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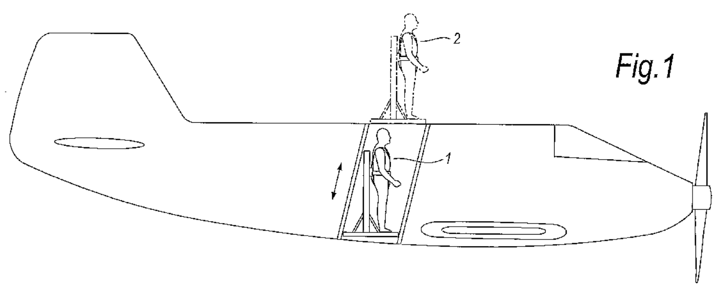

Fig.1

(57) Abstract: A safety support that comprises or is operably engagable with a safety harness for a person performing a stunt; wherein at least part of the support is movably mounted so that it can be moved from a first position where said person is located relatively safely for take off or landing, to a second, relatively exposed position, where said person can perform said stunt.

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Support

The present invention relates to a support, especially to a safety support useful for people performing stunts in an exposed position outside an aircraft.

Wing walking displays and stunts have been performed at airshows and by flying circuses since the 1920s. In the early days performers with no harness, safety line or parachute stood or walked on the wings of the aircraft in flight. Before long they were leaping from one aircraft to another in flight! As the stunts grew bolder, the death toll rose and the U.S. Federal Aviation Authority placed restrictions on these activities as early as 1936.

Today "wing walking" displays are as popular as ever at airshows. However the performers no longer walk about on the wings but are harnessed throughout the display. Such flights are therefore now more accurately described as "stand on wing" flights, although the term "wing walking" is more commonly used.

Over the last 30 years, a sizeable world wide market has developed in the provision of packaged adventure sport experiences to members of the public. The list of experiences that are now commercially available is extensive, including bungee jumping, parachuting, piloting a vintage aircraft, driving a racing car, or even participating in a Trans Atlantic yacht race, to name just a few. The scale of this industry can be seen from the fact that over 5 million people world-wide have paid to make a bungee jump.

For more than 25 years, display teams and other potential operators have repeatedly sought permission from the aviation authorities around the world to operate stand on wing flights for members of the public. This inventor made his first such application to the UK Civil Aviation Authority in 1988. These permissions have always been refused, all over the world, on safety grounds.

Standing outside an aircraft in flight is not inherently hazardous, providing that one is securely harnessed on. The problem is the safety of the Stand On Wing Passenger ("SOWP") during takeoff, taxiing and landing. From time to time, light aircraft flip onto their backs on the ground, most commonly during landing. This can be caused by pilot error, undercarriage or tyre failure or even a rabbit hole in an airstrip. Thanks to the cockpit construction, full harness and slow landing speed of most light aircraft, it is unusual for serious injury to result from such incidents. However, the exposed position of a SOWP in such an event would make serious injury or death much more likely.

In established display teams the "wing walkers" either take their chances on top of the aircraft, or else remain in the cockpit for takeoff, climb up onto the top wing and harness themselves on up there once airborne, perform the display and then un-harness themselves, in order to climb back down into the cockpit for landing.

In some cases aircraft are specially adapted by having safety supports attached to them. For example some aircraft have fixed external supports to which a safety line and/or a harness can be attached.

Such supports are normally located at a central position on top of the wings of the aircraft. This allows the person to be easily seen by onlookers. It also allows an even weight distribution.

In some cases the fixed support may even include a pivot point allowing the person a degree of freedom whilst still being attached to the support. This can be provided by a joint known as a "knuckle joint", which is used by some teams, including the "Utterly Butterly" display team.

Pivot points (of whatever nature) can allow various acrobatics to be performed by experienced wing walkers whilst retaining a degree of safety.

It will therefore be appreciated that various fixed safety supports are commonly used by wing walkers at airshows. Such wing walkers are generally highly experienced and may be professional or semi-professional.

There is however a major problem with such existing safety supports in that, while they have been widely approved for display purposes, they are not authorised for public transport wing walking flights by the general public by any major aviation authority.

A "public transport" flight can be broadly defined as a flight where an aircraft carries a passenger or crew member who has paid the air operator or owner of the aircraft or captain of the aircraft for the privilege of being aboard for the flight. Such flights are operated under much stricter regulation than flights for either private or display purposes. These regulations cover everything from the licensing of the aircraft and the crew to the maintenance schedules.

To date, applications for permission to carry out public transport wing walking flights have always been refused on safety grounds.

This is understandable given the dangers inherent for the wing walker of remaining in position outside the aircraft during takeoff and landing or the alternative difficulties and dangers involved in climbing out of the fuselage after take off, ensuring that a safety harness or line is properly attached and then climbing back for landing.

To date there has been no satisfactory solution to this long-standing technical problem, despite a high demand for wing walking from the general public over many years.

The present inventor has now solved this problem in an elegant manner that goes in a very different direction from the system used for many years for wing walking displays. Rather than place the support in a fixed position the present inventor has decided to use a movable support.

According to the present invention there is provided a safety support that comprises or is operably engagable with a safety harness for a person performing a stunt; wherein at least part of the support is movably mounted so that it can be moved from a first position where said person is located relatively safely for take off or landing, to a second position where said person can perform said stunt without being dangled below the aircraft.

This approach represents a radical break-through in the art. It has major implications in that at a stroke it allows the market for wing walking to be opened up to the public.

When the at least part of the support which is movably mounted, (referred to hereinafter as the "movable part"), is in the first position with the person harnessed to the support, the person is preferably located so that if the aircraft flips inverted onto the ground during landing but remains intact, the person is located in a protected zone.

The protected zone is provided by the frame of the aircraft. Indeed, even if the aircraft has an open cockpit, the frame can still serve to prevent the person's head contacting the ground if the aircraft accidentally flips over but remains intact. (See Figure 2 where a protected zone is illustrated by shading.) Thus severe head and neck injuries that might otherwise result and might be fatal can be avoided or can be reduced.

The first position is therefore also referred to herein as the “protected position” and the terms “first position” and “protected position” are used interchangeably.

More preferably the person, or at least the part of the person (including the person’s pelvis), will be within the fuselage of the aircraft in this position.

In contrast, when the movable part is in the second position a person attached to the support via a harness will be in a relatively exposed position. In this position the person, or at least part of the person (including the person’s pelvis), is preferably outside the fuselage of the aircraft.
In this exposed position the person may be fully or at least partially outside the “safety zone” discussed earlier. For example, the person may be positioned on top of a wing or a person’s head may be above the height of the wing. It is not however essential that the person be outside the safety zone in this position. The person may for example be within the safety zone, but outside the fuselage.

The second position is also referred to herein as the “exposed position” or the “deployed position”. The terms “second position”, “exposed position” and “deployed position” are therefore used interchangeably herein.

Although this position (where the stunt is performed) is relatively exposed, the combination of the support and harness provide a high degree of safety and reassurance.

They may serve to prevent the person falling to ground. They may also serve to prevent the person falling onto or damaging certain parts of the aircraft, such as the fuselage, the cockpit, the propeller (if present), etc.

The safety harness preferably comprises a lock. The lock may be releasable by a person performing the stunt. This embodiment is useful if the person is an experienced wing walker and can be trusted to have such control

However in many cases it is preferred a supervisor will have control over the lock. This is because the supervisor will generally be much more experienced than a member of the public performing a stunt and may also be more safety conscious. Here it is preferred that the person performing the stunt is normally not able to release the lock, at least until the situation is relatively safe. This may be at a stage when the person has performed the stunt and is back within the fuselage of the aircraft, or even at a later stage when the aircraft has landed.
The “supervisor” may in some circumstances be the pilot of the plane, in which case it is preferred the release of the lock can be controlled from within the cockpit. However it is preferred that the pilot concentrates on flying the aircraft and another person acts as the supervisor.

The supervisor may have sole control of the lock or may, for example, have control of an override system that allows the supervisor to override an attempt by the person performing the stunt to release the lock when the supervisor considers this to be unsafe.

The lock may be releasable by a variety of different means. These include, for example, mechanical or electronic means. For example, the lock may be releasable by a key, an electronic or wireless signal, a code, etc.

It is not however necessary for the release mechanism to be complex. For example it may be a simple release mechanism such as a catch or button that can be operated without a key.

If desired the lock may be positioned at a location that is not accessible to a person when harnessed. For example it may be positioned at a location that is out of arm's reach of the person when secured by the harness. (If the person's arms are constrained by the harness then this position can of course be relatively close to the person.) In some embodiments the lock may be released by simply pressing a button, releasing a bolt, undoing a catch, or pressing a lever, for example.

In an alternative or additional embodiment the lock may release automatically at a predetermined stage (e.g. when the support moves from the second to the first position or when the plane lands). One or more sensors may detect this movement and may trigger release of the lock.

It is preferred that the combination of lock and harness is such so that a person cannot disengage himself / herself from the harness once the lock is operated. Thus for example the lock may co-operate with one or more straps to ensure that there is a tight fit and a person cannot slip out of the harness. This can be useful in preventing/deterring reckless and irresponsible behaviour. The harness and/or locking mechanism may be adjustable to take into account different sizes of people.

Turning now to the at least part of the support that is movably mounted, this can work in a wide variety of ways, as long as it performs its function of allowing movement of a person harnessed to the support from the first to the second position or *vice versa.*

It may be slidably mounted and may therefore slide from the first position to the second position.

It may be pivotally mounted. For example, a pivotally mounted arm, platform or turntable may be provided. Indeed the support may comprise or consist of a rigid component (or several such components) that is movably mounted but has sufficient rigidity to support a user in a desired position or orientation when the support is in use.

The support may be extendable. For example, it may be in the form of a telescopic arm or any other structure that moves from a relatively contacted to a relatively extended position. Preferably the telescopic arm can be maintained in substantially rigid form at least for a significant period, when extended. The period can for example be the duration of a stunt

In an alternative embodiment the support may even be in the form of a lift. This may be arranged to move the person above or below the fuselage.

A conveyor belt system may even be used. Preferably the belt can be moved in both a forward and a reverse direction.

Any suitable power source can be used to move the movable part. It may be operably connected to the aircraft and run off the power source of the aircraft. It may be provided with its own power source. Preferably, however, the at least part of the support that is moveably mounted is electronically and/or hydraulically operated.

Alternatively, in some circumstance no power source may be provided a manual operation may be performed. Thus for example a pivot, a winch, turntable or other movable part may be manually operated. If desired one or more gears, pulleys, cogs, ratchets, pinions, bearings, wheels, cranks, etc. may be used to aid this. Such a system may even be provided as a back up for a powered system in the event of a power failure.

The support may optionally include a seat upon which a person can sit to perform the stunt.

The support may also optionally include a seat upon which a person can sit when not performing the stunt. Part or all of the seat on which a person sits in the protected position may optionally form part of or be operably engagable with the support. Under one such option, the back of such seat might form part of that part of the support which is movably mounted while the seat part of the seat remains in place. Under another such option, the whole of the seat may form part of that part of the support which is movably mounted, with the seat part of the seat folding down to allow the SOWP to stand up in the deployed position.

Alternatively or additionally, it may include a structure upon which the person can stand to perform the stunt. This may, for example, be a platform, a step, a rung, etc.

In some embodiments the support may allow a person to pivot whilst performing the stunt.

This can be useful in performing the stunt. However it may simply be used to allow the person to obtain a better view that can enhance the enjoyment of the experience (e.g. if the person wishes to identify local landmarks)

For example the person may be able to pivot through at least one of the following angles about a given axis:
a) at least 45°
b) at least 90°
c) at least 180°
d) at least 270°
e) at least 360°

(For the purposes of the present invention, pivoting includes rotation.)
The axis can be any axis. It may therefore be a vertical and /or a horizontal axis, for example.

One or more pivot points may be provided for this purpose. These may for example be in the form of "knuckle" joints or "universal" joints. The harness many be attached thereto and the joint may include an attachment point.

Alternatively the harness may be mounted onto a pole or other rigid member in a manner that allows movement around the pole but prevents the harness being removed from the pole (e.g. one or more stops may be provided). A further alternative is to provide a turntable or pivoting arm, as discussed earlier.

If desired, the degree of pivoting may be limited for safety reasons. Thus a stop that prevents pivoting beyond a given point may be provided.

Whatever the nature of the support, it is preferred that it is fully located within the fuselage of the aircraft when it is in the first position. This improves streamlining and stability.

Desirably the at least part of the support that is movable is powered and is operably linked to a control that, when operated, causes it to move from the first position to the second position.

Another control may be provided for moving it from the second position to the first position.

Alternatively, the same control may operate both movements. For example, when it is operated with the support / movable part thereof in the first position it may cause it to move to the second position and when it is operated with the support / movable part in the second position it may cause it to move to the first position.

As for the releasable lock discussed earlier, the control is preferably operated by an operator who is not the person performing the stunt.

It is preferred that a control that moves the person from the first to the second position is not normally operable by said person. As indicated earlier, it is possible that a person performing the stunt may not always act in a safe manner. Also the supervisor may notice things that are not apparent to the person performing the stunt (e.g. an approaching aircraft where a near miss situation might arise, an unsafe harness, changing weather conditions, etc.)

The control may be a remote control and may operate wirelessly. This is however not essential. For example, the control may be located upon or connected to the support.

A further safety feature may be included. This is an automatic mechanism that causes the at least part of the support to move from the second to the first position in the event of a given signal.

Alternatively or additionally, an alarm may be triggered by the signal. An operator can then notice the alarm and take appropriate action, such as operating the support so that it moves the SWOP from the second to the first position

The signal may be a signal of possible or impending danger. For example it may signal an undesired change or rate of change in one or more of the following:
a) power level
b) altitude
d) temperature
e) pressure
f) mechanical stress or strain
g) vibration.

