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(54) PATIENT ESOPHAGEAL DETECTOR DEVICE IN COMBINATION WITH A CARBON DIOXIDE DETECTOR

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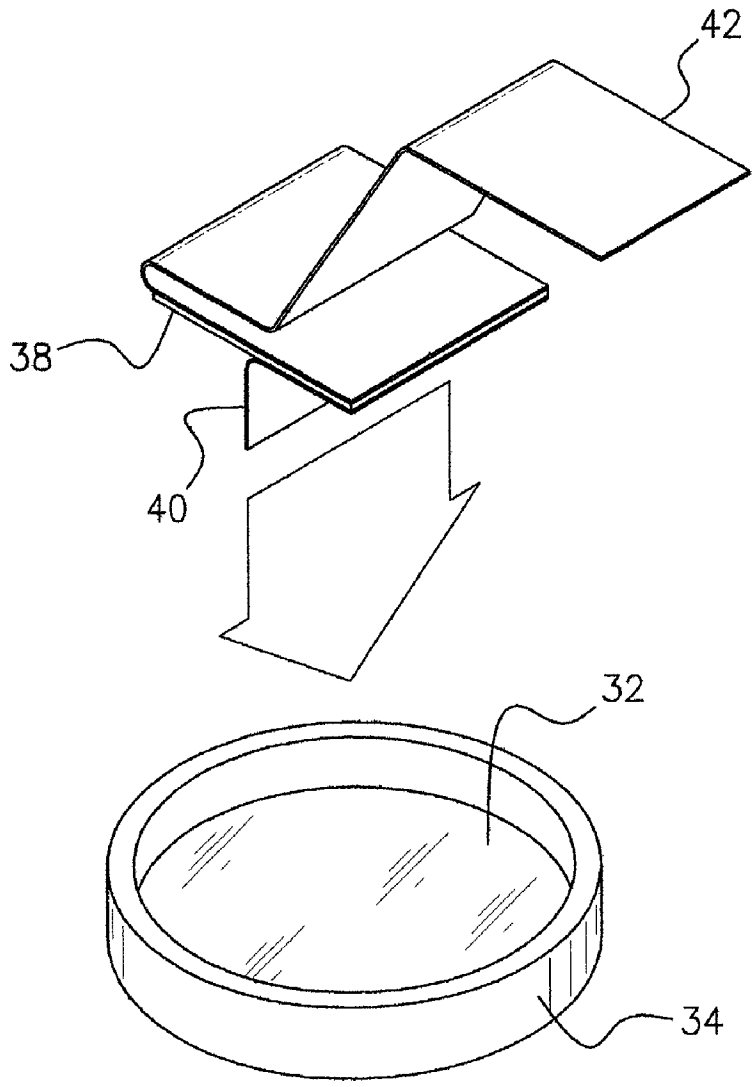
(57) **ABSTRACT**

The CO_2 detector has a disc attached to a rim which in turn is attached to a third port on a esophageal detector housing. A baffle rises from an interior surface of the housing to slightly below an opening to the third port. A first and second port of the housing on each side of the third port are in axial alignment. The first port is attached to an elastomeric bulb and the second port is adapted to be connected to an adapter which in turn is attached to an intubation tube. A calorimetric indicator paper is shown through a clear plastic cover after removing backing on the indicator paper through the second port.



