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

(11) **EP 3 950 567 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
09.02.2022 Bulletin 2022/06

(21) Application number: **21189390.4**

(22) Date of filing: **03.08.2021**

(51) International Patent Classification (IPC):
B66F 9/075 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
B66F 9/07545

(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: **04.08.2020 IT 202000019144**

(71) Applicant: **TOYOTA MATERIAL HANDLING MANUFACTURING ITALY S.p.A**
40132 Bologna (IT)

(72) Inventor: **PESSO, Tommaso**
44028 POGGIO RENATICO (FERRARA) (IT)

(74) Representative: **Casadei, Barbara**
Bugnion S.p.A.
Via di Corticella, 87
40128 Bologna (IT)

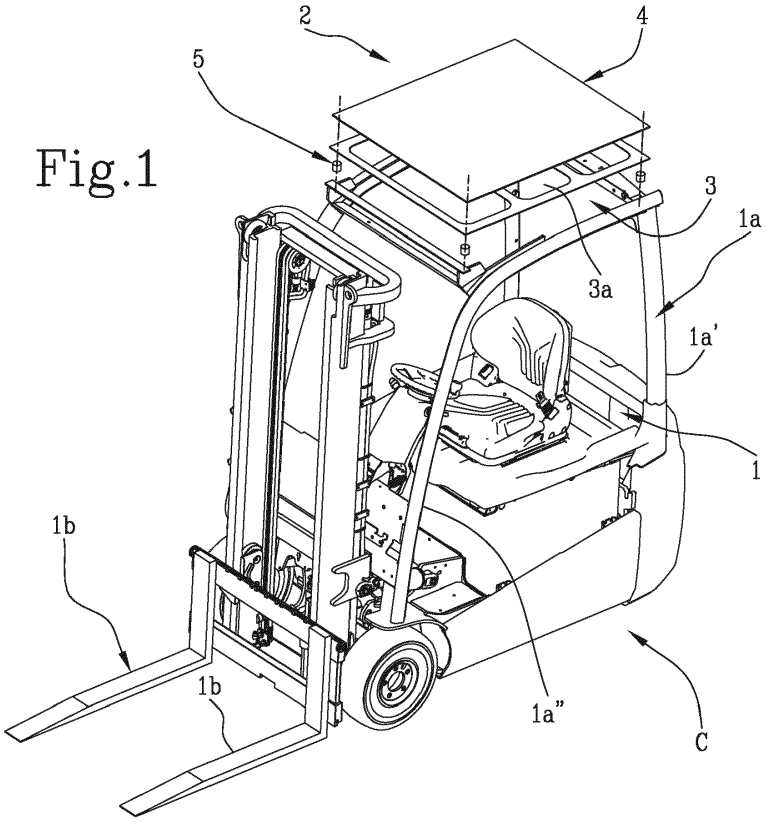
(54) **LIFT TRUCK**

(57) Described is a lift truck (C) comprising a driver protection (1) having a roof (2) comprising a supporting frame (3) fixed or fixable to a load-bearing structure (1a) of the driver protection (1).

The supporting frame (3) is equipped with at least one opening (3a) defining a window.

The roof (2) also comprises a sheet of glass (4) positioned above the supporting frame (3) and at least one damping element (5) interposed between the supporting frame (3) and the load-bearing structure (1a). The at least one damping element (5) is configured to dissipate energy deriving from an impact on the roof (2).

Fig.1



EP 3 950 567 A1

Description

[0001] This invention relates to a lift truck which is widely used in the field of moving loads inside companies and factories.

[0002] The prior art lift trucks are usually equipped with forks slidable along suitable vertical guides for positioning or picking up loads located, for example, on shelving present in the warehouses. These forks are moved between a lowered position, in which they are close to the ground, and a raised position, in which they are raised above the ground in such a way as to pick up/position loads in the highest zones of the shelving.

[0003] As is known, lift trucks also comprise a driver's cab from which an operator moves the lift truck and then the forks.

[0004] In particular, lift trucks are known which are equipped with a "panoramic" roof, that is to say, a roof usually comprising a part made of glass or transparent material, which allows the driver of the truck to also have a view above his/her head in such a way as to allow the driver to better control the picking up and positioning of the loads, in particular in the situation when the forks are in the most raised position.

