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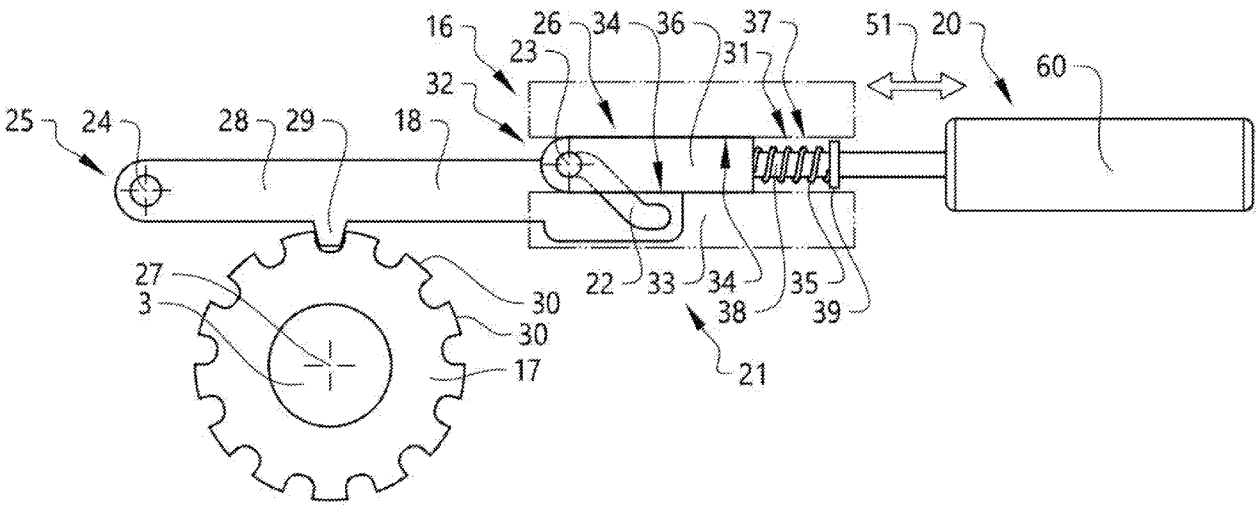


Fig. 2a

(57) Abstract: A parking lock device (16) for a transmission of a vehicle. The device comprising a wheel (17), a pawl (18) for locking the wheel against rotation and an actuator unit (20) arranged for movement of the pawl relative to the wheel. The pawl (18) has a locked position where the pawl and the wheel are engaged and an unlocked position where the pawl and the wheel are disengaged. The pawl (18) and the actuator unit (20) are mechanically coupled to each other by a pin and slot mechanism (21) having a guide slot (22) and a guide pin (23) received by the guide slot. The device is less complicated and enables a simplified production and assembling of the parking lock mechanism.

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[Continued on next page]

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A PARKING LOCK DEVICE

TECHNICAL FIELD

[0001] The invention relates to a parking lock device for a transmission of a vehicle, which device comprises a wheel, a pawl for locking the wheel against rotation and an actuator unit arranged for movement of the pawl relative to the wheel. The invention also relates to a transmission comprising such a parking lock device.

BACKGROUND

[0002] Vehicle transmissions usually have parking lock mechanisms with an actuation linkage system for engagement of a ratchet wheel and a pawl, for locking a shaft of the transmission.

[0003] Such a parking lock mechanism requires several components made with small tolerances, such as actuating rods, cone and cone interface, and springs. Due to the tolerance chain for the critical components, high demands are placed on the production. Further, the assembling process is also relatively complicated and since the packing space in the transmission is often very limited, it is desirable that the number of components be kept down.

SUMMARY

[0004] An objective of the invention is to provide a parking lock device for a transmission of a vehicle, which device is less complicated and enables a simplified production and assembling of the parking lock mechanism.

[0005] The objective is achieved by a parking lock device for a transmission of a vehicle, wherein the device comprises a wheel, a pawl for locking the wheel against rotation and an actuator unit arranged for movement of the pawl relative to the wheel, and the pawl has a locked position where the pawl and the wheel are engaged and an unlocked position where the pawl and the wheel are disengaged, and wherein the pawl and the actuator unit are mechanically coupled to each other by a pin and slot mechanism having a guide slot and a guide pin received by the guide slot.

[0006] The invention is based on the insight that by such a parking lock device, a number of components can be omitted at the same time as a robust design for the parking lock function can be achieved.

[0007] Although the guide pin is suitably attached to the actuator unit and the guide slot is arranged in the pawl, it would also be possible to attach the pin to the pawl and arrange the guide slot in the actuator unit.

[0008] According to one embodiment of the parking lock device, the actuator unit is arranged to move the pawl from the unlocked position to the locked position by movement of the guide pin along the guide slot in a first direction, and from the locked position to the unlocked position by movement of the guide pin along the guide slot in a second direction. Hereby, both engagement and disengagement of the parking lock device can be performed with one and the same actuator unit. For example, the second direction can be opposite to the first direction.

[0009] According to a further embodiment, the actuator unit comprises a pushrod for linear movement which pushrod is mechanically coupled to the pawl by the pin and slot mechanism. Hereby, the pawl can be moved by a non-complicated motion of the pushrod. The actuator unit preferably comprises a hydraulic cylinder for movement of the pushrod. Hydraulic fluid can then be provided by a hydraulic system already used for other functions of a transmission.

