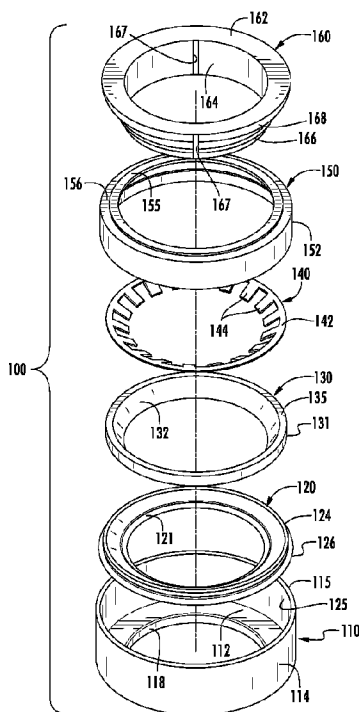




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(57) **Abstrégé/Abstract:**

A push-to-connect modular cartridge for a plumbing fitting includes a cylindrical cup having an annular surface at one end and a cylindrical shoulder at an opposite end. A circular seal is positioned against the annular surface, and a circular backing ring is positioned against the seal on a side opposite the annular surface. A grab ring including inwardly projecting tines is seated against the backing ring on a side opposite the seal, and a containment ring contacts the grab ring on a side opposite the backing ring. The containment ring is engaged by the shoulder of the cup to hold the containment ring, grab ring, backing ring, and seal together. This modular push-to-connect cartridge can be welded to a plumbing fitting which uses significantly less material, thereby greatly reducing the cost to manufacture.

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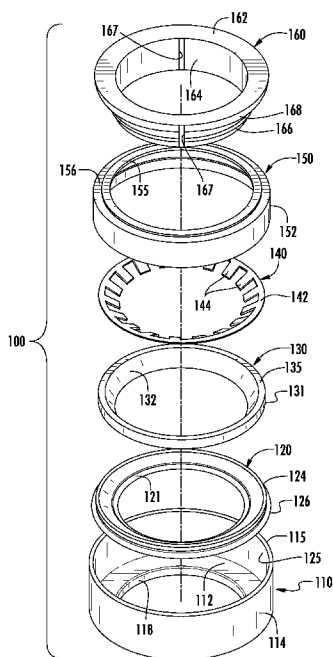


FIG. 2

(57) Abstract: A push-to-connect modular cartridge for a plumbing fitting includes a cylindrical cup having an annular surface at one end and a cylindrical shoulder at an opposite end. A circular seal is positioned against the annular surface, and a circular backing ring is positioned against the seal on a side opposite the annular surface. A grab ring including inwardly projecting tines is seated against the backing ring on a side opposite the seal, and a containment ring contacts the grab ring on a side opposite the backing ring. The containment ring is engaged by the shoulder of the cup to hold the containment ring, grab ring, backing ring, and seal together. This modular push-to-connect cartridge can be welded to a plumbing fitting which uses significantly less material, thereby greatly reducing the cost to manufacture.

WO 2017/204818 A1

MODULAR PUSH-TO-CONNECT ASSEMBLY

BACKGROUND OF THE INVENTION

- [0001] The present invention relates to an end module for welding to plumbing fittings, such as couplings, T's, elbows, valves, or the like, to allow the fittings to receive and sealably hold fluid conduits in a push-to-connect structure.
- [0002] There exists numerous push-to-connect plumbing fittings which eliminate the need for laborious steps, such as soldering, threading, or the like when connecting fluid conduits to fittings. In many installations, PEX tubing and mating fittings employ some form of push-to-connect junctions between the PEX conduits and the fittings. In some cases, fittings may involve transitions between PEX plumbing members and mating copper fittings. Also, copper and copper alloy fittings likewise incorporate a variety of push-to-connect assemblies which allow copper or copper alloy tubing, conduits, or plastic conduits to be installed in conventional copper alloy or low lead copper alloy plumbing fittings, such as valves, T's, elbows, and straight couplings.
- [0003] Many push-to-connect plumbing fittings integrally include structure, such that the installer can select and use the fitting necessary for a particular plumbing system as needed. Cartridges have been proposed that can be inserted into existing solder plumbing fittings to form push-to-connect fittings. Such cartridges are disclosed in US Publication No. 2015/019792 and US Publication No. 2015/0240980.

