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

(11) **EP 4 053 359 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
07.09.2022 Bulletin 2022/36

(21) Application number: **22160247.7**

(22) Date of filing: **04.03.2022**

(51) International Patent Classification (IPC):
E04G 23/02 *(2006.01)* ***B66F 3/08*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
E04G 23/0229; B66F 3/08; E04G 23/0244

(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
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **04.03.2021 IT 202100005075**

(71) Applicant: **Next Innovation in Engineering S.r.l.**
20097 San Donato Milanese (Milano) (IT)

(72) Inventor: **VANZI, Ivo**
80123 Napoli (IT)

(74) Representative: **Savoca, Agatino et al**
Jacobacci & Partners S.p.A.
Corso Emilia, 8
10152 Torino (IT)

(54) **JACK ADAPTED TO BE INSERTED INTO THE THICKNESS OF A STRUCTURAL ELEMENT, AND METHOD FOR INSERTING SAID JACK IN SAID STRUCTURAL ELEMENT**

(57) A jack (9) which is adapted to be inserted into the thickness of a structural element (P) and to divert the flow of tensions in the material thereof, comprising a plate (10) having a trapezoidal cross section along a longitudinal direction, and at least one guide (12) in the form of a prism elongated along said longitudinal direction and comprising a groove (14) extended along said longitudinal direction, the plate (10) being slidably received within said groove (14) along an oblique side of said plate (10).

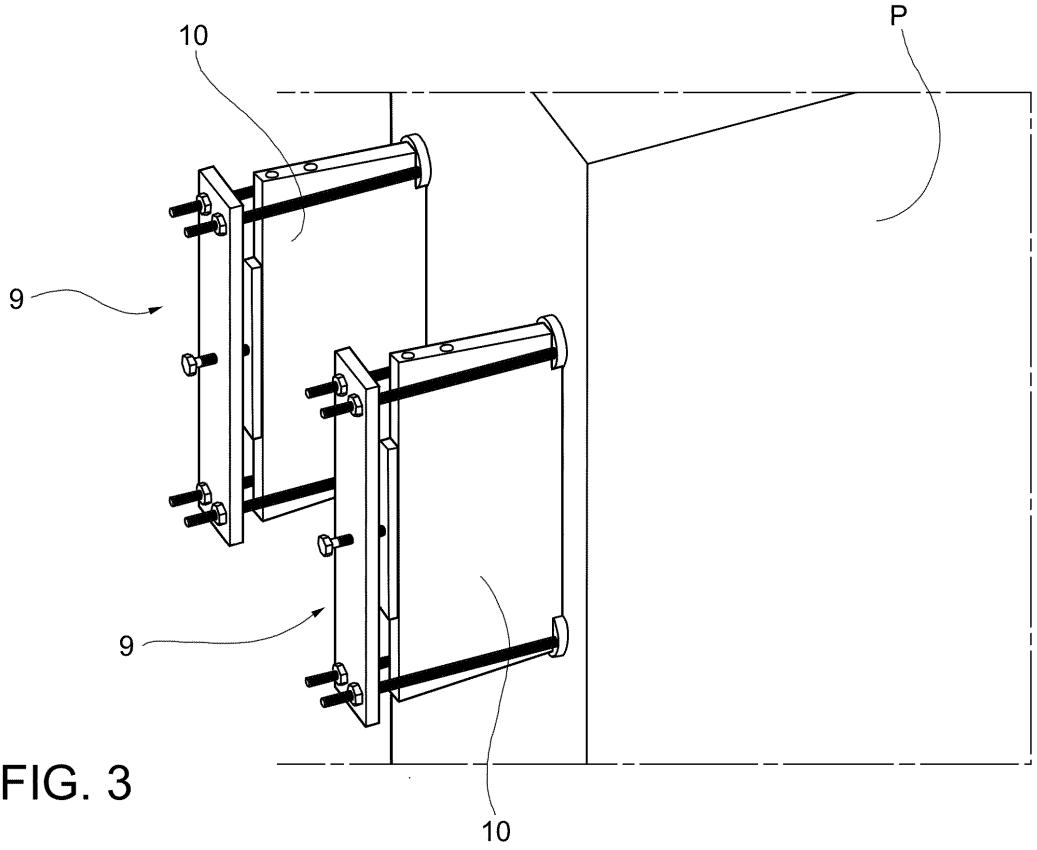

FIG. 3

EP 4 053 359 A1

Description

Technical field

[0001] This invention lies, in general, within the construction sector; in particular, the invention relates to a jack which is adapted to be inserted into the thickness of a structural element, and a process for inserting said jack into said structural element.

