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(54) **TEMPORARY CLAMPING MECHANISM**

(57) The invention discloses a temporary clamping mechanism comprising a hinge, a pin and a temporary stopper having an E-clip-type cavity.

The temporary clamping mechanism is configured to allow opening and fixing the door in a predetermined open position at a predetermined angle θ and releasing the door from the predetermined open position in a predetermined number of cycles of fixing and releasing the door.

Fixing the door in the predetermined open position is performed by engaging the pin into the E-clip-type cavity using a predetermined opening torque.

Releasing the door from the predetermined open position is performed by disengaging the pin from the E-clip-type cavity using a predetermined closing torque.

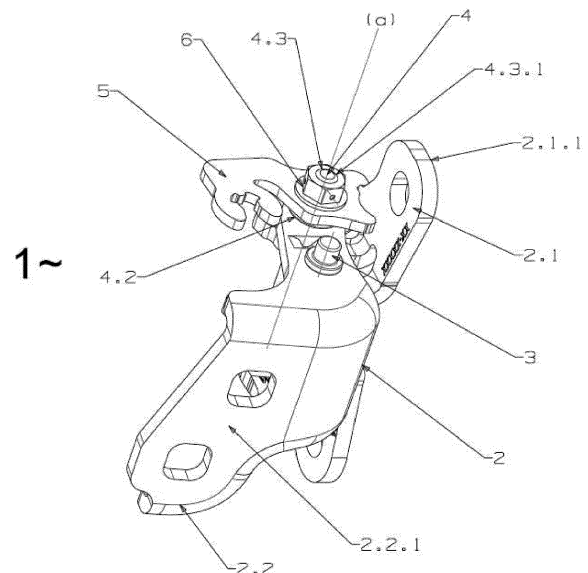


Fig. 1

Description

Technical field

[0001] The present invention relates to a temporary clamping mechanism for maintaining a door open in a fixed position, a method of use of the temporary clamping mechanism and a method of producing of the temporary clamping mechanism.

Background

[0002] There are situations in practice where it is needed to maintain a door open in a fixed position for a specified period of time.

[0003] Throughout present invention, unless otherwise specified, the term "door" refers to any door that is based on a hinge mechanism in order to move it from open to closed and from closed to open position.

[0004] For example, the door can be a building door or a vehicle door.

[0005] One non-limiting example is when the door is a vehicle door and the need of maintaining the door open for the specified time occurs during the manufacturing process of the vehicle.

[0006] Another non-limiting example is when the door is a building door and the need of maintaining the door open for the specified time occurs during the ventilation of a room.

[0007] Currently there are some temporary limiting mechanisms known in the prior art.

[0008] The application CN204492417U discloses a car door hinge with temporary limiting mechanism. The car door hinge comprises a fixed hinge plate fixedly connected to a car frame and a movable hinge plate fixedly connected to a car door. The fixed hinge plate is hinged to the movable hinge plate through a hinge shaft. A limiting pin fixedly connected to the fixed hinge plate and a limiting plate detachably connected to the movable hinge plate through the hinge shaft are further included. The limiting plate is made of elastic materials. A limiting hole matched with the limiting pin is formed in the limiting plate. A guide element matched with the limiting pin to jack up the free end of the limiting plate is arranged on the limiting plate. The fixed hinge plate and the movable hinge plate can be kept at a fixed angle under the cooperation action of the limiting pin and the limiting hole.

[0009] The application CN104343304A discloses temporary door brake devices with temporary shaft having clamping teeth.

Disadvantages of prior art

[0010] The prior art has some disadvantages among which are the following:

- the devices are fastened by means of screws to the door and this increases the manufacturing times;

- the parts are expensive and must be reused several times, requiring removal after painting process and a cleaning phase before being reused;
- after clipping, due to manufacturing limitations, the clipping interface is not tight fit with the pin, making difficult for the hinge to respect the angular characteristic;
- the shapes are too complex, requiring complicated manufacturing processes;
- after the first maneuver, due to unequal clipping arms, the exterior arm will be plastically deformed and the temporary stopper cannot maintain the same torque for several maneuvers;

15 Problem solved by the invention

[0011] The drawback of the prior art can be solved by providing a temporary clamping mechanism having a robust and simpler design, being able to maintain the door firmly fixed in a predetermined position, being able to allow several cycles of fixing and releasing the door without breaking the temporary clamping mechanism, and being able to allow re-use of a part of the clamping mechanism to a subsequent door.

Summary of the invention

[0012] In order to solve the problem, in a first aspect of the invention the inventors conceived a **temporary clamping mechanism** comprising:

- A hinge comprising:
 - a mobile hinge element having a mobile hinge element surface arranged to be fitted on a door,
 - a fixed hinge element having a fixed hinge element surface arranged to be fixed on a door frame,
 - a hinge shaft arranged parallel to the mobile hinge element surface, the hinge shaft having a rotational axis a and comprising:
 - a first hinge shaft end arranged to accommodate the hinge such that to allow the rotation of the mobile hinge element around the first hinge shaft end between a closed position and an open position of the door,
 - a second hinge shaft end provided with a thread the thread arranged to be assembled with a nut,
- an intermediary hinge shaft part located between the first hinge shaft end and the second hinge shaft end and arranged to accommodate a temporary stopper by a temporary stopper hole.
- A pin located on the fixed hinge element and having

the central axis parallel to the rotational axis a at a first predetermined distance in respect to the rotational axis a ,

- The temporary stopper placed in a plane perpendicularly to the hinge shaft and perpendicularly to the mobile hinge element surface and comprising:
 - the temporary stopper hole having a temporary stopper hole center, the temporary stopper hole being arranged between a first temporary stopper end and a second temporary stopper end to accommodate the intermediary hinge shaft part,
 - an E-clip-type cavity placed at the second temporary stopper end and having:
 - a fixing circular central portion having an inner diameter d_E and a circular central portion center, the circular central portion center placed at a first predetermined distance from the temporary stopper hole center, such that to arrange a second predetermined distance between the projection of the circular central portion center and the projection of the temporary stopper hole center on the mobile hinge element surface,
 - two open ends and an opening range between said two open ends, the opening range having the wide dimensioned such that it engages with the pin with a predetermined engaging tolerance,
 - a limiting area arranged in the first temporary stopper end for solidary assembling the temporary stopper with the mobile hinge element in a perpendicular plan to the mobile hinge element surface, such that the E-clip-type cavity faces the pin.

[0013] Said temporary stopper has a specific bending stiffness determined by the material and the thickness of the temporary stopper and by the two open ends dimensions.

[0014] Said temporary clamping mechanism is configured to allow:

- opening and fixing the door in a predetermined open position at a predetermined angle between the closed position and the open position by engaging the pin into the E-clip-type cavity with a predetermined opening torque, the predetermined angle being directly proportional to the second predetermined distance and
- releasing the door from the predetermined open position by disengaging the pin from the E-clip cavity with a predetermined closing torque.

[0015] Said opening and closing torque are directly proportional to the specific bending stiffness of the tem-

porary stopper and to the predetermined engaging tolerance.

[0016] Said temporary clamping mechanism is configured to allow a predetermined number of cycles of fixing and releasing the door.

[0017] In a second aspect of the invention it is provided a method of use the temporary clamping mechanism of the first aspect of the invention the method comprising the following steps:

- fixing the temporary stopper in the intermediary hinge shaft part of a door hinge,
- fixing the nut on the thread of the second hinge shaft end in order to fix the temporary stopper on the hinge shaft part,
- opening the door from the closed position to a predetermined open position at the predetermined angle,
- fixing the door by engaging the pin into the E-clip-type cavity with a predetermined opening torque such that to ensure maintaining the door open at the predetermined angle ,
- releasing the door from the predetermined open position by disengaging the pin from the E-clip-type cavity with a predetermined closing torque,
- removing the nut and removing the temporary stopper.

[0018] In a third aspect of the invention it is provided a method of producing the temporary clamping mechanism containing a temporary stopper made of steel, the method comprising a step of producing the temporary stopper selected from the group of stamping from metallic blankets, laser cutting and electrical wire discharge.

Advantages of the invention

[0019] The main advantages of the temporary clamping mechanism of the invention are the following:

- It has a robust and simple design,
- It is easy to be firmly and accurately fixed in the predetermined position, easy to be fixed to the door frame by using the existing door hinges and to remove it from the door frame and easy to adapt to the configurations of the existing door hinges. It maintains the same torque for the predetermined number of open-close cycles. The temporary clamping mechanism allows a predetermined number of cycles of fixing and releasing the door, the elasticity and the thickness of the temporary stopper determining the predetermined number of cycles.
- It is used for the pre-set number of cycles of opening-closing the door.
- It allows easy use of it either by the human operator or by robot(s).
- It allows quite soft interaction with the surfaces of the door frame and the door itself; no painting or

repairing is needed to the door frame or to the door after having removed the temporary stopper.

