

MODULAR CAMERA SYSTEMS FOR HAZARDOUS ENVIRONMENTS

BACKGROUND

[0001] Cameras for hazardous environments normally require a very high strength design, which is very heavy and expensive. In these hazardous environments, ignition sources can cause explosions. Therefore, anything that can cause an ignition needs to be sealed to prevent an explosion. Furthermore, the housing providing the seal needs to be strong enough so that if an internal explosion occurs, that explosion would be contained within the housing and not spread outside of the housing to the surrounding hazardous environment. For cameras in these environments, the camera, the motors and other associated components needed to rotate the camera to capture multiple angles and/or views include internal enclosures that are fully interconnected and therefore include a single volume of gas. This relatively large gas volume is present inside the housings, requiring the housings to be made of thick, heavy-duty, high-strength materials to prevent an internal explosion from propagating outside of the housings.

BRIEF SUMMARY

[0002] Modular camera systems for hazardous environments are disclosed herein. The modular camera systems include housings that are rotatable about two axes, providing the ability for the camera to capture pictures and/or video of objects around the modular camera system. Furthermore, the compact, modular design of the camera limits the volume of gas within the housings as well as provides optimal flame paths, which allows the housings to be made of a lightweight material, such as a polymer, while meeting requirements for products intended to be used in explosive atmospheres. When enclosures and/or housings for parts of the camera are realized as separate, flameproof enclosures and/or housings, the flameproof enclosures and/or housings prevent propagation of any potential flame and/or explosions from exiting the housings themselves.

[0003] A modular camera system for hazardous environments includes a first housing for enclosing a camera assembly, a second housing for enclosing one or more motors for rotating the camera assembly. The second housing is coupled to the first housing. The first housing is flameproof such that an ignition inside the first housing is prevented from propagating outside of the first housing.

[0004] This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to

identify key features or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

- [0005] **Figures 1A-1C** illustrate modular camera systems for hazardous environments.
- [0006] **Figures 2A and 2B** illustrate cross-sectional views of modular camera systems for hazardous environments.
- [0007] **Figure 3A** illustrates a cross-sectional view of a first housing and a portion of a second housing of a modular camera system for hazardous environments.
- [0008] **Figure 3B** illustrates a cross-sectional view of a portion of a second housing and a base of a modular camera system for hazardous environments.
- [0009] **Figure 4** illustrates an exploded view of certain components of a first housing and a second housing of a modular camera system for hazardous environments.
- [0010] **Figures 5** illustrates an exploded view of certain components of a second housing and a base of a modular camera system for hazardous environments.
- [0011] **Figures 6A-6C** illustrate various views of a first housing of a modular camera system for hazardous environments.
- [0012] **Figure 7** illustrates a window sub-assembly of a modular camera system for hazardous environments.
- [0013] **Figure 8** illustrates an electronics module of a modular camera system for hazardous environments.
- [0014] **Figure 9** illustrates a transmission assembly for coupling a motor to a housing in a modular camera system for hazardous environments.

DETAILED DESCRIPTION

[0015] Modular camera systems for hazardous environments are disclosed herein. The modular camera systems include housings that are rotatable about two axes, providing the ability for the camera to capture pictures and/or video of objects around the modular camera system. Furthermore, the compact, modular design of the camera limits the volume of gas within the housings as well as provides optimal flame paths, which allows the housings to be made of a lightweight material, such as a polymer, while meeting requirements for products intended to be used in explosive atmospheres. When enclosures and/or housings for parts of the cameras are realized as separate, flameproof enclosures and/or housings, the flameproof

enclosures and/or housings prevent propagation of any potential flame and/or explosions from exiting the housings themselves.

[0016] In previous systems, a camera assembly and one or more motors were enclosed in a single and/or fully interconnected housings. Due to the extra volume required to house these components along with the complex flame paths, including obstacles and expanding of the volume through the housing, pressure piling and high reference pressures are created during an ignition event inside the housing. Due to the pressure piling and high reference pressures, housings for previous systems are generally made of thick, heavy-duty, high-strength materials, which are heavy (e.g., more than 20 kilograms) and expensive. Furthermore, due to the weight, moving and/or lifting the previous systems is a potential workplace hazard for employees. As used herein, a flame path prevents a flame from passing through.

