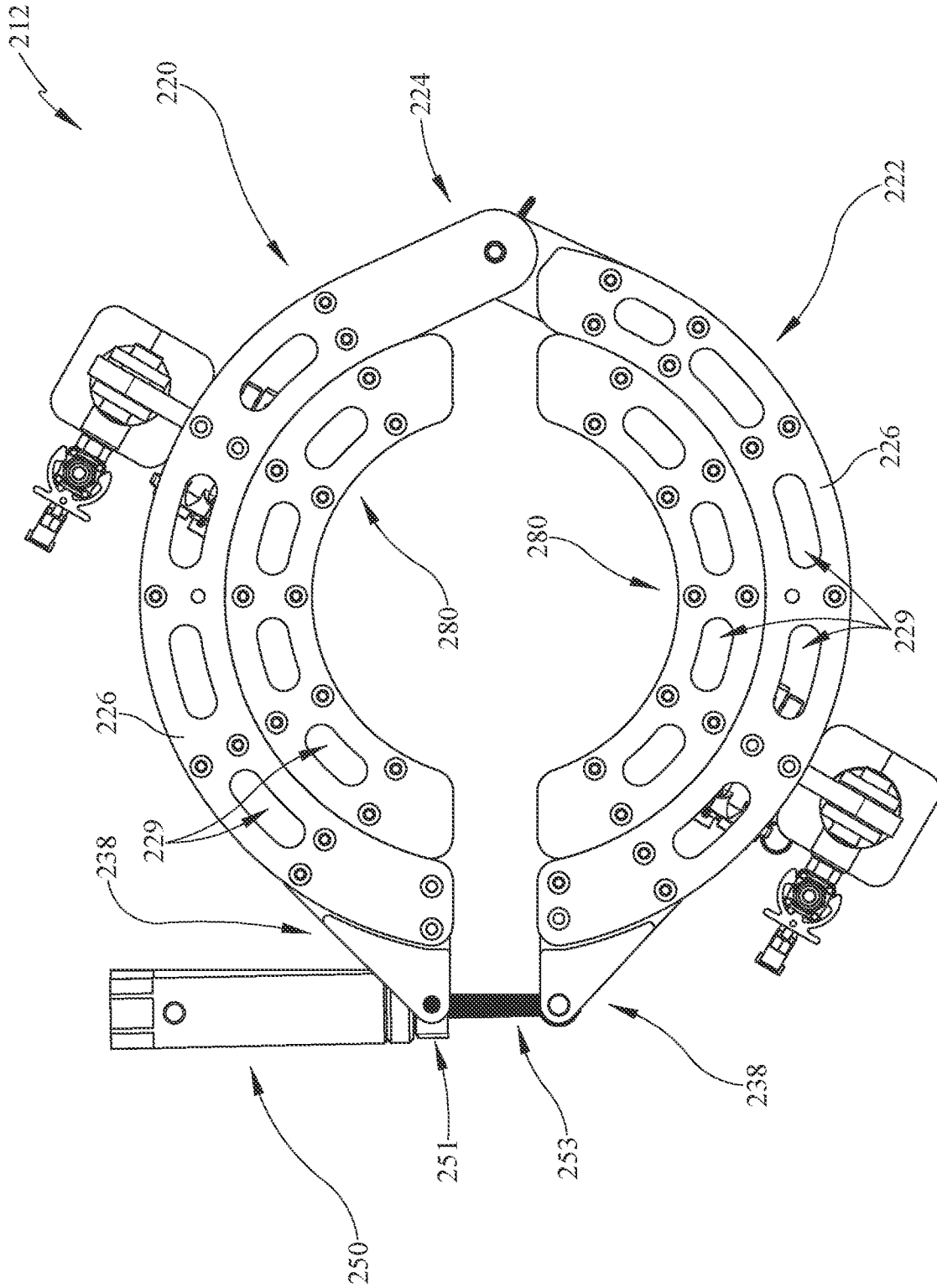


FIG. 15

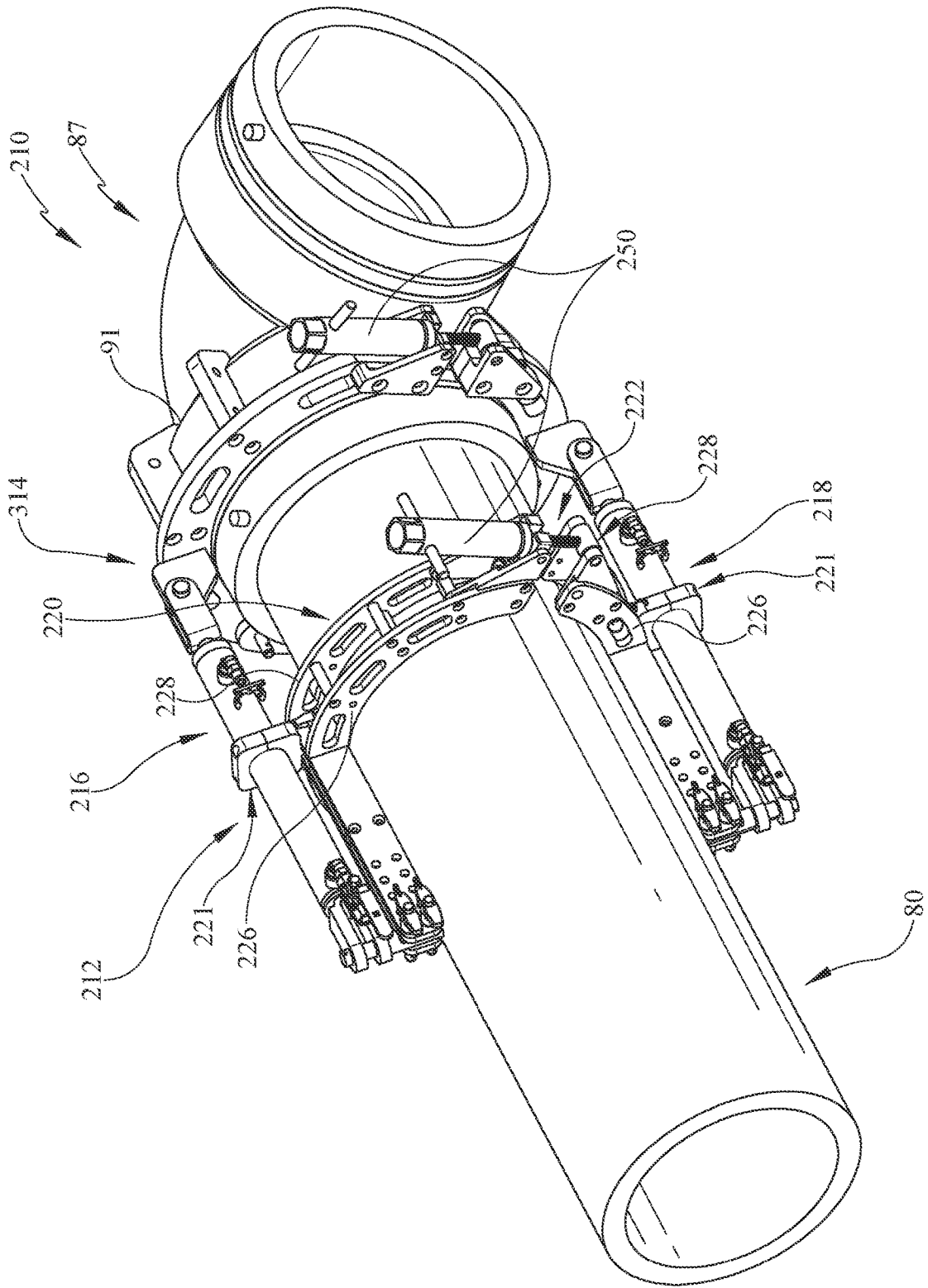


FIG. 16

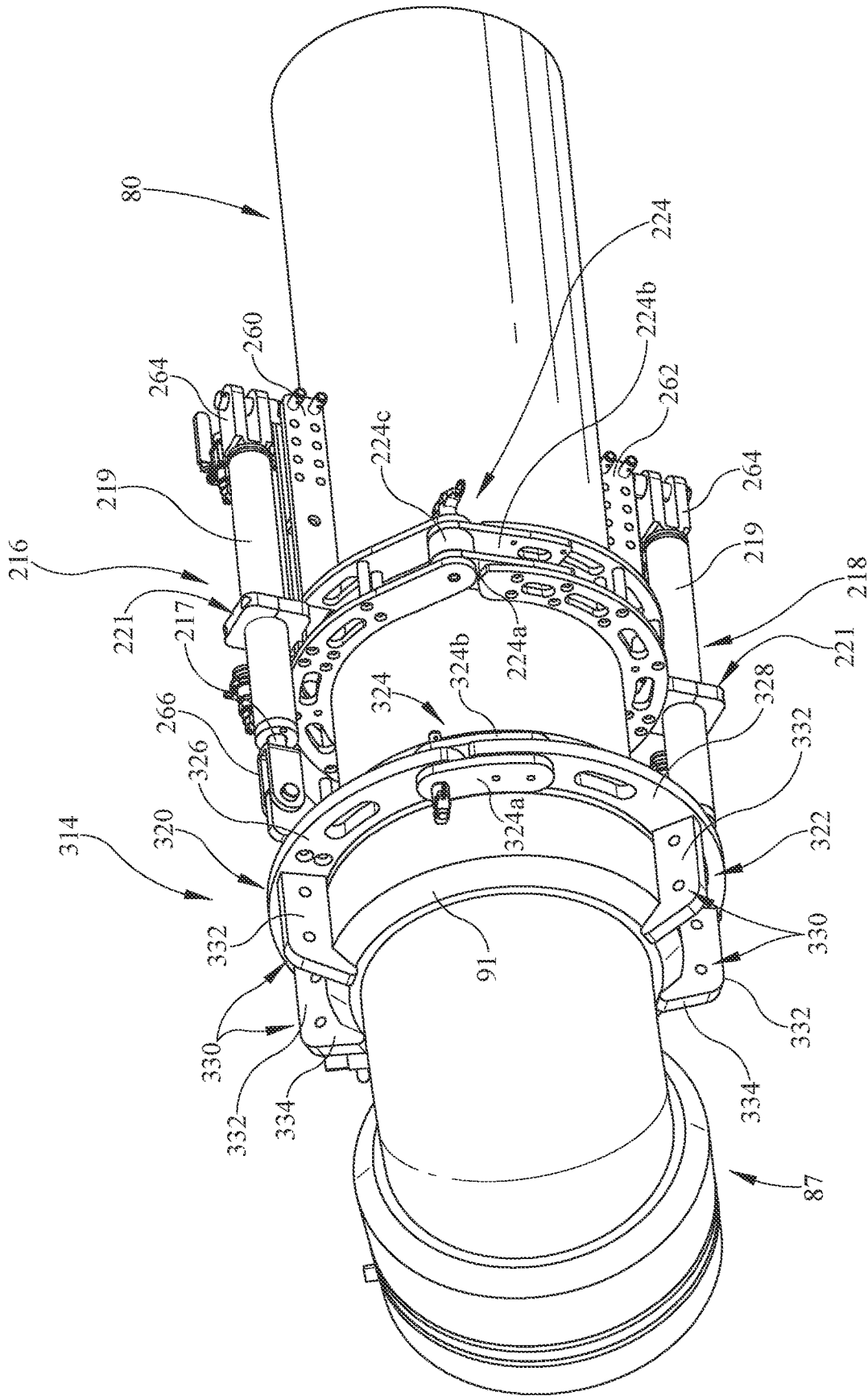


FIG. 17

**ASSEMBLY AND METHOD OF COUPLING
PIPES**

CLAIM TO PRIORITY

This application is a continuation-in-part of, and claims priority to and benefit of, under 35 U.S.C. § 120, U.S. patent application Ser. No. 17/021,424, filed on Sep. 15, 2020, now U.S. Pat. No. 11,813,804, which is a continuation of and claims priority to and benefit of U.S. patent application Ser. No. 15/207,004, filed on Jul. 11, 2016, now U.S. Pat. No. 10,780,649, which is a continuation of and claims priority to U.S. patent application Ser. No. 14/132,700, filed on Dec. 18, 2013, now U.S. Pat. No. 9,415,452, all of which are incorporated by reference herein.

BACKGROUND

1. Field of the Invention

Present embodiments relate to jig assemblies for coupling of piping. More specifically, the present embodiments relate, but are not limited to, jig assemblies for coupling of thermal plastic piping and methods of positioning a coupling using the jig assemblies.

2. Description of the Related Art

Thermal plastic piping is utilized in a wide array of manufacturing and utility fields. In joining segments of piping, for example in new construction or repair of existing pipes, jig assemblies are utilized to hold piping segments together in order for a welding process or step to occur. Thermal plastic piping may include, but is not limited to, high density polyethylene (HDPE), low density polyethylene (LDPE), acrylonitrile butadiene styrene (ABS), polypropylene (PP), polyethylene (PE), and polyvinylidene fluoride (PVDF), for example.

One problem with the state of the art jig assemblies is related to size of the equipment. Many jigs are utilized which are enormous in size due to the size of the piping involved, for example in water or sewage service lines. When a break occurs in a service line, the area of substrate covering at the break is dug up and the jig assembly must be brought in to retain the pipes in position for a welding process. However, the