[0005] In other words, in the position of maximum raising of the forks, the panoramic roof allows the driver to control in a more convenient and efficient manner the movement of the loads thanks to the high visibility provided by the roof.

[0006] An example of a lift truck equipped with a "panoramic" roof is described and illustrated in patent document JPH078106.

[0007] It is also known that such panoramic roofs must comply with specific safety regulations in such a way as to guarantee the safety of the driver in the event of accidental falling of a load above the driver's cab, that is to say, over the driver's protection.

[0008] In fact, it is sometimes possible that loads slide from the forks and fall on the driver's protection roof, causing, in impact, a plastic deformation and/or a breaking of the roof.

[0009] Currently, the roofs of lift trucks must meet certain requirements, including, for example, the Dynamic Test ISO 6055, Par. 3.4.2. According to the above-mentioned test, weights are dropped onto the driver's protection roof and the plastic deformation of the roof measured. If the plastic deformation is less than a predetermined limit value the test is considered to be passed, that is to say, the roof satisfies the Dynamic Test.

[0010] In order to keep the plastic deformation value less than the limit value specified by the Test, the prior art trucks are reinforced and, if necessary, devices and/or membranes are mounted on them which are able to at least partly dissipate the energy deriving from an impact due to a falling load.

[0011] In this regard, prior art trucks have some disadvantages in terms of weight of the roof structure, cost and visibility permitted for the driver.

[0012] More in detail, in order to pass the Dynamic Test and therefore withstand any impact of a falling load, the structure of the roof is strengthened, for example by thickening the glass and/or the frame of the roof, thus becoming heavy and expensive, also limiting the presence of any panoramic windows, to the detriment of the visibility of the driver. Disadvantageously, moreover, in order to guarantee the safety of the driver, the surface of the glass part of the roof is considerably reduced so as to strengthen its structure.

[0013] In this situation, the view available to the driver is considerably reduced, making the operations for moving the forks and the loads awkward and difficult.

[0014] In addition, if a membrane is introduced to dissipate the energy of a falling load, it obstructs the vision of the driver from the driver's protection, forcing the driver to adopt non-ergonomic working positions.

[0015] The technical purpose of the invention is therefore to provide a lift truck which is able to overcome the drawbacks of the prior art.

[0016] The aim of the invention is therefore to provide a truck having a roof which is able to pass the Dynamic Test, in such a way as to make the entire lift truck safe, and which is able at the same time guarantee a high level of visibility during use and reduced production costs.

[0017] A further aim of the invention is to provide a lift truck whose roof has a lightweight structure but resistant to impacts and safe for the driver.

[0018] The technical purpose indicated and the aims specified are substantially achieved by a lift truck comprising the technical features described in one or more of the appended claims.

[0019] The dependent claims correspond to possible embodiments of the invention.

[0020] In particular, the aims specified are achieved by a lift truck comprising a driver protection having a roof comprising a supporting frame fixed or fixable to a load-bearing structure of the driver protection and provided with at least one opening. The roof also comprises a sheet of glass positioned above the supporting frame and at least one damping element interposed between the supporting frame and the load-bearing structure and configured to dissipate energy deriving from an impact striking on the roof.

[0021] Advantageously, the interposing of the at least one damping element between the load-bearing structure of the cab and the supporting frame is such that the roof is dampened and therefore undergoes, following impact, a plastic deformation much less than a limit plastic deformation value. Advantageously, since the plastic deformation is much smaller than the limit, the roof may be made using a supporting frame with larger openings to allow a greater and better visibility for the driver.

[0022] Advantageously, the sheet of glass may be thinner than those commonly used since it must withstand a plastic deformation which is less than a plastic deformation which normally occurs on the roofs of known type. Further features and advantages of the invention are

more apparent in the non-limiting description which follows of a non-exclusive embodiment of a lift truck.

[0023] The description is set out below with reference to the accompanying drawings which are provided solely for purposes of illustration without restricting the scope of the invention and in which:

- Figure 1 shows a perspective view of a lift truck according to the invention;
- Figure 2 shows a front view of a detail of the lift truck of Figure 1.

[0024] With reference to the accompanying drawings, the label "C" denotes a lift truck comprising a pair of forks 1b designed to lift loads and a driver protection 1 having a roof 2.

