

USER TERMINAL CLAMP

Statement of Related Cases

[0001] This application claims priority to U.S. Non-Provisional Pat. App. S.N. 15/457,707, filed March 13, 2017, which claims priority to U.S. Provisional Pat. App. S.N. 62/310,922, filed March 21, 2016, both disclosures of which are incorporated by reference herein.

Field of the Invention

[0002] The present disclosure relates to user terminals for satellite communications systems.

Background

[0003] Satellite systems for bringing low-cost broadband internet service to any location on the earth are currently being developed. Such systems typically include gateway antennas that link the internet to a fleet of non-geostationary satellites, which in turn link to inexpensive user terminals positioned on the earth. The user terminals deliver internet connectivity to residences and businesses.

[0004] The inexpensive user terminal mentioned above includes an antenna that requires an unobstructed view over a large section of the sky in all azimuthal directions (north, south, east, and west directions) in order to receive uninterrupted service from the satellites.

[0005] Individual users with a minimum of expertise are likely to be mounting and installing the user terminal on the roof of their residences or businesses. Accordingly, an inexpensive and easy-to-use device is needed for enabling a user to securely couple the user terminal to a roof.

Summary

[0006] The present invention provides a clamping device that, without the use of tools, clamps to structure, such as a wall or roof of a building, *etc.*, in either of two orthogonal orientations and receives a user terminal, as mentioned above.

[0007] A user-terminal clamp in accordance with the illustrative embodiment includes a frame having a pair of movable clamping members that are actuated by a handle. By virtue of the structure of the frame, the mounted user terminal has the same orientation (e.g., with respect to the ground) regardless of the clamping orientation. The frame includes a coupler to couple the user terminal to the user-terminal clamp. In the illustrative embodiment, the coupler comprises slots or channels that receive ribs that are disposed on the underside of the user terminal.

[0008] The handle is operatively coupled to an internally disposed actuation mechanism, which includes a cable, a cable ramp, a pulley, and a cable tensioner. The actuation mechanism couples to the clamping members. Rotation of the handle thus causes the clamping members to move; in particular, to a clamping position.

[0009] The cable ramp, by virtue of its shape, imparts a variable rotary motion. The cable is attached to one end of the cable ramp; the other end of the cable is coupled to one or more cable tensioners. In the illustrative embodiment, the cable tensioners are anchored within at least one of the clamping members. The cable ramp is operatively coupled to the handle, so that when the handle is rotated, the cable ramp rotates as well.

[0010] When the user-terminal clamp is in a fully open, un-tensioned state, the cable ramp is in a first position that effectively creates a relatively shorter path for the cable between its two points of attachment. Partial rotation of the handle moves the cable ramp towards a second position that effectively lengthens the path for the cable between its two points of attachment. The lengthening of the path, for the (fixed length) cable creates a tension that draws the clamping members upward to a clamping position.

[0011] The user-terminal clamp includes two features that impart adjustability in terms of the thickness of the structure to which the clamp attaches. Varying thickness is accommodated, primarily, via the cable tensioner(s). When clamping to a relatively thicker member, less travel of the clamping members is required. In such a situation, the clamping members engage the structure when the handle and cable ramp have only moved through a portion of the total available rotation. As the handle (and cable ramp) are rotated to their final

position, the cable tensioner(s) stretch (tension) or compact (compression) depending on their design, to accommodate the remaining rotation of the handle. The tension imparted to the cable provides a clamping force. Because of this particular arrangement, the clamp provides a greater clamping force when clamping to a relatively thicker structure than a relatively thinner one.

[0012] The second feature that imparts adjustability is foam pads that are disposed on the clamp heads of the clamping members. In some embodiments, the clamp is formed from metal. A plastic housing overlies the metal structure.

Brief Description of the Drawings

[0013] FIGs. 1A-1B depict perspective views of the user-terminal clamp coupled to a user terminal. The two figures depict the user-terminal clamp being used in two different orientations.

[0014] FIG. 2A depicts a first perspective view of an embodiment of a user-terminal clamp in accordance with the present invention.

[0015] FIG. 2B depicts a second perspective view of the user terminal-clamp of FIG. 2A, showing the internal actuation mechanism.

[0016] FIGs. 3A-3C depict the handle of the user-terminal clamp being partially rotated ending with the clamp making contact with a structure being clamped (not depicted).

[0017] FIG. 3D depicts the action of the cable tensioner to enable full handle rotation and clamping.

[0018] FIGs. 4A-4D depict the cable system and the positions of the cable ramp corresponding to the states (*i.e.*, positions of the handle of the user-terminal clamp) depicted in FIGs. 3A-3D.

