



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
01.11.2017 Bulletin 2017/44

(51) Int Cl.:
G05G 1/327 (2008.04)

(21) Application number: **17168620.7**

(22) Date of filing: **28.04.2017**

(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:
MA MD

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(30) Priority: **29.04.2016 IT UA20163017**

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(54) **COLLAPSIBLE CONTROL PEDAL FOR A VEHICLE**

(57) The pedal (10) comprises a pedal arm (12) with a lower arm portion (20) which carries a pad (14) and an upper arm portion (18) hinged to a fixed support structure so as to be rotatable around a first axis of rotation (x1). The upper arm portion (18) and the lower arm portion (20) are hinged (22) to each other so as to be rotatable relative to each other around a second axis of rotation (x2) parallel to the first axis of rotation (x1). The pedal (10) further comprises a connection mechanism (26, 36) to releasably connect the upper arm portion (18) with the lower arm portion (20), in such a manner that the pedal (10) is normally kept in a working position, where rotation of the upper arm portion (18) relative to the lower arm portion (20) around the second axis of rotation (x2) is prevented, and is shiftable to a release position, in case of a frontal impact of the vehicle such as to cause a rearward movement of the pedal, that is to say, a movement of the pedal towards the driver, where the upper arm portion (18) and the lower arm portion (20) are freely rotatable relative to each other around the second axis of rotation (x2) to allow forward rotation of the lower arm portion (20).

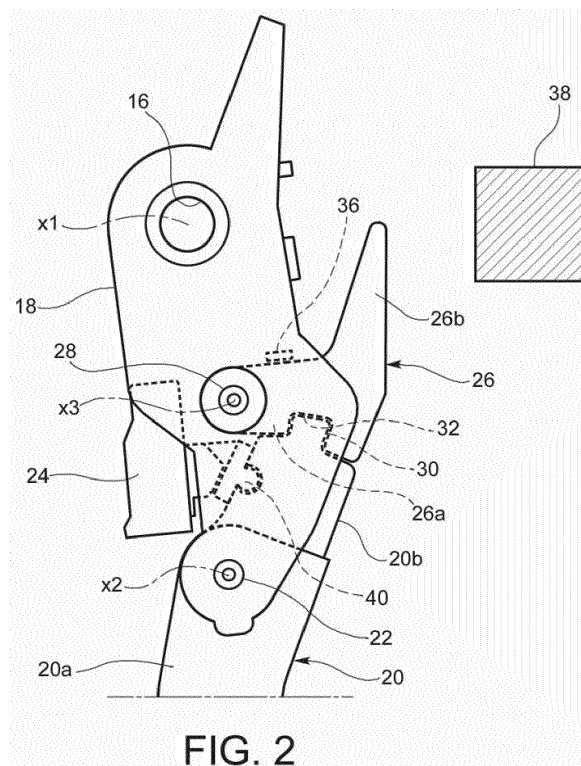


FIG. 2

Description

[0001] The present invention generally relates to a vehicle control pedal, such as a brake pedal or a clutch pedal, and more specifically to a collapsible control pedal for a vehicle that is configured to collapse in the event of a frontal impact of the vehicle.

[0002] Collapsible control pedals for a vehicle are known, in which the pedal arm comprises an upper arm portion, which is hinged to a support structure fixed to the body of the vehicle to rotate around a first axis of rotation, and a lower arm portion, separate from the upper arm portion, which carries at its free end (lower end) a pad on which the driver can act with his foot. The upper arm portion and the lower arm portion are hinged to each other around a second axis of rotation located below an insert that is fixed to the pedal arm and through which the pedal arm acts on a control member for transmitting to the related device or system of the vehicle (friction clutch, in the case of a clutch pedal, or brake system, in the case of a brake pedal) the commands given by the driver on the pedal. In the normal working position of the pedal, a releasable connection mechanism of the pedal drivingly connects the two pedal arm portions with each other, preventing them from rotating relative to each other around the second axis of rotation. In this condition, the two pedal arm portions rotate as a single body around the first axis of rotation of the pedal. The releasable connection mechanism of the pedal is arranged to disconnect the two pedal arm portions, allowing them to rotate relative to each other around the second axis of rotation, in case of rearward movement of the pedal support structure (i.e. the displacement of the pedal support structure towards the driver), resulting from a frontal impact of the vehicle, above a certain limit which is suitably chosen to prevent an excessive rearward movement of the pedal from jeopardizing the integrity of the lower limbs of the driver. In this condition, the lower arm portion may rotate freely around the second axis of rotation with respect to the upper arm portion so as to move the pedal pad forward, thereby at least partially compensating for the rearward movement of the pedal and thus reducing the risk of injury to the lower limbs of the driver.

