United States Patent [19]

Balogh

[11] **3,844,378**

[45] **Oct. 29, 1974**

[54] **CONTROL SYSTEM FOR AN AERIAL DEVICE**

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[22] Filed: **May 31, 1973**

[21] Appl. No.: **365,488**

Related U.S. Application Data

[63] Continuation of Ser. No. 165,916, July 26, 1971, abandoned, and a continuation-in-part of Ser. No. 31,577, April 24, 1970, abandoned.

[52] **U.S. Cl.** ..... **182/141,** 91/420, 91/459, 182/2, 250/217 S

[51] **Int. Cl.** **E04g 1/18,** F15b 13/044

[58] **Field of Search** ..... 182/2, 141; 250/217 S; 91/420, 459, 275, 361

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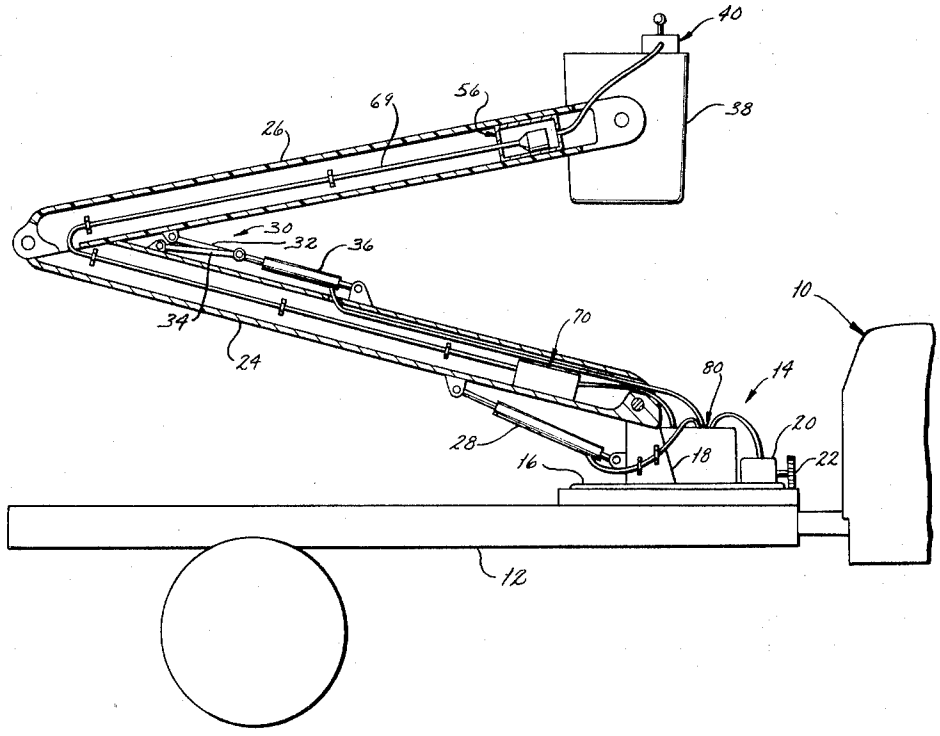
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[57] **ABSTRACT**

This invention is a control system for an aerial device having movable beams, drive means for moving the beams, and a workman's basket supported on the upper end of the beams. The control mechanism includes a lamp assembly mounted adjacent the basket and means for varying the light intensity radiated by lamps within the lamp assembly. Optic fibers conduct light radiated from the lamp assembly to a photocell mounted adjacent the lower end of the beams. The photocell reacts to light conducted by the optic fibers and cooperates with an amplifier to cause actuation of drive means for moving the beams.

