

**A DEVICE FOR REDUCING LIQUID INGRESS INTO A TUBE
AND
AN ASSEMBLY COMPRISING SAID DEVICE AND SAID TUBE**

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TECHNICAL FIELD

Various embodiments relate to a device for reducing liquid ingress into a tube and an assembly comprising said device and said tube.

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BACKGROUND

A pitot tube may be used as a pressure measurement instrument to measure fluid flow velocity. For example, a pitot tube may be used to determine the airspeed of an aircraft or to measure air and gas velocities in various industrial applications. A pitot tube may comprise an open tube for pointing directly into a fluid flow. The fluid flow may be brought into stagnation in the tube, for example, the pitot tube may have no outlet. A pressure of the fluid flow in the tube can be measured. This pressure can be used as the stagnation pressure of the fluid, also known as the total pressure or, particularly in aviation, the pitot pressure.

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It is known to mount a pitot tube to an aircraft in order to measure airspeed of the aircraft in flight. In this case, a static pressure may be measured using static ports on a side of the aircraft. The dynamic pressure may be calculated as the difference between the stagnation pressure determined via the pitot tube and the static pressure determined via the static ports. The dynamic pressure can be used to determine the airspeed of the aircraft.

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The accuracy of the pitot tube may be degraded by ingress of liquid into the pitot tube.

30 **SUMMARY**

Various embodiments provide a device for reducing liquid ingress into a tube, the device comprising: a coupling portion adapted to couple the device to the tube, a guiding channel portion comprising a tubular portion and adapted to receive gas and liquid moving relatively towards an inlet of the device, and a plurality of diverting channel portions circumferentially distributed around a sidewall of the tubular portion and adapted to divert the liquid away from an inlet of the tube, the diverting channel portions being in fluid communication with the guiding channel portion, wherein the guiding channel portion is configured in use to guide the gas into the inlet of the tube, but guide the liquid into respective inlets of the diverting channel portions.

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In an embodiment, a size of the inlet of the diverting channel portion is greater than a size of the inlet of the tube.

5 In an embodiment, a distance between the inlet of the device and the inlet of the diverting channel portion is set in dependence on a pre-determined speed at which the device moves relatively towards the gas and liquid.

In an embodiment, the guiding channel portion comprises a tubular portion.

10 In an embodiment, the inlet of the device comprises an inlet of the tubular portion.

In an embodiment, the coupling portion comprises an outlet portion of the tubular portion, the outlet portion being adapted to receive a portion of the tube.

15 In an embodiment, the diverting channel portion comprises a bore through a sidewall of the tubular portion.

In an embodiment, the bore is positioned in an inlet end portion of the tubular portion.

20 In an embodiment, a longitudinal axis of the bore is at an angle of 7° to 35° to a longitudinal axis of the tubular portion.

In an embodiment, the device further comprises a plurality of diverting channel portions circumferentially distributed around the sidewall of the tubular portion.

25 In an embodiment, the plurality comprises an odd number of diverting channel portions.

In an embodiment, a diverting channel portion is present at a lowest portion of the tubular portion.

30 In an embodiment, the sidewall of the tubular portion is continuous at a highest portion of the tubular portion.

35 In an embodiment, the inlet of the device comprises a chamfered leading edge to promote separation of gas and/or liquid at the inlet of the device.

In an embodiment, the device is made of a thermally insulating material.

In an embodiment, the device is made of a non-absorbent material and/or a material having a low surface energy.

5 Various embodiments provide an assembly comprising: a tube having an inlet in fluid communication with an internal bore, and a device for reducing liquid ingress into the tube as described herein.

10 In an embodiment, the assembly further comprises a connector for connecting the internal bore of the tube to a pressure measuring device.

In an embodiment, an external surface of an inlet portion of the tube comprises a tapered portion, wherein the taper diverges in a direction from the inlet of the tube.