[0017] Figures 1A-1C illustrate modular camera systems for hazardous environments. Referring to Figures 1A-1C, a modular camera system **100** includes a first housing **102**, a second housing **104**, and a base **106**. The first housing **102** can enclose a camera assembly. The second housing **104** can enclose one or more motors for rotating the camera assembly. For example, a first motor can rotate the first housing **102** about the horizontal **X** axis and a second motor can rotate the second housing **104** about the vertical **Y** axis, which rotates the camera assembly to the desired viewing angle to capture images and/or video. The first housing **102** is flameproof such that an ignition inside the first housing **102** is prevented from propagating outside of the first housing **102**.

[0018] In some cases, the first housing **102** and the second housing **104** are made of lightweight material. In some cases, the lightweight material is a polymer. In some cases, the first housing **102** and the second housing **104** are made of a traditional used material, such as stainless steel, but with a much thinner and therefore lighter amount of that traditional material due to the lowered potential explosive pressures faced by the first housing **102** and the second housing **104** in the hazardous environments. In some cases, the first motor provides at least 180° rotation of the first housing **102** about a horizontal **X** axis of the first housing **102** and the second motor provides 360° rotation of the second housing **104** about a vertical **Y** axis of the second housing **104**. In some cases, the first motor provides 360° rotation of the first housing **102** about a horizontal **X** axis of the first housing **102**. In some cases, a first transmission assembly couples the first motor to the first housing **102** to provide the at least 180° and/or 360° rotation of the first housing **102** about the horizontal **X** axis of the first housing **102** and a second transmission assembly couples the second motor to the second housing **104** to provide

the 360° rotation of the second housing **104** about the vertical **Y** axis of the second housing **104**.

[0019] In some cases, the base **106** can be part of the second housing **104**. In some cases, there is no base **106** and the second housing couples to fixed wiring. In some cases, the base **106** is considered an additional housing which encloses external connections, such as field wiring connectors and/or other suitably protected interfacing electronics. In some cases, the first housing **102** is an explosion protection, flameproof housing that is strong enough to withstand an internal explosion from gas build-up, such as methane build-up, from the hazardous environment. In some cases, the first housing **102** is designed such that an ignition and/or explosion within the first housing **102** will not fracture the first housing **102**. In some cases, the first housing **102** includes multiple flame paths to limit the pressure piling and/or high reference pressures caused by an internal explosion.

[0020] In some cases, the second housing **104** is an explosion protection, flameproof housing that is strong enough to withstand an internal explosion from gas build-up, such as methane build-up, from the hazardous environment. In some cases, the second housing **104** is designed such that an ignition and/or explosion within the second housing **104** will not fracture the second housing **104**. In some cases, the first housing **102** and/or the second housing **104** can be manufactured via 3D printing and/or molding.

[0021] Figures 2A and 2B illustrate cross-sectional views of modular camera systems for hazardous environments. Referring to Figures 2A and 2B, a modular camera system **200** includes a first housing **202**, a second housing **204**, and a base **206**. A camera assembly **208** is disposed within the first housing **202**. A tilt transmission assembly **210** is disposed within the second housing **204** for rotating the first housing **202** about the horizontal axis. One or more motors **212** are disposed within the second housing for providing rotational movement to the camera assembly **208**. An electronics module for providing control of the modular camera system **200** are disposed within the second housing **204**. External connections **214**, such as wiring, are provided through the base **206**.

