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[54] **HOT CELL EXAMINATION TABLE**

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[51] **Int. Cl.**[5] **A47B 85/00**
[52] **U.S. Cl.** **108/20**; 108/137
[58] **Field of Search** 108/20, 137, 139, 143; 74/89

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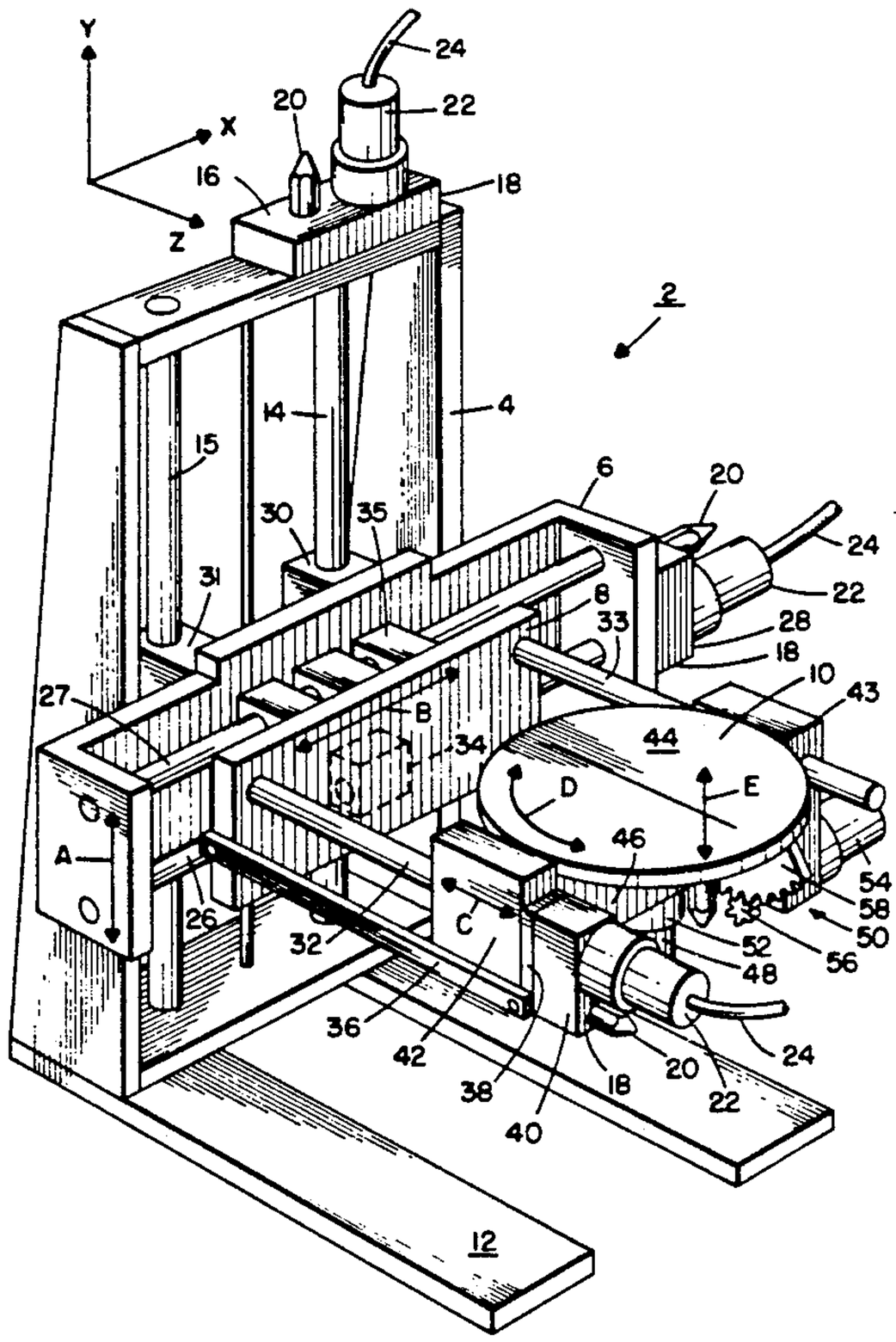
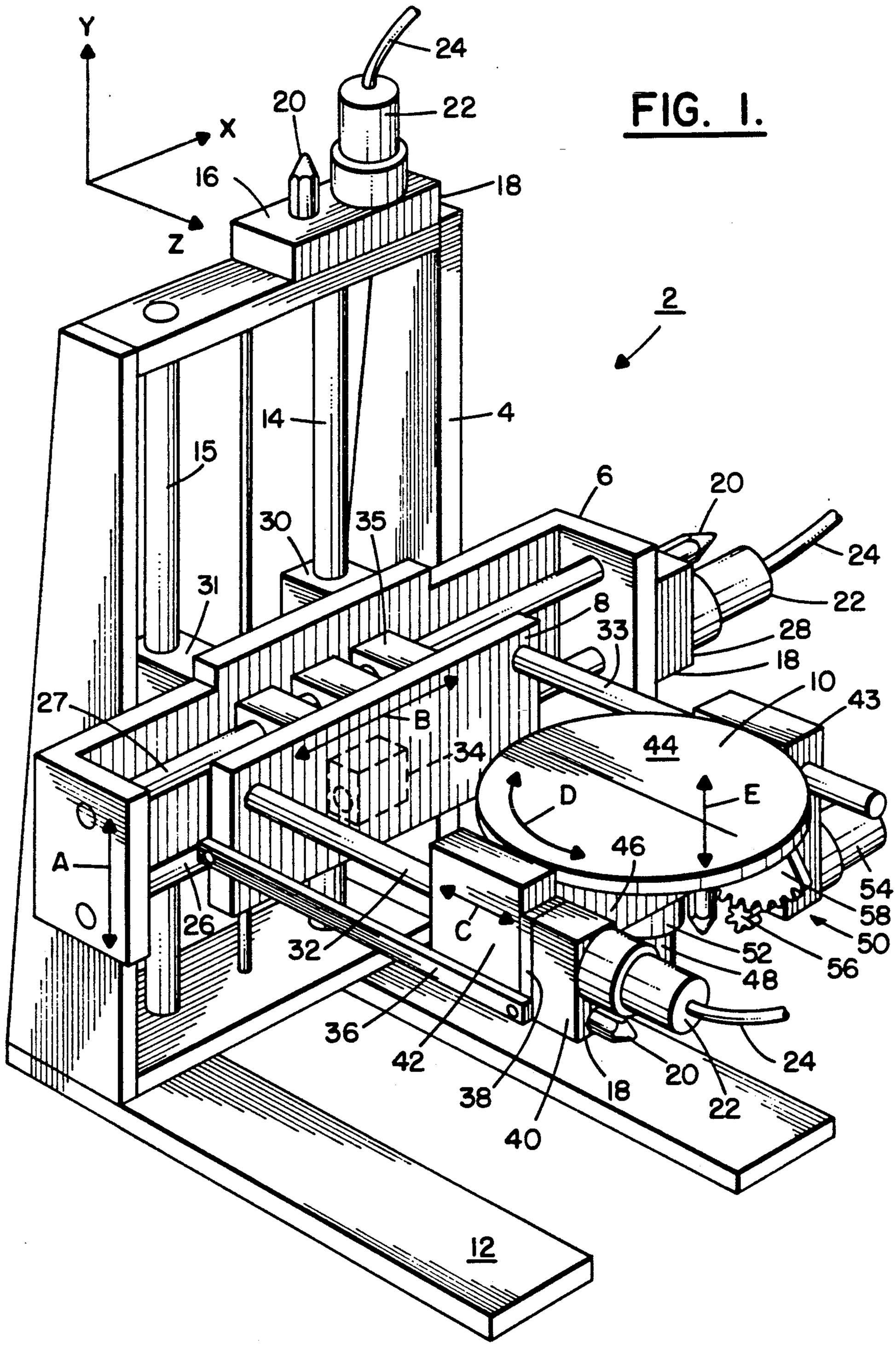
[57] **ABSTRACT**