[0010] For at least a part of the guide slot, the main extension direction of the guide slot is preferably angled relative to the linear movement direction of the pushrod. The main extension direction of said guide slot part has suitably an extension direction component perpendicular to the linear movement direction of the pushrod in a direction away from the wheel when the guide pin moves in the first direction. Hereby, the pawl can be moved by the guide pin being pushed against a surface defining the guide slot.

[0011] According to a further embodiment, the actuator unit has a support portion arranged to guide the pushrod for counteracting deviation from the linear movement of the pushrod. Hereby, a robust design for movement of the pawl can be achieved.

[0012] According to a further embodiment, the actuator unit comprises a spring arranged to counteract movement of the pawl from the locked position towards the unlocked position. Hereby, the locked position of the pawl can be reached even if initially there is a mismatch

between a tooth of the pawl and teeth of the wheel, and when the locked position is reached the engagement of the pawl and the wheel can be secured by the spring.

[0013] The spring is preferably arranged on the pushrod for counteracting movement of the pawl from the locked position towards the unlocked position. Hereby, a compact and robust design can be achieved.

[0014] According to a further embodiment, the pawl is pivotally arranged for pivoting about a pivot axis between the locked position and the unlocked position, and preferably, in the unlocked position of the pawl, the wheel is pivotable about a pivot axis which is substantially in parallel with the pivot axis of the pawl. Hereby, a robust and compact design for movement of the pawl relative to the wheel can be achieved.

[0015] The main extension direction of the guide slot is suitably perpendicular to the pivot axis of the pawl.

[0016] According to a further embodiment, the pawl has a body with a first end pivotally arranged for pivoting about the pivot axis and a second end mechanically coupled to the actuator unit by the pin and slot mechanism, wherein the body is provided with a tooth for engagement with the wheel which tooth is arranged between the first end and the second end of the pawl body. Hereby, a robust and non-complicated design for locking the wheel can be achieved.

[0017] According to a further aspect of the invention, a further objective is to provide a transmission comprising a parking lock device.

[0018] The advantages of the transmission are substantially the same as the advantages already discussed hereinabove with reference to the different embodiments of the parking lock device.

[0019] Further advantages and advantageous features of the invention are disclosed in the following description and in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] With reference to the appended drawings, below follows a more detailed description of embodiments of the invention cited as examples.

[0021] In the drawings:

[0022] Fig. 1 is a schematic view showing an example embodiment of a transmission for a vehicle,

[0023] Fig. 2a is a side view showing a parking lock device when a pawl and a wheel are engaged,

[0024] Fig. 2b is a side view of the parking lock device in Fig. 2a when the pawl and the wheel are disengaged,

[0025] Fig. 3a is a top view of the parking lock device in Fig. 2a,

[0026] Fig. 3b is a top view of the parking lock device in Fig. 2b, and

[0027] Fig. 4 is an enlarged view of a guide slot of a pin and slot mechanism.

DETAILED DESCRIPTION

[0028] Fig. 1 is a schematic view showing a transmission 1 for a vehicle.

[0029] The transmission has an input shaft 2 and an output shaft 3. The input shaft 2 and the output shaft 3 are connected to each other by gear wheels 4. For example, a first gear wheel 5 of the input shaft 2 is engaged with a first gear wheel 6 of the output shaft 3, and a second gear wheel 7 of the input shaft 2 is engaged with a second gear wheel 8 of the output shaft 3. The gear wheels 6, 8 of the output shaft 3 can be idle wheels, i.e. these gear wheels 6, 8 are journaled on the output shaft 3 but can be rotationally locked to the output shaft by a synchronizer 9. By movement of a synchronizer sleeve 10 in a first direction, the first gear wheel 6 of the output shaft 3 is rotationally locked to the output shaft 3. By movement of the synchronizer sleeve 10 in a second opposite direction, the second gear wheel 8 of the output shaft 3 is rotationally locked to the output shaft 3. Thus, one gear is represented by the first gear wheel 5 of the input shaft 2 and the first gear wheel 6 of the output shaft 3. A further gear is represented by the second gear wheel 7 of the input shaft 2 and the second gear wheel 8 the output shaft 3.

[0030] The input shaft 2 can be driven by a motor 11. The motor 11 can be any suitable motor, such an internal combustion engine, electric motor, etc. Between the motor 11 and the transmission 1, a clutch 12 is suitably arranged for enabling the transmission 1 to be connected or disconnected to/from the motor 11.

[0031] In the example embodiment illustrated in Fig. 1, the output shaft 3 has an output gear wheel 13. The output gear wheel 13 is rotationally locked to the output shaft 3 and is

engaged with a ring gear wheel 14 of a differential device 15, thereby connecting the output shaft 3 to the ring gear wheel 14. The differential device 15 is in turn suitably conventionally connected to the driven wheels of a vehicle (not shown).

[0032] As schematically indicated in Fig. 1, the transmission 1 comprises a parking lock device 16. The parking lock device 16 has a wheel 17, such as a gear wheel or ratchet wheel rotationally locked to a shaft 3 of the transmission 1. In the example embodiment illustrated in Fig. 1, the wheel 17 is arranged on the output shaft 3. The transmission 1 further comprises a pawl 18 and an actuator unit (not shown in Fig. 1) arranged for movement of the pawl 18 relative to the wheel 17.

