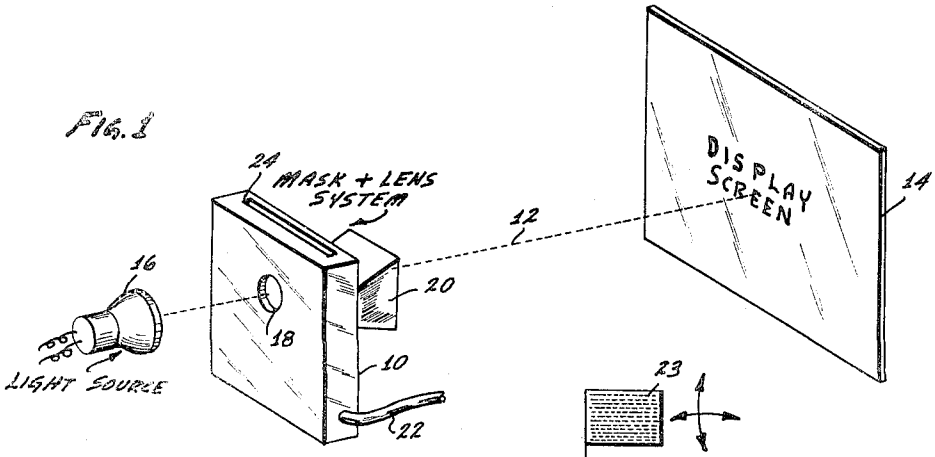
350-269 CROSS REFERENCE SEARCH ROOM

Dec. 30, 1969 W. H. SAYLOR 3,486,388

SIGNAL-CONTROLLED POSITIONING APPARATUS

Filed June 27, 1968 2 Sheets-Sheet 1

Fig. 1



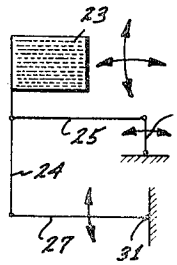
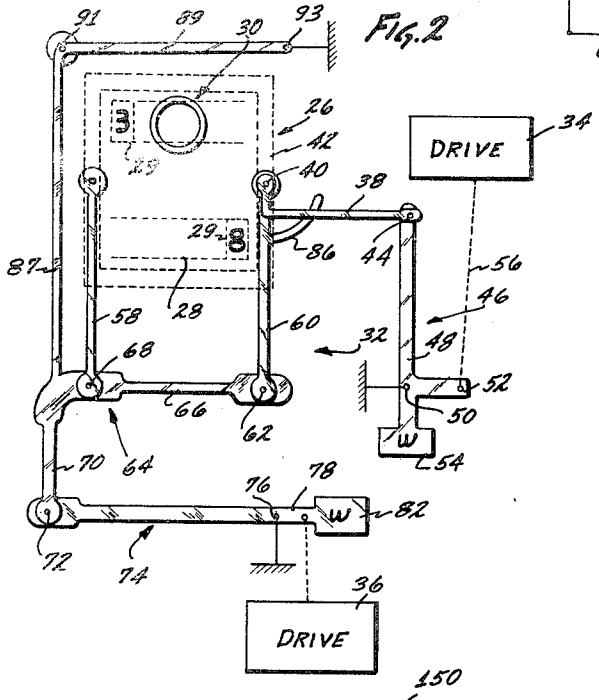


