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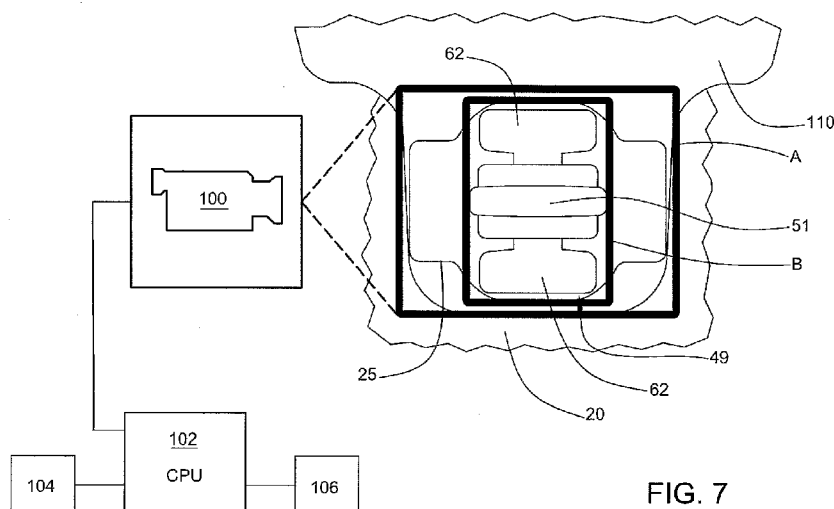


FIG. 7

(57) Abstract: A system is disclosed for verification of the installation of a component such as a side curtain air bag into a vehicle passenger compartment where energy absorbing quarter-turn fasteners attached to the air bag are employed to affix hanger brackets to structural base plates in the vehicle. The system includes an image capturing camera, stored data in a machine readable form of an acceptable installation, a central processing unit to compare the captured images to the stored machine readable data and an output generator to create an output signal based on the results of the comparison.

ROTATABLE FASTENER VERIFICATION

Cross-Reference to Related Applications

[0001] This application claims priority pursuant to Title 35 USC § 119(e) to U.S. Provisional Application Serial No. 61/738,143, filed December 17, 2012, for "Rotatable Fastener Verification," the entire content of the specification and drawings of which are hereby incorporated by reference herein as if fully set forth.

Background

[0002] This disclosure relates to utilization of energy absorbing rotatable locking fasteners. More particularly, it relates to use of energy absorbing rotatable locking fasteners for installation of curtain air bags in vehicles and to a system for verification of the installation of such fasteners during an assembly process.

[0003] Rotatable, energy absorbing, fasteners have been successfully employed in assembly processes involving installation of accessory equipment. One known application is the installation of curtain airbags into automotive vehicles.

[0004] Typically a suitable fastener for securement of a curtain air bag is a unitary plastic and metal structure insertable through appropriately formed apertures in an air bag retention tab and a vehicular body plate and rotatable ninety degrees (90°) to secure the tab to the vehicle. The fastener includes energy absorbing structure that absorbs energy of air bag deployment to minimize potential damage to the vehicular components.

[0005] Such fasteners possess numerous desirable features that make them particularly suitable for use. The rotatable fastener is easily inserted into the airbag tab and similarly inserted into a base plate on the vehicle frame. It is easily rotated to lock it into position to secure the airbag tab to the frame. Moreover, current designs of quarter-turn fasteners incorporate energy absorbing characteristics which absorb the energy of airbag deployment and minimize structural damage to the vehicle frame.

[0006] One such fastener is disclosed in International Publication No. WO 2012/129471 A2 published September 27, 2012 entitled "Verification Arrangement for Fastener System" the entire content of the specification and drawings of which are hereby incorporated by reference herein as if fully set forth.

[0007] While the fasteners described herein, and in the identified International Application, are particularly suited for assembly of curtain airbags into the frame of an automotive vehicle, it is contemplated that such fasteners, and consequently the systems of this disclosure have wide application in assembly processes involving installation of a component. Though described and illustrated in connection with vehicular assembly, the fastener and the verification system may be employed wherever the features of the fasteners provide a desirable advantage.

[0008] As disclosed in the above identified WO Publication No. 2012/129471, the use of quarter-turn fasteners as described for installation of curtain air bags renders the assembly process suitable to effective and efficient verification of satisfactory completion of the installation process. This capability is a desirable advantage to the OEM manufacturer and augments the desirability and usefulness of the quarter-turn fastener. The present disclosure provides an efficient and effective verification capability, using image capturing recognition, evaluation and acceptance of the assembly process employing the quarter-turn energy absorbing fastener.

Description of the Drawings

[0009] Fig. 1 is an exploded perspective view of an energy absorbing rotatable fastener employed in attachment of a component to a base plate;

[0010] Fig. 2 is a rear perspective view of the fastener of Fig. 1;

[0011] Fig. 3 is a front perspective view of the fastener of Fig. 1;

[0012] Fig. 4 is a rear perspective view of the base plate of Fig. 1 to which a component is being attached employing the fastener of Fig. 1 with the fastener in its initial insertion position;

[0013] Fig. 5 is a rear perspective view of the base plate of Fig. 1 to which a component is being attached employing the fastener of Fig. 1 with the fastener in its rotated and locked, energy absorbing position;

[0014] Fig. 6 illustrates a typical installation of a side curtain air bag into the interior of a vehicle employing energy absorbing quarter-turn fasteners;

[0015] Fig. 7 is a schematic of the verification system of the present disclosure utilizing machine vision to verify installation and proper completion of the assembly process using quarter-turn fasteners.

[0016] Fig. 8 illustrates an assembly verification system in accordance with the present disclosure utilizing fixed position camera arrangement.

[0017] Fig. 9 illustrates a modification to the structure of the components of the installation to augment verification capabilities.

Detailed Description of the Illustrated Embodiments

[0018] Fig. 6 is illustrative of the installation of a side curtain air bag in an automotive vehicle. The curtain air bag assembly 10 includes a rolled inflatable fabric 12 supported by a plurality of hanger brackets 25 affixed in spaced intervals to the air bag fabric 12 and secured in spaced intervals to a vehicular base plate 20 within the vehicle passenger compartment. An energy absorbing, quarter-turn fastener 49 secures each hanger to base plate 20. In Fig. 6, three fastener hanger bracket connections are shown. However, each side curtain air bag installation may include as many such connections of the curtain air bag to the vehicle interior structure as necessary to support it within the vehicle.

