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(54) **BIKE MOUNT**

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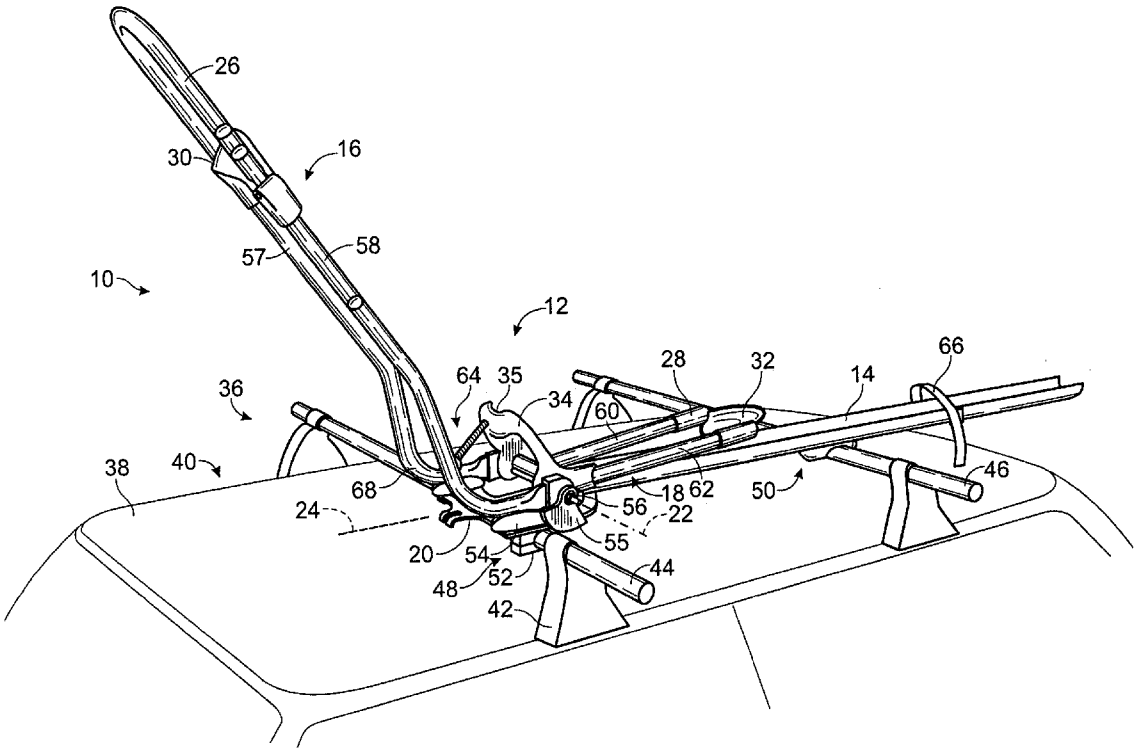
(57) **ABSTRACT**

A bike mount for securing a bicycle to a vehicle rack. The bike mount includes arms that pivot apart to receive a bicycle wheel and pivot together to cooperatively hold the bicycle wheel. The bike mount may be configured to include a lever that pivots the arms together as the bicycle is positioned on the vehicle rack.



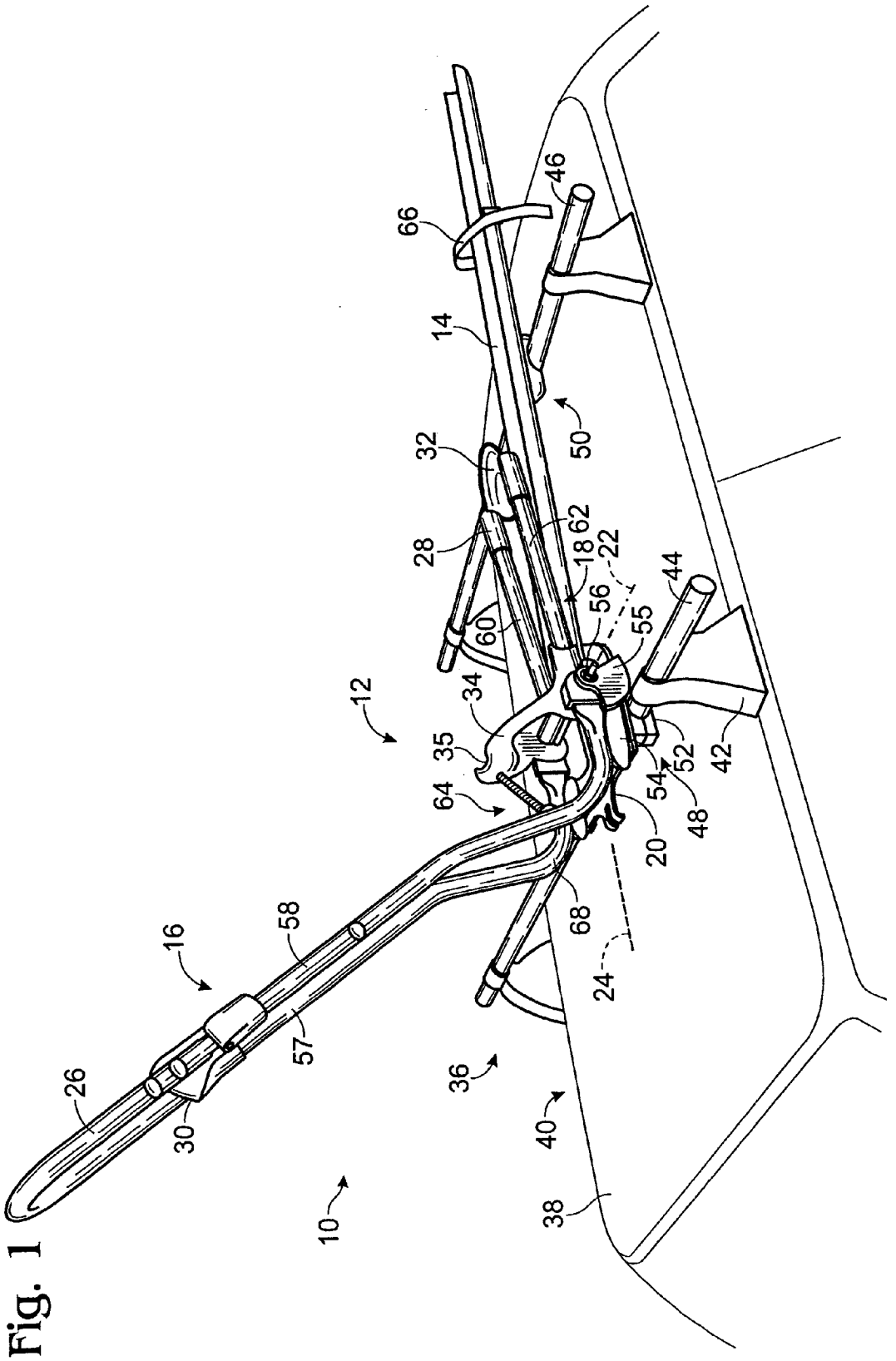

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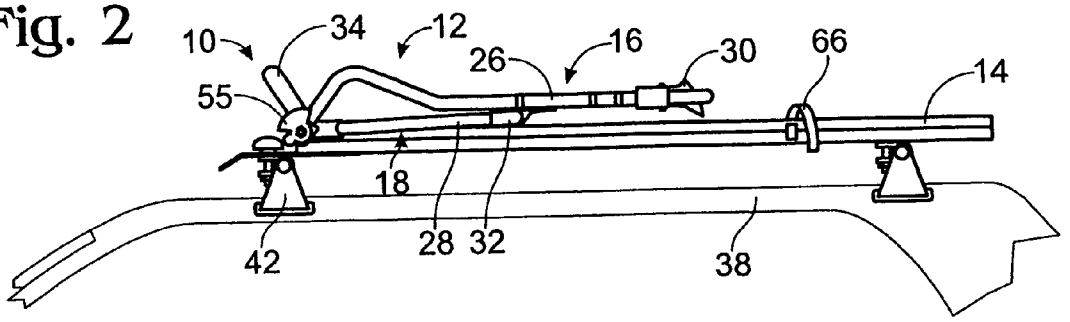
Fig. 1

