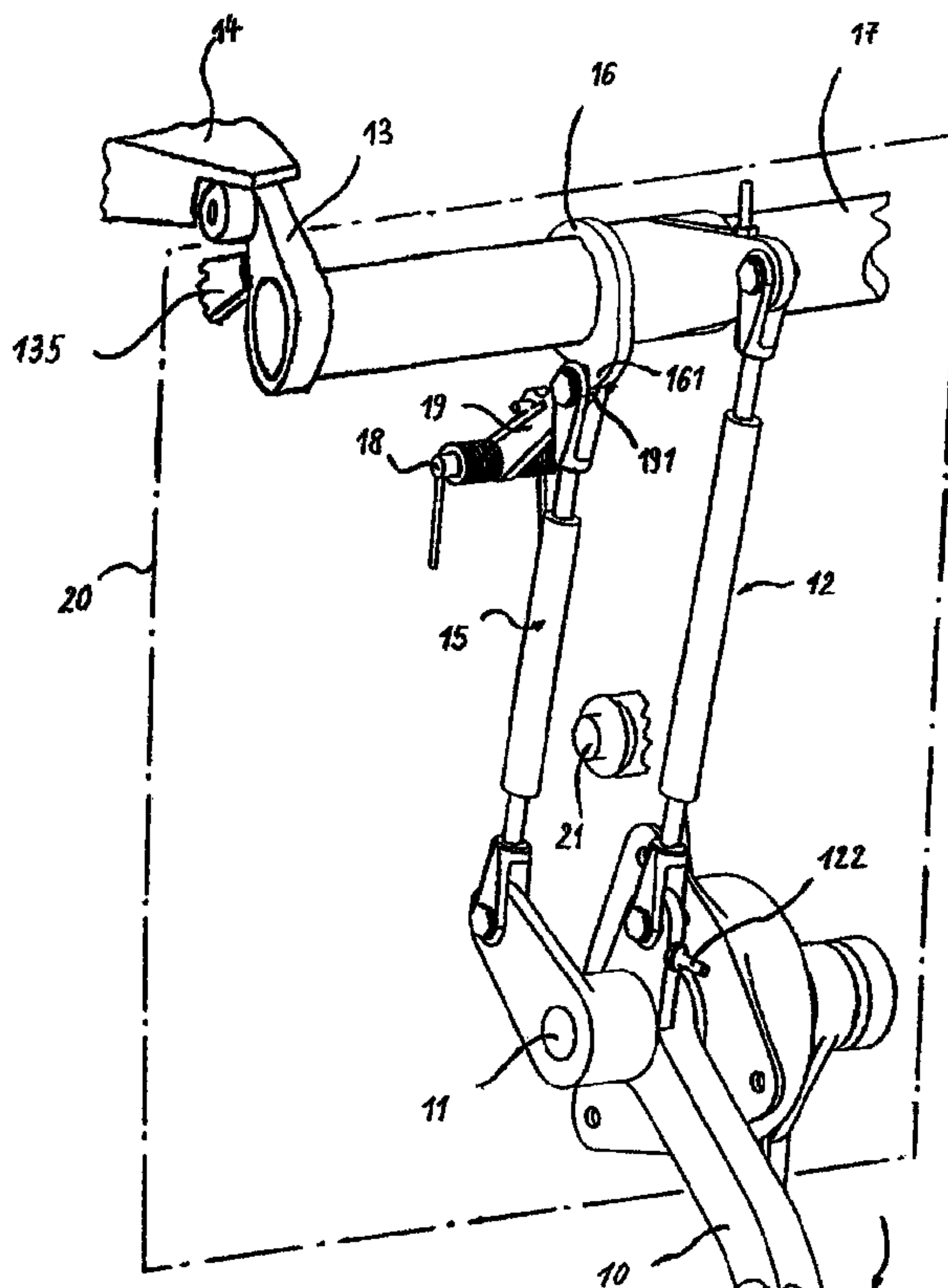




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(57) Abrégé/Abstract:

The invention relates to a method and a device for closing a door of an aircraft. There is provided a latch mechanism, which holds the latched position of the door. The latch mechanism is locked by means of a lock mechanism which due to delayed movement of a movement mechanism is activated by the drive. The drive shaft is connected to a lock drive which is connected to a lock, which is hingeably or slideably held on a lock axis, and in that the lock is arranged so as to engage a lock element attached to the latch axis.

ABSTRACT

The invention relates to a method and a device for closing a door of an aircraft. There is provided a latch mechanism, which holds the latched position of the door. The latch mechanism is locked by means of a lock mechanism which due to delayed movement of a movement mechanism is activated by the drive. The drive shaft is connected to a lock drive which is connected to a lock, which is hingeably or slideably held on a lock axis, and in that the lock is arranged so as to engage a lock element attached to the latch axis.

