(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 643 855 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
16.06.2021 Bulletin 2021/24

(21) Application number: **19794859.9**

(22) Date of filing: **02.07.2019**

(51) Int Cl.:
E04H 9/02 *(2006.01)* ***E04B 2/56*** *(2006.01)*
E04B 1/98 *(2006.01)*

(86) International application number:
PCT/CN2019/094446

(87) International publication number:
WO 2020/019948 (30.01.2020 Gazette 2020/05)

(54) VARIABLE-STIFFNESS ENERGY DISSIPATION MEMBER AND METHOD FOR INSTALLING SAME

ENERGIEABLEITENDES ELEMENT MIT VARIABLER STEIFIGKEIT UND VERFAHREN ZUR INSTALLATION EINES SOLCHEN ENERGIEABLEITENDEN ELEMENTS

ORGANE DE DISSIPATION D'ÉNERGIE DE RIGIDITÉ VARIABLE ET PROCÉDÉ D'INSTALLATION D'UN TEL ORGANE DE DISSIPATION D'ÉNERGIE

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **24.07.2018 CN 201810818668**

(43) Date of publication of application:
29.04.2020 Bulletin 2020/18

(73) Proprietor: **Zhang, ChunWei**
Shibei District
Qingdao City,
Shandong 266033 (CN)

(72) Inventors:
- **ZHU, Limeng**
  Qingdao City
  Shandong 266033 (CN)
- **ZHANG, Chunwei**
  Qingdao City
  Shandong 266033 (CN)
- **SUN, Li**
  Qingdao City
  Shandong 266033 (CN)
- **KONG, Lingmao**
  Qingdao City
  Shandong 266033 (CN)
- **ZHENG, Jie**
  Qingdao City
  Shandong 266033 (CN)

(74) Representative: **Vitina, Maruta et al**
Agency TRIA ROBIT
P.O. Box 22
1010 Riga (LV)

(56) References cited:
CN-A- 102 535 669 **CN-A- 106 639 030**
CN-A- 107 035 018 **CN-A- 107 687 212**
CN-A- 108 952 283 **CN-U- 207 032 577**
CN-U- 207 032 577 **KR-A- 20180 070 998**
KR-B1- 101 457 059

EP 3 643 855 B1

Description

TECHNICAL FIELD

[0001] This application relates to seismic resistances of buildings, and more particularly to assembled energy dissipators with variable stiffness for lateral connection of shear walls.

BACKGROUND OF THE INVENTION

[0002] There is an increasing number of complex high-rise and super high-rise buildings as China's urbanization rapidly develops, which poses new challenges to earthquake proofing techniques and the durability and shock resistance of structures. Due to higher bearing capacity and deformability, composite shear walls have been widely used in structural systems, but a larger bending deformation will be caused to the shear wall under lateral and vertical forces. When the wall cracks, a relative shear slip deformation will be generated on vertical contact surfaces, and the lateral stiffness and bearing capacity continuously decrease under large and super-large earthquakes, thereby causing the collapse of walls. Therefore, an energy-dissipating and loading device is considered to be added to a deformation focus of the shear wall, but large residential deformation and stress will be caused when the lateral connection of the energy-dissipating device and two adjacent shear walls is in welded manner.

[0003] The existing energy-dissipating shear dampers are mainly single-type shear yielding dampers, in which the stiffness of the shear wall stops enhancing after the damper yields, so the reduced bearing capacity and stiffness of the shear wall cannot be enhanced again. At the same time, the single-type yielding shear damper cannot combine the functions of dissipating energy, loading, enhancing stiffness and separating the functions of dissipating energy and loading.

[0004] Korea patent publication KR 20180070998 A discloses a damper for a structure to dissipate vibration energy by vibration or shock due to an earthquake acting to various structures. A damping plate is combined to an upper mounting board and a lower mounting board to connect them with each other. The damping plate includes a plurality of connection dampers for connecting an upper connection part and a lower connection part with each other, and horizontal brace supporters protruding from both ends of one among the upper and lower connection parts.

[0005] Chinese patent publication CN 107035018A discloses a coupling beam soft steel damper comprising energy dissipation soft steel plates, constraint steel plates, rigid end plates, left angle steel, right angle steel, high-strength bolts, constraint bolts and limiting bolts. Each set of energy dissipation soft steel plates is clamped between two constraint steel plates, the rigid end plates are clamped between the two sets of energy dissipation soft steel plates, the left ends of all the energy dissipation soft steel plates are clamped between the two pieces of left angle steel, and the right ends of all the energy dissipation soft steel plates are clamped between the two pieces of right angle steel.

SUMMARY OF THE INVENTION

[0006] In order to overcome above defects, the present invention provides an assembled energy dissipator with variable stiffness for lateral connection of shear walls, which has a controllable threshold and can realize a second enhancement of stiffness, achieving a reliable lateral connection of adjacent shear walls via bolts, in which the welding is avoided. Moreover, the assembled energy dissipator is easy to be assembled or disassembled.

[0007] Provided is an assembled energy dissipator with variable stiffness for lateral connection of shear walls, comprising an energy-dissipating zone, a stiffness enhancing zone, and end plates for connecting shear walls. The shear walls are connected by the end plates via a high-strength binding stay bolt. The stiffness enhancing zone is independent from the energy-dissipating zone and comprises a plurality of steel plates arranged in a same plane and buckling-restrained plates which are respectively arranged on two sides of adjacent steel plates and are connected to the steel plates via bolts. A gap is provided between the adjacent steel plates. The stiffness enhancing zone is provided with a deformation threshold control device. The bolts of the stiffness enhancing zone may be high-strength bolts.

[0008] The energy-dissipating zone may adopt mild steel plates with a low yield point, and the enhancing zone may adopt high-strength steel plates with an ordinary or high yield point.

[0009] Steel plates of the energy-dissipating zone may be made of mild steel plates or stainless steels, and steel plates of the enhancing zone may be made of ordinary or high-strength steel plates.