[0019] In the attachment arrangement of the present disclosure, hanger brackets 25 are steel structural members. Energy absorbing rotatable fasteners are employed to affix the hanger brackets 25 in spaced intervals to the base plate 20, which is also a steel structural member,

integrated to the vehicle body. Notably, the vehicular base plate 20 is shown as a single panel to which all hanger brackets are connected. It is contemplated that separate base plates 20 may be utilized for the hanger bracket-fastener combinations.

[0020] Fig. 1 shows a hanger bracket 25, a base plate 20, and a rotatable energy absorbing fastener 49. As illustrated, hanger bracket 25 includes a cruciform shaped hole 28 having a long slot and a short slot sized to receive an inserted portion of the fastener 49. Notably the hole 28 includes a tab 27 extending inward, in the direction of fastener insertion, at the opposite ends of the long slot of the cruciform shape.

[0021] The base plate 20 includes complimentary cruciform shaped hanger receptacle or hole 22 having an intersecting long slot and short slot to similarly receive the inserted portion of the fastener 49. Importantly, as best seen in Figs. 4 and 5, the distal ends of the long slot of hole 22 are shaped to receive the tabs 27 of the hanger bracket 25 on attachment of the hanger by the fastener 49. The engagement of tabs 27 fix the hanger bracket 25 against rotation relative to base plate 20.

[0022] Figs. 1 to 5 show an exemplary rotatable, energy absorbing fastener, generally referred to as a quarter-turn fastener, illustrated to secure a side curtain airbag to the roof rail of an automotive vehicle. This illustrated use is exemplary and not limiting. For example, the fastener can rotate more or less than ninety degrees as desired.

[0023] It should be understood that throughout this specification reference to "horizontal" and "vertical" is for clarity of description of the illustrations and not limitation. That is, fastener components could be oriented in any angular disposition relative to a longitudinal or vertical plane and the fastener configured and positioned accordingly. Also, longitudinally means along a line in the direction of insertion, transverse means perpendicular to that line. Forward or front, and rearward or back, is in reference to the direction of insertion of the fastener 49 into the receiving apertures 22 and 28. In this regard, front or forward is visible to the user or viewer and back or rearward is concealed.

[0024] Fastener 49 is configured to attach hanger bracket 25 to base plate 20 by insertion of a portion of the fastener through hole 28 in hanger bracket 25 and through hole 22 in base plate 20 followed by rotation of fastener 49 to a locked or secured position. When so positioned, the fastener securely affixes the hanger bracket 25 to base plate 20 and additionally provides energy absorbing capability to dissipate energy of airbag deployment.

[0025] Seen in Figs. 1 to 3, fastener 49 has a body elongate along an axis in the direction of insertion comprising a rear attachment portion 50 and a forward head portion 51 joined by a central shaft portion 52.

[0026] The head portion 51 defines an elongate grip 57 for manual manipulation. Radial wings 62 extend laterally from head portion 51. The wings 62 are configured to extend in the direction of insertion and upon contact with the front surface of hanger 27 deform to act as cantilever leaf springs to urge the fastener outward in the direction opposite the direction of insertion.

[0027] The attachment portion 50 is cruciform shaped and includes long bars 47 and short bars 44. The long bars include planar abutment surfaces 46 arranged to contact the rear surface of base plate 20 when fastener 49 is in the locked position. The long bars 47 comprise energy absorbing structure 54. Each bar 47 includes a series of voids 55 along its exterior edge which contribute to its energy absorbing characteristics. Each abutment surface 46 of long bar 47 includes a rearwardly directed lug 48 at its transversely inward end.

[0028] The short bars 44 include flexible fingers 43 best seen in Figs. 2, 4 and 5 extending toward head portion 51. The fingers 43 are spaced apart a distance somewhat longer than the length of the short slot of the cruciform hole 28 in hanger bracket 25. The outermost edges of the fingers 43 may be tapered to converge in the direction of insertion to assist in passage through the short slot of hole 28 in hanger bracket 25.

[0029] On insertion of the attachment portion 50 into the hole 28, the flexible fingers 43 are deformed toward each other to pass through the short slot. The fingers 43 surpass the hole 28

and spring laterally outward behind the rear surface of hanger bracket 25. At that position, the wings 62 are in contact with the front surface of the hanger bracket 25 and deformed sufficiently to urge the fastener 49 in the direction opposite the direction of insertion.

[0030] The fingers 43 abut the rear surface of hanger bracket 25 and retain the fastener on hanger bracket 25. Importantly, the fastener 49 and hanger bracket 25 may be preassembled by the manufacturer of the airbag for later installation into a vehicle by the vehicle manufacturer.

[0031] The fastener 49 includes a rigid core that extends between head portion 51 and attachment portion 50. The shell or cover surrounding the core is made of an energy absorbing material.

[0032] Installation of the curtain airbag assembly 10 into a vehicle is accomplished by insertion of fastener 49 on each hanger bracket 25 into a fastener receptacle hole 22 in a plate 20. The fastener 49 is inserted against the opposing force of wings 62 sufficiently for abutment surfaces 46 including rearward lugs 48 of long bars 47 to surpass the rear surface of base plate 20. The fastener 49 is rotated, such as by ninety degrees (90°) or one-quarter-turn, to align the short bars 44 with the long slots in base plate 20. On release of fastener 49, the restoring force imparted by the deformed wings 62 causes the short bars 44 to lodge within the long slots of base plate 20 arresting rotation of the fastener in its locked position. Also, the lugs 48 engage within the short slots of cruciform shaped aperture 22 of base plate 20 to further insure retention of the fastener 49 in its rotated, locked position with the energy absorbing bars 47 positioned behind the rear surface of base plate 20. In this position, the abutment surfaces 46 of long bars 47 are positioned against the rear surface of base plate 20 placing the energy absorbing structure of bars 54 in operative position.

[0033] Assurance that the fasteners employed to attach a component such as the curtain air bag hanger bracket to a vehicle base plate are properly inserted, and rotated to a locked, energy absorbing position, is an important aspect of this disclosure. In this regard, a verification system is illustrated in the present disclosure that employs an image capturing camera in conjunction with a central processing unit, connected to comparison data in the form of a machine readable

medium to confirm complete insertion of each fastener and placement into the locked, energy absorbing position. The system, of course, could be employed to verify the installation, utilizing energy absorbing rotatable fasteners, of any form of component.

[0034] Referring to Fig. 7, the equipment of the disclosed system includes one or more image capturing digital cameras 100, a central processing unit 102, data stored in a machine readable medium 104, and an output device 106. The system operates to compare image data received from the camera 100 with stored data of an image or images of an acceptable configuration within the machine readable medium 104. The central processing unit 102 compares one or more images of the configuration of the viewed installation captured by the image capturing camera 100 with the stored image or images in the stored data of the machine readable medium 104 to determine the condition of the installation being viewed. In the event of a negative determination, the central processing unit activates the output device 106. The output device 106 may signal a failure, or may take an action, such as to temporarily terminate the assembly process, or any other desired action. In the event of a positive determination the output device may provide any suitable acceptance signal.