size of the jig equipment requires that the hole be much larger in size than merely the area immediately surrounding the break. The jig equipment cannot typically fit into a hole and therefore, the cover substrate must be removed so that portions of the broken pipe may be brought to the surface and fitted into the jig assembly.

Another problem with attempts to either join or repair thermal plastic piping is that following initial manufacture and/or use over a period of time, large diameter pipes begin to sag and change shape from round to oblong. This is due to the inability of the material to support the weight of large sized piping. Additionally, soil loads on buried piping may cause this to occur. When coupling sections of pipe together, the oblong shape of the pipe makes welding sections together difficult, for example when welding a new piece of piping to an older piece or when welding pieces that have been stored for some period of time. The oblong shape must be corrected in order to render a pipe a round shape which may be aligned with and welded to another section of piping.

Additionally, one type of pertinent welding involves fusion welding where a small coupling joint material is placed at a joint between two pieces of piping. In large

diameter piping, known methods of inserting the coupling on to a first pipe involves a hammer and piece of wood being used to beat the coupling over the end of at least one of the pieces of pipe. This difficulty is in addition to the difficulty associated with oblong shaping of piping and another reason that the piping sections must be positioned into a round shape to allow use with a coupling section. Further, this method provides opportunity for an injury in the field and/or damage to the coupling being forced on to the piping.

Accordingly, it would be desirable to overcome these and other known deficiencies to provide a jig assembly which may be positioned within a hole in the earth for new construction or repair and improves the method of positioning pipe assemblies during welding, for example.