[0010] The steel plates of the energy-dissipating zone may be arranged at two outer sides of the steel plates of the enhancing zone.

[0011] Bolt connection plates may be connected to the steel plates of the energy-dissipating zone via bolts, and may be welded to the end plates.

[0012] The steel plates of the stiffness enhancing zone may comprise an upper steel plate and a lower steel plate.

[0013] The bolt connection plates may be located on inner and outer sides of the steel plates of the energy-dissipating zone. The bolt connection plates on the inner side of the steel plates are welded to the end plates. The steel plates of an outer side of the energy-dissipating zone may not be welded with the end plates but rather be directly fixed with the bolt connection plates via bolts.

[0014] The deformation threshold control device may be realized by means of bolt holes provided on the steel plates of the stiffness enhancing zone and connecting with the buckling-restrained plates. The bolt holes on the adjacent steel plates may be different in diameter, and a bolt hole on a side of the steel plates of the stiffness enhancing zone may be larger than a bolt rod in diameter.

[0015] A bolt hole on one of the steel plates of the stiffness enhancing zone may fit a rod portion of the bolt, and a diameter of a bolt hole on the other one of the steel plates of the stiffness enhancing zone may be 2-3 mm larger than the diameter of the rod portion of the bolt.

[0016] The end plates may be provided with slide rails fitting the steel plates of the stiffness enhancing zone, whereby the slide rails are configured to avoid out-of-plane buckling of the steel plates.

[0017] The adjacent steel plates of the stiffness enhancing zone may be respectively welded to the end plates, and gaps provided on sides of the end plates opposite to weling sides. Slide rails may be arranged on the sides of the end plates having the gaps.

[0018] Six steel plates may be arranged in parallel in the energy-dissipating zone. The six steel plates may be evenly spaced, and preferably, a spacing is 15-35 mm.

[0019] The bolt connection plates of an outer side of the energy-dissipating zone may not be welded to the end plates, and a gap may be provided between the bolt connection plates, where the gap may be equal to the gap between the steel plates of the energy-dissipating zone.

[0020] The steel plates of the stiffness enhancing zone may be connected to the buckling-restrained plates via high-strength bolts.

[0021] In a second aspect, provided is a mounting method of the assembled energy dissipator with variant stiffness for lateral connection of shear walls, comprising:

1) pre-processing of bolt holes: pre-processing bolt holes with desired sizes on steel plates of the energy-dissipating zone and the stiffness enhancing zone, the buckling-restrained plates and the bolt connection plates of the energy-dissipating zone;
2)welding of steel plates: welding the bolt connection plates on inner side of the energy-dissipating zone to the end plates; and respectively welding the steel plates of the enhancing zone to a side of the end plates;
3) bolt connection: connecting the steel plates of the stiffness enhancing zone to the buckling-restrained plates in parallel, wherein the steel plates of the stiffness enhancing zone and the buckling-restrained plates are connected via high-strength bolts; and
4) connecting of shear walls: connecting the end plates with shear walls of composite steel plates on two sides via the high-strength binding stay bolt.

[0022] The present invention has the following advantages.

1) The assembled energy dissipator of the present invention realizes a reliable lateral connection of shear walls via bolts, and is easy to be assembled and disassembled. The present invention provides a novel shearing damper which can dissipate energy and achieve a secondary enhancement of stiffness. Moreover, the present invention adopts a configuration that the steel plates of the energy-dissipating zone are arranged outside and the steel plates of the enhancing zone are arranged inside.
2) The energy-dissipating zone adopts energy-dissipating steel plates made of the mild steel with a low yield point, which has good ductility, deformation capability, hysteretic performance and energy dissipating capacity. In addition, it is less affected by the external environment, and is convenient to be manufactured, mounted and replaced.
3) The threshold control device is mainly achieved by reserving the slide rails on the steel plates and changing diameters of the bolt holes on the steel plates, which allows the damper to dissipate seismic energy in stages. Under a small or moderate earthquakes, the mild steel of the damper yields to dissipate energy while the steel plates in the stiffness enhancing zone are not required to work. When a strong or super strong earthquake occurs, the steel plates in the stiffness enhancing zone begins to work to enhance the structural performance.
4) The stiffness enhancing zone is provided inside the damper, and a deformation threshold is set. The stiffness enhancing zone begins to work when a deformation is beyond the deformation threshold, which allows the two adjacent shear walls to enter a second stage in which the two adjacent shear walls work together, so the energy dissipator of the present invention can improve lateral loading capacity again when it reduces after reaching the peak value.
5) The reliable connection of the damper and the shear wall reduces seismic damages of the shear wall.
6) The steel plates of the energy-dissipating zone are connected via bolts, which are easy to be dissembled and replaced.
7) The energy-dissipating zone and the shear wall are connected via high-strength binding stay bolt, which are easy to be dissembled and replaced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

FIG. 1 is a perspective view of an assembled energy dissipator with variant stiffness for lateral connection of shear walls according to the present invention.
FIG. 2 is a top view of the assembled energy dissipator with variant stiffness for lateral connection of shear walls according to the present invention.
FIG. 3 is a schematic diagram of a bolt connection plate of an energy-dissipating zone according to the present invention.
FIG. 4 is a schematic diagram of a threshold control

device of an stiffness enhancing zone and a schematic diagram showing a connection of buckling-restrained plates and the steel plates of the stiffness enhancing zone according to the present invention.

FIG. 5 is a schematic diagram of slide rails of the steel plate in the stiffness enhancing zone according to the present invention.

FIG. 6 is a schematic diagram showing a reliable lateral connection of the assembled energy dissipator and shear walls of composite steel plates.

[0024] In the drawings: 1, shear wall of composite steel plates; 2, end plates; high-strength binding stay bolt; 4, bolt connection plate; 5 steel plate of energy-dissipating zone; 6, bolt; 7, upper steel plate; 8, lower steel plate; 9, buckling-restrained plate; 10, high-strength bolt; 11, bolt hole of the upper steel plate; 12, bolt hole of the lower steel plate; 13, slide rail; 14, energy-dissipating zone; 15, stiffness enhancing zone.

