United States Patent

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[54] **MANEUVERING UNIT**
10 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **244/1,**
115/6.1, 244/4
[51] **Int. Cl.** **B64g 1/20**
[50] **Field of Search** ..... 244/1 (SS),
1, 4, 4.1; 114/16 (A); 115/6.1

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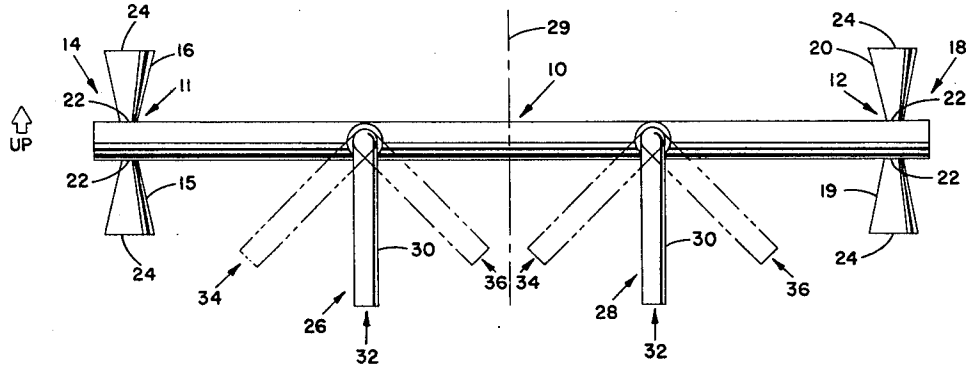
ABSTRACT: A hand-held device for propelling an individual through space wherein pressurized fluid is selectively and individually discharged from oppositely directed coplanar nozzles in response to movement of a pair of control handles relative to a supporting member.