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Method and device for closing a door of an aircraft

The invention relates to a method and a device for closing a door of an aircraft. The method-related aspect comprises a closing process where the door is moved from an open position to a closed position and then to a latched position, whereby the door is latched in the frame of the fuselage structure by means of a latch mechanism. The device comprises at least one latch mechanism with a drive shaft drivable by means of a drive; said drive shaft being connected to a latch element arranged on a latch axis by means of a latch drive, said latch element being able to engage a retention means arranged in the frame of the aircraft structure.

According to DE 197 02 084 C1, a door of an aircraft is moved from the open position to a closed position and then to a latched position, with the door being latched in the frame of the fuselage structure by means of a latch mechanism.

It is further known, during the closing process at the end of the hingeing-in movement, for the door to be guided along a vertical movement path which essentially conforms to the exterior contour of the aircraft. The vertical movement path is essentially aligned transversely to the hingeing direction of the passenger door. At the end of the path of a hingeing-in movement and at the start of the vertical movement path, the passenger door is lowered and guided to a closed position by means of manual operation of a hand lever. The closed position involves positive engagement of the stop elements which are fixed at the door, with the accommodating elements which are fixed at the door frame. At this stage the hand lever has not completed its entire travel path; there is still a small travel

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path to be completed. By further manual operation of the hand lever along the travel path until the limit position of the hand lever path has been reached, the passenger door is latched in the closed position by means of a door latch mechanism, i.e. it is brought to a latched position and held in that latched position. The latch mechanism for a passenger door functions independently of a support device and a tilt-position control system of the passenger door. In the simplest design case, latching of the passenger door is by a bolt or a hook movable to a retention position, said bolt or hook engaging an anchorage in the door frame of the aircraft structure, or encompassing a stop from behind. The latch mechanism with bolt or hook is for example activated by a rotatable drive shaft which is connected to the manually operable hand lever.

Aircraft which are in service now are equipped with doors which are manually pivotable, by activating a hand lever, to the closed position and onward to the latched position. The force of the hand lever is transmitted by means of a drive shaft and a rod assembly, right up to the latch axis with bolt or hook.

Dynamic loads on the door during the flight can result in vibration which may cause reversal of the latch action. This can lead to the danger of the passenger door opening during flight. Such a danger might also exist if the latch drive breaks.

It is thus one object of the invention to avoid failure during flight, of the latch mechanism of an aircraft door; while at the same time providing an economical design.

From a method-related point of view, this object is met in that the latch mechanism which holds the latched

position of the door is locked by means of a lock mechanism which due to delayed movement of a movement mechanism is activated by the drive.

From a device-related point of view, this object is met in that the drive shaft is connected to a lock drive which is connected to a lock, which is hingeably or slideably held on a lock axis, and in that the lock is arranged so as to engage a lock element attached to the latch axis.

In the case of an existing latch mechanism, the drive can be guided along a remaining section of travel by means of a movement mechanism, with a delayed movement of the lock, up to slightly spaced apart engagement with the lock element, being able to be achieved. The delayed movement is transferred to the lock element via the lock drive, with the latch drive remaining in the latched position. The movement mechanism can be a gear arrangement. The gear arrangement can comprise at least rods, gearwheels, eccentric disks or a cam control. The use of rods with angular positions and dead centres is cost-effective. According to a special embodiment, these rods with angular positions and dead centres constitute the movement mechanism. In the movement mechanism, an intermediate shaft can be arranged between the drive shaft and the lock drive or between the drive shaft and the latch drive. In this way, the movement mechanism can be optimised.

According to a further embodiment, the latch axis can be connected to a transmission mechanism which synchronises latching and locking of a vent flap in the door, in relation to the latch mechanism of the door. This can also be made possible for a display means in the door, said display means indicating the locked latched position. According to a further embodiment,

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the drive shaft can be connected to a transmission mechanism which guides the door from an open position to a closed position. This is an additional effect.

In an expanded sense, the door not only involves a passenger door, but the principle of the invention can be transferred to any other form of a door to be latched and locked. The term door is intended to include e.g. the freight door, the cargo hatch, any closable engine fairing or any other closure which is not subject to pressure, in the secondary structure of an aircraft. The term door further includes any closure cover which in its open position is not connected to the frame of a fuselage structure.

The invention provides the advantage that with only one drive, which already exists, the additional function of a "locked latched position" can be achieved. Associated with this are savings achieved by avoiding additional production costs and additional door weight. There is no increase in inspection expenditure.

Although this involves an additional operator function at the door, operator comfort with only one drive is maintained.

