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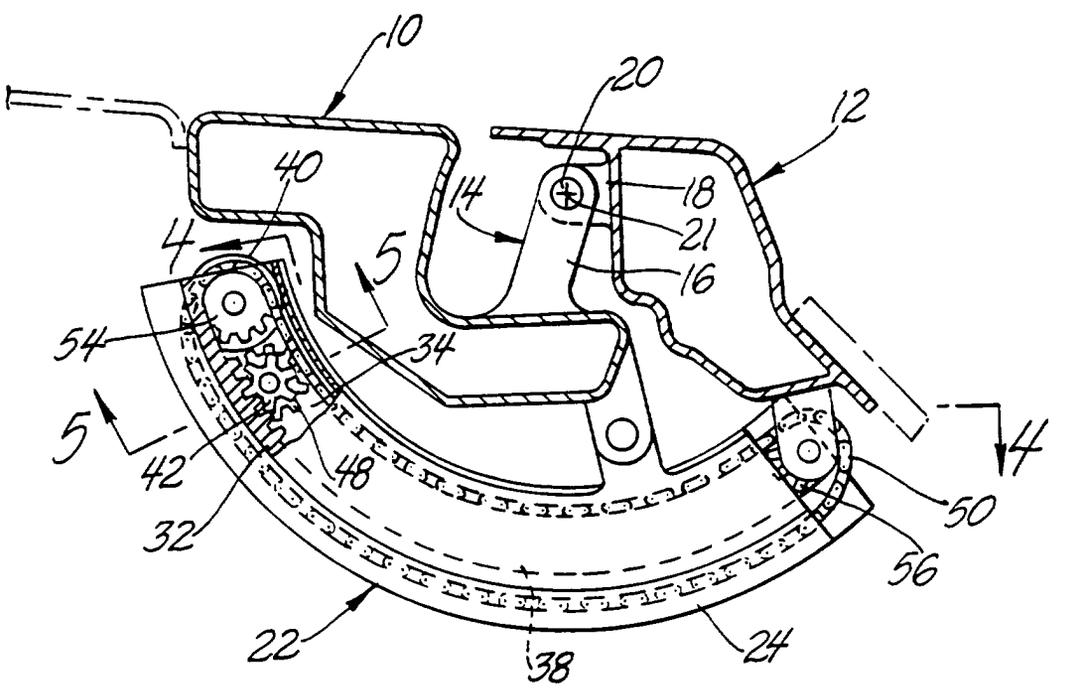
(54) Vehicle liftgate power operating system

(57) A power operating system for opening and closing a vehicle liftgate (12) has a pair of drive units (22) supported on the vehicle roof and connected to the liftgate for opening and closing the liftgate. Each drive unit includes a housing (24) having a curved track (26) and a curved drive link (38) that is guided by the curved track. The curved drive link (38) is extended and retracted by a pinion gear (42) that is journalled on the drive link and engages a curved rack (32) fixed to the housing. The pinion gear is rotated by a chain (50) that is driven in a loop by a reversible electric motor (52).

Fig.2.



EP 1 195 494 A1

Description

TECHNICAL FIELD

[0001] This invention relates to a power operating system for a vehicle liftgate that is pivotally attached to a vehicle compartment for pivotal movement about a generally horizontal hinge axis and more particularly to a power operating system that will move a liftgate from a closed position to a fully open position and from an open position to a fully closed position.

BACKGROUND OF THE INVENTION

[0002] Utility vehicles and vans with liftgates that are hinged at the top about a generally horizontal axis are used by large numbers of people today. Some of these liftgates are large and heavy. Their size and weight make some liftgates difficult to open and close. Some of the liftgates are also a great distance above the ground when they are fully opened. Their height above the ground makes them very difficult for some people to close. For these and other reasons many people would like to have a power operating system for opening and closing the liftgate.

[0003] A number of different liftgate openers have been tried in recent years. Some of these liftgate openers have a single cable that opens and closes a liftgate in connection with a counterbalance system, such as a gas spring counterbalance system. Liftgates with a single cable opener and closer are generally trunk lids that are lightweight and have a relatively small range of movement. Moreover, gas spring output varies with temperature. This complicates power liftgate systems that rely on gas springs to open the liftgate. The gas spring or springs must be strong enough to open the liftgate on the coldest day (-40° C). This results in gas springs that increase closing resistance substantially on the hottest day (80° C). Therefore a very large electric motor must be used to close the liftgate.