Brief description of the drawings

[0020]

Fig.1 represents a perspective representation of a first embodiment of the temporary clamping mechanism 1 in open position
 Fig. 2a and 2b represent a perspective representation of a second embodiment of the temporary clamping mechanism 1 in open position
 Fig. 2c represents a perspective representation of a hinge 2 corresponding to the second embodiment of the invention
 Fig. 3a represents a top representation of the first *embodiment* of the temporary stopper 5 showing the components of the temporary stopper 5
 Fig. 3b - represents a top representation of the first *embodiment* of the temporary stopper 5 showing the forces acting on the temporary stopper 5
 Fig. 4a represents a perspective representation of the second embodiment of the temporary stopper 5 showing the components of the temporary stopper 5
 Fig. 4b represents a perspective representation of the second embodiment of the temporary stopper 5 showing the forces acting on the temporary stopper 5
 Fig 5 represents a top view of the first embodiment of the temporary clamping mechanism 1 in door closed position, when the pin is disengaged from the E-clip-type cavity 5.2
 Fig. 6 represents a top view of the first embodiment of the temporary clamping mechanism 1 in door open position, when the pin is engaged in the E-clip-type cavity 5.2

List of references:

[0021]

1 temporary clamping mechanism
 2 hinge
 2.1 mobile hinge element
 2.1.1 mobile hinge element surface
 2.1.2 recess
 2.2 fixed hinge element
 2.2.1 fixed hinge element surface
 3 pin
 4 hinge shaft
 4.1 first hinge shaft end
 4.2 intermediary hinge shaft part
 4.3 second hinge shaft end
 4.3.1 thread

5 temporary stopper

5.1 temporary stopper hole

5.1.1 temporary stopper hole center

5.2 E-clip-type cavity

5.2.1 fixing circular central portion

5.2.1.1 circular central portion center

5.2.1.2 opening range

5.3 first temporary stopper end

5.4 second temporary stopper end

5.4.1 open end

5.5 limiting area

5.5.1 temporary stopper gap

5.5.2 anti-rotation leg

5.5.3 support leg

5.5.4 leaking gap

5.5.5 anti-rotation leg

6 nut

a rotational axis of the hinge shaft 4

t temporary stopper thickness

L_{Ea} first predetermined distance

L second predetermined distance

θ predetermined angle between the closed position and the open position of the door

d_E inner diameter of the fixing circular central portion 5.2.1

h width of the critical section of the open end 5.4.1

D_p outer diameter of the pin 3.

L_1 distance between the contact point of the pin 3 with the open ends 5.4.1 and the bending line of each of the open end 5.4.1. when the pin 3 is engaged within the opening range 5.2.1.2

L_{la} distance between the rotational axis a and the face of the anti-rotation leg in contact with the fixed part of the hinge.

l_{al} length of the anti-rotation leg 5.5.2, 5.5.5

F_N normal clamping force

F_a active opening/closing force

F_{al} force exerted on the anti-rotation leg 5.5.2, 5.5.5

Detailed description

[0022] As illustrated in Fig. 1, 2, 5 and 6, in a first aspect of the invention the inventors conceived a temporary clamping mechanism 1 for opening and fixing the door in a predetermined open position and releasing the door from the predetermined open position.

[0023] The temporary clamping mechanism 1 comprises a hinge 2, a pin 3 and a temporary stopper 5.

[0024] The hinge 2 comprises a mobile hinge element

2.1, a fixed hinge element 2.2 and a hinge shaft 4. The mobile hinge element 2.1 has a mobile hinge element surface 2.1.1 arranged to be fitted on a door.

[0025] The fixed hinge element 2.2 has a fixed hinge element surface 2.2.1 arranged to be fixed on a door frame.

[0026] The hinge shaft 4 is arranged parallel to the mobile hinge element surface 2.1.1 and has a rotational axis a. The hinge shaft 4 comprises a first hinge shaft end 4.1, an intermediary hinge shaft part 4.2 and a second hinge shaft end 4.3.

[0027] The first hinge shaft end 4.1 is arranged to accommodate the hinge 2, such that to allow the rotation of the mobile hinge element 2.1 around the first hinge shaft end 4.1 between a closed position and an open position of the door.

[0028] The intermediary hinge shaft part 4.2 is located between the first hinge shaft end 4.1 and the second hinge shaft end 4.3 and is arranged to accommodate the temporary stopper 5 by a temporary stopper hole 5.1.

[0029] The second hinge shaft end 4.3 is provided with a thread 4.3.1, the thread 4.3.1 being arranged to be assembled with a nut 6.

[0030] The pin 3 is located on the fixed hinge element 2.2 and has its central axis parallel to the rotational axis a at a first predetermined distance L_{Ea} in respect to the rotational axis a.

[0031] The temporary stopper 5 is placed in a plane perpendicularly to the hinge shaft 4 and perpendicularly to the mobile hinge element surface 2.1.1.

[0032] The temporary stopper 5 comprises a temporary stopper hole 5.1, an E-clip-type cavity 5.2, a temporary stopper gap 5.5.1 and a limiting area 5.5.

[0033] The temporary stopper hole 5.1 has a temporary stopper hole center 5.1.1 which is arranged between a first temporary stopper end 5.3 and a second temporary stopper end 5.4 in order to accommodate the intermediary hinge shaft part 4.2.

[0034] The E-clip-type cavity 5.2 is placed at the second temporary stopper end 5.4 and comprises a fixing circular central portion 5.2.1, two open ends 5.4.1 and an opening range 5.2.1.2.

[0035] The fixing circular central portion 5.2.1 has an inner diameter d_E and a circular central portion center 5.2.1.1.

[0036] The circular central portion center 5.2.1.1 is placed at the first predetermined distance L_{Ea} from the temporary stopper hole center 5.1.1. such that to set the second predetermined distance L between the projection of the circular central portion center 5.2.1.1 and the projection of the temporary stopper hole center 5.1.1 on the mobile hinge element surface 2.1.1.

[0037] The opening range 5.2.1.2 is dimensioned such that it engages with the pin 3 with a predetermined engaging tolerance.

[0038] The temporary stopper gap 5.5.1 is located between the E-clip-type cavity (5.2) and the temporary stopper hole 5.1.

[0039] The limiting area 5.5 is arranged in the first temporary stopper end 5.3 for solidary assembling the temporary stopper 5 with the mobile hinge element 2.1 in a perpendicular plan to the mobile hinge element surface 2.1.1, such that the E-clip-type cavity 5.2 faces the pin 3.

[0040] The temporary clamping mechanism 1 is configured to allow opening and fixing the door in a predetermined open position and releasing the door from the predetermined open position, respectively.

[0041] The opening and fixing the door in a predetermined open position at a predetermined angle θ between the closed position and the open position is carried out by engaging the pin 3 into the E-clip-type cavity 5.2 with a predetermined opening torque, the predetermined angle θ being directly proportional to the second predetermined distance L.

[0042] The opening torque is the torque necessary to open the door in the predetermined open position at the predetermined angle θ , namely the torque necessary to engage the pin 3 into the E-clip-type cavity 5.2.

[0043] Releasing the door from the predetermined open position is carried out by disengaging the pin 3 from the E-clip-type cavity 5.2 using a predetermined closing torque.

[0044] The closing torque is the torque necessary to close the door from the temporary open position, namely the torque necessary to disengage the pin 3 from the E-clip-type cavity 5.2.

[0045] The fixing of the door in the predetermined open position at the predetermined angle θ is carried out within a preset tolerance interval of the predetermined angle θ .

[0046] In order to be able to fix the door in the predetermined open position at the predetermined angle θ , the temporary stopper 5 has a specific bending stiffness.

[0047] The bending stiffness depends on the Young's modulus and on the area moment of inertia of the cross-section of the temporary stopper 5, being determined by the material and the thickness t of the temporary stopper 5 and by the dimensions of the two open ends 5.4.1.

[0048] Both the opening and the closing torque are directly proportional to the specific bending stiffness of the temporary stopper 5 and directly proportional to the predetermined engaging tolerance.

[0049] According to Fig. 3b, the inner diameter of the fixing circular central portion 5.2.1 is designated by d_E and the outer diameter of the pin is designated by D_p .

[0050] In order to allow the engaging/disengaging of the pin 3 into/from the fixing circular central portion 5.2., the surfaces of the two open ends 5.4.1 facing toward the pin 3 are moving by a displacement f representing the predetermined engaging tolerance divided by 2 as follows:

$$F=(D_p-d_E)/2$$

[0051] The E-clip-type cavity 5.2 defines within the second temporary stopper end 5.4 an E-clip-type fastener

or retaining ring comprising a semi-flexible ring with two open ends 5.4.1. and an opening range 5.2.1.2 between the two open ends 5.4.1. which can be snapped into place on the pin 3.

[0052] The minimum width of the temporary stopper gap (5.5.1) is the value of the displacement f .

[0053] The displacement f determines a bending moment in the sections of the open ends 5.4.1. located at the distance L_1 between the contact point of the pin 3 with the open ends 5.4.1 and the bending line of each of the open end 5.4.1.

[0054] A critical cross-section of the open end 5.4.1 is defined by a bending line, located where the minimum distance between the inner and outer contours of the E-clip is identified.

[0055] The bending line is the connecting line between the open end 5.4.1 with the remaining part of the temporary stopper.

$$M = f \cdot (3 \cdot E \cdot I_c) / (L_1)^2$$

where:

$E \cdot I_c$ is bending stiffness R of the temporary stopper 5
 E is the Young's modulus of the temporary stopper 5 material;

I_c is the section modulus of the temporary stopper 5 defined by the equation: $I_c = (h^3 \cdot t) / 12$

t - temporary stopper thickness;

h - width of the critical section (the width of the open end 5.4.1 on the bending line);

[0056] During the engaging of the pin 3 within the opening range, a normal clamping force F_N is exerted by the open ends 5.4.1 on the pin 3:

$$F_N = M / L_1$$

wherein M is the bending moment.