[0033] The pawl 18 has a locked position where the pawl 18 and the wheel 17 are engaged and an unlocked position where the pawl 18 and the wheel 17 are disengaged from each other. When the pawl 18 and the wheel 17 are engaged with each other, the output shaft 3 is locked to a housing 19 of the transmission 1.

[0034] Fig. 2a and 2b show a side view of the parking lock device 16 more in detail.

[0035] In Fig. 2a the parking lock device locks the shaft 3 against rotation. The parking lock device 16 comprises the wheel 17, the pawl 18 and the actuator unit 20 arranged for movement of the pawl 18 relative to the wheel 17. In Fig. 2a the pawl 18 is in a locked position where the pawl 18 and the wheel 17 are engaged, thereby locking the shaft 3 against rotation.

[0036] The pawl 18 and the actuator unit 20 are mechanically coupled to each other by a pin and slot mechanism 21 having a guide slot 22 and a guide pin 23 received by the guide slot 22. In the example embodiment illustrated in Fig. 2a, the guide pin 23 is attached to the actuator unit 20 and the guide slot 22 is arranged in the pawl 18, though in another embodiment the guide pin could be attached to the pawl and the guide slot could be arranged in the actuator unit.

[0037] The pawl 18 is suitably pivotally arranged for pivoting about a pivot axis 24 from the locked position to the unlocked position, and from the unlocked position to the locked position. In the example embodiment illustrated in Figs. 2a and 2b, the pawl has a body 28 with a first end 25 pivotally arranged for pivoting about the pivot axis 24 and a second end 26 mechanically coupled to the actuator unit 20 by the pin and slot mechanism 21.

[0038] The first end 25 of the pawl 18 is pivotally connected to a fixed point, such as the housing 19 of the transmission 1. The guide slot 22 is arranged at the second end 26 of the pawl 18, opposite to the first end 25 of the pawl 18.

[0039] The body 28 is provided with a tooth 29 for engagement with the wheel 17 which tooth 29 is arranged between the first end 25 and the second end 26 of the pawl body 28. The wheel 17 has suitably corresponding teeth 30 for receiving the tooth 29 between two teeth 30.

[0040] The wheel 17 (and the shaft 3) is pivotable about a pivot axis 27 when the pawl 18 and the wheel 17 are disengaged. This wheel pivot axis 27 can be substantially in parallel with the pawl pivot axis 24.

[0041] The actuator unit 20 is arranged to move the pawl 18 from the unlocked position to the locked position by movement of the guide pin 23 along the guide slot 22 in a first direction, and from the locked position to the unlocked position by movement of the guide pin 23 along the guide slot 22 in a second direction. In Figs. 2a and 2b, the first direction is from right to left, and the second direction is from left to right.

[0042] In Fig. 2a the guide pin 23 is positioned in a leftmost position corresponding to the locked position of the pawl 18 where the pawl 18 and the wheel 17 are engaged. In Fig. 2b the guide pin 23 is positioned furthest to the right in a position corresponding to the unlocked position of the pawl 18 where the pawl 18 and the wheel 17 are disengaged.

[0043] The actuator unit 20 comprises a pushrod 31 for linear movement which pushrod 31 is mechanically coupled to the pawl 18 by the pin and slot mechanism 21. At a free end 32 of the pushrod 31, the guide pin 23 is attached to the pushrod 31. For example, the actuator unit 20 may comprise a hydraulic cylinder 60 for movement of the pushrod 31. In other words; the pushrod 31 is connected to a piston of the hydraulic cylinder 60. In Fig. 2a the pushrod 31 has been moved by the hydraulic cylinder 60 to an extended position, whereas in Fig. 2b the pushrod has been moved to a retracted position by the hydraulic cylinder 60. Optionally, the hydraulic cylinder can be replaced by an electric motor and a ball screw, or a pneumatic cylinder, or by any another suitable drive unit.

[0044] The actuator unit 20 can have a support portion 33 arranged to support and guide the pushrod 31 for counteracting deviation from the linear movement of the pushrod 31. Such a support portion 33 may have one or more guiding surfaces 34 for guiding the pushrod 31 in the linear direction.

[0045] In the example embodiment illustrated in Figs. 2a and 2b, the actuator unit 20 comprises a spring 35 arranged to counteract movement of the pawl 18 from the locked position towards the unlocked position. The spring 35 can be a coil spring or any other suitable spring. The spring 35 will enable engagement of the pawl 18 and the wheel 17 even if initially there is a mismatch between the tooth 29 of the pawl 18 and the teeth 30 of the wheel 17. As soon as the relative position between the pawl 18 and the wheel 17 is achieved the spring 35 will ensure engagement of the pawl 18 and the wheel 17.

[0046] The spring 35 can be arranged on the pushrod 31. In the example embodiment illustrated in Figs. 2a and 2b, the pushrod 31 has a first outer portion 36 to which the guide pin 23 is attached. The outer portion 36 is arranged to interact with the guiding surfaces 34 as described hereinabove. Further, the pushrod 31 has an inner portion 37 with a rod 38 receiving the spring 35. The outer portion 36 and the inner portion 37 are axially displaceable relative to each other in the movement direction 51 of the pushrod 31. The spring 35 is arranged between the outer portion 36 and a support part or spring seat 39 of the inner portion 37 of the pushrod 31, for counteracting relative movement of the inner portion 37 and the outer portion 36.

