Nov. 5, 1963 J. E. JENNINGS 3,109,968

TIP-OFF FOR PROCESSED TUBES

Filed Aug. 21, 1958

Fig_4

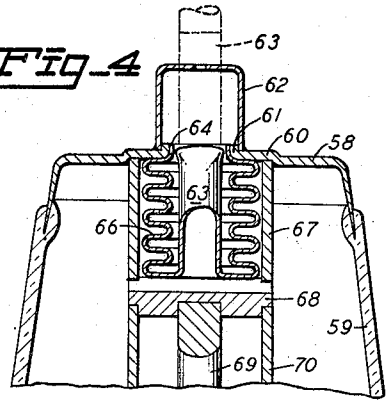


Fig_2

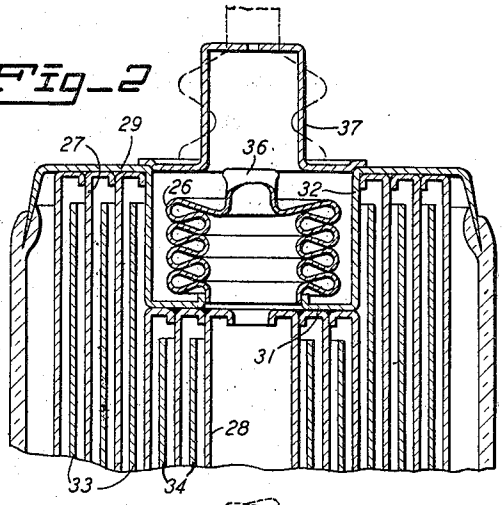
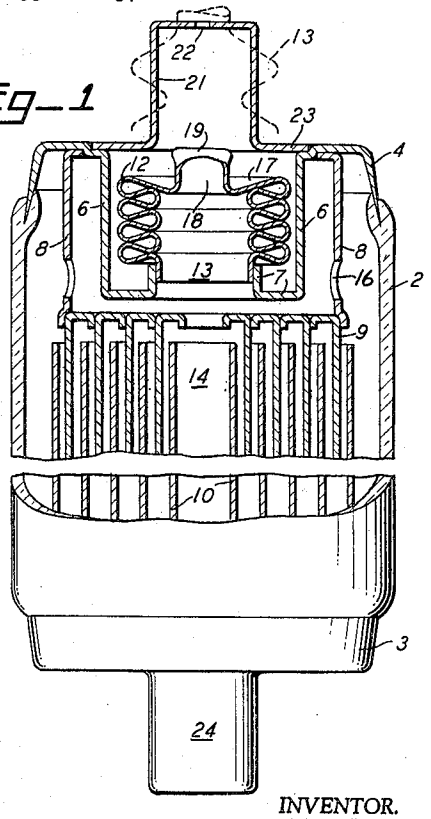


Fig_1



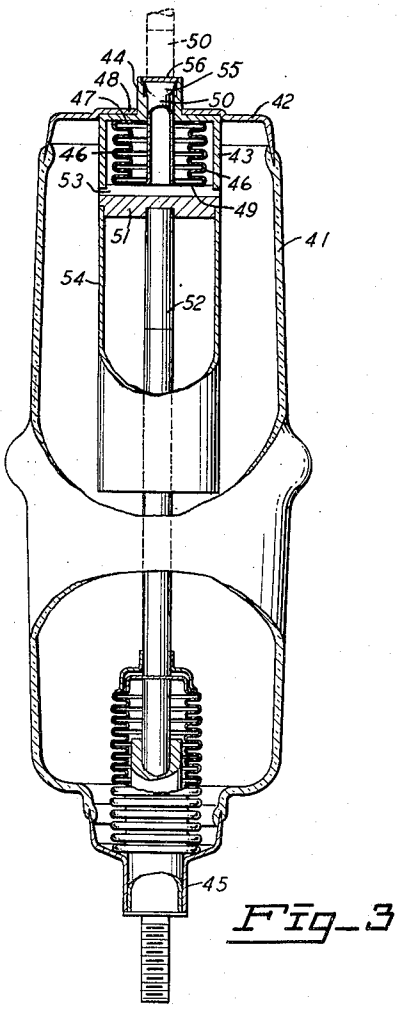


Fig_3

INVENTOR.
JO EMMETT JENNINGS

BY Charles S. Evans

his ATTORNEY

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TIP-OFF FOR PROCESSED TUBES

Jo Emmett Jennings, San Jose, Calif., assignor, by mesne assignments, to Jennings Radio Manufacturing Corporation, San Jose, Calif., a corporation of Delaware

