



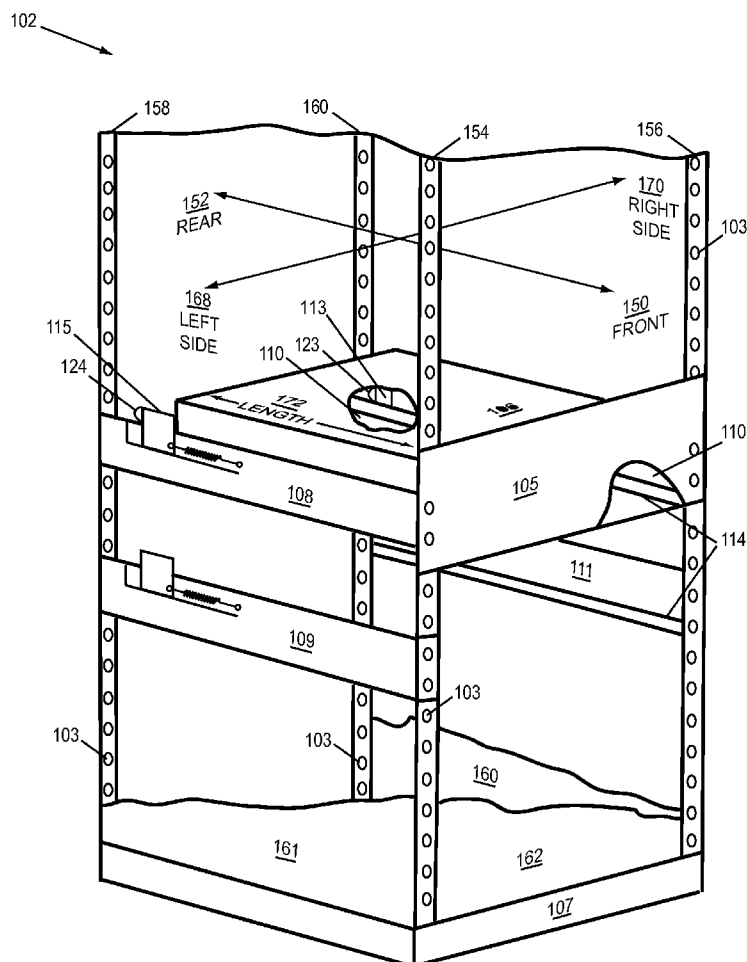
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(19) **United States**(12) **Patent Application Publication****Adams et al.**(10) **Pub. No.: US 2007/0247044 A1**(43) **Pub. Date: Oct. 25, 2007**(54) **SELF-LOCATING REAR MOUNT SYSTEM  
AND METHOD FOR RACK MOUNTABLE  
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**A47B 88/00** (2006.01)(52) **U.S. Cl.** ..... **312/334.5; 312/265.4**(75) Inventors: **Eric E. Adams**, Pittsboro, NC (US);  
**David F. Champion**, Durham, NC  
(US); **James R. Drake**, Burlington, NC  
(US); **Todd W. Justus**, Chapel Hill, NC  
(US); **James S. Womble**, Hillsborough,  
NC (US)

Correspondence Address:

**IBM CORPORATION (RTP)****C/O SCHUBERT OSTERRIEDER &  
NICKELSON PLLC****6013 CANNON MOUNTAIN DRIVE, S14  
AUSTIN, TX 78749 (US)**(73) Assignee: **International Business Machines Cor-  
poration**, Armonk, NY(21) Appl. No.: **11/380,143**(22) Filed: **Apr. 25, 2006**(57) **ABSTRACT**

In accordance with the present disclosure, a rack equipment mount with a self-locating/self-adjusting rear fastener mechanism is disclosed. The equipment mount can have a first rail and a second rail securable horizontally in a rack system, wherein self-locating fasteners or receivers can be slidably connected to the rails. Rack mountable equipment to be inserted into the rack can have a mating fastener attached to the rear of its chassis and the self locating fasteners can engage with the mating fasteners as the chassis is slid into the rack. The self-locating fastener can be spring loaded in a forward position and slide along the rail to self-locate at the appropriate depth when a chassis is inserted into the rack. The self-locating fasteners allow equipment chassis of varying depths to be installed into a rack and easily secured at the rear of the rack. Such a self-locating rear fastener system can comply with NEBS requirements when the screw is utilized to secure the rail to the self-locating fastener receiver and the chassis.