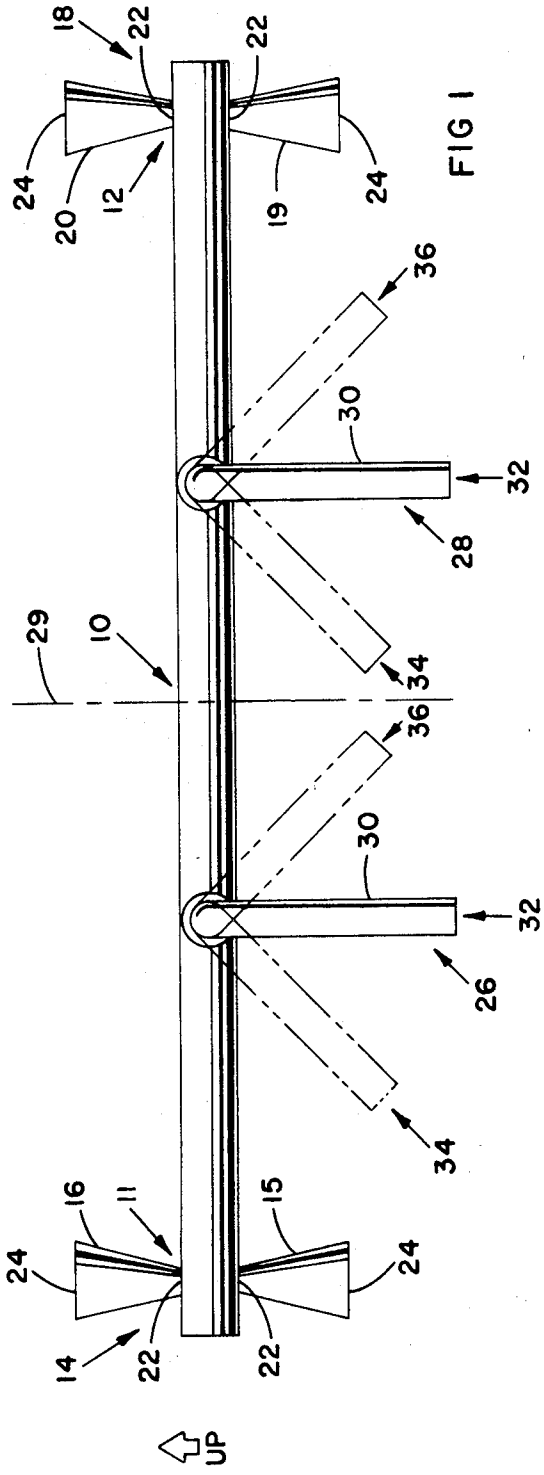


FIG 1

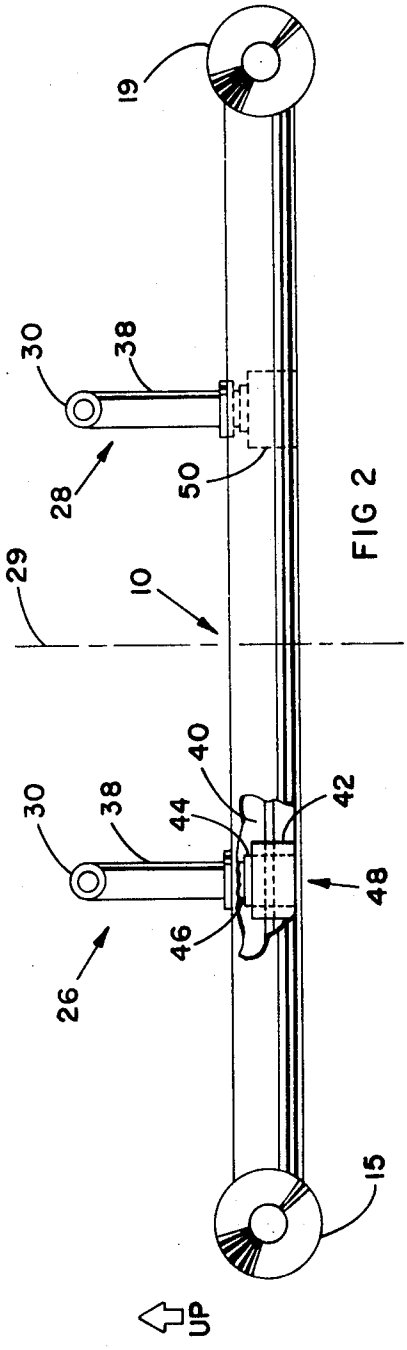


FIG 2

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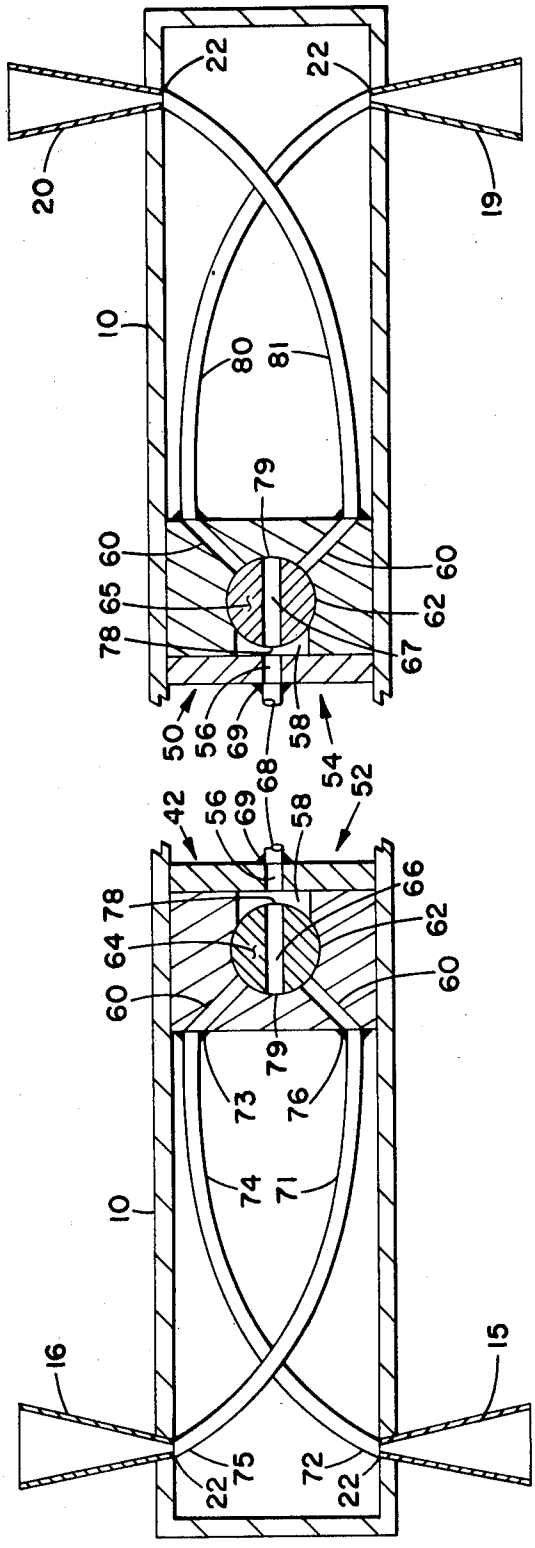