Accordingly, in one aspect, the invention provides a device for closing a door of an aircraft, the device comprising a door drive, for closing the door, and a movement mechanism driven by the door drive and comprising a latch drive for operating a latch mechanism and a lock drive for operating a lock mechanism, the latch mechanism comprising a latch element moveable about a latch axis by the latch drive to a latching position in which it engages with a

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retention means arranged in the frame of the aircraft structure to latch the closed door, and the lock mechanism comprising a lock moveable by the lock drive to a locking position in which it is engageable with a lock element mounted on the latch axis to lock the door in its latched position, wherein, during operation of the door drive, the latch drive moves the latch mechanism to its latching position whilst the lock drive is moving the lock mechanism towards its locking position, and wherein, when the latch mechanism is its latching position, further movement of the door drive moves the lock mechanism into its locking position.

In another aspect, the invention provides an apparatus for latching and safety locking a door in a door frame, the apparatus comprising a drive shaft rotatably mounted in the door, drive means operatively connected to the drive shaft for rotating the drive shaft through a first angular range toward a dead point and through a second angular range beyond the dead point, a latching and locking shaft rotatably mounted in the door, a latching force transmitting link operatively interposed between the latching and locking shaft and the drive shaft for transmitting a latching drive force from the drive shaft to the latching and locking shaft when the drive shaft is rotated toward the dead point, a locking force transmitting link operatively interposed between the drive shaft and the latching and locking shaft for transmitting a locking force from the drive shaft to the latching and locking shaft when the drive shaft is rotated through the second angular range beyond the

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dead point, a first pair of stop means cooperating with the latching and locking shaft for stopping further rotation of the latching and locking shaft when the drive shaft reaches the dead point after passing through the first angular range, a second pair of stop means cooperating with the drive shaft for stopping any further rotation of the drive shaft outside the second angular range, so that the locking force transmitting link is movable during rotation of the drive shaft through the second angular range into a position for applying the locking force to the latching and locking shaft.

One embodiment of the invention is shown in the drawings and described in more detail below.

The following are shown:

Fig. 1 A diagram of the device according to the invention in the latched position and in the locked latched position;

Fig. 2a A device according to the invention in the unlatched and unlocked position;

Fig. 2b A device according to the invention in latched position and unlocked position;

Fig. 2c A device according to the invention in latched position and secure latched position.

The passenger door is a construction which as is known has been described in DE 197 02 084 C1. By way of a support arm, the passenger door is hingeably arranged on one side of the frame of the aircraft fuselage, so as to be liftable and turnable.

The following description refers to Fig. 1. and explains which functions are possible to achieve the position, shown in Fig. 1, of a movement mechanism 20. Fig. 1 shows the device according to the invention in "latched position" and in "locked latched position".

During the closing process of a passenger door or a freight door (for the sake of brevity, herein referred to as "door"), the operator moves it from an open position along a hingeing-in path. At the end of the hingeing-in path, the door is positioned in front of the door opening. The operator in the interior of the passenger cabin operates the drive 10 of the door. The drive 10 can be a hand lever, electric motor with control system or similar. An electric motor can for example be a single drive for a latch mechanism or it can be a central drive which is activated as required by means of a control gear assembly. In the following drawings the drive 10 is a hand lever. The drive 10 is connected to a drive shaft 11 which is held in the door. The drive 10 (e.g. a hand lever) is guidable along a section of an arc-shaped track (approx. 110°). The drive 10 can be independently operated either by an operator situated inside or outside the aircraft cabin.

When the drive 10 is activated, the door is lowered along a vertical movement path into a closed position. The closed position involves a positive engagement of the stop elements which are fixed on the door side, with the accommodating elements which are fixed to the frame, of the aircraft structure.

Immediately after the closed position, a movement of the latch element 13, arranged on a latch axis 17, takes place into a retention means 14 by way of further movement of the drive shaft 11 and the latch drive 12 connected to said drive shaft. When the two are engaged, latching is complete. The latch element 13 can for example be a hook or a roller; correspondingly, the retention means 14 can be an eyelet, roller or an opposite fitting. The retention means 14 is arranged in the door casement, i.e. in the frame of the aircraft structure. The movement path of the latch element 13 is limited by at least one stop means 122. The latch drive 12 for example comprises a rod assembly with angular positions and dead centres. However, other designs e.g. an eccentric disk could also be implemented.

Since the latch element 13 is arranged together with a lock element 16 on a latch axis 17, said lock element 16 also moves to a limit position.

Thus the door is latched and in the "latched position", i.e. the latch element 13 engages the retention means 14 while the lock element 16 is in its limit position.

With this latched position as it stands, the invention makes it possible for a small additional movement of the drive 10 to take place. When the latched position is reached, the drive 10 still has a small remaining

section to travel (approx. 4°) to the limit position of its arc-shaped track.

