REDUCING TAP PLUG ASSEMBLY INCORPORATING A PROBE

INVENTOR: LUZZI, GLENN A.

FIELD OF THE INVENTION

[0001] The present invention disclosed herein relates to the field of high voltage power connectors utilized in power distribution systems. More particularly, the present invention relates to separable electrical connectors and improvements in the assembly of separable electrical connectors such as loadbreak and deadbreak connectors including an improved probe and reducing tap plug and method for using the same in a safer manner during the assembly and servicing of power distribution systems requiring detaching and reattaching connectors from electrical equipment.

SUMMARY OF THE INVENTION

[0002] Safely constructing and servicing high-voltage power distribution systems is a critical process. In order to provide maintenance for underground power distribution system components a noncontinuous break must be apparent prior to performing system service. Crews use insulated "hot sticks" to maintain a safe distance from the equipment as connections and disconnections are made between the high voltage cables and the equipment such as a transformer, switch, or junction.

[0003] High-voltage power systems are designed in various configurations. For example, an equipment structure may be required to allow for equipment capable of carrying 600 ampere currents for distribution to equipment designed for 200 ampere currents. In this scenario, a high voltage equipment cabinet panel and high voltage cable, including an appropriately-rated equipment bushing, may be connected to a 600 ampere connector. To transfer the current, an appropriately rated reducing tap plug may be installed in the other side of the connector which is designed to transfer the load to 200 ampere components. Specifically, a reducing tap plug (“RTP”) enables a utility to establish a 200 ampere, deadbreak, tap point from a 600 ampere connector, such as an elbow or T-connector. The use of the RTP is important in the field as the RTP allows for the use of equipment designed to carry reduced current as well as the ability to provide a grounding point for servicing the equipment in the event of failure.

[0004] In order to establish a connection from a 600 ampere connector to a 200 ampere component, such as a 200 ampere deadbreak elbow, an RTP is first connected at a first end to the 600 ampere component and properly torqued in position with the aid of a spanner wrench which is designed to grasp the outer portion of RPT at holes positioned around the circumference of the RTP housing. At the opposing end of the RTP, it is common in the art to incorporate a two component system comprised of a 200 ampere RTP female contact and a 200 ampere male deadbreak elbow insert as part of the connection. The RTP female contact, manufactured of copper and typically exhibiting a threaded portion, is tubular and is inserted into RTP. The RTP female contact is screwed into the RTP. This coupling of the RTP female contact with the RTP is generally performed at the point of manufacture or in some instances on site, often in a confined space, by a line crew member. Similarly, the 200 ampere male deadbreak elbow insert is screwed into the deadbreak elbow via a threaded portion at one end of the insert. The male deadbreak elbow insert includes a tin-plated copper insert at the opposing end of the threaded portion which is manufactured of a diameter (typically less than 1/3 inch). This outer diameter is slightly larger than the internal diameter of the RTP female contact which allows for a secure contact between the two component once mated. Once the female and male contacts are in place, the female contact and the male contact are wedged together and the connection is complete.

[0005] Due to the confined space in which such power systems reside, operating with the female and male contacts required to make the connection proves difficult. This difficulty is primarily the result of the design of common RTPs in the art. Specifically, RTPs are manufactured from a rigid epoxy-based insulation system. As mentioned, epoxy RTPs are equipped with a plurality of holes around the circumference of the RTP housing to allow for the use of spanner wrenches to torque the RTP into position. This torquing operation often proves difficult in the confined space and damage to the housing often occurs. Also, in many instances the force required to assemble and disassemble the components may weaken other connections within the configuration.