FIG 3

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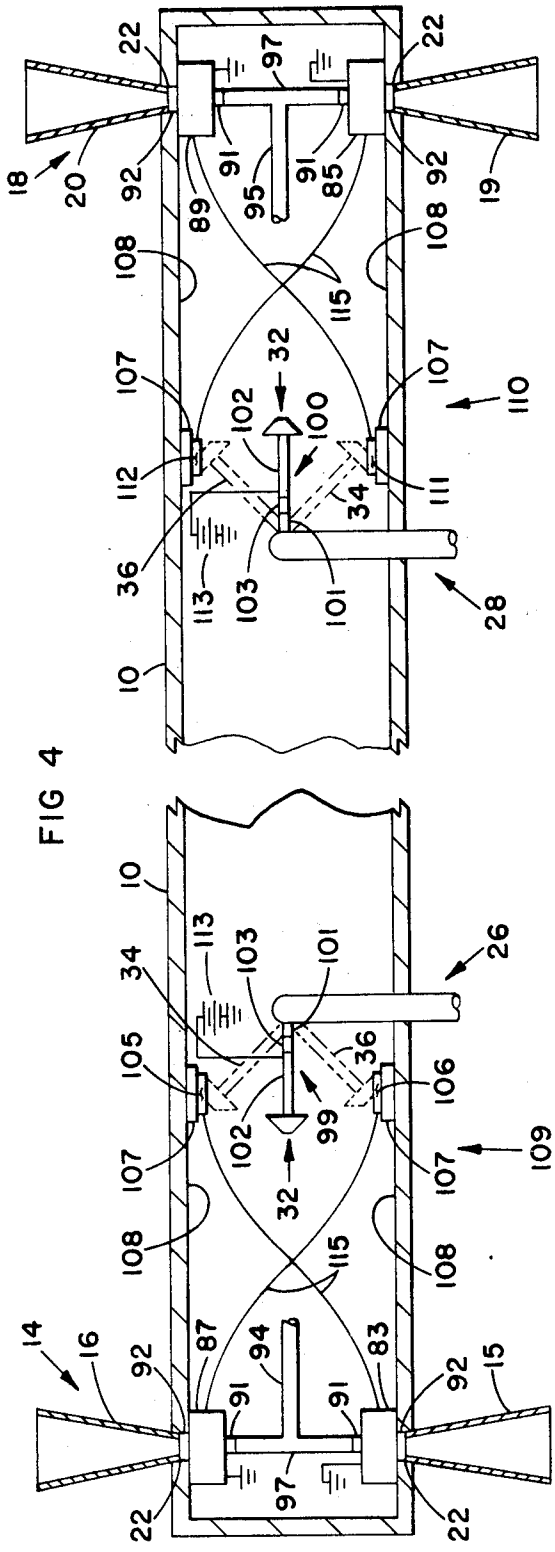

FIG 4

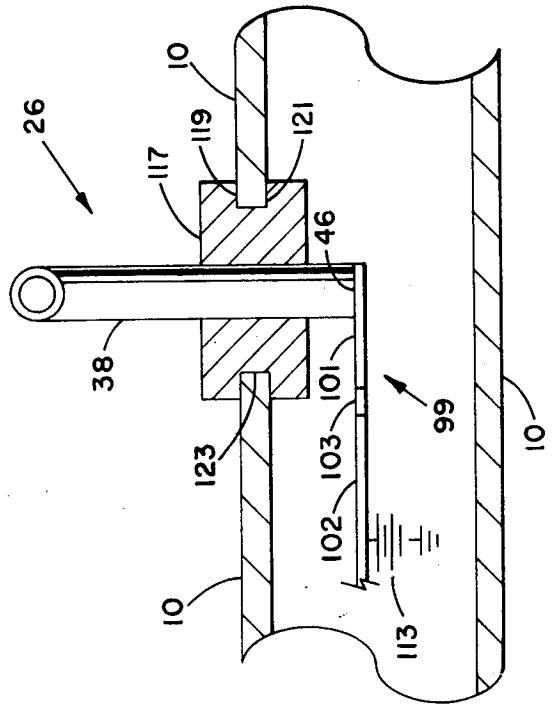

FIG 5

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MANEUVERING UNIT

This invention relates to thrust-propelled devices and, more particularly, to an improved hand-held maneuvering unit for propelling an individual through space.

