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(54) **MAP POSITIONING SYSTEM**

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(*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(52) **U.S. Cl.** **340/995**; 340/990; 701/207; 701/208

(58) **Field of Search** 340/990, 995; 701/207, 208

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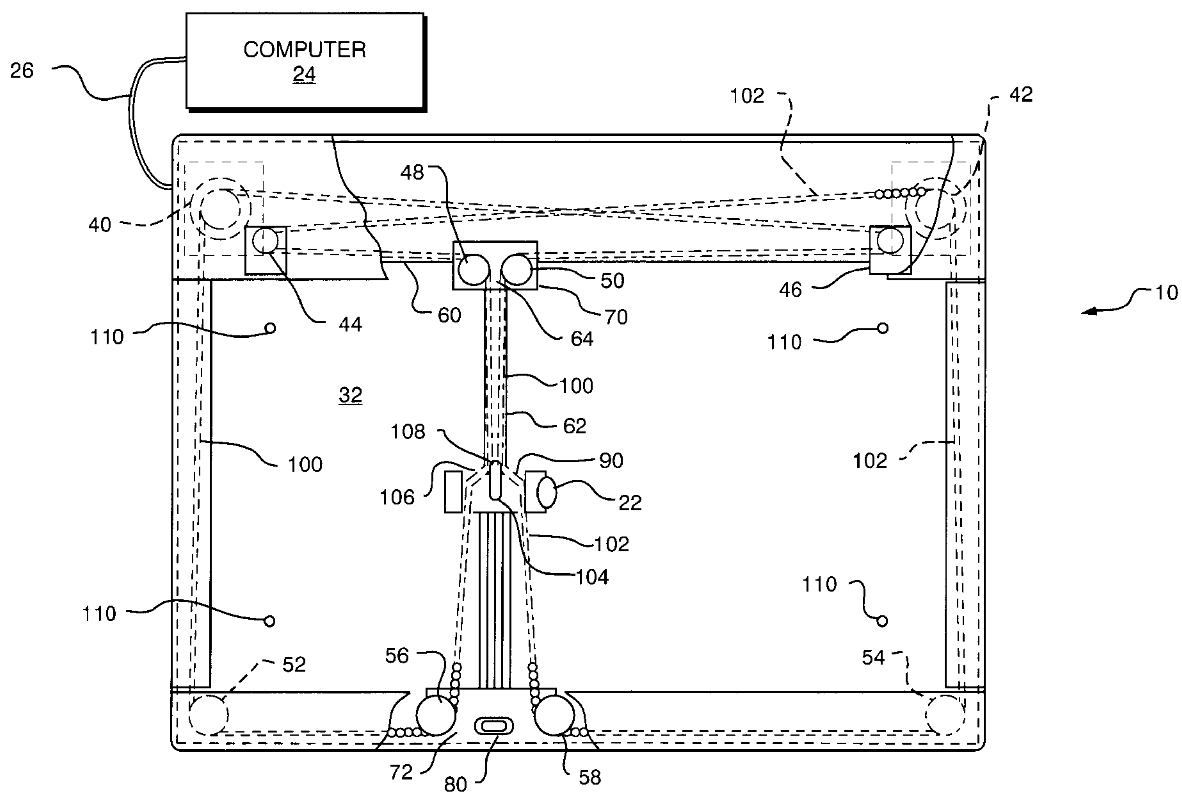
(57) **ABSTRACT**

A map positioning system is presented. The map positioning system has a rectangular or X-Y drive having a map support surface coupled thereto and receptive to a map. The X-Y drive mechanism is computer controlled to drive an indicator to a definite coordinate relative to the map support thereby illuminating the exact coordinate point when the indicator is energized.