SUMMARY OF THE INVENTION

- [0004] This invention provides a modular cartridge which can be universally attached to a variety of metal plumbing fittings by welding and preferably by laser welding. For the manufacturer of existing fittings, adapting existing couplings, T's, elbows, valves, and the like with push-to-connect assemblies utilizes a significant amount of material, which can be reduced substantially by the modular system of the present invention.
- [0005] In one embodiment, a push-to-connect end assembly for a fluid fitting comprises a cylindrical cup having an annular surface at one end and a cylindrical shoulder at an opposite end. A circular seal is positioned against the annular surface, and a circular backing ring is positioned against a seal on a side opposite the annular surface. A grab ring including inwardly projecting tines is seated against the backing ring on a side

opposite said seal, and a containment ring contacts the grab ring on a side opposite the backing ring. The containment ring is engaged by the shoulder of the cup to hold the containment ring, grab ring, backing ring, and seal together.

[0006] This modular cartridge has a circular edge which can be welded in a butt joint to mating copper-based or other metal fittings, such as couplings, elbows, T's, and valves. Such fittings can be made using significantly less material, thereby greatly reducing the cost to manufacture. Also, the modular cartridge can be made in a variety of standard sizes to universally adapt metal plumbing fittings of all sizes to push-to-connect fittings.

[0007] These and other features, objects and advantages of the present invention will become apparent upon reading the following description thereof together with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Fig. 1 is a cross-sectional view of a modular cartridge assembly of the present invention;

[0009] Fig. 2 is an exploded perspective view of the components of the assembly shown in Fig. 1;

[0010] Fig. 3 is a side elevational view of a coupling with modular cartridges welded thereto at opposite ends by a laser welding apparatus;

[0011] Fig. 4 shows the coupling of Fig. 3 with fluid conduits coupled together using the coupling shown in Fig. 3;

[0012] Fig. 5 is a side elevational view of a ball valve incorporating a pair of the modular cartridges of the present invention;

[0013] Fig. 6 is a comparison of a standard in-line coupling (at the top) as compared to a coupling (at the bottom) which can be used with a modular cartridge of the present invention;

[0014] Fig. 7 shows a pair of elbows with the upper elbow showing the typical solder-type connection and the lower elbow being adapted to receive a modular cartridge of the present invention; and

[0015] Fig. 8 is a similar comparison of a T-coupling at the top of conventional construction and the reduced material T-coupling which can be used with the modular cartridge of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0016] Referring now to Figs. 1 and 2, a modular cartridge 100 is shown which embodies the present invention. Modular cartridge 100 includes a generally cylindrical cup 110 having an inner annular surface 112, a cylindrical side wall 114, and a shoulder 116 formed by roll-forming the upper edge 115 over the annular shoulder 156 of a containment ring 150. As seen in Figs. 1 and 2, the cup also includes an outwardly extending cylindrical extension 118 which, as described below, has a circular edge 119 which can be welded to mating plumbing fittings, such as one of a coupling, elbow, T, or valve. The cup 110 is made of a metallic material and preferably made of a copper alloy, as is the plumbing fitting to which modular cartridge 100 is attached. The following materials are examples of those which can be employed for the cup 110 and mating fittings:

Wrought Copper Alloys:

Coppers:	C10200
	C11000
	C12200
Brasses:	C27450
	C27451
	C46400
	C46500
Bronzes:	C69300
	C69400
	C69430

Cast Copper Alloys:

Brasses	C87500
	C87600
	C87850

A European alloy identified by the British standard BS EN 12165, which is CW511L, can also be employed.

Also, the American Iron and Steel Institute (AISI) types can be employed:

Austenitic Stainless Steels: 304
304L
316
316L

[0017] A circular generally washer-shaped seal 120 is fitted within the cup 110 and includes an outer lower annular surface 122 (Fig. 1) which engages the annular surface 112 of cup 110. The seal 120 also includes an upwardly extending annular rim 124 having a diameter slightly less than the annular surface 122 and an outer cylindrical rim 126 which engages the inner wall 125 of the cylindrical side wall 114 of cup 110. Seated against the seal 120 is a backing ring 130 which has a conically tapered inner wall 132 and a step-cut recess 134 (Fig. 1) which receives rim 124 of seal 120. Seal 120 includes an inner cylindrical surface 121 which sealably engages the outer wall of a conduit, such as walls 191 and 196 of conduits 190 and 195 shown in Fig. 4. Thus, when installed as seen in Fig. 1, seal 120 seals the components within cup 110 and seals a conduit held by modular cartridge 100.