SUMMARY

A jig assembly is provided and a method of use thereof which allows for joining of sections of pipe. The jig assembly includes a first jaw assembly and a second jaw assembly which are both hydraulically openable and closable to grasp, release and re-round the piping. Additionally, the jaw assemblies are joined by jaw actuators to move the jaw assemblies closer or farther from one another allowing movement of the pipes, coupling or both.

According to some embodiments, a method of coupling pipes for a fusion weld comprises connecting a first re-rounder to a first pipe, connecting at least one linear actuator to the first re-rounder, the linear actuator being movable in a first direction which is transverse to the first re-rounder, connecting a second end of the at least one linear actuator to a backstop, the backstop being movable with the at least one linear actuator, a first moving of a coupling on to the first pipe with the backstop and the at least one linear actuator, connecting a second re-rounder to a second pipe, reversing orientation of the at least one linear actuator to connect to the second re-rounder, a second moving of the coupling into engagement with the second pipe to join said first and second pipes, and, fusion welding the coupling to the first and second pipes.

Optionally, the first moving may be a pull or a push. The second moving may be a moving of the first pipe and the coupling. The second moving may be moving of the first pipe. The second moving may be moving of the coupling. The method may further comprise connecting of electrodes to the coupling for the fusion welding.

According to some embodiments, a method of joining piping comprises connecting a first jaw assembly to a first pipe segment, connecting a second jaw assembly to a second pipe segment, clamping the first and second jaw assemblies to round the first and second pipe segments, respectively, connecting the first and second jaw assemblies with at least one linear actuator, actuating the linear actuator to move the first and second pipe segments closer together, and, connecting the segments by abutting the pipe segments.

Optionally, the pipe segments being joined with a coupling. One of the first and second jaw assemblies may move the coupling by actuation of the at least one linear actuator. The coupling may be positioned over adjacent ends of the first and second pipe segments. The coupling may be fusion welded. Alternatively, the method may comprise engaging pipe segment engagement structures of the first and second pipe segments to connect the piping segments. The actuating may include movement of the at least one linear actuator a first move. The method may further comprise changing

orientation of the at least one linear actuator. The method may further comprise moving the at least one linear actuator in a second direction.

According to still a further embodiment, a method of joining piping with a jig assembly, comprises applying a first jaw assembly to a first pipe segment, applying a second jaw assembly to a second pipe segment, connecting a first end of a linear actuator to one of the first jaw assembly and the second jaw assembly, connecting a second end of the linear actuator to the other of the first jaw assembly and the second jaw assembly, actuating the linear actuator to move one of the pipe segments and a coupling, reversing the orientation of the linear actuator, and, positioning the coupling over adjacent ends of the first and second pipe segments. The positioning may include movement of the coupling. Alternatively, the positioning may include moving one of the pipe segments into the coupling. As a further alternative, the positioning may include movement of at least one of the first and second pipe segments.

According to some embodiments, a pipe supported jig assembly for connecting pipes by a fusion weld comprises a first re-rounder having a jaw actuator to open and close the first re-rounder, a second re-rounder spaced from the first re-rounder, the second re-rounder having a second jaw actuator to open and close the second re-rounder, a first linear actuator extending between the first re-rounder and the second re-rounder to vary spacing between the first re-rounder and the second re-rounder, at least one pump for actuating the first and second jaw actuators and the linear actuator, and, a backstop connectable to the first linear actuator.

Optionally, the first re-rounder and the second re-rounder may each have a first jaw and a second jaw. The first jaw and the second jaw being pivotally connected at a hinge. The jaw actuators may be disposed opposite the hinges. The jaw actuators move in a tangential direction of the re-rounders. The re-rounders may have eyelets disposed on a circumference of the first jaw actuator. The eyelets may be in a plane extending in an axial direction of the re-rounders. The jig may further comprise a second jaw actuator. The second jaw actuator maybe disposed opposite the first actuator. The first and second re-rounders only being connected by the first linear actuator. The at least one pump may be one of a hand pump or an automated pump.

According to another embodiment, a pipe supported jig assembly for joining pipes may comprise a first jaw assembly having pivotally connected arms, a second jaw assembly having pivotally connected arms, the first and second jaw assembly having a jaw actuator near adjacent ends of the arms to pivotally open and close the first and second jaw assemblies, a first linear actuator connected to the first and second jaw assemblies and a second linear actuator connected to the first and second jaw assemblies, the first and second linear actuators movable to position the jaw assemblies closer to one another.

Optionally, the first and second jaw assemblies may have an eyelet for connection of the linear actuator. The first and second jaw assemblies may have opposed linkages for connection of the jaw actuators. The linear actuators may be in flow communication with a hydraulic pump. The jaw actuators may be in flow communication with a hydraulic pump. The hydraulic circuit may include an automated pump or a manual pump. The actuators may be fluid powered and/or may be manually operable.

According to a further embodiment, a pipe supported jig assembly comprises a first jaw assembly which is generally circular in shape and pivotally openable and closeable, a

second jaw assembly which is generally circular in shape and pivotally openable and closeable, each of the first and second jaw assemblies including a first pair of segments pivotally connected to a second pair of segments, the first and second jaw assemblies each having a jaw actuator to cause opening and closing thereof, a linear actuator connected to the first jaw assembly at a first end and to the second jaw assembly at a second end, the linear actuator capable of moving the first and second jaw assemblies closer or farther from one another. The jig assembly may further comprise at least one fluid pump which may be a hand pump or automated.

All of the above outlined features are to be understood as exemplary only and many more features and objectives of the jig assemblies and method of use may be gleaned from the disclosure herein. Therefore, no limiting interpretation of this summary is to be understood without further reading of the entire specification, claims, and drawings included herewith.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the embodiments may be better understood, embodiments of the jig assembly and methods will now be described by way of examples. These embodiments are not to limit the scope of the claims as other embodiments of the jig assembly and methods will become apparent to one having ordinary skill in the art upon reading the instant description. Non-limiting examples of the present embodiments are shown in figures wherein:

FIG. 1 is an isometric view of an exemplary embodiment of a jig assembly;

FIG. 2 is an end view of a jaw assembly in an open position with a pipe section therein in an oblong orientation;

FIG. 3 is an end view of the jaw assembly of FIG. 2 in a closed position with a pipe section in a rounded orientation;

FIG. 4 is an isometric view of the jig assembly in a first extended position;

FIG. 5 is an isometric view of the jig assembly in a second retracted position;

FIG. 6 is a first exemplary step of a method of using the jig assembly;

FIG. 7 is a second exemplary step of a method of using the jig assembly;

FIG. 8 is a third exemplary step of a method of using the jig assembly;

FIG. 9 is a fourth exemplary step of a method of using the jig assembly;

FIG. 10 is an alternative method of the step depicted in FIG. 9

FIG. 11 is an isometric view of a portion of the jig assembly including a coupling positioned on one of the pipe sections;

FIGS. 12-14 depict an alternative method sequence for joining pipe segments;

FIG. 15 is a perspective view of an embodiment of a jaw assembly having inserts which allow for pipe usage of reduced diameter;

FIG. 16 is a first perspective view of an embodiment of a jig assembly for use with piping elbow installation; and,

FIG. 17 is a second perspective view of an embodiment of the jig assembly of FIG. 16.

DETAILED DESCRIPTION

It should be understood that the assembly and method of coupling pipes is not limited in its application to the details

of construction and the arrangement of components set forth in the following description or illustrated in the drawings. The embodiments are capable of other features and of being practiced or of being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. The use of "including," "comprising," or "having" and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items.

