US Patent & Trademark Office
Patent Public Search | Text View

United States Patent	12394878
Kind Code	B2
Date of Patent	August 19, 2025
Inventor(s)	Gardner; Daniel

Solar-powered electronic system

Abstract

Disclosed herein includes a quick-release tubular seal including a tube having a first end and a second end. The quick-release tubular seal also includes first seal assembly configured to selectively seal against the first end of the tube and a second seal assembly configured to selectively seal against the second end of the tube. Additionally, the quick-release tubular seal includes a cam disposed on the first seal assembly, the cam being operable between a first position and a second position. The quick-release tubular seal includes a shaft mechanically coupled to the cam, the first seal assembly, and the second seal assembly, the shaft configured to actuate both the first seal assembly to seal against the first end of the tube and actuate the second seal assembly to seal against the second end of the tube when the cam is actuated from the first position to the second position.

Inventors: **Gardner; Daniel (Glenview, IL)**

Applicant: **MeshPlusPlus, Inc.** (Chicago, IL)

Family ID: **1000008764083**

Assignee: **MeshPlusPlus, Inc. (Chicago, IL)**

Appl. No.: **17/670210**

Filed: **February 11, 2022**

Prior Publication Data

Document Identifier	Publication Date
US 20220263216 A1	Aug. 18, 2022

Related U.S. Application Data

us-provisional-application US 63200095 20210212

Publication Classification

Int. Cl.: **F16C11/04** (20060101); **H01Q1/12** (20060101); **H02S20/20** (20140101); **H02S20/30** (20140101); **H05K7/20** (20060101); H01Q1/22 (20060101)

U.S. Cl.:

CPC **H01Q1/125** (20130101); **F16C11/04** (20130101); **H02S20/20** (20141201); **H02S20/30** (20141201); **H05K7/2039** (20130101); H01Q1/2291 (20130101)

Field of Classification Search

CPC: H01Q (1/125); H01Q (1/2291); H02S (20/20); H02S (20/30); F16C (11/04); H05K (7/2039)

References Cited

U.S. PATENT DOCUMENTS

Patent No.	Issued Date	Patentee Name	U.S. Cl.	CPC
11539111	12/2021	Raybern	N/A	H01Q 1/1228
2011/0283755	12/2010	Chen	70/158	G09F 3/0376
2020/0292919	12/2019	Goodman	N/A	H04N 23/54
2022/0263456	12/2021	Gardner	N/A	N/A

FOREIGN PATENT DOCUMENTS

Patent No.	Application Date	Country	CPC
111835274	12/2019	CN	N/A

Primary Examiner: Ramos; Mayla Gonzalez

Attorney, Agent or Firm: MARSHALL, GERSTEIN & BORUN LLP

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION (1) This application claims the benefit of the filing date of U.S. Provisional Patent Application No. 63/200,095, filed Feb. 12, 2021. The contents of U.S. Provisional Patent Application No. 63/200,095 is hereby incorporated by reference in its entirety.

FIELD OF THE DISCLOSURE
(1) The present disclosure relates to outdoor electronic devices and, more particularly, to mechanisms for mounting solar-powered devices in outdoor environments.
BACKGROUND
(2) Certain electronic devices, such as wireless routers, sensors, power controllers, etc. can be installed outdoors in difficult-to-reach places such as utility poles or rooftops. For example, solar-powered devices such as wireless routers that operate according to IEEE 802.11 standards (generally known as WiFi® routers) can be disposed on utility poles. To protect the electronics from water or dust, mounted electronic devices can include various levels of environmental protection. For example, electronic devices can be sealed inside a protective housing.

(3) However, as technology improves, electronic devices disposed in the field may require upgrades or replacement of certain components, and sealing makes access to these devices more difficult. On the other hand, lack of sealing generally provides lower levels of protection.

(4) Further, electronic devices equipped with antennas (such as wireless routers mentioned above) require additional cabling between antennas and processing circuitry. Mounting mechanisms that require long cables interconnecting such components present additional difficulties because long cables are generally lossy.

(5) Still further, some installations may include power sources such as solar panels along with electronic components. For example, it may be desirable to place a solar power in close proximity to a wireless router to eliminate wired connections to the wireless router. The solar power in such a system may require re-orientation to optimize power output.

