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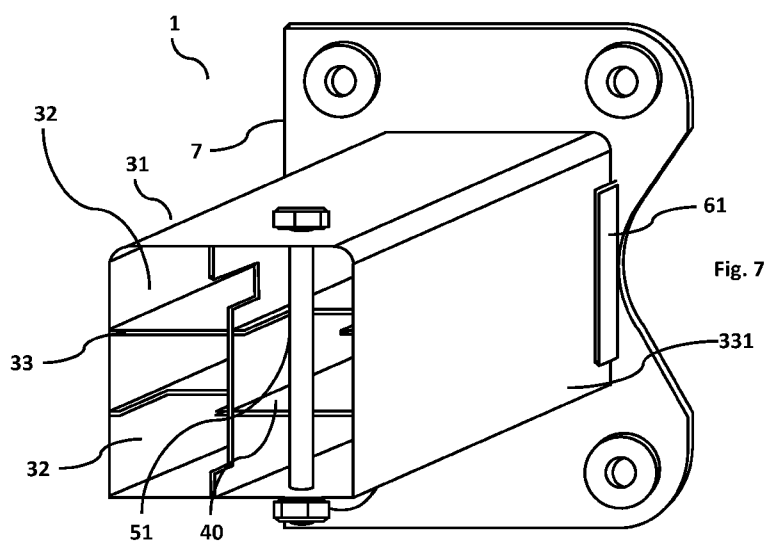
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(54) Title: PROGRESSIVE CRASH BOX MEMBER AND ITS ARRANGEMENT



(57) Abstract: The invention relates to a progressive crash box member (1) comprising multiple channels (32), the channels being restricted by an external (31) and internal (33) structure, the structures being orientated essentially parallel to the direction of an impact compression force, wherein at least one internal structure inside the member comprises at least one recess (51).

PROGRESSIVE CRASH BOX MEMBER AND ITS ARRANGEMENT

Technical field

[0001] The present invention relates to a crash box member, an arrangement comprising said crash box member, a vehicle comprising the crash box, and a vehicle comprising the arrangement.

Background art

[0002] Vehicles transporting persons comprise structures which absorb external forces during impact. Specifically the front portion of a vehicle needs structures which are able to absorb significant compression forces which are e.g. generated during a frontal crash. Although the structures must be designed to absorb significant forces e.g. during a frontal crash it is desired that said structures are capable of also handling minor (compression) forces without damaging expensive structural members of the vehicle. Also, such structures shall also be capable of coping with non-impact stresses during normal driving conditions.

[0003] US 6502874 discloses a coupling structure of a shock transmitting member, a shock absorbing member and a bumper. US 6502874 does not teach the presence of recesses in the partitions in the crash box.

[0004] The present invention provides a crash box member and an arrangement with a design effective to cope with significant compression loads while also managing minor loads without damaging expensive structural parts of a vehicle and also maintaining these characteristics during the lifetime of the vehicle.

Brief description of drawings

[0005] The invention is now described, by way of example, with reference to the accompanying drawings, in which:

[0006] Fig. 1 and 2 depict a progressive crash box member, a beam and a plate with different geometries.

[0007] Fig. 3 shows a progressive crash box member, a beam and a plate.

[0008] Fig. 4 shows cross sectional views of a rectangular progressive crash box comprising six channels and a plate.

[0009] Fig. 5 depicts a cross sectional view of a rectangular progressive crash box and a plate, with six channels and a bolt.

[0010] Fig. 7 shows a cross sectional view of a rectangular progressive crash box and a plate comprising a flange, with six channels and a bolt.

[0011] Fig. 8 shows a cross sectional view of a rectangular progressive crash box with internal structures of different thicknesses.

[0012] Fig. 9 shows part of an internal structure with a recess.

[0013] Fig. 10 shows the plate with two flanges.

[0014] Fig. 11 shows a cross sectional view of an alternative embodiment of a progressive crash box member.

[0015] Fig. 12 shows the alternative embodiment of the progressive crash box member according to Fig. 11.

[0016] Fig. 13 shows yet another alternative embodiment of a progressive crash box member.

Invention

[0017] The present invention relates to a compressive crash box member 1 comprising multiple channels 32, where the channels are restricted by an external 31 and internal 33 structure, the structures being orientated essentially parallel to the direction of an impact compression force, wherein at least one internal structure inside the member comprises at least one recess 51.

[0018] A further aspect of the invention relates to a crash box member 1 obtainable by extrusion comprising multiple channels 32 being restricted by an external 31 and internal 33 structure, whereby the member is positioned such that the direction of an impact compression force is essentially parallel to the direction

of extrusion, the member comprising multiple channels being restricted by external and internal structures, wherein at least one structure inside the member comprises at least one recess 51.

[0019] It is preferred that the internal structures 33 of the crash box member 1 comprises a multitude of recesses 51 in the internal structure which suitably are positioned at a location of the member exhibiting the impact force early in a time frame from impact to completed deformation of the member. The recesses 51 in the internal structure 33 are preferably located in a location as far as possible for the chassis as possible such as between the middle of the member and the front end of the member. By front end is meant the region of the member fixed to a structure obtaining the initial impact.

[0020] The term “compression forces” should be understood as forces that are generated as a result of a sudden impact and do not include forces induced under normal driving conditions. Compression forces may be generated during a collision of a vehicle with an object, such as another moving vehicle or stationary objects.

[0021] Although the crash box member 1 can be formed by a variety of processes the crash box is preferably formed by extruding a suitable metal. Such metal can be selected from any metal providing sufficient rigidity and load absorption. The crash box member suitably comprises of aluminium or an alloy comprising aluminium.

[0022] According to an embodiment the member 1 comprises external and internal structures which have non-uniform thicknesses.

[0023] According to yet another embodiment the member 1 has preferably an essentially rectangular cross-section. According to this embodiment the member comprises an external structure which comprises upper 311 and lower 312 external sub structures and side sub structures 331, 332. These four external sub structures may have different thicknesses.

[0024] Furthermore, analogously to that the progressive crash box member 1 comprises external and internal structures 31, 33 which may have non-uniform

thicknesses. At least two of the internal structures 33, 333 have different thicknesses T2, T3, T4. Each of the internal structures 33; 333 may have non-uniform thicknesses T2, T3, T4 and each of the upper 311 and lower 312 external sub structures and side sub structures 331, 332 may have non-uniform thicknesses, respectively T1, T5.

[0025] According to yet another embodiment the crash box member 1 comprises six channels which are restricted by internal 33 and external 31 structures.

[0026] According to a further embodiment the crash box member 1 has preferably an essentially rectangular cross-section comprising an internal structure 33 which comprises sub structures 333 being essentially parallel to the external structure. These internal sub structures 333 may all have different thicknesses. The thickness distribution of an internal sub structure 333 may be evenly distributed, yet, the thickness of an internal sub structure 333 may also exhibit a thickness distribution. According to one aspect, the thickness of an internal sub structure 333 is evenly distributed.

[0027] According to a further embodiment the crash box member 1 does not comprise structures which are essentially perpendicular to both the internal and external structures.

[0028] A further embodiment of the invention relates to a crash box member 1 comprising multiple channels 32, the channels being restricted by an external 31 and internal 33 structure, the structures being orientated essentially parallel to the direction of an impact compression force, the member exhibiting an essentially rectangular cross-section, the external structure comprising upper and lower external sub structures 311, 312 and side sub structures 331, 332, the internal structure 33 comprising sub structures 333 being essentially perpendicular and parallel to the external structure, wherein the internal structure 33 inside the member comprises at least one recess 51. Suitably, the crash box member 1 comprises six channels 32 said channels being restricted by an internal structure 33 comprising seven internal sub structures 333 and an external structure 31

comprising upper and lower external sub structures 311, 312 and side sub structures 331, 332, whereby the upper and lower substructures 311, 312 and side sub structures 331, 332 are essentially parallel. The internal sub structures 333 may exhibit different thicknesses such that each internal sub structure may have a distinct thickness. According to an embodiment the thickness of the external and internal structures may have different ranges depending on multiple factors. For example, the weight of the vehicle and the coefficient of elasticity for the material of the crash box influences the thickness. However, in one embodiment is the thickness range from about 1,9 mm up to about 2,3 mm.