[0003] An example of a collapsible control pedal for a vehicle is known from Italian patent application No. ITTO20020423.

[0004] According to this known example, the releasable connection mechanism of the pedal includes a release lever which is hinged to the upper arm portion of the pedal so as to be able to rotate with respect to this arm portion around a third axis of rotation vertically interposed between the first and second axes of rotation and is also releasably connected to the lower arm portion of the pedal. The release lever is configured for collision, in the event of an excessive rearward movement of the pedal support structure carrying the pedal arm as a result of a frontal impact of the vehicle, against an abutment element fixed to the vehicle body, the collision of the release

lever against the abutment element causing the rotation of the release lever with respect to the upper arm portion of the pedal around the third axis of rotation, whereby the release lever is released from the lower arm portion of the pedal. Following the release of the release lever from the lower arm portion of the pedal, the lower arm portion of the pedal may rotate forward relative to the upper arm portion around the second axis of rotation. The forward rotation of the lower arm portion of the pedal relative to the upper arm portion is automatically caused by a spring which is suitably mounted with preload between the two arm portions. The releasable connection between the release lever and the lower arm portion of the pedal is obtained by means of a screw inserted into a corresponding bushing fixed to the lower arm portion and engaging in a corresponding seat provided in the release lever. A nut is screwed onto the screw to tighten a side wall of the upper arm portion against the adjacent front face of the bushing. The upper arm portion is thus maintained secured to the bushing, and hence to the lower arm portion, due to the friction between the aforementioned side wall of the upper arm portion and the aforementioned front face of the bushing obtained by screwing the nut on the screw.

[0005] According to the known solution discussed above, the force (hereinafter referred to as the release force) required to disengage the release lever from the lower arm portion, and thus to allow the free rotation of this arm portion relative to the upper arm portion, depends therefore on the frictional force acting on the aforementioned side wall of the lower arm portion due to the nut being screwed onto the screw. A disadvantage of this known solution is therefore that the release force is variable over a rather wide range, which penalizes the reliability and safety of the pedal. Furthermore, with such a pedal it is very difficult to adjust the release force to meet, for example, the requirements set forth by the vehicle manufacturer.

[0006] A collapsible control pedal for a vehicle is also disclosed for example in US 2013/0239738. According to this known solution, in order to allow the release lever to rotate relative to the upper arm portion so as to disengage the lower arm portion and thereby allow the lower arm portion to rotate relative to the upper arm portion, it is necessary to shear a shear pin which is made as a separate part both from the release lever and from the upper arm portion and, in the normal working condition of the pedal, secures the release lever to the upper arm portion.

[0007] It is an object of the present invention to provide a collapsible control pedal for a vehicle that allows the release force to be adjusted within a smaller range than in the prior art.

[0008] A further object of the present invention is to provide a collapsible control pedal for a vehicle which has a smaller number of pieces and can be manufactured at a lower cost than the prior art.

[0009] This and other objects are fully achieved ac-

cording to the invention by a control pedal for a vehicle having the features defined in the appended independent claim 1.

[0010] Advantageous embodiments of the invention are set forth in the dependent claims, the subject-matter of which is to be understood as forming an integral and integrating part of the following description.

[0011] In summary, the invention is based on the idea of providing a collapsible control pedal for a vehicle of the aforementioned type, wherein the upper arm portion is provided with one or more shearable locking elements that are made in one piece with the upper arm portion and are configured to prevent, in the normal working position of the pedal, the release lever from rotating relative to the upper arm portion, and hence the release lever from disengaging from the upper arm portion, and to be sheared by the release lever when the latter strikes against the abutment element fixed to the vehicle body in the event of a frontal impact of the vehicle, in order to allow the release lever to rotate around the third axis of rotation, thereby causing disengagement of the release lever from the lower arm portion.

[0012] The use of shearable locking elements made in one piece with the upper arm portion for locking the release lever in the position wherein the release lever is connected to the lower arm portion, and hence prevents the lower arm portion from rotating relative to the upper arm portion, allows the release force (which will be, in this case, the force required to shear the locking elements) to be adjusted more precisely than in the prior art and thus to make the pedal safer and more reliable. In addition, this solution allows the total number of pedal pieces to be reduced and the manufacturing process of the pedal to be made simpler and less expensive.