Fig. 1a

Fig. 2



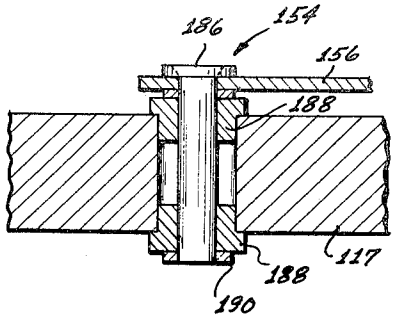


Fig. 4

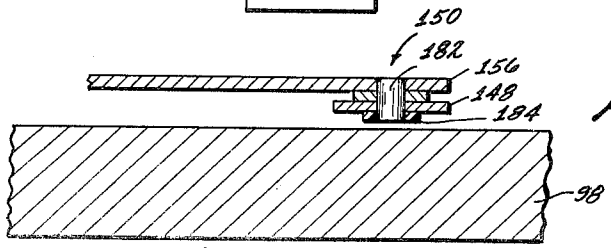


Fig. 5

INVENTOR
WILLIAM H. SAYLOR

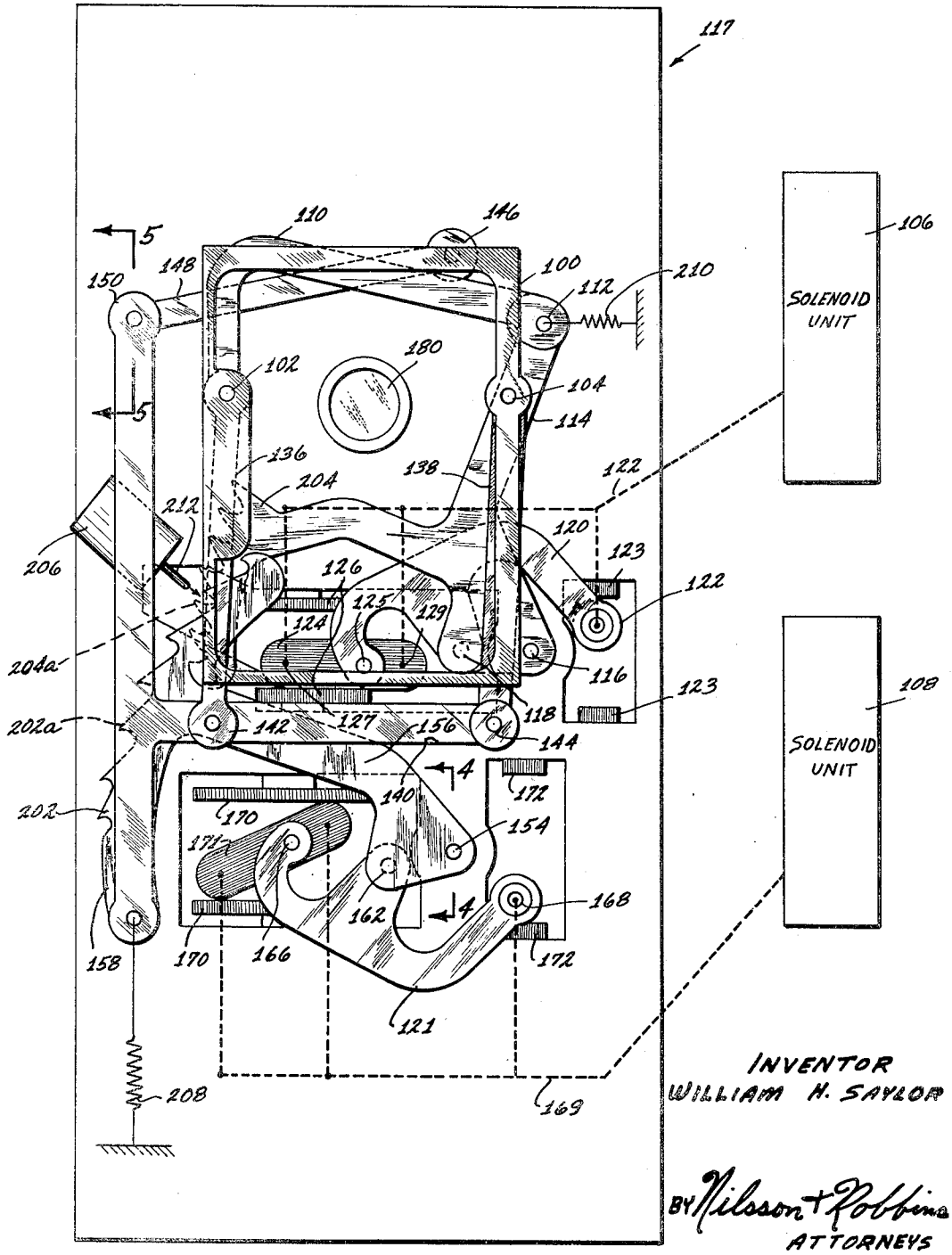
BY Nilsson & Robbins
ATTORNEYS

Dec. 30, 1969 W. H. SAYLOR 3,486,388

SIGNAL-CONTROLLED POSITIONING APPARATUS

Filed June 27, 1968 2 Sheets-Sheet 2

Fig. 3



INVENTOR
WILLIAM H. SAYLOR

BY Nilsson & Robbins
ATTORNEYS

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SIGNAL-CONTROLLED POSITIONING APPARATUS

William H. Saylor, South Laguna, Calif., assignor to S.S. & S. Company, a partnership

Continuation-in-part of application Ser. No. 458,973, May 26, 1965. This application June 27, 1968, Ser. No. 740,674

Int. Cl. F16h 21/44, 21/54, 25/18

U.S. Cl. 74—96

10 Claims

ABSTRACT OF THE DISCLOSURE

A mechanism (as for use in a display apparatus) is disclosed along with solenoid actuators, for selectively positioning a frame or array that may define any of a variety of images or the like. The frame is moved along a somewhat-arcuate path by a pivotal support structure that may be variously actuated, as by a solenoid drive unit. Another pivot structure actuates the frame along an intersecting somewhat-arcuate path so that the combination of movements may accomplish selective two-dimensional positioning. In one embodiment the pivot structure includes two somewhat-similar parallel links to the frame which preserve a parallelogram configuration as the frame is variously positioned enabling improved space utilization. The system is disclosed to additionally include: counter balancing weights for the pivotal structures to accomplish gravitational independence, a locking structure including a pair of intersecting arcuate racks for engagement by a single detent, and a limiting toggle structure for gaging the extent of displacement.

FIELD OF THE INVENTION

The present invention relates to positioning apparatus as controlled by electrical signals and is a continuation-in-part of U.S. pending patent application, Ser. No. 458,973 filed May 26, 1965, now Patent No. 3,448,444.

BACKGROUND AND SUMMARY OF THE INVENTION