9 Claims, 3 Drawing Sheets



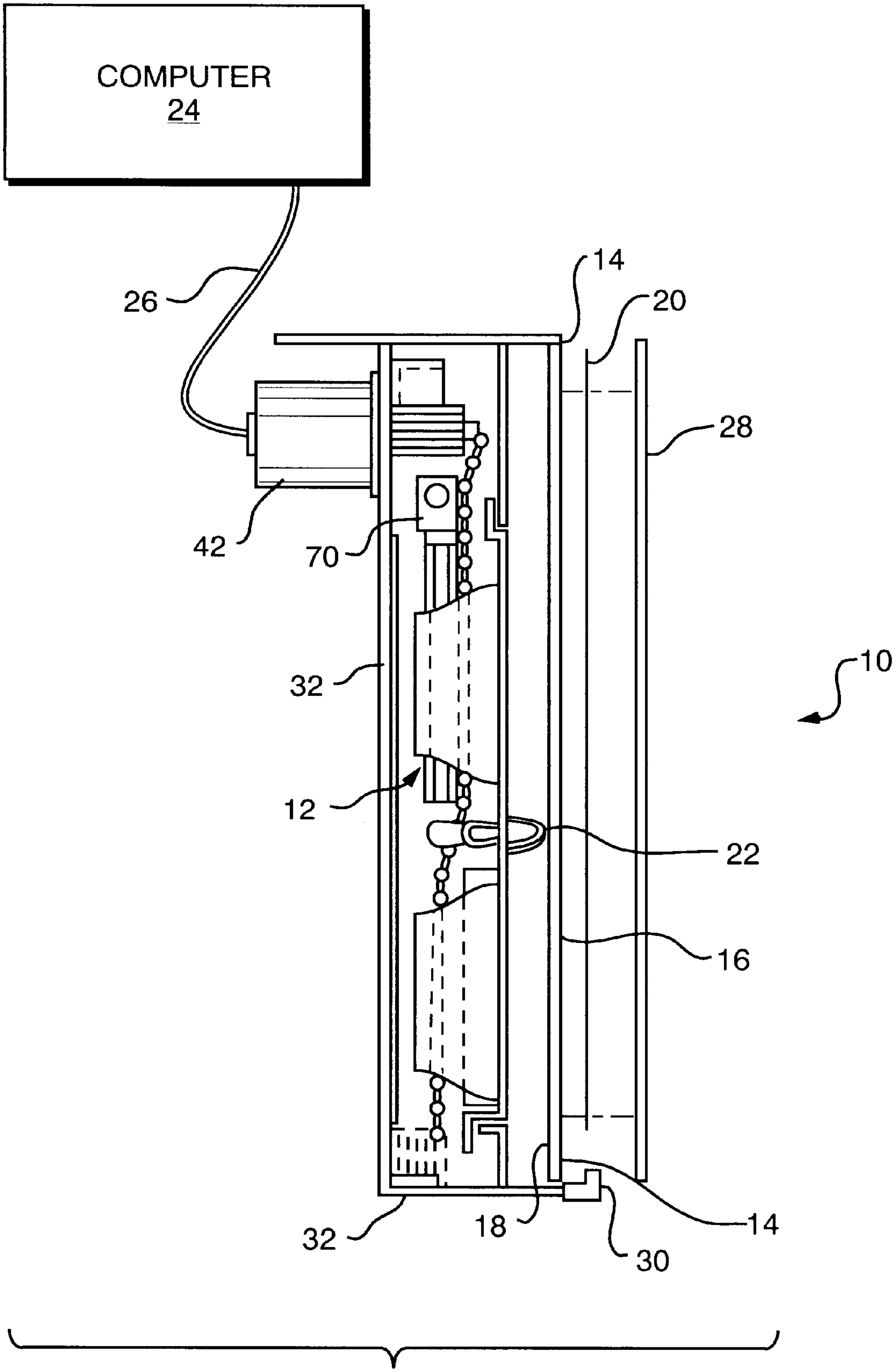