[0018] Stacked above the backing ring 130 is a grab ring 140, which is generally circular, having an outer rim 142 and a plurality of spaced-apart downwardly inclined, inwardly projecting tines 144 for gripping a conduit positioned in the plumbing fitting, including the modular cartridge 100, as illustrated in Fig. 4. Grab ring 140 is made of a spring steel and frequently made of stainless steel. The lower surface of rim 142 of grab ring 140 rests upon upper annular surface 135 of backing ring 130. A containment ring 150 sandwiches the grab ring 140 and backing ring 130 together and includes a cylindrical side wall 152 which engages the inner cylindrical wall 125 of cup 110. Ring 150 includes a stepped upper rim including a surface 154, which overlies and engages the rim 142 of grab ring 140, as best seen in Fig. 1. The containment ring 150 also includes an annular shoulder 156, which is clamped in position by shoulder 116 of the cup 110 when roll-formed over the containment ring, as seen in Fig. 1. The containment ring 150 also includes an inwardly projecting flange 155 defined by a reduced diameter cylindrical wall 158. Flange 155 has a lower annular surface 159 which lockably receives and holds a release ring 160. Ring 150 includes an inwardly extending annular lower end 157 with a ridge which snap-fits under an annular projecting edge 131 of backing ring 130, as best seen in Fig. 1.

[0019] A release ring 160 is employed to selectively deflect the tines 144 of grab ring 140 outwardly for releasing a conduit from the modular cartridge 100. Release ring 160 includes an annular flange 162, which projects above the containment ring 150, as seen in Fig. 1, and a downwardly projecting cylindrical wall 164 which surrounds and generally is aligned with tines 144 of the grab ring 140. The lower end of cylindrical wall 164 includes a tapered outer edge 166 which aligns with and engages the tines 144 to deflect them outwardly when the release ring is pushed downwardly in the direction indicated by arrow A in Fig. 1. Edge 166 forms a cam surface to provide the necessary deflection. The release ring 160 is captively held within the assembly by the interface of annular shoulder 159 of containment ring 150 and the outwardly extending annular surface 168 of the conically tapered member 166, as best seen in Fig. 1. To facilitate insertion of release ring 160 into the modular cartridge 100 and specifically the containment ring 150, a pair of slots 167 spaced at 180° may be provided in cylindrical wall 164 to allow some flexing of the edges 166.

[0020] Fig. 3 illustrates the application of two modular cartridges 100 and 100' of identical construction to a coupling 170, which can be a relatively short thin walled cylindrical member having circular annular edges 172 and 174, that abut and align with the same diameter edges 119 of cup 110 and form a butt joint by a welding apparatus 200. Welding apparatus 200 is preferably a laser welding apparatus in which the laser beams 210 are directed to the butt joints between edges 172 and 174 and edges 119 of the cups 110 as the cup and fitting are rotated under the beam. The welding apparatus can be any number of commercially available laser welding apparatuses, such as made by Trumpf North America, P Thomas, IPG Photonics, or other commercially available apparatus that will fuse the metal at the butt joints of the assembly as it is rotated approximately 4 to 7 RPM. A suitable holding and rotating jig is used for successively holding members 100 and 170, and subsequently 100' and 170, during the welding process in which a narrowly focused laser beam of about 1 mm is applied to the butt joint. The rotation speed and narrowly focused laser beam allows the welding of members 170 and 100, 100' without damaging the surrounded polymeric materials forming the seal 120, the backing ring 130, the containment ring 150, or the release ring 160.