[0057] The active force F_a , namely the opening/closing force exerted during engaging/disengaging of the pin 3 into/from the fixing circular central portion 5.2.1 will be:

$$F_a = 2 F_N \cdot \mu$$

wherein μ is the friction coefficient characterizing the surfaces in contact of the open ends 5.4.1 and of the pin 3.

[0058] The bending moment M is limited by the value of the admissible stress in the critical section

$$M_{lim} = \sigma_a \cdot W_C$$

wherein: σ_a is the admissible stress given by $\sigma_a = \sigma_y / C$, as σ_y is the yield stress of the material and C is the safety

coefficient imposed by the operating conditions ($\min(C)=1$).

[0059] Each of the opening/closing forces and implicitly the opening and the closing torque is directly dependent on:

- Young modulus of the material (E)
- Thickness of the temporary stopper 5 (t);
- width of the critical section (h);
- Admissible stress in the critical cross-section (σ_a).

[0060] Each of the opening/closing forces and implicitly the opening and the closing torque is indirectly dependent on:

- Friction coefficient (μ)
- Position of the critical cross section (L_1)
- Safety coefficient (C);

[0061] Due to the specific bending stiffness of the temporary stopper 5 and of the geometry of the temporary clamping mechanism 1, the temporary clamping mechanism 1 is configured to allow a predetermined number of cycles of fixing and releasing the door.

[0062] The temporary clamping mechanism has the advantage that it has a robust and simple design, it is easy to be fixed firmly and accurately in the predetermined position, it is easy to be fixed to the door frame by using the existing door hinges and to be removed from the door frame and easy to adapt to the configurations of the existing door hinges.

[0063] This advantage stems from the configurations of the entire temporary clamping mechanism and in particular from the configurations of the temporary stopper 5, allowing to advantageously determine accurately the firmly fixed predetermined position according to the specifications either by the predetermined angle θ or by the the predetermined distance L .

[0064] The temporary clamping mechanism disclosed has the advantage that it maintains the same torque for the predetermined number of open-close cycles. The temporary clamping mechanism allows a predetermined number of cycles of fixing and releasing the door, the elasticity and the thickness of the temporary stopper determining the predetermined number of cycles.

[0065] The temporary stopper has the advantage that is used for the pre-set number of cycles of opening-closing the door. This advantage is of economic nature.

[0066] The temporary clamping mechanism has the advantage that it allows easy use either by the human operator or by robot(s).

[0067] The temporary clamping mechanism allows quite soft interaction with the surfaces of the door frame and the door itself; no painting or repairing is needed to the door frame or to the door after having removed the temporary stopper.

[0068] In the following two non-limitative examples of a temporary stopper 5, the limiting area 5.5 arranged for

solidary assembling the temporary stopper 5 with the mobile hinge element 2.1 comprises an anti-rotation leg (5.5.2, 5.5.5) which is chosen depending on the constructive configuration of the hinge 2, more precisely depending on the mobile hinge element surface 2.1.1 to be fitted on the door.

[0069] In one example of the temporary stopper 5, the limiting area 5.5 comprises:

- An anti-rotation leg 5.5.2 dimensioned depending on the predetermined opening torque,
- a support leg 5.5.3 dimensioned depending on the predetermined closing torque, *and*
- a leaking gap 5.5.4 arranged between the anti-rotation leg 5.5.2 and the support leg 5.5.3,

[0070] In this example, as illustrated in Fig. 3a and 3b, for the purpose of solidary assembling of the temporary stopper 5 with the mobile hinge element 2.1, it is provided an anti-rotation leg 5.5.2 comprised in the limiting area 5.5 in a plan perpendicular to the mobile hinge element surface 2.1.1.

[0071] The dimensions of the anti-rotation leg 5.5.2 depends on the predetermined opening torque, as follows: The circular central portion center 5.2.1.1 of the E-clip-type cavity 5.2 is located at a first distance L_{Ea} from the rotational axis *a* while the anti-rotation leg (5.5.2) is located at a distance L_{la} . Considering F_a the active force, namely the opening and the closing force, the force F_{al} exerted on the anti-rotation leg (5.5.2) for engaging/disengaging the pin 3 into /from the fixing circular central portion 5.2.1 is:

$$F_{al} = (F_a * L_{Ea}) / L_{la}$$

[0072] The force exerted on the anti-rotation leg (5.5.2) is developing a shear stress in the cross section of the anti-rotation leg (5.5.2). Thus, the length l_{al} of the cross-section of the anti-rotation leg is defined by the equation:

$$l_{al} = F_{al} / (\tau_a * t)$$

where: τ_a is the maximum admissible shear stress. A limit of the length of the cross-section of the anti-rotation leg is given by $\tau_a = \sigma_a / 2$.

[0073] The advantage of the anti-rotation leg 5.5.2 is that prevents the movement of the temporary stopper 5 around the mobile hinge element 2.1 in order to ensure maintaining the door firmly fixed in a predetermined position and allowing several cycles of fixing and releasing the door without breaking the temporary clamping mechanism.

[0074] The support leg (5.5.3) is dimensioned depending on the predetermined opening torque. When the opening torque is applied to the stopper 5, it is created a moment around the hinge shaft 4 determining the ro-

tation of the stopper 5, which is prevented by the support leg 5.5.3.

[0075] The configuration of the support leg 5.5.3 as well as the configuration of the arrangement of the leaking gap 5.5.4 between the anti-rotation leg 5.5.2 and the support leg 5.5.4 has the advantage of an accurate positioning of the stopper 5.

[0076] In another example of the temporary stopper 5, as illustrated in Fig. 4a and 4b, the limiting area 5.5 comprises an anti-rotation leg 5.5.5 dimensioned depending on the predetermined opening torque, as shown in Fig. 4a neither a support leg, nor a leaking gap are required in this example.

[0077] Similarly to the first example, as illustrated in Fig. 4b, the circular central portion center 5.2.1.1 of the **E-clip-type cavity** 5.2 is located at a first distance L_{Ea} from the rotational axis *a* while the anti-rotation leg (5.5.5) is located at a distance L_{la} . Considering F_a the active force, namely the opening and the closing force, the force F_{al} exerted on the anti-rotation leg (5.5.5) for engaging/disengaging the pin 3 into /from the fixing circular central portion 5.2.1 is:

$$F_{al} = (F_a * L_{Ea}) / L_{la}$$

[0078] The force exerted on the anti-rotation leg (5.5.5) is developing a shear stress in the cross section of the anti-rotation leg (5.5.5). Thus, the length l_{al} of the cross-section of the anti-rotation leg is defined by the equation:

$$l_{al} = F_{al} / (\tau_a * t)$$

where: τ_a is the maximum admissible shear stress. A limit of the length of the cross-section of the anti-rotation leg is given by $\tau_a = \sigma_a / 2$.

[0079] As illustrated in Figs. 2a and 2b, the anti-rotation leg 5.5.5 is arranged to extend in a direction parallel with the hinge shaft 4.

[0080] The location of the anti-rotation leg 5.5.5 is imposed either by the geometrical conditions of the hinge 2 defined by the assembly to be designed - or by the material properties such as the maximum admissible shear stress in the cross-section.

[0081] As illustrated in Fig. 2c, the mobile hinge element 2.1 is provided with a recess 2.1.2 for accommodating the anti-rotation leg 5.5.5.

[0082] The configuration of the anti-rotation leg 5.5.5 to extend in the direction parallel with the hinge shaft 4 has the advantage that prevents the movement of the temporary stopper 5 with respect to the mobile hinge element 2.1 in order to ensure the maintaining the door firmly fixed in a predetermined position during and allowing several cycles of fixing and releasing the door without breaking the temporary clamping mechanism.

[0083] In a preferred embodiment of the invention, as illustrated in Figs. 1, 2a, 2b, 5 and 6, there is provided a

temporary clamping mechanism 1 for opening and fixing a vehicle door in a predetermined open position and releasing the vehicle door from the predetermined open position.

[0084] Different examples of this preferred embodiment are provided by selecting the vehicle door hinge from the group of vehicle side door hinges, vehicle front hood hinges and vehicle trunk hood hinges.

[0085] Using the temporary clamping mechanism in the preferred embodiment where the door is a vehicle door, in all its examples, has the advantage that the temporary clamping mechanism is rapidly configured by mounting the temporary stopper 5 to the existing door hinge 2 and it is easily removable from the door hinge when no longer needed.

[0086] Due to the firm fixing, when the door is a vehicle door, the temporary clamping mechanism has the advantage that it allows low-speed move of the vehicle with the doors open, for example during the manufacturing process of the vehicles.

[0087] In another preferred embodiment of the invention, there is provided a temporary clamping mechanism 1 comprising a temporary stopper 5 made of steel.

[0088] An advantage of the temporary stopper 5 made of steel is given by the resistance conferred by the steel.

[0089] In a non-limiting example of the above-captioned preferred embodiment, there is provided a temporary clamping mechanism (1) comprising a temporary stopper (5) made of steel where the opening torque is at least 30 Nm, the closing torque is at least 20Nm, the predetermined number of opening/closing cycles is at least 30 and the predetermined open position angle is $16,2^{\circ} \pm 2^{\circ}$.

[0090] Said parameters shall be considered for exemplification only and shall not be considered limiting the invention.

[0091] The non-limiting example above is used maintaining the vehicle doors open, during the manufacturing process of the vehicles.