[0022] To provide the necessary connections, such as external connections **214**, from the second housing **204** to the first housing **202** while maintaining the first housing **202** as a flameproof enclosure and permitting independent rotational movement of the first housing **202**, a multiconductor rotating flame path assembly **216** is disposed from the second housing **204** to the first housing **202**. In some cases, a flameproof bushing and/or a flameproof cable gland can be used in lieu of the multiconductor rotating flame path assembly **216**. In some cases, to provide the necessary connections, such as external connections **214**, from the base **206** to the

second housing **204** while maintaining the second housing **204** as a flameproof enclosure and permitting independent rotational movement of the second housing **204**, a second multiconductor rotating flame path assembly **218** is disposed from the base **206** to the second housing **204**. The multiconductor rotating flame path assembly **216** and the second multiconductor rotating flame path assembly **218** are utilized to provide power and/or to transfer electrical signals as well as rotation functionality while maintaining explosion proof and/or flame proof properties of the respective housings. For example, the multiconductor rotating flame path assembly **216** and the second multiconductor rotating flame path assembly **218** allow the rotation of the respective housings while still providing external connections such as wiring to, for example, the camera assembly and other electrical components, and preventing an ignition and/or flame from the respective housings from propagating outside of those respective housings.

[0023] In some cases, the second housing **204** is not a flameproof enclosure and the potential ignition sources, such as the one or more motors **212** and the electronics module, include an ignition protection such that an internal fault of the one or more motors **212** and/or the electronics module does not cause an ignition within the second housing **204**. In some cases, the ignition protection of the one or more motors **212** and the electronics module includes enhanced safety protection and/or separate fault protection and/or encapsulation to prevent a fault, such as a spark and/or a hotspot, from igniting any potential internal explosion inside the second housing **204** from gas build-up from the hazardous environment. In some cases, a second camera assembly is disposed within the first housing **202**.

[0024] In some cases, the modular camera system **200** further includes a third housing and a second camera assembly disposed within the third housing. In some cases, the third housing is coupled to the second housing **204**. In some cases, the third housing is flameproof such that an ignition inside the third housing is prevented from propagating outside of the third housing. In some cases, the third housing includes any combination of features as the first housing (e.g., first housing **202**) described herein for enclosing a camera assembly. In some cases, an axial bearing is disposed between the second housing **204** and the third housing. In some cases, the axial bearing is disposed proximal to an outer diameter of the second housing **204** or an outer diameter of the third housing. In some cases, the axial bearing is disposed proximal to a smaller diameter of the outer diameter of the second housing **204** and the outer diameter of the third housing.

[0025] Figure 3A illustrates a cross-sectional view of a first housing and a portion of a second housing of a modular camera system for hazardous environments. Referring to Figure

3A, a first housing 302 and a second housing 304 are coupled together. In some cases, the first housing 302 and the second housing 304 are coupled together by a threaded lock ring assembly 306. In some cases, the first housing 302 and the second housing 304 are coupled together by press fit, adhesive, interlock mechanism, and/or any other coupling mechanism suitable to prevent an ignition source and/or flame from propagating outside of the first housing 302.

[0026] The first housing 302 encloses a camera assembly 308. The window and/or external lens of the camera assembly 308 can be coupled to the first housing by a threaded lock ring assembly, press fit, adhesive, interlock mechanism, and/or any other coupling mechanism suitable to prevent an ignition source and/or flame from propagating outside of the first housing 302.

[0027] To provide the necessary connections to the camera assembly 308, such as wiring for power and/or optical wiring for images and/or video feed from the camera assembly 308 to an external source, from the second housing 304 to the first housing 302 while maintaining the first housing 302 as a flameproof enclosure and permitting independent rotational movement of the first housing 302, flameproof busing 310 is disposed from the second housing 304 to the first housing 302. In some cases, a multiconductor rotating flame path assembly and/or a flameproof cable gland can be used in lieu of the flameproof bushing 310. The

[0028] In some cases, an axial bearing is disposed between the first housing 302 and the second housing 304. In some cases, the axial bearing is disposed proximal to an outer diameter of the first housing 302 or an outer diameter of the second housing 304. In some cases, the axial bearing is disposed proximal to a smaller diameter of the outer diameter of the first housing 302 and the outer diameter of the second housing 304.