SUMMARY

(6) In one example implementation, a mechanism of this disclosure includes a quick-release tubular seal including a tube having a first end and a second end. The quick-release tubular seal also includes a first seal assembly configured to selectively seal against the first end of the tube and a second seal assembly configured to selectively seal against the second end of the tube. Additionally, the quick-release tubular seal includes a cam disposed on the first seal assembly, the cam being operable between a first position and a second position. The quick-release tubular seal includes a shaft mechanically coupled to the cam, the first seal assembly, and the second seal assembly, the shaft configured to actuate both the first seal assembly to seal against the first end of the tube and actuate the second seal assembly to seal against the second end of the tube when the cam is actuated from the first position to the second position.

(7) Also disclosed herein is a sealed tubular antenna alignment system including a tube having a window disposed approximate a first end and a cap disposed on the first end, the cap including a key to orient the cap with the tube. The sealed tubular antenna alignment system also includes an antenna coupled to the cap, wherein the key configured to orient the cap aligns the antenna with the window.

(8) Also disclosed herein is a sealed tubular antenna alignment system including a tube having a window disposed approximate a first end and an electronics module pivotably and axially movable relative to the tube. The sealed tubular antenna alignment system also includes an antenna coupled to the electronics module, wherein the electronics module is configured to position the antenna adjacent to the window.

(9) Additionally disclosed herein is a solar panel angle adjustment system for actuation with a single hand, comprising of a mounting panel rotationally coupled to an axle and a positioning member configured to control the angular position of the mounting panel. The solar panel angle adjustment system also includes an adjustment mechanism adapted to lock the positioning member in a first position and adapted to adjust the positioning member in the second position and a biasing member adapted to bias the adjustment mechanism to the first position. Further including when the positioning member adjusts the angle of the mounting panel in response to the control member actuating the adjustment mechanism in the second position.

(10) Also disclosed herein is a solar panel angle adjustment system for actuation with a single hand, comprising a mounting panel rotationally coupled to an axle, the mounting panel configured to couple with a solar panel. The solar panel adjustment system also includes a tensioned variable ribbon configured to adjust the angular position of the mounting panel and a gear adapted to adjust the tensioned variable ribbon and configured to translate between a first position and a second position. Further, disclosed is a gear shaft mechanically coupled with the gear and configured to translate from the first position to the second position and actuate the gear and a spring adapted to bias the gear from the second position to the first position. Wherein the tensioned variable ribbon adjusts the angle of the mounting panel in response to the gear shaft actuating the gear in the second position, and wherein the gear shaft is locked when disposed in the first position.

(11) Also disclosed herein is a rotational panel quick lock, comprising of a first panel including a first slot configured to receive a first axle and a first aperture disposed adjacent the slot and a second panel, pivotable relative to the first panel, including a second slot configured to receive the axle and a second aperture disposed adjacent to the slot. The second panel of the rotational panel quick lock is pivotable between a first position and a second position and a pivoting axle passes through the first aperture and the second aperture. The second slot of the rotational panel quick lock in the second position is both aligned with the first slot and disposed at an angle relative to the first slot, thereby closing the first slot.
(12) Additionally disclosed herein is a tubular clamping mechanism, comprising of a static cradle defining a tubular slot having an upper portion and a lower portion. The tubular clamping mechanism also includes a pivotable clamp disposed in the lower portion of the static cradle and pivotable about an axle between a first position and a second position. The tubular clamping mechanism also includes an adjustment mechanism to pivot the clamp from the first position to the second position, wherein the clamp in the second position encloses a portion of the tubular slot.
(13) Further disclosed herein is a sealed-tube heat exchanger, comprising a tube, a heat sink axially movable relative to the enclosed tube, and a biasing member configured to bias the heat sink against an inner surface of the enclosed tube.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) FIG. **1** is a perspective view of the solar-powered electronic system in accordance with the present disclosure.
(2) FIG. **2** is another view of the solar-powered electronic system of FIG. **1** in accordance with the present disclosure.
(3) FIG. **3** is an alternative view of the solar-powered electronic system of FIG. **1** in accordance with the present disclosure.
(4) FIG. **4** is a view of the tube of FIG. **1** in accordance with the present disclosure.
(5) FIG. **5** is a side view of an enclosed wireless router configured for use with the solar-powered electronic system of FIG. **1**.
(6) FIG. **6** is a side view of the internally mounted wireless router electronics configured for use with the solar-powered electronic system of FIG. **1** and FIG. **2**.
(7) FIG. **7** is a side view of the internally mounted wireless router electronics of the present disclosure.
(8) FIG. **8** is a cross-sectional view of the enclosed wireless router of FIGS. **1** and **2** including a quick-release waterproof seal.
(9) FIG. **9** is a cross section view of the enclosed wireless router of FIGS. **1** and **2** including quick-release waterproof seal in a partially opened configuration.
(10) FIG. **10** is a perspective view of the mount of FIG. **1** in accordance with the present disclosure.
(11) FIG. **11** is a perspective view of a single-hand actuated solar angle set button in a locked configuration accordance with the present disclosure.
(12) FIG. **12** is a perspective view of the single-hand actuated solar angle set button in an unlocked configuration in accordance with the present disclosure.
(13) FIGS. **13**, **14**, and **15** are perspective views of the solar panel quick-lock apparatus in accordance with the present disclosure
(14) FIG. **16** is a side view of the mount clamp, in accordance with the present disclosure, in an open configuration.
(15) FIG. **17** is a side view of the mount clamp, in accordance with the present disclosure, in a closed configuration.