[0092] In another preferred embodiment of the invention, there is provided a temporary clamping mechanism 1 comprising a temporary stopper 5 made of plastic material.

[0093] An advantage of the temporary stopper 5 made of plastic material is given by non-corrosive characteristic of the plastic material.

[0094] Different examples of this preferred embodiment are provided by selecting the plastic material from the group of Acrylonitrile butadiene styrene and Polypropylene.

[0095] Said plastic materials shall be considered for exemplification only and shall not be considered limiting the invention.

[0096] In the most preferred embodiment of the invention, there is provided a temporary clamping mechanism 1 for opening and fixing a passenger car door in a predetermined open position and releasing the passenger car door from the predetermined open position.

[0097] The purpose of the temporary clamping mechanism of the most preferred embodiment of the invention is to keep the doors of the passenger car in the predetermined open position during the painting carried out when the passenger car is being built by the car manufacturer.

[0098] The passenger car comprises the body of the passenger car and the doors.

[0099] During the manufacturing process, a final door stop is typically mounted on each door of the passenger car by means of an appropriate door stopper, that positions the door relative to the body and maintains the opening position at one or more angles. However, during the body finishing operation (sealing, painting) of body with openings fitted, the final door stopper cannot be attached to the vehicle body and door, as its functionality can be substantially affected by the finishing process.

[0100] Since the final door stop is not compatible with the step of coating the body and doors, as the fluids used during these processes can affect the quality of the surface or even, while drying, can stuck the part, the temporary stopper is mounted to the vehicle during the manufacturing process prior to installation of the final door stop. Each temporary stopper keeps the door open during the operation of immersing in the electrophoresis tank and/or paint projection. The temporary stoppers must withstand the coating operation and allow multiple openings/closings of the door, for example 20 times or 30 times, without a loss of performance. The functionality of hinges that have been coated are not affected since the temporary stopper is removed after the finishing process.

[0101] Once the body finishing process is completed, the doors are removed from the body shell and removed from the passenger car line to apply specific installations and finishing in a separate workshop.

[0102] At present, most of the passenger car doors still use conventional hinges, which can only provide basic door opening and closing functions. The conventional passenger car hinges cannot provide door closing assistance, and need to add additional mechanical mechanisms such as limiters, which makes the door capable to stay in opened position.

[0103] Therefore, the temporary clamping mechanism of the invention, according to the most preferred embodiments, has 3 main functions:

- To maintain the passenger car door in the predetermined open position set by the predetermined angle θ during the passenger car assembly process,
- To ensure a specific minimum value for opening and closing torque and maintain these torques, above minimum imposed values for a specific number of opening-closing cycles of the passenger car doors
- To be easily removable from the passenger car door hinge when no longer needed.

[0104] The value of predetermined angle θ , the minimum value for opening and closing torque and the

number of opening-closing cycles are specific to each car manufacturer and each passenger car model.

[0105] The temporary stopper 5 of the invention can be used on all types of passenger car hinges: lateral door hinges, which are equipping the lateral doors of the car, front hood hinges which are equipping the hood or bonnet of the car, and trunk hinges which are equipping the rear or trunk doors.

[0106] The dimensions of the interior holes of the E-clip-type cavity 5.2 are set in order to reduce the contact between the open ends 5.4.1 with the pin 3 and to reduce friction and effort caused by paint accumulation on the inner surface of the E-clip-type cavity 5.2.

[0107] The leaking gap 5.5.4 between anti-rotation leg 5.5.2 and support leg 5.5.3 is designed to reduce the contact surface of the temporary stopper 5 with the mobile hinge element 2.1 and in order to reduce the paint accumulation on the temporary stopper 5.

[0108] The temporary stopper 5 material can be metal or plastic, depending on the required value of the open/closed torque. The metal is used for higher torque values (e.g. steel with high carbon content) and the plastic is used for lower torque values (e.g. molded plain polypropylene), as the value of Young modulus is directly affecting the material performance.

[0109] Compared to technical solutions of the prior art, the temporary clamping mechanism of the invention has the advantage that it maintains a minimum closing and opening torque for a bigger number of opening-closing cycles, it is easier removable and it maintains more accurately the door open in the predetermined open position at the predetermined angle θ , the last advantage being known for professionals as better fixation of the opening angle.

[0110] In a second aspect of the invention, there is provided a method of use the temporary clamping mechanism 1 of the first aspect of the invention for maintaining a door at a predetermined angle θ between the closed position and the open position comprising the following steps:

- fixing the temporary stopper (5) in the intermediary hinge shaft part 4.2 of a door hinge,
- fixing the nut (6) on the thread of the second hinge shaft end 4.3 in order to fix the temporary stopper 5 on the hinge shaft part 4.2,
- opening the door from the closed position to a predetermined open position at the predetermined angle θ ,
- fixing the door by engaging the pin 3 into the E-clip-type cavity 5.2 with a predetermined opening torque such that to ensure maintaining the door open at the predetermined angle θ ,
- releasing the door from the predetermined open position by disengaging the pin 3 from the E-clip-type cavity 5.2. with a predetermined closing torque,
- removing the nut 6 and removing the temporary stopper 5.

[0111] Compared to technical solutions of the prior art, using the temporary clamping mechanism of the invention has the advantage that it maintains a minimum closing and opening torque for a bigger number of opening-closing cycles, it is easier removable and it maintains more accurately the door open in the predetermined open position at the predetermined angle θ , the last advantage being known for professionals as better fixation of the opening angle.

[0112] In a preferred embodiment it is provided a method of use the temporary clamping mechanism 1 for opening and fixing a passenger car door in a predetermined open position and releasing the passenger car door from the predetermined open position.

[0113] In another aspect of the invention it is provided a method of producing the temporary clamping mechanism where the material of the temporary stopper 5 is steel and/or where the opening torque is at least 30 Nm, the closing torque is at least 20Nm, the predetermined number of opening/closing cycles is at least 30 and the predetermined open position angle is $16,2^\circ \pm 2^\circ$.

[0114] The method used to produce the temporary stopper 5 can be stamping from metallic blankets, laser cutting, electrical wire discharge or any other method that is capable to provide the shape and tolerances of the finished parts.

[0115] A forming process is required to bend the anti-rotation leg 5.5.5.

[0116] While certain embodiments of the present invention have been described in detail, those familiar with the art to which this invention relates will recognize various alternative designs and embodiments for practicing the invention as defined by the following claims.

Claims

1. Temporary clamping mechanism (1) comprising:

- A hinge (2) comprising:

- a mobile hinge element (2.1) having a mobile hinge element surface (2.1.1) arranged to be fitted on a door,
- a fixed hinge element (2.2) having a fixed hinge element surface (2.2.1) arranged to be fixed on a door frame,
- a hinge shaft (4) arranged parallel to the mobile hinge element surface (2.1.1), the hinge shaft 4 having a rotational axis a and comprising:

- a first hinge shaft end (4.1) arranged to accommodate the hinge (2) such that to allow the rotation of the mobile hinge element (2.1) around the first hinge shaft end (4.1) between a closed position and an open position of the door,

- a second hinge shaft end (4.3) provided with a thread (4.3.1), the thread (4.3.1) arranged to be assembled with a nut (6),
 - an intermediary hinge shaft part (4.2) located between the first hinge shaft end (4.1) and the second hinge shaft end (4.3) and arranged to accommodate a temporary stopper (5) by a temporary stopper hole (5.1).
- A pin (3) located on the fixed hinge element (2.2) and having the central axis parallel to the rotational axis a at a first predetermined distance L_{Ea} in respect to the rotational axis a ,
- The temporary stopper (5) placed in a plane perpendicularly to the hinge shaft 4 and perpendicularly to the mobile hinge element surface (2.1.1) and comprising:
- the temporary stopper hole (5.1) having a temporary stopper hole center (5.1.1), the temporary stopper hole (5.1) being arranged between a first temporary stopper end (5.3) and a second temporary stopper end (5.4) to accommodate the intermediary hinge shaft part (4.2),
 - an E-clip-type cavity (5.2) placed at the second temporary stopper end (5.4) and having:
 - a fixing circular central portion (5.2.1) having an inner diameter d_E and a circular central portion center (5.2.1.1), the circular central portion center (5.2.1.1) placed at a first predetermined distance L_{Ea} from the temporary stopper hole center (5.1.1), such that to arrange a second predetermined distance L between the projection of the circular central portion center (5.2.1.1) and the projection of the temporary stopper hole center (5.1.1) on the mobile hinge element surface (2.1.1),
 - two open ends (5.4.1) and an opening range (5.2.1.2) between said two open ends (5.4.1), the opening range (5.2.1.2) having the wide dimensioned such that it engages with the pin (3) with a predetermined engaging tolerance,
 - a limiting area (5.5) arranged in the first temporary stopper end (5.3) for solidary assembling the temporary stopper (5) with the mobile hinge element (2.1) in a perpendicular plan to the mobile hinge element surface (2.1.1), such that the E-clip-type cavity (5.2) faces the pin (3),

wherein the temporary stopper (5) has a specific bending stiffness determined by the material and the thickness t of the temporary stopper (5) and by the two open ends (5.4.1) dimensions, wherein the temporary clamping mechanism (1) is configured to allow:

- opening and fixing the door in a predetermined open position at a predetermined angle θ between the closed position and the open position by engaging the pin (3) into the E-clip-type cavity (5.2) with a predetermined opening torque, the predetermined angle θ being directly proportional to the second predetermined distance L , and
- releasing the door from the predetermined open position by disengaging the pin (3) from the E-clip cavity (5.2) with a predetermined closing torque,

wherein the opening and the closing torque are directly proportional to the specific bending stiffness of the temporary stopper (5) and to the predetermined engaging tolerance, and wherein the temporary clamping mechanism (1) is configured to allow a predetermined number of cycles of fixing and releasing the door.

