

FASTENER APPARATUS WITH SELF-LEVELING HEAD

by

Marshall W. Curtis

and

David A. W. Curtis

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to construction hardware, and more particularly to an improved fastener apparatus for metal roofing and steel building construction.

Description of the Related Art

Fasteners for use in roofing and steel building construction presently include the ring shank, self-sealing nail and the self-sealing hex head. Manufacturers of these fasteners recommend replacement of the installed fasteners every five years. This recommended replacement schedule is necessitated by damage to the exposed rubber seals used for these fasteners by ultraviolet rays. Additionally, the gravitational shearing forces of ice and snow on roofing surfaces employing the hex head builds up against the hex head vertical walls, loosening the fasteners and causing damage to the fasteners and their seals.

U.S. Patent No. 6,764,262 discloses and claims a weatherproof fastener comprising a shank and head, wherein the head further comprises a recessed lower surface. A gasket is positioned in the recess and, as the fastener is employed to join two elements, the gasket is compressed to entirely fill the recess to prevent ingress of undesirable materials. The 6,764,262 patent

fails to address or protect situations where the fastener is applied at any off angle other than ninety degrees, since the solid connection between the shank and the head create a solid "T" shape. When the fastener of the 6,764,262 patent is applied at an off angle, one head side contacts the workpiece while the opposing head side rises up creating a gap between the workpiece and the head outer rim. This gap provides ingress of undesirable materials to the head underside, and eventual fastener failure.

The foregoing patent and/ or products reflect the current state of the art. Reference to, and discussion of, these patent and/or products is intended to aid in discharging Applicants' duty of candor in disclosing information relevant to the examination of claims of this application. It is respectfully submitted, however, that none of the above-indicated patent and/or products disclose, teach or suggest, motivate, show or otherwise render obvious, either singly or when considered in combination, the novel invention disclosed and claim in this application.

BRIEF SUMMARY OF THE INVENTION

The present invention provides an improved fastener apparatus for use in roofing and steel building construction. The inventive fastener provides a self-adjusting and automatically self-leveling head which is separate from the threaded shank portion. This self-leveling head provides a frusto-hemispherical head, a curved outer surface, a base, a peripheral edge, and a rounded annular cup center. The rounded annular cup center is wider and having near vertical sides at the uppermost portion, and curves and narrows towards a nearly horizontal surface at the lower portion. The cup center is sized and designed to receive a separate threaded shank inserted through the separate head.

The threaded shank has threads leading to a threadless tip at one end and a rounded ball shank at the other end, and a flat top surface bearing a tool fitting.

The combined annular cup head and rounded ball shank create a free moving ball joint which allows the free moving head to self level under compression of installation regardless of the angle of installation of the threaded shank. The head has a downwardly-appending lip which extends from the head peripheral edge, thus defining an annular recess in the base. The annular recess comprises a flat upper surface which transitions to a vertically downwardly-appending lip. The vertically downwardly-appending lip transitions into an annular wall at approximately 100- to 110-degrees to the horizontal, and ends in a curved lowermost bottom of the annular lip. The bottom of the lip is substantially flat and transfers into an upwardly-appending peripheral edge sloping outwardly at approximately 110 degrees from the horizontal, and then transfers into the frusto-hemispherical head. The recesses and downwardly appending lip are sized to receive a sealing gasket which seats around the threadless top of the shank to create a water tight seal.

The self-leveling head prevents the fastener head perimeter and downwardly-appending lip from scratching a painted workpiece during installation. The sealing gasket contacts the workpiece as it is being fastened and begins to compress and provide resistance. In this manner, the remaining uncompressed portion of the gasket seal contacts the workpiece and adjusts the free-moving head to a level position before final compression of the gasket seal occurs, resulting in a final fastener head position that is flush with the workpiece, yet level to the horizontal plane.

A second thin sealing gasket is also inserted

between the rounded ball head of the shank and the rounded cup of the free-moving head recess. This second seal gasket provides a barrier between the ball and cup to prevent rusting or electrolysis and to stop any ingress of water into the recess.

