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(54) **ENERGY-DISSIPATING JUNCTION ASSEMBLY AND SHOCKPROOF STRUCTURE USING THE SAME**

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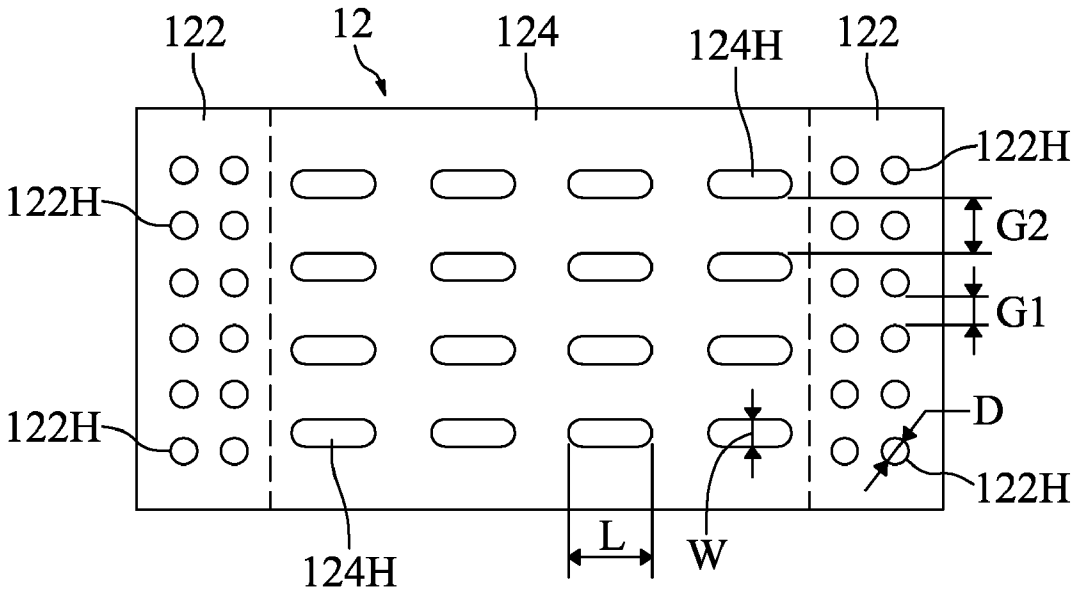
(57) **ABSTRACT**

An energy-dissipating junction assembly includes a junction plate and a plurality of bolts. The junction plate includes two junction sections and an energy-dissipating section. The two junction sections are used to connect a structure body. The energy-dissipating section is located between the two junction sections and has a plurality of slots, wherein each slot has a length. The bolts are separately disposed at each slot of the energy-dissipating section, so as to connect the energy-dissipating section to the structure body. Each bolt has a head portion, and an external diameter of each head portion is smaller than the length of each slot. The disclosure can convert external force (such as acting force of earthquakes or typhoons) acting on the structure body into uniform tensile force and pressure, so as to avoid generation of stress concentration to damage the structure body.