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My invention relates to means for sealing off a vacuumized or gas-filled envelope or tube, such as is used for switches, capacitors and other varieties of vacuumized or gas-filled tubular implements.

An object of my invention is the provision of a tip-off structure which is concealed or emplaced within the boundary surface of the envelope or tube which it serves.

Another object of my invention is the provision of such a tip-off structure which provides a flexible connection between the envelope during evacuation or other processing and the processing and sealing-off apparatus.

Still another object is the provision of a tip-off practically immune to accidental break or injury during handling of the envelope.

A further object is the provision of a tip-off which can be inspected for fault or injury should one be suspected.

Other objects of the invention together with the foregoing will be set forth in the following description of the preferred embodiments of my invention which are illustrated in the accompanying drawing. It is to be understood that I do not limit myself to the showing made by the said descriptions and drawings, as I may adopt variations of my preferred forms within the scope of my invention as set forth in the claims.

Referring to the drawings:

FIG. 1 is an elevation in part longitudinal axial half section, of a capacitor, the vacuumized envelope of which embodies my tip-off invention. A portion of the capacitor is omitted to reduce the length of the figure.

FIG. 2 is an elevation in longitudinal axial half section, of one end of a vacuum capacitor embodying my invention in slightly different form.

FIG. 3 is an elevation of a vacuum switch partly in longitudinal axial half section, and embodying my invention.

FIG. 4 is an elevation in longitudinal axial half section, of one end of a vacuum switch embodying my invention in somewhat different form.

In the electronic and electric arts, many tubes or envelopes are evacuated, but others are filled with nitrogen, or argon or other gases or mixtures of gases. In the following description, I shall explain my invention largely as applied to vacuumized tubes or envelopes, but it should be understood that my invention is equally applicable to gas filled tubes or envelopes.

In its broadest aspect my invention contemplates the use of a conduit or tubulation preferably of metal, extending from the fixed pump manifold or gas tank to the envelope to be processed. A flexible and expansible bellows is interposed between the tubulation and the envelope so that relative flexing and axial movement between them may occur without danger to the hermetic security of the connection. Preferably the bellows is positioned in an inwardly extending recess formed in the wall of the envelope, so that the attached tubulation can be drawn out during the processing, then pinch-closed and severed, leaving only a stub projection which is drawn back into the envelope with recovery movement of the bellows. The tip-off thus formed is safe from injury, since in retracted position it lies within the recess and outer boundaries of the envelope, but if desired for greater security the recess may be closed over the tip-off, and in a proper case, the closure cap may also function as an external electrode for the device.

In one of its embodiments my invention comprises a metallic end structure forming part of the vacuumized or gas charged implement. This end structure includes a relatively small housing open to the atmosphere but preferably projecting into the envelope, and thus in fact forming an inward extension of the envelope wall. Within the housing chamber so formed, a generally cylindrical expansible metallic bellows is brazed at one of its ends to the housing, so that the edge of an open end of the bellows is integrally united to the edge of an aperture in the housing. This connects the interior of the bellows to the interior of the envelope.

At the opposite end of the bellows, which lies closely adjacent the opposite end of the enclosing housing and envelope end, a metal tubulation opening into the bellows is integrally united. It extends outwardly a distance convenient for handling and pinch-closing at the proper time to form the tip-off. Thus the expansible bellows is interposed between the tubulation and the envelope, making it possible to extend the tubulation and bellows from the fixed envelope while maintaining the flexible connection between tubulation and envelope, and at the same time position the site of the closing pinch at the desired location to provide a short tip-off when the tubulation is severed and the bellows allowed to collapse back into its housing, as of course it will do under pressure of the atmosphere.