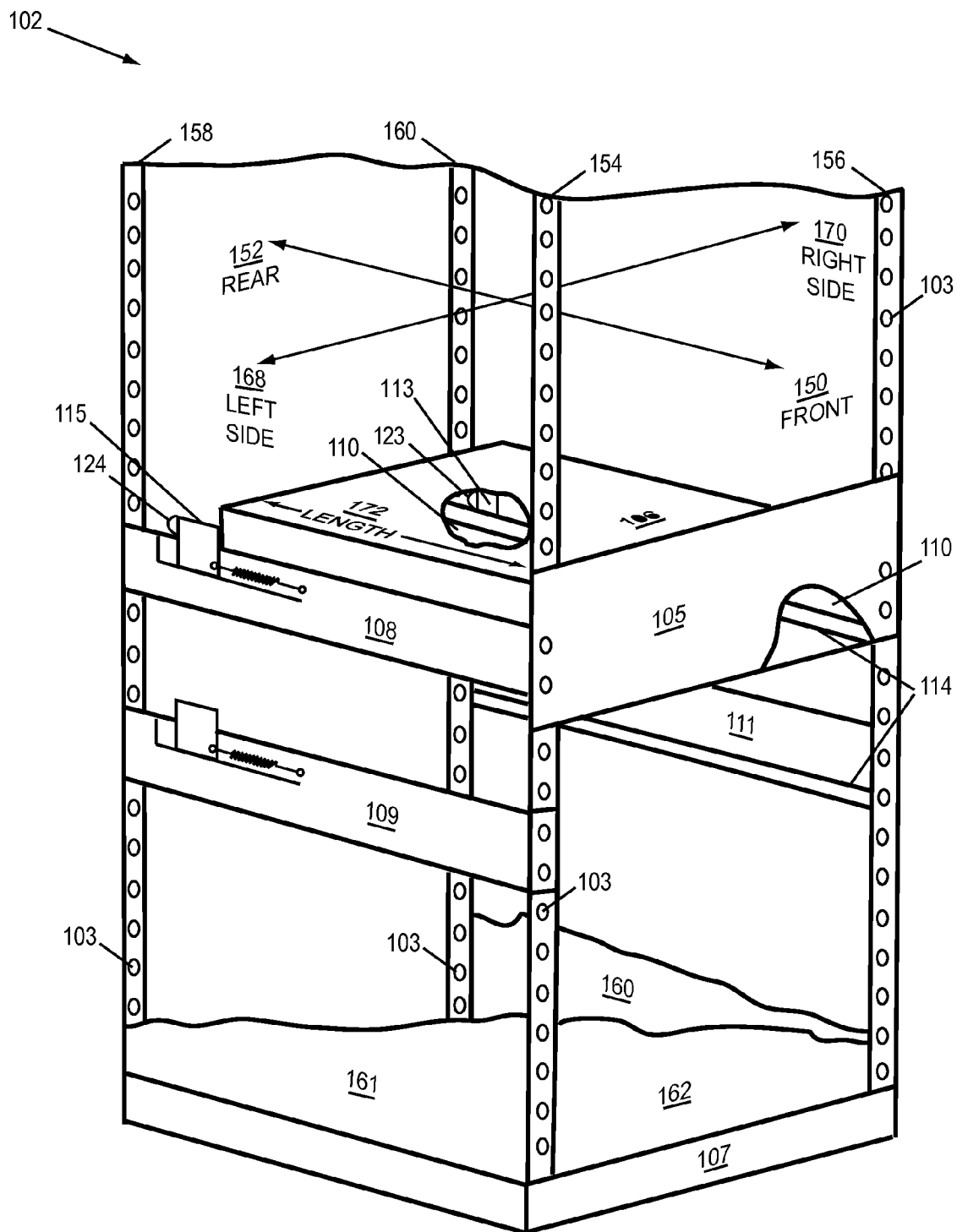


FIG 1

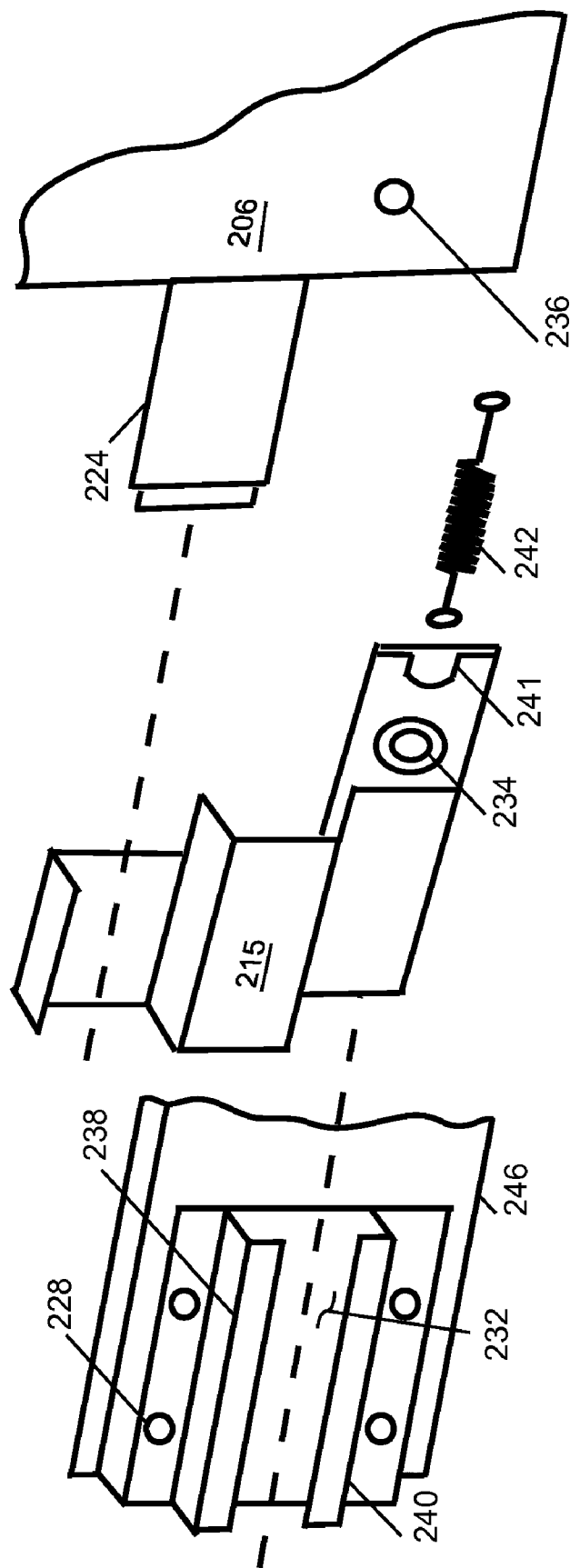


FIG 2

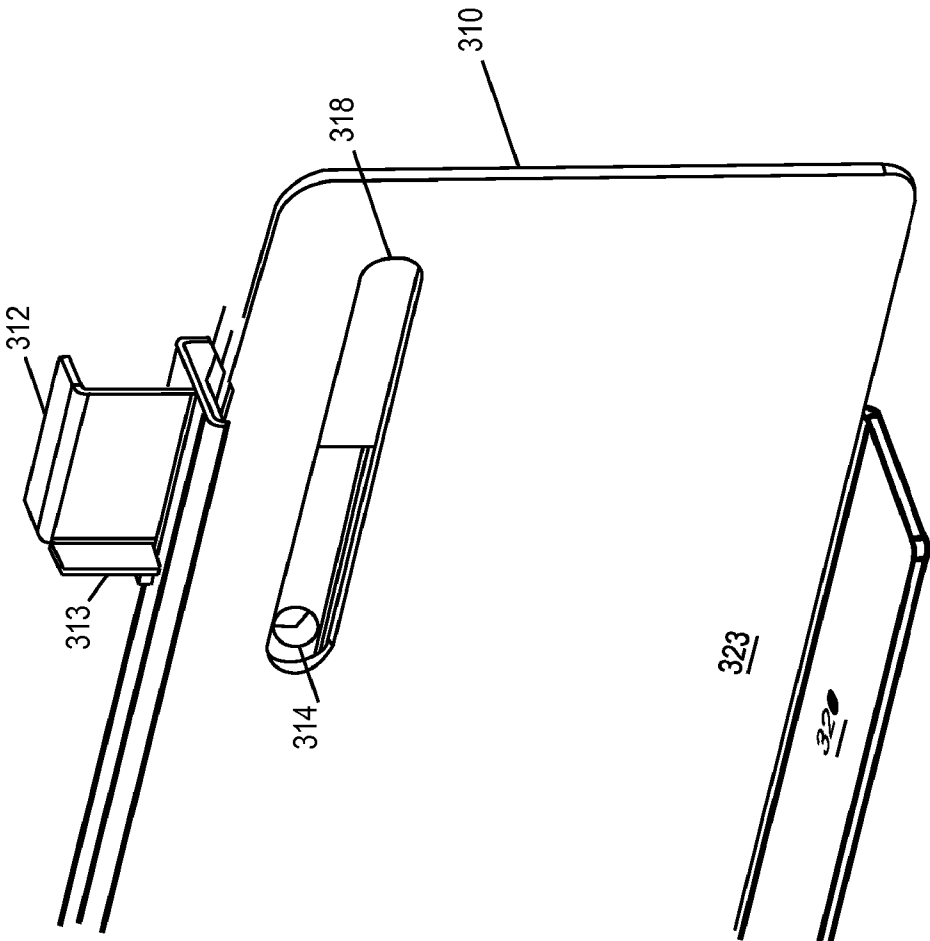