15 In an embodiment, the internal bore at an inlet portion of the tube comprises a tapered portion, wherein the taper converges in a direction from the inlet of the tube.

In an embodiment, the inlet of the tube comprises a rounded inner leading edge to promote a consistent stream of gas to enter the internal bore of the tube.

20 In an embodiment, the device is configured to receive a portion of the tube to couple the device to the tube.

25 In an embodiment, an internal surface portion of the device is adapted to couple to an external surface portion of the tube via an interface fit, and wherein a contact point of the interface fit is located adjacent the inlet of the or each diverting channel portion.

30 In an embodiment, the device is configured to receive the portion of the tube to locate the inlet of the tube adjacent to the inlet of the or each diverting channel portion of the device.

In an embodiment, the tube is a pitot tube.

35 In an embodiment, the tube further comprises a mounting portion for mounting the assembly to a vehicle.

In an embodiment, the vehicle is an unmanned aerial vehicle.

BRIEF DESCRIPTION OF THE DRAWINGS

5 Embodiments of the invention will be better understood and readily apparent to one of ordinary skill in the art from the following written description, by way of example only, and in conjunction with the drawings, wherein like reference signs relate to like components, in which:

10 Figure 1 shows a picture illustrating an environment in which an embodiment may operate;

15 Figure 2 shows an embodiment in a separated configuration, wherein Figure 2a provides a perspective view and Figure 2b shows a cross-section view along line A-A' of Figure 2a;

Figure 3 shows the embodiment of Figure 2 in a coupled configuration, wherein Figure 3a shows a perspective view and Figure 3b shows a cross-section view along line B-B' of Figure 3a;

20 Figure 4a shows a side view of a portion of an embodiment, whereas Figure 4b shows a cross-section view along line C-C' of Figure 4a;

25 Figures 5a to 5e show a series of diagrams representing an exemplary operation of an embodiment;

Figure 6 shows a cross section view of a portion of an embodiment; and

Figure 7 shows a cross section view of a portion of an embodiment.

30 DETAILED DESCRIPTION

Figure 1 illustrates an example environment in which some embodiments are intended to operate. Referring to Figure 1, there is shown a device 2 for reducing liquid ingress into a tube 4. For example, the tube 4 may be a pitot tube. Additionally, the tube 4 may be mounted on a wing 6 of an aircraft, for example, an unmanned aerial vehicle. The tube 4 may be used to measure the airspeed of the aircraft. For example, the tube 4 may be used to determine a stagnation pressure, whereas a static pressure may be measured by one or more static ports (not shown) of the aircraft. The airspeed may be determined from a dynamic pressure, being a difference between the stagnation and static pressures. The device 2 and the tube 4 may

comprise an assembly in accordance with an embodiment. It is to be understood that in some other embodiments, the device 2 and tube 4 may be attached to another part of the aircraft, for example, a nose portion or a fuselage portion.

- 5 Figures 2a, 2b, 3a, 3b, 4a and 4b illustrate a device 100 and a tube 200 in accordance with an embodiment. Figures 2a and 2b illustrate the device 100 and the tube 200 in a separated configuration, whereas Figures 3a, 3b, 4a and 4b illustrate the device 100 and the tube 200 in coupled configuration. The device 100 may comprise a guiding channel portion 104 with an inlet 106 and an outlet 108. The guiding channel portion 104 may comprise a tubular portion.
- 10 The device 100 may comprise one or more diverting channel portions 110. The or each diverting channel portion 110 may be positioned towards an inlet 106 end portion of the guiding channel portion 104. The or each diverting channel portion 110 may comprise a bore through a sidewall of the guiding channel portion 104. The guiding channel portion 104 may be in fluid communication with the or each diverting channel portion 110. As seen more
- 15 particularly on Figure 4a, the device 100 may comprise an odd number of diverting channel portions 110, such as, for example, five diverting channel portions 110. The diverting channel portions 110 may be circumferentially distributed around a sidewall of the tubular portion of the guiding channel portion 104. In an embodiment, each diverting channel portion 110 is located at the same axial distance from the inlet 106 of the guiding channel portion 104. As
- 20 seen more particularly on Figure 2a, a longitudinal axis of the or each diverting channel portion 110 may be at an angle of about 7° to about 35° to a longitudinal axis of the guiding channel portion 104 depending on a wall thickness of device 100 and location of the inlet 204 of the tube 200. As demonstrated on Figure 3b, the inlet 204 of the tube 200 may be positioned within line D-D', representing the receiving portion of diverting channel portion 110
- 25 of device 100.