[0004] Liftgates that have two or more gas springs for a counter balance system are common. These gas springs generally occupy a position in which their axis is substantially parallel to the liftgate so that the gas springs are hidden when the liftgate is closed. In this closed position the moment arm of the gas springs is quite small. With such systems the lift gate may move about one-third of their total travel range before the gas cylinders exert sufficient force to open a liftgate further without the application of an independent lifting force. There are even some systems in which the gas springs pass over center and bias a liftgate toward a closed position when the liftgate is closed. With these self-closing systems a liftgate may need to be more than one-third open before the gas springs will open the liftgate further.

[0005] The force required to hold a liftgate in a given position along its path of movement from a closed position to a fully open position varies substantially in some liftgate opening systems. A power liftgate closer must exert sufficient force to hold a liftgate in any given position along the path of movement, plus the force to overcome friction, and plus the force required to accelerate the liftgate during liftgate closing. If the total force exerted by the liftgate power closure varies substantially from one position between fully opened and closed to another position between fully opened and closed, it may be difficult for the control system to detect an obstruction and stop the liftgate without incurring damage to the vehicle or to the object that obstructs the liftgate.

SUMMARY OF THE INVENTION

[0006] The object of the invention is to provide an improved vehicle liftgate power operating system.

[0007] A feature of the invention is that the vehicle liftgate power operating system can move the liftgate from a closed position to a fully opened position as well as from an open position to a fully closed position.

[0008] Another feature of the invention is that the liftgate power operating system allows the liftgate to be moved manually when an efficient gear set is selected.

[0009] Still another feature of the invention is that the drive unit of the liftgate power operating system has a curved drive link attached to the liftgate that is guided by a curved track that is preferably shaped to hug the interior roof structure and thus minimize intrusion into the cargo area of the vehicle and maximize the unobstructed load height at the liftgate opening.

[0010] Yet another feature of the invention is that the liftgate power operating system preferably has a moveable curved drive link attached to the liftgate that is preferably shaped and guided to swing concentrically with respect to the hinge axis of the liftgate so that the moveable curved drive link can be sealed easily and/or exit outside the liftgate perimeter seal.

[0011] Still yet another feature of the invention is that the liftgate power operating system has a curved drive link attached to the lift gate that is driven by an endless flexible member that travels in a loop next to the track thereby reducing the length of the drive unit substantially.

[0012] Still yet another feature of the invention is that the power operating system can be used in conjunction with a counterbalance system.

[0013] These and other objects, features and advantages of the invention will become more apparent from the following description of a preferred embodiment taken in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The presently preferred embodiment of the invention is disclosed in the following description and in the accompanying drawings, wherein:

Figure 1 is a perspective view of the rear portion of

a vehicle equipped with a liftgate power operating system of the invention showing the liftgate in an open position;

Figure 2 is an enlarged side view of the right hand drive unit of the power operating system of figure 1 showing the drive unit with parts removed to show internal detail when the liftgate is closed;

Figure 3 is an enlarged side view of the right hand drive unit shown in figure 2 with parts removed to show internal detail when the lift gate is open;

Figure 4 is a section taken substantially along the line 4-4 of figure 2 looking in the direction of the arrows; and

Figure 5 is a section taken substantially along the lines 5-5 of figure 2 looking in the direction of the arrows.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0015] Referring now to the drawings, vehicle 10 has a liftgate 12 that is attached to the aft end of the vehicle roof by two hinge assemblies. The typical right hand hinge assembly 14 is shown in figures 2 and 3.

[0016] Hinge assemblies 14 have hinge portions 16 that are secured to a roof channel of the vehicle 10 and hinge portions 18 that are secured to a top channel of liftgate 12. Hinge portions 18 are attached to hinge portions 16 by pivot pins 20 so that liftgate 12 pivots about a hinge axis indicated at 21 in figures 2 and 3 from a closed position shown in figure 2 to an open position shown in figure 3. Hinge axis 21 is generally substantially horizontal and liftgate 12 is generally permitted to pivot about 90° about hinge axis 21. However, the range of movement can be varied substantially from one vehicle 10 to another.

