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Case Number: T 1085/15 - 3.2.01

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Actuator

Patent Proprietor:
Goodrich Actuation Systems Ltd.

Opponent:
Messier-Bugatti-Dowty

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Case Number: T 1085/15 - 3.2.01

D E C I S I O N
of Technical Board of Appeal 3.2.01
of 1 June 2017

Appellant: (Opponent)	Messier-Bugatti-Dowty Inovel Parc Sud 78140 Vélizy-Villacoublay (FR)
Representative:	Parzy, Benjamin Alain Cabinet Boettcher 16, rue Médéric 75017 Paris (FR)
Respondent: (Patent Proprietor)	Goodrich Actuation Systems Ltd. Stratford Road Solihull B90 4LA (GB)
Representative:	Taylor, Adam David Dehns St Bride's House 10 Salisbury Square London EC4Y 8JD (GB)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 1 April 2015 rejecting the opposition filed against European patent No. 2149496 pursuant to Article 101(2) EPC.**

Composition of the Board:

Chairman	G. Pricolo
Members:	W. Marx
	P. Guntz

Summary of Facts and Submissions

I. The appeal is directed against the decision rejecting the opposition against European patent No. 2 149 496.

II. The appellant relied on the following evidence filed during the opposition procedure:

- E1: FR 844 787 B1;
- E2: VEAUX, Jacques, "Un demi-siècle d'aéronautique en France: les trains d'atterrissage et les systèmes associés", PARIS, COMAERO, 2006;
- E3: Dossier ressources de l'épreuve de CAP mécanicien cellules aéronef - Session 2004;
- E6: FR 2 895 482 A1;
- E9: GB 2 435 877 A1;
- E11: CN 1012 24791 and a machine translation of the document.

The appellant filed the following further evidence with its statement of grounds of appeal:

- E12: "Locking Actuators Today and Beyond", SAE Technical Paper Series, 1988.

III. At oral proceedings held on 1 June 2017 the appellant (opponent) requested that the decision under appeal be set aside and the European patent revoked. The respondent (patent proprietor) requested that the appeal be dismissed.

IV. Claim 1 as granted reads as follows:

"1. An aircraft landing gear actuator comprising a screw shaft (22), a nut (24) translatable along the shaft (22) between a retracted position and an extended position, and **characterised by** a tine component (32) carried by the nut (24), the tine component (32)

including tine fingers (36) formed with projections (38) each being engageable with a formation (44) provided on a housing (10) when the nut (24) occupies its extended position to secure the nut (24) against axial movement, and a lock member (46) engageable with the tine fingers (38) to restrict radial movement of the tine fingers (38)."

V. The appellant's submissions in as far as they are relevant to this decision may be summarised as follows:

Claim 1 related to aircraft landing gear actuators, comprising a known internal finger locking mechanism (see E2 of 1938, by company Messier) for stabilising it in the deployed position. The invention resided in choosing a particular locking mechanism and adapting it to a screw drive actuator, in view of the tendency in aircraft industry since 1990 to replace hydraulically powered actuators by electrically powered (complex) actuators in order to avoid the weight and maintenance of hydraulic circuits. The subject-matter of claim 1 was broad, covering any (electrically, hydraulically or even manually driven) mechanical screw drive in the preamble and not specifying (apart from "engageable") how the locking member was actuated, neither any means for releasing the locking member or for extending the landing gear in case of failure. Locking the actuator in the retracted position was equivalent to locking it in the extended position and depended only on the lifting kinematics of the landing gear.

Hydraulically actuated cylinders comprising a claw lock connected to the shaft (the displaceable element) were known from E1 to E3, and a locking mechanism used for aircraft actuators including flexible fingers was also known from E12 which described four locking mechanisms.

Although primarily dealing with hydraulic actuators, E12 indicated that linear mechanical actuators existed that were locked and that a finger locking mechanism was compatible with these actuators (see also E6).