[0035] The word "image" or "images" is used to refer to the data recorded by camera 100. It could comprise a single view of the entire installation, or it could include separately identifiable elements, such as the hanger bracket 25 or fastener 49, or any combination of the elements of the installation.

[0036] The system works by first taking one or more pictures of a known "good" assembly and using that as the basis to digitally compare assemblies in production for verification. This baseline data, stored in a machine readable medium 104 could include the presence, position and location of the fastener 49 and hanger bracket 25 as assembled to base plate 20. In this regard the camera 100 may capture separate images, for example, of the hanger bracket 25 (Image A, Fig. 7) or fastener 49 (Image B, Fig. 7) to make the requisite comparisons to the stored data of the machine readable medium 104 and supply separate images to the central processing unit. Alternatively, the captured image may include the entire installation.

[0037] During verification, the central processing unit compares distinct features of the assembled components received from camera 100 to the stored data base of an acceptable, "good" assembly to assess the condition of the viewed assembly. Recognition of completion of a proper installation results in an appropriate output signal. Similarly, recognition of a flawed installation results in an appropriate output signal denoting a failure.

[0038] Fig. 7 shows fully inserted fastener 49 rotated to its locked energy absorbing position attaching a hanger bracket 25 to a base plate 20. In this position, the grip 57 extends horizontally and the wings 62 are disposed transversely on either side vertically of the grip.

[0039] A sensor in the form of an image capturing camera 100 is shown schematically in Fig. 7. It is utilized to view the fastener 49 and environment including the fastener 49, hanger bracket 25 and base plate 20. Camera 100 captures the image then stored in the form of machine readable data in a machine readable medium 104 for processing by the central processing unit 102. It may view the hanger bracket 25, fastener 49 separately as image A and image B, or collectively as a single image.

[0040] The central processing unit makes a comparison of the images received with a stored image of an acceptable installation. On recognition of a completed assembly, as illustrate in Fig. 8, the central processing unit will acknowledge a complete and satisfactory installation (PASS). For example, the image sensing camera 100 will check for the presence of hanger bracket 25 and the presence and orientation of fastener 49. If the condition illustrated in Fig. 7 is present, the system will accept the installation.

[0041] The chart below is illustrative of some of the capabilities of the verification system. It identifies various conditions of the installation that may be recognized by the image capturing camera 100 and indicates the resultant output signal from the output device 106.

Condition Recognized	Result
Fastener missing	Fail
Hanger missing	Fail
Fastener not fully installed in hanger	Fail
Fastener turned in hanger	Fail
Fastener not fully pushed in vehicle	Fail
Fastener not turned in vehicle	Fail
Fastener only partially turned in vehicle	Fail
Fastener turned too far in vehicle	Fail
Fastener missing from curtain	Fail
Hanger missing (not installed)	Fail
Fastener not fully installed in hanger	Fail
Fastener turned in hanger prior to assembly to body	Fail
Fastener turned in hanger (as above) but operator tries to align fastener and curtain to body hole by rotating whole curtain assembly	Fail

[0042] In using the system of the present disclosure, it is contemplated that a vision system image capturing camera 100 may be placed, for example, at a verification station adjacent an automotive assembly line designated 107 carrying advancing, partly assembled vehicles 108. In this exemplary arrangement, an image capturing camera 100 is located at a fixed station adjacent the advancing vehicles. Camera 100 is arranged to view, for example, the interior of the vehicle at the location illustrated in Fig. 6, the location of the area above the window openings where installation of a component, illustrated as side curtain air bag 10 has been made using energy absorbing quarter-turn fasteners 49. As a vehicle advances, camera 100 gathers information through image capture for comparison to data representative of a proper installation stored in the machine readable medium 104, including the presence of, and relative positions of, the fastener 49 and hanger brackets 25.

[0043] The stored data can also include information concerning the number of fasteners 49 representing a complete installation. On such comparison, the central processing unit will provide a "pass" signal, or in instances of some form of recognized anomaly indicate a "fail" signal. The output device may also initiate action to temporarily pause the assembly process.

[0044] As an alternative, it is also contemplated that an image capturing camera 100 could be mounted on a robotic arm for insertion and inspection of the interior of each vehicle being assembled as it passes the verification station.

[0045] Vision recognition hardware and software is commercially available. One source contemplated for supply of equipment useful in carrying out the verification process disclosed herein is Cognex Corporation, Plymouth, MI.

[0046] Another variation on the capability of component installation verification utilizing image capture is illustrated in Fig. 9. Here there is disclosed an installation of a curtain air bag assembly 110 supported upon a hanger bracket 125 utilizing an energy absorbing fastener 149 having the functional elements as described in connection with Figs. 1 to 5. The installation to be verified includes a curtain air bag assembly 110, in which a plurality of hanger brackets 125 support a rolled air bag fabric 112.

[0047] As illustrated in Fig. 9, energy absorbing rotatable fastener 149 secures the hanger bracket 125 to the vehicle at base plate 120. It is contemplated that the hanger bracket 125 and base plate 120 include cruciform shaped slots such as the slots 28 and 20 described in connection with the installation illustrated in Figs. 1 to 5. Hanger bracket 125 includes reference indicia comprising a pair of generally horizontally elongate slots 126, one on either side of the center slot in the center of the hanger bracket (as in Fig. 1). Alternatively, slots 126 may comprise upstanding horizontally elongate protrusions.

[0048] Fastener 149 is configured essentially the same as the fastener 49 of Figs. 1 to 5. It includes a forward head portion 151 shaped somewhat differently than the forward head portion of the fastener 49 of the earlier embodiment. In all other respects, it is structurally and

functionally the same as fastener 49. Head portion includes a central knob with diametrically opposed grips 157 and diametrically opposed cantilevered wings 162.

[0049] Each fastener 149 includes a reference indicia comprising a horizontally elongate projection 158 on each grip 157. The projections 158 could, however, optionally be depressions, or scribed lines.

[0050] As illustrated in Fig. 9, when the fastener 149 is inserted into hanger bracket 125 and base plate 120 and rotated ninety degrees (90°) to its locked energy absorbing position the elongate projections 158 are aligned generally parallel to the elongate slots or protrusions 126 on hanger bracket 125.

