Ames

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. : 3,583,322

Government or Corporate Employee : U.S. Government

Supplementary Corporate Source (if applicable) : NA

NASA Patent Case No. : ARC-10153

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 . . ."

Elizabeth A. Carter

Elizabeth A. Carter
Enclosure
Copy of Patent cited above

PATENTED JUN 8 1971

3,583,322

SHEET 1 OF 3

N71-28619

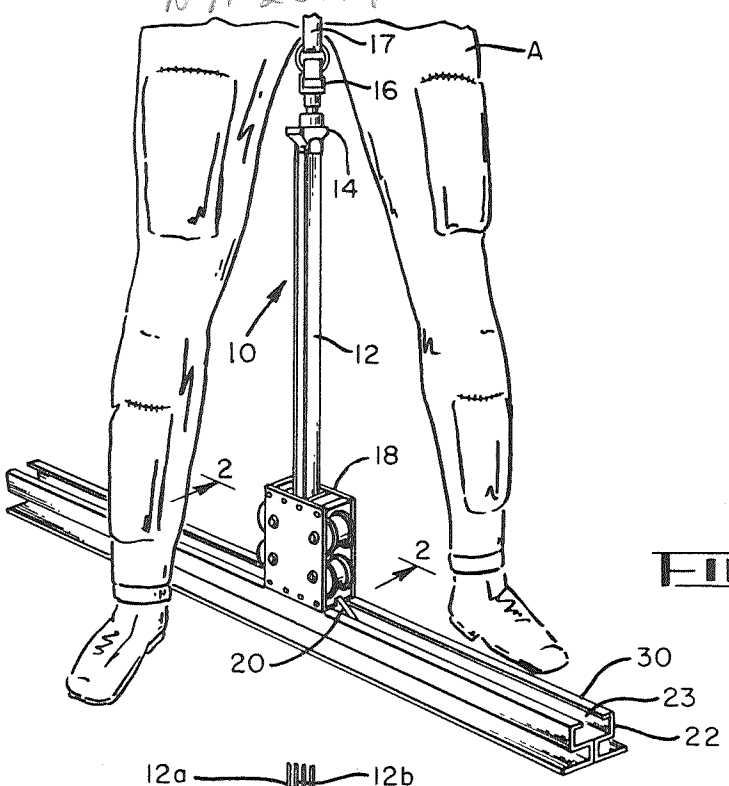

FIG-1

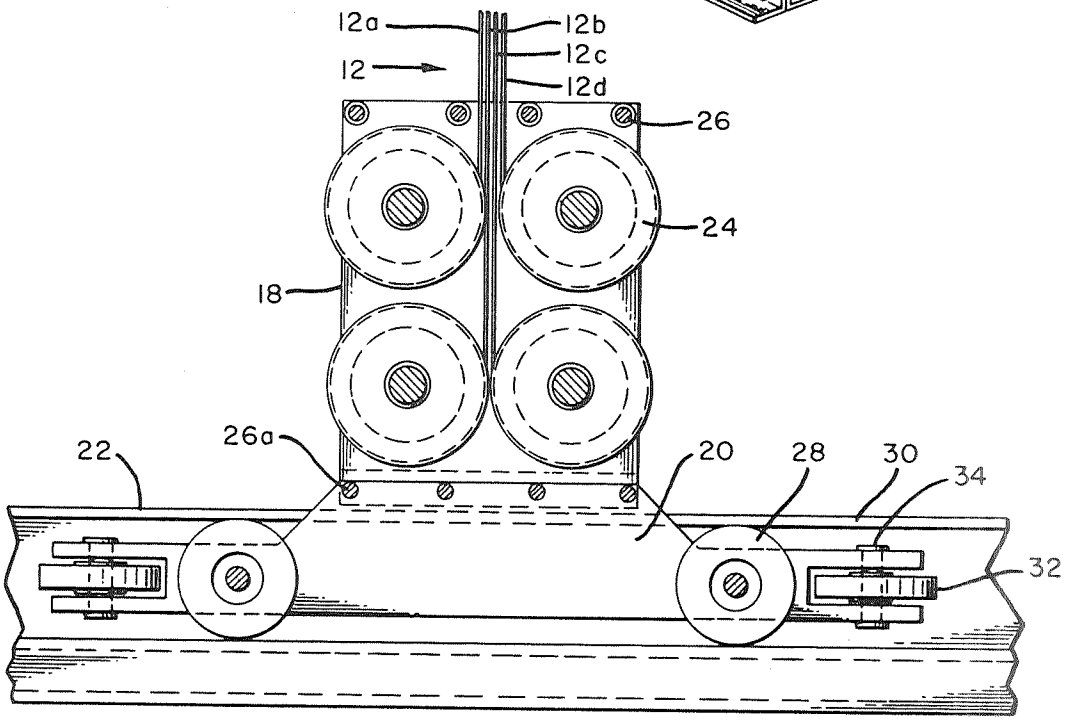

FIG-2

INVENTOR.
HUBERT C. VYKUKAL

BY Howson & Howson
Darrell G. Brubaker
ATTORNEYS

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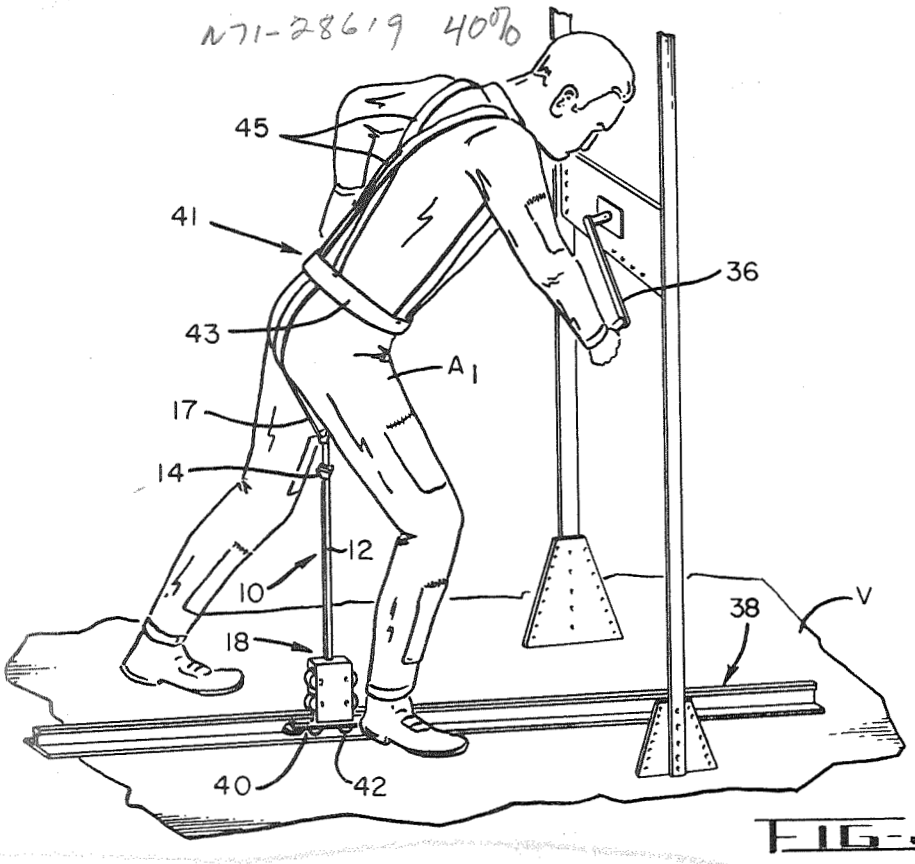