In FIGS. 1 and 2, I have shown my invention with a bellows which is extended from the stationary or fixed envelope to facilitate evacuation and tip-off. In FIGS. 3 and 4 my invention is shown with a bellows which is collapsed during the processing, and expands into its housing after the pinch-closing of the tubulation.

In greater detail and referring first to FIG. 1, my invention is there shown to be incorporated in a vacuum condenser of fixed or variable type, comprising the glass shell 2 closed at one end by the metal end cap 3, and at the other end by the metal end cap 4. The caps are hermetically joined to the shell in the conventional manner as shown.

The end cap 4 is provided with an integral cylindrical, concentric housing 6, projecting into the envelope and terminating in an inwardly turned angular flange 7. Also integral with the cap 4 and concentric with the housing 6 is a mounting shell 8, extending into the envelope past the inner end of the housing, and positioned between it and the glass shell 2 of the envelope. Integrally mounted on the mounting shell 8 and thereby on the end cap 4 is one set of condenser plates 9, the other and opposed set of plates 10 being integrally mounted on the opposite end cap 3 in any desired or conventional manner.

Disposed in the chamber within the housing 6 is a bellows 12 having a flange 13 at one end integrally united as by brazing to the angular flange 7, so that the interior of the bellows is hermetically continuous with the interior of the envelope through the passage or space 14 at the center of the plates 9 and 10, and also through the apertures 16 in the mounting shell.

Integrally united to the outer end 17 of the bellows and opening into it, is a tubulation 18 of sufficient length when the bellows is expanded and drawn partly out of its housing to provide a conveniently arranged and flexible hermetic union with the vacuum pump manifold; and position the inner end of the tubulation closely adjacent the bellows for pinch-closing by appropriate mechanism to form the tip-off 19, after pumping has been completed.

After the pinch-closing of the tubulation, the bellows, now closed at its outer end by the tip-off 19, collapses into its housing under atmospheric pressure, the free end of the tip-off lying generally within the plane of the end 4. With the flexible and expansible bellows intervened be-

tween the envelope and evacuating unit, both are better held, and relative movement and vibration are absorbed by the bellows without injury to the hermetic connection between them.

After the bellows and tip-off have been seated within the housing, a closure 21, having a small vent 22 in the end, and centered in the annular rim or flange 23 is brazed on the end cap 4 to protect the relatively fragile bellows and provide a connecting terminal or stud similar to the terminal 24 at the opposite end of the implement.

In FIG. 2 I have shown a similar tip-off construction in a capacitor in which the condenser plates are mounted in short and long groups at each end. At the end adjacent the bellows 26 an outer group of long cylindrical plates 27 and an inner group of short cylindrical plates 28 are concentrically mounted on the end cap 29 and the annular bottom 31, respectively, of the housing 32.

At the opposite end a similar grouping of condenser plates 33 and 34 is arranged on the end cap. By extending long condenser plates into the annular space surrounding the bellows housing, the construction shown in FIG. 2, gives a proportionately greater capacitance than that of FIG. 1. There is also the advantage of better conductivity of heat to the end cap, since the housing 32 is directly connected only to the shorter inner group of condenser plates; and each of the longer plates is connected individually to the end cap, so that heat generated during operation of the capacitor disclosed in FIG. 2 is dissipated into the air from the end caps with especial rapidity.

The tip-off 36 is formed in the same way as already described; and when retracted with the bellows 26 into its housing 32, the closure 37 is brazed into place.

Instead of extending the bellows beyond the confines of its housing as shown in both FIGS. 1 and 2, I find it desirable sometimes to integrate the outer end of the bellows with the end cap; and the inner end of the tubulation with the inner end of the bellows, as shown in FIGS. 3 and 4, in each of which my concealed tip-off is embodied in a vacuum switch.