The separate heads of the fastener combine to provide one low profile head to reduce friction between the fastener and unloading snow and ice which can shear the fastener head and tear the entire fastener from an installed position.

The lip has six specific features. First, on the lip inside surface, the top twenty percent of the annular recess is vertical in order to catch the top surface of the seal gasket and prevent it from expanding horizontally, thus increasing resistance between the seal gasket and the workpiece to self-level the fastener head. Second, seventy percent of the annular recess wall transitions into a 110 degree sloping wall which widens as it nears the lip bottom, thus allowing the seal gasket to slowly expand and fill the recess. Third, the final ten percent of the annular recess is rounded so that the seal gasket escaping the recess and extending under the lip is not pinched or cut by the inside surface of the recess wall. The bottom-most lip surface is substantially flat and wide to accommodate a portion of the seal gasket and to create a scratch barrier between the lip and the workpiece being fastened. The bottom-most lip surface transitions into a rounded portion which removes any sharp edges that might scratch the workpiece being fastened. The outer peripheral edge slopes up towards the main body of the fastener head at a 110 degree angle. This section creates a horizontal V-shaped cavity which accommodates the excess seal gasket that escapes from the recess to be protected from unloading snow and ice as it resides within the horizontal V-shape

created between the workpiece and the peripheral edge at a 110 degree angle of the edge. As such, the recessed lip works in unison with the seal gasket, the workpiece, and the free moving head of the fastener to self-level the head portion regardless of the angle the threaded shank is installed.

As the fastener is installed, the seal gasket within the annular recess first makes contact with the workpiece and is sandwiched between the free moving head and the workpiece being fastened. The seal gasket is slightly compressed and begins to expand outwardly in a horizontal plane. The short top twenty percent vertical wall of the lip is sized to stop the outward expansion of the seal gasket as the seal contacts the vertical recess wall. The seal gasket contact with the vertical wall also creates immediate and increased resistance from the seal which causes the free moving head to self-level. Once the free moving head has self-leveled, the lowermost portion of the seal gasket is allowed to gradually expand along the angled 110 degree mid portion and fill the remaining recess. The extreme bottommost portion of the inner recess wall is rounded and will not damage the seal gasket as it expands at an acceptable rate for the composition of the seal, eventually escaping from the recess and providing a scratch barrier between the fastener head lip and the workpiece being fastened. The substantially flat and wide bottom surface of the lip is designed to accommodate the escaping seal and further aid in the self-leveling of the free moving head and provide a scratch barrier between the lip and the workpiece. The final portion of the downwardly-appending lip is the peripheral edge designed at a 110 degree outward angle to accommodate a small amount of seal gasket which may completely escape from the recess and even beyond the lip portion of the recess to stop the ingress of undesirable

materials and water.

The separation of the threaded shank portion with a rounded ball head and the head portion with rounded cup combine and create a ball joint which allows the threaded shank portion to spin during installation while the free moving head portion is held by the installer without the head portion spinning in the installer's fingers.

Further, as the head and seal gasket make contact with the workpiece being fastened, the seal gasket contained inside the recess is not subjected to extreme twisting and binding which would damage the seal gasket during installation.

It is, therefore, an object of the fastener apparatus with self-leveling head to provide an improved fastener that can withstand the elements.

It is another object of the fastener apparatus with self-leveling head to provide a new and improved fastener that protects the seal from extreme forces under the installation process including, without limitation, twisting, binding, rolling and heat generated by friction caused during the final seating of installation.

It is yet another object of the present invention to decrease the time required to replace failed concrete surfaces over the art.

It is still yet another object of the fastener apparatus with self-leveling head to provide a new and improved fastener in which the head self-levels and provides a tighter seal in order to stop ingress of undesirable materials under the head not provided by existing solid head-to-shank fasteners.

A further object of the fastener apparatus with self-leveling head to provide a new and improved fastener which will protect the workpiece surface from scratching during installation due to the self-leveling aspect of the separated head and shank.