- As seen more particularly on Figure 4b, a diverting channel portion 110 may be present at a lowest portion (y) of the guiding channel portion 104, for example, at a lowest portion of the tubular portion of the guiding channel portion 104. However, a diverting channel portion 110
- 30 may be absent at a highest portion (x) of the guiding channel portion 104, for example, the sidewall of the tubular portion of the guiding channel portion 104 may be continuous. It is noted that 'lowest' and 'highest' relate to the device when orientated as indicated in Figure 4, i.e. where 'lowest' is closest to the ground and 'highest' is furthest from the ground.

- 35 The device 100 may include a coupling portion adapted to couple the device to the tube 200. In an embodiment, the coupling portion of the device 100 may be configured in use to receive a portion of the tube 200 in order to couple together the device 100 and tube 200. For example, the outlet 108 of the guiding channel portion 104 may be configured in use to receive the inlet 204 of the tube 200. In this way, when the device 100 and tube 200 are

pushed together, the device 100 may couple to (i.e. mate with) the tube 200 via an interface fit. Accordingly, an outlet 108 end portion of the device 100 may include a coupling portion of the device 100.

5 As seen more particularly on Figure 2b, the tube 200 has the inlet 204 in fluid communication with an internal bore 206. The tube 200 may comprise a tapered portion 208 having an external surface with a diverging taper from the inlet 204, i.e. the taper diverges in a direction from the inlet 204 and along the tube's outer surface. . The tapered portion 208 may be at an inlet end portion of the tube 200. The tube 200 may also comprise a first constant diameter portion 210 adjacent the tapered portion 208, wherein the first constant diameter portion 210 has a first outer diameter. The tube 200 may also comprise a second constant diameter portion 212 adjacent the first constant diameter portion 210, wherein the second constant diameter portion 212 has a second outer diameter. The first outer diameter may be smaller than the second outer diameter. A step 214 may be present at the interface between the outer surface of the first and second constant diameter portions. The first outer diameter may be slightly less than the internal diameter of the guiding channel portion 104 of the device 100. The second outer diameter may be substantially the same of the outer diameter of the guiding channel portion 104. Accordingly, the taper of the tapered portion 208 may facilitate easy entry of the tube 200 into the device 100 to mate the two components together. When the tube 200 is fitted far enough into the device 100, the outer surface of the first constant diameter portion 210 may abut the inner surface of the guiding channel portion 104 in order to fix the two components together via an interface fit. In this manner, the outer surface of the first constant diameter portion 210 may form at least part of a coupling portion of the tube 200, whereas the inner surface of the guiding channel portion 104 may be form at least part of a coupling portion of the device 100. The location of the step 214 may repeatably locate the tube 200 within the device 100 at the same location. The outer diameter of the second constant diameter portion 212 may ensure that the outer surface of the device 100 is flush with the outer surface of the tube 200. This configuration can be seen more particularly on Figure 3 and 4.

30 As seen more particularly on Figure 2b and 3b, the internal bore 206 of the tube 200 may comprise a converging tapered portion from the inlet 204 of the tube 200, i.e. the taper converges in a direction from the inlet 204 and along the tube's inner surface. The tapered portion may be positioned at an inlet end portion of the tube 200. The inlet 204 of the tube 200 may comprise a rounded inner leading edge to promote a consistent stream of gas to enter into the internal bore 206. The internal bore 206 of the tube 200 may have a constant diameter portion after the converging tapered portion, i.e. the tube 200 may have a constant inner diameter after the converging tapered portion.