[0019] FIG. 5A depicts installation of the user terminal wherein the clamp is clamping in a horizontal orientation, such as when mounting to a roof eave.

[0020] FIG. 5B depicts installation of the user terminal wherein the clamp is clamping in a vertical orientation, such as when mounting to a parapet.

Detailed Description

[0021] FIGs. 1A and 1B depict user-terminal clamp **102** coupled to a user-terminal **100** for clamping the user terminal to the structure (not depicted). User terminal **102** includes antenna **560** and supporting electronics **560** enclosed by radome **560** (see FIG. 5B).

[0022] FIG. 1A depicts user-terminal clamp **102** in a horizontal orientation, such as for mounting to a roof eave. FIG. 1B depicts user-terminal clamp **102** in a vertical orientation, such as for mounting to a parapet.

[0023] As depicted in FIGs. 1A and 1B, user-terminal clamp **102** includes frame **104** comprising two support members **105** and **106** that are in parallel, spaced-apart relation to one another. Each support member comprises two segments that are disposed orthogonally to one another. In particular, support member **105** includes horizontal support segment **105A** and vertical support segment **105B**. Likewise, support member **106** includes horizontal support segment **106A** and vertical support segment **106B**.

[0024] Paired horizontal supports segments **105A** and **106A** couple to and support user terminal **100** when user-terminal clamp **102** is being used in a horizontal position, as in FIG. 1A. Paired vertical supports segments **105B** and **106B** couple to and support user terminal **100** when user-terminal clamp **102** is being used in a vertical position, as in FIG. 1B.

[0025] User-terminal clamp **102** further includes clamping members **108A** and **108B**. Clamping region **110** is defined between a portion of the clamping members and horizontal supports segments **105A** and **106A**. In use, the portion of the structure (e.g., eaves, parapet, etc.) to which user-terminal clamp **102** is to be clamped is positioned in clamping region **110** and the clamp is then tightened to the structure.

[0026] FIGs. 2A and 2B depict, via perspective views, further detail of user-terminal clamp **102**. As depicted in these figures, frame **104** of the user-terminal clamp is u-shaped, wherein portion **107** bridges the separation between spaced support members **105** and **106**. In some embodiments, portion **107** is attached to support members **105** and **106** (e.g., welded, soldered, glued, bolted, etc.). In the illustrative embodiment, frame **104** is formed as a unitary, monolithic structure. For use in this disclosure and the appended claims, portion **107** is

referred to as a **"bridging portion"** of the frame, which designation applies to embodiments in which the frame is assembled from individual members as well as embodiments in which the frame is formed as a unitary, monolithic structure.

[0027] Horizontal support segments **105A** and **106A** each include channel or slot **211A**. The slot receives ribs, bosses, or other type of projections (hereinafter simply "ribs") disposed on the bottom of user terminal **100** (see, e.g., FIGs. 5A and 5B), thereby enabling user-terminal clamp **102** and user terminal **100** to couple to one another.

[0028] Each slot **211A** includes widened entry region **213A**, which facilitates insertion of the ribs of the user terminal into the slots. Slot **211A** includes a locking feature for immobilizing a rib of the user terminal in the slot. In the illustrative embodiment, the locking feature is lip **212A**, which runs along the length of the outer edge of the slot. To couple a user terminal to user-terminal clamp **102**, the (two) ribs disposed on the base of the user terminal are slid into the two slots **211A**. With each slot, the rib is inserted such that a coupling feature of the rib (e.g., protrusions extending from the outer edge the rib, an upper edge of the outer edge of the rib, etc.) is disposed below the underside of lip **212A**. This immobilizes the rib and, hence, the user terminal. To disengage the user terminal from the user-terminal clamp, the rib/user terminal is slid out of slot **211A**. Each slot **211B** functions in the same manner as slots **211A** to couple a user terminal to the user-terminal clamp for a vertical clamping application. In some other embodiments, the locking feature could include two lips, one on each side of the slot, or a lip on the inside edge of the slot, or the lips could be on the right edge of each slot or the left edge of each slot.

[0029] Another salient feature of user-terminal clamp **102** are clamping members **108A** and **108B**. The clamping members are rotatably coupled to the vertical support segments **105B** and **106B** near the base thereof at pivot point **238** (not visible in FIG. 2A; see FIG. 2B, the pivot point attachment at vertical support segment **105B** is obscured.)

[0030] Each clamping member includes arm **216** and clamp head **218**. In the illustrative embodiment, clamp head **218** is rigidly fixed to arm **216**. In some other embodiments, clamp head **218** is rotatably coupled to arm **216**.