(16) FIG. **18** is a perspective view of the mount and casing in accordance with the present disclosure.
(17) FIG. **19** is a perspective view of a sliding heat spreader in accordance with the present disclosure.
(18) FIG. **20** is a perspective cross-section view of the enclosed wireless router including the sliding heat spreader of FIG. **19**.
(19) FIG. **21** is an additional view of the tube in accordance with the present disclosure.
(20) FIG. **22** is an additional side view of the electronic mount in accordance with the present disclosure.
(21) FIGS. **23**A, **23**B, **23**C, and **23**D are alternative views of the mounting clamp in accordance with the present disclosure.
(22) FIGS. **24**A, **24**B, and **24**C are alternative views of the mount and mounting panel.
DETAILED DESCRIPTION
(23) Generally speaking, the mechanisms of this disclosure improve accessibility to, and simplify maintenance of, electronic devices installed outdoors. The techniques of this disclosure are particularly useful in application to wireless routers installed on exterior structures (especially utility poles) and powered by solar panels. As discussed below, an example solar-powered electronic system of the present disclosure include several mechanisms that allow for one person to set up and replace electronic modules. Additionally, the solar-powered electronic system is designed to withstand rain, dust, sand, and (in some cases) submersion.
(24) FIG. **1** is a perspective view of a solar-powered electronic system **100** in accordance with the present disclosure. The solar-powered electronic system **100** includes a mount **102**, a tube **104**, and a solar panel **106** having a proximal end **107***a* and a distal end **107***b*. As shown, the solar-powered electronic system **100** is mounted to a utility pole **108**; however, the solar-powered electronic system **100** in other situations can be mounted on lamp posts, trees, etc. The mount **102** includes a pair of hose clamps or steel banding to secure the mount **102** to the utility pole **108**. Additionally, in other examples, the solar-powered electronic system **100** is mounted onto other surfaces such as buildings and other infrastructure, or even vehicles. In such examples, bolts can pass through mount **102** into a flat surface to secure the mount **102** to the building or other infrastructure. Additionally, both the tube **104** and the solar panel **106** are both disposed on the mount **102**.
(25) FIGS. **2** and **3** are alternative views of the solar-powered electronic system **100** of FIG. **1** in accordance with the present disclosure. The mount **102** of FIGS. **1** and **2** includes a mounting clamp **204** controlled by a clamping knob **206**. The mounting clamp **204** and clamping knob **206** (discussed in greater detail below) secure the tube **104** in the mount **102**. The mount **102** includes an opening **208** that is generally semi-circular. As a result, in operation, the mounting clamp **204** closes off the opening **208** and also secures the tube **104** to an upper end of the mount **102**.
(26) In some examples, the mount **102** includes an additional mounting feature **220**. The mounting feature **220** can include various slots and connections to attach modules to the mount **102**. These modules can further increase the modularity of the solar-powered electronic system **100**. Additionally, the solar-powered electronic system **100** includes a power connection **230** disposed on mounting bracket **1010** (discussed in greater detail in connection with FIG. **10**). The power connection **230** can facilitate power connections between the solar panel **106** and the mount **102** and/or modules disposed on the mounting feature **220**.
(27) FIG. **4** is a perspective view of the tube **104** of FIG. **1**. In some examples, the tube **104** is an aluminum tube, but generally the tube **104** can be manufactured using various materials. In preferential alternatives, the tube **104** is made of material with a high thermal conductivity. The tube **104** includes a first end **402** having a first key **403** and a second end **404** having a second key **405**. As shown in FIG. **4**, the tube **104** includes windows **410** disposed proximate the first end **402**. In some examples, the tube **104** further includes windows **412** disposed on the second end **404**. The tube **104** also includes a non-metallic cover **414** disposed over the windows **410**. The non-metallic