[0025] As shown in Figure 1, the roof 2 is mounted in an upper portion of the driver protection 1 in such a way as to provide a cover for the driver protection 1.

[0026] In more detail, the roof 2 is mounted on a load-bearing structure 1a of the driver protection 1.

[0027] According to the preferred embodiment, the load-bearing structure 1a is defined by four longitudinal members of which a first pair of longitudinal members 1a' extends vertically from a rear portion of the lift truck "C" whilst a second pair of longitudinal members 1a extends from a front portion of the lift truck "C".

[0028] As shown in detail in Figure 1, the second pair of longitudinal members 1a" is curved towards the first pair 1a' in such a way as to delimit the driver protection 1 at the top. In this situation, the roof 2 is mounted on the second pair of longitudinal members 1a" in such a way as to form a cover for the driver protection 1.

[0029] With reference to the roof 2, it comprises a supporting frame 3 fixed or fixable to the load-bearing structure 1a of the driver protection 1. Preferably, the supporting frame 3a is made of metal and even more preferably the supporting frame 3 is made of steel.

[0030] Advantageously, the steel makes the supporting frame 3 resistant but at the same time light.

[0031] The supporting frame 3 is also equipped with at least one opening 3a defining a window.

[0032] According to the embodiment illustrated in the accompanying drawings, the supporting frame 3 has a plurality of openings 3a, in particular three openings 3a, having in plan view a substantially rectangular cross-section. According to other possible embodiments, not illustrated, the supporting frame 3 may have a variable number of openings 3a with a plan cross section of any shape, for example square or circular.

[0033] According to a preferred embodiment, the openings 3a are placed side by side along a direction of extension of the supporting frame 3a and are uniformly distributed on the supporting frame 3 in such a way as to form a "grill".

[0034] Preferably, the openings 3a each have a first dimension of between 500 mm and 4000 mm and a second dimension of between 100 mm and 1000 mm.

[0035] Even more preferably, the first dimension is approximately equal to 1000 mm whilst the second dimension is approximately equal to 850 mm.

[0036] The terms "first dimension" and "second dimension" means the dimension of the sides of the opening 3a considering a rectangular or quadrangular shape.

[0037] Advantageously, the presence of a plurality of openings 3a allows the driver to make use of a wide visual view in such a way that the movement of the load on the raised forks 1b can be easily and clearly controlled. In a parallel fashion, the arrangement and size of the openings 3a allow the roof 2 to withstand in an optimum fashion in the event of impact with a falling load.

[0038] As shown in detail in Figure 2, the roof 2 also comprises a sheet of glass 4 positioned above the supporting frame 3.

[0039] Since the sheet of glass 4 is transparent, this allows the driver to have a view outside the cab 1 through the openings 3a but at the same time prevents external objects from entering the driver protection 1 through the openings 3a themselves.

[0040] Preferably, the sheet of glass 4 comprises a glass of layered type. Even more preferably, the sheet of glass 4 has a thickness greater than or equal to 10 mm, preferably between 10 and 25 mm.

[0041] As shown in the accompanying drawings, the roof 2 also comprises at least one damping element 5 interposed between the supporting frame 3 and the load-bearing structure 1a.

[0042] The damping element 5 is configured for dissipating an energy deriving from an impact on the dampened roof 2.

[0043] During use of the lift truck "C", loads located on the raised forks 1b may fall on the lift truck "C" itself and in particular on the roof 2. In this situation it is important that the roof 2 is able to withstand this impact, preserving the safety of the driver.

[0044] The damping element 5 is configured to dissipate the energy linked to the impact in such a way that the driver protection 1, during impact, is plastically deformed by a deformation value less than a limit deformation value so as to maintain the safety of the driver.

[0045] In other words, at the moment of impact of the load on the roof 2, the damping element 5 absorbs part of the kinetic energy of the load falling, dissipating it and therefore preventing the entire driver protection 1 from being perforated and/or crumpled, squashing the driver inside it. Advantageously, the damping element 5 makes the roof 2 a dampened roof, that is to say, a roof 2 which is able to absorb the energy deriving from an impact with a load falling in such a way as to limit the plastic deformation imparted to the driver protection 1 by the load, thereby avoiding risks for the health of the driver.