FIG-3

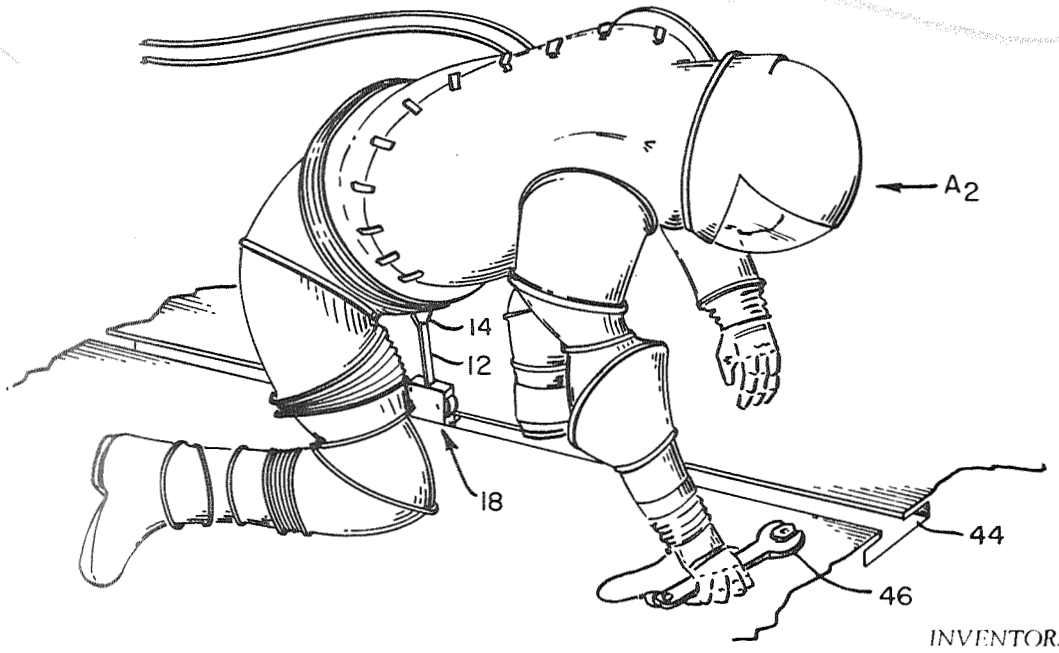

FIG-4

INVENTOR.
HUBERT C. VYKUKAL

BY Howson & Howson
Darrell G. Brake
ATTORNEYS

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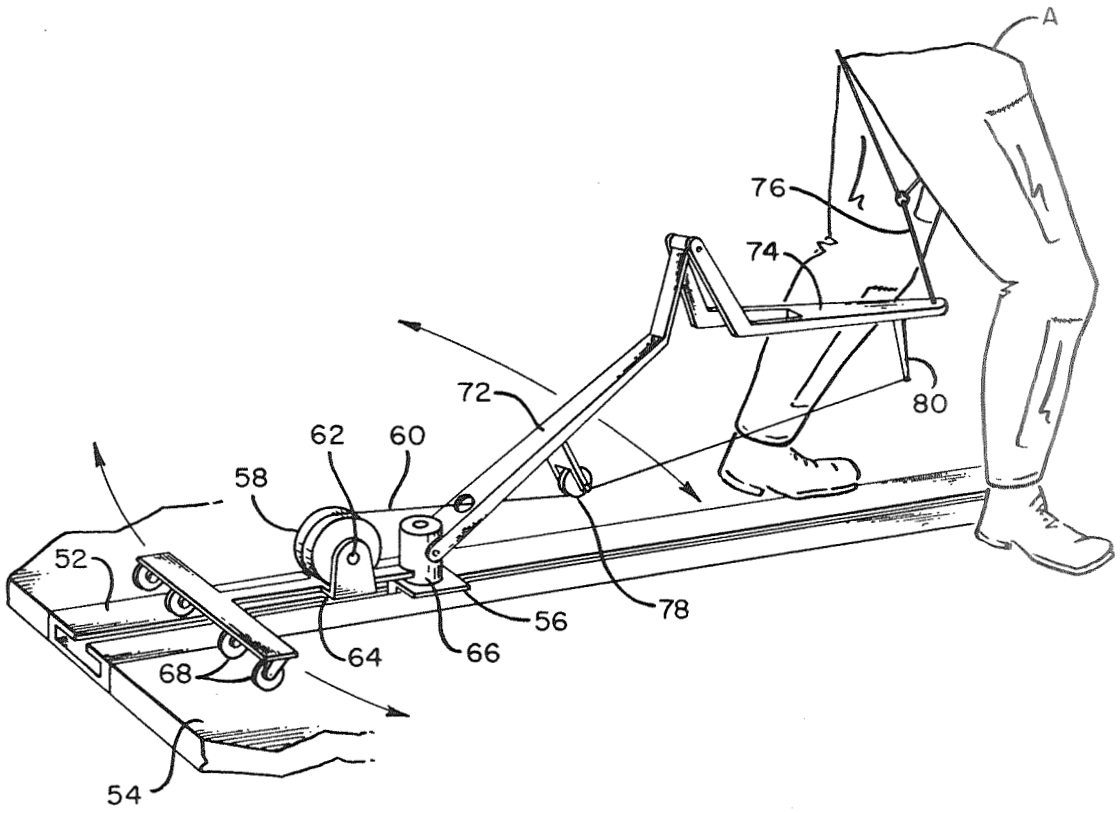