19 Claims, 8 Drawing Figures



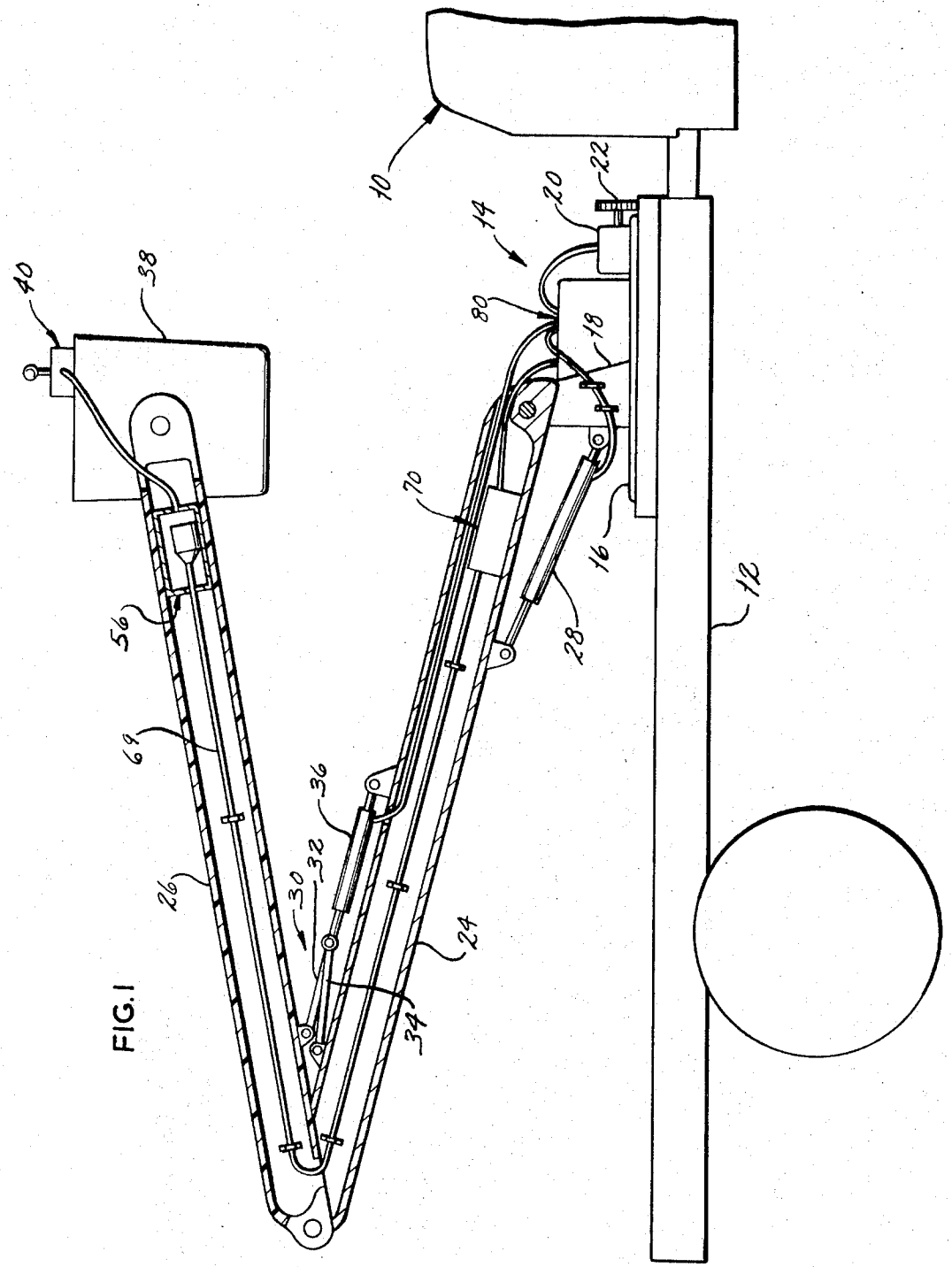


FIG. 1

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FIG. 2

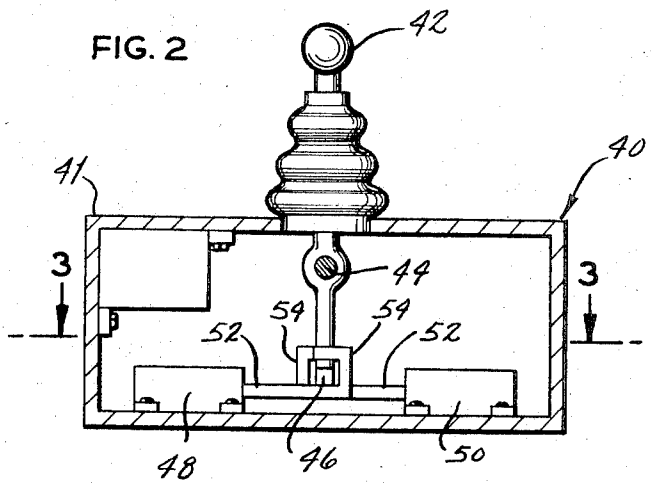


FIG. 3

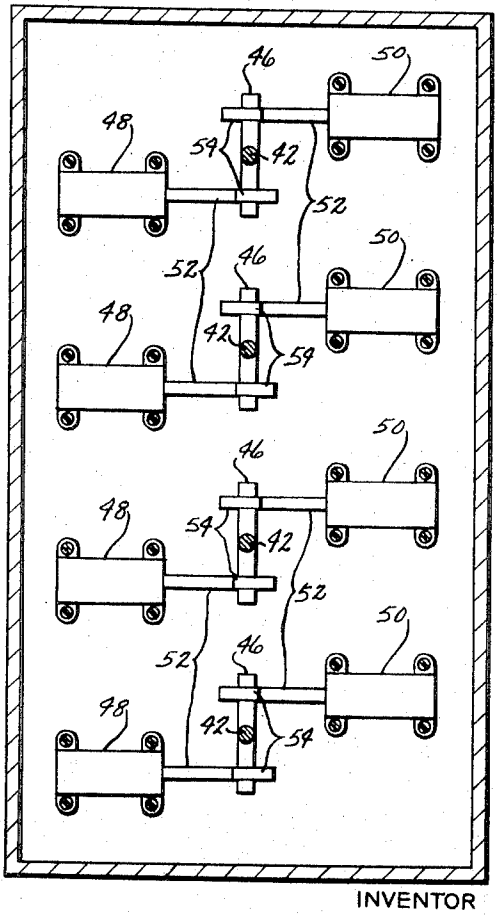
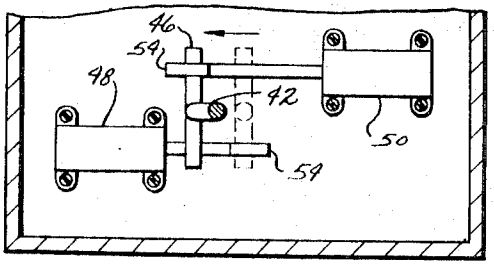