cover **414** seals the window from exterior environment. In some examples, the non-metallic cover **414** is transparent such that numerous electromagnetic waves can pass through the non-metallic cover **414** (e.g., optical electromagnetic waves, radio waves, etc.). For example, the non-metallic could be a transparent polycarbonate. In other examples, the non-metallic cover **414** is not transparent to some electromagnetic waves (e.g., optical electromagnetic waves) but still transparent to other electromagnetic waves (e.g., radio waves).

(28) FIG. **5** is a side view of an enclosed wireless router **500** or electronic module configured for use with the solar-powered electronic system of FIG. **1**. The enclosed wireless router **500** includes the tube **104** of FIG. **4**, a first cap **502** disposed adjacent the first end **402** of the tube **104**, and a second cap **504** disposed adjacent the second end **404**. The first cap **502** includes a cam **510** connected to a shaft **514**. The cam **510** can be actuated between a first position and a second position to actuate the shaft **514**. The shaft **514** passes through the tube **104** along the longitudinal axis of the tube **104**, and terminates at the second cap **504**. For example, the shaft **514** terminates at a nut **518** disposed on the second cap **504**. The shaft **514** is discussed in greater detail in connection with FIGS. **6** and **7**.

(29) FIG. **6** is a side view of the enclosed wireless router **500** configured for use with the solar-powered electronic system of FIG. **1** and FIG. **2**. The enclosed wireless router **500** includes a first seal assembly **602**, a second seal assembly **604**, and an electronics module **606**. As shown, the first seal assembly **602** is disposed adjacent to the first cap **502** and the second seal assembly **604** is disposed adjacent to the second cap **504**. In some examples, the seal assembly is integral with the corresponding cap or disposed within the corresponding cap.

(30) As shown, the first seal assembly **602** and the second seal assembly **604** define radial seals including a sealing ring **610** disposed between and a first beveled plate **612** and a second beveled plate **614**. In some examples, the sealing ring **610** is a silicone ring. In other examples, the sealing ring **610** is made of another gasket material. Additionally, the sealing ring **610** includes a triangular cross-sectional shape. In some examples, the sealing ring **610** has different cross sectional shapes such as circular, quadrilateral, pentagonal, etc. As a result, movement of the second beveled plate **614** towards the first beveled plate **612** displaces the sealing ring **610** radially outward. The shape of the sealing ring **610** cooperates with the first beveled plate **612** and the second beveled plate **614** to displace the sealing ring **610** radially outward. The first beveled plate **612** is movable relative to the second beveled plate **614**. When disposed within the tube **104**, the first seal assembly **602** and the second seal assembly **604** seals the tube **104** from the external environment. In some examples, the first seal assembly **602** and the second seal assembly **604** cause the tube **104** to be airtight (i.e., inhibit the movement of gas into or out of the tube **104**).

(31) The first cap **502** includes the cam **510**. As shown in FIG. **6**, the cam **510** is in a first position. In the first position, the first beveled plate **612** and the second beveled plate **614** are pressed together to displace the sealing ring **610** outward in a sealing position. In a second position, the cam **510** causes the first beveled plate **612** and the second beveled plate **614** to separate and no longer displace the sealing ring **610** outward. In some examples, the cam **510** is perpendicular with the longitudinal axis in the first position and parallel with the longitudinal axis in the second position.