E1 did not disclose a screw shaft cooperating with a nut forming the displaceable element of the actuator. The invention solved the technical problem of making driving of the displaceable element of the actuator possible by other means, e.g. a rotary driving device such as a hydraulic motor or an electric motor. The person skilled in the art knew from the document E12 that a finger locking mechanism was compatible with linear mechanical actuators. The person skilled in the art was thus naturally incited to install, in the actuator of E1, a threaded shaft as known from E6 to be driven by an electric motor and to provide the rod with a threaded portion forming a nut, which together with the threaded shaft provided a screw/nut connection for causing the linear displacement of the rod during the shaft's rotation. In this combination, the claws were fixed to the rod and the nut, and the locking sleeve was operated as in E1. Since claim 1 did not specify the conditions for operating the locking sleeve, it was "engageable". Moreover, it was always possible to provide (as in E6) an electric control of the locking sleeve for retracting it, which the skilled person would adopt if necessary. E1 did not exclusively relate (see page 1, lines 5-8: "entre autres"; or summary on page 3, lines 26 ff) to systems in which piston displacement was hydraulically controlled (electrical actuation was derivable from E6), and hydraulically unlocking the mechanical locking device was described in E1 (page 3, lines 52-57) as a specific embodiment only and therefore not mandatory.

The actuator of E6 (screw 9 and nut 10 connected to a rod 2 displaceable along shaft 9) corresponded to the preamble of claim 1. The technical problem was to modify the actuator of E6 to allow locking of the rod in the extended position, which was more compact than the external locking means of E6 (issue of space-shortage in aircrafts). The skilled person knew claw locks (see e.g. E3) and that they were compatible with linear mechanical actuators (see E12). E6 even showed an electrically controlled claw lock locking an auxiliary rod 20 within the main rod 2, comprising a claw 30 and a spring-biased locking sleeve 32 which was unlocked via motor 33. It was obvious to place such type of locking between E6's cylinder (and a formation provided on the housing) and the rod (and a claw provided on the rod which formed the nut) in order to lock the rod in the extended position, i.e. by simply duplicating the locking mechanism of E6 at the end of the rod. The skilled person would not be put off by the problem of jamming of screw actuators, and it was evident that an internally locked actuator would not be used together with an externally locking brace.

The actuator of E9 (nut 42 displaceable along a threaded shaft) comprised a radially mobile locking element 56 engaging a groove of a sleeve 64 connected to the nut, and a spring-biased locking sleeve 50 engageable with element 56 in order to prevent radial displacement of the locking element. Although locking occurred in E9 in a retracted position, this was equivalent from a kinematic point of view to locking in the extended position. E9 did not show a claw lock carried by the nut and engaging a formation on the housing. Moreover, the arrangement of E9 (which required follower 72) was rather complex. The problem to be solved was a more simple alternative locking.

Different locking mechanisms used in this technical field were known from E12 and it was known that they were compatible with a mechanical screw drive actuator as shown in E9. Moreover, claw locks comprised rigid fingers (which did not require a supporting follower like the lock keys in E9) translatable by the moving part of the actuator as suggested by E1, i.e. by nut 42 in E9. A formation was easily provided on the housing, and the form of the locking sleeve was adapted to pass under the fingers and prevent them from bending in the locked position, after having pushed back - as in E1 - the locking sleeve. The locking sleeve of E9 was retracted by initially rotating the drive shaft.

E11 showed the preamble of claim 1 and a complex ball locking mechanism for locking in the retracted and in the deployed position. The subject-matter of claim 1 was distinguished from this actuator by using - instead of the balls of E11 - a claw comprising resilient fingers provided on the nut. The invention resided in a more simple alternative locking. The skilled person knew (as evidenced by E12) three alternative locking systems. A finger lock was particularly adapted for the actuator of E11, so the skilled person was incited to remove the ball lock and replace it with a finger lock provided on the nut of E11, no matter whether locking in the second position was lost. Thus, the actuator's structure was simplified and - due to the fingers being small - more compact.
Moreover, the same conclusion was reached starting from E11 and combining it with E1. The person skilled in the art who wanted to use only a single energy source could actuate the locking device of E1 electrically.
Moreover, he would not be put off by having an electrically actuated screw actuator in combination with a hydraulically actuated locking device.

VI. The respondent countered essentially as follows:

It was requested not to admit late-filed document E12 and the new inventive step attack based on E9 combined with E1. The entire citation E12 (aside from paragraph "Item Definition" - page 1) related to linear hydraulic actuators and a finger locking mechanism provided therein (similar to E1 to E3), but there was no teaching that such a locking mechanism could be applied to a mechanical (ball and screw) locking actuator.