[0017] Liftgate 12 is opened and closed by a power operating system that includes two identical drive units 22 that are installed in the aft end of the vehicle roof. Drive units 22 are laterally spaced from each other and near the respective vertical body pillars at the aft end of vehicle 10 that define the rear opening that is closed by liftgate 12. The typical drive unit 22 is shown in figures 2, 3, 4 and 5 with an interior trim cover removed to show detail of drive unit 22.

[0018] Each drive unit 22 comprises a housing 24 having a curved track 26 between two curved side chambers 28 and 30. Chamber 28 has a curved rack 32 with interior teeth that is fixed adjacent an exterior side wall of housing 24. Chamber 30 has an upper drive channel 34 and a lower return channel 35 separated by a curved partition wall 36. A curved drive link 38 is disposed in the curved track 26 of housing 24 and pivotally attached to vehicle liftgate 12 at a protruding outboard end. Drive link 38 is guided by the curved track 26 by a roller 40 that is carried at an opposite inboard end. Roller 40 travels in the curved track 26 with a running fit.

[0019] A pinion gear 42 is rotatably attached to curved drive link 38 by an axle 44. Pinion gear 42 is near roller 40 and the inboard end of curved drive link 38 preferably as close as possible. Axle 44 extends outwardly of drive link 38 into chamber 28 so that pinion gear 42 is disposed in chamber 28 and meshes with curved rack 32 as best shown in figures 4 and 5.

[0020] Drive unit 22 includes drive means 46 to rotate pinion gear 42 so that the pinion gear 42 walks along the curved rack 36 and moves the curved drive link 38 with respect to the housing 24 and track 26.

[0021] Drive means 46 comprises a rotor 48 that is non-rotatably attached to the axle 44 that is joumalled on curved drive link 38 to rotatably support pinion gear 42, and an endless flexible drive member 50. Flexible drive member 50 is arranged in a closed loop and driven in the loop by a reversible electric motor 52 via a gear set 53. The closed loop is defined by an output wheel 54 attached to an output shaft of the gear set 53 at one end, the rotor 48, an idle roller 56 journalled on housing 24 at the outboard end and two guides; one guide being the return channel 35 and the other guide being the upper curved roof 37 of drive channel 34.

[0022] The axle 44 also extends outwardly of drive link 38 into drive channel 34 so that rotor 48 engages flexible drive member 50 as best shown in figures 4 and 5. The flexible drive member 50 is preferably a drive chain in which case rotor 48, output wheel 54 and idle roller 56, are all sprockets, that is a rotor sprocket 48, an output sprocket 54 and an idle sprocket 56.

[0023] The curved drive link 38, the curved track 26, the curved roof 37, and the curved rack 32 all preferably have a radius of curvature that is centered on hinge axis 21. Such curvature results in curved drive link 38 swinging concentrically with respect to hinge axis 21 so that the curved drive link 38 can be sealed easily and/or exit outside liftgate perimeter seal.

[0024] The power operating system further includes a conventional power source such as the vehicle battery (not shown) and a suitable motor control for energizing and shutting off reversible electric motor 52. Motor controls are well known to those skilled in the art and thus need not be described in detail.

[0025] The power operating system operates as follows. Assuming that the liftgate 12 is closed as shown in figure 2, electric motor 52 is energized to open liftgate 12. When energized, electric motor 52 rotates output wheel 54 counterclockwise driving flexible drive member 50 counterclockwise in the loop. Flexible drive member 50 in turn drives rotor 48 and pinion gear 42 fastened to rotor 48 by axle 44, counterclockwise. This causes pinion gear 42 to walk along curved rack 32 and move curved drive link 38 to the right as viewed in figure 2. Electric motor 52 continues to drive output wheel 54 until drive link 38 is driven to the fully extended position shown in figure 3. This action raises liftgate 12 from the closed position shown in figure 2 to the open position shown in figures 1 and 3. When the liftgate 12 is fully opened, a limit switch or the like is actuated to shut off

electric motor 52. Liftgate 12 is closed by reversing electric motor 52 so that output wheel 54 drives curved drive link 38 back to the retracted position shown in figure 2.