2. Temporary clamping mechanism (1) according to claim 1, wherein the limiting area (5.5) comprises an anti-rotation leg (5.5.2, 5.5.5) dimensioned depending on the predetermined opening torque.
3. Temporary clamping mechanism (1) according to claim 2, wherein the limiting area (5.5) further comprises:
 - a support leg (5.5.3) dimensioned depending on the predetermined closing torque and
 - a leaking gap (5.5.4) arranged between the anti-rotation leg (5.5.2) and the support leg (5.5.3).
4. Temporary clamping mechanism (1) according to claim 2 wherein the anti-rotation leg (5.5.5) is arranged to extend in a direction parallel with the hinge shaft (4) and is dimensioned depending on the predetermined closing torque.
5. Temporary clamping mechanism (1) according to any of the preceding claims wherein the door hinge is a vehicle door hinge.

6. Temporary clamping mechanism (1) according to claim 5 wherein the vehicle door hinge is selected from the group of side door hinges, front hood hinges and trunk hood hinges.

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7. Temporary clamping mechanism (1) according to any of the preceding claims wherein the material of the temporary stopper (5) is steel.

8. Temporary clamping mechanism (1) according to claim 7 wherein the opening torque is at least 30 Nm, the closing torque is at least 20Nm, the predetermined number of opening/closing cycles is at least 30 and the predetermined open position angle is $16,2^{\circ} \pm 2^{\circ}$.

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9. Temporary clamping mechanism (1) according to any of the claims 1 to 6 wherein the material of the temporary stopper (5) is plastic.

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10. Temporary clamping mechanism (1) according to claim 9, wherein the material of the temporary stopper (5) is Acrylonitrile butadiene styrene or Polypropylene.

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11. Temporary clamping mechanism (1) according to any of the preceding claims wherein the vehicle is a car.

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12. Method of use the temporary clamping mechanism (1) of any of the claims 1 to 11 for maintaining a door at a predetermined angle θ between the closed position and the open position, the method comprising:

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- fixing the temporary stopper (5) in the intermediary hinge shaft part 4.2 of a door hinge,
- fixing the nut (6) on the thread of the second hinge shaft end 4.3 in order to fix the temporary stopper (5) on the hinge shaft part 4.2,
- opening the door from the closed position to a predetermined open position at the predetermined angle θ ,
- fixing the door by engaging the pin (3) into the E-clip-type cavity (5.2) with a predetermined opening torque such that to ensure maintaining the door open at the predetermined angle θ ,
- releasing the door from the predetermined open position by disengaging the pin (3) from the E-clip-type cavity (5.2) with a predetermined closing torque,
- removing the nut (6) and removing the temporary stopper (5).

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13. Method of use the temporary clamping mechanism (1) according to claim 12, wherein the door is a car door.

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14. Method of producing the temporary clamping mech-

anism (1) according to claim 7 or 8 comprising a step of producing the temporary stopper (5) selected from the group of stamping from metallic blankets, laser cutting and electrical wire discharge.

Amended claims in accordance with Rule 137(2) EPC.

1. Temporary clamping mechanism (1) comprising:

- A hinge (2) comprising:

- a mobile hinge element (2.1) having a mobile hinge element surface (2.1.1) arranged to be fitted on a door,
- a fixed hinge element (2.2) having a fixed hinge element surface (2.2.1) arranged to be fixed on a door frame,
- a hinge shaft (4) arranged parallel to the mobile hinge element surface (2.1.1), the hinge shaft 4 having a rotational axis a and comprising:

- a first hinge shaft end (4.1) arranged to accommodate the hinge (2) such that to allow the rotation of the mobile hinge element (2.1) around the first hinge shaft end (4.1) between a closed position and an open position of the door,
- a second hinge shaft end (4.3) provided with a thread (4.3.1), the thread (4.3.1) arranged to be assembled with a nut (6),
- an intermediary hinge shaft part (4.2) located between the first hinge shaft end (4.1) and the second hinge shaft end (4.3) and arranged to accommodate a temporary stopper (5) by a temporary stopper hole (5.1).

- A pin (3) located on the fixed hinge element (2.2) and having the central axis parallel to the rotational axis a at a first predetermined distance L_{Ea} in respect to the rotational axis a,

- The temporary stopper (5) placed in a plane perpendicularly to the hinge shaft 4 and perpendicularly to the mobile hinge element surface (2.1.1) and comprising:

- the temporary stopper hole (5.1) having a temporary stopper hole center (5.1.1), the temporary stopper hole (5.1) being arranged between a first temporary stopper end (5.3) and a second temporary stopper end (5.4) to accommodate the intermediary hinge shaft part (4.2),
- an E-clip-type cavity (5.2) placed at the

second temporary stopper end (5.4) and having:

- a fixing circular central portion (5.2.1) having an inner diameter d_E and a circular central portion center (5.2.1.1), the circular central portion center (5.2.1.1) placed at a first predetermined distance L_{Ea} from the temporary stopper hole center (5.1.1), such that to arrange a second predetermined distance L between the projection of the circular central portion center (5.2.1.1) and the projection of the temporary stopper hole center (5.1.1) on the mobile hinge element surface (2.1.1),

- two open ends (5.4.1) and an opening range (5.2.1.2) between said two open ends (5.4.1), the opening range (5.2.1.2) having the wide dimensioned such that it engages with the pin (3) with a predetermined engaging tolerance,

- a middle prong (5.2.2) arranged equidistant between the two open ends (5.4.1)

- two circular grooves (5.2.3) *located on either side of the middle prong*, each circular groove being arranged to form a *bending line* of each of the two open ends 5.4.1

- a limiting area (5.5) arranged in the first temporary stopper end (5.3) for solidary assembling the temporary stopper (5) with the mobile hinge element (2.1) in a perpendicular plan to the mobile hinge element surface (2.1.1), such that the E-clip-type cavity (5.2) faces the pin (3),

- a temporary stopper gap 5.5.1 located between the E-clip-type cavity (5.2) and the temporary stopper hole 5.1, the minimum width of the temporary stopper gap (5.5.1) defining the value of the displacement f between the two open ends (5.4.1)

wherein the temporary stopper (5) has a specific bending stiffness determined by the material and the thickness t of the temporary stopper (5) and by the two open ends (5.4.1) dimensions,

wherein the temporary clamping mechanism (1) is configured to allow:

- opening and fixing the door in a predetermined open position at a predetermined an-

gle θ between the closed position and the open position by engaging the pin (3) into the E-clip-type cavity (5.2) with a predetermined opening torque, the predetermined angle θ being directly proportional to the second predetermined distance L , and
 - releasing the door from the predetermined open position by disengaging the pin (3) from the E-clip cavity (5.2) with a predetermined closing torque,

wherein the opening and the closing torque are directly proportional to the specific bending stiffness of the temporary stopper (5) and to the predetermined engaging tolerance, and wherein the temporary clamping mechanism (1) is configured to allow a predetermined number of cycles of fixing and releasing the door.

2. Temporary clamping mechanism (1) according to claim 1, wherein the limiting area (5.5) comprises an anti-rotation leg (5.5.2, 5.5.5) dimensioned depending on the predetermined opening torque.

3. Temporary clamping mechanism (1) according to claim 2, wherein the limiting area (5.5) further comprises:

- a support leg (5.5.3) dimensioned depending on the predetermined closing torque and
- a leaking gap (5.5.4) arranged between the anti-rotation leg (5.5.2) and the support leg (5.5.3).

4. Temporary clamping mechanism (1) according to claim 2 wherein the anti-rotation leg (5.5.5) is arranged to extend in a direction parallel with the hinge shaft (4) and is dimensioned depending on the predetermined closing torque.

5. Temporary clamping mechanism (1) according to any of the preceding claims wherein the door hinge is a vehicle door hinge.

6. Temporary clamping mechanism (1) according to claim 5 wherein the vehicle door hinge is selected from the group of side door hinges, front hood hinges and trunk hood hinges.

7. Temporary clamping mechanism (1) according to any of the preceding claims wherein the material of the temporary stopper (5) is steel.

8. Temporary clamping mechanism (1) according to claim 7 wherein the opening torque is at least 30 Nm, the closing torque is at least 20Nm, the predetermined number of opening/closing cycles is at least 30 and the predetermined open position angle is 16,2

° +/- 2°.

