

## A Ladder

### Description of Invention

- 5     The present invention relates to a ladder and more particularly relates to a ladder for use with an aircraft.

10     A conventional aircraft ramp ladder comprises a base that supports an inclined set of steps to provide user access from the ground to the door switch panel of an aircraft. The ladder incorporates wheels which are mounted to the base so that the ladder can be moved along the ground to a desired position.

15     A conventional ladder usually incorporates a single lever locking mechanism which, when operated by a user, locks the wheels to prevent the ladder accidentally moving along the ground when it is being stored or when it is in use. The problem with this arrangement is that users often forget to lock the wheels after moving the ladder. Ladders are therefore frequently left unlocked and free to move along the ground. This can be dangerous for a person using a ladder because the ladder is unstable and also for a person on the ground who might  
20     be struck accidentally by the ladder if the ladder is moved by the wind. An unintentionally unlocked ladder might also move accidentally and hit an aircraft in the vicinity; thereby posing another serious aviation safety risk at the airport.

25     The present invention seeks to provide an improved ladder.

30     According to one aspect of the present invention, there is provided, a ladder for use with an aircraft, the ladder comprising: a base carrying a set of steps; first and second movement devices which are carried by the base, each movement device configured to support the ladder and to permit movement of the ladder along the ground; a braking device which is configured to support the ladder and to resist movement of the ladder along the ground; and an activation mechanism configured, upon activation by a user, to move one of the braking device and the second movement device relative to the base, wherein: when

the activation mechanism is not activated by a user, the ladder is supported on the ground by the first movement device and the braking device such that the braking device provides a frictional engagement with the ground which resists movement of the ladder along the ground, and wherein: when the activation  
5 mechanism is activated by a user, the ladder is supported on the ground by the first movement device and the second movement device, but not the braking device, such that the movement devices permit movement of the ladder along the ground, the ladder further comprising: a biasing arrangement which biases one of the braking device and the second movement device so that when the  
10 activation mechanism is not activated by a user the ladder is supported automatically by the braking device to resist movement of the ladder along the ground.

Preferably, each of the first and second movement devices is a wheel  
15 assembly.

Conveniently, the braking device is an elongate element which is carried at one end by the base of the ladder, the other end of the braking device comprising a braking surface which is configured to contact the ground and provide a  
20 frictional engagement with the ground.

Advantageously, the weight of the ladder is greater than 200kg.

Preferably, the ladder is a ramp ladder for providing user access from the  
25 ground to the door switch panel of an aircraft.

Conveniently, the activation mechanism comprises: an activation lever which is configured to be moved by a user to activate the activation mechanism; and a linked lever arrangement incorporating a plurality of pivotally connected levers  
30 which are configured to be moved by the activation lever, the linked lever arrangement being configured to amplify a force exerted by a user on the activation lever and to apply the amplified force to one of the braking device and the second movement device.

Advantageously, the activation mechanism comprises a flexible cable which is connected between the activation lever and the linked lever arrangement to transfer force from the activation lever to the linked lever arrangement.

- 5 In one embodiment, the activation mechanism is configured, upon activation by a user, to move the second movement device away from the base of the ladder so that the second movement device contacts the ground and is biased against the ground by a force from the activation mechanism, such that the force from the activation mechanism lifts part of the ladder so that the braking device does  
10 not contact the ground.

- In another embodiment, the activation mechanism is configured, upon activation by a user, to move the braking device towards the base of the ladder to lower part of the ladder so that the second movement device contacts the ground and  
15 the braking element does not contact the ground.

Preferably, the ladder comprises at least one further movement device, at least one further activation mechanism and at least one further braking device.

- 20 So that the present invention may be more readily understood, embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

- Figure 1 is a diagrammatic perspective view of a ladder of an embodiment of  
25 the invention,

Figure 2 is a side view of the ladder of figure 1,

- Figure 3 is an end view of the ladder of figure 1,  
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Figure 4 is a diagrammatic exploded view of an activation mechanism of an embodiment of the invention,

Figure 5 is a view of part of the activation mechanism of figure 4, with the activation mechanism in an un-activated condition, and

Figure 6 is a view of part of the activation mechanism of figure 4, with the  
5 activation mechanism in an activated condition.