[0029] According to yet a further embodiment the crash box member comprises a bolt 40. The bolt is preferably secured with a nut 41. The bolt 40 is typically located in the front region of the crash member. If the crash member 1 exhibit an essentially rectangular cross section the bolt passes through the upper and lower external sub structures 311, 312. According to a further embodiment the bolt passes through an internal sub structure in an area of a recess 51. The bolt may pass through several internal sub structures which is partly dependent on the number of channels.

[0030] According to yet another embodiment the progressive crash box member may be attached to a plate 7. The plate 7, which is located at the opposite side with respect to a structural member such as a chassis, suitably comprises at least a flange 61 which supports the crash box member. The flange and the crash box member is are preferably welded together.

[0031] According to another embodiment is the flange 61 is an anti-ripping device 61 adapted to limit bending forces (moment) during offset crashes wherein impact forces only affects a portion of the front beam 2. The flange 61 may be an extruded flange 61 with a heat effected weld zone.

[0032] A further aspect of the invention relates to an arrangement comprising a front beam 2 and a structural member (not shown), wherein the crash box member 1 as elaborated herein is positioned between said front beam and the structural

member. Suitable, the arrangement comprises a plate 7 between the front beam 2 and the crash box 1.

[0033] With reference to the vehicle the front beam 2 extends longitudinally in the lateral extension of the vehicle. In other words the front beam 2 extends along the width of the vehicle. The arrangement may advantageously be arranged so that the front beam 2 is arranged behind a front bumper of a vehicle with reference to a person standing in front of the vehicle, wherein the progressive crash box member 1 is arranged behind the front beam 2 from the same reference. The arrangement may similarly be arranged so that the front beam 2 is arranged behind a rear bumper of a vehicle with reference to a person standing at the rear, behind, the vehicle, wherein the progressive crash box member 1 is arranged behind the front beam 2 from the reference of the person standing at the rear of the vehicle.

[0034] According to one embodiment of an arrangement wherein the crash box member 1 further comprises a flange 61 arranged adjacent to an external structure 31, preferably abutting a side sub structure 331, 332 is the flange 61 adapted to be an anti-ripping device 61.

[0035] The flange 61 serves the purpose of absorbing moment forces during a small offset collision, or any offset collision, through enhancing the interface between the plate 7 and the crash box member 1. In one embodiment is the flange 61 welded to both the crash box member 1 and the plate 7, in another embodiment is the flange 61 part of the plate 7 and welded to the crash box member 1.

[0036] The crash box member 1 is mounted on the structural member with the plate 7.

[0037] Yet a further aspect of the invention relates to a vehicle comprising a crash box member as elaborated herein.

[0038] As illustrated in Figs. 1 and 2 two crash box members 1 are positioned between the front beam 2 and the structural member. The two progressive crash

box members 1 are separated and positioned one on each lateral side of the front beam 2, i.e. one in a first lateral end area 3 of the front beam 2 and one in a second lateral end area 4 of the front beam 2.

[0039] Yet a further aspect of the invention relates to a vehicle comprising an arrangement as defined above.

[0040] Fig. 11-13 shows views of two additional alternative embodiments of the progressive crash box member 10. The alternative embodiment of the progressive crash box member 10 shown in Figs. 11-13 comprises the progressive crash box member 1 as described above according to Fig. 1-10, below referred to as a first progressive crash box member 1, and a second progressive crash box member 80, 80'.

[0041] The second progressive crash box member 80, 80' is complementary to the progressive crash box member 1 and has an object to further improve absorption of external impact forces during a crash scenario called small offset collisions. Similarly to the first progressive crash box member 1, the second progressive crash box member 80, 80' is adapted to absorb energy early during a crash scenario in order to reduce the impact influence on the structural member. The second progressive crash box member 80, 80' may advantageously be arrangeable laterally to the progressive crash box member 1 so as to provide a laterally wider collision absorption area. In other words, when the progressive crash box member 10 is arranged on a vehicle the second progressive crash box member 80, 80' overlaps more with an impact area of a barrier or object in a small offset collision. One effect of this may be that the intrusion of a collision object into for example a passenger compartment may be reduced, in particular in the scenario of small offset collisions. Furthermore, the risk of irreparable damage to the structural damage may also be further reduced, in particular in the scenario of small offset collisions. The first progressive crash box member 1 and/or the second progressive crash box member 80, 80' are replaceable if subjected to an impact, and the structural member, such as the chassis, may remain intact.

[0042] In one example embodiment of the arrangement, as arranged on a vehicle, two second progressive crash box members 80, 80' are respectively arranged one on each of two first progressive crash box members 1. The second progressive crash box members 80, 80' are arranged on the lateral sides of the side sub structures 331 of the first progressive crash box members 1. In this example embodiment the second progressive crash box members 80, 80' are arranged on the outer lateral sides of the respective first crash box member 1. In this example outer lateral may be understood with reference to the vehicle on which the arrangement is arranged along the width of the vehicle. The first progressive crash box member 1 and the second progressive crash box member 80, 80' are arranged close to each other and are fixedly attached to each other. In this example they form one unit and may cooperate in absorbing impact forces in the event of an impact.

[0043] In the examples illustrated in Figs 11-13 the second progressive crash box member 80, 80' comprises at least one channel structure 81; 82. In the illustrated examples the second progressive crash box member 80, 80' comprises two channel structures 81, 82. The channel structures 81, 82 are positioned next to each other in a lateral and longitudinal direction of the vehicle, as shown in Fig. 11-13. The channel structures 81, 82 are positioned next to each other to increase the impact absorbing area in case of a small offset collision. While the scenario small offset collision is known in the field, more specifically within this context a small offset collision is defined as 25% of a width of a vehicle. The channel structures 81, 82 are arranged to extend essentially parallel to the direction of an impact compression force, such that the direction of an impact compression force is essentially parallel to the direction of extension of the channel structures 81, 82. Furthermore, when arranged on a vehicle the channel structures 81, 82 are arranged to extend essentially parallel to the straight driving direction, wherein straight should be interpreted as the driving direction when all wheels are aligned. Furthermore, the channel structures 81, 82 are parallel with the multiple channels 32 of the first progressive crash box member 1.

[0044] The second progressive crash box member 80, 80' can be formed by a variety of processes. Preferably, the second progressive crash box member 80, 80' is formed by extruding a suitable metal. Such metal can be selected from any metal providing sufficient rigidity and load absorption. The second progressive crash box member 80, 80' suitably comprises of aluminum or an alloy comprising aluminum. The material thickness of the second progressive crash box member 80, 80 is of uniform thickness, this to be able to optimize the impact absorbing capacity by moderating the material thickness of the second progressive crash box member.

[0045] The second progressive crash box member 80, 80' is positioned between the upper and lower external sub structures 311, 312. Preferably, the second progressive crash box member 80, 80' is positioned between the upper and lower sub structures 311, 312, preferably in the middle between the upper and lower sub structures 311, 312, this to utilize and deform the whole structure of the second progressive crash box member 80, 80' in an essentially longitudinal direction of the vehicle in the event of an impact. In the event that the second progressive crash box member 80, 80' is positioned to close to the upper or lower sub structures 311, 312 the second progressive crash box member 80 risks being bent either upwards or downwards, and less impact force can be absorbed since the channel structures 81, 82 are deformed in an uncontrolled manner, rather than being compressed in a controlled manner essentially along the longitudinal direction of the channel structures 81, 82.

[0046] The second crash box member structure 80 can extend along the whole length of the first progressive crash box member 1 between the front beam 2 and the structural member, as shown in Fig. 12, or the second crash box member 80' can extend from the structural member in a direction from the rear of the vehicle towards the front of the vehicle and the front beam 2, preferably ending midway from the structural member towards the front beam 2, as shown in Fig. 13. Thus, the length and material thickness of the second crash box member 80 depend on the amount of impact force that are to be absorbed.

