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(71)(72) Applicants and Inventors: LAWSON, Rick, A. [US/US]; 15602 River Ridge Court, Houston, TX 77068 (US). KELLY, Michael, S. [US/US]; 18418 Ella Boulevard, Spring, TX 77388 (US).

(74) Agent: SLAYDEN, Bruce, W.; Bardehle & Partners, Suite 550, Three Riverway, Houston, TX 77056 (US).

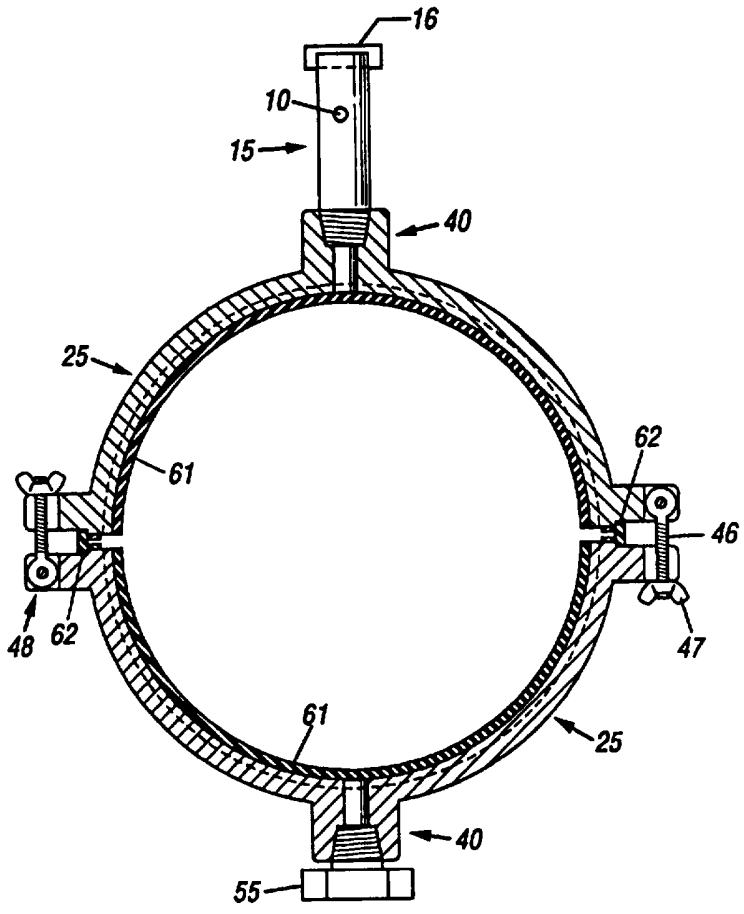
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(54) Title: FUGITIVE EMISSIONS DETECTION SYSTEM AND COMPONENTS THEREOF

(57) Abstract

A monitoring device and system for detecting fugitive emissions including emissions from valves and bolted flange connections, such as pertaining to stuffing box valves or bolted pipe flanges. The monitoring device comprises: firstly, an enclosure having at leeast two mating halves or connection enclosure members (25) fastened mechanically to encompass the volume about the valve or bolted flange connection, with ring-like gaskets (61) used on each side of the valve or bolted flange connection to seal the air space around the valve or between the members of the flange; and secondly, an indicating cartridge (15) with an emission indicating strip (10) or an adsorption detector within installed on the enclosure which contains material which will register a change if emissions leak into the enclosed air space of the enclosure around such a valve or bolted flange connection.



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FUGITIVE EMISSIONS DETECTION SYSTEM AND COMPONENTS THEREOF

This is a continuation-in-part application of Application Serial No. 08/341,419, filed on November 17, 1994.

Technical Field

The present invention is directed to the containment and detection of fugitive emissions, for example, leaking from valves and bolted flange connections. Also, the present invention is directed to a system for detecting and monitoring emissions. In another embodiment. the present invention relates to enclosures for valves and pipe connections or joints. In another aspect, the present invention relates to novel detectors for the detection of fugitive emissions.

Background of the Invention

One of the major environmental concerns is the amount of polluting emissions which are leaked directly into the atmosphere due to the failure of present systems. The existing systems are expensive and technically inadequate. It is believed that the two primary sources responsible for over 95% of industrial fugitive emissions are valve stuffing boxes and bolted pipe flange connections used in the oil and gas, and petrochemical industries.

One example of the present state of the art in detection systems includes equipment which monitors large areas; such equipment detects leaks only after the emissions have entered the atmosphere. Another detection system requires an individual to use small. hand-held units in order to detect leaks. This method is unreliable, especially if detection takes place in the presence of even a small cross wind. Both methods allow leakage to continue for significant periods of time before detection and correction can occur. The ever stricter standards set by environmental agencies has led to the need for a more effective and efficient monitoring system for fugitive emissions. The present invention provides a solution to eliminate 95% of the fugitive emissions.

Summary of the Invention

The present invention is directed to a monitoring system which detects fugitive emissions, for example, those leaking from valves and bolted flange connections in the oil and gas, and petrochemical industries. The invention is also directed to systems applicable in the chemical, pharmaceutical and the food processing industries. The system of the present invention may be comprised of a set of enclosures, a set of detectors for the enclosures, a set of signalers in communication with the detectors, and, if desired, a central processing location for monitoring the status of the enclosed sites.

The present invention is also directed to novel enclosures for pipe flange connections and valve stuffing boxes as used in the oil and gas, and petrochemical industries. The pipe flange connection enclosures are comprised of members, preferably two semi-circle shaped members, which when combined encompass the flange connection. The members form a centrally located internal channel. On either side of the centrally located channel are walls, preferably of gaskets or seals, such that when the semi-circle members are joined around or encompass a pipe flange connection, the centrally located channel forms an enclosure around the gasket area between the pipe flanges of the connection. The channel of one of the members includes a port for sealably receiving a detector of the present invention. Alternatively, one of the members also includes a port in the channel for receiving a vent plug.

The present invention is also directed to new enclosures for valve stuffing boxes. The valve stuffing box enclosures are preferably comprised of two members or half-pieces preferably shaped when joined like a hollow frustrum, i.e., it is frustroconical in shape when joined. Each member may include, according to one embodiment, gaskets or seals around the inside top portion, i.e., the narrow end of the frustrum and at the inside bottom portion, i.e., the wider end of the frustrum. In addition, one member of the pair includes lengthwise channels for receiving the other member having lengthwise gaskets or seals.

In a preferred embodiment, the valve stuffing box enclosures of the present invention are comprised of two members or half-pieces (mirrored pieces/halves) that when joined are preferably shaped like a hollow frustrum. Preferably, the enclosures do not include any gaskets or seal-type material around any of the edges of the

members. Preferably, each member includes a receiver to receive a side of the other half to form a mechanical connection between the two halves. The receiver of one half and the opposing side of the other half when joined form a mechanical seal such that emissions leaked from the valve stuffing box are reliably detected by the detector in communication with the inside space of the enclosure.

The invention is also directed to valve stuffing box enclosures comprising first and second members (mirror image half-pieces) having an inside and an outside, the outside having preferably, a greater circumference than the inside. Each member includes a receiver on the inside running vertically along an edge of the member, preferably for a majority of the length of said member. The receivers are constructed preferably as folds or pleats integral with the member such that they accept the other member when joined together to form a mechanical seal on the inside of the members sufficient to ensure reliable detection by a detector associated with the enclosure.

The valve stuffing box enclosures are preferably used in conjunction with the pipe flange connection enclosure. The valve stuffing box enclosures are designed to overlap and connect to the pipe flange enclosure forming a heretofore unknown and unrealized combination for the containment and detection of emissions from valve stuffing boxes.

The present invention is also directed to a heretofore unknown adsorption detector. The preferred detector is comprised of a substrate, e.g., metal or ceramic, electrode elements, adsorbent particles, like carbon, of substantially the same size, and an elastomer or a binder type gas permeable material. Preferably, the detector is operated in a non-current saturated mode or in a linear region and can detect substances having a Van der Waals "a" constant of less than about 9. Optionally, if desired, the detector may include non-adsorbent particles. Further, if desired, the detector may include a temperature detector or sensor. In some systems, for example, smaller systems, an indicating cartridge can be used as the detector and signaler. For instance, chemical-treated granules affixed to paper or chemical granules will change color when a threshold emission occurs. The indicator material (or detector/signaler) is enclosed in a housing, like a cylinder, which is installed or connected to the enclosures of the present invention. It is the main object of the present invention to

provide a monitoring system to detect emissions before any significant amounts reach the atmosphere which is both convenient and inexpensive to use.

It is another object of the present invention to provide a monitoring system for valve stuffing boxes and pipe flange connections as used in the oil and gas and petrochemical industries.

It is another object of this invention is to provide novel enclosures for pipe flange connections and valve stuffing boxes.

It is another object of the present invention to provide novel adsorption detectors for detecting fugitive emissions at heretofore unmeasurable low levels in the field.

Brief Description of the Drawings

Fig. 1A is a see-through, perspective view of a fugitive emissions detection cylinder.

Fig. 1B is a cross-sectional view of the cylinder in Fig. 1A.

Fig. 2a is a side view of an application of the invention, enclosing a valve stuffing box.

Fig. 2b is a top view of an application of the invention, enclosing a flange.

Fig. 3A is a cross-sectional side view of a valve stuffing box enclosure, showing the cap-end of the cylinder in place.

Fig. 3B is the cross-sectional top view of Fig. 3A, of a valve stuffing box enclosure in a disassembled state.

Fig. 3C is a cross-sectional side view (Fig. 3A rotated 90° about a vertical axis) of a valve stuffing box enclosure in a disassembled state.

Fig. 4A is a cross-sectional view of one half of a flange enclosure.

Fig. 4B is a top view of a flange enclosure, showing the threading of the half coupling.