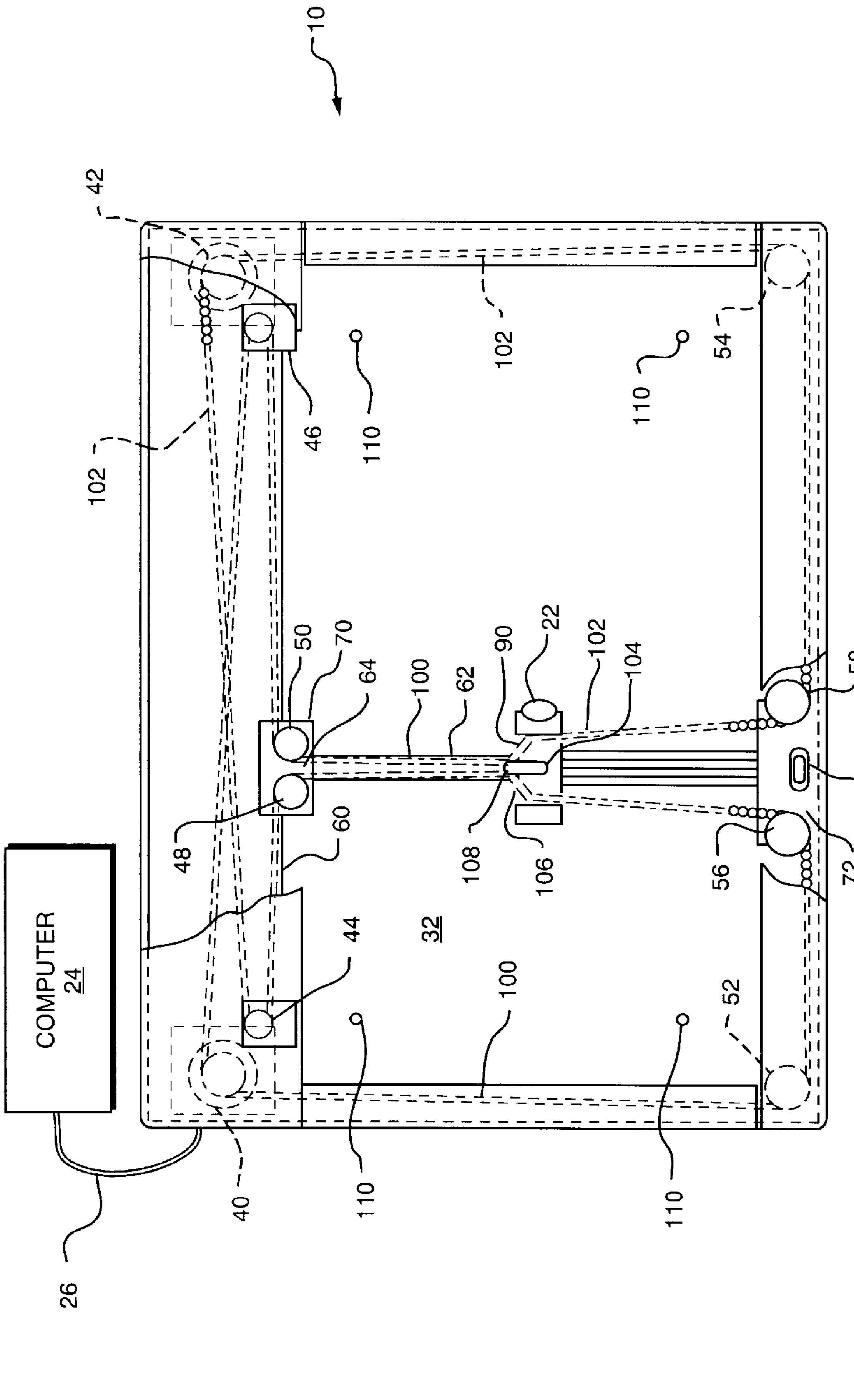