FIG 3

410  
↘

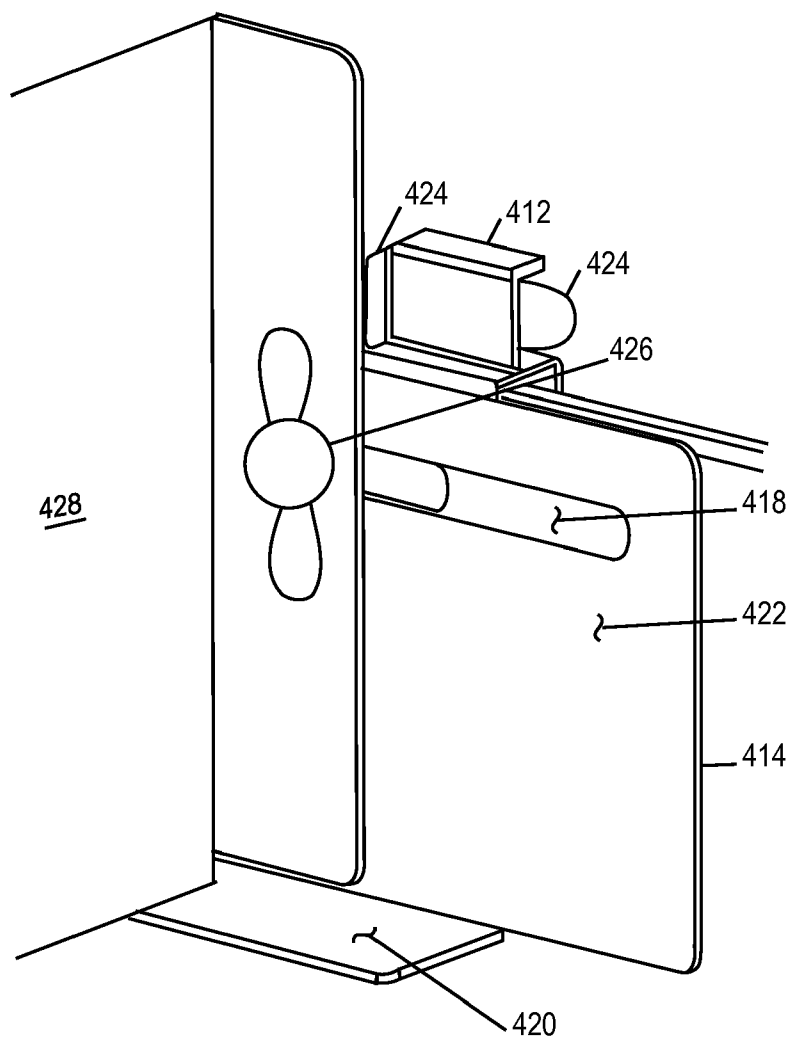
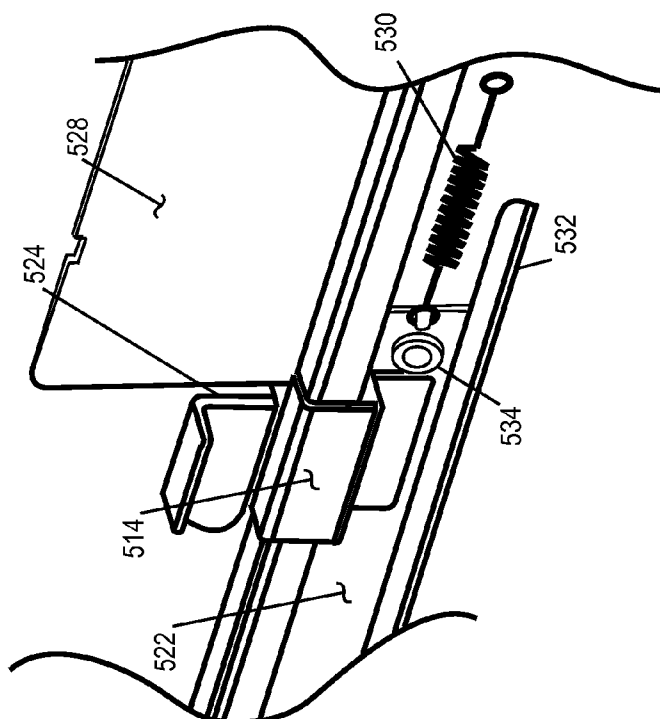