Referring now in detail to the figures, wherein like numerals indicate like elements throughout several views, there are shown in FIGS. 1 through 14 various embodiments of a jig assembly and method of coupling pipes. The jig assembly includes first and second jaw assemblies which are, according to one embodiment, not frame mounted and therefore, allow for easier positioning within a hole where a break in piping has occurred. The jig assembly allows for grasping of a first pipe and a second pipe for re-rounding. The jaw assembly also allows for positioning of the first and second pipes and positioning of a coupling segment on either or both of the first and second pipes for subsequent welding. The jig assembly is supported by the pipes on which it is mounted.

Referring now to FIG. 1, an isometric view of a jig assembly 10 is depicted. The jig assembly 10 includes a first jaw assembly 12, a second jaw assembly 14 and at least one linear actuator 16, 18 to move the first and second jaw assemblies 12, 14 closer or further from one another. According to the instant embodiment, the jig assembly 10 includes a first linear actuator 16 and a second linear actuator 18 spaced apart about 180° from one another. Although two actuators are shown, embodiments are considered which may include a single actuator or more than two actuators.

The first jaw assembly 12 is openable and closable to engage or disengage a pipe 80 (FIG. 2). The first jaw assembly 12 is formed of a first arm 20 and a second arm 22. The first and second arms 20, 22 are generally semi-circular in shape and are connected by a pivot 24. The arms 20, 22 are semicircular and formed of a first segment 26 and a parallel second segment 28. The arms 20, 22 may have a constant curvature corresponding to a specific diameter piping or may have a curvature which varies allowing usage of the jaw assemblies 12, 14 with various diameter pipe size. As a further alternative, a master jig size may be formed and inserts may be used to allow usage of the jaw assemblies 12, 14 with various pipe sizes. Each of the segments 26, 28 has an outwardly facing surface 30 which is substantially flat. These surfaces 30 allow for engagement of a coupling segment as will be described further herein. While these surfaces 30 are flat, they may have some friction enhancing aid such as knurling or the like.

The inner edge of each arm 20, 22 forms a generally circular shape to grasp the outside surface of a pipe segment 80 (FIG. 2). Additionally, the inner edge of each arm 20, 22 may be used to engage or grasp coupling and move such coupling on to or along an outer surface of a piping segment 80.

Each of the arcuate segments 26, 28 are separated by at least one spacer 32. The at least one spacer 32 creates a space 34 between the segments 26, 28 further allowing for positioning of a linkage 38, 40. According to the instant embodiment, each linkage 38, 40 has a head 42 disposed between segments 26, 28. The head 42 has a length which is the same as the spacer 32. Alternatively, the spacer 32 may be of a different size where the segments 26, 28 are bent or other

structure is used to accommodate for such change in size of the head 42. The linkage 38 extends from the head 42 to a second end 44.

Extending between the upper and lower linkages of each jaw assembly 12, 14 is a jaw actuator 50. The jaw actuators 50 may also be referred to as tangential actuators which move linearly as these move the arms 20, 22 and vary the circumference of the jaw assemblies 12, 14. The jaw actuators 50 move in a generally tangential direction. This movement opens and closes the first and second arms 20, 22 which move about pivot 24 in order to grasp or release a piping segment 80. Additionally, such closing may cause rounding of the pipe segment 80 as described further.

The jaw actuators 50 may be in the form of hydraulic actuators. According to such embodiment, the hydraulic fluid may be pumped by hand or by an automated pump 29 in order to cause extension or retraction of a piston rod. When the actuator 50 extends, the first and second arms 20, 22 move away from one another about the pivot 24. When the actuator 50 retracts, the first and second arms 20, 22 move toward one another to decrease circumference of the jaw assemblies 12, 14. The hydraulic system may have a circuit that includes a manual hand pump or an automated pump 29. Alternatively, an electric actuator may be utilized. An actuator of this type may have a rotating motor which drives the piston rod in two directions to extend or retract. The motor may rotate about the axis of the actuator 50 or may be turned to rotate about an axis which is perpendicular to the actuator 50. As a further alternative, the jaw actuator may comprise a manually operable clamping mechanism which, for example, may be rotated manually to open or close the jaw assemblies 12, 14. In one exemplary embodiment, such embodiment may include a threaded eyebolt, with clamp knob, such as a hex shaped clamp knob, and a thrust bearing to accommodate manual operation. However, various devices may be utilized as the manually operable jaw actuator.

The actuators 50 each may include clevis structures 54, 56 which are connected to the linkages 38, 40. Various fastening arrangements may be utilized. Further, it may be desirable to utilize a connector which allows pivoting motion about at least one axis and further provides easy connect and disconnect functionality. When the actuators 50 are closed, the jaw assemblies 12, 14 are in the circular form to grasp and hold the pipe segment 80 in a round cross-sectional shape.

The first and second jaw assemblies 12, 14 are movable toward or further from one another by way of the linear actuators 16, 18. The actuators 16, 18 are connected to eyelets 60, 62 extending from the first arm 20 and second arm 22. Each of the eyelets 60, 62 includes a neck 64 and a head having an opening (not shown). The neck 64 may be formed of a flat bar stock material wherein the surface of the material lies in a plane extending an axial direction. A hole is cut into the neck 64 material to define a location wherein a clevis of the linear actuators 16, 18 may be positioned and connected by a pin, fastener or the like.

As with the jaw actuators 50, the linear actuators 16, 18 may take various forms. For example, the depicted actuators 16, 18 are hydraulic in nature and have a cylinder 17 and piston 19 to cause extension and retraction. However, alternate types of actuators may be utilized such as air powered or electric actuators. Additionally, further linear actuators are contemplated which may include manual actuators such as ratchet straps, chain and binders, come-alongs, threaded rod and corresponding threaded female receivers or the like. These may be used in a single direction or in two directions.

According to the instant embodiment, the actuators **16, 18** are spaced apart about 180°. Other embodiments are contemplated where a single actuator is utilized, or alternatively more than two actuators, to move the first jaw assembly **12** and the second jaw assembly **14** relative to one another in axial directions.

The jig assembly **10** may further comprise a fluid powered circuit. This may be hydraulic or air powered, for example. Further, the fluid powered circuit may be operated by pumps **29** which may be hand pumps or automated pumps to actuate.

Referring now to FIG. 2, an end view of the jig assembly **10** is depicted. The jaw actuator **50** is positioned in an extended orientation so that the first arm **20** and the second arm **22** are spread apart from a normal grasping position. In this position, the jaw assembly **12** can receive a pipe segment **80**. The actuator **50** may be disconnected at the piston end to easily position the pipe segment **80** therein or alternatively the actuator **50** may be extended and the jaw assembly **12** positioned over an end of the pipe segment **80**.

The pipe segment **80** is depicted as oblong or ob-round shaped. This mis-shaping occurs generally after a pipe segment is manufactured or after some time in service and may be due to the high weight of the relatively larger size piping, or alternatively due to the weight of fill material on the top of the pipe segment **80** or a combination. This oblong shaping may increase as pipe diameters increase. The oblong shape is generally horizontal however, the oblong shape may be vertical as depicted in broken line or further may be at other angles. The pipe segment **80** is held in position along the outer surface of the pipe segment **80** at inner edges **23** of arms **20, 22**.

