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Systems and methods for forming a joint between a pipe and a hose

Abstract

A method of connecting a pipe and a hose includes providing a transition assembly including a hose end, a pipe end opposite the hose end, and an inner surface defining a transition assembly passage extending through the transition assembly from the hose end to the pipe end, engaging the hose end of the transition assembly with the hose such that a first connection is formed between the transition assembly and the hose, and engaging the pipe end of the transition assembly with the pipe such that a second connection between the transition assembly and the pipe is formed. The second connection is spaced an axial distance from the first connection.

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Background/Summary

BACKGROUND

(1) The field of the disclosure relates to creating a joint between a pipe and a hose, and more particularly to, systems and methods for joining a pipe and a flexible hose together using a transition assembly.

(2) Conventionally, a joint may be created between a pipe and a hose by manually forming a series of welds. The hose may be a flexible metal hose having multiple layers, such as an inner corrugated layer, a braided metal intermediate layer, and/or a protective outer layer. The joint may be initially formed with an internal weld that extends across the multiple layers of the flexible metal hose. An external weld may then be formed across the internal weld and the pipe, such that during the process, the internal weld becomes at least partially obscured by the external weld.

(3) After the internal and external welds are formed, the joint is inspected. However, because the internal weld is at least partially obscured, a visual inspection is not sufficient and as such, various

other inspection methodologies must be used, including pressure testing, vacuum box testing, nondestructive testing, and/or radiography, to determine the leak tightness and robustness of the joint. Furthermore, if a leak is identified, it may be challenging to repair and/or replace the joint and depending on the severity of the leak and/or the relative location of the leak, in some cases, the whole assembly must be scrapped. For example, if a leak forms between the internal weld and the hose, and/or a leak is found between the boundary of the internal weld and the external weld, there may not be any access to such a leak location to repair or replace the weld. Furthermore, because of the location of the joint, sharp edges may be formed and consequently, cracks may propagate within the joint between and through the internal weld and the external weld.

(4) Conventionally, the internal and external welds are formed manually, at least partially because the first weld extends across along an irregular boundary of the multiple exposed layers of the hose. Subsequently, the external weld is formed across the irregular boundary of the hose and the internal weld. Furthermore, manual welding may be required because clamping of the working pieces, required for automatic welding operations, may deform and/or perforate the thin layers of the hose.

(5) Accordingly, a need exists for an improved method of connecting the joint between a pipe and a hose that alleviates the aforementioned drawbacks of conventional joint forming processes used to join a hose and pipe.

SUMMARY

(6) In one aspect, a method of connecting a pipe and a hose is provided. The method includes providing a transition assembly including a hose end, a pipe end opposite the hose end, and an inner surface defining a transition assembly passage extending through the transition assembly from the hose end to the pipe end. The method includes engaging the hose end of the transition assembly with the hose such that a first connection is formed between the transition assembly and the hose. The method further includes engaging the pipe end of the transition assembly with the pipe such that a second connection between the transition assembly and the pipe is formed. The second connection is spaced an axial distance from the first connection.

(7) In another aspect, a transition assembly for connecting a pipe to a hose is provided. The transition assembly includes a pipe end formed with a first surface that is shaped complementary to a pipe contact surface of the pipe and an opposite hose end formed with a second surface that is shaped complementary to a hose contact surface of the hose. The transition assembly further includes an inner surface defining a transition assembly passage that extends between the pipe and hose ends. A first connection is formed when the hose is engaged with the hose end and a second connection is formed when the pipe is engaged with the pipe end. A second connection is spaced an axial distance from the first connection.

(8) In another aspect, a connection system for connecting a hose and a pipe is provided. The connection system includes a pipe including an outer surface having a pipe contact surface and an inner surface defining a pipe passageway and a hose including an inner layer and at least one secondary layer. The inner layer includes a hose contact surface and defines a hose passage. The system includes a transition assembly including a pipe end formed with a first surface that is shaped complementary to the pipe contact surface of the pipe, an opposite hose end formed with a second surface that is shaped complementary to the hose contact surface of the hose, and an inner surface defining a transition assembly passage that extends between the pipe and hose ends. A first connection is formed when the hose is engaged with the hose end and a second connection is formed when the pipe is engaged with the pipe end. The second connection is spaced an axial distance from the first connection.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) These and other features, aspects, and advantages of the present disclosure will become better understood when the following detailed description is read with reference to the accompanying drawings in which like characters represent like parts throughout the drawings, wherein:

(2) FIG. **1** is a schematic illustration of a conventional joint formed between a hose and a pipe.

