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Tetreault et al.

[11] **3,860,315**

[45] **Jan. 14, 1975**

[54] **EXPLOSION PROOF CONNECTOR**

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[73] Assignee: **Anderson Power Products, Inc.,** Boston, Mass.

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[52] **U.S. Cl.** ..... **339/89 M,** 285/175, 339/111

[51] **Int. Cl.** **H01r 13/54**

[58] **Field of Search** 339/82, 87, 89, 111, 174; 285/175, 357, 392

[56] **References Cited**

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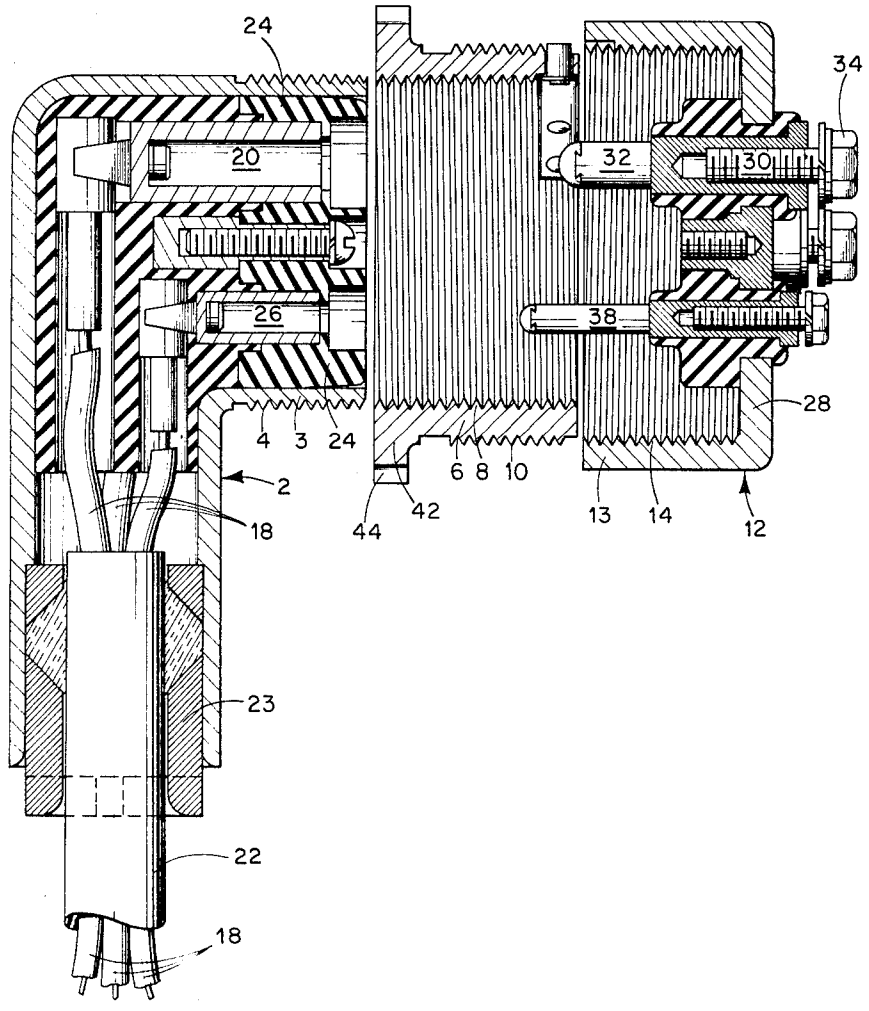
Primary Examiner—Richard E. Moore

Attorney, Agent, or Firm—Richard J. Birch

[57] **ABSTRACT**

An electrical connector in which the contacts can be safely closed and opened in the presence of a surrounding explosive or combustible atmosphere. The contacts are closed and opened within a sealed small space. The structure is strong enough to withstand the internal pressure caused by ignitable gas within the small space and provides means for the ignited gas to cool below the ignition point of the surrounding combustible atmosphere before the connector is completely separated. The connector is of novel telescoping character which substantially diminishes the longitudinal length of the connector in both open and closed condition.