Alternatively it may indicate one or more of the following:
a) the aircraft descending below a given altitude
b) the aircraft pitching beyond a given degree
c the aircraft yawing beyond a given degree
d) the aircraft rolling beyond a given degree
e) the aircraft exceeding a given speed or acceleration
f) an impact to the aircraft.

A danger signal may be detected by one or more sensors. These may be located in or on the support or harness. Alternatively they may be located in or on the aircraft.

It is not however essential that a signal be designed to indicate danger. It may simply indicate that a given time period has expired. This is helpful if it has been agreed that the stunt should last for said time period. The time period may be adjustable by an operator. (For example a stunt may be desired to last for 1 minute for 5 minutes, for 10 minutes or for longer. Different fees may be set for different time periods.)

A still further safety feature is a means that allows the person performing the stunt to indicate when the person wishes the stunt to end. Thus a control may be provided that can be operated by the person to cause the at least part of the support to move from the second position to the first position. This can be useful if the person becomes anxious or unwell and wishes to abort the stunt. It is also useful in providing reassurance to a person contemplating performing a stunt prior to making a decision and paying for the stunt. This is because the fact that the person will have control over moving from an exposed to a protected position can provide increased confidence.

If desired, this control may override one or more other systems. For example it may override a timed control that would otherwise only return the support to the first position after a pre-set time interval. It may also override a control (if present) that is operated by a supervisor.

In an alternative embodiment the control may transmit a signal (e.g. an alarm) to an operator. The operator can then operate a system that causes the support to return to the first position. In these circumstances the operator may optionally check first to ensure that the alarm has been correctly operated. Thus, for example, if the person performing the stunt indicates that the alarm was operated unintentionally, the operator may choose to ignore it.

In a simple embodiment the control may even be a microphone that enables the person performing the stunt to contact the operator and request that the stunt be terminated or aborted.

Whatever the nature of the support, it is preferred that a part of it is secured (either directly or indirectly) to the aircraft. Preferably it is secured to a position within the fuselage, e.g. an inner floor, wall or roof of the fuselage.

For example it may be screwed, bolted, riveted, hooked welded, clamped or tied in place. Desirably this is done at one or more strong points fixed to appropriate load bearing parts of the aircraft structure.

The support or at least a part thereof preferably has a high degree of structural strength. More preferably it can stably support an adult weighing at least 12 stone (e.g. at least 14 stone, at least 6 stone, at least 18 stone, or in some cases at least 20 stone) in a given position where the person is fully or partially outside the aircraft.

If it is desired to remove the safety support from the aircraft at some stage (e.g. for servicing or so that the aircraft can be used for another purpose) the support may be removably mounted to the aircraft. In these circumstances, relatively permanent fixing means such as welding or riveting are not preferred.

Turning now to the first and second positions, it is preferred that these position are at least 1 metre apart. They may even be least 1.5, at least 2 metres apart, at least 2.5 or at least 3 metres apart.

The first and second positions may lie along a common generally horizontal axis. They may lie along a generally vertical axis. They may lie along an axis that is at an angle to the horizontal or vertical.

As indicated earlier, it is preferred that the first position is within the fuselage of the aircraft The second position is where the stunt is intended to be performed. The stunt may, for example, be performed upon a wing, upon the exterior of the fuselage, or away from the wing or fuselage. Releasable stops or other releasable engaging means may be provided that act when the movable part is at the first and/or or second positions. These can be useful in preventing accidental movement and can improve stability.

Preferably such engaging means can be overridden (e.g. by a control or release, which is desirably operated by the operator).

In some cases one or more guides may be provided to facilitate movement in a given direction. This may for example be in the form of one or more rails, tracks, slots, etc. Castors, wheels, bearings, or other movable members may also be provided to assist in movement. For example a platform may be supported by wheels that move along tracks.

Undesired or excessive movement may be constrained in various ways. For example automatic brakes may be provided. One or more retaining members may also be provided to prevent movement away from a desired direction. (For example, a slidable sleeve may act so as to constrain movement along a rail; a wheel may be constrained to move along a track by side walls, ratchet and pinion mechanism may be used to provide a controlled motion in a given direction, etc.)

The present invention includes not only the support as described, but also an aircraft with the support fitted thereto.

The support may be positioned within the aircraft so that in use it allows a person to be moved through an existing closure or aperture of the aircraft.

Indeed a closure (e.g. a door) may be synchronised to open/close accordingly with the operation of the support. Thus the support can be fixed to the aircraft in a manner so that as the movable part moves towards the door of an aircraft the door opens automatically to allow it the movable part to move through the door towards the second position. After it moves back through the open door towards the first position the door may then close automatically behind it. Sensors can be used to control automatic opening/closing. Alternatively a timing mechanism may be used.

Alternatively, a door may be a standard one and may simply be opened or closed by an operator at the desired stage.

If an existing aircraft does not already have an aperture or closure at a desired position then the aircraft may be modified accordingly by an aircraft engineer. An aperture or closure can be provided for example in the wall, roof or floor of the fuselage, for example.

In some cases the support itself may even provide the closure. For example the support may include a door. This may for example be located at an end of a movable part of the support. When this part of the support moves towards the second position this moves the door with it so that the door opens. It may then be located at some distance from the fuselage (e.g. in the case of an extending arm). When it moves back to the first position this closes the door.

A further example is a lift may move up through an aperture in the roof of the fuselage. When the lift is in a first position within the fuselage (prior to operation) a roof of the lift may form the closure. When the lift moves upwards the aperture can be considered to be open because the lift has moved through it and the person in the lift is exposed. When the lift is fully deployed upwards, the floor of the lift may also form a second closure. A corresponding situation applies if a lift is arranged to move downwardly. The base of the lift can then provide a closure when the lift is in the first position. The aperture is considered to be open in the second position when the lift has moved downwardly through the fuselage and the person is exposed.

A closure (of whatever nature) may be provided with an airtight seal.

However this is not essential, especially if the aircraft is not pressurised. Indeed a partial closure may be sufficient for many purposes.

Indeed in some cases a closure may not be provided and the support may simply move in and out through an open area. For example, an aircraft may have an open cockpit. Alternatively it may have an aperture in the fuselage that is not fitted with a closure, as is sometimes used for skydiving, for example.

In addition to the foregoing aspects of the invention, the invention also includes various kits. For example it includes a kit comprising a support of the present invention and a harness for attachment thereto. It may also include securing means for attaching the harness to the support (e.g. straps, catches, hooks, eyes, bolts, clamps, etc.). The kit can also include a parachute, if desired.

The invention also includes a kit comprising the support (either with or without the harness) and means for securing the support to an aircraft.

The kits, of whatever nature, preferably include instructions for use. They and may be provided in a sealed container (e.g. to prevent tampering, loss of parts etc.)

The present invention also includes various methods.

It includes a method of performing a stunt wherein a person performing said stunt is secured by means of a support of the present invention. The method is industrially applicable because it allows stunts to be performed either by members of the public or by professionals (e.g. display teams) with increased safety.

It is important to appreciate that the present invention is not limited in its application to a stunt performed by a single person. It is possible for several people to perform stunts at the same time.

For example, a support may be arranged to carry a plurality of people who can be moved in and out of the fuselage at the same time (e.g. on a common platform). A plurality of harnesses may be provided for this purpose.

It is of course not essential that a plurality of people perform stunts at the same time. They may take it in turns. Thus a first person may be secured to the support, may perform a stunt at the exposed position and may then return to the protected position. The first person can then be released from the support so that it is available for the second person to perform a stunt, etc.

The succession of people performing stunts may use a single harness. Alternatively each may have his/her own harness that can be releasably attached to the support.

A further alternative is to provide an aircraft with a plurality of supports of the present invention. These may be arranged so that they can be operated at the same time, if desired.

For example, two movable platforms may be provided and may move outwards on opposite sides of the aircraft at the same, each carrying a person who is secured thereto by a harness. This is useful in allowing an even distribution of weight.

If the aircraft is large it may be able to support large numbers of people performing stunts at the same time. The stunts can be the same or different.

If several supports are provided, it is of course not necessary that they all be deployed at the same time. They may simply serve to increase efficiency because one person can be harnessed onto one support whilst another person is performing a stunt on another support.
It will therefore be appreciated that the present invention has large numbers of applications and variants.

Indeed it is not even necessary for a support of the present invention to be used for performing stunts. It may be used as a means for moving a person from the first to the second position (and *vice versa*) for any purpose.

The purpose may include aircraft maintenance, checking the aircraft whilst it is flight, monitoring the weather or climate, photography etc.

The supports may even be used to move people away from the main body of the aircraft so that they can sky dive with a reduced risk of accidentally hitting a part of the fuselage, wing, wheel, tail, etc, whilst jumping. In these circumstances the person will of course not normally need to be returned to the aircraft and will not necessarily be harnessed to the support. (If they are temporarily harnessed they will normally be able to release the harness so as to sky dive.)

Having described various aspects of the invention in general terms, the invention will now be described by way of example only with reference to the accompanying drawings, wherein:

Figure 1 illustrates one embodiment of the present invention, whereby a SWOP can be moved via a lift mechanism from a protected to an exposed position.

Figure 2 illustrates a zone of an aircraft within which a SWOP when not performing a stunt can be protected by the airframe of the aircraft against direct impact with the ground, should the aircraft accidentally contact the ground in an inverted position.

Figures 3 and 4 illustrate the operation of a scissor type lift that can be used to move a SWOP in a vertical plane.

Figure 5 is a cross-sectional view from above of a floating sleeve on a vertical member that can be used in a further embodiment of the present invention

Figures 6 and 7 show a SWOP using a support of the present invention in its deployed position in stunts in which the SWOP pivots through up to 180° about a horizontal axis.

Figure 8 illustrates an embodiment of the present invention in which a platform is mounted at the end of a swinging arm.

Figure 9 shows a cross-sectional view from above of a preferred mounting structure for a swinging arm.

Figure 10 and 11 illustrate an embodiment of the present invention in which a movable structure can be deployed in a plane parallel to the floor of the aircraft

Figure 12 illustrates an embodiment of the present invention that is manually operated; whereby crew members can push the movable structure out of the aircraft along rails to a deployed position and can then subsequently pull the movable structure back in again to a protected position.

Figure 13 illustrates an embodiment of the invention whereby a SWOP can walk along stairs or steps to an exposed position whilst being secured to a harness that is movably mounted to guide rails.

Figure 14 illustrates an embodiment of the invention in which the movable structure is deployed in a vertical plane using power from electric motors to turn a cylindrical reel, around which a cable is wound.

Figures 15 and 16 illustrate an embodiment of the invention in which a movable structure is rotated in a horizontal plane about a vertical axis using power from an electric motor.

Components shown in the Figures

For ease of reference the components shown in the figures and described in the following examples are listed below:

Figure 1

1 'Protected Position'
2 'Deployed Position'

Figure 2

6 'Protected Zone'
7 Rudder post: a vertical structural member on which the rudder is mounted
8 Rudder

Figure 3

20 Movable Structure
21 Harness
22 Buckle
23 Backplate
24 Vertical member
25 Joint
26 Floor platform
27 Braces
28 Additional joint
36 Scissor lift
40 Base plate
41 Load bearing members
46 Vertical members
47 Guide channels

Figure 4

As for Figure 3 plus:

35 Hydraulic cylinder
38 Scissor arm pivot bearing
39 Scissor arm rolling bearing
42 Scissor arm pivot bearing
43 Scissor arm rolling bearing
44 Heavy duty mounting point
45 Heavy duty mounting point

Figure 5
11 Sleeve
12 Protruding tongue
13 Oversize groove
24 Vertical member

Figure 6
SOWP Position rotated to right

Figure 7
SOWP Position rotated to left

Figure 8
20 Movable Structure
26 Floor platform
51 Hydraulic cylinder
52 Swinging arm
53 Vertical fillet
54 Bush and pin
55 Bush and pin
56 Stabilisation rod
57 Mounting structure
58 Bush and pin
59 Bush and pin
60 Bush and pin

Figure 9
65 Mounting structure
66 Mounting structure
67 Bracing arm
68 Bracing arm
69 Bush and pin

Figure 10
80 Hydraulic cylinder
81 Rails
82 Wheels
83 Mounting platform
84 Braces
85 Side wall of fuselage
86 Aperture
87 Mounting bracket

Figure 11
As for Figure 10

Figure 12
90 Extension arm
91 Handle

Figure 13
100 Guide rail
101 Steps
102 Horizontal member
103 Joint
104 Guide channel
120 Movable structure incorporating horizontal member

Figure 14
121 Cable reel
122 Cable
123 Rubber stop
124 Pulley wheel
130 Electric motor

Figure 15
140 Vertical axis
141 Vertical beam

Figure 16
As for Figure 15

Example 1

Example 1 describes an embodiment of the invention shown in figure 3 and figure 4, in which the movable structure 20 is deployed in a vertical plane using power from an engine driven hydraulic pump (not shown) to operate a hydraulic cylinder 35 which extends and retracts a scissor type lift 36.

Movable Structure

The movable structure 20 incorporates the following elements: a harness 21 including a lockable buckle 22 is mounted on a back plate 23 which is attached to a vertical member 24 by means of a joint 25. The vertical member is mounted on a horizontal floor platform 26 and is braced to that floor platform with three triangulation members 27.

The harness 21 is of conventional design and manufacture, of the six point type frequently used in safety harnesses fitted to aerobatic aircraft and racing cars. It is preferable however to fit such a harness 21 with a non-standard buckle 22 which requires a key in order to release the harness 21. This key would not be passed to the SOWP but would be retained by a member of the crew while the SOWP was in the deployed position 2, shown in Figure 1. This would make it impossible for an SOWP to release themselves from the harness 21 in-flight either accidentally, or in the case of the truly deranged, on purpose.

For the same reason, it is also preferable that the adjustment buckles of the harness 21 be repositioned from the standard frontal positions, designed for easy adjustment by the wearer, to a position at the rear, where the wearer cannot reach them and as a further precaution, fitted with a security lock.

