Nov. 10, 1970 R. RUETE ET AL 3,539,972

ELECTRICAL CONNECTOR FOR HIGH VOLTAGE ELECTRICAL SYSTEMS

Filed May 21, 1968 3 Sheets-Sheet 1

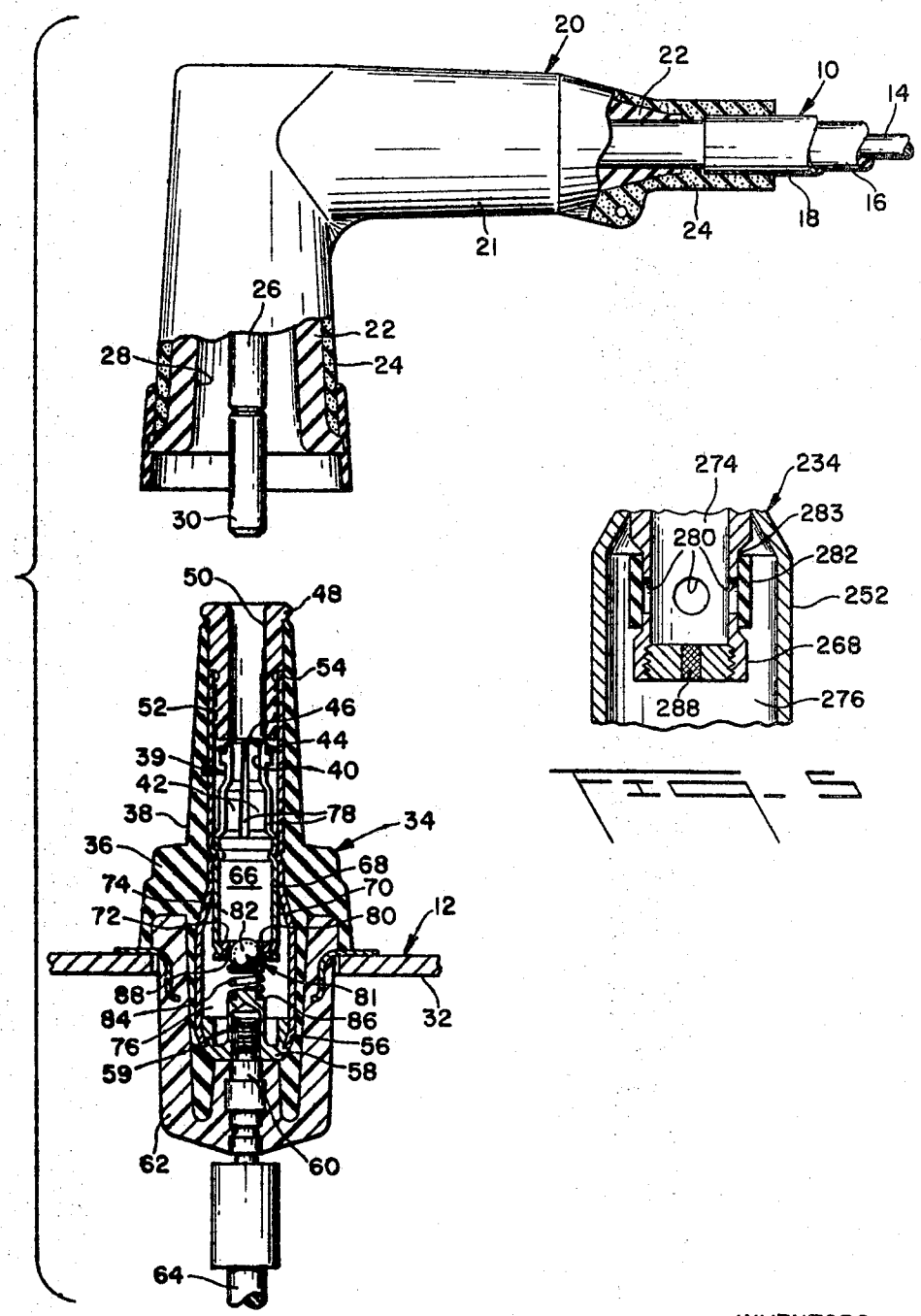


FIG. 1

FIG. 5

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ELECTRICAL CONNECTOR FOR HIGH VOLTAGE ELECTRICAL SYSTEMS

Filed May 21, 1968 3 Sheets-Sheet 2

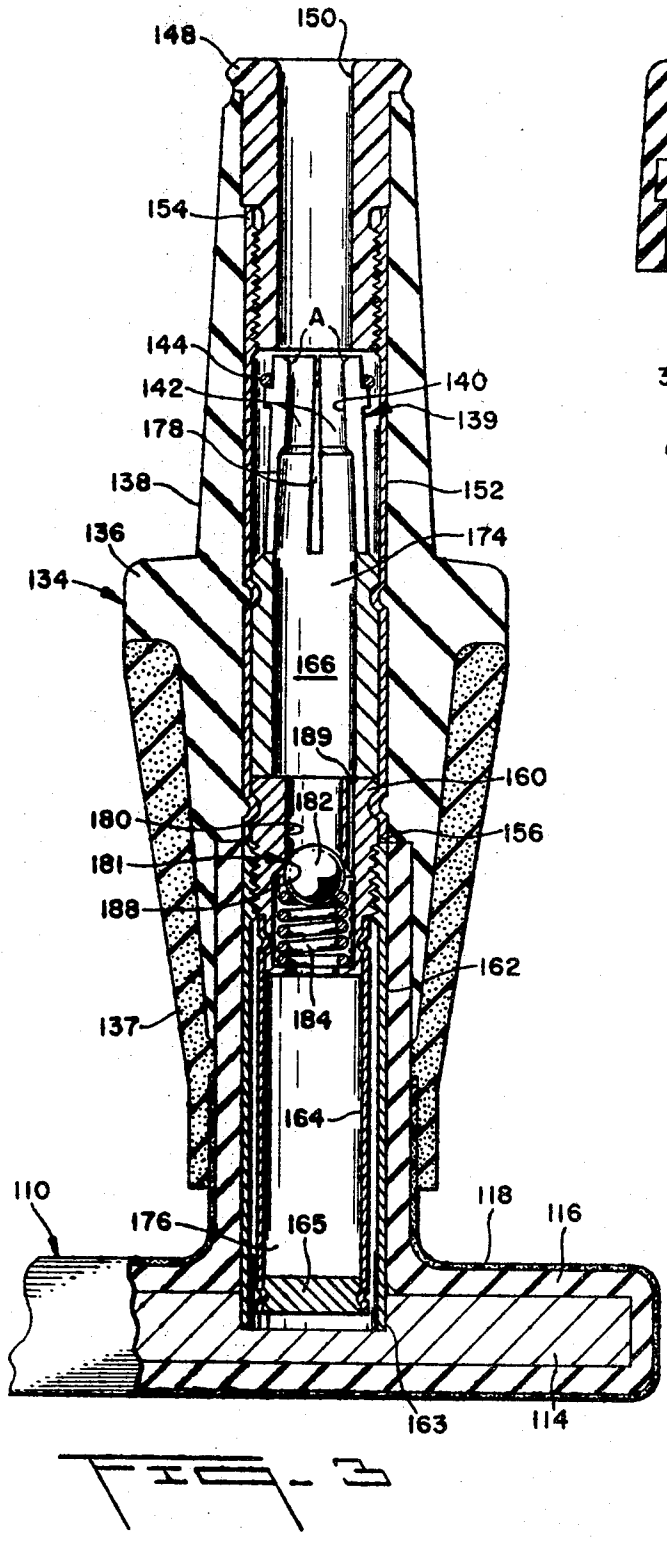


FIG-3

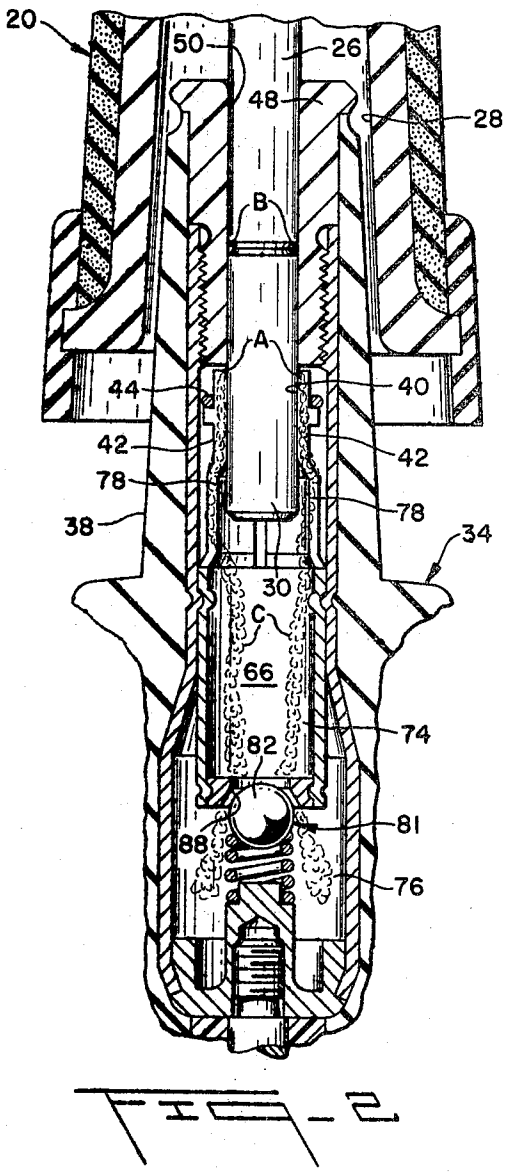


FIG-2

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ELECTRICAL CONNECTOR FOR HIGH VOLTAGE ELECTRICAL SYSTEMS

Filed May 21, 1968 3 Sheets-Sheet 3

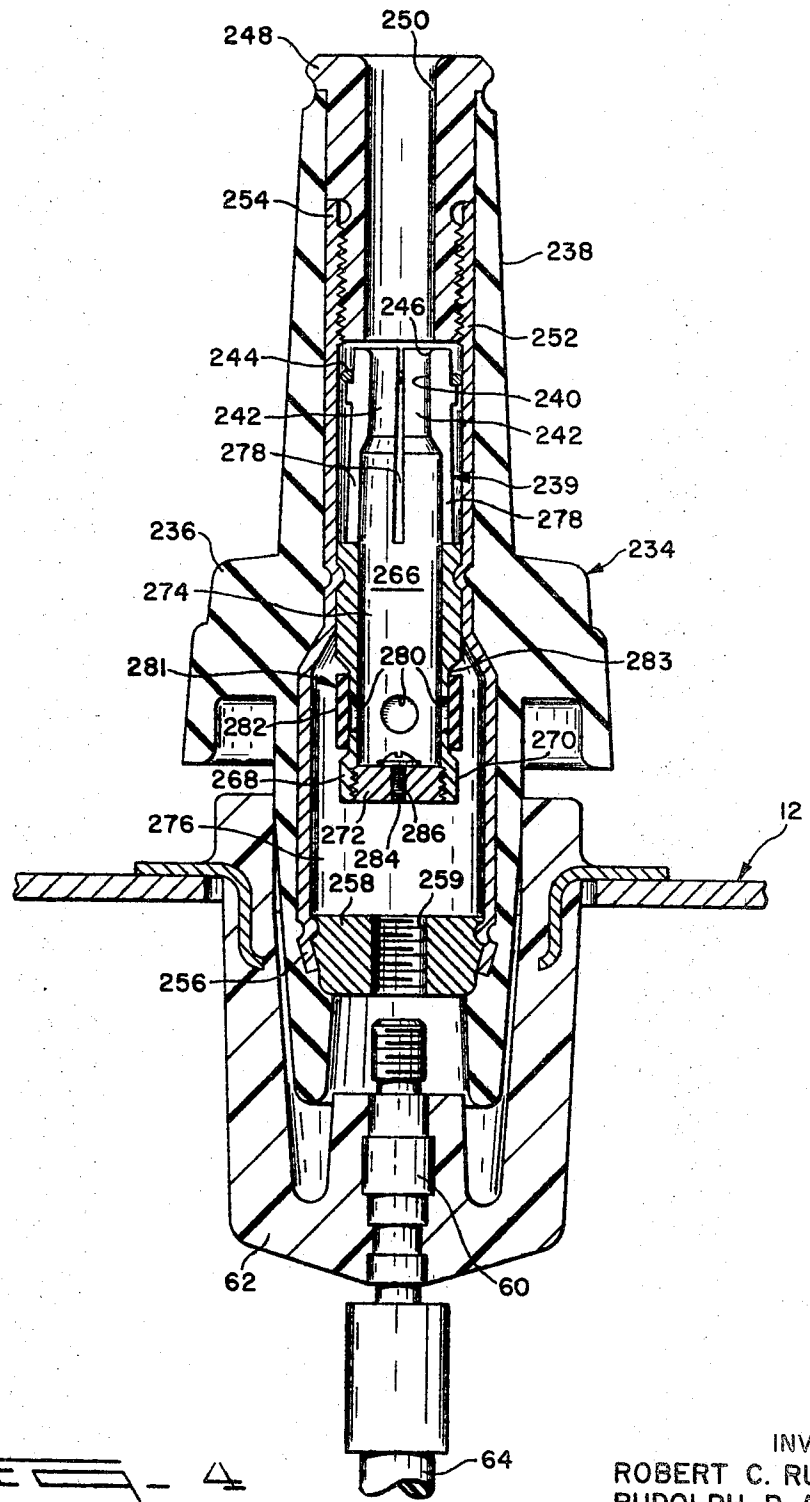


FIG. 4

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3,539,972

ELECTRICAL CONNECTOR FOR HIGH VOLTAGE ELECTRICAL SYSTEMS

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Int. Cl. H01r 13/52
U.S. Cl. 339—111 18 Claims

ABSTRACT OF THE DISCLOSURE

An electrical connector element for use in high voltage electrical systems and capable of being connected and disconnected under high voltage load conditions and being safely connected under short circuit conditions by virtue of a structural arrangement which accommodates gases generated by an electric arc ordinarily struck during such connection and disconnection, the connector element including a cavity, an electrical contact, a wall dividing the cavity into a first chamber in open communication with the portion of the contact where the electric arc is struck and a second chamber, and a valve interconnecting the first and second chambers such that gases generated by the electric arc at the portion of the contact may be relieved from the first chamber into the second chamber. The gases thus passing into the second chamber may be dissipated relatively slowly through a relatively small passage, preferably leading back into the first chamber.