Referring initially to figures 1 to 3 of the accompanying drawings, a ladder 1 of a preferred embodiment of the invention comprises a base 2 which is constructed from a plurality of interconnected struts. Upstanding support struts 3 are  
10 connected to the base 2 at the edges of a generally rectangular portion of the base 2. The upper ends of the support struts 3 are connected to a raised rectangular platform 4 which, in this embodiment, is a metal grid. The raised platform 4 is configured to be positioned adjacent the door switch panel of an aircraft so that users can stand on the raised platform 4 and access the door  
15 switch panel of the aircraft.

The ladder 1 further comprises an inclined set of steps 5 which is supported by further upstanding support struts 6 that are attached to the base 2. The further support struts 6 support the set of steps 5 in an inclined configuration with the  
20 lower end of the set of steps 5 positioned at one end of the ladder 1 and the other end of the set of steps 5 positioned adjacent the raised platform 4. The inclined set of steps 5 provide a ramp ladder which enables a user to walk from ground level up and onto the raised platform 4.

25 First and second handrails 7, 8 are attached to respective sides of the set of steps 5 and extend at least partly along the length of the set of steps 5.

A safety rail arrangement 9 is provided around edges of the raised platform 4 to reduce the risk of a user falling from the raised platform 4.

30 The ladder 1 is preferably constructed from an aluminium steel alloy such that the ladder is of an appropriate weight to allow manual movement of the ladder along the ground. The ladder 1 of a preferred embodiment of the invention has

an overall length approximately 2.7m, an overall width of approximately 1.5m and an overall height of approximately 2.7m.

5 The total weight of the ladder 1 of a preferred embodiment of the invention is approximately 220kg. However, in embodiments of the invention, the total weight of the ladder 1 may be greater than 100kg or greater than 200kg.

10 In other embodiments the ladder may be larger in size or weight than the ladder of the preferred embodiment of the invention. However, in each embodiment the ladder is of sufficient size to enable the ladder to be suitable for use with an aircraft. Ladders of embodiments of the invention are therefore larger in size and weight than a typical ladder or step ladder that is suitable for use by one user at a time in a domestic or commercial situation. Typical ladders or step ladders that are suitable for use by one user at a time also do not incorporate a  
15 raised platform that is realistically capable of supporting more than one person.

The ladder 1 comprises a first movement device which, in this embodiment, is a wheel 9 which is carried by a portion of the base 2 which is positioned beneath the raised platform 4. A further movement device which, in this embodiment, is  
20 in the form of a further wheel 10 is carried by an opposing side of the base 2, beneath the raised platform 4. The wheels 9, 10 are preferably non-swivel type wheels. In this embodiment, the planes of rotation of the wheels 9, 10 are parallel with one another and fixed relative to the base 2 so that the planes of rotation of the wheels 9, 10 do not rotate relative to the base 2. The wheels 9,  
25 10 support the portion of the base 2 beneath the raised platform 4 and permit this portion of the base 2 to be moved along the ground.

The ladder 1 further comprises a braking device in the form of an elongate braking element 11. One end of the braking element 11 is carried by a portion  
30 of the base 2 which is positioned beneath the lower end of the inclined set of steps 5. The other end of the braking element 11 is configured to rest on and provide a frictional engagement with the ground beneath the ladder 1. In this embodiment, the ladder 1 comprises a further braking device in the form of a

further elongate braking element 12 which is identical to the braking element 11. The further braking element is carried on a portion of the base 2, opposite the breaking element 11. Each braking element 11, 12 is configured to support the ladder 1 and to provide a frictional engagement with the ground. The frictional  
5 engagement resists or prevents movement of the ladder 1 along the ground.

In this embodiment, when the ladder 1 is not being deliberately moved by a user, the ladder 1 rests primarily on the wheels 9, 10 and the braking elements 11, 12. The substantial weight of the ladder 1 acts on the braking elements 11,  
10 12 to provide a frictional engagement with the ground that is sufficient to resist or prevent the ladder 1 from accidentally moving along the ground, for instance by forces due to wind blowing on the ladder 1. The ladder 1 therefore remains safely in a fixed position.

