(12) UK Patent Application (19) GB (11) 2 221 199 (13) A

(43) Date of A publication 31.01.1990

(21) Application No 8916783.7

(22) Date of filing 21.07.1989

(30) Priority data
(31) 3825174 (32) 23.07.1988 (33) DE

(71) Applicants
Autoflug GmbH & Co

(Incorporated in the Federal Republic of Germany)

Industriestraβe 10, D-2084 Rellingen 2, Federal Republic of Germany

Ohb-Opto-Elektronik und Hydraulik-System GmbH

(Incorporated in the Federal Republic of Germany)

Hemelinger Hafendamm 1 A, D-2800 Bremen 44, Federal Republic of Germany

(72) Inventors
Herbert Just
Manfred Fuchs
Alfred Tegtmeier
Frank Jakob
Wolfgang Wienss

(74) Agent and/or Address for Service
Frank B Dehn & Co
Imperial House, 15-19 Kingsway, London, WC2B 6UZ,

(51) INT CL[4]
B64D 25/12, B64G 1/52

(52) UK CL (Edition J)
B7G G3B1 G3D
U1S S1842

(56) Documents cited
GB 2200877 A GB 0788643 A US 3999728 A
US 3756546 A

(58) Field of search
UK CL (Edition J) B7G
INT CL[4] B64D 25/12, B64G 1/52

(54) Escape unit for the crew members of a space craft

(57) An escape unit 12, in the form of a rocket, for at least one crew member of a space craft 10 comprises: a cabin 24 for accommodating at least one person, preferably in a seated or recumbent position; a separate drive unit 26, with thrust nozzle means, that, for firing the escape unit 12 from the space craft, is self-sufficient relative to the drive means of the space craft; and a containment module 22 for the control of the flight path and/or the speed of the escape unit after the same is fired from the space craft. The module 22 houses electronic apparatus 34 and parachutes 36. As the unit 12 descends by parachute, air bags (38) (Fig 4) are deployed to keep the unit afloat in water.