FIG-5

INVENTOR.
HUBERT C. VYKUKAL

BY Dowell & Dowell G. Brubaker
ATTORNEYS

United States Patent

[11] 3,583,322

[72] Inventor **Hubert C. Vykukal**
Cupertino, Calif.

[22] Filed **Dec. 12, 1968** SN 783,377
[45] Patented **June 8, 1971**

[73] Assignee **The United States of America as represented by the Administrator of the National Aeronautics and Space Administration**

[54] **LOCOMOTION AND RESTRAINT AID**
5 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **104/1,** 35/29, 104/139, 119/96, 238/1, 248/361, 272/70
[51] **Int. Cl.** **A63b 71/00,** B61b 13/00
[50] **Field of Search** 272/24, 60, 70, 80, 81, 82; 35/29, 120; 119/96, 124, 117; 248/361; 16/210; 104/173, 178, 242, 243, 244.1, 1, 245, 60, 139; 238/1

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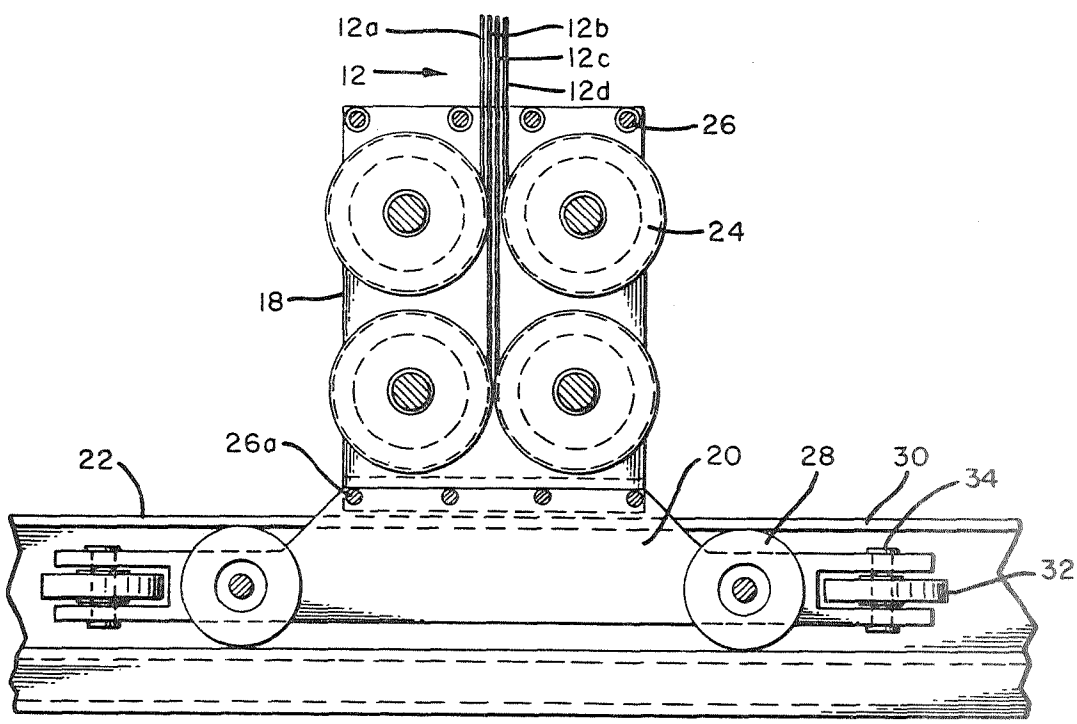
Primary Examiner—Arthur L. LaPoint
Assistant Examiner—Richard A. Bertsch
Attorneys—Darrell G. Brekke and G. T. McCoy