Thus after the latched position has been attained, a delayed movement of the lock 19 becomes possible. This delayed "lock movement" is possible as a result of the design of the movement mechanism 20. Said movement mechanism, which is located within the door, comprises the drive shaft 11, the latch drive 12, the lock drive 15 as well as the latch axis 17 and the lock axis 18. The movement mechanism 20 can for example be designed such that, by means of rod assemblies, angular positions and dead centres can be achieved which after the latch axis has been reached, still allow a delayed movement of the lock 19 after the latch operation has been reached.

The rod assembly of the movement mechanism 20 could also be combined with eccentric disks, gearwheels or with a cam control or a so-called Maltese cross. The use of other forms of gearing is also possible. According to another embodiment, the movement mechanism 20 could also be designed such that an intermediate shaft can be arranged between the lock drive 15 and the drive shaft 11 or between latch drive 12 and the drive shaft 11. The intermediate shaft could also be arranged between the drive shaft 11 and the latch drive. However, basically this does not alter the described function of the invention. In addition, force-supporting elements (e.g. springs) can lock the movement mechanism 20 in its limit position.

When the drive 10 traverses this remaining section of travel (approx. 4°), a lock drive 15 is activated which is movably connected to a lever arm of the drive shaft 11. The slight rotation of the drive shaft 11 transmits the force onto the lock drive 15 which can for example

also be formed from a rod assembly (rods and levers). Through the angular positions and dead centres of its rod assembly, the latch drive 12 moves through a dead point towards an over-centred region. Over-centring means moving the rod assembly past a neutral position (dead point), positioning it against an end stop so that forces other than those connected with the drive cannot apply an opening moment on the rod assembly. The latch drive 12 cannot leave the overcentred region e.g. as a result of vibration alone.

The lock drive 15 leads to the lock 19 movably held in said lock drive, with the root of said lock being hingeably held in a lock axis 18. The lock drive 15 hinges the lock 19 with its head 191 directly in front of the stop 161 of the lock element 16. Both are in positive engagement, slightly spaced apart. If the latch axis 17 is moved in the direction of the door opening and if at the same time there is a failure within the latch drive 12, the lock element 16 and the lock 19 are positively engaged.

The lock element 16 firmly connected to the latch axis 17 thus locks any reverse rotation of the latch axis if the latch drive 12 should break, i.e. it prevents unlatching.

This locks the latch axis 17 against unwanted reverse rotation out of the latched position. The latch is thus additionally locked. The door has reached a so-called "locked latched position".

When the latch element 13 is functioning properly, the lock mechanism with the lock element 16 and the lock 19, are not subjected to any loads and are functionally ready. If the latch axis 17 starts to be subjected to loads and if at the same time there is a fault in the

latch drive 12, the lock 19 is pushed against the lock element 16, thus locking the latch axis 17 against reverse rotation. It is also advantageous if the free play for hingeing away the latch element 13 is relatively large before any movement which lifts the door is initiated.

If eccentric disks are used in the movement mechanism 20, then they should be designed such that in the state of being in the locked latched position, no forces must act on the lock 19 as a result of the latching function taking place.

Figures 2a, 2b, 2c show snapshots from the movement sequence of the device according to the invention. The latch mechanism was designed using a roller as a latch element 130 and an armature as a retention means 140. The drive 100 was designed as a hand lever, but it could instead be an electric motor drive.

Figure 2a shows a movement mechanism 200 of a door with a non-latched and non-locked latch axis 170.

In this state, the door is neither in a "latched position" nor in a "locked latched position".

The drive 100 (hand lever) attached to the drive shaft 110 on its movement path from top to bottom, has just established the "closed position" of the door. As is shown, the drive shaft 110 comprises three arms 111, 112 and 114. A rod 113 with spring means is movably held in the arm 112. The lock drive 150 is movably held in the arm 111 while the latch drive 120 is movably held in the arm 114. The latch drive 120 is located away from the stop means 121. The lock drive 150 movably holds a cog of the lock 190 in a fork. The lock 190 is hingeably held in the lock axis 180.

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The latch drive 120 is movably held in the arm 114 of the drive shaft 110 and movably held in the arm 132 of the latch axis 170. The latch axis 170 carries the lock element 160 and, on arm 131, the latch element 130 which can be guided against a stop means 135. Furthermore, a rod 134 with spring means is movably arranged on the arm 133, but said rod is not essential. A retention means 140 is attached to the frame of the aircraft structure, with the latch element 130 to be latched in said retention means.

Figure 2b shows the device in "latched position" but not yet in "locked latched position".

As is shown, the drive 100 has continued hingeing and the drive shaft 110 has been turned further. Consequently the latch drive 120 has clearly been activated, thus further rotating the latch axis 170. During this further rotation of the latch axis 170, the arm 131 with the latch element 130 was pushed onto the retention means 140. On the retention means 140, the roller forming the latch element 130, was guided to its limit position, i.e. into the "latched position". The latched position is reached; the arm 131 rests against stop 135.