- [0021] The coupling 170 of Fig. 3 is shown in Fig. 4 with a pair of modular cartridges 100 and 100' welded thereto for receiving fluid conduits 190 and 195 for providing a fluid communication between conduits 190 and 195. Conduits, such as conduits 190 and 195 and other such conduits, can also be fit into other plumbing fittings, such as shown in Figs. 5-8, or valves including the modular cartridges of the present invention.
- [0022] Use of the modular cartridges 100 saves the weight of material used. Cup 110 can be made of a thinner walled material. An example of the thickness of the copper making up the cup 110 and a mating fitting, such as coupling 170, can be .029 inches instead of the usual thickness of .040 to .060 inches for a ½ inch to ¾ inch fitting. As an example, the savings in metal, such as copper for larger sized fittings from ¾ inch to 2 inches, is up to 50% of the weight of material typically employed. This unexpected result is due to the design of the modular cartridge which allows laser welding of the push-to-connect cartridge to thinner walled plumbing fittings.
- [0023] In Fig. 5, there is shown a ball valve 180 of generally conventional construction including a typical internal ball flow control element controlled by a handle 182 to control the flow of fluids through the valve. Welded to the input and output ends of the valve 180 are modular cartridges 100 of the same construction as that shown in Figs. 1 and 2. The cartridges are laser welded as in the above process at junctions indicated by arrows B in Fig. 5.
- [0024] In Fig. 6, a conventional coupling 205 is shown at the top and is twice the length of a coupling 170 using modular cartridges 100, such as shown in Figs. 3 and 4. Similarly, the wall thickness of coupling 205 is typically 15% to 20% thicker than the thickness necessary with the coupling 170.
- [0025] Fig. 7 shows a pair of elbows with a prior art, typically soldered, elbow 215 at the top. Elbow 215 is both thicker and larger in size, i.e., length of the two legs, than an elbow 220, which can be welded to the modular cartridges 100 of the present invention.
- [0026] Similarly, in Fig. 8, a standard T-fitting 230 is shown at the top which is thicker and has legs which are substantially larger than the legs of fitting 240, which can be used with the modular cartridges 100 of the present invention.
- [0027] Thus, with the use of the modular cartridges embodying the present invention, standard solder-type plumbing fittings can be inexpensively replaced with fittings using

less material and be converted during manufacturing to push-to-connect fittings, allowing easy installation at a job site.

[0028] It will become apparent to those skilled in the art that various modifications to the preferred embodiments of the invention as described herein can be made without departing from the spirit or scope of the invention as defined by the appended claims.

The invention claimed is:

1. A push-to-connect modular assembly for a push-to-connect end to be coupled to a second plumbing fitting comprising:

a cylindrical cup having a cylindrical side wall with an inner surface, an annular seal-receiving surface at one end and an annular axially inwardly projecting shoulder at an opposite end;

a circular seal having a flat annular surface positioned against said annular seal-receiving surface of said cup, said circular seal further including a first annular rim opposite said flat annular surface and an outer annular rim engaging said inner surface of said cylindrical side wall of said cup;

a circular backing ring including a recess for receiving said first annular rim of said seal and positioned against said seal on a side opposite said annular surface;

a grab ring including inwardly projecting tines seated against said backing ring on a side opposite said seal;

a containment ring contacting said grab ring on a side opposite said backing ring, said containment ring engaging said seal and said backing ring and further engaged by said annular shoulder of said cup to hold said containment ring, grab ring, backing ring and seal together; and

wherein said cup includes a cylindrical section at an end opposite said annular shoulder, which cylindrical section extends outwardly from said annular seal-receiving surface and includes an edge welded to an edge of a cylindrical second plumbing fitting.

2. The assembly as defined in claim 1 wherein said cup is made of metal such that said edge of said cylindrical section can be laser welded to a second plumbing fitting made of a compatible material.

3. The assembly as defined in claim 1 and further including a release ring captively held by said containment ring and including a cam surface that selectively engages said tines of said grab ring when said release ring is moved into contact with said tines for releasing a conduit positioned in said assembly.

4. The assembly as defined in claim 3 wherein said backing ring and said containment ring are made of a polymeric material.

5. The assembly as defined in claim 4 wherein said seal is a substantially washer-shaped member made of a polymeric material.

6. A push-to-connect assembly for coupling plumbing components together, said assembly comprising:

a metal cup having an end with an exposed edge for welding to one end of one of a coupling, elbow, T, or valve, said cup having a cylindrical side wall with an inner surface, an annular seal-receiving surface at one end and an annular radially inwardly extending shoulder at an opposite end;

a cartridge positioned in said cup, said cartridge having a push-to-connect grab ring for receiving and holding a fluid conduit and a seal for sealing a fluid conduit positioned in said cartridge, wherein said seal has a flat annular surface positioned against said annular seal-receiving surface of said cup and an outer annular rim engaging said inner surface of said cylindrical side wall of said cup, wherein said annular shoulder of said cup engages and compressively holds said cartridge in said assembly; and

wherein said exposed edge of said metal cup is welded to one of a coupling, elbow, T, or valve.

7. The assembly as defined in claim 6 wherein said seal is generally washer-shaped.

8. The assembly as defined in claim 6 wherein said exposed edge of said metal cup is secured to one of a coupling, elbow, T, or valve by laser welding.