FIG. 4



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FIG. 5

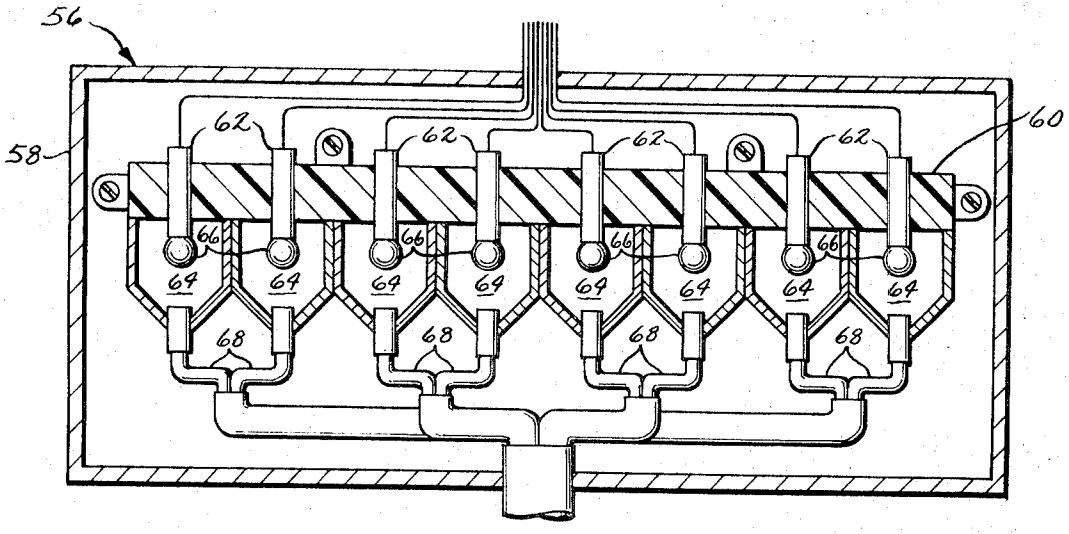
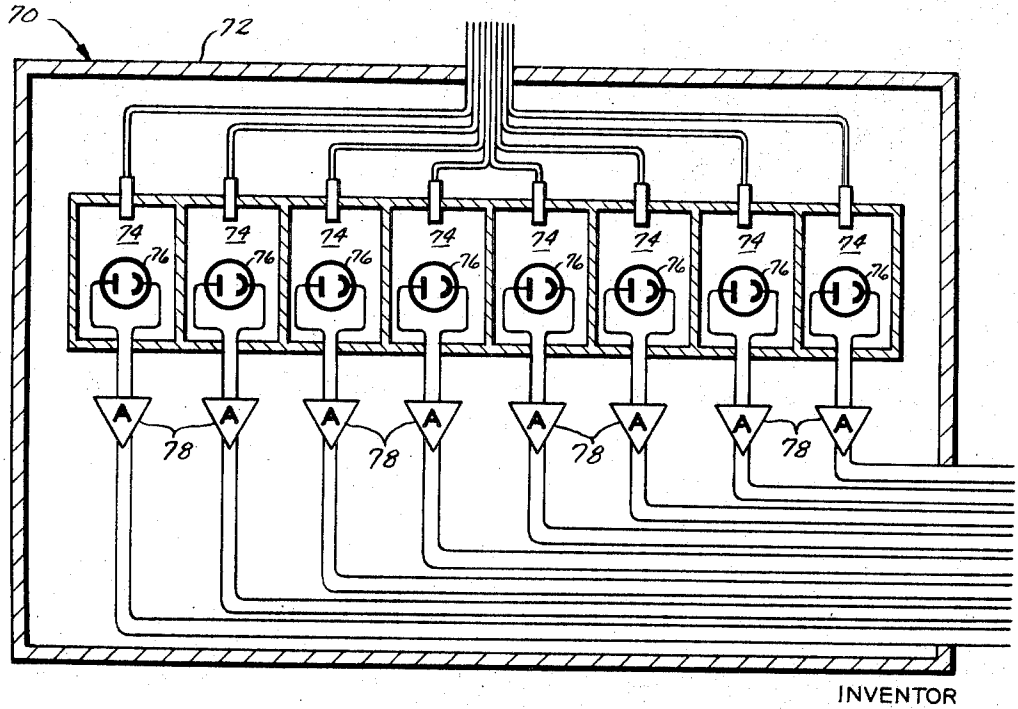