[0031] Resilient pads **220** are disposed on the upper surface of each clamp head **218**. Resilient pad(s) **214** (see FIG. 28) are disposed on frame **104** at the surface thereof that opposes clamp heads **218**. In the illustrative embodiment, the resilient pads comprise medium density foam.

[0032] Clamping members **108A** and **108B** are actuated to clamp via handle **222**. The handle comprise two plates **224** (one plate on a portion of the inside surface of each support member **105** and **106**) and grip **226**. Handle **222** is rotatably coupled to frame **104** at pins **228**.

[0033] Actuation mechanism **229** by which handle **222** actuates clamping members **108A/108B** is depicted in FIG. 28. In the illustrative embodiment, there are two instances of actuation mechanism **229**; one in each of vertical support segments **105B** and **106B** (although only the mechanism in segment **106B** is depicted). However, in some alternative embodiments, the user-terminal clamp includes only one actuation mechanism **229** situated, for example, in one of the vertical support segments.

[0034] Actuation mechanism **229** includes cable **230**, cable ramp **232**, pulley **236**, and cable tensioner **244**. As depicted in FIG. 28, one end of cable **230** is attached to cable ramp **232** at attachment point **234**. The cable runs downward through vertical support segment **106B**, engages pulley **236** near the bottom thereof, and enters the base of arm **216** through opening **246**.

[0035] Cable tensioner **244** is disposed in internal chamber **240**. In the illustrative embodiment, cable tensioner **244** is a spring. One end of the spring is fixed to distal end **242** of chamber **240**. The second end of cable **230** is attached to the end of the spring nearest opening **246**. In the illustrative embodiment, cable tensioner **244** is arranged so that it is placed in tension when it is tensioning cable **230**. Without limitation, in such embodiments, cable tensioner **244** can be implemented as one or more springs, such as conventional spiral or helical springs, elastic and resilient members, a pneumatic spring, etc. In some other embodiments, the cable tensioner is arranged so that it is placed in compression to effect cable tensioning. In such an embodiment, cable **230** would typically be coupled to cable tensioner **244** at the distal end thereof (i.e., the end furthest from opening **246**). Without limitation, in

such embodiments, cable tensioner **244** can be implemented as a compression spring, a Belleville washer, resilient washers, or other resilient members. In some further embodiments, cable tensioner **244** is a motor.

[0036] The operation of actuation mechanism **229** is best understood with reference to FIGs. 3A through 3D and 4A through 4D.

[0037] FIGs. 3A through 3D depict movement (partial rotation) of handle **222** to actuate user-terminal clamp **102**. FIG. 3A depicts user-terminal clamp **102** in a fully opened and un-tensioned state. FIG. 3B depicts handle **222** being partially rotated upward to cause clamp heads **218** of clamping members **108A** and **108B** to move upward. The rotation of handle **222** is continued in FIG. 3C. At this point, it is assumed that the clamp heads have engaged the structure (not depicted) being clamped and tensioning device **244** is applying tension to cable. In FIG. 3D, handle **222** is fully rotated. The movement of handle **222** past the point at which clamp heads **218** engaged the structure (FIG. 3C) creates a tension in cable **230** that provides a clamping force.

[0038] FIGs 4A through 4D depict various states of actuation mechanism **229**, which correspond to the clamping sequence depicted in respective FIGs. 3A through 3D. Each of Figures 4A through 4D depict cable **230**, cable ramp **232**, pulley **236**, cable tensioner **244**, and internal chamber **240**.

[0039] FIG. 4A depicts the state of actuation mechanism **229** that corresponds to the position of handle **222** shown in FIG. 3A. This represents user-terminal clamp **102** in a fully open state. As depicted in FIG. 4A, cable ramp **232** points "up." In this orientation, there is minimal tension on cable **230** because the path from one end of the cable at attachment point **234** to the other end of the cable is the shortest possible path.

[0040] In FIG. 4B, cable ramp **232** begins to rotate "downward" in concert with the upward rotation of handle **222**. Note that handle **222** and cable ramp **232** are coupled via pin **228**.

[0041] In FIG. 4C, the rotation of cable ramp **232** continues as handle **222** is rotated further upward. It is notable that as cable ramp **232** rotates "downward" about pin **228** in concert with the upward rotation of handle **222**, cable **230** traverses increasingly more of curved lobe **450** of

the cable ramp. Initially, this causes clamp heads **218** to rise (e.g., FIGs. 3B, 3C). However, once contact is made with a structure to be clamped, further rotation of handle **222** and cable ramp **232** tensions the cable, increasing the clamping pressure on structure being clamped.