The switch operating mechanism is of the character shown and described in United States Patent 2,740,867 dated April 3, 1956, and beyond identification of its main parts needs no description herein. The glass envelope 41 is closed at the fixed end by copper end cap 42, into the center of which is brazed the housing 43, having the tubular extension 44 projecting axially through the end cap as shown in FIG. 3. The extension constitutes one of the connecting terminals, the other terminal 45 being at the opposite end of the envelope.

A fully expanded bellows 46 is placed in the housing, its outer end 47 brazed to the upper or outer wall 48 and its lower or inner end 49 connected integrally to the central tubulation 50 which extends upwardly and through the bellows and extension 44 to an end adapted for connection with the pump manifold.

In the fully expanded condition of the bellows the inner end lies against the plate 51 brazed into the housing to form its bottom, and with the housing and end cap providing a stable mounting structure for the fixed switch point or electrode 55. In order to provide wide open communication between the tubulation and the interior of the housing, a groove 53 is formed across the upper face of the plate 51, against which the inner end of the bellows rests. The plate 51 also provides a convenient and secure mounting for the cylindrical shield 54.

Connection between tubulation and pump is made in the usual way, the tubulation being drawn out and the bellows being collapsed against the upper wall 48 of the housing. At the proper time, and place in the tubulation, the tubulation is pinch-closed to form the tip-off 55, after which the bellows can be allowed to expand against the plate 51. This draws the stub end of tubulation into the bellows and seals the tip-off within the outer end of the tubular extension or terminal, the open end of which may be closed if desired by an apertured disk 56.

In FIG. 4, I show a slightly different end cap and terminal construction, having perhaps a small advantage in cost of production. The end cap 58 closing the glass shell 59 is formed with a concentric annular offset 60 with a short outwardly extending flange 61 around the edge of the central aperture. On the outside, the flange provides a seat for brazing the terminal cap 62 after the tubulation 63 has been drawn back into the bellows. On the inside, the flange is brazed to the adjacent rim 64 of the bellows 65.

On the inside of the end cap, the offset 60 provides a concentric seat for accurate placement of the housing 67. The grooved mounting plate 68, switch point or electrode 69 and shield 70 are the same as similar parts shown in FIG. 3.

From the foregoing it will be clear that my tip-off construction provides inherent strength and security against accidental injury in a vitally important element of a vacuumized or gas filled envelope; and because of the flexible and yieldable character of the hermetic connection between envelope and pump or tank, both of which are preferably held in positions of relative fixity, such connection is easy to make and maintain without hazard to the envelope or interruption of the vacuumizing or gas filling procedure.

I claim:

1. In an envelope closed to the atmosphere, a wall structure including a metal housing and having an opening into the envelope, a metal bellows arranged in the housing and at one end hermetically united with the wall structure around said opening, and a metal tubulation hermetically united with the bellows at its opposite end, said tubulation adapted to be pinched off and sealed on evacuation of said envelope and said bellows on evacuation of the envelope being adapted to contract and draw within said housing the bellows and tubulation for protection thereof.

2. In an envelope closed to the atmosphere, a wall structure including a metal housing extending into the envelope and having an opening into the envelope, a metal bellows arranged in the housing and at one end integral with the wall structure completely around said opening, and a metal tubulation hermetically united with the bellows at its opposite end, said tubulation adapted to be pinched off and sealed on evacuation of said envelope and said bellows on evacuation of the envelope being adapted to contract and draw within said housing the bellows and tubulation for protection thereof.

3. An envelope having a wall structure hermetically closing the envelope to the atmosphere and including a portion thereof constituting a housing lying within the outside surface of the envelope and having an opening into the envelope, a tubulation for conveying gas to or from the envelope, and a bellows hermetically connected at one end to the wall structure of the envelope around the opening and at the other end to the tubulation, said tubulation adapted to be pinched off and sealed and said bellows on sealing off said tubulation being adapted to draw along with said tubulation into said housing for protection.