FIG. 6



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FIG. 7

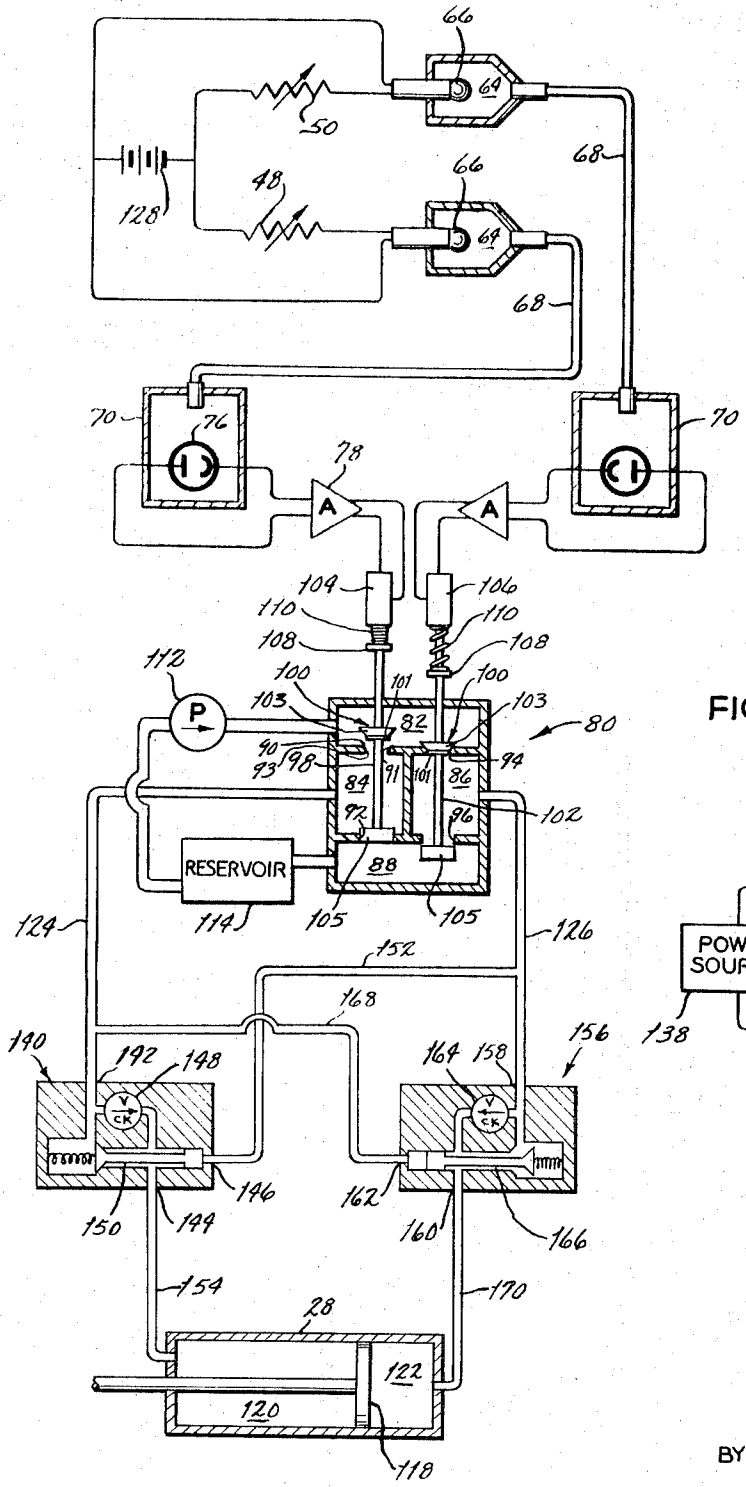
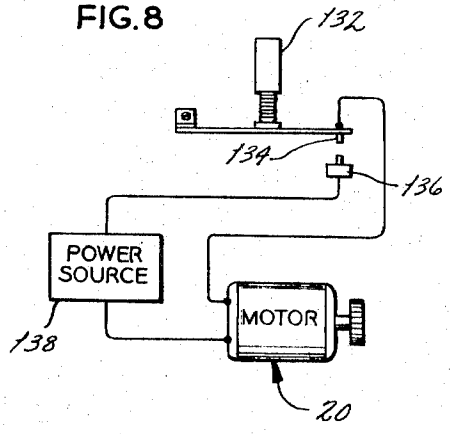


FIG. 8



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CONTROL SYSTEM FOR AN AERIAL DEVICE

This is a continuation of application Ser. No. 165,916, filed July 26, 1971, and now abandoned.

This is a continuation-in-part of my copending application Ser. No. 31,577, filed Apr. 24, 1970, and now abandoned.

This invention relates to aerial devices and particularly to a control system for aerial devices.

Several types of aerial devices are presently being used for lifting workmen into the air. These devices are sometimes mounted on vehicles such as trucks so that they may be transported wherever they are needed. One known articulated aerial device includes two articulated beams which pivot with respect to each other about a horizontal axis and which beams are mounted on a mast capable of rotating about a vertical axis. Telescopic aerial devices are also in present use. They often include a lower beam hinged to a rotatable mast and one or more additional beams telescopically mounted within the lower beam. Workmen's baskets or platforms are generally mounted at the extreme ends of both of these types of aerial devices and are adapted to carry workmen to the desired elevation.

Controls have been provided in baskets of aerial devices so that a workman can control a basket's movement while inside the basket. There are generally four basic controls: One control for moving the upper beam or beams with respect to the lower beam; a second control for moving the lower beam about its horizontal pivotal axis with respect to the mast; a third control for rotating the mast assembly about a vertical axis; and a fourth control connected to an emergency power source or to an alarm. The control systems presently used on aerial devices include a control box located within the basket and a plurality of hydraulic or electrical lines running from the control box downwardly through the inside of the beams to a control center located near the mast. The control center responds to the signals given from the control box and causes the various drive means to be actuated to move the beams.

There are several disadvantages in the control systems presently being used. The hydraulic lines which run through the beams are heavy and space-consuming. Their weight puts additional stress on the beams, thereby requiring the beams to be constructed of heavier material and limiting the weight which they can lift. In telescopic beams hydraulic cylinders for extending the beams are usually located inside the beams and as a result there is very little space left for hydraulic lines. When hydraulic lines are also included within the beams, precautions must be taken to prevent their becoming tangled with the hydraulic cylinders. Another problem presented by hydraulic lines is that they are occasionally pinched or punctured by the movement of the beams, thereby cutting off or releasing the fluid within the line so that it is ineffective in controlling the beams' movement.

