NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

REPLY TO ATTN OF: GP

TO: USI/Scientific & Technical Information Division
Attention: Miss Winnie M. Morgan

FROM: GP/Office of Assistant General Counsel for Patent Matters

SUBJECT: Announcement of NASA-Owned U. S. Patents in STAR

In accordance with the procedures agreed upon by Code GP and Code USI, the attached NASA-owned U. S. Patent is being forwarded for abstracting and announcement in NASA STAR.

The following information is provided:

U. S. Patent No. : 3,570,785

Government or Corporate Employee : U.S. Government

Supplementary Corporate Source (if applicable) :

NASA Patent Case No. : MFS-20130

NOTE - If this patent covers an invention made by a corporate employee of a NASA Contractor, the following is applicable:
Yes ☐ No ☑

Pursuant to Section 305(a) of the National Aeronautics and Space Act, the name of the Administrator of NASA appears on the first page of the patent; however, the name of the actual inventor (author) appears at the heading of Column No. 1 of the Specification, following the words ". . . with respect to an invention of . . ."

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Enclosure
Copy of Patent cited above

FACILITY FORM 602
N71-27585 (ACCESSION NUMBER) (THRU)
16 (PAGES) 00 (CODE)
(NASA CR OR TMX OR AD NUMBER) 28 (CATEGORY)

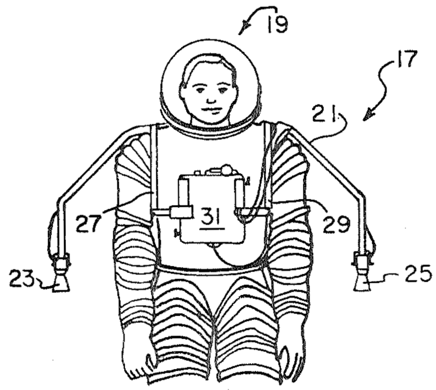

FIG. 1

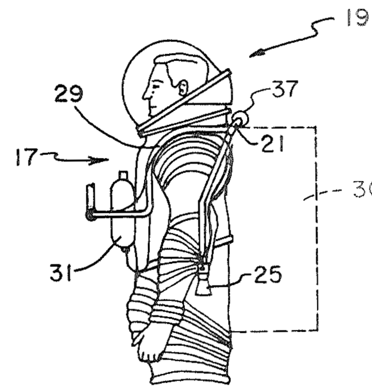

FIG. 2

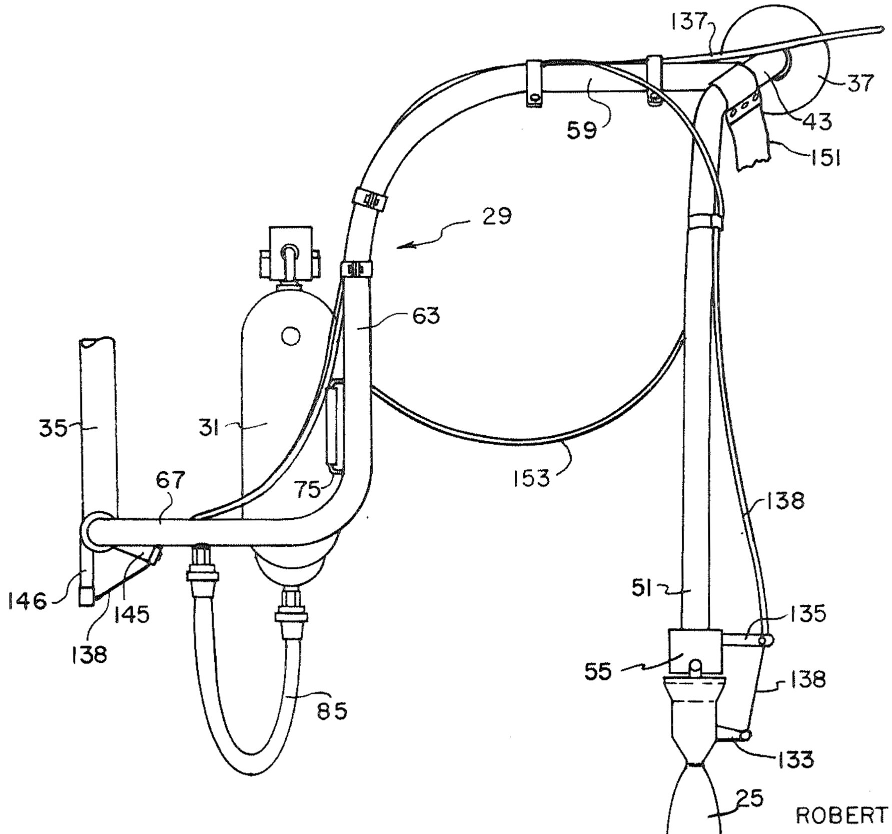

FIG. 5

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PATENTED MAR 16 1971 3,570,785