Fig. 2



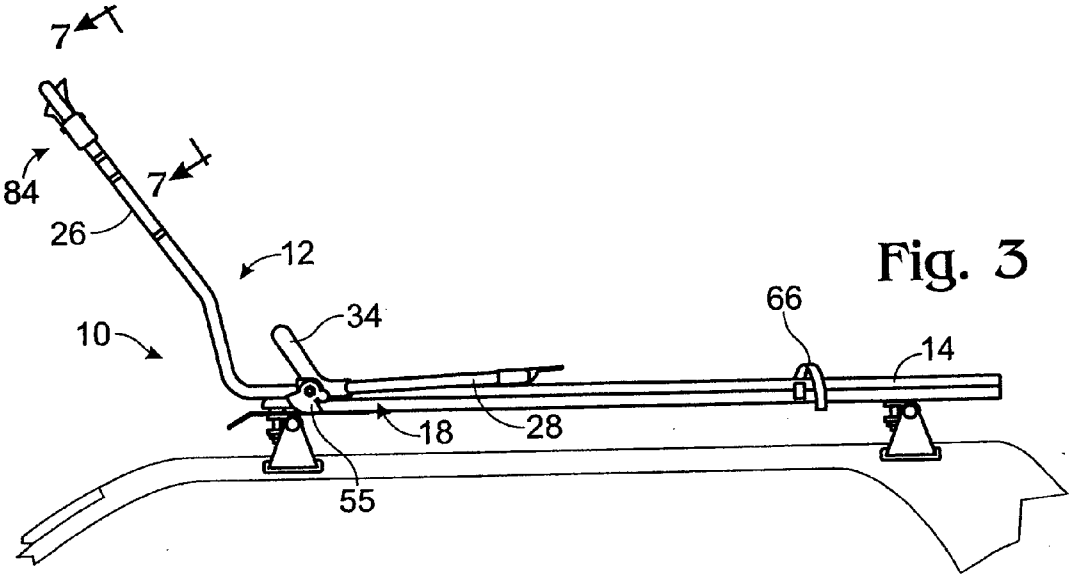


Fig. 3

Fig. 7

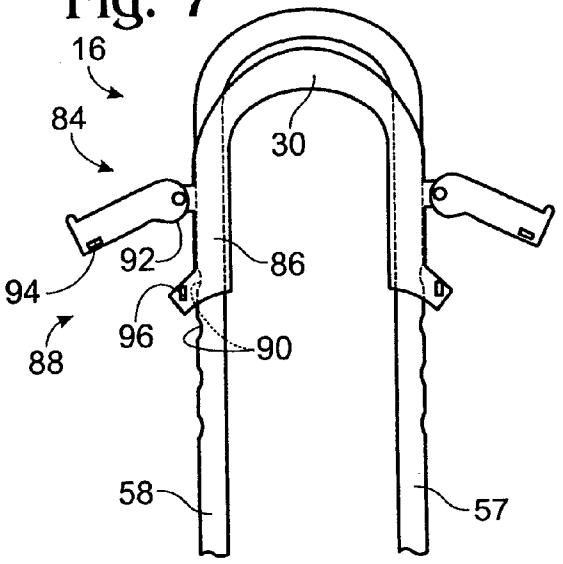


Fig. 8

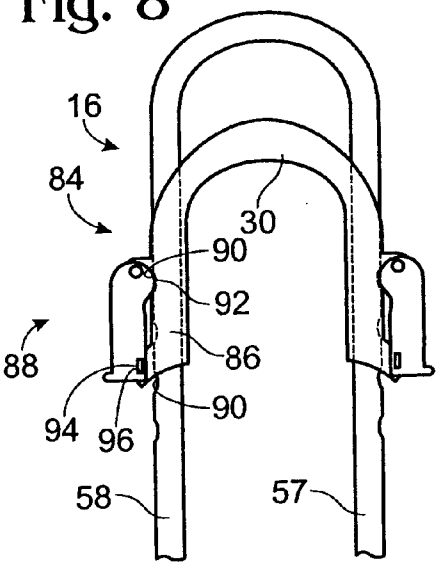


Fig. 4

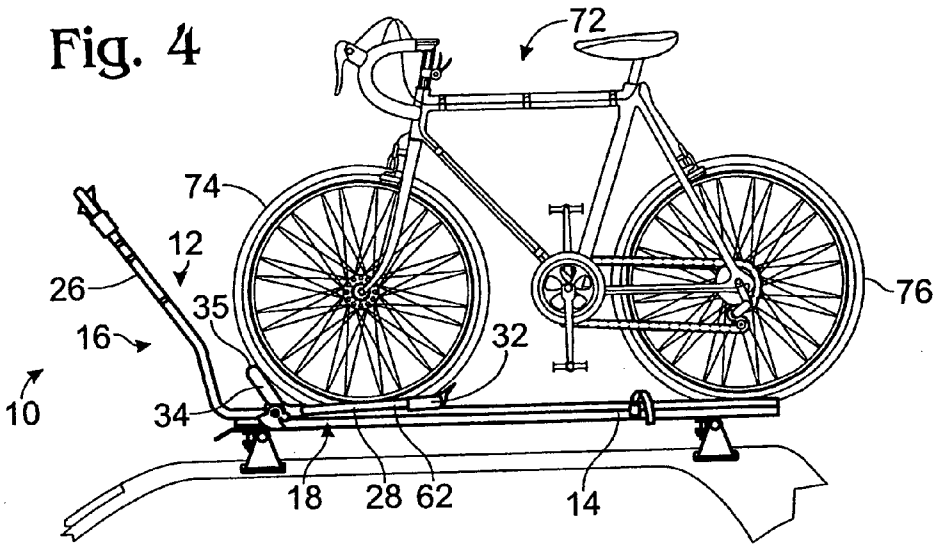


Fig. 5

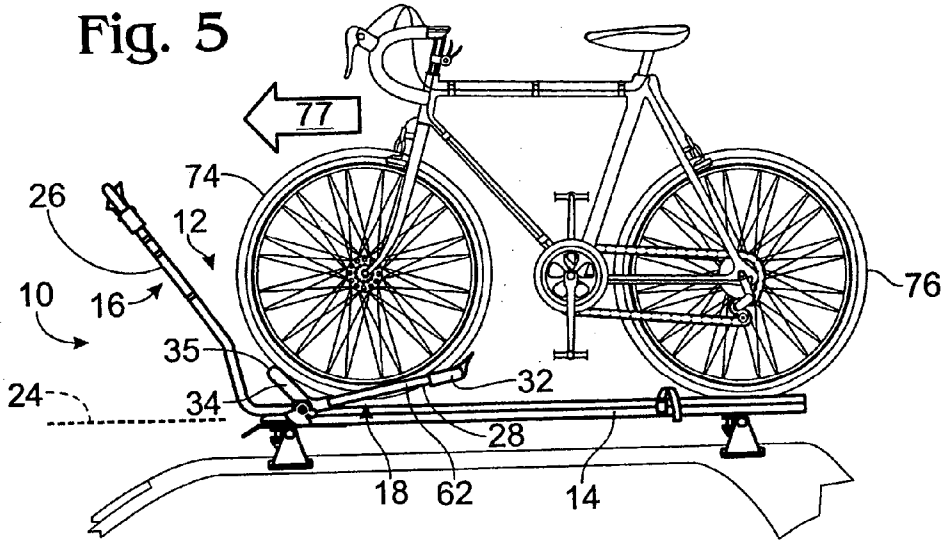