DETAILED DESCRIPTION OF EMBODIMENTS

[0025] The present invention will be further illustrated below with reference to the accompanying drawings.

Example 1

[0026] As shown in FIG. 1, illustrated is an assembled energy dissipator with variant stiffness for lateral connection of shear walls, comprising a stiffness enhancing zone 15, an energy-dissipating zone 14 and end plates 2. The energy-dissipating zone comprises mild steel plates of the energy-dissipating zone 5, bolts 6 and bolt connection plates 4. The stiffness enhancing zone comprises an upper steel plate 7 and a lower steel plate 8, bolt holes of the upper steel plate 11, bolt holes of the lower steel plate 12, two buckling-restrained plates 9, high-strength bolts 10 and slide rails 13.

[0027] As shown in FIG. 2, the energy-dissipating zone 14 is provided outside the damper, and the stiffness enhancing zone 15 is provided inside the damper. The bolt connection plates on an inner side of the energy-dissipating zone 14 have the same height with the end plates, and are arranged on two sides of the steel plates of the energy-dissipating zone and are welded to the end plates. A gap is arranged between the bolt connection plates on an outer side of the energy-dissipating zone which have the same height and quantity with the steel plates of the energy-dissipating zone. The bolt connection plates on the outer side of the energy-dissipating zone are arranged on two ends of the steel plates and are not welded to the end plates. The steel plates of the energy-dissipating zone 5 are connected to the bolt connection plate via bolts 6. The bolted connection effectively avoids local stress concentration and residual deformation, and realizes the detachable replacement of the mild steel of the energy-dissipating zone. The steel plates of the stiffness enhancing zone are connected with the pre and post buckling-restrained plates via high-strength bolts. A side of the upper steel plate is welded to a left or right end plate, and a side of the lower steel plate is welded to a right or left end plate. A gap is respectively arranged between the other side of the upper steel plate and the left or right end plate and between the other side of the lower steel plate and the right or left end plate. The slide rails 13 capable of restraining the bucking of the steel plates are provided at front and back sides of the steel plates of the stiffness enhancing zone.

[0028] As shown in FIG. 3, the bolt connection plates of the energy-dissipating zone are arranged at right and left ends of the mild steel plate of the energy-dissipating zone. One bolt connection plate having the same height with the end plates is welded to the end plates, and the other bolt connection plate is not welded to the end plates, and gaps are provided on welding sides of the end plates. The gaps have the same length with the gap between the mild plates, so that a sufficient space is provided to allow the deformation of the steel plates of the energy-dissipating zone to dissipate the seismic energy and to disassemble the mild plates. Thus, the mild steel plates are replaceable, which is low-carbon, energy-saving, green, ecological and sustainable.

[0029] As shown in FIGS. 4 and 5, the steel plates of the stiffness enhancing zone comprises an upper steel plate 7 and a lower steel plate 8. The upper and lower steel plates connect with the buckling-restrained plates in parallel via the high-strength bolts. The threshold control device is realized by means of bolt holes (bolt holes of the upper steel plate 11 and the lower steel plate 12). A diameter of the bolt holes of the upper or lower steel plate is 2-3 mm larger than a diameter of the bolt holes of the lower or upper steel plate, so the mild steel plates of the energy-dissipating zone firstly dissipate energy, and the stiffness enhancing zone enters the secondary stiffness enhancing stage after the mild steel plate yields. The slide rails are respectively arranged at the sides of the steel plates having the gap. When entering the stiffness enhancing stage, due to the lacking of planar constraint, the upper and lower steel plates buckle while suffering a force, but the slide rails are capable of effectively enhancing the planar constraint of the upper and lower steel plates, so the secondary stiffness enhancing is fully achieved by the upper and lower steel plates.

[0030] The energy dissipating and the stiffness enhancing of the energy-dissipating damper with variant stiffness for lateral connection are designed to be carried out in stages. The steel plates of the energy-dissipating zone can be used for dissipating energy and providing an initial stiffness, and are easy to be disassembled and replaced. A deformation threshold is set for the steel plates of the stiffness enhancing zone. When a deformation is beyond the deformation threshold, two adjacent shear walls enter a second stage in which they work together, and are capable of enhancing the lateral bearing capacity when it reduces after reaching a peak value.

Example 2

[0031] This embodiment provides a mounting method of the energy dissipator with variant stiffness for lateral connection of shear walls, comprising the following steps:

1) Pre-processing of bolt holes

[0032] Bolt holes with desired sizes are pre-processed on the steel plates of the energy-dissipating zone, the stiffness enhancing zone, the buckling-restrained plates and the bolt connection plates of the energy-dissipating zone.

2) Welding of steel plates

[0033] Bolt connection plates on an inner side of the energy-dissipating zone are welded to the end plates; and the steel plates of the stiffness enhancing zone are respectively welded to the end plates.

3) Bolt connection

[0034] The steel plates of the stiffness enhancing zone are connected to the buckling-restrained plates which are arranged in parallel on front and back sides of stiffness enhancing zone via high-strength bolts; and the steel plates of the energy-dissipating zone are connected to the bolt connection plates on the outer side of the energy-dissipating zone via bolts.

4) Connection of shear walls

[0035] Two shear walls of composite steel plates 1 are connected by the end plates via the high-strength binding stay bolt 3.

[0036] The above is only some preferred embodiments of the present invention, and is not intended to limit the scope of the present invention.

Claims

1. An assembled energy dissipator with variable stiffness for lateral connection of shear walls, comprising:

    an energy-dissipating zone (14);
    a stiffness enhancing zone (15);
    end plates (2) for connecting shear walls; and high-strength binding stay bolts (3);
    wherein the shear walls are connectable to the end plates (2) via the high-strength binding stay bolts (3);
    characterised in that the stiffness enhancing zone (15) is independent from the energy-dissipating zone (14) and comprises a plurality of steel plates arranged in a same plane and buckling-restrained plates (9) which are respectively arranged on two sides of adjacent steel plates and are connected to the said adjacent steel plates via bolts; a gap is provided between the adjacent steel plates; and the stiffness enhancing zone (15) is provided with a deformation threshold control device.