9. The assembly as defined in claim 6 wherein said cartridge further includes a release ring with a cam surface for engaging tines on said grab ring to deflect said tines away from a conduit inserted into said cartridge to release said conduit for removal from said cartridge.

10. A plumbing fitting with a push-to connect end comprising:

one of a coupling, elbow, T, or valve;

a metal cup having an edge welded to a mating edge of a metal coupling, elbow, T, or valve, said cup having a cylindrical side wall with an inner surface, an annular seal-receiving surface at one end and an annular radially inwardly extending shoulder at an opposite end;

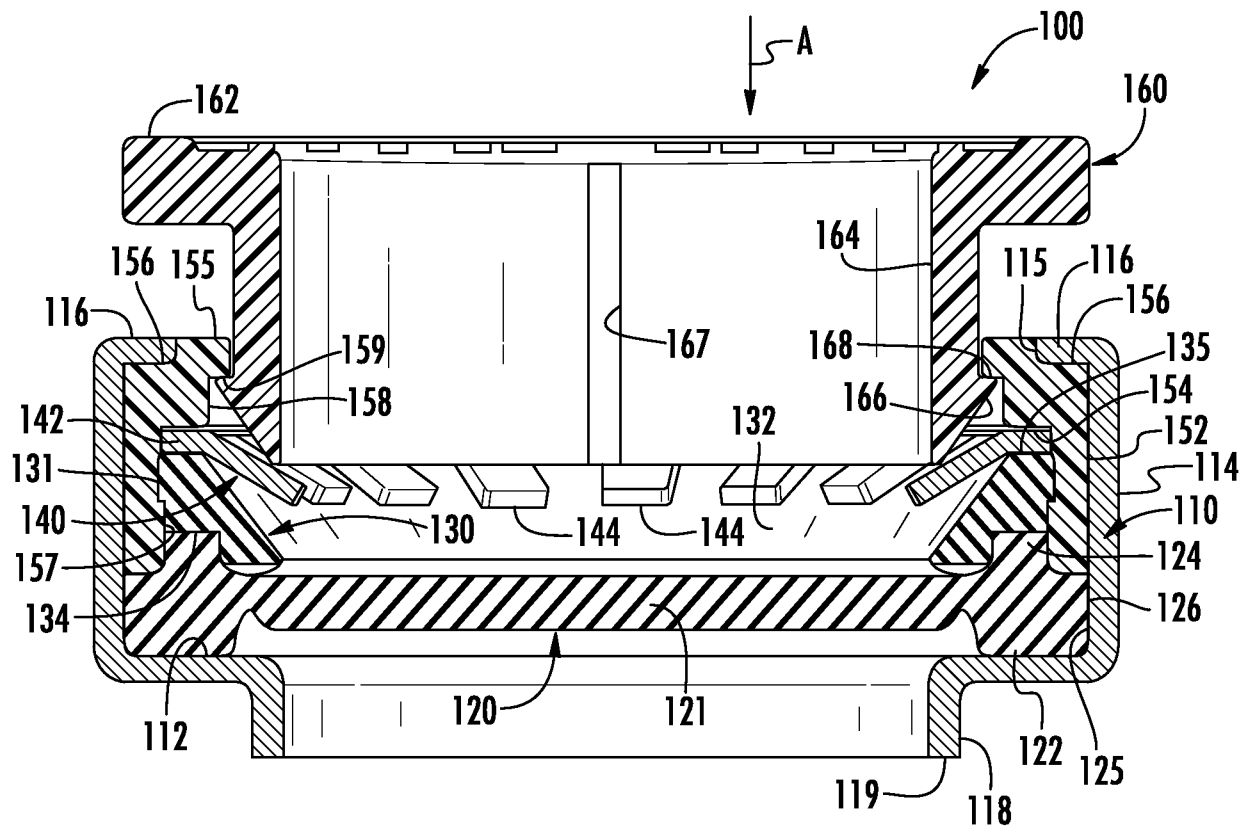
a cartridge positioned in said cup, said cartridge having a push-to-connect grab ring for receiving and holding a fluid conduit, a backing ring, and a seal for sealing a fluid conduit positioned in said cartridge; and

wherein said seal has a flat annular surface positioned against said annular seal-receiving surface of said cup, said seal further including a first annular rim opposite said flat annular surface engaging said backing ring and an outer annular rim engaging said inner surface of said cylindrical side wall of said cup, wherein said annular shoulder of said cup engages and holds said cartridge in said plumbing fitting.