A table for use in a hot cell or similar controlled environment for use in examining specimens. The table has a movable table top that can be moved relative to a table frame. A shaft is fixedly mounted to the frame for axial rotation. A shaft traveler having a plurality of tilted rollers biased against the shaft is connected to the table top such that rotation of the shaft causes the shaft traveler to roll along the shaft. An electromagnetic drive is connected to the shaft and the frame for controllably rotating the shaft.

12 Claims, 2 Drawing Sheets

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B
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44
D
E
A
46
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58
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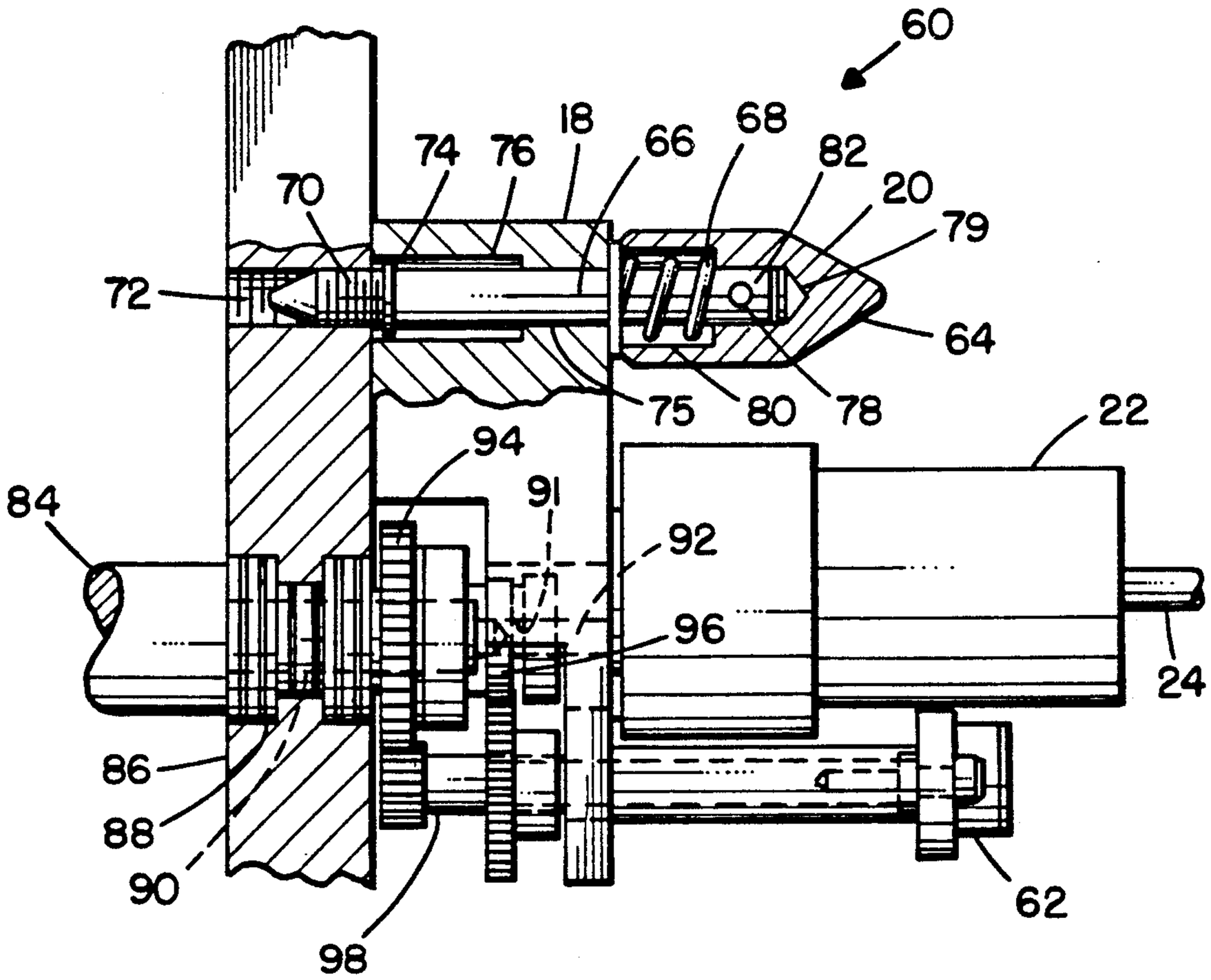
FIG. 1.

FIG. 2.