[0029] Figure 3B illustrates a cross-sectional view of a portion of a second housing and a base of a modular camera system for hazardous environments. Referring to Figure 3B, the second housing 304 and a base 312 are included. To provide the necessary connections from the base 312 to the second housing, such as wiring for power and/or optical wiring for images and/or video feed from the camera assembly to an external source and wiring for power and/or communication for an electronics module disposed in the second housing 304 and for one or more motors moving the camera assembly, from the base 312 to the second housing 304, a second flameproof busing 314 is disposed from the base 312 to the second housing 304. In some cases, a multiconductor rotating flame path assembly and/or a flameproof cable gland can be used in lieu of the second flameproof bushing 314.

[0030] In some cases, an axial bearing is disposed between the base 312 and the second housing 304. In some cases, the axial bearing is disposed proximal to an outer diameter of the

base 312 or an outer diameter of the second housing 304. In some cases, the axial bearing is disposed proximal to a smaller diameter of the outer diameter of the base 312 and the outer diameter of the second housing 304. In some cases, a seal is disposed around the axial bearing.

[0031] Figure 4 illustrates an exploded view of certain components of a first housing and a second housing of a modular camera system for hazardous environments. Referring to Figure 4, a modular camera system 400 includes a first housing 402, a second housing 404, and a base 406. The first housing 402 encloses a camera assembly 408. A tilt axis locking ring assembly 410 is included to prevent unwanted movement of the first housing 402 with respect to the second housing 404, including during rotational movement of the first housing 402 about the horizontal axis. To provide the rotational movement of the first housing 402 about the horizontal axis, a tilt axis transmission assembly 412 is included, as explained in further detail with respect to Figure 9. The tilt axis transmission assembly 412 and a first motor 414 are enclosed in the second housing 404.

[0032] In some cases, the first motor 414 provides at least 180° and/or 360° rotation of the first housing 402 about a horizontal axis of the first housing 402. In some cases, the tilt axis transmission assembly 412 couples the first motor 414 to the first housing 402 to provide the at least 180° and/or 360° rotation of the first housing 402 about the horizontal axis of the first housing 402.

[0033] Figures 5 illustrates an exploded view of certain components of a second housing and a base of a modular camera system for hazardous environments. Referring to Figure 5, a modular camera system 500 includes a first housing 502, a second housing 504, and a base 506. The base 506 is a pluggable base in that the second housing 504 can be plugged into the base 506 using the quick connect interface 508 of the base 506. In some cases, the base 506 is not pluggable and is instead a fixed base. A pan axis locking ring assembly 510 is included to prevent unwanted movement of the second housing 504 with respect to the base 506, including during rotational movement of the second housing 504 about the vertical axis. To provide the rotational movement of the second housing 504 about the vertical axis, a pan axis transmission assembly 512 is included, as explained in further detail with respect to Figure 9. The pan axis transmission assembly 512 and a second motor 514 is enclosed in the second housing 504.

[0034] In some cases, the second motor 514 provides 360° rotation of the second housing 504 about a vertical axis of the second housing 504. In some cases, the pan axis transmission assembly 512 couples the second motor 514 to the second housing 504 to provide the 360° rotation of the second housing 504 about the vertical axis of the second housing 504.

[0035] Figures 6A-6C illustrate various views of a first housing of a modular camera system for hazardous environments. Referring to Figures 6A-6C, a first housing 602 of a modular camera system includes a camera enclosure cover 604 and a camera enclosure 606. In some cases, the first housing 602 is an explosion protection, flameproof housing that is strong enough to withstand an internal explosion from gas build-up, such as methane build-up, from the hazardous environment. In some cases, the first housing 602 includes multiple flame paths.

[0036] The camera enclosure 606 includes a window aperture 608 and a window sub-assembly 610 to enclose the window aperture 608. The camera assembly 612 includes a camera. In some cases, at least a portion of the window sub-assembly 610 is transparent so that the camera of the camera assembly 612 can capture images and/or video feed through the window sub-assembly 610. In some cases, at least a portion of the window sub-assembly 610 is a germanium lens for a thermal camera to capture thermal images and/or thermal video feed through the window sub-assembly. As explained in further detail with respect to Figure 7, the window sub-assembly 610 can include a window 614 and a molded insert 616. A cemented seal 618 is included to couple the window 614 to the molded insert 616. The cemented seal 618 prevents an ignition and/or flame from propagating outside of the first housing 602. In some cases, a threaded joint and/or a spigot joint can be included in addition to or in lieu of the cemented seal 618. The molded insert 616 can include threading 620 to couple to threading 622 of the camera enclosure 606 around the window aperture 608 to form a first threaded joint 624. The first threaded joint 624 prevents an ignition and/or flame from propagating outside of the first housing 602. In some cases, a cemented seal and/or a spigot joint can be included in addition to or in lieu of the first threaded joint 624.