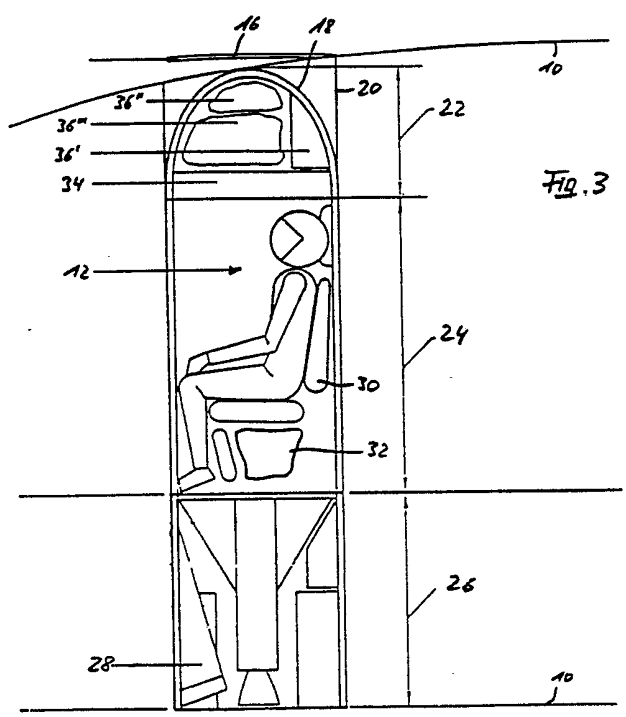


Fig. 3

GB 2 221 199 A

2221199

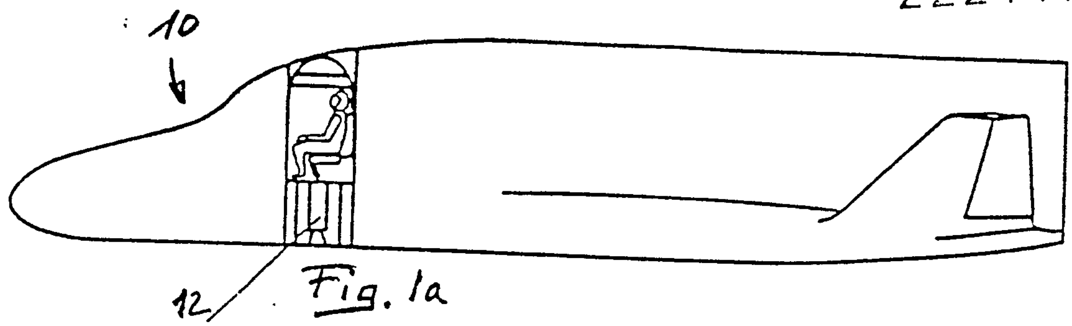