2 Claims, 5 Drawing Figures



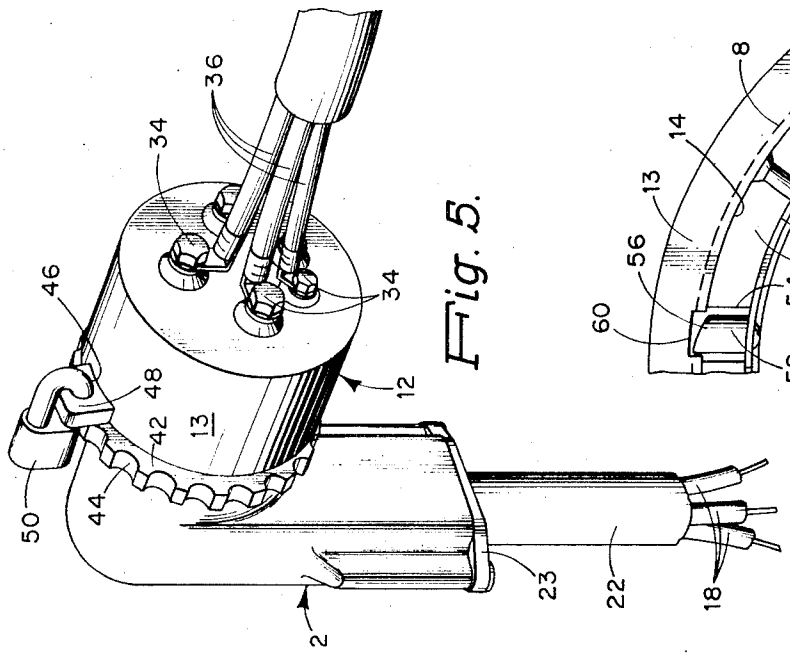


Fig. 5.

Fig. 4.