Furthermore, Figure 2b shows that the lock element 160 is positioned in its limit position. It also shows that the lock 190 with its cam was swivelled in the direction of the lock element 160. However, the lock element 160 and the lock 190 are not yet engaged; they are still spaced apart. Thus the "locked latched position" has not yet been reached.

Fig. 2c shows the device in "latched position" and "locked latched position". This state was reached in

that the drive 100 moves along a small remaining section of travel up to its limit position, and in that the arm 114 of the drive shaft 110 rests against the stop means 121. In this way, in addition to the "latched position" as shown in Figure 2b, a "locked latched position" is reached. By means of a respective design of the movement mechanism 200, this additional movement for the lock drive 150 can be made possible in an existing latch drive 120. For example a mechanism of rods with angular positions and dead centres can be used for this purpose. The latch drive 120 rests against the stop means 121; at the same time the arm 131 of the latch element 130 rests against the stop means 135.

Figure 2c shows that the cam of the lock 190 engages the lock element 160, at a slight distance. This provides a safeguard against any unintentional reverse rotation of the latch axis 170 after a failure or deformation of the latch drive 120. Thus, apart from the "latched position", the "locked latched position" has been reached.

Opening of the door takes place in reverse order. When the drive is activated in the opposite direction, first the "locked latched position" and then the "latched and closed positions" are neutralised. The door is lifted and can be hinged for opening.

According to another embodiment, the invention makes it possible, by way of the rotary movement of the latch axis 17, for example additionally to move a vent flap in a passenger door, by means of a suitable transmission mechanism. In this way, in a synchronised switching action towards the locked latched position, the vent flap, too, is latched and locked. This is an advantageous additional effect. Synchronised control

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could also be realised for a movable display means arranged in the door. Furthermore, it would also be possible to move the door from an open position to the closed position.

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The embodiments of the present invention in which an exclusive property or privilege is claimed are defined as follows:

1. A device for closing a door of an aircraft, the device comprising:

a door drive, for closing the door; and

a movement mechanism driven by the door drive and comprising a latch drive for operating a latch mechanism and a lock drive for operating a lock mechanism;

said latch mechanism comprising a latch element moveable about a latch axis by the latch drive to a latching position in which it engages with a retention means arranged in the frame of the aircraft structure to latch the closed door; and

said lock mechanism comprising a lock moveable by the lock drive to a locking position in which it is engageable with a lock element mounted on the latch axis to lock the door in its latched position;

wherein, during operation of the door drive, the latch drive moves the latch mechanism to its latching position whilst the lock drive is moving the lock mechanism towards its locking position; and

wherein, when the latch mechanism is its latching position, further movement of the door drive moves the lock mechanism into its locking position.

2. The device according to claim 1, wherein the movement mechanism comprises a gear arrangement.

3. The device according to claim 2, wherein the gear arrangement comprises at least one of the group consisting of rods, gearwheels, eccentric disks or a cam control.

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4. The device according to claim 1, wherein the movement mechanism comprises rods moveable to angular positions and dead centres.

5. The device according to claim 4, wherein the movement mechanism comprises a drive shaft having first and second arms, the latch drive is in the form of a rod having one end pivotally connected to the first arm and its other end pivotally connected to an arm on the latching axis, and the lock drive comprises a rod pivotally connected at one end to the second arm and, at its other end, to the lock.

6. The device according to claim 1, wherein the movement mechanism comprises a drive shaft and includes an intermediate shaft connected between the drive shaft and the lock drive.

7. The device according to claim 1, wherein the movement mechanism comprises a drive shaft and includes an intermediate shaft connected between the drive shaft and the latch drive.

8. The device according to any one of claims 1 to 7, wherein a transmission mechanism is connected to the latch axis and synchronises the latching and locking of a valve-flap in the door with respect to the latching and locking of the door.

9. The device according to any one of claims 1 to 8, wherein a transmission mechanism is connected to the latch axis and this moves a display means in the door.

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10. The device according to any one of claims 1 to 9, wherein the movement mechanism comprises a drive shaft and a transmission mechanism is connected to the drive shaft to guide the door from its open position to its closed position.

11. The device according to any one of claims 1 to 10, wherein the lock is mounted so as to be hingeable on a lock axis.

12. The device according to any one of claims 1 to 10, wherein the lock is slidably mounted on a lock axis.

13. An apparatus for latching and safety locking a door in a door frame, said apparatus comprising:

a drive shaft rotatably mounted in said door, drive means operatively connected to said drive shaft for rotating said drive shaft through a first angular range toward a dead point and through a second angular range beyond said dead point, a latching and locking shaft rotatably mounted in said door, a latching force transmitting link operatively interposed between said latching and locking shaft and said drive shaft for transmitting a latching drive force from said drive shaft to said latching and locking shaft when said drive shaft is rotated toward said dead point, a locking force transmitting link operatively interposed between said drive shaft and said latching and locking shaft for transmitting a locking force from said drive shaft to said latching and locking shaft when said drive shaft is rotated through said second angular range beyond said dead point, a first pair of stop means cooperating with said latching and locking shaft for stopping further rotation of said latching and locking shaft when said drive

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shaft reaches said dead point after passing through said first angular range, a second pair of stop means cooperating with said drive shaft for stopping any further rotation of said drive shaft outside said second angular range, so that said locking force transmitting link is movable during rotation of said drive shaft through said second angular range into a position for applying said locking force to said latching and locking shaft.