FIG. 1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110
26

FIG. 2

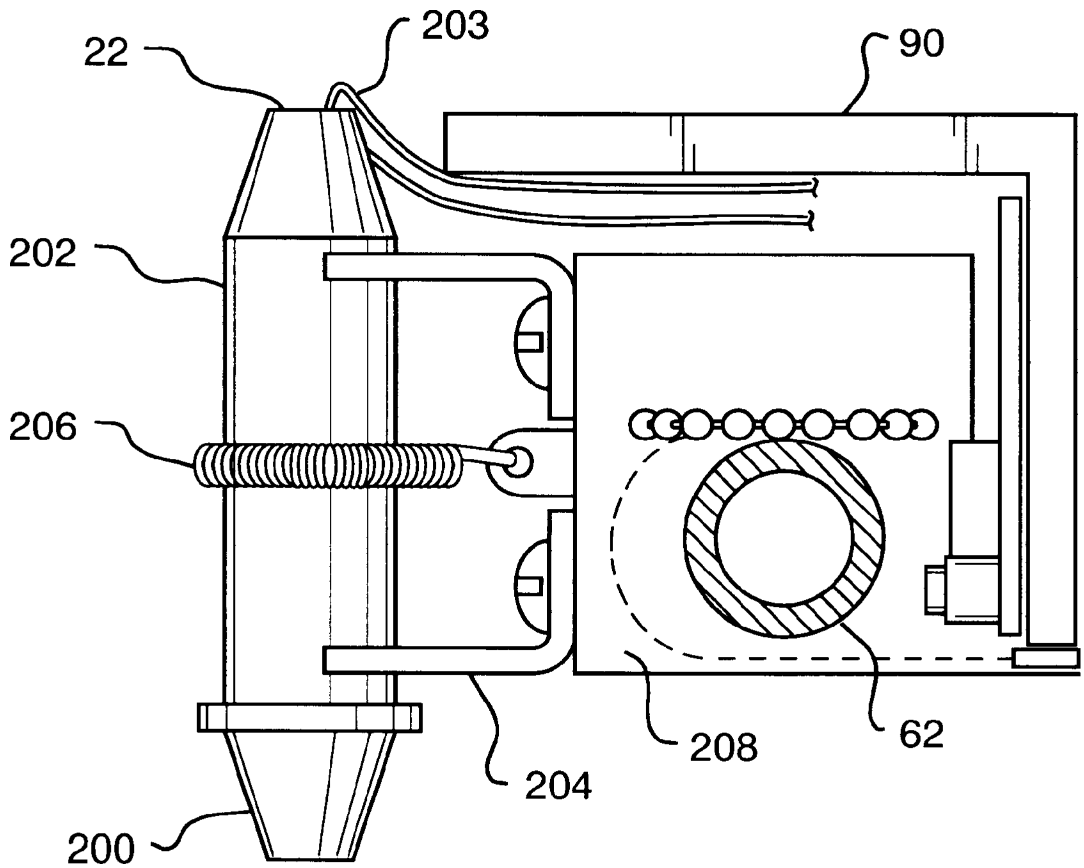

FIG. 3

MAP POSITIONING SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to motive power systems involving computerized drive mechanisms and is more specifically directed to a computerized drive mechanism for driving an LED (light emitting diode) indicator on a map display so that multiple coordinate points may be indicated on the map.

2. Brief Discussion of the Related Art

Positioning systems are well known and cable-driven positioning systems are generally known in the art. For example, fixed sheet plotters fixedly position a sheet on a flat bed and a pen, used for writing or cutting, is held on a traveling rail which travels in both directions, i.e. back and forth along the X-axis such that the pen travels in both directions, and back and forth along the Y-axis on the sheet held and fixed on the flat bed, whereby images are formed on the sheet using the pen for writing or cutting.

Positioning systems and plotting systems are also used in navigational systems to track a vessel or vehicle or to create a permanent record of the movement of same. For example, in U.S. Pat. No. 4,393,448 to Dunn et al., there is disclosed a navigational plotting system utilizing hyperbolic navigation coordinates to drive the plotter for the track of the vessel and when required to superimpose hyperbolic time difference lines either on a chart or on a plain charting surface. Navigational plotting systems are useful in plotting the track of the vessel or vehicle on a plotting surface so as to achieve a permanent record of the vehicle's progress. One use of such a system is illustrated in terms of commercial fishing. In commercial fishing, it is often times necessary to display the area that a vessel traverses over a pre-determined fishing ground so that the pilot of the vessel may more accurately control the vessel for complete coverage of the fishing ground.

Navigational plotting systems are also useful in air-sea search missions in terms of giving the navigator a clear picture of the area searched so that completeness of the search may be ascertained as well as the prevention of duplication of efforts. In addition, navigational plotters create a permanent record of the track of the vehicle so that proximity to navigational hazards may be readily ascertained; therefore, allowing the progress to a given point, harbor or place or refuge to be quickly ascertained and displayed.