60
18
68
74
76
66
82
20
70
79
72
64
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80
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22
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92
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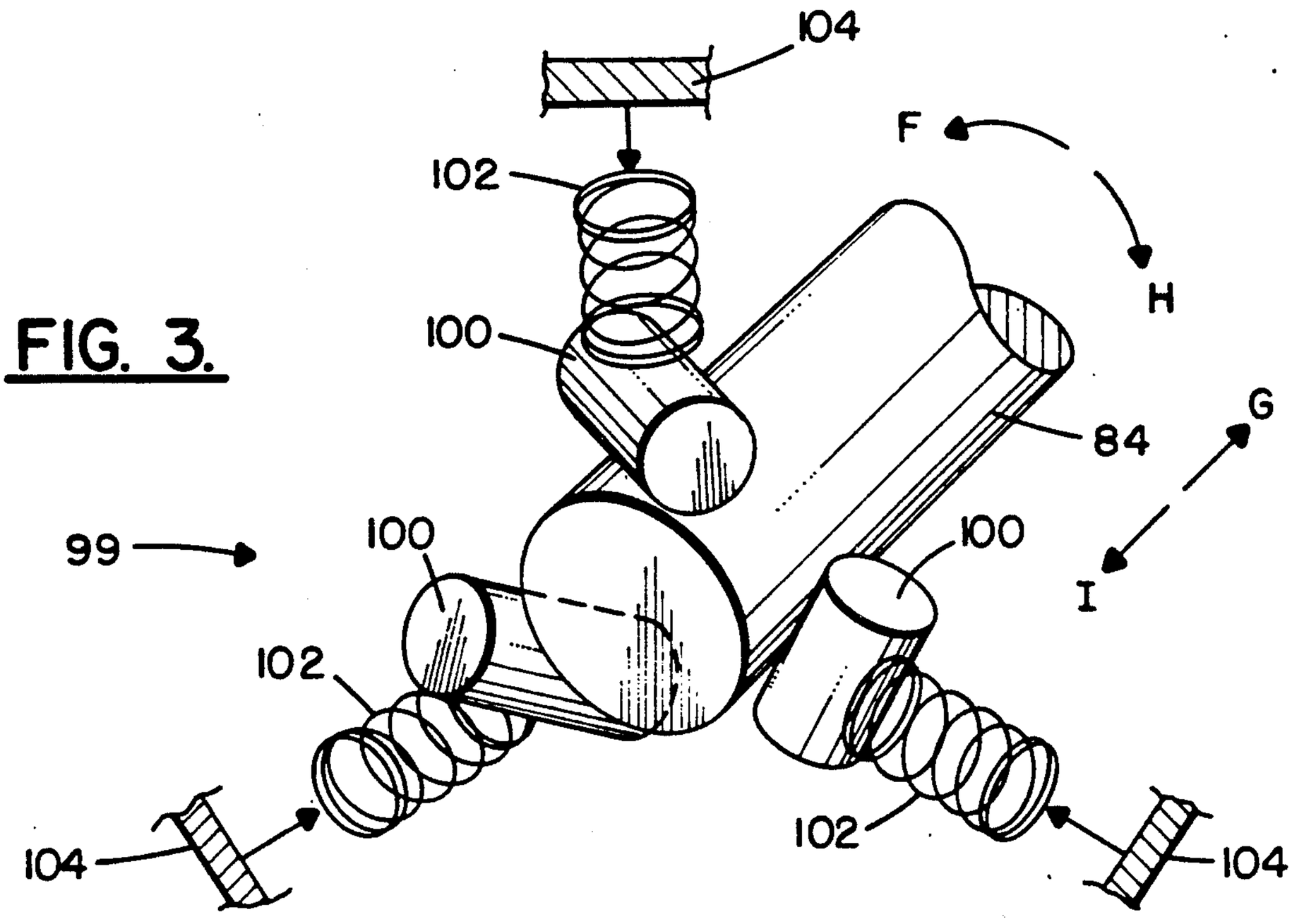
24
86
88
90
62
98

FIG. 3.


104
F
102
H
100
84
G
99
100
100
I
102
102
104
104

HOT CELL EXAMINATION TABLE

The Government has rights in this invention pursuant to Contract No. N00024-79C-4026 awarded by the U.S. Department of Energy.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to tables for use in examination procedures and, more particularly, to a table having a movable table top.