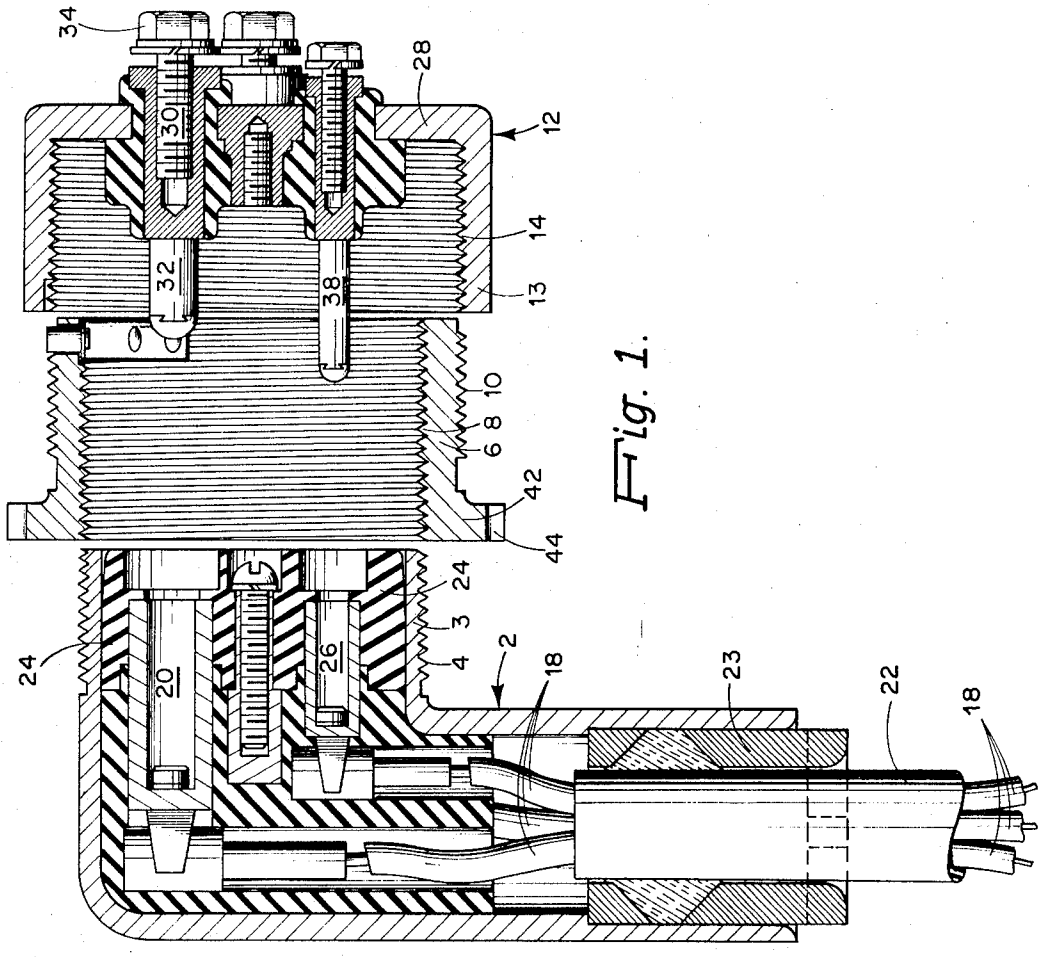


Fig. 1.

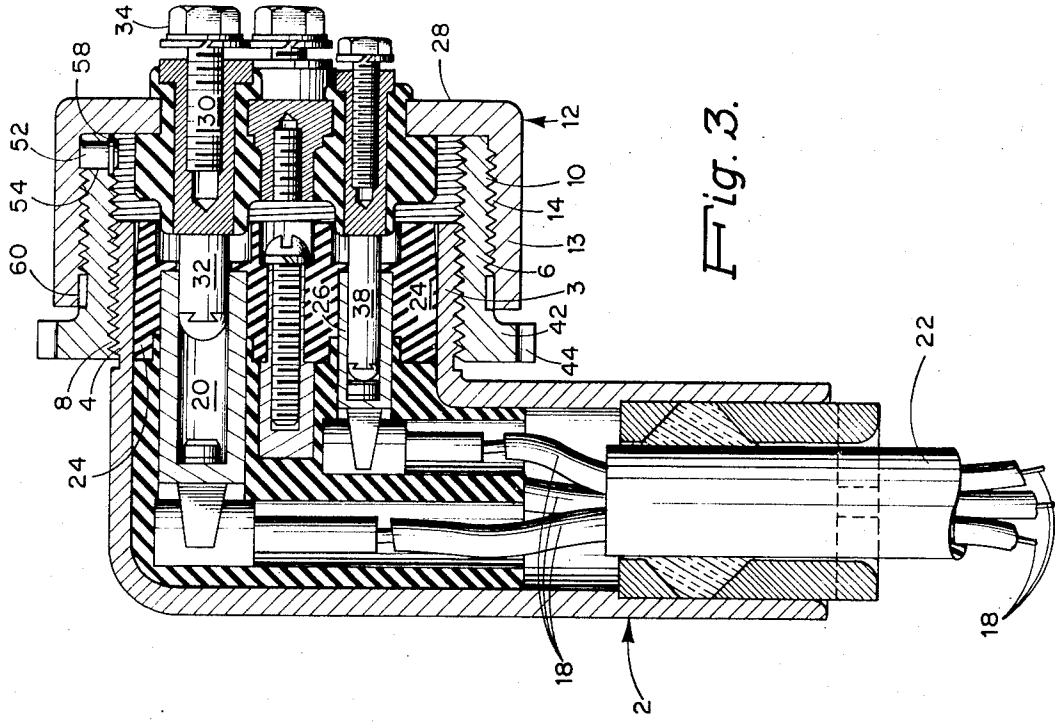

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Fig. 3.

