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Harvey et al.

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[54] **LINEAR-PIVOTAL CONVERTER**

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[52] **U.S. Cl.** ..... **244/102 SL**, 46/77, 74/99 R

[51] **Int. Cl.** **B64c 25/26**

[58] **Field of Search** ..... 74/99 R; 46/74, 76, 46/77, 78; 244/102 R, 102 SL, 101, 100 R

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[57] **ABSTRACT**

A device for converting reversible linear motion to reversible pivotal motion wherein the member undergoing pivotal motion is locked against motion at both limits thereof.

10 Claims, 7 Drawing Figures

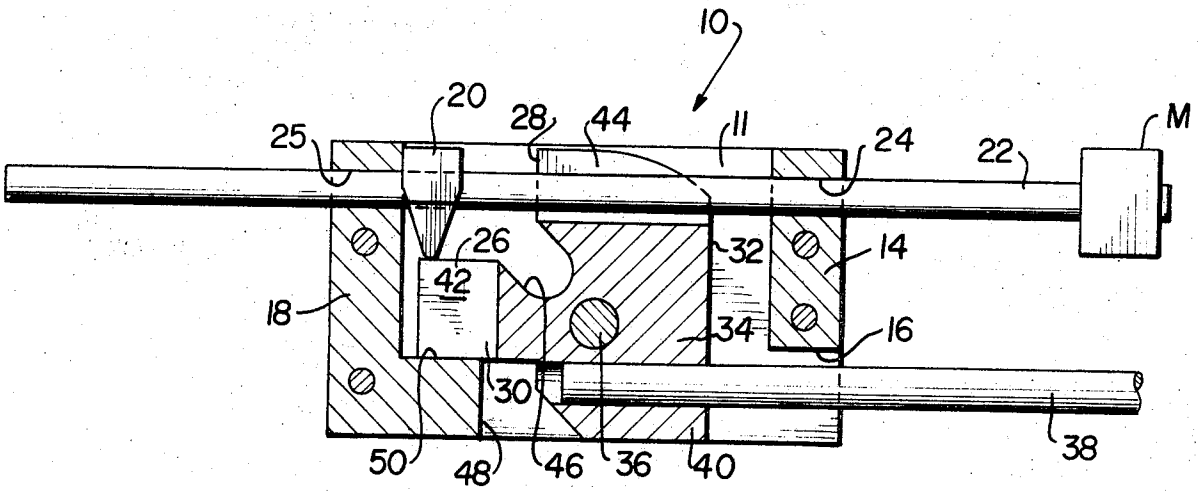


FIG. 1

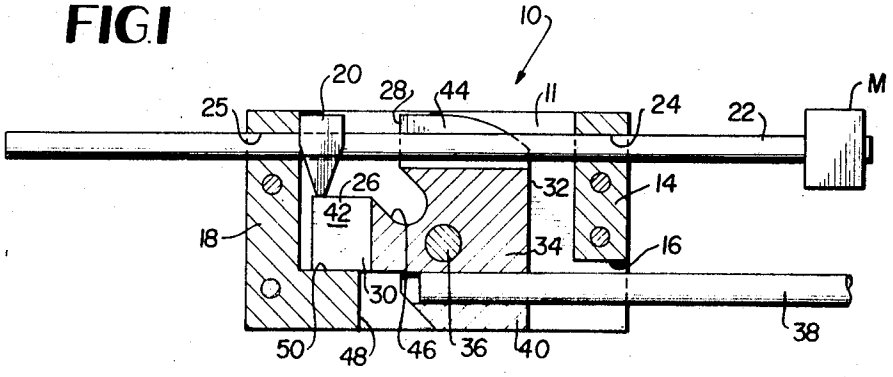


FIG. 2

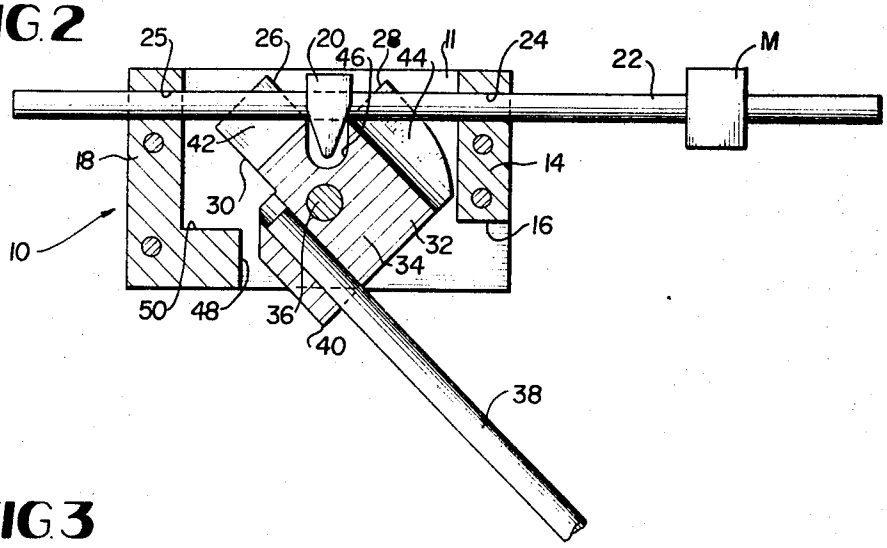


FIG. 3

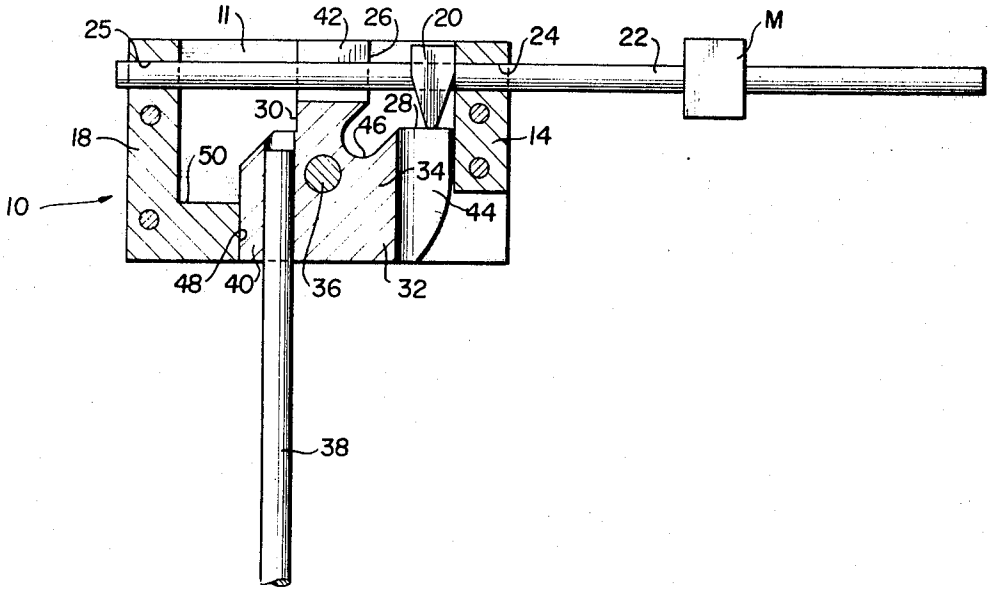


FIG.4

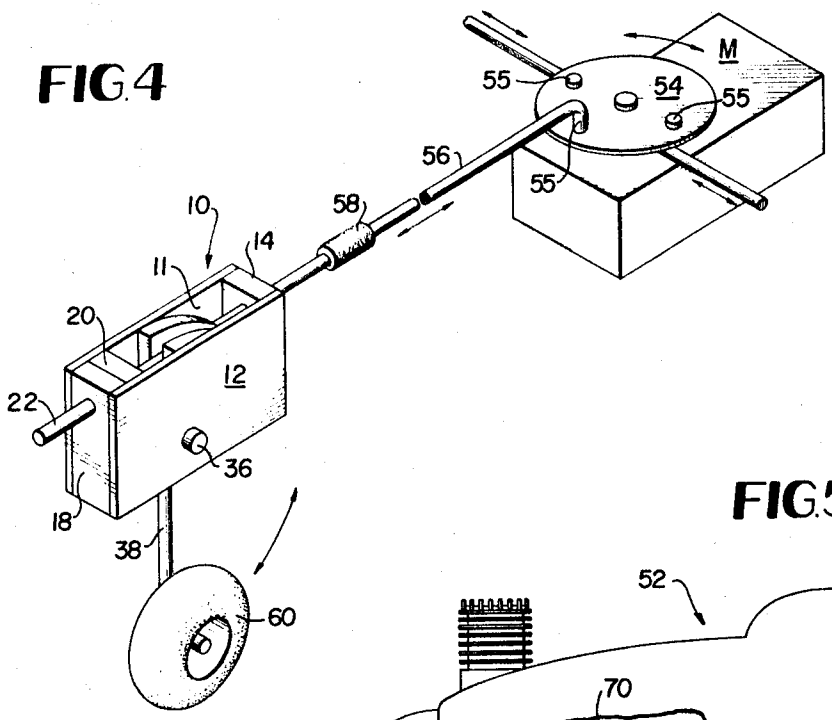
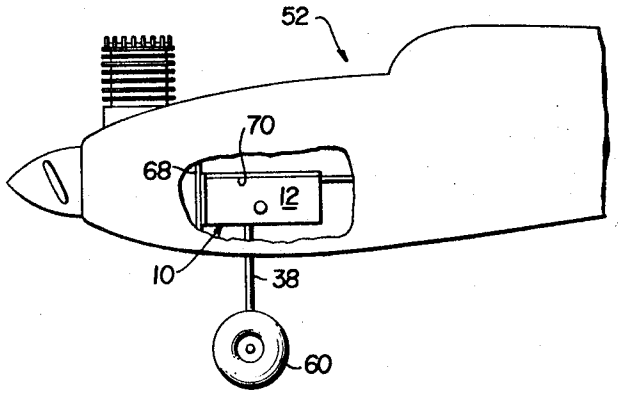


FIG.5



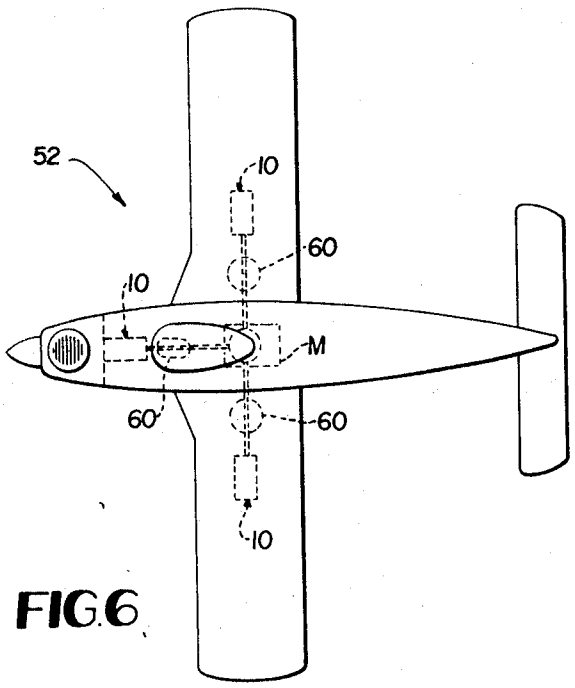
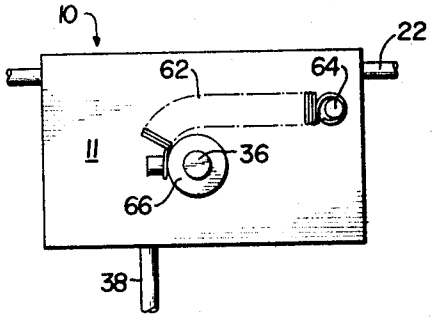


FIG.6

FIG.7



LINEAR-PIVOTAL CONVERTER

This invention relates generally to devices for converting one type of motion to another and more particularly to a device which will convert reversible linear motion to reversible pivotal motion with the pivotable member being locked at either end of its pivotal movement through a given arc.

Linear to pivotal converters are known in the art but insofar as is known, are characterized by various inherently disadvantageous features. Among these are a complexity of structure rendering them difficult to manufacture and hence unnecessarily expensive, the use of cables requiring frequent replacement or maintenance, and a lack of reliability in operation.