[0026] With a proper motor control circuit, electric motor 52 can be deenergized at any time in which case liftgate 12 can be stopped at any intermediate position and held in the intermediate position by the friction in gear set 53 without any need for a brake, detent or the like. The liftgate 12 can then be moved by energizing electric motor 52 or the liftgate 12 can then be moved manually because gear train 28 can be designed with sufficient efficiency to permit back drive to electric motor 52.

[0027] The power operating system can be designed to work alone or in conjunction with a gas spring strut counterbalance system. Such systems which are well known in the art with the primary adjustment being the size of the electric motor 52 when the power rotating system is used with a counterbalance system.

[0028] The power operating system described above preferably includes two identical drive units 22 for balanced operation and reduced manufacturing costs. However, the drive units need not be identical and in some instances, a single drive unit may be sufficient.

[0029] It is also possible to use two drive units with a single reversible electric motor driving both flexible drive members via one or two gear sets. In other words, many modifications and variations of the present invention in light of the above teachings may be made. It is, therefore, to be understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

Claims

1. A power operating system for opening and closing a vehicle liftgate that is pivotally attached to an aft end of a vehicle roof for pivotal movement between an open position and a closed position about a hinge axis, **characterized in that** the power operating system has at least one drive unit comprising:

   a housing (24) having a curved track (26) between two side walls,
   a curved rack (32) that is fixed adjacent the curved track (26),
   a curved drive link (38) that is disposed in the housing and that is pivotally attached to the vehicle liftgate (12) at one end and that is guided by the curved track (26),
   a pinion gear (42) that is rotatably attached to the curved drive link (38) by an axle (44),
   the pinion gear (42) engaging the curved rack (32), and
   drive means to rotate the pinion gear (42) whereby the curved drive link (38) travels with respect to the track (26) and the housing (24).

2. The power operating system as defined in claim 1 further including a roller (40) at a forward end of the curved drive link (38) that travels in the curved track (26) with a running fit to guide the curved drive link for swinging movement.

3. The power operating system as defined in claim 1 or 2 wherein the drive means comprises a rotor (48) that is attached to the axle (44) of the pinion gear (42) and an endless flexible drive member (50) that rotates the rotor (48) when driven.

4. The power operating system as defined in claim 3 wherein the endless flexible drive member (50) is driven in a loop by a reversible electric motor (52), the loop being defined by an output wheel (54) associated with the reversible electric motor (52), the rotor (48), at least one idle roller (56) and at least one guide (35 or 37).

5. The power operating system as defined in claim 4 wherein the endless flexible drive member 50 is a chain and the output wheel (54), the rotor (48) and the idle roller (56) are all sprockets.

6. The power operating system as defined in any of the preceding claims wherein the pinion gear (42) is attached to one end of the axle (44) and the rotor (48) is attached an opposite end of the to axle (44).

7. The power operating system as defined in claim 6 wherein the curved drive link (38), the curved track (26), and the curved rack (32) all have a radius of curvature that is centered on the hinge axis (21).

Fig.1.