The circumferential actuator **50** is extended to increase interior diameter of the jaw assemblies **12, 14** to allow positioning of the pipe segment **80** between the arms **20, 22**. As depicted, the arms **20, 22** contact the pipe segment **80** in two locations, one near pivot **24** and a second point at opposite ends of the arms **20, 22**. When the first and second arms **20, 22** begin to close due to the retraction of the actuator **50**, the contact between radial inner edges **23, 25** and the outer surface of the pipe segment **80** will increase causing the pipe segment **80** to assume the shape of the inner edges **23, 25**.

With reference now to FIG. 3, in addition to grasping and retaining the pipe segment **80** in a specific position, the first arm **20** and the second arm **22** function to re-round the pipe segment **80** to a proper circular cross-section for joining to a second pipe segment. As shown, the actuator **50** is retracted closing the arms **20, 22**. As the arms **20, 22** close, the inner edges **23, 25** (FIG. 2) of the arms **20, 22** engage the pipe segment **80** outer surface. The pipe segment **80**, due to the flexible nature of the material, is forced to change cross-sectional shape from the oblong form of FIG. 2, to the round cross-section shown in FIG. 3. Thus, the jaw assemblies **12, 14** may also be referred to as re-rounders.

Once the pipe segment **80** is re-rounded, the linear actuators **16, 18** may be moved to the pipe segment **80**. Alternatively, depending on the orientation of the actuators **16, 18**, the pipe segment **80** may remain stationary in axial directions and an adjacent pipe segment **80** may be caused to move. According to the depicted view, the axial direction is movement either into the page or out of the page.

With reference now to FIG. 4, an isometric view of the jig assembly **10** is shown. The view shows linear actuators **16, 18** oriented so that the cylinder portion **17** of the actuators are engaging the second jaw assembly **14**. In this orientation, the second jaw assembly **14** may be fixed relative to a pipe

segment (not shown) and the first jaw assembly **12** may move in an axial direction. The first jaw assembly **12** may cause movement of another pipe segment or alternatively, may be used to move a coupling which is positioned on either pipe segment associated with the jaw assemblies **12, 14**.

In the depicted view, the linear actuators **16, 18** include the cylinder portions **17** and piston portions **19**. The cylinder **17** is mounted at the stationary end of the jig assembly **10** and the piston portion **19** is connected to the moving end of the jig assembly **10**. The piston portions **19** depicted are moving away from the cylinder end **17** to an extended position. The actuators **16, 18** are easily connectable and disconnectable to change orientation of the actuators **16, 18** and move either of the jaw assemblies **12, 14** relative to the other.

Additionally, the jaw assemblies **12, 14** are shown having two segments **26, 28** forming each arm **20, 22**. While two segments are shown, it is within the scope of the instant embodiments that a single solid segment be utilized. However, the presently depicted embodiment reduces weight as compared to solid arms while still providing the requisite strength and rigidity needed for pipe joining operations. The weight savings allows for easier handling of the jaw assemblies **12, 14** when positioning within a hole, for example following a line breakage and during a repair process. As shown at the top of the jaw assemblies **12, 14**, lifting eyelets **27** may be utilized to aid handling and maneuvering of the jaw assemblies **12, 14** either with or without piping segments therein. The lifting eyelets **27** may be used in combination with a crane or other hoisting structure for lifting and moving if necessary.

Referring now to FIG. 5, an isometric view of the jaw assemblies **12, 14** is again shown. In this embodiment, the actuators **16, 18** are shown retracted. Specifically, the cylinder portions **17** remain oriented toward the second jaw assembly **14** and the piston portions **19** are retracted within the cylinders pulling the first jaw assembly **12** closer to the second jaw assembly **14**. The cylinder portion **17** is generally stationary and the piston portion **19** is generally moveable to move or maintain position of associated jaw assemblies **12, 14**.

Referring now to FIGS. 6-10, a sequence of views is depicted for moving a first pipe segment **80** relative to a second pipe segment **86** prior to joining the pipe segments. The first jaw assembly **12** is shown connected to a first pipe segment **80**. The pipe segment **80** includes a first end **82** which is open. The open end **82** may be present due to a break in a line or the pipe segment **80** may be for new construction where two pipe segments need to be joined. A second pipe segment **86** is spaced from the first pipe segment **80**. The second pipe segment **86** includes an open end **88** corresponding to the opening **82** where the two pipe segments **80, 86** are to be joined. The second pipe segment **86** is grasped or retained by the second jaw assembly **14**. In the view depicted, the circumferential actuators **50** are on the backside of the pipe segments **80, 86**. Accordingly, these are not shown.

Extending from the first jaw assembly **12** are the linear actuators **16, 18**.

The actuators **16, 18** are arranged such that they extend from the first jaw assembly **12** to a backstop **90** in order to move the backstop. The backstop **90** may take various forms. For example, the structure may be a rectangular cross-section bar or a circular cross-section tube. Alternatively, the backstop **90** may be circular in shape with projections which may engage the pistons **19**. Various

shapes and structures may be utilized which are equal to or greater than the diameter of the coupling **84**. With the backstop **90** sized greater than the diameter of the coupling **84**, the backstop **90** will extend across the entirety of the coupling **84** touching the coupling **84** at two locations and allowing the actuators **16, 18** to engage the backstop **90**. The instant embodiment of the backstop **90** includes a middle portion **92** which extends between a first end **93** and a second end **94**. According to the instant embodiment, the backstop **90** includes first and second holes through which a clevis **75** may be connected. However, alternate embodiments may be utilized.

The actuators **16, 18** have the cylinder portion **17** connected to the first jaw assembly **12**. The pistons **19** extend from the cylinder **17** and are connected by the clevis **75** to the backstop **90**. The open ends **82, 88** of the pipe segments **80, 86** may be cleaned or trimmed to remove oxidation or scale from the outer surface.

In the instant embodiment, the jaw assembly **12** is clamped to the outer surface of the first pipe segment **80**. The assembly **12** allows for positioning of the structure within a hole where the pipe is located or alternatively, for use during construction above ground. The jig assembly **10** is not frame mounted but instead is supported during use by the pipe(s) being coupled. Thus, the jig assembly **10** is not self-supporting. The coupling **84** is disposed at or near an open end **82** of the pipe segment **80** and captured by the backstop **90**. The coupling **84** is circular in cross-section having an inner diameter that is sized to appropriately fit over the outer diameter of the first pipe segment **80** and second pipe segment **86**.

The cylinders **17** are positioned closest to the first jaw assembly **12** and the pistons **19** are extended. The coupling **84** is positioned against the backstop **90** and ready for retraction of the actuators **16, 18**.

Referring now to FIG. 7, a side view of a step following the sequence of FIG. 6 is depicted. With the first jaw assembly **12** affixed to the first pipe segment **80**, and the pistons **19** are retracted in a first move causing the backstop **90** to pull toward the end **82** (FIG. 6) of pipe segment **80**. As this first move retraction occurs, the coupling **84** begins to slide over the outer surface of pipe segment **80**. The coupling **84** has a first end **83** and a second end **85**. The first end **83** is shown sliding over the pipe end **82** (FIG. 6). The coupling **84** is retracted by way of the backstop **90** until the backstop **90** engages the pipe end **82** (FIG. 6). In this position, the coupling second end **85** is also flush with the pipe end **82** (FIG. 6). One skilled in the art will understand that the length of coupling **84** in the axial direction should be less than the travel distance of the piston **19** so that the coupling **84** may be fully retracted onto the first pipe segment **80**. However, in another embodiment, the first pipe segment **80** may be marked so that the coupling **84** is not pulled completely flush against the end of the pipe segment **80**. Instead, the coupling **84** may overhang the first pipe segment **80** a preselected distance so that second pipe segment **86** may be positioned into the coupling. Additionally, depending on orientation of the linear actuators **16, 18**, the first move may alternatively be a push movement.