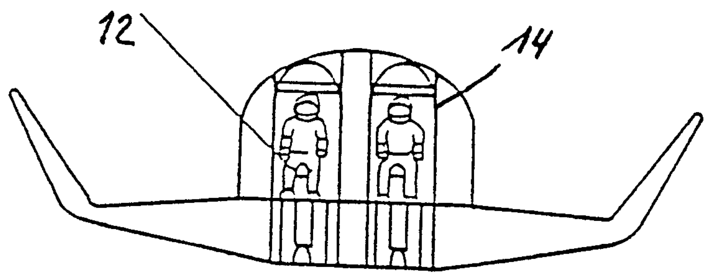


Fig. 1a

Fig. 1b



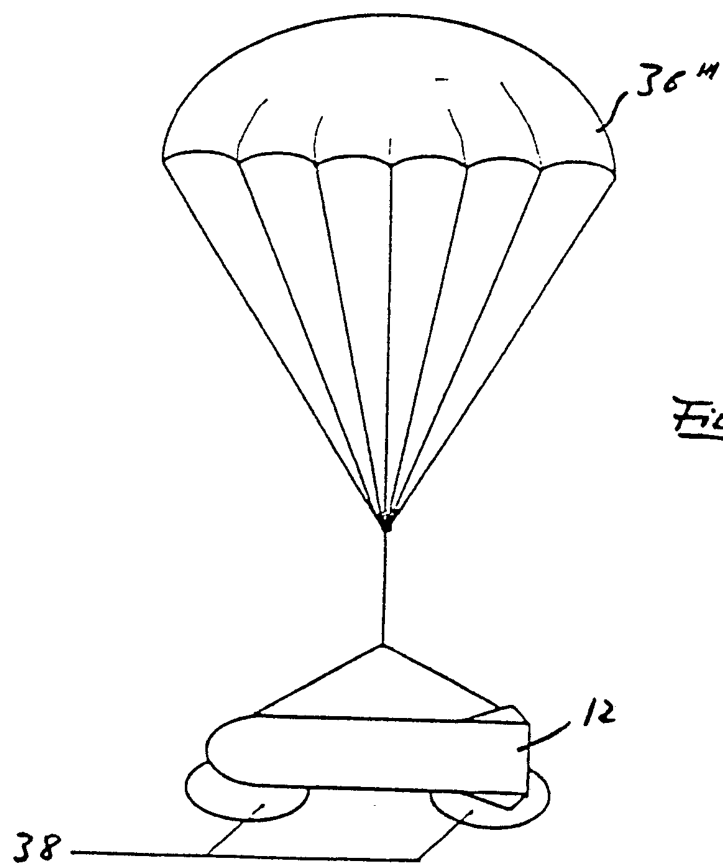
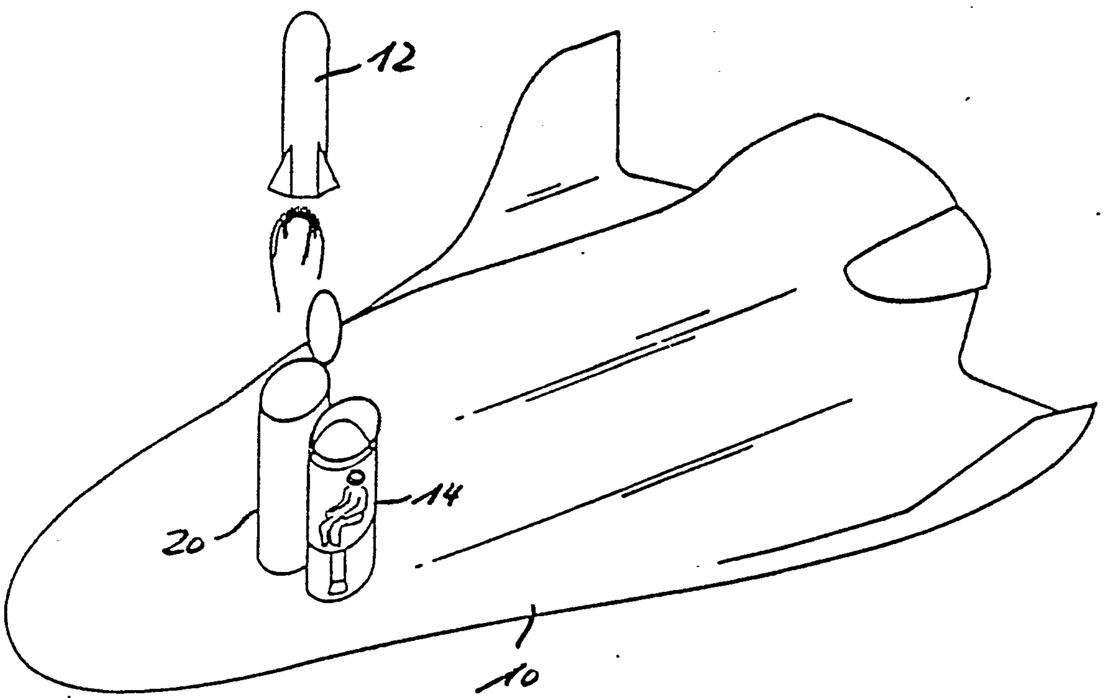