(32) As shown in FIGS. **6** and **7**, the first cap **502** includes first antennas **622** and the second cap **504** includes second antennas **624**. Additionally, the first cap **502** and the second cap **504** are connected by the shaft **626**. The first cap **502**, the first antennas **622**, the second cap **504**, the second antennas **624**, and the shaft **626** comprise the electronics module **606**. The electronics module **606** is pivotably and axially movable relative to the tube **104**, but in some examples, the electronics module is only axially movable relative to the tube **104**. Additionally, in accordance with the present disclosure, the electronics module **606** is configured to position at least one of the antennas adjacent to one of the windows (e.g., windows **410** or windows **412**). Permanently-placed antennas would require long, flexible cables when attached to a moving electronics module. This

window and alignment system keeps the antennas mounted to the same structure as the electronics for short, potentially rigid low-loss antenna cables.

(33) As shown in FIGS. **6** and **7**, the electronic module **606** additionally includes various batteries **630**, circuits, and a heat sink **632** (discussed in greater detail in FIGS. **19** and **20**). The various circuits included in the electronic module **606** are provided to support the wireless and radiofrequency operations of the solar-powered electronic system **100**. The various electronic components of the electronic module **606** are connected to the shaft **514** and move concurrently with the shaft and electronic module **606**. The various electronic components of the electronic module **606** can be adapted for quickly replacing with updated technology.

(34) FIGS. **8** and **9** are a cross-sectional view of the enclosed wireless router **500** including a quick-release waterproof seal. A cam-actuated seal allows for immediate, one-handed, opening and closing of the device for modification or repair, while maintaining a waterproof tube. The waterproof tube in some implementations can conform to IP68 requirements.

(35) Antennas are affixed to the same internal mount as the electronics and batteries. This entire mount is slid in and out of place. When the internal capsule is fully slid into place, an orientation key on either end locks into the correct orientation. This lines the internal antennas up with cutouts in the aluminum, which have polycarbonate "windows" keeping them waterproof while radio frequency (RF) transparent.

(36) In some examples, the tube **104** includes a first key **403** and a second key **404**. The first key **403** is configured to correspond with the first cap **502**. As a result, the first key **403** causes the electronic module **606** to be aligned with the windows **410** (shown in FIG. **4**). Additionally, the tube **104** can include a second key **405** configured to correspond with the second cap **504**. Additionally, in some examples, both the first key **403** and the second key **404** are configured to align both the first cap **502** and the second cap **504** simultaneously. As a result, electronics (e.g., antennas) disposed on the first cap **502** and the second cap **504** can be automatically aligned with windows **410** and **412** automatically.

(37) FIG. **10** is a perspective view of the mount **102** of FIG. **1** in accordance with the present disclosure. The mount **102** includes a mounting panel **1010**, a gear **1012**, and a gear shaft **1014**.

(38) As shown in FIG. **10**, the mounting panel **1010** includes a proximal end **1020**, adjacent the mount **102** and a distal end **1022** opposite the proximal end **1020**. The mounting panel **1010** is secured to the solar panel **106** via fasteners such as screws or bolts on both the proximal end **1020** and the distal end **1022**. The mounting panel is rotationally coupled, relative the mount **102**, to an axle **1024**. The axle **1024** is positioned such that the mounting panel **1010** is gravity biased to rotate. As shown in FIG. **10**, the distal end **1022** of the mounting panel **1010** is gravity biased to rotate downward, towards the mount **102**. Additionally, the mounting panel **1010** is configured to couple with a solar panel, which is also biased to rotate with the mounting panel **101**. The mounting panel **1010** provides a flexible solution capable of tolerating higher wind speeds than rigidly mounted solar panels. Additionally, the edge **1040** of the mount **102** may include a flexible polymer cover. The flexible polymer cover can bend under pressure to help secure the tube **104** in the mount, inhibiting the tube **104** from vibrating under constantly changing wind forces.

(39) The mounting panel **1010** also includes a tensioned variable ribbon **1028** configured to adjust the angular position of the mounting panel. As shown, the tensioned variable ribbon **1028** is mechanically coupled to the proximal end **1020** of the mounting panel **1010**. As a result, the tensioned variable ribbon **1028** counteracts the gravity biased rotation of the mounting panel **1010**.