Yet another object of the fastener apparatus with self-leveling head to provide a new and improved fastener which inhibits rust and electrolysis between the fastener head and the workpiece.

Other novel features, advantages, and objects of the present invention will become apparent with reference to the following description and accompanying drawings. It is to be expressly understood, however, that the drawings are for illustration and description only, and are not intended as definitions of the limits of the fastener apparatus with self-leveling head. The various features of novelty which characterize the fastener apparatus with self-leveling head are pointed out with particularity in the claims annexed to and forming part of this disclosure. The fastener apparatus with self-leveling head resides not in any one of these features taken alone, but rather in the particular combination of all its structures for the specified functions.

There has thus been broadly outlined the more important features of a fastener apparatus with self-leveling head in order that the detailed description thereof that follows may be better understood, and in order that the present contribution to the art may be better appreciated. There are, of course, additional features of the fastener apparatus with self-leveling head that will be described hereinafter and which will form additional subject matter of the claims appended hereto. Those skilled in the art will appreciate that the conception upon which this disclosure is based readily may be utilized as a basis for designing other structures, methods, and systems for carrying out the several purposes of a fastener apparatus with self-leveling head. It is important, therefore, that the claims be regarded as including such equivalent constructions insofar as they do not depart from the

spirit and scope of the fastener apparatus with self-leveling head.

Certain terminology and derivations thereof may be used in the following description for convenience in reference only, and will not be limiting. For example, words such as "upward," "downward," "left," and "right" would refer to directions in the drawings to which reference is made unless otherwise stated. Similarly, words such as "inward" and "outward" would refer to directions toward and away from, respectively, the geometric center of a device or area and designated parts thereof. References in the singular tense include plural, and vice versa, unless otherwise noted.

BRIEF DESCRIPTION OF DRAWINGS

The fastener apparatus with self-leveling head will be better understood and objects other than those set forth above will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings.

Fig. 1A is a side elevation view of a fastener apparatus with self-leveling head fully assembled **100** installed to fasten a workpiece **19** to a substrate **20**.

Fig. 1B is a side elevation view of a fastener apparatus with self-leveling head **100** having a threaded shank portion installed at an off angle of approximately 20 degrees from vertical, wherein the free moving head has self-leveled automatically and equal pressure has been applied to the seal gasket **7**.

Fig. 2A is an exploded side elevation view of the components of a fastener apparatus with self-leveling head **100**.

Fig. 2B is a side elevation view of an assembled fastener apparatus with self-leveling head **100** having a threaded shank portion installed at an off angle of

approximately 20 degrees from vertical.

Fig. 2C is a side elevation view of an assembled fastener apparatus with self-leveling head **100** having a threaded shank portion installed vertically.

Fig. 3 is a top view of a fastener apparatus with self-leveling head.

Fig. 4 is a cross sectional side view of an assembled fastener apparatus with self-leveling head **100**.

Fig 5 is an enlarged side elevational view an assembled fastener apparatus with self-leveling head **100** depicting the features of the downwardly-appending lip and annular recessed wall.

Fig. 6A is a side elevation view of existing solid connecting head and shank installed vertically in a workpiece.

Fig. 6B is a side elevation view of existing solid connecting head and shank installed at an off angle of 15 degrees from vertical in a workpiece.

Fig. 6C is a side elevation view of existing solid connecting head and shank installed at an off angle of 25 degrees from vertical in a workpiece.

Fig 7A is a cross-sectional side view of an assembled fastener apparatus with self-leveling head **100** prior to the seal gasket making contact with the workpiece.

Fig. 7B is a cross-sectional side view of an assembled fastener apparatus with self-leveling head **100** as the seal gasket begins to compress and the recess vertical wall **12** causes the gasket to secure itself around the un-threaded top portion **8** of the shank.

Fig. 7C is a cross-sectional side view of an assembled fastener apparatus with self-leveling head **100** depicting the seal gasket in a final, installed position.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Figs. 1A - 7, wherein like reference numerals refer to like components in various views, there is a new and improved fastener apparatus, generally denominated **100** herein.