[0051] As previously described in connection with the embodiment of Figs. 1 to 5, when fastener 149 is in its locked energy absorbing position various structural elements prevent rotation from that position. Thus, when properly installed, the fastener 149 may rotate relative to hanger bracket 125 no more than four to six degrees (4° to 6°) angularly in either a clockwise or counter-clockwise direction. That is, a projection 158 on a grip 157 may converge toward, or diverge away from a slot or protrusion 126 on hanger bracket 125 by from four to six degrees (4° to 6°). Such rotation, could be recognized as a variance of the angular relationship, designated alpha (α) in Fig. 9, of projections 158 and slots 126.

[0052] The installation verification system disclosed is readily adapted to recognition of the relationship between the lines or projections 158 formed on the grips 157 and the slots or protrusions 126 formed on hanger bracket 125.

[0053] Referring to Fig. 6, in the alternative system contemplated here, camera 100 is arranged to capture the image of the fastener 149 and hanger bracket 125 including the relationship of the angular position of the lines or projections 158 to the holes or protrusions 126. The data stored within the machine readable medium 104 includes the information definitive of the limits of relative angular variance between the projections 158 and slots or slots 126 in a properly locked fastener 149. On comparison of the captured images to the stored data, central

processing unit 102 provides an output "pass" signal if the captured image shows that relationship between the acceptable limits. Should the angular relationship exceed the permissible movement of a locked fastener 149, relative to its associated hanger 125, the central processing unit would activate a "fail" signal from output device 106.

[0054] It is also contemplated that the image capturing system illustrated in Fig. 6 could be arranged to perceive, and take action based on the distance in the direction of insertion, for example from the outer surface of fastener 149 to the vehicle body plate 120. An acceptable distance relationship would be stored in the comparison data of machine readable medium 104 between those surfaces representative of a properly attached installation.

[0055] Variations and modifications of the foregoing are within the scope of the present invention. It is understood that the invention disclosed and defined herein extends to all alternative combinations of two or more of the individual features mentioned or evident from the text and/or drawings. All of these different combinations constitute various alternative aspects of the present invention. The embodiments described herein explain the best modes known for practicing the invention and will enable others skilled in the art to utilize the invention. The claims are to be construed to include alternative embodiments to the extent permitted by the prior art.

Claims

1. A verification system for the verification of the installation of a component having at least one hanger bracket to a base plate utilizing an energy absorbing, rotatable fastener,

wherein said hanger bracket and said base plate have an aperture for insertion therethrough of a portion of said fastener,

said fastener includes an attachment portion for engaging said base plate in an energy absorbing relation and a head portion for securing said hanger bracket to said fastener, when

said fastener is rotatable to a locked, energy absorbing, position after insertion of a portion thereof through said apertures in said hanger bracket and base plate;

wherein said system comprises:

an image capturing camera to capture an image of the installation of the component in machine readable form;

a machine readable medium including data representative of at least one hanger bracket attached to a base plate with an energy absorbing rotatable fastener rotated to its locked, energy absorbing position;

a central processing unit for receiving data from said image capturing camera and said machine readable medium;

said central processing unit for comparing said captured images to said representative data to determine the condition of said installation and deliver an output signal in response to said comparison.

2. A system as claimed in claim 1 wherein said captured image includes the presence of said hanger bracket and the presence of said fastener.

3. A system as claimed in claim 2 wherein said data in said machine readable medium includes the presence of said hanger bracket and said fastener and the comparison by said central processing unit includes recognition of the presence of said hanger bracket and fastener.

4. A system as claimed in claim 2 wherein said captured image includes the position of said fastener.

5. A system as claimed in claim 4 wherein said data in said machine readable medium includes the position of said fastener and the comparison by said central processing unit includes recognition of the position of said fastener.

6. A verification system as claimed in claim 1 wherein said output signal initiates a "pass" or "fail" output signal based on said comparison.

7. A verification system as claimed in claim 6 wherein said output signal initiates an action on a "fail" signal.

8. A verification system as claimed in claim 1 wherein the component includes a plurality of hanger brackets to be affixed to a base plate utilizing a plurality of energy absorbing rotatable fasteners, wherein

said image capturing camera captures images of said plurality of hanger brackets and fasteners, and

said machine readable medium includes data representative of a predetermined number of hanger brackets and fasteners, and

said central processing unit compares said captured image to said stored data and delivers an output signal in response to the number of hanger brackets and fasteners present in the image captured and the number of hanger brackets and fasteners in said stored data.

9. A verification system as claimed in claim 1 wherein said hanger bracket includes a cruciform shaped receptacle having an intersecting long slot and short slot;

said base plate includes a cruciform shaped hole having an intersecting long slot and short slot;

said rotatable quarter-turn fastener has an elongate body comprising:

a forward head portion;

an attachment portion including an energy absorbing portion, and

a central connecting portion;

said connection portion including a pair of oppositely directed energy absorbing bars, each defining a rearward abutment surface, and

wherein said attachment portion of said fastener is inserted through said long slots of said hanger bracket and said base plate and rotated ninety degrees (90°) to place said energy absorbing portion in an energy absorbing position relative to said base plate.

10. A verification system as claimed in claim 9 wherein said image capturing camera captures images of said forward head portion of said fastener and said machine readable medium includes stored data representative of said connection portion of said fastener when in said energy absorbing position and said central processing unit compares said captured image to said stored data to determine the condition of said installation.

11. A verification system as claimed in claim 10 wherein said image capturing camera captures images of said hanger bracket and said machine readable medium includes stored data representative of said hanger bracket and said central processing unit compares said captured image of said hanger bracket to said stored data of said hanger bracket to determine whether said fastener is in said energy absorbing position.

12. A verification system as claimed in claim 11 wherein said installation includes a plurality of said hanger brackets and fasteners and said camera captures images of said plurality of hanger brackets and fasteners and said central processing unit compares said captured image to said stored data to determine the condition of said installation.

13. A verification system as claimed in claim 12 wherein said output signal initiates a "pass" or "fail" output signal based on said comparison.

14. A verification system as claimed in claim 13 wherein said output signal initiates an activity on a "fail" signal.

15. A verification system as claimed in claim 1 wherein said hanger bracket includes a reference indicia and

wherein said fastener includes a reference indicia,

and wherein said machine readable medium includes data representative of a range of acceptable angular relationships between said indicia,

said image capturing camera of said system captures the angular relationship between said reference indicia of said hanger bracket and said reference indicia of said fastener,

and said central processing unit recognizes the relationship between said indicia and compares such relationship to said range of acceptable angular relationships and provides an output signal.

16. A verification system as claimed in claim 15 wherein said reference indicia on said hanger bracket comprises at least one elongate slot, and said reference indicia on said fastener includes at least one elongate projection and wherein said indicia of said hanger bracket and said fastener are generally parallel.