14. The apparatus of claim 13, wherein said latching force transmitting link comprises a first coupling rod and journal members operatively connecting said first coupling rod to said drive shaft and to said latching and locking shaft, and wherein said locking force transmitting link comprises a second coupling rod, a locking member and further journal members for operatively connecting said second coupling rod to said locking member for applying said locking force to said latching and locking shaft when said drive shaft is rotated through said second angular range beyond said dead point.

15. The apparatus of claim 13 or 14, further comprising a first latching element operatively connected to said latching and locking shaft, a second latching element rigidly secured to a fixed point in a position for cooperation with said first latching element, wherein said first latching element comprises a latching cam or roller for cooperation with said second latching element, and further comprising a locking member rigidly connected to said latching and locking shaft, and wherein said locking force transmitting link comprises a locking cam for cooperation with said locking member.

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16. The apparatus of any one of claims 13 to 15, comprising a third coupling link operatively connected to said latching and locking shaft.

17. The apparatus of any one of claims 13 to 16, wherein said second angular spacing beyond said dead point is sufficient for moving said locking force transmitting link into a locked position that can be released only by a rotation of said drive shaft in an unlocking direction.

18. The apparatus of claim 17, wherein said second angular spacing is 4°.

19. The apparatus of any one of claims 13 to 18, comprising a fourth coupling link operatively connected to said drive shaft.

20. The apparatus of any one of claims 13 to 19, wherein said first pair of stop means and said second pair of stop means are so positioned that said second stop means become effective after said first stop means when said drive shaft is rotated counterclockwise for establishing a latched and locked condition of said door.

21. The apparatus of any one of claims 13 to 20, further comprising a first coupling lever arm rigidly connected to said drive shaft, a second coupling lever arm rigidly connected to said drive shaft, an angular spacing between said first and second coupling lever arms around said drive shaft, and a third coupling lever arm rigidly connected to said single latching and locking shaft.