Fig. 4

2221199

Fig. 2



2221199

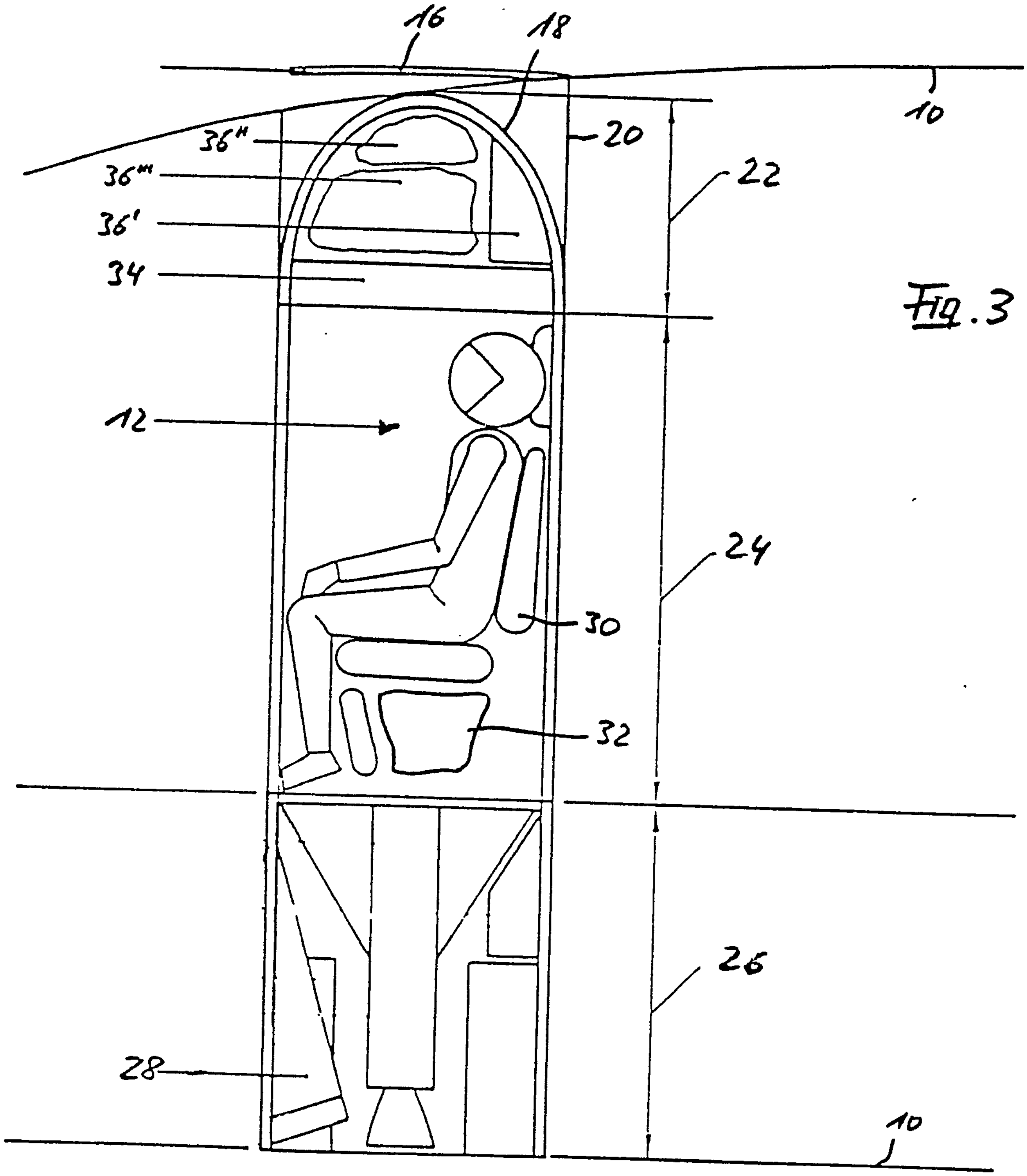


Fig. 3

2221199

ESCAPE UNIT FOR THE CREW MEMBERS OF A SPACE CRAFT

The present invention relates to an escape unit, in the form of a rocket, for the crew members of a space craft.

The tragic events that occurred during the takeoff of the space shuttle Challenger in the United States in 1986 have made it clear that especially accidents at the beginning of a space flight can take on catastrophic proportions, in particular because at this point in time an enormous quantity of propellant is still available to the shuttle, and the shuttle systems are operating at maximum power.

The result of an accident can be explosions that are spread over several square kilometers.

Although no separate escape systems were provided for the crew members of the space shuttle Challenger, naturally as a consequence of this accident thoughts have been given to suitable escape systems.

Due to a certain similarity of such reusable space shuttles or gliders with conventional aircraft, it was obvious to test ejection seats, and particularly those known from military aircraft, for space shuttles.

However, for numerous reasons the known ejection seat arrangements have only a very limited use for the aforementioned applications during the landing phase, and are not suitable at all during the lift off phase. For one thing, the crew members are to a large extent unprotected relative to the surrounding atmosphere and therefore in all likelihood would be burned while passing through an explosion field. Furthermore, the thrust forces and flight speeds of an orbiter are already so great after several seconds that enormous pressure heads result that make it impossible for a seat to safely eject. The thrust, and the duration of thrust, of conventional ejection seats are not enough for an adequate separation of explosion source and landing spot of an astronaut that is seeking escape and rescue. The time required for clearing an ejection path is too great if first the structure of the space shuttle must be separated (where ejection is through the roof of the vehicle).

It is therefore an object of the present invention to provide an escape unit for the crew members of a space craft, where the escape unit is embodied in such a way that it can be safely separated from the space craft at any time during the flight of the space craft between the launch pad and the time it leaves the earth's atmosphere, and after reentry into the atmosphere and up to the time of landing.

The present invention is based on the general recognition that this object can preferably be realized with a self-sufficient escape rocket that is integrated in the space craft.