[0013] Further features and advantages of this invention will become more apparent from the following detailed description, which is given purely by way of non-limiting example with reference to the accompanying drawings, wherein:

Figure 1 is a perspective view of a collapsible control pedal for a vehicle according to an embodiment of the present invention, in the normal working position of the pedal;

Figures 2 to 4 are lateral views showing in detail the releasable connection mechanism of the pedal of Figure 1, in the normal working position of the pedal, in the initial release position of the release lever and in the position where the lower arm portion of the pedal is rotated forward with respect to the upper arm portion, respectively; and

Figure 5 is a lateral view showing schematically the releasable connection mechanism of the pedal of Figure 1 in the normal working position of the pedal.

[0014] In the following description and claims, terms such as "front" and "rear", "upper" and "lower" etc. are to be understood as referring to the mounted condition

of the control pedal on board a motor vehicle.

[0015] Referring first to Figure 1, a collapsible control pedal for a vehicle according to an embodiment of the present invention is generally indicated 10 and basically comprises a pedal arm 12, a pad 14 secured to one end (lower end) of the pedal arm 12 and a hinge bushing 16 fixed to the opposite end (upper end) of the pedal arm 12 to enable the pedal arm 12 to be rotatably mounted around a substantially horizontal first axis of rotation x1 on a support structure (not shown) fixed to the vehicle body below the dashboard.

[0016] The pedal arm 12 comprises two distinct arm portions, namely an upper arm portion 18 and a lower arm portion 20. The hinge bushing 16 is fixed to the upper arm portion 18, so that the upper arm portion 18 is rotatable relative to the support structure around the first axis of rotation x1. The lower arm portion 20 carries the pad 14 at its lower end. The upper arm portion 18 and the lower arm portion 20 are hinged to each other by means of a hinge pin 22 so as to be rotatable relative to each other around a second axis of rotation x2. The second axis of rotation x2 is oriented parallel to the first axis of rotation x1 and is located below an insert 24 which is attached to the pedal arm 12, specifically to the upper arm portion 18, and through which the pedal arm 12 acts on a control member (not shown, but of per-se known type) for transmitting to the related device or system of the vehicle (friction clutch, in the case of a clutch pedal, or brake system, in the case of a brake pedal) the commands given by the driver on the pedal.

[0017] With reference also to Figures 2 through 5, in the normal working position of the pedal (Figures 1, 2 and 5) the upper arm portion 18 and the lower arm portion 20 are rigidly connected to each other (and hence are locked in rotation with respect to each other around the second axis of rotation x2) to rotate as a single body around the first axis of rotation x1.

[0018] In the pedal release position (Figures 3 and 4), in which the pedal is positioned following a frontal impact of the vehicle such as to cause an excessive rearward movement of the pedal support structure carrying the pedal, the upper arm portion 18 and the lower arm portion 20 are free to rotate relative to each other around the second axis of rotation x2. In this second condition, therefore, the lower arm portion 20 rotates forward (clockwise, with respect to the point of view of a person observing Figures 2 through 4) around the second axis of rotation x2, both by inertia and as a result of a possible contact with the driver's foot, without however providing resistance against the driver's foot (at least until this pedal portion has reached the end of its travel) and therefore without causing trauma or injury to the driver's foot.

[0019] In order to keep the pedal normally in the aforementioned normal working position and to automatically cause the pedal to move to the release position as a result of a frontal impact of the vehicle, the pedal 10 is provided with a releasable connection mechanism comprising a release lever 26 which is hinged to the upper

arm portion 18 by means of a hinge pin 28 so as to be able to rotate with respect to this arm portion around a third axis of rotation x_3 which is oriented parallel to the first and second axes of rotation x_1 and x_2 and is vertically interposed between these latter. The release lever 26 is also detachably connected to the lower arm portion 20 by engagement of a tooth-shaped protrusion 30 provided at the upper end of the lower arm portion 20 in a corresponding seat 32 provided in the release lever 26.

[0020] Preferably, the lower arm portion 20 comprises a lower part 20a of plastic material (on the lower end of which there is provided the pad 14) and an upper part 20b formed by a metal insert. In this case, the protrusion 30 is formed by the metal insert constituting the upper part 20b of the lower arm portion 20. According to one embodiment, the metal insert is made as a plate element arranged with its middle plane oriented vertically, and more specifically perpendicular to the axes of rotation x_1 , x_2 and x_3 .