Positioning systems also have important use in military applications for general mapping and cartography purposes. It is desirable to have a positioning system which can quickly indicate multiple targets or track the movement of troops or objects (e.g. vessels, aircraft, land vehicles) relative to conventional military maps.

SUMMARY OF THE INVENTION

In accordance with the present invention, the map positioning system (e.g., the aforementioned cable-drive positioning system) comprises a rectangular or X-Y drive having a map support coupled thereto, wherein the map support has a front surface and a back surface with the front surface receiving a map. The drive mechanism drives an LED (light emitting diode) or other suitable indicator to a correct position relative to the back surface of the map support thereby illuminating an exact coordinate on the map. The map positioning system of the present invention is particularly suitable for military applications including military mapping and cartography purposes. Any suitable map may be positioned on the map support and multiple targets (i.e., locations or coordinates) may be quickly indicated on the map by use of the indicator which is driven by the computer controlled X-Y drive. The X-Y drive unit positions the indicator behind the map and shows an exact coordinate specified from a computer system via standard HPGL commands. The map support may include map guide lines or pins to ensure proper positioning of the map on the map support. Therefore by properly aligning the map on the map support surface via map guide lines or pins, the computer coordinates are easily matched to the map coordinates. Typical uses of the system of the present invention in a military setting include but are not limited to locating enemy fire, tracking friendly ship positions or tracking drone flight paths. However, other non-military applications are also contemplated by the present invention, e.g., navigational tracking.

The rectangular or X-Y drive comprises a pair of driving motors which have a capacity for moving a carrier in arbitrary motions over a defined area. Preferably, this device is computer controlled and the X-Y drive is driven responsively to intelligence from the computer. The driving motors function separately or unisonly through appropriate trains to drive the carrier over a planar area. Rotation of either motor alone will be seen to move the carrier diagonally. The desired positioning is normally attained by the simultaneous rotation of both motors. A protective cover may also be provided to secure the map in a proper position on the map support surface and to protect the map from any damage or contaminants. The construction of the map positioning system is such that it is designed to pass full vibration and shock testing in accordance to military specifications.

The above-discussed and other features and advantages of the present invention will be appreciated and understood by those skilled in the art from the following detailed description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring now to the drawings wherein like elements are numbered alike in the several FIGURES:

FIG. **1** is a party exploded side crosssectional view and partial block diagram of the map position system in accordance with the present invention;

FIG. **2** is a view in top plan showing the map positioning system of the present invention; and

FIG. **3** is an enlarged side view of the carriage assembly having an LED indicator mounted thereto, in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Turning now to FIG. **1**, a map positioning system is generally shown at **10**. System **10** comprises a rectangular or X-Y drive **12** having a map support **14** coupled thereto. The map support **14** has a front surface **16** and a back surface **18** with the front surface **16** receiving a map **20**. The drive mechanism **12** drives an indicator **22** to a desired position relative to the back surface **18** of the map support **14** thereby illuminating an exact coordinate on the map **20** when indicator **22** is energized. Preferably, indicator **22** comprises an LED (light emitting diode). A computer **24** is connected to drive mechanism **12** by way of cable **26** which permits computer **24** to communicate with drive mechanism **12**, as described more fully hereinbelow.

The map positioning system **10** is particularly useful in a military setting where the system may be used to locate enemy fire, track friendly ship positions or track drone flight paths. Any suitable map **20**, such as a standard paper map, may be positioned on the map support **14**, which preferably comprises a material sufficiently transparent so as to permit indicator **22** to be visible through the map material when the indicator **22** is energized. The map support **14** preferably further includes map guide lines or pins **110** to ensure proper positioning of the map **20** on the map support **14**. Proper positioning of the map **20** is important because the X-Y drive **12** is computer controlled and operates within a defined coordinate system covering a delineated area of the map support surface **14**. To ensure a proper interface between the computer software and the X-Y drive **12** and consequently proper positioning of the indicator **22** relative to a specific coordinate point on a positioned map **20**, the coordinate system of both needs to be the same (or transferable). After properly positioning the map **20** on the map support **14**, a protective cover **28** may be placed over the map **20** to further secure the map **20** to the map support **14** and to protect the map **20** from environmental contaminants and tearing. Protective cover **28** is secured to map support **14** by retaining clip **30** or by other suitable retaining means. Retaining clip **30** is attached to a housing **32**. The protective cover **28** may be composed of any suitable transparent material and preferably comprises a thin sheet of transparent plastic. When the protective cover **28** is disposed on the map **20**, the map **20** and its details must be viewable by those viewing map **20**.