The internal bore 206 of the tube 200 may be connected to a measuring device (not shown), for example, a pressure measuring device, via a connector 300. The tube 200 may comprise a connector socket 220 for receiving at least part of the connector 300. Accordingly, when the connector 300 is plugged into the socket 220, the measuring device coupled to the connector 300 may be able to measure a pressure in the internal bore 206. An outer portion of the tube may comprise a mounting portion 216. In an embodiment, the mounting portion 216 may extend from the tube 200 at an opposite end portion of the tube 200 to the inlet 204. The mounting portion 216 may be for mounting the assembly onto the aircraft, for example, an unmanned aerial vehicle.

Referring to Figure 3b, the tube 200 may be mated with the device 100 in the manner described above. As mentioned above, the tube 200 may be coupled with the device 100 via an interface fit. When the device 100 and the tube 200 are mated together, the geometries of the device 100 and the tube 200 may be set to define a specific interface fit configuration. For example, a start of the contact area of the interface fit may be located adjacent an edge of an inlet of the or each diverting channel portion 110, wherein the edge is the edge which is furthest the inlet 106. An end of the contact area of the interface fit may be located at the step 214. In this way, it may be possible to avoid gaps within which liquid can pool and cause corrosion.

In use, the device 100 may be connected to the tube 200 as described above to form an assembly. In an embodiment, the assembly may be fixed to an aircraft, such as, for example, an unmanned aerial vehicle. In this configuration, the guiding channel portion 110 of the device 100 may be adapted to receive gas (e.g. air) and liquid (e.g. rain) moving relatively towards the inlet 106. For example, the device 100 may be attached to a tube 200 which is mounted on an aircraft that is flying towards the gas and liquid. Additionally or alternatively, the gas and liquid may be travelling towards the device 100 as a result of current weather conditions. In this situation, the guiding channel portion 104 is configured in use to guide gas which enters the device 100 via inlet 106 into the tube 200 via inlet 204. However, the guiding channel portion 104 is configured in use to guide liquid which enters the device 100 via the inlet 106 into the one or more diverting channel portions 110. In turn, the or each diverting channel portion 110 is configured in use to divert the liquid received from the guiding channel portion 110 away from the inlet 204 of the tube 200.

In an embodiment, the inlet 106 of the guiding channel portion 104 may comprise a chamfered leading edge. In use, the chamfered leading edge may promote separation of gas and/or liquid at the inlet 106 of the device 100. Accordingly, if liquid is present, the liquid may be carried away with the separating free stream along an outer surface of the device 100, for

example, an outer surface of the guiding channel portion 104. In this way, the device 100 may reduce the amount of liquid which enters the device 100 via inlet 106.

5 In an embodiment, it is more difficult for unwanted liquid, for example rain, to directly enter through the top of the device 100 since no diverting channel portion 110 is present at the highest portion of the tubular portion of the guiding channel portion 106. The remaining diverting channel portions 110 may be offset to the side and, therefore, rain droplets are less likely to enter the device 100 since the inlet of the diverting channel portion 110 may be tilted with respect to the entry angle of the rain, thereby reducing the effective size of the inlet.

10 Moreover, any rain which does enter the device 100 via a diverting channel portion 110 may be diverted around the inner surface of the device 100 and exit at the lower diverting channels 110 by virtue of gravity. Additionally, tiny droplets of rain are likely to adhere to the taper portion 208 of device 200 and may be carried away by the fast flowing free-stream readily. In this way, the device 100 may function to prevent liquid from entering the tube 200.

15 In view of the above, advantageously, fluid which may enter the device 100 via an upper or the uppermost diverting channel portion 110 may articulate around the outer surface of the tube 200 and exit the device 100 via a lower or the lowermost diverting channel portion 110. In this way, the device 100 may function to prevent liquid from entering the tube 200.