[0021] According to one embodiment, the release lever 26 has a generally L-shaped configuration, with a first branch 26a extending substantially horizontally and having at its front end a hole 34 for the hinge pin 28, and with a second branch 26b extending from the rear end of the first branch 26a. The release lever 26 is, for example, formed by a single piece of metal, in particular steel. Preferably, the first branch 26a is formed as a plate portion, the middle plane of which is oriented vertically, and more specifically perpendicular to the axes of rotation x_1 , x_2 and x_3 . The second branch 26b is also preferably made as a plate portion which may be coplanar with the first branch 26a or, as in the example shown in the drawings (see Figure 1), inclined at a certain angle to the first branch 26a.

[0022] In the normal working position of the pedal, the release lever 26, which is connected to the upper pedal portion 18 by the hinge pin 28, is also connected to the lower pedal portion 20 by virtue of the engagement of the aforementioned protrusion 30 in the aforementioned seat 32. The lower arm portion 20 cannot therefore rotate with respect to the upper arm portion 18 around the second axis of rotation x_2 , but rotates together with the upper arm portion 18 around the first axis of rotation x_1 , thereby transmitting to the control member, through the insert 24 fixed to the upper arm portion 18, the commands imparted by the driver on the pad 14. The release lever 26 is normally held in such a position by at least one shearable locking element 36, which is made in one piece with the upper arm portion 18 and against which the release lever 26 abuts, particularly at an upper edge of the first branch 26a. In this way, the release lever 26 cannot rotate (in counterclockwise direction, with respect to the point of view of a person observing Figures 2 through 5) relative to the upper arm portion 18 to disengage the protrusion 30 of the upper arm portion 18 from its seat 32. The locking element 36 is, for example, made in the form of a small tooth projecting laterally from the upper arm portion 18. Preferably, the upper arm portion 18, and also the

locking element 36 with it, is made of plastic material.

[0023] As shown in Figures 3 and 4, in case of excessive rearward movement of the pedal support structure carrying the foot pedal 12, as a result of a frontal impact of the vehicle, such as to bring the release lever 26, in particular the second portion 26b of the release lever 26, against an abutment member 38 fixed to the body of the vehicle, the impact of the release lever 26 against the abutment member 38 tends to cause the release lever 26 to rotate with respect to the upper arm portion 18 around the third axis of rotation x_3 , resulting in the release lever 26 exerting an impulsive force on the locking member 36. If this force is sufficient to cause the shearing of the locking member 36, then the release lever 26 is free to rotate (in counterclockwise direction) with respect to the upper arm portion 18, thus disengaging from the lower arm portion 20 (Figure 3). The release force, i.e. the force necessary to disengage the release lever 26 of the lower arm portion 20, is thus the force required to shear the locking member 36. Due to the fact that the locking member 36 is a member made in one piece with the upper arm portion 18, preferably made of plastic material, the force required to shear the locking member 36 is not much subject to variations in case of changes in size of the locking member 36 due to manufacturing tolerances, and may therefore be maintained within a sufficiently narrow range.

[0024] Once the release lever 26 is disengaged from the lower arm portion 20, the latter is free to rotate forward (in clockwise direction, with respect to the point of view of a person observing Figures 2 through 5) with respect to the upper arm portion 18 around the second axis of rotation x_2 , as shown in Figure 4, thus moving the pad 14 forward and therefore away from the driver's foot.

[0025] Due to such a releasable connection mechanism, the release force may be set in advance by appropriately designing the locking member 36, in particular by appropriately defining its shape and thickness. Moreover, such a releasable connection mechanism allows to considerably reduce the range of variation of the release force with respect to the prior art discussed above.

[0026] Preferably, in order to ensure a certain preload between the two arm portions 18 and 20, the pedal also comprises an elastic element 40 interposed between these arm portions. According to the illustrated embodiment, the elastic element 40 is carried by the upper arm portion 18 and engages, with its protrusion 42, in a corresponding seat 44 provided in the lower arm portion 20 above the second axis of rotation x_2 . In this way, in order to be able to rotate freely with respect to the upper arm portion 18 around the second axis of rotation x_2 when the pedal is in the aforementioned release position, i.e. when the release lever 26 has released the lower arm portion 20, the lower arm portion 20 must disengage from the elastic member 40, as shown in Figures 3 and 4.

[0027] Naturally, the principle of the invention remaining unchanged, the modes of carrying out the invention may be greatly varied with respect to those described

and illustrated here purely by way of a non-limiting example, without thereby departing from the scope of the invention as defined in the accompanying claims.

[0028] For example, although in the illustrated embodiment the engagement between the release lever and the lower arm portion in the normal working position of the pedal is obtained by insertion of a protrusion formed at the upper end of the lower arm portion into a corresponding seat on the release lever, the protrusion might be formed by the release lever and the corresponding seat be provided at the upper end of the lower arm portion.