(3) FIG. **2** is an image of an exemplary sharp edge formation that consequently may form a fracture in a conventional joint formed between a hose and a pipe.

(4) FIG. **3** is a cross-sectional view of an exemplary joint formed between a hose and a pipe including one embodiment of a transition assembly.

(5) FIG. **4** is a detailed cross-sectional view of the transition assembly shown in FIG. **3**.

(6) FIG. **5** is a cross-sectional view of an exemplary joint formed between a hose and a pipe including an alternative embodiment of a transition assembly.

(7) FIG. **6** is a detailed cross-sectional view of the transition assembly shown in FIG. **5**.

(8) FIG. **7** is a flowchart of an exemplary method of forming a joint using a transition assembly.

(9) Unless otherwise indicated, the drawings provided herein are meant to illustrate features of embodiments of the disclosure. These features are believed to be applicable in a wide variety of systems comprising one or more embodiments of the disclosure. As such, the drawings are not meant to include all conventional features known by those of ordinary skill in the art to be required for the practice of the embodiments disclosed herein.

DETAILED DESCRIPTION

(10) In the following specification and the claims, reference will be made to a number of terms, which shall be defined to have the following meanings. The singular forms “a,” “an,” and “the” include plural references unless the context clearly dictates otherwise. “Optional” or “optionally” means that the subsequently described event or circumstance may or may not occur, and that the description includes instances where the event occurs and instances where it does not. Furthermore, references to “one embodiment” are not intended to be interpreted as excluding the existence of additional embodiments that also incorporate the recited features. Moreover, unless explicitly stated to the contrary, embodiments “including” or “having” an element or a plurality of elements having a particular property may include additional such elements not having that property.

(11) Referring now to the drawings, FIG. **1** illustrates an exemplary conventional joint **50** between a pipe **52** and a hose **54**. In the exemplary embodiment, joint **50** is formed with both an internal weld **56** and an external weld **58**, and includes an optional collar **60** that circumscribes the hose **54**. During the process, the internal weld **56** is initially formed on a front-end surface of the hose **54**, e.g., the weld **56** extends across one or more layers of the hose **54**, and/or a front-end surface of the collar **60**. Subsequently, after the internal weld **56** is formed, the external weld **58** is then extended across at least a portion of the internal weld **56** and the pipe **52**. When completed, the external weld **58** is in direct contact with the internal weld **56** such that a boundary **62** is created between the internal and external welds **56** and **58**, respectively. As seen in FIG. **1**, after the external weld **58** is complete, at least a portion of the internal weld **56** is “covered” and is visually obstructed. For example, in the exemplary embodiment, after the external weld **58** is complete, the internal weld **56** may not be visible or accessible. As such, the internal weld **56** may not be visually inspected, or manually reformed (e.g., reheated, patched, etc.), repaired, and/or replaced, after the external weld **58** is complete.

(12) FIG. **2** depicts an image of an exemplary crack formation that may form the boundary **62** created between the internal weld **56** and the external weld **58** of the joint **50**. Over time, continued exposure to flexing, thermal strains, and/or movement may cause cracking to develop in the boundary **62**. Moreover, depending on the types of materials used in fabricating the pipe **52** and/or hose **54**, the integrity of the welds **56** and/or **58**, a grain boundary may form at the boundary **62** defined between the welds **56** and **58**. Stresses, strains, crack propagation, and/or creep may be

increased within at least some known grain boundaries.

(13) With reference to FIGS. **3-6**, exemplary embodiments are described herein that relate to methods and systems for use in forming a joint **100**, such as a sealed connection, between the pipe **52** and the hose **54**. The joint **100** formed includes a transition assembly **102** including a pipe connection end **104** and an opposite hose connection end **106**. The transition assembly **102** includes an outer surface **112** and an inner surface **114** that defines a transition assembly passage **116**. The transition assembly passage **116** extends completely through the transition assembly **102**. The transition assembly **102** may engage with both the hose **54** and the pipe **52**. For example, the pipe connection end **104** may couple with the pipe **52**, and hose connection end **106** may engage the hose **54**, such that the hose **54** and the pipe **52** are engaged at opposing ends of the transition assembly **102** thereby separating the hose **54** and the pipe **52** in both an axial A direction and/or a radial R direction. The transition assembly **102** maintains at least one of an axial separation A.sub.102 and/or a radial separation R.sub.102, between the hose **54** and the pipe **52** such that two independent connections may be formed, i.e., a hose connection **108** between the hose **54** and the transition assembly **102**, and a pipe connection **110** between the pipe **52** and the transition assembly **102**.