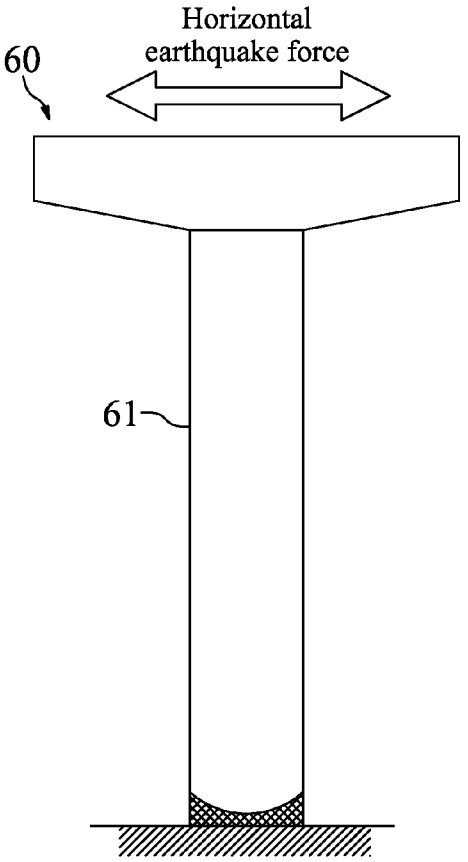


FIG. 1

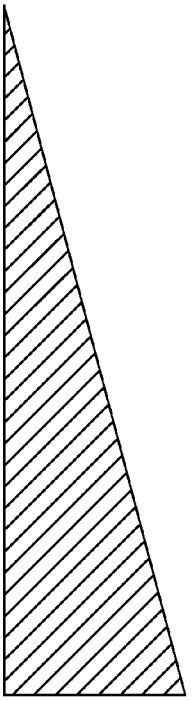


FIG. 2

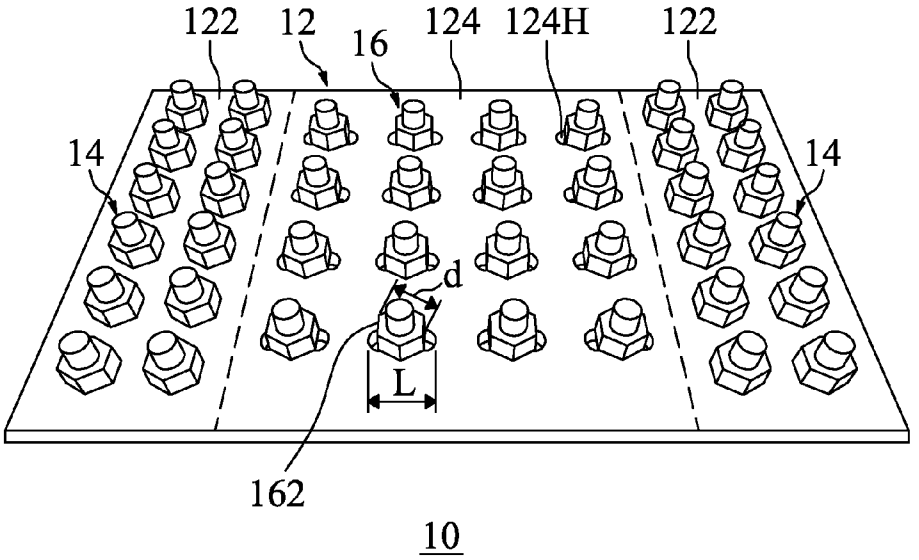

122
12
16
124
124H
122
14
14
d
L
162
10

FIG. 3

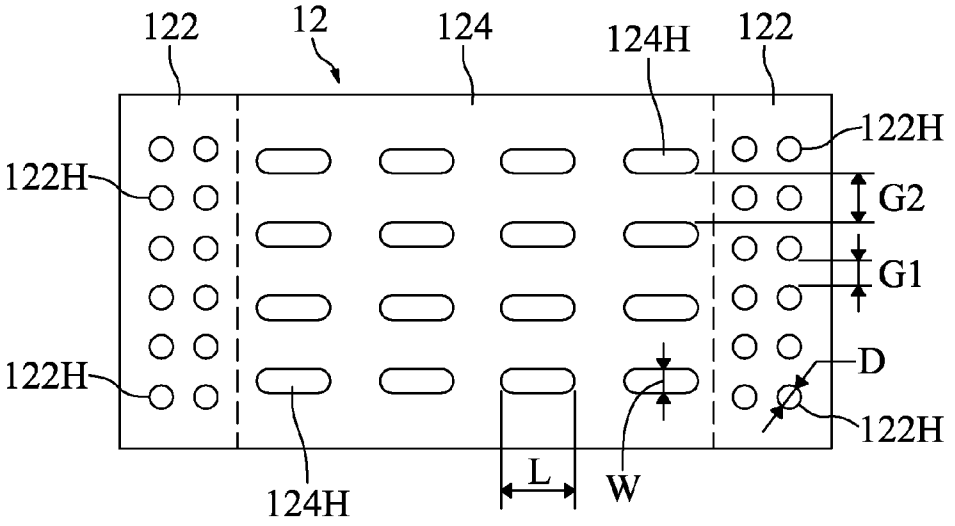

122
12
124
124H
122
122H
122H
G2
G1
D
122H
122H
124H
L
W

FIG. 4

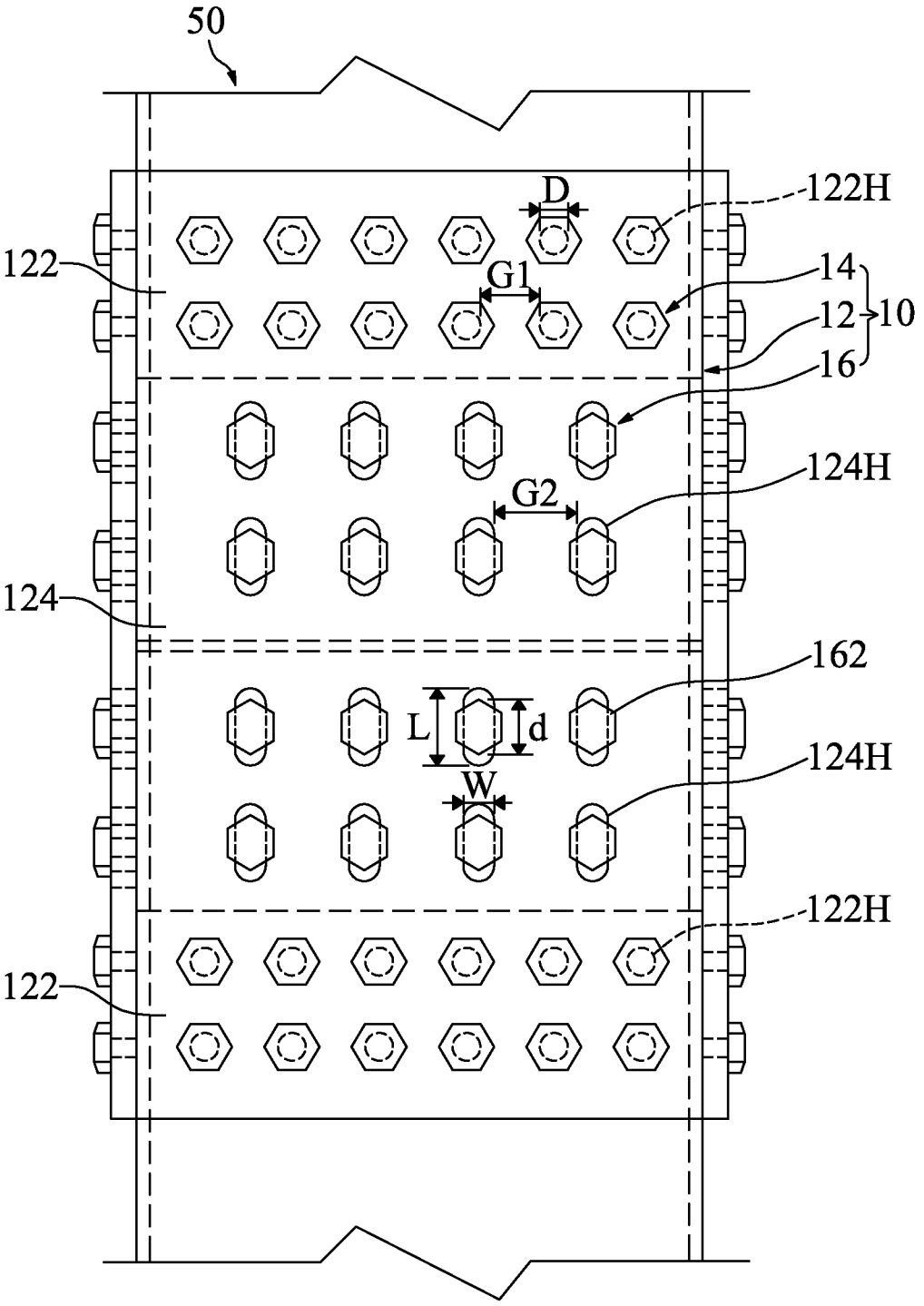


FIG. 5