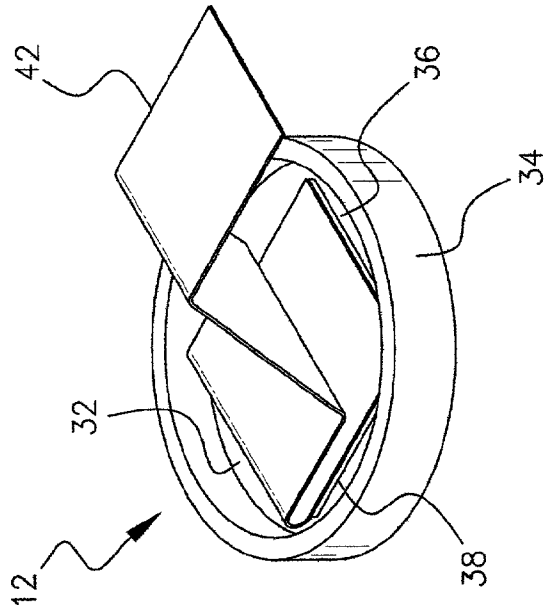


FIG. 2

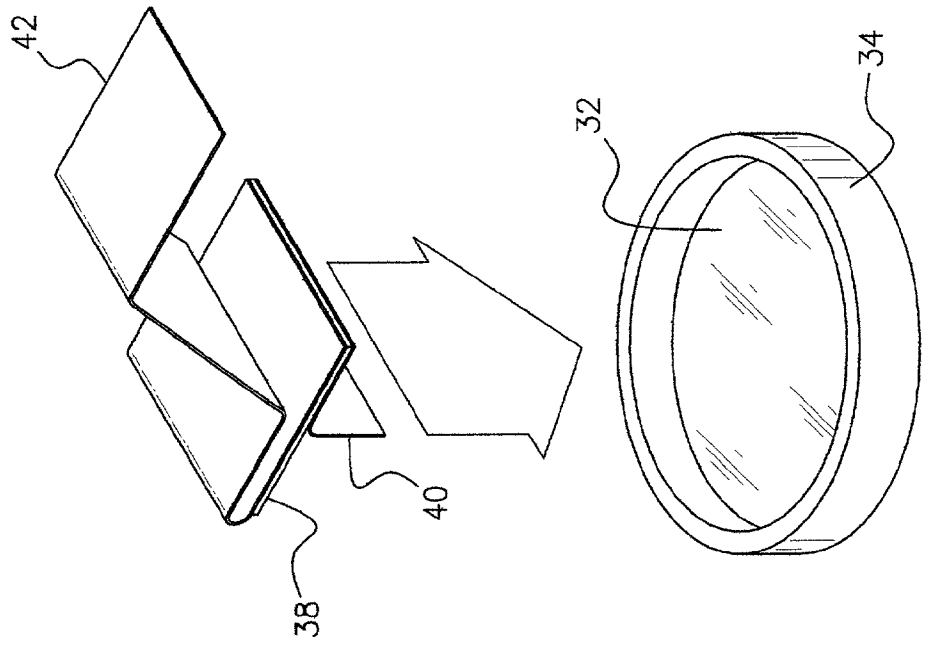


FIG. 1

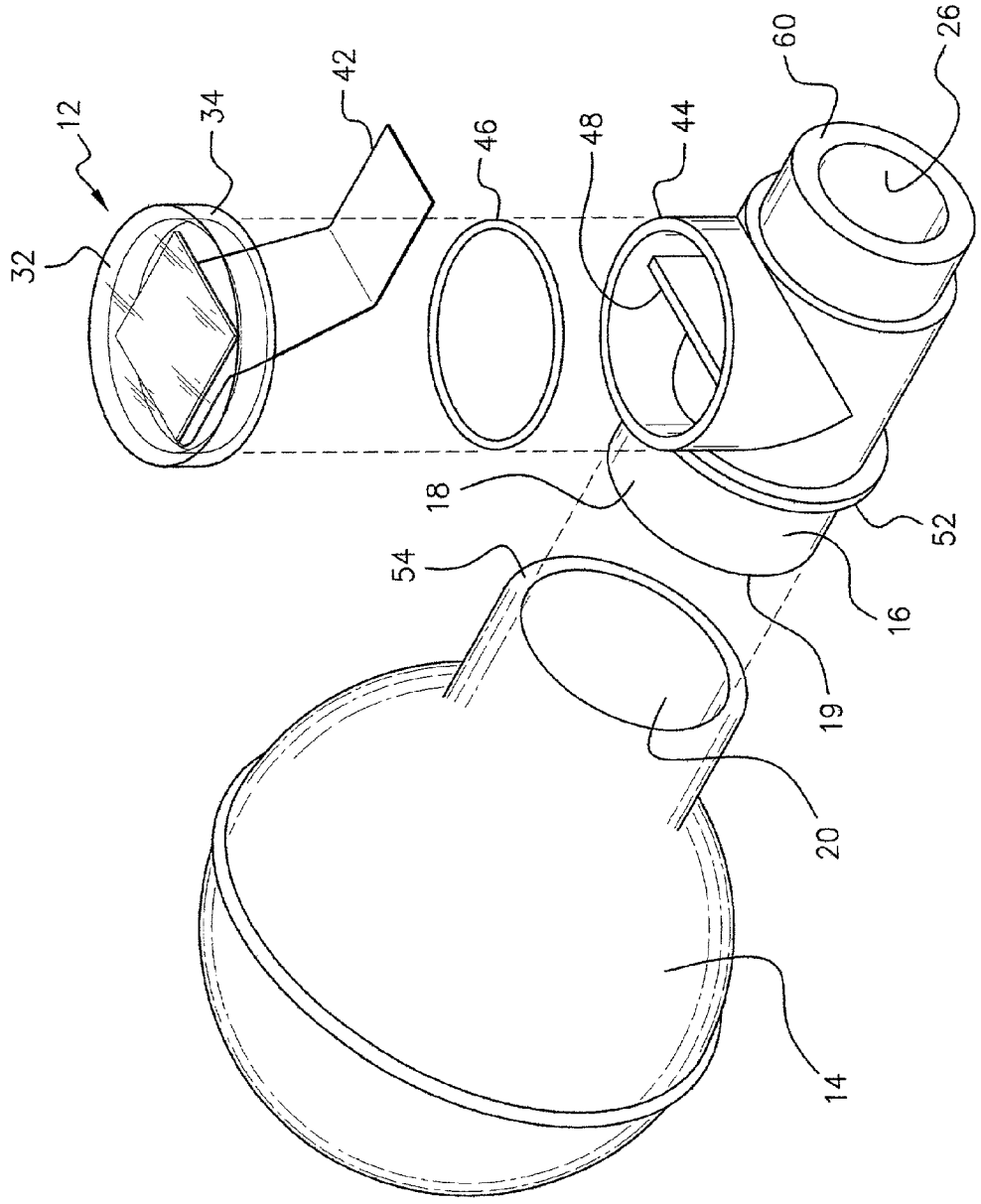


FIG. 3

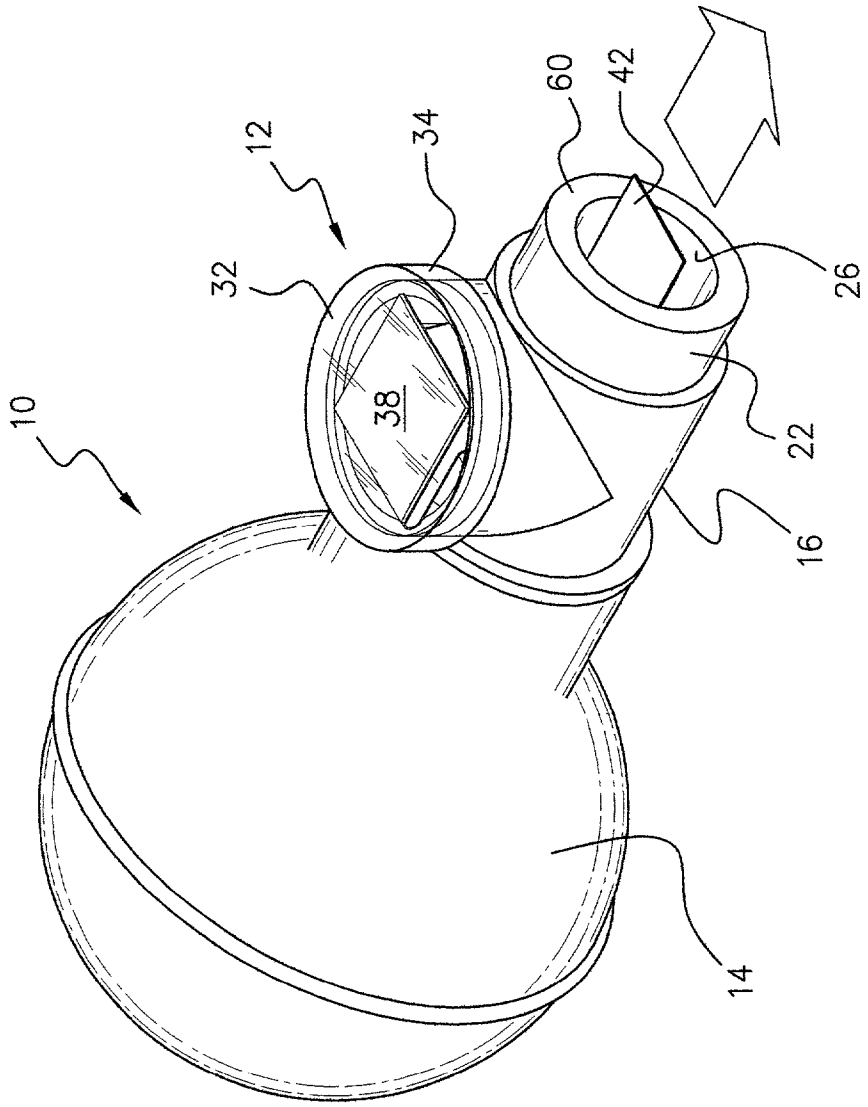


FIG. 4

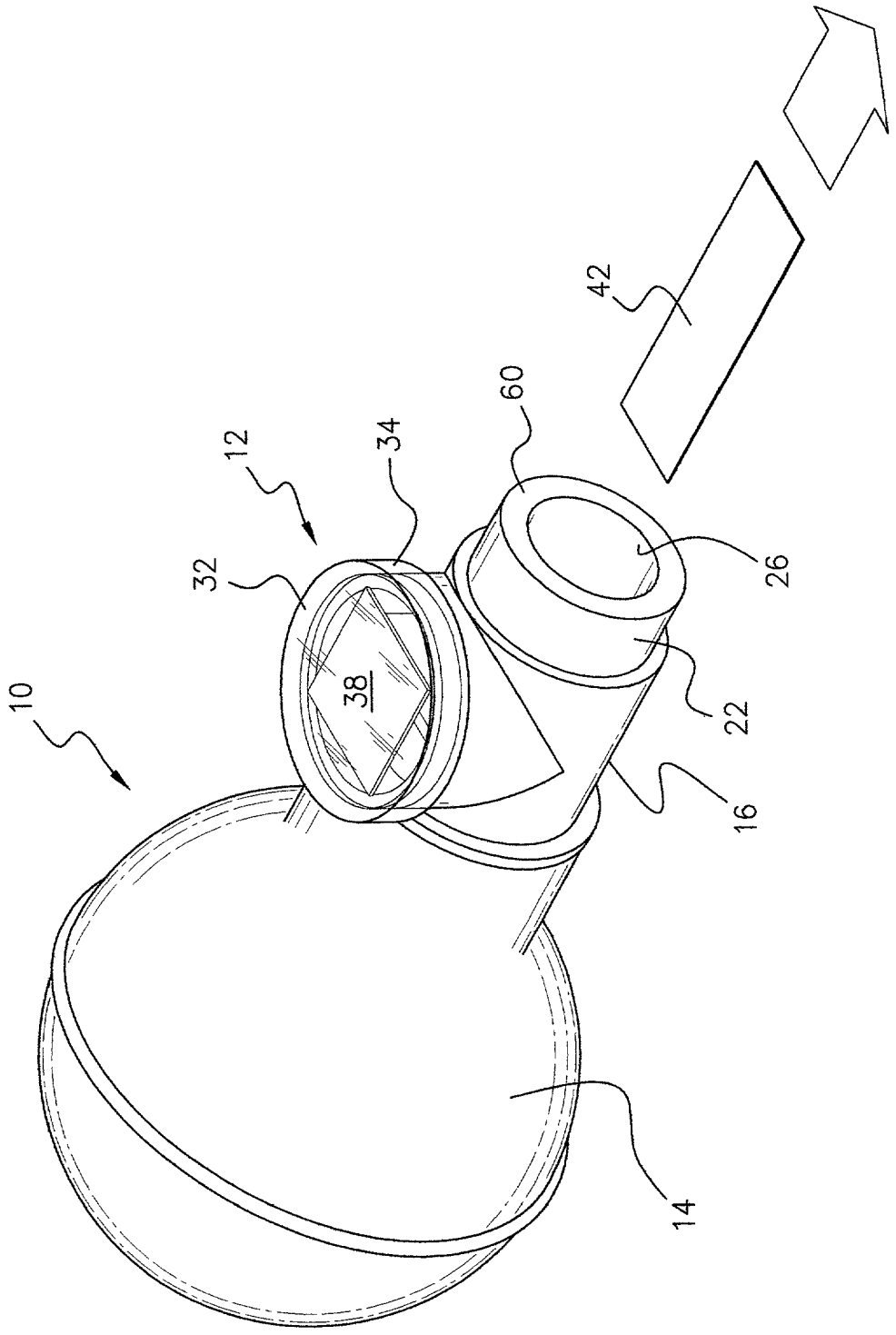


FIG. 5

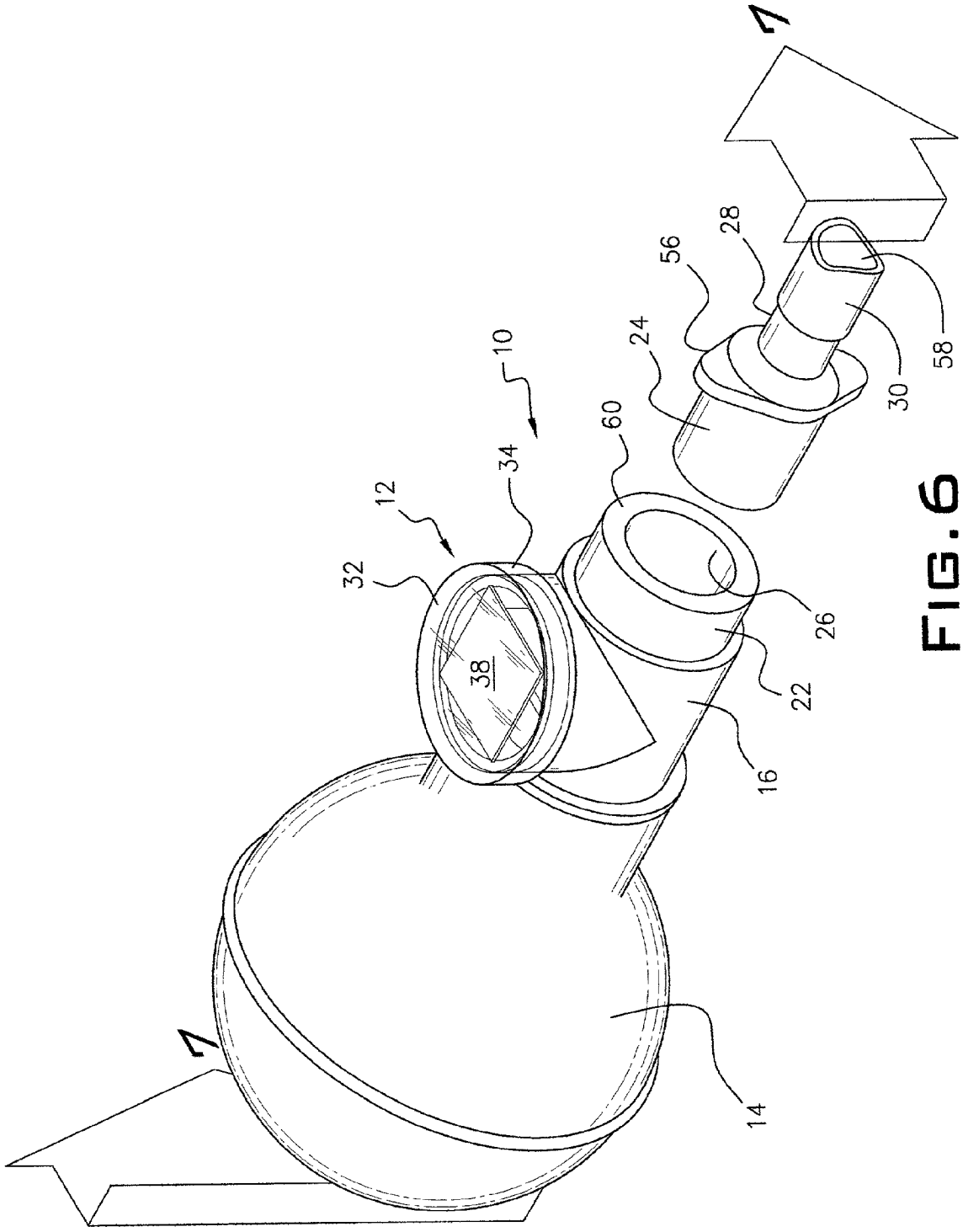


FIG. 6

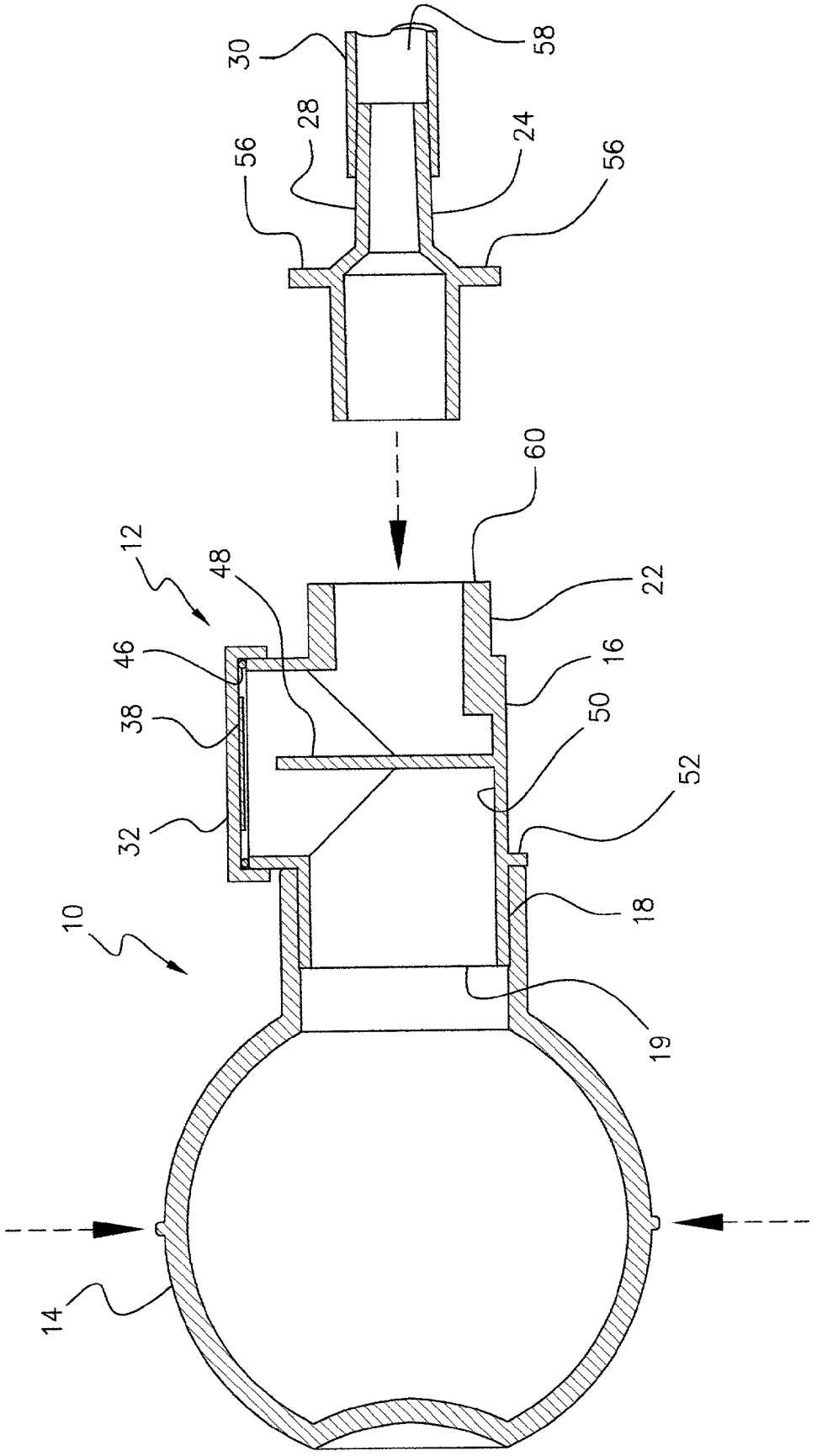


FIG. 7

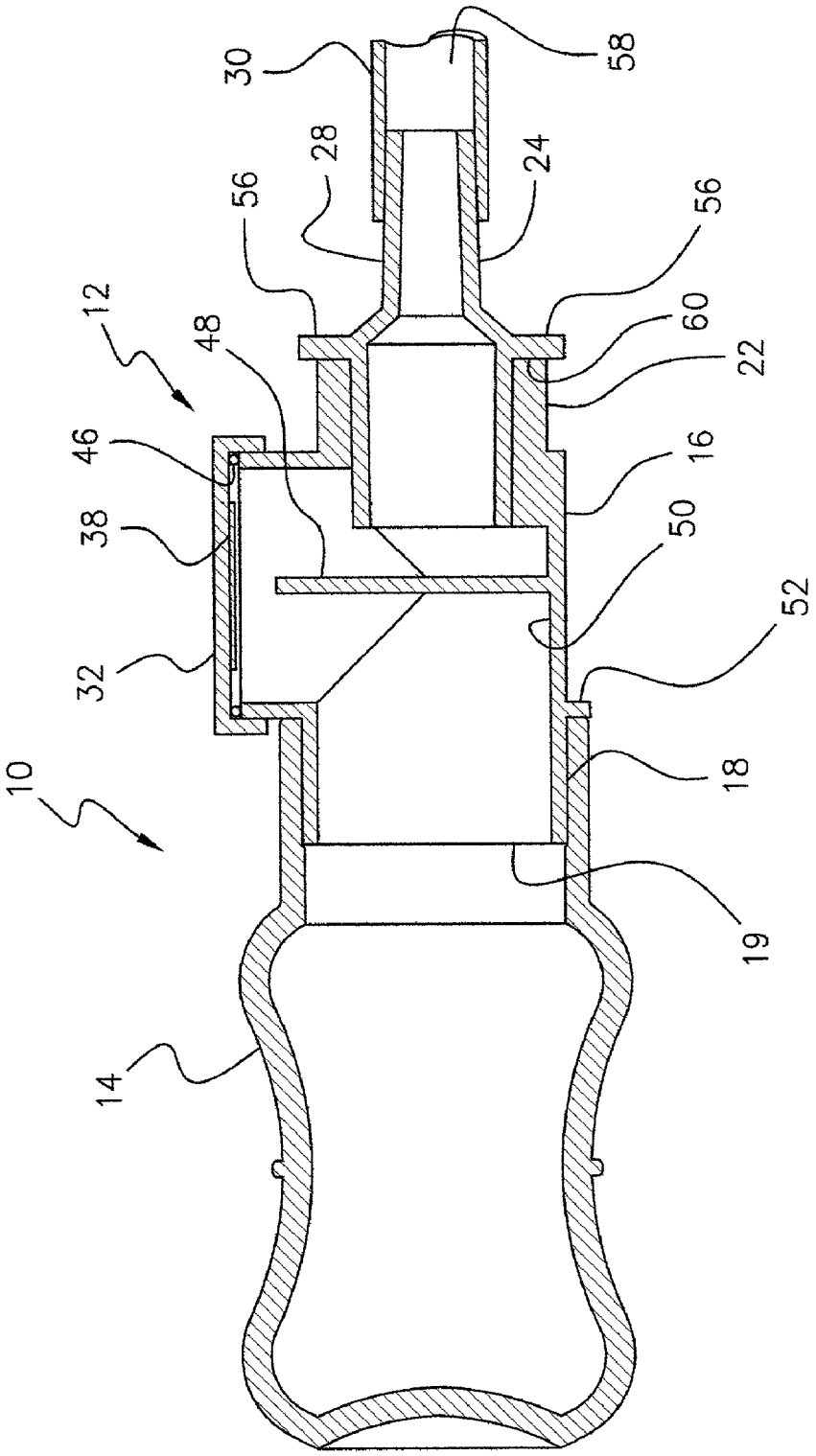