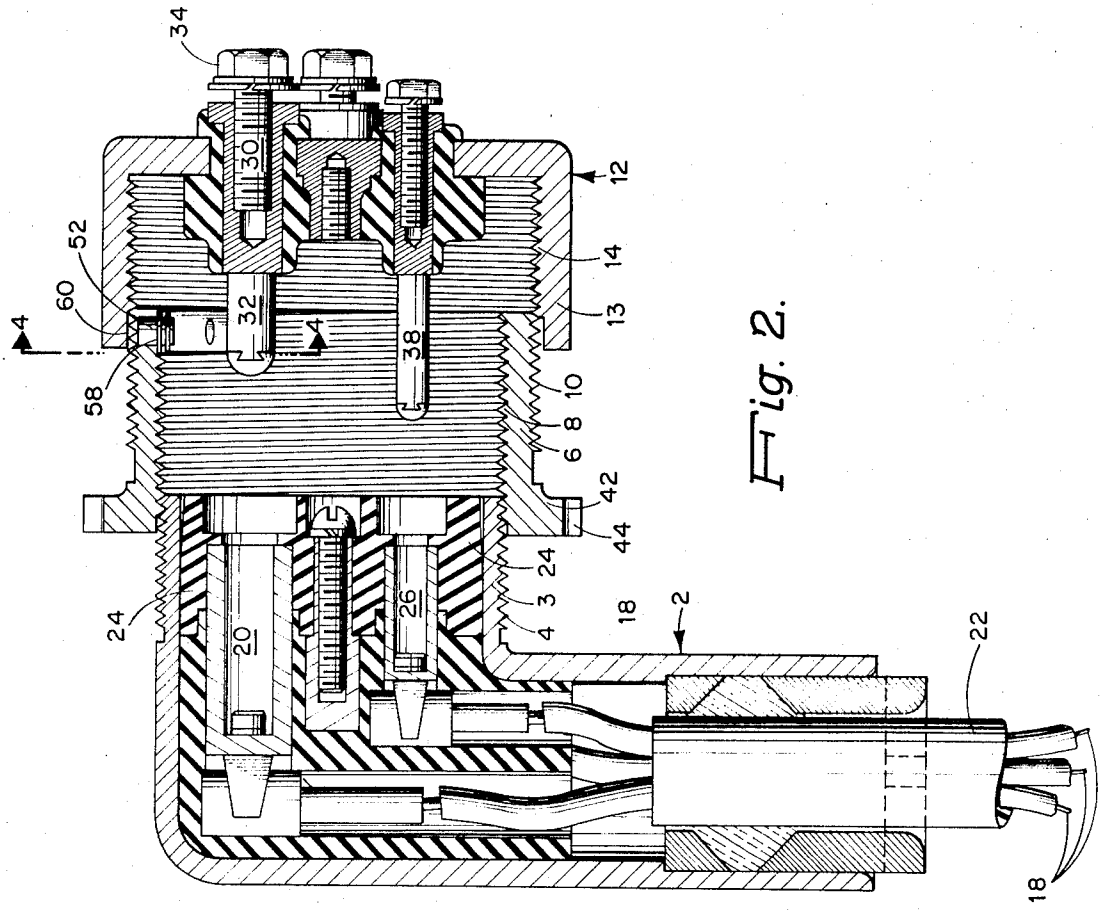
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Fig. 2.

EXPLOSION PROOF CONNECTOR

BACKGROUND OF THE INVENTION

There are many situations in which an explosive or combustible atmosphere is present and in which electrical circuits have to be closed and opened from time to time. Since such opening or closing of a circuit invariably creates a spark at the contacts, it is essential that such electrical contacts be effectively segregated from the ignitable surrounding atmosphere. As a result, electrical connectors have been developed in which the contacts at the time the circuit is closed or opened are located within a small substantially gas-tight container. If at the time the circuit is made or broken and the gas in the sealed container is ignited by the spark, the flame will immediately burn itself out after which the container can then be opened and the separated electrical contacts exposed without danger of igniting the surrounding atmosphere. Similarly, if the contacts are to be closed in the presence of a surrounding combustible atmosphere, the sealed container is first established and then the contacts are closed. The resulting sparking will ignite the small quantity of gas within the container, but there is no danger of igniting the surrounding atmosphere because the burned gases, even if leaked from the container, will at the time of their escape be at a temperature below the ignition point of the surrounding atmosphere.

One patent directed toward accomplishing the above results is that to Glaudot U.S. Pat. No. 3,475,569 for Electrical Connector Assembly. In this patent, the container is established by connecting the threaded ends of two contactor containing elements by means of an internally threaded sleeve. Through the use of appropriately located right and left hand threads, the sleeve will draw the two elements together while forming a gas-tight container therebetween. When the electrical contacts are made or broken, the ignited gas within the container can leak only slowly to the surrounding atmosphere through the connecting threads. By the time the burned gas has reached the atmosphere, it is of low temperature incapable of igniting the surrounding atmosphere.