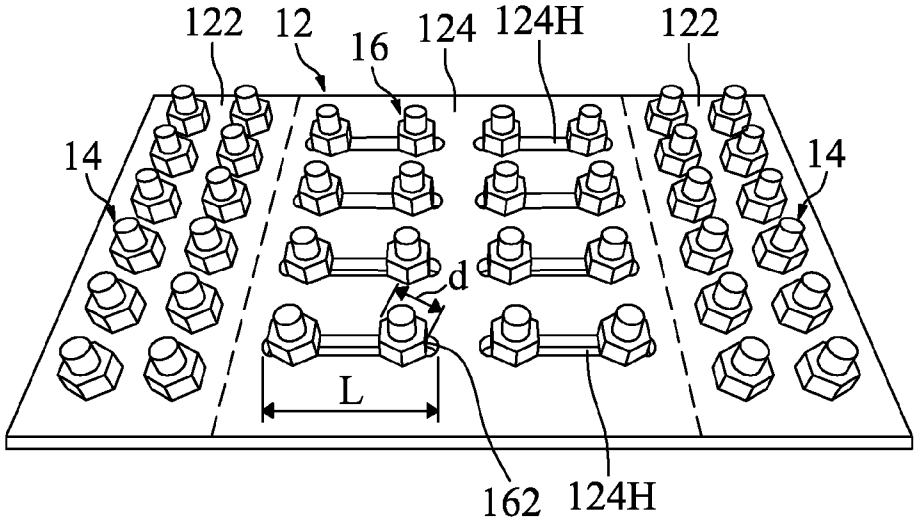

122
12
16
124
124H
122
14
14
d
L
162
124H

FIG. 6

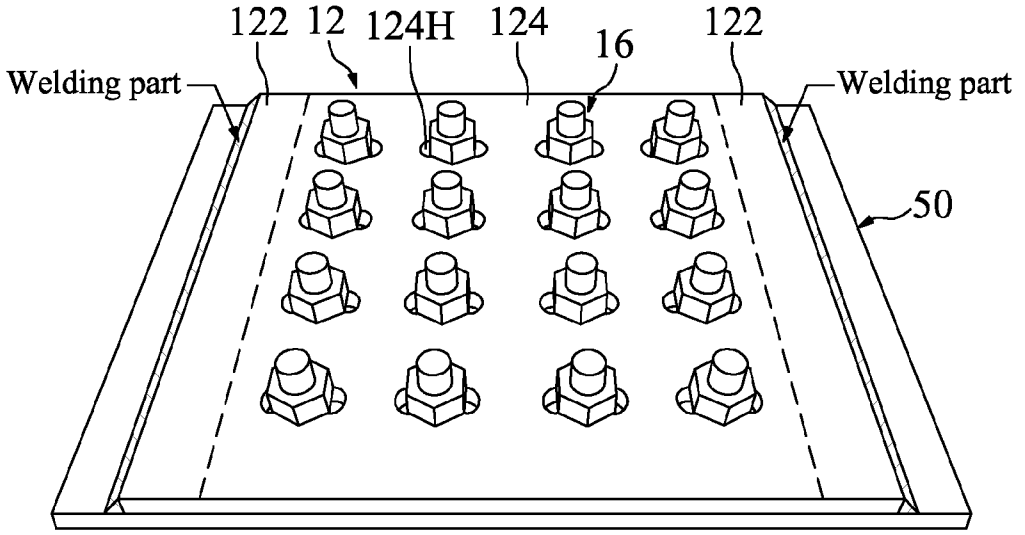

122
12
124H
124
16
122
Welding part
Welding part
50

FIG. 7

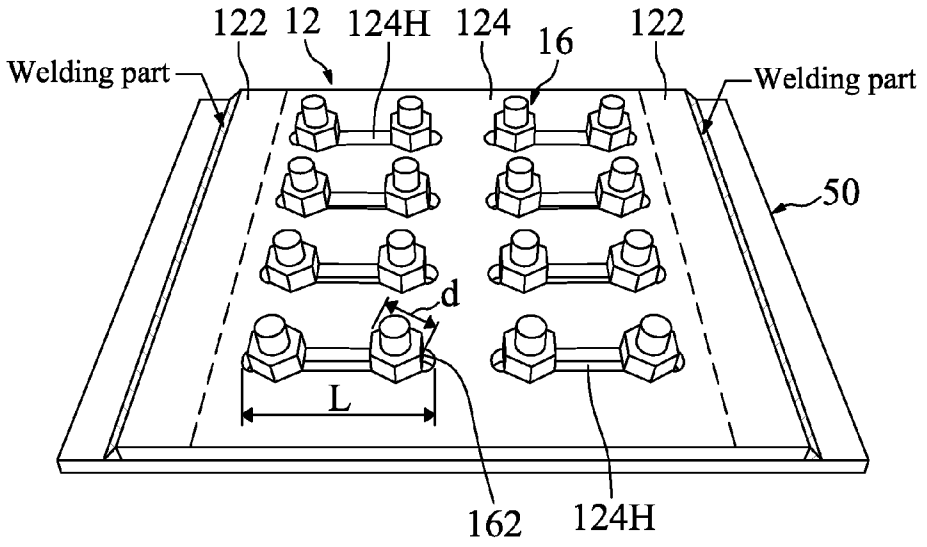

122
12
124H
124
16
122
Welding part
Welding part
50
d
L
162
124H

FIG. 8

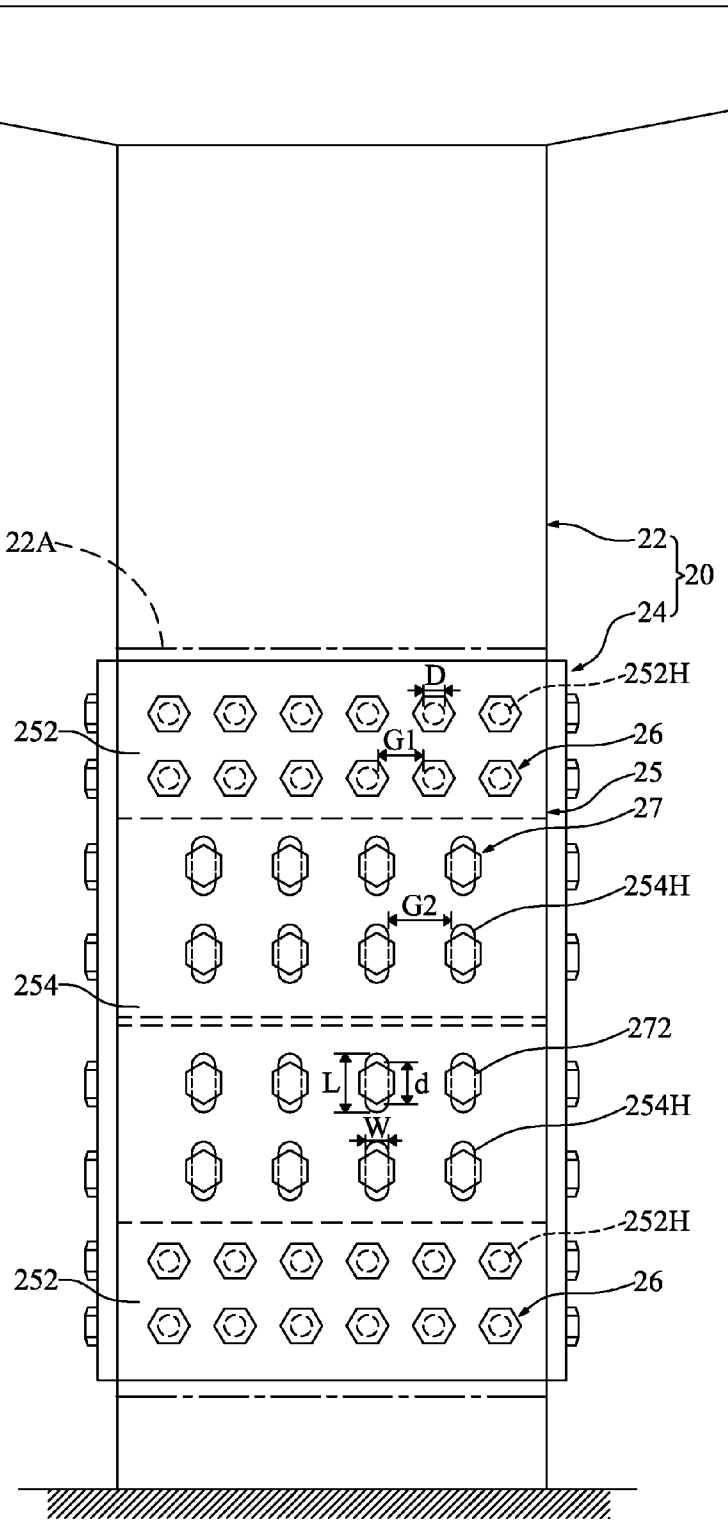

22A
22