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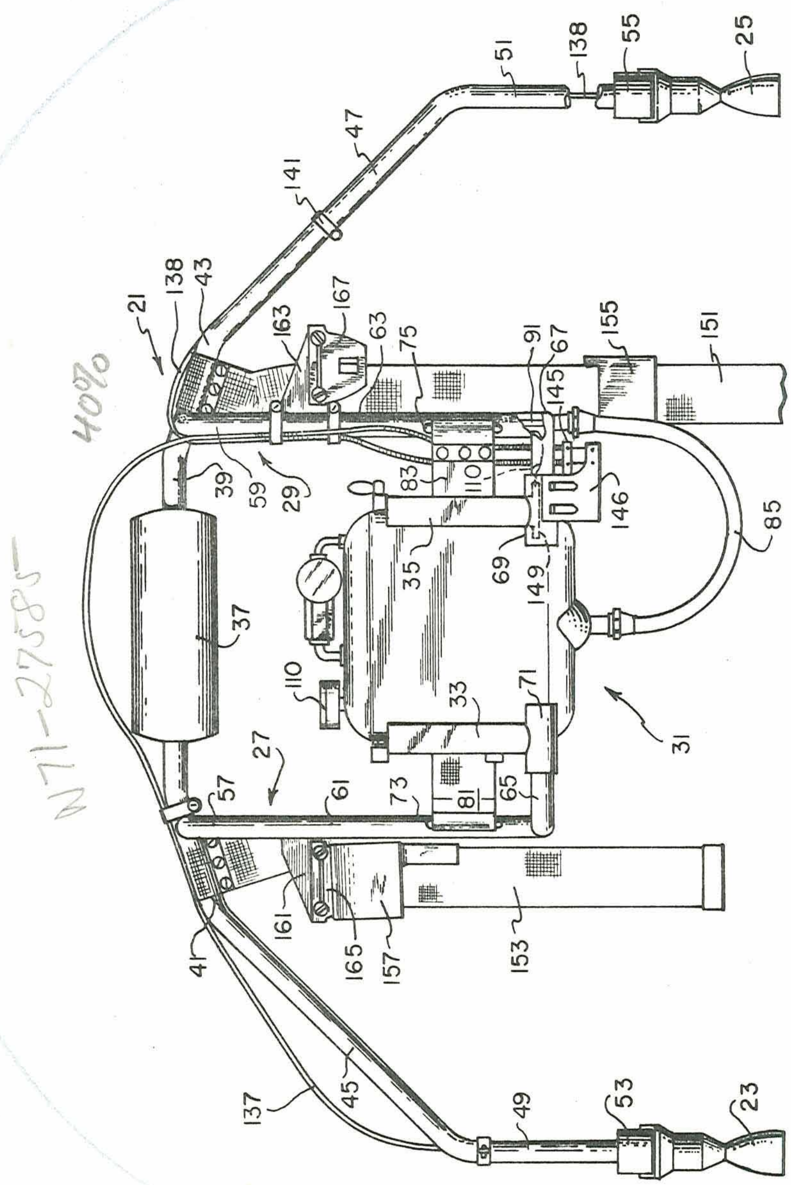

FIG. 3

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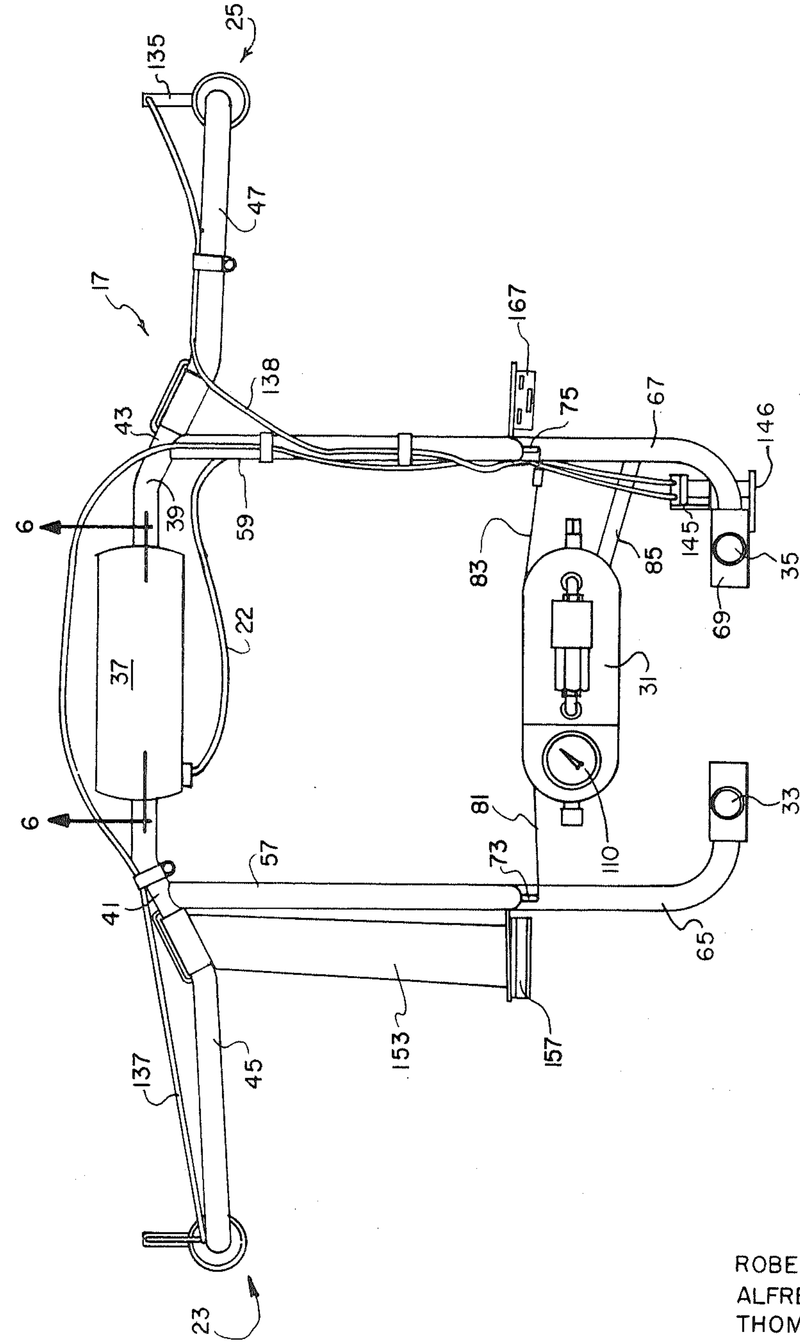