15 The ladder 1 further comprises a second movement device which, in this embodiment, is in the form of a second wheel arrangement 13. The second wheel arrangement 13 is carried by a portion of the base 2 which is adjacent one of the braking elements 11.

20 The second wheel arrangement 13 is, in this embodiment, a castor wheel arrangement which is rotatably mounted to the base 2 to permit the wheel assembly to pivot about a vertical axis. The second wheel arrangement 13 is coupled to an activation mechanism 14 which is described in more detail below.

25 The ladder 1 of this preferred embodiment of the invention comprises a further movement device in the form of a further wheel arrangement 15 and an associated further activation mechanism 16 which are positioned on an opposite side of the ladder 1 to the first wheel arrangement 13 and the first activation mechanism 14. The further wheel arrangement 15 and the further  
30 activation mechanism 16 are identical to the first wheel arrangement 13 and the first activation mechanism 14. For simplicity, only the first wheel arrangement 13 and the first activation mechanism 14 will be described below.

In this embodiment, the ladder 1 rests lightly on the wheels of the second and further wheel arrangements 13, 15 when the activation mechanisms 14, 16 are not activated. However, the majority of the weight of the ladder 1 rests on the wheels 9, 10 and the braking elements 11, 12.

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In further embodiments, the wheels of the second and further wheel arrangements 13, 15 are configured not to contact the ground and support the ladder 1 when the activation mechanisms 14, 16 are not activated.

10 Referring now to figure 4 of the accompanying drawings, the second wheel arrangement 13 comprises a rotational mounting arrangement 17 which incorporates a mounting post 18 that is connected to one end of a support column 19. The support column 19 is a generally cylindrical element with a larger diameter portion 20 and a smaller diameter portion 21. A biasing element  
15 which, in this embodiment, is in the form of a helical spring 22 sits around the narrower portion 21 and abuts an edge of the larger diameter portion 20.

The support column 19 is retained within an elongate cylindrical housing 23. The housing 23 is carried by a mounting plate 24 which is attached to the ladder  
20 1 by a plurality of bolts 25. An upper end of the support column 19 extends through an aperture 26 which is provided in one end of the housing 23. One end of the spring 22 is connected to the end of the housing 23 so that the spring 22 sits within the housing 23. While the activation mechanism 14 is not activated, the column 19 is in a raised position with the upper end of the column  
25 19 extending outwardly from the aperture 26 in the housing 23. The spring 22 biases the second wheel arrangement 13 into contact with the ground so that the second wheel arrangement 13 carries a small portion of the ladder weight which is equivalent or substantially equivalent to the biasing force of the spring 22. The majority of the weight of the ladder is, however, carried by the braking  
30 elements 11, 12 and the wheels 9 and 10. The ladder 1 is therefore in a locked configuration.

The upper end of the support column 19 is pivotally connected by a pivot arrangement 27 to a linked lever arrangement 28, as shown in figure 5.

5 The linked lever arrangement 28 comprises two parallel, spaced apart lower links 29 which are pivotally connected at one end to the pivot arrangement 27 and pivotally connected at the other end to a link pivot arrangement 30. The link pivot arrangement 30 is provided on one end of a central lever 31. The central lever 31 is pivotally mounted at a central point to the mounting plate 24 so that the central lever 31 may rotate relative to the mounting plate 24.

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An upper end of the central lever 31 is provided with a connection aperture 32. One end of a flexible elongate drive element in the form of a cable 33 is pivotally connected to the connection aperture 32. The other end of the cable 33 is pivotally connected to part of an activation lever 34. The activation lever 15 34 is pivotally mounted to a portion of the ladder 1 which, in this embodiment, is a portion of the handrail 7. The activation lever 34 is mounted via a mounting assembly 35 which also retains an outer sheath of the cable 33.