(14) In the exemplary embodiment, the pipe **52** includes an inner surface **120** that defines a pipe passage **122** extending through the pipe **52**. The pipe **52** includes an outer surface **124**. The inner surface **120** and the outer surface **124** may be cylindrical, such that the pipe **52** has an inner radius R.sub.52i and an outer radius R.sub.520. The pipe **52** may also include a pipe contact surface **126** that contacts the transition assembly **102** when the transition assembly **102** engages the pipe **52**.

(15) In some embodiments, contact surface **126** may be tapered, e.g., cone shaped, and may include an obliquely-oriented surface **126***a* see FIG. **3**. More specifically, contact surface **126** may be tapered relative to the axial direction, and/or may be tapered relative to the inner surface **120** of the pipe **52**. In some embodiments, contact surface **126** may not be tapered, e.g., the pipe contact surface **126** may be formed with a substantially constant radius R.sub.520, see FIG. **5**. Alternatively, the pipe **52**, and the pipe contact surface **126**, may be any other type of pipe **52**, having any suitable shape and/or dimension that enables the pipe **52** to be engaged with the transition assembly **102**, as described herein.

(16) The hose **54** may be a braided metal hose including one or more layers **130**. In the exemplary embodiment, the hose **54** includes an inner layer **132** having an inner surface **134** that defines a hose passage **136**. The inner layer **132** may be corrugated. For example, the inner layer **132** may have corrugations that are substantially parallel, e.g., the corrugations are independent and spaced a distance from adjacent corrugations. Alternatively, the inner layer **132** may have a helical corrugation e.g., the corrugation is formed as a continuous corrugation that spirals about the length of the hose **54**. The hose **54** may include one or more braided layers and/or an armor **140**. The one or more braided layers and/or an armor **140** may circumscribe the inner layer **132**. The hose **54** may include a protective layer **142**. The protective layer **142** may circumscribe the one or more braided layers **140** and/or the inner layer **132**. The hose **54** may also include at least one hose contact surface **138** that engages the transition assembly **102** when the transition assembly **102** is fully coupled with the hose **54**. The hose contact surface **138** may be a curved surface, e.g., the corrugated inner layer **132**, but is not limited to only being a curved surface. The hose **54** includes an inner radius R.sub.54i and an outer radius R.sub.540.

(17) The hose **54** may be flexible and/or the hose **54** may be rated for high-pressure applications. For example, the hose **54** may be rated for pressures up to 310 Bar (1500° F.), 365 bar (1500° F.), and/or 827 bar (1500° F.). Alternatively, the hose **54** may be any other type of hose, having any suitable shape and/or dimension, that enables the hose **54** to be engaged with the transition assembly **102**, as described herein.

(18) With reference to FIG. **4**, in the exemplary embodiment, the hose end **106** includes a first outer surface **150** and a first inner surface **156**, and the pipe end **104** includes a second outer surface **152**

and a second inner surface **158**. The first outer surface **150** may be shaped complementary to the hose contact surface **138**, and the second inner surface **158** may be shaped complementary to the pipe contact surface **126**. For example, the first outer surface **150** may be shaped to contact the hose contact surface **138** and the second inner surface **158** may be shaped to contact the pipe contact surface **128**. The first outer surface **150** and the second inner surface **158** may be shaped to conform to the contact surfaces **138**, **126**, respectively, as described below.

(19) The first inner surface **156** may be formed with a radius R.sub.156, and the second inner surface **158** may be formed with a radius R.sub.158 that in the exemplary embodiment is different than radius R.sub.156. For example, the radius R.sub.158 may be greater than radius R.sub.156. The radius R.sub.156 and the radius R.sub.158 may be substantially constant or, alternatively, may vary to form a tapered slope, relative to the axial direction A. In some embodiments, the radius R.sub.156 and/or the radius R.sub.158 may be approximately the same as the R.sub.52i of the pipe **52** and/or the R.sub.54i of the hose **54**.

(20) When the hose **54** is engaged with the transition assembly **102**, a hose boundary connection **160** is formed between the first outer surface **150** and the hose contact surface **138**. Similarly, when the pipe **52** is engaged with the transition assembly **102**, a pipe boundary connection **162** is formed between the second inner surface **158** and the pipe contact surface **126**. The hose boundary connection **160** and the pipe boundary connection **162** are separated by at least one of the axial distance A.sub.104 and/or the radial distance R.sub.104.