SUMMARY OF THE PRESENT INVENTION

The present invention constitutes an advance over all of the known prior art of which we are aware in that it provides a substantially gas-tight chamber within which are located electrical contacts. Before the contacts can be brought into engagement to produce a spark, the integrity of the small chamber is fully established and ignition of the surrounding atmosphere from the closing of the contacts is rendered impossible. Another advantage of the present invention is found in its short overall length which is achieved by the overlapping arrangement of the ends of the two tubular members that support the electrical contacts. A reduction in length as much as 25 percent can be achieved by the present construction over the arrangement shown, for example, in U.S. Pat. No. 3,475,569 previously referred to even though the movement of the contacts toward each other in both cases would be the same.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings,

FIG. 1 is an exploded view showing the three essential elements of the construction in separated condition.

FIG. 2 shows the intermediate sleeve in initial threaded connection with both of the tubular elements and in addition shows the locking mechanism which precludes the complete unscrewing of the sleeve from the larger of the tubular elements.

FIG. 3 is similar to FIGS. 1 and 2 but with parts drawn together to put the contacts in full engagement with each other.

FIG. 4 is a fragmentary cross-section taken on the line 4—4 of FIG. 2.

FIG. 5 is a small perspective view of the connector in closed operative position showing means for locking the unit against separation.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring first to FIG. 1 which is an exploded view of the several parts in separated condition, there is a first tubular element **2** having an end **3** at an angle to the other part of the body. End **3** is externally threaded at **4**, preferably with left hand threads. A sleeve **6** is threaded internally at **8** with left hand threads which will cooperate with threads **4**. The sleeve **6** is externally threaded at **10** with a right hand thread.

A second tubular element **12** has its end **13** internally threaded at **14** with a right hand thread which will cooperate with thread **10** of the sleeve **6**. From an examination of FIGS. **2** and **3**, it will be understood that the sleeve **6** can be threaded onto the threaded end **3** of tubular element **2**, and likewise sleeve **6** can be threaded into the internally threaded end **13** of tubular element **12**, and upon rotation of the sleeve **6** clockwise with respect to element **12** the two tubular ends **3** and **13** will be drawn together to be placed in telescoping relation as illustrated in FIG. **3**.

Tubular element **2** has a plurality of insulated electrical wires extending therein as indicated at **18**. These terminate in related contacts **20** (only one of which is shown in FIGS. **1, 2,** and **3**) which are firmly supported in conventional insulated manner within the confines of the end **3** of element **2**. This particular construction is shown in U.S. Pat. No. 2,955,275, issued Oct. 4, 1960 to L. C. Cobbett, et al for INSULATED ELECTRICAL CONNECTOR. The wires **18** pass through sleeve **22** which be means of a locking mechanism **23** is firmly secured within the end of tubular element **2**. Insulating material **24** surrounds all of the contacts **20** and a locating socket **26** so that no gas can flow through the end **3**.

Element **12** is generally in the form of a cup having a circular body and an end wall **28** through which pass in gas-tight relationship three conductors **30** (only one of which is shown in FIGS. **1, 2,** and **3**) leading to contacts **32** which are shaped to make suitable electrical engagement with contacts **20** when brought together by the rotation of threaded sleeve **6**.

The terminals **34** of the conductors **30** have previously been connected to the insulated wires **36** that are to be connected to wires **18** by engagement of contacts **20** and **32**.

The wall **28** acts as means for preventing the flow of gas through the tubular element **12** in the same manner that the insulating material **24** acts to prevent the flow of gas through end **3**.