Summary of the invention

[0002] Known hydraulic jacks are adapted to be inserted into the thickness of a structural element (a beam, post or pillar) in order to locally discharge the tensions of the material, and make one or more holes in this material. The jacks are therefore responsible for compensating for the local increase in tensions that is caused by removing the material from the structural element.

[0003] However, hydraulic jacks may burst. They are low-reliability systems for such delicate work. The loss of a jack would in fact cause a post to break.

[0004] Moreover, in order to be inserted, hydraulic jacks require significant volumes of the continuum to be demolished. The variation in the tensional state in the continuum of the material is not negligible for the operations of inserting hydraulic jacks.

[0005] Alternatively, the prior art describes jacks which utilize the mutual sliding of wedge-shaped portions in order to mutually lift structural elements. These devices are designed to be arranged horizontally between the two elements, thus causing one to be gradually lifted/lowered with respect to the other, and are typically used when a beam or girder is intended to be placed on a post in a controlled manner, or a wall portion is intended be supported on a lintel.

[0006] Examples of solutions of this kind are known from KR 2004 0069098 A, JP H07 166514 A and DE 203 17 225 U1.

[0007] However, these solutions are not suitable for being inserted into the material of a structural element in order to locally discharge tensions therefrom and allow portions of material to be removed, for example in order for an anti-seismic isolator to be inserted therein.

[0008] The object of this invention is to overcome the aforementioned problems.

[0009] To achieve this, a jack according to this invention which is adapted to be inserted into the thickness of a structural element and to divert the flow of tensions in the material thereof comprises a plate having a trapezoidal cross section, i.e. which is tapered in a longitudinal direction, and at least one guide in the form of an elongated prism which includes a groove in which the plate is slidably received along an oblique side thereof.

[0010] The prismatic guide is adapted to abut against a wall of a seat made in the material of the structural element into which the jack is inserted. Once the guide has been positioned in the thickness of the structural element, the forced insertion of the plate inside the groove in the guide (i.e. from the smaller base of the trapezoidal cross section of the plate towards the longer base thereof) generates a wedge effect on the guide, leading to the loading of the jack.

[0011] In general, this is therefore a system based on the wedge effect (which may be assisted by thermal dilation imposed on the plate of the jack) that is adapted to divert the flow of tensions in a continuous (or non-continuous), elastic or non-elastic medium in the desired manner.

[0012] More particularly, this is a system adapted to divert compression isostatics by transferring them from volumes of the continuum that are intended to be discharged by compression or other volumes of the same continuum.

[0013] The aforementioned diversion and transfer take place with the insertion of the jack into the continuum. This insertion is very easy to do, requiring only dry machining and the removal of a negligible volume of material; it also creates a negligible variation in the initial tensional state.

[0014] Moreover, with the same area occupied in the cross section of the post, known hydraulic jacks may exert tensions in the tens of MPa, whereas a jack according to this invention may exert tensions in the hundreds of MPa.

[0015] According to one embodiment of the invention, a method for inserting a jack into a structural element includes the step of coring the concrete above and below the jack, thus creating a cut having a suitable thickness for said jack to be inserted therein (for example equal to 30 mm); the cylindrical guide(s) (preferably made of aluminum) are then inserted into the holes, and the plate of the jack is inserted into the tracks made in said cylinders and is clamped therein by a screw system inside the tracks; the concrete is thus discharged (in this step, the jack acts as a wedge).

[0016] The plate and/or the prismatic guides are advantageously cooled before their insertion or heated afterwards. In this case, once the plate has been forced inside the guides, there is a wait (for example for approximately 30 minutes) for the temperature of the jacks to change from the initial temperature (for example approximately -20 °C, which may be achieved by keeping the plate in a freezer before insertion into the guides) to the ambient temperature, for example 20°. The thermal gradient causes dilation of the jack and further discharge of tensions of the concrete. The thermal gradient may also be increased by bringing the jack to temperatures less than -20° before insertion and/or by bringing the jack to temperatures greater than ambient temperature after insertion. To this end, electrical resistors may be inserted into the jack.

[0017] After these steps, the concrete between two jacks is discharged and may be removed.

[0018] After the concrete between the two jacks has been removed, a seismic isolator may be inserted, for

example, and the jacks are then discharged and the two remaining parts of concrete cover are cut.

[0019] During all of these works, reinforcements formed by a piece of C-shaped steel and threaded bars may be present. The C shapes confine the concrete and divert the flow of tensions in the desired manner.

[0020] All of the steps are very fast to perform as they are carried out dry.

[0021] A jack according to this invention may be successfully used to insert anti-seismic isolators inside posts of buildings made of reinforced concrete or in posts of bridges (for example to create manholes, if not already present, in hollow bridge posts or in the caissons of bridge decks), or to demolish wall screw taps in masonry buildings, in order to prevent vertical movements at the upper levels and subsequent damage, or even breakage, of structural elements (floor beams) and non-structural elements (floors, windows, doors).