The present invention relates generally to electrical connectors for use in high voltage electrical systems and pertains, more specifically, to electrical connector elements embodying means for accommodating gases generated by an electric arc ordinarily struck during connection and disconnection under high voltage conditions so that such connection and disconnection may be accomplished without failure of the connector structure.

It is now commonplace to find disconnectable electrical connectors employed in a variety of locations in high voltage electrical distribution systems. While it is always best to make or break such disconnectable connections under no-load conditions, it is not always easy or expeditious to determine whether or not high voltage is present in a connection and then assure that no voltage is present before disconnecting a connection or reconnecting the connection. Thus, connections and disconnections are constantly being made under high voltage load conditions.

Such practices ordinarily lead to the formation of an electric arc between the contacts of the electrical connectors which are being connected or disconnected. The arc will very rapidly generate relatively large quantities of gases. Upon the connection of a pair of complementary electrical connectors under short circuit conditions, these gases have been known to build up sufficient pressure to preclude completion of the connection or cause failure of one or the other of the connectors, often in such a violent manner as to constitute a hazard to personnel in the vicinity of the connection. These gases actually have been known to cause explosive failure of connector elements with the concomitant danger of flying debris.

It is therefore an important object of the invention to provide an electrical connector construction which enables successful connection under high voltage, short circuit conditions without a disastrous failure of the electrical connector.

Another object of the invention is to provide an electrical connector construction which enables such electrical connector elements to be either connected or disconnected under load in high voltage systems with improved life of the connectors.

Another object of the invention is to provide electrical connector elements having a construction which will accommodate gases ordinarily generated by an electric arc struck during connection under short circuit conditions without a disastrous failure of the electrical connector.

A further object of the invention is to provide a construction for electrical connectors for permitting the making or breaking of a connection under load, the construction having an overall configuration which is compact and compatible with current standards and equipment.

A still further object of the invention is to provide an electrical connector having a relatively simple construction capable of economical fabrication.

The above objects, as well as further objects and advantages, are attained by the invention which may be described briefly as an electrical connector element for use in high voltage electrical systems and capable of being connected and disconnected under high voltage conditions, the connector element including means for accommodating gases generated by an electric arc ordinarily struck during such connection and disconnection, the gas accommodating means comprising means providing a cavity within the electrical connector element, means dividing the cavity into a first chamber and a second chamber, an electrical contact having at least that portion where the electric arc is struck in open communication with the first chamber, and valve means interconnecting the first and second chambers and operable between a first position wherein the first chamber and the second chamber are in communication with one another and a second position wherein the first chamber and the second chamber are closed to one another, the valve means being responsive to the relative gas pressures in the chambers such that a pressure in the first chamber greater than the pressure in the second chamber will open the valve means to vent gas from the first chamber to the second chamber and a pressure in the first chamber no greater than the pressure in the second chamber will allow the valve means to remain closed.

The invention will be more fully understood and further objects and advantages thereof will become apparent in the following detailed description of preferred embodiments of the invention illustrated in the accompanying drawing, in which:

FIG. 1 illustrates complementary electrical connectors with a connector element constructed in accordance with the invention shown in a longitudinal cross-sectional view;

FIG. 2 is an enlarged fragmentary cross-sectional view of portions of the connectors of FIG. 1 as the connectors are being connected;

FIG. 3 is a cross-sectional view of another connector element illustrating another embodiment of the invention;

FIG. 4 is a longitudinal cross-sectional view illustrating a connector element in the form of a bushing constructed in accordance with the invention; and

FIG. 5 is a reduced fragmentary cross-sectional view illustrating an alternate construction for a portion of the connector element shown in FIG. 4.

Referring now to the drawing, and particularly to FIG. 1, an electrical connection is to be made between a high voltage cable **10** and a transformer **12** in a high voltage electrical distribution system. The high voltage cable **10** has a central conductor **14**, which is covered with an insulating jacket **16** which, in turn, is sheathed within a conductive shield **18**. The cable **10** is terminated within an electrical connector element **20** shown in the form

of an elbow having a body **21** which includes an inner member **22** of insulating elastomeric material and an outer member **24** of conductive elastomeric material. A central electrical contact is shown in the form of a pin **26** of conductive metal projecting axially through a receptacle **28** in the body **21** of the connector element **20**. A tip **30** of nonconductive plastic material is affixed to the end of the pin **26** for purposes which will be described hereinafter.