Fig. 4C shows a portion of Fig. 4A,. rotated 90° about a horizontal axis.

Fig. 4D is a cross-sectional view of a flange enclosure with the cylinder in place.

Fig. 4E is a cross-sectional view showing how the cylinder is installed in the half coupling.

Fig. 5 is a perspective view of one embodiment of the valve stuffing box enclosure.

Fig. 5A is a perspective side view of a mounted valve stuffing box enclosure in conjunction with a pipe flange connection enclosure.

Fig. 5B is a perspective view of another embodiment of two halves of a valve stuffing box enclosure.

Fig. 5C is a perspective side view of an assembled valve stuffing box enclosure.

Fig. 5D is a bottom view of an assembled valve stuffing box enclosure.

Fig. 6 is a cross-sectional view of a pipe flange connection enclosure for use in conjunction with the valve stuffing box enclosure.

Fig. 7 is a top view of an adsorption detector without the carbon-elastomer mixture.

Fig. 8 is a top view of the detector substrate with electrode elements and temperature detector (particle/binder mixture not shown).

Description of the Preferred Embodiments

Fig. 1A shows an emissions indicating strip **10** (a detector and signaler) contained within an acrylic or fiberglass cylinder **15**. The emissions indicating strip **10** is chemically-treated paper, here shown in the shape of a tube; the paper discloses a color change when emissions react with the chemical present on the surface of the paper (for example, paper treated with litmus will show a color change from red to blue when exposed to ammonia). Similarly, chemically-treated granule detectors/signalers change color upon reaction with emissions, or emissions actuate a gas detector which would trip a relay and activate a light signaler to switch on, also within the acrylic cylinder. The lower portion of the cylinder **15** has threads **12** for insertion into a stuffing box enclosure coupling **30**, or into a flange enclosure coupling **40**. Cylinder cap **16** seals cylinder **15** and has a one-way cylinder cap vent **18** to relieve any pressure build-up from within the stuffing box enclosure or flange enclosure.

Fig. 1B is a cross-sectional view of a cylinder **15**, showing emissions indicating strip **10** (detector and signaler) contained within it, as well as the cylinder cap **16** and the cylinder cap vent **18**.

Figs. 2a and 2b show two applications of the invention. Fig. 2a shows an embodiment of the stuffing box enclosure housing **20** enclosing the valve stuffing box **19**. A cylinder **15** containing emissions indicating strip **10** has been inserted into the stuffing box enclosure coupling **20**. Fig. 2b shows the flange enclosure housing **25** enclosing the flange connection **24**. A cylinder **15** containing, for example, an emissions indicating strip **10** (not shown) or another detector and signaler (not shown) has been inserted into the flange enclosure coupling **40**.

Figures 3A through 3C show views of the two-piece valve stuffing box enclosure, used for detecting emissions from a valve stuffing box. The stuffing box enclosure can be constructed of a material such as Ultem 1000 or aluminum. The two-piece construction allows the enclosure to be easily installed around the top and bottom of a yoke of a valve stuffing box. The seals, which can be made from a material such as silicone, provide a seal to the area around the stuffing box and are designed to prevent outside air from entering the area contained within the stuffing box enclosure and possibly causing the indicating material or detector and signaler to produce a false reading.

Fig. 3A is a cross-sectional side view of one embodiment of a stuffing box enclosure housing **20**. Yoke gasket seal **64** and bonnet gasket seal **65** provide seals between the stuffing box enclosure housing **20** and a valve stuffing box. The seal between the two halves of the stuffing box enclosure housing **20** is created by the stuffing box enclosure gasket seal **67**. A screw and nut **41**, **42** assembly may be used to bolt together the two halves of the stuffing box enclosure housing **20**. The stuffing box enclosure housing coupling **30** has threads to receive the threads **12** of cylinder **15** (not shown).

Fig. 3B is a cross-sectional top view of the two halves of the stuffing box enclosure housing **20** before assembly. Each half has a yoke gasket seal **64**, which forms a closed circle upon assembly. The seal is completed with the lip gasket seal **66**. The path the screw and nut assembly **41**, **42** follows is shown. Threaded stuffing box enclosure couplings **30** are shown on both sides of the stuffing box

enclosure housing **20.** (The lower yoke gasket seals **65** [not shown] on the lower portion of the stuffing box enclosure housing **20** look exactly like the upper yoke gasket seals **64.**)

Fig. 3C is a cross-sectional side view of the stuffing box enclosure housing **20** in two halves (Fig. 3A rotated 90° about a vertical axis), showing the upper yoke gasket seals **64**, the lower yoke gasket seals **65**, the lip gasket seals **66**, and the threaded stuffing box enclosure couplings **30**. It also shows the stuffing box enclosure gasket seal **67**, which creates the seal between the two halves or members of the stuffing box enclosure housing **20.**

Figures 4A through 4E show views of the preferred two-piece flange enclosure, used for detecting emissions from a flange. The flange enclosure can be constructed of a material such as aluminum. The two-piece construction allows the enclosure to be easily installed by aligning the two halves or members over the space between the two flanges and securing the two members together. The seals. which can be made from a material such as silicone, together provide an air-tight seal to the area around the flange and are designed to prevent any outside air from entering the area contained within the flange enclosure and possibly causing the indicating material or detector to produce a false reading.

Fig. 4A shows a cross-sectional view of one of the halves or members of the flange enclosure housing **25** with threaded flange enclosure coupling **40**. One of the flange enclosure gasket seals **61** can be seen running along the inside edge of flange enclosure housing **25**. The flange enclosure seals **62** complete the seal when both halves of flange enclosure housing **25** are joined together with the wing and nut assembly **46, 47.**

Fig. 4B shows the top of one of the halves of flange enclosure housing **25** with the threaded flange enclosure coupling **40**. The dotted lines show the internal channels and the placement of flange enclosure gasket seals **61** and flange enclosure connection seal **62** (on the underside of the flange enclosure housing **25**. not shown).

Fig. 4C illustrates anchor pin **48** inserted into an anchor pin hole. and eyebolt **46**, which secure the two halves or members of flange enclosure housing **25** in place around the flange. Fig. 4C also shows the placement of flange enclosure connection seals **62.**

Fig. 4D shows both halves or members of flange enclosure housing **25** joined together with eyebolt **46**, wing nut **47** and anchor pin **48**. The flange enclosure gasket seal **61** forms a circle on the inside edge of the flange enclosure housing **25**, and flange enclosure connection seals **62** complete the seal. The cylinder **15**, containing emission indicating strip **10** (detector/signaler) or an adsorption detector (not shown) and sealed with cylinder cap **16**, is shown threaded into one of the flange enclosure couplings **40**. A flange coupling plug **55** has been threaded into the other flange enclosure coupling **40**.

Fig. 4E shows a cross-sectional side view of flange enclosure coupling **40** on flange enclosure housing **25**. Cylinder **15**, containing emission indicating strip **10** (detector/signaler) and sealed with cylinder cap **16**, is threaded into flange enclosure coupling **40**. The view shows that two flange enclosure gasket seals **61** run along the inside edge of flange enclosure housing **25**, one on each outer edge of such housing, creating an enclosure space in a centrally defined channel to contain emissions from the flange, which diffuse into the cylinder **15** and are detected by the emissions indicating strip **10** in communication with the channel.

The present invention is also directed to a system comprised of a set of enclosures, a set of emission detectors for the enclosures, and a set of signalers, like transmitters, for the enclosures. The enclosures of the present invention include enclosures for pipe flange connections and valve stuffing boxes. Referring to Fig. 4D, the pipe flange connection enclosures are preferably comprised of two semi-circle shaped members 25 or halves. The members can be constructed of various metals, like aluminum, or thermoplastics depending on the application. The members may vary in size depending upon the size or circumference of the pipe flange connection to be enclosed. Nevertheless, the members are of such a size such that when they are combined, they encompass the pipe flange connection. Preferably, two members are used but the enclosure can be constructed of more than two members. As known in the art, a customary pipe flange connection includes two pipe flanges bolted together with a gasket positioned between the two flanges. As shown in Fig. 4B, members 25 of the enclosure of the present invention have first (A), second (B) and third (C) internal channels. The first (A) and third (C) channels hold gaskets and are sealed such that when the two members are joined to encompass the pipe flanges, the

second (B) channel, that is, the middle channel, forms an enclosure around the gasket area between the two bolted pipe flanges. Referring to Figure 4D, preferably, one of the members includes port 40 for sealably receiving a detector and/or signaler of the present invention. Alternatively, and preferably, the other member of the pair includes port 40 for receiving a vent plug.

The pipe flange connection enclosure may be secured around the pipe flange connection by any suitable means, e.g., a wing-nut assembly as shown in Fig. 4A or any other type of securing means including straps, buckles, latches, velcro, adhesives, bolts, screws, hook and loop materials, etc.

It should also be recognized that the pipe flange connection enclosure may also be constructed of a single unitary piece that is adjustable to form the appropriate desired enclosure around the gasket area between the two joined pipe flanges. This unitary construction obviously can be used at the point when the flanges are joined. The preferred embodiments have been described in relation to existing pipe flange connections, however, the same discussion and basic construction applies equally to unitary enclosures.

The enclosure of the present invention for a pipe flange connection may be comprised of: (a) a flange-enclosure assembled from two mirror-image half-clamps or semi-circle members for disposition around or to encompass the circular outer surfaces of two connected flanges, each of the members having a threaded coupling and two extensions located at each end of the members oriented perpendicularly to the outer surface of the members; (b) a resilient seal ring is affixed to the outer edge of the inside diameter of each of the members; (c) another seal ring is affixed to the opposing outer edge of the inside diameter of each of the members such that when the members are disposed around the outer surfaces of the two flanges a seal is created; (d) a resilient gasket seal is affixed to the surface of the extensions of one of the members; (e) means for joining the two members thereby defining an air space between the flanges; (f) a cylindrical indicating cartridge (detector and signaler) with one open end having outer threads and an opposing end sealed with a one-way vent cap, the cartridge is designed to exhibit or signal a change upon exposure of its contents with emissions from between the two the flanges, and the open end of said

cartridge being threadably disposed in the coupling of one of the members; and (g) a plug threadably disposed in the coupling of the other.