The back plate 23 on which the harness 21 is directly mounted is of aluminium tubular construction with external padding and is shaped to the approximate contour of the rear of the human torso, curving forwards in its lower section to provide support for the SOWP as he or she leans back and sits slightly into it.

Alternatively a backplate 23 could also be constructed from moulded composite materials such as e - glass, carbon fibre and epoxy resin.

A joint 25 is rigidly fixed to the rear side of the tubular backplate 23 in a position that would align approximately with the central lower back of a person strapped into the harness 21. The other side of the joint is attached to the vertical member 20.

In the case of a composite backplate, the forward end of the joint 25 could be moulded directly into the backplate 23, taking care to insulate any carbon fibre used from the metal of the joint 25.

It is preferable that the height of the backplate 23 above the floor platform 26 can be adjusted. This makes it possible for SOWP's of different heights and shapes to stand comfortably on the floor platform 26 while securely fastened into the harness 21 and the backplate 23.

Such an adjustment mechanism can be embodied in a number of different ways.

In one embodiment, the vertical member 24 is fabricated from a single cylindrical tube of constant diameter. The joint 25 is not fixed directly to the vertical member 24 but is instead fixed to a cylindrical sleeve (not shown) which fits over the vertical member with sufficient clearance that the sleeve may slide up and down the length of the vertical member 24. Both the sleeve and the vertical member 24 are drilled with holes of constant size aligned with the diameter in both cases in such a manner that when the holes of the sleeve are aligned with the holes in the vertical member 24, the joint 25 is positioned in line with the fore aft centre line of the fuselage. A pin or bolt is inserted through the aligned holes in order to fix the sleeve in the desired position on the vertical member 24.

It may be desirable to leave the sleeve floating with a top and bottom stop fixed onto the vertical member 24 to set the outer limits of travel for the sleeve on the vertical member 24. A floating sleeve would also be able to incorporate a rotational movement about the axis of the vertical member 24, doing away with the necessity for a second joint 28 as discussed below. Figure 5 shows a cross-sectional view from above of a floating sleeve 11 on a vertical member 24 where the range of rotational movement available to the sleeve is restricted by the addition of a protruding tongue 12 to the surface of the vertical member 24 and the machining of an oversize groove 13 into the inner face of the sleeve 11. In the embodiment shown in figure 5, the size of the groove 13 limits rotation of the sleeve 11 about the member 24 to approximately 90 degrees, for safety reasons.

In another embodiment (not shown), the vertical member 24 is fabricated from two heavy gauge aluminium cylindrical tubes one of which fits inside the other with sufficient clearance that the smaller tube can slide in and out of the larger tube. The smaller tube, which is arranged as the lower of the two sections, contains a hydraulic cylinder, which is fixed rigidly within the tube.

The top end of the piston of this hydraulic cylinder is fixed rigidly inside the larger tube which is arranged as the upper of the two sections, in such a manner that the two sections of the vertical member overlap throughout the full range of travel possible for the piston of this cylinder. When the piston is fully withdrawn into the cylinder, the height of the harness 21 and backplate 23 above the floor platform 26 is at its lowest. As the piston is extended from the cylinder, the height of the harness 21 and backplate 23 above the floor platform 26 increases thus accommodating a taller SOWP.

In another version of this second mechanism the height can be adjusted manually. The two sections of the vertical member 24 are arranged as above, but no hydraulic cylinder is incorporated. Each of the sections has a series of holes of constant size drilled through them in line with the diameter of the section. These are arranged in such a way that when the sections are overlapped and the holes are aligned, the joint 15 will lie on the fore - aft centre line of the fuselage. A pin or bolt may then be inserted through the holes to fix the height at the desired level.

In a further embodiment of an adjustment mechanism the joint 25 incorporates a flange (not shown) which fits over a rail (not shown) running up and down the vertical member 24. The position of the joint 25 on this rail is adjustable. This can be achieved most simply by the incorporation of a series of threaded holes running horizontally from side to side through both the flange and the vertical rail together with a threaded pin or bolt that can be screwed through both the mounting flange of the joint and the vertical rail. The height of the harness 21 and backplate 23 above the floor platform 26 will be varied depending on which hole in the rail is selected.

In a preferable version of this embodiment, one side of the vertical rail would incorporate a continuous row of metal teeth and the mounting flange of the joint 23 would incorporate a handle that turned a metal cog, which was meshed into the row of metal teeth on the vertical rail. The height of the backplate 23 above the floor platform 26 would thus be capable of quick and accurate adjustment by turning the handle.

The joint 25 can be rigid in the form of a short tube attached to the tubular backplate 23 at one end and to the vertical member 24 by one of the means described above at its other end.

In a preferred embodiment of the joint 25, it incorporates a shaft and bearing that allows the backplate 23 to rotate around the horizontal axis formed by the shaft thus allowing the SOWP to move between the position shown in figure 6 and the position shown in figure 7 while they are deployed in flight. For display purposes this joint would normally allow the SOWP to rotate their body through 360°. However in installations designed to carry paying SOWP's it is preferable to restrict the available rotation to 180° or less for safety reasons as shown in figure 6 and Figure 7.

The vertical member 24 is constructed from heavy gauge aluminium tube approximately 10 cm in diameter. The bottom of the member is welded to the floor platform 26. This construction is further strengthened by the addition of three aluminium tubular braces 27 triangulating the gap between the tube and the floor 26. The other details of its construction vary depending on which of the above methods is chosen to achieve an adjustment in the backplate height.

It is also possible though not necessary, to incorporate a second joint 28 in the vertical member 24 itself. This would allow the top part of the vertical member to rotate about a vertical axis while the bottom part of the vertical member and the floor platform remained fixed. As with the joint 25, for display purposes this joint could allow the SOWP to rotate their body through 360°. But in installations designed to carry paying SOWP's it is preferable to restrict the available rotation to 180° or less for safety reasons.

The position of the second joint 28 on the length of the vertical member 20 must be at a point between the top of the braces 27 and the joint 25 at the lowest position on the height adjustment range available to joint 25. Further constraints on the position of the second joint 28 may also be present, depending upon the exact design of any backplate height adjustment mechanism incorporated.

The rectangular shaped floor 26 is fabricated from aluminium plate, which may be drilled in order to save weight.

Scissor Lift Deployment

The floor is constructed in the standard form for a platform intended to be lifted using a scissor type mechanism and therefore incorporates a channel running along each of two opposing sides.

Moving to Figure 4: the platform 26 is mounted on top of two linked pairs of double scissor arms 36. Figure 4, being a side view shows only one of the linked pairs of scissor arms. The two arms 39 at one end of the platform 26 are fixed to the platform 26 using a pin running through a bush. The two arms at the other end of the platform are fitted with rotating wheels , or alternatively sliding blocks, that are enclosed within the channels running down each side of the platform 26.

The bottom of the scissor arms 36 are mounted on a base plate 40 which is rigidly fixed to load-bearing members 41 in the floor of the fuselage. The scissor arm mountings 42 at one end of the base plate 40 are made using a pin and bush or pin and bearing system which allows the arms 36 to rotate in a vertical plane relative to the base plate 40. The scissor arm mountings 43 at the other end of the base plate 40 are fitted with rotating wheels or sliding blocks (not shown) that are enclosed within the channels running down each side of the base plate 40. A heavy duty mounting point 44 is rigidly fixed to the base plate 40 and one end of a hydraulic cylinder unit 35 is attached to this mounting point 44 with a pin and bush that allows the cylinder 35 to rotate relative to the base plate 40 in a parallel plane to the scissor arms 36. The other end of the hydraulic cylinder 35, being the outside end of the piston, is mounted using a pin and bush into a heavy duty mounting point 45 incorporated rigidly into the second layer of scissor arms 36 up from the platform 40.

When the piston is withdrawn within the hydraulic cylinder 35 the scissor arms 36 will be collapsed and the platform forming the base of the movable structure will be at its lowest level, as shown in Figure 3. As the piston is pushed out of the cylinder 35 using hydraulic pressure the scissor arms 36 will open and extend and the movable structure 20 will be deployed vertically upwards from the protected position into the deployed position. As the piston is withdrawn back into the cylinder 35 the scissor arms 36 will close and contract and the movable structure 20 will be moved vertically downwards from the deployed position shown in Figure 4 back into the protected position shown in Figure 3.

A hydraulic lock is incorporated into the hydraulic system to guard against the risk of the movable structure 20 being suddenly withdrawn by accident or hydraulic failure.

It is preferable that at least two vertical members 46 incorporating guides 47 should be fixed to load-bearing members 41 in the fuselage structure, on opposite sides of the movable structure 20, in order to prevent lateral movement of the movable structure 20 while it is being deployed or withdrawn in a vertical direction.

It is preferable that a means of mechanically locking the platform 26 in position once it is in the deployed position should be fitted either onto the platform 26 or on to a load-bearing part of the fuselage adjacent to the platform 26. The advantage of a mechanical lock over the hydraulic lock already fitted to the system is that it prevents vibration and movement of the platform 26 relative to the fuselage of the aircraft and guards against accidental retraction.

It is preferable that some kind of seal be fitted to the edge of the aperture in the fuselage (other than in an open cockpit aircraft) through which the movable structure 20 is moved during deployment and that the size of the platform is such that the platform locates on the seal and prevent excessive draught entering the fuselage of the aircraft when the movable structure 20 and the SOWP are deployed during flight.

It is preferable that a hatch is fitted to close and seal the aperture at times when the movable structure 20 is not deployed.

Example 2

Example 2 describes an embodiment of the invention shown in Figure 8, in which the movable structure 20 is deployed in a vertical plane using power from an engine driven hydraulic pump (not shown) to operate a hydraulic cylinder 51 which lifts and controls a swinging arm 52 on the end of which the movable structure 20 is mounted.

The movable structure 20 incorporates the following elements shown in Figure 3: a harness 21 including a lockable buckle 22 is mounted on a back plate 23 which is attached to a vertical member 24 by means of a joint 25. The vertical member is mounted on a horizontal floor platform 26 and is braced to that floor platform with three triangulation members 27.

The movable structure 20 is embodied in one of the numerous forms described at length in example 1.

The platform 26 is mounted on the top end of a heavy duty swinging arm 52 as shown in Figure 8.

A strong vertical fillet 53 is rigidly fixed to the centre line of the floor platform 26. Further bracing is fixed between the fillet and the floor to each side of the fillet.

At the lower forward corner the fillet 53 is fixed to the end of the swinging arm by means of a bush and pin 54.

At the upper forward corner the fillet 53 is fixed to the end of the parallel link stabilisation rod 56 by means of a bush and pin 55.

These two bushes 54 & 55 are aligned so as to enable the swinging arm and the stabilisation rod to rotate relative to the floor platform 26 in the same plane.

The bottom end of the swinging arm 52 incorporates a heavy duty mounting structure 57 a hydraulic cylinder 51and a mounting flange on the arm.

The mounting structure 57 is rigidly fixed to one or more structural members in the floor of the fuselage. A hydraulic cylinder 51 is fixed to the base of the mounting structure 57 using a pin and bush 58. The other end of the hydraulic cylinder, being the end of the piston, is fixed by means of a pin and bush to the bottom of a mounting flange which is rigidly fixed to the bottom of the swinging arm 52.

The end of the swinging arm 52 is fixed to the mounting structure 57 above the hydraulic cylinder by means of another bush and pin 59. The bottom end of the stabilisation rod 56 is fixed to the mounting structure 57 above the swinging arm 52 by means of a further bush and pin 60.

The 3 bushes in the mounting structure 58, 59 & 60 are aligned so that the stabilisation rod 56, the swinging arm 56 and the hydraulic cylinder 51 can all rotate relative to the mounting structure 57 in the same plane.

When the piston is fully withdrawn into the hydraulic cylinder 51, the platform 26 will be at its lowest position. As the piston is driven forward out of the cylinder 51 by hydraulic pressure it will drive the swinging arm 52 upwards in a vertical plane lifting the movable structure 20 upwards in an arc. At the same time the stabilisation rod 56 will apply a force to the floor platform 26 which maintains the platform 26 in a plane parallel to the floor of the aircraft at all times as the swinging arm 52 moves through its arc.

As the piston is withdrawn back into the hydraulic cylinder 51 it will pull the swinging arm 52 downwards in a vertical plane lowering the movable structure 20 downwards in an arc. The stabilisation rod 56 will once more control the floor platform 26 in a manner which maintains the platform 26 in a plane parallel to the floor of the aircraft at all times as the swinging arm 52 moves through its arc.

Sensors are fitted at either end of the range of travel of the movable structure 20 that automatically stop the swinging arm 52 at each of these points.

The operation of the hydraulics is by means of a standard electronic control which operates bidirectional hydraulic valves.

A hydraulic lock is incorporated into the hydraulic system to guard against the risk of the movable structure 20 being suddenly withdrawn by accident or hydraulic failure.

It is preferable that a means of mechanically locking the platform 26 in position once it is fully deployed should be fitted either onto the platform 26 or on to a load-bearing part of the fuselage adjacent to the platform 26. The advantage of a mechanical lock over the hydraulic lock already fitted to the system is that it prevents vibration and movement of the platform 26 relative to the fuselage of the aircraft and guards against accidental retraction.

It is preferable that some kind of seal be fitted to the edge of the aperture in the fuselage (other than in an open cockpit aircraft) through which the movable structure 20 is moved during deployment and that the size of the platform 26 is such a platform 26 locates on the seal and prevents excessive draught entering the fuselage of the aircraft when the movable structure 20 and the SOWP are deployed during flight.