FIG. 8

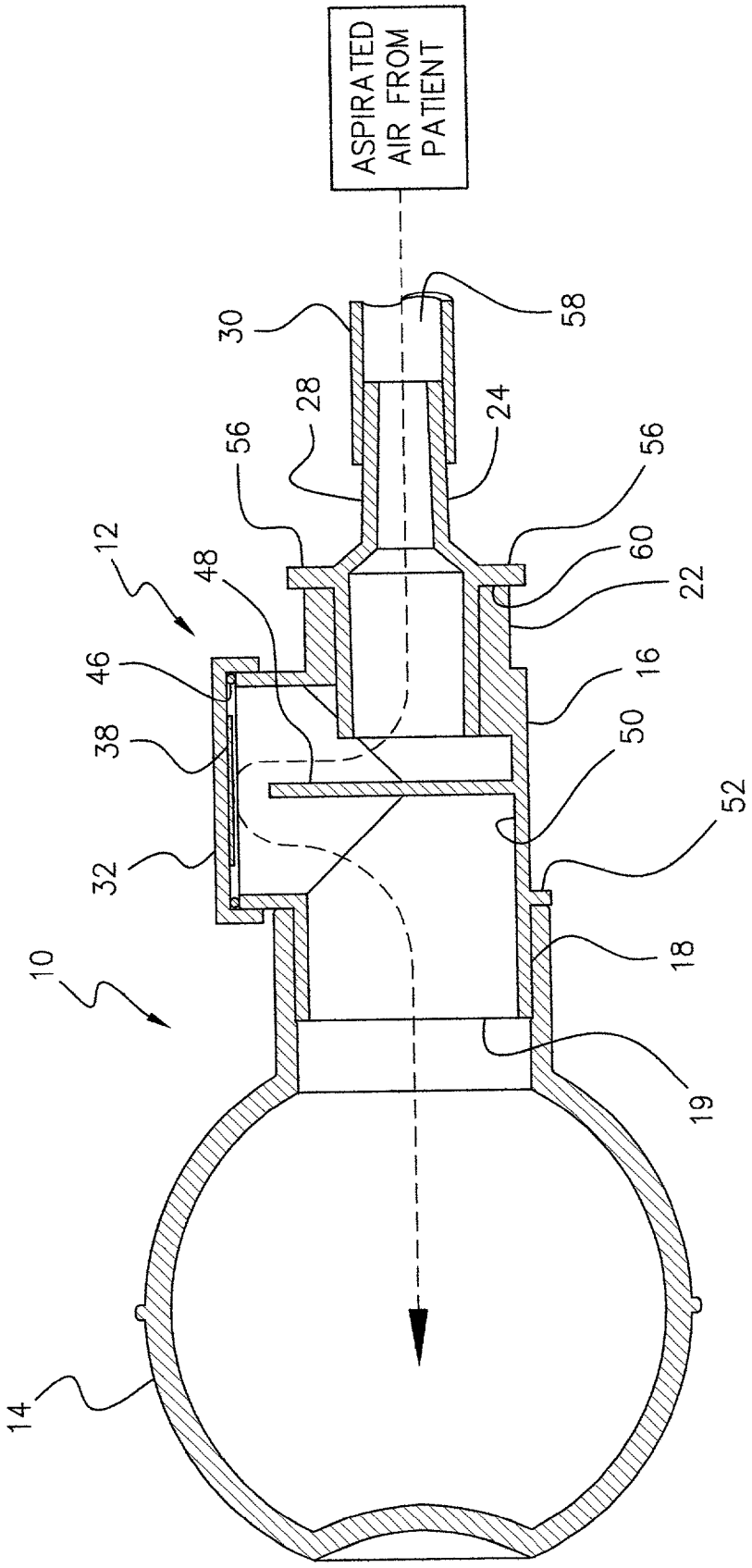

ASPIRATED AIR FROM PATIENT
30
58
28
24
56
56
12
48
60
22
46
16
38
50
52
32
10
18
19
14

FIG. 9

PATIENT ESOPHAGEAL DETECTOR DEVICE IN COMBINATION WITH A CARBON DIOXIDE DETECTOR

FIELD OF THE INVENTION

[0001] This invention relates to carbon dioxide (CO_2) detectors. More particularly, it refers to a housing containing CO_2 calorimetric indicator paper, the housing attached to a bulb style esophageal detector device for detecting CO_2 levels in the aspirated air from a patient following intubation.

BACKGROUND OF THE INVENTION

[0002] U.S. Pat. No. 4,691,701 describes an early portable CO_2 detector in the form of a transparent disc containing a chemical substance exhibiting a color change indication when exposed to carbon dioxide from a patient.

[0003] U.S. Pat. Nos. 5,197,464 and 5,291,879 describe methods of monitoring CO_2 levels in a patient using a reversible indicator solution so that the indicator changes color continuously with the breathing of a patient.

[0004] Other references that include references to CO_2 color change devices are 4,790,327; 4,928,687; 4,994,117; 5,005,572; 5,166,075; 5,179,002; 5,846,836 and 5,965,061.

[0005] A critical step in the intubation of a patient is a determination that the intubation tube or endotracheal tube is placed in the trachea and not in the esophagus. If the tube is in the esophagus, there is no return of CO_2 beyond ambient levels from a patient's aspirated air. If the tube is in the trachea, CO_2 will be present up to about five percent concentration.