FIG. 4

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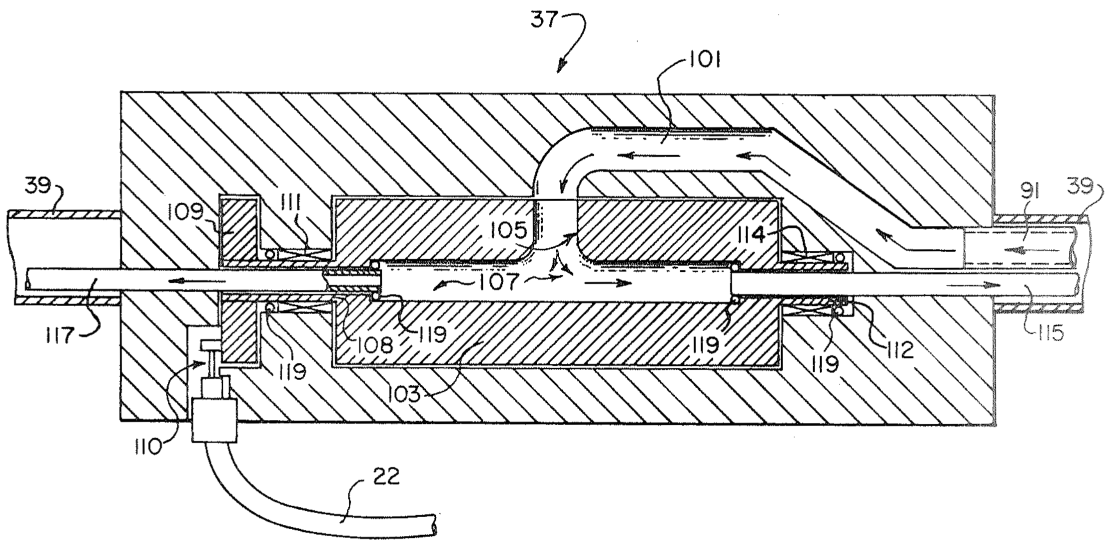