Accordingly, the main object of the present invention is to provide an improved linear to pivotal motion converter which will obviate the above and other disadvantageous features characterizing known devices.

An important object of the present invention is to provide an improved linear-pivotal motion converter in which the pivotal member is locked in position at each limit of motion.

Another important object of the present invention is to provide an improved linear-pivotal motion converter in which the pivotal member moves through a predetermined arc which is determined by the angle defined by a pair of seating surfaces against which the pivotal member is selectively locked.

A further important object of the present invention is to provide a linear to pivotal motion converter which has a minimum of moving parts, is strong and of long life in use, has many useful applications, and is susceptible of ready and economic manufacture.

Other objects and advantages of the present invention will become apparent during the course of the following description.

In the drawings we have shown one embodiment of the invention. In this showing:

FIG. 1 is a central, vertical sectional view of the invention showing the pivotal member locked in position at one limit of its movement;

FIG. 2 is a similar view thereof showing the pivotal member in an intermediate, unlocked position thereof;

FIG. 3 is a similar view showing the pivotal member locked in position at the other limit of its movement;

FIG. 4 is a perspective view thereof to a reduced scale showing the linear-pivotal motion converter in one of its many practical and useful applications;

FIG. 5 is a fragmentary side elevational view to a further reduced scale with portions cut away also showing the application of the converter to an aircraft but slightly modified for positioning against its fire shield;

FIG. 6 is a top plan view to a still further reduced scale of the same application to aircraft; and

FIG. 7 is a side view of the converter showing a retraction spring mounted thereon.

Referring to the drawings, numeral **10** designates the converter as a whole which comprises a rectangular box-like housing having opposed sides **11** and **12**, an end **14** having a lower portion cut away as at **16**, an opposing L-shaped end **18**, and a wedge shaped shuttle **20** fixed to and mounted on an actuator rod **22** journalled in bearing holes **24, 25** positioned respectively in alignment in the upper portions of the ends **14** and **18**.

The rod mounted shuttle **20** has reversible linear movement between the inner faces of the two ends **14, 18** and also between the inner, upper faces **26** and **28**

of the outer ends of the legs **30** and **32** respectively of an L-shaped cam **34** which is pivotally mounted in and between the sides of the housing walls **11** and **12** as by a pin **36**. The member **38** which is to be reversibly pivoted is suitably mounted in the heel **40** of the L-shaped cam **34**.

The outer ends of the legs **30** and **32** of the cam **34** are bifurcated as at **42** and **44** respectively to permit sliding movement of the actuator rod **22** therebetween but not the shuttle **20** which transmits its linear motion to the pivotal cam **34**. The juncture of the legs **30** and **32** is recessed as at **46** to enable the cam to provide constant support for the shuttle and the rod when the hole **25** is not utilized as will be described in connection with a slight modification of the invention. It is to be noted that the passing of the actuator rod **22** through the bifurcations **42** and **44** of the cam legs eliminates any side load forces.

As shown in FIGS. **1–3** inclusive, the shorter leg of the end wall **18** has an end face **48** and an upper face **50** which function respectively as stops or seating faces for the cam heel **40** and the cam bifurcations **42** when the pivotal member **38** is in the vertical and horizontal positions and are locked against such seating surfaces by the wedge shaped shuttle **20**.

A feature of the invention resides in the fact that the distance the shuttle **20** moves between the end walls **14** and **18** is not critical because cam **34** is locked in either limit of its pivotal movement as long as the shuttle engages any part of the upper surfaces **26** (FIG. 1) or the upper surfaces **28** (FIG. 3) of the bifurcated legs of the cam. Also, while the converter is shown as converting the linear movement of the shuttle **20** into a 90° pivotal movement of the member **38**, the amount of arc may be increased or decreased as desired by changing the relative angle between the seating surfaces or the contacting faces or their thicknesses.