[0047] In the event that the vehicle is subjected to a low speed collision the front beam 2 will be pushed backwards, towards the second crash box member 80' and the rear of the vehicle, and in the event the impact from the colliding obstacle is small enough, the second crash box member 80', ending midway between the structural member and front beam 2, will be affected by the impact from the colliding obstacle but not the structural member. Within this scenario the structural member will remain unaffected and intact and not subjected to any torque from the colliding obstacle. Thus, the repair cost will be kept at a low level as well as the insurance premium since few components, such as the front beam 2 and the second crash box member 80', need to be exchanged even after a low speed collision.

[0048] The length and thickness of the second crash box structure 80, 80' may be tuned in relation to the desired absorbed impact force.

[0049] The properties of the different embodiments described above may be combined without departing from the scope of the invention.

CLAIMS

1. A progressive crash box member (1) comprising multiple channels (32), the channels being restricted by an external (31) and internal (33) structure, the structures being orientated essentially parallel to the direction of an impact compression force, wherein at least one internal structure inside the member comprises at least one recess (51).
2. A progressive crash box member (1) obtainable by extrusion comprising multiple channels (32) being restricted by an external (32) and internal structure (33), whereby the member is positioned such that the direction of an impact compression force is essentially parallel to the direction of extrusion, wherein at least one structure inside the member comprises at least one recess (51).
3. The progressive crash box member (1) according to claims 1 and 2, wherein the internal structure (33) comprise multiple recesses (51).
4. The progressive crash box member (1) according to any one of the preceding claims, wherein the recess(es) (51) is/are positioned in a location between the middle and the front end of the member (in the direction of initial impact).
5. The progressive crash box member (1) according to any one of the preceding claims, wherein the internal structure inside the crash box has non-uniform thicknesses.
6. The progressive crash box member (1) according to any one of the preceding claims, wherein the external structure (31) of the member has non-uniform thicknesses.
7. The progressive crash box member (1) according to any one of the preceding claims, comprising a bolt (40) through the crash box and a front beam.

8. The progressive crash box member (1) according to claim 7, wherein the bolt is positioned such that the bolt passes through the at least one recess of the internal structure.
9. The progressive crash box member (1) according to any one of the preceding claims, wherein the member has an essential rectangular cross-section.
10. The progressive crash box member (1) according to any one of the preceding claims, wherein the member comprises aluminium.
11. The progressive crash box member (1) according to any one of the preceding claims, wherein the member comprises at least five channels, preferably six channels.
12. An arrangement comprising a front beam and a structural member, wherein the progressive crash box member (1) as defined by claim 1 to 11 is positioned between said front beam (2) and the structural member.
13. An arrangement comprising a front beam and a structural member, wherein two progressive crash box members (1) as defined by claim 1-11, are positioned between the front beam (2) and the structural member and the progressive crash box members (1) are separated and one is positioned in a first lateral end area 3 of the front beam 2 and one in a second lateral end area 4 of the front beam 2.
14. The arrangement according to claim 12 or 13, wherein the arrangement further comprises second progressive crash box members (80) one positioned on each lateral side of side sub structures (331) of the progressive crash box members (1).
15. The arrangement according to claim 14, wherein the second progressive crash box members (80) extend between the front beam (2) and the structural member or midway from the structural member towards the front beam (2).
16. The arrangement according to claim 15, wherein the arrangement further comprises a plate (7), said plate (7) comprises a flange (61) arranged adjacent to

an external structure (31) of the crash box member (1) abutting a side sub structure (331, 332).