Figs. 1A and 1B provide side elevation views of the fastener apparatus with self-leveling head **100** installed. Figs 2A - 2C include three cross-sectional elevation views detailing individual components making up the completed fastener apparatus with self-leveling head **100**: unassembled, Fig. 2A; assembled and vertically installed, Fig. 2B; and assembled and installed showing the free-moving, threaded hank at an off angle, Fig. 2C. Fig. 3 is a top plan view of the fastener head. Fig. 4 is a side, cross-sectional view detailing the elements of the fastener apparatus with self-leveling head, and which is the preferred embodiment of the invention for fastener apparatus with self-leveling head. Fig. 5 is a side elevation view in a cross-section and is a close-up of the individual features that create the recessed inner wall and self-leveling elements of the preferred embodiment of the fastener apparatus with self-leveling head. Figs. 6A - 6C are side elevation views and depict an existing one piece fastener with solid head and shank connection. Figs. 7A - 7C depict the fastener apparatus with self-leveling head being installed and further depict how the recessed wall works in unison with the seal gasket to properly seat under compression.

The fastener apparatus with self-leveling head **100** includes four principal elements: 1) the threaded shank **50**; 2) the free moving head **75**; 3) a first, upper seal **6**; and 4) a second, lower recess seal gasket **7**. These elements combine together and create a fastener apparatus with self-leveling head **100**.

The threaded shank **50** is inserted through the upper seal **6**, and then through the free moving head **75**. The threaded shank finally passes through the second, lower recess seal gasket **7**, Figs. 1A - 2C, 4, and 7A - 7C.

The fastener threaded shank **50** includes a frusto-hemispherical head **1**, having a flat top surface **2**, bearing a tool fitting, a curved ball bottom **3**, a threaded mid-portion **9**, and smooth threadless top portion **8** between the threaded mid-portion **9** and curved ball bottom **3** of the frusto-hemispherical head **1**, Figs. 3 and 4. The shank portion **50** is connected to the base **80**, and the shank **50** further includes the threaded shank mid-portion **9** and shank tip **90**.

Further, the fastener apparatus with self-leveling head **100** includes a free moving head **75**, Figs. 2A, 3 and 4. The free moving head **75** comprises a frusto-hemispherical head **5**, a hollow center formed in a rounded cup shape **4**, a flat base **17**, and a peripheral edge **16**. A downwardly-appending lip **30** extends from the peripheral edge **16** and defines an annular recess **40** in the base **17**, Figs. 4 and 5. The annular recess **40** has a flat upper surface created by two pieces defined as threaded mid-shank **50** and the free moving head **75**, more particularly identified as **17** and **18**, respectively, Fig. 5. The lip **30** has a 110 degree angled outer edge **10**, a curved lower edge **15**, a substantially wide and flat bottom **11**, and an inner edge: ten percent of which is curved at the bottom **14**; seventy percent of which is a 110 degree angled mid-section; and twenty percent of which is a vertical upper section **12**, terminating in the annular recess flat upper surface **17**, Fig. 5.

The threaded shank **50** and the free moving head **75** combine to create a ball joint to allow the fastener to

self-level the head regardless of the angle the shank 50 is installed off vertical, Figs. 3 - 6. The ball 3 on the head 80 bottom of the shank 50 combines with the cup 4 of the free-moving head 75 and provides a durable head that rotates to any position up to 30-degrees off vertical. This rotational freedom allows the free-moving head 75 to self-level under the compression of installation. The free-moving head 75 also aids the installer to maintain the free-moving head tightly in their fingers without the friction burn from the head spinning while the threaded shank 50 sits inside of the free-moving head 75. Since the free-moving head 75 does not spin, the seal gasket 7 within the annular recess 40 does not spin or bind and the seal gasket 7 is not damaged during installation.