[0047] This means that when the pushrod is being extended (moved from right to left in Figs. 2a and 2b) the force will be transferred from the inner portion 37 to the outer portion 36 by means of the spring 35. When the pushrod is being retracted (moved from left to right in Figs. 2a and 2b), the spring will be unloaded, and the force will be directly transferred from the inner portion 37 to the outer portion 36.

[0048] Figs. 3a and 3b show the parking lock device 16 in Figs. 2a and 2b in top views. Fig. 3a corresponds to Fig. 2a with respect to the guide pin position, and Fig. 3b corresponds to Fig. 2b with respect to the guide pin position.

[0049] The outer portion 36 of the pushrod 31 has two legs 40 forming a fork and the pawl 18 is received between the legs 40. The guide pin 23 is attached to the legs 40 and received by the guide slot 22 of the pawl 18. The outer portion 36 has a through hole 41 for receiving the rod 38 of the inner portion 37. At the end of the rod 38 a carrier or pusher unit 42 is arranged to transfer the force from the inner portion 37 to the outer portion 36 when the pushrod 31 is being retracted.

[0050] Fig. 4 shows an example embodiment of a guide slot 22 of the pin and slot mechanism 21.

[0051] For at least a part 55 of the guide slot 22, the main extension direction 50 of the guide slot 22 is angled relative to the linear movement direction 51 of the pushrod 31, thereby causing the guide pin 23 to push against a surface 52 defining the guide slot 22, when the pushrod 31 is moved.

[0052] When the pushrod 31 is being retracted the guide pin 23 will push the pawl 18 away from the wheel 17. The guide pin 23 will push against an upper portion 52a of the guide slot defining surface 52. In the example embodiment illustrated in Figs. 2a and 2b, this means the pawl 18 is pivoted anti-clockwise about the pawl pivot axis 24. When the pushrod 31 is being extended the guide pin 23 will push the pawl 18 towards the wheel 17. The guide pin 23 will push against a lower portion 52b of the guide slot defining surface 52. In the example embodiment illustrated in Figs. 2a and 2b, this means the pawl 18 is pivoted clockwise about the pawl pivot axis 24.

[0053] In other words; the main extension direction 50 of said guide slot part 55 has an extension direction component 53 perpendicular to the linear movement direction 51 of the pushrod 31 in a direction away from the wheel 17 when the guide pin 23 moves in the first direction from the unlocked position towards the locked position. Further, the main extension direction 50 of said guide slot part 55 has an extension direction component 54 in parallel with the linear movement direction 51 of the pushrod 31 in a direction towards the locked position when the guide pin 23 moves in the first direction.

[0054] In addition to the inclined part 55 of the guide slot 22, at an end 56 of the guide slot 22, the guide slot 22 can have a different extension direction 57, preferably an extension direction 57 substantially in parallel with the movement direction 51 of the pushrod 31.

[0055] Hereby, the position of the guide pin 23 at the end position (corresponding to the locked position of the pawl) can be more stable preventing accidental movement of the guide pin 23 and the pawl 18 from the locked position. Optionally, both ends 56, 58 of the guide slot 22 can have such parts with a main extension direction substantially in parallel with the movement direction of the pushrod. Thus, the guide slot 22 can be Z-shaped for instance.

[0056] It is to be understood that the present invention is not limited to the embodiments described above and illustrated in the drawings; rather, the skilled person will recognize

that many changes and modifications may be made within the scope of the appended claims.

WHAT IS CLAIMED IS:

1. A parking lock device (16) for a transmission (1) of a vehicle, the device comprising a wheel (17), a pawl (18) for locking the wheel against rotation and an actuator unit (20) arranged for movement of the pawl relative to the wheel, the pawl (18) having a locked position where the pawl (18) and the wheel (17) are engaged and an unlocked position where the pawl (18) and the wheel (17) are disengaged, characterized in that the pawl (18) and the actuator unit (20) are mechanically coupled to each other by a pin and slot mechanism (21) having a guide slot (22) and a guide pin (23) received by the guide slot.

2. A device according to claim 1, characterized in that the guide pin (23) is attached to the actuator unit (20) and the guide slot (23) is arranged in the pawl (18).

3. A device according to claim 1 or 2, characterized in that the actuator unit (20) is arranged to move the pawl (18) from the unlocked position to the locked position by movement of the guide pin (23) along the guide slot (22) in a first direction, and from the locked position to the unlocked position by movement of the guide pin (23) along the guide slot (22) in a second direction.

4. A device according to any preceding claim, characterized in that the actuator unit (20) comprises a pushrod (31) for linear movement which pushrod is mechanically coupled to the pawl (18) by the pin and slot mechanism (21).

5. A device according to claim 4, characterized in that the actuator unit (20) comprises a hydraulic cylinder (60) for movement of the pushrod (31).

6. A device according to claim 4 or 5, characterized in that the actuator unit (20) has a support portion (33) arranged to guide the pushrod (31) for counteracting deviation from the linear movement of the pushrod (31).

7. A device according to any of claims 4-6, characterized in that for at least a part (55) of the guide slot (22), the main extension direction (50) of the guide slot (22) is angled relative to the linear movement direction (51) of the pushrod (31).

8. A device according to claim 7, characterized in that the main extension direction (50) of said guide slot part (55) has an extension direction component (53) perpendicular to the linear movement direction (51) of the pushrod (31) in a direction away from the wheel (17) when the guide pin (23) moves in the first direction.