Claims

1. Collapsible control pedal (10) for a vehicle, comprising a pedal arm (12) and a pad (14), wherein the pedal arm (12) comprises a lower arm portion (20) carrying the pad (14) at its lower end and an upper arm portion (18) separate from the lower arm portion (20) and arranged (16) to be hinged to a support structure fixed to the vehicle body so as to be rotatable around a first axis of rotation (x1), wherein the upper arm portion (18) and the lower arm portion (20) are hinged (22) to each other so as to be rotatable relative to each other around a second axis of rotation (x2) parallel to the first axis of rotation (x1), wherein the pedal (10) further comprises connecting means (26, 36) for releasably connecting the upper arm portion (18) with the lower arm portion (20), whereby the pedal (10) is normally kept in a working position, where rotation of the upper arm portion (18) relative to the lower arm portion (20) around the second axis of rotation (x2) is prevented, the upper arm portion (18) and lower arm portion (20) being thus rotatable as a single body around the first axis of rotation (x1), and is shiftable to a release position, as a result of a frontal impact of the vehicle such as to cause a rearward movement of the pedal, that is to say, a movement of the pedal towards the driver, where the upper arm portion (18) and the lower arm portion (20) are freely rotatable relative to each other around the second axis of rotation (x2) to allow forward rotation of the lower arm portion (20), wherein said connecting means (26, 36) comprise a release lever (26) which is hinged to the upper arm portion (18) so as to be rotatable relative to the latter around a third axis of rotation (x3) parallel to the first and second axes of rotation (x1, x2) and vertically interposed between the first and second axes of rotation (x1, x2), between a first position, where the release lever (26) engages (30, 32) with the lower arm portion (20) so as to prevent rotation of the lower arm portion (20) relative to the upper arm portion (18) around the second axis of rotation (x2), and a second position, where the release lever (26) is dis-

engaged from the lower arm portion (20), thereby allowing rotation of the lower arm portion (20) relative to the upper arm portion (18) around the second axis of rotation (x2),

wherein said connecting means (26, 36) further comprise locking means (36) arranged to keep the release lever (26) normally locked in said first position and to allow movement of the release lever (26) to said second position as a result of an impact of the release lever (26) against an abutment member (38) fixed to the vehicle body due to the rearward movement of the pedal (10) resulting from a frontal impact of the vehicle,

characterized in that said locking means (36) comprise at least one locking element (36) which is made in one piece with the upper arm portion (18) and is configured to be sheared by the release lever (26) when the latter impacts against the abutment member (38), thereby allowing rotation of the release lever (26) around the third axis of rotation (x3) from said first position to said second position.

2. Pedal according to claim 1, wherein said at least one locking element (36) projects laterally from the upper arm portion (18).
3. Pedal according to claim 1 or claim 2, wherein the upper arm portion (18), and therefore also said at least one locking element (36), is made of plastic material.
4. Pedal according to any of the preceding claims, wherein the lower arm portion (20) includes, at its upper end, a protrusion (30) adapted to engage in a corresponding seat (32) of the release lever (26) to ensure engagement of the release lever (26) with the lower arm portion (20) when the release lever (26) is in said first position.
5. Pedal according to any of claims 1 to 3, wherein the release lever (26) includes a protrusion adapted to engage in a corresponding seat at the upper end of the lower arm portion (20) to ensure engagement of the release lever (26) with the lower arm portion (20) when the release lever (26) is in said first position.
6. Pedal according to any of the preceding claims, wherein the release lever (26) is formed by a single piece of metal.
7. Pedal according to any of the preceding claims, wherein the lower arm portion (20) comprises a lower part (20a) of plastic material and an upper part (20b) formed by a metal insert.
8. Pedal according to any of the preceding claims, further comprising an elastic element (40) interposed between the upper arm portion (18) and the lower

arm portion (20) to apply an elastic preload between said arm portions (18, 20).

