Title: MOUNTING ARRANGEMENT FOR RAILWAY WAYSIDE SIGNAL APPLICATIONS

Abstract: A mounting arrangement (100) includes an attachment member (102) for attachment to an end of a post (114), a connecting member (104) coupled to the attachment member (102), and a plurality of fastening elements (110) coupling the connecting member (104) to the attachment member (102), each fastening element (110) comprising a longitudinal axis (110A) and longitudinal axes (110A) of the plurality of fastening elements (110) being substantially parallel to each other. The connecting member (104) is coupled to the attachment member (102) in a direction defined by the longitudinal axes (110A) of the plurality of fastening elements (110), wherein the attachment member (102) and the connecting member (104) comprise mating cylindrical surfaces (118, 140) which allow a tilting motion of the connecting member (104) about a rotating axis which is perpendicular to the longitudinal axes (110A) of the plurality of fastening elements (110).
SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG). Published:

— with international search report (Art. 21(3))
MOUNTING ARRANGEMENT FOR RAILWAY WAYSIDE SIGNAL APPLICATIONS

CROSS REFERENCE TO RELATED APPLICATIONS


BACKGROUND

1. Field

[0002] Aspects of the present invention generally relate to a mounting arrangement for mounting a utility, such as a signalling unit, to an end of a post or mast. Specifically, the mounting arrangement is for use in a railway setting, for mounting railway signal units to posts which are positioned to the side of railway tracks and which provide signals to train operators. It will be appreciated that the present invention will have wider applicability and, for example, will be applicable to many forms of post mounted lighting, signalling or other utility.

2. Description of the Related Art

[0003] The railroad industry, including but not limited to the freight railroad industry, employs wayside signals including for example signal lights to inform train operators of various types of operational parameters. For example, colored wayside signal lights are often used to inform a train operator as to whether and how a train may enter a block of track associated with the wayside signal light. The status/color of wayside signal lights, i.e. lamps, is sometimes referred to in the art as the signal aspect. One simple example is a three color system known in the industry as Automatic Block Signaling (ABS), in which a red signal indicates that the block associated with the signal is occupied, a yellow
signal indicates that the block associated with the signal is not occupied but the next block is occupied, and green indicates that both the block associated with the signal and the next block are unoccupied. It should be understood, however, that there are many different kinds of signaling systems. Other uses of signal lights to provide wayside status information include lights that indicate switch position, hazard detector status (e.g., broken rail detector, avalanche detector, bridge misalignment, grade crossing warning, etc.), search light mechanism position, among others.

[0004] Wayside signals are typically mounted on a post, herein also referred to as mast, which include for example a signal head comprising the signal lights at some height above the track so that the signal lights can be seen at a distance. The post or mast is designed such that the signal head can be mounted to the top of the post or mast.

[0005] Existing top mast designs include for example an assembly intended to mount a utility, such as a railway signal head, to a first member of the assembly, while a second member is arranged to be attached to the upper end of a supporting post. A connection between the first member and the second member of the assembly has to be strong as well as allow adjustment of the railway signal head. Because signals are often required to be visible to a train operator over a significant distance, orientation or direction of the signal head requires a high degree of accuracy. Typically, the alignment accuracy must be within \( \pm 2.5^\circ \). But current top mast designs can be susceptible to high wind failures (high winds include winds with wind speeds of 90 mph or more), serviceability issues, shipping damage, which can further result in rail disruptions from signal outages, for example excessive train delays. Thus, there exists a need for an improved mounting arrangement for mounting a railway signal head to a post or mast.

**SUMMARY**

[0006] Briefly described, aspects of the present invention relate to a mounting arrangement for mounting a utility, such as a signalling unit, to an end of a post or mast, and a railway wayside signal assembly comprising such a mounting arrangement. Specifically, the mounting arrangement is for mounting railway signal units to posts
which are positioned to the side of railway tracks and which provide signals to train operators.

[0007] A first aspect of the present invention provides a mounting arrangement comprising an attachment member for attachment to an end of a post, a connecting member coupled to the attachment member, and a plurality of fastening elements coupling the connecting member to the attachment member, each fastening element comprising a longitudinal axis, longitudinal axes of the plurality of fastening elements being substantially parallel to each other, wherein the connecting member is coupled to the attachment member in a direction defined by the longitudinal axes of the plurality of fastening elements, and wherein the attachment member and the connecting member comprise mating cylindrical surfaces which allow a tilting motion of the connecting member about a rotating axis which is perpendicular to the longitudinal axes of the plurality of fastening elements.