9. A device according to any preceding claim, characterized in that the actuator unit (20) comprises a spring (35) arranged to counteract movement of the pawl (18) from the locked position towards the unlocked position.

10. A device according to claim 4 and 9, characterized in that the spring (35) is arranged on the pushrod (31).

11. A device according to any preceding claim, characterized in that the pawl (18) is pivotally arranged for pivoting about a pivot axis (24) between the locked position and the unlocked position.

12. A device according to claim 11, characterized in that the main extension direction (50) of the guide slot (22) is perpendicular to the pivot axis (24) of the pawl (18).

13. A device according to claim 11 or 12, characterized in that in the unlocked position of the pawl (18), the wheel (17) is pivotable about a pivot axis (27) which wheel pivot axis is substantially in parallel with the pivot axis (24) of the pawl (18).

14. A device according to any of claims 11-13, characterized in that the pawl (18) has a body (28) with a first end (25) pivotally arranged for pivoting about the pivot axis (24) and a second end (26) mechanically coupled to the actuator unit (20) by the pin and slot mechanism (21), the body (28) being provided with a tooth (29) for engagement with the wheel (17) which tooth is arranged between the first end (25) and the second end (26) of the pawl body (28).

15. A transmission (1) comprising a device (16) according to any of claims 1-14.

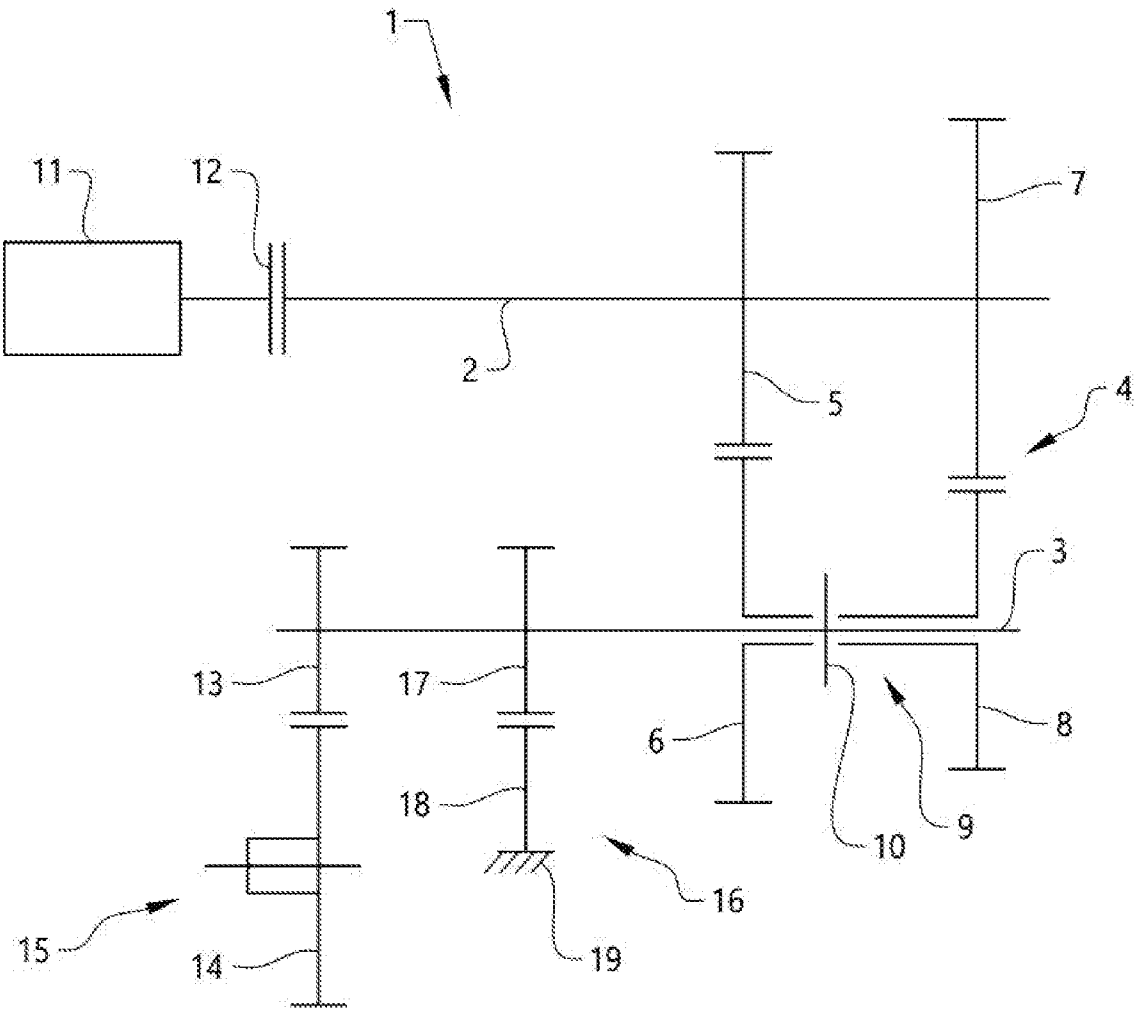


Fig. 1

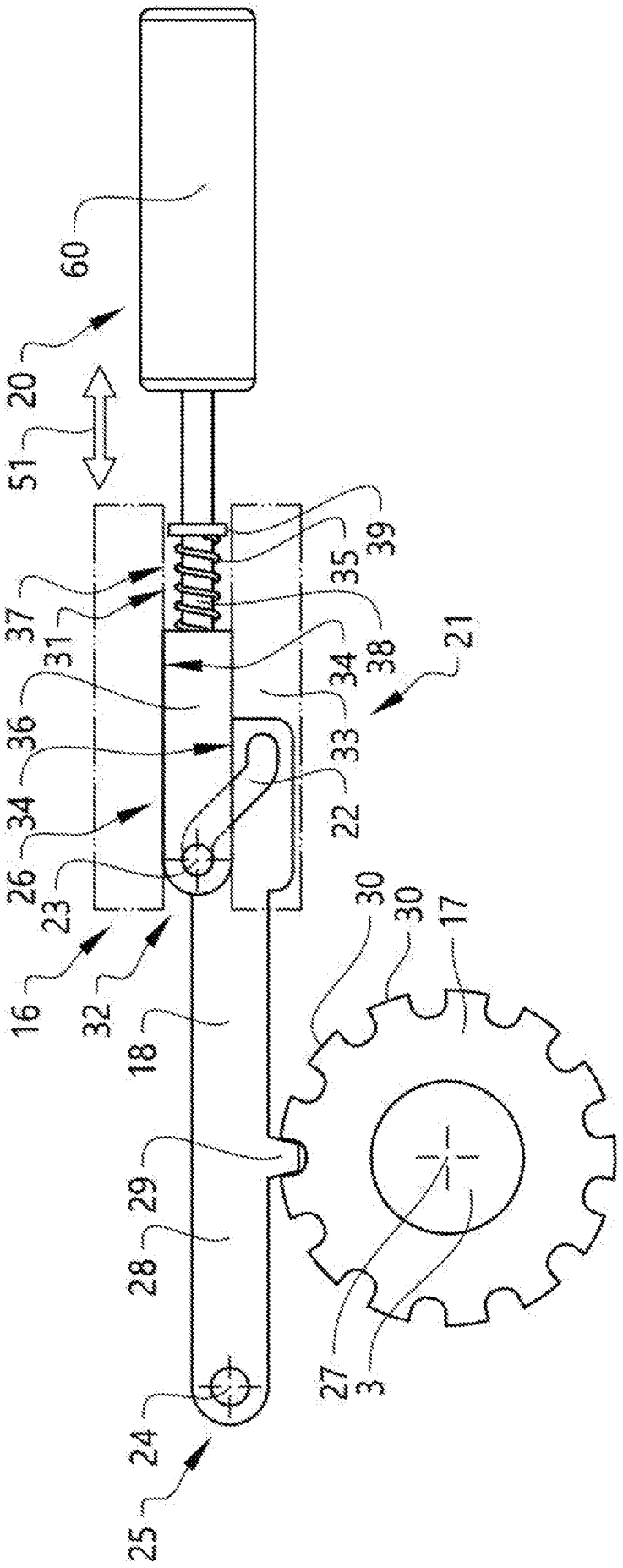