[0046] As shown in the accompanying drawings, the damping element 5 is a separate element which is interposed between the load-bearing structure 1a and the roof 2 (in particular, the supporting frame 3) in such a way as to keep, following an impact with a falling load, a value

of plastic deformation of the driver protection 1 below a limit value.

[0047] Advantageously, this arrangement allows the lift truck "C" according to the invention to pass the above-mentioned Dynamic Test, having plastic deformation values well below the limit values.

[0048] Advantageously, this arrangement makes it possible to obtain a roof 2 which is resistant and at the same time sufficiently "panoramic" so that the driver can easily and ergonomically see through the roof 2 to the outside the driver protection 1.

[0049] According to a preferred embodiment, the roof 2 comprises a plurality of damping elements 5 positioned at respective vertices of the supporting frame 3.

[0050] Preferably, the plurality of damping elements 5 comprises a damping element 5 for each vertex of the supporting frame 3.

[0051] In the case of the embodiment illustrated, since the supporting frame 3 is substantially rectangular in shape, the roof 2 comprises four damping elements 5, each of which is located at a respective vertex of the supporting frame 3.

[0052] According to another aspect of this invention, the roof 2 comprises a damping element 5 positioned in a central zone of the supporting frame 3. According to a further variant, the roof 2 comprises a damping element 5 positioned in a central zone of the supporting frame 3 in addition to the damping elements 5 positioned at a respective vertex of the supporting frame 3.

[0053] These embodiments are preferable when the pairs of the longitudinal members 1a', 1a" of the lift truck "C" cross each other close to the roof 2 to form an X-shaped load-bearing structure 1a.

[0054] In this situation, a damping element 5 is positioned at the centre of the X-shaped structure.

[0055] Advantageously, the possibility of positioning the damping elements 5 at different points of the supporting frame 3 allows the latter to be adapted to any type of load-bearing structure 1a.

[0056] Preferably, the damping elements 5 are made of a material comprising vulcanised rubber.

[0057] Even more preferably, each damping element 5 comprises at least one hydraulic piston preferably preloaded with air.

[0058] In other words, the roof 2 is applied to the load-bearing structure 1a of the driver protection 1 by interposing damping elements 5 which are able to "dampen" the roof 2 so that it can be sufficiently strong and safe if a load falls and, at the same time, can allow a wide field of vision for the driver. Advantageously, the interposing of the damping elements 5 between the load-bearing structure 1a of the driver protection 1 and the supporting frame 3 allows openings 3a to be made which are larger than those of the openings made on prior art roofs, thus facilitating the vision of the driver. Advantageously, this interposing also makes it possible to dissipate in a more efficient manner the energy deriving from an impact with a load in such a way that it can apply above the supporting frame 3 a sheet of glass 4 with a thickness greater than or equal to 10 mm, preferably between 10 and 25 mm.

[0059] In other words, thanks to the interposing of the damping elements 5 between the structure 1a of the driver protection 1 and the supporting frame 3, the lift truck "C" is capable of optimally supporting the impacts (and hence of having plastic deformation values less than a limit value). This results in a lightening of the roof 2 since the sheet of glass 4 has less thicknesses than those known in the prior art. This also results in an extension of the field of vision of the driver since the openings 3a may be larger than those made on prior art roofs, allowing a greater field of vision. The invention achieves the preset aims, overcoming the drawbacks of the prior art.

[0060] In particular, the presence and the positioning of the damping elements 5 allows lift trucks "C" to be obtained which are reliable in terms of safety because, during the Dynamic Test, they have optimised plastic deformation values, that is to say, well below the acceptable limit values. The optimisation also makes it possible to widen the field of vision of the driver by introducing a supporting frame 3 with large openings 3a making the lift truck "C" safe in terms of resistance and at the same time comfortable and ergonomic for use by the driver to monitor the movement of the loads above the driver protection 1.

Claims

1. A lift truck (C) comprising a driver protection (1) having a roof (2) comprising:

   - a supporting frame (3) fixed or fixable to a load-bearing structure (1a) of said driver protection (1), said supporting frame (3) being equipped with at least one opening (3a) defining a window;
   - a sheet of glass (4) positioned above said supporting frame (3);
   - at least one damping element (5) interposed between said supporting frame (3) and said load-bearing structure (1a), configured for dissipating energy deriving from an impact striking the roof (2);

   characterized in that
   the damping element (5) comprises at least one hydraulic piston preferably preloaded with air.