[0037] The camera enclosure cover 604 can include threading to couple to threading 626 of the camera enclosure 606 to form a second threaded joint 628. The second threaded joint 628 prevents an ignition and/or flame from propagating outside of the first housing 602. In some cases, a cemented seal and/or a spigot joint can be included in addition to or in lieu of the second threaded joint 628.

[0038] To provide rotational movement to the first housing 602 about the horizontal X axis, a tilt axis transmission assembly can be coupled to the camera enclosure 606 of the first housing 602 by a tilt axis shaft sub-assembly 630 and/or a multiconductor rotating flame path. The camera enclosure 606 can include additional threading to couple to threading 632 of the tilt axis shaft sub-assembly 630 to form a third threaded joint 634. The third threaded joint 634 prevents an ignition and/or flame from propagating outside of the first housing 602. In some

cases, a cemented seal and/or a spigot joint can be included in addition to or in lieu of the third threaded joint 634.

[0039] The first housing 602 can further include a wiper assembly 636 positioned proximate to the camera of the camera assembly 612 to clean the window sub-assembly 610 of the camera assembly 612. The wiper assembly 636 can include a wiper seating surface 638. A servo motor 640 can be disposed in the first housing 602 to provide movement to the wiper assembly 636. In some cases, a communication assembly including a microphone for receiving audio and/or outputting audio (e.g., an audio output device, such as a speaker), is also included as part of the modular camera system and coupled to the first housing 602. In some cases, the communication assembly is located proximate to the camera of the camera assembly 612.

[0040] Figure 7 illustrates a window sub-assembly of a modular camera system for hazardous environments. Referring to Figure 7, a window sub-assembly 700 includes a molded insert 702 that includes threading 704 for being threaded to a camera enclosure and/or first housing of a modular camera system, a window 706, cement 708 for attaching the window 706 to the molded insert 702 to provide a secure flame path, a glass cushion 710 for providing cushioning to the window 706 while preventing an ignition and/or flame from the first housing from propagating outside of the camera enclosure and/or first housing of a modular camera system, an internal retaining ring 712, and an O-ring seal 714. Advantageously, the window sub-assembly 700 provides impact resistance in case of, for example, an internal explosion in the respective housing or external damage from user error or the external environment, while being easily replaced by being able to simply thread the window sub-assembly 704 to the camera enclosure and/or first housing of a modular camera system. Furthermore, the window sub-assembly reduces tooling that is required in previous window sub-assemblies.

[0041] In some cases, a threaded joint and/or a spigot joint can be included in addition to or in lieu of the cement 708 for attaching the window 706 to the molded insert 702. In some cases, cement can be used to create a cemented seal that can be utilized in addition to or in lieu of the threading 704 of the molded insert 702. In some cases, a spigot joint can be included in addition to or in lieu of the threading 704 of the molded insert 702. In some cases, the window 706 can be impact resistant glass and/or other impact resistant material. In some cases, the window 706 of the window sub-assembly 700 includes a germanium lens for a thermal camera. In some cases in which more than one camera assembly is included, a second window sub-assembly can be utilized. In some cases, the glass cushion 710 is an elastomeric glass cushion.

[0042] Figure 8 illustrates an electronics module of a modular camera system for hazardous environments. Referring to Figure 8, an electronics module 800 of a modular camera system

includes a first printed circuit board assembly **802** (PCBA) having a receiver and power management disposed thereon, a second PCBA **804**, board stacking headers **806** disposed between the first PCBA **802** and the second PCBA **804**, and system controller wiring terminals **808**. These components can be enclosed by an electronics potting cup **810** to a top portion of the second housing such that an ignition and/or flame is prevented from exiting the potting cup **810** and second housing.