[0006] As referenced above, in addition to providing a reducing interface to combine 600 ampere equipment to 200 ampere equipment, RTPs are typically a primary point of service allowing for the disconnection of high voltage cables to and from equipment at specified points in high-voltage power distribution systems. If service within the high-voltage power distribution systems is required, such as if line failure occurs resulting in, for example, tripped station breakers and de-energized cables, the RTP provides a deadbreak point for accessing the system. To accomplish this task, first, the line crew opens a local switch that de-energizes the cable. Next, if present, the line crew member removes the 200 ampere dead break elbow. The operator inserts a test rod into the RTP to confirm that the cable is not energized. Also, for safety reasons, the line crew must test and establish a grounding point before any work may commence. The grounding point must be sufficiently large to safely carry any current to ground in the event that the cable inadvertently becomes re-energized while line service is being performed. The grounding of the current prevents excessive voltage from appearing on the cable which could possibly injure a crew member or damage the high-voltage power system. To accomplish this task in current prior art systems, the crew installs a grounding elbow or similar device into the 600 ampere elbow. This is accomplished by first breaking the connection. To break the connection, a "hot stick" is used to remove the 200 ampere deadbreak elbow. Next the RTP must be removed since due to the use of the female and male contacts, the internal diameter of the connection from the RTP is minimized (rated at 10 kiloamperes) and is not of a sufficient diameter (now approximately 1/3 inch) to carry the necessary grounding current (which in some instances is as high as 30 kiloamperes). The line crew utilizes spanner wrenches to remove the RTP, which as mentioned often causes damage to prior art RTPs. At this stage, the 600 ampere rated interface is exposed. Of course, one of ordinary skill in the art will readily recognize the safety concerns involved if this procedure is not properly performed. Further, this process could yield additional exposure to other 600 ampere connectors in the assembly. Finally, the line crew installs a grounding device, often a grounding elbow, into the 600 ampere interface. This grounding device is designed to be capable of carrying any 600 ampere-system fault currents (which is typically at least 25 kiloamperes, which is far in excess of the 10 kiloamperes of the current RTP-based connection) to ground.

[0007] Once the grounding device is properly installed and testing of the system is complete, service of the specific section of the underground power supply can be performed. Once the service is completed, an assembly process is performed which is substantially the reverse of aforementioned process. While there are several inherent safety concerns in this reverse assembly process, it is imperative that connectors designed for 600 ampere systems must be torqued together at a minimum of 50 foot-pounds in order to safely carry steady-state currents, short-time currents, and to withstand connector movements that would loosen connections assembled with lower torques. As previously referenced, due to the confined space in which such power systems reside, applying the desired torque proves difficult in the field. Most importantly, the grounding point must be sufficiently large to safely carry any current to ground and in the case of 600 ampere cables the available currents are in excess of the currents which are able to be carried by current RTP technology, which is why the aforementioned complicated process requires the use of grounding elbows.

[0008] While aforementioned methods and apparatuses are generally suitable for the particular purpose discussed herein, it is clear that there exists a need in the art for a safer improved method and apparatus that progresses the state of the art, as well as one that provides the additional benefits enumerated in the present application.

[0009] Specifically, it is a primary aspect of the present invention to provide a safe-operating reducing tap plug.

[0010] Another aspect of the present invention is to provide a safe-operating reducing tap plug for testing, grounding, and isolating a connector from a high voltage system by utilizing an integrated insert which allows for simplified torquing.

[0011] Yet another aspect of the present invention, as set forth above, is to provide the safe-operating reducing tap plug with a tubular solid probe which will mate with the inner diameter of the elbow contact allowing for the elimination of a male contact and female contact system commonly utilized in the art.

[0012] A further aspect of the present invention is to provide an apparatus and method to install an RTP which is manufactured of a material which exhibits improved life expectancy to surpass the current life expectancy of prior art epoxy-insulated RTPs.

[0013] The present invention is further designed to reduce the likelihood of line damage which results from establishing and terminating grounding points by eliminating the need to remove RTPs from established line connections in a high-voltage power system.

[0014] In addition, another aspect of the present invention is to provide an improved grounding method and apparatus exhibiting ease of use in the field and improved safety to line crew members which does not weaken downstream connections.

[0015] Another aspect of the present invention is to provide a tubular solid probe which will directly mate with an elbow flared contact.