[0008] A second aspect of the present invention provides a railway wayside signal assembly comprising a post or mast for installing along a railway track, a mounting arrangement carried by the post or mast, the mounting arrangement comprising an attachment member for attachment to an end of the post or mast, a connecting member coupled to the attachment member, and a plurality of fastening elements coupling the connecting member to the attachment member, each fastening element comprising a longitudinal axis, longitudinal axes of the plurality of fastening elements being substantially parallel to each other, wherein the connecting member is coupled to the attachment member in a direction defined by the longitudinal axes of the plurality of fastening elements, and wherein the attachment member and the connecting member comprise mating cylindrical surfaces which allow a tilting motion of the connecting member about a rotating axis which is perpendicular to the longitudinal axes of the plurality of fastening elements.
BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 illustrates a front view of a known mounting arrangement including a signal head.

[0010] FIG. 2 illustrates a perspective view of a mounting arrangement in accordance with an exemplary embodiment of the present invention.

[0011] FIG. 3 illustrates a perspective view of an attachment member of a mounting arrangement in accordance with an exemplary embodiment of the present invention.

[0012] FIG. 4 illustrates a top view of the attachment member of FIG. 3 in accordance with an exemplary embodiment of the present invention.

[0013] FIG. 5 illustrates a perspective view of a connecting member of a mounting arrangement in accordance with an exemplary embodiment of the present invention.

[0014] FIG. 6 illustrates a top view of the connecting member of FIG. 5 in accordance with an exemplary embodiment of the present invention.

[0015] FIG. 7 illustrates a sectional view of a longitudinal cut through the connecting member as indicated in FIG. 6 in accordance with an exemplary embodiment of the present invention.

[0016] FIG. 8 illustrates a sectional view of a longitudinal cut through the mounting arrangement in accordance with an exemplary embodiment of the present invention.

[0017] FIG. 9 illustrates an enlarged view of a section of the mounting arrangement of FIG. 8 in accordance with an exemplary embodiment of the present invention.

[0018] FIG. 10 illustrates an exploded view of the mounting arrangement as illustrated in FIG. 2 in accordance with an exemplary embodiment of the present invention.
invention.

DETAILED DESCRIPTION

[0019] To facilitate an understanding of embodiments, principles, and features of the present invention, they are explained hereinafter with reference to implementation in illustrative embodiments. In particular, they are described in the context of a mounting arrangement, and a railway wayside signal assembly comprising a post or mast for installing along a railway track carrying such a mounting arrangement for railway wayside signal applications. Embodiments of the present invention, however, are not limited to use in the described devices or methods.

[0020] The components and materials described hereinafter as making up the various embodiments are intended to be illustrative and not restrictive. Many suitable components and materials that would perform the same or a similar function as the materials described herein are intended to be embraced within the scope of embodiments of the present invention.

[0021] FIG. 1 illustrates a front view of a known arrangement 10 for railway wayside signal applications. The arrangement 10 includes a first member 12 and a second member 14 coupled to each other. The first member 12 is arranged to be attached to an upper end of a supporting post 20, and the second member 14 is for mounting a railway signal head 16 to an upper surface of the second member 14. The signal head 16 comprises a plurality of signal lights 18a, 18b, 18c. FIG. 1 shows an example of a three color system comprising for example a red signal 18a, a yellow signal 18b, and a green signal 18c. The signals 18a, 18b and 18c can comprise LED and/or incandescent lighting. But known arrangements, such as the arrangement 10, may be susceptible to breakage during shipping or failures when installed, for example because connections 22 between the first member 12 and second member 14 may not be as strong and secure as required. Furthermore, the signal head 16 is connected to the upper surface of the second member 14 by multiple bolts and lock nuts, shown schematically as bolt-nut-
connections 17. As FIG. 1 shows, the bolt-nut-connections 17 are not easily accessible, because the heads of the bolts are positioned inside the second member 14 and the lock nuts are positioned inside the signal head 16. But the bolt-nut-connections 17 may loosen during shipping or installing or simply over time once installed in the field, and therefore may need to be accessed and retightened. In order to be able to access and retighten the connections 17, the first member 12 and second member 14 have to be disassembled via the connections 22. Disassembling of the first and second members 12 and 14 complicates maintenance and service of the signal arrangement 10.

[0022] FIG. 2 illustrates a perspective view of a mounting arrangement 100 in accordance with an exemplary embodiment of the present invention. The mounting arrangement 100 comprises an attachment member 102 and a connecting member 104. The attachment member 102 is arranged to be attached to an upper end of a supporting post, and the connecting member 104 is for mounting a railway signal head to an upper surface of the connecting member 104. The attachment member 102 and the connecting member 104 are assembled in such a way that a strong and secure connection as well as adjustment of the connecting member 104 and thus a signal head attached to the connecting member 104 are provided.