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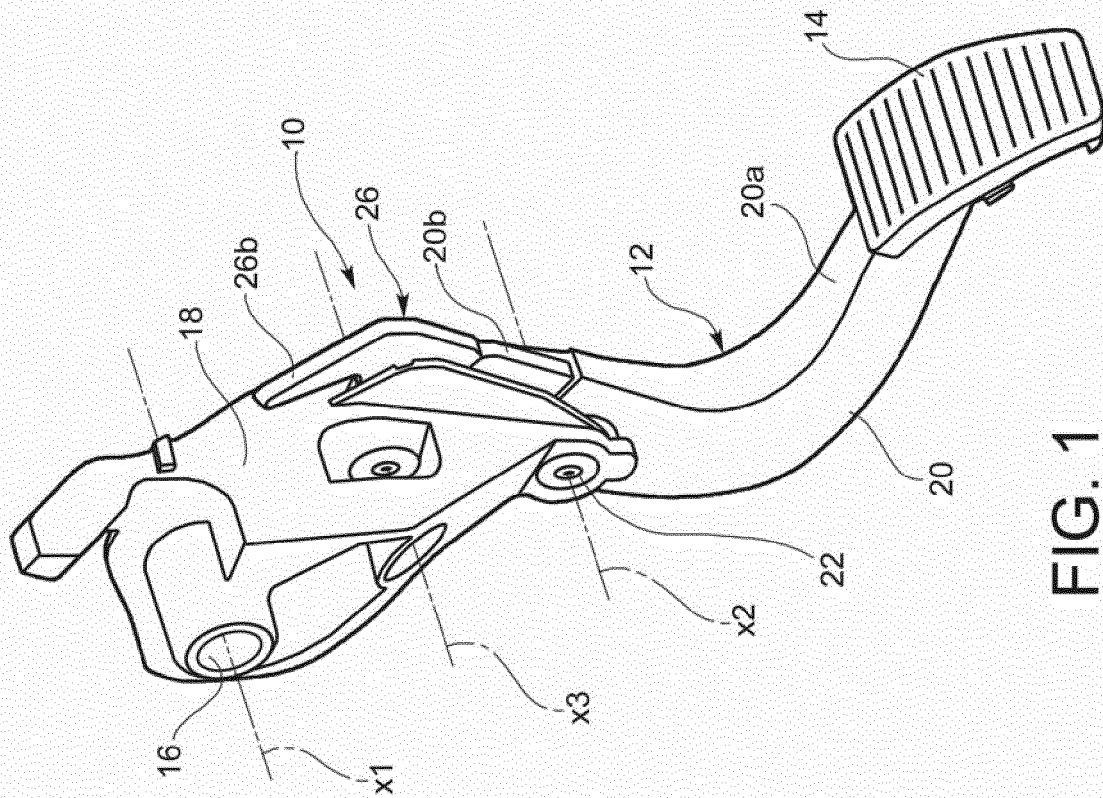