[0043] In some cases, the second PCBA **804** can include connections to other components such as, for example, one or more motors, an external power source, a camera assembly, audio communications, and the like. In some cases, the system controller wiring terminals **808** include increased safety, such as terminal locking mechanisms that prevent a fault at the terminal connection point.

[0044] Figure 9 illustrates a transmission assembly for coupling a motor to a housing in a modular camera system for hazardous environments. The transmission assembly **900** described herein is a pan axis transmission assembly for rotating the second housing about the vertical axis by coupling the second motor to the second housing. A tilt axis transmission assembly that can rotate the first housing about the horizontal axis can include similar features and/or components as the transmission assembly **900** described herein. The tilt axis transmission assembly couples the first motor to the first housing.

[0045] Referring to Figure 10, a transmission assembly **900** includes a motor **902** for providing rotational movement to the second housing, a motor mounting plate **904** coupled to the to the motor using fasteners **906**, such as screws, a planetary gearbox **908** coupled to the motor **902** by the motor mounting plate **904** and fasteners **906**, a main drive pinion gear **910** coupled to the planetary gearbox **908**, and a transmission positioning encoder **912** for determining and instructing positioning of the second housing. The motor **902** and the transmission positioning encoder **912** are encapsulated to prevent a fault, such as a spark and/or a hotspot, from igniting any potential internal explosion inside the second housing. In some cases, the motor **902** and the transmission positioning encoder **912** are enhanced safety protected and/or flameproof to prevent a fault, such as a spark and/or a hotspot, from igniting any potential internal explosion inside the second housing. In some cases, a belt drive or an independent gear train assembly can be used in lieu of the planetary gearbox **908** to provide rotational movement to the second housing.

[0046] The transmission assembly **900** further includes a positioning encoder spur gear **914** coupled to the transmission positioning encoder **912**, and a transmission mounting bracket **916** for mounting and/or carrying the above-described components, including the motor **902** and

the transmission positioning encoder 912. On the opposite side of the transmission mounting bracket 916, the transmission assembly 900 further includes a shaft tension and locking nut 918, a main shaft encoder spur gear 920, a main shaft drive spur gear 922, a roller bearing 924, a housing O-ring 926, and a flange plate 928 coupled to the transmission mounting bracket 916 using fasteners 930, such as screws. The flange plate 928 includes a shape and/or design that alters the resonant frequency of the camera assembly when vibration occurs through the base (e.g., base 106) from environmental factors of the hazardous environment, such as vibration and/or wind loading. The flange plate 928 mounts and/or carries the shaft tension and locking nut 918, a main shaft encoder spur gear 920, a main shaft drive spur gear 922, and a roller bearing 924. On the opposite side of the flange plate 928, the transmission assembly 900 further includes a rotary shaft seal 932 and a thrust bearing 934. The thrust bearing 934 can prevent unwanted movement and/or wobble of the housing from environmental factors of the hazardous environment, such as vibration and/or wind loading. A shaft is positioned through the roller bearing 924 and the motor mounting plate 904, which provide further stability and support to prevent unwanted movement and/or wobble of the housing during rotation of the second housing. In some cases, a multiconductor flame path assembly is positioned within the flange plate 928 by using a radial bearing.

[0047] Clause 1. A system, comprising: a first housing for enclosing a camera assembly; and a second housing for enclosing one or more motors for rotating the camera assembly, the second housing coupled to the first housing; wherein the first housing is flameproof such that an ignition inside the first housing is prevented from propagating outside of the first housing.

[0048] Clause 2. The system of clause 1, wherein the first housing and the second housing are made of lightweight material.

[0049] Clause 3. The system of clause 1 or 2, wherein the lightweight material is a polymer.

[0050] Clause 4. The system of any clause 1-3, further comprising: the camera assembly disposed within the first housing, the camera assembly comprising a camera.

[0051] Clause 5. The system of any clause 1-4, further comprising a multiconductor rotating flame path assembly positioned between the first housing and the second housing for providing wiring to the camera assembly while preventing an ignition from propagating outside of the first housing.