[0023] The attachment member 102 and the connecting member 104 are connected to each other by a plurality of connections or joints 106. Each connection or joint 106 comprises a fastening element 110 which is configured as an adjusting stud. Each fastening element 110 comprises a longitudinal axis 110A, longitudinal axes 110A of the plurality of fastening elements 110 being substantially parallel to each other. The longitudinal axes 110A of the fastening elements 100 define a direction for coupling the attachment member 102 and the connecting member 104.

[0024] With further reference to FIG. 2, the connecting member 104 comprises openings 108 used for connecting a signal head to the connecting member 104. For example, the openings 108 can be tapped mounting holes, wherein the signal head is fastened by bolts to the connecting member 104. In an exemplary embodiment, the connecting member 104 comprises four tapped mounting holes 108, wherein each tapped
mounting hole 108 receives a bolt. FIG. 2 illustrates an example of a bolt 109 and how the bolt 109 would be positioned in relation to the connecting member 104. In contrast to known arrangements 10 as for example illustrated in FIG. 1, bolt heads of bolts 109 are now positioned within a signal head housing (schematically indicated by section 105), instead of the connecting member 104, and can thus be easily accessed from the signal head housing. Additional lock nuts are not necessary because the mounting holes 108 are embodied as tapped or threaded mounting holes 108. Attachment member 102 and connecting member 104 do not need to be disassembled in order to be able to access the bolts 109 in case they need to be retighten once the signal unit is installed in the field which provides easier maintenance and service of the signal unit.

[0025] Furthermore, the connecting member 104 comprises wire openings 107 which are used for arranging electric connections such as for example power cables and control signal wires for the signal head (see also FIG. 8) needed for operation of the signal head.

[0026] The fastening elements 110 provide strong and secure connections between the attachment member 102 and the connecting member 104, and function as structural supports in all wind loaded directions when the mounting arrangement 100 together with a signal head are installed along a railway track.

[0027] In an exemplary embodiment, the fastening elements 110 comprise metal and/or metal alloy. For example, the fastening elements 110 comprise aluminum, in particular consist entirely of aluminum. In a further embodiment, the fastening elements 110 comprise aluminum which has T6 heat treatment to increase strength. T6 heat treatment is applied to aluminum castings to increase for example hardness and other mechanical properties. It should be noted that one of ordinary skill in the art is familiar with T6 heat treatment.

[0028] Furthermore, the mounting arrangement 100 allows adjusting of the connecting member 104, and thus an attached signal head, because signal heads need to be able to be aligned in order to be properly visible to a train operator over a significant distance. Thus, the connections 106 are designed such that they allow for at least a ± 2.5° tilting motion, i.
e. a total tilting motion over at least about 5°, of the connecting member 104 to align the signal head once installed in the field. The mounting arrangement 100 can be designed such that it allows a total tilting motion greater than 5°. Further details of the mounting arrangement 100 will be described with reference to the following figures.

[0029] FIG. 3 illustrates a perspective view of an attachment member 102, and FIG. 4 illustrates a top view of the attachment member 102 of FIG. 3, in accordance with an exemplary embodiment of the present invention.

[0030] The attachment member 102 comprises a cylindrical base body 112 so that the attachment member 102 can be fixed to an end of a cylindrical post 114. The attachment member 102 can be fixed to the post 114 in many suitable manners, for example via a plurality of set screws or bolts 160 as illustrated for example in FIG. 8 and FIG. 9. Thus, the base body 112 comprises a plurality of openings 116, for example threaded openings, for receiving the set screws 160. Specifically, the base body 112 comprises four evenly distributed threaded openings 116 located at a lower end of the base body 112, wherein each opening 116 is provided for receiving a set screw 160. The base body 112 can comprise more or less openings 116 according to different requirements. Other forms of attachment of the attachment member 102 to the post end 114 can include for example grub screws or friction fits.