In the future, activities of a human individual in space will often require a large portion of time spent independently and apart from his space vehicle. His duties in outer space will comprise such functions as the repair of space stations, the making of exterior adjustments to space vehicles, and the direction of docking maneuvers.

In order to move effectively and efficiently in space from one position to another, it is necessary for the operator to sense satisfactorily the point of actuation of the controls, easily align the propelling forces relative to his longitudinal axis and/or his center of mass, and obtain delivery of opposed propelling forces that are symmetrically spaced from his longitudinal axis and/or his center of mass.

Space travel demands the utilization of heavy protective clothing which obstructs the operator's tactile and kinesthetic senses. The control actuating means of prior maneuvering units do not require sufficient motion of the control means actuator relative to a fixed reference to enable a properly clothed operator to sense satisfactorily the point of actuation of the control.

Previously used maneuvering units which are attached to the operator's body are generally bulky, relatively complex and expensive, contain numerous moving parts which tend to malfunction, and deliver forces which are not easily aligned relative to the operator's longitudinal axis or his center of mass.

Hand-held maneuvering units are less bulky and complex and contain fewer moving parts than prior, body-mounted units, but often deliver propelling forces which are difficult to align relative to the operator's longitudinal axis and/or his center of mass and generally are not constructed to deliver opposed propelling forces that are applied in locations symmetrically spaced from the operator's longitudinal axis and/or his center of mass and that act in either of two, opposed directions.

It is, accordingly, a major object of this invention to provide an improved propulsive device for use by an individual in a substantially zero-gravity environment.

A related object is to provide, for such a device, control means easily and accurately operable through less acute use of the kinesthetic sense than in previous devices for such purpose.

Another object is to provide a device of the above character, which device has increased maneuverability.

A further object is to provide a device of the above character, which device has more accurate maneuverability characteristics.

Yet another object is to provide a device of the above character, which device is more easily aligned relative to the operator's center of mass and his longitudinal axis than previously used devices.

A still further object is to provide a device of the above character which device is small, compact, and of low mass.

Still another object is to provide a device of the above character, which device is simple and economical to construct.

Other objects and advantages will be apparent from the specification and claims and from the accompanying drawing illustrative of the invention.

In the drawing:

FIG. 1 is a view of an embodiment of the device of the invention in one of its preferred operating positions;

FIG. 2 is a view of the device of FIG. 1 in another preferred operating position, portions of the supporting member being cut away;

FIG. 3 is an enlarged plan view, partially in longitudinal section, of the controlling means of the device of FIG. 1, portions of the device being cut away;

FIG 4 is an enlarged plan view, partially in longitudinal section, of a modification of the controlling means of the device of FIG. 1, portions of the device being cut away and electrical connections being shown schematically; and

FIG. 5 is an enlarged frontal view, partially in longitudinal section, of the controlling means of FIG. 4, portions of the device being cut away and electrical connections being shown schematically.

Referring to FIG. 1, an elongated member **10** of the device of this invention has a longitudinal axis (not shown) and first and second end portions **11, 12**. The length of the member **10** is greater than the breadth of the body of an average, adult, male person.

A pair of oppositely directed, coaxial, coplanar nozzles (**14** or **18**), each nozzle **15, 16, 19, 20** of a nozzle pair having a longitudinal axis (not shown) and inlet and outlet ends **22, 24**, are rigidly and perpendicularly attached to each member end portion **11, 12** with the longitudinal axes (not shown) of the two pairs **14, 18** lying in a common plane (not shown). The first and third nozzles **15, 16** constitute the first nozzle pair **14** of the device and are rigidly attached to the member's first end portion **11** with the inlet end **22** of the first nozzle **15** adjacent the inlet end **22** of the third nozzle **16**. The second and fourth nozzles **19, 20** constitute the second nozzle pair **18** of the device and are rigidly attached to the member's second end portion **12** with the inlet end **22** of the second nozzle **19** adjacent the inlet end of the fourth nozzle **20**. The first and second nozzles **15, 19** are oriented in one, same direction and third and fourth nozzles **16, 20** in another.