The phrase "self-sufficient escape rocket" refers to the fact that the escape rocket has its own drive system in order to be able to release itself from the space craft, whereby the drive system furthermore may serve to set a defined flight path, and may then be relieved, in operation, by a rescue system that provides for a retarded or slowed-down return of the escape rocket to the earth at a defined steady rate of descent.

According to the invention there is provided an escape unit, in the form of a rocket, for at least one crew member of a space craft, with said escape unit comprising: a cabin for accommodating at least one person, preferably in a seated or recumbant position; a separate drive unit, with thrust nozzle means, that, for firing said escape unit from said space craft, is self-sufficient relative to drive means of said space craft; and a containment module for the control of the flight path and/or the speed of said escape unit after the same is fired from said space craft.

It is to be understood that the escape unit, or rocket, will also generally contain appropriate life support systems, including oxygen supply and cabin pressure in the escape rocket, that in an emergency can be established and/or regulated independently of the on-board systems of the space craft.

The escape rocket has its own cabin, which can have space for several people, although preferably has space for only one person. Therefore, as the case may be, several of such escape rockets are provided in a space craft.

The cabin is preferably provided with its own door and with a window. During automatic launch of the space craft, during which time the danger of accident is the greatest, a respective crew member takes his place in the cabin of the escape rocket and seals this cabin hermetically. Preferably, as soon as the person is seated in the cabin, and an escape signal has been triggered, the closing of the door is effected automatically. During a normal space flight, the crew members leave the escape rocket and, as before, work in the actual space shuttle itself. This essentially applies also for the landing phase, which is in the form of a mere gliding phase. If irregularities occur during this time, the crew members could again occupy their respective escape rockets, close the same, and be freed from the space craft in a manner to be described subsequently.

The support systems, such as oxygen supply and pressure, for an emergency are accommodated within the cabin. If the astronauts are in the escape cabin, and the latter has not been separated from the space craft, the occupants are supplied via the on-board systems of the space craft. Only if the escape rocket is to be fired, are the connections to the space craft severed by a coupling, and the self-sufficient emergency systems of the escape rocket take over supply to the crew members that are escaping.

It is to be understood that also the necessary operating elements for igniting the escape rocket and for controlling the same are disposed within the escape rocket.

The crew members are preferably placed in a seated or recumbent position in the escape rocket, because this is the best position for absorbing the strong thrust forces, and conventional safety belt systems (safety belts, etc.) operate optimally to hold the crew members in place.

In this connection, the present invention proposes, pursuant to one advantageous specific embodiment, to dispose the reposing or seat unit in such a way that it can change position and is cushioned against impact within the cabin; this can be effected, for example, via appropriate air cushions. This suitably dampens the transmission of the impact energy of the escape rocket when landing on earth. The adjustability is preferably effected automatically, for example during initiation of individual escape procedures.

As indicated previously, the escape rocket is provided with its own drive system that has appropriate thrust nozzles that are provided in such a way that the escape rocket can be released from the orbiter within a very short period of time and at high speed. In principle, known boosters can be used for this. It is to be understood that an appropriate propellant supply must also be provided for the drive unit.

In contrast to heretofore known ejection systems, the escape rocket makes it possible to fire the crew members within a very short period of time to a distance of at least several kilometers from the actual space craft, thereby bringing the crew members to a zone that, for example in the case of an explosion of the space craft, is no longer endangered by wreckage that is flying around, pressure waves, widespread fire, etc. It is precisely this efficient, safe separation of the escape rocket from the space craft that is an essential feature of the present invention. Due to the previously described separate drive unit, the safe and reliable separation is assured even when the speed of a space craft is approximately 7 mach, i.e. a speed at which the heretofore known space craft leave the earth's atmosphere. Despite the high pressure heads that have to be overcome under these conditions, the escape rocket can even then be safely separated due to its separate drive system, and thus offers protection to the crew members that wish to escape.

In order to assure a defined flight path of the escape rocket after it has separated, one advantageous specific embodiment of the present invention proposes providing the escape rocket with gyroscopic stability.

It is furthermore proposed to provide the escape rocket with fins that are disposed on the periphery and that simultaneously serve for setting a defined flight path.