[0031] The attachment member 102 further comprises a convex surface. In an exemplary embodiment, the convex surface is configured as a half cylinder or half round, and herein referred to as cylindrical surface 118. The cylindrical surface 118 is arranged on an upper end of the base body 112 opposite the openings 116, and forms part of an upper surface 120 of the attachment member 102. The convex cylindrical surface 118 is curved toward the connecting member 104 (see for example FIG. 8). The cylindrical surface 118 is arranged such that a cylinder axis (or central axis) 118A of the mathematical half cylinder providing the surface 118 is perpendicular to a cylinder axis (or central axis) 112A of the cylindrical base body 112. The cylindrical surface 118 comprises a circular opening 128 used for arranging signal head hardware such as for example cables etc.
With reference to **FIGs. 3 and 4**, the attachment member **102** comprises a plurality of extensions **122a, 122b, 122c** on an upper end of the base body **112** used for providing the connections **106** (see **FIG. 2**). The extensions **122a, 122b, 122c** extend outwards from the base body **112** and upper sides of the extensions **122a, 122b, 122c** form parts of the upper surface **120** of the attachment member **102**. As **FIG. 4** illustrates, the extension **122b** is arranged at a right angle to the extensions **122a** and **122c**, and the extensions **122a** and **122c** lie opposite each other.

Each extension **122a, 122b, 122c** comprises a circular opening **124a, 124b, 124c** which each receive a fastening element **110** as introduced in **FIG. 2** for coupling the connecting member **104** to the attachment member **102**. The openings **124a, 124b, 124c** are each configured as tapped holes. The opening **124b** of extension **122b** is arranged substantially centric within the extension **122b**. The openings **124a** and **124c** are arranged eccentric, i.e. off-center, within the extensions **122a** and **122c**. All the openings **124a, 124b, 124c** are arranged such that center points of the circular openings **124a, 124b, 124c** lie on a mathematical circle **126**. Angles **a** between center points of openings **124a** and **124b** as well as openings **124b** and **124c** is for example 110°. But the extensions **122a, 122b, 122c** and/or the openings **124a, 124b, 124c** can be arranged at different angles to each other.

The attachment member **102** is configured such that it is mountable to the end of the post **114** which is cylindrical. But the present mounting arrangement **100**, specifically the attachment member **102**, can be modified such that it is also applicable to post ends having a different shape, such as square, rectangular or hexagonal cross-section, or beams having a web and flange cross-section such as an I-beam or a C-beam.

**FIG. 5** illustrates a perspective view of a connecting member **104** of a mounting arrangement **100**, and **FIG. 6** illustrates a top view of the connecting member **104** of **FIG. 5**, in accordance with an exemplary embodiment of the present invention.

As described before, the connecting member **104** is for mounting a railway
signal head to upper surfaces 130 of the connecting member 104. As described before in connection with FIG. 2, the connecting member 104, specifically the upper surfaces 130, each comprise a wire opening 107 and tapped mounting holes 108 used for connecting a signal head to the connecting member 104, and for providing electric connections to the signal head.

[0037] The connecting member 104 is a casted component comprising a plurality of extensions 132a, 132b, 132c in a lower portion of the connecting member 104 which are used for providing the connections 106 (see FIG. 2). The extensions 132a, 132b, 132c extend outwards from the connecting member 104. Each extension 132a, 132b, 132c comprises a circular opening 134a, 134b, 134c which each receive a fastening element 110 (see FIG. 2). The openings 134a, 134b, 134c are each configured as tapped holes. As FIGs. 4 and 6 show, the extensions 132a, 132b, 132c correspond to the extensions 122a, 122b, 122c of the attachment member 102 so that the fastening elements 110 can couple the connecting member 104 and the attachment member 102 via the extensions 122a, 122b, 122c, 132a, 132b, 132c. Specifically, extension 132a faces extension 122a, extension 132b faces extension 122b, and extension 132c faces extension 122c (see also FIG. 9).

[0038] With further reference to FIG. 6, the extension 132b is arranged at a right angle to the extensions 132a and 132c, and the extensions 132a and 132c lie opposite each other. The openings 134a, 134b, 134c are arranged substantially centric within the extensions 132a, 132b, 132c. All the openings 134a, 134b, 134c are arranged such that center points of the circular openings 134a, 134b, 134c lie on a mathematical circle 136. Angles a between center points of openings 134a and 134b as well as openings 134b and 134c can be 110°. The extensions 132a, 132b, 132c and/or the openings 134a, 134b, 134c can be arranged at different angles to each other. But when arranged at different angles, the extensions 132a, 132b, 132c and openings 134a, 134b, 134c must then be aligned with corresponding extensions 122a, 122b, 122c and openings 124a, 124b, 124c of the attachment member 102 in order to be able to insert the fastening elements 110.

[0039] FIG. 7 illustrates a sectional view of a longitudinal cut through the connecting
member 104 as indicated in FIG. 6 in accordance with an exemplary embodiment of the present invention.