The pipe flange connection enclosure members 25 may be constructed from extruded aluminum. The extrusion design allows for the acceptance of a standard closed cell foam sheet gasket material which is cut to fit in the grooves or internal channels of the extruded aluminum sheet. The extruded aluminum material is cut to the appropriate lengths and then rolled to whatever diameter that is necessary. The design preferably requires two identical members 25 or halves to enclose the outside diameter of mating flanges, with one gasket fitting on one side and the other gasket fitting on the other side, thus capturing any leak occurring in the gasket area between the mating flanges. Preferably, on each flange enclosure half 25, it will have a half-inch hole 40 drilled in order to accept either a vent plug or a detector or detector/signaler assembly. The method of installation is to put one half of the flange enclosure on the topside of the mating flanges, and fit the other half of the flange enclosure on the bottom. A simple attaching mechanism is utilized to secure and seal the two halves together around the mating flanges and compress the two halves together tight enough to prevent any outside ambient conditions, i.e., air-tight, from violating the airspace on the inside without creating a pressure containing part.

The present invention includes enclosures for valve stuffing boxes. (See Figures 3A, 3B, 3C, 5, and 5A) Referring to Fig. 5, the valve stuffing box enclosure 68 is preferably comprised of two members (68a and 68b) or half-casings which are, preferably, when joined, shaped like a hollow frustrum, that is, the enclosure is frustro-conical in shape; however, clearly other shapes can be utilized depending on the application. (See, e.g., Figures 3A, 3B and 3C) Moreover, the enclosure can be constructed from more than two casings if desired. Each member may include gaskets or seals 72 around the inside top portion, that is, the narrow end of the frustrum and at the inside bottom portion, that is, the wider end of the frustrum. Each member may also include an attachment means, for example, straps and buckles 71, to secure the enclosure around the valve stuffing boxes. Any means of securing the enclosure can be used including hook and loop materials, velcro, buckles, latches, wing-nut assemblies, bolts, adhesives, screws, etc. In addition, according to one embodiment, one member of the pair includes lengthwise channels (not shown) for

receiving the other member having lengthwise gaskets or seals (not shown). The valve stuffing box enclosure is preferably used in conjunction with the pipe flange connection enclosure described above. Referring to Figures 5a and b, the valve stuffing box enclosure 73 of the present invention is designed to overlap and connect or engage with pipe flange enclosure 74 to form a heretofore unknown and unrealized combination for the containment and detection of emissions from valve stuffing boxes. This is accomplished by including a channel or groove 75 (shown in Fig. 6) on the pipe flange connection enclosure whereby the bottom of the valve stuffing box enclosure sealably sits and secures around the pipe flange enclosure.

The enclosure for valve stuffing boxes of the present invention may be comprised of (a) a casing assembled from two half-casings or members, shaped to be disposed around the outer configuration of a gland flange and yoke of a valve bonnet. each of the half-casings or members including a threaded coupling; (b) a resilient upper seal ring affixed around the inner edge of the upper portion of each of the half-casings, designed to create a seal with the upper portion of the yoke; (c) a resilient lower seal ring affixed around the inner edge of the lower portion of each of the half-casings designed to create a seal with the lower portion of the yoke; (d) two resilient gasket seals, disposed along the length of each one of the longitudinal edges of one of the two half-casings; (e) a groove along the length of both longitudinal edges of the other of the two half-casings designed to accept a resilient gasket seal creating a seal between the two assembled half-casings; (f) four lip gasket seals, each affixed at one of the four abutting corners of one of the two half-casings, to complete a seal between the two half-casings and the yoke of the valve bonnet; (g) means for joining the two half-casings; (h) a cylindrical indicating cartridge, having one open end with outer threads, and having the opposing end sealed with a one-way venting cap, the indicating cartridge (detector/signaler) is designed to exhibit a change upon exposure to emissions from the valve bonnet, and the open end of the indicating cartridge being threadably disposed in the coupling of one of the half-casings; and (i) a plug threadably disposed in the coupling of the other of the half-casings.

Fig. 5B shows a side view of two halves or members (100, 101) of the preferred valve stuffing box enclosure. The halves or members are mirrored pairs and each includes along the inside edge of one side (102a or 102b) a receiver (103a

and 103b) for receiving, when joined together, the corresponding side (104a and 104b) of the mirrored pair member to form a mechanical connection between the two halves along the vertical length of the adjoining sides. The receiver may be a pleat or fold made integral with the particular member. The connection is preferably a metal to metal seal sufficient such that any emissions leaked into the enclosure are reliably detected by the detector. Moreover, preferably, the seal is sufficient such that the path of least resistance for an emission to pass is into the area where the detector is located. As shown in Figure 5B, the receivers 103a and 103b are large enough or wide enough such that a connection can be made of varying degrees, i.e., the enclosures with the receivers are self-adjusting and therefore, can be utilized with valve stuffing boxes of varying dimensions or with gaskets/seals of varying thicknesses. Fig. 5C and Fig. 5D, utilizing the same reference numbers, show members 100 and 101 joined. Preferably, the bottom portion of members 100 and 101 are corrugated.

It should also be recognized that the valve stuffing box enclosure, while being described in relation to existing valve stuffing boxes, can also be of an unitary construction and enclosed around the valve stuffing box when it is assembled or connected in the field. The basic construction of the non-unitary enclosure applies equally to the unitary construction.

The valve stuffing box enclosures are preferably made from a standard sheet of aluminum. The valve enclosures have a certain height and circumference depending on manufacture, design, and pressure class of the valve to be enclosed. After cutting the sheet material to the desired specification, the material is then rolled per the appropriate configuration. The preferred valve enclosure design requires two halves or members that attach to the yoke down to the base of the bonnet on the bolted area where the valve is joined at the body bonnet connection. On each half, according to one embodiment, there is affixed an extruded gasket comprised of a closed cell sponge or silicone material secured around the top, vertical, and bottom of the two valve enclosure half-casings. The first half-casing of the valve enclosure fits against the yoke and valve bonnet and the other half-casing accepts or fits on the outside of the other half. Each valve enclosure is affixed with simple attachment means to provide a snug fit from top, vertical, and bottom by drawing the two halves together creating a protected environment from outside ambient conditions so

that pressure is not contained in the valve enclosure. Preferably, the enclosure contains a hole to accept a vent plug.

The detectors of the present invention are, according to one embodiment, adsorption type detectors. The detectors of the present invention may be comprised of a substrate, electrode elements, adsorbent particles, and an elastomer or binder. Additionally, the detectors may be further comprised of non adsorbent particles like metal oxides, e.g., titanium oxide. Optionally, the detectors of the present invention may include a temperature detector. In operation, a voltage is supplied across the detector which has a standard resistivity. When the detector is exposed to an emission of certain substances, the resistivity of the detector changes. Referring to Fig. 7, substrate 78 of the detector may be comprised of alumina or silica or mixtures thereof and may be approximately 0.025 inches in thickness. Electrode elements 77 are preferably in an inter-digitated configuration. Electrode elements 77 may be formed of any conductive material including gold, platinum, silver, or any other chosen metals and preferably are formed by thick-film metallization. The particle component (not shown) of the adsorption detector of the present invention may be in the form of particles of substantially uniform size or may be contained in a thick-film ink. Preferably, carbon or purified carbon particles of substantially uniform size are utilized. For example, Carbone of America Series F purified uniform sized particles may be utilized in the practice of the present invention. However, in some circumstances it is preferred to utilize a mixture of carbon particles with, for example, non adsorbent particles, e.g., SiO_2, Al_2O_3, or mixtures thereof, e.g., pumice. It has been found that the addition of SiO_2, Al_2O_3, TiO_2 or mixtures thereof are particularly useful for increasing the heat resistance of the detector. Various elastomers or binders (not shown) may be used in the construction of the adsorption detector of the present invention; however, it has been found that gas permeable silicone-based elastomers are preferred. An example of an elastomer/binder useful in the present invention, especially in high temperature applications, includes silicone, for example, "SYLGARD" manufactured by Dow Chemical. In any event, the elastomer or binder chosen should preferably be purified so that it does not outgas at high temperatures leading to a false emission reading.

The optional temperature detector is manufactured onto the substrate, e.g., in the same manner as on the electrode elements. The temperature detector unlike the electrode elements is not covered by the elastomer/binder and may be comprised of platinum, preferably 95% pure for use in high temperature applications. Fig. 8 illustrates the temperature detector placement on the substrate (binder/elastomer and particles not shown.)

Preferably, the temperature detector is fabricated utilizing the same techniques described above for the fabrication of the electrode element of the adsorption detector. It is preferred to simply fabricate the temperature detector on the backside of the substrate on which the adsorption detector is fabricated. Referring to Fig. 8, an embodiment of the temperature detector **79** is shown on the frontside of the substrate. The material utilized to fabricate the element of the temperature detector is preferably "PTC Thermistor Composition PC 10315" available from METECH, Inc., Route 401, Elverson, PA 19520. This material has a viscosity of 125-225 kcps (Brookfield HBT, Spindle SC4-14, 10 rpm, 25° C +/- 1° C). The product contains a thinner "Metech 3995" also available from the same company. The "PTC Thermistor" material has the following fired properties: resistivity[2] (ohms/square) of 10; tolerance of +/- 10%; TCR (ppm/c)[2] of 3000 +/- 200.