[0022] A jack according to this invention may also be advantageously used to demolish elements made of concrete or reinforced concrete, even in difficult working conditions, for example to demolish foundations in underwater works, tunnel linings, and small buildings.

[0023] The aforesaid and other objects and advantages are achieved, according to an aspect of the invention, by a jack and a process for inserting said jack into a structural element, which jack and process have the features defined in the appended claims. Preferred embodiments of the invention are defined in the dependent claims.

Brief description of the drawings

[0024] The functional and structural features of some preferred embodiments of a jack according to the invention will now be described. Reference is made to the accompanying drawings, in which:

- Fig. 1 is a perspective schematic view of a jack according to an embodiment of this invention;
- Fig. 2 is a perspective, partially exploded view of the jack in Fig. 1;
- Fig. 3 is a perspective schematic view of a structural element into which a pair of jacks is inserted, according to an embodiment of this invention; and
- Fig. 4A to 4D show a sequence of steps for applying a seismic isolator inside a structural element, using a pair of jacks, according to an embodiment of this invention.

Detailed description

[0025] Before describing in detail a plurality of embodiments of the invention, it should be clarified that the invention is not limited in its application to the design details and configuration of the components presented in the following description or illustrated in the drawings. The invention is able to assume other embodiments and to be implemented or constructed in practice in different ways. It should also be understood that the phraseology and terminology have a descriptive purpose and should not be construed as limiting.

[0026] With reference, by way of example, to Fig. 1, a jack 9 which is adapted to be inserted into the thickness of a structural element P and to divert the flow of tensions in the material thereof comprises a plate 10 which includes a pair of faces having a trapezoidal profile, which faces are parallel to one another and transversely spaced by a thickness of the plate 10, said plate 10 being designed to be inserted into a vertical slit made in the structural element P.

[0027] The jack 9 also comprises at least one guide 12 in the form of a prism or cylinder elongated along a longitudinal direction and comprising a groove 14 which is extended along this longitudinal direction and adapted to slidably receive an oblique side of said plate 10.

[0028] The 'longitudinal direction' may advantageously be understood to mean a direction extending between the longer base and the smaller base of the trapezoidal faces, and/or a direction in which the jack 9 is inserted into the relevant vertical slit made in the structural element P.

[0029] The 'oblique side' of said plate 10 may advantageously be understood to mean a perimeter face of this plate 10 that is formed by the thickness thereof along an oblique joining line between the longer and smaller bases of the parallel faces of the plate 10.

[0030] The guide 12 is preferably designed as a cylinder extended along this longitudinal direction and having an at least partly circular cross section.

[0031] The groove 14 advantageously has a constant cross section along said longitudinal direction.

[0032] According to one embodiment, the groove 14 has a decreasing cross section along said longitudinal direction, complementary to the profile of the oblique side of the plate 10 that is able slide within said groove 14.

[0033] The plate 10 may have a right trapezoidal profile (i.e. may have three sides consecutively perpendicular to each other and only one oblique side). In the example shown, the cross section of the plate 10 along the longitudinal direction is instead isosceles trapezoidal (i.e. with a longer base in the wider cross section, a smaller base spaced apart from the longer base along said longitudinal direction, and two oblique sides converging from the longer base towards the smaller base). The jack 9 also comprises a pair of guides 12 arranged symmetrically with respect to a longitudinal center line of the plate 10, the oblique sides of said plate 10 being slidably received in respective guides 12.

[0034] The jack 9 preferably also comprises a tie rod 16 connected to the plate 10 and to at least one guide 12, this tie rod 16 being adapted to pull the plate 10 and the guide 12 towards each other such that the plate 10 slides inside the groove 14 of the guide 12.

[0035] The tie rod 16 may comprise a bracket 18 which abuts against the transverse thickness of the longer base of the plate 10, a threaded rod 20 which engages at one

end with said bracket 18 and at the other end with a relevant guide 12, and a pusher 22 which is adapted to slide the bracket 18 along the threaded rod 20 so as to push the plate 10 towards said guide 12.

[0036] According to one embodiment, the plate 10 comprises a coil adapted to exchange heat with said plate 10.

[0037] According to a further aspect of the invention, shown by way of example in Fig. 4A-4D, a process for removing a portion of material from a structural element P comprises the steps of:

a) making a pair of vertical slits which pass through the thickness of the structural element P and are shaped to laterally delimit the portion of material to be removed;
b) inserting respective jacks 9 into said slits;
c) orienting said jacks 9 such that the respective guides 12 abut against corresponding ends of the respective slits;
d) pushing the plate 10 towards the relevant at least one guide 12 such that the former slides inside the latter along a relevant oblique side of said plate 10, from the smaller cross section of the latter towards the greater cross section of same (in so doing, a wedge effect is achieved, created by the forced insertion of the plates 10 into the respective guides 12); and
e) when a predetermined stress exerted by the jacks 9 on the surrounding material is reached, removing the portion of material to be removed (for example, a portion of material between the two facing plates 10).