FIG. 6

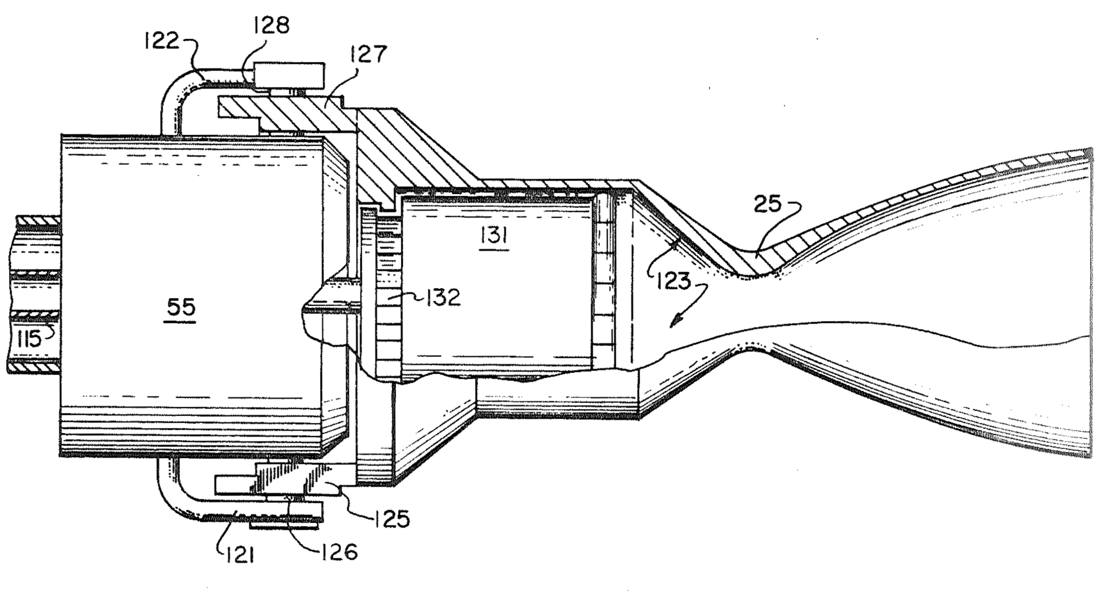

FIG. 7

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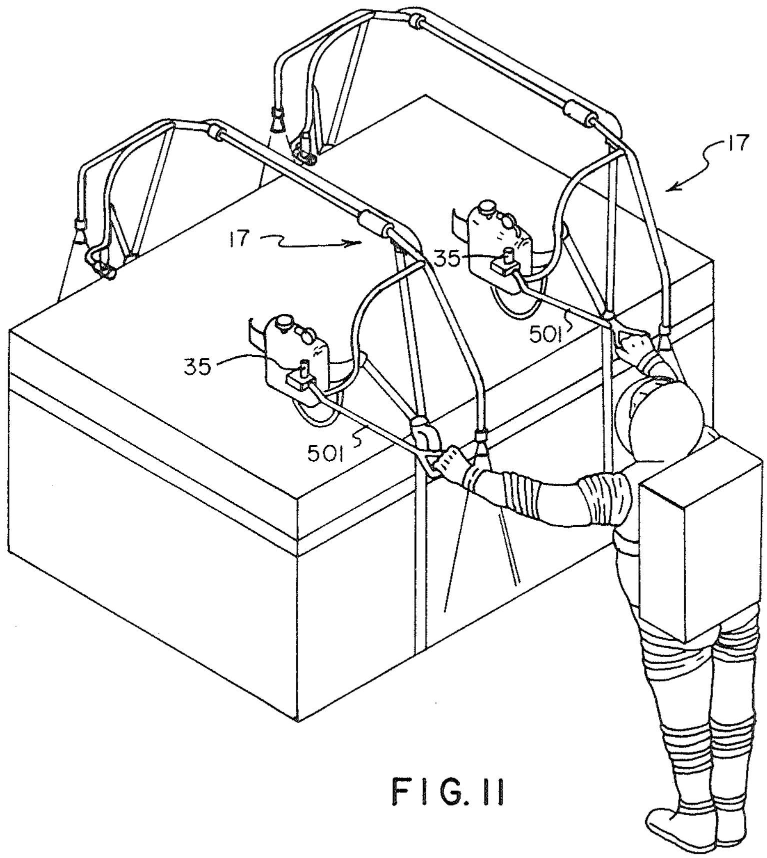

FIG. 11

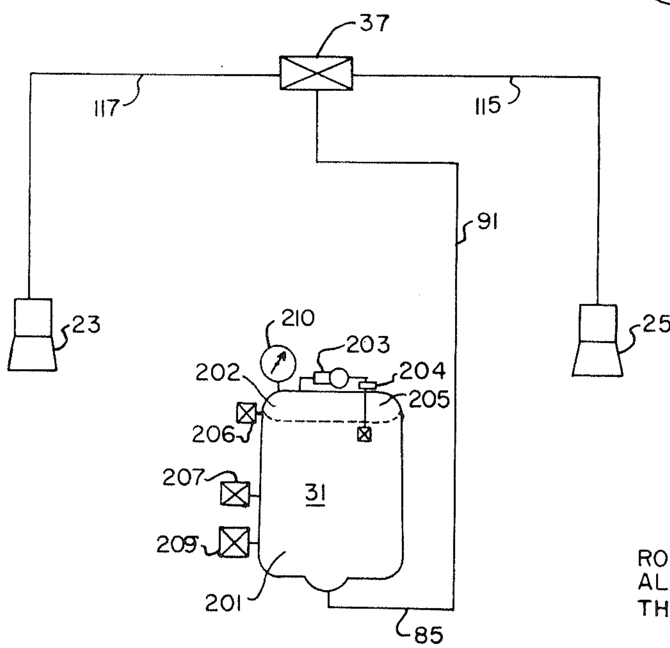

FIG. 8

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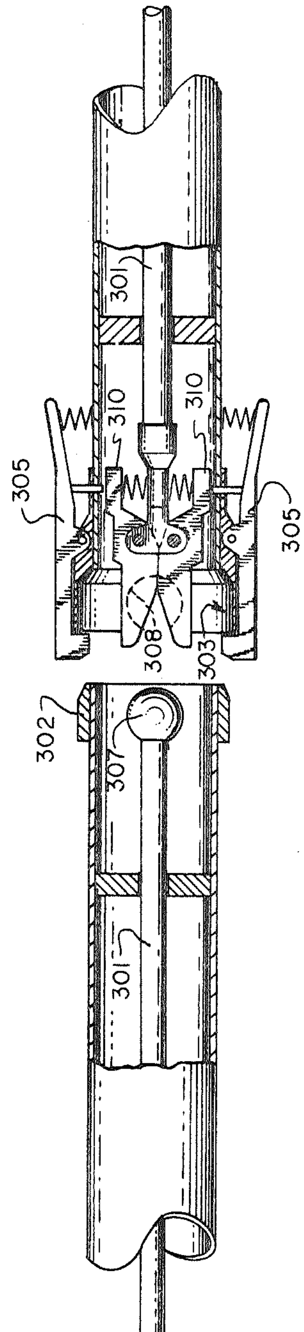