2. The assembled energy dissipator according to claim 1, **characterized in that** the steel plates of the stiffness enhancing zone (15) comprises an upper steel plate and a lower steel plate.

3. The assembled energy dissipator according to claim 1, **characterized in that** the energy-dissipating zone (14) comprises a plurality of steel plates which are connected to the end plates (2) via bolt connection plates (4).

4. The assembled energy-dissipator according to claim 3, **characterized in that** the bolt connection plates (4) are positioned on inner and outer sides of the steel plates (5) of the energy-dissipating zone, and the bolt connection plates (4) on the inner sides of the energy-dissipating zone (14) are welded to the end plates (2).

5. The assembled energy dissipator according to claim 1, **characterized in that** the deformation threshold control device is achieved by means of bolt holes which are located on the steel plates of the stiffness enhancing zone (15) and are connected to the buckling-restrained plates (9); and the bolt holes of the adjacent steel plates are different in diameter, and a diameter of a bolt hole on one of the adjacent steel plates of the stiffness enhancing zone is larger than that of a rod portion of a said bolt.

6. The assembled energy dissipator according to claim 1, **characterized in that** a bolt hole on one of the adjacent steel plates of the stiffness enhancing zone (15) fits a rod portion of a bolt, and a diameter of a bolt hole on the other one of the adjacent steel plates is 2-3 mm larger than the diameter of a rod portion of a bolt.

7. The assembled energy dissipator according to claim 1, **characterized in that** the end plates (2) are provided with slide rails (13) fitting the steel plates of the stiffness enhancing zone (15).

8. The assembled energy dissipator according to claim 1, **characterized in that** the adjacent steel plates of the stiffness enhancing zone (15) are respectively welded to the end plates (2), and gaps are provided on sides of the end plates opposite to welding sides; and slide rails (13) are arranged on the sides of the end plates (2) having the gaps.

9. The assembled energy dissipator according to claim 4, **characterized in that** the steel plates (5) of the energy-dissipating zone are made of mild steel or stainless steel; and the steel plates of the stiffness enhancing zone (15) are made of ordinary steel or high-strength steel.

10. A mounting method of the assembled energy dissipator with variant stiffness for lateral connection of shear walls according to claims 4-9, comprising:

1) pre-processing of bolt holes: pre-processing bolt holes with desired sizes onto steel plates (5) of the energy-dissipating zone and the stiffness enhancing zone (15), the buckling-restrained plates (9) and the bolt connection plates (4) of the energy-dissipating zone (14);
2) welding of steel plates: welding the bolt connection plates (4) onto an inner side of the energy-dissipating zone (14) to the end plates (2); and respectively welding the steel plates of the stiffness enhancing zone (15) to the end plates (2);
3) bolt connection: connecting the steel plates of the stiffness enhancing zone (15) to the buckling-restrained plates in parallel via the bolts, and connecting the steel plates (5) of the energy-dissipating zone to the bolt connection plates (4) on the outer side via the bolts; and
4) connection of shear walls: connecting shear walls (1) of composite steel plates by the end plates (2) via the high-strength binding stay bolt (3).

Patentansprüche

1. Zusammengebauter Energiedissipator mit variabler Steifigkeit zur seitlichen Verbindung von Scherwänden, umfassend:

eine energiedissipierende Zone (14);
eine Steifheitsverbesserungszone (15);
Endplatten (2) zum Verbinden von Scherwänden; und
hochfeste Bindestehbolzen (3);
wobei die Scherwände über die hochfesten Bindestehbolzen (3) mit den Endplatten (2) verbindbar sind; **dadurch gekennzeichnet, dass** die Steifigkeitsverbesserungszone (15) unabhängig von der energiedissipierenden Zone (14) ist und mehrere Stahlplatten, die in derselben Ebene angeordnet sind, und Knickschutzplatten (9), die jeweils auf zwei Seiten benachbarter Stahlplatten angeordnet und über Bolzen mit den benachbarten Stahlplatten verbunden sind, umfasst; wobei zwischen den benachbarten Stahlplatten ein Spalt vorgesehen ist; und wobei die Steifheitsverbesserungszone (15) mit einer Verformungsschwellensteuervorrichtung versehen ist.

2. Zusammengebauter Energiedissipator nach Anspruch 1, **dadurch gekennzeichnet, dass** die Stahlplatten der Steifigkeitsverbesserungszone (15) eine obere Stahlplatte und eine untere Stahlplatte umfassen.

3. Zusammengebauter Energiedissipator nach Anspruch 1, **dadurch gekennzeichnet, dass** die energiedissipierende Zone (14) mehrere Stahlplatten umfasst, die über Bolzenverbindungsplatten (4) mit den Endplatten (2) verbunden sind.

4. Zusammengebauter Energiedissipator nach Anspruch 3, **dadurch gekennzeichnet, dass** die Bolzenverbindungsplatten (4) an der Innen- und Außenseite der Stahlplatten (5) der energiedissipierenden Zone angeordnet und die Bolzenverbindungsplatten (4) an den Innenseiten der energiedissipierenden Zone (14) mit den Endplatten (2) verschweißt sind.

5. Zusammengebauter Energiedissipator nach Anspruch 1, **dadurch gekennzeichnet, dass** die Verformungsschwellensteuervorrichtung mittels Bolzenlöchern erreicht wird, die sich auf den Stahlplatten der Steifigkeitsverbesserungszone (15) befinden und mit den Knickschutzplatten (9) verbunden sind; wobei die Bolzenlöcher der benachbarten Stahlplatten einen unterschiedlichen Durchmesser aufweisen, und wobei ein Durchmesser eines Bolzenlochs in einer der benachbarten Stahlplatten der Steifigkeitsverbesserungszone größer als der eines Stangenabschnitts eines Bolzens ist.