11. The plumbing fitting as defined in claim 10 wherein said cartridge is laser welded to said one of a coupling, elbow, T, or valve.

12. The plumbing fitting as defined in claim 11 wherein said grab ring has spaced-apart tines for gripping and holding a conduit positioned within said cartridge and wherein said cartridge further includes a release ring with a cam surface for engaging said tines on said grab ring to deflect said tines away from a conduit inserted into said cartridge to release said conduit for removal from said cartridge.

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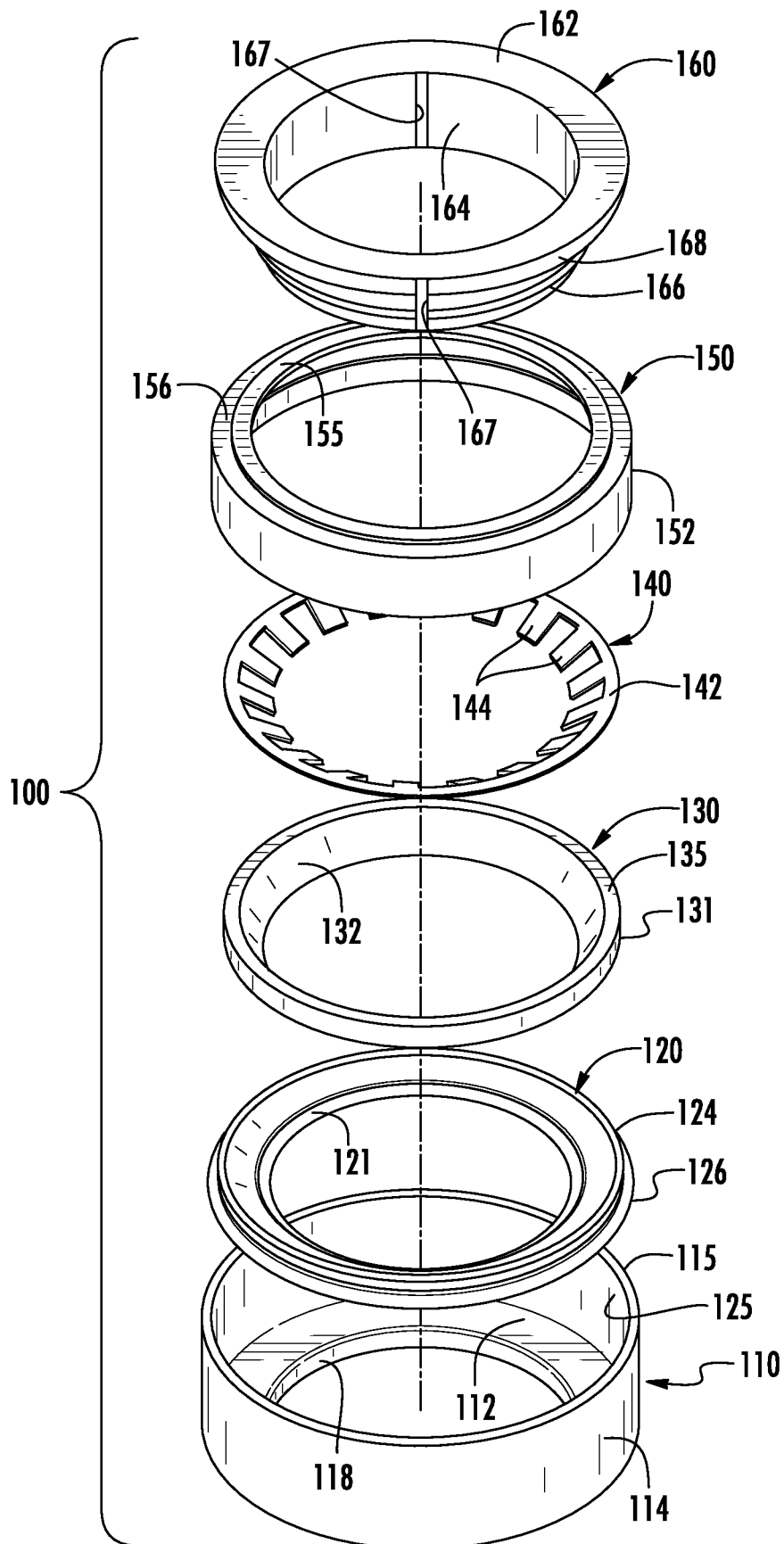
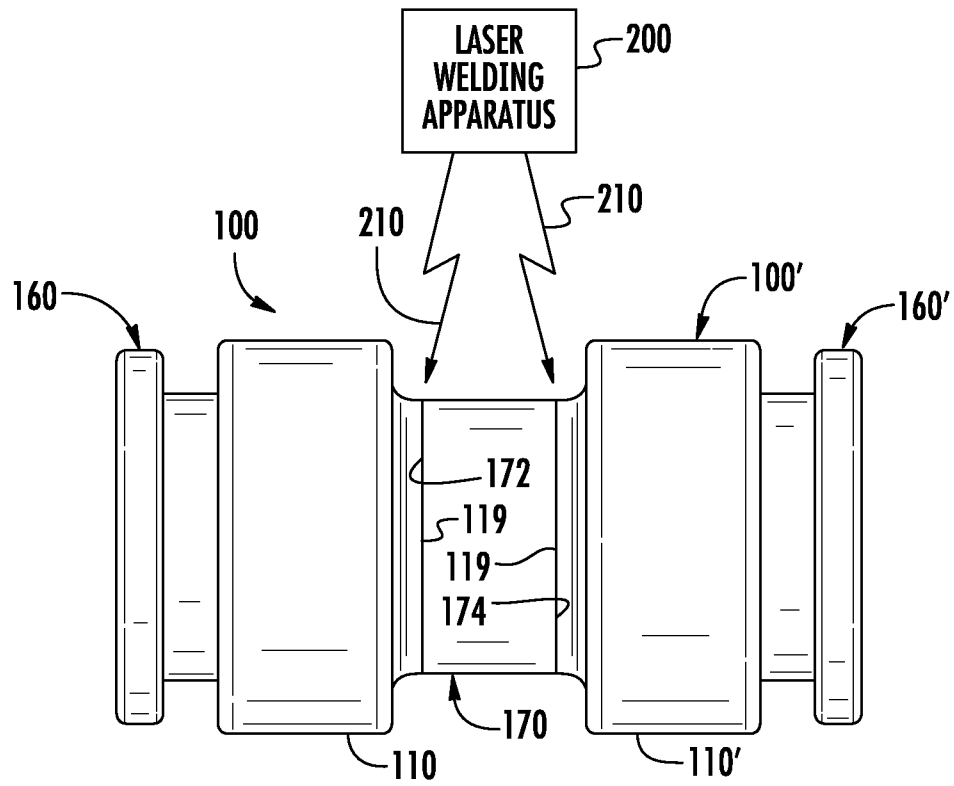
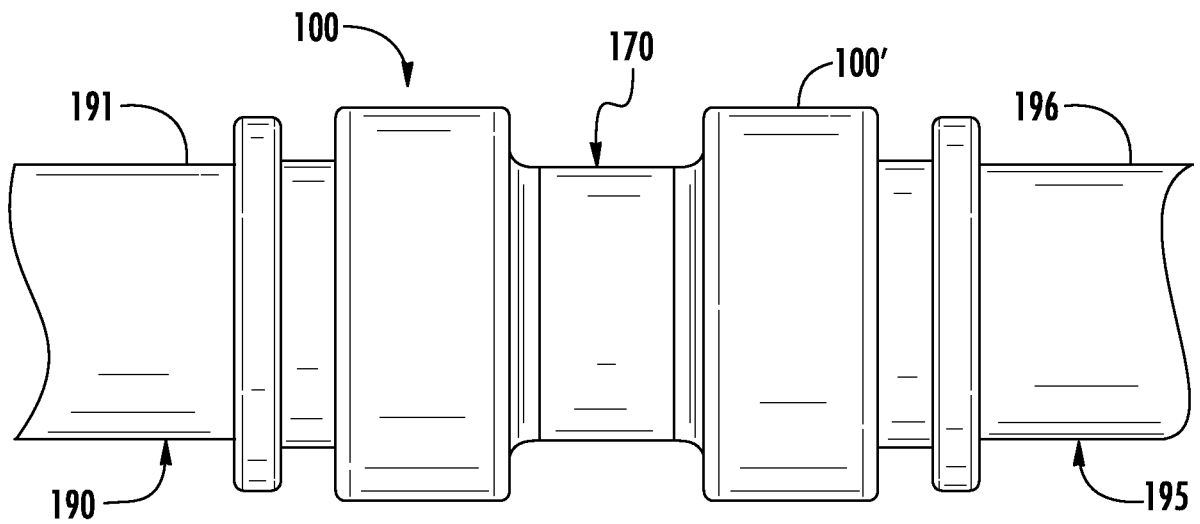
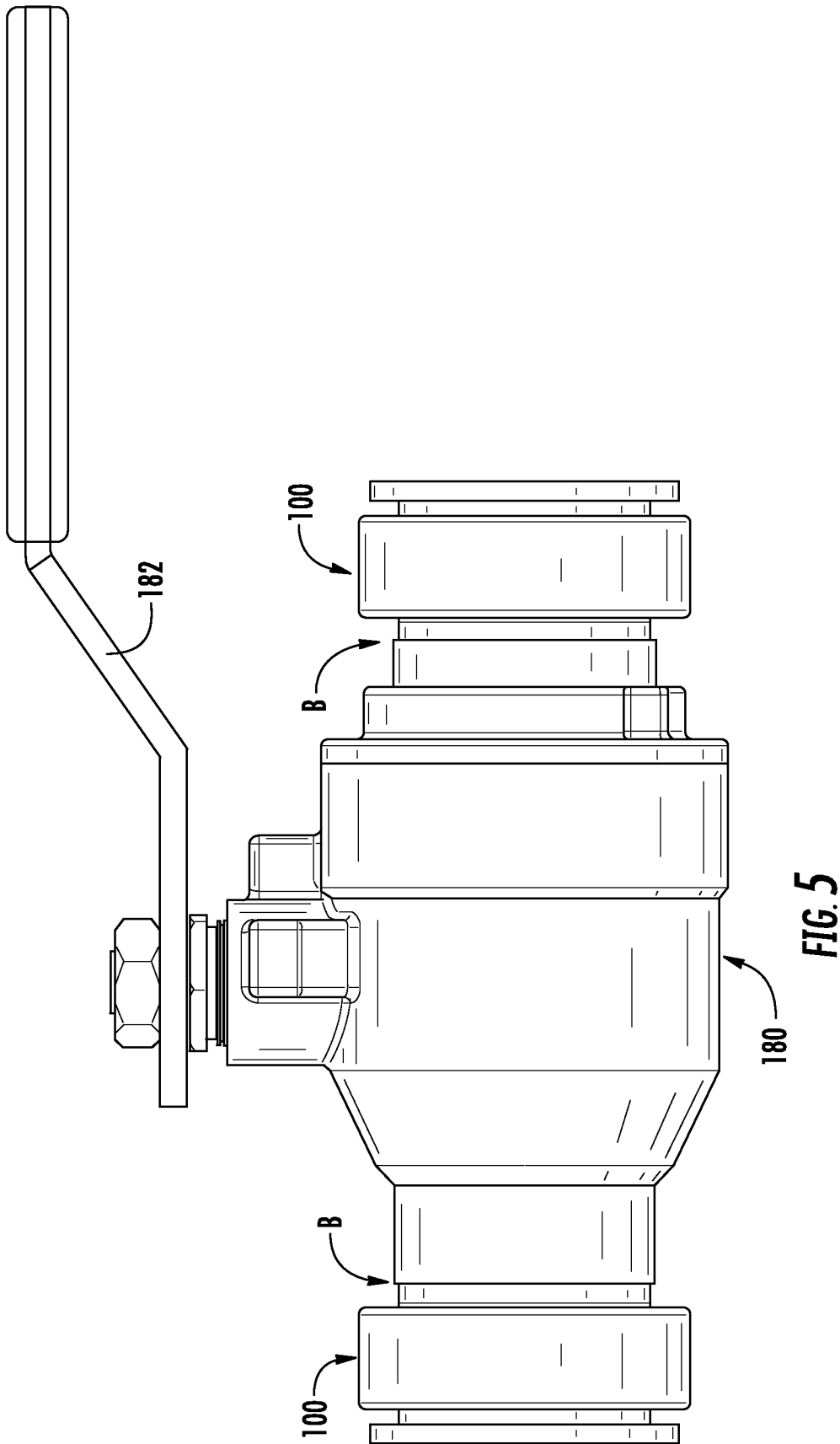


FIG. 2

3/5

**FIG. 3****FIG. 4**



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