[0016] Yet another aspect of the present invention is to make for improved use of the internal bore diameter of an RTP, allowing an RTP to act as a component in system grounding.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] A further understanding of the present invention and the objectives other than those set forth above can be obtained by reference to the various implementations set forth in the illustrations of the accompanying figures. Although the implementations illustrate certain aspects of the present invention, including the apparatus and method of use of the invention, in general, together with further objectives and advantages thereof, may be more easily understood by reference to the drawings, examples, and the following description. The examples and figures are not intended to limit the scope of this invention, which is set forth with particularity in the claims as appended or as subsequently amended, but merely to clarify and exemplify the invention. The detailed description makes reference to the accompanying figures wherein:

[0018] FIGURE 1 – PRIOR ART is a perspective view of a known assembly system utilizing an RTP common in the art;

[0019] FIGURE 2 is a perspective view of the preferred embodiment of the present invention of an RTP assembly system; and

[0020] FIGURE 3 is a perspective view of an RTP assembly system depicting a preferred grounding progression using the preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

[0021] Provided herein is an improved unitary tubular probe for use with an improved reducing tap plug. This unitary tubular probe is designed to provide improved assembly in the field and eliminate the need for excess components required for safety grounding components when servicing 600 ampere high-voltage power systems.

[0022] A detailed description of the aforementioned embodiment of the present invention is disclosed herein. However, techniques of manufacture and resulting structures in accordance with the present invention may be embodied in a wide variety of forms and modes, some of which may be quite different from those in the disclosed embodiment. Consequently, the specific structural details disclosed herein are merely representative, yet in that regard, they are deemed to represent suitable implementations for purposes of disclosure and to provide a basis for the claims herein, which define the scope of the present invention. Well known methods, procedures, and substances for both carrying out the objectives of the present invention and illustrating the preferred embodiment are incorporated herein but have not been described in detail as not to unnecessarily obscure novel aspects of the present invention.

[0023] Unless the context clearly requires otherwise, throughout the description and the claims, the words “comprise,” “comprising,” and the like are to be construed in an inclusive sense, as opposed to an exclusive or exhaustive sense; that is to say, in the sense of “including, but not limited to.” As used herein, the terms "connected," "coupled," or any variant thereof, means any connection or coupling, either direct or indirect, between two or more elements; the coupling of connection between the elements can be physical, logical, or a combination thereof. Additionally, the words “herein,” “above,” "below," and words of similar import, when used in this application, shall refer to this application as a whole and not to any particular portions of this application. Where the context permits, words in the above Detailed Description using the singular or plural number may also include the plural or singular number respectively. The word "or," in reference to a list of two or more items, covers all of the following interpretations of the word: any of the items in the list, all of the items in the list, and any combination of the items in the list.

[0024] Turning to Figure 1 – PRIOR ART, depicted is a perspective view of a known prior art power supply assembly using an RTP common in the art. As discussed above, 600 ampere service equipment terminates at one end of RTP 100. RTP 100 enables a utility to establish a 200 ampere, deadbreak, tap point from a 600 ampere elbow connector. RTP 100 includes a plurality of contact points 102 around the circumference to allow the use of spanner wrenches to torque the RTP 100 to the desired torque, in this case 50 – 60 ft-lbs of torque. At the opposing end of RTP 100, opening 104 is threaded to allow for the insertion of female contact 106. Female contact 106 includes sufficient interior threading on a portion to allow female contact 106 to connect with stud at the base of opening 104 at one end and includes a hollow portion at the other end to allow for the insertion of 200 ampere male deadbreak elbow insert 108 therein. 200 ampere male deadbreak elbow insert 108 includes a male end for insertion into female contact 106 and an opposing threaded male end for coupling into 200 ampere deadbreak elbow 110. Once the female contact 106 is connected to RPT 100 and 200 ampere male deadbreak elbow insert 108 is connected to 200 ampere deadbreak elbow 110, female contact 106 and the 200 ampere male deadbreak elbow insert 108 are wedged together into position.

[0025] Improving upon the prior art RTP assembly system common in the art, FIGURE 2 provides a modified assembly system. 600 ampere service equipment terminates at a first end of RTP 200. RTP 200 enables a utility to establish a 200 ampere, deadbreak, tap point from a 600 ampere elbow connector. In the present invention, RTP 200 is manufactured of elastomeric material such as EPDM (ethylene propylene diene monomer) rubber, a preferred synthetic material often utilized in high-voltage power system components. The use of such elastomeric material is preferred over the more common epoxy material used in the prior art RTP 100 identified in FIGURE 1 for several reasons. (One of ordinary skill in the art will recognize that epoxy material is utilized in prior art systems since, prior to the present disclosure, RTPs required contact points around the circumference to allow for the use of spanner wrenches to properly torque the assemblies – a tool that is no longer required in the present assembly.) First, the elastomeric material exhibits improved life expectancy over the prior art assembly manufactured, in part, of an epoxy. In addition, the current designs of prior art RTPs make it impossible for the RTPs to be manufactured from elastomeric materials because there would be no known method of assembling the device to the required 50 to 60 ft-lbs.