[0038] Step b) above is carried out by providing jacks 9 which each comprise a plate 10 having a trapezoidal cross section along a longitudinal direction, and at least one guide 12 in the form of a prism or cylinder elongated along said longitudinal direction and comprising a groove 14 which is extended along said longitudinal direction, the plate 10 being slidably received within said groove 14 along an oblique side of said plate 10, and/or by providing jacks 9 which each comprise a plate 10 that includes a pair of faces having a trapezoidal profile (which faces are parallel to one another and transversely spaced apart by a thickness of the plate 10), and at least one guide 12 in the form of a prism or cylinder elongated along a longitudinal direction and comprising a groove 14 which is extended along this longitudinal direction and adapted to slidably receive an oblique side of said plate 10.

[0039] Step b) above is advantageously preceded by a step of cooling the plate 10 and/or is followed by a step of heating the plate 10.

[0040] Step e) may be followed by the step of removing the jacks 9, thus gradually discharging the material surrounding the slits.

[0041] Moreover, between steps e) and f), it is also possible, for example, to arrange a seismic isolator 15 inside the cavity formed in the structural element P by the removal of the material, which seismic isolator is for example an elastomeric isolator or a curved surface isolator, sliding flat surface isolator, sliding pendulum isolator, etc. Elastomeric isolators, for example, are typically composed of a series of steel plates separated by layers of elastomeric material (rubber) that have been bonded by vulcanization. In general, seismic isolators 15 are adapted to decrease the accelerations to which the construction is subjected by means of two factors, namely an increase in the fundamental period of vibration, and an increase in energy dissipation (damping). Therefore, the jacks 9 and the portions of the structural element P to the sides of the seismic isolator 15 may be removed, so as to create a complete break of continuity vertically in the material of the structural element P. The seismic isolator 15 is loaded accordingly.

[0042] Various aspects and embodiments of a jack adapted to be inserted into the thickness of a structural element and a process for inserting said jack into said structural element according to the invention have been described. It is understood that each embodiment may be combined with any other embodiment. Moreover, the invention is not limited to the embodiments described, but may be varied within the scope defined by the appended claims.

Claims

1. A jack (9), adapted to be inserted into the thickness of a structural element (P) and to divert the flow of tensions in the material thereof, comprising:

   - a plate (10) comprising a pair of faces having a trapezoidal profile, which faces are parallel to one another and transversely spaced by a thickness of the plate (10), said plate (10) being designed to be inserted into a vertical slit made in the structural element (P); and
   - at least one guide (12) in the form of a prism or cylinder elongated along said longitudinal direction and comprising a groove (14) which is extended along said longitudinal direction and adapted to slidably receive an oblique side of said plate (10).

2. Jack according to claim 1, wherein the guide (12) is designed as a cylinder extended along said longitudinal direction and having an at least partly circular cross section.

3. Jack according to claim 1 or 2, wherein the groove (14) has a constant cross section along said longitudinal direction.

4. Jack according to claim 1 or 2, wherein the groove (14) has a decreasing cross section along said lon-

gitudinal direction, complementary to the profile of the oblique side of the plate (10) that is able to slide within said groove (14).

5. Jack according to any one of the preceding claims, wherein the cross section of the plate (10) along the longitudinal direction is isosceles trapezoidal, said jack (9) further comprising a pair of guides (12) arranged symmetrically with respect to a longitudinal center line of the plate (10), the oblique sides of said plate (10) being slidably received in respective guides (12).

6. Jack according to any one of the preceding claims, further comprising a tie rod (16) connected to the plate (10) and to at least one guide (12), said tie rod (16) being adapted to pull the plate (10) and the guide (12) towards each other such that the plate (10) slides inside the groove (14) of the guide (12).

7. Jack according to claim 6, wherein the tie rod (16) comprises a bracket (18) which abuts against the transverse thickness of the longer base of the plate (10), a threaded rod (20) which engages at one end with said bracket (18) and at the other end with a relevant guide (12), and a pusher (22) which is adapted to slide the bracket (18) along the threaded rod (20) so as to push the plate (10) towards said guide (12).

8. Jack according to any one of the preceding claims, wherein the plate (10) comprises a coil, adapted to exchange heat with said plate (10).