(21) In the exemplary embodiments, the pipe end **104** is sized and shaped to circumscribe a portion of the outer surface **124** of the pipe **52**, e.g., a portion of the pipe **52** may be disposed within the transition assembly passage **116**, such that the second inner surface **158** of the transition assembly **102** may contact the pipe contact surface **126** of the pipe **52**. The hose end **106** is sized and shaped to fit within the hose passage **136**, and the first outer surface **150** may contact the hose contact surface **138** of the hose **54**, as will be described in more detail below. Alternatively, in some other embodiments, the pipe end **104** may be sized and shaped to fit within the pipe passage **122**, and the hose end **106** may be sized and shaped to circumvent the exterior of the hose **54**, e.g., a portion of the hose **54** may be disposed within the transition assembly passage **116**.

(22) In the exemplary embodiment, the first outer surface **150** is sized and shaped to engage the inner layer **132** of the hose **54**. For example, surface **150** may engage layer **132** in a friction fit, a press fit, a clearance fit, a transition fit, and/or any other engagement that enables assembly **102** to function as described herein. The fits and tolerance may be selected according to ISO standards and/or ANSI standards, for example. The clearance defined between the first outer surface **150** and the inner surface **134** may be any suitable clearance necessary for best practices for press-fit assemblies. In the exemplary embodiment, the first outer surface **150** is sized and shaped complementary to the hose contact surface **138** of the hose **54**. For example, the hose contact surface **138** of the hose **54** may be corrugated, as described above, and the first outer surface **150** may have a radius R.sub.150 that is substantially similar to, or less than a radius of curvature of a corrugation of the hose **54**. The first outer surface **150** may be smooth, and formed without sharp corners or edges, to prevent the first outer surface **150** from deforming or puncturing the hose **54**, e.g., puncturing the inner layer **132** of the hose **54**. For example, the first outer surface **150**, and/or the first inner surface **156**, may include one or more rounded edges. In addition, the first outer surface **150** may be shaped to reduce stress concentrations from forming between the first outer surface **150** and the hose **54**.

(23) The second inner surface **158** is sized and shaped to engage with the pipe contact surface **126** of the pipe **52**. For example, surface **158** may engage pipe contact surface **126** in a friction fit, a press fit, a clearance fit, a transition fit, and/or any other engagement that enables assembly **102** to function as described herein. The fits and tolerance may be selected according to ISO standards and/or ANSI standards, for example. The clearance between the second inner surface **158** and the pipe contact surface **126** may be any suitable clearance necessary for best practices for press-fit

assemblies. In the exemplary embodiment, the second inner surface **158** is sized and shaped complementary to the one or more pipe contact surfaces **126** of the pipe **52**. For example, the second inner surface **158** may be tapered to match the obliquely-oriented pipe contact surface **126***a*. See FIG. **3**. In another embodiment, the second inner surface **158** may be cylindrical to match with the cylindrical pipe contact surface **126**. See FIG. **5**. The second inner surface **158** may be any suitable shape and size such that the second inner surface **158** may contact the pipe contact surface **126** with limited clearance. The second inner surface **158** may be any suitable shape and size such that at least a portion of the pipe **52** may be press fit within the transition assembly passage **116** defined by the second inner surface **158**. In some embodiments, the second inner surface **158** includes a secondary surface **158***a* that contacts the pipe **52**, restricting further insertion of the pipe **52** into transition assembly passage **116**. See FIG. **5**. In some embodiments, the secondary surface **158***a* is annular in shape, matching the annular surface of the pipe **52**.

(24) FIG. **7** illustrates an exemplary method **800** of forming a joint between a hose, e.g., hose **54**, and a pipe, e.g., pipe **52**, is provided. For the purposes of discussion, the method **800** is described in conjunction with the components described in FIGS. **1-6**. However, it should be noted that method **800** is not limited to only being used with the components described herein. In the exemplary embodiment, the method **800** includes providing **802** the transition assembly **102** including the hose end **106** and the pipe end **104**. In an alternative embodiment, the method **800** may also include forming the transition assembly **102** via a machining process, a lathing process, and/or a casting process. A machining process may be used to bore out the transition assembly passage **116**, e.g., to smooth and form the inner surfaces **156**, **158**, and/or to smooth and to form the outer surfaces **150**, **152** of the transition assembly **102**.