[0040] FIG. 7 shows that the connecting member 104 further comprises a concave surface, herein referred to as cylindrical surface 140. The cylindrical surface 140 is arranged opposite the surfaces 130 used for mounting a signal head to the connecting member 104. The cylindrical surface 140 is curved toward an inside of the connecting member 104. FIG. 7 further shows one of the extensions, in particular extension 132b with circular opening 134b.

[0041] FIG. 8 illustrates a sectional view of a longitudinal cut through the mounting arrangement 100 in accordance with an exemplary embodiment of the present invention. Specifically, the view of connecting member 104 in FIG. 8 corresponds to the view as illustrated in FIG. 7, wherein the sectional view is extended to the attachment member 102.

[0042] With reference to FIGs. 7 and 8, the arrangement 100 is designed such that the connecting member 104 can be tilted relative to the attachment member 102. This is achieved by the convex cylindrical surface 118 of the attachment member 102 and the concave cylindrical surface 140 of the connecting member. The cylindrical surfaces 118 and 140 are mating cylindrical surfaces, which allow the tilting motion of the connecting member 104 relative to the attachment member 102 as indicated by arrow 104A. In particular, the mating surfaces 118 and 140 allow a tilting motion (see arrow 104A) of at least ±2.5° to align a signal head carried by the connecting member 104 (see also FIG. 9).

[0043] FIG. 8 further illustrates electric connections 138, for example wires and cables, which run through the attachment member 102, specifically the through hole 128 (see FIG. 3), and the connecting member 104, specifically the wire openings 108, to the signal head (not illustrated). The present configuration of the attachment member 102 allows easy access to the electric connections 138.

[0044] Each fastening element 110 comprises a longitudinal axis 110A, longitudinal
axes 110A of the plurality of fastening elements 110 being substantially parallel to each other. As illustrated in FIGs. 2 and 8, the connecting member 104 is coupled to the attachment member 102 in a direction defined by the longitudinal axes 110A of the plurality of fastening elements 110. The tilting motion of the connecting member 104 relative to the attachment member 102, indicated by the arrow 104A, is about a rotating axis which is perpendicular to the longitudinal axes 110A of the plurality of fastening elements 110. The rotating axis corresponds to the cylinder axis 118A of the cylindrical surface 118 (see FIG. 3). The connecting member 104 is rotatable about the rotating axis over an angle of at least about 5°.

[0045] To support the tilting motion 104A of the connecting member 104, a design of the connections 106 is adapted accordingly. In an exemplary embodiment, the circular openings 134a, 134b, 134c of the connecting member 104 are designed such that they each comprise concave spherical radiuses at both ends of the openings 134a, 134b, 134c. For example, FIG. 7 illustrates that the opening 134b comprises a concave spherical radius 142a at one axial end of the opening and a further concave radius 142b at an opposite axial end. In addition, spherical washers 144 with a convex spherical radius are provided (see FIGs. 8 and 9).

[0046] With reference to FIG. 8, spherical washers 144 are placed such that they abut upon the concave spherical radiuses 142a, 142b of the opening 134b. The spherical washers 144 comprise a convex surface. The spherical washers 144 together with the openings 134a, 134b, 134c comprising spherical radiuses provide a secure connection, specifically when the connecting member 104 is tilted relative to the attachment member 102 (see FIG. 9). In such a case, the extensions 122a, 122b, 122c of the attachment member 102 and the extensions 132a, 132b, 132c of the connecting member 104 are non-parallel and thus need special features to provide a strong and secure connection. The spherical washers 144 together with the specific openings 134a, 134b, 134c of the connecting member 104 and the fastening elements 110 provide such a strong and secure connection. The connections between the fastening elements 110 and the extensions 122a, 122b, 122c of the attachment member 102 are rigid connections since a position of the
attachment member 102 does not change when tilting the connecting member 104.

[0047] FIG. 9 illustrates an enlarged view of a section of FIG. 8 in accordance with an exemplary embodiment of the present invention. FIG. 9 illustrates that the connecting member 104 is tilted relative to the attachment member 102. This means that the extensions 122b and 132b are not parallel to each other, but arranged at an angle $\beta$ to each other. Angle $\beta$ may be between $0^\circ$ and about $+2.5^\circ$ (or between $0^\circ$ and about $-2.5^\circ$ when tilted in an opposite direction). FIG. 9 further illustrates the fastening elements 110 supported by the spherical washers 144, specifically upper spherical washer 144a and lower spherical washer 144b. Additional washers 146 and nuts 148 can be used, wherein different numbers and/or shapes of washers and/or nuts can be used when assembling the attachment member 102 and the connecting member 104.