20
24
252H
D
252
G1
26
25
27
254H
G2
254
272
L
d
W
254H
252H
252
26

FIG. 9

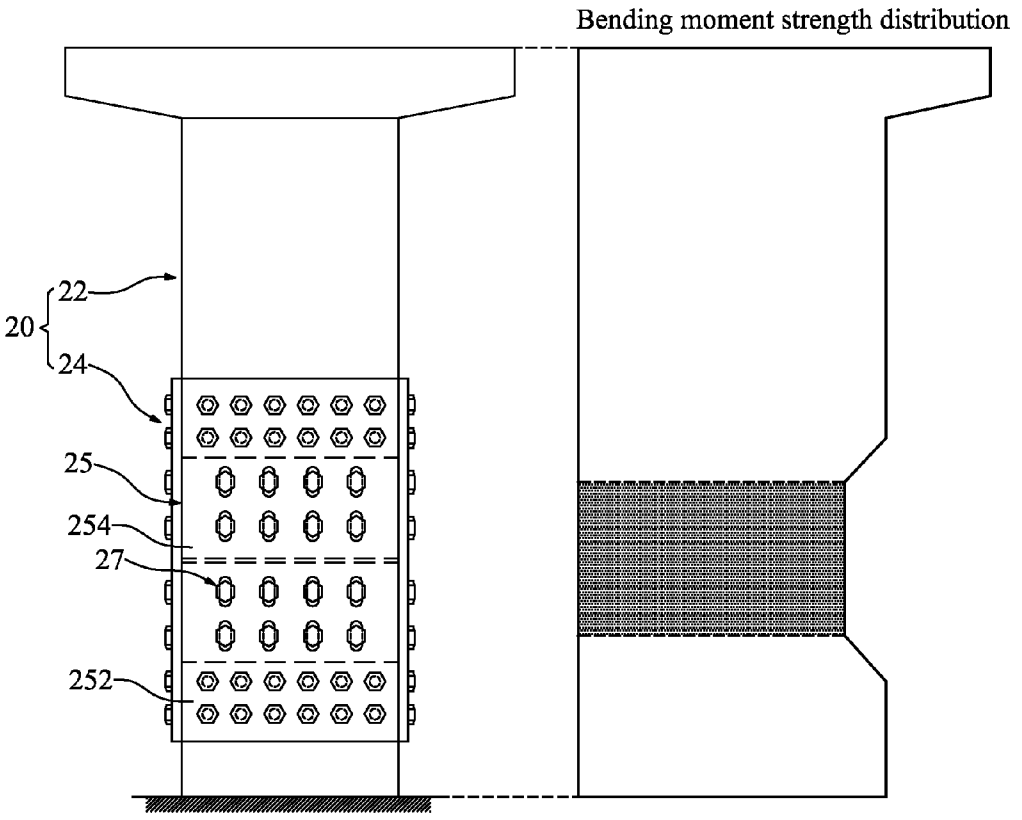


FIG. 10

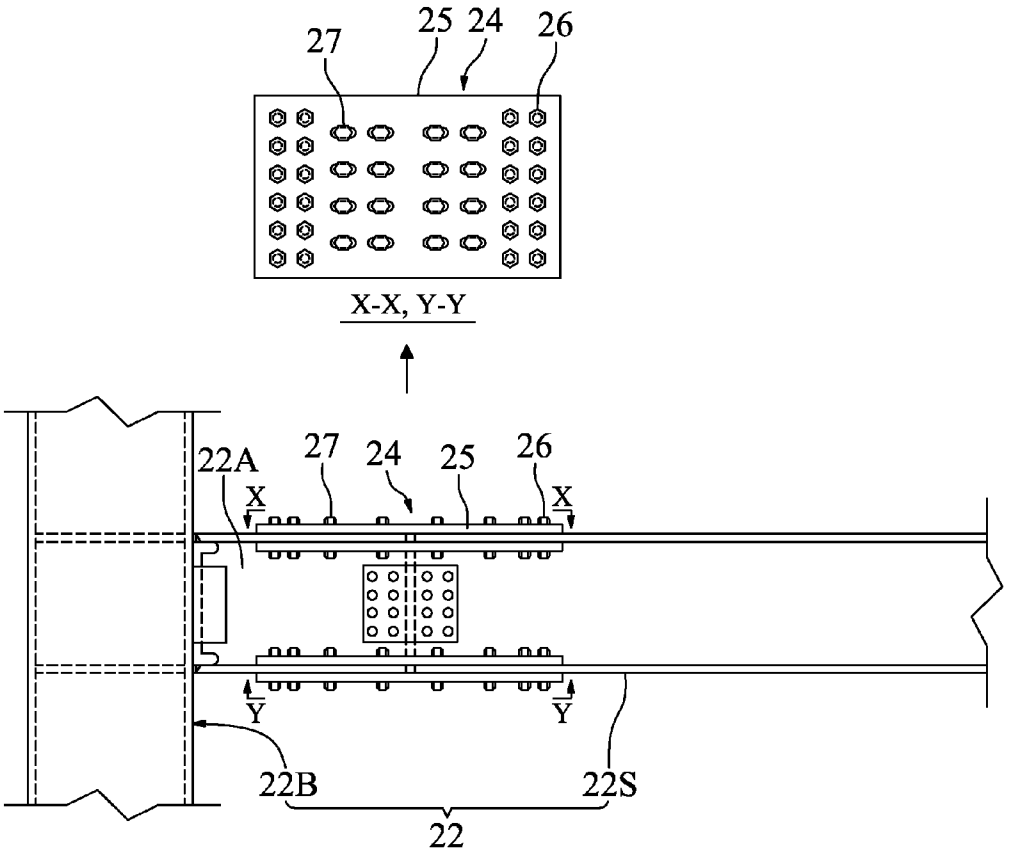


FIG. 11

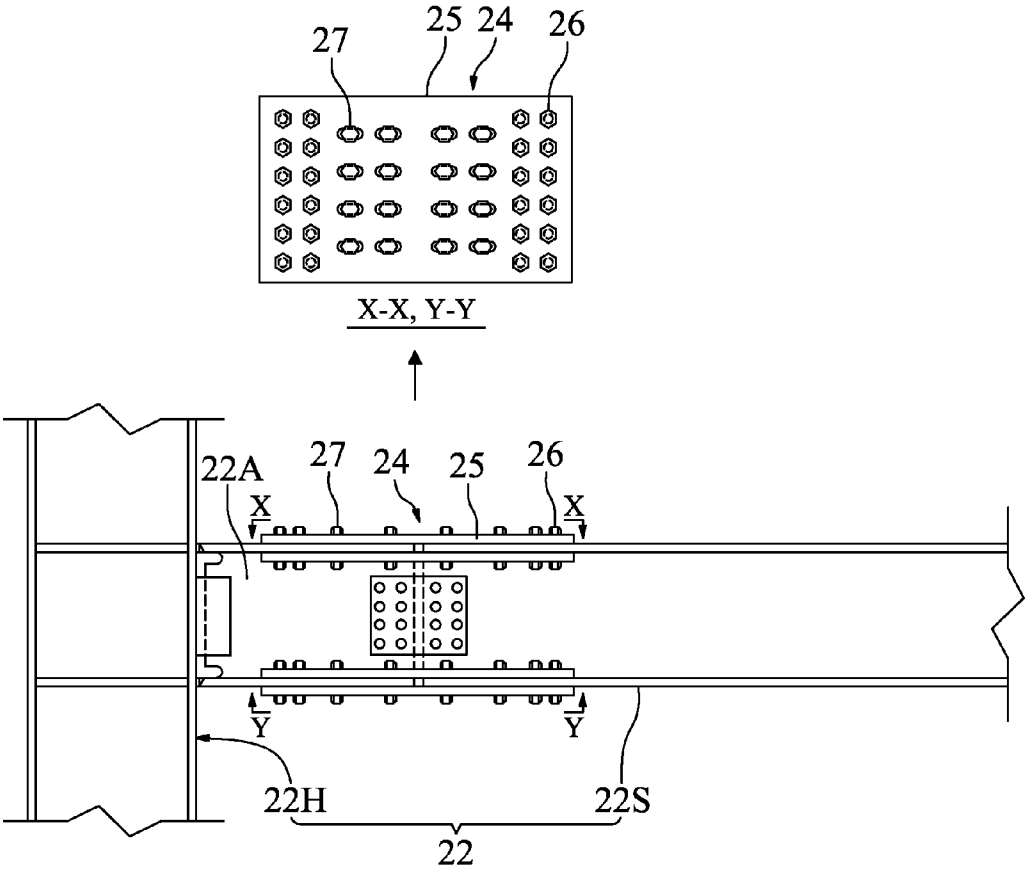


FIG. 12

ENERGY-DISSIPATING JUNCTION ASSEMBLY AND SHOCKPROOF STRUCTURE USING THE SAME

FIELD

[0001] The disclosure relates to an energy-dissipating shockproof structure, more particular to an energy-dissipating junction assembly and a shockproof structure using the same.

BACKGROUND

[0002] It is known that constructional steel structures or steel bridge columns (beams) often collapsed or are damaged because of being hit by earthquakes or typhoons, leading to difficult restoration.