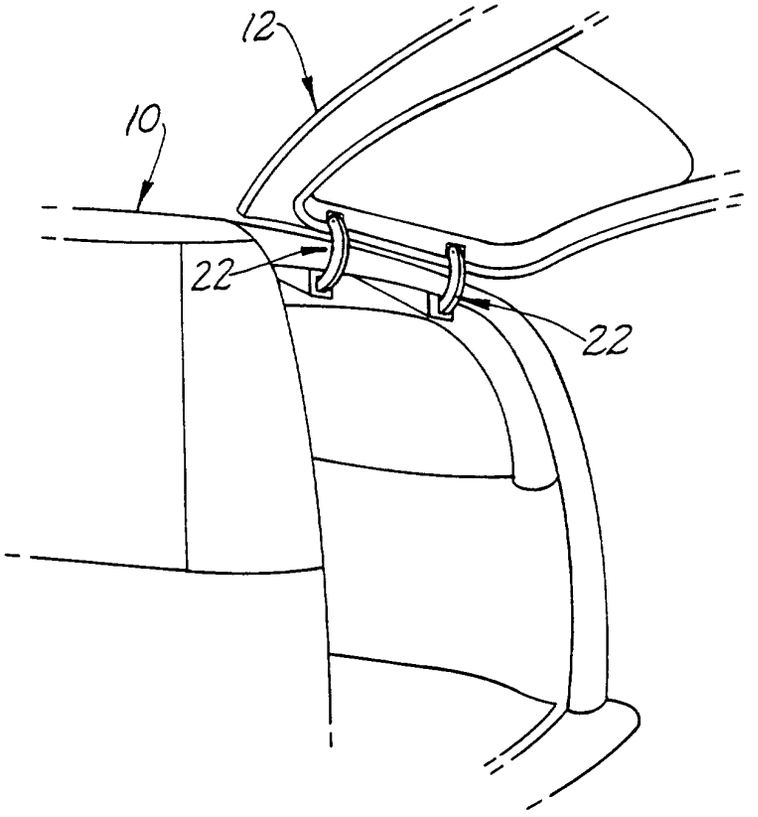


Fig.2.

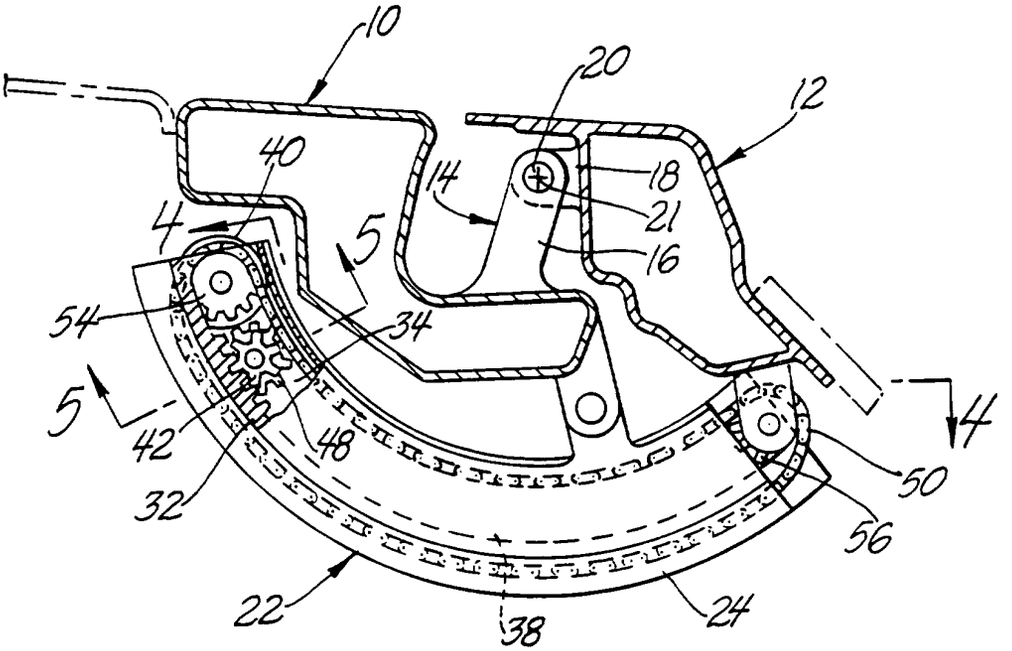


Fig.3.