[0048] A maximum tilting motion (forward or rearwards) of the connecting member 104 is limited by an inner diameter of the upper spherical washer 144a. According to an exemplary embodiment of the present invention, the inner diameter of the upper spherical washer 144a is increased in order to increase the maximum tilting motion of the connecting member 104. An increased inner diameter of the upper spherical washer 144a together with a larger through hole 134b in the extension 132b allow an increased maximum tilting motion. In a further exemplary embodiment of this invention, the inner diameter of the upper spherical washer 144a can be chosen such that it provides a tilt limiting function. This means that the inner diameter will come in contact with the adjusting stud 10 when the connecting member 104 reaches a maximum (tilting) angle $\beta$ thereby preventing further tilting. FIG. 9 illustrates that the left side of the inner diameter of the washer 144a is in contact with the adjusting stud 10. When the connecting member 104 is tilted in an opposite direction, the right side of the inner diameter of the washer 144a would be in contact with the adjusting stud 10 and prevent further tilting of the connecting member 104. A degree of the tilting angle $\beta$ is in correlation to an offset of the washer 144a to the stud 10. In other words, the greater the tilting angle $\beta$, the greater the offset of the upper washer 144a to the stud 10. The lower spherical washer 144b may also be offset to the stud 10 (the offset of the lower washer 144b is less than the offset of the
upper washer 144a) but does not provide the tilt limiting function as described for the upper spherical washer 144a.

[0049] FIG. 10 illustrates an exploded view of the mounting arrangement 100 as illustrated in FIG. 2 in accordance with an exemplary embodiment of the present invention.

[0050] As described before with reference to FIG. 2, the attachment member 102 can be fixed to an end of a cylindrical post, for example via the set screws or bolts 160 (see also FIG. 8). Thus, the attachment member 102 comprises the openings 116, for example threaded openings, for receiving the set screws 160. Nuts 162 and washers 164 can be used in combination with the set screws 160. It should be noted that the set screws 160 can also be used for a rotational adjustment, for example left to right aiming adjustment, of the mounting arrangement 100 when mounted to the post 114 (see FIG. 3) which also serves as rotational adjustment of a signal head coupled to the arrangement 100. The rotational adjustment of the arrangement 100 includes loosening the bolts 160, rotating the arrangement 100, and retightening the bolts 160.

[0051] FIG. 10 further illustrates the fastening elements 110, embodied for example as adjusting studs, used for connecting the attachment member 102 and the connecting member 104. The fastening elements 110 are supported by spherical washers 144, wherein each fastening element 110 are assigned two spherical washers 144. Additional washers 146 and nuts 148 can be used, wherein different numbers and/or shapes of washers and/or nuts can be used when assembling the mounting arrangement 100.

[0052] In a further exemplary embodiment, the attachment member 102 and connecting member 104 comprise metal and/or metal alloy. For example, the attachment member 102 and connecting member 104 comprise aluminum, in particular consist entirely of aluminum. Specifically, the attachment member 102 and connecting member 104 are aluminum alloy castings. In a further embodiment, the attachment member 102 and connecting member 104 comprise aluminum alloy which has T6 heat treatment to increase strength, hardness and other mechanical properties. As noted before, one of
ordinary skill in the art is familiar with T6 heat treatment. For example, the attachment member 102 and connecting member 104 comprise aluminum casting alloy A356 T6.

[0053] Summarizing, the mounting arrangement 100 is designed such that a secure and strong connection of the attachment member 102 and the connecting member 104 is provided. Specifically, the fastening elements 110, configured as adjusting studs, contribute to the strong and secure connection and function as structural supports in all wind loaded directions when the mounting arrangement 100 together with a signal head is installed along a railway track. The mounting arrangement 100 withstands high winds with wind speeds of 90 mph or more when installed.

[0054] Additionally, an adjustable tilting feature is provided by the two mating cylindrical surfaces 118 and 140 of the two members 102 and 104. Also, the two mating cylindrical surfaces 118 and 140 transfer dead load of a signal assembly (including a signal head) to the post 114 and post supporting structure directly. Thus, the internal cylindrical surfaces 118 and 140 allow for an improved load bearing connection while the fastening elements 110, specifically three adjustment studs, securely hold the two members 102 and 104 together and allow for fine up and down aiming/tilting of the arrangement 100. Spherical washers 144 are used in combination with the fastening elements 110 so that the strong and secure connection is guaranteed even when the connecting member 104 is tilted relative to the attachment member 102, wherein the spherical washers 144 further provide a tilt limiting feature. The mating surfaces 118 and 140 allow at least a ± 2.5° tilting motion, i.e. a total tilting motion of at least 5°, to align a signal head carried by the connecting member 104. A rotational (left to right) aiming adjustment point is shifted to the post attaching set screws 160 (or alternatively to a mast to junction box connection). Furthermore, the presented mounting arrangement 100 is faster to assemble and easier to service in the field as the signal attaching hardware is now completely accessible in the signal head housing.