The detector of the present invention may be comprised of carbon and elastomer/binder on a substrate with electrode elements or as follows: from about 35% to about 60% by weight elastomer, from about 15% to about 35% by weight adsorbent particles, and, optionally, from about 25% to about 35% by weight non adsorbent particles. Specific example formulations include: (1) 30% by weight metal oxide, 20% by weight carbon, and 50% by weight elastomer/binder; (2) 27.75% by weight metal oxide, 26% by weight carbon, and 46.25% by weight elastomer/binder; (3) 28.50% by weight metal oxide, 24.0% by weight carbon, and 47.50% by weight elastomer/binder; and (4) 27% by weight metal oxide, 28% by weight carbon, and 45% by weight elastomer/binder. Preferably, the metal oxide is titanium dioxide which can be of one uniform size, e.g., 1 micron, the carbon is purified carbon particles of substantially the same size available from Carbone of America under the tradename "UCP-1-M-Grade," e.g., 1 micron or less, and the elastomer is silicone, e.g., "SYLGUARD" available from Dow Chemical.

Generally, the adsorption detectors of the present invention can be fabricated using micro-electronic fabrication technology. Specifically, photolithographic reduction and thick-film metallization and silk-screening techniques may be used. Indeed, it is preferred that the adsorbent particles, like carbon, mixed with the elastomer are placed as a layer onto the surface of the electrode element by silk-screening. It is believed that the thickness of this layer affects the sensitivity of the detector.

In making the above described detector, the following steps are followed: (1) mix carbon and silicone to form a mixture, (2) add a metal oxide to the mixture (optional), (3) mix or blend to ensure an equal dispersion of components throughout and in the silicone material, and (4) apply the mixture to the substrate making sure the thickness is uniform. The particles may be substantially contained within the elastomer, i.e., substantially non-protruding from the surface or they may protrude from the surface depending upon the application of the detector.

The adsorption detector of the present invention, unlike prior art adsorption detectors, can detect substances having a Van der Waals' "a" constant of less than about 9 when operated in a non-current saturated mode or in a linear region using carbon or adsorbent particles of substantially uniform size. The term "current saturated mode" as used herein means that small increments in the voltage across the detection device do not show the corresponding increases in the current flowing through the device as would otherwise be predicted by Ohm's Law, but instead the current flowing through the device remains substantially constant. Another way of expressing the same, is that in a current saturated mode, voltage is applied to the detection device to a level after which the current no longer increases linearly, that is, it operates in a non-linear region. Of course, in a non-current saturated mode, as the voltage is increased the current increases linearly or as predicted by Ohm's law, i.e., the detector is operating in a linear region.

The present inventive system may also be utilized with transmitters, in communication with a set of detectors and a set of enclosures. The transmitters send signals, e.g., to one central processing location identifying the status of a particular possible emission site. For example, each transmitter can have its own predetermined programmed identification code and an internal clock to transmit a status report on a predetermined time interval. The system can be set up that in the event a certain

transmitter misses a check-in period, the system will allow for a predetermined number of missed check-in times before setting off an alarm. Any transmitter useful in the present inventive system preferably is equipped with a low battery transmission signal which notifies when the battery or power supply source must be replaced.

An example of a transmitter that may be useful in conjunction with the present invention operates with a 3.0 volt, 3.2 volt or 3.5 volt battery power supply and is a one-way R.F. transmitter, i.e, radio frequency, 900 megahertz spread spectrum system which is capable of handling up to 3000 points in a single cell site. The transmitter is in communication with the detector such that upon the detector coming into contact with an emission, the resistivity of the detector changes and the transmitter sends an alarm signal. The alarm can be audible, visual, local, and/or at a remote location.

While the preferred embodiment has been described with reference to a gas detector, other detectors may be utilized including temperature, pressure, and level detectors alone or in combination with others. In relation to the preferred embodiment utilizing a gas detector, it is especially preferred to use it in combination with a temperature detector.

While the illustrative embodiments of the invention have been described with particularity, it will be understood that various other modifications will be apparent to and can be readily made by those skilled in the art without departing from the spirit and scope of the invention. Accordingly, it is not intended that the scope of claims appended hereto be limited to the examples and description set forth herein. but rather that the claims be construed as encompassing all the features of patentable novelty which reside in the present invention, including all features which would be treated as equivalents thereof by those skilled in the art to which the invention pertains.

What we claimed is:

1. A system for the detection of emissions comprising:

a set of enclosures for emission sites including pipe flange connections wherein the pipe flange connection enclosures encompass flange connections, said flange connections comprised of two joined pipe flanges with a gasket in the area between the two flanges, said pipe flange enclosures having first, second, and third internal channels, said first and third channels having walls such that when the enclosure encompasses the pipe flange connection, the second channel forms an enclosure around the gasket area between the joined pipe flanges; and

a set of detectors for said enclosures, wherein the detectors for the pipe flange connection enclosures are attached such that they are in communication with the enclosed gasket area.

2. The system of claim 1 wherein the detectors are comprised of a substrate, electrode elements, and adsorbent particles.

3. The system of claim 1 further comprising a set of signalers in communication with the detectors.

4. An enclosure for two connected pipe flanges with a gasket in the area between the two flanges, said enclosure comprising:

a set of members having centrally located internal channels, wherein upon joinder of the members around a pipe flange connection, a single enclosure channel is formed around the gasket area between the flanges.

5. The enclosure of claim 4 further comprising a port for sealably receiving a detector or a vent plug in the channel of one of the members.

6. The enclosure of claim 4 further comprising an outside channel for sealably receiving a valve stuffing box enclosure.

7. A system for the detection of emissions comprising:

a set of enclosures for emission sites including pipe flange connections and valve stuffing boxes, and

a set of detectors in communication with said enclosures, said detectors comprised of a substrate, electrode elements, and adsorbent particles of substantially uniform size, wherein said detector is capable of detecting substances having a Van der Waals' "a" constant of less than about 9 in a non-current saturated mode.

8. The system of claim 7 further comprising a set of signalers in communication with the detectors.

9. A detector for use in a fugitive emissions detection system comprising:

a substrate;

electrode elements on said substrate; and

a material on said electrode elements, wherein said material comprises adsorbent particles of substantially uniform size such that when the detector is operated in a linear region it detects substances having a Van der Waals' "a" constant of less than about 9.

10. The detector of claim 9 further comprising non-adsorbent particles.

11. A heat resistant detector for use in a fugitive emissions detection system comprising:

a substrate;

electrode elements on said substrate; and

a material superjacent said elements, said material containing adsorbent particles, and non-adsorbent particles of substantially uniform size.

12. The detector of claim 11 wherein the non-adsorbent particles are selected from the group consisting of aluminum oxide, silicon dioxide and titanium dioxide.

13. The detector of claim 11 wherein the material is gas permeable.

14. The detector of claim 11 further comprising a temperature detector on said substrate.

15. The detector of claim 14 wherein the temperature detector is comprised of about 95% pure platinum.

16. The detector of claim 14 wherein the temperature detector is comprised of "PTC Thermistor Composition PC10315."

17. A detector for use in fugitive emissions detection systems comprising:
a substrate, electrode elements on said substrate, and a material comprised of from about 35% to about 60% by weight silicone, from about 15% to about 35% carbon particles, and from about 25% to about 35% metal oxide.

18. The detector of claim 17 wherein said detector further comprises a temperature detector.

19. An enclosure for a valve stuffing box, said enclosure comprising:
first and second members having an inside and an outside, each member having a receiver on the inside;
said receivers being constructed for accepting the other member such that upon joinder of the two members a mechanical seal is formed on the inside of the members.

20. The enclosure of claim 19 wherein the receivers are comprised of pleats integral with the members.

21. The enclosure of claim 19 wherein the receivers are comprised of folds integral with the members.

22. A system for the detection of emissions comprising:

a set of enclosures for valve stuffing boxes comprising first and second joined members each having an inside and an outside, wherein the inside of each member has a receiver, said receiver being constructed for accepting the other member such that upon joinder of the two members around a valve stuffing box a mechanical connection is formed on the inside of the members; and

a set of detectors in communication with the inside of the joined members of the enclosures.

23. The system of claim 22 further comprising a set of signalers in communication with said detectors.

24. A system for the detection of fugitive emissions from pipe flange connections and valve stuffing boxes, said system comprising:

a set of pipe flange connection enclosures comprised of a set of members having centrally located internal channels wherein upon joinder of the members around a pipe flange connection, a single enclosure channel is formed around a gasket area between the flanges;

a set of valve stuffing box enclosures comprised of first and second members having an inside and an outside, each member having a receiver on the inside constructed for accepting the other member such that upon joinder of the members a mechanical connection is formed on the inside of said members;

a set of adsorption detectors in communication with the enclosures, said detectors comprised of a substrate, electrode elements on said substrate, and a material superjacent said elements, said material comprised of adsorbent particles; and

a set of signalers in communication with said detectors.

25. A detector for use in a fugitive emissions detection system, said detector comprising:

a substrate,

electrode elements on said substrate, and

a gas permeable material containing adsorbent particles wherein said material is superjacent said elements.