FIG. 9

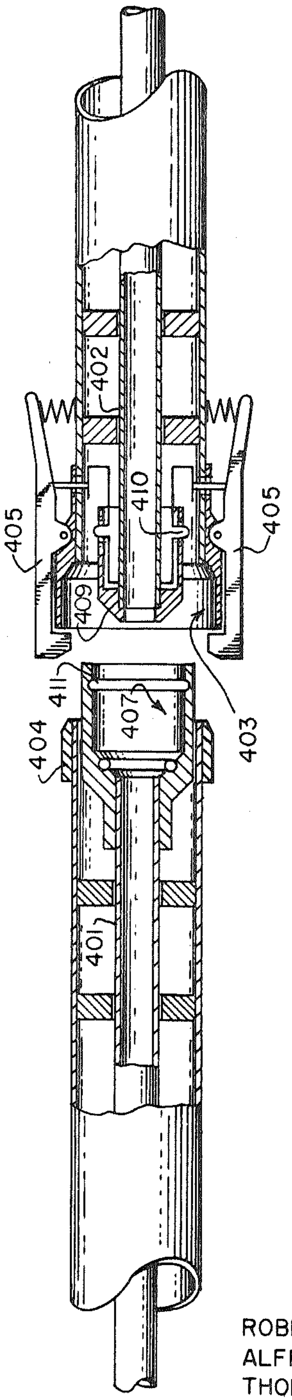

FIG. 10

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United States Patent

[11] 3,570,785

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[22] Filed Mar. 24, 1969
[45] Patented Mar. 16, 1971
[73] Assignee The United States of America as represented by the Administrator of the National Aeronautics and Space Administration

[54] PERSONAL PROPULSION UNIT
1 Claim, 6 Drawing Figs.

[52] U.S. Cl. 244/4
[51] Int. Cl. B64c 39/00
[50] Field of Search 244/1, 4, 4.1, 52, 2; 60/257, 215, 218; 224/5.15, 5.24, 6, 9, 10, 11, 25, 25.1; 137/209; 222/52, 61, 399

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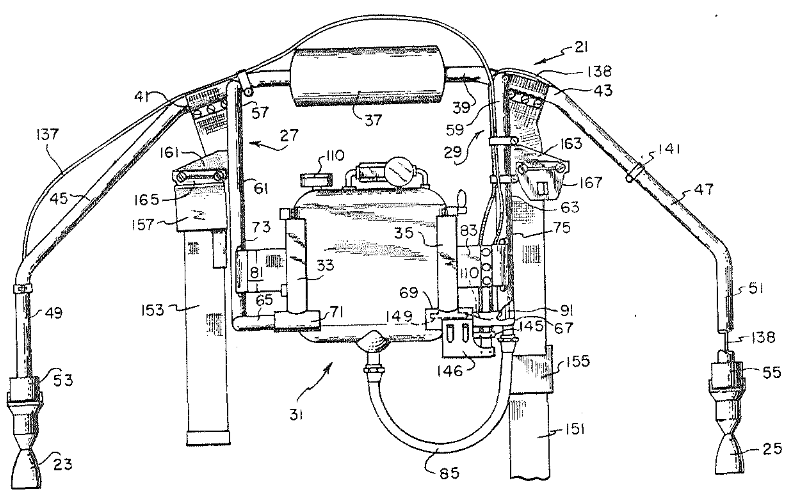
ABSTRACT: A monopropellant propulsion system which is used as an assist unit to augment an astronaut's jumping ability on the lunar surface. The unit is composed of a tubular framework which fits onto the shoulders of an astronaut and supports a disposable propellant tank adjacent the astronaut's chest and has thrusters adjacent each side of the astronaut about at the level of the hips. Propellant lines are contained within the tubular framework. Controls are provided for tilting the thrusters toward the front and back as well as for throttling the thrusters. Extensions may be added to the tubular framework to achieve different configurations, such as would be suitable for cargo handling.



PERSONAL PROPULSION UNIT

ORIGIN OF THE INVENTION

The invention described herein was made by employees of the United States Government and may be manufactured and used by or for the Government for governmental purposes without the payment of any royalties thereon or therefor.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a propulsion unit and more specifically to a small propulsion unit suitable to assist movement of personnel and equipment across the lunar surface.

2. Description of the Prior Art

Propulsion units have recently been developed which are suitable for mounting on a person and are capable of lifting the person from the ground and propelling him to another location. These units, however, were designed for use on the earth and are relatively heavy and complicated. They do provide a safe, reliable, and easily controllable rocket propulsion system for use on the earth.

Such propulsion systems are not satisfactory for use on the moon by astronauts because of their rather complicated structure which present reliability problems in an extremely, remote and harsh environment but also their bulk and design interfere with the life support equipment the astronaut must carry while operating in a cumbersome pressurized suit.