In this connection, it is proposed pursuant to one advantageous specific embodiment of the present invention to embody the fins in such a way that they can be converted from an essentially tangential orientation relative to the outer surface of the escape rocket into a radial orientation.

The reason for such a configuration is that for aerodynamic reasons the rocket generally has a cylindrical body that is pointed or rounded off in the direction of flight. In order to provide the rocket with a defined flight path, a reliable guidance is necessary during launch, for which reason the escape rocket is preferably disposed in a corresponding, cylindrical receiving means of the space craft. However, radially projecting fins would disrupt launch, and for this reason the present invention proposes fins that can be extended.

Hinged, inflatable fabric fins can be provided.

If one proceeds from a seated position of the crew member in the escape rocket, for example during launch of the space craft, whereby the escape rocket, pursuant to one advantageous specific embodiment of the present invention, is disposed at an angle that is greater than 0° and less than 90° to the direction of flight of the space craft, then the pilot is initially in a position within the rocket where his head is directed in the direction of flight.

After the separate drive unit has provided an adequate distance between the rocket and the orbiter, the thrust forces of the drive unit are practically reduced to zero, whereupon the rocket alters its direction of flight to an orbit directed toward earth, as a result of which the pilot would be riding the further flight path "on his head".

To avoid this, the present invention furthermore proposes to provide the escape rocket with means for influencing the attitude of flight relative to the flight path thereof. In this connection, the rockets are displaced either into a horizontal orientation or into an orientation where the pilot again traverses the landing phase with his head to the top.

This can be effected, for example, by appropriate means for providing a counter thrust for retarding the speed or for providing a stabilizing slowdown. However, it is also possible to provide additional auxiliary nozzles for changing the rockets over into the desired orientation. Alternatively, this objective can also be achieved by, for example, separating off individual components of the rocket to provide a specific orientation via an appropriate shift in weight.

The means for influencing the flight attitude can be part of the containment module, which pursuant to one advantageous specific embodiment of the present invention includes aerodynamic deceleration means having at least one parachute, and preferably a multi-stage parachute system.

A multi-stage parachute system is preferred in particular for the reason that the rocket must be slowed down from different heights and speeds, depending upon what point in time the accident occurs.

Proceeding from the previously described extreme case, where the accident occurs shortly prior to leaving the earth's atmosphere, with the space craft having a speed of, for example, 7 mach, the multi-stage deceleration mechanism offers the advantage of a stage-wise reduction of the maximum speed to lower speeds, where parachutes can be opened without danger and can provide for a reduction of the rate of descent to values that are customary for a landing.

The multi-stage parachute system, for example a three-stage system, is preferably embodied in such a way that each individual parachute stage (the individual parachute) is disposed in its own casing, and the casings are connected to one another. This enables an appropriate stage-wise opening of the individual parachutes.

In order to enable as gentle a touchdown as possible of the escape rocket on the water or on land, it is finally proposed pursuant to the present invention to dispose additional cushioning systems on that side of the escape rocket that is remote from the parachute, so that the rocket first strikes a surface with these cushioning elements. The cushioning elements are again preferably embodied as air cushions (air bags) that when landing on water simultaneously enable the rocket to float.

The cushioning elements emerge from the rocket via an appropriate control or regulation, and/or manually, at the proper time and after opening of appropriate flaps or covers in the outer wall of the rocket.

The escape rocket is preferably produced from materials that are customary for space flight, and that must primarily fulfill the following criteria: they must be resistant to heat, they must have as poor a heat conductivity as possible, they should have a good structural strength, and above all they must be light in order to keep the transport weight of the orbiter as low as possible. For this reason, larger, separable capsules, that can, for example, accommodate the entire crew, are less desirable.

One material that fulfills these requirements is titanium. Furthermore, especially the end or head of the rocket can be provided with a heat shield, for example of ceramic (ceramic tiles) or wood, whereby rather than wood as such, rather the material charred to charcoal by the frictional heat assures an advantageous heat shield.