Figure 9 shows a cross-sectional view from above of the mounting structure in a preferable version of this embodiment. Three heavy duty mounting structures 57, 65 & 66, are fixed side-by-side to load-bearing members in the fuselage structure. The hydraulic cylinder, swinging arm and stabilisation rod are all mounted to the middle of these three mounting structures 57 in an identical fashion to the basic version of this example shown in Figure 8. Further bracing arms 67 & 68 are fixed to each of the outer mounting structures 65 & 66 using bushes and pins 69 & 70. The three bushes of the swinging arm 52 and the two bracing arms 67 & 68 are exactly aligned with one another. The other end of each bracing arm 67 & 68 is rigidly fixed to the side of the swinging arm 52. The swinging arm 52 and the two bracing arms 67 & 68 now form a single swinging structure which moves up and down as the hydraulic cylinder is operated. However the addition of the bracing arms 67 & 68 will significantly reduce lateral movement of the swinging arm 52 and hence the movable structure 20 while it is being deployed or withdrawn in a vertical arc.

Example 3

Example 3 describes an embodiment of the invention shown in Figure 10 and Figure 11, in which the movable structure 20 is deployed in a plane parallel to the floor of the aircraft using power from an engine driven hydraulic pump (not shown) to operate a hydraulic cylinder 80 connected to the bottom of the movable structure 20which is mounted on two parallel rails 81mounted in a plane parallel to the floor of the aircraft.

The movable structure 20 incorporates the following elements: a harness 21 including a lockable buckle 22 is mounted on a back plate 23 which is attached to a vertical member 24 by means of a joint 25. The vertical member is mounted on a horizontal floor platform 26 and is braced to that floor platform with three triangulation members 27.

The movable structure 20 is embodied in one of the numerous forms described at length in example 1.

Three or more wheels 82 are mounted underneath the floor 26 of the movable structure 20. These are positioned to run on two parallel rails 81 mounted on a platform 83 in a plane parallel to the floor of the aircraft and supported by braces 84 to load-bearing members in the bottom of the fuselage. The direction of the rails is preferably set at 90° to the centre line of the fuselage.

The wheels 82 are of a design which cannot be removed from the rails 81 making it impossible to lift the movable structure 20 off the rails 81.

The platform and the rails are extended through the side wall 85 of the fuselage and are supported externally by triangulated bracing 84 running from the outer edge of the platform 83 to load-bearing members in the bottom of the fuselage.

An aperture 86 in the side wall of the fuselage is provided through which a SOWP can pass while secured in the harness 21 incorporated into the movable structure 20. It is preferable that a door should be provided enabling the crew to close the aperture once the SOWP is deployed.

The base of the hydraulic cylinder 80 is attached to a mounting bracket 87 using a bush and pin. The mounting bracket 87 is rigidly fixed to a load-bearing member in the floor of the fuselage in a position that causes the hydraulic piston when extended to lie between the rails 81 and parallel to them. The end of the hydraulic piston is attached to a mounting point on the floor platform 26 of the movable structure 20 using a pin and bush.

When the hydraulic piston is fully withdrawn inside the cylinder 80 the movable structure is positioned inside the fuselage in the protected position as shown in Figure 10. As the piston deploys from the cylinder 80 driven by hydraulic pressure it pushes the movable structure 20 along the rails 81 to the deployed position outside the side wall of the fuselage as shown in Figure 11. As the piston is withdrawn back into the cylinder 80 it draws the movable structure 20 back along the rails 81 to its position inside the side wall of the fuselage, as shown in Figure 10.

The hydraulic cylinder can be operated using a standard electronic control connected to bidirectional hydraulic valves.

This example could also be powered from numerous other sources including an electric motor and gearbox or direct human propulsion.

Figure 12 shows an embodiment of direct human propulsion where an extension arm 90 and handle 91 are fitted to a pickup point mounted on the inside edge of the floor platform 26. A member or members of the crew could then push the movable structure 20 out of the aircraft along the rails 81, to the deployed position shown in Figure 12 and subsequently pull the movable structure 20 back in again to the protected position. A mechanical lock would be required to fix the movable structure 20 firmly in place once it was deployed outside the aircraft.

Example 4

Figure 13 describes an embodiment of the invention in which the movable structure 120 is mounted on one or more guide rails that determine the trajectory along which the movable structure 120 can pass, as well at the end points of that trajectory. In this example, no mechanical electrical or hydraulic source of power is utilised to deploy the movable structure 120. Instead, the SOWP walks out of the protected zone of the aircraft using stairs or steps 101 while safely harnessed into the movable structure 120.

The movable structure 120 incorporates the following elements: a harness 21 including a lockable buckle 22 is mounted on a back plate 23 which is attached to a horizontal member 102 by means of a joint 103. A means (not shown) is provided by which the height of the backplate 23 relative to the horizontal member 102 can be varied. One or more wheels or rollers (not shown) are fixed at each end of the horizontal member 102.

The horizontal member 102 is mounted between two guide rails 100 which each incorporate a guide channel 104. The wheels or rollers at the ends of the horizontal member 102 are located inside the guide channels. The clearance between the wheels or rollers and the guide channel 104 is such that the movable structure 120 can run up and down the length of the guide rails 100 between the end stops, freely and with minimum friction or drag. The wheels or rollers cannot be withdrawn from the guide channels 104, thus securing the movable structure 120 between the guide rails 100.

The guide rails 100 run from a position inside the aircraft, at which the SOWP can be harnessed into the movable structure 120 that is mounted on the guide rails 100, to a point outside the aircraft positioned above a stationary platform (not shown) fixed to load bearing members in the fuselage. The rails 100 are positioned so that when the movable structure 120 has reached the end point of its travel along the rails 100, a SOWP harnessed into the movable structure 120 may stand comfortably on the platform, outside of the aircraft in the deployed position.

Steps or stairs 101 are incorporated into the aircraft, allowing a SOWP who is harnessed into the movable structure 120 to climb out of the aircraft. The position and path of the steps 101 relative to the guide rails 100 is set so that a SOWP may move freely from the protected position to the deployed position, while continuously harnessed into the movable structure 120, with minimum hindrance.

It is highly preferable that a mechanical lock is fitted to the guide rails 100, that fixes the position of the movable structure 120 once deployed. It is further highly preferable that a brake is fitted to the movable structure 120 to retard the descent of the SOWP in the event that the SOWP fell off the steps 101 while either climbing them or descending them. This brake could be either operated by the crew or preferably operated automatically on an inertia reel principle.

Example 5

Example 5 describes an embodiment of the invention shown in Figure 14, in which the movable structure 20 is deployed in a vertical plane using power from electric motors 130 to turn a cylindrical reel 121 around which a cable 122 is wound.

The movable structure 20 incorporates the following elements: a harness 21 including a lockable buckle 22 is mounted on a back plate 23 which is attached to a vertical member 24 by means of a joint 25. The vertical member is mounted on a horizontal floor platform 26 and is braced to that floor platform with three triangulation members 27.

The movable structure 20 is embodied in one of the numerous forms described at length in Example 1.

In its fully down position the floor platform 26 rests on four rubber stops 123 fixed to the aircraft floor members, which take its weight and absorb any impact when the floor 26 is returned to the down position.

At each corner of the floor platform a protruding component (not shown) is attached which locates the corner of the platform 26 into the channel 47 within the vertical member 46. One or more rollers may be incorporated into this protruding component in order to smooth the passage of the protruding component up and down the channel 47.

The four vertical members 46 are fabricated from aluminium section and are rigidly fixed to load-bearing members in the fuselage structure at the top and bottom of each of the vertical members 46.

In this embodiment a pulley wheel 124 is mounted at the top end of each of the vertical members 46.

A cable 122 is attached to each corner of the platform 26 and runs around the pulley wheel 124 back down to a cable drum 121. The positions of the cable attachment, the pulley wheel 124 and the cable drum 121 are aligned in order to achieve a smooth run of the cable 122 around the pulley wheel 124 and on to the drum 121 when the drum 121 is turned.

A proprietary cable handling device (not shown) is fitted to each drum 121 to lay the cable 122 neatly on the drum 121 as it is recovered.

The drums 121 are driven by an electric motor 130. It is possible though not preferable for each drum 121 to be driven independently by its own motor, the motors sharing a common control. However this may lead to the motors recovering cable at different speeds in the different corners as a consequence of slight variation between the motors performance. In an extreme case, this would cause the platform 26 to jam in position before the movable structure 20 was fully deployed.

It is therefore highly preferable that the cable drums 121 should be linked together by means of common gearbox or chain drive linkage which allows all four drums to be driven by a single motor.

This motor is controlled using a standard bidirectional electronic control. When the control is operated in the up direction the motor drives the drums 121 in a clockwise direction causing them to recover the cable 122 thereby lifting the movable structure 20 vertically upwards from the protected position to the deployed position. When the control is operated in the down direction the motor drives the drums 121 in an anticlockwise direction causing them to pay out the cable 122 thereby allowing movable structure 20 to move vertically downwards under gravity from the deployed position back to the protected position. Sensors are fitted at either end of the range of travel of the movable structure 20 that automatically stop the motor at this point and prevent it from continuing to run.

Example 6

Example 6 describes an embodiment of the invention shown in Figure 15 and Figure 16, in which the movable structure 20 is rotated in a horizontal plane about a vertical axis 140 using power from an electric motor transmitted through a mechanical gearbox to the bottom of the movable structure 20 which is mounted on two bearings mounted on load-bearing members in the sidewall of the fuselage of the aircraft.

The movable structure 20 incorporates the following elements: a harness 21 including a lockable buckle 22 is mounted on a back plate 23 which is attached to a vertical member 24 by means of a joint 25. The vertical member is mounted on a horizontal floor platform 26 and is braced to that floor platform with three triangulation members 27.

The movable structure 20 is embodied in one of the numerous forms described at length in Example 1.

In this case the floor platform 26 of the movable structure 20 is of a semicircular shape and is mounted on a vertical beam 141 which supports it. The top and bottom ends of this vertical beam are mounted in bearings on load-bearing members in the sidewall of the aircraft fuselage. These bearings allow the beam 141 and the movable structure 20 mounted on it to rotate around an axis 140 running along the length of the beam 141, which lies at 90 degrees to the floor of the aircraft in line with the side wall of the fuselage.

A curved gear ring (not shown) is fixed to the bottom of the floor platform 26 so that the gear teeth point downwards. A drive cog mounted on the final driveshaft of the mechanical gearbox is meshed with this gear ring and as the electric motor is operated to drive the gearbox, the drive cog turns clockwise or anticlockwise and thus rotates the movable structure 20 about a vertical axis 140 in one direction or the other.

In the protected position shown in Figure 15, the SOWP is located inside the fuselage and is facing towards the tail. As the motor rotates the movable structure 20 into the deployed position the SOWP is relocated to a point outside of the fuselage facing forwards, as shown in Figure 16.

It is preferable to incorporate a sliding panel door to close the aperture through which the SOWP has passed after they have been deployed.

Glossary

Various terms used herein will now be described in greater detail for the avoidance of doubt

"Fuselage"

This is the main central body of an aircraft. It is generally hollow. It includes one or more areas where passengers or crew would normally be located during take off or landing. Thus it includes the cockpit (whether open or closed), the passenger area and any cargo area.

"Wing walking"

This term includes not only walking on an aircraft but any other stunt as defined below performed outside the aircraft.

"Stunt"

This term is used very broadly. It includes various manoeuvres that a person may perform in an exposed position on an aircraft, but also includes the person being stationary in such a position. At the exposed position it is preferred that at least part of the person is outside of the fuselage. For example at least the person's pelvis may be outside the fuselage. The term includes both leisure activities and professional activities done for entertainment at air shows, etc (e.g. by professional of stunt teams). It does not include instances of air rescue or of air transport of patients/medical services as may be undertaken by the emergency services. Thus for example a rescued/injured person who is outside/partially outside the fuselage and is strapped to a stretcher at a particular stage is of course not considered to be performing a stunt. In any event the "stunt" does not include dangling below the aircraft (e.g. on a wire, cable, rope, bungee, etc.).

Indeed it is preferred that the stunt is performed at a substantially stable position in relation to the aircraft and the support is sufficiently rigid when in use to allow the person performing the stunt to be positioned accordingly.

Absolute rigidity of the support in this position is not essential. Thus, for example, a support when in a position at which a stunt is to be performed may move or flex slightly (e.g. due to wind conditions and/or as the aircraft manoeuvres), but this will still be considered to be a stable position as long as the stunt can be performed safely and without undue disturbance.

Thus, it is preferred that the support can be held in a position in which the stunt is to be preformed without moving wildly relative to the aircraft (at least for the duration of the stunt). Preferably it moves less than one metre in any given direction when in said stable position. More preferably it moves less than 50 cm or less than 25 cm, when in said position. Thus, although some movement can be permitted (e.g. due to wind conditions, aircraft manoeuvres, aircraft speed, materials, etc.,) the support still provides a safe platform for allowing stunts to be performed.

This is therefore very different from prior art methods where a person may be dangled below the aircraft and be free to swing wildly in relation to the aircraft, especially under high wind conditions. The present invention can therefore allow stunts to be performed in a safe manner without the support swinging, swaying or otherwise moving excessively. The present invention can therefore help to increase the confidence of a person performing or seeking to perform a stunt.

Thus the support can be deployed and maintained at a substantially fixed position in relation to the fuselage for a sufficient period for the stunt to be performed. Of course, whilst the support provides a stable platform, it may still allow a degree of freedom, if desired, for a person performing the stunt (depending on the nature of the stunt). For example, it may allow a degree of freedom in wing-walking, performing acrobatics, waving, moving limbs, etc.

In many cases an aircraft will be limited in the manoeuvres it can make, passengers it can carry etc., especially by safety considerations. These can include aviation authority regulations or recommendations, manufacturer's regulations and recommendations etc. These may vary from country to country or from aircraft to aircraft. The present invention allows stunts to be performed in a many different countries, with a variety of aircraft whilst still adhering to appropriate safety considerations. Indeed it allows stunts to be performed much more safety than with many prior art systems.

"SOWP"

This term is an acronym for "Stand on Wing Passenger" and is here defined as a person who intends to perform a stunt, who has performed a stunt or is in the process of performing a stunt.

"Safety harness"

This includes a harness, a belt, a line, a fastener, or any other means that can be used to connect a person to a safety support.