ABSTRACT: A locomotion and restraint aid for humans operating in conditions of zero gravity, comprising a spring biased tension member secured at one end to the operator and at the other to a trolley which moves along a track secured to a space vehicle. The track and trolley permit a limited range of movement, including walking, and the tension member simulates gravitational pull to provide stabilization during the performance of manual operation.



LOCOMOTION AND RESTRAINT AID

The invention described herein was made by an employee of the United States government and may be manufactured and used in or for the Government for Governmental purposes without the payment of any royalties therein or therefor.

OBJECTS AND DESCRIPTION

This invention relates to a locomotion and restraint aid and, more particularly, to a restraint aid which simulates gravitational pull to enable a person to perform manual operations and exercise greater control over his movements at zero gravity.

Locomotion aids previously considered for operation at zero gravity include a rope tether, one end of which is attached to the astronaut and the other end to the vehicle. However, this means of locomotion is satisfactory only for returning to the vehicle by hand-over-hand operation. Other devices considered include hand rails or taut ropes which are attached at both ends to the vehicle also to permit hand-over-hand movement but, of course, the movement is confined to the rail or rope. Other devices such as magnets or "Velcro" patches may permit a wider range of movement but, as in the case of the other devices cited above, none of these devices overcome the infirmities of working or moving in conditions of zero gravity and they do not provide any stabilizing effect to aid the operator under such conditions.

It is, therefore, an object of this invention to provide a restraint aid which permits movement of an astronaut within or outside a space vehicle under simulated gravitational pull.

Another object of this invention is to provide a locomotion aid which permits movement of an astronaut at zero gravity while being pulled toward the surface on which he is moving at a predetermined, constant force.

A further object of this invention is to provide a restraint aid which permits an astronaut in a zero gravity environment to utilize conventional, reaction-type tools.

In carrying out this invention, there is provided a tension member which is secured at one end to the astronaut as by hooking it to a strap at the astronaut's crotch and the other end of the tension member is pulled at a constant force by means attached to a trolley. In the preferred embodiment, the tension member comprises a selected number of strips of constant force spring metal which are contained on coils secured to the trolley. The trolley, in turn, is movable along a track which is secured to the space vehicle and tracks may be secured to both the inside and outside of the vehicle. In one embodiment of the invention, the spring members are carried on the end of a rod which is pivotably mounted on the trolley for articulation transversely of the track so that the astronaut is permitted to move along the track and within a limited range of movement on both sides.

Other objects and advantages of this invention will become apparent from the description following when read in conjunction with the accompanying drawings wherein:

FIG. 1 is an enlarged view in perspective showing the restraint aid of this invention in detail;

FIG. 2 is a partial section view of the trolley and track forming a part of this invention taken along line 2–2 of FIG. 1;

FIG. 3 is a view in perspective of an astronaut working within a space vehicle with the restraint means of this invention attached to him;

FIG. 4 is a view in perspective of an astronaut in hard space suit working on the exterior of a space vehicle; and

FIG. 5 is a view in perspective showing another embodiment of this invention.