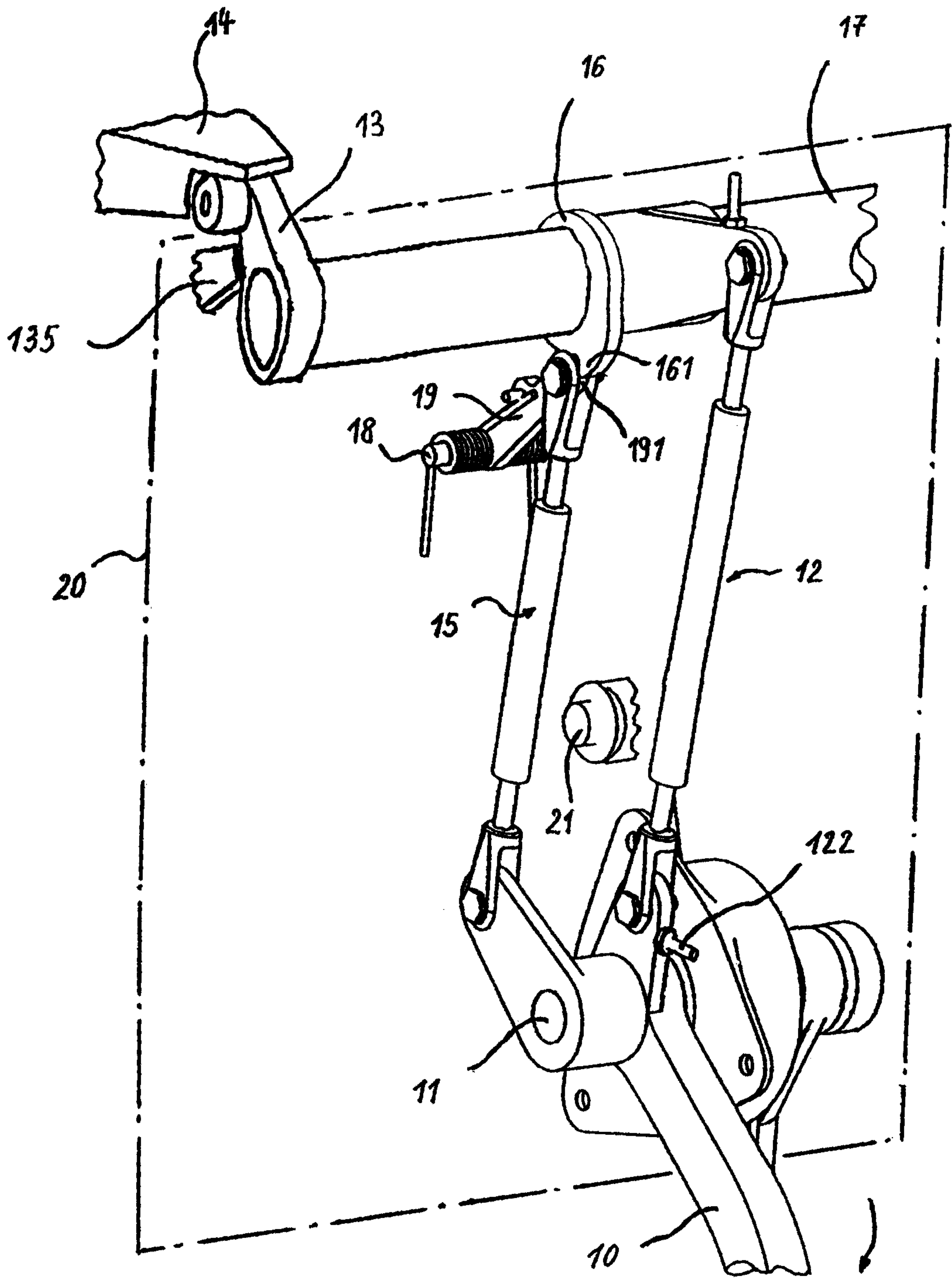
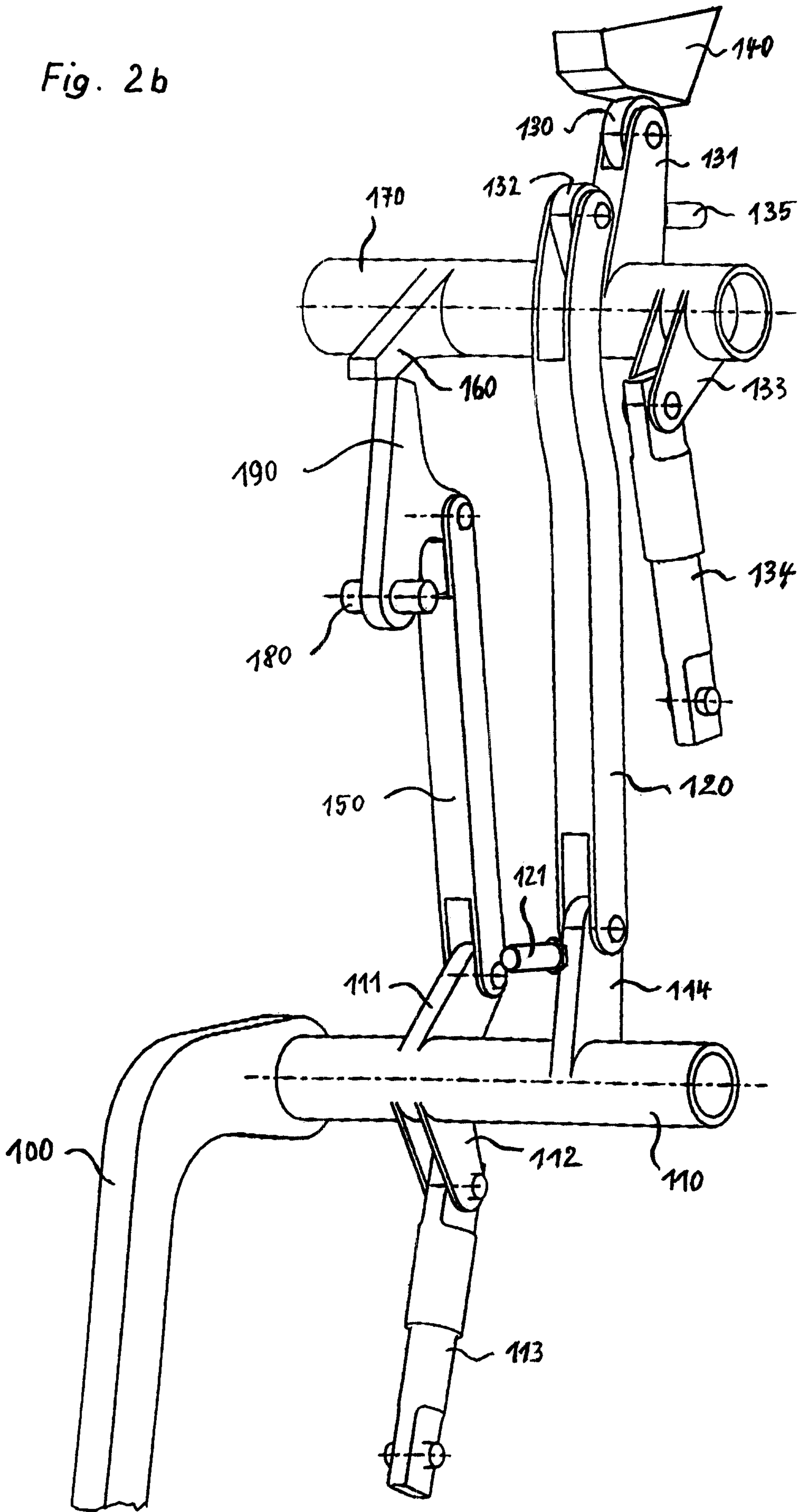