[0055] While embodiments of the present invention have been disclosed in exemplary forms, it will be apparent to those skilled in the art that many modifications, additions, and deletions can be made therein without departing from the spirit and scope of the
invention and its equivalents, as set forth in the following claims.
CLAIMS

1. A mounting arrangement (100) comprising:
   an attachment member (102) for attachment to an end of a post (114),
   a connecting member (104) coupled to the attachment member (102), and
   a plurality of fastening elements (110) coupling the connecting member (104) to
   the attachment member (102), each fastening element (110) comprising a longitudinal
   axis (110A), longitudinal axes (110A) of the plurality of fastening elements (110) being
   substantially parallel to each other,
   wherein the connecting member (104) is coupled to the attachment member (102)
   in a direction defined by the longitudinal axes (110A) of the plurality of fastening
   elements (110), and
   wherein the attachment member (102) and the connecting member (104) comprise
   mating cylindrical surfaces (118, 140) which allow a tilting motion of the connecting
   member (104) about a rotating axis (118A) which is perpendicular to the longitudinal
   axes (110A) of the plurality of fastening elements (110).

2. The mounting arrangement as claimed in Claim 1, wherein the connecting
   member (104) is rotatable about the rotating axis (118A) over an angle of at least
   about 5°.

3. The mounting arrangement as claimed in Claim 1 or 2, wherein the
   attachment member (102) comprises a cylindrical base body (112) including a plurality of
   threaded openings (116) for fastening the attachment member (102) to the post (114) via
   a plurality of bolts (160), the plurality of bolts (160) allowing a rotational adjustment of
   the attachment member (102).

4. The mounting arrangement (100) as claimed in Claim 3, wherein the
   attachment member (102) comprises a convex cylindrical surface (118) arranged on an
   upper end of the base body (112) curved toward the connecting member (104).
5. The mounting arrangement (100) as claimed in Claim 3, wherein the attachment member (102) comprises a plurality of extensions (122a, 122b, 122c) on an upper end of the base body (112) extending outwards from the base body (112), each extension (122a, 122b, 122c) comprising a circular opening (124a, 124b, 124c) which each receive a fastening element (110) of the plurality of fastening elements (110).

6. The mounting arrangement (100) as claimed in any of the preceding Claims, wherein the connecting member (104) comprises a concave cylindrical surface (140) arranged on a lower end of the connecting member (104) and curved toward an inside of the connecting member (104).

7. The mounting arrangement (100) as claimed in any of the preceding Claims, wherein the connecting member (104) comprises a plurality of extensions (132a, 132b, 132c) in a lower portion of the connecting member (104) extending outwards from the connecting member (104), each extension (132a, 132b, 132c) comprising a circular opening (134a, 134b, 134c) which each receive a fastening element (110) of the plurality of fastening elements (110).

8. The mounting arrangement (100) as claimed in Claim 7, wherein the openings (134a, 134b, 134c) of the connecting member (104) face the extensions (124a, 124b, 124c) of the attachment member (102), the plurality of fastening elements (110) extending through the openings (124a, 124b, 124c, 134a, 134b, 134c).

9. The mounting arrangement (100) as claimed in Claim 7, wherein the circular openings (134a, 134b, 134c) each comprise concave spherical radiuses (142a, 142b) at axial ends of the openings (134a, 134b, 134c).

10. The mounting arrangement (100) as claimed in any of the preceding Claims, further comprising spherical washers (144) used in combination with the fastening elements (110) for coupling the connecting member (104) to the attachment member (102).
11. The mounting arrangement (100) as claimed in Claim 10, wherein the spherical washers (144) are placed such that the spherical washers (144) abut upon the concave spherical radiuses (142a, 142b) of the openings (134a, 134b, 134c).

12. The mounting arrangement (100) as claimed in Claim 10, wherein for each fastening element (110) an upper spherical washer (144a) and a lower spherical washer (144b) are provided, wherein the upper spherical washer (144a) comprises an increased inner diameter to allow an increased maximum tilting motion of the connecting member (104), and wherein a section of the increased inner diameter of the upper spherical washer (144a) is in contact with the fastening element (110) when the connecting member (104) reaches a maximum tilting angle (β) preventing further tilting of the connecting member (104).

13. The mounting arrangement (100) as claimed in any of the preceding Claims, wherein the plurality of fastening elements (110) are configured as studs.