"Aircraft"

This includes any flying means of transport. Thus for example airplanes, jets, helicopters, gliders, microlites, hang gliders, balloons, airships, etc., are all included. Fixed wing aircraft are preferred.

"Horizontal" and "Vertical"

The natural horizon can of course vary in relation to an aircraft during flight, e.g. as an aircraft turns, ascends or descends. The term horizontal is used herein indicate a plane that lies parallel to the floor of the part of the aircraft where a passenger is seated or stands (sometimes known as the flight deck). "Generally horizontal indicates a tolerance of within 25°, more preferably within 10° or most preferably within 5° of such a plane.

The term "vertical" used to indicate a plane that is perpendicular to said horizontal plane. "Generally vertical" indicates a plane that is within 25°, more preferably within 10°, or most preferably within 5° of the vertical.

"Air Operator"

A company or person that is engaged in the business of operating aircraft flights for commercial reward.

In most countries, such a person would require a specific licence to carry out such activity, termed an 'air operator's certificate'.

"Public Transport Wingwalking Flight"

This phrase is used to mean an aircraft sortie during which a stunt as defined above is performed and where the person performing the stunt pays (whether directly or indirectly) the air operator, aircraft owner or aircraft captain for being carried on the aircraft and/or the right to perform the stunt.

Claims

1. A safety support that comprises or is operably engagable with a safety harness for a person performing a stunt; wherein at least part of the support is movably mounted so that it can be moved from a first position where said person is located relatively safely for take off or landing, to a second, relatively exposed position, where said person can perform said stunt without being dangled below the aircraft.

2. A safety support according to claim 1; wherein when said at least part of the support is in the first position with the person harnessed to the support, the person is positioned so that if the aircraft flips inverted onto the ground during landing, takeoff or taxiing but remains intact, the person's head will not contact the ground.

3. A safety support according to claim 2; wherein, when said at least part of the support is in the first position with the person harnessed to the support, the person is located within the fuselage of the aircraft, or at least part of the person (including the pelvis) is within the fuselage.

4. A safety support according to any preceding claim; wherein when the support is in the second position the person is located outside the fuselage of the aircraft, or at least part of the person (including the pelvis) is located outside the fuselage of the aircraft.

5. A safety support according to any preceding claim; wherein the safety harness comprises a releasable lock (e.g. a lock that is not normally releasable by the person performing the stunt).

6. A safety support according to any preceding claim; wherein the harness and/or lock are adjustable to take into account different sizes and/or shapes of persons.

7. A safety support according to any preceding claim; wherein at least part of the support is slidably mounted.

8. A safety support according to any preceding claim; wherein at least part of the support is pivotally mounted.

9. A safety support according to any preceding claim that is sufficiently rigid when supporting a person in the second position so that said position is a substantially stable position in relation to the aircraft.

10. A safety support according to any preceding claim that is extendable (e.g. telescopically mounted).

11. A safety support according to any preceding claim that comprises a lift mechanism.

12. A safety support according to any preceding claim that comprises a hydraulic system.

13. A safety support according to any preceding claim that is electrically powered

14. A safety support according to any preceding claim that does not have a power source, but is operated manually.

15. A safety support according to any preceding claim that includes a seat or part of a seat upon which a person can sit before and/or after performing the stunt.

16. A safety support according to any preceding claim that incorporates a structure upon which

the person can stand to perform the stunt.

17. A safety support according to any preceding that allows a person performing the stunt to pivot about a given axis through at least one of the following angles:
a) at least 45°
b) at least 90°
c) at least 180°
d) at least 270°
e) at least 360 °

18. A safety support according to any preceding claim that is fixed to one or more fixing points within the fuselage of the aircraft

19. A safety support according to any preceding claim that is fully located within the fuselage of the aircraft when in the first position.

20. A safety support according to any preceding claim that is operably linked to a control that, when operated, causes the support to move from the second position to the first position, or *vice versa.*

21. A safety support according to claim 20, wherein said control is operated by an operator who is not the person performing the stunt.

22. A safety support according to claim 20 or 21, wherein said control is not normally operable by the person performing the stunt.

23. A safety support according to any preceding claim that is operable by a remote control.

24. A safety support according to any preceding claim that includes an automatic mechanism that causes said at least part of the support to move from the second to the first position in the event of a given signal.

25. A safety support according to any preceding claim that includes an alarm that operates automatically in the event of a given signal.

26. A safety support according to claim 24 or 25, wherein the signal is a change in one or more of the following:
a) power level
b) altitude
d) temperature
e) pressure
f) mechanical stress or strain
g) vibration.

27. A safety support according to any of claims 24 to 26; wherein the signal is caused by one or more of the following:
a) the aircraft pitching beyond a given degree
b) the aircraft yawing beyond a given degree
c) the aircraft rolling beyond a given degree
d) the aircraft exceeding a given speed or acceleration
e) the aircraft descending below a given altitude .

f) an impact to the aircraft.

28. A safety support according to any of claims 24 to 27; wherein the signal is detected by one or more electronic sensors.

29. A safety support according to any preceding claim; wherein the first and second positions are at least one metre apart.

30. A safety support according to any preceding claim; wherein the first and second positions are at least two metres apart.

31. A safety support according to any of claims 1 to 30; wherein the first and second positions are along a generally horizontal axis.

32. A safety support according to any of claims 1 to 30; wherein the first and second positions are along a generally vertical axis.

33. A safety support according to any of claims 1 to 30; wherein the second position is at a non horizontal or non vertical angle relative to the first position.

34. A safety support according to any preceding claim that is arranged so that the stunt can be performed:
a) upon a wing; or
b) upon the fuselage; or
c) away from the wing or fuselage.

35. A safety support according to any preceding claim that comprises or is engagable with a plurality of harnesses.

36. An aircraft comprising a support according to any of claims 1 to 35.

37. An aircraft comprising a plurality of supports according to any of claims 1 to 35.

38. An aircraft according to claim 36 or 37 that is a fixed wing aircraft.

39. A method of moving a person, or allowing the person to move, from a first to a second position, or *vice versa*, wherein the person is moved or moves using a support according to any of claims 1 to 35.

40. A method of modifying an aircraft comprising fitting one or more supports according to any of claims 1 to 35 to said aircraft.

41. A kit comprising a support according to any of claims 1 to 36 and one or more harnesses for attachment thereto.

42. A method comprising attaching one or more harness to a support according to any of claims 1 to 35.

43. A method of allowing a person to perform a stunt during a flight; wherein a person performing said stunt is secured by means of a support according to any of claims 1 to 35.

44. A method of allowing a plurality of persons to perform stunts during a single flight; wherein said persons are secured by means of one or more supports according to any of claims 1 to 35.

45. A method of allowing a plurality of persons to perform stunts during a single flight; wherein said persons take it in turn to use a support according to any of claims 1 to 35.

46. A method according to claim 45; wherein the persons use the same harness and are successively secured to and removed from said harness during said flight.