Affixed to the transformer **12**, and projecting outwardly of the casing **32** thereof, is an electrical connector element constructed in accordance with the invention and shown in the form of a transformer bushing **34**. Bushing **34** is provided with a housing **36**, preferably fabricated of an elastomeric material and having an axially projecting outer body portion **38** constructed of a dielectric material, preferably an insulating elastomer. Within the housing **36** is an electrical contact **39** shown in the form of a metallic socket **40** having a plurality of segments **42** which are biased radially inwardly by an annular spring member **44** which encircles segments **42** adjacent the mouth **46** of the socket **40**. A plastic sleeve **48** is juxtaposed with the socket **40** within the housing **36** and has an axially directed cylindrical bore **50** therein for receiving the plastic tip **30** of the corresponding connector element **20** as the connector elements **20** and **34** are connected.

Both the electrical contact **39** and the plastic sleeve **48** are actually affixed to a first tubular member **52** adjacent one end **54** thereof. The first tubular member **52** extends axially to the other end **56** thereof where the tubular member **52** is terminated by a base **58**. The base **58** has a threaded aperture **59** so that the bushing **34** may be removably secured to a threaded stud **60** carried by a well member **62** which is permanently secured to the transformer casing **32**. The threaded stud **60** is mechanically fixed and electrically connected to a lead **64** of the transformer **12**. The first tubular member **52** and the base **58** are electrically conductive and are constructed of metal. The first tubular member **52** and the base **58** thus establish a cavity **66** within the bushing **34**. A second tubular member **68**, which is actually an integral portion of the electrical contact **39**, extends axially into the cavity **66** and has an annular wall **70** spaced radially from the first tubular member **52** and closed off by an end wall **72** secured thereto, thus establishing dividing means for dividing the cavity **66** into a first chamber **74** and a second chamber **76**. The first chamber **74** is in open communication with passages **78**, established between the segments **42** of the socket **40**, and with the interior of the socket, while the second chamber **76** is sealed off from the housing **36** by the first tubular member **52** and the base **58**. An opening **80** in the end wall **72** communicates with both the first chamber and the second chamber and a valve means **81** is provided in the form of a ball valve having a ball **82** resiliently biased by a helical spring **84** which engages a shoulder **86** on the base **58** and which urges the ball **82** toward the first chamber **74** and into engagement with a seat **88** provided for the ball at the opening in the end wall member to close the opening **80**.

As best seen in FIG. 2, as the complementary connector elements **20** and **34** are brought together, the plastic tip **30** will cooperate with the plastic sleeve **48** to serve as a pilot for aligning the respective electrical contacts prior to the making of any electrical contact between these contacts. As the connector element **20** is pushed toward full engagement with the bushing **34**, the metallic pin **26** will approach the socket **40** and an electric arc may be struck between portions A and B, immediately causing a rapid generation of a relatively large volume of gas C which could, if not relieved, either preclude a full engagement of the connector elements by establishing a back pressure or could cause an explosive failure of the bushing **34**. However, since the socket **40** provides an internal path between the arc and the interior of the

socket in the form of passages **78**, which path is in open communication with the first chamber **74**, the gas C can flow into the first chamber and, as the volume available in the first chamber for the gas decreases by virtue of the penetration of the contact pin **26** and tip **30** and the pressure of the gas builds up in the first chamber **74**, the first chamber will be vented through valve means **81** into the second chamber **76**. Thus, the cavity **66** provides the volume necessary to relieve the internal pressure which would otherwise build up to an intolerable level so as to permit completion of the connection between the metallic pin **26** and the socket **40** before the uncontrolled generation of very large volumes of gas can take place with concomitant deleterious effects. Immediately upon the completion of such a connection the electric arc is extinguished and no further gas is generated. Completion of the connection enables the axially projecting body portion **38** of the housing **36** to be seated within the receptacle **28** of the complementary connector element **20** to esablish a watertight connection.

It is noted that bushing **34** provides an extra measure of protection against violent explosive failure and flying debris when the housing **36** is constructed of an elastomeric material. Should the volume of gases generated by an electric arc become so great as to cause the bushing to burst, such a failure would merely rupture and tear the elastomeric material and would not tend to throw harmful fragments which could injure persons in the vicinity of the connector.

Upon disconnecting the complementary connector **20** from the bushing **34** under high voltage load conditions, an electric arc may again be struck as the metallic pin **26** is withdrawn from the socket **40** and again approaches the position shown in FIG. 2. It is desirable to extinguish this arc as quickly as possible and to restrain any gases which may be generated by the arc so that the arc will cause no damage and ionized gases do not escape and restrike an arc to ground which could injure personnel in the vicinity of the connection. As the contact pin **26** and the plastic tip **30** are withdrawn from the socket **40** and the first chamber **74**, a partial vacuum is established in the first chamber **74** by virtue of the withdrawal of the elements formerly occupying the socket **40** and chamber **74** and the closing of the valve means **81** to maintain the available volume of the chamber **74** relatively small. Since the ambient pressure will now be greater than the pressure within the first chamber, the gases generated by the electric arc will be drawn into the first chamber **74** and held there by the higher ambient pressure outside the bushing **34** until the contact pin **26** is withdrawn far enough for the arc to be extinguished. Hence, the combination of the first and second chamber **74** and **76**, respectively, with a valve means **81** between the chambers provides adequate volume for accommodating gases generated upon connection of the complementary connector elements to enable complete connection without back pressure and provides a more limited volume upon disconnection of the connector elements to restrain gases generated upon disconnection of the elements.