Neither E1 nor E6 disclosed a tine component mounted to a nut locking it in the extended position, i.e. the present invention was not merely the straightforward aggregation or juxtaposition of the two prior art systems. The disclosures of E1 and E6 as a whole and their compatibility had to be considered. In this respect, E12 only taught that claw locks were known in the context of hydraulic actuators (as in E1). Starting from E1's locking hydraulic actuator and seeking to create a locking actuator driven by rotation, the skilled person would not consider the non-locking mechanical actuator of E6. In any event, both disclosures could not obviously be combined using the screw and shaft configuration of E6 (main shaft 2, auxiliary shaft 20) and its finger lock that was provided at a different place than in E1. Even assuming the skilled person were to consider retaining the locking mechanism from E1 when implementing the shaft of E6, it was not apparent where this mechanism could be installed such that it would operate correctly. In E6, if the main shaft jammed then the auxiliary shaft was released to extend, i.e. the main shaft was never fully extended and would not lock when connecting the claws to the main shaft as suggested by the appellant.

Thus, this implementation would be unsafe and not obvious. Moreover, it was not obvious to retain the hydraulic locking mechanism disclosed in E1, which operated automatically because of the synergistic configuration whereby pressurising chamber 5 to retract the shaft automatically released the slide ring 10. Therefore, when removing the hydraulic chamber the locking mechanism would also be replaced with a known mechanical locking mechanism.

E6 did not show the characterising portion of claim 1 and locking in the extended position. The technical problem as set out by the appellant contained pointers to the claimed invention and did not arise in the system of E6, which related to a non-locking actuator intended for use with an aircraft undercarriage that employed a separate side brace to retain the undercarriage in its deployed position, in which no locking mechanism was provided. The obvious starting point was therefore an existing locking mechanical actuator, not E6. If the problem was to reduce space and the skilled person would seek to place the locking mechanism inside, then E1 only showed a hydraulic actuator and E11 suggested a ball lock. In any event, the skilled person would not arrive at the claimed invention. There was no suggestion in E6 to use the particular locking mechanism (used as emergency release mechanism) for retaining the auxiliary shaft 20 within the main shaft 2 as a routine locking mechanism for the fully extended position (which might be engaged and released with much higher frequency). Moreover, it was not apparent how to modify the nested rod system composed of two shafts in view of E6. Even assuming that the locking mechanism used for retaining the auxiliary shaft was copied, it was not apparent where this mechanism could be installed such that it would

operate correctly, i.e. this implementation would be unsafe and not obvious as argued already with regard to E1.

E9 disclosed a locking mechanical actuator (nut 42 of shaft 11 locked against axial movement by key 56) that retained the shaft in the retracted position, but failed to show the characterising portion of claim 1. Locking an actuator in the retracted as opposed to the extended position changed the function of an actuator, so the skilled person seeking an actuator that locked in the extended position would not start from E9. Such actuators were required for different purposes and were not simply equivalent. Moreover, the locking mechanism in E9 could not be implemented at the opposite end of shaft 11 (to lock in the extended position) because the drive sleeve 30 that caused the collar 54 to retract had to link the drive shaft 6 to the screw shaft 40, i.e. the location of the locking mechanism in E9 was also fundamentally linked to its operation.

E11 only disclosed the pre-characterising features of claim 1, in particular a locking mechanical actuator comprising a ball lock that was automatically engaged when the shaft reached either the extended or retracted position. There was no reason to replace this locking mechanism which was described as an essential feature. Three alternative locking mechanism were discussed in E12 only in the context of a hydraulic actuator system. The fact that ball locks existed in both a hydraulic and a mechanical context did not imply that a hydraulic finger locking mechanism could also be used in such a manner, because a significant feature of the finger lock was the automatic hydraulic release mechanism. Taking the locking mechanism from a hydraulic actuator, modifying a key, hydraulic functionality of the

mechanism so as to electrify it, and then incorporating it in place of an existing mechanical mechanism was not the obvious choice. Moreover, taking an entirely mechanical system and modifying it to include a separate hydraulic system (and the associated hydraulics required in the aircraft) in order to "simplify" the device would result in a far more complex system.
The skilled person would also not combine the non-compatible locking mechanisms of E1 (only providing locking at one end) and E11 (automatic locking at both ends based upon movement of the nut). The E1 mechanism could not simply be substituted for the E11 mechanism because the resulting actuator would then lose the functionality of locking in the retracted position, which was not an obvious step to take.

Reasons for the Decision

1. Novelty of the subject-matter of claim 1 as granted was not contested. In fact, none of the cited documents discloses all the features of claim 1.