Fig. 6

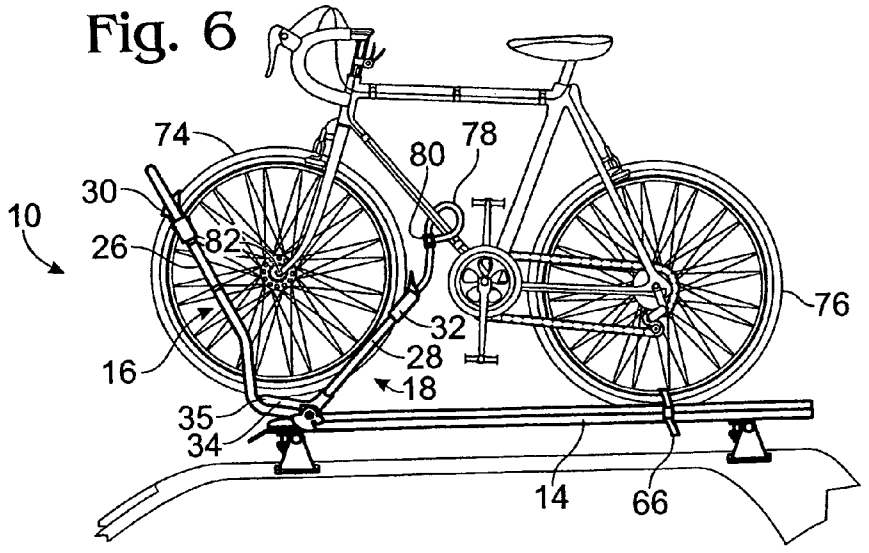


Fig. 9

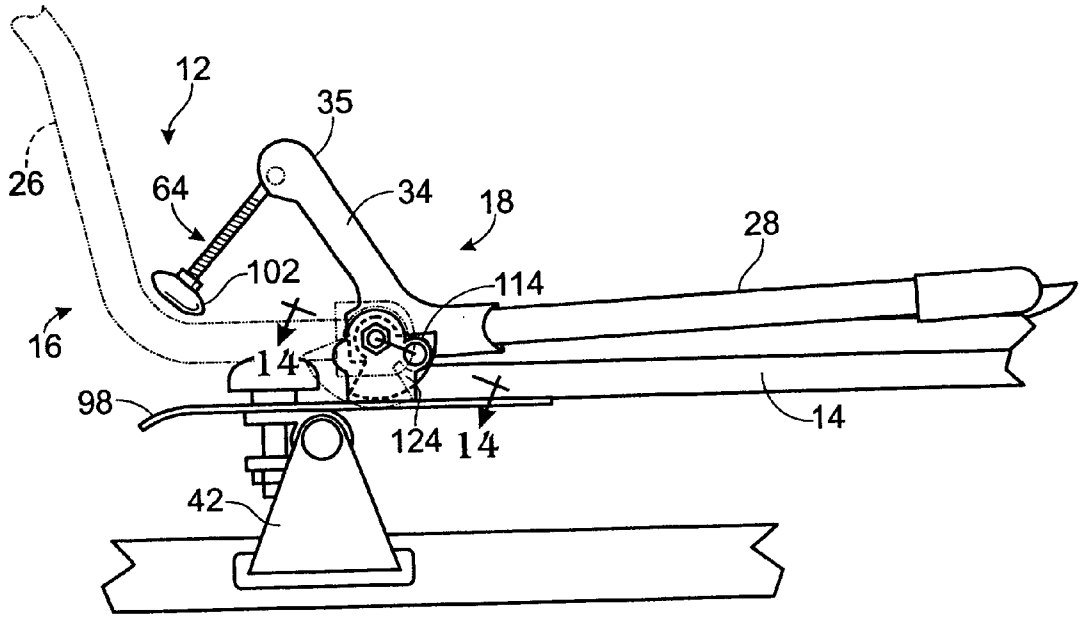

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Fig. 10

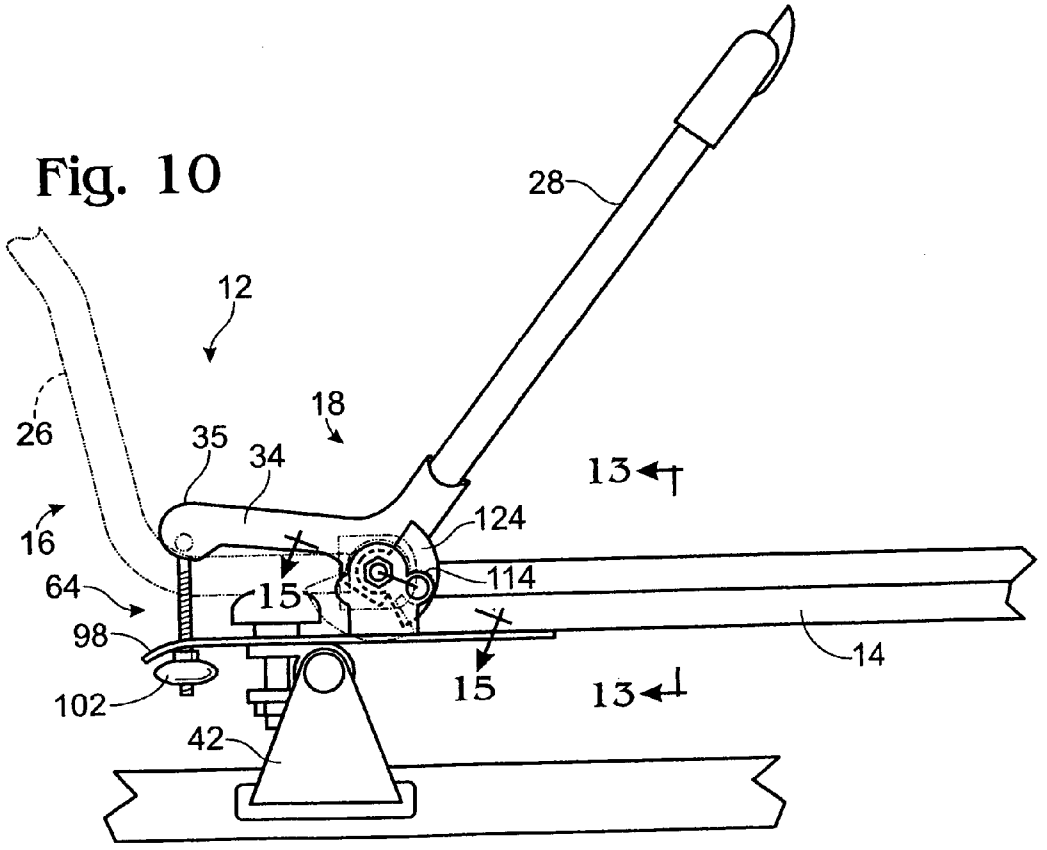
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Fig. 11