Also shown in FIG. 7, the second jaw assembly **14** is positioned on the second pipe **86**. In this step, the second jaw assembly **14** is ready for operation but may not be utilized.

Referring now to FIG. 8, a third step is shown. In this embodiment, the second jaw assembly **14** is clamped to the pipe segment **86**. The linear actuators **16, 18** have been reversed so that the cylinder portions **17** are connected to the second jaw assembly **14**. The first jaw assembly **12** is

loosened on the first pipe segment **80**. The pistons **19** are extended so that the first jaw assembly **12** is engaging the first end **83** of the coupling **84** for moving the coupling **84** over the seam between pipes **80, 86**.

When the jaw assembly **12** is loosened, the pistons **19** may be retracted moving toward the right side of the figure. The jaw assembly **12** engages coupling **84** and causes movement of the coupling **84** to the right, in the depicted embodiment. Alternatively, a spacer or other similar structure may be located between the first jaw assembly **12** and the coupling **84**. Alternatively, a backstop structure may be connected to the pistons **19** so that retraction of the pistons **19** causes movement of the coupling **84**. However, such backstop structure would need to be varied to accommodate for, or surround, the first pipe segment **80** while still engaging the coupling **84**. Various shapes could be utilized including, but not limited to, square or circular in order to use a backstop in such an alternative manner.

Referring now to FIG. 9, the coupling **84** is moved from its position in FIG. 8 and is generally covering the first end **82** of pipe segment **80** in the first end **88** of pipe segment **86**. In this position, the jaw assembly **12** is fully retracted. Alternatively, the backstop **90** is moved to a position causing the coupling **84** to be generally centered at the abutting ends **82, 88** of the pipe segments **80, 86**. Accordingly, the coupling **84** is disposed over the seam between segments **80, 86** and the coupling **84** may be welded to the first and second pipe segments **80, 86**.

It is also contemplated that the coupling **84** may be positioned over an edge of one pipe segment and the jig assembly **10** may be used to move the second pipe segment into the open end of the coupling.

Referring to FIG. 10, a further alternative method step is provided which differs from the step depicted in FIG. 9. In FIG. 10, the coupling **84** is moved from its position in FIG. 8 to its final position, which is generally centered over both of the pipe segments **80, 86**. In this embodiment, however, the second jaw assembly **14** is initially positioned at a final resting position for the coupling **84**. Then the first jaw assembly **12** is fully retracted so that when the coupling move is complete, the coupling **84** is disposed against both the first jaw assembly **12** and the second jaw assembly **14**. Thus, by comparison with FIG. 9 where the second jaw assembly **14** may be spaced away from the coupling **84** when the coupling is in its final position, the embodiment of FIG. 10 provides that the second jaw assembly **14** may be positioned against the coupling **84** when the coupling **84** is in its final or home position. In the first embodiment of FIG. 9, it may be desirable to mark a stopping point on the pipe segment **86** prior to moving the coupling **84**. Alternatively, in the embodiment of FIG. 10, rather than marking the pipe segment **86**, the second jaw assembly **14** need only be placed at the stopping position so that the coupling **84** abuts the second jaw assembly **14** in the final position. It should be understood that the length of the actuators **16, 18** may need to accommodate a design and method where jaw assemblies **12, 14** are abutting the coupling **84** in the finished or home position. For example, the actuators **16, 18** in FIG. 10 are shorter than in FIG. 9.

Referring now to FIG. 11, an isometric view of the jig assembly **10** is shown. The coupling **84** is positioned over one of the exemplary pipe segments **80, 86**. The coupling **84** includes at least two leads **89** disposed near axial ends of the coupling. The exemplary embodiment includes four leads, for example. The leads **89** are connected to wires which wrap about the coupling **84** within the coupling material and,

11

when connected to a voltage source of desired current, will weld the pipe segments **80, 86** and the coupling **84** together.

Referring now to FIG. **12** an alternate method of using the jig assembly **10** is depicted. In the alternate method, the jaw assembly **12** is located on a first pipe segment **180** and the jaw assembly **14** is located on a second pipe segment **184**. According to the instant embodiment, the coupling structure is not utilized. Instead, the pipe segments **180, 184** are joined by integrally formed connecting structures **190, 192**. For example in one embodiment, the pipe segments **180, 184** may have a male engagement structure **190** and a female engagement structure **192** which engage one another when the segments are pulled together. The male and female structures **190, 192** provide a locking engagement but may alternatively be a non-permanent locking engagement. Additionally, the structures **190, 192** may include a sealing feature or may have a separate, independent sealing feature. The jig assembly **10** is shown further comprising at least one of linear actuator **16, 18** in the embodiment depicted. The actuators **16, 18** extend between the jaw assemblies **12, 14** and allow for movement of the jaw assemblies **12, 14** in the axial direction of the pipe segments **180, 184**. By connection of the jaw assemblies **12, 14** to segments **180, 184** respectively, the pipe segments **180, 184** may also be moved by the jig assembly **10**.

With reference now to FIG. **13**, the segments **180, 184** are shown pulled closer together by the jig assembly **10**. In this figure, the actuators **16, 18** are contracted thereby pulling the jaw assemblies **12, 14** closer together. As a result, the male and female connectors **190, 192** are closer to engagement by comparison to FIG. **12**.

With reference now to FIG. **14**, the pipe segments **180, 184** are positioned together and the connectors **190, 192** are shown (internally) due to the engagement. The linear actuators **16, 18** have fully connected the engagement structures **190, 192** and the pipe segments **180, 184** are abutting one another. With this type of pipe segment, the structure is fully connected and sealed. Additionally, other embodiments of piping may be utilized such as butt-welded pipe wherein the jig assembly may be utilized to pull the segments together for the butt-welding process.

Referring now to FIG. **15**, a view of a jaw assembly **212** is depicted. While a single jaw assembly **212** is shown, it should be understood that jaw assembly is capable of use with a second jaw assembly (not shown) as in previous embodiments. Further, as previously described, the jaws of the various embodiments may also comprise an insert **280**. This allows use of the jaw assembly **212** with smaller diameter pipes and/or elbows and increases the functionality of the jaw assemblies. The insert **280** may be arcuate having an outer radius that corresponds to the inside radius of the jaw portions **220, 222**.

The inserts **280** may be formed on the jaw portions **220, 222**, or may be formed separately and connected to the jaw portions **220, 222**. In the depicted embodiment a plurality of bolt holes are shown extending in a radial pattern such that a radially extending structure, an axially extending structure, or both may extend within the jaw portions **220, 222** between the inserts **280** and the jaw portions **220, 222**. In the depicted embodiment, the inserts **280** are arcuate with a radial dimension which reduces the diameter of pipe that may be used with the jaw **212**. The radial dimension of the inserts **280** may vary depending on the size of pipe being used. Others structures may be used as well to allow for differing diameters. The inserts **280** may be each formed of two arcuate segments **226, 228** (FIG. **16**) similar to jaw **212** or may each be formed of a single arcuate segment.

12

In this embodiment, the first jaw **212** comprises a first jaw portion **220** having a first end and a second end, and a second jaw portion **222** having a first end and a second end. One of the first and second ends of the first jaw portion is connected by a hinge or hinged connection **224** to one of the end of the second jaw portion. For example, the first ends of each of the jaw portions **220, 222** may be hingedly connected. The second ends of the jaw portions **220, 222** may be disposed opposite the first ends. In this way, the first ends are connected at hinged connection **224** and the second ends are spaced apart from the hinge connection **224**, so that the jaw **212** may be opened and closed to accept or retain the pipe **80**.