6. Zusammengebauter Energiedissipator nach Anspruch 1, **dadurch gekennzeichnet, dass** ein Bolzenloch in einer der benachbarten Stahlplatten der Steifigkeitsverbesserungszone (15) auf einen Stangenabschnitt eines Bolzens passt und ein Durchmesser eines Bolzenlochs in der anderen der benachbarten Stahlplatten 2-3 mm größer als der Durchmesser eines Stangenabschnitts eines Bolzens ist.

7. Zusammengebauter Energiedissipator nach Anspruch 1, **dadurch gekennzeichnet, dass** die Endplatten (2) mit Gleitschienen (13) versehen sind, die auf die Stahlplatten der Steifigkeitsverbesserungszone (15) passen.

8. Zusammengebauter Energiedissipator nach Anspruch 1, **dadurch gekennzeichnet, dass** die benachbarten Stahlplatten der Steifigkeitsverbesserungszone (15) jeweils mit den Endplatten (2) verschweißt und Lücken an den zu den Schweißseiten gegenüberliegenden Seiten der Endplatten vorgesehen sind; wobei Gleitschienen (13) an den mit den Lücken versehenen Seiten der Endplatten (2) angeordnet sind.

9. Zusammengebauter Energiedissipator nach Anspruch 4, **dadurch gekennzeichnet, dass** die Stahlplatten (5) der energiedissipierenden Zone aus Weichstahl oder Edelstahl bestehen; wobei die Stahlplatten der Steifheitsverbesserungszone (15) aus gewöhnlichem Stahl oder hochfestem Stahl bestehen.

10. Montageverfahren für den zusammengebauten Energiedissipator mit variabler Steifigkeit zur seitlichen Verbindung von Scherwänden nach den Ansprüchen 4-9, umfassend:

1) Vorbearbeiten von Bolzenlöchern: Vorbearbeiten von Bolzenlöchern mit gewünschten Größen auf Stahlplatten (5) der energiedissipierenden Zone und der Steifigkeitsverbesserungszone (15), den Knickschutzplatten (9) und den Bolzenverbindungsplatten (4) der energiedissipierenden Zone (14);
2) Schweißen von Stahlplatten: Schweißen der Bolzenverbindungsplatten (4) an eine Innenseite der energiedissipierenden Zone (14) an die Endplatten (2); und jeweiliges Schweißen der Stahlplatten der Steifigkeitsverbesserungszone (15) an die Endplatten (2);
3) Bolzenverbindung: Verbinden der Stahlplatten der Steifigkeitsverbesserungszone (15) mit den Knickschutzplatten parallel über die Bolzen und Verbinden der Stahlplatten (5) der energiedissipierenden Zone mit den Bolzenverbindungsplatten (4)) an der Außenseite über die Bolzen; und
4) Verbinden von Scherwänden: Verbinden von Scherwänden (1) von Verbundstahlplatten durch die Endplatten (2) über den hochfesten Bindestehbolzen (3).

Revendications

1. Dissipateur d'énergie assemblé à rigidité variable pour connexion latérale de murs de cisaillement, comprenant:

une zone de dissipation d'énergie (14);
une zone de renforcement de rigidité (15);
plaques d'extrémité (2) pour relier lesdites murs de cisaillement; et
boulons de tirant de contrainte à haute résistance (3);
dans lequel lesdites murs de cisaillement peuvent se connecter auxdites plaques d'extrémité (2) via lesdits boulons de tirant de contrainte à haute résistance (3); **caractérisé en ce que** ladite zone de renforcement de rigidité (15) est indépendante de ladite zone de dissipation d'énergie (14) et comprend une pluralité de plaques d'acier disposées dans un même plan et de plaques retenues au flambage (9) qui sont respectivement disposées sur deux côtés de plaques d'acier adjacentes et sont reliées auxdites plaques d'acier adjacentes via boulons; un espace est prévu entre lesdites plaques d'acier adjacentes; et ladite zone de renforcement de rigidité (15) est pourvue d'un dispositif de commande du seuil de déformation.

2. Ledit dissipateur d'énergie assemblé selon la revendication 1, **caractérisé en ce que** lesdites plaques d'acier de ladite zone de renforcement de rigidité (15) comprennent une plaque d'acier supérieure et une plaque d'acier inférieure.

3. Ledit dissipateur d'énergie assemblé selon la revendication 1, **caractérisé en ce que** ladite zone de dissipation d'énergie (14) comprend une pluralité de plaques d'acier qui sont reliées auxdites plaques d'extrémité (2) via plaques de connexion boulonnées (4).

4. Ledit dissipateur d'énergie assemblé selon la revendication 3, **caractérisé en ce que** lesdites plaques de connexion boulon (4) sont positionnées sur côtés intérieur et extérieur desdites plaques d'acier (5) de ladite zone de dissipation d'énergie, et lesdites plaques de connexion boulon (4) sur lesdits côtés intérieurs de ladite zone de dissipation d'énergie (14) sont soudés auxdites plaques d'extrémité (2).

5. Ledit dissipateur d'énergie assemblé selon la revendication 1, **caractérisé en ce que** ledit dispositif de commande du seuil de déformation est réalisé au moyen de trous de boulons qui sont situés sur lesdites plaques d'acier de ladite zone de renforcement de rigidité (15) et sont reliés auxdites plaques de retenue au flambage (9); et lesdits trous de boulon desdites plaques d'acier adjacentes sont de diamètre différent, et un diamètre d'un trou de boulon sur l'une desdites plaques d'acier adjacentes de ladite zone de renforcement de rigidité est plus grand que celui d'une partie de tige d'un boulon.