[0003] FIG. **1** illustrates a schematic view for a known steel bridge column (beam) structure subjected to horizontal earthquake force. FIG. **2** illustrates a bending moment diagram for a known steel bridge column (beam) structure subjected to horizontal earthquake force. With reference to FIG. **1** and FIG. **2**, when a known is steel bridge column (beam) structure **60** is subjected to the horizontal earthquake force, a great acting bending moment may be generated at a bottom of a steel bridge column **61**, leading to generation of flexural deformation and local buckling of the steel bridge column **61**, so that the steel bridge column **61** breaks, and an anchorage part of the steel bridge column **61** is deeply buried underground; and therefore, it is also difficult to detect damage conditions of the steel bridge column **61** after earthquakes. Furthermore, the steel bridge column **61** only can generate a mechanical conventional plastic hinge in an ideal state, and therefore, its shockproof capability is also limited.

[0004] In addition, a reason for damages of the known constructional steel structure often lies in that acting force of earthquakes concentrates at a beam-column joint area, leading to breakage or collapse of the structure.

[0005] Damages of the foregoing structure may cause severe disasters and substantial property losses. Therefore, it is necessary to provide an energy-dissipating junction assembly and a shockproof structure to solve the foregoing problems.

SUMMARY OF THE INVENTION

[0006] In accordance with one aspect of the present disclosure, an energy-dissipating junction assembly includes a junction plate and a plurality of bolts. The junction plate includes two junction sections and an energy-dissipating section. The two junction sections are used to connect a structure body. The energy-dissipating section is located between the two junction sections and has a plurality of slots. Each slot has a length. The bolts are separately disposed at each slot of the energy-dissipating section, so as to connect the energy-dissipating section to the structure body. Each bolt has a head portion, and an external diameter of each head portion is smaller than the length of each slot.

[0007] In accordance with another aspect of the present disclosure, a shockproof structure includes a structure body and an energy-dissipating junction assembly. The structure body has a selected energy-dissipating area. The energy-dissipating junction assembly includes a junction plate and a plurality of bolts. The junction plate includes two junction sections and an energy-dissipating section. The two junction sections are connected to the selected energy-dissipating area of the structure body. The energy-dissipating section is located between the two junction sections and has a plurality of slots. Each slot has a length. The bolts are separately disposed at each slot of the energy-dissipating section, so as to connect the energy-dissipating section to the selected energy-dissipating area. Each bolt has a head portion, and an external diameter of each head portion is smaller than the length of each slot.

[0008] The energy-dissipating junction assembly of the present disclosure can convert external force (such as acting force of earthquakes or typhoons) acting on the structure body into uniform tensile force and pressure, so as to avoid generation of stress concentration to damage the structure body. In addition, with a constraint role played by the bolts on the energy-dissipating section of the junction plate, out-of-plane deformation of the structure body can be inhibited.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Aspects of the present disclosure are understood from the following detailed description when read with the accompanying figures. It is emphasized that, in accordance with the standard practice in the industry, various features are not drawn to scale. In fact, the dimensions of the various features may be arbitrarily increased or reduced for clarity of discussion.

[0010] FIG. **1** illustrates a schematic view for a known steel bridge column (beam) structure subjected to horizontal earthquake force.

[0011] FIG. **2** illustrates a bending moment diagram for a known steel bridge column (beam) structure subjected to horizontal earthquake force.

[0012] FIG. **3** illustrates a perspective view of an energy-dissipating junction assembly in accordance with a first embodiment of the present disclosure.

[0013] FIG. **4** illustrates a top view of a junction plate in accordance with a first embodiment of the present disclosure.

[0014] FIG. **5** illustrates a schematic view of an energy-dissipating junction assembly in connection to a structure body in accordance with a first embodiment of the present disclosure.

[0015] FIG. **6** illustrates a perspective view of an energy-dissipating junction assembly in accordance with a second embodiment of the present disclosure.

[0016] FIG. **7** illustrates a perspective view of an energy-dissipating junction assembly in accordance with a third embodiment of the present disclosure.

[0017] FIG. **8** illustrates a perspective view of an energy-dissipating junction assembly in accordance with a fourth embodiment of the present disclosure.

[0018] FIG. **9** illustrates a schematic view of a shockproof structure in accordance with a first embodiment of the present disclosure.

[0019] FIG. **10** shows a bending moment strength distribution of a shockproof structure in accordance with a first embodiment of the present disclosure.

[0020] FIG. **11** illustrates a schematic view of a shockproof structure in accordance with a second embodiment of the present disclosure.

[0021] FIG. **12** illustrates a schematic view of a shockproof structure in accordance with a third embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE INVENTION

[0022] It is to be understood that the following disclosure provides many different embodiments or examples, for implementing different features of various embodiments. Specific examples of components and arrangements are described below to simplify the present disclosure. The present disclosure may, however, be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein; rather, these embodiments are provided so that this description will be thorough and complete, and will fully convey the present disclosure to those of ordinary skill in the art. It will be apparent, however, that one or more embodiments may be practiced without these specific details.

[0023] In addition, the present disclosure may repeat reference numerals and/or letters in the various examples. This repetition is for the purpose of simplicity and clarity and does not in itself dictate a relationship between the various embodiments and/or configurations discussed.

[0024] It will be understood that singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise.

[0025] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms; such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and the present disclosure, and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0026] FIG. **3** illustrates a perspective view of an energy-dissipating junction assembly in accordance with a first embodiment of the present disclosure. FIG. **4** illustrates a top view of a junction plate in accordance with a first embodiment of the present disclosure. FIG. **5** illustrates a schematic view of an energy-dissipating junction assembly in connection to a structure body in accordance with a first embodiment of the present disclosure.

[0027] Referring to FIGS. **3**, **4**, and **5**, an energy-dissipating junction assembly **10** in accordance with the first embodiment of the present disclosure includes a junction plate **12**, a plurality of junction bolts **14**, and a plurality of bolts **16**.

[0028] The junction plate **12** includes two junction sections **122** and an energy-dissipating section **124**. The two junction sections **122** are used to connect a structure body **50**, and the structure body **50** is selected from one of the following: a steel beam, a steel column, a building, a bridge, a bridge column, and a combination of at least two of the foregoing. In this embodiment, the junction plate **12** is a steel plate, and each junction section **122** has a plurality of circular junction holes **122**H.