Turning now to FIG. **2**, rectangular or X-Y drive **12** of the present invention is generally shown. As shown, a pair of fixed-position driven motors **40** and **42** are fixed on housing **32**, a sequential series of pulleys **44**, **46**, **48**, **50**, **52**, **54**, **56** and **58**, a fixed guide rail **60**, a movable guide rail **62** normally perpendicularly disposed as to guide rail **60** but pivotable relative thereto by means of a pivot or hinged joint **64**, a pair of spaced carriages **70** and **72**, a carriage **70** mounting pulleys **48** and **50** and movable along fixed guide rail **60**, carriage **72**, mounting pulleys **56** and **58** and being movable along movable guide rail **62**, and carrier **90** slidably mounted on movable guide rail **62**. A support wheel **80** is mounted on carriage **72**. Pulleys **44** and **46** are mounted on housing **32**. Drive **12** comprises a rectangular drive system with the significant characteristic that the ultimate positional accuracy of the driven member **90** is maintained using small and lightweight first and second carriages **70**, **72**. The motion of the driven member or carrier **90**, having indicator **22** mounted thereon, is provided by a chain (i.e., a drive member) **100**, **102** which is motivated by motors **40**, **42** fixedly mounted on housing **32**.

The chain will be considered to consist of two parts, namely part **100**, represented by solid lines, and part **102**, represented by dash lines which chain is entrained in turn about the freely rotatable drive pulleys of the drive motors and the pulleys as will be described for driving and orienting carrier **90**. It is best to consider each chain part **100**, **102** separately or individually in order to appreciate more readily the capability of the chain parts to orient carrier **90** and hold same in desired orientation.

Chain **100**, **102** is attached directly to the driven member **90**, eliminating the possibility of lost motion between the motor drivers and the driven member **90**. Driven carrier **90** is movable along and relative to movable guide rail **62** and chain parts **100**, **102** cooperantly allow a free translation of carrier **90** while forcing the carrier **90** to be held rigidly in any angular orientation and this is so whether one drive motor is rotating while the other drive motor is not rotating or both drive motors are rotating simultaneously. Whatever the rotation or non-rotation of the drive motors, the motion is such that as one chain part is driven the other chain part is driven responsively wherefor any desired positioning of the carrier is possible.

In following the chain train, one terminus of chain part **100** is seen to be fixed to a post **104** on carrier **90** and is entrained over pulleys **50** and **46**, thence over the drive pulley of drive motor **40**, and thence is entrained over pulleys **52** and **56** before return to the carrier where it is looped over a retainer **106**, then passing outwardly from the carrier as chain part **102** for passage over pulleys **58** and **54**, thence over the drive pulley of drive motor **42**, and thence over pulleys **44** and **48** before return to the carrier when the opposite terminus is fixed to a post **108**.

The stringing of the chain is such that the angular orientation of the first carriage **70** is maintained entirely by the chain and not at all by its constraining guide rail **60**. It is this feature which makes possible a mechanism light-weight and compact in size and low in cost of production.

Since the positional accuracy of the driven member **90** (and therefore, the indicator **22**) is ultimately determined by relative motions between the operating members, closely fit rigid structures are dictated while still allowing smooth and free motions between components. The motion of the driven element **90** is constrained in one direction by a stationary structure in the form of a rigid bar or guide rail **62**. The mechanism used to drive the driven element **90** in a direction parallel to the guide rail **62** is mounted on housing **32**. Size, weight and location being relatively unimportant, good positional accuracy, repeatability and rigidity are readily realized.