47. The invention substantially as hereinbefore described, with reference to the accompanying drawings and/or examples.

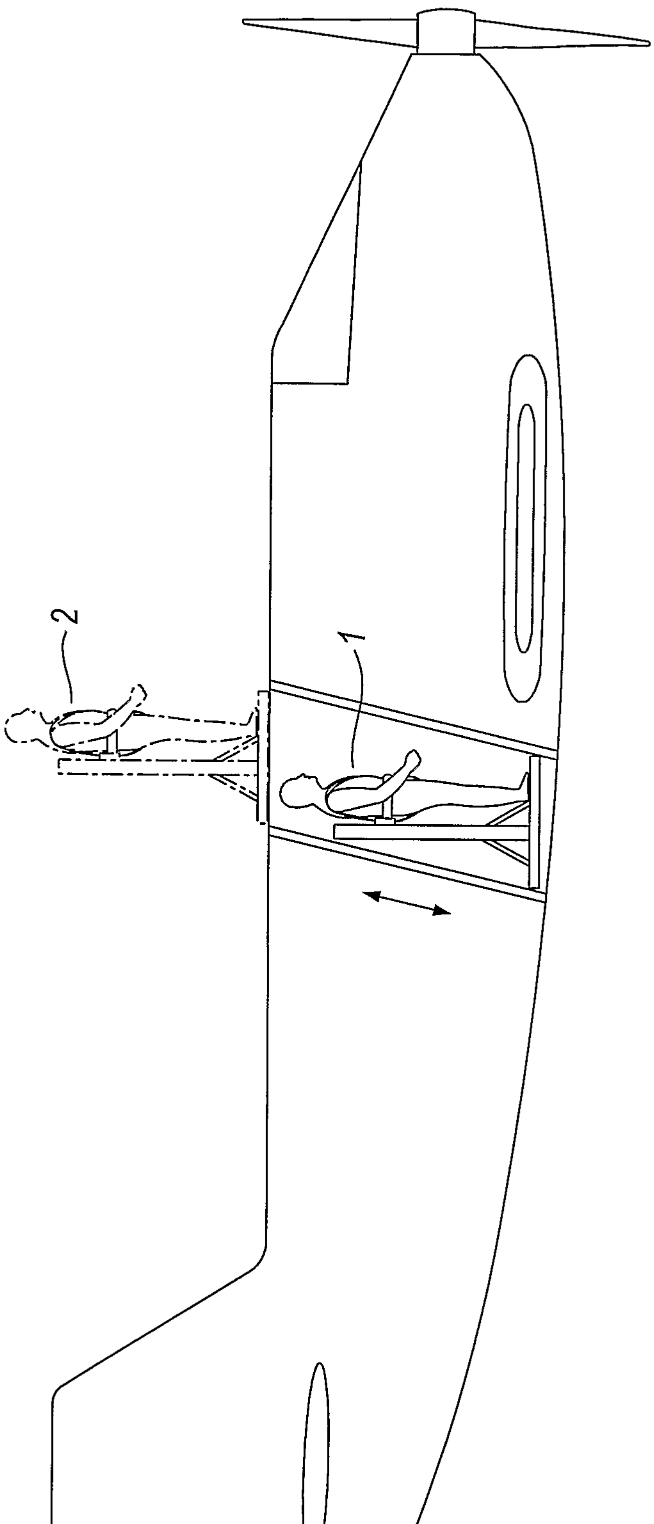

Fig.1

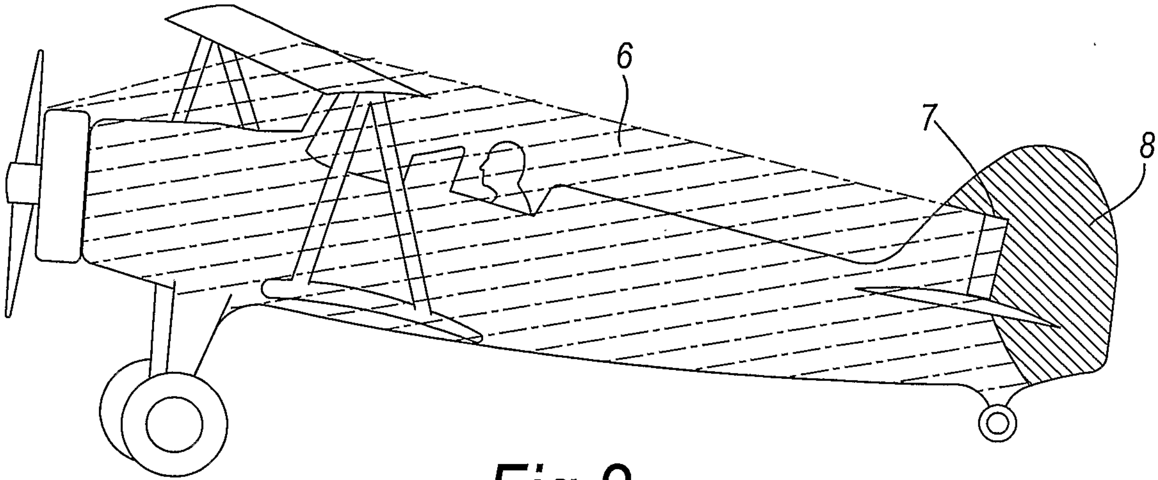

Fig.2

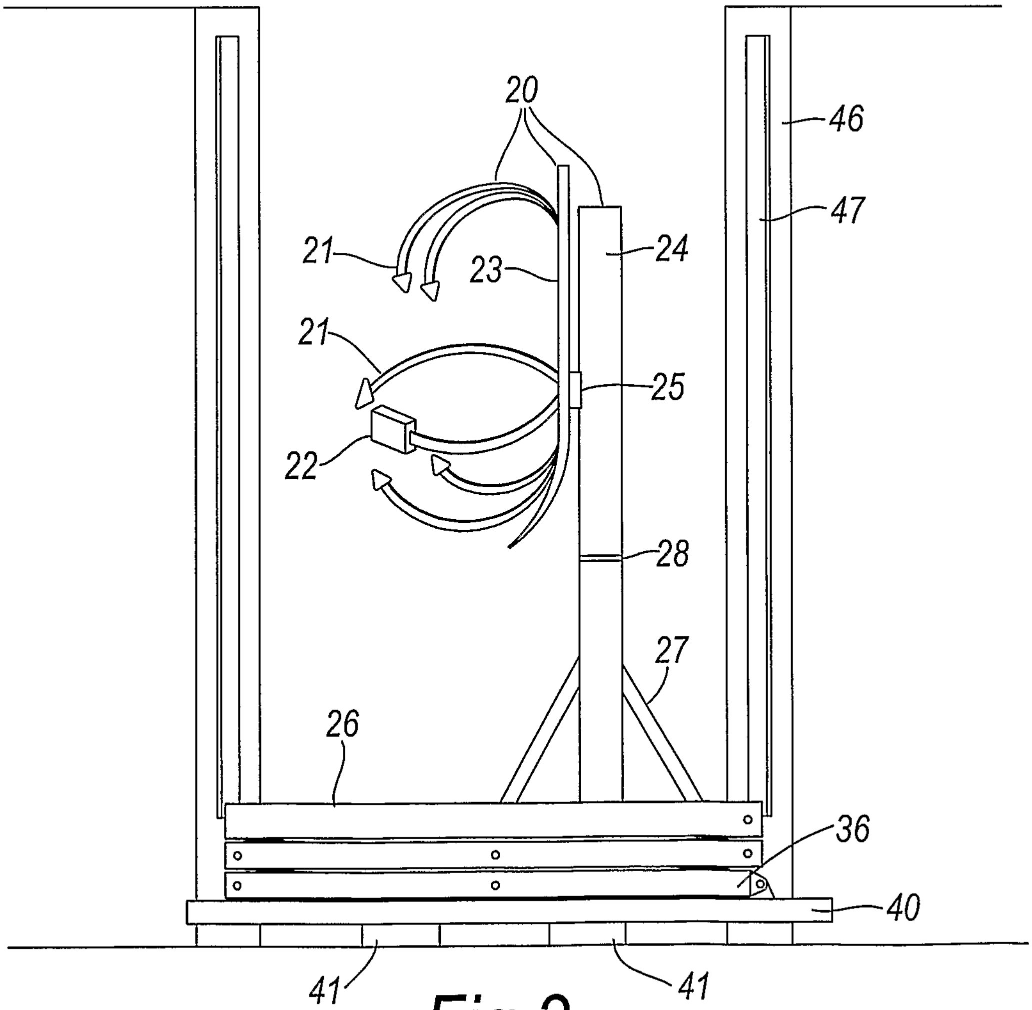

Fig.3

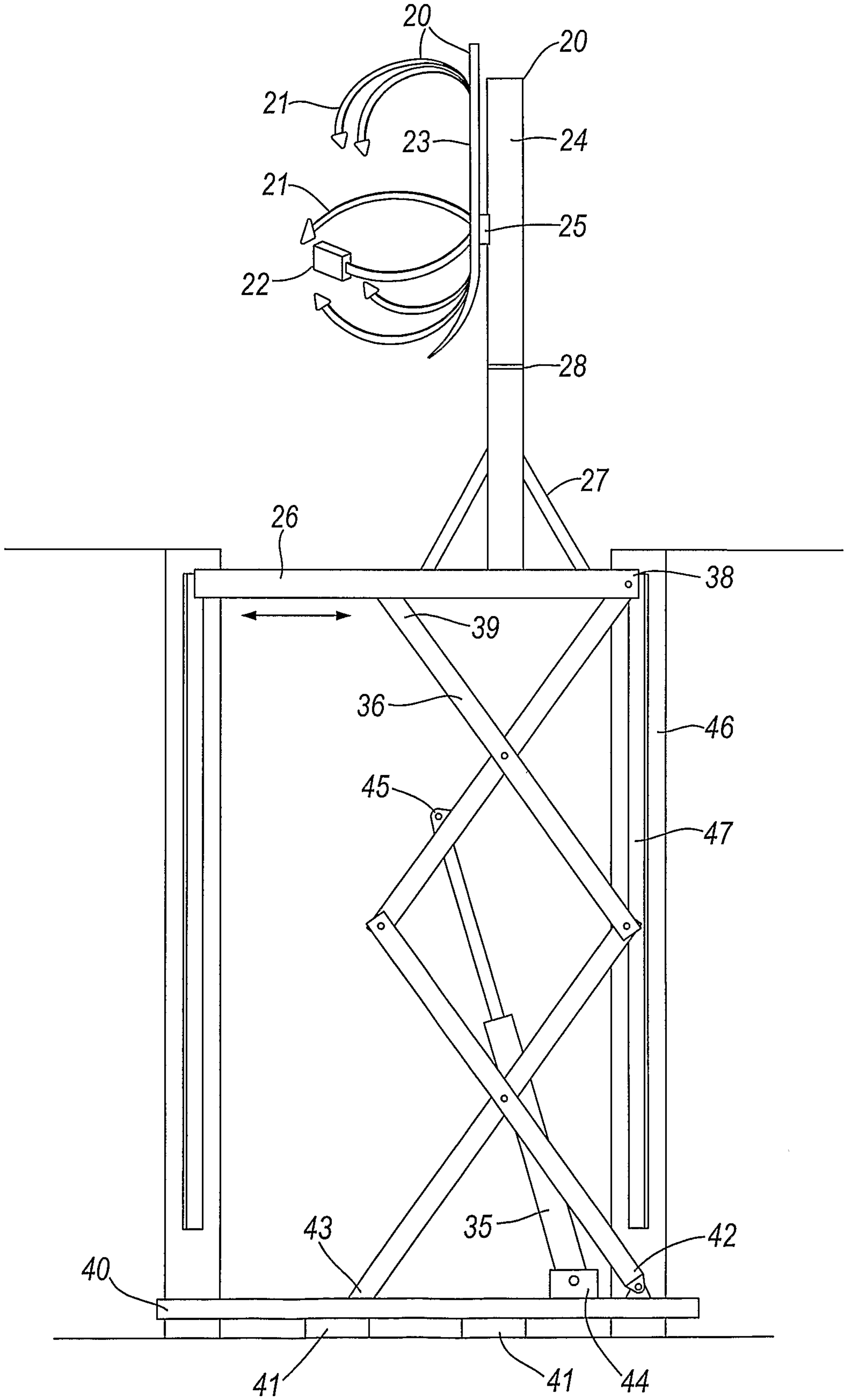

Fig.4

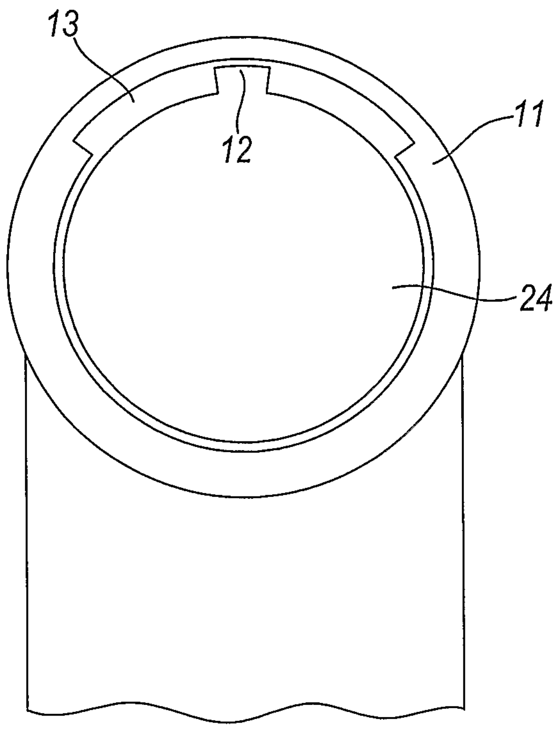

Fig.5

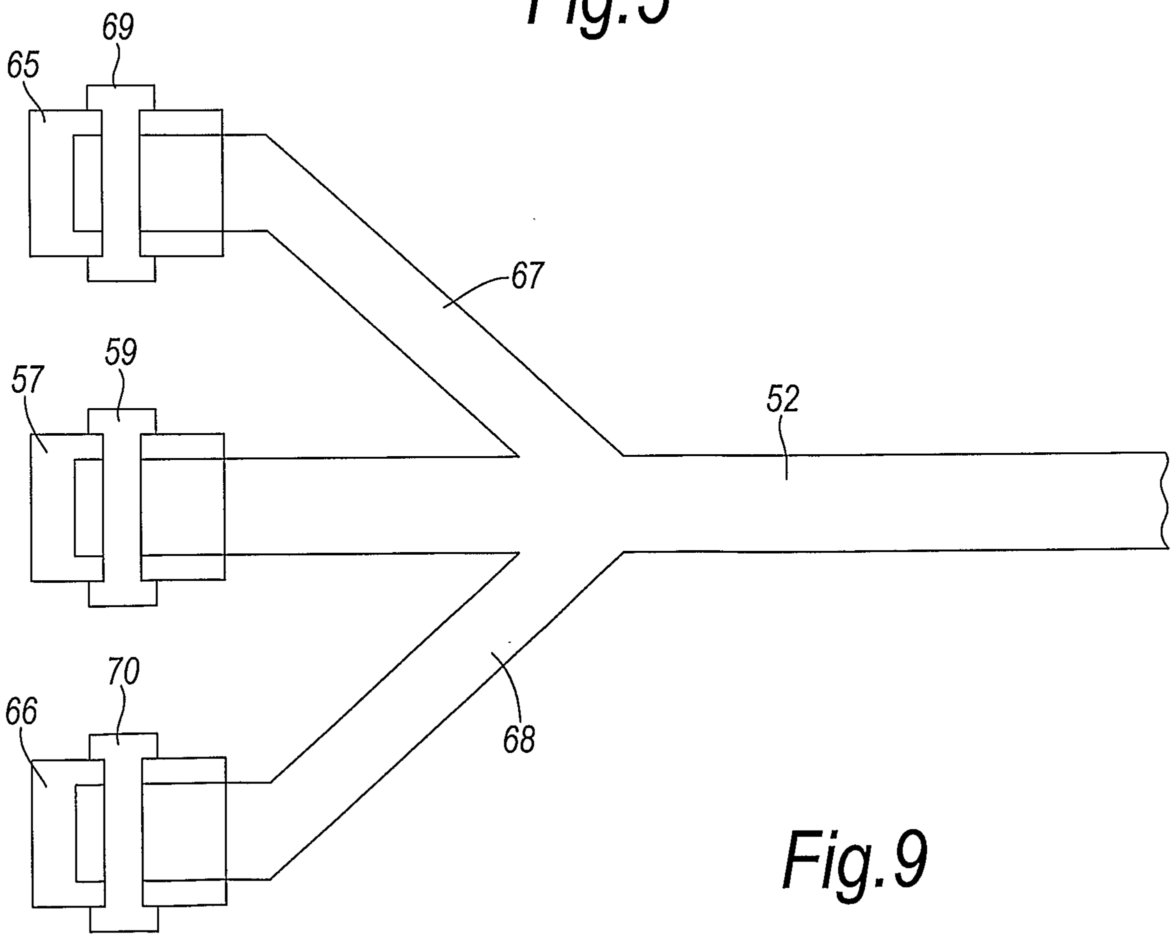

Fig.9

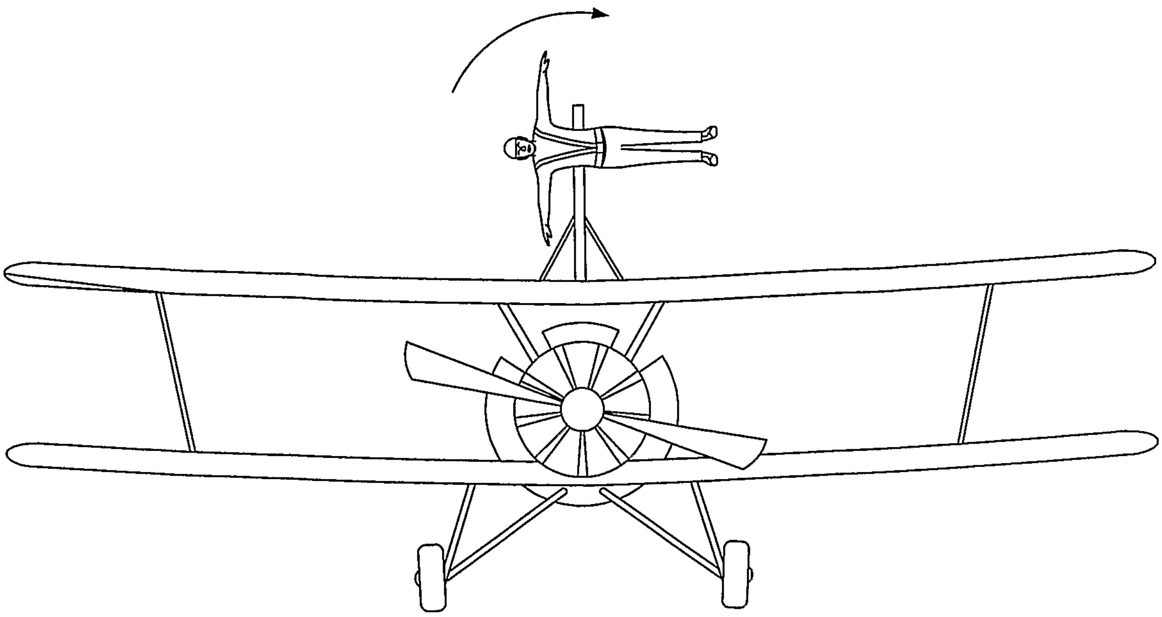

Fig.6

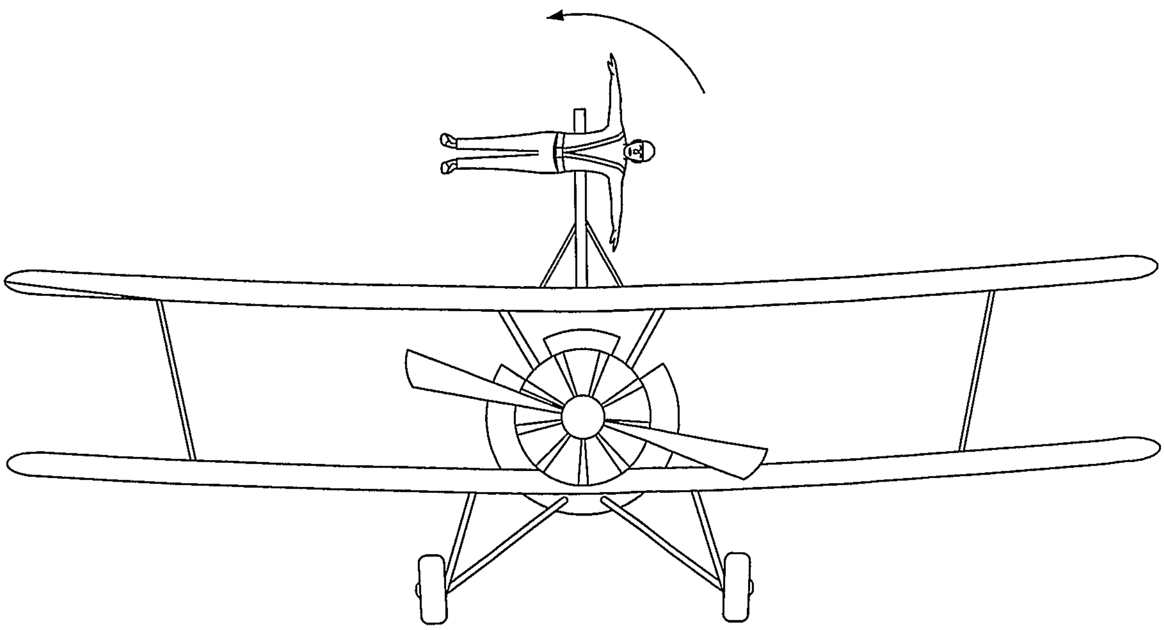

Fig.7

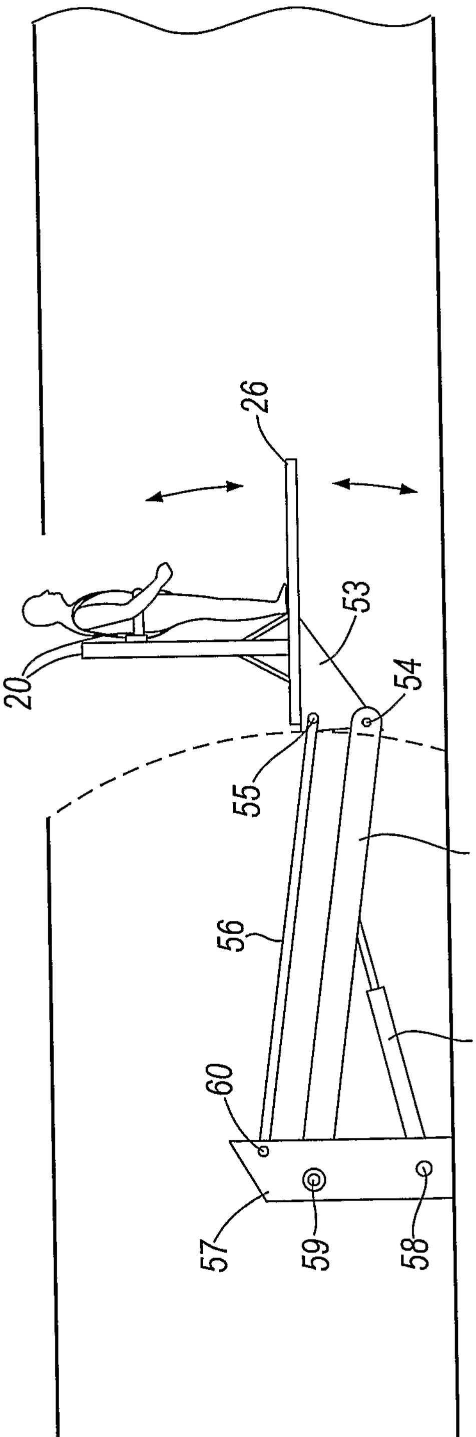

Fig.8

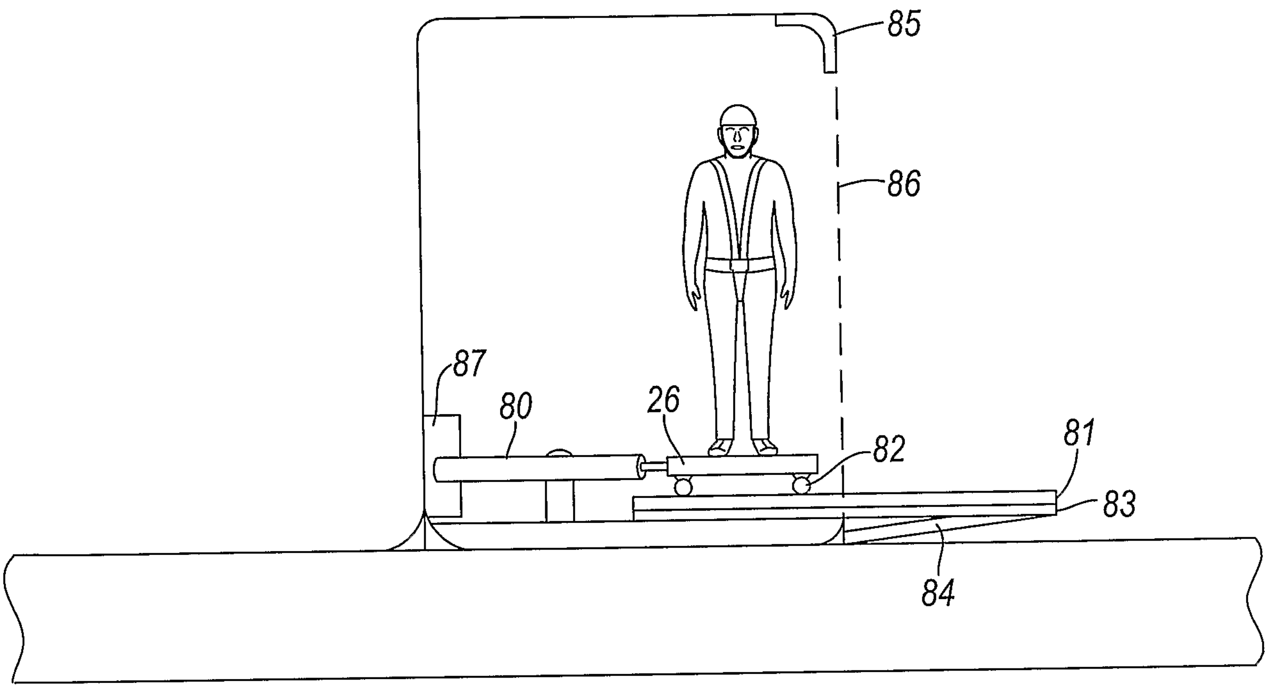

Fig.10

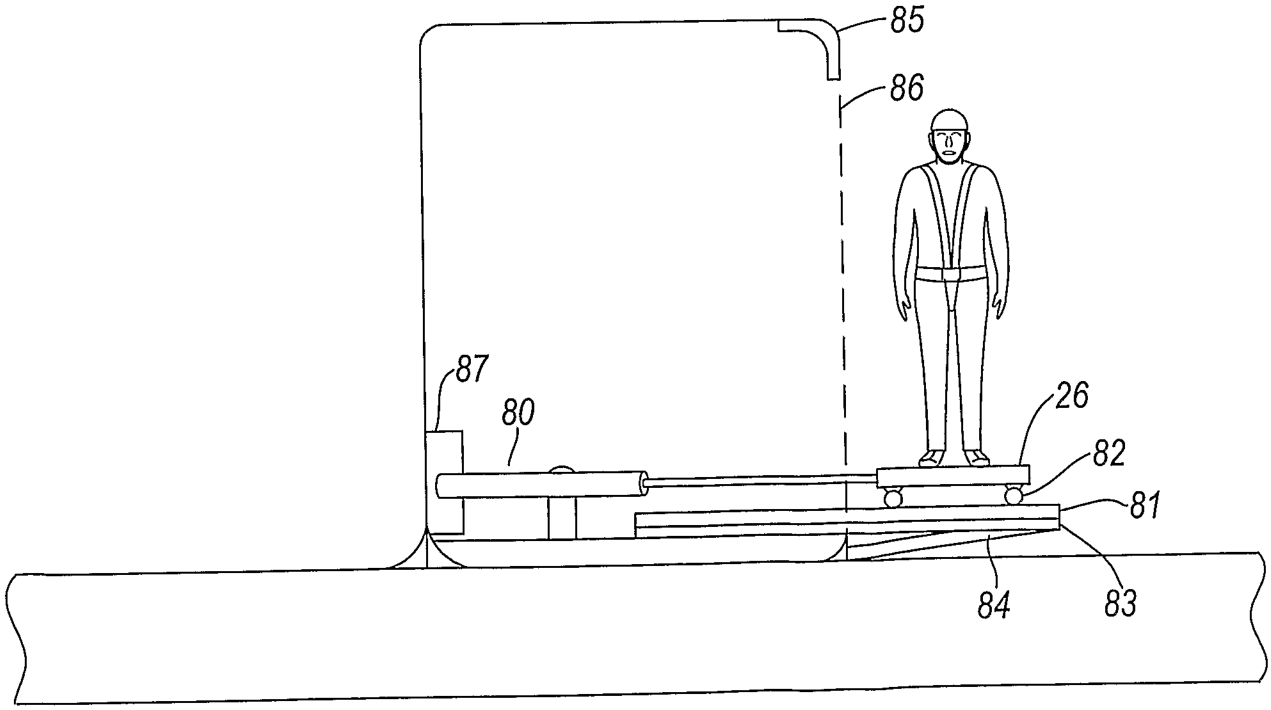

Fig.11