SUMMARY OF THE INVENTION

In the present invention a simple, lightweight personal propellent propulsion unit is provided which enables an astronaut to increase his mobility both horizontally and vertically on the lunar surface. The unit will not interfere to any appreciable extent with the normal movement of the astronaut or with the other equipment usually associated with a lunar space suit. It may also be used by an astronaut operating in space and other low gravity situations.

The unit has a tubular structure adapted to fit across the upper back of the astronaut with a distinct thrust structure extending down and outwardly on each side of the astronaut to support thrusters. Also, another distinct pipe structure extends down and in front of the astronaut to which is fitted a disposable fuel tank. Fuel lines from the fuel tank are generally contained within the tubular structure between the fuel tank and thrusters. A control means with control lines is readily available to the astronaut to pivot the thrusters toward the front and back as well as a control means to throttle the fuel to the thrusters. Straps extend from the tubular structure and under the armpits of the astronaut. During operation, the astronaut receives the thrust as lift applied under his armpits. The tubular structure may readily be modified on the lunar site by the astronaut by the use of tubular extensions so it may be adapted to move large and irregular shaped objects.

Accordingly, it is an object of the present invention to provide a simple, lightweight, propulsive backpact unit suitable for use by an astronaut on the lunar surface.

Another object is to provide a compact astronaut propulsion unit which will not interfere with the mobility of the astronaut or his life support equipment.

Yet another object is to provide a personal propulsion unit which may be readily adapted to other uses.

Other objects and advantages of the present invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1 and 2 are front and side views of an astronaut wearing the propulsion unit of the present invention;

FIG. 3 is a front view of the propulsion unit;

FIG. 4 is a top view of the propulsion unit;

FIG. 5 is a side view of the propulsion unit;

FIG. 6 is a sectional view of the throttle component taken along line 6–6 of FIG. 4.

FIG. 7 is a partial sectional view of a thruster;

FIG. 8 is a schematic illustrating the propulsion system;

FIG. 9 is a sectional view of a control cable quick disconnect fitting;

FIG. 10 is a sectional view of a propellant line quick disconnect fitting; and

FIG. 11 is a view of two propulsion units modified to support a rectangular box.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, and in particular to FIGS. 1 and 2 wherein is illustrated a propulsion unit **17** of the present invention in operating position on an astronaut **19**. The unit **17** is composed essentially of a tubular pipe structure **21** which rests across the upper back of the astronaut **19** and extends downwardly along each of his sides to support thrusters **23** and **25**. Two other pipe structures **27** and **29** are integrally joined to the back pipe structure **21** and extend across the shoulders and downward in front of the chest. A propellant tank **31** is fitted between the two front pipe structures **27** and **29**. A control handle **35** extends from the left-hand front structure **29** and controls a throttle component **37** adjacent the neck of the astronaut **19** as well as the front and back movement of the thrusters **23** and **25**. The life support equipment **30** normally carried by the astronaut **19** is indicated by dash lines in FIG. 2.

The back tubular pipe structure **21** shown in more detail in FIGS. 3, 4 and 5 has a center horizontal portion **39** containing the throttle component **37**, which will be discussed further in regard to FIGS. 6 and 7. The back pipe structure **21** has a right and left short portions **41** and **43** joined to the center portion **39** each of which slants downwardly as well as toward the front, slightly, so as to follow the shoulder line of the astronaut. From each short portion **41** and **43**, right and left long portions **45** and **47** extend out from the sides of the astronaut and forward to a location offset from the middle of the upper arm. Also, right and left short portions **49** and **51** extend straight down from the long portions **45** and **47** to the thrusters **23** and **25**, respectively which are at a location offset from the astronaut's waist.

Adjacent each end of the central pipe portion **39**, left and right pipe arms **27** and **29** of the front pipe structure extends in a curving manner across the upper shoulder of the astronaut so as to form upper shoulder portions **57** and **59**. From the shoulder portions **57** and **59** each front arm structure extends straight down along the astronaut's front side to about the middle of his chest to form what is identified as chest portions **61** and **63**. At this point, each right and left arm **27** and **29** extends horizontally outward for a short distance to form two cantilevered portions **65** and **67** (see FIGS. 4 and 5). The outward ends of the cantilevered portions are turned toward each other at a right angle and support right and left control handles **33** and **35**.

The left cylindrical control handle **35** as shown best in FIG. 3, has a base collar **69** rotatably joined to the ends of the left cantilevered portion **67**. The left handle **35** is also rotatably attached to a limited extend within its base collar **69**. The right cylindrical handle **33** as well as its collar **71** is rigidly joined to the end of the right cantilevered portion **65**.

As indicated best in FIGS. 3 and 4, a propellant tank **31** is fitted between the chest arm portions **27** and **29** so as to be positioned in front of the astronaut's chest. The right and left chest arm portions **27** and **29** each have a U-shaped bar **73** and **75** welded thereto which receives a C-shaped clasp of a supporting belt, attached to the back of the propellant tank **31**. The belt is in two parts, and the right part **81** is made of thin metal and the left part **83** is made of a stretchable web material.