14. The mounting arrangement (100) as claimed in any of the preceding Claims, wherein each of the plurality of fastening elements (110) comprises metal alloy.

15. The mounting arrangement (100) as claimed in any of the preceding Claims, wherein the attachment member (102) and the connecting member (104) comprise metal alloy castings.
16. A railway wayside signal assembly comprising:
a post or mast (114) for installing along a railway track,
a mounting arrangement (100) carried by the post or mast (114), the mounting
arrangement (100) comprising:
an attachment member (102) for attachment to an end of the post or mast
(114),
a connecting member (104) coupled to the attachment member (102), and
a plurality of fastening elements (110) coupling the connecting member
(104) to the attachment member (102), each fastening element (110) comprising a
longitudinal axis (A), longitudinal axes (A) of the plurality of fastening elements (110)
being substantially parallel to each other,

wherein the connecting member (104) is coupled to the attachment member (102)
in a direction defined by the longitudinal axes (A) of the plurality of fastening elements
(110), and

wherein the attachment member (102) and the connecting member (104) comprise
mating cylindrical surfaces (118, 140) which allow a tilting motion of the connecting
member (104) about a rotating axis (B) which is perpendicular to the longitudinal axes
(A) of the plurality of fastening elements (110).

17. The railway wayside signal assembly as claimed in Claim 16, wherein the
connecting member (104) is adapted to carry a signal unit.

18. The railway wayside signal assembly as claimed in Claim 17, wherein the
connecting member (104) comprises a plurality of tapped mounting holes (108) for
mounting the signal unit to the connecting member (104) by bolts (109) such that heads
of the bolts (109) are accessible from the signal unit.

19. The railway wayside signal assembly as claimed in any of the preceding
Claims, wherein the mating cylindrical surfaces (118, 140) transfer dead load of a railway
signal unit to the post or mast (114).
20. The railway wayside signal assembly as claimed in any of the preceding Claims, wherein the post or mast (114) comprises a cylindrical cross section.
### A. CLASSIFICATION OF SUBJECT MATTER

INV. B61L5/18 F16M11/10

**ADD.**

According to International Patent Classification (IPC) or to both national classification and IPC

### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B61L F16M F21S

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>DE 487 045 C (GEN RAILWAY SIGNAL CO) 29 November 1929 (1929-11-29) page 2, lines 23 - 25; figures 1, 2</td>
<td>1-20</td>
</tr>
<tr>
<td>A</td>
<td>GB 212 905 A (GEN RAILWAY SIGNAL CO) 18 September 1924 (1924-09-18) figure 4</td>
<td>1-20</td>
</tr>
<tr>
<td>A</td>
<td>EP 2 154 474 A2 (HI LTI AG [LI]) 17 February 2010 (2010-02-17) figure 1</td>
<td>1-20</td>
</tr>
<tr>
<td>A</td>
<td>DE 84 23 129 U (GENERAL RAILWAY SIGNAL COMPANY) 31 October 1984 (1984-10-31) figures 1-3</td>
<td>1-20</td>
</tr>
</tbody>
</table>

Further documents are listed in the continuation of Box C.  See patent family annex.

* Special categories of cited documents:
  - "A" document defining the general state of the art which is not considered to be of particular relevance
  - "E" earlier application or patent but published on or after the international filing date
  - "L" document which may throw doubts on priority claim(s) one of which is cited to establish the publication date of another citation or other special reason (as specified)
  - "O" document referring to an oral disclosure, use, exhibition or other means
  - "P" document published prior to the international filing date but later than the priority date claimed
  - "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principal of theory underlying the invention
  - "X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
  - "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
  - "Z" document member of the same patent family

Date of the actual completion of the international search: 21 September 2016

Date of mailing of the international search report: 30/09/2016

Name and mailing address of the ISA:
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer: Pl utzer, Stefan
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td>DE 487045</td>
<td>29-11-1929</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>GB 212905</td>
<td>18-09-1924</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>EP 2154474 A2</td>
<td>17-02-2010</td>
<td>CN 101645575 A</td>
<td>10-02-2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DE 102008041029 A1</td>
<td>11-02-2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 2154474 A2</td>
<td>17-02-2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 5603574 B2</td>
<td>08-10-2014</td>
</tr>
<tr>
<td>J P 2010038919 A</td>
<td>18-02-2010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>US 2010031520 A1</td>
<td>11-02-2010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DE 8423129 U1</td>
<td>31-10-1984</td>
<td>NONE</td>
<td></td>
</tr>
</tbody>
</table>