9. Temporary clamping mechanism (1) according to any of the claims 1 to 6 wherein the material of the temporary stopper (5) is plastic. 5
10. Temporary clamping mechanism (1) according to claim 9, wherein the material of the temporary stopper (5) is Acrylonitrile butadiene styrene or Polypropylene. 10
11. Temporary clamping mechanism (1) according to any of the preceding claims wherein the vehicle is a car. 15
12. Method of use the temporary clamping mechanism (1) of any of the claims 1 to 11 for maintaining a door at a predetermined angle θ between the closed position and the open position, the method comprising: 20
 - fixing the temporary stopper (5) in the intermediary hinge shaft part 4.2 of a door hinge,
 - fixing the nut (6) on the thread of the second hinge shaft end 4.3 in order to fix the temporary stopper (5) on the hinge shaft part 4.2, 25
 - opening the door from the closed position to a predetermined open position at the predetermined angle θ ,
 - fixing the door by engaging the pin (3) into the E-clip-type cavity (5.2) with a predetermined opening torque such that to ensure maintaining the door open at the predetermined angle θ , 30
 - releasing the door from the predetermined open position by disengaging the pin (3) from the E-clip-type cavity (5.2) with a predetermined closing torque, 35
 - removing the nut (6) and removing the temporary stopper (5).
13. Method of use the temporary clamping mechanism (1) according to claim 12, wherein the door is a car door. 40
14. Method of producing the temporary clamping mechanism (1) according to claim 7 or 8 comprising a step of producing the temporary stopper (5) selected from the group of stamping from metallic blankets, laser cutting and electrical wire discharge. 45

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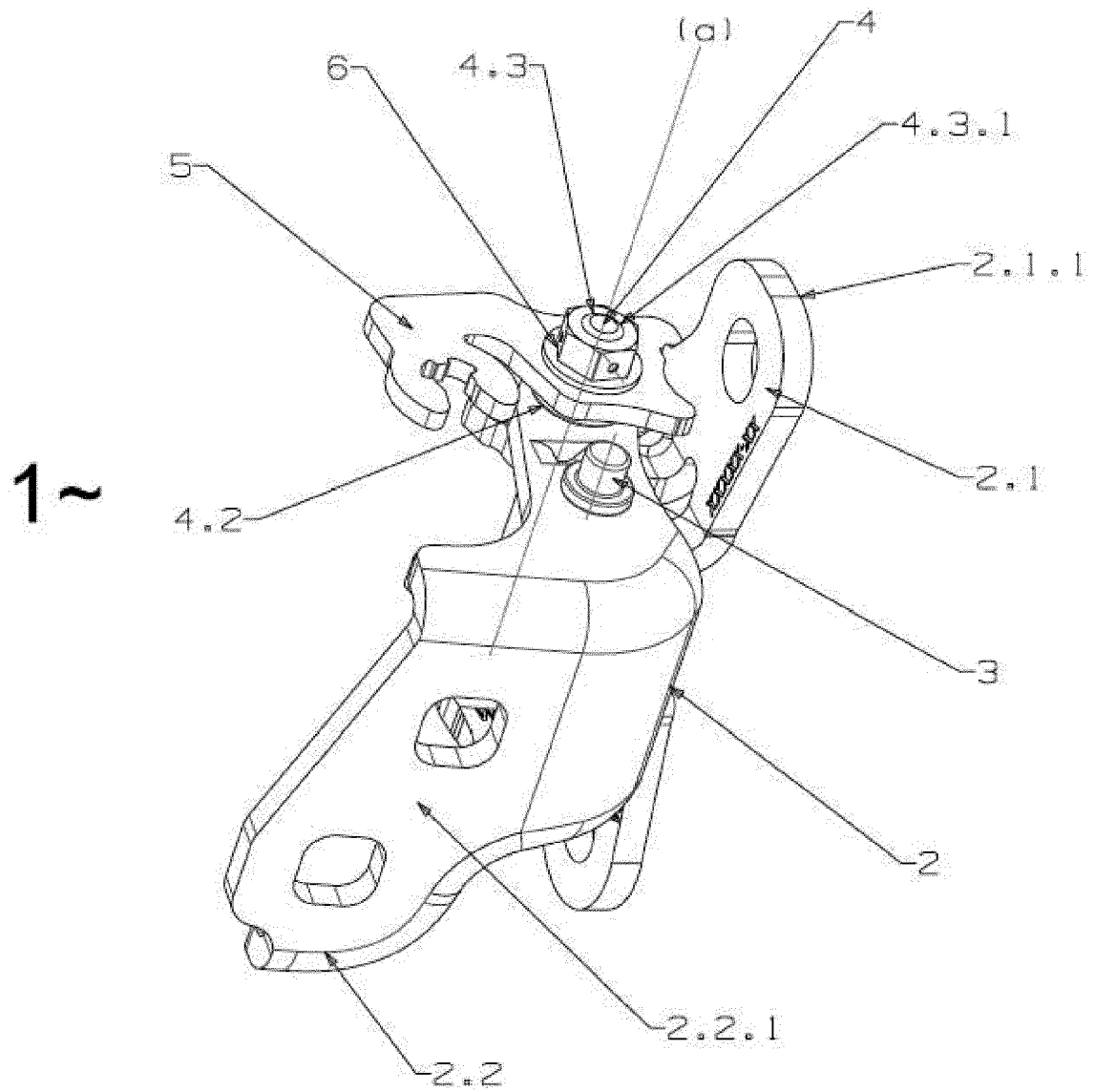
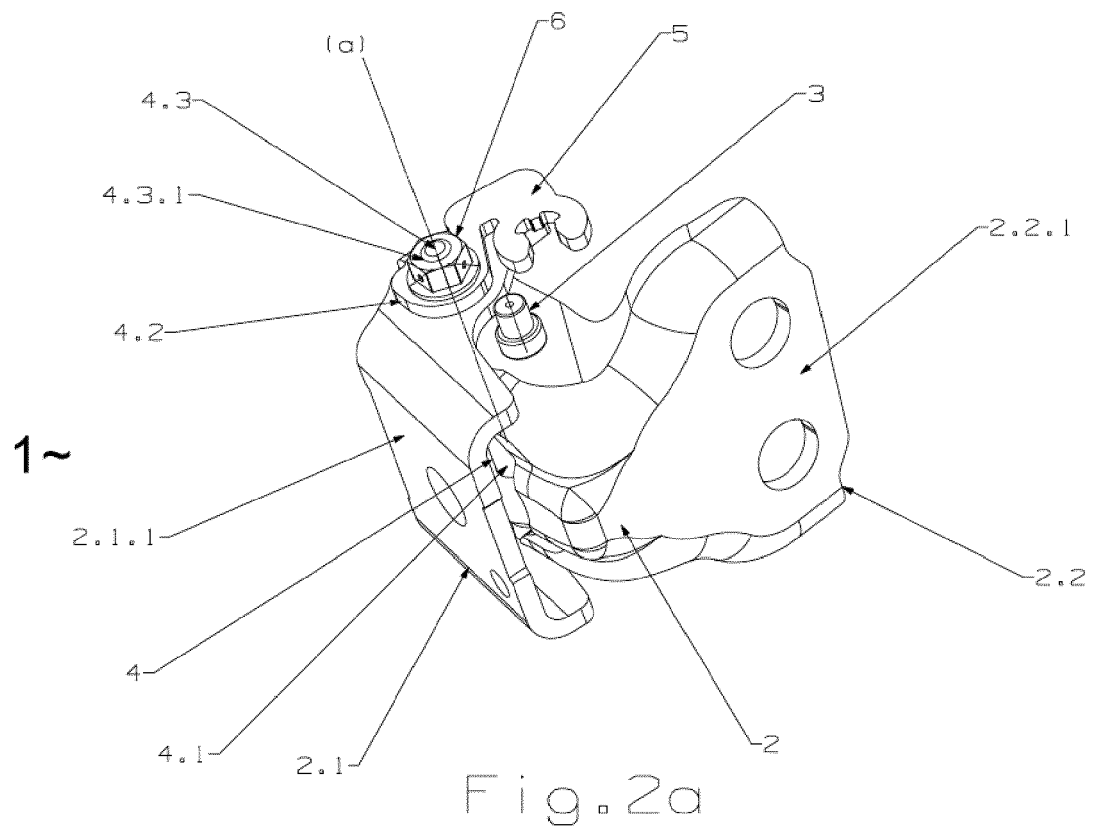