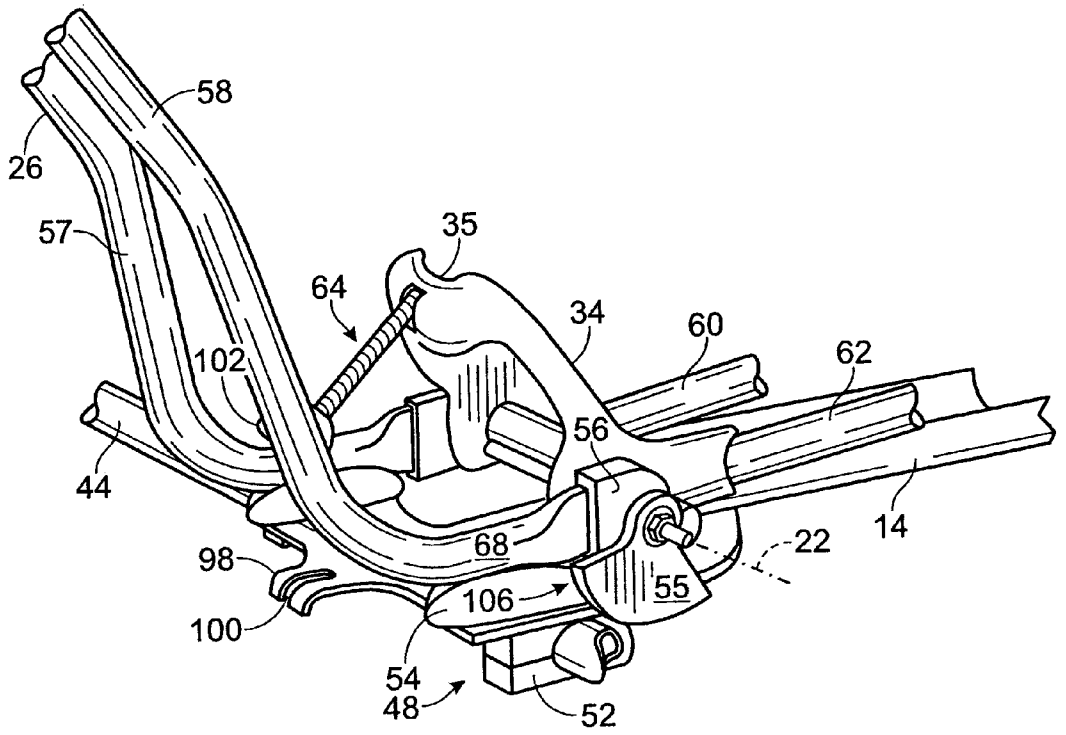
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Fig. 12

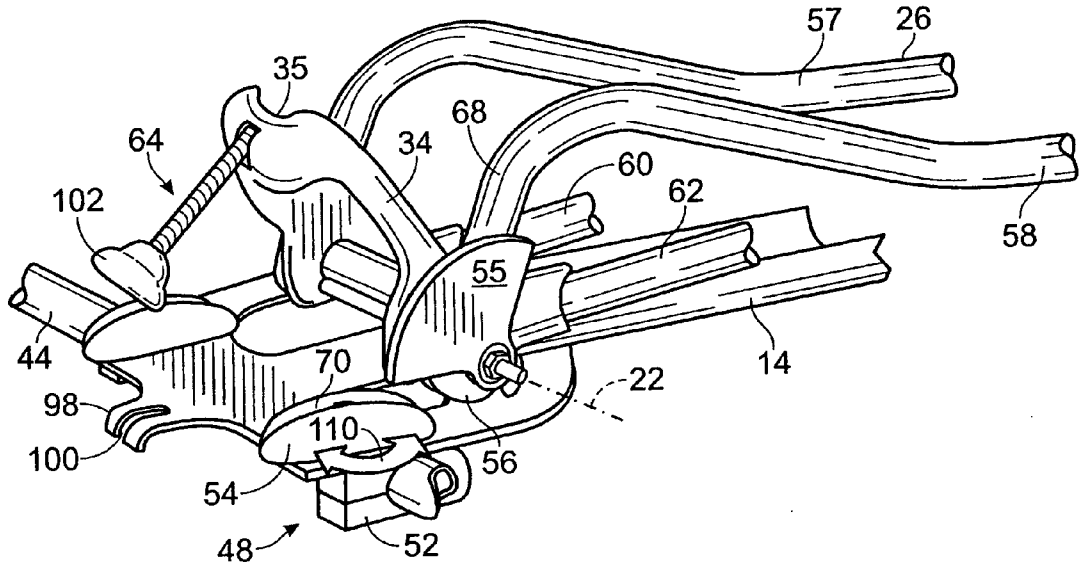
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Fig. 13