9. Process for removing a portion of material from a structural element (P), comprising the steps of:

a) making a pair of vertical slits which pass through the thickness of the structural element (P) and are shaped to laterally delimit the portion of material to be removed;
b) inserting respective jacks (9) which each comprise a plate (10) having a trapezoidal cross section along a longitudinal direction, and at least one guide (12) in the form of a prism or cylinder elongated along said longitudinal direction and comprising a groove (14) which is extended along said longitudinal direction, the plate (10) being slidably received within said groove (14) along an oblique side of said plate (10), and/or jacks (9) designed according to any one of the preceding claims, into said slits;
c) orienting said jacks (9) such that the respective guides (12) abut against corresponding ends of the respective slits;
d) pushing the plate (10) towards the relevant at least one guide (12) such that the former slides inside the latter along a relevant oblique side of said plate (10), from the smaller cross section of the latter towards the greater cross section of the same; and
e) when a predetermined stress exerted by the jacks (9) on the surrounding material is reached, removing the portion of material to be removed.

10. Process according to claim 9, comprising, after step e), the step of removing the jacks (9), thus gradually discharging the material surrounding the slits.

11. Process according to claim 9 or 10, comprising, after step e), the steps of:

f) applying a seismic isolator (15) in the portion of material removed in step e);
g) removing the jacks (9); and
h) removing the portions of the structural element (P) to the sides of the seismic isolator (15), in order to create a complete break of continuity vertically in the material of the structural element (P).

12. Process according to any one of claims 9 to 11, wherein step (b) is preceded by a step of cooling the plate (10) and/or is followed by a step of heating the plate (10).