A flexible detachable hose **85** connects with the fuel compartment of the tank **31** by a suitable fitting and extends to the left control arm structure **29** where it is joined to a fitting within the cantilevered arm portion 67 (shown best in FIGS. 3 and 5) which is attached to a propellant or fuel line 91 contained therein. The astronaut by stretching the tank belt web 83 may remove the clasp from the left structural arm portion 29 and also by detaching the hose 85 from the fittings may remove the tank 31 and if desired, dispose of it. A filled tank 31 may easily be placed in operating position in a similar manner.

The tubular fuel line 91 extends upwardly through the left front pipe 29 as indicated by FIG. 3, and then through the central pipe portion 39 to the throttle component 37 located next to and behind the astronaut's neck. The throttle component 37, shown in section in FIG. 6, has an internal inlet passageway 101 in its main body connected with the fuel line 91. A cylindrical, Teflon coated valve plug 103 is rotatably mounted within the main body. The valve plug 103 has a center circular opening 105 extending into longitudinal passageway 107 which feeds the left and right fuel lines 115 and 117 within the central pipe portion 39. The right side of the valve plug 103 is secured by a short integral sleeve 108 which partially encloses the propellant line 117 and is rigidly secured to a circular member 109. A control cable 110 is attached to the lower periphery of member 109. The right integral sleeve 108 is mounted in a suitable bearing 110 which permits rotation of the sleeve 108 and thus the valve plug 103. The left side of the valve plug 103 also has a short integral sleeve 112 which partially encloses the fuel line 115. The left sleeve 112 is also mounted in a bearing 114 which allows for rotation of the sleeve 112.

In operation, the pulling or pushing of the control cable 110 will cause the circular member 109 to rotate thereby causing the valve plug 103 to rotate and position its circular opening 105 in or out of alignment with fuel inlet passageway 101. Suitable O-rings 119 serve to prevent any fuel leakage into the pipe structure 39.

The throttle component 37 may be modified for additional throttling mechanisms on each propellant line 115 or 117 in order to obtain differential thrust chamber throttling for roll control. A suitable throttling mechanism would be needle valves which would be controlled, for example, by a modified right handle 33.

The left thruster structure 25 secured to the left short pipe portion 51 is shown in detail by FIG. 7. The thruster 25 has a collar 55 attached to the lower end of the short pipe portion which has side extending ears or lugs 121 and 122. The upper portion of the thruster chamber 123 has two upstanding portions 125 and 127 with shafts 126 and 128 rotatably secured to the ears 121 and 122 whereby the thruster chamber nozzle structure may pivot toward the front and back. An integral catalyst silver screen insert 131 with a fuel dispensing plate 132 is positioned within the upper portion of the thruster chamber-nozzle structure and is attached to the end of the flexible propellant fuel line 115. The fuel line 115 is sufficiently flexible as to allow the pivoting of the thruster chamber-nozzle structure without "kinking" or constricting.

FIG. 5 shows another lug 133 which extends from the back of the thruster chamber-nozzle structure 25 and still another lug 135 which extends from the back of the thruster collar 55. A left control cable 138 with a protective sleeve extends along the left side portions of the pipe structure 21. The protective sleeve is clamped to the collar lug 55 and the cable itself 138 is clamped to the thruster-nozzle structure lug 133. Thus, the control cable 138 may push or pull the thruster chamber-nozzle 25 toward the front and back of the astronaut.

Right thruster 23 is identical to the thruster 25 and also has, as shown by FIG. 3, a similar right control cable 137. The left and right control sleeve and cables 138 and 137 are secured by clamps 141 to the back pipe structure 21 but both are guided down the left front pipe structure 29 to a bracket 145 secured to the back surface of the right angled part of cantilevered portion 67, as shown best in FIGS. 3 and 4.

A bracket 146 is also secured to the front of the left rotatable collar 69, and the thruster control cables 137 and 138 from both the right and left thrusters 23 and 25 are secured to the bracket 146 while their protective sleeves are secured to the stationery bracket 145. It is now apparent that the astronaut by pushing and pulling on the left control handle 35 will cause a rotation of the base collar 69 and a corresponding pushing and pulling on the control cables 137 and 138.

It has previously been noted that the left handle 35 is rotatably attached to the base collar 69. As indicated by dash lines in FIG. 3, the rotatable handle 35 extends within the base collar and has a front attached bracket 149, internal of the collar 69, which is attached to the control cable 110 which extends to the circular member 109 of the throttle component 37 discussed in regard to FIGS. 6 and 7. As indicated by FIG. 4, the throttle control cable 110 extends upwardly within the left front pipe structure 29 but exits from an opening adjacent the back pipe 21 structure and extends directly to the throttle component 37. The throttle control cable 110 is provided with a protective sleeve 22 between the throttle component 37 and the right front pipe structure 59.

Thus it is apparent that the astronaut by rotating the left control handle 35 on its own longitudinal axis will cause a pulling or pushing on the throttle component control cable 110. The right control handle 33 which is fixed to the right front pipe structure 27 aids the astronaut in maintaining stability and control.