17. A vehicle comprising an arrangement as defined by any one of claims 12 to 16.

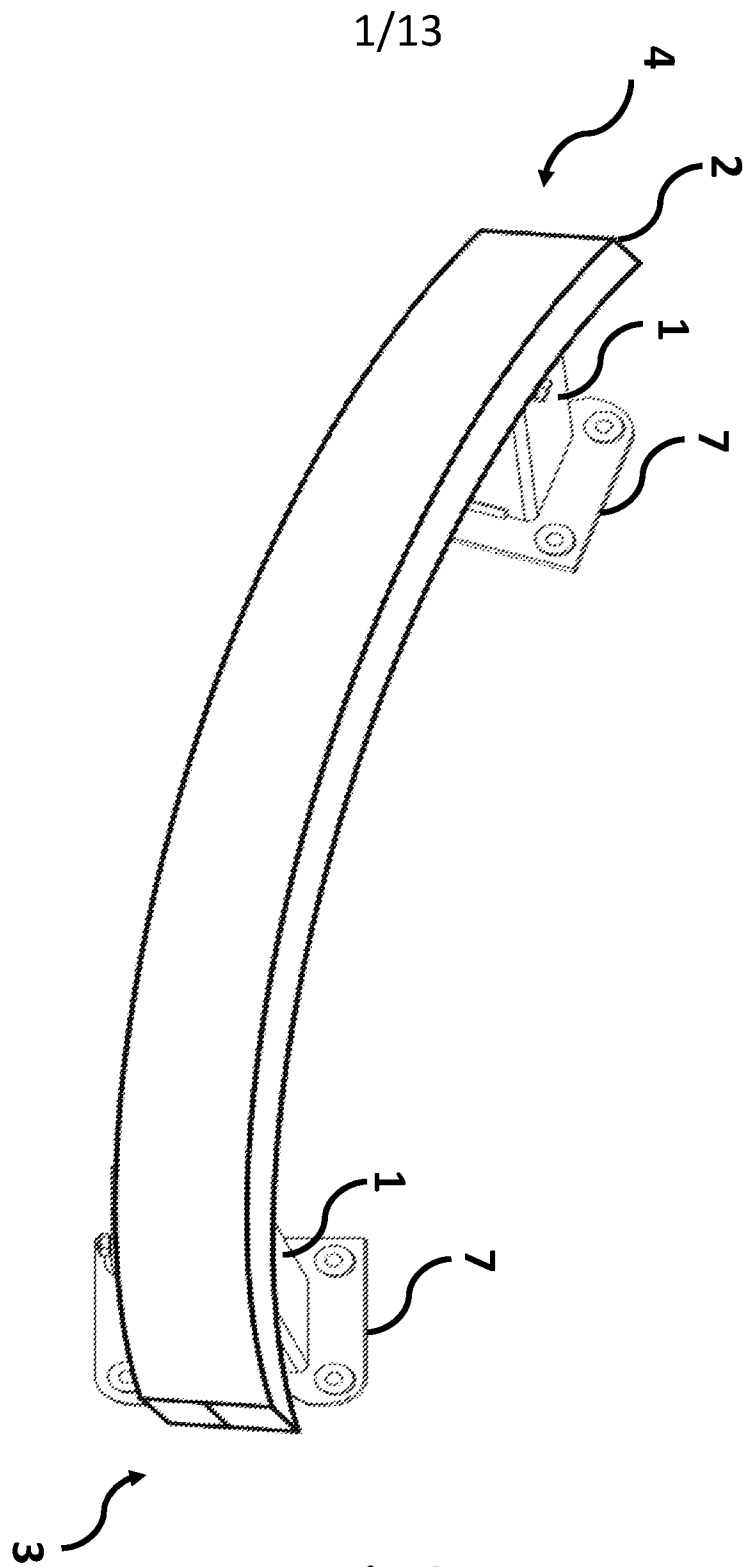


Fig. 1

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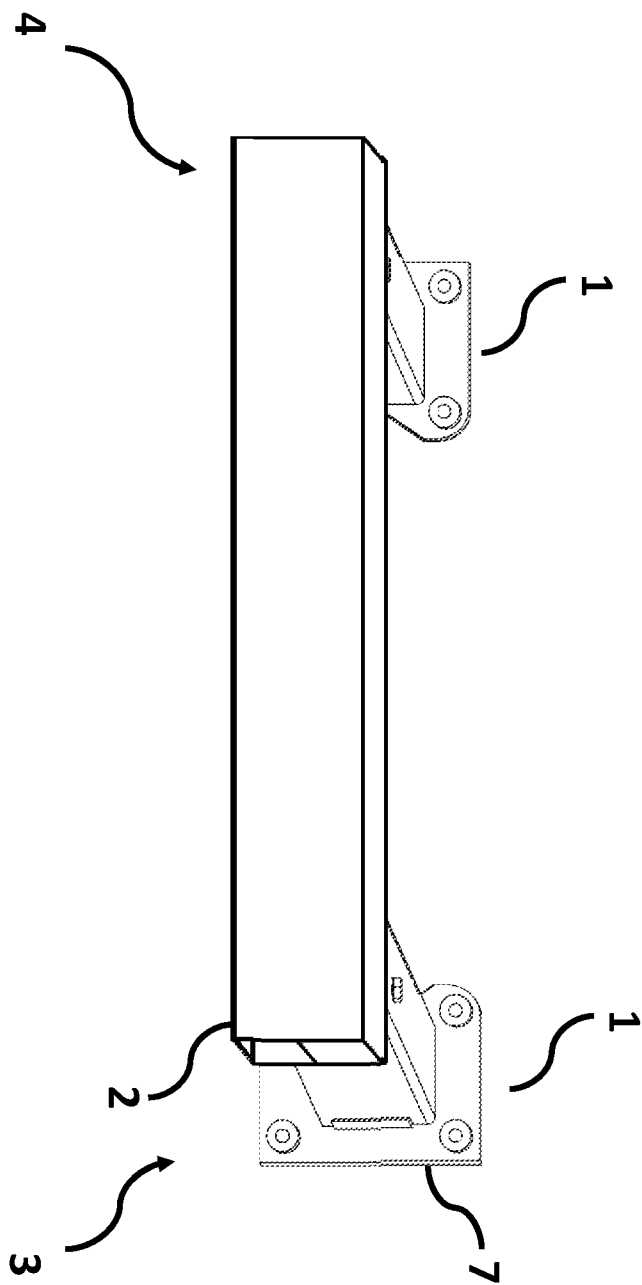