[0026] Opening of RTP 200 allows for the insertion of the flared end of probe 206 and the opposing end of probe 206 is designed to mate with the contact of 200 ampere deadbreak elbow 210. This singular probe 206, generally manufactured of copper, is wedged into place and therefore no tool is required to position probe 206 and make the contact between RTP 200 and 200 ampere deadbreak elbow 210.

[0027] The use of probe 206 of the present invention as compared to the two unit female contact and male contact of the prior art (discussed in FIGURE 1) improves field safety for a line crew. In addition, use of the improved probe allows for the proper torquing required in the field (i.e., a minimum of 50 foot-pounds in order to safely carry steady-state currents, short-time currents, and to withstand connector movements that would loosen connections assembled with lower torques) with a common hex wrench rather than a spanner wrench. As previously mentioned, the use of spanner wrenches as known in the art often causes damage to an epoxy RTP and the forces employed may cause damage to equipment downstream of the present equipment being serviced. Further, line crew are able to utilize tools commonly associated with 600 ampere systems rather than having to utilize extra tools required in 200 ampere systems. In addition, the probe of the present invention allows for a much larger available inside diameter of RTP. Since a female connector is not used in the present invention thereby reducing the bore of the RTP, the larger available inner diameter of RTP bore (likely manufactured of entirely copper instead of a copper and other metal common in prior art systems - an improvement in RTP manufacturing) is now sufficiently large to accept a threaded grounding rod designed to carry momentary currents at least as high or higher than typical 600 ampere system momentary currents (e.g., 30 kiloampere). This effectively eliminates the need to remove the RTP during the servicing of the system as previously described in the prior art (further discussed below).

[0028] FIGURE 3 is a perspective view of a component assembly system utilizing an RTP depicting a grounding progression using the preferred embodiment of the present invention. Two united 600 ampere T-connectors 300 are depicted in progressions FIGURE 3A through

FIGURE 3E. In FIGURE 3A one of the T-connectors 300 is connected to a 200 ampere/600 ampere RTP 304. RTP 304 is joined to a 200 ampere deadbreak elbow 302 using the probe of the present invention (not shown). Disassembly of deadbreak elbow 302 from RTP 304, as shown in FIGURE 3B, results in the probe of the present invention (not shown) remaining in 302 and therefore removed from the connection. Since bore of 304 is of a larger dimension as described above in the present application, the full internal diameter (in this case 1/2 inch) of bore of RTP 304 is available as shown in FIGURE 3C. This increased available bore size allows for the insertion of grounding tool 306. Thus, grounding tool 306 can be inserted directly into connection of RTP 304 without the need of grounding elbow currently utilized in the art as depicted in FIGURE 3D. Grounding tool 306 is threaded into and secured into RTP 306 as shown in FIGURE 3E. One of ordinary skill in the art will readily recognize that the reverse procedure of the progression in FIGURE 3 can be performed to remove grounding tool 306 and reconnect 200 ampere deadbreak elbow 302 to reestablish the connection.

[0029] While certain aspects of the device are presented below in certain claim forms, the inventor contemplates the various aspects of the apparatus and method in any number of claim forms. Accordingly, the inventor reserves the right to add additional claims after filing the application to pursue such additional claim forms for other aspects of the apparatus and method.