The operation of the converter is believed to be readily apparent. Linear movement of the shuttle **20** with the actuation rod **22** to the right from one limit of movement position of the pivotal member **38** (FIG. 1) is effected by means of a suitable servo motor M. As the shuttle **20** moves off of the locking surface **26** of the bifurcated legs **30** to the intermediate unlocked position (FIG. 2), it engages the faces **28** of the bifurcated legs **32** to initiate pivotal movement of the member **38**.

As the shuttle **20** moves further to the right, it effects further clockwise pivoting of the cam **34** to the position of FIG. 3 where the shuttle engages and moves over the face **28** of the bifurcated legs **32** to lock the cam and its member **38** in vertical position against the seating face **48** by the cam heel **40**. When it is desired to reverse the 90° pivotal movement of the member **38**, the servo motor is reversely actuated and the identical series of movements, etc. described above is reversed to regain the position of FIG. **1**.

As will be appreciated, the linear-pivotal converter has many applications of which one is disclosed in FIGS. **4–7** inclusive. This relates to its installation in an aircraft, actual or a model thereof, designated generally by numeral **52**. Three converters **10** are employed to actuate the retractable landing gear, one for the nose gear and one for each of the gear positioned in the aircraft's wings. A single servo motor M which provides a reversible 180° rotation of a disc **54** to which the actuator rods **22** of each converter **10** are connected as at **55** by slightly flexible shafts **56** and couplings **58** to

accommodate the disc movement, is positioned in alignment with each converter. In this application, the pivotable members **38** of each converter have a landing wheel **60** mounted on the outer ends thereof.

FIGS. **4, 5** and **7** show the pivotal member **38** with its landing wheel **60** locked in the vertical, extended position. To offset the weight of the landing wheel during its retraction, a heavy coil spring **62** may be secured to the converter housing wall **11** as at **64**, partially wound about the cam pivot pin **36** and secured to a collar **66** fixed to the pin (FIG. **7**). Where the converter **10** to which the nose wheel **60** is mounted is positioned against an aircraft firewall **68** (FIG. **5**), the end of the actuator rod **22** projecting from the left of the converter (position of FIG. **1**) may be cut off and proper guidance of the spindle **20** and rod **22** obtained by suitably securing a top cover **70** to the converter housing.

It is to be understood that the forms of our invention herewith shown and described are to be taken as preferred examples of the same and that various changes in the shape, size and arrangement of parts may be resorted to without departure from the spirit of the invention or the scope of the subjoined claims.

What is claimed is:

1. A linear-pivotal motion converter comprising, in combination, a housing having side and end walls; one of said walls being L-shaped and having stops for the legs of a cam; an L-shaped cam rotatably mounted in the side walls of said housing; a member fixed to said cam for pivotal movement therewith; an actuator rod mounted for reversible linear motion in said end walls adjacent said cam; a shuttle fixed to said actuator rod and positioned between the legs of said cam for alternate engagement therewith; and means for effecting reversible linear movement of said rod and said shuttle to engage the legs of said cam and effect pivotal movement thereof and of said member.

2. The combination recited in claim **1** wherein said shuttle moves one of said cam legs against one of said stops in either limit of pivotal movement to lock said cam and said member against movement.

3. The combination recited in claim **2** wherein said cam legs are unlocked when said shuttle is in a position intermediate the end walls of said housing.

4. The combination recited in claim **1** wherein said cam legs are bifurcated to accommodate said actuator rod.

5. The combination recited in claim **1** wherein said housing is mounted on an aircraft, said member pivots downwardly to a substantially vertical position, and a wheel is mounted on the outer end of said member to function as an aircraft landing wheel.

6. The combination recited in claim **5** wherein a spring connects said cam and said housing to assist in the reverse pivoting of said landing wheel to a position within the aircraft.

7. The combination recited in claim **1** wherein said housing is provided with a cover to act as a guide for said shuttle.

8. The combination recited in claim **2** wherein said housing is mounted on an aircraft, said member pivots downwardly to a substantially vertical position, and a wheel is mounted on the outer end of said member to function as an aircraft landing wheel.

9. The combination recited in claim **8** wherein a spring connects said cam and said housing to assist in the reverse pivoting of said landing wheel to a position within the aircraft.

10. The combination recited in claim **2** wherein said housing is provide with a cover to act as a guide for said shuttle.

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