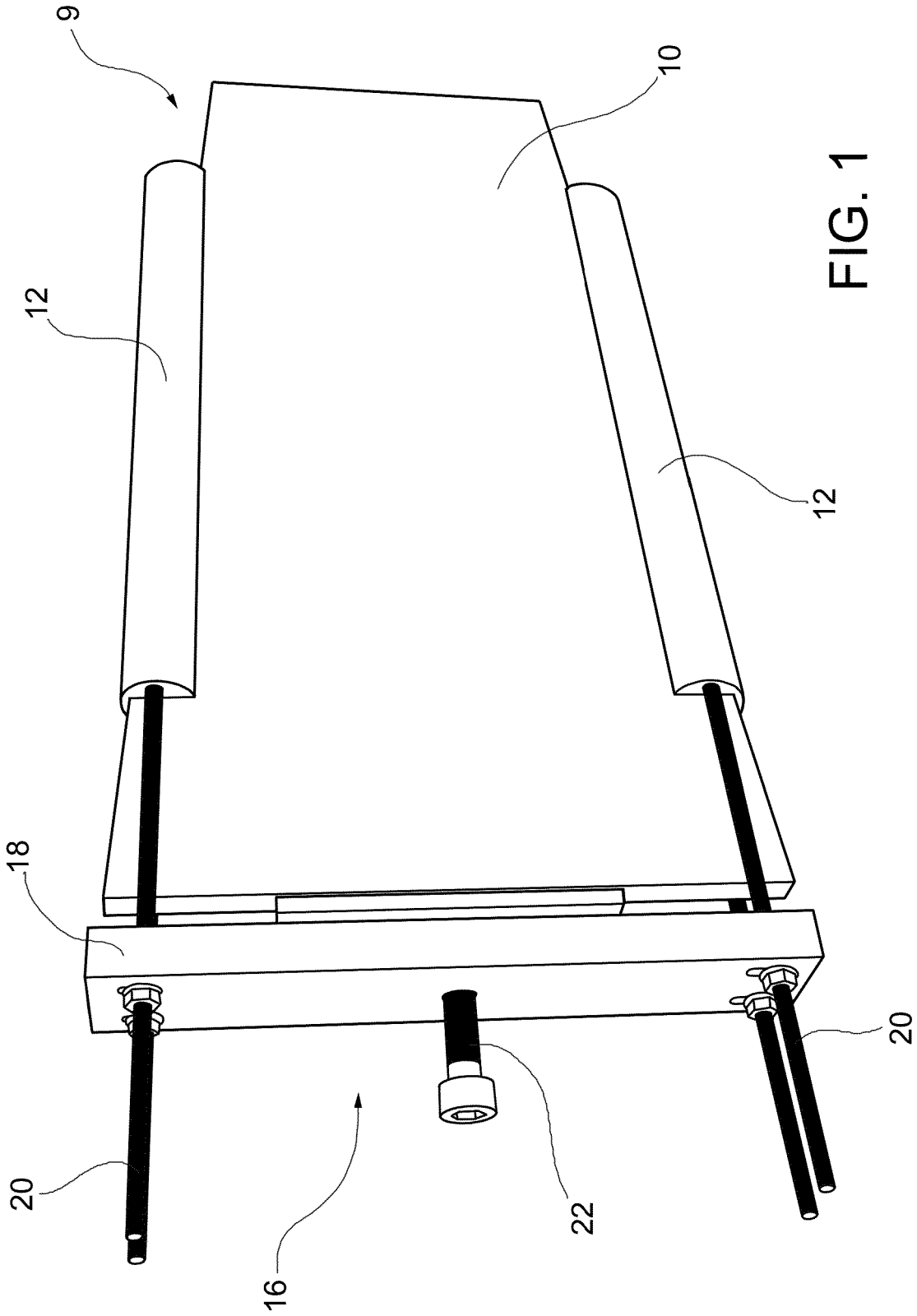

FIG. 1

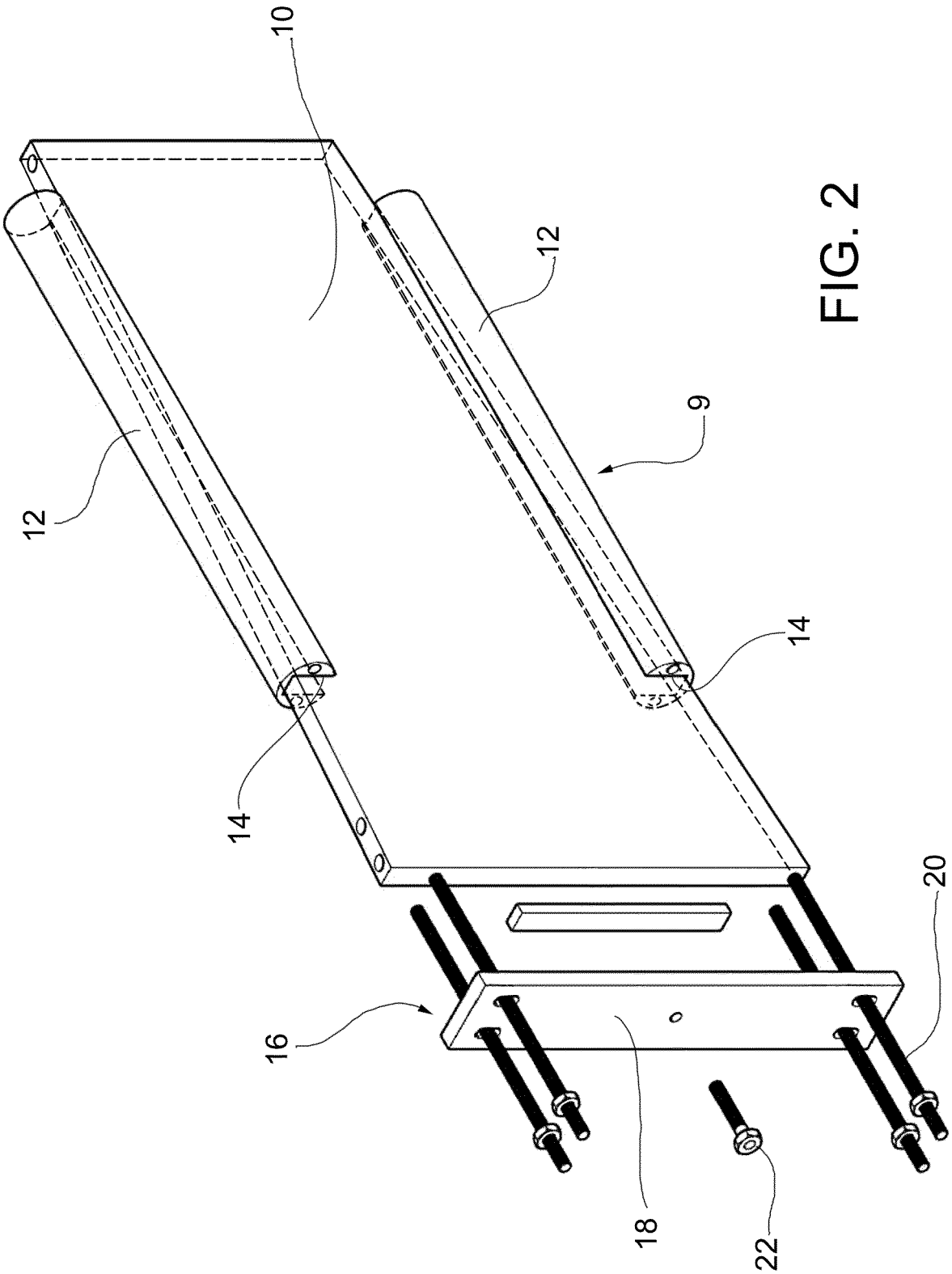

FIG. 2

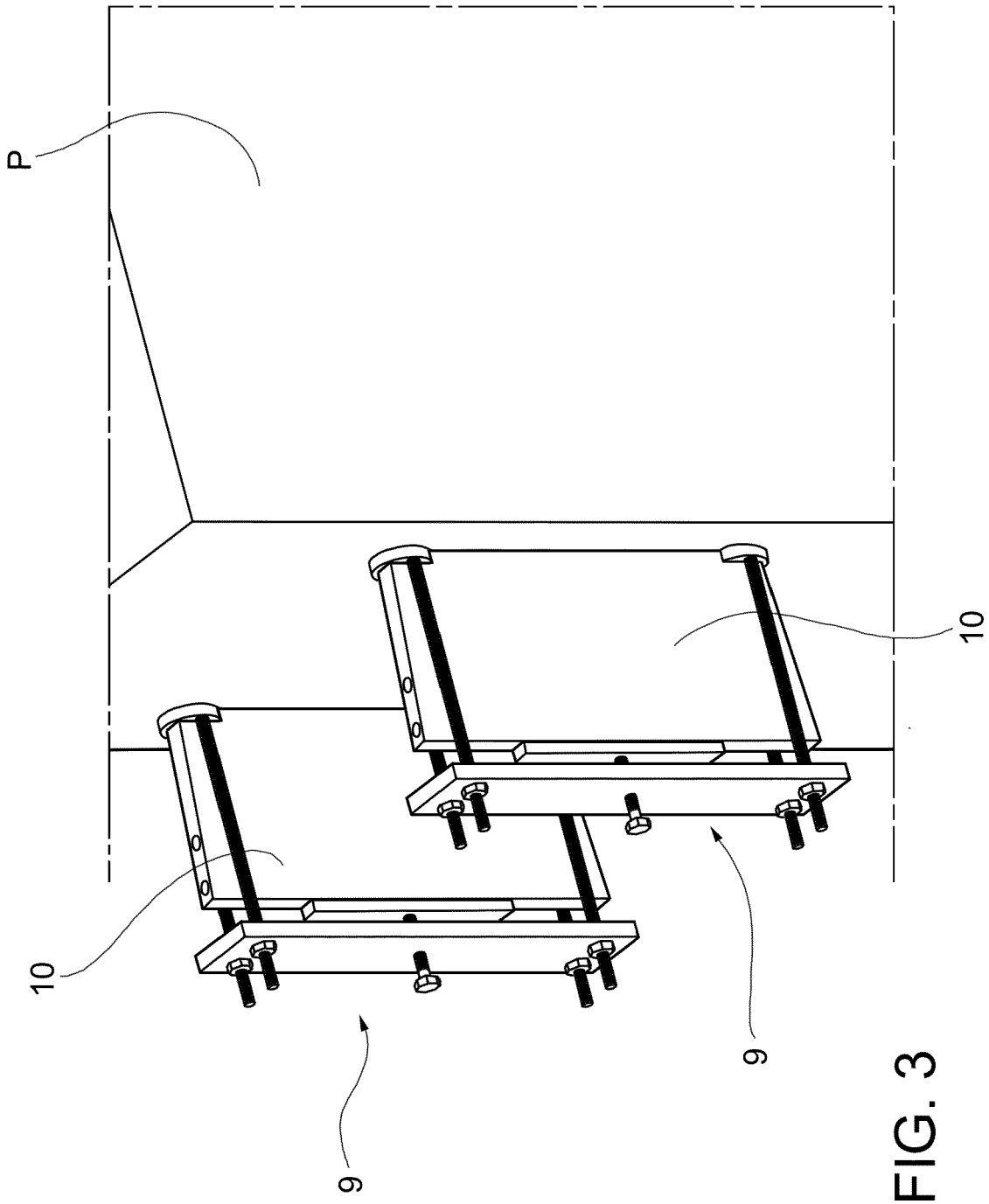

FIG. 3

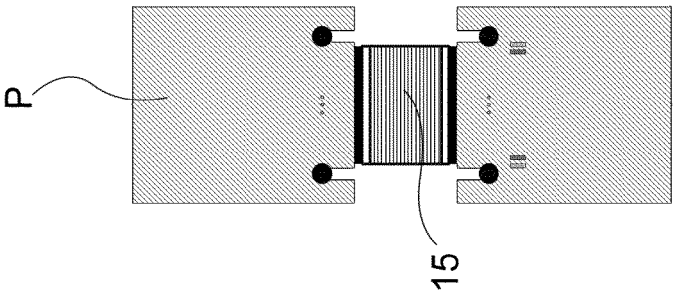

FIG. 4D

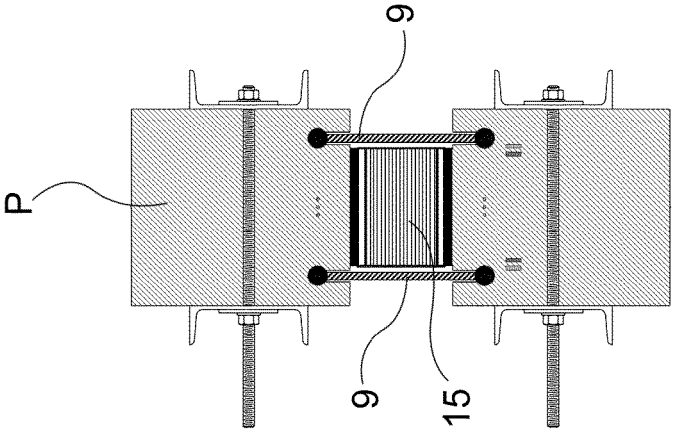

FIG. 4C

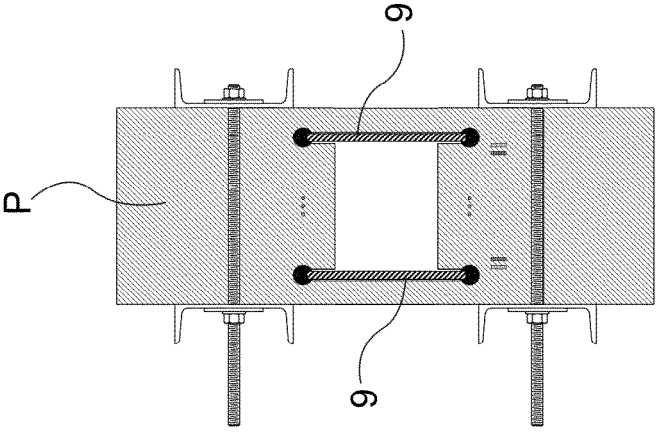

FIG. 4B

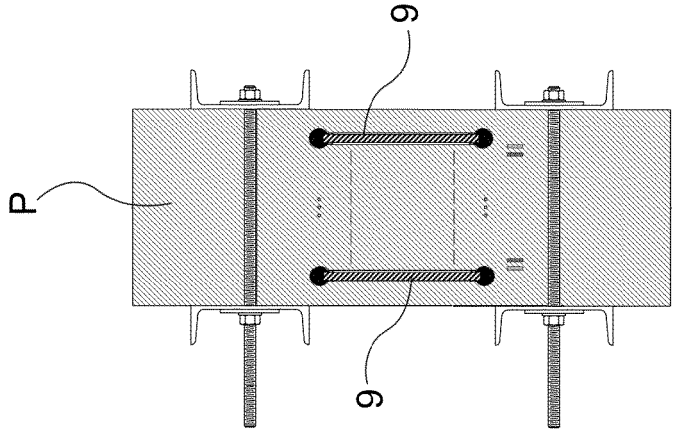

FIG. 4A

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 22 16 0247

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	KR 2004 0069098 A (ULSAN IND EDUCATION FOUNDATION) 4 August 2004 (2004-08-04)	1-3,5,6, 8	INV. E04G23/02
A	* the whole document *	9-12	B66F3/08
X	JP 2000 086169 A (NONAKA HARUO) 28 March 2000 (2000-03-28)	1-8	