6. Ledit dissipateur d'énergie assemblé selon la revendication 1, **caractérisé en ce qu'**un trou de boulon sur une desdites plaques d'acier adjacentes de ladite zone de renforcement de rigidité (15) s'adapte à une portion de tige d'un boulon, et un diamètre d'un trou de boulon sur l'autre desdites plaques d'acier adjacentes est de 2 à 3 mm plus grand que celui d'une partie de tige d'un boulon.

7. Ledit dissipateur d'énergie assemblé selon la revendication 1, **caractérisé en ce que** lesdites plaques d'extrémité (2) sont pourvues de rails coulissants (13) assortis audites plaques d'acier de ladite zone de renforcement de rigidité (15).

8. Ledit dissipateur d'énergie assemblé selon la revendication 1, **caractérisé en ce que** lesdites plaques d'acier adjacentes de ladite zone de renforcement de rigidité (15) sont respectivement soudées auxdites plaques d'extrémité (2), et espaces sont prévus sur côtés desdites plaques d'extrémité opposés au soudage côtés; et rails coulissants (13) sont disposées sur côtés desdites plaques d'extrémité (2) ayant lesdits espaces.

9. Ledit dissipateur d'énergie assemblé selon la revendication 4, **caractérisé en ce que** lesdites plaques d'acier (5) de ladite zone de dissipation d'énergie sont en acier doux ou en acier inoxydable; et lesdites plaques d'acier de ladite zone de renforcement de rigidité (15) sont en acier ordinaire ou en acier à haute résistance.

10. Procédé de montage dudit dissipateur d'énergie assemblé à rigidité variable pour connexion latérale de murs de cisaillement selon les revendications 4 à 9, le procédé comprenant les étapes consistant à:

1) prétraitement des trous de boulon: prétraiter trous de boulon avec dimensions souhaitées sur plaques d'acier (5) de ladite zone de dissipation d'énergie et de ladite zone de renforcement de rigidité (15), lesdites plaques de retenue au flambage (9) et lesdits plaques de connexion boulon (4) de ladite zone de dissipation d'énergie (14);
2) soudage de plaques d'acier: souder lesdites plaques de connexion boulon (4) sur un côté intérieur de ladite zone de dissipation d'énergie (14) auxdites plaques d'extrémité (2); et souder respectivement lesdites plaques d'acier de ladite zone de renforcement de rigidité (15) auxdites plaques d'extrémité (2);
3) connexion par boulon: connecter lesdites plaques d'acier de ladite zone de renforcement de rigidité (15) auxdites plaques de retenue au flambage en parallèle via lesdits boulons, et connecter lesdites plaques d'acier (5) de ladite zone de dissipation d'énergie auxdites plaques de connexion boulon (4) sur ledit côté extérieur via lesdits boulons; et
4) connexion des murs de cisaillement: connecter lesdits murs de cisaillement (1) de plaques d'acier composite par lesdites plaques d'extrémité (2) via lesdits boulons de tirant de contrainte à haute résistance (3).