17. A verification system as claimed in claim 16 wherein the range of acceptable angular relationships between said indicia on said hanger bracket and on said fastener stored in said machine readable medium is an angular relationship of four to six degrees (4° to 6°) in either a clockwise or counterclockwise direction.

18. A method of verification of the installation of a component having at least one hanger bracket to a base plate utilizing an energy absorbing, rotatable fastener,

wherein said hanger bracket and said base plate have an aperture for insertion therethrough of a portion of said fastener,

said fastener includes an attachment portion for engaging said base plate in an energy absorbing relation and a head portion for securing said hanger bracket to said fastener, when

said fastener is rotated to an energy absorbing position after insertion of a portion thereof through said apertures in said hanger bracket and base plate; and

wherein said system comprises:

an image capturing camera to capture an image of the installation of the component;

a machine readable medium including data representative of at least one hanger bracket attached to a base plate with an energy absorbing rotatable fastener rotated to its energy absorbing position;

a central processing unit for receiving data from said image capturing camera and said machine readable medium;

said central processing unit capable of comparing said captured images to said representative data to determine the condition of said installation and deliver an output signal in response to said comparison;

said method comprising:

capturing an image using said image capturing camera,

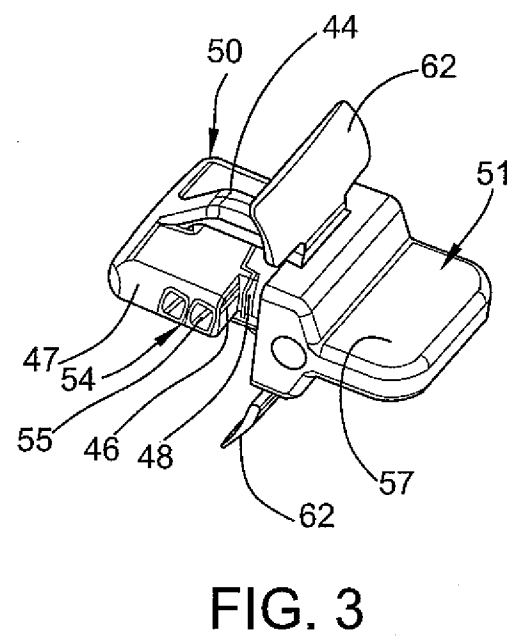
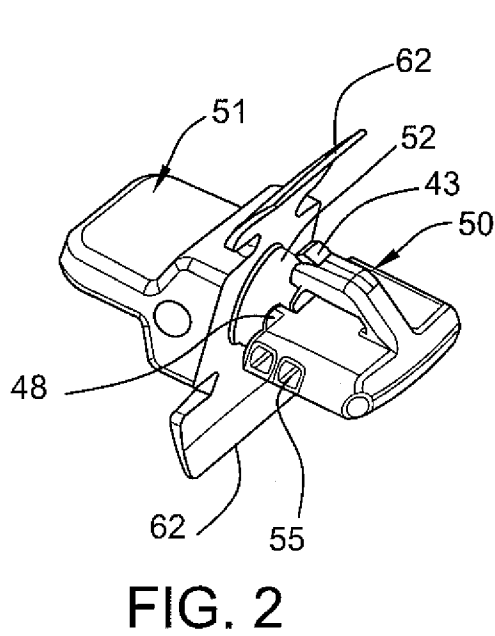
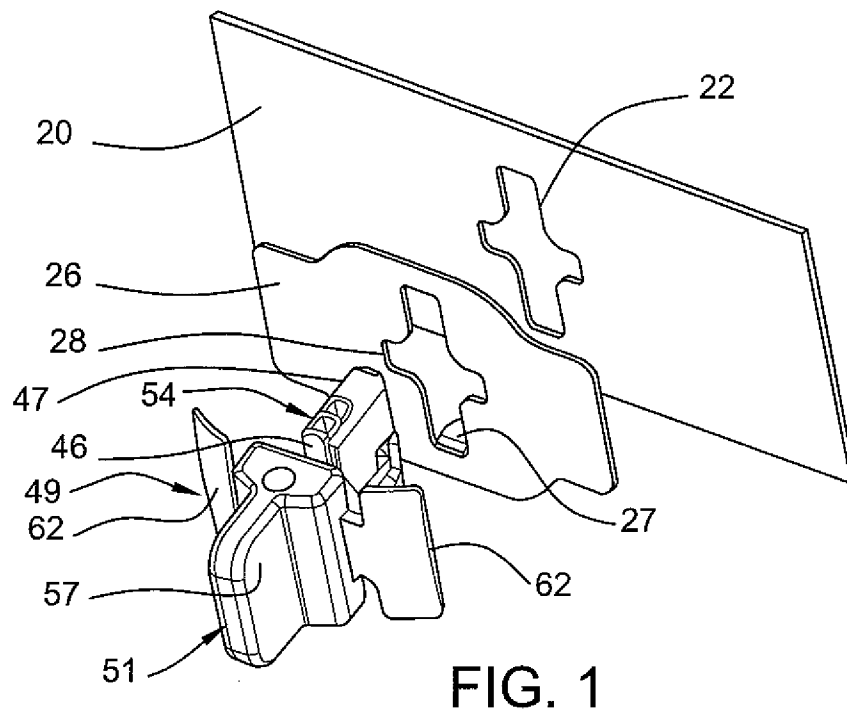
comparing said image to said data stored in said machine readable medium;