When the activation lever 34 is in a normal resting position and the activation 20 lever 34 is not activated by a user, the activation lever 34 does not exert an activation force on the linked lever arrangement 28, which in turn does not exert an activation force on the end of the support column 19.

The support column 19 is in a raised position, with the first wheel arrangement 25 13 contacting the ground but only carrying a small portion of the ladder weight which is equivalent or substantially equivalent to the biasing force of the spring 22. The ladder 1 is therefore partially supported by the first wheel arrangement 13 while the majority of the weight of the ladder 1 is supported by the braking elements 11, 12 and wheels 9 and 10. The braking elements 11, 12 provide a 30 frictional engagement with the ground which resists or prevents movement of the ladder 1 along the ground. The ladder 1 remains in this locked configuration while the activation lever 34 is not activated by a user.

If a user wishes to move the ladder 1 along the ground, the user activates the activation lever 34 by moving the activation lever 34 to exert an activation force on the cable 33. The activation force moves the cable 33 which drives the linked lever arrangement 28 to move the central lever 31 and the lower levers 5 29. The levers 29, 31 of the linked lever arrangement 28 pivot relative to one another to amplify the activation force. The linked lever arrangement 28 exerts the amplified activation force, together with the biasing force of the spring 22, on the end of the support column 19 which moves the support column 19 downwardly so that the first wheel arrangement 13 is biased more forcefully 10 against the ground, thereby raising the braking elements 11, 12 away from the ground, to permit movement of the ladder along the ground.

The downward force exerted by the linked lever arrangement 28 and the biasing force of the spring 22 cause part of the ladder 1 to lift relative to the ground as 15 the first wheel arrangement 13 is biased against the ground by the amplified activation force. The braking elements 11, 12 are lifted out of engagement with the ground so that the ladder 1 is only supported by the four wheels 9, 10 and 13, 15. The wheels 9, 10 and 13, 15 enable a user to move the ladder 1 along the ground to a desired position. The ladder 1 is thus in an unlocked and 20 moveable configuration.

It is to be appreciated that the biasing force of the spring 22 reduces the amount of force that must be exerted by a user on the activation levers in order to lift part of the ladder 1 so that the braking elements 11, 12 do not contact the 25 ground. This enables a user to lift part of the ladder 1 manually by moving the activation levers, despite the relatively heavy weight of the ladder (preferably in excess of 200kg).

When the user releases the activation lever 34, the first wheel arrangement 13 30 retracts towards the base 2 but still carries part of the ladder weight which is equivalent or substantially equivalent to the biasing force of the spring 22, thereby lowering the ladder 1 until the braking elements 11, 12 contact the ground. The weight of the ladder 1 acting substantially on the braking elements

11, 12 provides a frictional engagement which locks the ladder in position on the ground. This returns the ladder 1 automatically to the locked configuration when the activation lever 34 is not activated by a user. The normal resting state of the ladder 1 is therefore with the locking elements 11, 12 fully contacting the ground to resist or prevent movement of the ladder 1 along the ground. This avoids the possibility of the ladder accidentally being left in an unlocked and moveable condition.

In the preferred embodiment, the further wheel arrangement 15 and the further activation mechanism 16 operate in an identical manner to the first wheel arrangement 13 and the first activation mechanism 14. A user must move both of the activation levers to activate both of the activation mechanisms 14, 16 in order to move the ladder. This minimises the risk of the ladder 1 moving accidentally since a user must consciously activate both activation levers simultaneously.

In the embodiments described above, the wheel assemblies 13, 15 are moved by the activation mechanisms 14, 16 to raise the ladder 1 so that the braking elements 11, 12 are moved out of contact with the ground. However, in other embodiments, the wheel arrangements 13, 15 are not moveable in a vertical direction relative to the base 2. In these other embodiments, it is the braking elements 11, 12 which are moved by the activation mechanisms 14, 16 relative to the base 2. In a normal resting configuration, the activation mechanisms 14, 16 automatically bias the braking elements 11, 12 into contact with the ground while the wheel arrangements 13, 15 only carry a small portion of the ladder weight which is equivalent or substantially equivalent to the biasing force of the spring 22.