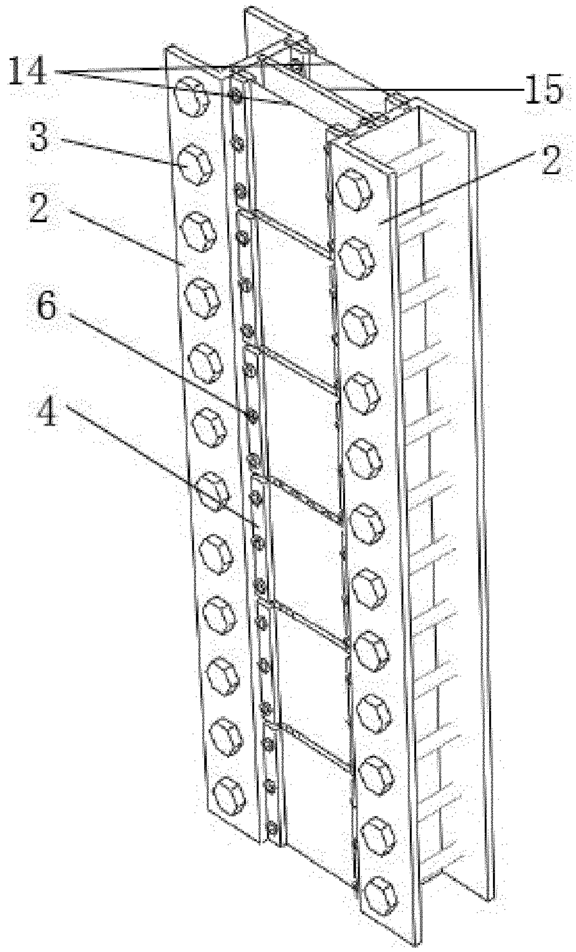

FIG. 1

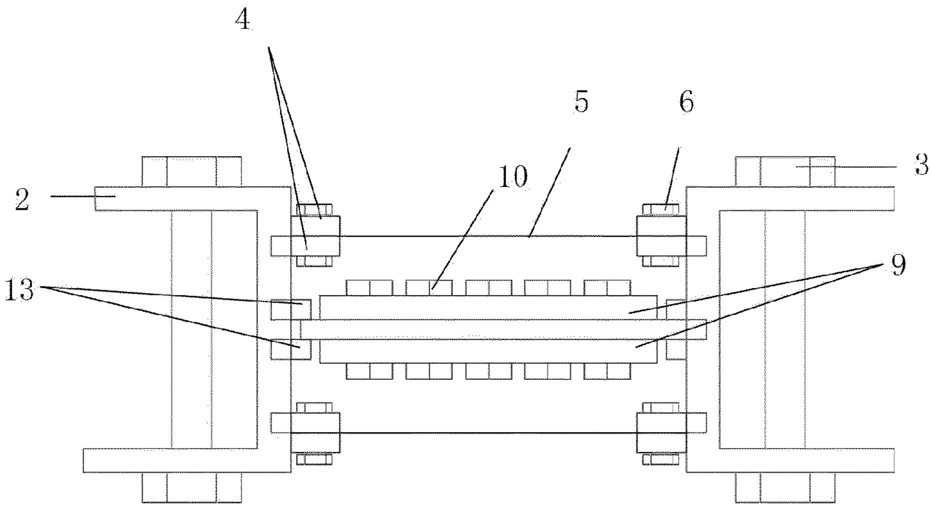

FIG. 2

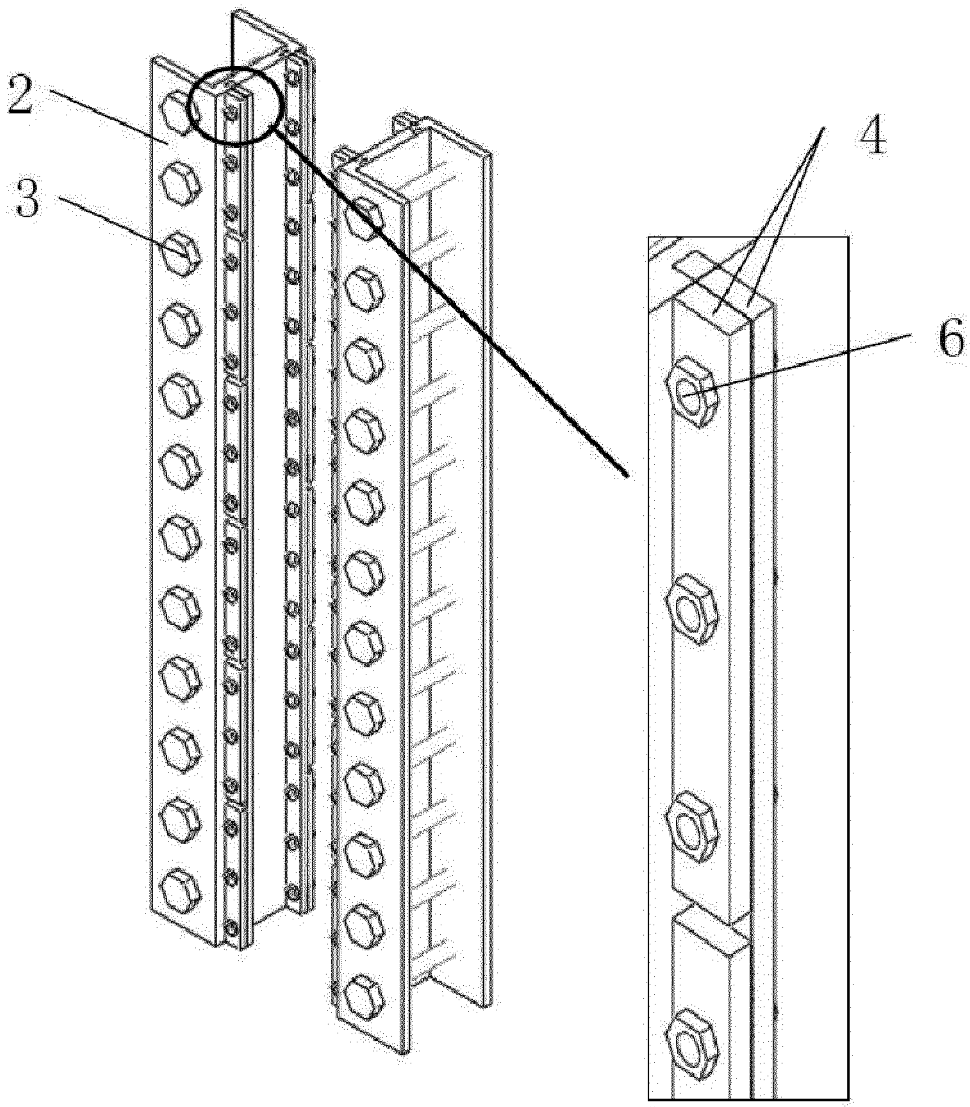

FIG. 3

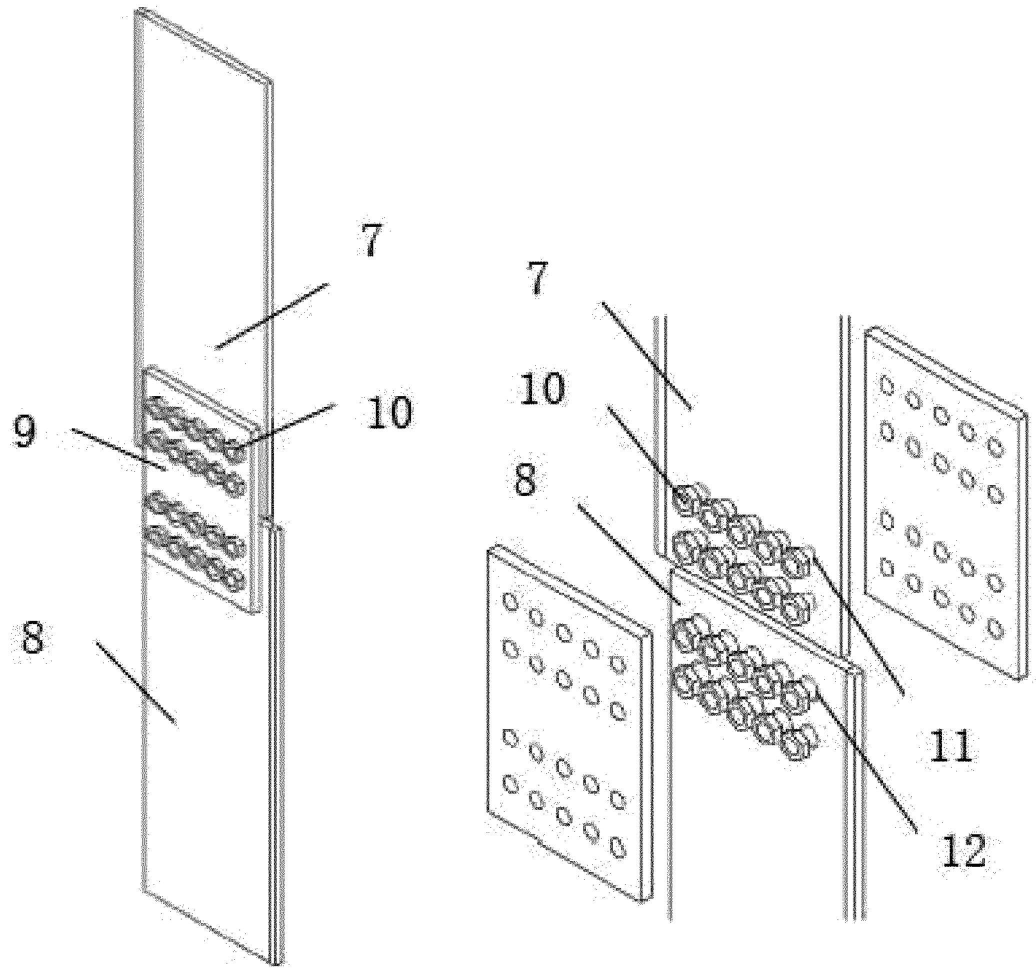

FIG. 4