The device is provided with first and second control handles **26, 28** which (as will be described) are pivotally mounted on the member **10** in respective positions wherein they are equally spaced from the end portions **11, 12** of the member **10** and separated from each other by a distance preferably greater than the breadth of the body of an average, male person. Of the two handles **26, 28**, the first handle **26** is the nearer to the first nozzle pair **14**. Each handle **26, 28** has a first portion **30** which has a respective longitudinal axis (not shown) and a length greater than the width of the hand of an average, adult, male person, extends laterally from the member **10** in the same direction as the first **15** and second **19** nozzles, and lies in a plane preferably parallel to the nozzles' plane. The first portion **30** of each handle **26, 28** is pivotally moveably relative to the member **10** from a neutral position **32**, in which the longitudinal axis (not shown) of the handle first portion **30** is generally perpendicular to the longitudinal axis of the member **10**, to first **34** and second **36** positions. In the handle's first position **34**, the handle first portion **30** is moved relative to the member **10** to a location preferably 45° clockwise from its neutral position **32** and, in the handle's second position **36**, the handle first portion **30** is moved relative to the member **10** to a location preferably 45° counterclockwise from its neutral position **32**.

Referring to FIG. 2, which shows the first and second nozzles **15, 19**, member **10**, and the handle first portion **30** of FIG. **1**, the second portion **38** of each handle **26, 28** extends laterally from the member **10** and substantially perpendicularly to the member longitudinal axis (not shown) and the nozzle plane (not shown). Rigidly mounted within the hollow interior **40** of the member **10** is a first valve housing **42** from which protrudes the upper end **44** of a rotatable valve element, (shown by broken line) on which element the lower end **46** of the first handle **26** second portion **38** is rigidly mounted by welding or other suitable means (not shown). In this (or equivalent) manner, the end of the handle **46** is individually and rigidly connected to a respective controlling means **48** (i.e., a control valve within the housing) and pivotally mounted on the member **10** for movement from its neutral position (shown) to its first or second position (to be described). The second handle **28** is similarly connected in relation to a second valve housing **50** also mounted within the interior **40** of the member **10**. As shown in FIG. **2**, the handles **26, 28** are preferably tubular in order to endow them with maximum rigidity and to provide a grasping surface of optimum size while employing a minimum of the material of which the handle is made.

As shown in FIG. 3, each valve 52, 54 is of two-way construction and has a housing 42, 50, an inlet port 56 and chamber 58, two outlet ports 60, a seat 62, and a rotatable element 64, 65 which is mounted in the seat and through which conventionally extends a passageway 66, 67. Each valve housing 42, 50 is rigidly attached within the member 10.

The first valve 52 has an inlet conduit 68 having first (not shown) and second ends 69 is attached at its first end to a fluid reservoir (not shown), extends through the member 10, and is attached (by suitable means, not shown) at its second end to the housing inlet port 56, through which it has communication with the housing chamber 58. A conduit 71 having first and second ends 72, 73 is attached at its first end 72 to the inlet 22 of the first nozzle 15, extends through the member 10, and is attached at its second end 73 to one of the housing outlet ports 60, through which it communicates with the valve seat 62. Another conduit 74 having first and second ends 75, 76 is attached at its first end 75 to the inlet 22 of the third 16 nozzle, extends through the member 10, and is attached at its second end 76 to the other of the housing outlet ports 60. The second valve 54 is similar to the first 52.

Each valve element passageway 66, 67 has inlet 78 and outlet 79 ends. Rigidly connected to a respective handle (not shown), each element 64, 65 is sealingly and rotatably mounted within its associated seat 62 by movement by the related handle relative to the member 10, hence the housing (42, 50). Accordingly, the element 64, 65 also has neutral (shown), first, and second positions (to be described). In the neutral position (shown) of the first element 64, the passageway 66 extends along the longitudinal axis (not shown) of the member 10, with the passageway outlet end 79 adjacent and closed by the seat 62. In the first element's first position (not shown), its outlet end 79 preferably opens into the second end 73 of the conduit 71 leading to first nozzle 15 and, in the second position (not shown) of that element 64, its outlet end 79 preferably opens into the second end 76 of the conduit 74 connected to the third nozzle 16. Similarly, when the second element 65 is in its neutral position (shown), its passageway 67 lies along the longitudinal axis (not shown) of the member 10 with the passageway outlet end 79 adjacent and closed by the seat 62. In the first position (not shown) of the second element 65, however, its passageway outlet end 79 preferably is connected to the conduit 80 to the fourth nozzle 20 and, in that element's second position (not shown), its passageway outlet end 79 preferably is connected, by the conduit 81, to the second nozzle 19. At all positions of the handles (not shown), the inlet ends 78 of each element passageway 66, 67 is open into the associated inlet chamber 58.