[0030] Thus, there has been summarized and outlined, generally in broad form, a plurality of the most important features of the present invention. While this summary is presented so that the novelty of the present contribution to the related art may be better appreciated, it will further be apparent that additional features of the invention described hereinafter (which will form the subject matter of the claims appended hereto) will further define the scope, novelty, and in certain instances the improvements upon any existing art. The following description provides specific details for a thorough understanding of, and enabling description for, various examples of the improvement in the described field of art. One skilled in the art will understand that the method and apparatus may be practiced without many of these details and it is to be readily understood that the invention presented herein is not limited in its application to the details of construction and to the arrangements of the components set forth in the following description or illustrated in the various figures integrated and categorized herein. For example, in some instances, well-known structures and functions have not been shown or described in detail to avoid unnecessarily obscuring the description of the examples of the invention. It is intended that the terminology used in the description presented below be interpreted in its broadest reasonable manner, even though it is being used in conjunction with a detailed description of certain examples of the invention. Although certain terms may be emphasized, any terminology intended to be interpreted in any restricted manner will be overtly and specifically defined as such in this detailed description section. Those skilled in the art will appreciate that the disclosure of the present invention may readily be utilized as a basis for the designing of other similar structures, methods, and systems for carrying out the various purposes and objectives of the present invention.

I CLAIM:

1. A connector assembly comprising:

a reducing tap plug;

a probe; and

a connector capable of carrying an electrical current.