Utilization of the mechanism just described is accomplished in the following manner. The wires **18** are to be connected to the wires **36** in a manner which will effectively prevent spark ignition of any combustible surrounding atmosphere. The wires **18** end at contacts **20** which are in the form of sockets. The wires **36** end in contacts **32** which are in the form of plugs adapted to be positioned within sockets **20** and to make proper electrical connection therewith. The elements **2** and **12** are movable toward and away from each other to a limited degree by virtue of the flexibility of the circuits leading thereto. The sleeve **6** is initially threaded into threads **14** of element **12** for a distance sufficient to establish proper threaded engagement. The threads **4** of end **3** of element **2** are then placed in threaded connection with the interior threads **8** of sleeve **6** by bringing the two parts together and continuing clockwise rotation of sleeve **6** for a few times. It will now be appreciated that a unit has been assembled in which the interior space running from insulator **24** to wall **28** is completely sealed from the surrounding atmosphere. In this condition, the parts will be substantially as shown in FIG. **2** with the contacts **20** and **32** still a substantial distance apart. As rotation of sleeve **6** is continued, the ends **3** and **13** of elements **2** and **12** are drawn together so that the plug contact **32** will enter into the corresponding socket contact **20.**

When initial engagement is made between contacts **20** and **32,** a spark will occur if the lines **18** and **36** are alive. This spark will ignite the limited amount, if any, of combustible gas that may be present within the chamber formed by elements **2, 12** and the connection sleeve **6.** On the other hand, if the gas within the chamber is not of a combustible nature, nothing will happen within the chamber and the spark between the contacts **20** and **32** will be immediately extinguished as soon as firm electrical engagement is made.

If the gas within the chamber of the unit is combustible, it will on burning generate increased pressure but this pressure will not be sufficient to rupture any of the parts as they are made of adequate strength. Some planned leakage of the burning gas may occur through the engaged threads **4** and **8** and **10** and **14.** However, any gas finally escaping through the threads will not be burning and it will be of a sufficiently reduced temperature as to be below the ignition point of the surrounding combustible atmosphere.

Any suitable means for angularly aligning ends **3** and **13** to ensure proper engagement of contacts **20** and **32** as they are drawn together by continued rotation of sleeve **6** may be resorted to. Suitable marking lines may be cast into the tubular elements on their adjacent exteriors, or, as another example, an extra long guide pin, such as the pin **38** which is adapted to make early contact with the previously referred to locating socket **26** mounted within end **3** might be used. The pin **38,** normally grounded, is of course, no part of the live electrical circuit, so its early engagement with socket **26** does not create any spark.

Rotation of sleeve **6** is continued until the parts are all drawn firmly together as shown in FIG. **3.** In this position, the contacts **20** and **32** are in firm electrical engagement and the desired circuits are now properly established. The sleeve **6** has an exterior circumferential flange **42** notched thereabout as at **44.** One of the notches will always end up in substantial alignment with a hole **46** extending through an ear **48** which is an integral part of the end portion **13** of element **12.** A conventional padlock **50** may then be passed through hole **46** to lie in the aligned notch **44** of flange **42.** In this way, unauthorized separation of elements **2** and **12** is prevented.

When it is desired to break the previously established circuit, reverse procedures are followed. Sleeve **6** is unlocked from ear **48** and is then rotated counterclockwise causing separation of contacts **20** and **32** which separation occurs before the sleeve **6** becomes unthreaded from either of the tubular elements **2** or **12.** Such sparking as may occur at the time of separation of contacts **20** and **32** will be within the closed chamber, but this time there will be no burning of whatever gas is then within the chamber as it was burned previously when the contacts were being established. Thus, sparking occurring within the chamber as the circuit is broken is likewise completely sealed off from the surrounding combustible atmosphere.

In due course, continued counterclockwise rotation of sleeve **6** will cause it to separate completely from threads **4** of end **3,** but by this time the contacts **20** and **32** are far apart so no sparking is then possible. It is apparent, however, that if sleeve **6** should be completely removed from the threads **14** of end **13,** it might be possible for the ends **3** and **13** to be moved together, albeit unintentionally, causing contacts **20** and **32** to engage so that an exposed spark could occur. To prevent this from happening, means is provided whereby removal of sleeve **6** from end **13** cannot occur in the ordinary manipulation of the parts. This result is achieved through the use of a detent **52** which extends radially through a hole **54** in the wall of sleeve **6** close to the end that first engages the threads **14** of tubular element **12.** The outer end of detent **52** is beveled as at **56** so that when sleeve **6** is rotated clockwise to move further into end **13,** the detent will ride on the crest of threads **14** and the screwing together of threads **10** and **14** can proceed unimpeded the same as if detent **52** were not present.