FIG. 1

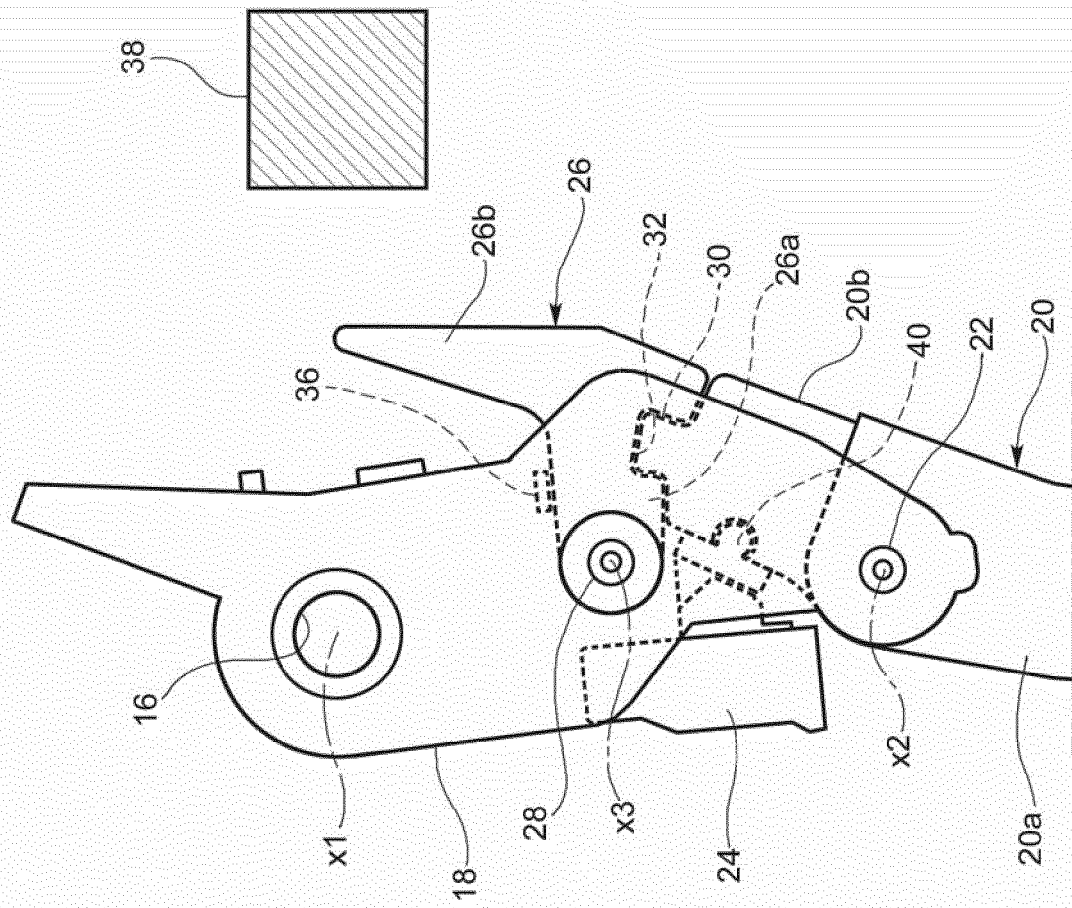


FIG. 2

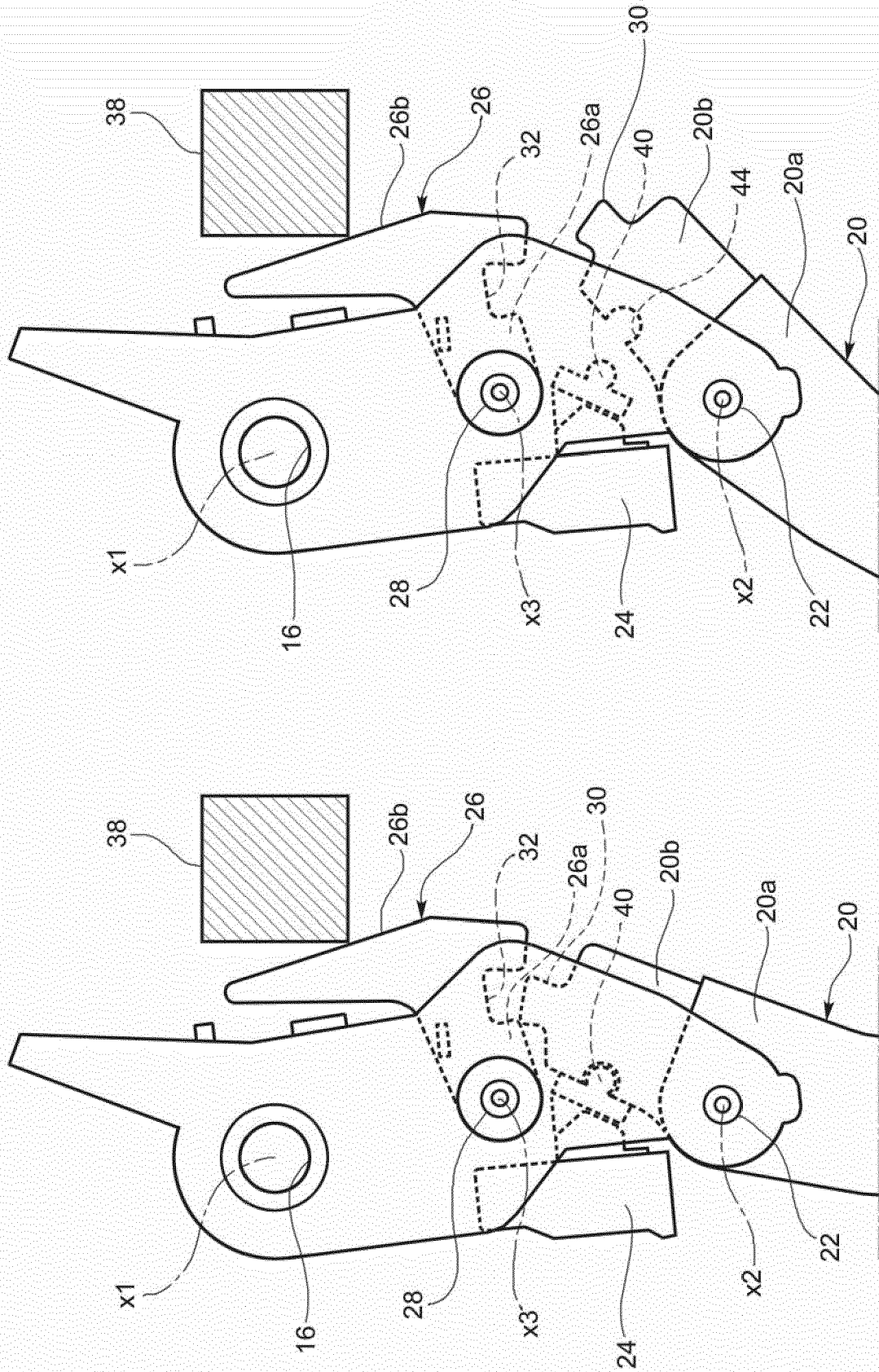


FIG. 4

FIG. 3

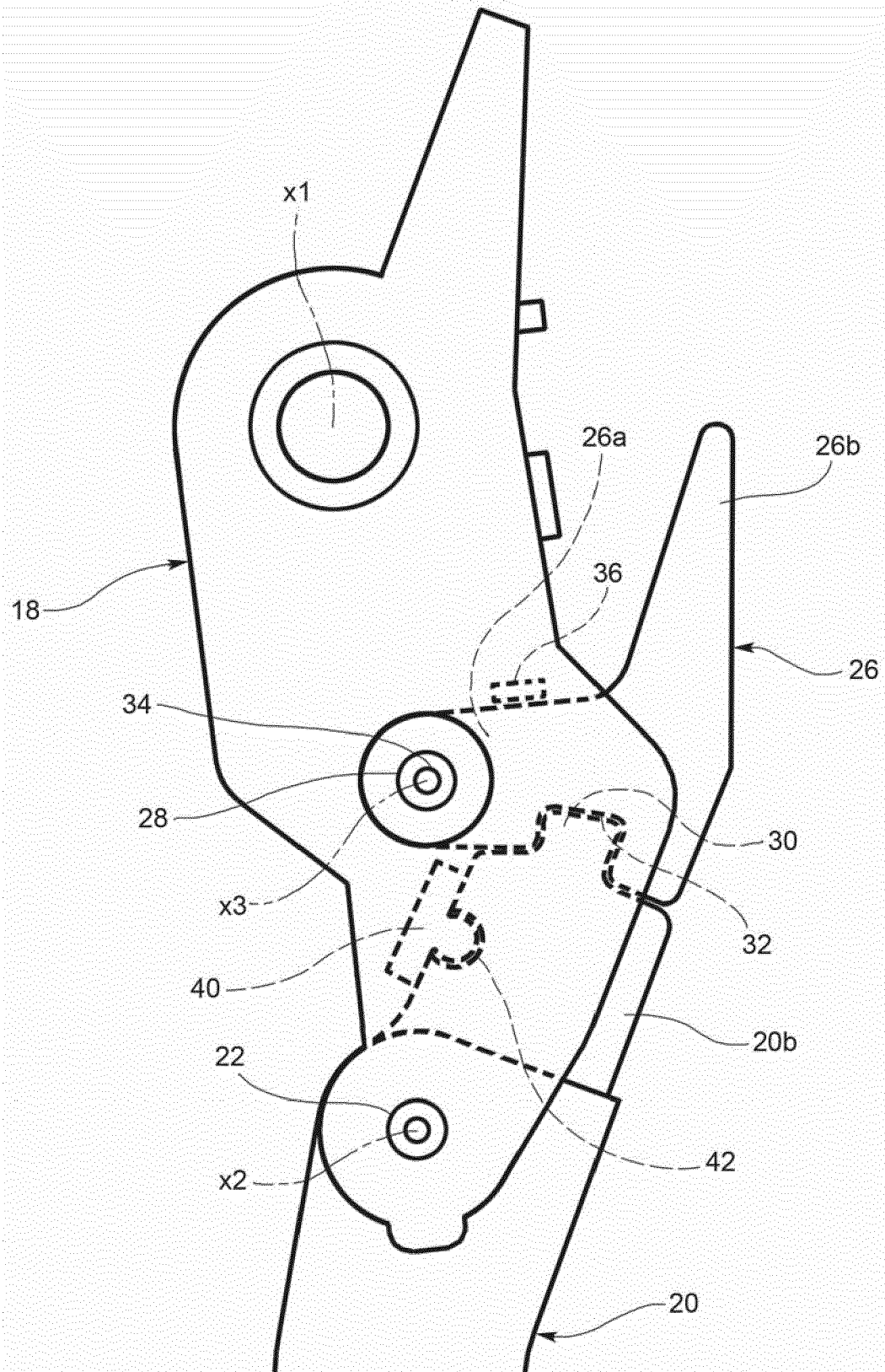


FIG. 5



EUROPEAN SEARCH REPORT

Application Number
EP 17 16 8620

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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