[0029] The energy-dissipating section **124** is located between the two junction sections **122**. The area of the energy-dissipating section **124** is greater than that of each junction section **122**, and the energy-dissipating section **124** has a plurality of slots **124**H. In some embodiments, the area of the energy-dissipating section **124** may be smaller than that of each junction section **122**.

[0030] In this embodiment, the slots **124**H are arranged regularly, and the size of each slot **124**H is the same. Furthermore, the size of each slot **124**H is greater than that of each circular junction hole **122**H; and preferably, a spacing G**2** between the slots **124**H is greater than a spacing G**1** between the circular junction holes **122**H.

[0031] In this embodiment, each slot **124**H is a long slot, and therefore, each slot **124**H has a length L and a width W. Preferably, the length L of each slot **124**H is greater than a diameter D of each circular junction hole **122**H, and the width W of each slot **124**H is greater than or equal to the diameter D of each circular junction hole **122**H.

[0032] The junction bolts **14** are separately disposed at each circular junction hole **122**H of each junction section **122**, so as to connect each junction section **122** to the structure body **50**. In this embodiment, the number of the junction bolts **14** on each junction section **122** is the same.

[0033] The bolts **16** are separately disposed at each slot **124**H of the energy-dissipating section **124**, so as to connect the energy-dissipating section **124** to the structure body **50**. In this embodiment, each bolt **16** has a head portion **162**; and an external diameter d of each head portion **162** is smaller than the length L of each slot **124**H, but is greater than the width W of each slot **124**H. With a constraint role played by the bolts **16** on the energy-dissipating section **124** of the junction plate **12**, out-of-plane deformation of the structure body **50** can be inhibited. In addition, the head portion **162** of each bolt **16** can be a nut.

[0034] The energy-dissipating junction assembly **10** of the present disclosure can convert external force (such as acting force of earthquakes or typhoons) acting on the structure body **50** into uniform tensile force and pressure, so as to avoid generation of stress concentration to damage the structure body **50**.

[0035] FIG. **6** illustrates a perspective view of an energy-dissipating junction assembly in accordance with a second embodiment of the present disclosure.

[0036] Referring to FIGS. **3** and **6**, structural features of an energy-dissipating junction assembly in accordance with the second embodiment of the present disclosure are basically the same as those of the first embodiment, and a difference therebetween only lies in that the length L of each slot **124**H is greater than or equal to twice of the external diameter **2***d* of each head portion **162** of each bolt **16**, so that each slot **124**H can be disposed with a plurality of bolts **16**.

[0037] FIG. **7** illustrates a perspective view of an energy-dissipating junction assembly in accordance with a third embodiment of the present disclosure.

[0038] Referring to FIGS. **3**, **4**, and **7**, structural features of an energy-dissipating junction assembly in accordance with the third embodiment of the present disclosure are basically the same as those of the first embodiment, and a difference therebetween only lies in that the two junction sections **122** omit to form the circular junction holes **122**H and omit to use the junction bolts **14**, and the two junction sections **122** are connected to the structure body **50** in a welding manner

[0039] FIG. **8** illustrates a perspective view of an energy-dissipating junction assembly in accordance with a fourth embodiment of the present disclosure.

[0040] Referring to FIGS. **7** and **8**, structural features of an energy-dissipating junction assembly in accordance with the fourth embodiment of the present disclosure are basically the same as those of the third embodiment, and a difference therebetween only lies in that the length L of each slot **124**H is greater than or equal to twice of the external diameter **2***d* of each head portion **162** of each bolt **16**, so that each slot **124**H can be disposed with a plurality of bolts **16**.

[0041] FIG. **9** illustrates a schematic view of a shockproof structure in accordance with a first embodiment of the present disclosure.

[0042] As shown in FIG. **9**, a shockproof structure **20** in accordance with the first embodiment of the present disclosure includes a structure body **22** and an energy-dissipating junction assembly **24**.

[0043] In this embodiment, the structure body **22** is a bridge column, and the structure body **22** has a selected energy-dissipating area **22**A. The size of the selected energy-dissipating area **22**A is determined according to a shockproof demand, and the strength of the selected energy-dissipating area **22**A is designed to be a little lower than the acting force generated by earthquakes.

[0044] The energy-dissipating junction assembly **24** includes a junction plate **25**, a plurality of junction bolts **26**, and a plurality of bolts **27**.

[0045] The junction plate **25** includes two junction sections **252** and an energy-dissipating section **254**. The two junction sections **252** are connected to the selected energy-dissipating area **22**A of the structure body **22**. In this embodiment, the area of each junction section **252** is the same, and each junction section **252** has a plurality of circular junction holes **252**H; preferably, the number of the circular junction holes **252**H of each junction section **252** is the same, and a spacing G**1** between the circular junction holes **252**H is also the same. The energy-dissipating section **254** is located between the two junction sections **252**. The area of the energy-dissipating section **254** is greater than that of each junction section **252**, and the energy-dissipating section **254** has a plurality of slots **254**H.

[0046] In this embodiment, the slots **254**H are arranged regularly, and the size of each slot **254**H is the same. In addition, the size of each slot **254**H is greater than that of each circular junction hole **252**H; and preferably, a spacing G**2** between the slots **254**H is greater than a spacing G**1** between the circular junction holes **252**H. Furthermore, in this embodiment, each slot **254**H is a long slot, and therefore, each slot **124**H has a length L and a width W. Preferably, the length L of each slot **254**H is greater than a diameter D of each circular junction holes **252**H, and the width W of each slot **254**H is greater than or equal to the diameter D of each circular junction hole **252**H.

[0047] The junction bolts **26** are separately disposed at each circular junction hole **252**H of each junction section **252**, so as to connect each junction section **252** to the selected energy-dissipating area **22**A. In some embodiments, each junction section **252** may be connected to the selected energy-dissipating area **22**A in a welding manner.