26. The detector of claim 25 wherein said material further comprises a metallic oxide.

27. The detector of claim 25 wherein said particles are of a substantially uniform size.

FIG. 1A

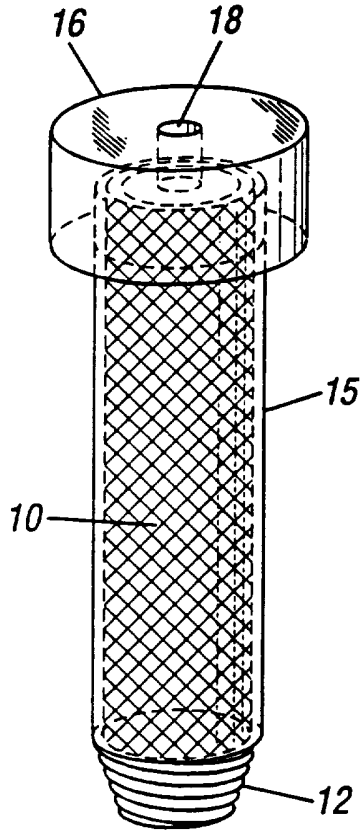


FIG. 1B

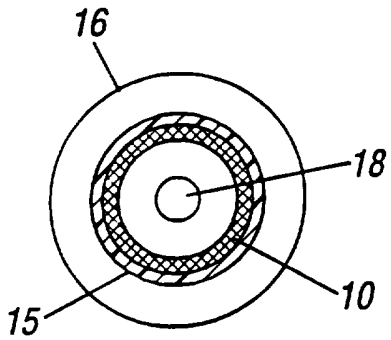


FIG. 2A

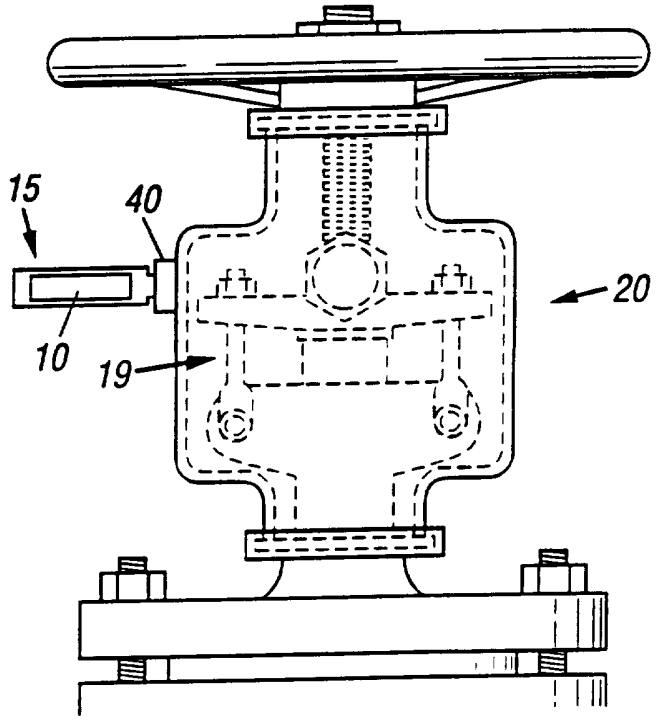
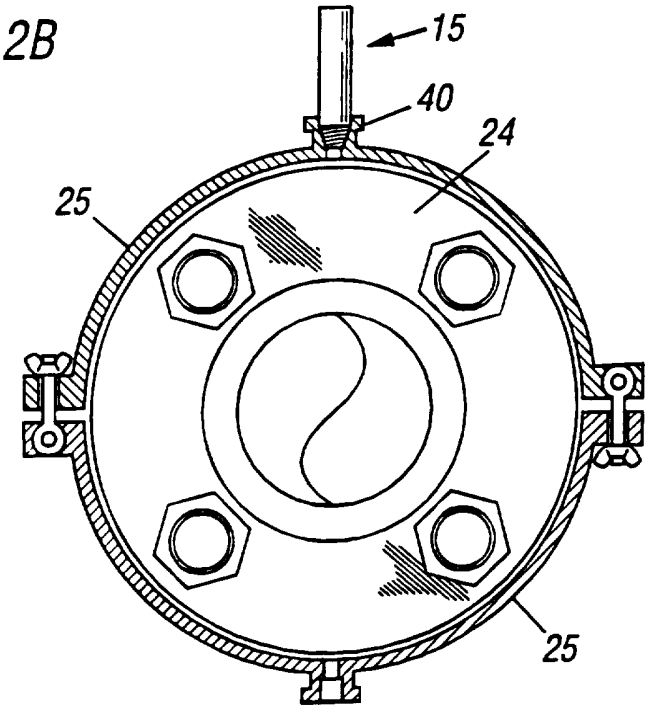


FIG. 2B



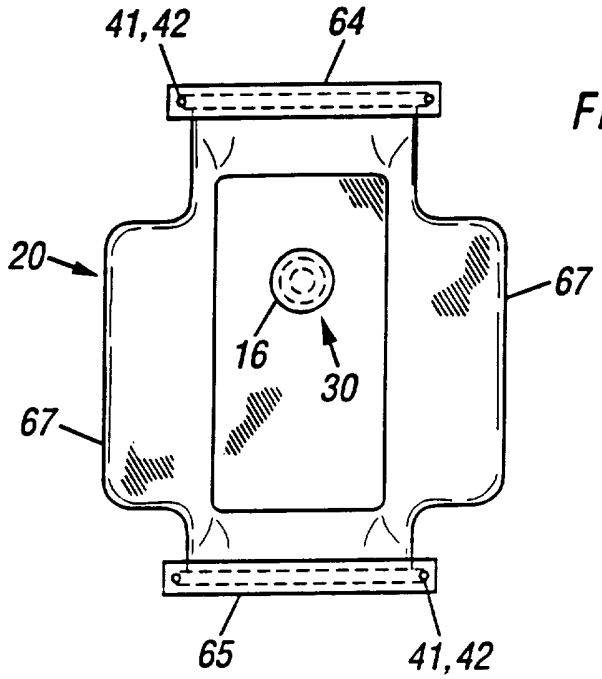
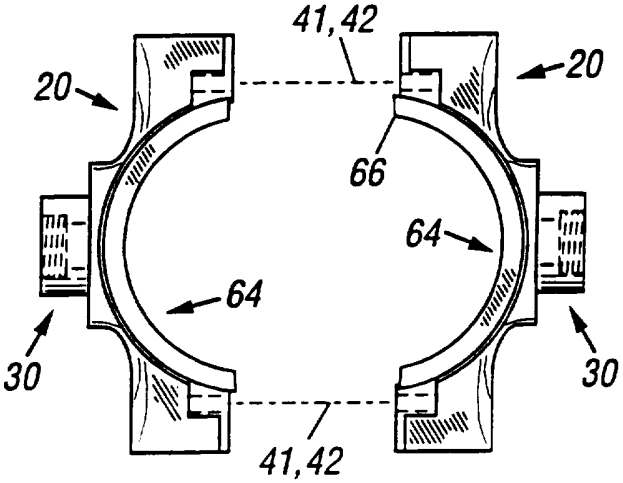