FIG 4



**FIG 5**

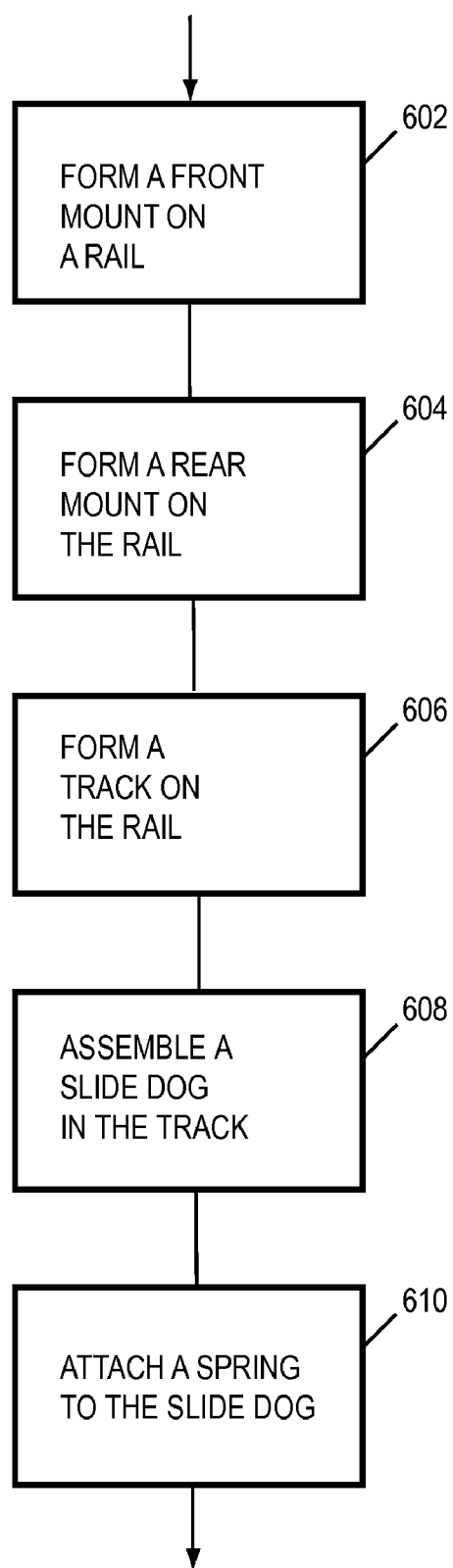


FIG 6

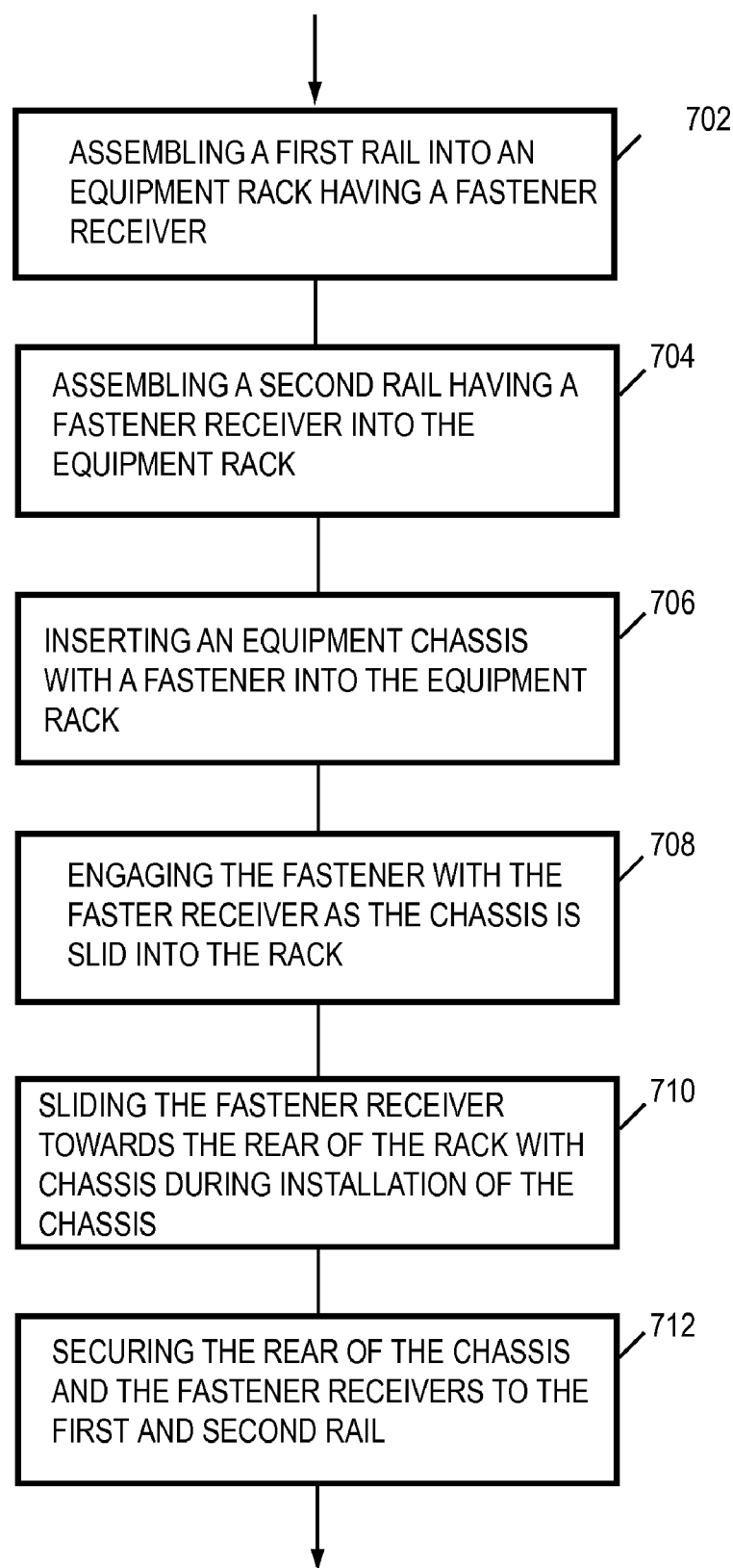


FIG 7

## SELF-LOCATING REAR MOUNT SYSTEM AND METHOD FOR RACK MOUNTABLE EQUIPMENT

### FIELD OF THE DISCLOSURE

[0001] The present disclosure is generally related to rack mounted electronic equipment and more particularly to systems and methods for securing rack mountable equipment.

### BACKGROUND

[0002] Large electronic systems are typically created by combining numerous functionally distinct pieces of electronic equipment. Generally, each system has different functional requirements and rack mountable electronic equipment can be purchased from different vendors and integrated into racks to form a complete system. For example, a business may need a mail server, a voice over Internet protocol server, a web page server, a business phone system and a large amount of data storage. This equipment can be purchased from the individual vendors, mounted in a rack, and then interconnected with wires and cables to form such a system.

[0003] Rack mountable equipment comes in many shape and sizes. A robust equipment installation requires equipment or equipment chassis to be adequately secured in the rack. Many industry standards and specifications exist that specify how rack mountable equipment should be secured to a rack. One such specification is the network equipment building system, (NEBS) guidelines. NEBS guidelines include a set of technical requirements, that when complied with, make rack mounted equipment more resistant to failures. For example, NEBS requirements can minimize the likelihood of damages to rack mounted equipment should an earthquake occur. The NEBS standard was initially developed by Bell Labs® for the telecommunications industry. However, the NEBS standard is often utilized as a guideline in many other industries that utilize rack mounted equipment.

[0004] Thus, many industries and customers strive to meet specific mechanical requirements provided by the NEBS guidelines. Equipment chassis are typically shaped like a "rectangular box" and one NEBS guideline is to secure all four corners of the equipment chassis to the rack. Since meeting this basic mechanical requirement is a good business practice, many vendors comply with the NEBS requirements. For example, when racks or cabinets are populated with equipment and wired prior to shipping, it would be impractical to ship such a system without adequately securing the equipment in the rack.

[0005] The spacing of vertical fastening members within commercially available racks and the spacing of the holes in the vertical members are dictated by another set of guidelines, the electronics industry alliance (EIA) guidelines. The EIA guideline provide standard mounting hole dimensions for equipment racks. A typical EIA compliant rack will have two vertical members at the front of the rack and two vertical members at the rear of the rack. Specific spacing is typically provided between the vertical rack members and between the holes within these members. EIA compliant racks can be purchased in different standard widths to accommodate equipment chassis that are, for example 24, 28, or 30 inches wide.

[0006] Thus, to accommodate different rack mountable electronic equipment, a rack can be selected according to the width of the chassis of the electronic equipment to be mounted. Holes in the front panels of these chassis can be fabricated such that they line up with the holes in the vertical members of the rack when the chassis is inserted into the rack. A first step in securing equipment in a rack can be to secure the front of the chassis at each end of a faceplate. This is accomplished utilizing holes in the faceplate to secure the faceplate to the front vertical members of the rack. However, one troubling issue is that rack mountable equipment almost always varies in length and securing the rear of a chassis to the rear vertical members of the rack is, by no means a simple or standard procedure.

[0007] As stated above, many different types of equipment from many different vendors can be mounted into a rack. Consequently, equipment chassis are made to specific widths but vary significantly in length, and consequently, vary in how deep the rear of the chassis penetrates the rack. The EIA standard places the back vertical member of a rack at a fixed distance from the front vertical members and often the rear of an equipment chassis will not extend even close to the rear vertical members.

[0008] Traditionally, some vendors ship rear tie down hardware with equipment that is unique to the individual equipment to be mounted in a rack based on the mechanical requirements for locating the rear tie-down locations of the equipment chassis. This inefficient practice requires unique attachment products to accommodate chassis with special tie-down locations, and proprietary tie down methods.

[0009] Another common approach for equipment vendors is to supply a universal set of brackets with the electronic equipment such that, with the right combination of pieces, the equipment chassis can be fastened to the vertical members at the back of the rack. This "ladder" solution, as it is often called, can confuse the installer, because the installer may not understand which brackets are to be utilized, which tie-down locations on the chassis are to be connected to the rear vertical members and which mounting fasteners are to be utilized to secure the brackets.