[0042] FIG. 4D depicts actuation mechanism in a fully tensioned state, wherein cable **230** engages the maximum amount of curved lobe **450** of cable ramp **232**. In this state, cable **230** is under maximum tension. Since clamp heads **218** substantially stop moving “upward” after contacting the clamped structure (FIG. 3C/4C), the additional tension in the system is applied as clamping force to the clamped structure.

[0043] FIG. 5A depicts user-terminal clamp **102** and user terminal **100** in preparation for coupling in a horizontal orientation (see FIG. 1A). Ribs **511** on the bottom of user terminal **100** couple to slots **211A** in user-terminal clamp **102**. In the illustrative embodiment, each rib **511** comprises a piece of material (e.g., metal, etc.) folded into a v-shape, wherein only one of the two major edges (the “inside” edge) of rib **511** attaches to or is formed as part of the bottom of the user terminal. The other major edge **552** does not attach to the bottom of the user terminal and is positioned under lip **212A** as it is slid into slot **211A**.

[0044] FIG. 5B depicts user-terminal clamp **102** and user terminal **100** in preparation for coupling in a vertical orientation (see FIG. 1B). Ribs **511** on the bottom of user terminal **100** couple to slots **211B** in user-terminal clamp **102** in the same fashion as discussed above in conjunction with FIG. 5A.

[0045] It is to be understood that the disclosure describes a few embodiments and that many variations of the invention can easily be devised by those skilled in the art after reading this disclosure and that the scope of the present invention is to be determined by the following claims.

What is claimed is:

- 1.** A clamp that is intended for use with a user terminal, the clamp comprising:

 - a frame, the frame having two support members that are disposed in parallel, spaced-apart relation to one another, each support member having two segments that are disposed orthogonally to one another, and wherein each segment includes a coupler comprising a recess and a mating projection, and further wherein paired segments, one from each support member, couple the user terminal to the frame;
 - two clamping members rotatably coupled to the frame;
 - a handle rotatably coupled to the frame; and
 - an actuation mechanism operatively coupled to the clamping members and the handle, wherein partial rotation of the handle results in upward movement of the clamping members.
- 2.** The claim of claim 1 wherein the actuation mechanism includes:

 - (a) a cable;
 - (b) a cable ramp that is operatively coupled to the handle, wherein a first end of the cable is attached to the cable ramp; and
 - (c) a cable tensioner that, in conjunction with movement of the cable ramp, is operative to impart tension to the cable.
- 3.** The clamp of claim 1 wherein the coupler comprises a slot.
- 4.** The clamp of claim 2 wherein the cable tensioner and the cable are arranged so that the cable tensioner is placed in tension to impart tension to the cable.
- 5.** The clamp of claim 2 wherein the cable tensioner and the cable are arranged so that the cable tensioner is placed in compression to impart tension to the cable.

6. The clamp of claim 1 wherein the actuation mechanism is arranged so that partial rotation of the handle results in upward movement of the clamping members until the clamping members contact a structure.

7. The clamp of claim 6 wherein the actuation mechanism is arranged so that after clamping members contact a structure, additional partial rotation of the handle results in an increasing clamping force against the structure.

8. The clamp of claim 2 wherein the cable ramp comprises a curved lobe.

9. The clamp of claim 2 wherein a second end of the cable is attached to the cable tensioner.

10. The clamp of claim 9 wherein the actuation mechanism further comprises a pulley, wherein the pulley contacts the cable between the first end thereof and the second end thereof, redirecting the cable so that movement of the cable ramp causes the clamping members to rise.

11. The clamp of claim 1 wherein the recess of the coupler of each segment comprises a slot, and further wherein paired segments, one from each support member, receive a projection comprising ribs disposed on a bottom of the user terminal, thereby coupling the user terminal to the frame.

12. The clamp of claim 11 wherein the frame comprises a bridging portion, which, in conjunction with the one segment of each support member that is proximal to the bridging portion, is arranged in a u-shape configuration.

13. The clamp of claim 11 wherein the actuation mechanism comprises two instances of:
a cable;
a cable ramp that is operatively coupled to the handle, wherein a first end of the cable is

attached to the cable ramp; and

a cable tensioner, wherein the cable tensioner is disposed in line with the cable, and further wherein the cable tensioner, in conjunction with movement of the cable ramp, is operative to impart tension to the cable, and wherein:

one of the two instances of the actuation mechanism is disposed in a first one of the support members and the rotatably coupled clamping member and the second of the two instances is disposed in a second one of the support member and respective rotatably coupled clamping member.