Referring now more particularly to FIG. 1, the restraint and locomotion aid 10 of this invention comprises a tension member 12 which may be attached to the wearer as by a quick disconnect coupling 14, one element 16 of which is secured to a strap 17 of a body harness briefly described below at the crotch of the wearer A so that the force of the tension member is directed approximately through the wearer's center of gravity. The other end of the tension member 12 is secured to a housing 18 which is carried on a trolley 20 movable along a track 22 so that the wearer A may move along the length of the track 22 while being pulled toward the surface on which he is standing or walking in simulation of gravitational pull.

As is shown more clearly in FIG. 2 the tension member may actually comprise a plurality of constant force spring metal bands 12*a*, 12*b*, 12*c* and 12*d* which are normally carried on coils 24 attached to and between the walls of the housing 18. The coiled metal bands 12*a* to 12*d* resist uncoiling with a constant force and hence may be extended to considerable lengths to permit kneeling, walking, crawling, or climbing. Extension spring devices of this type are well known and are available commercially. For example, the Hunter Spring Company of Hatfield, Pennsylvania carries a complete line of constant tension springs bearing the trade name "NEGATOR." While four coiled bands are here illustrated, any number of springs may be selected according to the force desired to simulate gravitational pull and provide adequate stabilization. In this connection, it has been found that a force of 60 pounds is satisfactory although the invention is not limited to any specific total force.

The spring housing 18 is secured together by suitable means such as bolts 26 the bottom row 26*a* of which secures it to the trolley body 20 which extends through an opening 23 in the track 22 and has wheels 28 mounted on both sides to engage under and be restrained by the inwardly turned rims 30 of the channellike tracks. Preferably, additional front and rear horizontal wheels 32 are mounted for rotation about vertical axes 34 to increase lateral stability.

Referring now to FIG. 3, there is shown a wearer A_1 working on the interior of a space vehicle with the restraint aid 10 pulling downward through his normal center of gravity and providing stabilization to enable him to turn a crank 36 or the like and to move along a track 38 which may extend completely around the vehicle V. In this embodiment a spring housing 18 similar to that shown in FIG. 1 is provided. However, the rail 38 may be of T-shaped configuration with the trolley 40 straddling it so that the wheels 42 engage under the crossarm of the T. It will be noted that the wearer has no helmet or oxygen equipment since the interior of the vehicle is completely pressurized.

FIG. 3 also illustrates a suitable body harness 41 which may be employed to carry the strap 17. As illustrated, this harness 41 may include a belt 43 with crossed shoulder straps 45 secured thereto and the crotch strap 17 being secured at both ends to the belt portion. Suitable safety catches may be incorporated in the harness to allow ready attachment of the harness to the wearer while at the same time preventing inadvertent release of the harness.

In FIG. 4, the astronaut A_2 is in a hard suit with air hoses extending therefrom and working on the exterior of the vehicle with the spring case 18 and trolley movable along a channellike track 44 similar to that shown in FIG. 1. A suitable hard suit is disclosed in my copending application entitled "Hard Space Suit," Ser. No. 566,397, filed July 19, 1966; now U.S. Pat. No. 3,405,406. The disconnect coupling 14 of the invention is secured to the pelvic portion of the suit. This may be accomplished by the use of a harness, as shown in FIG. 3 for example, or some hard suits incorporate a webbing in the crotch region to which a ring may be attached for joinder to the upper part of the coupling 14. The astronaut A_2 is in a kneeling position and the springs 12 have, of course, retracted to a shorter length while still applying a constant force. Stabilized by the constant force of springs 12, the astronaut A_2 is able to perform work with a conventional wrench 46 as opposed to a complex "zero-reaction" tool. Since the springs 12 create an "artificial gravity" for the astronaut A_2, he may ambulate to any surface of the space vehicle (sides, bottom, etc.) by suitable positioning of track 44.