[0010] There are a number of disadvantages associated with universal bracket type installations. When the series of rigid brackets in the kit are assembled to form a connection from the rear vertical member forward to the rear of the equipment chassis, it is often not known if the mounting configuration meets NEBS standards. Cantilevering numerous brackets off of the rear vertical member with numerous screws and nuts can provide an unacceptable mounting configuration by many standards. Further, a universal kit installation is often bulky and such an installation can interfere with the installation of additional equipment in adjacent rack locations. For example, additional equipment often cannot be installed directly above, below or beside equipment installed with bulky bracket kits.

[0011] Assembly for nearly all rear mounting configurations requires special tools such as short shafted screw drivers, nut drivers and wrenches. Additionally, it is often difficult to access the hardware utilized in the rear tie down locations. Further, the installer may be required to place his head and arms deep into the cabinet to tighten the hardware to secure the rear of a chassis to the rack. In such a confined space with wires and cables running everywhere at the rear

of the rack, it can be a dreaded task to install and remove equipment because of the difficulty in accessing the rear mounting hardware that secures the rear of the equipment chassis.

[0012] As stated above, it is cumbersome and time consuming for a technician to select brackets and attempt to create the correct hole alignments at the rear of the chassis when installing rack mountable equipment. In addition, it is cumbersome and time consuming for a technician to rework a rigid bracket mounting system when outdated or failed equipment must be replaced with a new piece of equipment that has a different chassis size. This is particularly true when a rack is fully populated and the replacement equipment has significantly different dimensions than the existing equipment. In view of the above-described disadvantages associated with current systems and methods for securing the rear of a chassis in a rack environment, there is clearly a need for improved equipment securing methods and arrangements.

#### SUMMARY OF THE INVENTION

[0013] The problems identified above are in large part addressed by methods and arrangements disclosed herein to mount equipment in an equipment rack. One embodiment provides an equipment mounting system with a fastening apparatus to secure each rear corner of an electronic chassis to the rack when the chassis is fully inserted into the rack. The fastening apparatus can self adjust to an appropriate location proximate to the rear of the rack according to the length of the equipment installed or according to the depth which the rear of the chassis penetrates the rack.

[0014] The equipment mounting system can also include two rails securable in a rack perpendicular to vertical members of the rack. Each rail can have a first end and a second end and a track disposed between the first and second end, wherein self-locating fasteners can slide on the tracks. The self-locating fasteners can be adapted to receive mating fasteners integrated with an equipment chassis as the equipment chassis is inserted into the equipment rack. A spring can be connected between the self-locating fasteners and the rails such that the self-locating fasteners are biased towards the front of the rack and, as the equipment chassis is inserted into the rack, the self-locating fasteners can receive the mating fasteners and slide towards the rear of the rack to the appropriate location. The rails of the equipment mounting system can also provide a horizontal "shelf" surface to support the chassis and align the fasteners as the chassis is slid into the rack.

[0015] In one embodiment the mating fastener can be a protrusion on the chassis of the electronic equipment that engages a recess in the self-locating fastener. In another embodiment the self-locating fastener can be a protrusion that fits into a recess formed by the mating fastener. A protrusion can include a blade, a pin, a tongue, and a tab and the recess can include a groove, a slot, and a hole. However, other mating configurations could also be utilized.

[0016] In another embodiment an equipment mounting system is disclosed that has a first rail and a second rail mounted horizontally between a first and second vertical member of an equipment rack. The first rail and the second rail can have tracks to secure a fastener receiver that slides along the track. The fastener receivers can be adapted to

engage a rear of a mountable chassis when the mountable chassis is inserted into the rack, and the fastener receivers can slide along the track as the chassis is slid into a final mounting position. When the chassis is in its final position screws can be utilized to secure the chassis to the rail via the self-locating fasteners.

[0017] A spring can be coupled between the first rail and the first fastener receiver to bias the fastener receiver in a position towards the front of the rail. Likewise, a spring can be coupled between the second rail and the second fastener receiver to bias the second fastener receiver in a forward position. A sliding surface and a side plate can be provided by the first and second rails to align the fastener receivers with fasteners on the chassis when the chassis is slid into the rack.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0018] Advantages of the invention will become apparent upon reading the following detailed description and upon reference to the accompanying drawings in which, like reference numbers may indicate similar elements:

[0019] FIG. 1 depicts an orthogonal front view of a cabinet having front and rear vertical members for mounting electronic equipment;

[0020] FIG. 2 depicts an orthogonal view of individual components that can be utilized to create an equipment mount;

[0021] FIG. 3 depicts an orthogonal view of a portion of an equipment mount with a rear self-locating fastener and a mating fastener on a chassis that is engaged with the self locating fastener;

[0022] FIG. 4 depicts a detailed view of a portion of an equipment mount with a self-locating fastener;

[0023] FIG. 5 depicts an orthogonal view of a self-locating fastener and a track that can slidably secure the self-locating fastener;

[0024] FIG. 6 depicts a flow diagram of a method for making an equipment mount; and

[0025] FIG. 7 depicts a flow diagram of a method for installing electronic equipment into a rack.

#### DETAILED DESCRIPTION OF THE DRAWINGS

[0026] The following is a detailed description of novel embodiments depicted in the accompanying drawings. The embodiments are in such detail as to clearly communicate the subject matter. However, the amount of detail offered is not intended to limit anticipated variations of the described embodiments; but on the contrary, the claims and detailed description are to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the present teachings as defined by the appended claims. The detailed descriptions below are designed to make such embodiments understandable to a person having ordinary skill in the art.

[0027] Generally, methods and arrangements to efficiently mount equipment of varying sizes into an equipment rack are provided herein. While specific embodiments will be described below with reference to equipment mounting configurations, those of skill in the art will realize that embodiments of the present disclosure may advantageously

be implemented with other components and configurations. The methods and arrangements described herein can be effectively utilized to efficiently mount equipment of various dimensions into a rack utilizing a self locating fastener system.

[0028] In accordance with the present disclosure, a rack equipment mounting system with a self-locating/self-adjusting rear fastener or fastener receiver is disclosed. The rack equipment mount can have a first rail and a second rail securable horizontally in a rack system, wherein self-locating fastener receivers can slide horizontally along to the rails. A rack mountable equipment chassis can have fasteners at each rear corner that can mate with the self locating fastener receivers of the rail as the equipment is installed into the rack. Thus, the self locating fastener receivers can receive or engage fasteners on the chassis and move rearward as the chassis is inserted and can self-locate at a final location when the chassis is fully inserted into the rack.

[0029] The self-locating fastener receiver can be spring loaded in a forward position and slide along the rail towards the rear of the rack to the appropriate depth from the front of the rack during installation of the chassis. The self-locating fasteners can be forced towards the rear of the rack by the mating fasteners on the chassis as the chassis becomes fully inserted into the rack. Thus, during installation of equipment, a chassis with a fastener can be inserted into the rack, and the fastener can engage the self-locating fastener receiver that is slidably secured by the rail and the self-locating fastener receiver can slide to the rear of the rack with the chassis, to secure the rear corners of the chassis to the rack. The sliding, self-locating fastener receivers allow equipment chassis of varying lengths to be installed into a rack and to be secured at the rear of the equipment chassis at varying depths in the rack.