2. Prior Art

To perform photographic, microscopic, photomicrographic and visual examination on small parts and components, especially specimens that may be radioactive, it is customary to execute these operations in a controlled environment. One such controlled environment for radioactive specimens is called a hot cell. The hot cell often has appropriate optical apparati that protrude through the protective walls of the hot cell. In order to manipulate the specimen or object under the optical viewer, remotely controlled stages are used to move the object.

It is also known to use tilted rollers biased against a rotatable shaft such that when the shaft is rotated, the biased tilted rollers frictionally roll along the shaft to move an article connected to the rollers.

It is an objective of the present invention to provide an examination table with a movable table top with minimal maintenance requirements for use in a hostile environment.

It is another objective of the present invention to provide an examination table with a movable table top having an overdrive capability to eliminate safety limit switches for the bounds of the table top travel.

It is another objective of the present invention to provide an examination table with a movable table top having a removable drive module with a minimum number of fasteners for readily removing and replacing the drive module using remote handling means such as manipulators, etc.

SUMMARY OF THE INVENTION

The foregoing problems are overcome and other advantages are provided by an examination table having a movable table top.

In accordance with one embodiment of the invention the table has a frame, a movable table top and means for controllably moving the table top relative to the frame. The moving means comprises shaft means, drive means and shaft travel means. The shaft means is fixedly mounted to the frame for axial rotation. The drive means is connected to the frame and shaft means for rotating the shaft means. The shaft travel means comprises a plurality of tilted rollers, means for biasing the tilted rollers against the shaft means and means for connecting the shaft travel means to the table top such that rotation of the shaft means causes the tilted rollers to frictionally roll along the shaft means whereby the table top is moved parallel to the shaft means as the shaft means is rotated.

In accordance with another embodiment of the invention, the table has a table top moving means comprising a shaft means, drive means and a single fastener. The shaft means is mounted to the frame for axial rotation and has a central aperture and a first gear at one end. The drive means is provided for rotating the shaft means and has a motor means, a drive shaft and a pinion gear means. The drive shaft has a second gear and is insertable into the shaft means central aperture with the pinion gear means connecting the first and second gears. The single fastener is provided for mounting the drive means to the frame.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing aspects and other features of the invention are explained in the following description, taken in connection with the accompanying drawings wherein:

FIG. **1** is a schematic perspective view of a hot cell examination table incorporating features of the invention.

FIG. **2** is a schematic partial cross-sectional view of a drive module.

FIG. **3** is a schematic view of a shaft travel mechanism of the table shown in FIG. **1**.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. **1**, there is shown one embodiment of an examination table **2** incorporating features of the present invention. The table **2** is generally used to perform photographic, microscopic, photomicrographic and visual examination on small parts and components such as radioactive parts and components in a radioactive hot cell (not shown). The hot cell would of course have appropriate optical apparati that would protrude through the protective walls of the hot cell. In order to manipulate the small part, component or object under the optical apparati, the table **2** is capable of moving the object relative to the optical apparati via remote controlled stages as will be described below.

The table **2**, in this embodiment, generally comprises a first frame member **4**, a second frame member **6**, a third frame member **8** and a table top assembly **10**. The table **2** also generally comprises a base **12** which is intended to be relatively stationarily positioned in the hot cell (not shown). The first frame member **4** is generally fixedly connected to the base **12** and, in the embodiment shown, extends vertically upward in the Y direction. In this embodiment, the first frame member **4** generally comprises two vertically extending bars or shafts **14** and **15** which are both fixedly mounted to the first frame member **4**. However, the first shaft **14**, in the embodiment shown, is also rotatably mounted with the first frame member **4** for axial rotation about its center axis. Mounted on top of the first frame member **4**, in the embodiment shown, is an electromechanical drive module **16**. The drive module **16** generally comprises a frame **18**, a fastener **20**, a drive motor **22** and an electrical conduit **24** for supplying power to the drive motor **22** and which can also be used for transmitting signals from a computer and/or control panel (not shown) located outside of the hot cell.