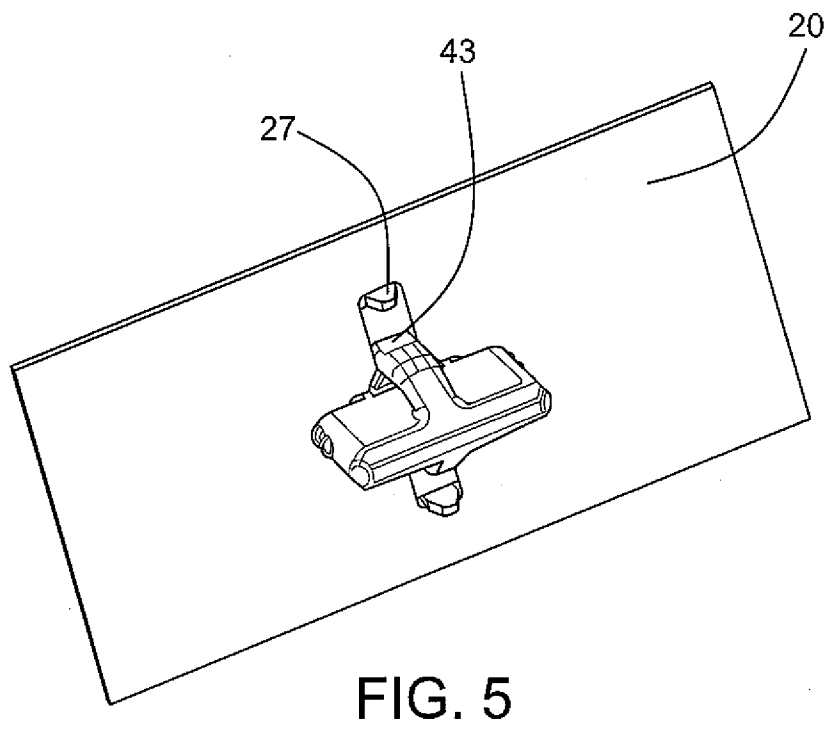
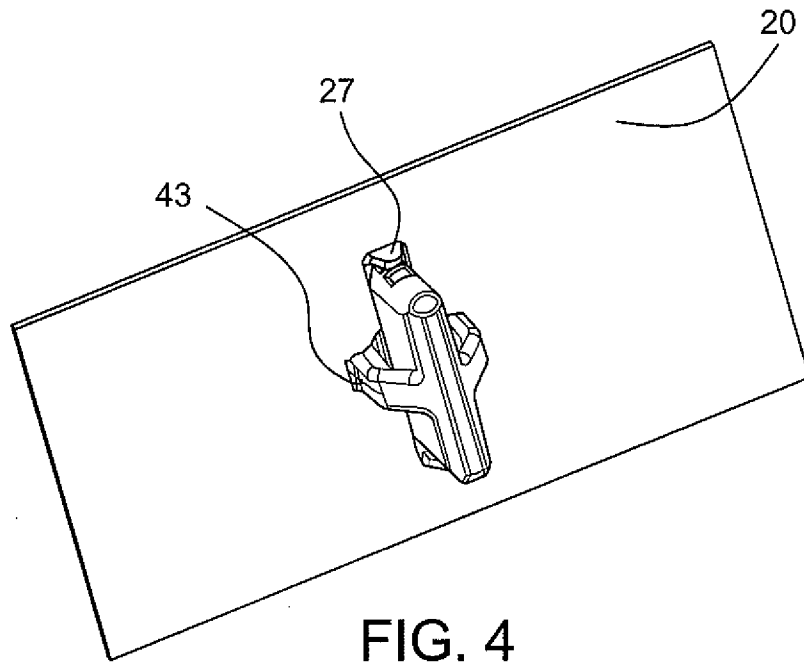
and providing an output signal.

19. A method for verification as claimed in claim 18 wherein said captured images and said data in said machine readable medium include separate images of said hanger bracket and said fastener.

20. A method for verification as claimed in claim 18 wherein said hanger bracket includes at least one reference indicia and said fastener includes at least one reference indicia, and

wherein said data stored in said machine readable medium includes data representative of an acceptable angular relationship between said reference indicia and wherein said image capturing camera captures an image of the angular relationship between said indicia, and said central processing unit compares said image of said angular relationship between said indicia to the data stored in said machine readable medium and provides an output signal based on such comparison.