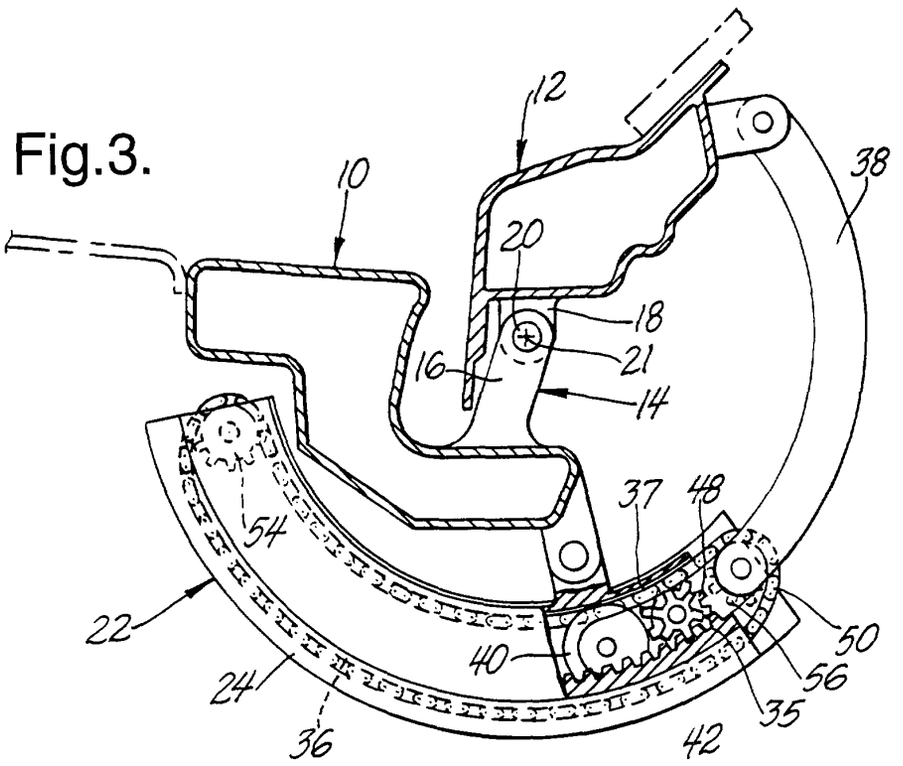


Fig.4.

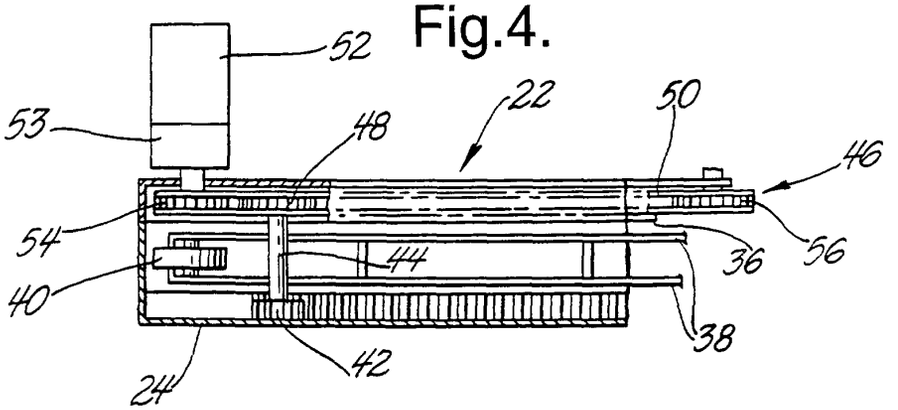
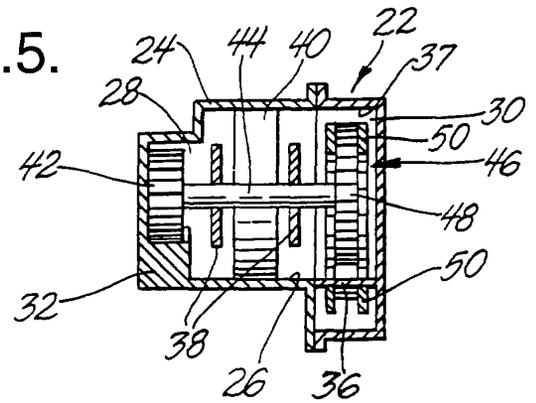


Fig.5.



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 20 3294

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 6 092 337 A (CRANSTON JOSEPH D ET AL) 25 July 2000 (2000-07-25) * figures 3,4 *	1	E05F15/12

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

E05F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	6 December 2001	Moreau, C

CATEGORY OF CITED DOCUMENTS

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06-12-2001

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US 6092337 A	25-07-2000	EP 1153191 A1	14-11-2001
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82