Fig. 2

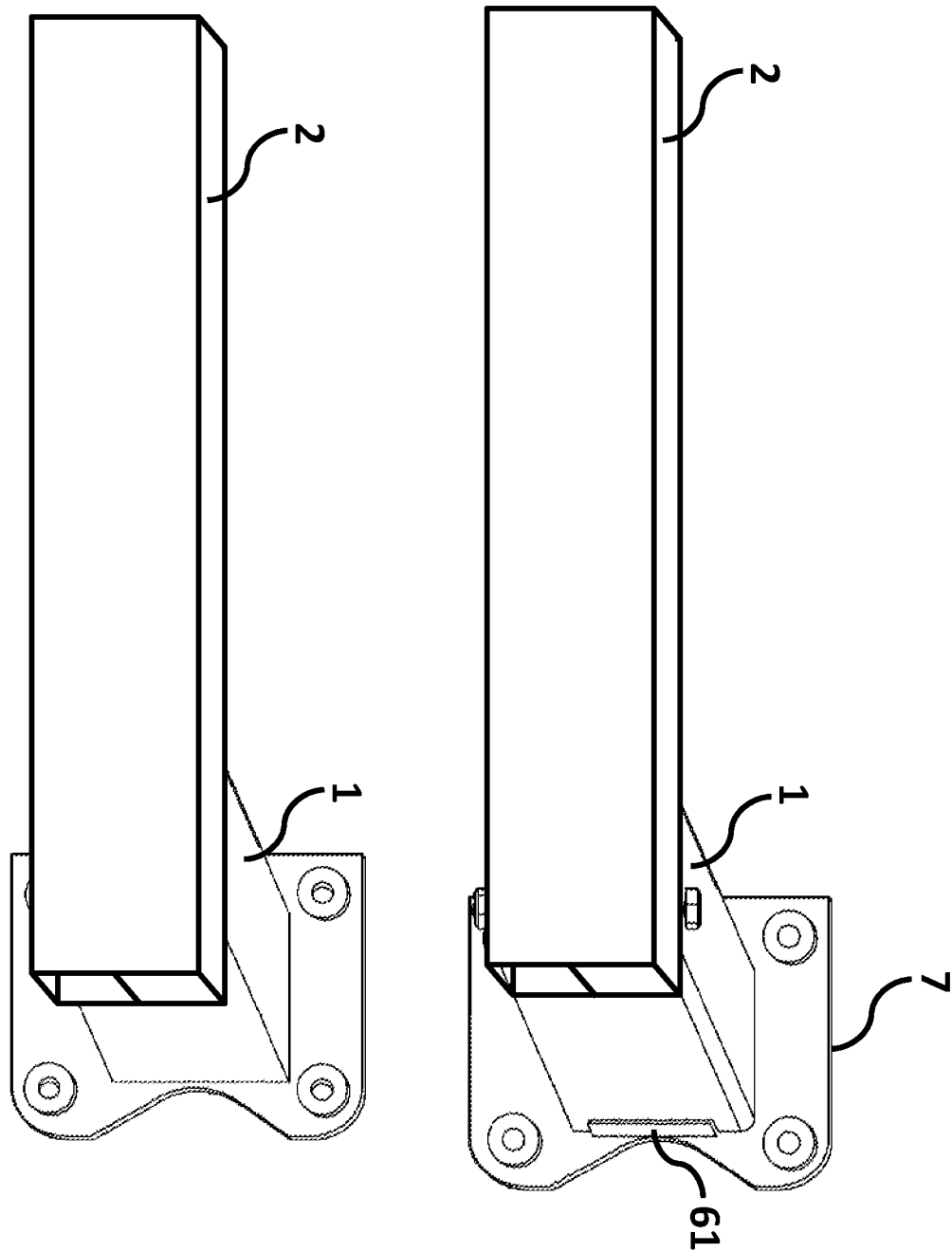


Fig. 3

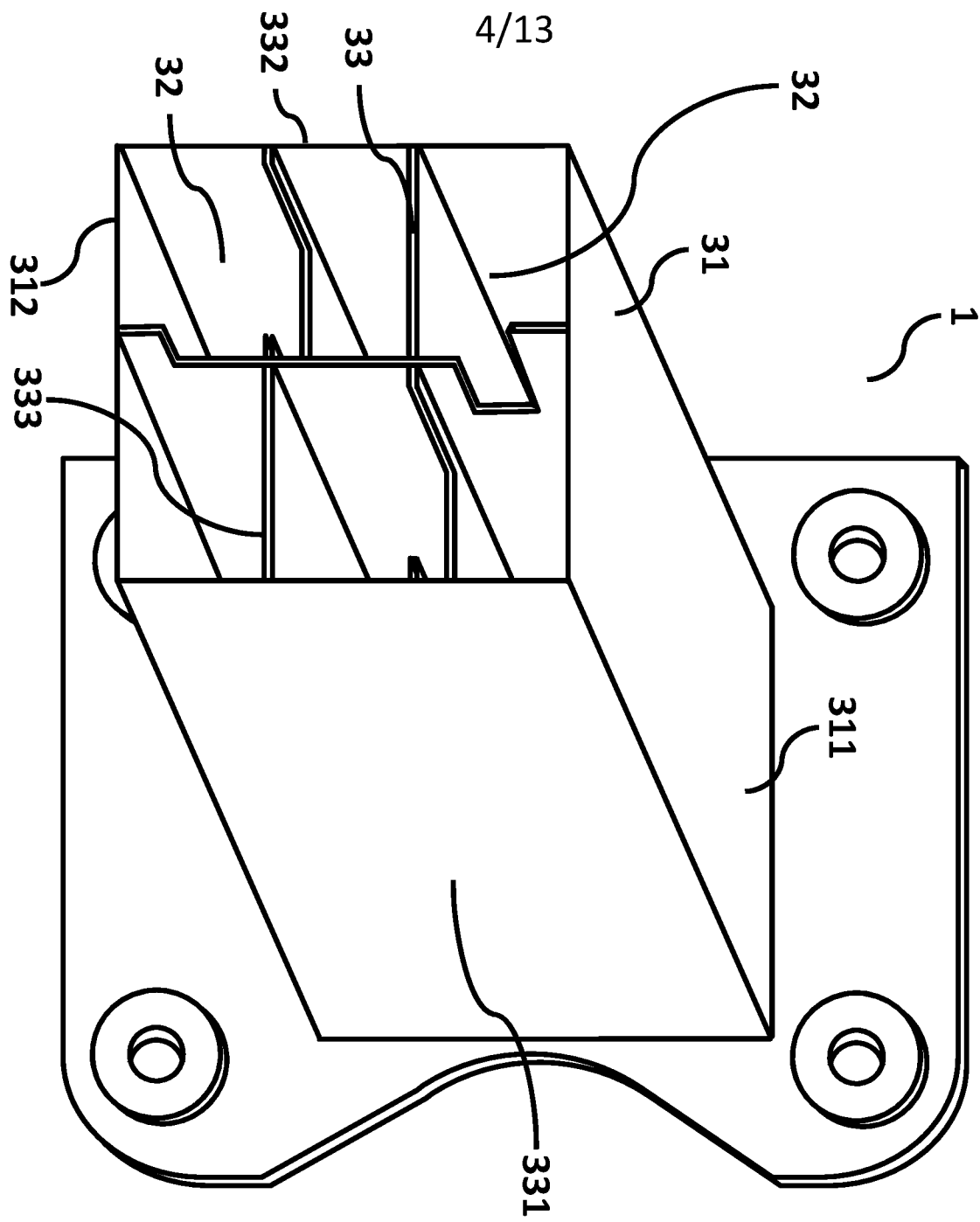


Fig. 4

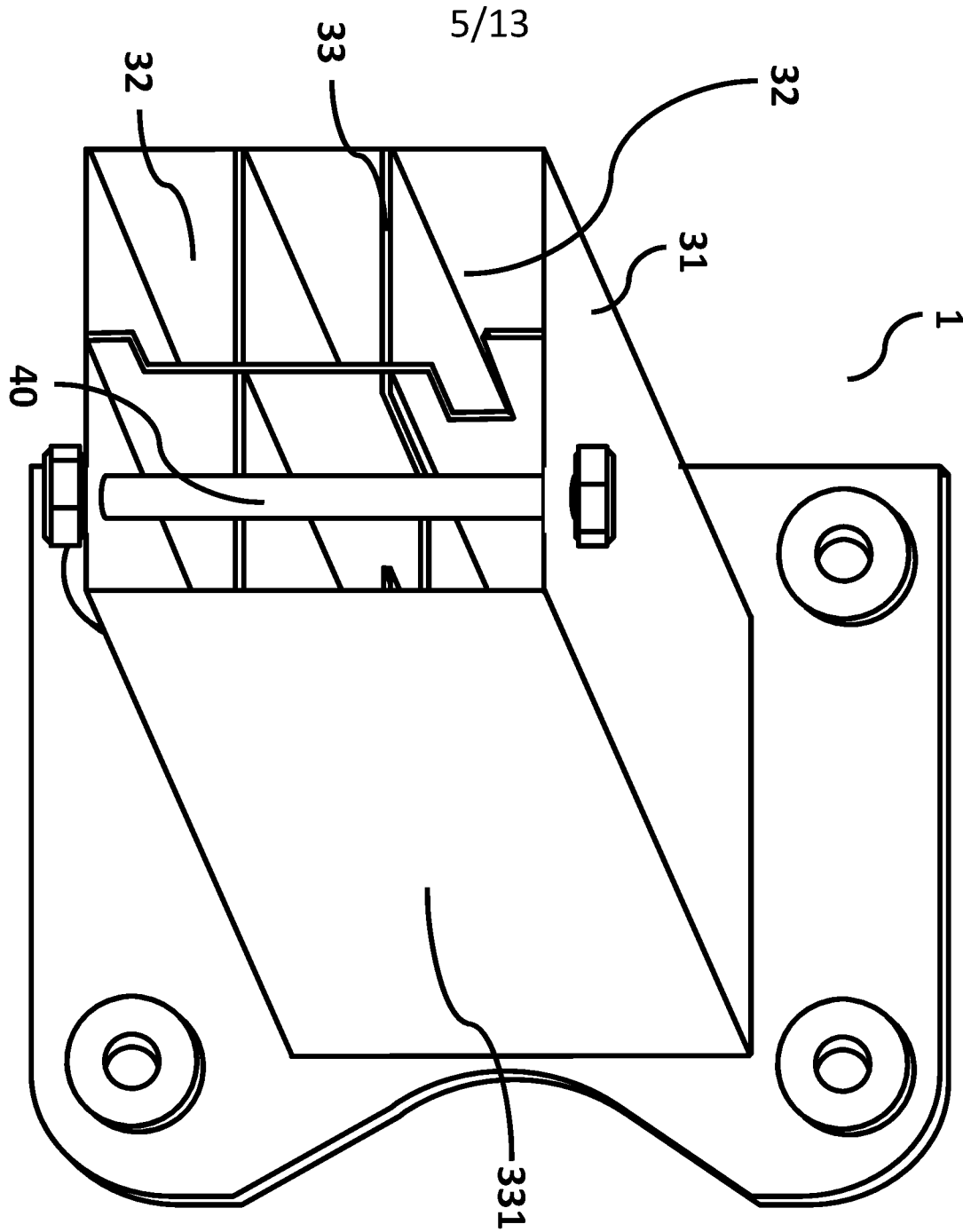


Fig. 5

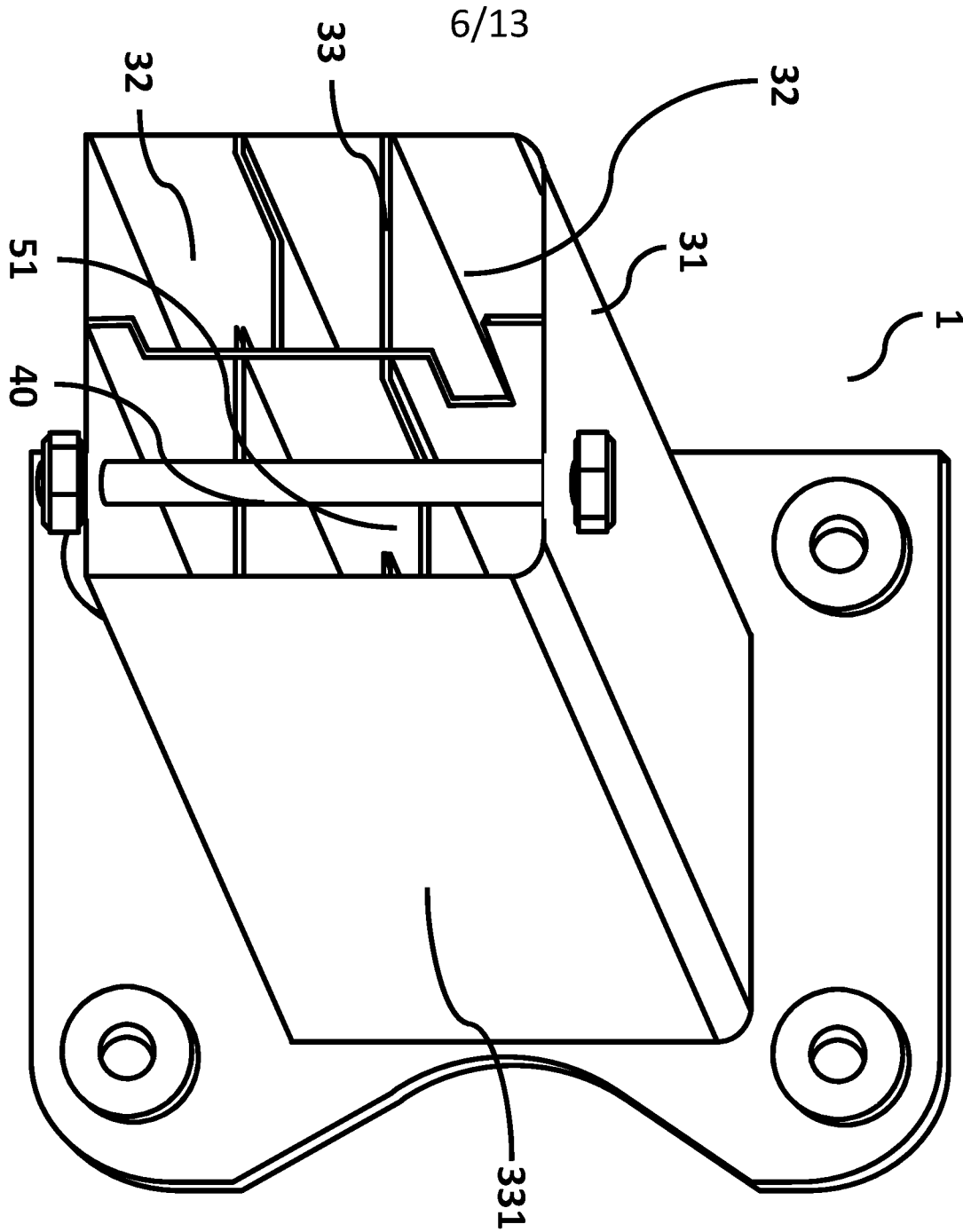