20 Referring to Figures 5a to 5e and in accordance with an embodiment, there is shown a series of diagrams representing an exemplary sequence of events involved in the device 100 guiding and diverting droplets of liquid away from the tube 200. In Figure 5a, a droplet 500 is moving relatively towards the inlet of the device 100, for example, the device 100 may be moving towards the droplet 500 and/or the droplet 500 may be moving towards the device 100. In Figure 5b, a portion (not shown) of the droplet 500 is separated from the remainder of the droplet 500 by the chamfered leading edge of the inlet 106 of the device 100. Nevertheless, some liquid is received into the guiding channel portion 104 via the inlet 106. In Figure 5c, the liquid is guided by the guiding channel portion 104. This function may be achieved due to the

25 fluid's natural adhesiveness to surface characteristic. In Figure 5d, the liquid is separated and each separate part is guided into one of the diverting channel portions 110 as a result of the fluid's natural adherence to the inner surface of the guiding and diverting channel portions. Accordingly, as shown in Figure 5e, the liquid is diverted away from the inlet 204 of the tube 200. In this way, the liquid is prevented from entering the internal bore 206 of the tube 200.

35 In an embodiment, the size of the inlet of the or each diverting channel portion 110 of the device 100 is bigger than the size of the inlet 204 of the tube 200. Accordingly, a larger amount of the liquid will be guided from the guiding channel portion 104 into the diverting channel portions 110 than the amount of liquid which enters the tube 200 via inlet 204.

Accordingly, the diverting channel portions 110 function to divert a majority of the liquid from the guiding channel portion 104 away from the inlet 204 of tube 200.

5 In an embodiment, liquid droplets which are significantly smaller than the inlet 106 may enter the guiding channel portion 104. In this case, these liquid droplets will hit the inside surface of the guiding channel portion 104 and will flow along the inside surface due to the liquid's viscosity. This function is the result of the fluid's natural adherence to the inner surface of the guiding and diverting channel portions. Accordingly, the liquid flowing along the inside surface of the guiding channel portion 104 will eventually enter one of the diverting channel portions 10
10 110 and, therefore, will be guided (i.e. diverted) away from the inlet 204 of tube 200. Accordingly, the diverting channel portions 110 function to divert a majority of the liquid from the guiding channel portion 104 away from the inlet 204 of tube 200.

15 In an embodiment, the guiding and diverting of the liquid by the guiding channel portion 104 and the diverting channel portion 110 may be influenced by the natural behavior and properties of the liquid received at the inlet 106. For example, the viscosity, surface tension, and density of the liquid may ensure that the liquid is caught by the guiding channel portion 104 and guided towards the diverting channel portions 110. By the same accord, the guiding of the gas into the tube 200 by the guiding channel portion 104 may be influenced by the
20 the natural behavior and properties of the gas received at the inlet 106. For example, the viscosity, surface tension and density of the gas may ensure that a proportion of the gas is permitted to enter via the inlet 106 and continue to the inlet 204 without being diverted to the diverting channel portions 110. Specifically, the difference between the viscosity, surface tension and density of liquid compared to gas may result in the liquid taking a different path
25 through the device as the gas.

In an embodiment, an assembly including device 100 and tube 200 may allow a constant stream of gas to be fed into inlet 204, while allowing a stream of gas that is able to pick up residual liquid within the guiding channel portion 104 and guide it through the diverting
30 channel portions 110 and away from the tube 200, thereby demonstrating the water repelling characteristic of the assembly. In view of the above, some liquid may enter the device 100 through the inlet 106. This liquid may temporarily remain in the device 100 before being expelled into the atmosphere via the diverting channel portions 110. Accordingly, such liquid will have only a negligible effect on pressure measurements taken using the tube 200.
35 Additionally, as mentioned previously, liquid entering the device 100 through the diverting channel portions 110 will only have a negligible effect on pressure measurements taken using the tube 200.