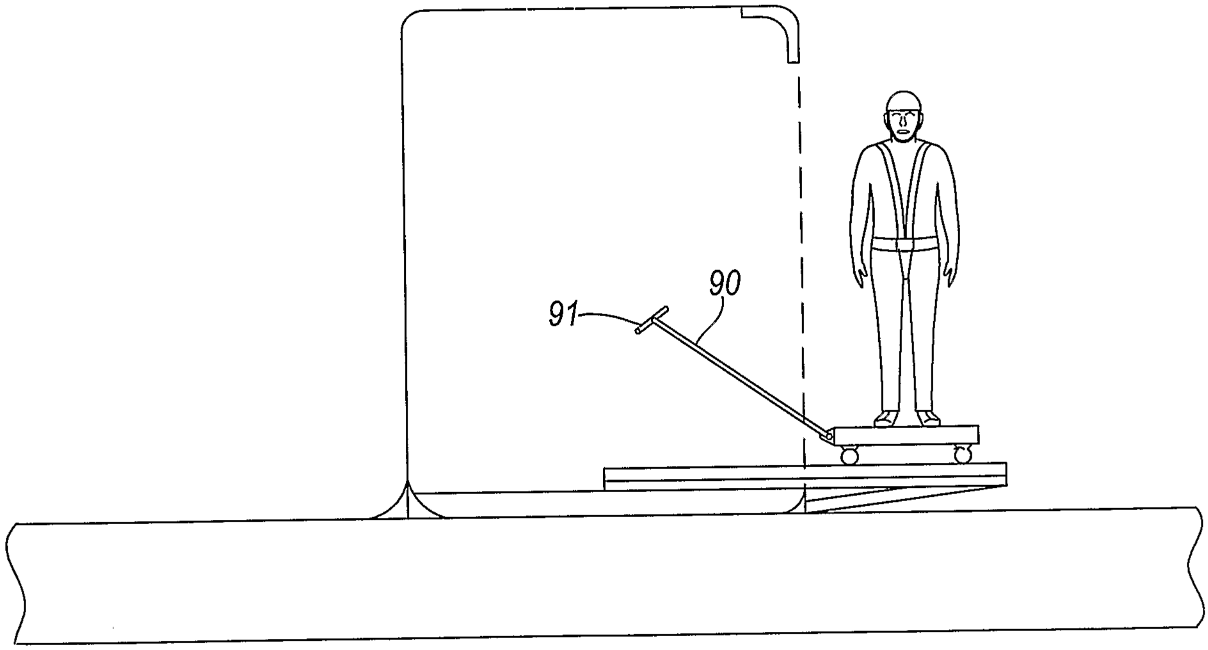

Fig.12

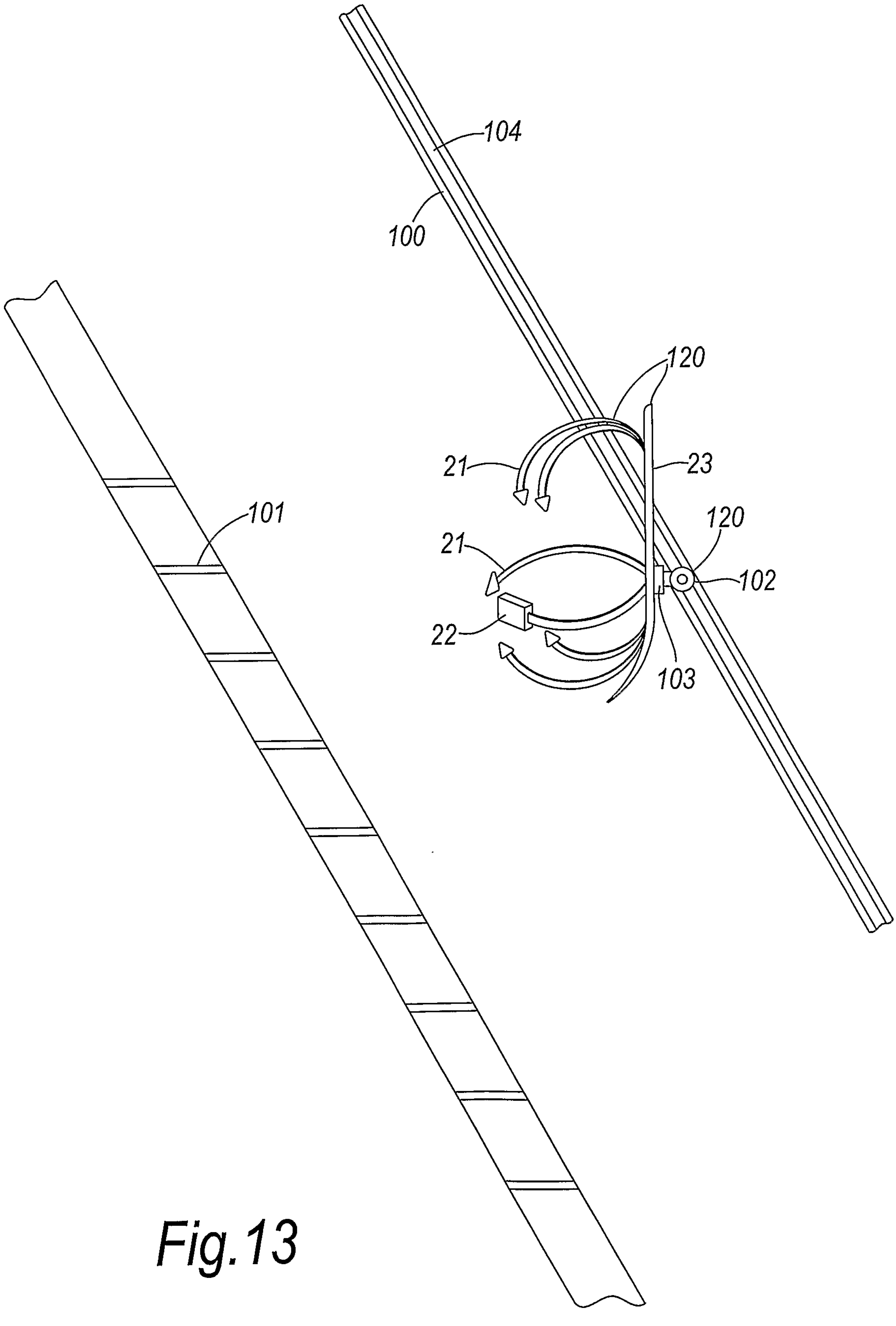

Fig.13

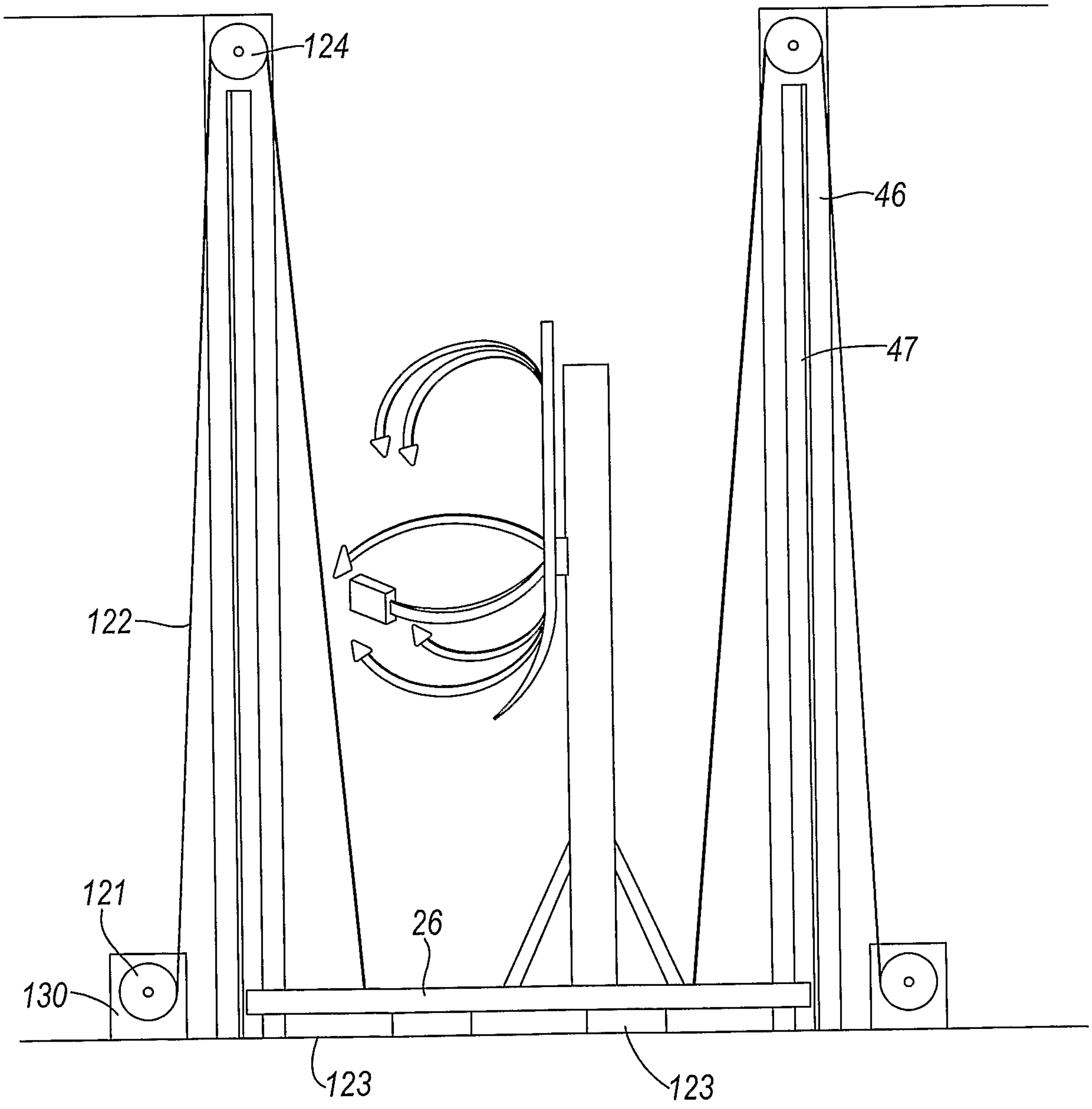

Fig.14

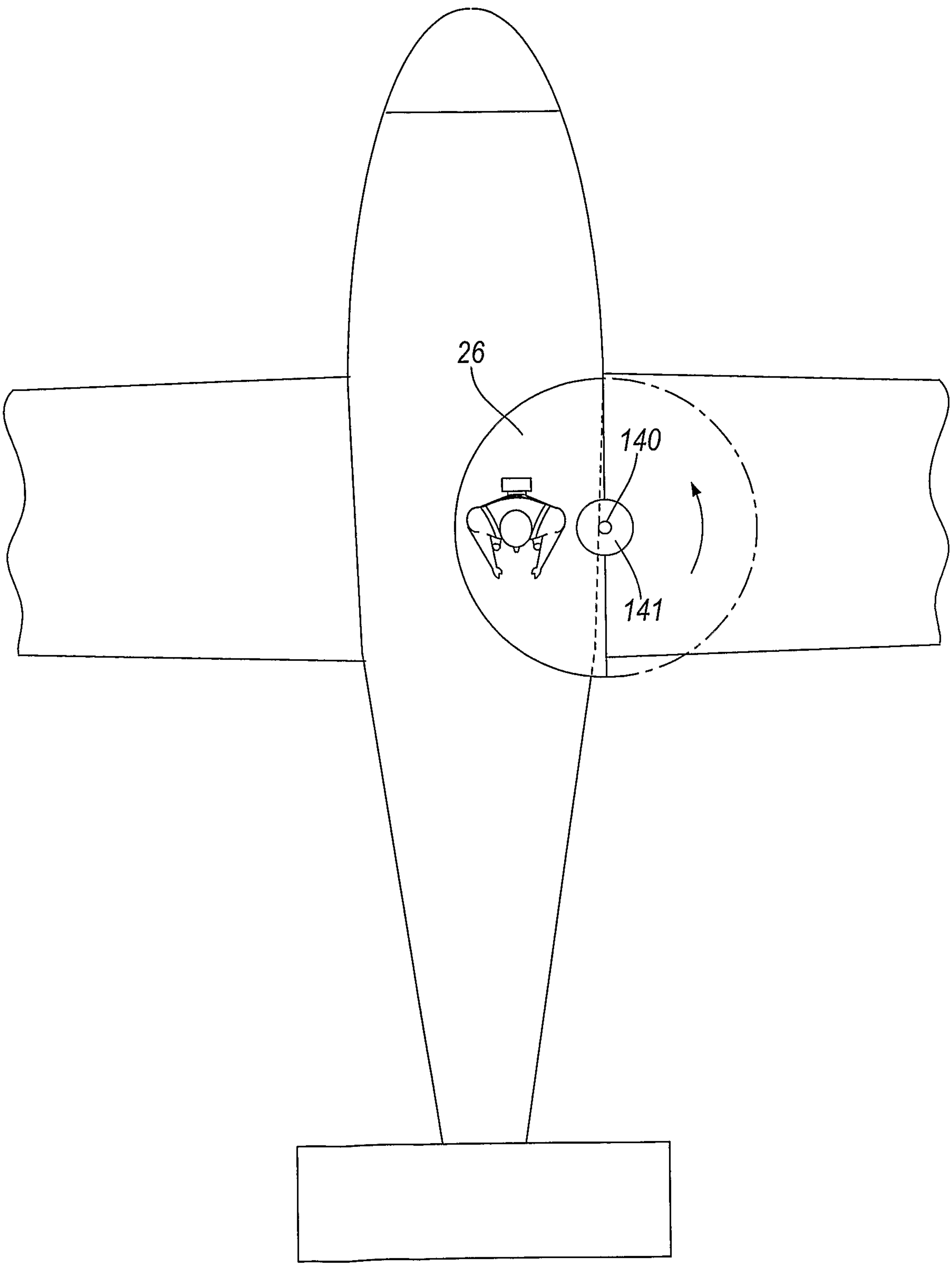

Fig.15

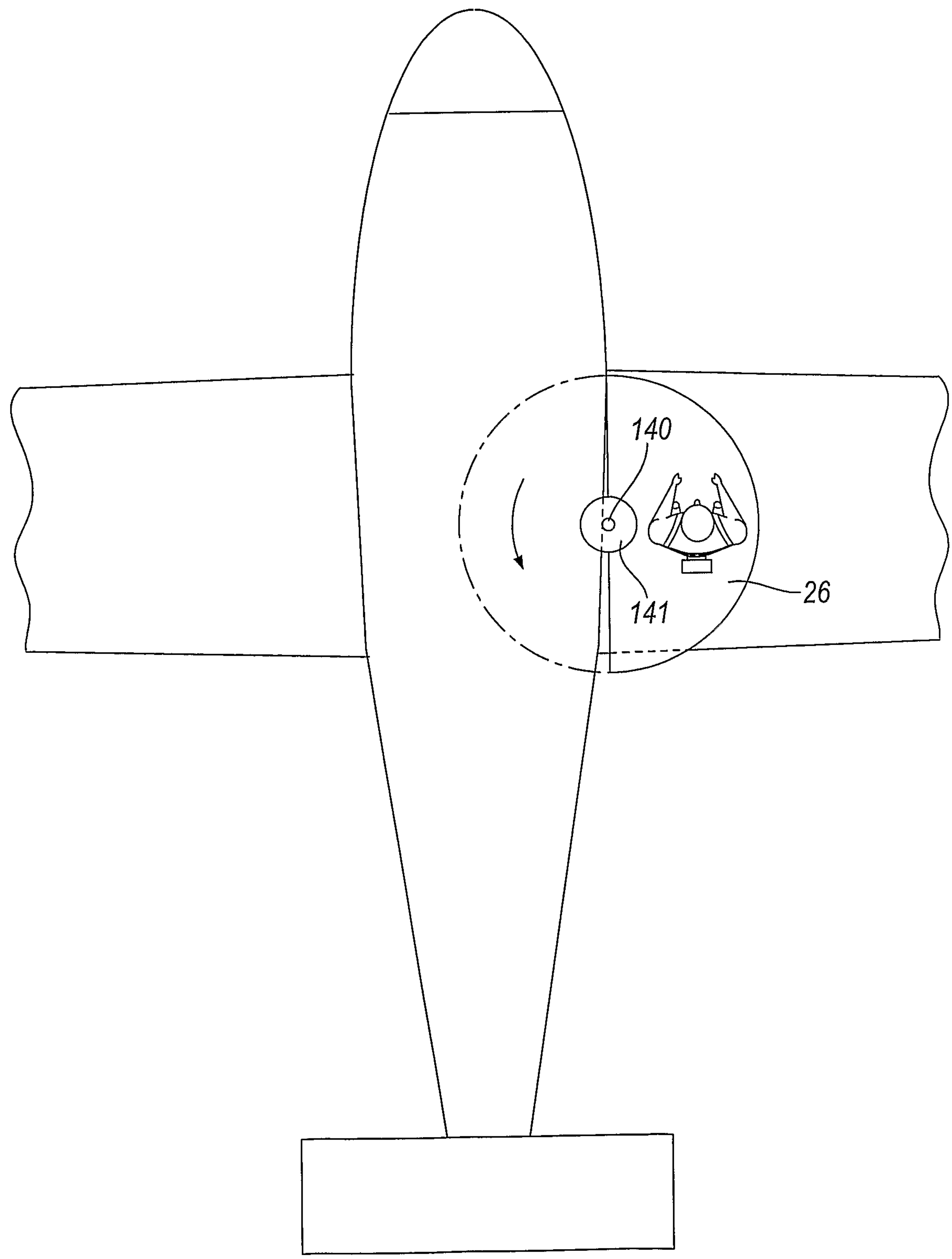

Fig.16

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2009/002197

A. CLASSIFICATION OF SUBJECT MATTER
INV. A62B99/00

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)
A62B B64D

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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 1 823 758 A (OWENS FRANK R) 15 September 1931 (1931-09-15) page 6, left-hand column, lines 46-48 page 6, right-hand column, lines 80-87; figures 1-3	1-47
A	US 2 018 448 A (JOHN JUERGENS) 22 October 1935 (1935-10-22) figure 1	
A	US 4 114 854 A (CLARK ALBERT L) 19 September 1978 (1978-09-19) figures 1,2	
A	FR 2 636 523 A (CAPOULADE CIE SNC [FR]) 23 March 1990 (1990-03-23) figures	

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"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
16 November 2009	24/11/2009

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	van Bilderbeek, Henk

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2009/002197

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 1823758	A	15-09-1931	NONE	
US 2018448	A	22-10-1935	NONE	
US 4114854	A	19-09-1978	NONE	
FR 2636523	A	23-03-1990	NONE	