Since the second chamber is of limited volume by virtue of cavity **66** being wholly within the bushing **34**, it will be seen that dissipation of enough of the gases entrapped within the second chamber should take place prior to making another connection at load so that any further gases generated during such a subsequent connection can be accommodated. Hence, the gases which have been trapped within the second chamber **76** may be allowed to dissipate slowly and preferably back into the first chamber **74** and thence out of the connection by passing through passages **78** between the segments **42** of the socket **40** and the cylindrical bore **50** of the plastic sleeve **48**. To this end, clearance may be provided between the seat **88** and the ball **82** so that even when the ball is seated in the seat and opening **80** is essentially closed to the rapid passage of large volumes of gas from one chamber to the other, a

relatively slow leakage of gas is permitted from the second chamber **76** to the first chamber **74**.

The rate at which gases may leak from the second chamber must be limited to a rate slow enough so as to maintain the partial vacuum established in the first chamber upon disconnection, as set forth above. In addition, the leak rate must be slow enough so that combustion of the gases leaking from the second chamber to the first chamber will not be supported. On the other hand, the leak rate must be great enough to dissipate a sufficient volume of gases from the second chamber for accommodating a subsequent connection after a disconnection.

Turning now to FIG. 3, a connector element is illustrated in connection with a bus bar assembly **110** having a central conductor **114** and a covering of insulating material **116** sheathed with a conductive shield **118** and is shown in the form of a bushing **134** projecting from the bus bar assembly **110**. The bushing **134** is provided with a housing **136** having an outer sleeve **137** of electrically conductive elastomeric material in electrical contact with the conductive sheath **118** of the bus bar assembly **110** and an externally tapered portion **138** and within which is affixed an electrical contact **139** shown in the form of a socket **140** having a plurality of segments **142** biased radially inwardly by a circular spring **144**. Juxtaposed with the socket **140** is a plastic sleeve **148** having a bore **150** and both the plastic sleeve **148** and the socket **140** are affixed to a tubular member **152** adjacent one end **154** thereof. Adjacent the other end **156** of the tubular member **152** there is affixed a valve assembly **160** which is threaded into a further tubular member **162** extending into the bus bar at **163**. A still further tubular member **164** of slightly smaller diameter is affixed at one end thereof to the lower end of the valve assembly **160** and carries a plug **165** closing the other end thereof. Thus, the tubular member **152** and the smaller tubular member **164** establish a cavity **166** which is divided into a first chamber **174** and a second chamber **176** by the valve assembly **160**. A plurality of passages **178**, which lie between the segments **142** of the electrical contact **139**, assure that the portions of the electrical contact in the vicinity of the electric arc are in open communication with the interior of the socket **140** and the first chamber **174** of cavity **166**.

The valve assembly **160** has an opening **180** communicating with the first and second chambers and includes valve means **181** in the form of a ball valve comprised of a ball **182** and a helical spring **184** which urges the ball against a seat **188**. The ball valve is thus operable between a first position wherein the ball **182** is away from the seat **188** and the first and second chambers are in open communication with one another through opening **180** and a second position wherein the ball **182** is seated upon the seat **188**, opening **180** is closed and the chambers **174** and **176** are essentially closed to one another in that the chambers are closed to the rapid passage of large volumes of gas from one chamber to the other.

Thus, as in the embodiment of FIGS. 1 and 2, gases generated by an electric arc struck at portion A during the making of a connection can enter the first chamber **174** and then pass through opening **180** into the second chamber **176**. Upon breaking the connection, as described in connection with the embodiment of FIGS. 1 and 2, the valve means **181** will remain closed and a partial vacuum will be formed in the first chamber **174** to restrain those gases generated by an arc struck at portion A as the connection is broken.

As in the earlier described embodiment, means are preferably provided for enabling any gases entrapped within the second chamber to be dissipated slowly through the first chamber **174**, the socket **140** and the sleeve **148** when the ball **182** closes opening **180**. In this instance, such means take the form of a passage **189** of very small diameter communicating with the first and second chambers.

As in the embodiment of FIGS. 1 and 2, the bushing **134** shown in FIG. 3 may be removed from the bus bar assembly **110** and replaced by merely disengaging the threaded connection between the valve assembly **160** and the tubular member **162**.