4. In an envelope closed to the atmosphere, a metal end cap closing the envelope, a metal housing hermetically united with the end cap and extending into the envelope and having an opening into the envelope, a metal tubulation for conveying gas to or from the envelope, a metal bellows interposed between the tubulation and the envelope and hermetically united with said tubulation and with said end cap to close said housing opening, and an electrode fixedly mounted on said housing within the envelope, said tubulation adapted to be pinched off and sealed and said bellows on sealing off said tubulation being adapted to draw along with said tubulation into said housing for protection.

5. In an envelope closed to the atmosphere, a metal end cap closing the envelope, a metal housing hermetically united with the end cap and extending into the envelope and having an opening into the envelope, a metal tubulation for conveying gas to or from the envelope, a metal bellows interposed between the tubulation and the envelope and hermetically united with said tubulation, and with said end cap to close said housing opening, the exterior of said bellows and the interior of said tubulation being exposed to the atmosphere within said envelope while the interior of the bellows and the exterior of the tubulation are exposed to the atmosphere outside said envelope, an electrode fixedly mounted on said housing within the envelope, and a shield fixedly mounted on said housing and extending beyond the free end of the electrode, said tubulation adapted to be pinched off and sealed and said bellows on sealing off said tubulation being adapted to draw along with said tubulation into said housing for protection.

6. In an envelope closed to the atmosphere, a metal end cap, a generally cylindrical metal housing hermetically united with the end cap and having its inner end opening into the envelope and its outer end opening into the atmosphere, a generally cylindrical metal bellows hermetically united with the inner end of the housing around the opening therein and having a diameter less than the inside of the housing, a metal tubulation hermetically united with the outer end of the bellows, the exterior of said bellows and tubulation and the interior of said generally cylindrical metal housing being exposed to atmospheric pressure external of said envelope, and condenser plates integrally mounted on the inner end of the housing, said tubulation adapted to be pinched off and sealed on evacuation of said envelope and said bellows on evacuation of the envelope being adapted to contract and draw within said housing the bellows and tubulation for protection thereof.

7. In an envelope closed to the atmosphere, a metal end cap, a generally cylindrical metal housing hermetically united with the end cap and having its inner end opening into the envelope and its outer end opening into the atmosphere, a generally cylindrical metal bellows hermetically united with the inner end of the housing around the opening therein and having a diameter less than the inside of the housing, a metal tubulation hermetically united with the outer end of the bellows, the exterior of said bellows and tubulation and the interior of said generally cylindrical metal housing being exposed to atmospheric pressure external of said envelope, concentric condenser plates integrally mounted on the inner end of the housing, and concentric condenser plates integrally mounted on the end cap, said tubulation adapted to be pinched off and sealed on evacuation of said envelope and said bellows on evacuation of the envelope being adapted to contract and draw within said housing the bellows and tubulation for protection thereof.

8. In an envelope closed to the atmosphere, a metal end cap, a generally cylindrical metal housing hermetically united with the end cap and having its inner end opening into the envelope and its outer end opening into the atmosphere, a generally cylindrical metal bellows hermetically united at its outer end with the end cap around the outer opening of the housing, and a metal tubulation hermetically united with the inner end of the bellows and extending outwardly through the bellows.

9. In an envelope closed to the atmosphere, a metal end cap, a generally cylindrical metal housing hermetically united with the end cap and having its inner end opening into the envelope and its outer end opening into the atmosphere, a generally cylindrical metal bellows hermetically united at its outer end with the end cap around the outer opening of the housing, a metal tubulation hermetically united with the inner end of the bellows and extending outwardly through the bellows, and an electrode fixedly mounted on the inner end of the housing.

10. In combination, an envelope hermetically closed to the atmosphere, a wall structure including a metal housing extending into the envelope and having an opening into the envelope, a metal bellows arranged in the housing and at one end integral with the wall structure completely around said opening, the exterior of said bellows and tubulation and interior of said metal housing being exposed at atmospheric pressure external of said envelope, a metal tubulation hermetically united with the bellows at its opposite end, and an electrode fixedly mounted on said housing within the envelope, said tubulation adapted to be pinched off and sealed and said bellows on sealing off said tubulation being adapted to draw along with said tubulation into said housing for protection.

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