With additional reference to FIG. **16**, the first jaw portion **220** and the second jaw portion **222** each may comprise one or more arcuate segments **226, 228**, defining the jaw portions **220, 222**. In the instant embodiment, each jaw portion **220, 222** of the first jaw assembly **212** are formed by a first and second parallel arcuate segments **226, 228**.

The parallel arcuate segments **226, 228** may be individually formed and connected or may be formed together as a unitary structure. The arcuate segments **226, 228** of the instant embodiment may comprise one or more weight saving apertures **229** to remove material and render the segments of a lighter weight.

At or near the second ends of the jaw portions **220, 222** and therefore the arcuate segments **226, 228**, a linkage **238** may be located. The linkages **238** may be of various shapes such as those previously described and shown, or in the instant embodiment of FIG. **15**, may be generally triangular shaped in some non-limiting embodiments. The linkages **238** may be formed of various other shapes and provide a location for connection of a jaw actuator. Specifically, the linkage **238** of the first jaw portion **220** connects to one portion of the jaw actuator **250** and the linkage **238** of the second jaw portion **222** connects to the other portion of the actuator **250**. With this construction, the movement of the first and second jaw portions **220, 222** causes the opening and closing of the jaw assembly **212**.

Referring now to FIGS. **16** and **17**, a further embodiment is provided in perspective views. In some instances, a pipe **80** (FIG. **9**) and a pipe **86** (FIG. **9**) are connected by a coupling as previously described. However, in some embodiments, it may be necessary to connect a pipe **80** to an elbow **87**. This calls for an alternate embodiment of a jig assembly **210**.

In the depicted embodiment, the jig assembly **210** comprises a first jaw or jaw assembly **212** which is similar to that which is previously described. The second jaw or jaw assembly **314** is altered however for operation with a flange **91** of an elbow **87**. The first jaw **212** and the second jaw **314** may be attached to the pipe **80** and the elbow **87** respectively, then the two structures **80, 87** pulled together and engaged with at least one linear actuator **216, 218**.

The jaw actuators **250** may be powered or may be manually operable in order to pull together the pipes or the pipe and elbow. The actuators **250** may be fluid powered such as hydraulic or air powered. Alternatively, the actuators **250** may be manual rotational-to-linear type actuators which convert rotation to linear movement for example, by use of a threaded rod. The jaw actuators **250** may be defined by a fixed portion **251** and a movable portion **253**. The fixed portion **251** is connected to one of the jaw portions **220, 222** and the movable portion **253** is connected to the other of the jaw portions **220, 222**. Thus when the actuator movable portion **253** moves, the jaw assembly **212** is opened or closed about the hinge **224**.

Still further, the second jaw **314** also comprises a hinged connection **324** between the first jaw portion **320** and a second jaw portion **322**. In this embodiment, the first and second jaw portions **320**, **322** are each defined by a single arcuate segment **326**, **328**. The arcuate segments **326**, **328** may be similar to the first jaw **212**, including a plurality of weight saving apertures **229**.

The first and second jaw portions **320**, **322** of the second jaw **314**, may comprise plurality of hook or catch structures **330**. The hook structures **330** extend away from the first and second jaw portions **320**, **322** and turn to engage an edge of an elbow flange **91**. The hook structures **330** may be fastened to the first and second jaw portion or may be joined by welding or formed integrally.

The hook structures **330** have a first segment **332** that extends from the jaw portions **320**, **322** and a curved or turned segment **334** that turns relative to the first segment **332**. The turned or curved segment **334** engages an edge of a flange **91** of the elbow **87**. Once the actuator **250** of the second jaw **314** tightens the second jaw **314** on the flange **91** of the elbow **87**, and the hooks **330** engage an edge of the flange **91**, the elbow **87** will move with movement of the second jaw **314**. This may be accomplished with the powered actuators **216**, **218**.

At least one linear actuator **216**, **218** is disposed between the first jaw **212** and the second jaw **314**. The linear actuator **216**, **218** may comprise a cylinder **217** and a piston **219**, in some embodiments. Each of the cylinder and the piston may include a clevis or other structure which allows for connection with the first jaw **212** and the second jaw **314**. As a result, the second jaw **314** and the first jaw **212** are connected by the linear actuators **216**, **218** are connected so that movement of the linear actuators **216**, **218** causes movement of one or both of the first and second jaws **212**, **314**. The jaw portions **220**, **222** may include fixtures or members to which the actuators **216**, **218**. The actuator mount **260**, **262** extend in the axial direction of the pipe and may include various adjustment apertures for connection of the linear actuators **216**, **218** at varying locations. Due to the length of the linear actuators **216**, **218**, a brace **221** may be mounted to one or both of the jaws **212**, **314** in order to stabilize the actuators **216**, **218**.

In operation, the first jaw **212** may be fixed to the pipe **80**, for example, so that the linear actuators **216**, **218** may pull the second jaw **314**, and the elbow **87**, toward the pipe **80**.

The linear actuators **216**, **218** may be a powered by hydraulics or air powered, or electric. In the hydraulic embodiment, the hydraulic pump may be a manual pump or may be a powered actuator, as previously described. In the instant embodiment, the linear actuator **216**, **218** is connected, either directly or indirectly to the first or second jaws **212**, **314**. In some embodiments, an actuator mount **260**, **262** extends from either the first or the second jaw **212**, **314**, in the instant embodiment the first jaw **212**. The actuator mount **260**, **262** is shown extending in an axial direction of the pipe **80** and may be formed of flat stock with a plurality of mounting holes. The actuator **216**, **218** comprises a piston **217** and a cylinder **219**. The cylinder **219** is connected to the actuator mount **260**, **262** and also extends in an axial direction of the mount **260**, **262**. In some embodiments, the cylinder end of the actuator **216**, **218** is connected to the actuator mount **260**, **262** by a clevis **264**. Other structures may be utilized and various structures may be used to connect the mount to the actuator to stabilize the actuator mount.

At the opposite end of the linear actuator **216**, **218**, the piston **217** is shown with a clevis **266** that connects to a

linkage at the second jaw **314**. The piston **217** may be connected in various manners, directly or indirectly, to the second jaw **314** or the first jaw **212** in a configuration opposite to that shown.

With reference again to FIG. **17**, an opposite side of the jig assembly **210** is shown. The first jaw **212** is shown having one type of hinge while the second jaw **314** is shown with a different type of hinge. The first jaw **212** is shown having first and second hinge segments **224a**, **224b** shown with an additional spacer **224c** disposed between the hinge segments **224a**, **224b**. The spacer **224c** spreads the hinge segments **224a**, **224b** so they are positioned to engage the arcuate segments **226**, **228** of the jaw portions, **220**, **222**. One end of the hinge **224** connects to one jaw portion and the other end of the hinge connects to the other jaw portion.

The second jaw **314** has a second hinge **324**. The second hinge differs since the second jaw only has single arcuate segments defining each jaw portion. In this second hinge, a pair of second hinge segments **324a**, **324b** are provided wherein each hinge segment comprises a first end and a second end. The first ends of the hinge segments **324a**, **324b** connect to one end of the jaw portion **320**. The second ends of the second hinge segments **324a**, **324b** connect to the corresponding end the other jaw portion **322**. In this way, each of the jaw portions can pivot relative to and between the second hinge segments **324a**, **324b**. The hinge **324** may be a removable structure by including a disconnectable fastener.