In an embodiment, the efficiency of the liquid diverting action may be related to the material properties of the device. In an embodiment, the efficiency of the liquid diverting action may be related to the geometry of the device. For example, that the liquid diverting action is more effective, the device 100 may be constructed from a material having a low surface energy, such as, for example, Telfon™, Ceramic, Glass, Sapphire, Polished Stainless Steel, etc. Additionally or alternatively, to encourage the liquid to run off the device surface rather than adhere to it, the device 100 may be made of a non-absorbent material with a smooth surface finish, such as, for example, Telfon™, Ceramic, Glass, Sapphire, Polished Stainless Steel, etc. In an embodiment, the device may be made of hydrophobic surfaces to prevent liquid from adhering to the surface and, instead, encourage the liquid to run off the device.

Referring to Figure 6 and in accordance with an embodiment, there is shown a schematic diagram of a falling trajectory of a fluid (e.g. rain) droplet after it has entered the inlet 106 of the device 100. An angle, ϕ , of trajectory of the fluid fall from the inlet 106 of the device 200 would be:

$$\phi = \tan^{-1}[V_{rv}/V_{dh}]$$

where

V_{rv} is the vertical velocity of the fluid droplet, and

V_{dh} is the horizontal velocity of the device of moving relatively towards to the fluid droplet.

For example, if the device (e.g. mounted on an aircraft) moves at a velocity of 25m/s and the fluid droplet falls at 9m/s:

$$\phi = \tan^{-1}[9/25] \approx 19.80^\circ$$

For example, if the device (e.g. mounted to an aircraft) moves at a velocity of 25m/s and the fluid droplet falls at 13m/s:

$$\phi = \tan^{-1}[13/25] \approx 27.47^\circ$$

By calculating the falling angle ϕ of a fluid droplet at a specified velocity, it is possible to determine the distance travelled by the fluid droplet into the device 100 from the inlet 106. Accordingly, with a known diameter of the device 100 (i.e. a known diameter of the guiding channel portion 104), it is possible to set a distance L between the inlet 106 and the middle of the inlet of the or each diverting channel portion 110 in dependence on a predetermined speed (e.g. intended cruising speed) at which the device moves relatively towards the gas and liquid. In other words, the length L (being the distance from the device inlet 106 to the

tube inlet 204) may be set in dependence on the predetermined speed of the aircraft to which the assembly is mounted. Specifically, the geometry of the device 100 and/or the tube 200 may be configured so that when the two components are mated together the inlet 106 and the inlet 204 are separated by a distance L. Advantageously, the distance L can be set such that at the predetermined speed, fluid droplets will enter the inlet 106 and directly exit the device via a diverting channel portion 110, as indicated in Figure 6 by 600. Additionally or alternatively, the distance L can be set such that at the predetermined speed, fluid droplets will enter the inlet 106, impact an inner wall of the guiding channel portion 104, and be guided out of the device via a diverting channel portion 110, as indicated by 602.

Referring to Figure 7 and in accordance with an embodiment, there is shown a schematic diagram of a portion of an assembly 700 comprising a device 702 and a tube 704. In an embodiment, the device 702 and/or the tube 704 is made of a thermally insulating material, such as, for example, TeflonTM, delrin or polymer. Such an arrangement may keep thermal interaction between device 702, the tube 704 and the atmosphere at a minimum. As the moving gas is brought to stagnation after it has entered into the tube 704, a higher velocity gas flow is experienced on an outer surface 706 of the tube 704. Accordingly, the outer surface 706 of the tube 704 may be at a lower temperature than an inner surface 708 of the tube 704 because of an insulating effect produced by the tube's material. Since condensation can occur on the cooler surface, fluid droplets may be formed on the outer surface 706 of the tube 704. Due to the location of the inlets of the diverting channel portions 710 with respect to the tube outer surface 706, these fluid droplets may rapidly repel out to the atmosphere through the diverting channel portions 710. Advantageously, condensation within the tube 704 may be minimized.