Fig. 1



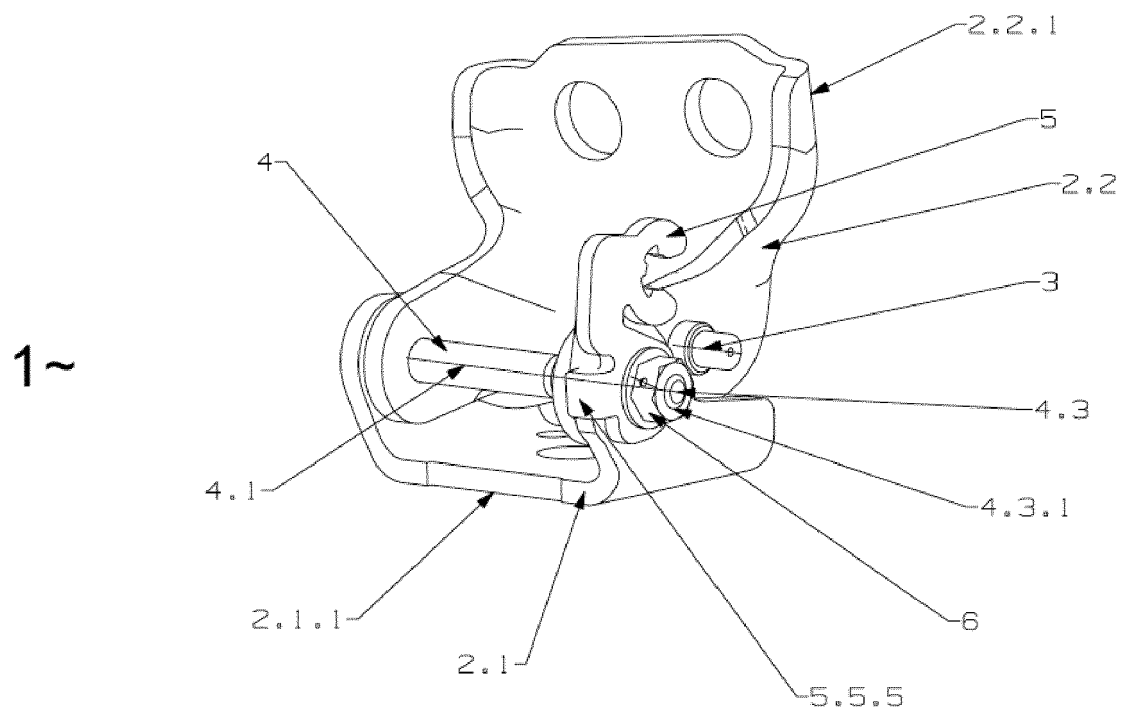


Fig. 2b

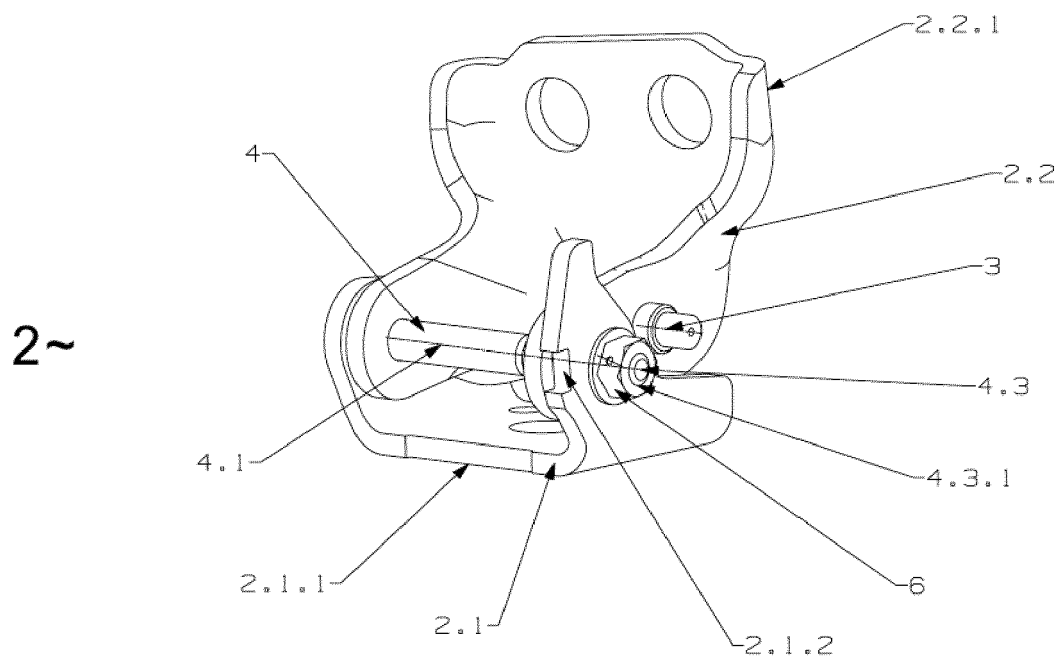


Fig. 2c

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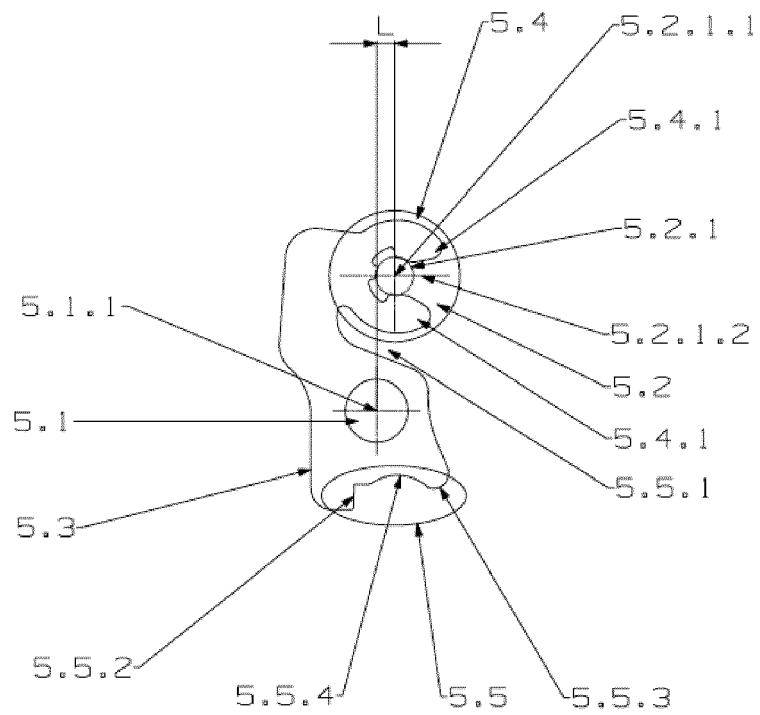