Each of the first and second hinges **224**, **324** are disposed opposite to the jaw actuators **250** allowing opening and closing of the first and second jaws **212**, **314**.

The hinges **224**, **324** may include one or more removable pins, so that the jaw portions may be disconnected at either or both of the hinges **224**, **324** or the jaw actuators **250**.

While several inventive embodiments have been described and illustrated herein, those of ordinary skill in the art will readily envision a variety of other means and/or structures for performing the function and/or obtaining the results and/or one or more of the advantages described herein, and each of such variations and/or modifications is deemed to be within the scope of the invent of embodiments described herein. More generally, those skilled in the art will readily appreciate that all parameters, dimensions, materials, and configurations described herein are meant to be exemplary and that the actual parameters, dimensions, materials, and/or configurations will depend upon the specific application or applications for which the inventive teachings is/are used. Those skilled in the art will recognize, or be able to ascertain using no more than routine experimentation, many equivalents to the specific inventive embodiments described herein. It is, therefore, to be understood that the foregoing embodiments are presented by way of example only and that, within the scope of the appended claims and equivalents thereto, inventive embodiments may be practiced otherwise than as specifically described and claimed. Inventive embodiments of the present disclosure are directed to each individual feature, system, article, material, kit, and/or method described herein. In addition, any combination of two or more such features, systems, articles, materials, kits, and/or methods, if such features, systems, articles, materials, kits, and/or methods are not mutually inconsistent, is included within the inventive scope of the present disclosure.

All definitions, as defined and used herein, should be understood to control over dictionary definitions, definitions in documents incorporated by reference, and/or ordinary meanings of the defined terms. The indefinite articles "a"

and “an,” as used herein in the specification and in the claims, unless clearly indicated to the contrary, should be understood to mean “at least one.” The phrase “and/or,” as used herein in the specification and in the claims, should be understood to mean “either or both” of the elements so conjoined, i.e., elements that are conjunctively present in some cases and disjunctively present in other cases.

Multiple elements listed with “and/or” should be construed in the same fashion, i.e., “one or more” of the elements so conjoined. Other elements may optionally be present other than the elements specifically identified by the “and/or” clause, whether related or unrelated to those elements specifically identified. Thus, as a non-limiting example, a reference to “A and/or B”, when used in conjunction with open-ended language such as “comprising” can refer, in one embodiment, to A only (optionally including elements other than B); in another embodiment, to B only (optionally including elements other than A); in yet another embodiment, to both A and B (optionally including other elements); etc.

As used herein in the specification and in the claims, “or” should be understood to have the same meaning as “and/or” as defined above. For example, when separating items in a list, “or” or “and/or” shall be interpreted as being inclusive, i.e., the inclusion of at least one, but also including more than one, of a number or list of elements, and, optionally, additional unlisted items. Only terms clearly indicated to the contrary, such as “only one of” or “exactly one of,” or, when used in the claims, “consisting of,” will refer to the inclusion of exactly one element of a number or list of elements. In general, the term “or” as used herein shall only be interpreted as indicating exclusive alternatives (i.e. “one or the other but not both”) when preceded by terms of exclusivity, such as “either,” “one of,” “only one of,” or “exactly one of.” “Consisting essentially of,” when used in the claims, shall have its ordinary meaning as used in the field of patent law.

As used herein in the specification and in the claims, the phrase “at least one,” in reference to a list of one or more elements, should be understood to mean at least one element selected from any one or more of the elements in the list of elements, but not necessarily including at least one of each and every element specifically listed within the list of elements and not excluding any combinations of elements in the list of elements. This definition also allows that elements may optionally be present other than the elements specifically identified within the list of elements to which the phrase “at least one” refers, whether related or unrelated to those elements specifically identified. Thus, as a non-limiting example, “at least one of A and B” (or, equivalently, “at least one of A or B,” or, equivalently “at least one of A and/or B”) can refer, in one embodiment, to at least one, optionally including more than one, A, with no B present (and optionally including elements other than B); in another embodiment, to at least one, optionally including more than one, B, with no A present (and optionally including elements other than A); in yet another embodiment, to at least one, optionally including more than one, A, and at least one, optionally including more than one, B (and optionally including other elements); etc.

It should also be understood that, unless clearly indicated to the contrary, in any methods claimed herein that include more than one step or act, the order of the steps or acts of the method is not necessarily limited to the order in which the steps or acts of the method are recited.

The foregoing description of several methods and an embodiment of the invention has been presented for purposes of illustration. It is not intended to be exhaustive or to

limit the invention to the precise steps and/or forms disclosed, and obviously many modifications and variations are possible in light of the above teaching. It is intended that the scope of the invention and all equivalents be defined by the claims appended hereto.

The invention claimed is:

1. A jig assembly, comprising:

a first jaw comprising a first jaw portion and a second jaw portion;

each of said first jaw portion and said second jaw portion comprising a first end and a second end;

said first jaw portion and said second jaw portion each comprising a hinged connection at said second ends;

each of said first jaw portion and said second jaw portion comprising a first arcuate segment and a second arcuate segment;

a first linkage disposed at the first end of the first jaw portion, and a second linkage disposed at the first end of the second jaw portion, opposite said hinged connection;

a jaw actuator disposed between said first linkage and said second linkage to open and close said first jaw portion and said second jaw portion, said jaw actuator disposed opposite said hinged connection;

a second jaw comprising a third jaw portion and a fourth jaw portion;

each of said third jaw portion and said fourth jaw portion comprising a third end and a fourth end;

said third jaw portion and said fourth jaw portion comprising a second hinged connection at said third ends;

each of said third jaw portion and said fourth jaw portion comprising a third arcuate segment and a plurality of catch structures extending from a surface of said second jaw facing away from said first jaw, said plurality of catch structures being arranged circumferentially about said second jaw, said plurality of catch structures each having a first segment having a first end connected to said second jaw and a turned segment extending from a second end of said first segment, said turned segment being capable of engaging a flange;

a third linkage disposed at the fourth end of the third jaw portion and a fourth linkage disposed at the fourth end of the fourth jaw portion;

a second jaw actuator disposed between said third linkage and said fourth linkage to open and close said third jaw portion and said fourth jaw portion, said second jaw actuator disposed opposite said second hinged connection;

a first linear actuator extending between the first jaw and the second jaw, said first linear actuator being connected to a hydraulic pump for varying spacing between said first jaw and said second jaw.

2. The jig assembly of claim 1, further comprising a second linear actuator disposed opposite said first linear actuator, said second linear actuator connected to said hydraulic pump.

3. The jig assembly of claim 2, further comprising a first brace extending from one of said first jaw or said second jaw.

4. The jig assembly of claim 3, wherein the first brace extends from the first jaw and the jig assembly further comprises a second brace extending from the second jaw.

5. The jig assembly of claim 4, said first brace and said second brace being respectively connected to said first linear actuator and said second linear actuator.

6. The jig assembly of claim 1, said jaw actuator and second jaw actuator being manual actuators.

7. The jig assembly of claim 1, further comprising at least one insert disposed along an interior of each of said first jaw portion and said second jaw portion.

8. The jig assembly of claim 7, further comprising at least one second insert disposed along an interior of said third jaw portion and said fourth jaw portion. 5

9. The jig assembly of claim 1, said plurality of catch structures extending in a direction away from said first jaw.

10. The jig assembly of claim 9, said plurality of catch structures capable of engaging an elbow flange. 10

* * * * *