[0030] Once the chassis is installed into the rack and the fastener receivers "self-adjust" to a location commensurate with the rear of the chassis, a threaded fastener can be placed in the chassis to secure the chassis to the rail and enhance the connection between the chassis and the rail. Such a threaded fastener in cooperation with the self-locating rear fastener system can comply with NEBS requirements. The self-locating fastener system provides a solid installation for equipment that may encounter rough handling practices during shipping.

[0031] Referring to FIG. 1, a cut away view of a portion of a rack 102 for mounting electronic equipment is illustrated. A typical rack installation would have side covers 160 and 161 and a front door 162 all depicted in a lower portion of the rack 102. Side covers 160 and 161 and a front door 162 have been "cut away" to illustrate the rack mounting features of the present disclosure. For reference, a coordinate axis has been provided to illustrate the front of the rack 150, the rear of the rack 152, the left side of the rack 168, and the right side of the rack 170 and although the mounting system is describe in the context of inserting equipment into the front of the rack 150, inserting equipment from the rear of the rack 152 would not part from the embodiments contemplated. As stated above, a rack can be selected based on a desired width as measured from the left side of the rack 168 to the right side of the rack 170.

[0032] The rack 102 can include front vertical members 154 and 156 and rear vertical members 158 and 160,

collectively referred to as (vertical members 154-160). The vertical members 154-160 can be secured about a base 107 and about a top cap (not shown). Vertical members 154-160 can have a cross section resembling an "L" shape. Thus, the vertical members 154-160 can be formed by bending a flat bar at a ninety degree angle or they can be made from angle stock to give the vertical rails 154-160 improved rigidity. The vertical members 154-160 can have a series of holes 103 that are spaced up and down the vertical members 154-160. The holes 103 in the vertical members 154-160 can be evenly spaced in three dimensions within the rack 102 in accordance with industry standards.

[0033] An equipment chassis, such a chassis 106 having a width that is compatible with the width of the rack 102 can be installed into the rack 102. A typical chassis will be a rectangular shape box having four corners and a defined length 172. The chassis 106 can be mounted into the rack 102 in accordance with acceptable standards by securing the chassis 106 to the rack 102 near the four corners of the chassis 106. Holes in a faceplate 105 of the chassis 106 can also be spaced according to the industry standard such that holes 103 in the vertical members 154-160 can interface with the holes in the face plate 105. Prior to installing the equipment chassis 106 in the rack 102, mounting rail 108 can be installed between front vertical member 154 and rear vertical member 158. Likewise mounting rail 110 (partially obstructed by chassis 106) can be installed between front vertical member 156 and rear vertical member 154. Each mounting rail can have a first end that is connected at the front of the rack 102 and a second end that is connected at the rear of the rack 152 respectively.

[0034] An unpopulated mounting system is also depicted where mounting rail 109 is installed between front vertical member 154 and rear vertical member 158, and mounting rail 111 is installed between front vertical member 156 and rear vertical member 160. Mounting rails (108-111) can be secured to holes 103 in the vertical members 154-160 with screws and nuts. After mounting rails 108 and 110 are configured in the rack 102, then chassis 106 can be inserted into the rack 102. The mounting rails 108-110 can have a guiding mechanisms such as sliding surfaces 114 (a horizontal surface) and a vertical surface to guide the chassis in the rack 102 during installation. The sliding surfaces 114 can support the weight of the chassis 106, as the chassis 106 is slid into the rack 102 and the vertical surfaces can guide the chassis 106 in relation to the left side 168 to the right side 170 as the chassis 106 is inserted into the rack 102.

[0035] As stated above, chassis of many different sizes can be installed into the rack 102 and chassis having different lengths traditionally pose a significant problem for installers of rack mountable equipment. As illustrated, chassis 106, when fully installed into the rack 102 may not extend to the rear vertical members 158 and 160 of the rack 152 such that the chassis 106 cannot be secured directly to the rear vertical members 158 and 160. If a rear portion of the chassis 106 is left unsupported, the chassis 106 will dangle, cantilevered from the attach points at the front panel or faceplate 105. Significant problems can result from such an incomplete or deficient installation.

[0036] In accordance with the present disclosure, self-locating fasteners 115 and 113 can be mounted on a track that is secured to the rails 108 and 110 such that the

self-locating fasteners **115** and **113** can slide in relation to the rails **108** and **110**. Mating fasteners **124** and **123** can be connected to the chassis **106** proximate to the rear corners of the chassis **106** such that when the chassis **106** is inserted into the rack **102**, the mating fasteners **124** and **123** can engage self-locating fasteners **115** and **113** respectively.

[0037] In one embodiment mating fasteners **124** and **123** can protrude from the rear of the chassis **106** such that during installation of the chassis **106** into the rack **102** mating fastener **124** and mating fastener **123** can be inserted into self-locating fastener **115** and **113** respectively, and as the chassis **106** is further inserted, the mating fasteners **124** and **123** can push the self-locating fasteners **115** and **113** towards the rear of the rack **152**. Self-locating fasteners **115** and **113** can be slidably mounted on the mounting rails **108** and **110** and when the chassis **106** is inserted into the rack **102** the sliding surfaces **114** and the side plates **114** can align the mating fasteners **124** and **123** such that they engage with the self-locating fastener **115** and **113**.

[0038] The distance between the bottom of the chassis **106** and the mating fasteners **124** and **123** can be approximately equal to the dimension between the sliding surface **114** and the self-locating fastener, **115** and **113**, such that when the chassis **106** slides on sliding surface **114** as the chassis **106** is pushed into the rack **102**, the mating fasteners **124** and **123** will automatically engage with the self-locating fastener **115** and **113**.

[0039] After engagement of the mating fasteners **124** and **123** with the self-locating fasteners **115** and **113**, the chassis **106** can be slid to its final position and during this chassis installation process, the self-locating fasteners **115** and **113** can slide towards the rear of the rack **152** to accommodate chassis of different lengths or depths. Generally, the self-locating fasteners **115** and **113** can be rigid members that catch, hold, or grip rigid fasteners on the chassis **106** to prevent the chassis **106** from moving in an undesirable direction.

[0040] Referring to FIG. 2 an orthogonal view of an alignment of individual mounting components is depicted. Generally, a sliding fastener **215**, a track **232** for slidably securing the sliding fastener **215** to a rail **246** and a mating fastener **224** that can engage the sliding fastener **215** are depicted. Thus, as stated above, when a chassis **206** (shown as a small cut away portion) is slid into a rack, the mating fastener **224** can engage self-locating fastener **215** and self-locating fastener **215** can move along the track **232** towards a rear of the rail **246**. When the mating fastener **224** is engaged with the self-locating fastener **215**, and the chassis **206** is fully inserted, the sliding fastener **215** can secure the back of the chassis **206** from moving up and down.