A thin seal 6 is installed between the ball 3 on the head 80 bottom of the shank 50 and the cup 4 of the free-moving head 75 to stop the ingress of water into the ball joint, Figs. 3 - 6. In this fashion, rusting and electrolysis of the assembled and installed fastener are prevented, as is the ingress of water into the annular recess 40 through the ball 3 and cup 4. The preferred embodiment of the seal 6 is made from nylon or rubber.

The head 80 of the threaded shank is rounded or convex 1, Fig 4. The free-moving head 75 external top surface is also convex and low profile to reduce friction between unloading snow and ice and the fastener head to reduce head shear.

The annular recess 40 is designed to accommodate a seal gasket 7 that, when in an uncompressed state, fills the recess from the threaded shank 9 to the vertical wall 12 of the annular recess 40 downwardly-appending lip 30. Under compression, the vertical wall 12 stops the top

portion of the seal gasket **7** from expanding laterally from center and causes the seal gasket to compress and close towards the center and seat around the un-threaded top length **8** of the shank **50**. The preferred embodiment of the seal gasket **7** is rubber.

The annular mid portion of the recessed wall **13** is at an angle of 110 degrees from the vertical wall, and allows the lower portion of the seal gasket **7** to compress and transition from the inward motion towards the top of the seal to a gradual outward motion along the annular mid portion of the recessed wall **13** of the downwardly-appending lip **30**, Figs. 4 and 5. This design compresses the seal gasket **7** around the smooth upper shank surface **8** to prevent ingress of water through the ball **3** on the head **80** bottom of the shank **50** and the cup **4** of the free-moving head **75** into the annular recess **40**.

The lowermost inner edge **14** of the downwardly-appending lip **30** is rounded so the free moving-head **75** has no sharp edges and does not cut or pinch the seal gasket **7** during installation, Figs. 4, 5, and 7A - 7C.

The bottom portion **11** of the downwardly-appending lip **30** is substantially flat and wide to allow a portion of the seal gasket **7** to entirely escape the annular recess **40** and move outwardly under the free moving-head **75** to provide a scratch barrier between the lip **30** and the workpiece being fastened, Figs. 1A, 1B, 4, 5 and 7A - 7C.

The outer edge **15** of the downwardly-appending lip **30** is rounded to allow a portion of the seal gasket **7** to entirely escape the free moving-head **75** without being cut or pinched, Figs. 4, 5, and 7A - 7C.

The outer edge **10** of the downwardly-appending lip **30** is angled outwards at an angle of 110 degrees from the

the outer edge **15** up to the peripheral edge **16**, and is designed to create a "V" shape **95** laterally to protect the exposed seal gasket **7** from damage due to unloading snow and ice forces pushing the seal over the free-moving head peripheral edge **16** and therein tearing it apart from the installed fastener, Figs. 1A and 5. The "V" shape **95** is created by the edge of the free-moving head **10** and the horizontal surface of the workpiece **19**.

The disclosure provided herein is sufficient to enable one of ordinary skill in the art to practice the fastener apparatus with self-leveling head, and provides the best mode of practicing the fastener apparatus with self-leveling head presently contemplated by the inventors. While there is provided herein a full and complete disclosure of the preferred embodiment of the fastener apparatus with self-leveling head, it is not desired to limit the invention to the exact construction, dimensional relationships, and operation disclosed, shown, and/or described. Various modifications, alternative constructions, changes and equivalents will readily occur to those skilled in the art and may be employed, as suitable, without departing from the true spirit and scope of the fastener apparatus with self-leveling head. Such changes might involve alternative materials, components, structural arrangements, sizes, shapes, forms, functions, operational features, and the like.

Therefore, the above description and illustrations should not be construed as limiting the scope of the fastener apparatus with self-leveling head, which is defined by the appended claims.