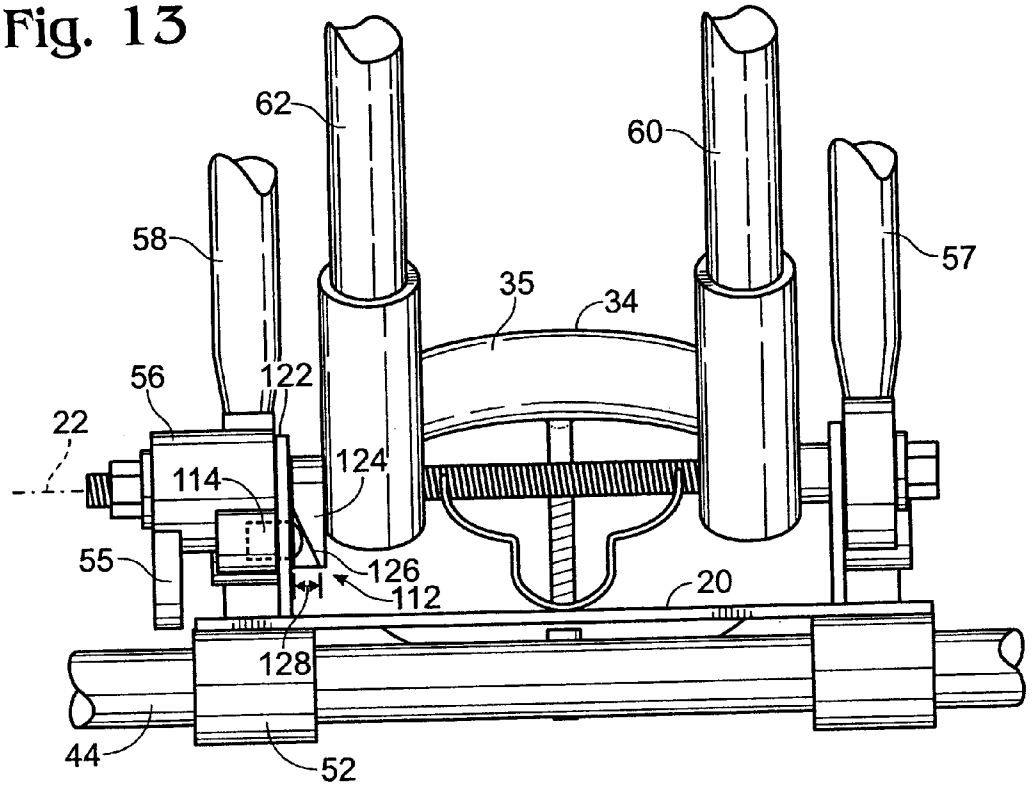


Fig. 14

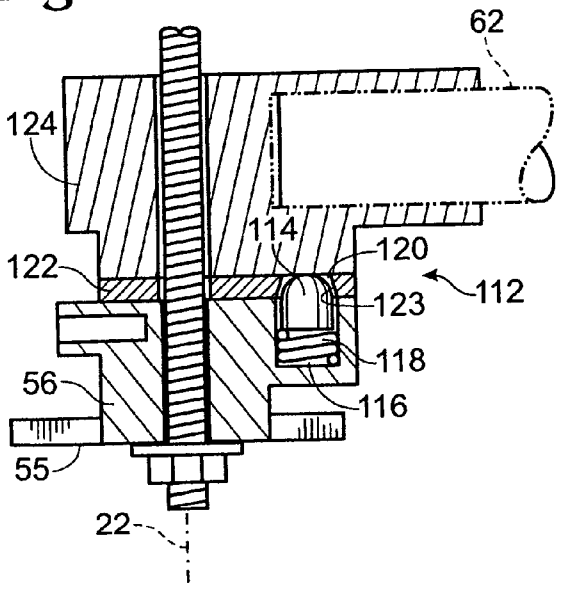
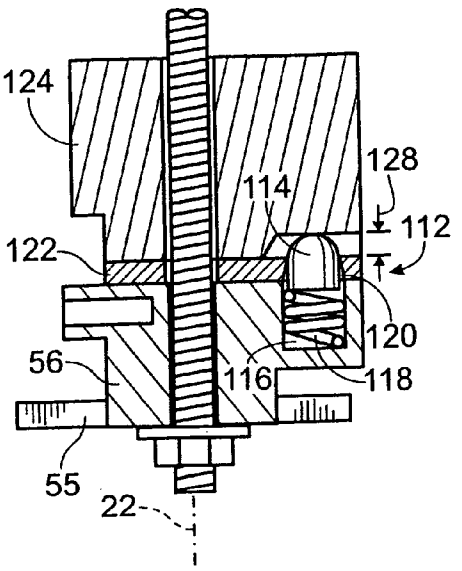


Fig. 15



BIKE MOUNT

CROSS-REFERENCES

[0001] This is a continuation application of U.S. patent application Ser. No. 10/193,737, filed Jul. 10, 2002, which is incorporated herein by reference in its entirety for all purposes.

FIELD OF THE INVENTION

[0002] The present invention is related to bike mounts. More specifically, the present invention is related to bike mounts that secure a bicycle to a vehicle rack.

BACKGROUND

[0003] The convenience of carrying bicycles on a vehicle rack has prompted the development of a number of approaches for attaching a bicycle to a carrier mounted on the vehicle rack. Generally, bicycles may be attached through their frames, their wheels, or a combination thereof. Frame attachment may effectively secure the bicycle to the vehicle rack. However, the rigidity of the bicycle frame may transfer potentially damaging motions from the vehicle to the bicycle. As result, the frame may be damaged structurally. In addition, points of carrier engagement on the frame may be damaged cosmetically, that is, dented or scratched. By contrast, wheel attachment overcomes some of these problems associated with frame attachment. Bicycle tires have an inherent shock-absorbing ability, generally reducing the effects of sudden vehicle motions on an attached bicycle.

[0004] Despite the advantages of wheel attachment, an effective bicycle carrier that relies on wheel attachment has not been described for use on a roof-mounted vehicle rack. For example, some wheel-based carriers do not grip a bicycle wheel tightly enough to safely carry a bicycle on a vehicle roof at high speeds. Other wheel-based carriers are not designed for easy bicycle loading on a vehicle roof. As a result, it may be difficult for one person to position and balance a bicycle on the carrier as the bicycle is attached.

[0005] Therefore, a vehicle-mounted bicycle carrier is needed that is easily loaded with a bicycle and that holds a wheel of the bicycle effectively.

SUMMARY OF THE INVENTION

[0006] A bike mount for securing a bicycle to a vehicle rack is provided. The bike mount includes arms that pivot apart to receive a bicycle wheel and pivot together to cooperatively hold the bicycle wheel. The bike mount may be configured to include a lever that pivots the arms together as the bicycle is positioned on the vehicle rack.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] **FIG. 1** is a perspective view of an embodiment of a bike mount attached to a vehicle rack on a vehicle, in accordance with aspects of the invention.

[0008] **FIG. 2** is a side elevation view of the bike mount of **FIG. 1** in a stowed position.

[0009] **FIG. 3** is a side elevation view of the bike mount of **FIG. 1** in a bicycle-receiving position.

[0010] **FIG. 4** is a side elevation view of the bike mount of **FIG. 1** supporting a bicycle in the bicycle-receiving position of **FIG. 3**.

[0011] **FIG. 5** is a side elevation view of the bicycle and bike mount of **FIG. 4** with the bicycle in an intermediate position during loading on the bike mount, showing an arm of the mount pivoted out of the bicycle-receiving position.

[0012] **FIG. 6** is a side elevation view of the bicycle and bike mount of **FIG. 4**, showing the bike mount engaged with a wheel of the bicycle and locked to the frame of the bicycle.

[0013] **FIG. 7** is a top plan view of an adjustable wheel engagement mechanism on an arm of the bike mount of **FIG. 1**, shown in a slidable configuration viewed generally along line **7-7** of **FIG. 3**.

[0014] **FIG. 8** is a top plan view of the wheel engagement mechanism of **FIG. 7** in a fixed configuration.

[0015] **FIG. 9** is a fragmentary side elevation view of the bike mount of **FIG. 1**, illustrating an arm locking mechanism prior to use.

[0016] **FIG. 10** is a fragmentary side elevation view of the bike mount of **FIG. 9** in a wheel-retaining position and with the arm locking mechanism deployed.

[0017] **FIG. 11** is a fragmentary perspective view of the bike mount of **FIG. 1** in a bicycle-receiving position.

[0018] **FIG. 12** is a fragmentary perspective view of the bike mount of **FIG. 11** in a stowed position.

[0019] **FIG. 13** is a fragmentary rear elevation view of the bike mount of **FIG. 10**, showing an arm retaining mechanism in a locked configuration.

[0020] **FIG. 14** is a fragmentary sectional view of the bike mount of **FIG. 9**, viewed generally along line **14-14** of **FIG. 9**, illustrating the arm retaining mechanism in an aligned, but unlocked configuration.

[0021] **FIG. 15** is a fragmentary sectional view of the bike mount of **FIG. 10**, viewed generally along line **15-15** of **FIG. 10**, further illustrating the arm retaining mechanism of **FIG. 13** in a locked configuration.

DETAILED DESCRIPTION

[0022] The present invention provides a bike mount that may be attached to a vehicle rack and used to secure a bicycle to the rack. The bike mount includes first and second arms coupled to a rack support structure. The arms pivot apart to receive a bicycle wheel and pivot together to hold the wheel, for example, by gripping the wheel cooperatively with the arms. The wheel may be engaged by the bike mount, using the arms or the arms plus the rack support structure, at three or more spaced positions around the perimeter of the wheel to hold the wheel in place. In some embodiments, the bike mount may have a self-loading feature in which the second arm includes a lever. The lever is configured to pivot the second arm from a receiving position toward a retaining position when the received bicycle wheel (and bicycle) is pushed toward the first arm. Each of the arms may be locked in the retaining position to hold the wheel, to hold one arm in position as the arms are separated from the wheel, and/or as part of a security mechanism.

[0023] When the bicycle is received, engaged, and/or retained, another wheel of the bicycle may be supported by and secured to a support tray that is integral with or separate from the rack support structure and the arms. The support tray generally provides a spaced site for attachment of the bike mount to the vehicle rack.

[0024] **FIG. 1** shows an embodiment of a bike mount **10** constructed according to the invention. Bike mount **10** includes a clamp assembly **12** for holding one of the wheels of a bicycle, usually a front wheel, and a tray **14** that supports another wheel, usually a rear wheel of the bicycle.