Fig. 3a

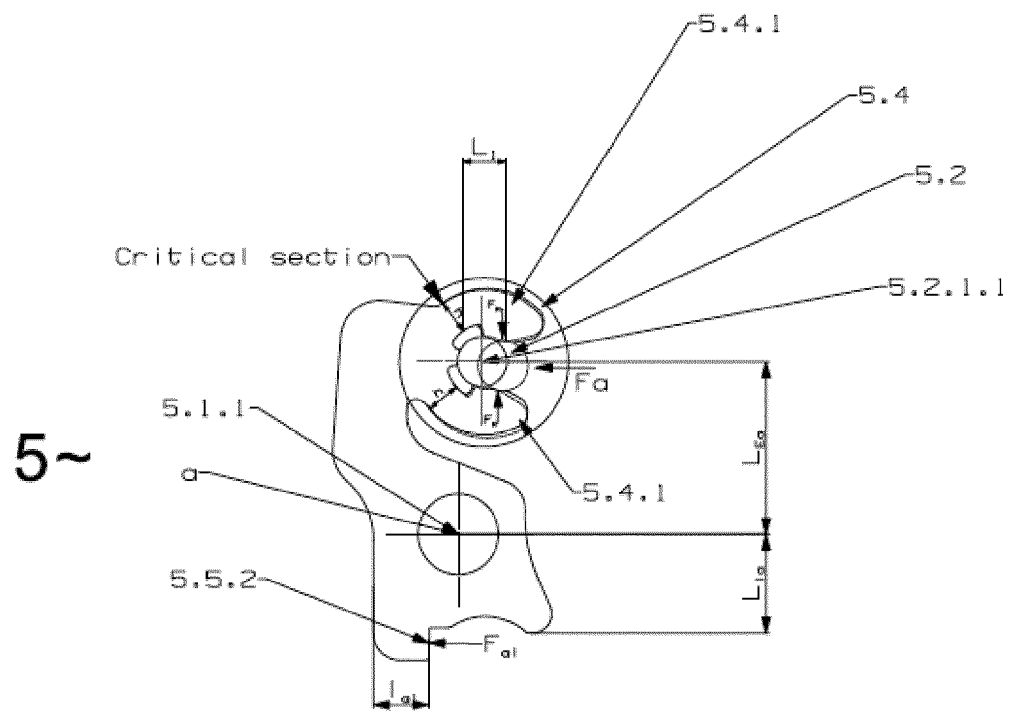


Fig. 3b

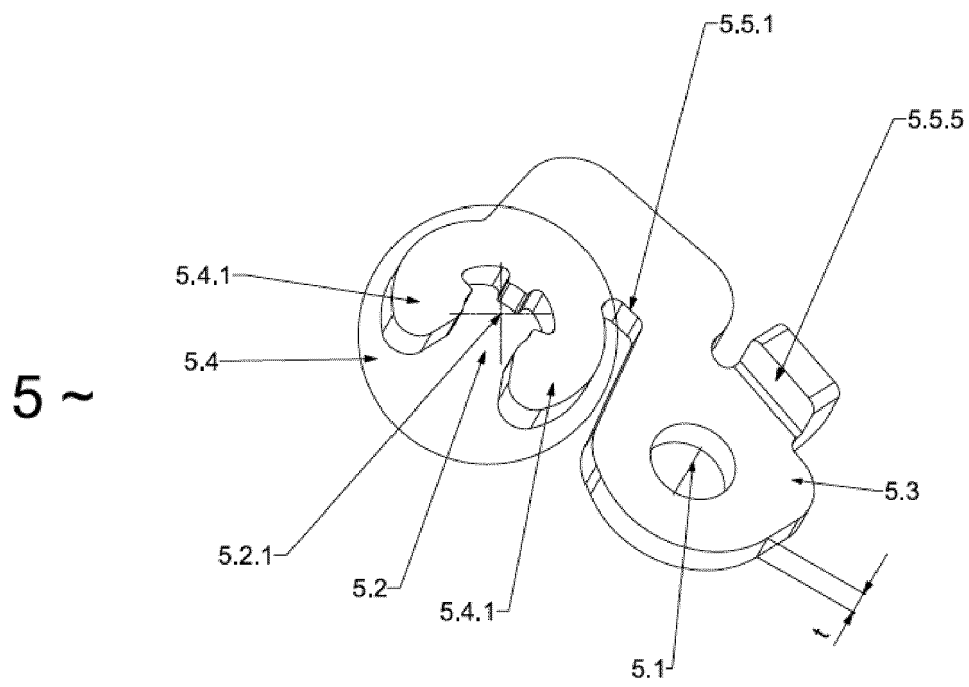


Fig.4a

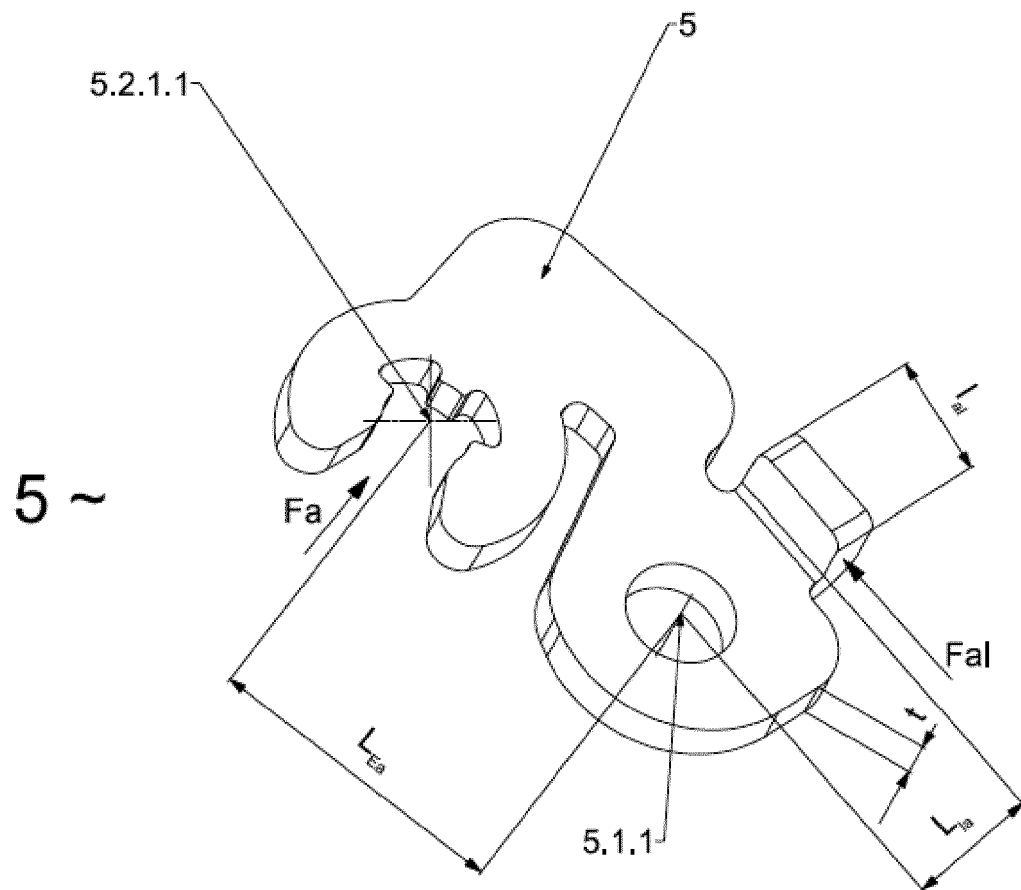


Fig. 4b

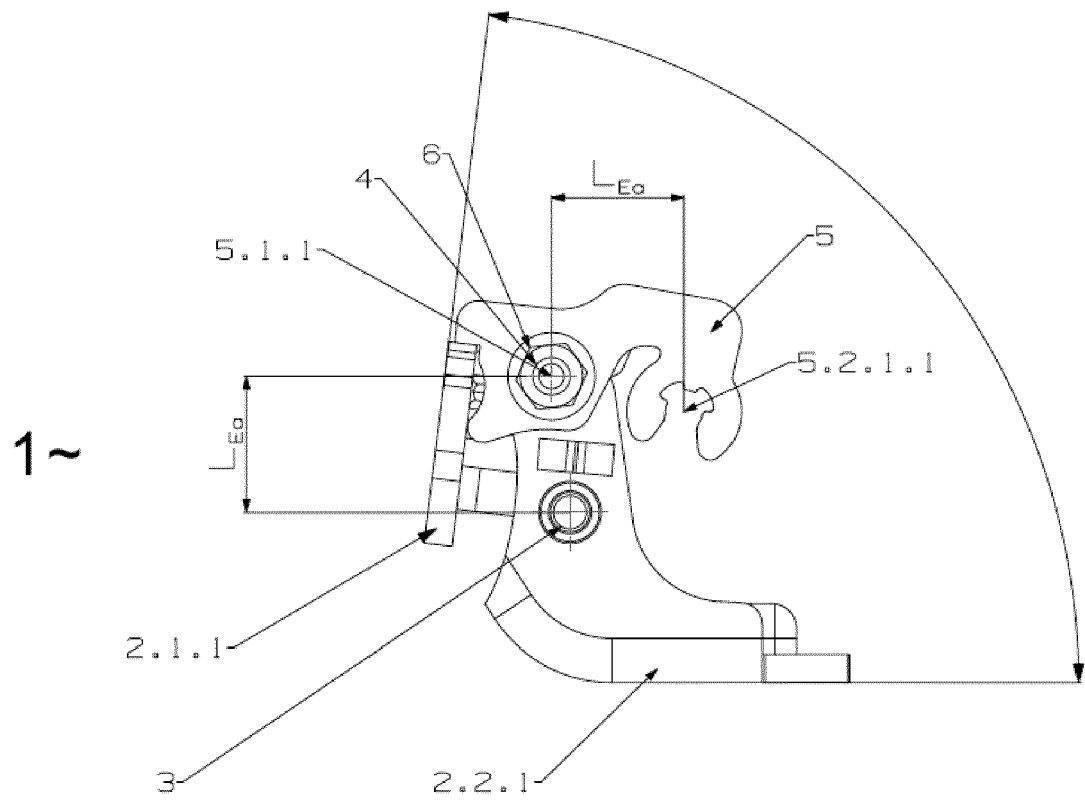


Fig. 5

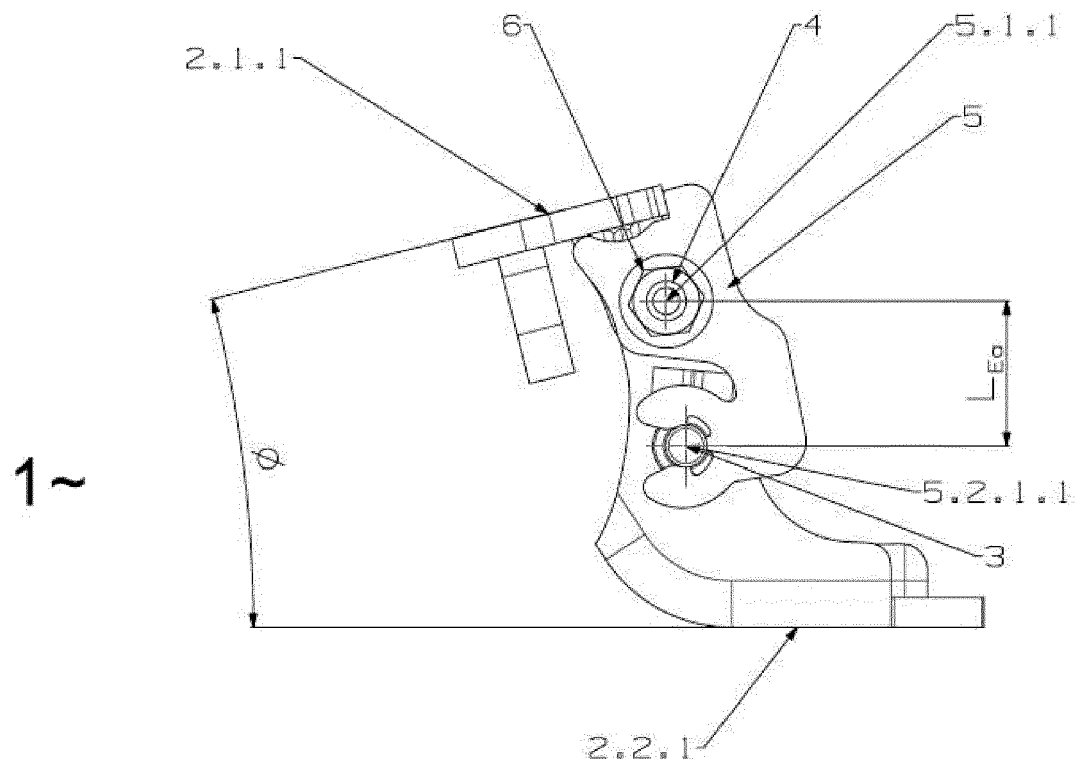


Fig. 6



EUROPEAN SEARCH REPORT

Application Number

EP 21 19 8259

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EPO FORM 1503 03.82 (P04C01)

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Y	* page 5, line 19 - page 11, line 8 * * page 19, line 4 - page 20, line 11 * * figures 1-4, 9-12, 21-24 *	12, 13	

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Y, D	CN 204 492 417 U (DONGFENG PEUGEOT CITROEN AUTOMOBILE CO LTD) 22 July 2015 (2015-07-22)	12-14	
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			E05D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 2 March 2022	Examiner Klemke, Beate
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	

**ANNEX TO THE EUROPEAN SEARCH REPORT
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CN 204492417 U	22-07-2015	NONE	

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