Turning now to the embodiments of the invention illustrated in FIGS. 4 and 5, a transformer bushing **234** is shown having a configuration very similar to that described in connection with bushing **34** of FIGS. 1 and 2. Thus, the bushing **234** is provided with a housing **236** having an externally tapered portion **238** and within which there is fixed an electrical contact **239** in the form of a metallic socket **240** having a plurality of segments **242** biased radially inwardly by an annular spring **244** surrounding the segments. Juxtaposed with the mouth **246** of the socket is a plastic sleeve **248** having a cylindrical bore **250** axially aligned with the opening of the socket. Both the electrical contact **239** and the plastic sleeve **248** are affixed to a tubular member **252** adjacent one end **254** thereof. The tubular member **252** extends axially to the other end **256** which is closed by means of a base **258** having an aperture **259** into which may be threaded the stud **60** carried by the well member **62** of transformer **12** and connected to a transformer lead **64** as in the embodiment of FIGS. 1 and 2.

A cavity **266** is thus established within tubular member **252**. Both the tubular member **252** and the base **258** are electrically conductive, and are fabricated of metal, to complete an electrical path between the contact **239** and the stud **60** which will be threaded into aperture **259**. The electrical contact **239** has an axial extension shown in the form of a second tubular member **268** having a smaller diameter than the first tubular member **252** so that the annular wall **270** thereof is spaced radially from the wall of the first tubular member. An end wall **272** seals off the end of the second tubular member **268** to divide the cavity **266** into a first chamber **274** and a second chamber **276**. The first chamber **274** is in open communication with passages **278** established between the segment **242** of the socket **240** and with the interior of the socket. A plurality of apertures **280** are spaced circumferentially around and extend radially through the annular wall **270** of the second tubular member and valve means **281** shown in the form of an annular band **282** of elastomeric material normally closes the apertures **280** by virtue of the resilience of the elastomeric material of the band. The annular band **282** is seated within an annular recess **283** in the annular wall **270** so as to be positively retained against axial movement along the second tubular member **268**.

In response to a greater gas pressure in the first chamber **274** than in the second chamber **276** the annular band **282** will dilate resiliently to allow such pressure to be relieved so that the construction illustrated in FIG. 4 will operate in a manner similar to that described in connection with FIGS. 1 and 2.

As in the earlier described embodiments, slow leakage of gas is permitted from the second chamber **276** to the first chamber **274** by virtue of a relatively small passage established by a screw **284** loosely fitted in a threaded aperture **286** in the end wall **272**.

As seen in FIG. 5, the screw **284** of the bushing **234** of FIG. 4 may be replaced by a plug **288** of porous material such as a porous member of sintered metal which will allow slow leakage of gas from the second chamber **276** to the first chamber **274** when the valve provided by the annular elastomeric band **282** is closed over apertures **280**.

It is to be understood that the above detailed description of embodiments of the invention is provided by way of example only. Various details of design and construction may be modified without departing from the true spirit and scope of the invention which is set forth in the appended claims.

The embodiments of the invention in which an ex-

clusive property or privilege is claimed are defined as follows:

1. An electrical connector element for use in high voltage electrical systems and capable of being connected and disconnected under high voltage load conditions, said connector element having a construction including means for accommodating gases generated by an electric arc struck during such connection and disconnection, said gas-accommodating means comprising:
- means providing a cavity within said electrical connector element;
- means dividing said cavity into a first chamber and a second chamber;
- an electrical contact having at least that portion where the electric arc is struck in open communication with the first chamber;
- means providing at least one opening communicating with the first and second chambers such that rapid passage of gas from one said chamber into the other said chamber is permitted through said opening-providing means; and
- valve means associated with the opening-providing means and operable between a first position wherein the opening is open and the first and second chambers are in open communication and a second position wherein the opening is closed, the valve means being responsive to the relative gas pressures in the chambers such that a pressure in the first chamber greater than the pressure in the second chamber will open the valve means to vent gas through the opening from the first chamber to the second chamber and a pressure in the first chamber no greater than the pressure in the second chamber will allow the valve means to maintain the opening closed.

2. The electrical connector element of claim 1 including means for permitting relatively slow dissipation of gas from the second chamber when the valve means is in the second position.

3. The electrical connector element of claim 2 wherein said means for permitting relatively slow dissipation of gas communicates with the first chamber such that gas is dissipated from the second chamber into the first chamber.

4. The electrical connector element of claim 1 wherein the dividing means includes a wall separating the first and second chambers and wherein the valve means includes a valve member resiliently biased against said open in the direction toward the first chamber.

5. The electrical connector element of claim 4 wherein:
- the valve member is a ball;
- the opening includes a seat for the ball; and
- the valve means includes a spring biasing the ball against the seat in the second position and permitting displacement of the ball away from the seat in the first position.