[0025] The clamp assembly includes a first arm **16**, a second arm **18**, and a rack support structure or base **20**. First arm **16** may be pivotably attached to rack support structure **20** at pivot axis **22**, and second arm **18** is pivotably attached at pivot axis **22**, or a second, generally parallel pivot axis. Alternatively, first arm **16** may be non-pivotable and thus may have a fixed angular position relative to long axis **24**. First and second arms **16**, **18** may include first and second arm members **26** and **28**, respectively. Each arm also may include a wheel engagement structure **30** and **32**, positioned in a spaced relation to pivot axis **22** on a distal portion of the arm. Second arm **18** also may include a lever **34** that is operably coupled to second arm member **28**, for example, at or near pivot axis **22**. Lever **34** may provide a third wheel engagement structure **35**, generally disposed proximally on the arm, which is structured to support and engage a wheel of a bicycle. Rack support structure **20** may be coupled to tray **14**, which may be aligned substantially orthogonally to pivot axis **22** and parallel to long axis **24**.

[0026] Bike mount **10** may be attached to a vehicle rack **36** positioned above a roof **38** of a vehicle **40**, or any other suitable vehicle surface, such as the bed of a truck. Vehicle rack **36** generally includes towers **42** that secure the carrier to vehicle **40** and crossbars **44** and **46**. The crossbars are linked to towers **42**, typically in a spaced relation to roof **38** and transverse to the long axis of vehicle **40**. A bike mount may be secured to crossbars **44** and **46** through rack support structure **20** and tray **14**.

[0027] Rack support structure **20** and tray **14** may include adjustable fastener mechanisms **48** and **50**, respectively, which anchor bike mount **10** to vehicle rack **36**. As shown here, each fastener mechanism may include at least one clamp **52** that grips a portion of a crossbar **44** or **46**. A fastener assembly, such as a nut and bolt, may be used to secure clamp **52** to the crossbar. In bike mount **10**, the nut, or alternatively, the head of the bolt, may be secured to or may include an enlarged gripping structure, such as fastener handle **54**. Fastener handle **54** may control engagement of clamp **52** with crossbar **44**, thus allowing adjustment of fastener mechanism **48** without gripping tools. As will be described in detail later, rotation of handle **54** may be blocked by the position of a pivotable retainer **55** on hub **56** of first arm **16**.

[0028] Arm members **26** and **28** may have any suitable structure. As shown in **FIG. 1**, first arm member **26** and second arm member **28** may have an extended arch-like structure, referred to as a hoop. Here, pairs of spaced supports **57** and **58**, **60** and **62**, extend generally normal to pivot axis **22** and may flank a received, engaged, and/or retained bicycle wheel laterally to the wheel. A hoop may be formed as a single component, such as first arm member **26**, where supports are formed from a single piece of tubular material. Alternatively, as shown for second arm member **28**, supports may be discrete components that are joined by a separate component, such as wheel engagement structure **32**, or may be joined directly to each other. In other embodiments, first and second arm members may have any suitable structure that allows them to position wheel engagement structures **30** and **32** distally from rack support structure **20** and/or pivot axis **22**. For example, each arm member **26** and/or **28** may include only one support that extends generally normally to pivot axis **22** and is joined to a wheel engagement structure at the distal portion of the arm member. Suitable materials for the arm members may include, but are not limited to, a sturdy, lightweight material such as aluminum or other metal alloy, a plastic, or a combination thereof.

[0029] Wheel engagement structures **30** and **32** may have any structure that can hold a peripheral portion of a wheel, usually by contact with the tire portion of the wheel. Wheel engagement structures may provide a concave surface that is at least partially complementary to a perimetrical transverse section of a bicycle wheel. For example, each wheel engagement structure may have an arcuate configuration with a radius large enough to accommodate a bicycle tire, such as shown in **FIG. 7**. Other configurations may be suitable, such as an angular surface, for example, a pointed arch. As described more fully below, each wheel engagement structure **30**, **32** may have a fixed position along the long axis of an arm **16** or **18**, or may have an adjustable position. The long axis of each arm is defined by each arm member, **26** or **28**.

[0030] Lever **34** is any structure that is operably coupled to second arm **18** to pivot the second arm toward first arm **16** as a bicycle wheel is rolled against the lever, generally toward the first arm. For example, lever **34** may extend at a fixed angle relative to second arm member **28**, generally normal to pivot axis **22**. The lever may contact and support a lower portion of the bicycle wheel when the wheel is received, and/or may support and engage the wheel when it is held by the first and second arms **16**, **18**. In some embodiments, lever **34** may provide a site for attaching an arm locking mechanism **64**, as described below.

[0031] Rack support structure **20** is any structure or assembly that couples arms **16** and **18** to vehicle rack **36**. Accordingly, rack support structure **20** at least partially defines spatial positions of arms **16** and **18** relative to the vehicle rack and/or vehicle. In bike mount **10**, rack support structure is a platform that attaches to crossbar **44** and carries first and second arms **16**, **18**. Alternatively, the rack support structure may include separate components that individually couple each arm to crossbar **44** (or **46**) or to any other suitable portion of vehicle rack **36**.

[0032] Tray **14** is any structure or assembly capable of supporting and positioning a second wheel of a bicycle when clamp assembly **12** grips the first wheel. As shown in **FIG. 1**, tray **14** may be a channel with a bottom portion that supports a wheel of a bicycle and sidewalls that limit transverse movement of the wheel. An end portion of tray **14** may be attached directly to clamp assembly **12**, such as through rack support structure **20**, and another portion may be attached to crossbar **46**. This configuration attaches bike mount **10** at two spaced positions on separate crossbars and

may help prevent unwanted rotation of bike mount **10** about the long axis of each crossbar. Alternative forms of a tray may be suitable. For example, the tray may substantially shorter than tray **14** of **FIG. 1** and thus may be attached to crossbar **46**, but not directly coupled to clamp assembly **12**. Tray **14** may also include a wheel retainer **66**, such as the strap shown in **FIG. 1**, to secure the second wheel of the bicycle to the bike mount.

[**0033**] Stowed and Receiving Positions

[**0034**] Bike mount **10** may be configured to include distinct stowed and receiving positions; see **FIGS. 2, 3, 11** and **12**. The stowed (or storage) position places both arms in a generally horizontal position, and thus may be suitable for carrying bike mount **10** on vehicle rack **36** without a bicycle. The receiving (or loading) position spaces distal portions of arms **16** and **18**, usually by pivoting apart, to ready the arms (and wheel engagement structures **30, 32**) for receiving a bicycle wheel. As used throughout, arms (and wheel engagement structures) are pivoted apart or away from each other when the smallest angle defined by the long axes of the arms increases, and are pivoted together or toward each other when the smallest angle decreases. Such pivotal movement is movement of the arms relative to each other, and thus may involve pivoting each of the arms or only one of the two arms relative the rack support structure.

[**0035**] **FIG. 2** shows a stowed position for bike mount **10**. In this position, first arm **16** has been pivoted toward second arm **18** so that the first and second arms are aligned and disposed in a generally horizontal position on tray **14**. The stowed position is a configuration that only may be achieved by first arm **16** when the first arm is configured to be pivotable.

[**0036**] **FIGS. 2, 3, 11** and **12** provide a comparison of a stowed position and a receiving (or loading) position. In **FIGS. 3 and 11**, relative to **FIGS. 2 and 12**, first arm **16** has been pivoted away from second arm **18**, through an angle of about 120 degrees. This places the first arm in a receiving position, which may function also as an enaged (and/or retaining) position (see below). A pivotable first arm may be pivotable through any suitable angle, or an angle of about 90 degrees to 160 degrees, about 105 degrees to 150 degrees, or about 110 degrees to 140 degrees relative to the stowed position. To enable first arm **16** to pivot past second arm **18**, particularly lever **34**, first arm member **26** may have a widened proximal portion **68** adjacent the pivot axis (see **FIGS. 1 and 11**).