(25) Method **800**, in the exemplary embodiment, includes engaging **804** the hose end **106** of the transition assembly **102** with the hose **54** to form the hose boundary connection **160**. In some cases, engaging **804** the transition assembly **102** with the hose **54** may include inserting the hose end **106** into the hose passage **136**. When the transition assembly **102** is fully engaged **804** with the hose **54**, the inner layer **132** of the hose **54** may contact at least a portion of the first outer surface **150** of the hose end **106**. Engaging **804** the transition assembly **102** with the hose **54** may also include press-fitting the hose end **106** into the hose passage **136** such that an interference fit, or any suitable fit, is created between the first outer surface **150** of the transition assembly **102** and the hose contact surface **138** of the hose **54**. The fit created between the hose end **106** and hose passage **136** facilitates retaining the position of the hose **54** and the transition assembly **102** in alignment. In some embodiments, engagement between the transition assembly **102** and the hose **54** may not be necessarily fixedly secured in position, such that the position of the hose **54** and the transition assembly **102** is retained, but in a fit that is not tight enough to create a seal between the hose **54** and transition assembly **102** that would prevent leakage of a fluid, (e.g., a liquid and/or a gas). Alternatively, engagement between the transition assembly **102** and the hose **54** may retain the position of the hose **54** and the transition assembly **102** and create a seal between the hose **54** and the transition assembly **102**.

(26) After the transition assembly **102** is fully engaged with the hose **54**, method **800** includes forming **806** the hose connection **108** between the transition assembly **102** and the hose **54**. In the exemplary embodiment, the hose connection **108** creates a seal that prevents leakage of fluid, at the hose boundary connection **160** between the transition assembly **102** and the hose **54**. The hose connection **108** may also rigidly connect the hose **54** and the transition assembly **102**, preventing relative motion, e.g., axial translation and/or rotation, between the hose **54** and the transition assembly **102**. Forming **806** the hose connection **108** between the hose **54** and the transition assembly **102** may include one or more of the following processes: welding, brazing, and/or soldering. For example, forming **806** the hose connection **108** may include heating adjacent components above or below, the melting point of the material of the components. In another example, forming **806** may include heating and/or melting a material and placing the melted

material on both components. Cooling of the melted material forms the hose connection **108** between the two components.

(27) Method **800** also includes engaging **808** the pipe end **104** of the transition assembly **102** with the pipe **52** to form the pipe boundary connection **162**. In some cases, engaging **808** the transition assembly **102** with hose **54** includes inserting at least a portion of the pipe **52** into the transition assembly passage **116**. When the pipe **52** is inserted into the transition assembly passage **116**, a portion of the second inner surface **158** of the transition assembly **102** may contact the pipe contact surface **126** of the pipe **52**. Engaging **809** the transition assembly **102** with the pipe **52** may include press-fitting the pipe **52** within the transition assembly passage **116** creating an interference fit, or any suitable fit, between second inner surface **158** of the transition assembly **102** and the pipe contact surface **126** of the pipe **52**, thus retaining the position of the pipe **52** and the transition assembly **102**. In some cases, engagement between the transition assembly **102** and the pipe **52** may not be necessarily tight, e.g., the engagement may retain the position of the pipe **52** and the transition assembly **102**, but in a fit that is not tight enough to create a seal between the pipe **52** and transition assembly **102** that would prevent leakage of a fluid (e.g., a liquid and/or a gas). Alternatively, engagement between the transition assembly **102** and the pipe **52** may retain the position of the pipe **52** and the transition assembly **102** and create a seal between the pipe **52** and the transition assembly **102**.

(28) After the transition assembly **102** is engaged **808** with the pipe **52**, method **800** includes forming **810** the pipe connection **110** between the transition assembly **102** and the pipe **52**. The pipe connection **110** may create a seal, preventing leakage of a fluid, at the pipe boundary connection **162** between the transition assembly **102** and the pipe **52**. The pipe connection **110** may also rigidly connect the pipe **52** and the transition assembly **102**, preventing relative motion, e.g., axial translation and/or rotation, between the pipe **52** and the transition assembly **102**. Forming **810** the pipe connection **110** between the pipe **52** and the transition assembly **102** may include one or more of the following processes: welding, brazing, and/or soldering. For example, forming **810** the pipe connection **110** may include heating adjacent components above or below, the melting point of the material of the components. In another example, forming **810** may include heating and/or melting a material and placing the melted material on both components. Cooling the melted material forms a connection between the two components.