[0006] The trachea is substantially rigid because it is made up of C-shaped ridges of rigid cartilagineous rings joined vertically by fibro elastic tissue. The esophagus, on the other hand, is a fibro muscular tube having no intrinsic structure to maintain any rigidity. The use of a bulb at the end of the often used and well known esophageal detector device is based on the principal that the esophagus will collapse when a negative pressure is applied to its lumen, whereas a trachea will not because of its greater rigidity. Normally, an intubation tube is placed in the patient's trachea and a soft rubber bulb is compressed and then attached at one end of the intubation tube. The tube will aspirate gas freely from the patient's lungs without any resistance if the tube is in the trachea when the bulb is released. If the intubation tube is in the esophagus, the negative pressure caused by the bulb will cause the esophagus to collapse and the bulb will stay compressed. Misplacement of the intubation tube can affect the mortality of the patient.

[0007] Since it is common in emergency situations for less highly skilled technicians to apply intubation tubes for maintaining the patient's airway, it is important to have a portable single patient device confirming the proper initial placement of the intubation tube. A CO_2 detector serves this purpose. Although CO_2 detector's exist, the use with an esophageal detector device to provide confirmation of proper intubation tube placement is not known. Such a combined device exhibiting ease of use, low cost and connection to existing breathing apparatus is needed.

SUMMARY OF THE INVENTION

[0008] The invention described herein is an improvement over existing esophageal detector devices used for verifying placement of an intubation tube in a patient's trachea. The CO_2 detector employed in this invention has an easily mountable colorimetric indicator paper that changes color in response to CO_2 levels in aspirated air from a patient. It is easily mountable in communication with an esophageal detector device housing, is lightweight and gives easily readable and reliable CO_2 detection to confirm intubation tube placement in the patient's trachea.

[0009] The preferred CO_2 detector is a clear plastic disc mounted on a rim. Indicator paper is mounted on the inside surface of the plastic disc. Backing paper on the indicator paper is removed prior to use of the detector by pulling on the backing paper protruding from a port in a cylindrical housing on which the rim of the disc is mounted. The backing paper insures that the indicator paper will not be exposed prior to use. The disc rim is glued or heat welded to the esophageal detector housing. A baffle is mounted on an inner wall of the esophageal detector housing between a first and second axially positioned port. The first port is connected to an elastomeric bulb and the second port is connected to an intubation tube adapter leading to an intubation tube for insertion in a patient's trachea. Provided the tube is properly placed, the aspirated air from the patient will cause a color change on the calorimetric indicator paper viewed through the clear plastic cover of the CO_2 detector of this invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The invention can be best understood by those having ordinary skill in the art of patient intubation by following the detailed description when considered in conjunction with the accompanying drawings in which:

[0011] **FIG. 1** is an exploded view in perspective of the indicator paper being affixed to a bottom surface of a disc for the CO_2 detector of the invention.

[0012] **FIG. 2** is a perspective view of folded indicator paper backing prior to insertion into a port of the housing.

[0013] **FIG. 3** is an exploded view in perspective of the bulb and housing components in the esophageal detector device with the CO_2 detector.

[0014] **FIG. 4** is a perspective view of the indicator paper backing inserted into a port on the esophageal detector housing.

[0015] **FIG. 5** is a perspective view of the backing paper being removed from the CO_2 detector.

[0016] **FIG. 6** is a perspective view of the intubation tube adapter being inserted in a port of the esophageal detector housing.

[0017] **FIG. 7** is an elevational view in section of the combined CO_2 detector and esophageal detector device of **FIG. 6** along lines **7-7**.

[0018] **FIG. 8** is an elevational view in section of the combined device of **FIG. 6** showing a compressed soft bulb.

[0019] **FIG. 9** is an elevational view in section of the combined device of **FIG. 6** along line **7-7** showing the route of a patient's aspirated air past the CO_2 detector when the compressed bulb is released.

DETAILED DESCRIPTION OF THE INVENTION

[0020] Throughout the following detailed description, the same reference numerals refer to the same elements in all figures.

[0021] The esophageal detector device **10** with CO_2 detector **12** of this invention shown in **FIG. 6** has several principal components as shown in **FIGS. 3 and 6**. The detector device **10** has a soft elastomeric bulb **14** at a first end of a housing **16**.

[0022] The housing **16** is preferably in the form of a hollow cylinder attached at a first end **18** at a first port **19** to the elastomeric bulb **14** through opening **20** and at a second end **22** to an intubation tube adapter **24** through second port **26**. The first and second ports are preferably axially aligned. Alternatively, housing **16** can have an elliptical, square or other practical geometric shapes and the first and second ports can be offset from each other. The adapter **24** has a tapered insertion end **28** for engagement with an intubation tube **30** as seen in **FIG. 6**.

[0023] The CO_2 detector **12** shown in **FIGS. 1 and 2** has a clear plastic disc **32** attached to an annular rim **34**. Alternatively, the disc can be clear glass. A calorimetric indicator paper **38** or other chemically impregnated substrate is affixed to a bottom surface **36** of the disc **32**. In the case of indicator paper, it is affixed by glue after first removing a bottom section of backing paper **40** as seen in **FIG. 1**. Another section of backing paper **42** is folded downwardly as shown in **FIG. 3** and passes out through second port **26** in housing **16**. The rim **34** is glued, snap-fit or heat welded over a top rim **44** of housing **16**.

[0024] An O-ring **46** seals the CO_2 detector rim **34** to the housing rim **44**. Alternatively, the calorimetric indicator paper can be a saturated paper containing a CO_2 sensitive color change chemical.

[0025] A vertically placed baffle **48** is integral with interior surface **50** of housing **16**. Such baffle **48** protrudes upwardly to a position slightly below rim **44**.

[0026] The elastomeric bulb **14** is attached to first end **18** of housing **16** as seen in **FIG. 3**. A flange **52** acts as a stop against edge **54** of the elastomeric bulb **14**. The intubation tube adapter **24** is inserted into the second port **26**. The flange **56** may engage edge **60** of the housing **16**. The tapered end **28** of the adapter **24** fits into an opening **58** of an intubation tube **30**.