FIG. 4 shows an alternate controlling means for this device. Four conventional solenoid valves 83, 85, 87, 89, each having inlet and outlet ports 91, 92 are each rigidly connected at its outlet port, by any conventional means, to the inlet end 22 of one of the nozzles 15, 16, 19, 20. A plurality of conduits 94, 95, each having first ends 97 and a second end (not shown) are each rigidly connected at its first ends 97 to the inlet ports 91 of one of the solenoid valves 83, 85, 87, 89 and at its second end (not shown) to a fluid reservoir (not shown).

First and second elongated, switch-actuating bars 99, 100 each having first and second end portions 101, 102, an insulating portion 103 separating the first and second portions, and a longitudinal axis (not shown) are each connected at its first end 101 to a respective one of the handles 26, 28 at the handle end portion (not shown) that is pivotally attached to the elongated member 10. The first bar 99 extends from the handle 26 and within the member 10 along the member's longitudinal axis, preferably in the direction of the nozzle pair 14 nearer that handle, for movement in response to movement of the associated handle 26 from a neutral position 32 wherein the bar 99 lies along the member longitudinal axis to first and second positions 34, 36. As described, the first bar 99 is connected to the first handle 26.

First and second contact elements 105, 106, mounted on respective insulating blocks 107 which electrically isolate them from the elongated member 10, are each rigidly attached to the inner walls 108 of the member 10 adjacent and in the path of the second end portion 102 of the first bar 99 in locations in which the second end portion 102 of the bar 99, at its first position 34, is in electrical contact with the first element 105 and the second end portion 102 of the bar 99, at its second position 36, is in electrical contact with the second element 106. The elements 105, 106 and bar 99 thus cooperate to form a first single-pole, double-throw switch 109. A similar, second switch 110 is formed by the second bar 100 and an associated pair of elements 111, 112 similar to the elements 105, 106 and bar 99.

A power source 113 is connected to the second end portion 102 of each bar 99, 100, and electrical control lines 115 are connected between the contact elements 105, 106, 111, 112 and the solenoid valves 83, 85, 87, 89. As preferred, the first element 105 of the first switch 109 is connected to the solenoid valve 83 associated with the first nozzle 15, the second element 106 of the first switch 109 is connected to the solenoid valve 87 associated with the third nozzle 16, the first element 111 of the second switch 110 is connected to the solenoid valve 89 associated with the fourth nozzle 20, and the second element 112 of the second switch 110 is connected to the solenoid valve 85 associated with the second nozzle 19.

Referring to FIG. 5, (which shows in more detail the first handle 26 and first bar 99 previously described with reference to FIG. 4), the electrical power source 113 is connected, as stated above, to the second end portion 102 of the first bar 99, and the bar insulator 103 is positioned to form a part of the bar 99 lying between the electrical power source 113 and the first end portion 101 of the bar 99. The first end portion 101 of the first bar 99 is within the member 10 and is rigidly mounted to the first handle end 46 by welding or other suitable means. A bearing 117 having a peripheral groove 119 encompasses the handle second portion 38 adjacent an opening through the member 123 and is preferably rigidly attached to the handle second portion 38. The handle 26 is pivotally mounted through the member opening 123 by extension of material of the member wall 121 into the peripheral groove 119 of the bearing 117, the bearing being rotatable relative to the member 10. The second handle (not shown) and second bar (not shown) are similar to the first.

In the operation of the device, the operator grasps in his hands the second portion 38 of each handle 26, 28 and places the member directly in front of his body. The device is operable at any alignment of the nozzle plane relative to the longitudinal axis 29 of the operator's body, but it is preferred that the device be operated from only two positions. In one of the preferred operating positions, shown in FIG. 1, the nozzle plane is parallel to the longitudinal axis 29 of the operator. In the other preferred operating position, shown in FIG. 2, the nozzle plane bisects the body of the operator substantially perpendicularly to his longitudinal axis 29.