The second frame member **6** is generally provided for movement in the vertical Y direction along the first and second shafts **14** and **15** of the first frame member **4**. The second frame member **6** generally has two horizontal bars or shafts **26** and **27** positioned along the X axis which are both fixedly mounted with the second frame member **6**. However, the third shaft **26** is also mounted for axial rotation along its center axis. Mounted on the side of the second frame member **6** is a second electromechanical drive module **28** which is substantially identical to the first electromechanical drive module **16** and

thus, like numbers are used to identify similar parts. The second frame member **6**, in the embodiment shown, also comprises two shaft travel mechanisms **30** and **31** which are fixedly connected to the second frame member **6**. The first travel shaft mechanism **30** has the first shaft **14** of the first frame member **4** passing therethrough. As will be described below, the first shaft travel mechanism **30**, when the first shaft **14** is rotated, is capable of moving the second frame member **6**, the third frame member **8** and the table top assembly **10** up and down in the vertical Y direction depending upon the direction of rotation of the first shaft **14**. The second shaft travel mechanism **31** generally has the second shaft **15** of the first frame member **4** passing therethrough. Suitable means are provided in the second travel mechanism **31**, such as a bearing means, that allows the second shaft travel mechanism **31** to move relatively freely up and down the shaft **15** while also providing movement stability of the second frame member **6** as it moves up and down along the first and second shaft **14** and **15** as generally indicated by the arrow A.

The third frame member **8** is generally provided for movement in the horizontal X direction. Connected to the frame **8**, in the embodiment shown, are a fifth shaft **32**, a sixth shaft **33**, a third shaft travel mechanism **34**, a fourth shaft travel mechanism **35** and a frame extension **36**. The third shaft travel mechanism **34** and the fourth shaft travel mechanism **35** are substantially identical to the first and second shaft travel mechanisms **30** and **31**, respectively. With the axial rotation of shaft **26**, the third shaft travel mechanism **34** is capable of moving the third frame **8** and the table top assembly **10** in the horizontal X direction as indicated by arrow B depending upon the direction of rotation of the third shaft **26**. The fourth shaft travel mechanism **35** is substantially identical to the second shaft travel mechanism **31** in that suitable means are provided (not shown) such that as the frame **8** moves along the shafts **26** and **27** the fourth shaft travel mechanism **35** allows the frame **8** to move relatively freely along the fourth shaft **27** while also providing stability to the cantilevered table top assembly **10**. The frame extension **36** generally extends from the third frame member **8** in the Z direction and has an end plate **38** which has a third electromechanical drive module **40** mounted thereto. In the embodiment shown, the third electromechanical drive module **40** is substantially identical to the first and second electromechanical drive modules **16** and **28**, therefore, like numbers are used to represent like parts. The sixth shaft **33** is generally fixedly mounted with the third frame member **8**. The fifth shaft **32** is generally mounted to the third frame member **8** and the end plate **38** for axial rotation therebetween. The table top assembly **10** is generally connected to the fifth and sixth shafts **32** and **33** via a fifth shaft travel mechanism **42** and a sixth shaft travel mechanism **43**. The fifth travel mechanism **42** is substantially identical to the first and third shaft travel mechanism **30** and **34**. The table top assembly **10** generally also comprises a table top member **44**, a frame **46**, a rotation mechanism **48** and a tilt mechanism **50**. The frame **46** is connected to the fifth and sixth shaft travel mechanisms **42** and **43** such that rotation of the fifth shaft **32** results in movement of the table top assembly **10** in the Z direction indicated by arrow C. The rotation mechanism **48** generally comprises a fourth electromechanical drive module **52** which is substantially identical to the other electromechanical drive modules of the table. The fourth electromechanical drive module **52** allows the table top member **44** to rotate as indicated by arrow D. The tilt mechanism **50** generally comprises a fifth electromechanical drive mechanism **54** having a gear **56** that can move a tilt member **58** which is connected to the frame **46** for tilting the frame **46** and thus tilting the table top member **44** as indicated by arrow E.