(29) Forming **810** the pipe connection **110** and/or the hose connection **108**, may include an automated operation, e.g., a welding operation, having one or more automated steps. The welding operation may include mounting, e.g., rigidly fixing, the transition assembly **102**. The transition assembly **102** includes one or more mounting surfaces, e.g., the outer surface **112** and/or the inner surface **114**, that may be gripped during mounting. The transition assembly **102** may be mounted using any suitable mounting mechanism, such as a clamp. The transition assembly **102** may be minimally deformed when mounted with a gripping force sufficient to maintain the position of the transition assembly **102** without causing significant deformation or deflection of the transition assembly **102**. In particular, the gripping force does not cause deformation or deflection of the transition assembly **102**, such that the transition assembly **102** would not be enabled to function as described herein, e.g., a significant deformation would cause the transition assembly **102** to not be able to be engaged with the hose **54** and/or the pipe **52**. For example, the transition assembly **102** may have size and shape, e.g., a thickness, and/or is composed of a suitable material, steel, or steel alloy, such that the assembly may be mounted without being significantly deformed.

(30) The transition assembly **102** may then be engaged with either or both of the hose **54** and the pipe **52**, as described above, when the transition assembly **102** is mounted. In another example, the transition assembly **102** may be mounted before, or after, the transition assembly **102** is engaged with the hose **54** and/or the pipe **52**.

(31) The automated process(es) may include forming one or more tack welds. The tack welds may be formed using an arc welding process using electricity to weld the hose **54** to the transition

assembly **102** and/or the pipe **53** to the transition assembly **102**. The tack welds may be formed spaced apart about the circumference of the hose boundary connection **160** between hose **54** and the transition assembly **102**, and/or the pipe boundary connection **162** between the pipe **52** and the transition assembly **102**. In some embodiments, the tack welds may be formed by a manual welding process. The tack welds maintain the relative position between the hose **54** and the transition assembly **102** and/or the pipe **52** and the transition assembly **102** for a subsequent automated process.

(32) The automated process(es) may be performed by an orbital welding machine. The machine may clamp the transition assembly **102**. The machine may rotate the transition assembly **102** while forming a weld about the entire circumference of the hose boundary connection **160** between the transition assembly **102** and the hose **54** and/or the pipe boundary connection **162** between the transition assembly **102** and the pipe **52**. Alternatively, and/or additionally, the machine forms the weld about the entire circumference of the hose and/or pipe boundary connections **160**, **162** by rotating a welding arc about the transition assembly **102**. In another example, the automated process(es) may be performed by any suitable robotic welding machine. In alternative embodiments, the hose and pipe connections **108**, **110** may be formed using a manual welding operation.

(33) Forming **804** the hose connection **108** and the pipe connection **110** includes forming **810** the hose connection **108** and pipe connection **110** at least one of an axial distance and/or a radial distance apart.

(34) In some embodiments, forming the joint **100** includes forming a connection, e.g., boundary connection **160**, **162**, by engaging the pipe **52** and/or the hose **54** with the transition assembly **102**, and then subsequently forming the hose connection **108** and/or the pipe connection **110** at the boundary connections **160**, **162**, respectively. In alternative embodiments, forming the joint **100** may include forming the boundary connection **160**, **162**, by engaging the pipe **52** and/or the hose **54** with the transition assembly **102**.

(35) Exemplary embodiments described herein relate to methods and systems for use in forming a joint, such as a sealed connection, between a pipe and a hose. The transition assembly, including a pipe connection end and an opposite hose connection end, maintains at least one of an axial separation and/or a radial separation, between the hose and the pipe. For example, the hose may be engaged with the transition assembly forming a hose boundary and the pipe may be engaged with the transition assembly forming a pipe boundary. Subsequently, two independent connections may be formed, i.e., a hose connection between the hose and the transition assembly and a pipe connection between the pipe and the transition assembly. The pipe and hose connections, e.g., welds, may be formed at the pipe boundary and the hose boundary such that the pipe and hose connections are spaced by at least one of an axial and/or radial distance apart. Accordingly, the first and second connections may be visually inspected, reformed, and/or tested, at least in part because the two connections are not overlapping. Furthermore, the transition assembly enables an automatic welding process to be performed at least because the transition assembly may be easily gripped by a mounting frame of the automatic welding machine.

(36) Further aspects of the present disclosure are provided by the subject matter of the following clauses: 1. According to a first aspect, a method of connecting a pipe and a hose, said method comprising: providing a transition assembly including a hose end, a pipe end opposite the hose end, and an inner surface defining a transition assembly passage extending through the transition assembly from the hose end to the pipe end; engaging the hose end of the transition assembly with the hose such that a first connection is formed between the transition assembly and the hose; and engaging the pipe end of the transition assembly with the pipe such that a second connection between the transition assembly and the pipe is formed, wherein the second connection is spaced an axial distance from the first connection. 2. The method according to Clause 1, wherein engaging the pipe end of the transition assembly includes forming the second connection a radial distance