[0041] The track **232** can be formed by an upper flange **238** and a lower flange **240** that extend outward from the rail **246** and form a channel or a track allowing a portion of the self-locating fastener **215** to slide between a portion of the flanges **238** and **240** and the rail **246** to slidably securing the self-locating fastener **215** to the rail **246**. The flanges **238** and **240** can be fastened to the rail **246** with rivets **228** or they could be spot welded to the rail **246**. The self-locating fastener **215** can secure a press nut **234** that will align with a hole **236** in chassis **206** when the chassis **206** is installed in the mount.

[0042] In the embodiment illustrated, the mating fastener **224** is a “blade” shaped member and the self-locating fasteners **215** is a “U” shaped member configured to accept the blade shaped mating fastener **224**. In another embodiment any type of fastener such as a protrusion, a tongue, a tab, or a pin can be placed on the chassis **206** and the self-locating fastener **215** could have a hole, a recesses or a groove to engage the mating fastener **224**. In other embodiments the mating fastener **224** could be the recess, hole or groove and the self-locating fastener **215** could have the protrusion to engage the recess. A tab **241** can be configured on the self-locating fastener such that spring **242** can be secured to the tab **241** to bias the self-locating fastener **215** towards the front of the rack or to a side of the rack where the chassis **206** will be inserted.

[0043] Referring to FIG. 3, an orthogonal view of a portion of a surface that faces a chassis in a rack equipment mounting system **310** is illustrated. A typical rack mount installation for a single piece of electronic equipment will include two equipment mounting brackets, only one of which is illustrated in FIG. 3. The equipment mounting system can include a vertical retaining member or a side plate **323** and a horizontal surface or a sliding surface **320** that facilitates alignment of a chassis during installation of the chassis into a rack. Such surfaces allow a self-locating fastener **312** receiver to properly engage a mating fastener on a chassis (not shown). The self-locating fastener receiver **312** can slide along the length of rail **310** to accommodate chassis having different lengths as the chassis is inserted into the rack. The self-locating fastener receiver **312** can have a beveled edge **313** such that as the mating fastener approaches the self-locating fastener receiver **312**, the mating fastener can be guided into, and secured by, the self-locating fastener receiver **312**.

[0044] A slot **318** can be provided in the side plate **323** such when the self-locating fastener receiver **312** slides to adjust for the length of a chassis inserted into the rack, a hole **314** in the self-locating fastener receiver **312** can be accessed on the chassis side of the rail **310**. Such access can be achieved regardless of the position of the self-locating fastener receiver **312** on the track. Thus, after a chassis is fully installed, a screw can be placed through a chassis (not illustrated), through the slot **318** and into the hole **314** of the self-locating fastener receiver **312** to secure the chassis and the self-locating fastener receiver **312** in the appropriate location.

[0045] Referring to FIG. 4, an orthogonal view of a portion of a mounting system **410** with a chassis **428** secured to a mounting rail **414** is provided. The mounting rail **414** has a sliding surface **420**, a side plate **422** and a slot **418** in the side plate **422**. As an electronic equipment chassis **428** is slid into position, the fastener **424** on the chassis **428** can force the self-locating fastener receiver **412** towards the rear of the mounting rail **414**. Thus, as the chassis **428** is slid into its final position, the self-locating fastener receiver **412** can slide along the mounting rail **414** with the chassis **428**. The self-locating fastener receiver **412** can have a hole (covered in FIG. 4) that tracks along the slot **418** as the self-locating fastener receiver **412** slides along the mounting rail **414**.

[0046] After the front panel of the chassis **428** engages the front of the rack, the face plate can be secured to the rack. Then, the rear of the chassis **428** can be secured by placing

a threaded fastener **426** such as screw through the chassis **428**, the slot **418** and, the self-locating fastener receiver **412** and into a nut possibly retained by the self-locating fastener receiver **412**. In the embodiment illustrated, a screw with “wings” or ears is depicted such that fingers can be utilized to tighten the screw, eliminating the need for special tools to install and remove an equipment chassis from the rack. However, in other embodiments a standard screw or a bolt could be utilized.

[0047] Referring to FIG. 5, a more detailed orthogonal illustration of an equipment mounting bracket system **510**, having a self-locating fastener receiver **514** is illustrated. The view provided in FIG. 5 is of a side of a mounting rail **522** that faces away from an equipment chassis **528**, when the chassis **528** is installed into the rack. The system **510** can include a track **532** which confines the self-locating fastener receiver **514** such that the self-locating fastener receiver **514** can slide in a linear relationship to a mounting rail **522**.

[0048] The equipment chassis **528** can have a fastener **524** attached to a rear corner of the equipment chassis **528**. As the chassis **528** is installed into the rack, the fastener **524** of the chassis **528** can engage self-locating fastener receiver **514**. The self-locating fastener receiver **514** can be retained by the track **532** as it slides along the mounting rail **522**. The self-locating fastener receiver **514** can be spring loaded in a forward position by extension spring **530**. Nut **534** on self-locating fastener receiver **514** can be utilized to secure the chassis **528** to the rail **522** with a threaded fastener when the chassis **528** is fully inserted into the rack.

[0049] Referring to FIG. 6, a flow diagram for manufacturing a rack equipment mounting device is provided. As illustrated by block **602**, a front mount can be created on a first end of a rail. The front mount can be made to engage with a vertical support in a rack. The front mount of the rail can be made by bending a right angle on a first end of the mounting device and creating holes in the front mount that will engage the vertical support members.

[0050] As illustrated in block **604**, a rear mount can be created by forming a right angle on a second end of the rail wherein the second end of the rail is at an opposite end of the rail than the first end of the rail. The rear mount can be created such that it can be secured to a rear vertical member in the rack.

[0051] A track can be formed on the rail, as illustrated in block **606**. The track can be bent from a piece of sheet steel such that the track can retain a self-locating fastener receiver. The self-locating fastener receiver can slide along the track of the rail to secure chassis of different lengths when fully installed in the rack. The track could be formed as a separate piece and secured to the rail with rivets or another securing method such as spot welding. The self-locating fastener receiver can be formed from 1.6 mm thick steel sheet. The fastener could be 35 mm wide by 42 mm tall. The mating fastener or fastener that engages the self-locating fastener receiver can also be made from 1.6 mm thick material and can be approximately 40 mm in length by 20 mm in width.

[0052] As illustrated in block **608**, the self-locating fastener receiver can be secured by the track such that the self-locating fastener receiver can slide along the rail when a force is applied to the fastener. A spring can be attached

between the rail and the self-locating fastener receiver such that the self-locating fastener receiver is biased towards the first end of the rail as is illustrated by block **610**.

[0053] The sliding self-locating fastener receivers can “float” in the track such that manufacturing tolerances do not cause significant problems. The rails can be manufactured in different dimensions such that the rails can secure equipment chassis having varying depths and the rails can be installed in racks having different dimensions between the vertical rails.

[0054] Referring to FIG. 7 a flow chart of a method to assemble a piece of electronic equipment into a rack is provided. As illustrated in block **702** a first rail having a fastener receiver can be assembled into an equipment rack, and as illustrated in block **704** a second rail having a fastener receiver can be assembled into the equipment rack. A piece of electronic equipment with fasteners can be installed into the rack as illustrated by block **706**.