[**0037**] A receiving position of first arm **16** may be produced when pivotal movement of first arm **16** is blocked. In bike mount **10**, pivotal movement of first arm **16** is blocked by contact of proximal portion **68** of first arm member **26** with a pivot stop on base **20**. The contact prohibits further pivotal movement away from second arm **18**. In this example, the pivot stop is provided by fastener handle **54**, as shown in **FIGS. 11 and 12**. The pivot stop may include a contour **70** that is at least partially complementary to proximal portion **68**. For example, handle **54** may have a concave top structure or groove. In other embodiments, first arm **16** may be prevented from pivoting away from second arm **18** or prohibited from pivoting in both directions by any suitable arm locking mechanism, such as arm locking mechanism **64** of second arm **18** (see below). The arm locking mechanism may be user implemented, adjustable, and/or the like.

[**0038**] Bicycle Loading and Retention

[**0039**] **FIGS. 4-6** illustrate loading and retaining a bicycle **72** on vehicle rack **36** using bike mount **10**. In this example, clamp assembly **12** engages and retains front wheel **74**, and rear wheel **76** is supported by tray **14**. However, the bike mount may also be configured and used so that the clamp assembly secures and/or engages rear wheel **76** and the tray supports front wheel **74**.

[**0040**] **FIG. 4** shows a bicycle positioned at the outset of loading. A user disposes bicycle **72** so that second arm **18** supports front wheel **74** and rear wheel **76** rests on tray **14**. Tray **14** plays an optional role in this loading position. When bicycle **72** is supported in this receiving position, front wheel **74** may contact lever **34** and wheel engagement structures **32** and **35**, although at least one of these contacts may be replaced by contact with the tray or rack support structure. Wheel **74** may be flanked by supports **60** and **62**.

[**0041**] **FIGS. 5 and 6** show bicycle **72** at an intermediate loading position and an engaged (and/or retaining) position, respectively, during and after movement of the bicycle along arrow **77** toward first arm **16**, generally parallel to long axis **24**. As bicycle **72** is pushed forward, front wheel **74** pushes against lever **34** to pivot second arm **18** toward first arm **16**, counterclockwise in this view. This pivotal movement results in second arm **18** rotating away from a generally horizontal receiving position. When motion of bicycle **72** shifts the force distribution between lever **34** and wheel engagement structure **32** sufficiently, an over-center action uses the weight of bicycle **72** to pivot second arm toward, and often fully into, the retaining position of **FIG. 6**. In the retaining position, wheel engagement structures **30, 32** may concurrently contact wheel **74**. Depending on the particular wheel size, position of the first arm, position of wheel engagement structure **30**, and/or the like, the lever may pivot the second arm into full engagement as in **FIG. 6**, or into near engagement. With near engagement, further adjustment of arms **16, 18** and/or wheel-engagement structures **30, 32** may be desirable, for example, as described below. In the engaged position, further pivotal movement of the second arm toward the first arm may be blocked by wheel **74** pushing against wheel engagement structure **30** on first arm **16**. In addition, pivotal movement of the second arm away from the first arm may be impeded by the weight of the bicycle holding the lever in position. Accordingly, the bicycle may be engaged by both wheel engagement structures **30, 32**, although not yet secured for vehicle travel, so that a person loading the bicycle may release the bicycle without it falling over. The person then may lock second arm **18** in position and/or may adjust the second arm to pivot slightly toward or away from the first arm, for example, to adjust engagement with wheel **74**, as detailed below. Wheel retainer **66** also may be implemented to secure rear wheel **76**.

[**0042**] Security against theft of the mounted bicycle may be provided by a security mechanism. For example, **FIG. 6** shows second arm **18** with a cable **78** joined to a lock **80**. The cable and lock may be configured to lock second arm **18** to the frame of bicycle **72** so that pivotal movement of second arm **18** out of the engaged position is prevented.

[**0043**] In the engaged (and retaining) position shown in **FIG. 6**, clamp assembly **12** engages front wheel **74** at three (or more) positions around the perimeter of wheel **74**. A

bottom portion of wheel **74** is supported and engaged by engagement structure **35** of lever **34**, and middle or upper portions of wheel **74** are engaged by structures **30** and **32**. The three positions of engagement may form a triangle that surrounds axle **82** of wheel **74**. The smallest angle of the triangle may be about 30 degrees, about 40 degrees, or about 50 degrees.

[**0044**] Adjustable Wheel Engagement Structure

[**0045**] An embodiment of a bike mount may include a positionally adjustable wheel engagement mechanism on at least one of the first or second arm, **16** or **18**. The adjustable mechanism may allow the wheel engagement structure to move between plural fixed positions along the long axis of the first or second arm **16**, **18**. The fixed positions may be predefined or continuous.

[**0046**] **FIGS. 7 and 8** illustrate an embodiment of an adjustable wheel engagement mechanism **84** that is positionable to predefined positions along the long axis of first arm **16**. Mechanism **84** generally includes wheel engagement structure **30**, guide portions **86** connected to structure **30**, and position lock **88** on at least one guide portion **86**. A person may slidably position structure **30** using portions **86**, which may provide a collar-like engagement with supports **57** and **58**.

[**0047**] Positioning elements **90** on supports **57** and/or **58** may provide predefined positions at which engagement structure **30** may be fixed along the long axis of arm **16**. Four positioning elements on each support are shown here. Each positioning element **90** may be engaged by a complementary structure **92** in position lock **88**. As shown in **FIGS. 7 and 8**, each positioning element **90** may be a recess or hole on support **57** or **58**. Structure **92** may be pivoted into contact with element **90**, as shown by comparing the slidable position of **FIG. 7** with the fixed position of **FIG. 8**. In the fixed position, complementary structures **94** and **96**, in this case a tab and a slot, may snap together to maintain the fixed position. In alternative embodiments, position lock **88** may be provided by any mechanism that fixes the position of wheel engagement structure **30** along the long axis of first arm **16**. For example, position lock **88** may include a bolt and nut that are fastened through a hole or to a surface of support **57** or **58**. In some embodiments, element **90** may be omitted or may be a positional mark on support **57** and/or **58**.

[**0048**] Elements **90** may be disposed so that wheel engagement structure **30** is positioned to effectively engage and retain different standard wheel sizes. Generally, elements **90** position wheel engagement structure **30** so that the structure engages a wheel at an angle of approximately 15 degrees to 60 degrees, about 20 degrees to about 50 degrees, or about 25 degrees to about 35 degrees relative to a line extending between pivot axis **22** and the rotational axis **82** of the engaged wheel, where the pivot axis is the vertex of the angle. For example, elements **90** may be located to properly position structure **30** for efficient engagement of wheels of diameters such as 20", 24", 26", 700 *c*, and 29"/large downhill.

[**0049**] Arm Locking Mechanism

[**0050**] An engaged or nearly engaged position of bike mount **10**, such as shown in **FIG. 6**, may be fixed and further adjusted with an arm locking mechanism to provide a retaining position for holding the bicycle on a vehicle. The retaining position is any arm configuration in which the arms are fixed in position around a wheel to prohibit separation of the wheel from the arms during normal operation of the vehicle. Thus the wheel is held and secured. An arm locking mechanism is any mechanism that fixes the angular position of one of the arms relative to the other arm. The arm locking mechanism may be implemented volitionally, that is, as desired by the user. The arm locking mechanism may prohibit an arm from pivoting in both pivotal directions or in only one direction. When only one pivotal direction is prohibited, the wheel (and the other arm) may prohibit pivotal movement in the other direction.