FIG. 3A

FIG. 3B



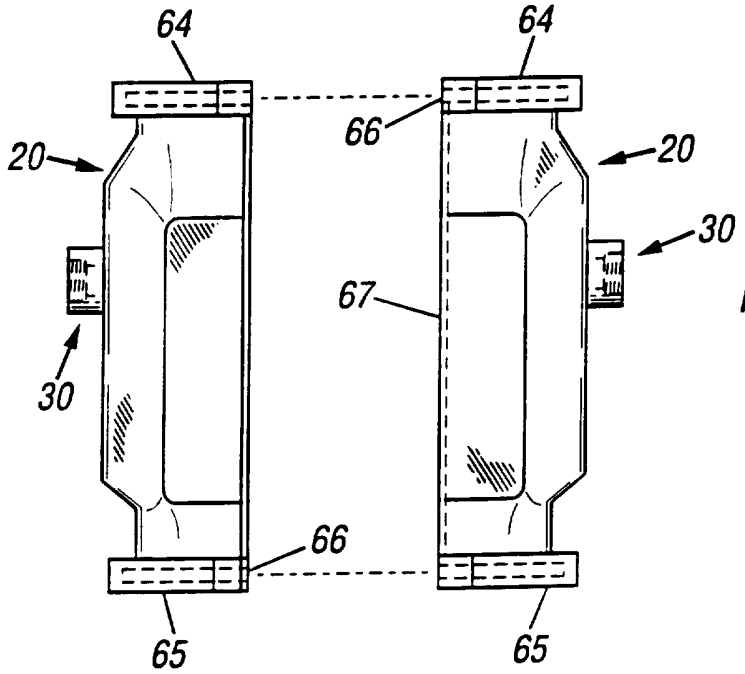


FIG. 3C

FIG. 4A

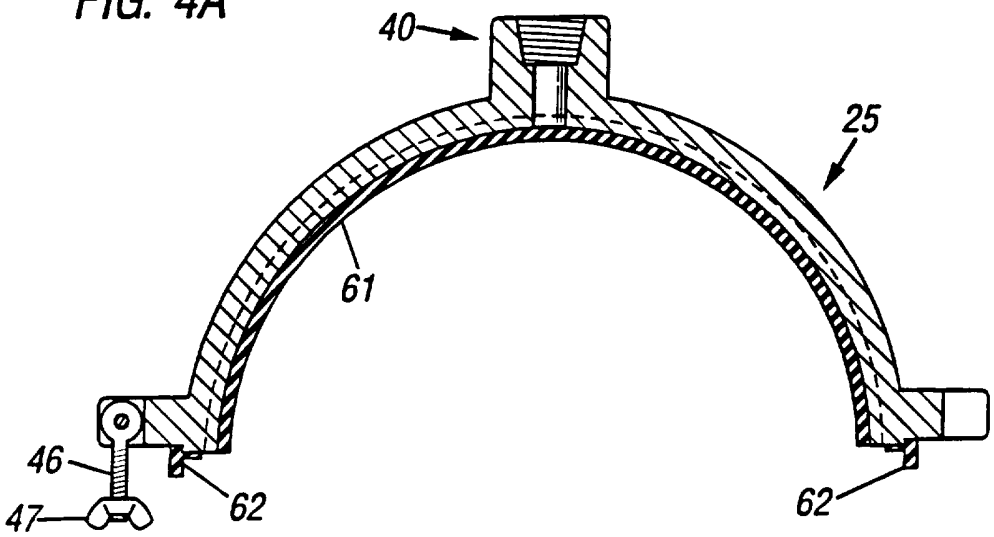


FIG. 4B

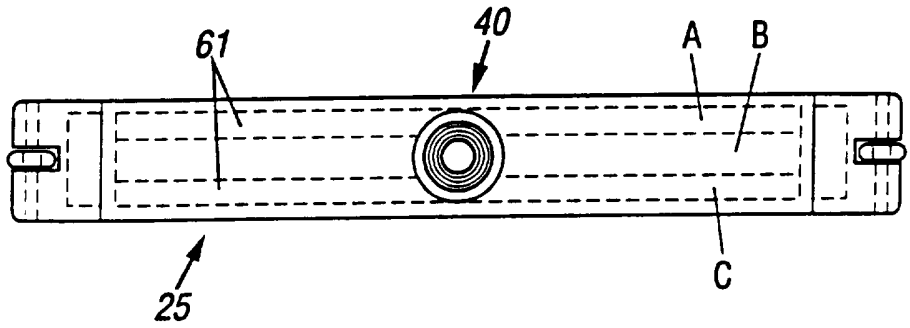
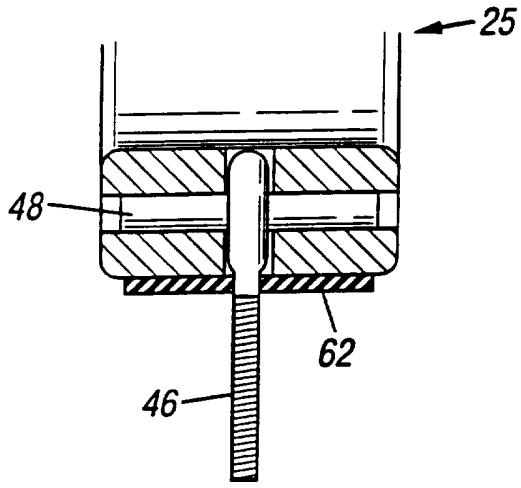