If a user wishes to move the ladder, the user activates the activation levers which in turn activate the activation mechanisms 14, 16 to move the braking elements 11, 12 out of engagement with the ground so that the wheel arrangements 13, 15 contact the ground. The ladder 1 is then in a movable condition with all four wheels 9, 10 and 13, 15 in contact with the ground. The

ladder automatically returns to the locked condition when a user releases the activation levers since the springs in the activation mechanisms 14, 16 automatically bias the braking elements 11, 12 into contact with the ground.

- 5 While in the embodiments described above, the second movement devices are in the form of wheel arrangements 13, 15 and the braking devices are in the form of braking elements 11, 12, in other embodiments the second movement devices are devices which provide a lower frictional engagement with the ground than the braking devices. For instance, in one embodiment, the second  
10 movement devices comprise slidable surfaces, such as skis, which engage the ground and which provide a lower frictional engagement with the ground than the braking devices.

In other embodiments of the invention, the ladder incorporates a greater or  
15 fewer number of movement devices and/or braking devices than the embodiments described above.

When used in this specification and claims, the terms "comprises" and "comprising" and variations thereof mean that the specified features, steps or  
20 integers are included. The terms are not to be interpreted to exclude the presence of other features, steps or components.

## CLAIMS

1. A ladder for use with an aircraft, the ladder comprising:
  - a base carrying a set of steps;
  - first and second movement devices which are carried by the base, each movement device configured to support the ladder and to permit movement of the ladder along the ground;
  - a braking device which is configured to support the ladder and to resist movement of the ladder along the ground; and
  - an activation mechanism configured, upon activation by a user, to move one of the braking device and the second movement device relative to the base, wherein:
    - when the activation mechanism is not activated by a user, the ladder is supported on the ground by the first movement device and the braking device such that the braking device provides a frictional engagement with the ground which resists movement of the ladder along the ground, and wherein:
    - when the activation mechanism is activated by a user, the ladder is supported on the ground by the first movement device and the second movement device, but not the braking device, such that the movement devices permit movement of the ladder along the ground, the ladder further comprising:
      - a biasing arrangement which biases one of the braking device and the second movement device so that when the activation mechanism is not activated by a user the ladder is supported automatically by the braking device to resist movement of the ladder along the ground.
2. The ladder of claim 1, wherein each of the first and second movement devices is a wheel assembly.
3. The ladder of claim 1 or claim 2, wherein the braking device is an elongate element which is carried at one end by the base of the ladder, the other end of the braking device comprising a braking surface which is

configured to contact the ground and provide a frictional engagement with the ground.

4. The ladder of any one of the preceding claims, wherein the weight of the ladder is greater than 200kg.

5. The ladder of any one of the preceding claims, wherein the ladder is a ramp ladder for providing user access from the ground to the door switch panel of an aircraft.

6. The ladder of any one of the preceding claims, wherein the activation mechanism comprises:

an activation lever which is configured to be moved by a user to activate the activation mechanism; and

a linked lever arrangement incorporating a plurality of pivotally connected levers which are configured to be moved by the activation lever, the linked lever arrangement being configured to amplify a force exerted by a user on the activation lever and to apply the amplified force to one of the braking device and the second movement device.

7. The ladder of claim 6, wherein the activation mechanism comprises a flexible cable which is connected between the activation lever and the linked lever arrangement to transfer force from the activation lever to the linked lever arrangement.

8. The ladder of any one of the preceding claims, wherein the activation mechanism is configured, upon activation by a user, to move the second movement device away from the base of the ladder so that the second movement device contacts the ground and is biased against the ground by a force from the activation mechanism, such that the force from the activation mechanism lifts part of the ladder so that the braking device does not contact the ground.

9. The ladder of any one of claims 1 to 7, wherein the activation mechanism is configured, upon activation by a user, to move the braking device towards the base of the ladder to lower part of the ladder so that the second movement device contacts the ground and the braking element does not contact the ground.

10. The ladder of any one of the preceding claims, wherein the ladder comprises at least one further movement device, at least one further activation mechanism and at least one further braking device.