It is to be understood that in the above-described embodiments, the device, the guiding channel portion and the diverting channel portions have a circular cross-section. However, in some other embodiments, one or more of these components could comprise a different shaped cross section, for example, a non-circular shape, such as, an irregular shape or a square shape.

In an embodiment, the thickness of the guiding channel portion could vary. In an embodiment, the diameter of the guiding channel portion could vary, for example, it could taper inwards or outwards towards the diverting channel portions and tube. In an embodiment, the length of the guiding channel portion could vary.

It is to be understood that in the present embodiment, there are shown five diverting channel portions evenly distributed (e.g. radially and axially) around the circumference of the guiding channel portion. This arrangement is advantageous since an evenly distributed arrangement

can improve aerodynamics. However, in some other embodiments, the number of diverting channels could be different, for example, there could be more or less than five diverting channel portions. Additionally, in some embodiments, the diverting channel portions could be unevenly distributed (e.g. radially and/or axially) around the circumference of the guiding channel portion.

In the above-described embodiments, the size of each diverting channel portion is constant. In some other embodiments, the size of the diverting channel portions could vary. For example, the lowermost diverting channel portion may be larger (i.e. a larger bore diameter) than the other diverting channel portions to promote drainage of fluid from the device.

In the above-described embodiments, the longitudinal axis of each diverting channel portion is at the same angle with respect to the longitudinal axis of the guiding channel portion. In some other embodiments, the longitudinal axis of some diverting channel portions may be at a different angle to the longitudinal axis of the tubular portion as the longitudinal axis of other diverting channel portions.

In an embodiment, the or each diverting channel portion may comprise an individual tubular portion extending from the guiding channel portion in addition to, or instead of, comprising a bore through a sidewall of the guiding channel portion.

In an embodiment, additional coupling means may be provided to attach the device to the tube. For example, mechanical fixtures may be used, such as, nails, tacks or screws.

An advantage of the above-described embodiments is that the device may function to reduce the chances of the tube becoming clogged by fluid and/or condensation. Accordingly, pressure measurements taken using the tube may be more accurate. In turn, airspeed measurements calculated using the pressure measurements may be more accurate.

An advantage of the above-described embodiments is that the device may prevent fluid entering the tube and, therefore, causing damage to a pressure sensor monitoring a pressure within the internal bore of the tube.

In an embodiment, exemplary dimensions for the device are: an outer diameter of about 6mm and a length of about 55mm. In other embodiments, dimensions for the device may vary.

In an embodiment, exemplary dimensions for the tube are: an outer diameter of the first constant diameter portion of about 4.4mm and a length of about 28mm for the tapered portion

plus the first constant diameter portion. In other embodiments, dimensions for the tube may vary.

- 5 It will be appreciated by a person skilled in the art that numerous variations and/or modifications may be made to one or more of the above-described embodiments without departing from the spirit or scope of the invention as broadly described in the appended claims. The above-described embodiments are, therefore, to be considered in all respects to be illustrative and not restrictive.