The need frequently arises to variously physically position a member in accordance with control signals. For example, a signal-controlled display device may include a mechanism to variously position a plane array of symbols to accomplish the selective individual display of one particular symbol. Such devices may incorporate optical apparatus and a source of illumination to afford a projected light display. In prior-art forms of such display devices, it has been proposed to move the array (or the frame supporting the array) in sliding contact with supporting members. However, in systems of this type, frictional forces inherent in sliding elements, make accurate control exceedingly difficult, with the result that the array is continually subject to misalignment with the optical system.

A desirable characteristic for a mechanism to position an array of symbols, as in a display apparatus, is independence from gravitational forces. Various systems of the prior art which utilize slides, ratchets and other similar mechanisms have sometimes presented a substantial load to be moved which is difficult if not impossible to balance for gravitational independence.

In the operation of a signal-controlled positioning apparatus, it is also sometimes desirable to lock the frame or other movable structure in a selected position so that the command signals may cease, yet the selected position of the frame is maintained. The simplicity of such a locking structure is quite important in mechanisms of this type as a factor in manufacture, maintenance, accuracy and speed-of-operation.

In general, the present invention resides in a positioning mechanism which utilizes a pair of arcuate-motion drive structures. The system may be adapted to a wide variety of applications as for example, systems to display photographic slides mounted in a frame as a single-plane array, systems for symbolic displays and so on. The system hereof enables a compact pattern of the individual displays by introducing a parallel mode of operation. More specifically, with regard to structure, in accordance with one embodiment hereof, the frame to be positioned is mechanically coupled by dual links from pivot points to the pivotal structure. As a result of such an arrangement, a stable, reliable, accurate and parallel, pivotal positioning structure is afforded which may incorporate balance weights, a locking mechanism that utilizes a single detent and an effective alignment mechanism.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, which constitute a part of this specification, there are set forth exemplary embodiments demonstrating various objectives and features hereof, specifically:

FIGURE 1 is a perspective and diagrammatic view of a system incorporating a structure in accordance with the present invention;

FIGURE 1*a* is a diagram illustrating the basic operation of a structure as may be embodied in the system of FIGURE 1;

FIGURE 2 is a diagrammatic and plan view of a somewhat-simplified structure incorporating the principles of the present invention;

FIGURE 3 is a diagrammatic and top plan view of a mechanism constructed in accordance with the present invention;

FIGURE 4 is a sectional view taken along line 4—4 of FIGURE 3; and

FIGURE 5 is a sectional view taken along line 5—5 of FIGURE 3.

DESCRIPTION OF THE ILLUSTRATIVE EMBODIMENTS

As required, detailed illustrative embodiments of the invention are disclosed herein. In that regard, it is to be understood that these embodiments exemplify the invention although various different forms thereof may be constructed. In any event, the embodiments set forth herein are presented as a basis for the claims defining the scope of the invention and to present a basis for an understanding thereof.

Referring initially to FIGURE 1, there is shown a somewhat-diagrammatic perspective view of a system incorporating apparatus of the present invention. Specifically, a housing 10 contains a frame (not shown) which in turn holds a light mask defining an array of symbols (not shown) which may be employed to symbolically modulate, define, and/or color a beam of light that is indicated by a line 12. In one application, the housing 10 may receive the light mask through a slot 24, which mask carries an array of photographic projection slides that are selectively displayed on a screen 14 via the beam represented by the line 12.

The housing 10 receives illumination from a light source 16 through an aperture 18 which is generally aligned with a lens holder 20. The structure contains a lens system as generally well known in the prior art for light image projection. The mechanism within the housing 10 aligns a selected symbol or portion of an array with the aperture 18 to thereby light-modulate and display a selected image. Such positioning may be accomplished by a solenoid unit or other motive means (not shown) contained within the housing 10, that is selectively energized through an electrical cable 22. Thus, electrical signals supplied through the cable 22 command the

display of a particular image on the screen 14, by selectively positioning a frame within the housing 10 to accomplish the requisite alignment with the aperture 18.

The basic pattern of motion within the housing 10 is illustrated in FIGURE 1*a*. A mask 23 defines several patterns, e.g. light projections, of varying opacity to form light images. The mask 23 is carried on a generally vertical post 24 which is pivotally connected to horizontal links 25 and 27. The link 25 is in turn pivotally connected to a pivot member 29 while the link 27 is anchored at a fixed pivot point 31. The pivotal movement of the link 27 (as by a solenoid drive unit) displaces the mask 23 along a somewhat vertical arcuate path, while such movement of the pivot member 29 accomplishes somewhat horizontal displacement. Thus, the two motion paths in combination are capable of providing selective two-dimensional positioning of the mask 23.

Although the structure depicted in FIGURE 1*a* is effective, there are certain problems in its use. For example, as the mask moves in an arcuate pattern (providing several attendant advantages) the individual projection images (normally rectangular) must be placed in a somewhat fan-shaped configuration which does not afford a compact array. Furthermore, it is desirable to include structure for precisely placing the mask 23 in each selected position, compensating for mechanical slippage, wear and so on.

One form of more sophisticated structure is shown in FIGURE 2 and will now be considered in detail. A frame 26 (shown in phantom) supports an opaque mask 28 defining an array of symbols 29, which mask is to be variously positioned with respect to an optical system 30. The frame 26 is connected through a generally-indicated pivotal mechanism 32 to solenoid drive units 34 and 36. Specifically, the drive unit 34 controls the displacement of the frame 26 along an arcuate path which is substantially horizontal, while the drive unit 36 positions the frame 26 along a substantially-vertical arcuate path.

Considering the mechanism 32 in greater detail, a horizontal arm or link 38 is connected from a dual pivot point 40 (on the right vertical leg 42 of the frame 26) to a floating pivotal connection 44. Thus, the link 38 is coupled to a pivotally-mounted actuation arm 46. The arm 46 includes: a major vertical extension 48 from a fixed pivot 50 to the pivotal connection 44; and a shorter horizontal extension 52 from the fixed pivot 50 (providing a lever arm for the solenoid drive unit 34) and a counter-balancing weight arm 54.