Although the employment of a pair of straight guide rails, one rail being hinged **60** and one rail **62** being pivotable relative to the other is disclosed, the positional accuracy is actually determined by the chain **100**, **102**. That is, no fixed angle is required to be structurally maintained by the guide rails **60**, **62**.

Assume first a rotative motion in drive motor **40**, in a counterclockwise direction as viewed in FIG. **2**, and assume further for the moment that drive motor **42** is non-rotative. The motion of carrier **90** will be upward and rightward. Clockwise rotation of drive motor **40**, still with drive motor **42** remaining idle, will see the motion of the carrier as being downward and leftward. In a symmetrical way, if drive motor **42** rotates while drive motor **40** is non-rotative, the carrier is otherwise driven. Counter clockwise rotation of drive motor **42** causes the carrier to move downward and rightward whereas clockwise rotation causes movement upward and leftward. By combining and controlling the relative rotations of motors **40** and **42**, obviously any desired motion of the carrier **90** (and therefore, the indicator **22**) is achievable. In every case, the resultant motion is caused by the responsiveness of one of the chain parts to the movement of the other of the chain parts.

With no initial slack in chain part **100**, its tensioning will not change when carriage **90** is moved in translation. Too, it will not offer any interference to the clockwise rotation of the carriage assembly around pivot **64**, although counterclockwise rotation of the assembly around the pivot would be precluded by chain part **100**. Similarly, chain part **102** would offer no interference with any translation of the carriage assembly but would prevent any clockwise rotation of the carriage assembly around pivot **64**, although counterclockwise rotation around the pivot would be allowed.

Combining the effect of both chain parts, the carriage assembly is free to translate but is rigidly held in angular orientation. Retainer **106** holds the ends of the chain parts thereby establishing their lengths and by moving within this retainer one chain part is lengthened while the other is shortened, thereby changing the angular orientation of the carriage assembly.

It should be incidentally noted that if carrier **90** were moved along movable guide rail **62**, the chain parts would move over their pulleys, but would not interfere with the motion. Again, to illustrate the motion of carrier **90**, let drive motor **40** rotate in the clockwise direction while drive motor **42** holds chain part **102** still at the motor. As drive motor **40** rotates clockwise, chain part **100** is drawn from pulleys **52** and **56** and released to pulleys **46** and **50**. The chain motion described would tend to move carrier **90** down and move the carriage assembly to the left or to move the carriage assembly and the carrier. However, either motion would cause chain part **102** to move.

If the carrier were to move down while the carriage assembly did not translate, chain part **102** would have to move the drive pulley at drive motor **42** in counter clockwise direction. On the other hand, if the carriage assembly were to move to the left without the carrier **90** moving down, chain part **102** would cause the drive pulley at drive motor **42** to rotate in clockwise direction.

Since motor **42** is not rotative in this example, the motion of the carriage assembly and the carrier must have equal motions to the left and down when the drive motor **40** rotates in clockwise direction. If drive motor **40** is rotated in the counter clockwise direction with drive motor **42** non-rotative, the motion of the carrier would be up and to the right. Contrariwise, if drive motor **42** rotates while drive motor **40** is not rotating, the carrier is driven in other directions. Counter clockwise rotation of drive motor **42** causes the carrier to move down and to the right whereas clockwise rotation causes rotation up and to the left. As aforesaid, by combining the rotations of drive motors **40** and **42**, any motion of the carrier is possible. Further details concerning X-Y drive **12** are disclosed in commonly assigned U.S. Pat. No. 4,833,785 to Parent et al., which is herein incorporated by reference in its entirety.

In accordance with the present invention, indicator **22** is coupled to carrier **90** whereby actuation of drive motors **40**, **42** positions carrier **90** and indicator **22** relative to map support **14**. Computer **24** preferably has an indicator position control circuit will include digital to analog (D/A) converter circuitry which controls the X and Y movements of the indicator and whether the indicator **22** is energized thereby emitting light or not energized thereby emitting no light as when the indicator **22** is being quickly repositioned to show a different target or movement of an object relative to map **20**.