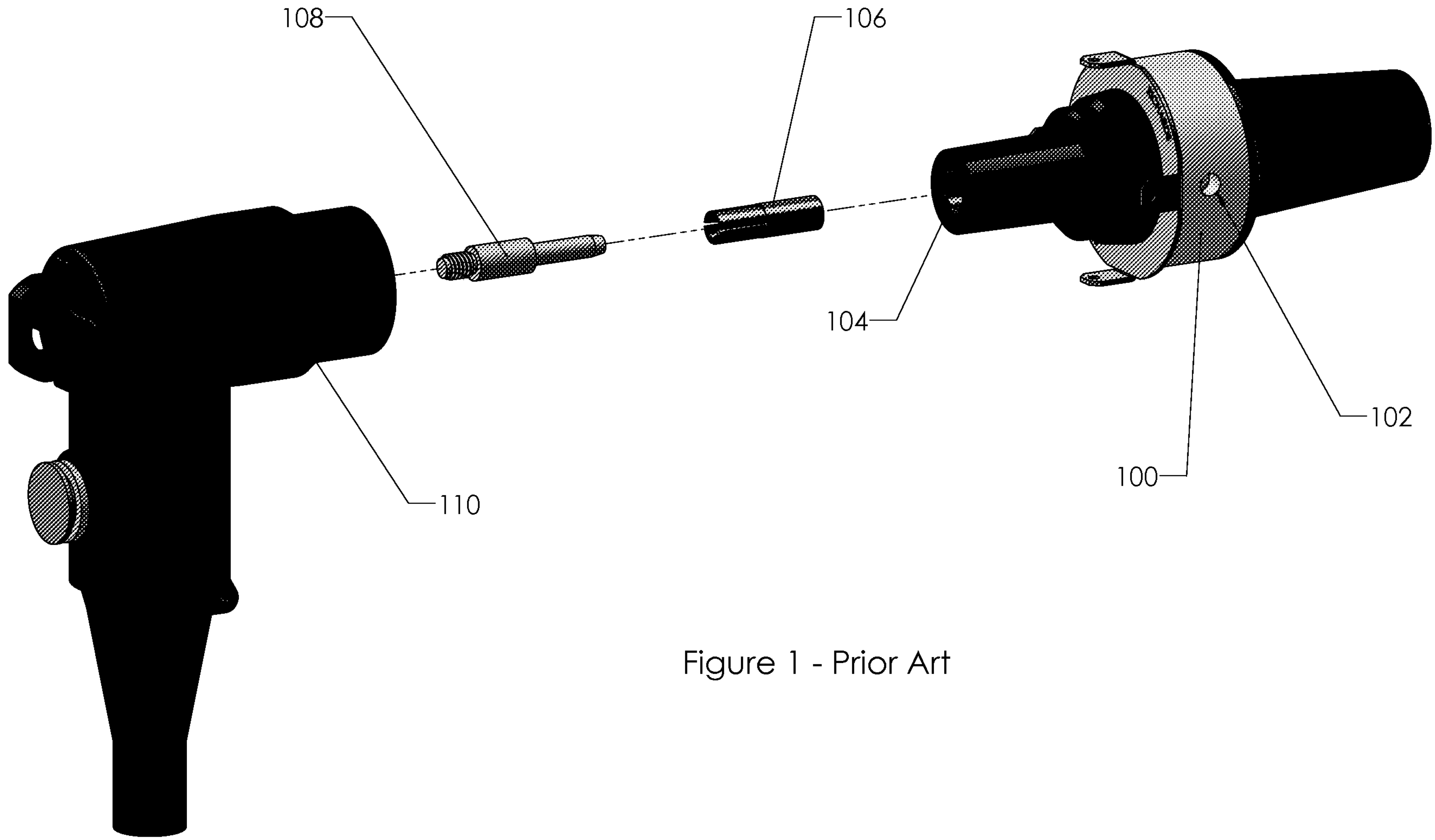

Figure 1 - Prior Art