Referring again to FIG. 3, there is shown right and left straps or belts 153 and 151 attached, respectively, to the right and left short portions 41 and 43 of the back pipe structure 21. The belts 153 and 151 (as indicated by FIG. 3) are adapted to extend from the back pipe structure 21 under the armpits of the astronaut 19 and to be clamped to their respective right and left front pipes structure 27 and 29 by quick release buckles 157 and 155. For this purpose flanges 161 and 163 are secured to the side surface of the right and left pipe arm structure 27 and 29 adjacent the end of the shoulder portions 57 and 59. Fasteners 165 and 167, adapted to cooperate with the respective buckles 157 and 155, are secured to each of the flanges 161 and 163. As presented in FIGS. 3, 4 and 5, the right strap 153 is shown with its quick release buckle 157 secured to the right fastener 165 and the left strap 151 is shown hanging downwardly, with its buckle 155 unattached to the left fastener 167. The belts 151 and 153 may be adjusted to the proper length by sliding of the buckles 155 and 157.

The propulsion piping of the unit is schematically illustrated in FIG. 8 and in this example is particularly designed for using hydrogen peroxide or hydrazine as the propellant. The propellant is stored in the fuel tank 31 within a lower compartment 201 and is pressurized by nitrogen gas located within an upper compartment 202. The nitrogen is forced through a filter and pressure regulator 203 after the opening of a start valve 204 by the astronaut and also through a check valve 205 and into the lower compartment 201 which contains the hydrogen peroxide. The nitrogen compartment 202 has a fill and vent valve 206 and the hydrogen peroxide compartment 201 has a fill and drain valve 207 and a vent valve 209. A pressure gauge 210 for the upper compartment is also available.

In operation, the propellant is forced into the fuel (or propellant) line 85 extending from the tank 31 and through the left control pipe propellant line 91 to the throttle valve 37 which divides and directs the propellant into the left and right back fuel lines 115 and 117 to the thrusters 23 and 25. The thrusters 23 and 25, as previously noted, have a silver screen bed which provides catalytic decomposition of the hydrogen peroxide into superheated steam and water which expands into the thruster chamber and provides the rocket thrust.

The propulsion unit 17 disclosed is simple, lightweight, and is adapted to serve primarily as a boost assist unit to augment an astronaut's jumping ability on the lunar surface. It can be worn by an astronaut with very little interference with his mobility or life support equipment. The unit 17 can assist the astronaut in obtaining lengthy horizontal distance jumps by supplying a horizontal thrust and by reducing the net vertical acceleration force component acting downwardly.

The unit could easily be made so as to be taken apart for storage. Also, it could be provided with pipe extensions units such as illustrated in FIGS. 9 and 10.

FIG. 9 shows a quick disconnect end fitting for either a structural tubular pipe with an internal cable, or a control cable protective sleeve with an internal cable (wire). While the structural pipe, as indicated by the prior FIGS., is considerably larger than the flexible control cable, for purposes of a disconnect end fitting they could both be similarly modified for an extension as indicated by this FIG. One end of the pipe (or sleeve, as the case may be) has a male collar **302** adapted to be received by a receptacle **303** on the other pipe end. Spring loaded latches **305** on the outer surface of the receptacle pipe end hold the rear of the male collar **302** and prevent the two end pipes from becoming disengaged. The control cable **301** on the male pipe end has an end ball **307** which is received within the hollow recess **308** formed by two spring clamps **310** on the other cable end within the receptacle pipe.

FIG. **10** shows a quick disconnect end fitting for a tubular pipe with an internal propellant line **401**. Again one end of the pipe has a male collar **404** adapted to be received by a receptacle **403** within the other pipe end together with spring loaded clamps **405** for preventing the two pipe ends from pulling apart. One end of the propellant line has a receptacle **407** which is adapted to receive the male member **409** attached to the other propellant line **402** end. The male member **409** has spring loaded detents **410** which spring outwardly when connected to the receptacle **407** into a peripheral recess **411** and thereby prevent the two ends from separating. The detents may be pushed inwardly by the clamps **405**.

By using extensions such as shown in FIGS. **10** and **11** the basic configuration of the unit **17** could be substantially altered. For example, a unit could be transformed into a portable crane to transport cargo as shown by FIG. **11**. In FIG. **11**, a remote control extension **501** handle is clamped onto the left control handle **35** of each unit **17** being used so that the astronaut may conveniently operate the unit.

It is now apparent that a novel propulsion unit has been disclosed which is particularly adapted for use by astronauts. Obviously, many modifications and variations of the present invention are possible in light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims the invention may be practiced other than as specifically claimed.

We claim:

1. A propulsion unit, comprising:

a substantially U-shaped, rigid, main tubular pipe structure;

a thruster structure pivotally secured to each end of said main pipe structure;

a pair of rigid tubular arm structures secured to said main tubular pipe structures adjacent each side of its middle portion;

said arm structure extending outwardly from the middle portion of said main pipe structure and then in the same general directions as the ends of the main pipe structure so as to be offset and between said thrusters;

a propellant tank secured to and extending between said arm structures;

means for directing propellant from said propellant tank to said thrusters, said means including propellant lines contained within said main tubular structure;

a control means secured to one of said tubular arm structure;

cable means extending between said control means and said thrusters for causing pivoting of said thrusters; and

said propellant tank is detachably secured to one of said arm structures with a metal strap and at the other of said arm structures with a stretchable web belt.