Aerial devices are very often used by utility companies for maintenance work on electrical lines. When workmen are in the basket and working on electrical lines, it is important that they be insulated from the ground to protect them from the danger of being electrocuted by the high voltage which runs through the lines. To insulate the basket from the ground, the upper beams of some aerial devices are made of a material having a low electrical conductivity. When hydraulic lines extend from the basket down to the mast, however, they present a hazard in that they provide an avenue of electrical conductance from the basket to the ground.

The control mechanism of this invention utilizes optic fibers for conducting light signals from the basket to the control center located adjacent the mast. These optic fibers are only a fraction of an inch in diameter and therefore occupy less space than previously used hydraulic lines. Optic fibers are also very poor electrical conductors and consequently contribute to the electrical insulation of the basket from the ground. Furthermore they are flexible and strong and therefore to not become inoperative when twisted, scraped, or pinched during movement of the beams. Because of their small diameter they are extremely light in weight, thereby minimizing the stress on the aerial beams.

Among the several objects of the present invention may be noted the provision of a new control mechanism for aerial devices which conveys signals from the basket to a control center adjacent the mast; the provision of a control mechanism for aerial devices wherein an optic fiber is used to transmit light signals from the basket to a control center located adjacent the mast; the provision of a control mechanism for aerial devices which may be operated from the basket at the extreme upper end of the beams and which has a minimum weight; the provision of a control mechanism for aerial devices which facilitates electrical insulation of the workman's basket or platform from the ground; the provision of a control mechanism for aerial devices which will actuate drive means to move the aerial beams in small increments; the provision of a control mechanism for aerial devices which utilizes light energy signals to actuate a hydraulic system for moving the beams; and the provision of a control mechanism for aerial devices which is simple in construction and economical to manufacture. Other objects and features will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the constructions hereinafter described, the scope of the invention being indicated in the following claims.

In the accompanying drawings, in which one of various possible embodiments of the invention is illustrated,

FIG. **1** is a partial sectional view of an articulated aerial device utilizing the control mechanism of this invention;

FIG. **2** is a sectiona view of the controller which is mounted in the basket of the aerial device;

FIG. **3** is a sectional view taken along line **3—3** of FIG. **2**;

FIG. **4** is a detailed view similar to FIG. **3** showing the movement of the lever;

FIG. **5** is a sectional view of the lamp assembly;

FIG. **6** is a sectional view of the receiver which is mounted adjacent the mast;

FIG. **7** is a schematic diagram of a part of the control mechanism and hydraulic system of this invention; and

FIG. **8** is a schematic diagram of a motor circuit responsive to the control mechanism of this invention.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

Numeral **10** designates a vehicle having a support platform **12.** Rotatably mounted on platform **12** is a mast assembly **14.** Assembly **14** includes a circular base

16 rotatably mounted on platform 12 and a mast 18 which extends upwardly therefrom. A drive motor 20 is also mounted on platform 12 and includes a rotatable cogwheel 22 which is engaged with cogs around the outer periphery of base 16. When motor 20 is actuated it causes base 16 to rotate about a vertical axis. A lower beam 24 is pivotally mounted at its lower end to the upper end of mast 18 and is adapted to swing about a horizontal axis. An upper beam 26 is pivotally mounted at its lower end to lower beam 24 and is adapted to swing about a horizontal axis. A lower hydraulic cylinder 28 is pivotally connected at its lower end to mast 18 and at its upper end to lower beam 24. Expansion of hydraulic cylinder 28 causes lower beam 24 to swing upwardly with respect to mast 18, and retraction of lower hydraulic cylinder 28 causes lower beam 24 to swing downwardly. A linkage assembly 30 interconnects upper beam 26 and lower beam 24 and includes an upper link 32 pivotally connected at one of its ends to upper beam 26 and pivotally connected at the other of its ends to a lower link 34. The other end of lower link 34 is pivotally connected to lower beam 24. An upper hydraulic cylinder 36 has one of its ends pivotally connected to lower beam 24 and the other of its ends pivotally connected to the juncture between upper link 32 and lower link 34. Extension of upper hydraulic cylinder 36 causes assembly 30 to spread, thereby causing upper beam 26 to swing about lower beam 24 so that the angle between lower and upper beams 24, 26, increases. Retraction of upper hydraulic cylinder 36 causes upper beam 26 to swing in the opposite direction, thereby decreasing the angle between upper beam 26 and lower beam 24. Pivotally mounted at the extreme upper end of upper beam 26 is a workman's basket 38 adapted to carry a workman.

The aerial device illustrated in FIG. 1 is of the articulated type but the control system of this invention may be used in conjunction with telescopic aerial devices or any other type of device for lifting a man in the air. The control system is shown in conjunction with hydraulic cylinders 28, 36, and drive motor 20 for illustrative purposes only, and it may be adapted for controlling other prime movers used on aerial devices.

Mounted within workman's basket 38 is a controller 40. Referring to FIGS. 2–4, controller 40 includes a frame 41 and a plurality of levers 42. Levers 42 are pivotally mounted on a rod 44 which is suspended within frame 41 of controller 40. At the extreme lower end of each lever 42 is a cross-pin 46. Also mounted within frame 41 are four first resistors 48 and four second resistors 50. Resistors 48, 50, are of the variable type. Their particular construction is not important to this invention, but they must be capable of varying the resistance in a circuit. Resistors 48, 50, each have a longitudinally movable rod 52 terminating in a hook 54 which is hooked around cross-pin 46. Each first resistor 48 is paired with and positioned opposite a second resistor 50. Hook 54 of resistor 48 engages one side of pin 46, and hook 54 of resistor 50 engages the opposite side of pin 46. Rods 52 are longitudinally movable within resistors 48, 50, and are spring loaded therein so that they are normally held in the position shown in FIG. 3. Rods 52 are yieldably movable longitudinally outwardly from within resistors 48, 50. The construction of resistors 48, 50, is such that the resistance which they create in an electrical circuit is decreased whenever rods 52 are pulled outwardly from the position shown in FIG. 3.