(40) The mount **102** further includes the gear **1012** adapted to adjust the tensioned variable ribbon **1028** and configured to translate between a first position, a second position, and a third position. The gear **1012** is centrally disposed on the mount in the first position, as shown in FIG. **10**. The second position and the third position are disposed on either side of the first position. As shown in FIG. **10**, the tensioned variable ribbon **1028** includes a plurality of apertures configured to receive the teeth of the gear **1012**. Additionally, the gear **1012** is mechanically coupled with a gear shaft

1014. Both the gear **1012** and the gear shaft **1014** are configured to translate together from the first position to the second position or the third position. Additionally, rotating the gear shaft **1014** cause the gear **1012** to rotate. Rotation of the gear **1012** causes the tensioned variable ribbon **1028** to translate vertically. As a result, the mounting plate **1010** pivots about the axle **1024**.

(41) The mount **102** additionally includes a spring **1030** adapted to bias the gear **1012** from the second position to the first position or the third position to the first position. As a result, the gear **1012** and the gear shaft **1014** are disposed in the first position as shown in FIG. **10**, unless actuated by a user against the force exerted by the spring **1030**. In some examples, the mount **102** includes pins **1042** on either side of the variable ribbon **1028** that inhibit the variable ribbon **1028** from pivoting to either side of the mount **102**. Additionally, the variable ribbon **1028** may include tabs **1046** (shown in greater detail in FIG. **24**B) configured to inhibit the unintentional separation of the variable ribbon **1028** from the mount **102**. Specifically, when the gear **1012** is in either the second or third position, the teeth of the gear **1012** will catch on one of the tabs **1046** instead of permitting the variable ribbon from disconnecting from the mount **102**.

(42) The gear shaft **1014** includes a hex bushing (not shown) and the mount **102** includes a hex socket configured to receive the hex bushing. When the gear shaft **1014** is disposed in the first position, the hex bushing is disposed in the hex socket. As a result, the gear shaft **1014** is locked and cannot be rotated when in the first position. Accordingly, the tensioned variable ribbon **1028** is also locked and the mounting bracket **1010** is inhibited from pivoting about the axle **1024** when the gear shaft **1014** is disposed in the first position. Other similar locking mechanisms are considered within the scope of this disclosure.

(43) FIGS. **11** and **12** are a perspective view of a single-hand actuated solar angle set system **1100** in a first and second position in accordance with the present disclosure. As illustrated, the mount **102** and various other elements are shown as partially cut away. As shown in FIG. **11**, the gear **1012** and the gear shaft **1014** are disposed in a first, locked position. In contrast, FIG. **12** shows the gear **1012** and the gear shaft **1014** disposed in a second, unlocked position in which the gear can be rotated and actuate the tensioned variable ribbon **1028**.

(44) As shown, the gear shaft **1014** includes a button **1102** on either end of the gear shaft **1014** and a gear **1012** disposed centrally on the gear shaft **1014**. The gear shaft **1014** also passes through panels **1104** of the hub **102**. The gear shaft **1014** includes a hex bushing **1110** corresponding to a hex socket **1112** disposed in the panels **1104** of the hub **102**. As a result, as shown in FIG. **11**, the hex bushing **1110** is disposed in the hex socket **1112** and the gear shaft **1014** is inhibited from rotating. In contrast, as shown in FIG. **12**, the gear shaft **1014** is pushed or pulled via the button **1102**, moving the gear shaft **1014** from the first position to the second position. As a result, the hex bushing **1110** is no longer disposed in the hex socket **1112** and the gear shaft **1014** is free to rotate and actuate the tensioned variable ribbon **1028**.

(45) FIGS. **13**, **14**, and **15** are perspective views of the solar panel quick-lock apparatus **1300** in accordance with the present disclosure. The solar panel quick-lock apparatus **1300** includes the mounting bracket **1010** and a locking paddle **1302**. The mounting bracket **1010** includes a top surface **1310**, a first panel **1312**, and a third panel **1314**. The first panel **1312** and the third panel **1314** include a first slot **1316** and an aperture **1318**. The slot **1316** is configured to receive an axle.

(46) The locking paddle **1302** includes a push surface **1320**, a second panel **1322**, and a fourth panel **1324**. The locking paddle **1302** also includes a slot **1326** and an aperture (not shown). As shown, the aperture **1318** aligns with the aperture of the locking paddle **1302** such that the mounting bracket **1010** and the locking paddle **1302** are pivotable relative to each other.