A preferred embodiment of the invention will now be described by way of example and with reference to the accompanying drawings, which are very schematic to simplify illustration, and in which:

Fig. 1a is a side view of one exemplary embodiment of an escape rocket in a space shuttle;

Fig. 1b is a front view of the arrangement of Fig. 1a;

Fig. 2 shows the launching or firing of an escape rocket from a space shuttle;

Fig. 3 shows details of the escape rocket in its position within the space shuttle; and

Fig. 4 shows the escape rocket during landing while suspended on a parachute.

Identical components, or components that operate in the same manner, are indicated in the drawings with the same reference numerals.

The reference numeral 10 indicates a space craft or shuttle, for example the planned space shuttle Hermes, a reusable shuttle that has a shape similar to that of an airplane and that after completion of a flight in outer space is to land back on earth without its own drive mechanism in the manner of a glider.

Disposed in the front portion of the space shuttle 10, perpendicular to the direction of flight, are two escape rockets 12, 14 that are spaced next to and at a distance from one another.

It should be noted, however, that the escape rockets 12, 14 could also be disposed at an angle, and in particular, with reference to Fig. 1a, at an angle of 45° to the vertical from the bottom right to the upper left. This has the advantage that upon takeoff of the orbiter or shuttle, where the latter is perpendicular to the position illustrated in Fig. 1a, the launch or firing of the escape rockets would not be horizontal and hence parallel to the ground, but rather would be effected at an angle of approximately 45° to the ground and the escape rockets would hence be directed on a conventional flight path. This optimizes the technical reliability of the escape unit.

Fig. 3 shows the construction of the escape rocket 12, which is structurally identical to that of the escape rocket 14.

As can be clearly seen from Fig. 3, the escape rocket 12 extends essentially over the entire height of the space shuttle 10, the top of which is provided with a hatch 16 that can separate in order to free a path for the escape rocket 12.

The rocket 12, which is essentially cylindrical and is provided with a rounded-off, preferably aerodynamically shaped end or head 18, is disposed in a cylindrical receiving means 20 of the shuttle 10.

The rocket 12 is divided into three stages, namely an upper containment module 22, a central cabin module 24, and a lower drive module 26.

The drive module 26, which is provided with a known type of drive system, is indicated merely schematically in the drawing. In this connection, the various known types of drive systems are available to one skilled in the art. It is to be understood that the drive module 26 must include a propellant tank and is open toward the bottom so that the thrust nozzles can operate.

Similarly schematically illustrated in Fig. 3 are the fins 28, which are disposed on the periphery of the rocket 12 and are embodied as hinged fins. As long as the rocket is still disposed within the shuttle, the fins are disposed tangential to the outer wall of the rocket. However, as soon as the rockets have enabled the escape unit to leave the shuttle, the fins 28 are unfolded radially in order to stabilize the escape craft during the further flight path.

The cabin module 24 is provided with a seat 30, below which is disposed an air cushion 32. In addition, the pilot is held securely in place by a safety belt system.

In the line of vision of the pilot, the rocket 12 is provided with a non-illustrated hinged door that serves for entry and exit, and that can be hermetically sealed.

Provided within the cabin 24 are the life support systems, as well as various control and regulation devices for manual operation by the pilot, for example for monitoring the various units of the rocket.

Finally, the containment module 22 serves in particular for accommodating the electronic devices 34 of the rocket as well as a parachute system 36, which in the illustrated embodiment comprises three parachutes 36', 36", 36''', with the smallest parachute 36' being the first to open, the medium size parachute 36" being the second to open, and the largest parachute 36''' being the third and last parachute to open during landing.

Naturally here too an appropriate, non-illustrated hatch is provided in the wall of the rocket for release of the parachutes.

Fig. 4 illustrates the rocket 12 as it is suspended from the parachute 36''' shortly before landing in water. At this point in time, two air cushions 38 have already been released on the underside of the rocket 12 and have been inflated; after the rocket has landed in the water, these air cushions assure that the rocket will float.