2. The lift truck (C) according to claim 1, comprising a plurality of damping elements (5) positioned at respective corners of said supporting frame (3), preferably said plurality of damping elements (5) comprising a damping element (5) for each corner of said supporting frame (3).

3. The lift truck (C) according to claim 1 or 2, comprising at least one damping element (5) positioned close

to a central zone of said supporting frame (3).

4. The lift truck (C) according to any one of the preceding claims, wherein said at least one damping element (5) is made of a material comprising vulcanised rubber.

5. The lift truck (C) according to any one of the preceding claims, comprising a plurality of openings (3a) each of said openings (3a) having a rectangular or quadrangular plan cross-section, preferably said plurality of openings (3a) being positioned alongside each other along a direction of extension of said supporting frame (3) and being uniformly distributed on said supporting frame (3).

6. The lift truck (C) according to claim 5, wherein each opening (3a) of said plurality of openings has a first dimension of between 500 and 4000 mm and a second dimension of between 100 and 1000 mm; preferably, the first dimension is equal to 1000 mm and the second dimension is equal to 850 mm.

7. The lift truck (C) according to any one of the preceding claims, wherein said supporting frame (3) is made of metallic material, in particular steel.

8. The lift truck (C) according to any one of the preceding claims, wherein the sheet of glass (4) comprises a layered glass.

9. The lift truck (C) according to any one of the preceding claims, wherein said sheet of glass (4) has a thickness greater than or equal to 10 mm, preferably between 10 and 25 mm.