[0048] The bolts **27** are separately disposed at each slot **254**H of the energy-dissipating section **254**, so as to connect the energy-dissipating section **254** to the selected energy-dissipating area **22**A. In this embodiment, each bolt **27** has a head portion **272**; and an external diameter d of each head portion **272** is smaller than the length L of each slot **254**H. With a constraint role played by the bolt **27** on the energy-dissipating section **254** of the junction plate **25**, out-of-plane deformation of the selected energy-dissipating area **22**A can be inhibited.

[0049] FIG. **10** shows a bending moment strength distribution of a shockproof structure in accordance with a first embodiment of the present disclosure.

[0050] It is proved by a result in FIG. **10** that the bending moment caused by horizontal earthquake force on the shockproof structure **20** can be effectively and uniformly transmitted by the junction plate **25**, and most of earthquake energy is dissipated by the energy-dissipating section **254** of the junction plate **25**.

[0051] FIG. **11** illustrates a schematic view of a shockproof structure in accordance with a second embodiment of the present disclosure.

[0052] As shown in FIG. **11**, structural features of a shockproof structure in accordance with the second embodiment of the present disclosure are basically the same as those of the first embodiment, and a difference therebetween only lies in that the structure body **22** is a combination of a steel beam **22**S and a box-type steel column **22**B. The selected energy-dissipating area **22**A is a beam-column joint area, and the energy-dissipating junction assembly **24** is disposed at the beam-column joint area.

[0053] FIG. **12** illustrates a schematic view of a shockproof structure in accordance with a third embodiment of the present disclosure.

[0054] As shown in FIG. **12**, structural features of a shockproof structure in accordance with the third embodiment of the present disclosure are basically the same as those of the second embodiment, and a difference therebetween only lies in that the structure body **22** is a combination of the steel beam **22**S and an H-type steel column **22**H.

[0055] Moreover, the scope of the present application is not intended to be limited to the particular embodiments of the process, machine, manufacture, and composition of matter, means, methods and steps described in the specification. As those skilled in the art will readily appreciate form the present disclosure, 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 disclosure.

[0056] Accordingly, the appended claims are intended to include within their scope such processes, machines, manufacture, and compositions of matter, means, methods or steps. In addition, each claim constitutes a separate embodiment, and the combination of various claims and embodiments are within the scope of the invention.

What is claimed is:

1. An energy-dissipating junction assembly, comprising:

a junction plate including two junction sections and an energy-dissipating section, wherein the two junction sections are used to connect a structure body; the energy-dissipating section is located between the two junction sections and has a plurality of slots; and each slot has a length; and

a plurality of bolts separately disposed at each slot of the energy-dissipating section for connecting the energy-dissipating section to the structure body, wherein each bolt has a head portion, and an external diameter of each head portion is smaller than the length of each slot.

2. The energy-dissipating junction assembly of claim **1**, wherein the structure body is selected from one of the following: a steel beam, a steel column, a building, a bridge, a bridge column, and a combination of at least two of the foregoing.

3. The energy-dissipating junction assembly of claim **1**, wherein the two junction sections of the junction plate are connected to the structure body in a welding manner.

4. The energy-dissipating junction assembly of claim **1**, further comprising a plurality of junction bolts, wherein each

junction section has a plurality of circular junction holes, and the junction bolts are separately disposed at each circular junction hole for connecting each junction section to the structure body.

5. The energy-dissipating junction assembly of claim **4**, wherein the number of the junction bolts on each junction section is the same.

6. The energy-dissipating junction assembly of claim **4**, wherein the length of each slot is greater than a diameter of each circular junction hole.

7. The energy-dissipating junction assembly of claim **4**, wherein each slot has a width, and the width of each slot is greater than or equal to a diameter of each circular junction hole.

8. The energy-dissipating junction assembly of claim **4**, wherein a spacing between the slots is greater than a spacing between the circular junction holes.

9. The energy-dissipating junction assembly of claim **4**, wherein the size of each slot is greater than that of each circular junction hole.

10. The energy-dissipating junction assembly of claim **1**, wherein the size of each slot is the same.

11. The energy-dissipating junction assembly of claim **1**, wherein the slots are arranged regularly.

12. The energy-dissipating junction assembly of claim **1**, wherein the length of each slot is greater than or equal to twice of the external diameter of each head portion.

13. The energy-dissipating junction assembly of claim **12**, wherein each slot is disposed with a plurality of bolts.

14. The energy-dissipating junction assembly of claim **1**, wherein the area of the energy-dissipating section is greater than that of each junction section.

15. A shockproof structure, comprising:

a structure body having a selected energy-dissipating area; and

an energy-dissipating junction assembly, comprising:

a junction plate including two junction sections and an energy-dissipating section, wherein the two junction sections are connected to the selected energy-dissipating area of the structure body; the energy-dissipating section is located between the two junction sections and has a plurality of slots; and each slot has a length; and

a plurality of bolts separately disposed at each slot of the energy-dissipating section for connecting the energy-dissipating section to the selected energy-dissipating area, wherein each bolt has a head portion, and an external diameter of each head portion is smaller than the length of each slot.

16. The shockproof structure of claim **15**, wherein the structure body is selected from one of the following: a steel beam, a steel column, a building, a bridge, a bridge column, and a combination of at least two of the foregoing.

17. The shockproof structure of claim **16**, wherein the selected energy-dissipating area is a beam-column joint area.

18. The shockproof structure of claim **15**, further comprising a plurality of junction bolts, wherein each junction section has a plurality of circular junction holes, and the junction bolts are separately disposed at each circular junction hole for connecting each junction section to the selected energy-dissipating area.

19. The shockproof structure of claim **18**, wherein the length of each slot is greater than a diameter of each circular junction hole.

20. The shockproof structure of claim **18**, wherein a spacing between the slots is greater than a spacing between the circular junction holes.

21. The shockproof structure of claim **15**, wherein the length of each slot is greater than or equal to twice of the external diameter of each head portion.

22. The shockproof structure of claim **21**, wherein each slot is disposed with a plurality of bolts.

23. The shockproof structure of claim **15**, wherein the area of the energy-dissipating section is greater than that of each junction section.

* * * * *