[**0051**] **FIG. 10** shows an embodiment of an arm locking mechanism, mechanism **64**, in a locked configuration, prohibiting pivotal movement of second arm **18** in one pivotal direction. Arm locking mechanism **64** is further illustrated in **FIGS. 9, 11**, and **12** in an unlocked configuration. In both **FIGS. 9 and 10**, first arm **16** is shown in dotted outline to facilitate understanding the arm locking mechanism. Arm locking mechanism **64** may be attached to lever **34** at a portion of the lever that is distal to pivot axis **22**, and attached to a retention structure on bike mount **10**, such as flange **98**. As illustrated in **FIGS. 11 and 12**, flange **98** may include a notched acceptor structure **100** into which a threaded fastener **102** may be placed and secured. When second arm **18** is pivoted into the engaged position, as shown in **FIG. 10**, fastener assembly **102** may be placed in acceptor structure **100**, with a nut of the assembly positioned below flange **98** (see **FIG. 12**). The nut of fastener assembly **102** may then be rotated, in this case by hand, so that it contacts structure **98**, and then further rotated to adjust the angular position of second arm **18**. This angular adjustment of arm **18** may be useful to regulate a gripping pressure exerted on wheel **74** by clamp assembly **12**.

[**0052**] Passive Security Mechanism

[**0053**] **FIGS. 11 and 12** illustrate a passive security mechanism **106** that may be included in a bike mount. Security mechanism **106** is configured to prevent bike mount **10** from being removed from crossbar **44** when the arms holding a wheel. Mechanism **106** is described as passive because the mechanism does not require a separate locking action that is distinct from the actions carried out by a person in retaining a bicycle wheel with the bike mount.

[**0054**] Passive security mechanism **106** may include a pivot-dependent retainer, such as pivotable retainer **55**, which is coupled to either first or second arm **16** or **18**, usually near pivot axis **22**. In the example of bike mount **10**, pivotable retainer **55** is included in first arm **16** and positioned near proximal portion **68**, as part of first arm hub **56**. Pivotable retainer **55** has a restrictive and a permissive position. In the restrictive position, illustrated in **FIG. 11** with first arm **16** in the loading (or engaged) position, pivotable retainer **55** is disposed in the pivotal path of fastener handle **54** and thus obstructs pivotal movement of the handle. In this restrictive position, fastener handle **54** cannot be pivoted a complete revolution and thus clamp **52** cannot be removed easily. By contrast, when first arm **16** is in the stowed position shown in **FIG. 12**, retainer **55** has pivoted to a permissive position that allows full pivotal movement of handle **54**, as shown by arrow **110**. Security mechanism may be based on the pivotal position of the first arm or the second arm.

[0055] First-Arm Retaining Mechanism

[0056] Bike mount **10** may include a first-arm retaining mechanism **112** shown in **FIGS. 13-15**. These illustrations are related to **FIGS. 9 and 10**, but now show portions of the first arm in solid rather than dashed lines to better illustrate the retaining mechanism. The first-arm retaining mechanism provides a lock that fixes the first arm in the loading (engaged) position, but fixing is regulated by the pivotal position of each arm.

[0057] The first-arm retaining mechanism may have the following properties. First, the mechanism may function when the first arm is in the loading/engaged position, but not when the first arm has been rotated away from the loading/engaged position. Second, when the first arm is in the loading/engaged position, the second arm permits the lock to function when the second arm is in the engaged position, but not when the second arm is in the loading position. The retaining mechanism may be useful when a bicycle is moved from the engaged position to the receiving (in this case unloading) position. Specifically, the engaged wheel may tend to remain associated with the first arm as the bicycle is moved to the unloading position. The arm retaining mechanism may act to temporarily hold the first arm in position, thus properly disengaging the wheel from the first arm as the second arm pivots away from the first arm. The retaining mechanism also may facilitate holding the wheel in position during engagement, and may restrict further the ability of a thief to overcome the passive security mechanism described above. The arm retaining mechanism described here also may be useful in locking the second arm in position based on the pivotal position of each arm.

[0058] **FIGS. 13-15** show the structure and operation of the first-arm retaining mechanism **112**. Mechanism **112** includes a biased displaceable member such as pin **114**, movably positioned within a recess **116** of first arm hub **56**. Pin **114** is coupled to a spring **118** at its base to bias the position of the member towards an extended configuration, as shown in **FIGS. 13 and 15**. When first arm **16** is in the loading/engaged position of **FIGS. 1, 3** and **9**, biased pin **114** is aligned with a through-hole **120** positioned in extension **122** of rack support structure **20**. As shown in **FIG. 14**, through-hole **120** may have beveled edges **123** that diverge toward first arm hub **56**. In this locked configuration, attempted movement of the first arm will be blocked by contact of pin **114** with base extension **122**.-Rather than a biased pin, another biased displaceable member may be suitable, such as a leaf spring.

[0059] As shown in **FIG. 13**, the second arm includes a second arm hub **124** with a beveled profile **126** on a side portion. The beveled profile determines the axial position of the biased pin as the second arm is pivoted, using an axial cam mechanism. Therefore, the gap **128** between the beveled profile and the base extension, at the position of the through-hole, varies according to the pivotal position of the second arm. In the engaged position shown in **FIGS. 13 and 15**, locking gap **128** is provided by the beveled profile. In contrast, pivotal movement of the second arm to the loading/unloading position significantly reduces the gap so that a rounded portion of pin **114** contacts beveled edge **123**. In this position, a ramping action of the beveled surface relative to the rounded portion of the pin further displaces pin **114** to allow rotation of the pin out of alignment with through-hole **120**. This is illustrated by comparing **FIGS. 14 and 15**. A role for the pivotal position of the second arm in the locking mechanism is also illustrated by comparing **FIGS. 14 and 15**. It should be noted that support **62** of second arm **28** is included in **FIG. 14**, in outline, to illustrate pivotal movement of second arm hub **124** relative to its position in **FIG. 15**. Support **62** would not normally be visible in the indicated view.

[0060] The specific embodiments disclosed and illustrated herein should not be considered as limiting the scope of the invention, as understood by a person having ordinary skill in the art. Numerous variations are possible without falling outside the scope of the appended claims. The subject matter of the invention includes all novel and nonobvious combinations and subcombinations of the various elements, features, functions, and/or properties disclosed herein.

I claim:

1. An apparatus for carrying a bicycle on a vehicle rack, comprising:

at least one wheel tray structure for supporting one or more wheels of a bicycle,

at least a first wheel gripping member pivotally connected to the wheel tray structure,

a lever portion connected to the wheel gripping member, the lever portion being positioned along the wheel tray such that when a tire rolls along the wheel tray, it contacts the lever causing the wheel gripping member to pivot into gripping engagement with the wheel.

2. The apparatus of claim 1 further comprising

a second wheel gripping structure which cooperates with the first wheel gripping structure to grip the wheel from different sides.

3. The apparatus of claim 1, wherein the vehicle rack includes a crossbar, the rack support structure being configured to be attached to the crossbar.

4. The apparatus of claim 1, further comprising a detent mechanism, the detent mechanism being volitionally implementable to restrict the second arm from pivoting out of engagement with the wheel from the fixed retaining position.

5. The apparatus of claim 1, the apparatus being configured to have at least three spaced positions of engagement with the tire of the wheel when the first and second arms cooperatively engage the wheel.

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