2. The subject-matter of claim 1 involves an inventive step over the cited prior art (Article 56 EPC).

As will be shown in the following, the appellant's arguments starting from either document E1, E6, E9 or E11 as the closest prior art were not convincing to the board. A broad definition of the subject-matter of claim 1, not specifying e.g. details on actuation or release of the lock member, is not a reason sufficient for denying inventiveness, as alleged by the appellant. Assessing inventive step requires to consider whether the person skilled in the art, having regard to the

state of the art, would arrive in an obvious manner at the invention as defined by the features of the claim. Moreover, it is noted that the alleged teaching of E12 that finger locking mechanisms were compatible with linear mechanical actuators was already known from E6.

2.1 E1 discloses a linear, hydraulic actuator comprising a lock member (10) engageable with the tine fingers (8) of a tine component formed with projections (9) engageable with a formation (15, 16) provided on a housing (3) to restrict radial movement of the tine fingers in the extended position of a rod (2), used in an aircraft landing gear actuator (page 1, lines 9-16).

As acknowledged by the appellant, E1 fails to disclose a screw shaft cooperating with a nut translatable along the shaft between a retracted position and an extracted position, as required by the pre-characterising features of claim 1. Moreover, the tine component of E1 is not carried by a nut for locking it in the extended position, but fixed to a hydraulically actuated piston (1) which is connected to the rod (2).

The technical problem can be seen in providing other means for driving the displaceable element of the actuator. A combination of the non-locking mechanical actuator of E6 (which is locked in the extended position by external means) with the locking hydraulic actuator of E1 (which is locked in the extended position by an internal locking means provided inside the cylindrical housing) might already be questionable, as argued by the respondent. In any event, even taking into account the teaching of E6 to use an electric motor for driving a threaded shaft via a screw/nut connection for causing a linear displacement of the rod actuator of E1, the board is not convinced that this

modification would obviously result in a finger lock mechanism cooperating with a locking sleeve operated hydraulically as in E1 (for release) against the force of a biasing spring, as suggested by the appellant.

On the one hand, replacing the hydraulically actuated rod in E1 by an electrically actuated rod would be at odds with retaining a hydraulically actuated release function in view of the tendency in aircraft industry to avoid the weight and maintenance of hydraulic circuits, as argued by the appellant himself. Although claim 1 does not specify (apart from being "engageable" with the tine fingers) operation of the lock member or any release means, simply omitting the hydraulic release means described in E1 is also not an obvious step to take when modifying the actuator of E1, because without means for releasing the lock member the landing gear could only be actuated once until reaching its locked deployed position for the first time.

On the other hand, E6 explicitly proposes a shaft configuration comprising a main shaft 2 and an auxiliary shaft 20 in order to address the problem of jamming of the main shaft, which is a typical problem in screw-nut drives, and ignoring this part of the overall disclosure of E6 would mean to ignore the requirements for fail-safe operation, which is of utmost importance in aircraft design. Providing a rod with a threaded portion forming a nut cooperating with an electrically driven threaded shaft and fixing the claws to the nut, as suggested by the appellant, would result in a rod that is possibly not locked under known failure conditions, e.g. when not reaching the fully extended position due to jamming. As acknowledged by the appellant himself when discussing E6, the skilled person would not provide internal locking means

together with the external locking means known from E6. Therefore, the obvious solution when taking the teachings of E1 and E6 together would be to replace the actuator of E1 by the fail-safe actuator of E6, which only provides a finger lock mechanism between the main shaft and the auxiliary shaft but does not cooperate with a formation on the housing, whereas locking in the extended position would be realised by external locking means as described in E6. This would not lead to the subject-matter of claim 1.
For the same reason, it is not obvious to simply replace the hydraulic actuation of the locking sleeve in E1 by an electric control when seeking to avoid any hydraulic circuitry, which again would not take into account the problem of jamming.

The appellant also cited passages in E1 to show that the teaching of E1 was not confined to hydraulically controlled piston displacement or to a mechanical locking device which was hydraulically released. However, when assessing inventive step starting from a document representing the closest prior art, the subject-matter serving as the most promising starting point has to be determined, which in the present case is the embodiment as disclosed in Figure 1 of E1. This embodiment defines the framework for further development in assessing inventiveness and shows a hydraulically controlled displacement of the piston and a hydraulic release of the locking device.

2.2 E6 discloses (Figure 1) a mechanical actuator for an aircraft landing gear (page 6, lines 12 ff) according to the preamble of claim 1, comprising a screw shaft (9) driven by an electric motor (5) and a nut (10) connected to a main shaft or rod (2) translatable along the shaft between a retracted and an extended position.