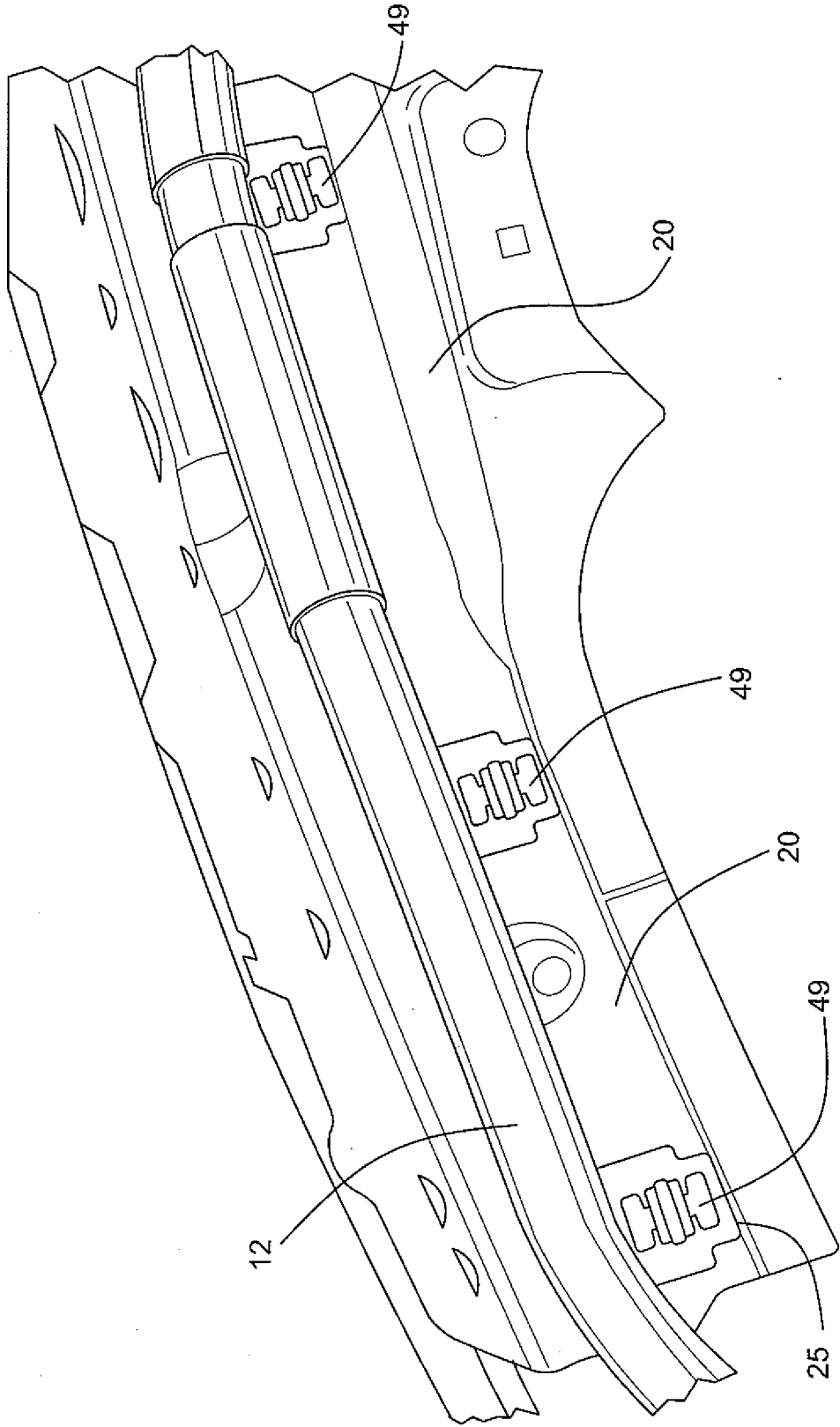


FIG. 6

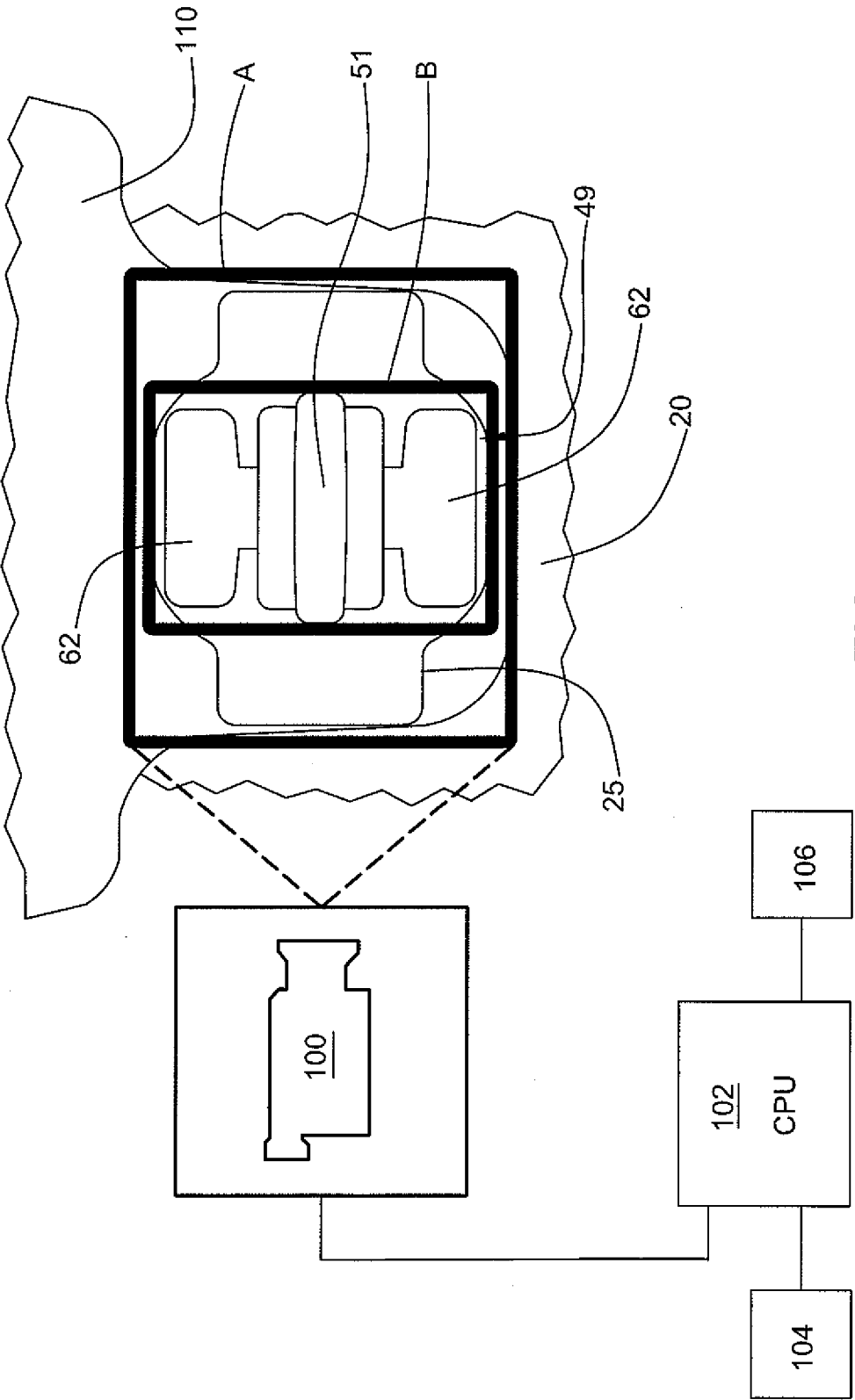


FIG. 7

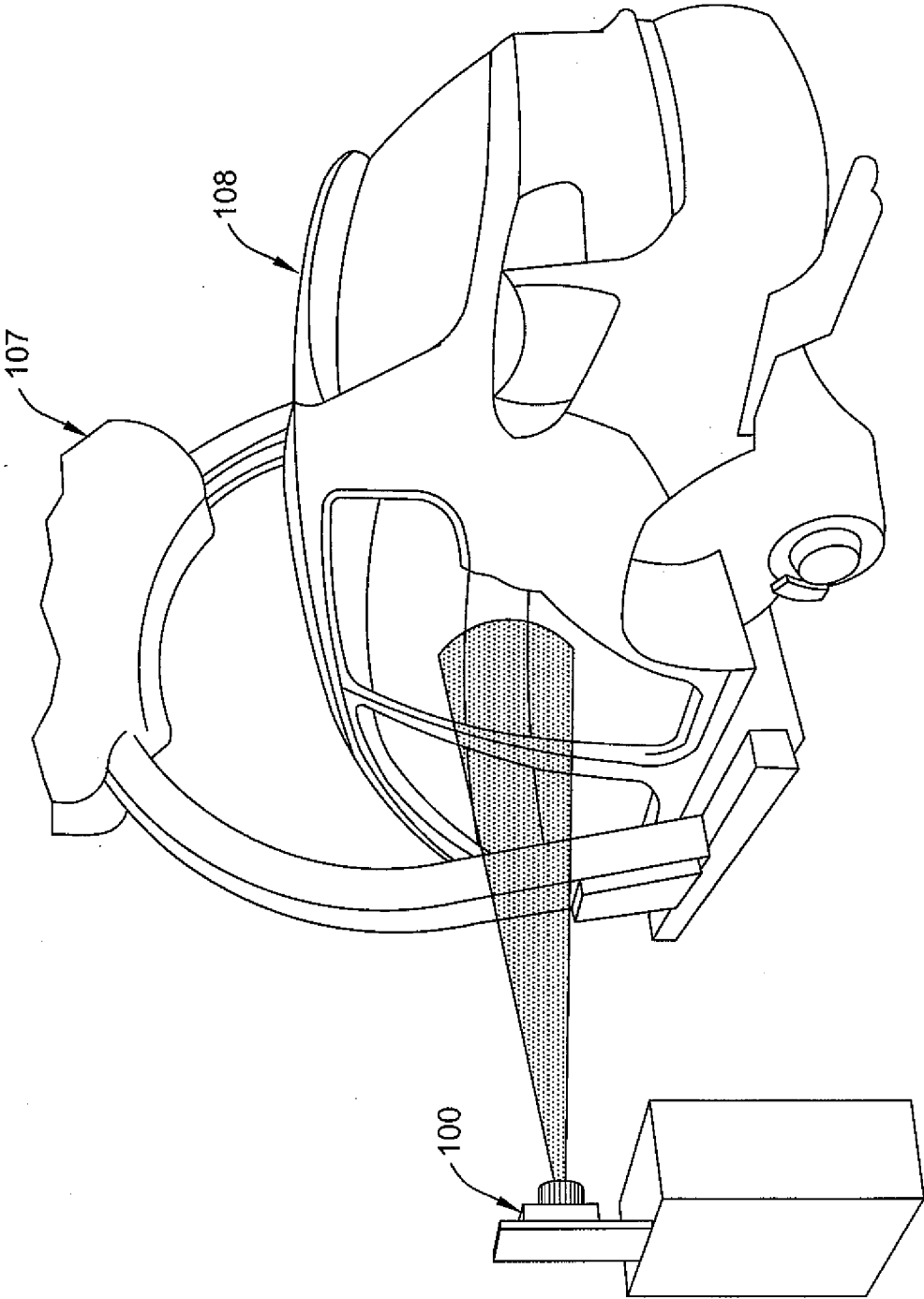


FIG. 8

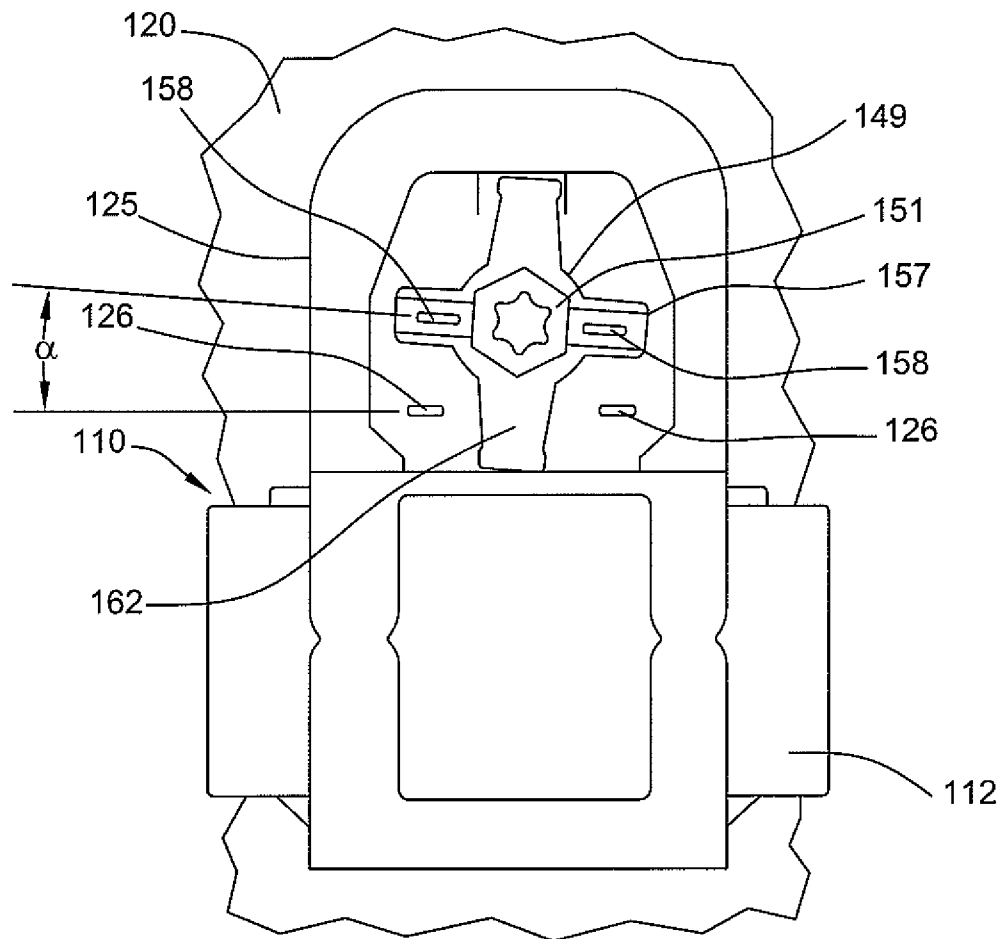


FIG. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/075204

A. CLASSIFICATION OF SUBJECT MATTER

INV. B60R21/213 B62D65/14 F16B21/02 B23P19/10 B25J9/16
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B60R B62D F16B G05B B23P B25J

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2012/129471 A2 (ILLINOIS TOOL WORKS [US]; EVERARD STEPHEN M [US]) 27 September 2012 (2012-09-27) cited in the application paragraph [0026] paragraph [0027] paragraph [0031] - paragraph [0035] figures 1,2,7-9	1-20
Y	EP 1 978 430 A1 (FORD GLOBAL TECH LLC [US]) 8 October 2008 (2008-10-08) paragraph [0018] - paragraph [0024] paragraph [0024] paragraph [0051] - paragraph [0056] ----- -/-	1-20



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

18 March 2014

Date of mailing of the international search report

27/03/2014

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/075204

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2007/158931 A1 (BAUMGARTNER PETER [DE] ET AL BAUMGARTNER PETER [DE]) 12 July 2007 (2007-07-12) paragraph [0086] paragraph [0106] - paragraph [0110] -----	1,18
A	WO 2012/144157 A1 (NIFCO INC [JP]; FUKUMOTO MITSURU [JP]) 26 October 2012 (2012-10-26) paragraph [0037] - paragraph [0038]; figures -----	1,18

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2013/075204

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2012129471 A2	27-09-2012	CN 103547818 A	29-01-2014
		EP 2689150 A2	29-01-2014
		KR 20140010439 A	24-01-2014
		US 2014017036 A1	16-01-2014
		WO 2012129471 A2	27-09-2012

EP 1978430 A1	08-10-2008	NONE	

US 2007158931 A1	12-07-2007	US 2007158931 A1	12-07-2007
		US 2009020986 A1	22-01-2009
		US 2011062684 A1	17-03-2011

WO 2012144157 A1	26-10-2012	CN 103620239 A	05-03-2014
		EP 2700828 A1	26-02-2014
		JP 2012225396 A	15-11-2012
		US 2014056663 A1	27-02-2014
		WO 2012144157 A1	26-10-2012