A	* the whole document *	9-12	
X	DE 203 17 225 U1 (SCHOECK ENTWICKLUNGSGMBH [DE]) 8 January 2004 (2004-01-08)	1-3,5	
A	* the whole document *	6-12	
X	JP H07 166514 A (MATSUO ENG KK) 27 June 1995 (1995-06-27)	1,2,4-8	
A	* the whole document *	9-12	
A	US 2004/000103 A1 (CHEN CHING-SHYANG [TW] ET AL) 1 January 2004 (2004-01-01) * paragraphs [0005], [0023]; figures 1-16 *	8	
A	JP H11 50675 A (TAISEI CORP) 23 February 1999 (1999-02-23) * the whole document *	8	TECHNICAL FIELDS SEARCHED (IPC) E04G E01D E04H
A	JP H10 184032 A (KUMAGAI GUMI CO LTD) 14 July 1998 (1998-07-14) * the whole document *	9-12	B66F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	8 July 2022	Garmendia Irizar, A

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 16 0247

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

08-07-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 20040069098 A	04-08-2004	NONE	
JP 2000086169 A	28-03-2000	NONE	
DE 20317225 U1	08-01-2004	NONE	
JP H07166514 A	27-06-1995	JP 2809114 B2	08-10-1998
		JP H07166514 A	27-06-1995
US 2004000103 A1	01-01-2004	NONE	
JP H1150675 A	23-02-1999	NONE	
JP H10184032 A	14-07-1998	JP 3437904 B2	18-08-2003
		JP H10184032 A	14-07-1998

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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 20040069098 A **[0006]**
- JP H07166514 A **[0006]**
- DE 20317225 U1 **[0006]**