A claw lock is also known from E6, namely a claw (30) and a spring-biased locking sleeve (32) locking an auxiliary rod (20) within the main rod (2). However, this claw lock does not engage a formation provided on the housing to secure the main rod or the nut against axial movement, as required for the tine component of the characterising portion of claim 1.

The board cannot accept the appellant's formulation of the problem to be solved ("to modify the actuator of E6 to allow locking of the rod in the extended position") because it contains already a pointer to the claimed solution and does not arise in the system of E6, which employs a separate side brace retaining the undercarriage in its deployed position and requires no further locking mechanism in the extended position (i.e. it relates to a "non-locking actuator" as argued by the respondent). It seems that according to the appellant an internal lock member in the extended position provided the advantage of a more compact actuator than the actuator known from E6 having a separate side brace, i.e. external locking means.

Following the appellant in that the objective technical problem is to reduce space, there is no suggestion in E6 to use the emergency release locking mechanism for retaining the auxiliary rod within the main rod as a locking mechanism for the fully extended position, i.e. to place such type of locking between the cylinder and the main rod by simply duplicating the known locking mechanism at the end of the main rod. As acknowledged by the appellant, the skilled person would not provide such internal locking means together with the external locking means known from E6, but would replace the external side brace structure originally used in E6. However, as argued above with regard to E1, this would

lead to an unsafe configuration in view of the possibility of jamming of the screw-nut actuator resulting in a missing locking mechanism in the extended position in this typical failure situation, which is not considered to be an obvious solution.

2.3 The actuator of E9 for use in aircraft actuation systems comprises a threaded shaft (40) carrying a nut (42) which is fixed to the end of a ram member or rod (11) and translatable between a retracted and an extended position, as specified in the preamble of claim 1. The rod is locked against axial movement in the retracted position by a radially movable locking key (56) engaging a groove of a sleeve (64) connected to the nut, i.e. E9 shows a key lock (or segment lock as recited in E12) instead of the tine component or finger lock mechanism specified in the characterising portion of claim 1.

The board concurs with the appellant that the arrangement of E9 is rather complex and that the problem to be solved is a more simple alternative locking. Although claw or finger locks are well-known to the person skilled in the art, the board finds that replacing the segment lock of E9 by a finger lock mechanism would require a complete re-design of the actuator of E9 (i.e. providing flexible fingers on the nut and a formation on the housing, adapting the form of the locking sleeve so that it can pass under the fingers), which is not an obvious modification the skilled person would consider. Moreover, such modification would still not provide a lock in the extended position, as required by the wording of claim 1.

2.4 E11 undisputedly shows the pre-characterising features of claim 1, but the linear mechanical actuator of E11 comprises - instead of a finger lock as specified in the characterising portion of claim 1 - a ball lock that automatically engages when reaching either the extended or the retracted position.

Following the appellant in that the invention resides in a more simple alternative locking, the board agrees that alternative locking mechanisms are known to the skilled person, e.g. a finger lock is known from E1 for hydraulic actuation (or from E12), and E6 even shows a claw lock for a linear mechanical actuator. However, the board cannot see why a finger lock would be particularly adapted for the actuator of E11, such that the skilled person would be motivated to replace the ball lock used in E11 by a finger lock in the extended position. Such modification would result in losing the locking functionality in the retracted position, which cannot be ignored, and therefore speaks against a replacement of the ball lock arrangement of E11 as an obvious step to take, irrespective of whether a finger lock was only known so far in the context of hydraulic actuators.

For the same reason, even taking into consideration the teaching of E1 which discloses a hydraulic actuator comprising a finger lock mechanism in the extended position, the skilled person would not be incited to replace the ball lock of E11 by fingers provided on the nut (25) which would only lock the rod fixed to the nut in the extended position.

2.5 It follows from the foregoing that it is not obvious to a person skilled in the art to arrive at the claimed solution, starting from either E1 or E6 or E9 or E11 as

the closest prior art, taking into account the common general knowledge and also the teaching of E12 or E1 to E3 and E6. The invention as specified in claim 1 as granted therefore involves an inventive step.

2.6 Granted dependent claims 2 to 9 concern particular embodiments of claim 1 and are therefore likewise allowable.

3. Since as shown above, the subject-matter of granted claim 1 is not rendered obvious by the prior art even when taking into account the late-filed submissions based on document E12 and E9 (see point VI above, first paragraph), there is no need to address here the issue of admissibility thereof in appeal proceedings.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

A. Vottner G. Pricolo

Decision electronically authenticated