FIG. 4C



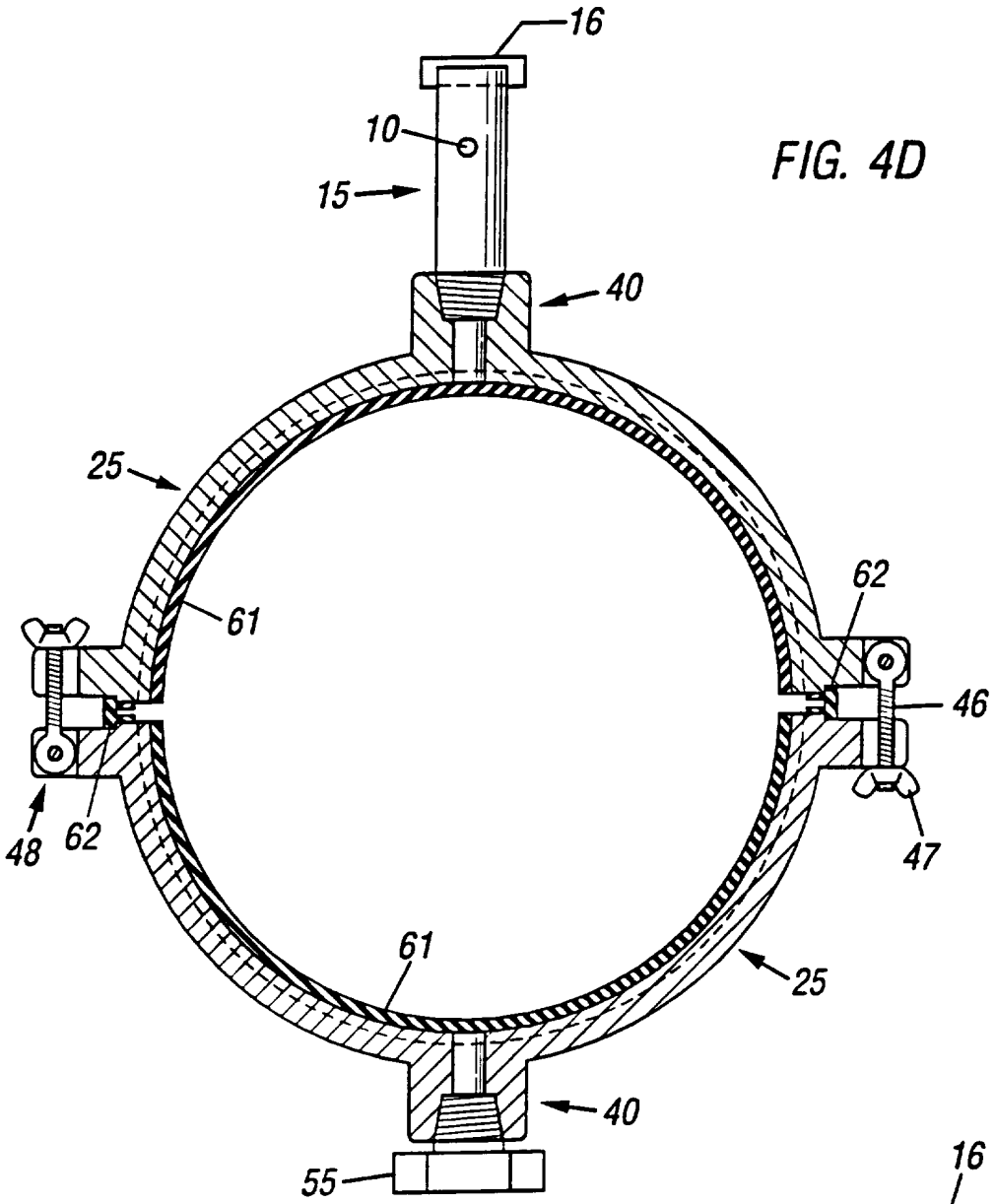


FIG. 4D

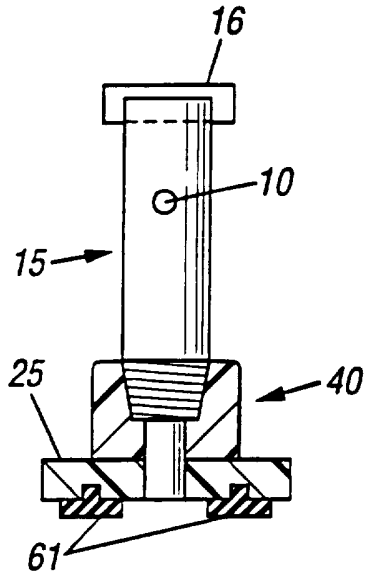


FIG. 4E

FIG. 5

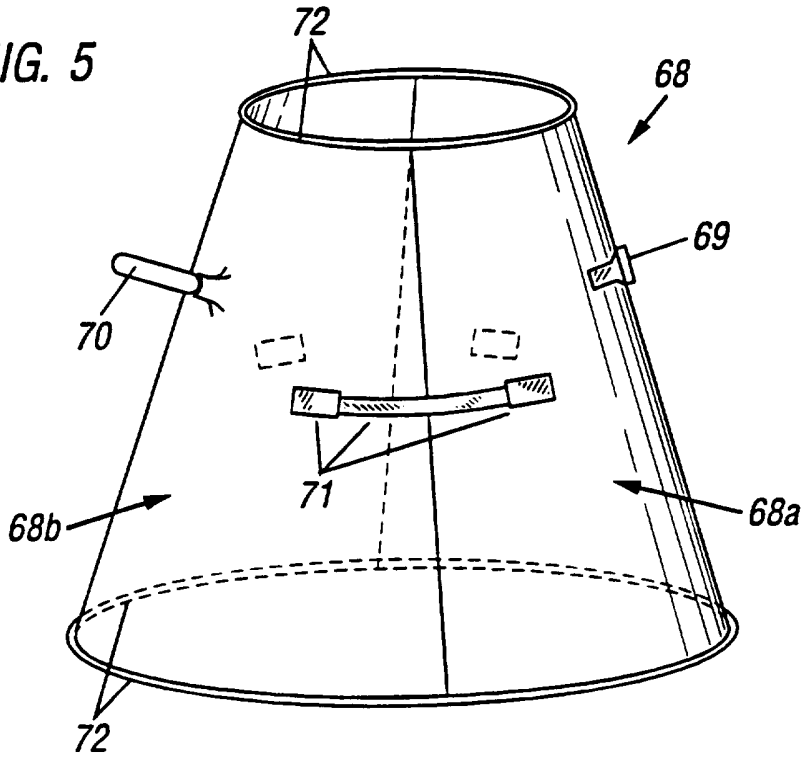


FIG. 5A

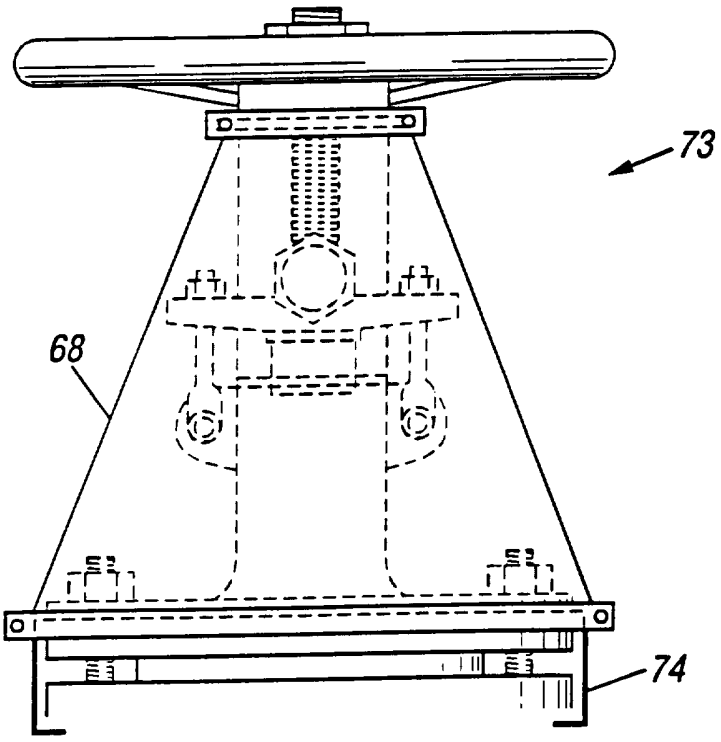
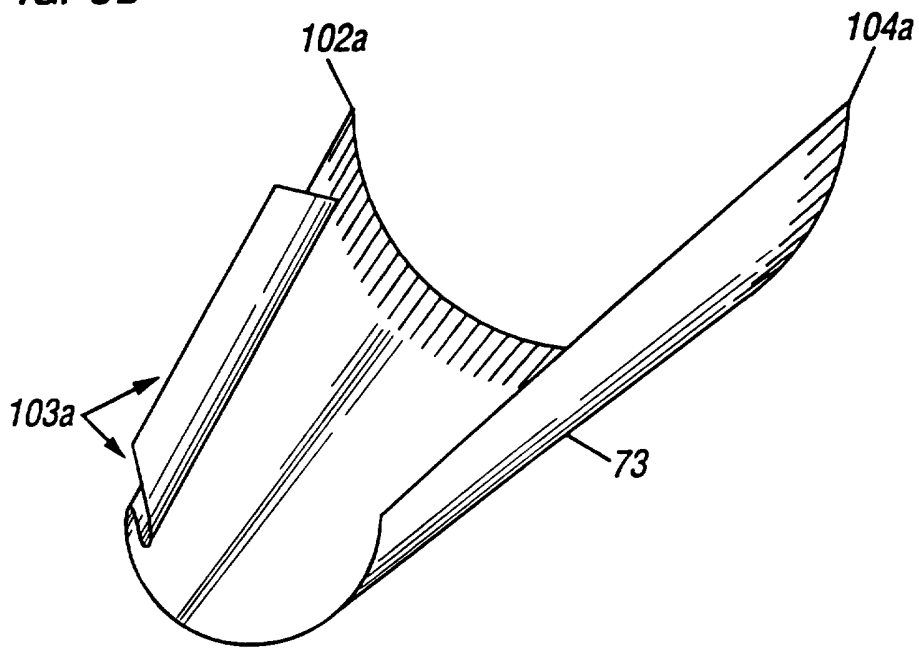