Referring now to FIG. **2**, one embodiment of an electromechanical drive module is shown. As described above, the first, second, third, fourth and fifth drive modules **16**, **28**, **40**, **52** and **54** are substantially identical to each other. Each module comprises a frame **18**, a fastener **20**, a drive motor **22** and an electrical conduit **24**. In the embodiment shown in FIG. **2** the drive module **60** also comprises a potentiometer **62** to detect turns within the module **60**. The fastener **20**, in the embodiment shown, generally comprises a fastener head **64**, a shaft **66** and a spring **68**. The shaft **66** has a first end **70** with threads thereon to engage a threaded hole **72** located in each of the first frame member **4**, second frame member **6**, end plate **38**, table top frame **46** and sixth shaft travel mechanism **43**. The module frame **18** comprises an aperture **75** for passage of the shaft **66** therethrough. The aperture **75** also includes an enlarged aperture portion **76**. A clip **74** is attached to the shaft **66** proximate the threaded portion **70** and prevents the shaft **66** from being removed from the aperture **75** while also allowing limited movement within the aperture **75** when the module **60** is not attached to the table **2**. The fastener head **64** generally comprises a receiving aperture **79** for receiving a second end **82** of the shaft **66**. A pin **78** fixedly attaches the fastener head **64** to the second end **82** of the shaft. The fastener head **64** also comprises an enlarged portion **80** of the receiving aperture **79** which has the spring **68** at least partially contained therein, the spring being compressed between the fastener head **64** and the module frame **18**. The spring loaded fastener **20** allows for easy mounting and dismounting of the module **60** such that the threaded end **70** of the shaft **66** does not interfere with positioning of the module **60** on the table **2** and also allows for quick removal of the module **60** when the threaded end **70** of the shaft **66** is unthreaded from the threaded hole **72**.

In the embodiment shown in FIG. **2** a shaft **84** is shown which is rotatably mounted in a frame **86** for axial rotation. The shaft **84** generally symbolizes either the first shaft **14**, third shaft **26**, fifth shaft **32**, a shaft extending between the table top member **44** into the frame **46** or a shaft extending from the gear **56** into the sixth travel mechanism **43**. The frame **86** is generally intended to symbolize either the first frame member **4**, second frame member **6**, end plate **38**, table top frame **46** or sixth shaft travel mechanism **43**. In the embodiment shown in FIG. **2**, suitable bearing means **88** are provided such that the shaft **84** can rotate within the frame **86**. The end **90** of the shaft **84**, in this embodiment, extends past the frame **86** into a central aperture **91** of a mating co-axial shaft **92** extending from the drive motor **22**. In an alternate embodiment of the invention, the shaft **92** may extend into a central aperture of the shaft **84**. The end of the shaft **84** also comprises a gear **94** fixedly connected thereto. The mating shaft **92** extending from the drive motor **22** also comprises a gear **96** fixedly connected thereto. Both the gears **94** and **96** of the mating shaft **92** and the shaft **84**, in the embodiment shown, have identical gear sizes thereon. The shaft end **90** of shaft **84** and the central aperture **91** have a circular cross-section such that the two shafts **84** and **92** can be mated at any desired orientation. However, the actual

power coupling between the shaft **92** and shaft **84** is accomplished with an idler pinion gear **98** connecting the two gears **94** and **96**. The modular frame **18** has a suitable aperture for positioning of the shafts and gears therein. In attaching the module **60** to the shaft **84** and frame **86**, once the two shafts **84** and **92** are inserted into each other as male and female, the only degree of freedom left is rotational, which does not effect the meshing of the gear transmission. The single fastener **20** in addition to holding the module **60** to its base or frame **86** is able to restrict this rotation freedom of movement. Thus, when the module **60** is connected to the frame **86** rotation of the shaft **92** by the drive motor **22** can cause the shaft **84** to rotate axially.

Referring now also to FIG. **3**, there is shown a schematic view of the shaft travel mechanisms contained in the first travel mechanism **30**, third travel mechanism **34** and fifth travel mechanism **42**. The shaft travel mechanism **99** shown in FIG. **3** generally comprises a frame **104**, tilted rollers **100** and springs **102**. The shaft **84** is located between the tilted rollers **100** and makes frictional contact therewith. The tilted rollers **100** are biased against the shaft **84** by springs **102**. The frame **104** provides a support for the springs **102** and contain the tilted rollers **100** and springs **102** within the shaft travel mechanism **99**. In operation, when the shaft **84** is axially rotated in a clockwise direction as indicated by arrow F, the shaft travel mechanism **99** is frictionally moved along the shaft **84** in the direction indicated by arrow G. When the shaft **84** is axially rotated in the counter clockwise direction as indicated by arrow H the shaft travel mechanism **99** will be moved along the shaft **84** in the direction of the arrow I. Thus, the actual translation of the power supplied by shaft **92** to the movement of a frame member along a shaft **84** is accomplished with the relatively smooth shaft **84** rotating between the tilted rollers **100** that are spring loaded against it. The unique nature of this application is having no drive screw, its maintenance in a hostile environment is greatly eased. Furthermore, having a natural overdrive capability, the tilted rollers **100** will simply start to slip on the shaft **84** when the translational resistance exceeds a set value. This allows the elimination for the need of separate safety limit switches on both ends of the travel of the shaft **84**.