Fig. 6

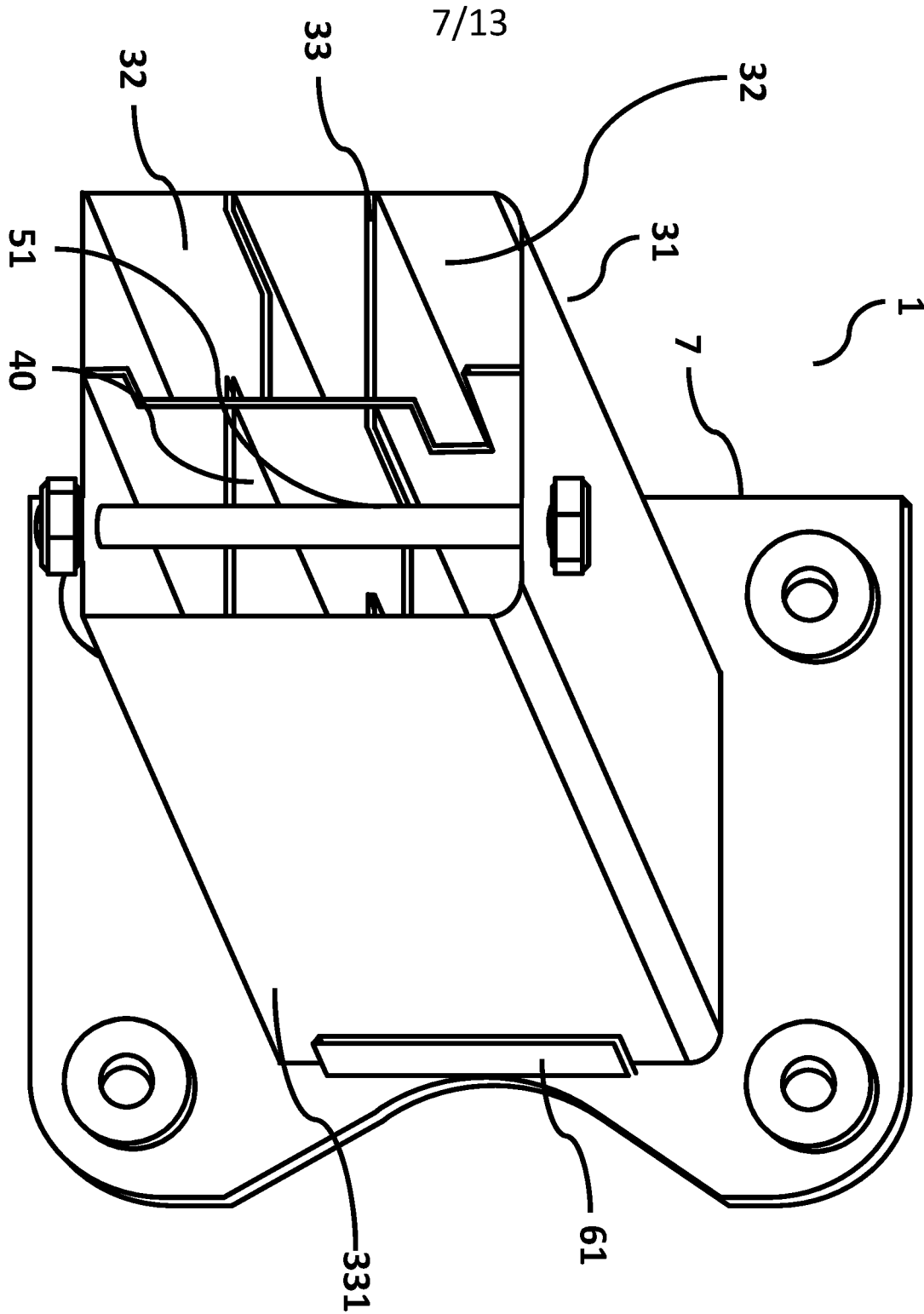


Fig. 7

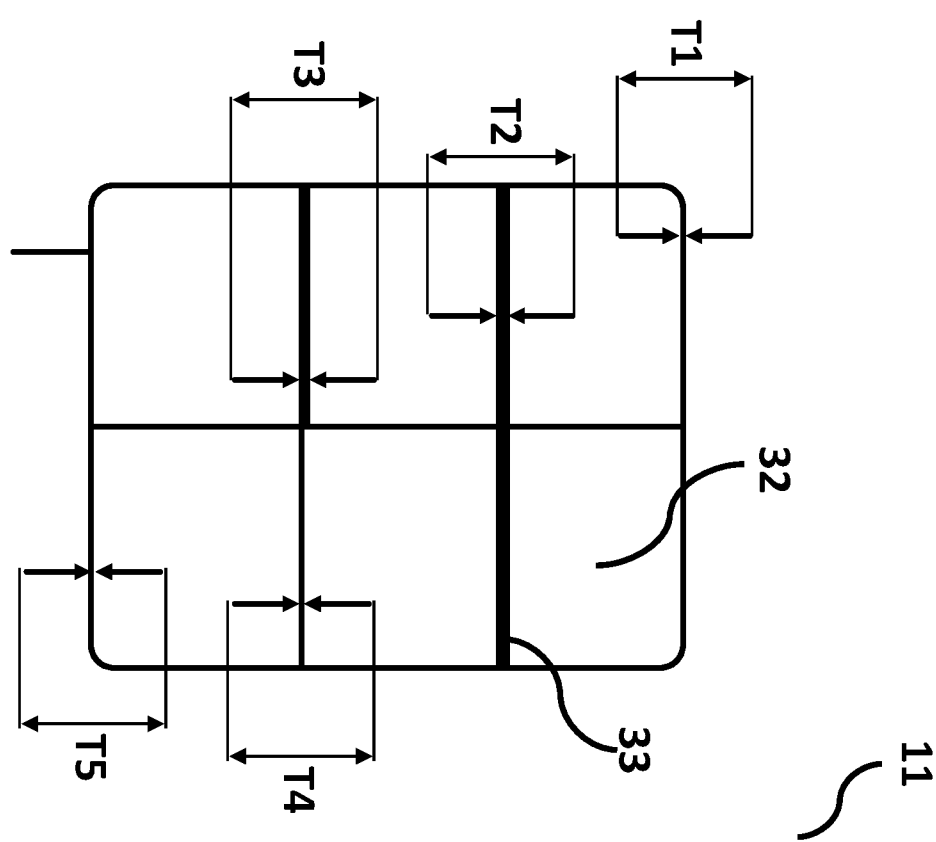


Fig. 8

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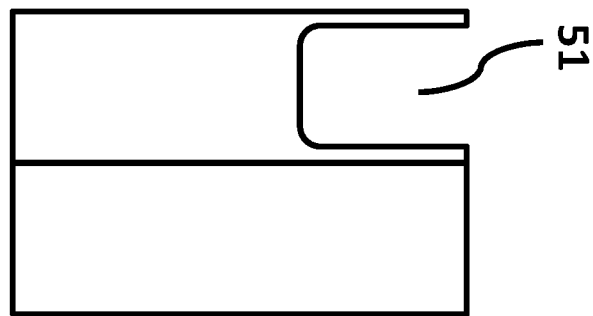