The extension 52 is coupled to the solenoid drive unit 34 through a mechanical linkage, represented by dashed lines 56, in accordance with well known techniques. In this regard, the solenoid drive unit 34 may operate with binary-code displacement, driving the extension 52 rotationally about the pivot 50 in binary-code increments. Thus, as the extension 52 is raised or lowered by discrete motions (in a substantially arcuate pattern) such motion is translated through the link 38 to traverse the frame 26 along a substantially-horizontal arcuate path.

The major vertical displacement of the frame 26 is accomplished through a pair of parallel vertical links 58 and 60 which are of similar length. The link 60 is connected from the pivot point 40 to a floating pivotal connection 62 of the member 64, the horizontal extension 66 of which also includes a pivotal connection 68 to the link 58.

A vertical downward extension 70 of the member 64 terminates at a floating pivotal connection 72 that is coupled to an actuating arm 74, mounted at a fixed pivotal reference point 76. A short horizontal extension 78 of the member 74 is mechanically coupled to the solenoid drive unit 36 (indicated by dashed lines 80) whereby to rotatably displace the arm 74 in accordance with energization of the solenoid drive unit 36, as in binary significance.

The weight of the frame 26 along with certain of the structure is somewhat counter-balanced by the weight 54

along with the weight 82 affixed to the extension 78 of the arm 74. The facility to accomplish such counter-balancing is a significant feature of the present structure as it enables dynamic response that is identical for all positions of the system. Another feature hereof is illustrated by an arcuate extension 86 from the vertical link 60. The extension 86 provides a support or guide for the swinging generally-horizontal link 38 as it moves in relation to the link 60. Such a support or guide affords a considerable advantage in a pivotal system incorporating the principles of the present invention.

Another important feature of the structure of FIGURE 2 is illustrated by the parallel links 58 and 60. These members hold the frame 26 in a parallelogram configuration with the extension 66 thereby enabling a much more compact arrangement or pattern of the individual images. As a consequence, a significantly increased area within the frame 26 may be usefully employed. Somewhat similarly, for the vertical, an extension 87 from the member 64 receives a pivotal arm 89 at a floating pivot point 91. The arm 89 is fixed at a pivot point 93 to provide a parallelism for the frame 26 in cooperation with the actuating arm 74 (of similar operational length).

Considering the actual operation of the system of FIGURE 2, to variously position the frame 26 in accordance with arcuate displacement of the extension 52 and 78 of the drive units 34 and 36, respectively, it is to be noted that the parallel links 58 and 60 consistently maintain the frame 26 in referenced alignment. That is, as the solenoid drive unit 34 actuates the arm 46 to move the link 38 laterally, thereby displacing the frame 26 horizontally, the two links 58 and 60 swing in fixed relationship to the arm 64, preserving the motion of the frame 26 in an established vertical orientation pattern. Somewhat similarly, as the solenoid drive unit 36 actuates the arm 74, to raise and lower the frame 26, through the arm 64 and the links 58 and 60, the pivot link 89 is cooperatively instrumental in maintaining the frame 26 oriented throughout the arcuate vertical-motion path.

By differently energizing the solenoid drive units 34 and 36 as well known in the art, various symbols 29 that are defined in the array 28 may be aligned with the optical system 30 to thereby project a light image of such a symbol. Thus, signals applied to the solenoid drive units may position the frame 26 to accomplish a desired positional relationship and in turn present a desired display as depicted in FIGURE 1.

A still more-sophisticated embodiment of the present invention is illustrated in the remaining FIGURES 3, 4 and 5, which will now be considered in detail. In these figures the frame 100 (generally coinciding to the frame 26) is shaded in order to better distinguish it from the connecting arms and linkages. Fundamentally, the frame 100 is moved in a manner substantially similar to that previously described with reference to FIGURE 2. Specifically, the frame 100 is supportedly carried by a pair of pivotal connections 102 and 104 and driven by a pair of solenoid units 106 and 108.