A major requirement for equipment working in hostile environments is the ease of replacement of electrical components that tend to fail more frequently, and the ability to accomplish this replacement with remote means such as manipulators. Minimizing the number of fasteners, and arranging them into accessible patterns is imperative. Since visibility is also a problem it is necessary to insure that insertion of a module into a position is to be done without the need for viewing small features and handling small components. The electromechanical drive module described above fully meets these requirements. Another feature of the present invention is the combined use of the smooth shaft translator with a single home position sensor on one end of the travel of the translator in conjunction with a computer to provide intelligence to gain and retain absolute position control along the shaft travel. Another feature of the present invention is the disconnectable or demountable combined drive/sensor module that lends itself well for remote maintenance or replacement. In this solution, all electrical and electromechanical parts are combined into one module. Another feature of the present invention is the coupling and alignment method between the demountable drive/sensor module and the drive member which uniquely lends itself to remote handling while insuring critical alignment of rotating components without need for sensitive adjustments. Still another feature of the present invention is the use of single turn potentiometers to detect multi turn movements within the module and logically scrutinizing the output in software to define multi counting of cycle turns.

It should be understood that the foregoing description is only illustrative of the invention. Various alternatives and modifications can be devised by those skilled in the art without departing from the spirit of the invention. Accordingly, the present invention is intended to embrace all such alternatives, modifications and variances which fall within the scope of the appended claims.

What is claimed is:

1. An examination table for use in a hostile environment having a frame, a movable table top, and means for controllably moving said table top relative to said frame, said moving means comprising:

shaft means fixedly mounted to said frame for axial rotation;

electromechanical drive means connected to said frame and said shaft means for rotating said shaft means; and

shaft travel means for traveling along said shaft means, said shaft travel means comprising a plurality of tilted rollers, means for biasing said tilted rollers against said shaft means and means for connecting said shaft travel means to said table top such that rotation of said shaft means causes said tilted rollers to frictionally roll along said shaft means whereby said table top is moved parallel to said shaft means as said shaft means is rotated.

2. A table as in claim **1** wherein said shaft means comprises at least three shafts, each shaft oriented in a different plane.

3. A table as in claim **1** further comprising means for rotating said table top relative to said frame.

4. A table as in claim **3** further comprising means for tilting said table top relative to said frame.

5. A table as in claim **1** wherein said drive means comprises a shaft with a gear end for coaxial coupling with a gear end of said shaft means.

6. A table as in claim **5** wherein said drive means further comprises an idler pinion gear coupling said drive means shaft with said shaft means.

7. A table as in claim **6** further comprising a single fastener for mounting said drive means to said frame whereby said coaxial coupling of said drive means shaft and said shaft means, and said single fastener allows easy replacement of said drive means by use of a remote means.

8. A table as in claim further comprising sensor means to sense the position of said shaft travel means on said shaft means.

9. A table as in claim **8** further comprising computer means for processing information from said sensor means to gain and retain position control of said shaft travel means along said shaft means.

10. A table as in claim **8** wherein said sensor means and said drive means are contained in a module which is disconnectably mounted to said frame and said shaft means.

11. A table as in claim 10 further comprising single turn potentiometer means to detect multiple turn movements within said module.

12. An examination table having a frame, a movable table top, and means for controllably moving said table top relative to said frame, said moving means comprising:

shaft means mounted to said frame for axial rotation, said shaft means having a first end extending past said frame and a first gear at said first end;

drive means for rotating said shaft means, said drive means having a motor means, a drive shaft, a pinion gear means and a second gear, said drive shaft having a central aperture for at least partially receiving said shaft means first end with said pinion gear means connecting said first and second gears; and

a single fastener for mounting said drive means to said frame.

* * * * *