[0052] Clause 6. The system of any clause 1-5, further comprising a second camera assembly disposed within the first housing.

[0053] Clause 7. The system of any clause 1-6, further comprising: a third housing coupled to the second housing, wherein the third housing is flameproof such that an ignition inside the

third housing is prevented from propagating outside the third housing; and a second camera assembly disposed within the third housing.

[0054] Clause 8. The system of any clause 1-7, further comprising a second multiconductor rotating flame path assembly positioned between the second housing and the third housing for providing wiring to the camera assembly while preventing an ignition from propagating outside of the third housing.

[0055] Clause 9. The system of any clause 1-8, further comprising an axial bearing disposed between the second housing and the third housing.

[0056] Clause 10. The system of any clause 1-9, further comprising a wiper assembly positioned proximate to the camera assembly to clean a window of the camera assembly.

[0057] Clause 11. The system of any clause 1-10, further comprising a communication assembly for receiving and outputting audio.

[0058] Clause 12. The system of any clause 1-11, further comprising one or more motors disposed within the second housing for providing rotational movement to the camera assembly.

[0059] Clause 13. The system of any clause 1-12, further comprising: a transmission assembly that includes a flange plate, a shaft tension and locking nut, a main shaft encoder spur gear, a main shaft drive spur gear, and a roller bearing, wherein the flange plate mounts the shaft tension and locking nut, the main shaft encoder spur gear, the main shaft drive spur gear, and the roller bearing; a multiconductor rotating flame path and a radial bearing positioned within the flange plate; a transmission positioning encoder for determining and instructing positioning of the second housing; and a transmission mounting bracket mounting the transmission positioning encoder and the one or more motors.

[0060] Clause 14. The system of any clause 1-13, wherein the one or more motors disposed within the second housing include an ignition protection such that an internal fault of the one or more motors does not cause an ignition within the second housing.

[0061] Clause 15. The system of any clause 1-14, wherein the one or more motors comprise a first motor and a second motor, wherein the first motor provides at least 180° rotation of the first housing about a horizontal axis of the first housing, wherein the second motor provides 360° rotation of the second housing about a vertical axis of the second housing.

[0062] Clause 16. The system of any clause 1-15, further comprising: a first transmission assembly coupling the first motor to the first housing to provide the at least 180° rotation of the first housing about the horizontal axis of the first housing; and a second transmission assembly coupling the second motor to the second housing to provide the 360° rotation of the second housing about the vertical axis of the second housing.

[0063] Clause 17. The system of any clause 1-16, wherein the camera assembly comprises a camera.

[0064] Clause 18. The system of any clause 1-17, wherein the first housing further comprises a window sub-assembly for the camera to capture an image or video, the window sub-assembly comprising: a molded insert having threading for being threaded to the first housing; a window attached to the molded insert; and a glass cushion for providing cushioning to the window while preventing an ignition or flame from the first housing from propagating outside of the first housing.

[0065] Clause 19. The system of any clause 1-18, wherein the second housing is flameproof such that an ignition inside the second housing is prevented from propagating outside of the second housing.

[0066] Clause 20. The system of any clause 1-19, wherein the first housing will not fracture due to an ignition inside the first housing.

[0067] Clause 21. The system of any clause 1-20, further comprising an electronics module disposed within the second housing, wherein the electronics module includes an ignition protection such that an internal fault of the electronics module does not cause an ignition within the second housing.

[0068] Clause 22. The system of any clause 1-21, further comprising a base coupled to a bottom end of the second housing.

[0069] Clause 23. The system of any clause 1-22, further comprising an axial bearing disposed between the base and the second housing.

[0070] Clause 24. The system of any clause 1-23, wherein the second housing is coupled to the first housing by a threaded lock ring assembly.

[0071] Clause 25. The system of any clause 1-24, further comprising an axial bearing disposed between the first housing and the second housing.

[0072] Although the subject matter has been described in language specific to structural features and/or acts, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as examples of implementing the claims and other equivalent features and acts are intended to be within the scope of the claims.