Controller 40 is operated by pushing the upper end of lever 42 either to the left or to the right as seen in FIG. 2. Movement of lever 42 to the right will cause pin 46 to be displaced to the left in the position shown in FIG. 4. As pin 46 moves to the left it pulls rod 52 out of second resistor 50, thereby reducing the resistance which resistor 50 provides in a circuit. Movement of pin 46 to the left has no effect on first resistor 48 because of the open end of hook 54 of resistor 48. When the operator releases his grip from the upper end of lever 42, rod 52 returns to its original position as a result of its spring mounting within second resistor 50. Because of this construction lever 42 when pushed to the right reduces the resistance of second resistor 50 and when lever 42 is pushed to the left it reduces the resistance produced by first resistor 48.

Mounted within the upper end of upper beam 26 is a lamp assembly 56. Lamp assembly 56 may be located anywhere in the vicinity of basket 38. It may be within upper beam 26 or outside upper beam 26 or even within basket 38.

Referring to FIG. 5, assembly 56 includes a frame 58. A lamp mount 60 is secured within frame 58 and includes a plurality of bulb sockets 62 extending therethrough. Mounted on one side of mount 60 are eight transmission chambers 64 which are completely enclosed so that no light is permitted to enter from the outside. Sockets 62 each extend within one chamber 64 and are provided with lamp bulbs 66. Exposed to the interior of each chamber 64 is the end of an optic fiber 68.

Fibers 68 are capable of transmitting light in the same manner that copper wires conduct electricity. One example of this newly developed type of light transmitting media is manufactured by Dupont Company and sold under the trademark CROFON. Each of these plastic optic fibers has a transparent core of polymethyl methacrylate sheathed with a plastic having a lower refractive index. Light travels through the core in a zigzag pattern caused by internal reflections from the surrounding medium. These plastic optic fibers are extremely tough and flexible. An individual 10 ml. (0.1 inch) fiber, for example, can be tied tightly in an overhand knot without breaking. This allows the fibers to be readily bent around a small radius and repeatedly subjected to flexing and vibrations without losing their operativeness. Because of their small diameter these fibers contribute little weight to the aerial devices. They also are poor conductors of electricity and occupy a minimum of space.

Each of the eight fibers 68 is joined in a cable 69 and extends outwardly through frame 58 of lamp assembly 56. From assembly 56 fibers 68 extend downwardly within beams 24, 26, to the lower end of lower beam 24 where they terminate within a receiver assembly 70. Assembly 70 may be positioned within the extreme lower end of lower beam 24 or it may be positioned outside lower beam 24 in the general vicinity of mast 18. Assembly 70 includes a frame 72 having eight receiving chambers 74 provided therein. Each chamber 74 is completely enclosed so that light is not permitted to enter from the outside. Each optic fiber 68 terminates at its lower end inside one receiving chamber 74. Also within each chamber 74 is a photoelectric cell 76. Each cell 76 is electrically connected to an amplifier

78. Photoelectric cells 76 are adapted to be excited by light to produce electrical current. Amplifiers 78 magnify the current produced by cells 76 so that the current will be great enough to operate a conventional motor, solenoid or other electrically driven mechanism. Because the use of photoelectric cells in conjunction with amplifiers for this purpose is well known in the art, these elements are shown schematically (FIGS. 6 and 7).

As each bulb 66 in lamp assembly 56 is illuminated the light radiating therefrom is conducted by one optic fiber 68 through beams 24, 26, into one receiving chamber 74. As the light is emitted into receiving chamber 74 it causes excitement of photoelectric cell 76 which cooperates with amplifier 78 to produce electrical current. The electrical impulses produced by cell 76 and amplifier 78 correspond in intensity to the light intensity of bulb 66. When the light intensity increases or diminishes, the electrical impulses vary in the same manner.

The variable electric current produced by cell 76 and amplifier 78 can be used to energize an actuator in a manner whereby the actuator moves in proportion to the light intensity of bulb 66. It can also be appreciated that a variably responsive actuator can be used to selectively control the rate of movement of many types of drive systems. An example of one drive system utilizing this variable current to actuate movement of a derrick beam arrangement wherein the rate of beam movement is proportional to the light intensity of bulb 66 is illustrated schematically in FIG. 7.