It is to be clearly understood that there are no particular features of the foregoing specification, or of any claims appended hereto, which are at present regarded as being essential to the performance of the present invention, and that any one or more of such features or combinations thereof may therefore be included in, added to, omitted from or deleted from any of such claims if and when amended during the prosecution of this application or in the filing or prosecution of any divisional application based thereon. Furthermore the manner in which any of such features of the specification or claims are described or defined may be amended, broadened or otherwise modified in any manner which falls within the knowledge of a person skilled in the relevant art, for example so as to encompass, either implicitly or explicitly, equivalents or generalisations thereof.

Claims:

1. An escape unit, in the form of a rocket, for at least one crew member of a space craft, with said escape unit comprising:

a cabin for accommodating at least one person, preferably in a seated or recumbent position;

a separate drive unit, with thrust nozzle means, that, for firing said escape unit from said space craft, is self-sufficient relative to drive means of said space craft; and

a containment module for the control of the flight path and/or the speed of said escape unit after the same is fired from said space craft.

2. An escape unit according to claim 1, in which said drive unit is of such a design as to permit a spontaneous firing of said rocket to a safe distance from said space craft even at the speeds achievable by said space craft on its flight path within the earth's atmosphere.

3. An escape unit according to claim 1 or 2, in which said rocket is gyroscopically stabilized.

4. An escape unit according to claim 1, 2 or 3, which includes fins distributed about the periphery of said rocket.

5. An escape unit according to claim 4, in which said fins are convertible from an orientation where they are disposed essentially tangentially relative to an outer surface of said escape rocket, into a radial orientation.

6. An escape unit according to claim 5, in which said fins are foldable, of fabric, and/or inflatable.

7. An escape unit according to any preceding claim, which includes means for providing a counter thrust to a direction of flight of said escape rocket.

8. An escape unit according to claim 7, which includes means for influencing the flight attitude of said escape rocket relative to its flight path.

9. An escape unit according to claim 7 or 8, in which said means is part of said containment module.

10. An escape unit according to any of claims 1 to 6, in which said containment module contains at least one parachute, and preferably a multi-stage parachute system.

11. An escape unit according to claim 10, in which said parachute system is designed in such a way that each individual parachute stage, namely an individual parachute, is disposed in a separate casing, with said casings being connected with one

another.

12. An escape unit according to any preceding claim, which includes at least one cushioning element that can be moved out of said escape unit and is disposed on a side thereof remote from said parachute.

13. An escape unit according to claim 12, in which said cushioning element is an air cushion.

14. An escape unit according to any preceding claim, in which said cabin is provided with a hermetically sealable door.

15. An escape unit according to any preceding claim, in which said cabin is provided with a reposing or seat unit; and which includes means for cushioning said reposing or seat unit against impacts.

16. An escape unit according to claim 15, in which said cushioning means is an air cushion.

17. An escape unit according to any preceding claim, in which said rocket has a shell made of material that is resistant to high temperature, structurally strong, and specifically light.

18. An escape unit according to any preceding claim, in which at least an end region of said rocket is provided with a separately applied heat shield.

19. An escape unit according to any preceding claim, in which said cabin is provided with a reposing or seat

unit; and which includes means for changing the position of said reposing or seat unit.

20. An escape unit according to claim 19, in which said position changing means is of such a design as to shift said reposing or seat unit into a normal position during an inclined orientation of the escape unit in said space craft.

21. An escape unit according to any preceding claim, in which said drive unit, to improve initial acceleration, is provided with a telescopic ejection cannon to enhance the thrust of said rocket.

22. A space craft provided with an escape unit according to any preceding claim, in which the escape unit, relative to its direction of ejection, is disposed at an angle of greater than 0° and less than 90° relative to the direction of flight of said space craft.

23. An escape unit for at least one crew member of a space craft, substantially as hereinbefore described with reference to the accompanying drawings.

Published 1990 at The Patent Office. State House. 66 71 High Holborn, London WC1R 4TP. Further copies may be obtained from The Patent Office. Sales Branch, St Mary Cray, Orpington, Kent BR5 3RD. Printed by Multiplex techniques ltd. St Mary Cray, Kent. Con. 1/87