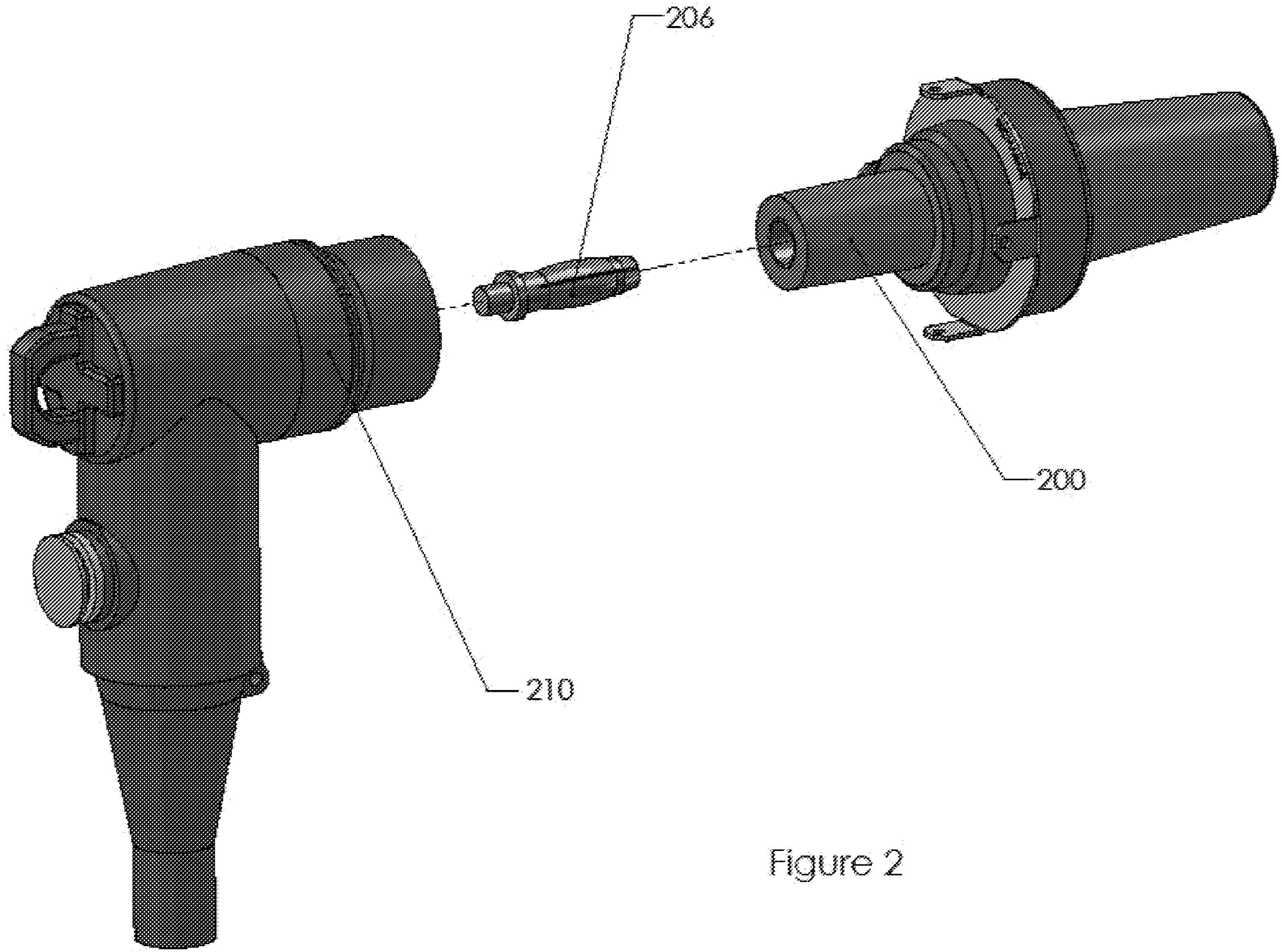

Figure 2

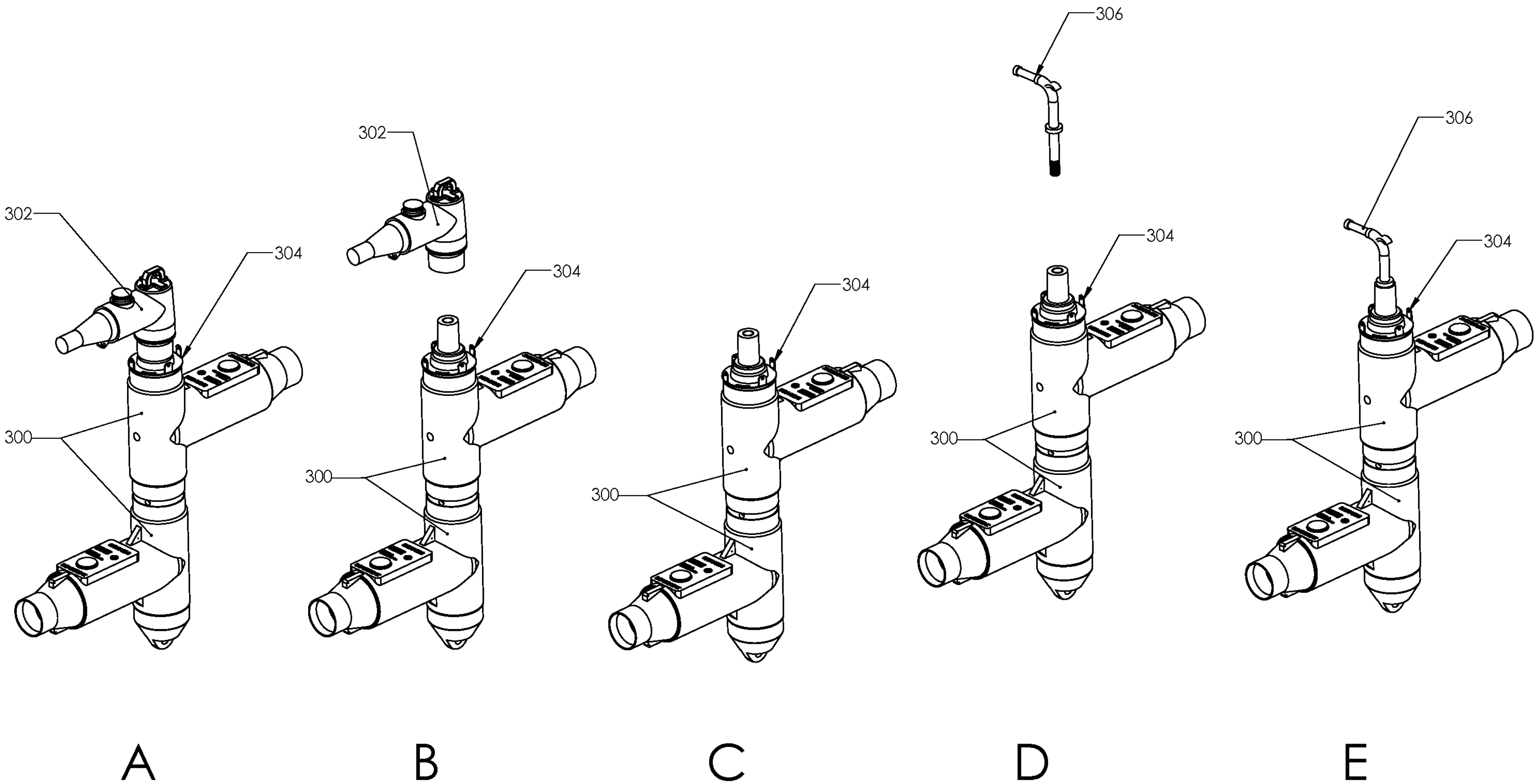

Figure 3