(47) In operation, the first panel **1312**, including the first slot **1316**, is configured to receive the axle **1024** (illustrated in FIGS. **10** and **14**) and the first aperture **1318** disposed adjacent the slot. The second panel **1322**, pivotable relative to the first panel **1312**, includes the second slot **1326** configured to receive the axle **1024** and a second aperture disposed adjacent to the slot. The second panel **1322** is pivotable, relative to the first panel **1312**, between a first position (shown in FIGS. **13**

and **14**) and a second position (shown in FIG. **15**). The solar panel quick-lock apparatus **1300** also includes a pivoting axle (not shown) passing through the first aperture **1318** and the second aperture of the second panel **1322**.

(48) As shown in FIG. **14**, the axle **1024** can be disposed in the first slot **1316** but not disposed in the second slot **1326**. But, as shown in FIG. **15**, when the locking paddle **1302** is pivoted into the second position, the second slot **1326** receives the axle **1024**. The second slot **1326** in the second position is both aligned with the first slot **1316**, yet disposed at an angle relative to the first slot **1316**, thereby closing the first slot **1316**. The axle **1024** disposed in both the first slot **1316** and the second slot **1326** is locked in place. The push surface **1320** is disposed on the underside of the solar panel **106** such that a user can actuate the push surface **1320** while holding the solar panel on the proximal end **107***a*.

(49) FIGS. **16** and **17** are a side view of the clamping system **1600**, in accordance with the present disclosure. The clamping system **1600** includes a static cradle **1602** having a tubular slot **1604**, the mounting clamp **204**, and an adjustment mechanism **1608**. The clamping system **1600** allows a device to be dropped into place and then tightened to the installed mount with a knob and without additional support. Without this, the mounting structure might require multiple people or preassembly.

(50) The clamping system **1600** includes a static cradle **1602** configured to receive the tube **104**. After the tube **104** is lowered into the static cradle **1602**, the knob on the bottom can be twisted to lift up the far edge of the clamp and lock the enclosure into place. The knob is able to create tension via a sliding T-nut which fits into a slot in the clamp metal, and a compression spring pushing the clamp open. As used in the clamping system **1600**, the T-nut does not rotate along with the knob, but rather, as the knob rotates the tension is increased as shown in FIGS. **16** and **17**.

(51) The static cradle **1602** defines the tubular slot **1604** having an upper portion **1610** and a lower portion **1612**. The mounting clamp **204** includes a pivotable clamp **1606** disposed in the lower portion **1612** of the static cradle **1602** and pivotable about an axle **1616** between a first, open position (shown in FIG. **16**) and a second, secured position (shown in FIG. **17**). The lower portion **1612** also includes the adjustment mechanism **1608** to pivot the pivotable clamp **1606** from the first position to the second position. The adjustment mechanism **1608** includes a knob **1620**, a nut **1622**, a shaft **1624**, and a spring **1626**. Actuating the knob **1620** causes the nut **1622** to move along the shaft **1624** of the actuating mechanism **1608**. In one example, rotating the knob **1620** causes the nut **1622** to move against the spring **1626**. In such an example, the shaft **1624** includes a screw mechanism to control the position of the nut **1622** as the spring **1626** pushes against the nut **1622**. The shaft **1624** may pass through the pivotable clamp **1606** while the nut **1622** is too large to pass through the pivotable clamp **1606**. As a result, when the nut **1622** is actuated down towards the actuating mechanism **1620**, the nut **1622** contacts the pivotable clamp **1606** and causes the pivotable clamp to pivot about the axle **1616**.

(52) As shown in FIG. **16**, the pivotable clamp **1606** is pivoted such that the tube **104** can be inserted into the tubular slot **1604**. However, when the pivotable clamp **1606** is pivoted into the closed position, the tube **104** is pushed against the upper portion **1610**, securing the tube in the tubular slot. In some examples, the pivotable clamp **1606** includes a silicone edge or cover to improve the clamping effect between the pivotable clamp **1606** and the tube **104**. Additionally, the pivotable clamp **1606** secures the tube **104** in the static cradle **1602** because the pivotable clamp **1606** in the second position encloses a portion of the tubular slot **1604**.