On the other hand, when sleeve **6** is unscrewed from end **13** and the parts are approaching separation, the detent **52,** spring pressed outwardly by a leaf spring **58** (see FIG. **4**) drops into a hole **60** cut into the threads **14** close to the outer end thereby to preclude any further unscrewing of the sleeve **6** with respect to end **13.** In this way, it becomes impossible for the contacts **20** to be placed in engagement with contacts **32** except by the procedure already described.

From the foregoing explanation, it will be understood that the structure hereinafter claimed makes it possible to close or open live electrical circuits in a location where a surrounding explosive or combustible atmosphere may be present without any danger or even possibility of igniting the surrounding atmosphere by the spark which will invariably be created as the circuits are closed or opened. The structure has the further advantage of occupying a minimum axial space due to the final telescoped arrangement of the ends of the two tubular elements which is achieved through the use of the intermediate sleeve threaded exteriorly and interiorly with threads of opposite hand.

It is intended to cover all changes and modifications of the examples of the invention herein chosen for purposes of the disclosure which do not constitute departures from the spirit and scope of the invention.

We claim:

1. An explosion-proof connector comprising:

a first tubular element having a plurality of first conductors extending therein and terminating short of one end of said first tubular element;
a contact on the end of each said first conductor;
means sealing said first tubular element against the passage of gas therethrough;
the said one end of said first tubular element being exteriorly threaded;
a second tubular element having an interior diameter greater than the exterior diameter of said first tubular element and having a corresponding plurality of other conductors extending therein and terminating short of one end of said second tubular element;
a contact on the end of each of said other conductors adapted to make electrical connection with the corresponding contact on one of said first conductors as the contacts are moved axially toward each other;
means sealing said second tubular element against the passage of gas therethrough;
the end of said second tubular element being interiorly and oppositely threaded from the exterior threads of said first tubular element;
a coupling in the form of a short sleeve threaded interiorly to engage the exterior threads of said first tubular element and threaded exteriorly to engage the interior threads of said second tubular element; and,
means for preventing complete removal of said sleeve from said second tubular member comprising: a spring pressed radially extending dog near one end of said sleeve; and, a cooperating notch in said second tubular element adapted to receive said dog when said sleeve has been unscrewed from said second tubular element to a predetermined position, whereby after said sleeve has been placed in initial threaded engagement with the said first and second tubular elements continued rotation of said sleeve will draw the ends of said elements into telescoping position and said contacts will engage each other, and whereby when said contacts are in engagement with each other and said sleeve is rotated in the opposite direction, said contacts will be separated before either of said first and second tubular elements is separated from said sleeve.

2. An explosion-proof connector comprising:
a first tubular element having a plurality of first conductors extending therein and terminating short of one end of said first tubular element;
a contact on the end of each said first conductor;
means sealing said first tubular element against the passage of gas therethrough;
the said one end of said first tubular element being exteriorly threaded;
a second tubular element having an interior diameter greater than the exterior diameter of said first tubular element and having a corresponding plurality of other conductors extending therein and terminating short of one end of said second tubular element, said second tubular element being in the form of a cup, the bottom of which acts to seal the second tubular element against the passage of gas therethrough and through which said other conductors pass;
a contact on the end of each of said other conductors adapted to make electrical connection with the corresponding contact on one of said first conductors as the contacts are moved axially toward each other;
the end of said second tubular element being interiorly and oppositely threaded from the exterior threads of said first tubular element; and,
a coupling in the form of a short sleeve threaded interiorly to engage the exterior threads of said first tubular element and threaded exteriorly to engage the interior threads of said second tubular element, whereby after said sleeve has been placed in initial threaded engagement with the said first and second tubular elements continued rotation of said sleeve will draw the ends of said elements into telescoping position and said contacts will engage each other, and whereby when said contacts are in engagement with each other and said sleeve is rotated in the opposite direction, said contacts will be separated before either of said first and second tubular elements is separated from said sleeve.

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