The pivotal connection 102 on the frame 100 receives an angular link 110 which is connected through a floating pivot connection 112 to an arm 114 that is carried on a fixed pivot mount 116 supported on a base plate 117. The arm 114 is also connected through a pivotal connection 118 to a drive control member 120 which is mechanically connected (as indicated by a dashed line 122) to be actuated by the solenoid unit 106.

The drive control member 120 is connected for drive at three pivot points which are spaced apart to incrementally move the arm 114 with displacements of binary significance, e.g. 1, 2, 4, etc. That is, the drive control member 120 gages the displacement of the frame 100 to predetermined vertical distances. Thus, although the motive force is applied in an arcuate pattern, the control member 120 limits the displacement of the frame 100 to horizontal projections of the arcuate pattern.

A similar drive control member 121 performs the same control for vertical motion. The operation of these structures will be considered below; however, it is to be noted that the top member 120 is pivotally coupled to the arm 114 at the connection 118 and extends to the right to an end stud 122 which is driven between stops 123, fixed in the plate 117. A leftward extension of the member 120 is coupled to a toggle-like member 124 at a pivot point 125, which is driven between limit stops 126 in the base plate 117 through end connections 127 and 129, by the solenoid drive unit 106.

Recapitulating, with regard to the mechanism generally, the solenoid unit 106 acts on the drive member 120 to variously pivot the arm 114 about the fixed pivot 116. As a result, the pivotal junction 112 (upper right) swings along an arcuate path which is a somewhat horizontal motion pattern that is directly applied through the link 110 to the pivotal connection 102 on the frame 100. Thus, various discrete displacements accomplished by the solenoid unit 106 (which may be arcuate) result in various displacements of the frame 100 along a substantially-horizontal, arcuate motion path metered to linear displacement.

The substantially-vertical displacement of the frame 100 is accomplished by the solenoid unit 108, acting through links 136 and 138 which are similar in length and parallel, both being connected from the frame 100 to an arm 140 at spaced-apart pivotal connections 142 and 144. The arm 140 is referenced to a fixed pivot amount 146 on the base plate 117, through a generally horizontal link 148 (top of drawing) and a pivotal connection 150. The arm 140 is also referenced to a fixed pivot mount 154 (also on the base plate 117) through a link 156 pivotally coupled at the connection 158 (lower left). The toggle drive and guide member 121 is connected through a pivot connection 162 to the arm 156 and carries drive ends 166 and 168. The end 168 is coupled to the solenoid drive 108 (mechanical coupling 169) while the end 166 is pivotally coupled to a toggle-like member 171 which operates between limit stops 170. In the same manner, the end 168 operates between limit stops 172 which are affixed in the base plate 117.

The vertical motion pattern is accomplished when the solenoid unit 108 variously displaces the drive member 121 to pivot the link 156 about the pivot mount 154, thereby moving the pivotal connections 142 and 144, raising or lowering them along generally-arcuate vertical paths. In this manner a desired vertical position of the frame 100 is accomplished. By combining such generally-vertical displacement and the similar generally-horizontal displacement (as considered above) two-dimensional position selectivity is provided for the frame 100, whereby various parallel sections, within the frame 100 may be selectively aligned with an optical system 180 for display.

In the system, the solenoid units 106 and 108 actually provide over drive to the control members 120 and 121 which limit the actual displacements to measured horizontal and vertical linear projections. As both members operate in the same manner, consider the lower, less-obstructed member 121. As indicated above, drive is applied from the solenoid unit 108 to the ends of the toggle-like member 171 and the end 168. The left (outward) end of the toggle-like member 171 has a vertical displacement indicative of a value of "one." In a related manner, the other end of the toggle-like member 171 is displaceable between the limit stops 170 to accomplish a displacement of "two." The movement at the end 168 of the control member 121 has an applied significance of "four." Thus, by selectively placing each of these junctions in raised or lowered positions, eight different displacement positions are available. Thus, the positions are accurately defined, in addition to being in a parallel configuration which permits dense packing.