CLAIMS

We claim:

1. A fastener apparatus having a free-moving, self-leveling head for securing a workpiece, the fastener comprising:
 - (a) a first, frusto-hemispherical head having a flat top surface bearing a tool fitting, a curved outer surface, a curved ball base, a peripheral edge, a shank connected to the base and having a threadless portion, screw threads and a tip;
 - (b) a second, free moving frusto-hemispherical head having a curved outer surface, a concave top surface sized to receive the first head ball base, a peripheral edge, a downwardly-appending lip extending from the second head peripheral edge and defining an annular recess with a flat upper surface and the lip having a 110 degree angled outer edge, a curved lower edge, a substantially flat bottom, a curved inner edge having a 110 degree angled inner edge and a vertical inner edge terminating in an annular recessed flat bottom upper surface;
 - (c) a first annular gasket comprising a top surface and a bottom surface, the annular gasket sized to receive and be carried on the first head shank threadless portion, whereby the gasket defines a first uncompressed position contained radially within the second head annular recess providing a seal having a peripheral edge equal to the second head lip vertical inner edge, and defines a second compressed position wherein the gasket top surface is compressed inward to seal around the shank threadless portion

whereby the first gasket seals the entire recess and the first gasket bottom surface extends radially beyond the lip outer edge; and

- (d) a second annular gasket sized to receive the shank threadless portion and fit within the second head annular recessed flat bottom upper surface.
2. The fastener of claim 1, wherein the apparatus provides for a self-leveling first head when the shank is installed into a workpiece at an angle deviating up to 30 degrees from vertical.
 3. The fastener of claim 1, wherein the second head downwardly- appending lip has six co-dependent angles from the flat base portion and extending radially terminating at the peripheral edge.
 4. The fastener of claim 3, wherein the six co-dependent angles comprise members selected from the list consisting of a vertical annular wall, a 110 degree angled wall, a curved lower edge, a substantially flat bottom, a curved outer edge, and a 110 degree outer edge.
 5. A free-moving, self-leveling fastener for securing a workpiece, the fastener comprising:
 - (a) a shank comprising a first frusto-hemispherical head flat top surface bearing a tool fitting, an un-threaded surface, a threaded surface, a curved outer surface, a curved ball base, a peripheral edge, and a tip;
 - (b) means for self-leveling the first frusto-hemispherical head under compression of installation;
 - (c) means for preventing the ingress of elements into the apparatus; and
 - (d) means for sealing the un-threaded shank surface.

6. The apparatus of claim 5, wherein means for self-leveling the first frusto-hemispherical head under compression of installation comprises a second, free moving frusto-hemispherical head having a curved outer surface, a concave top surface sized to receive the first head ball base, a peripheral edge, a downwardly- appending lip extending from the second head peripheral edge and defining an annular recess with a flat upper surface and the lip having a 110 degree angled outer edge, a curved lower edge, a substantially flat bottom, a curved inner edge having a 110 degree angled inner edge and a vertical inner edge terminating in an annular recessed flat bottom upper surface
7. The apparatus of claim 6, wherein means for preventing the ingress of elements into the apparatus comprises a first annular gasket comprising a top surface and a bottom surface, the annular gasket sized to receive and be carried on the un-threaded shank surface, whereby the gasket defines a first uncompressed position contained radially within the second head annular recess providing a seal having a peripheral edge equal to the second head lip vertical inner edge, and defines a second compressed position wherein the gasket top surface is compressed inward to seal around the shank threadless portion whereby the first gasket seals the entire recess and the first gasket bottom surface extends radially beyond the lip outer edge.
8. The apparatus of claim 7, wherein means for sealing the un-threaded shank surface comprises a second annular gasket sized to receive the shank threadless portion and fit within the second head annular recessed flat bottom upper surface.
9. The fastener of claim 8, wherein the apparatus

provides for a self-leveling first frusto-hemispherical head flat top surface when the shank is installed into a workpiece at an angle deviating up to 30 degrees from vertical.

10. The fastener of claim 9, wherein the second head downwardly- appending lip has six co-dependent angles from the flat base portion and extending radially terminating at the peripheral edge.
11. The fastener of claim 10, wherein the six co-dependent angles comprise members selected from the list consisting of a vertical annular wall, a 110 degree angled wall, a curved lower edge, a substantially flat bottom, a curved outer edge, and a 110 degree outer edge.