Fig. 9

10/13

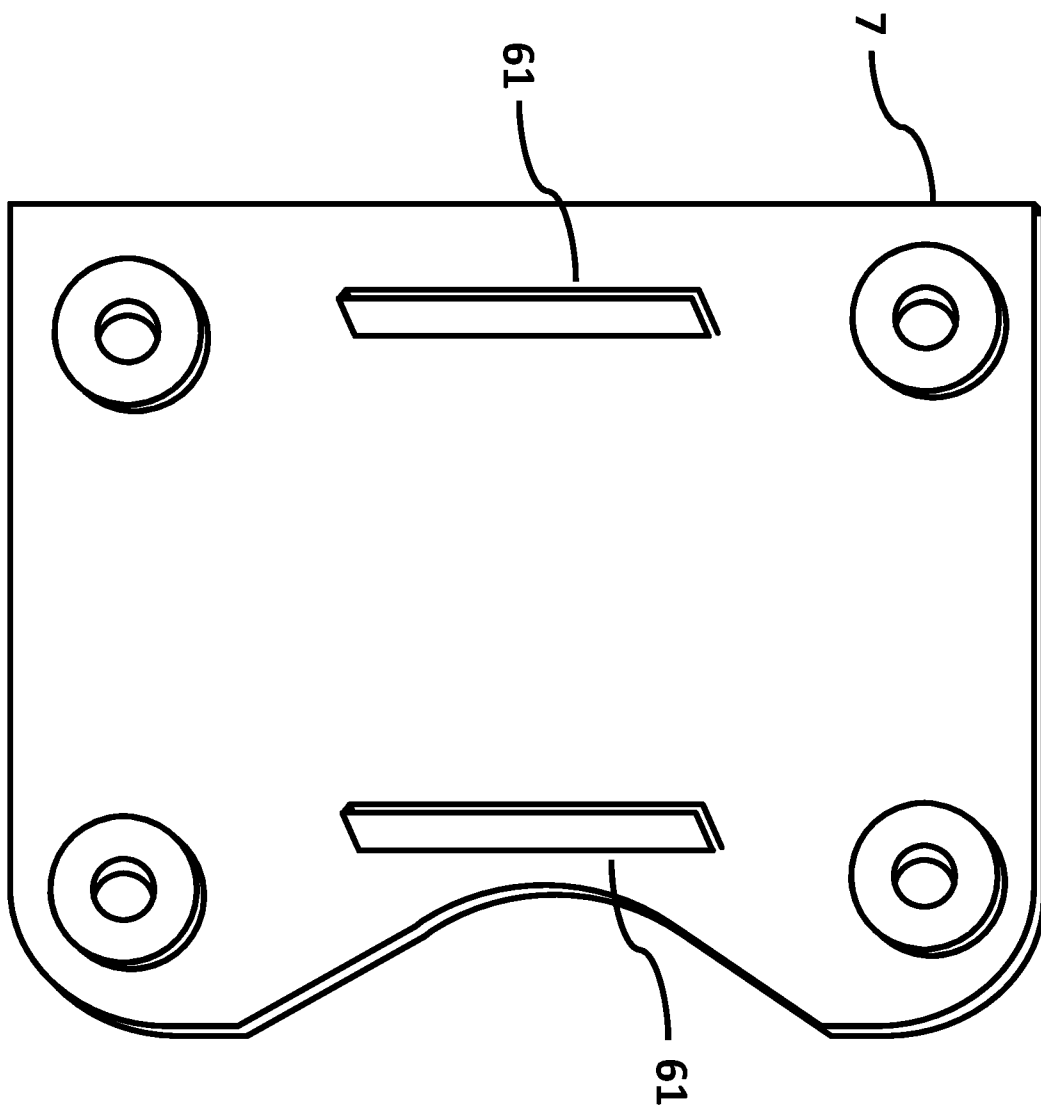


Fig. 10

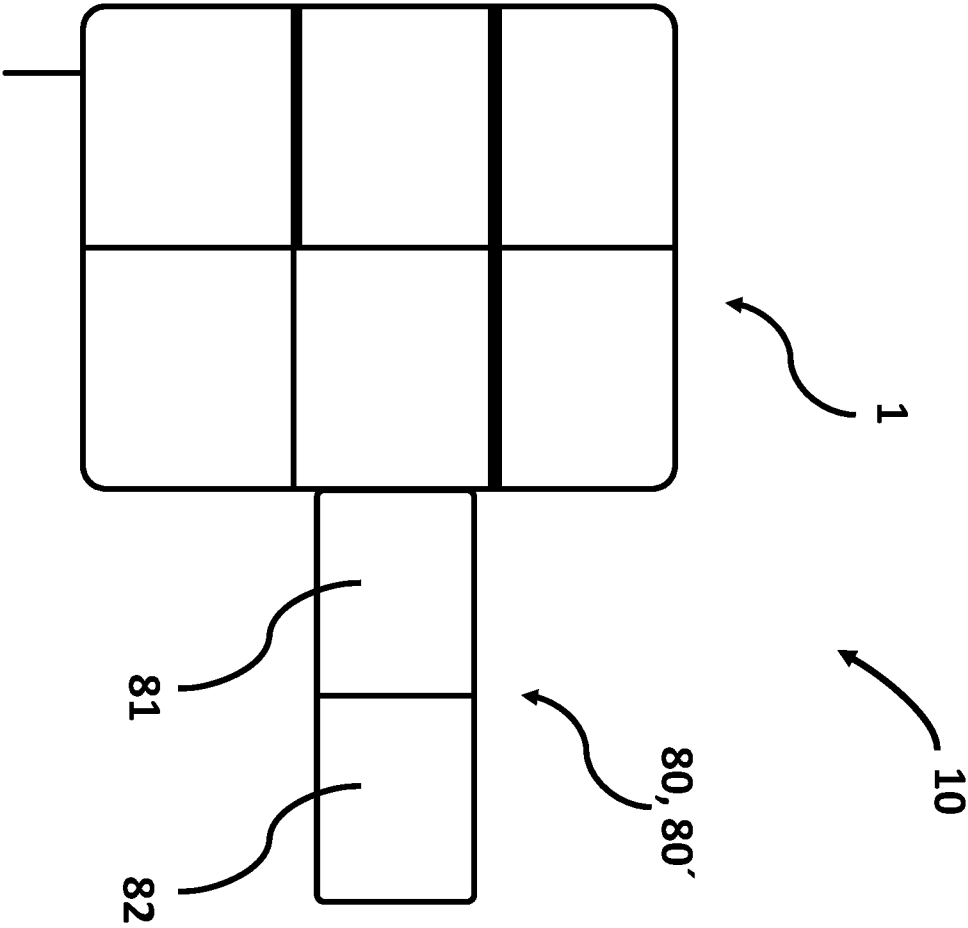


Fig. 11

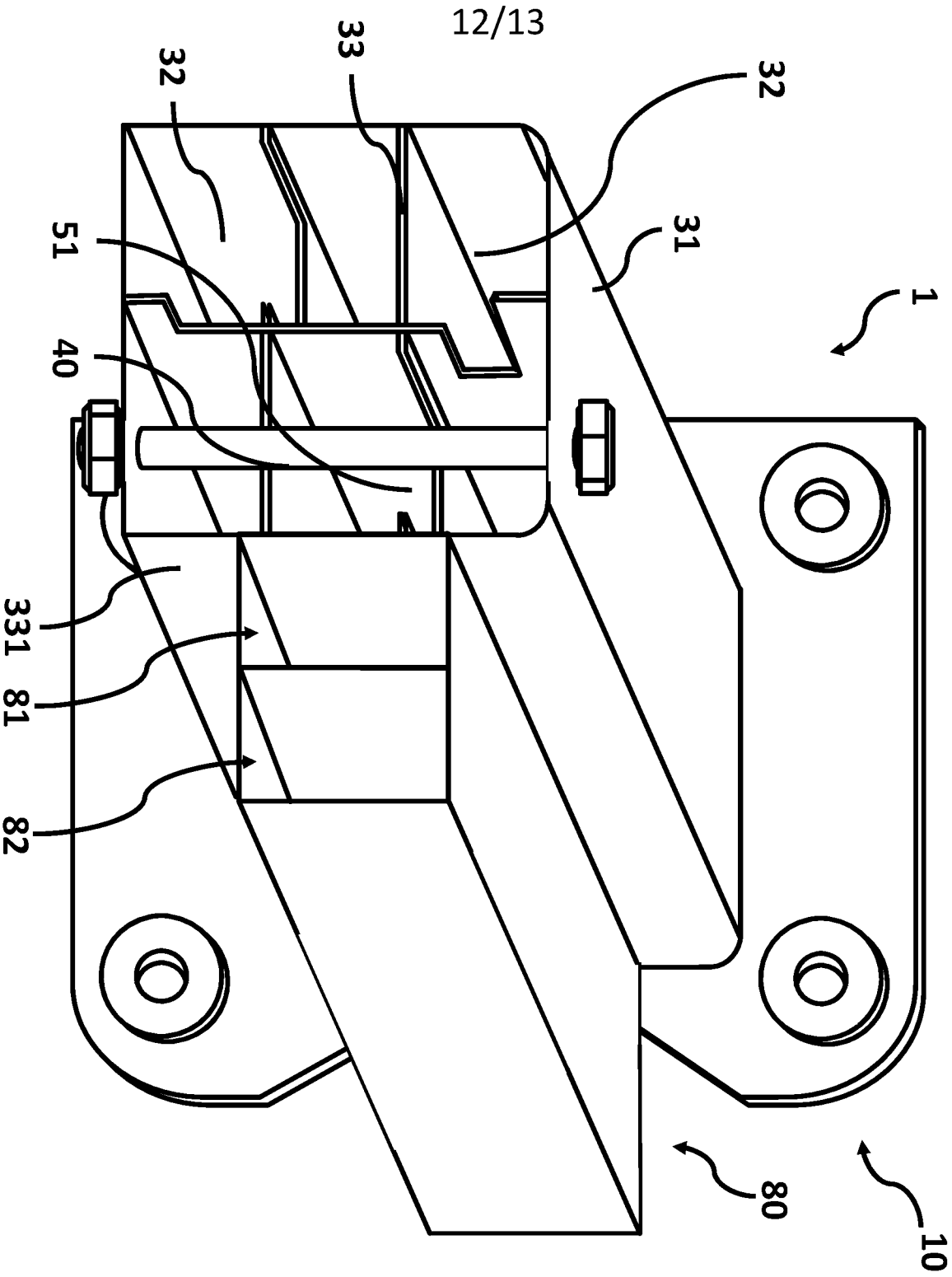


Fig. 12

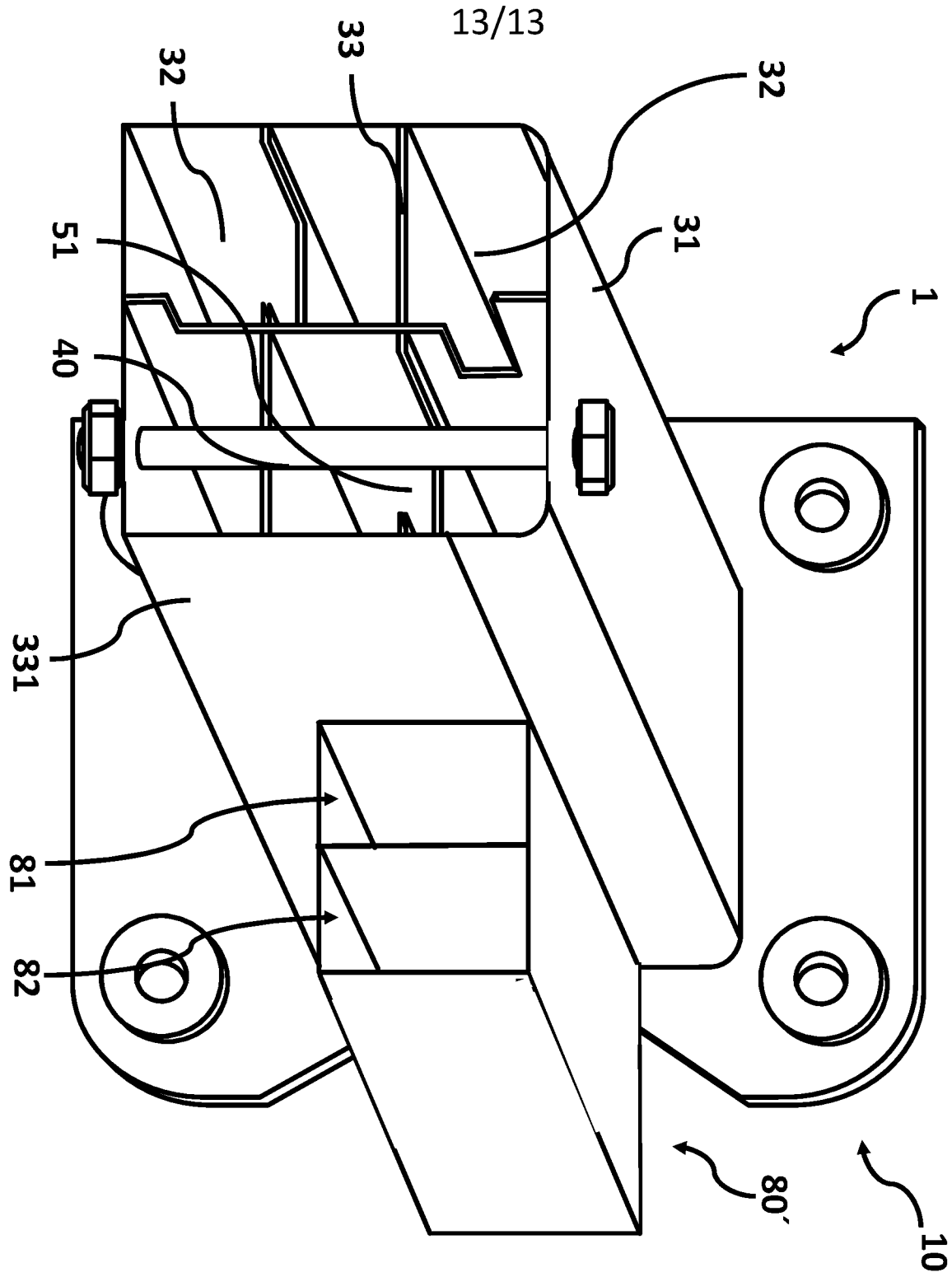


Fig. 13

INTERNATIONAL SEARCH REPORT

International application No
PCT/SE2016/050222

A. CLASSIFICATION OF SUBJECT MATTER

INV. B60R19/34 B60R19/18
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

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)

EP0-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.
X	JP 2001 130442 A (NIPPON LIGHT METAL CO) 15 May 2001 (2001-05-15)	1-4, 9-13, 16, 17
Y	paragraph [0030]	5, 6, 14, 15
A	figure 8	7
Y	----- DE 10 2004 034519 B3 (PORSCHE AG [DE]) 2 March 2006 (2006-03-02) paragraphs [0001], [0004], [0005], [0011] - [0013], [0016] figures	5, 6
Y	----- EP 1 264 739 A1 (ADLEV SRL [IT]) 11 December 2002 (2002-12-11) paragraphs [0011], [0013], [0014], [0018], [0020] figure 2 ----- -/-	14, 15

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

6 June 2016

Date of mailing of the international search report

10/06/2016

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
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Fax: (+31-70) 340-3016

Authorized officer

Jankowska, M

INTERNATIONAL SEARCH REPORT

International application No

PCT/SE2016/050222

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	paragraphs [0002], [0022] - [0030] figures	2,5-8, 14,15
Y	----- JP 2012 111356 A (SHOWA DENKO KK) 14 June 2012 (2012-06-14) paragraphs [0023], [0025] figures 1-3	2
Y	----- EP 1 447 283 A2 (ALCAN TECH & MAN LTD [CH]) 18 August 2004 (2004-08-18) paragraph [0023] claim 1 figure 3	5,6
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X	----- US 2010/126813 A1 (HAYASHI KENTARO [JP]) 27 May 2010 (2010-05-27) paragraphs [0002], [0006], [0007], [0015] - [0021], [0024] - [0027] figures	1-4, 9-11,17
X	----- EP 1 623 881 A1 (GM GLOBAL TECH OPERATIONS INC [US]) 8 February 2006 (2006-02-08) paragraphs [0004], [0017] - [0019]; figures 1,2 -----	1-4,7,8, 10-12, 16,17

INTERNATIONAL SEARCH REPORT

Information on patent family members

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