(53) FIG. **18** is a perspective view of the mount **102** and tube **104** in accordance with the present disclosure. As shown, the tube **104** is secured in the mount **102** because the pivotable clamp **1606** is disposed in the second position, securing the tube **104** within the tubular slot **1604**.

(54) FIGS. **19** and **20** are perspective views of a sliding heat spreader **2000** in accordance with the present disclosure. Because the tube **104** is designed to be waterproof, the sliding heat spreader **2000** is configured to conduct heat to the outside while not inhibiting movement for assembly and

disassembly. Springs continually push the heat spreader against the outer casing for a continuous and dynamic thermal connection. The springs push the heat spreader into the roof of the cylinder with enough force to achieve the necessary thermal conductivity without compromising the ability to shift the electronic module back and forth inside of the tube. As a result, no forced air or liquid cooling is necessary to cool the electronic module. As shown in FIG. **1**, the tube **104** is disposed in the shade of the solar panel **106** when the solar panel **106** is oriented toward the sun, and the shade of the solar panel **106** improves the cooling of the tube **104** and the heat spreader **2000**.
(55) The heat spreader **2000** includes a heat sink **2002** and a biasing member **2004** (e.g., a spring). The biasing member **2004** is disposed between the heat sink **2002** and the shaft **514**. The heat sink **2002** is made of a thermally conductive material, such as a metallic material. Further, the heat sink **2002** matches the curvature of the inner radius of the tube **104**. The heat spreader further includes a rim **2006**. The rim **2006** facilitates insertion of the heat sink **2002** into the tube **104**. To this end, the rim **2006** is configured to be inserted into the tube **104** first. The angle of the rim **2006** causes the heat sink **2002** and the biasing member **2004** to depress when being inserted into the tube **104**. In various other examples, the rim **2006** can be rounded.
(56) In various embodiments, the heat spreader **2000** may include a circuit board **2020** and fasteners **2022**, **2024**. As shown, the circuit board **2020** can be fastened to the biasing member **2004** via the fasteners **2022**. As a result, the circuit board **2020** in some implementations is structurally rigid enough to withstand the stresses and forces exerted by the biasing member **2004**. Additionally, the circuit board **2020** can be fastened to the heat sink **2002** via fasteners **2024**. Alternatively, the circuit board **2020** can be fastened to the heat sink **2002** and/or the biasing member **2004** via a different securing mechanism, such as an adhesive.
(57) As described, the solar-powered electronic system includes electronics and antennas for operation as a wireless router. However, the solar-powered electronic system is not limited to wireless routers. In some examples, the solar-powered electronic system could be used in other industries such as remote weather stations, remote utility computer systems, electrical system infrastructure, etc. Additionally, as shown the solar-powered electronic system can include alternative power source systems such as a wind-powered generator. As a result, the solar-powered electronic system can be used in a variety of outdoor electronic systems to provide an easily mounted, self-powered, and sealed electronic system.

Claims

1. A quick-release tubular seal, comprising: a tube including a first end and a second end; a first seal assembly configured to selectively seal against the first end of the tube; a second seal assembly configured to selectively seal against the second end of the tube; a cam disposed on the first seal assembly, the cam being operable between a first position and a second position; and a shaft mechanically coupled to the cam, the first seal assembly, and the second seal assembly, the shaft configured to actuate both the first seal assembly to seal against the first end of the tube and actuate the second seal assembly to seal against the second end of the tube when the cam is actuated from the first position to the second position.
2. The quick-release tubular seal of claim 1, wherein the first seal assembly is disposed within a first cap and the second seal assembly is disposed in a second cap.
3. The quick release tubular seal of claim 1, wherein the shaft is disposed along a longitudinal axis of the tube.
4. The quick release tubular seal of claim 3, wherein the shaft is threaded.
5. The quick release tubular seal of claim 1, wherein the first seal assembly and the second seal assembly define radial seals including a sealing ring disposed between and a first beveled plate and a second beveled plate.
6. The quick release tubular seal of claim 5, wherein the first beveled plate is movable relative to

the second beveled plate.
7. The quick release tubular seal of claim 6, wherein movement of the second beveled plate towards the first beveled plate displaces the sealing ring radially outward.
8. The quick release tubular seal of claim 5, wherein the sealing ring is a triangular.