Referring to FIG 1, placement of the handles 26, 28 in their neutral position 32 prevents the passage of fluid to the nozzles 15, 16, 19, 20. Clockwise rotation of the first handle 26 to its first position 34 permits fluid to flow through the first nozzle 15, and counterclockwise rotation of the handle to its second position 36 permits fluid to flow through the third nozzle 16. Clockwise rotation of the second handle 28 to its first position 34 permits fluid to flow through the fourth nozzle 20, and counterclockwise rotation of the handle 28 to its second position 36 permits fluid to flow through the second nozzle 19.

The discharge of fluid through the nozzles 15, 16, 19, 20 moves the member 10 and the operator relative to a fixed point. The direction of movement of the operator relative to a fixed point is controlled by positioning the member 10 at, for example, one of the preferred positions and passing fluid through the nozzles 15, 16, 19, 20. Since all nozzles 15, 16, 19, 20 are preferably connected to a common reservoir and are the same size, the thrust of simultaneously actuated nozzles are the same. With the member 10 in the preferred position shown in FIG. 1, movement of the first handle 26 to its first position 34 and the second handle 28 to its second position 36

releases fluid from the first and second nozzles **15**, **19** and moves the member **10** and the operator upward. Movement of the first handle **26** to its second position **36** and the second handle **28** to its first position **34** releases fluid from the third and fourth nozzles **16**, **20** and moves the operator downward. Clockwise movement of both handles **26**, **28** to their first positions **34** releases fluid from the first and fourth nozzles **15**, **20** and rotates the member **10**, hence, the operator, clockwise in a plane substantially normal to the longitudinal axis **29** of the operator. Counterclockwise movement of both handles **26**, **28** to their second positions **36** releases fluid from the second and third nozzles **19**, **16** and rotates the member **10** counterclockwise.

With the member of the preferred position shown in FIG. **2**, movement of the first handle **26** to its first position **34** and the second handle **28** to its second position **36** releases fluid from the first and second nozzles **15**, **19** and moves the member and the operator forward. Movement of the first handle **26** to its second position **36** and the second handle to its first position **34** releases fluid from the third and fourth nozzles **16**, **20** and moves the operator backward. Clockwise movement of both handles **26**, **28** to their first positions **34** releases fluid from the first and fourth nozzles **15**, **20** and rotates the operator clockwise around his longitudinal axis. Counterclockwise movement of both handles **26**, **28** to their second positions **36** releases fluid from the second and third nozzles **19**, **16** and rotates the operator counterclockwise around his longitudinal axis.

The handle first portion **30** effects a spacing of the handle second portion **38** from the nozzle plane. Most previously used maneuvering units do not have a vertical spacing between their nozzle plane and their control actuating-member and thus are difficult to operate at positions below the center of mass of the operator. By constructing the unit of this invention with two handles longitudinally spaced in the elongated member, the unit is more easily moved from one position to another and aligned relative to the longitudinal axis and/or the center of mass of the operator.

Since the forces produced by operation of the nozzles are equal, easily located substantially the same distance from the longitudinal axis of the operator, and can be easily positioned and aligned relative to the center of gravity of the body of the operator, the device has improved operating characteristics and provides, as compared to previously used maneuvering units, increased and more accurate maneuverability of the operator. Because the device has only four nozzles and simple controlling means, the device is small, compact, of low mass, and is simple and economically constructed.

Referring to the preferred control means shown in FIG. **3**, relatively large movements of the handles **26**, **28** are required to rotate the valve elements **64**, **65** from their neutral positions (shown) to their first or second positions. By constructing a unit which requires larger movements of the control actuating means than previously used maneuvering units, operation of the unit requires less acute use of the operator's kinesthetic sense.

Referring to FIG. **4**, operation of the controlling means shown therein also requires relatively large movements of the handles **26**, **28** for actuation of the nozzles, as described above. With the handles in the neutral position **32**, the flow of fluid from the reservoir is blocked by the solenoid valves **53**, **85**, **87**, **89**. Movement of the first handle **26** to its first position **34** moves the bar second end portion **102** into contact with the first element **105** and completes an electrical circuit which energizes and thereby opens the first solenoid valve **83** for obtaining reservoir fluid flow from the first nozzle **15**. Other nozzles of the unit are selectively actuated by movement of the handles in the manner previously described in reference to FIG. **3**.