FIG. 5B



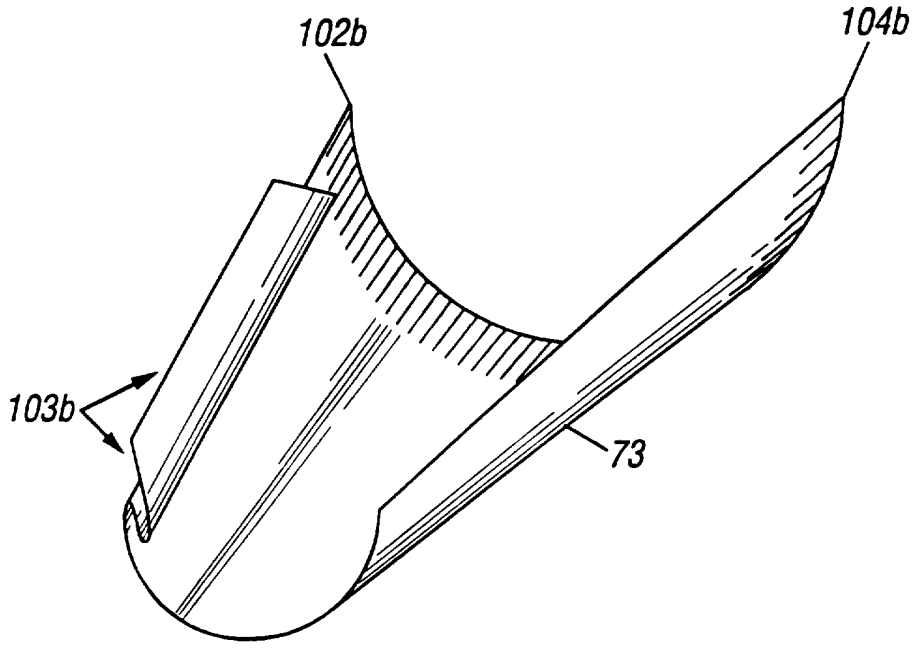


FIG. 5C

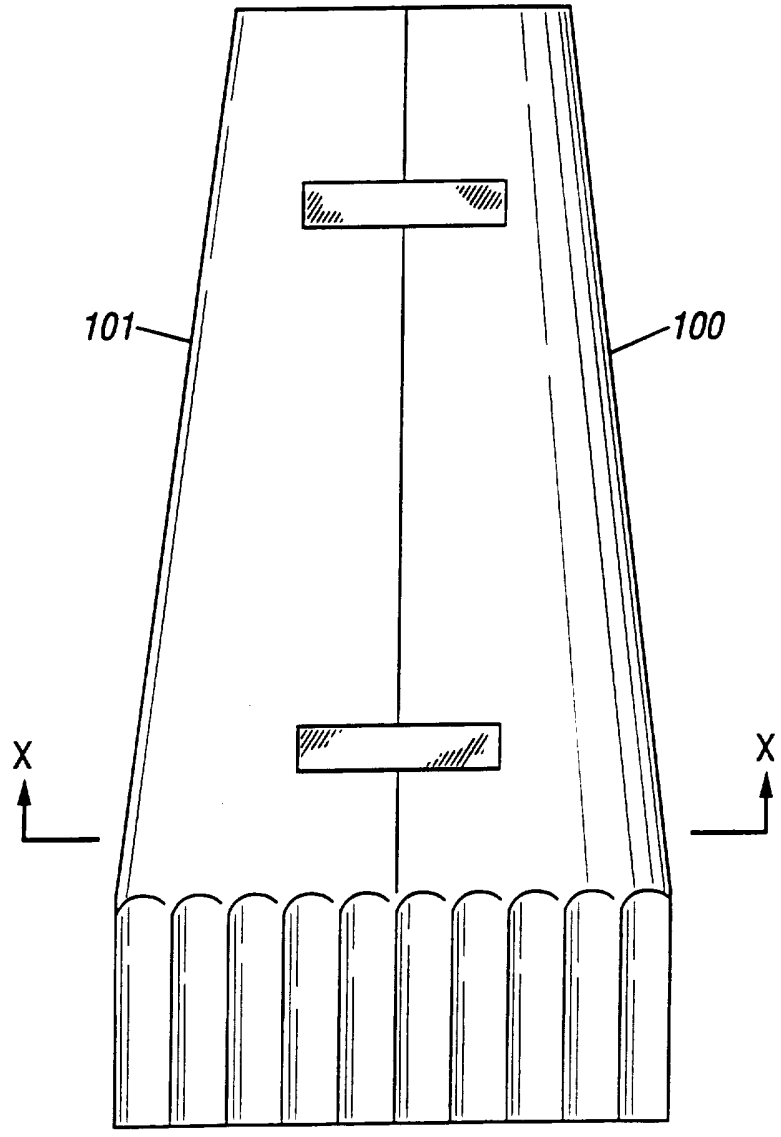


FIG. 5D

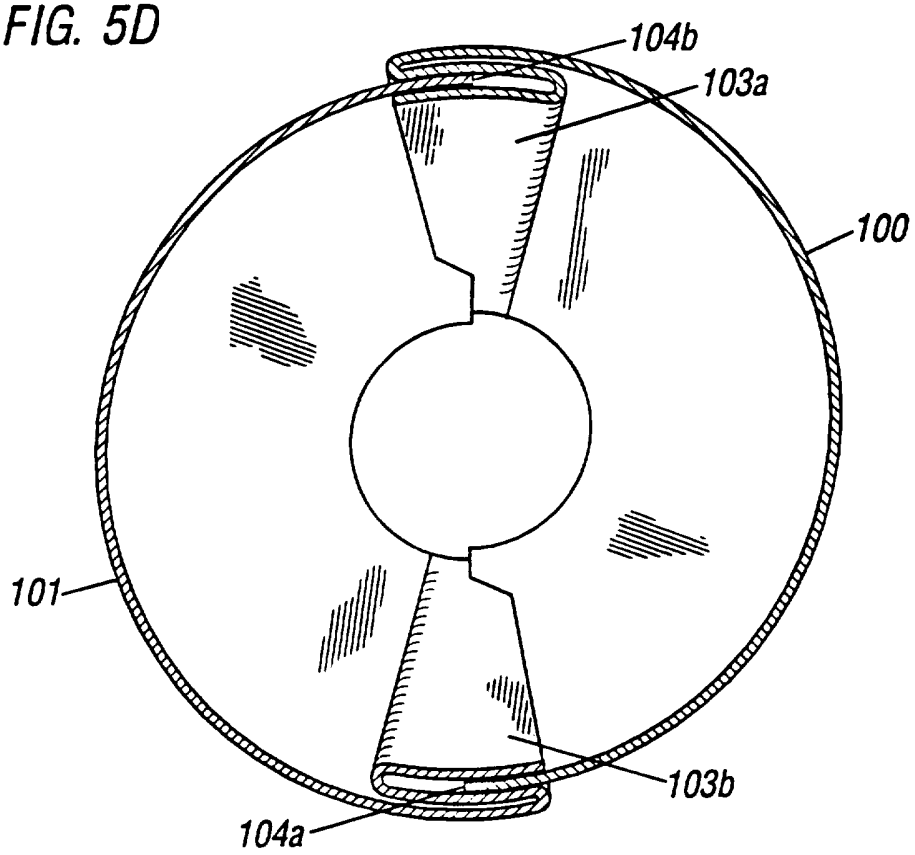


FIG. 6

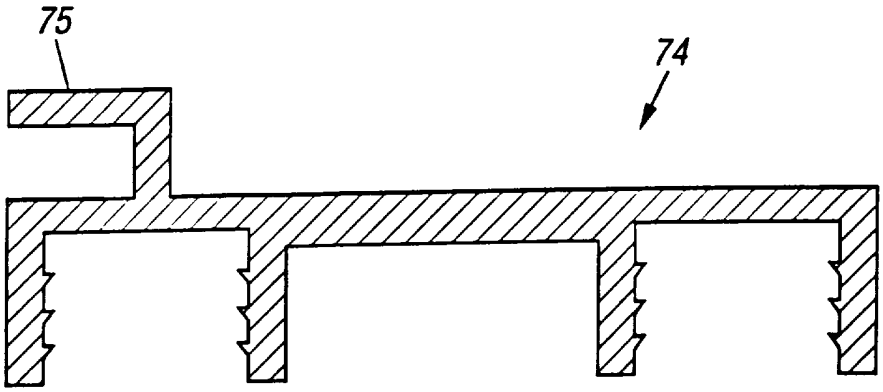


FIG. 7

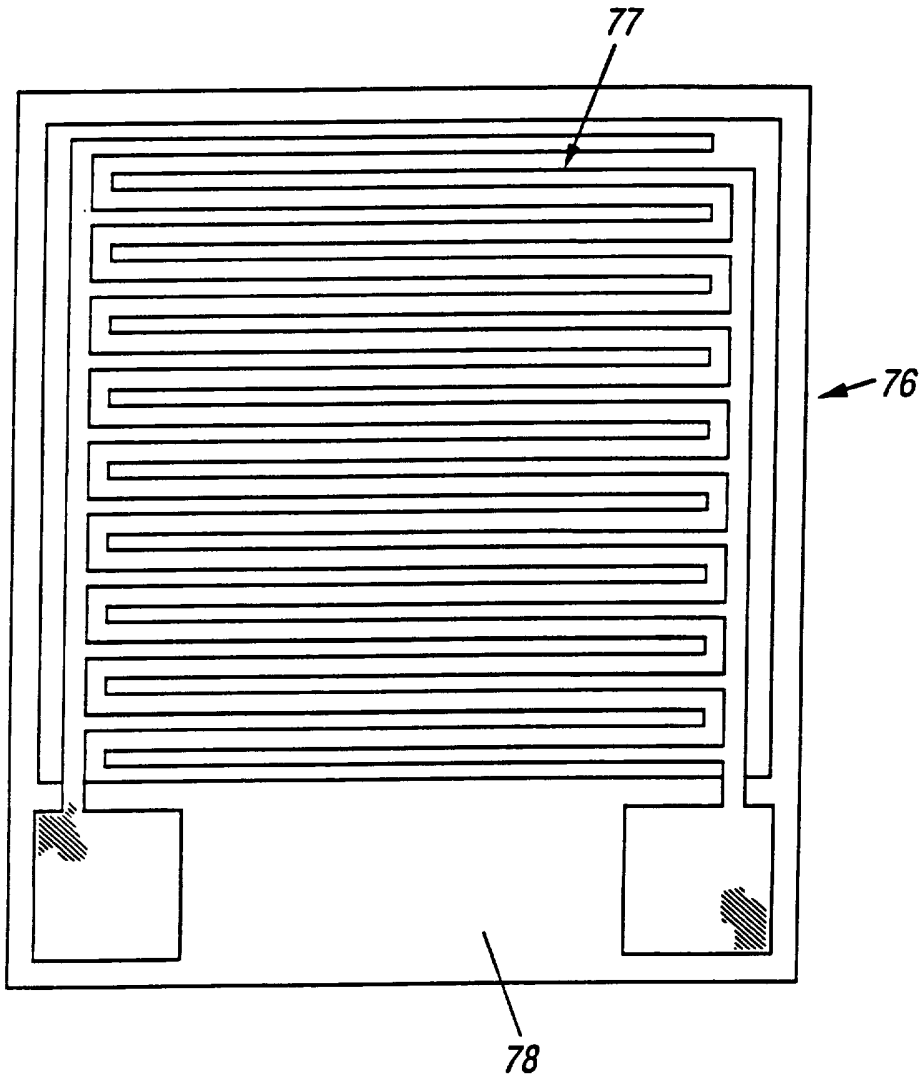
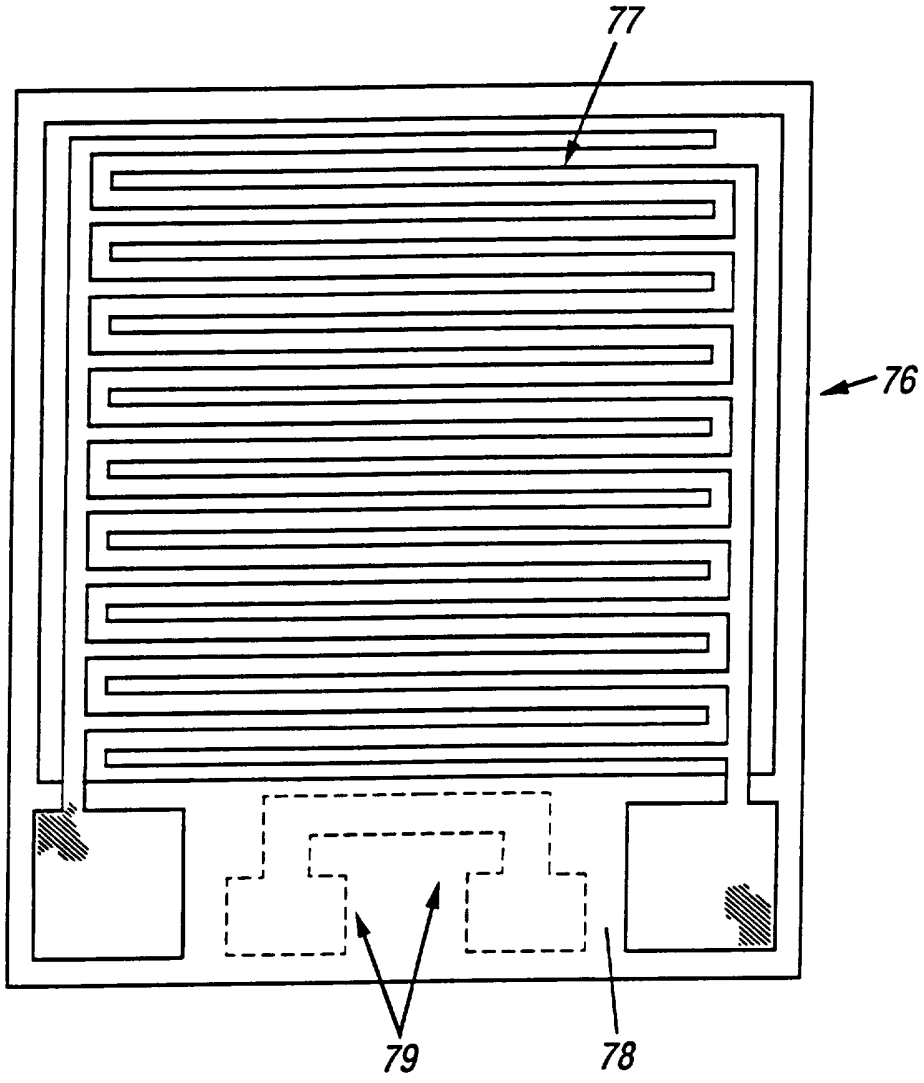


FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/15064

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :G01M 3/28, 3/20, 3/04; F16L 55/168
US CL :073/046, 040, 049.2, 040.5R; 340/605
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 073/046, 040, 049.2, 040.5R; 340/605

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 3,485,085 (HAWKINS, JR.) 23 December 1969.	1-12
A	US, A, 4,019,371 (CHAPLIN ET AL.) 26 April 1977.	1-12
A	US, A, 4,194,389 (LAGING) 25 March 1980.	1-12
A	US, A, 4,507,954 (BOUTWELL) 02 April 1985.	1-12
A	US, A, 4,864,847 (ANDERSON ET AL.) 12 September 1989.	1-12
A	US, A, 4,557,139 (CANTWELL ET AL.) 10 December 1985.	1-12
A	US, A, 4,601,194 (MILLER ET AL.) 22 July 1986.	1-12

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search	Date of mailing of the international search report
06 FEBRUARY 1996	12 MAR 1996
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer JOHN DAVID WIGGINS Telephone No. (703) 305-4884

Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/15064

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 4,876,884 (JANSCH) 31 October 1989.	1-12
A	US, A, 4,926,680 (HASHA ET AL.) 22 May 1990.	1-12
A	US, A, 5,209,105 (HASHA ET AL.) 11 May 1993.	1-12
A	US, A, 5,170,659 (KEMP) 15 December 1992.	1-12
A	US, A, 5,348,044 (EUGENE ET AL.) 20 September 1994.	1-12
Y	US, A, 4,466,273 (PILLETTE) 21 August 1984, Figures 2-4 and 6 and Column 2, lines 19-45, Column 4, lines 14-36, Column 6, lines 15-22 and Column 7, lines 22-54.	1-12
Y	US, A, 5,330,720 (SORBO ET AL.) 19 July 1994, Figures 1-3, and Column 2, lines 42-67 and Column 5, lines 16-19.	1-12
Y	US, A, 4,282,743 (PICKETT) 11 August 1991, The Figure and column 2, lines 31-60, and column 3, lines 3-65.	1-12