from the first connection. 3. The method according to any preceding clause, wherein engaging the hose end of the transition assembly includes inserting at least a portion of the hose end of the transition assembly within a passage defined within the hose. 4. The method according to any preceding clause, wherein engaging the pipe end of the transition assembly includes inserting at least a portion of the pipe within the transition assembly passage. 5. The method according to any preceding clause, forming a pipe connection at the first connection; and forming a hose connection at the second connection. 6. The method according to any preceding clause, wherein forming the pipe connection and the hose connection includes at least one of brazing, welding, and soldering. 7. The method according to any preceding clause, wherein forming the pipe and hose connections includes forming a fillet weld. 8. The method according to any preceding clause, wherein forming the pipe and hose connection comprises: mounting the transition assembly to a mounting frame; inserting at least a portion of the transition assembly within a hose passage; forming at least one tack weld between the transition assembly and the hose; and forming a circular weld that circumscribes the transition assembly using an automated orbital welding device. 9. The method according to any preceding clause, wherein forming the at least one tack weld includes forming the at least one tack weld using arc welding. 10. According to another aspect of the disclosure, a transition assembly for connecting a pipe to a hose, the transition assembly comprises: a pipe end formed with a first surface that is shaped complementary to a pipe contact surface of the pipe; an opposite hose end formed with a second surface that is shaped complementary to a hose contact surface of the hose; and an inner surface defining a transition assembly passage that extends between the pipe and hose ends, and wherein a first connection is formed when the hose is engaged with the hose end and a second connection is formed when the pipe is engaged with the pipe end, wherein the second connection is spaced an axial distance from the first connection. 11. The transition assembly according to Clause 10, wherein the first surface includes a curved surface formed with a radius of curvature that substantially matches a radius of curvature of the hose contact surface. 12. The transition assembly according to any of Clauses 10-11, wherein the second surface includes a cylindrical surface formed with having a radius of curvature that substantially matches a radius of curvature of the pipe contact surface of the hose. 13. The transition assembly according to any of Clauses 10-12, wherein the inner surface includes a first inner surface formed with a first radius and a second inner surface formed with a second radius that is different than the first radius. 14. The transition assembly according to any of Clauses 10-13, wherein the inner surface and an outer surface each include at least one rounded edge. 15. According to another aspect of the disclosure, a connection system for connecting a hose and a pipe, the connection system comprising: a pipe including an outer surface having a pipe contact surface and an inner surface defining a pipe passageway; and a hose including an inner layer and at least one secondary layer, wherein the inner layer includes a hose contact surface and defines a hose passage; and a transition assembly comprising: a pipe end formed with a first surface that is shaped complementary to the pipe contact surface of the pipe; an opposite hose end formed with a second surface that is shaped complementary to the hose contact surface of the hose; and an inner surface defining a transition assembly passage that extends between the pipe and hose ends, and wherein a first connection is formed when the hose is engaged with the hose end and a second connection is formed when the pipe is engaged with the pipe end, wherein the second connection is spaced an axial distance from the first connection. 16. The connection system of Clause 15, wherein the first surface includes a curved surface formed with a radius of curvature that substantially matches a radius of curvature of the hose contact surface. 17. The connection system of any of Clauses 15-16, wherein the second surface includes a cylindrical surface formed with having a radius of curvature that substantially matches a radius of curvature of the pipe contact surface of the pipe. 18. The connection system of any of Clauses 15-17, wherein the second surface includes a cylindrical surface formed with having a radius of curvature that substantially matches a radius of curvature of the pipe contact surface of the pipe. 19. The connection system of any of Clauses 15-18, wherein

the connection system further comprises: a pipe connection formed at the first connection; and a hose connection formed at the second connection. 20. The connection system of any of Clauses 15-19, wherein forming the pipe connection and the hose connection includes at least one of brazing, welding, and soldering.

(37) Although specific features of various embodiments of the disclosure may be shown in some drawings and not in others, this is for convenience only. In accordance with the principles of the disclosure, any feature of a drawing may be referenced and/or claimed in combination with any feature of any other drawing.

(38) This written description uses examples to disclose the embodiments of systems and methods, including the best mode, and also to enable any person skilled in the art to practice the systems and methods, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the systems and methods is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims.