Referring to FIG. 5, there will be seen to be illustrated another embodiment of the invention particularly adapted to afford substantial lateral motion of the astronaut with respect

to the track. As shown, a track 52 is provided in or on a surface 54 of a space vehicle, for example, and a trolley 56 is mounted therein or thereon. In this instance the track and trolley are similar to those illustrated in FIG. 4. A coil 58 of constant force spring metal band 60 is mounted on a horizontal axis 62 of a bracket 64 that is in turn connected to a horizontal pivot mount 66 atop the trolley. The bracket 64 is shown to extend from the pivot mount 66 to a crossbar having a plurality of pivotally mounted wheels 68 beneath same and riding on the surface 54.

With regard to attachment of the above-described arrangement to an astronaut, there is provided a first arm 72 mounted on the pivot connection 66 in extension forwardly and upwardly therefrom with an upward bend near the outer end thereof. A second arm 74 is pivotally connected to the first arm, as by means of the illustrated upwardly extending forked end thereof, and a connection 76 such as a flexible line is attached to the outer end of the second arm for attachment through disconnect means 14 to a harness or suit of an astronaut at the crotch thereof. The spring band 60 extends horizontally through a guide hole in the first arm 72 and under a pulley wheel 78 mounted beneath the first arm into connection with a lug 80 depending from the second arm near the outer end of same.

In operation of the embodiment of the invention illustrated in FIG. 5, the spring band, or bands if desired, exerts a downward force on the outer end of the second arm 74 of the device so as to pull downward on an astronaut attached thereto. Movement along the track is as described above but in this case the astronaut may move laterally of the track. Such movement is accommodated by the pivot connection 66 so that the arms 74 and 76 follow the astronaut. Also this pivots the bracket 64 on the wheels 68 so that the spring metal 60 remains in alignment with the arms. This embodiment thus provides the same restraint or gravity replacement force as described above and also provides additional freedom for lateral motion relative to the track so that an improved mobility is achieved.

While this invention has been described in conjunction with preferred embodiments thereof, it is obvious that modifications and changes therein may be made by those skilled in the art without departing from the spirit and scope of this invention as defined by the claims appended hereto.

I claim:

1. A device for aiding the performance of manual operations under conditions of reduced gravity comprising:

a tension member comprising constant force extension spring means,

means for attaching one end of said tension member to an operator, comprising a removable attachment to the operator having a portion depending from the crotch of the operator whereby tension force is exerted substantially through the center of gravity of the operator,

connecting means joining the other end of said tension member to a solid body upon which the operator is located, said connecting means comprising a track secured to said solid body, said track having at least one laterally extending restraining rim along the length thereof,

a trolley movable along said track, and

said tension member being secured to said trolley.

2. The device defined by claim 1 wherein:

said tension member comprises a plurality of constant force extension spring bands mounted in coils on said trolley.

3. The device defined in claim 1 wherein the connecting means further comprises:

at least one arm pivotally connected to said trolley for articulation transversely and normally of said track,

said tension member urging said arm toward the track, and

the means for attaching one end of the tension member to the operator being connected to the outer end of the arm.

4. The device defined in claim 3 further defined by:

a pivot mount attached to said trolley for movement about an axis normal to said track,

a bracket connected to said pivot mount for movement therewith and joined to said tension member, and

said arm pivotally connected to said mount for pivoting about an axis normal to the mount axis.

5. The device defined in claim 1 further defined by:

said tension member comprising a coiled band constant force extension spring,

a pivot mount upon said trolley for pivoting about an axis normal to the track and surface of said body carrying said track,

the coiled band tension member being mounted on said pivot mount to move therewith,

a first arm pivotally connected to said pivot mount for movement about an axis normal to the axis of the mount,

a second arm pivotally connected to the outer end of said first arm, and

means joining the end of the coil band tension member to the second arm beneath same near the outer end thereof for urging the arm toward the surface of the body mounting said track,

said connecting means extending from the outer end of said second arm to the operator.