Fig. 1

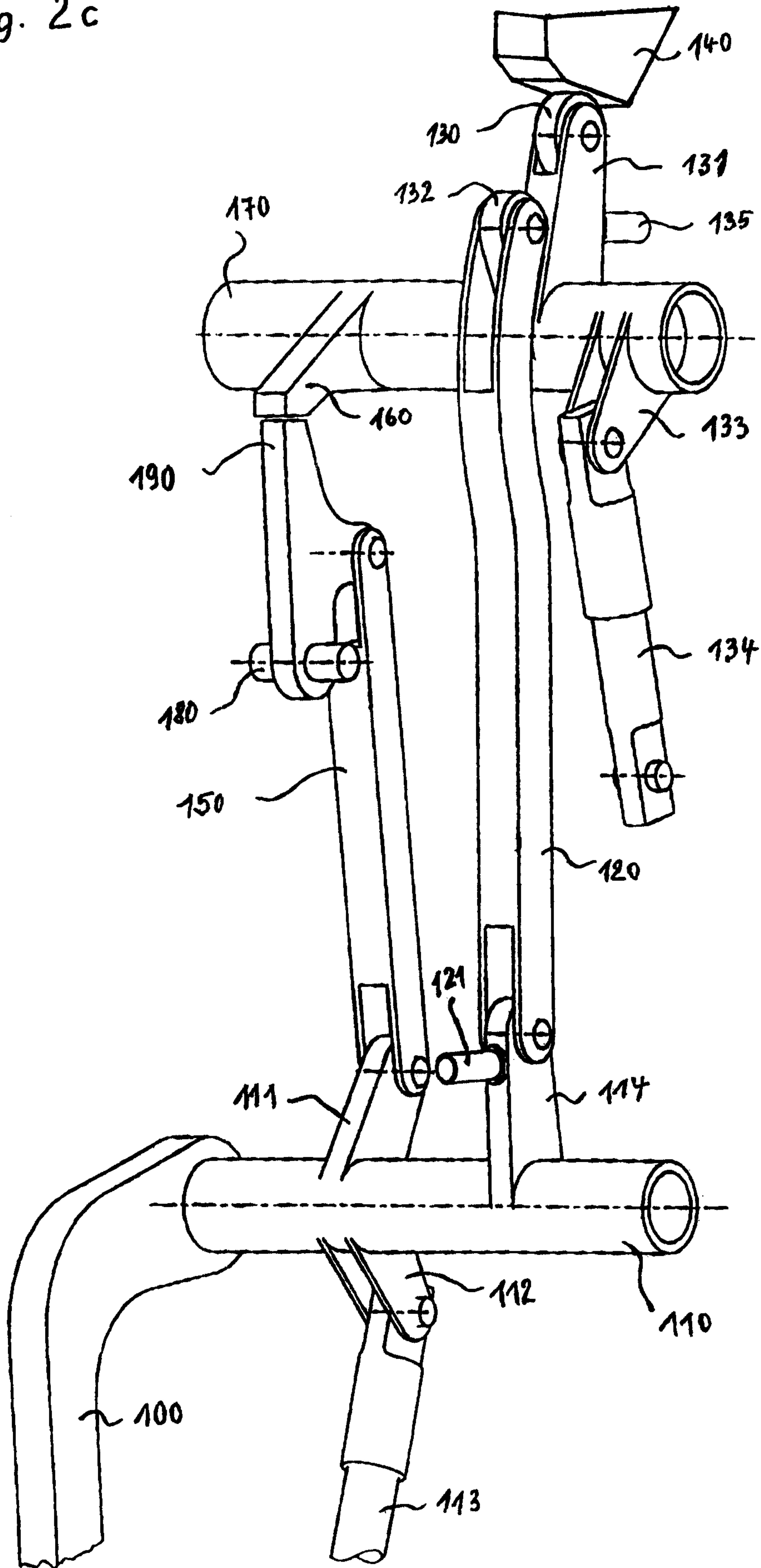
Marks & Clerk

Fig. 2b



Marks & Clerk

Fig. 2c



Marks & Clerk