CLAIMS

1. A device for reducing liquid ingress into a tube, the device comprising:
 - a coupling portion adapted to couple the device to the tube,
 - 5 a guiding channel portion comprising a tubular portion and adapted to receive gas and liquid moving relatively towards an inlet of the device, and
 - a plurality of diverting channel portions circumferentially distributed around a sidewall of the tubular portion and adapted to divert the liquid away from an inlet of the tube,
 - the diverting channel portions being in fluid communication with the guiding channel portion,
 - 10 wherein the guiding channel portion is configured in use to guide the gas into the inlet of the tube, but guide the liquid into respective inlets of the diverting channel portions.
2. The device of claim 1, wherein a size of an inlet of the diverting channel portions is greater than a size of the inlet of the tube.
- 15 3. The device of claim 1 or 2, wherein a distance between the inlet of the device and an inlet of the diverting channel portions is set in dependence on a pre-determined speed at which the device moves relatively towards the gas and liquid.
- 20 4. The device of any one of the preceding claims, wherein the inlet of the device comprises an inlet of the tubular portion.
- 25 5. The device of claim 4, wherein the coupling portion comprises an outlet portion of the tubular portion, the outlet portion being adapted to receive a portion of the tube.
6. The device of any one of the preceding claims, wherein each of the diverting channel portions comprises a bore through the sidewall of the tubular portion.
- 30 7. The device of claim 6 when dependent on claim 4, wherein the bore is positioned in an inlet end portion of the tubular portion.
8. The device of claim 6 or 7, wherein a longitudinal axis of the bore is at an angle of 7° to 35° to a longitudinal axis of the tubular portion.
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9. The device of any one of the preceding claims , wherein the plurality comprises an odd number of diverting channel portions.

10. The device of any one of the preceding claims , wherein a diverting channel portion is present at a lowest portion of the tubular portion.

11. The device of any one of the preceding claims, wherein the sidewall of the tubular portion is continuous at a highest portion of the tubular portion.

12. The device of any preceding claim, wherein the inlet of the device comprises a chamfered leading edge to promote separation of gas and/or liquid at the inlet of the device.

13. The device of any preceding claim, wherein the device is made of a thermally insulating material.

14. The device of any preceding claim, wherein the device is made of a non-absorbent material and/or a material having a low surface energy.

15. An assembly comprising:
a tube having an inlet in fluid communication with an internal bore, and
a device for reducing liquid ingress into the tube as claimed in any preceding claim.

16. The assembly of claim 15 further comprising a connector for connecting the internal bore of the tube to a pressure measuring device.

17. The assembly of claim 15 or 16, wherein an external surface of an inlet portion of the tube comprises a tapered portion, wherein the taper diverges in a direction from the inlet of the tube.

18. The assembly of any one of claims 15 to 17, wherein the internal bore at an inlet portion of the tube comprises a tapered portion, wherein the taper converges in a direction from the inlet of the tube.

19. The assembly of any one of claims 15 to 18, wherein the inlet of the tube comprises a rounded inner leading edge to promote a consistent stream of gas to enter the internal bore of the tube.

20. The assembly of anyone of claims 15 to 19, wherein the device is configured to receive a portion of the tube to couple the device to the tube.

5 21. The assembly of anyone of claim 20, wherein an internal surface portion of the device is adapted to couple to an external surface portion of the tube via an interface fit, and wherein a contact point of the interface fit is located adjacent the respective inlets of the diverting channel portions.

22. The assembly of claim 21, wherein the device is configured to receive the portion of the tube to locate the inlet of the tube adjacent to the respective inlets of the diverting channel portions of the device.

23. The assembly of any one of claims 15 to 22, wherein the tube is a pitot tube.

10 24. The assembly of any one of claim 15 to 23, wherein the tube further comprises a mounting portion for mounting the assembly to a vehicle.

25. The assembly of claim 24, wherein the vehicle is an unmanned aerial vehicle.

ABSTRACT**A DEVICE FOR REDUCING LIQUID INGRESS INTO A TUBE
AND****5 AN ASSEMBLY COMPRISING SAID DEVICE AND SAID TUBE**

Various embodiments provide a device for reducing liquid ingress into a tube. The device comprises a coupling portion, a guiding channel portion and a diverting channel portion. The coupling portion is adapted to couple the device to the tube. The guiding channel portion is adapted to receive gas and liquid moving relatively towards an inlet of the device. The diverting channel portion is adapted to divert the liquid away from an inlet of the tube. The diverting channel portion is in fluid communication with the guiding channel portion. The guiding channel portion is configured in use to guide the gas into the inlet of the tube, but guide the liquid into an inlet of the diverting channel portion. Various embodiments provide an assembly comprising said device and said tube.

FIGURE 2