Regarding other structure of the system of FIGURE 3, the floating pivotal connections, as the connection 150, may comprise simply a pin 182 (FIGURE 5) locked into the connecting members, e.g. link 148 and link 156 by a snap ring 184. The pivotal supports which are fixed to the base plate 117 are afforded bearing support. Specifically, for example, the pivot support 154 (FIGURE 4) includes an elongate pin 186 extending through the link 156, bearing elements 188 and terminating in a snap ring 190. Thus, the link 156 is pivotally anchored to the base plate 117.

In the operation of the system of FIGURE 3, various predetermined positions for the frame 100 are accomplished selectively energizing the solenoid units 106 and 108. A selected position can be maintained, after the solenoid units are de-energized. The structure for accomplishing this operation involves a pair of overlapping, curved racks 202 and 204 which are arcuate about pivots 154 and 116, respectively, each carrying teeth which are engaged by a solenoid-detent structure 206. The rack 202 defining teeth 202*a* is carried on the link 156 and is coupled through a spring 208 to the base plate 117. The rack 204, including teeth 204*a*, is carried on the arm 114 which is coupled through a spring 210 to the base plate 117.

In operation, the solenoid-controlled structure 206 is energized resulting in the withdrawal of a detent 212, after which the solenoid units 106 and 108 may freely act to position the frame in the desired physical relationship to the base 98 and the optical system 180 as described above. Subsequently, the solenoid structure 206 is de-energized allowing the detent 212 to be released into mutual engagement with the racks 202 and 204, thereby locking the two pivotal systems in the positions in which they are placed. As a result, a selected position is maintained until the solenoid 206 is again energized. Thus, the system may incorporate a simple memory structure.

The system hereof may be economically produced in a low-maintenance form that is capable of accomplishing desired positional relationships in accordance with electrical control signals or various other motive means. The system may be embodied in small miniature units or sizable display systems. Of course, many different forms are possible and in that regard the scope hereof is indicated by the claims hereof.

What is claimed is:

1. A mechanism for selectively positioning an array along first and second intersecting paths in a single plane comprising:

a first pivot means including a first arm affixed thereto, for movement in a first defined arc in said plane;

means for coupling said first arm to said array, whereby to traverse said array primarily along a first path;

a second pivot means including a second arm affixed thereto for movement in a second defined arc in said plane which second defined arc intersects said first defined arc;

linkage means including at least one connection on said array, and at least one linkage means coupled to each of said first and second pivot means whereby to traverse said array variously along said first and second intersecting paths to thereby selectively position said array in two dimensions.

2. A mechanism according to claim 1 wherein said linkage means includes at least two links of substantially equal lengths and connected in parallel configuration to said array.

3. A mechanism according to claim 1 further including first and second arcuate index means, said first index means coupled respectively to said first and second pivot means, and still further including detent means for mutually engaging said index means.

4. A mechanism according to claim 1 wherein said linkage means further includes a pivot arm extending in one dimension; and at least two pivots on said pivot arm, coupled to said two links at spaced-apart locations thereon.

5. A mechanism according to claim 4, wherein said two links are of substantially equal length.

6. A mechanism according to claim 1 further including at least one support extension integral with an element of said linkage means, for supporting at least one other of said means.

7. A mechanism according to claim 1 further including at least one counter-balance means coupled to one of said pivot means whereby to afford somewhat of a balance.

8. A mechanism according to claim 7 wherein said two links are of substantially equal length and further including first and second arcuate index means, said first index means coupled respectively to said first and second pivot means, and still further including detent means for mutually engaging said index means.

9. A mechanism according to claim 8 further including at least one support extension integral with an element of said linkage means, for supporting at least one other of said means.

10. A mechanism according to claim 1 further including a displacement limiting apparatus including a plurality

of pivotally-mounted interconnected toggle means and means for limiting the displacement of said toggle means.

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FRED C. MATTERN, JR., Primary Examiner

W. S. RATLIFF, JR., Assistant Examiner

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340—347; 350—269