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Fig. 2a

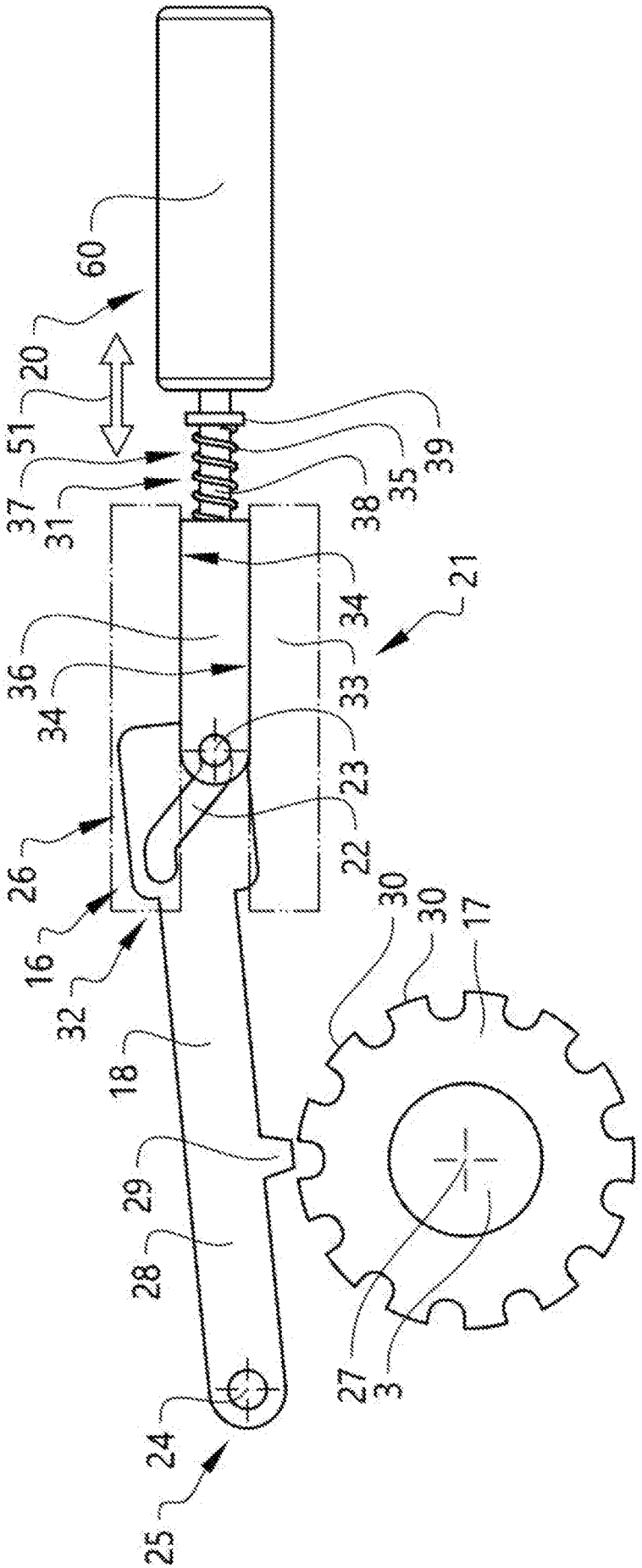

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Fig. 2b

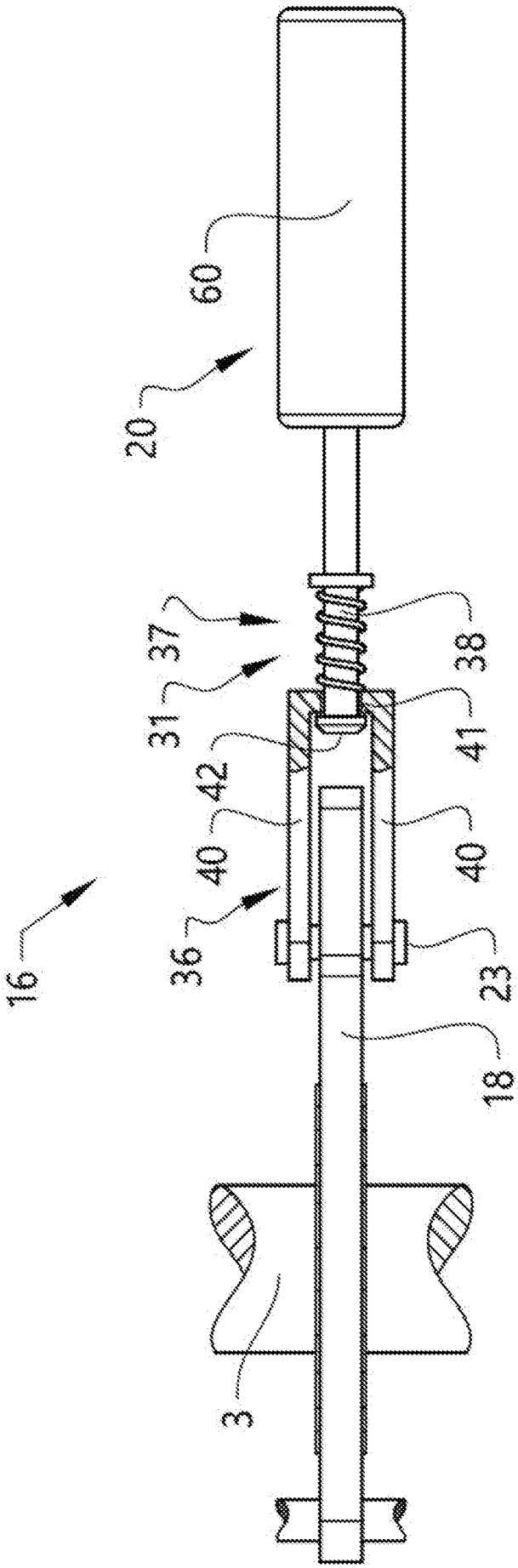


Fig. 3a

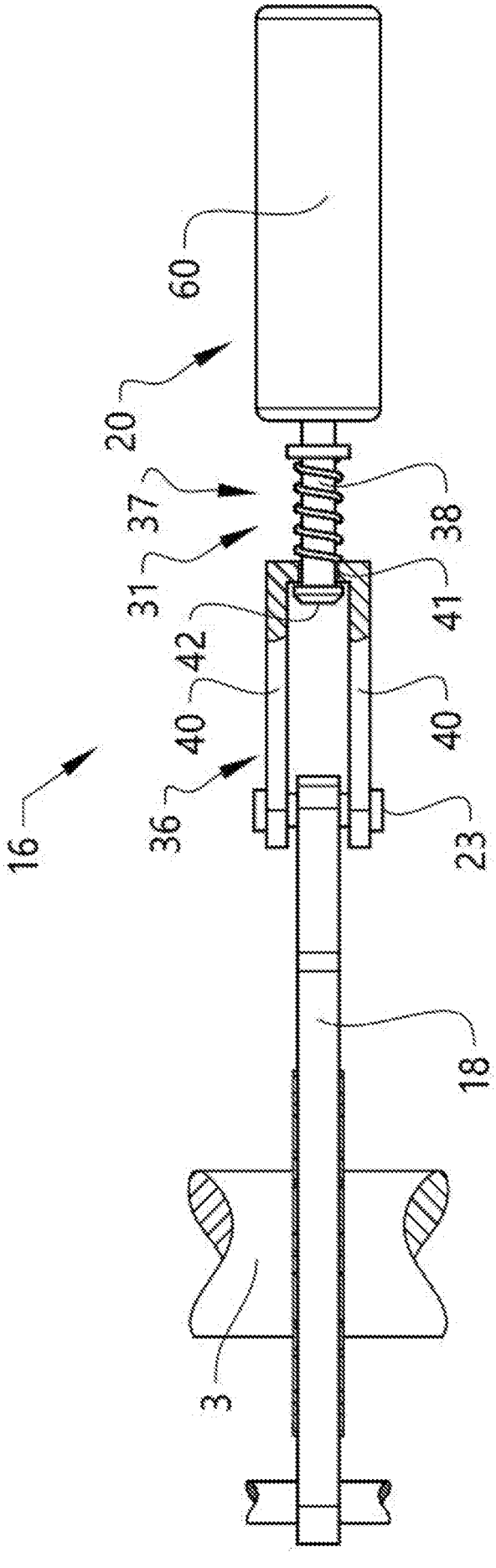


Fig. 3b

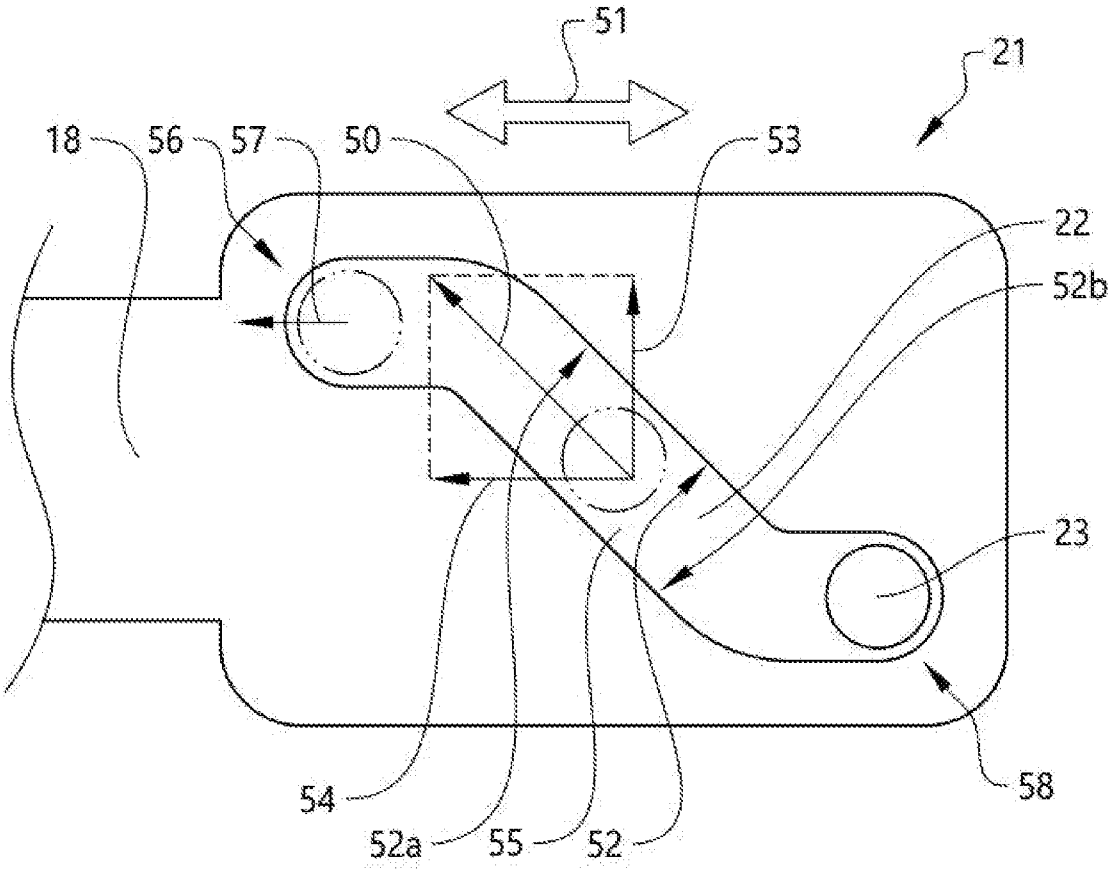


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2020/078835

A. CLASSIFICATION OF SUBJECT MATTER

F16H 63/34(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F16H,B60T,F16D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

VEN;CNABS;CNTXT;CNKI:slot?, pin?, groov?, recess, pawl, ratchet?, park+, lock+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 102017202443 A1 (ZAHNRADFABRIK FRIEDRICHSHAFEN) 16 August 2018 (2018-08-16) see description, paragraphs 28 to 51 and figures 1-10	1-15
X	DE 102013008604 A1 (AUDI AG) 18 September 2014 (2014-09-18) see the embodiment shown in figures 1-3	1-15
X	DE 102013106303 A1 (GETRAG GETRIEBE ZAHNRAD) 18 December 2014 (2014-12-18) see the embodiment shown in figures 1-5	1-15
X	JP 2003237550 A (TOYOTA MOTOR CORP) 27 August 2003 (2003-08-27) see the embodiment shown in figures 1-4	1-15
X	CN 107606146 A (SHANGHAI YIKONG POWER SYSTEM CO LTD) 19 January 2018 (2018-01-19) see the embodiment shown in figures 1-8	1-15
X	US 4157745 A (Nelson) 12 June 1979 (1979-06-12) see the embodiment shown in figures 1-2	1-15

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 May 2020	**10 June 2020**
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INTERNATIONAL SEARCH REPORT
Information on patent family members

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