[0055] As the chassis is installed into the rack each fasteners on the chassis can engage the fastener receivers on the first and second rail as illustrated by block **708**. As the chassis is slid into the rack the fastener receivers can slide along the rails with the fasteners as illustrated in block **710**. The rear of the chassis can be secured to the fastener receivers and the rail as illustrated in block **712**.

[0056] Another embodiment is implemented as a program product for implementing a design simulation to simulate one or more of the methods and arrangements described with reference to FIGS. 1-7. The program(s) of the program product defines functions of the embodiments (including the methods described herein) and can be contained on a variety of data and/or signal-bearing media. Illustrative data and/or signal-bearing media include, but are not limited to: (i) information permanently stored on non-writable storage media (e.g., read-only memory devices within a computer such as CD-ROM disks readable by a CD-ROM drive); (ii) alterable information stored on writable storage media (e.g., floppy disks within a diskette drive or hard-disk drive); and (iii) information conveyed to a computer by a communications medium, such as through a computer or telephone network, including wireless communications. The latter embodiment specifically includes information downloaded from the Internet and other networks. Such data and/or signal-bearing media, when carrying computer-readable instructions that direct the functions, represent embodiments.

[0057] In general, the routines executed to implement the embodiments, may be part of an operating system or a specific application, component, program, cell, object, or sequence of instructions. The computer program of the present invention typically is comprised of a multitude of instructions that will be translated by a computer into a machine-readable format and hence executable instructions. Also, programs are comprised of variables and data structures that either reside locally to the program or are found in memory or on storage devices. In addition, various programs described hereinafter may be identified based upon the application for which they are implemented in a specific embodiment of the invention. However, it should be appreciated that any particular program nomenclature that follows is used merely for convenience, and thus embodiments should not be limited to use solely in any specific application identified and/or implied by such nomenclature.

[0058] It will be apparent to those skilled in the art having the benefit of this disclosure that the present invention contemplates methods and arrangements to adjust a duty cycle of a clock signal. It is understood that the form of the invention shown and described in the detailed description and the drawings are to be taken merely as examples. It is intended that the following claims be interpreted broadly to embrace all the variations of the example embodiments disclosed.

[0059] Although the present invention and some of its advantages have been described in detail for some embodiments, it should be understood that various changes, substitutions and alterations can be made herein without departing from the spirit and scope of the invention as defined by the appended claims. Although an embodiment of the invention may achieve multiple objectives, not every embodiment falling within the scope of the attached claims will achieve every objective. Moreover, the scope of the present application is not intended to be limited to the particular embodiments of the process, machine, manufacture, composition of matter, means, methods and steps described in the specification. As one of ordinary skill in the art will readily appreciate from the disclosure of the present invention, processes, machines, manufacture, compositions of matter, means, methods, or steps, presently existing or later to be developed that perform substantially the same function or achieve substantially the same result as the corresponding embodiments described herein may be utilized according to the present invention. Accordingly, the appended claims are intended to include within their scope such processes, machines, manufacture, compositions of matter, means, methods, or steps.

What is claimed is:

1. An equipment mount comprising:

a rail securable in a rack perpendicular to vertical members in the rack, the rail having a first end and a second end;

a track disposed between the first end of the rail and the second end of the rail;

a self-adjusting fastener slidable on the track and adapted to receive a mating fastener coupled to an equipment chassis during insertion of the equipment chassis into the equipment rack; and

a spring coupled to the self-adjusting fastener and to the rail such that the self-adjusting fastener is biased towards the first end of the rail and, as the chassis is inserted into rack, the self-adjusting fastener slides towards the second end of the rail.

2. The equipment mount of claim 1 further comprising:

a second rail securable in a rack perpendicular to the vertical members in the rack, the rail having a first end and a second end;

a second track disposed between the first end of the rail and the second end of the rail; and

a second self-adjusting fastener slidable on the second track and adapted to receive a second mating fastener coupled to the equipment chassis during insertion of the equipment chassis into the equipment rack.

3. The equipment mount of claim 1 further comprising a sliding surface coupled to the rail.

4. The equipment mount of claim 1 further comprising a side plate coupled to the rail.

5. The equipment mount of claim 4 further comprising a slot in the side plate.

6. The equipment mount of claim 5 further comprising a hole in the self-adjusting fastener such that as the hole in the self-adjusting slides towards the rear of the rail the hole slides along the slot.

7. The equipment mount of claim 1 further comprising a nut coupled to the self-adjusting fastener and adapted to secure a threaded fastener.

8. The equipment mount of claim 7 wherein the chassis has a hole and wherein the threaded fastener in the hole and the nut secures the chassis to the rail.

9. The equipment mount of claim 1 wherein the mating fastener comprises a protrusion that engages a recess in the self-adjusting fastener.

10. The equipment mount of claim 1 wherein the self-adjusting fastener comprises a protrusion that fits into a recess of the mating fastener.

11. The equipment mount of claim 1 wherein the mating fastener comprises one of a blade, a pin, a tongue, and a tab.

12. The equipment mount of claim 1 wherein the self-adjusting fastener comprises one of a groove, a slot, and a hole.

13. An equipment mounting system comprising:

a first rail mounted horizontally between a first and second vertical member in an equipment rack, the first rail having a first track;

a second rail mounted horizontally between a third and fourth vertical member in the equipment rack, the second rail having a second track; and

a first fastener receiver slidably coupled to the first track and adapted to engage a rear of a mountable chassis when the mountable chassis is inserted into the rack and to slide along the first track as the chassis is moved into a mounting position.

a second fastener receiver slidably coupled to the second track and adapted to engage the rear of a mountable chassis when the mountable chassis is inserted into the rack and to slide along the second track as the chassis is moved into the mounting position.

14. The equipment mounting system of claim 13 further comprising a spring coupled between the first rail and the first fastener receiver to bias the fastener receiver in a first position.

15. The equipment mounting system of claim 13 further comprising a sliding surface coupled to the first rail and a side plate coupled to the first rail to align the first fastener receiver with a fastener on the chassis when the chassis is slid into the rack.

16. The equipment mounting system of claim 13 further comprising a second sliding surface and a second side plate coupled to the second rail to align the second fastener receiver with a mating fastener on the chassis when the chassis is slid into the rack.

17. A method of configuring equipment in a rack comprising:

aligning an equipment chassis within a rack utilizing rails in the rack, the equipment chassis having fasteners and the rails having slidable fastener receivers;

engaging the fastener receivers with the fasteners;

sliding a fastener receiver towards a rear of the rack to as the fastener is engaged with the fastener receiver; and

securing the equipment chassis to the rack, wherein securing the rear of the equipment chassis to the rail with the fastener receivers secures the equipment chassis to the rack.

**18.** The method of claim 17 further comprising fastening a front panel of the equipment chassis to the rack.

**19.** The method of claim 17 further comprising securing a threaded fastener from the fastener receiver to the equipment chassis.

**20.** The method of claim 17 wherein sliding further comprises sliding the equipment chassis on a sliding surface.

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