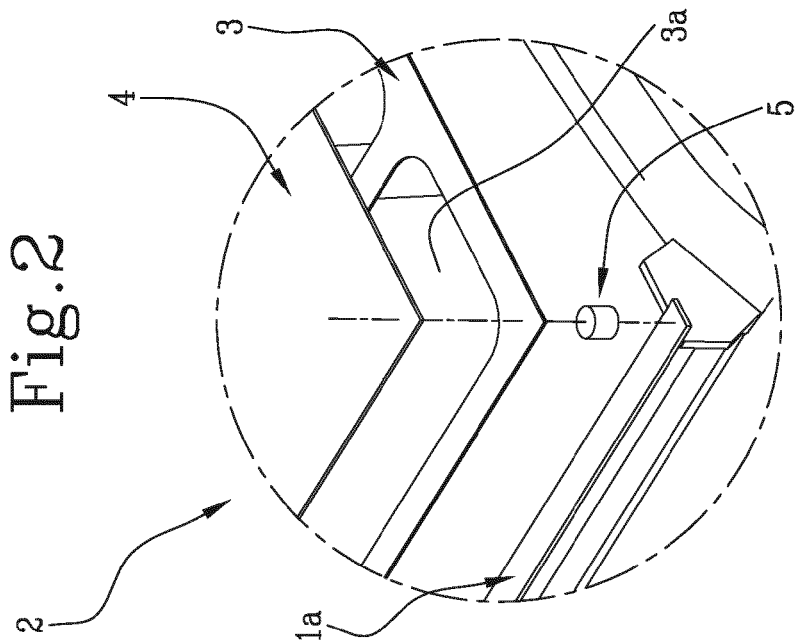


Fig.2

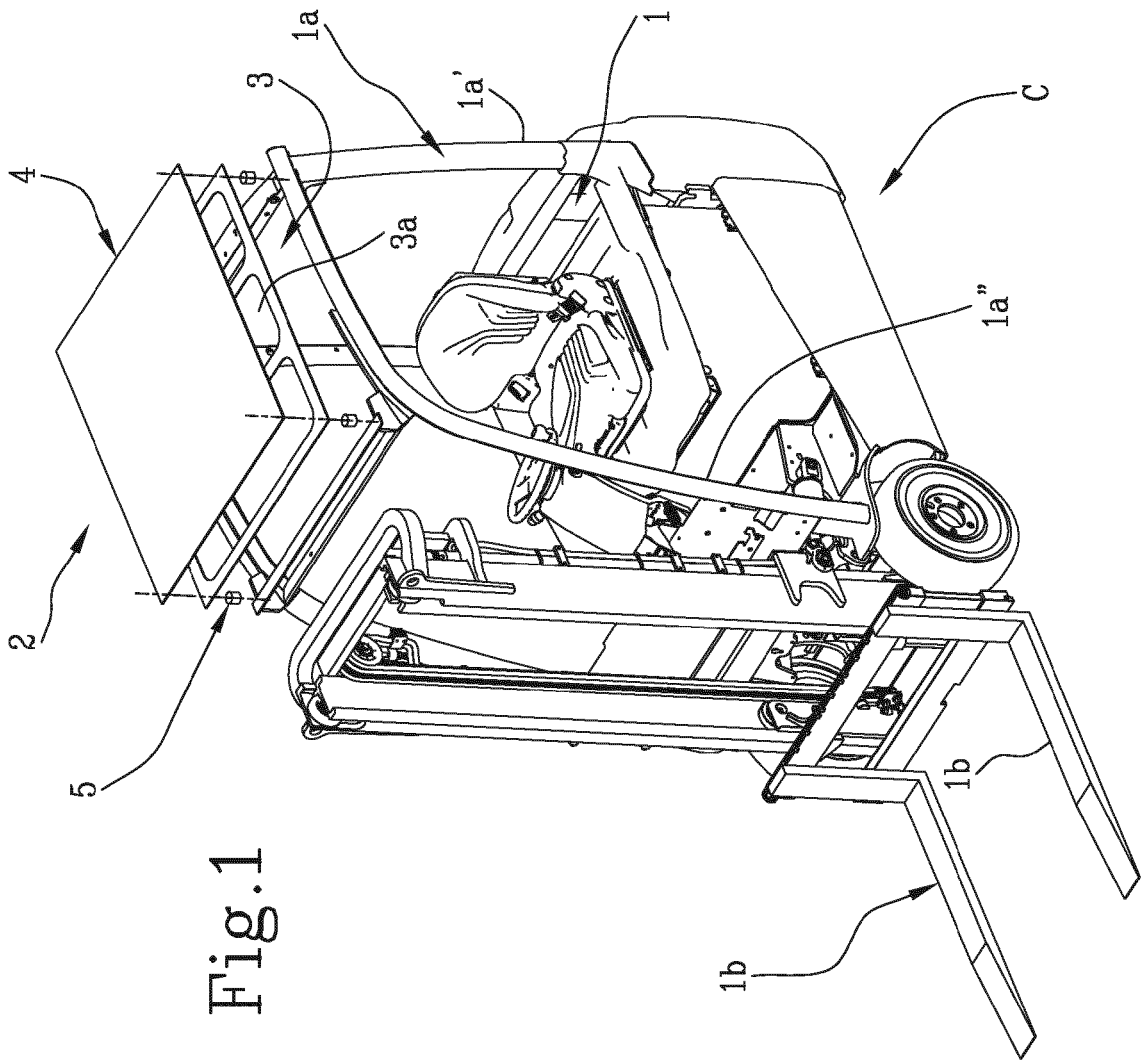


Fig.1

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 21 18 9390

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	JP H07 8106 U (TOYO UMPANKI CO., LTD.) 3 February 1995 (1995-02-03) * paragraphs [0020], [0011]; figures 3,1 *	1-9	INV. B66F9/075
A	US 4 205 874 A (MARTIN ROBERT P [US]) 3 June 1980 (1980-06-03) * figure 2 *	1-9	
A	DE 10 2016 118434 A1 (LINDE MATERIAL HANDLING GMBH [DE]) 29 March 2018 (2018-03-29) * abstract *	1-9	
A	JP H11 348822 A (TOYODA AUTOMATIC LOOM WORKS) 21 December 1999 (1999-12-21) * abstract *	1-9	
A	US 4 079 985 A (MARTIN ROBERT P) 21 March 1978 (1978-03-21) * abstract *	1-9	

TECHNICAL FIELDS SEARCHED (IPC)

B66F
B60R
B60J

1 The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	16 December 2021	Serôdio, Renato

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 21 18 9390

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.

16-12-2021

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP H078106 U	03-02-1995	JP 2607281 Y2	28-05-2001
		JP H078106 U	03-02-1995
US 4205874 A	03-06-1980	NONE	
DE 102016118434 A1	29-03-2018	NONE	
JP H11348822 A	21-12-1999	NONE	
US 4079985 A	21-03-1978	NONE	

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

- JP H078106 B **[0006]**