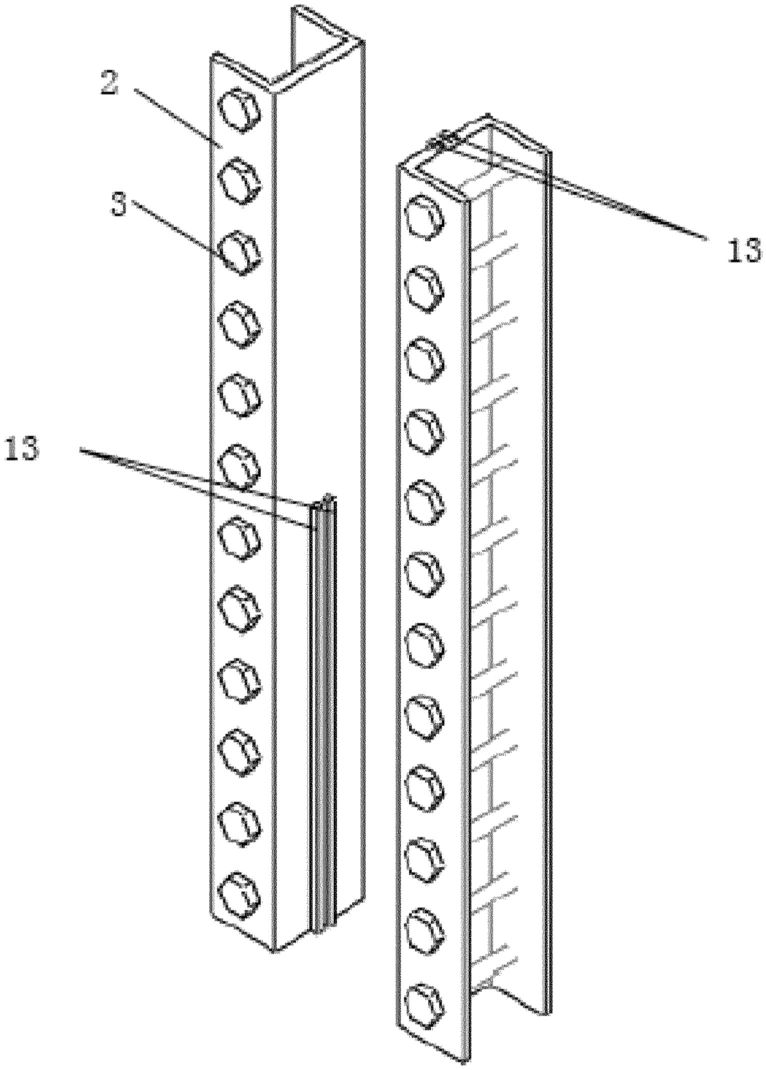

FIG. 5

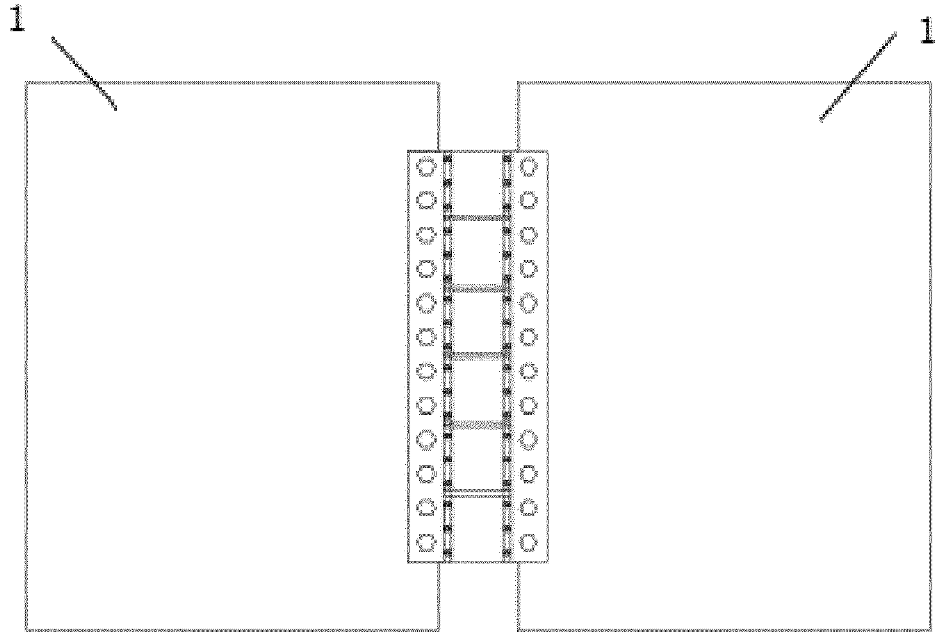

FIG. 6

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- KR 20180070998 A **[0004]**
- CN 107035018 A **[0005]**