A valve assembly 80 includes a pressure chamber 82, first and second middle chambers 84, 86, and a return chamber 88. A first inlet opening 90 forms communication between pressure chamber 82 and first middle chamber 84. Opening 90 includes a conical space 91 and a cylindrical space 93. A first outlet opening 92 in the form of a cylinder provides communication between first middle chamber 84 and return chamber 88. Second middle chamber 86 includes a second inlet opening 94 identical to opening 90 and a second outlet opening 96 identical to opening 92 providing communication into pressure chamber 82 and return chamber 88, respectively. A first valve stem 98 extends through first openings 90, 92, and includes a valve head 100 of complementary configuration with opening 90 and sized to form a fluid-tight closure therein. Valve head 100 comprises a cylindrical portion 101 and a portion 103 in the shape of a frustum of a cone. Valve stem 98 further includes a cylindrical valve head 105 of complementary configuration with opening 92 forming a movable fluid-tight closure therein. Valve 105 is spaced from valve head 101 a distance slightly greater than the distance between openings 90, 92, and valve stem 98 is longitudinally movable so that reciprocation thereof will cause openings 90, 92, to be alternatively opened and closed by valve heads 100 and 105. Because the distance between valve heads 100 and 105 is slightly greater than the distance between openings 90, 92, only one of the openings may be closed by valve heads 100 and 105 at a time. A second valve stem 102 identical in construction with first valve stem 98 extends through openings 94, 96, in second middle chamber 86. Although valve stems 98 and 102 are respectively shown in fully retracted and fully extended limit positions, each stem can be maintained, as will be hereinafter described, in positions that are intermediate their fully extended and fully retracted limit positions.

Operatively secured to valve stems 98, 102, are a first solenoid 104 and a second solenoid 106. Solenoids 104, 106, are each provided with an armature 108 which is longitudinally movable from a fully extended limit position to a fully retracted limit position. A spring 110 is provided on each of solenoids 104, 106, for biasing armatures 108 to their fully extended limit position. In their fully extended limit position armatures 108 hold valve stems 98, 102, in corresponding fully extended limit positions so that valve heads 100 close inlet openings 90, 94, of middle chambers 84, 86, respectively. When solenoids 104, 106, are actuated they cause armatures 108 to move toward their fully retracted positions against the bias of springs 110, thereby causing valve stems 98, 102, to move longitudinally so that valve heads 100 open inlet openings 90, 94, and valve heads 105 close outlet openings 92, 96.

In the schematic shown in FIG. 7, solenoid 104 is shown in its fully actuated state with armature 108 in its fully retracted position. Solenoid 106 is shown in its deactuated state with armature 108 in its fully extended position. The fully extended deactuated position of armature 108 is equivalent to the minimum light intensity condition of a corresponding bulb 66 whereas the fully retracted actuated position of armature 108 is equivalent to the maximum light intensity condition of a corresponding bulb 66. Armature positions intermediate the fully extended and fully retracted limit positions correspond proportionally to light conditions intermediate the maximum and minimum intensities.

A hydraulic pump 112 is in communication with pressure chamber 82. Pump 112 is preferably a pressure compensated pump which produces a constant hydraulic pressure regardless of the resistance encountered in the hydraulic circuit. Pump 112 can also include known sensing means (not shown) for shutting off the pumping action when solenoids 104 and 106 are deactuated whereby both valve heads 100 are seated to prevent fluid from entering middle chambers 84 and 86. A reservoir 114 is provided in communication between hydraulic pump 112 and return chamber 88. Lower hydraulic cylinder 28 includes a piston 118 which is longitudinally movable therein. Piston 118 divides cylinder 28 into a first cylinder chamber 120 and a second cylinder chamber 122.

A pair of hydraulic lines 124, 126 are respectively connected to middle chambers 84, 86, of valve assembly 80. A holding valve 140 is provided on line 124 and includes an entrance port 142, an exit port 144 and a pilot port 146. Holding valve 140 further includes a check valve 148 which permits fluid to flow from entrance port 142 to exit port 144 but prevents reverse flow therethrough. Holding valve 140 also includes a spring-restrained valve 150 biased to a normally closed position to prevent a reverse flow of fluid from exit port 144 to entrance port 140. A fluid line 152 connects pilot port 146 with line 126 and a fluid line 154 connects exit port 144 with cylinder chamber 120. A second holding valve 156 symmetrically identical to holding valve 140 is provided on line 126. Holding valve 156 includes an entrance port 158, an exit port 160, a pilot port 162, a check valve 164 and a spring-restrained valve 166 shown in an open position to permit a reverse flow of fluid from exit port 160 to en-

trance port **158.** A fluid line **168** connects pilot port **162** with fluid line **124** and a fluid line **170** connects exit port **160** with cylinder chamber **122.**

When solenoids **104, 106,** are in their deactuated state, inlet openings **90, 94,** are closed and the hydraulic pressure within cylinder chambers **120, 122,** is equal so that piston **118** is stationary.

Assuming that first solenoid **104** is actuated, it causes stem **98** to move toward solenoid **104** whereby portion **103** of valve **100** is unseated from inlet opening **90** of first middle chamber **84.** However, inlet opening **90** remains sealed during movement of stem **98** toward solenoid **104** until cylindrical portion **101** of valve **100** is displaced entirely into conical space **91** of opening **90.** When valve **100** has moved a sufficient distance toward solenoid **104** to permit inlet opening **90** to be opened, valve **105** will have moved into outlet opening **92,** closing it. Under this arrangement of valves **100** and **105,** opening **92** remains closed during further movement of stem **98** toward solenoid **104** to a fully open position of valve **100.** Consequently openings **90** and **92** are never simultaneously opened or simultaneously closed. Solenoid **106** and valves **100, 105,** of stem **102** operate in an identical manner.