6. The electrical connector element of claim 5 wherein sufficient clearance is provided between the ball and the seat to permit relatively slow leakage of gas from the second chamber to the first chamber when the ball is against the seat.

7. The electrical connector element of claim 4 wherein the valve member includes a resilient band biased against the opening by the resilience of the band in the second position and resiliently displaceable away from the opening in the first position.

8. The electrical connector element of claim 7 including a relatively small passage in the wall and communicating with each of the first and second chambers for permitting relatively slow leakage of gas from the second chamber to the first chamber when the band is against the opening.

9. The electrical connector element of claim 1 wherein:
- the cavity-providing means includes a housing having an outer body portion of dielectric material and an inner generally tubular member fixed within the outer portion and within which the cavity extends axially with respect to the electrical connector element; and
- the electrical contact is fixed within the tubular member and includes a passage communicating with said portion of the electrical contact and the cavity.

10. The electrical connector element of claim 9 wherein:
- the outer body portion is constructed of an insulating elastomeric material and the inner generally tubular member is a metallic sleeve having opposite ends, the electrical contact being fixed within the sleeve adjacent one of said opposite ends; and
- the connector element includes means closing the sleeve at the other of the opposite ends.

11. The electrical connector element of claim 10 wherein:
- the electrical contact includes a socket extending axially with the generally tubular member and having an interior for receiving a complementary electrical contact of a complementary connector;
- the dividing means includes a second generally tubular member fixed within the first generally tubular member, extending axially and having an annular wall spaced radially inwardly of said first generally tubular member, the interior of the second generally tubular member communicating with the interior of the socket, and the second generally tubular member being closed at one end thereof to establish the first chamber;
- said opening of the opening-providing means extends radially through the annular wall of the second generally tubular member; and
- the valve means includes an annular band of elastomeric material encircling said annular wall and normally closing said opening.

12. The electrical connector element of claim 11 wherein the means closing the end of the second generally tubular member includes a porous member for permitting relatively slow leakage of gas from the second chamber to the first chamber when the elastomeric band is in the closed position.

13. In an electrical connector for use in high voltage electrical systems and capable of being connected and disconnected under high voltage conditions, a connector construction including means for accommodating gases generated by an electric arc struck during such connection and disconnection, said connector construction comprising:
- a tubular member of electrically conductive metal and including an axially extending cavity therein;
- means dividing said cavity into a first chamber and a second chamber;
- an electrical contact affixed to the tubular member and having at least that portion where the electric arc ist struck in open communication with the first chamber;
- means providing at least one opening communicating with the first and second chambers such that rapid passage of gas from one said chamber into the other said chamber is permitting through said opening-providing means; and
- valve means associated with the opening-providing means and operable between a first position wherein the opening is open and the first and second chambers are in open communication and a second position wherein the opening is closed, the valve means being responsive to the relative gas pressures in the chambers such that a pressure in the first chamber greater than the pressure in the second chamber will open the valve means to vent gas through the opening from the first chamber to the second chamber and a pressure in the first chamber no greater than the pressure in the second chamber will allow the valve means to maintain the opening closed.

14. The electrical connector construction of claim 13

including means for permitting relatively slow dissipation of gas from the second chamber when the valve means is in the second position.

15. The electrical connector construction of claim 14 wherein said means for permitting relatively slow dissipation of gas communicates with the first chamber such that gas is dissipated from the second chamber into the first chamber.

16. The electrical connector construction of claim 13 wherein:

the electrical contact includes a socket extending axially within the tubular member and having an interior for receiving a complementary electrical contact;

the dividing means includes a further tubular member fixed within the first said tubular member, extending axially and having an annular wall spaced radially inwardly of the first said tubular member, the interior of the further tubular member communicating with the interior of the socket, and the further tubular member being closed at one end thereof to establish the first chamber;

said opening of the opening-providing means extends radially through the annular wall of the further tubular member; and

the valve means includes an annular band of elastomeric material encircling said annular wall and normally closing said opening.

17. The electrical connector construction of claim 16 wherein the means closing the end of the further tubular member includes means for permitting relatively slow leakage of gas from the second chamber to the first chamber when the elastomeric band is in the closed position.

18. The electrical connector construction of claim 17 wherein the means for permitting relatively slow leakage includes a porous member.

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RICHARD E. MOORE, Primary Examiner

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,539,972 Dated November 10, 1970

Inventor(s) Robert C. Ruete et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading of column 1, "Robert Ruete" should read -- Robert C. Ruete --; In the heading of each sheet of draw "R. RUETE ET AL" should read -- R. C. RUETE ET AL --
Column 4, line 20, "esablish" should read -- establish --
Column 7, line 48, "open" should read -- opening --
Column 8, line 18, "with" should read -- within --
Column 8, line 55, "ist" should read -- is --
Column 9, line 20 should not begin a new paragraph

Signed and sealed this 23rd day of January 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Paten