Claims

1. A connection system for connecting a hose and a pipe, the connection system comprising: a pipe including an outer surface having a pipe contact surface and an inner surface defining a pipe passageway; and a hose including a corrugated inner layer and at least one secondary layer positioned radially outward from the corrugated layer, wherein the inner layer includes a hose contact surface and defines a hose passage; and a transition assembly comprising: a pipe end formed with a first surface that is shaped complementary to the pipe contact surface of the pipe; an opposite hose end formed with a second surface that is shaped complementary to the hose contact surface of the hose; and an inner surface defining a transition assembly passage that extends between the pipe and hose ends, and wherein a first connection is formed when the hose is engaged with the hose end and a second connection is formed when the pipe is engaged with the pipe end, wherein the second connection is spaced an axial distance from the first connection, wherein when the second surface is in contact with the hose contact surface, the second surface is positioned adjacent to the at least one secondary layer.

2. The connection system of claim 1, wherein the first surface includes a curved surface formed with a radius of curvature that substantially matches a radius of curvature of the hose contact surface.

3. The connection system of claim 1, wherein the second surface includes a cylindrical surface formed with having a radius of curvature that substantially matches a radius of curvature of the pipe contact surface of the pipe.

4. The connection system of claim 1, wherein the inner surface includes a first inner surface formed with a first radius and a second inner surface formed with a second radius that is different than the first radius.

5. The connection system of claim 1, wherein the connection system further comprises: a pipe connection formed at the first connection; and a hose connection formed at the second connection.

6. The connection system of claim 5, wherein forming the pipe connection and the hose connection includes at least one of brazing, welding, and soldering.

7. A method of connecting a pipe and a hose including a corrugated layer and at least one secondary layer positioned radially outward from the corrugated layer, said method comprising: providing a transition assembly including a hose end including a second surface that is shaped complementary to a hose contact surface of the corrugated layer of the hose, a pipe end opposite the hose end, and an inner surface defining a transition assembly passage extending through the

transition assembly from the hose end to the pipe end; engaging the hose end of the transition assembly with the hose such that a first connection is formed between the transition assembly and the hose, wherein when the second surface is in contact with the hose contact surface, the second surface is positioned adjacent to the at least one secondary layer; and engaging the pipe end of the transition assembly with the pipe such that a second connection between the transition assembly and the pipe is formed, wherein the second connection is spaced an axial distance from the first connection.

8. The method according to claim 7, wherein engaging the pipe end of the transition assembly includes forming the second connection a radial distance from the first connection.

9. The method according to claim 7, wherein engaging the hose end of the transition assembly includes inserting at least a portion of the hose end of the transition assembly within a passage defined within the hose.

10. The method according to claim 7, wherein engaging the pipe end of the transition assembly includes inserting at least a portion of the pipe within the transition assembly passage.

11. The method according to claim 7, wherein the method further comprises: forming a pipe connection at the first connection; and forming a hose connection at the second connection.

12. The method according to claim 11, wherein forming the pipe connection and the hose connection includes at least one of brazing, welding, and soldering.

13. The method according to claim 7, wherein forming the pipe and hose connections includes forming a fillet weld.

14. The method according to claim 7, wherein forming the pipe and hose connection comprises: mounting the transition assembly to a mounting frame; inserting at least a portion of the transition assembly within a hose passage; forming at least one tack weld between the transition assembly and the hose; and forming a circular weld that circumscribes the transition assembly using an automated orbital welding device.

15. The method according to claim 14, wherein forming the at least one tack weld includes forming the at least one tack weld using arc welding.

16. A transition assembly for connecting a pipe to a hose including a corrugated layer and at least one secondary layer positioned radially outward from the corrugated layer, the transition assembly comprises: a pipe end formed with a first surface that is shaped complementary to a pipe contact surface of the pipe; an opposite hose end formed with a second surface that is shaped complementary to a hose contact surface of the corrugated layer of the hose; and an inner surface defining a transition assembly passage that extends between the pipe and hose ends, and wherein a first connection is formed when the hose is engaged with the hose end and a second connection is formed when the pipe is engaged with the pipe end, wherein the second connection is spaced an axial distance from the first connection, wherein when the second surface is in contact with the hose contact surface, the second surface is positioned adjacent to the at least one secondary layer.

17. The transition assembly according to claim 16, wherein the first surface includes a curved surface formed with a radius of curvature that substantially matches a radius of curvature of the hose contact surface.

18. The transition assembly according to claim 16, wherein the second surface includes a cylindrical surface formed with having a radius of curvature that substantially matches a radius of curvature of the pipe contact surface of the hose.

19. The transition assembly according to claim 16, wherein the inner surface includes a first inner surface formed with a first radius and a second inner surface formed with a second radius that is different than the first radius.

20. The transition assembly according to claim 16, wherein the inner surface and an outer surface each include at least one rounded edge.