[0027] In operation shown in **FIGS. 8 and 9**, after the intubation tube is placed in the patient's trachea, bulb **14** is squeezed to force air out prior to attaching the housing **16** to the adapter **24**. In the event that the intubation tube is properly placed into the trachea, as the trachea is substantially rigid, air is able to be aspirated from the trachea and the bulb **14** is able to freely re-expand. In addition, the air aspirated from the trachea, containing up to five percent CO_2, will pass over baffle **48** and change the color of the calorimetric indicator paper **38**, which is fully exposed because backing paper **42** has been pulled out through second port **26** as shown in **FIGS. 4 and 5**.

[0028] In the event that the intubation tube is improperly placed into the esophagus, as the esophagus has no intrinsic structure to maintain rigidity, the esophagus will collapse due to the vacuum created by the compressed bulb **14**, thus blocking and sealing the distal end of the intubation tube **30**. The bulb **14** will remain in a compressed state due to the internal partial vacuum. In addition, no aspirated air containing CO_2 will pass over baffle **48** and the color of the calorimetric indicator paper will remain unchanged, therefore warning the caregiver that the intubation tube **30** is not in the trachea and should immediately be reinserted. Absent the use of the calorimetric indicator paper **38** it sometimes occurs that even though the intubation tube **30** is wrongly placed in the esophagus, the bulb **14** reinflates because of a leak, suggesting that the tube is properly placed. The use of the calorimetric indicator paper **38** is therefore a fail-safe method of confirming the proper placement of the intubation tube **30**.

[0029] The components of the invention except for the bulb **14** and O-ring **46** are made of plastic with the disc made of clear plastic although it could be made of clear glass. The remaining components may or may not be made out of the clear plastic. The indicator paper backing **40** and **42** can be any acceptable commercial grade backing paper with a calorimetric indicator **38** such as described in U.S. Pat. Nos. 5,005,572 and 5,965,061, incorporated herein by reference.

[0030] The above description has described specific structural details of the combination CO_2 detector and esophageal detector of this invention. However, it will be within one having ordinary skill in the art to make modifications without departing from the spirit and scope of the underlying invention's inventive concept. The inventive concept is not limited to the structure described, but includes such modifications as would be considered equivalent.

Having thus described the invention, what is claimed and desired to be secured by Letters Patent is:

1. An esophageal detector device in combination with a carbon dioxide (CO_2) detector, the device and detector comprising:

an esophageal detector housing containing a first port connected to an elastomeric bulb, and a second port adapted for receipt of a first end of an intubation tube adapter and a third port between the first and second port; and

a disc overlaying a chemically treated calorimetric indicator paper and a support for the disc affixed to the third port.

2. The esophageal detector device in combination with the CO_2 detector according to claim 1 wherein a baffle is integral with an interior surface of the esophageal detector housing below the third port.

3. The esophageal detector device in combination with the CO_2 detector according to claim 1 wherein the disc is a clear plastic affixed to a rim with the colorimetric indicator paper glued to a bottom surface of the disc.

4. The esophageal detector device in combination with the CO_2 detector according to claim 3 wherein an O-ring is positioned between the rim of the clear plastic disc and a rim of the third port.

5. The esophageal detector device in combination with the CO_2 detector according to claim 1 wherein the esophageal detector housing is cylindrical in shape and the first and second port are in axial alignment with each other.

6. The esophageal detector device in combination with the CO_2 detector according to claim 1 wherein the indicator

paper is partially covered with a backing paper prior to use, the backing paper protruding through the second port in the esophageal detector device and being removed by pulling on the protruding backing paper to fully expose the indicator paper.

7. A carbon dioxide (CO_2) detector for use in combination with an esophageal detector, the CO_2 detector portion comprising:

a clear plastic disc seated on a rim affixed to the rim of a third port on a housing of the esophageal detector, the esophageal detector having a first and second port on each side distal from the third port,

a top surface of a calorimetric indicator paper affixed to a bottom surface of the clear plastic disc and a backing paper remaining on a bottom surface of the indicator paper, the backing paper protruding out of the second port on the esophageal detector and an elastomeric bulb attached to the first port of the esophageal detector, the backing paper having been pulled out of the second port prior to attachment of an intubation tube adapter to the second port.

8. The CO_2 detector and esophageal detector according to claim 7 wherein the CO_2 detector rim is snap-fit to the third port.

9. The CO_2 detector and esophageal detector according to claim 7 wherein the CO_2 detector rim is heat welded to the third port.

10. The CO_2 detector and esophageal detector according to claim 7 wherein the CO_2 detector rim is glued to the third port.

11. The CO_2 detector and intubation device according to claim 7 wherein a baffle is mounted on an inner surface of the esophageal detector housing and positioned to rise vertically to slightly below the indicator paper at the third port.

12. The CO_2 detector and esophageal detector device according to claim 7 wherein a flange on an outer surface of the adapter engages an outer edge of the esophageal detector housing and a flange on the esophageal detector housing engages an edge of an opening to the elastomeric bulb.

13. The CO_2 and esophageal detector device according to claim **7** wherein the esophageal detector housing is cylindrical in shape.

14. The CO_2 detector and esophageal detector device according to claim 7 wherein the first and second port on the esophageal detector device are in axial alignment.

15. An esophageal detector device in combination with a carbon dioxide (CO_2) detector, the device and detector comprising:

an esophageal detector housing containing a first port connected to an elastomeric bulb, and a second port adapted for receipt of a first end of an intubation tube adapter and a third port between the first and second port;

a disc overlaying a chemically treated calorimetric indicator paper and a support for the disc affixed to the third port; and

the intubation tube adapter affixed at a first end to the second port and affixed at a second end to an intubation tube.

* * * * *