Referring to FIG. **5**, the bar insulator **103** prevents electricity from flowing directly to the ground side of the power source **113** through the handle **26** and elongated member **10**. The bearing **117** is preferably formed of rubber, plastic or other like material which will electrically insulate the handle second portion **38** from the frame **10** and provide a smooth contact surface to facilitate rotation of the bearing **117** in contact with the walls **121** of the member **10**.

Other objects and advantages will be apparent from the specification and claims and from the accompanying drawing illustrative of the invention.

We claim:

1. A hand-held device for propelling an individual through space by selectively passing a compressed fluid through nozzles, comprising:

an elongated member having a longitudinal axis and first and second, opposed ends;

first and second pairs of oppositely directed, coplanar nozzles, each of said pairs having a longitudinal axis and being attached to a respective one of said ends with the longitudinal axis of the member substantially perpendicular to the longitudinal axis of the pair;

a pair of controlling means each for selectively and individually controlling the passage of fluid through the nozzles of a respective one of said pairs of nozzles, each of the controlling means being carried by the member;

a pair of rigid control handles pivotally attached to and mutually spaced along the longitudinal axis of the member and each connected to a respective one of the controlling means, each handle being adapted to pivot independently relative to the member to actuate the associated controlling means for the selective operation of an individual nozzle of a nozzle pair;

a plurality of conduits connected between each of the controlling means and the nozzles associated therewith for passing compressed fluid therebetween; and

means for connecting each of the controlling means to a source of compressed fluid.

2. A device such as set forth in claim **1** and wherein the controlling means for each nozzle pair is a two-way valve.

3. A device, as set forth in claim **1**, wherein the controlling means for each nozzle comprises;

a solenoid valve connected to the nozzle;

a switch connected to the solenoid valve; and

an electrical power source connected to the switch for operation of the solenoid valve.

4. A device, as set forth in claim **1**, wherein the length of the member is greater than the breadth of the body of an average, adult male person.

5. A device, as set forth in claim **1**, wherein each handle has an end and first and second portions, the second portion of each handle being pivotally mounted on the member for movement of the handle relative to the member, the second portion extending from the member substantially perpendicularly to the plane of the nozzles and the first portion extending from the second portion substantially parallel to the plane of the nozzles.

6. A hand-held device for propelling an individual through space by selectively emitting a compressed fluid from a plurality of nozzles, comprising:

an elongated member having a longitudinal axis and first and second, opposed ends;

two pairs of oppositely directed, coplanar nozzles, each of said pairs having a longitudinal axis and being attached to a respective one of said ends with the longitudinal axis of the member substantially perpendicular to the longitudinal axis of the nozzle pair, each nozzle of a nozzle pair having an inlet end adjacent the inlet end of the other nozzle;

a pair of two-way valves mounted on the member, each valve having an inlet port and outlet ports and a valve element rotatable relative to said ports for selectively and individually controlling passage of fluid through the nozzles;

a plurality of conduits connected between each of the two-way valves and the nozzles associated therewith, each conduit having first and second ends and being attached

at its first end to the inlet end of a given nozzle and at its second end to a respective outlet port of one of the valves;

means for connecting the inlet port of each of the two-way valves to a source of compressed fluid; and

means for rotating the valve element of each valve between a first position wherein the affected valve supplies a flow of fluid to one nozzle of a particular nozzle pair and to a second position wherein the valve supplies a flow of fluid to the other nozzle of the particular nozzle pair.

7. The device recited in claim 6 wherein each of the plurality of conduits extends, throughout at least some of its length, interiorly of the elongated member.

8. The device of claim 6 wherein rotation of one of the valve elements to its first position and the other of the valve elements to its second position is followed by fluid flow to two of the nozzles which are oriented in the same direction.

9. The device of claim 6 wherein the means for rotating the valve elements comprises a pair of rigid handles pivotally attached to and mutually spaced along the longitudinal axis of the elongated member, each of the handles being connected to a respective one of the valve elements for rotation of that element relative to its associated ports in response to pivoting the respective handle relative to the elongated member.

10. A device, as set forth in claim 9, wherein each handle has an end connected to the valve and first and second portions, the second portion of each handle extending from the member substantially perpendicularly to the plane of the nozzles and the first portion of each handle being substantially parallel to the plane of the nozzles.