The coupling between the indicator position control circuitry of the computer **24** and the X-Y mechanism **12** may be of conventional design, with the indicator **22** being conditioned in an energized mode (on) or a non-energized mode (off).

In the present example, the LED **200** is received in a connector or socket **202** having wires **203** connected thereto for powering (energizing) the LED. Indicator **22** is mounted on or held relative to a clamp **204** by a spring **206** or other suitable means, the clamp being fixed to a body **208** which is sleeved upon movable guide rail **62**. Body **208** is mounted to carrier **90** so that indicator **22** may be readily positioned by movement of carrier **90**. Carrier **90** being driven by the X-Y mechanism **12** as disclosed herein.

The X-Y drive **12** and indicator **22** coupled thereto are designed in accordance with the present invention to be responsively driven to the intelligence from computer **24**. Computer-generated signals drive the motors of the X-Y drive **12** and its other components, including the indicator **22**, so that the indicator **22** is readily movable to a desired, defined coordinate point relative to the back surface **18** of the map support **14**. The indicator **22** may be quickly repositioned to a different coordinate point by further drive signals from computer **24**.

It is within the scope of this invention that X-Y drive mechanism **12** may be vertically positioned relative to the ground whereby the map **20** is positioned on the map support **14** so that it may be easily viewed by a number of viewers. In another embodiment, the X-Y drive **12** is provided in horizontal relation to the ground and the map **20** is positioned on the map support **14** which is generally horizontal to the ground.

In accordance with the present invention, the map positioning system **10** is able to indicate multiple targets on map **20** quickly using this single indicator **22**. Advantageously, this system may be used to locate or track troops or objects on any given map.

While preferred embodiments have been shown and described, various modifications and substitutions may be made thereto without departing from the spirit and scope of the invention. Accordingly, it is to be understood that the present invention has been described by way of illustrations and not limitation.

What is claimed is:

1. A map positioning system for indicating at least one coordinate point on a map comprising:

a map support for supporting a map at one surface thereof;

an indicator;

an X-Y drive mechanism disposed under said map support comprising a pair of spaced bidirectional drive motors, a plurality of spaced guide pulleys, and a length of elongated flexible drive member defining a closed loop having opposite free ends fixed to a carrier, said X-Y drive mechanism having said indicator disposed on said carrier, said X-Y drive mechanism positioning said indicator to illuminate a coordinate point on said map wherein said indicator is disposed beneath said map surface.

2. The map positioning system set forth in claim **1** wherein said X-Y drive mechanism is light weight and vibration and shock resistant.

3. The map positioning system of claim **1** wherein:

said X-Y drive mechanism is responsive to drive signals from a computer so that said indicator is readily movable to said selected coordinate point relative to said map support and quickly repositioned to a different and unrelated coordinate point in response to said drive signals.

4. The map positioning system set forth in claim **3** wherein said drive signals are standard HPGL commands.

5. The map positioning system set forth in claim **4** wherein said indicator is able to track and indicate multiple targets on said map.

6. A method of indicating a point on a map comprising:

positioning a map on a map support which is transmittable to light;

in an environment prone to heavy vibrations and shocks, positioning an indicator which is disposed beneath said map surface at a coordinate point of said map, said positioning of said indicator comprises directing control signals from a computer to a vibration and shock resistant X-Y drive mechanism, said X-Y drive mechanism comprising a pair of spaced bidirectional drive motors, a plurality of spaced guide pulleys, and a drive chain defining a closed loop having opposite free ends fixed to a carrier having said indicator, said X-Y drive mechanism being positioned under said map support; and

illuminating said indicator to indicate said coordinate point of said map.

7. The method st forth in claim **6** wherein said directing control signals comprises directing standard HPGL commands from the computer to the X-Y drive mechanism.

8. The method of claim **6**, wherein positioning said map comprises:

orientating said map on said map support relative to a coordinate system of said X-Y drive mechanism.

9. The method of claim **6**, wherein said positioning of said indicator further comprises:

positioning said indicator relative to a back surface of said map support, whereby said indicator is visible through said map when illuminated.

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