CLAIMS

What is claimed is:

1. A system, comprising:
a first housing for enclosing a camera assembly; and
a second housing for enclosing one or more motors for rotating the camera assembly,
the second housing coupled to the first housing;
wherein the first housing is flameproof such that an ignition inside the first housing is prevented from propagating outside of the first housing.
2. The system of claim 1, wherein the first housing and the second housing are made of lightweight material.
3. The system of claim 2, wherein the lightweight material is a polymer.
4. The system of claim 1, further comprising:
the camera assembly disposed within the first housing, the camera assembly comprising a camera.
5. The system of claim 4, further comprising a multiconductor rotating flame path assembly positioned between the first housing and the second housing for providing wiring to the camera assembly while preventing an ignition from propagating outside of the first housing.
6. The system of claim 4, further comprising a second camera assembly disposed within the first housing.
7. The system of claim 4, further comprising:
a third housing coupled to the second housing, wherein the third housing is flameproof such that an ignition inside the third housing is prevented from propagating outside the third housing; and
a second camera assembly disposed within the third housing.
8. The system of claim 7, further comprising a second multiconductor rotating flame path assembly positioned between the second housing and the third housing for providing

wiring to the camera assembly while preventing an ignition from propagating outside of the third housing.

9. The system of claim 7, further comprising an axial bearing disposed between the second housing and the third housing.

10. The system of claim 4, further comprising a wiper assembly positioned proximate to the camera assembly to clean a window of the camera assembly.

11. The system of claim 4, further comprising a communication assembly for receiving and outputting audio.

12. The system of claim 4, further comprising one or more motors disposed within the second housing for providing rotational movement to the camera assembly.

13. The system of claim 12, further comprising:

a transmission assembly that includes a flange plate, a shaft tension and locking nut, a main shaft encoder spur gear, a main shaft drive spur gear, and a roller bearing, wherein the flange plate mounts the shaft tension and locking nut, the main shaft encoder spur gear, the main shaft drive spur gear, and the roller bearing;

a multiconductor rotating flame path and a radial bearing positioned within the flange plate;

a transmission positioning encoder for determining and instructing positioning of the second housing; and

a transmission mounting bracket mounting the transmission positioning encoder and the one or more motors.

14. The system of claim 12, wherein the one or more motors disposed within the second housing include an ignition protection such that an internal fault of the one or more motors does not cause an ignition within the second housing.

15. The system of claim 12, wherein the one or more motors comprise a first motor and a second motor, wherein the first motor provides at least 180° rotation of the first housing about

a horizontal axis of the first housing, wherein the second motor provides 360° rotation of the second housing about a vertical axis of the second housing.

16. The system of claim 15, further comprising:

a first transmission assembly coupling the first motor to the first housing to provide the at least 180° rotation of the first housing about the horizontal axis of the first housing; and

a second transmission assembly coupling the second motor to the second housing to provide the 360° rotation of the second housing about the vertical axis of the second housing.

17. The system of claim 4, wherein the camera assembly comprises a camera.

18. The system of claim 17, wherein the first housing further comprises a window sub-assembly for the camera to capture an image or video, the window sub-assembly comprising:

a molded insert having threading for being threaded to the first housing;

a window attached to the molded insert; and

a glass cushion for providing cushioning to the window while preventing an ignition or flame from the first housing from propagating outside of the first housing.

19. The system of claim 1, wherein the second housing is flameproof such that an ignition inside the second housing is prevented from propagating outside of the second housing.

20. The system of claim 1, wherein the first housing will not fracture due to an ignition inside the first housing.

21. The system of claim 1, further comprising an electronics module disposed within the second housing, wherein the electronics module includes an ignition protection such that an internal fault of the electronics module does not cause an ignition within the second housing.

22. The system of claim 1, further comprising a base coupled to a bottom end of the second housing.

23. The system of claim 22, further comprising an axial bearing disposed between the base and the second housing.

24. The system of claim 1, wherein the second housing is coupled to the first housing by a threaded lock ring assembly.

25. The system of claim 1, further comprising an axial bearing disposed between the first housing and the second housing.