When opening **90** is opened, hydraulic fluid is pumped from pressure chamber **82** into first middle chamber **84** through hydraulic line **124** into entrance port **142** of holding valve **140** through check valve **148,** exit port **144,** fluid line **154** and into first cylinder chamber **120.** This causes an imbalance in hydraulic pressure between first cylinder chamber **120** and second cylinder chamber **122.** Fluid also flows from line **124** through line **168** into pilot port **162** to exert a pressure on valve **166.** Valve **166,** in response to this fluid pressure, is displaced to an open valve position as shown such that fluid can flow in a reverse direction from exit port **160** to entrance port **158.**

As a result of the pressure imbalance between cylinder chambers **120, 122,** piston **118** moves to the right as viewed in FIG. **7.** The hydraulic fluid within second cylinder chamber **122** is forced through hydraulic line **170** into exit port **160** of holding valve **156** for reverse flow across valve **166** to entrance port **158,** fluid line **126** and into second middle chamber **86.** Because solenoid **106** is in a deactuated state, inlet opening **94** is closed and outlet opening **96** is opened, thereby permitting the hydraulic fluid to move from second middle chamber **86** to return chamber **88.** The fluid then progresses through reservoir **114** and is recirculated through pump **112.**

Under this arrangement of holding valves **140, 156,** piston **118,** which controls articulated movement of beam **24,** is displaced to the right only when pump **112** pumps fluid through line **124.** If for any reason pump **112** stops pumping fluid, valves **150** and **166** close and piston **118** is held in fixed position by the presence of fluid in chambers **120, 122.** This fluid, due to the closed positions of valves **150** and **166** and the arrangement of check valves **148** and **164,** cannot flow back to the reservoir. Consequently beam **24** is also held in a fixed position. When solenoid **104** is deactuated, spring **110** causes it to move out to its original position, thereby closing inlet opening **90** of first middle chamber **84** and neutralizing the pressure on opposite sides of piston **118.**

As pump **112** delivers fluid at constant pressure, regardless of the resistance in the hydraulic circuit the flow rate of fluid into cylinder chamber **120** is dependent upon the position of valve **100** with respect to opening **90,** which position governs the rate of flow into chamber **84** and eventually cylinder chamber **120.** The maximum flow rate into cylinder chamber **120** occurs when solenoid **104** is in its fully retracted limit position corresponding to maximum light intensity of bulb **66.** Less than maximum flow rates for open positions of valve **100** occur when solenoid **104** is not fully energized, whereby stem **98** is not fully retracted. Thus the rate of fluid flow into cylinder chamber **120** and the rate of movement of beam **24** is proportional to the light intensity of bulb **66.**

When solenoid **106** is actuated sufficiently to open inlet opening **94** of second middle chamber **86,** cutlet opening **96** of that chamber will be closed. This causes the line of pressure from pump **112** to be introduced through hydraulic line **126** and in a like manner as described for the pumping of fluid through chamber **84,** piston **118** is displaced to the left as viewed in FIG. **7.**

The control system for operating lower cylinder **28** is illustrated schematically in the upper half of FIG. **7.** When the operator desires to cause piston **118** to move to the right, he pulls lever **42** to the left as viewed in FIG. **2,** thereby causing cross-pin **46** to move to the right so that the resistance in first resistor **48** is reduced. Reduction of resistance in first resistor **48** permits current to flow from an electrical power source **128** through one lamp **66** in lamp assembly **56.** Lamp **66** is illuminated and the light therefrom is conducted by an optic fiber **68** to receiver assembly **70** where the light radiates toward photoelectric cell **76.** This light excites photoelectric cell **76** and causes electrical current to be produced. The electrical current is magnified by amplifier **78** and is transmitted to first solenoid **104.** Actuation of solenoid **104** causes the movement of piston **118** to the right as explained above.

When the operator releases lever **42,** it is pulled back to its original position by the spring bias of movable rod **52** in resistor **48.** This turns off lamp **66** and consequently the production of electrical current by photoelectric cell **76** is ended and first solenoid **104** becomes deactuated. At the time solenoid **104** becomes deactuated, piston **118** stops and remains stationary until the operator again manipulates lever **42.** If the operator wants to move piston **118** to the left as viewed in FIG. **7,** he moves lever **42** to the right as viewed in FIG. **2,** thereby reducing the resistance of second resistor **50.** Second resistor **50** is connected to a lamp **66,** fiber **68,** and receiver **70** which cooperate to actuate second solenoid **106** in the same manner that solenoid **104** is actuated by resistor **48.** Actuation of solenoid **106** causes piston **118** to move to the left until lever **42** is returned to its neutral position, whereupon movement of piston **118** ceases.

Referring to FIG. **8,** the control system of this invention may be utilized to actuate motor **20.** The control system is used to actuate a solenoid **132** in the same manner as previously described for solenoids **104, 106.** The armature of solenoid **132** in this instance is spring-biased to a retracted position and is connected to the movable terminal **134.** When solenoid **132** is energized the armature is adapted to extend and move terminal **134** into electrical contact with a fixed terminal **136.** When movable contact **134** engages fixed contact **136,**

the electrical circuit from a power source **138** to motor **20** is completed, thereby actuating motor **20.**

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A control system in combination with an aerial device having a movable beam assembly and a workman's support means movable between an extended limit position and a retracted limit position, said control system comprising a lamp assembly at a first station on said aerial device, said lamp assembly having at least one lamp for producing a light beam, said lamp assembly having means for controlling and varying the light intensity of said light beam, light transfer path means for transmitting said light beam to a second station remote from said first station, light sensing means at said second station for sensing variable light intensities of said light beam and producing an electric current in response to the light intensity of said light beam, the magnitude of said electric current produced by said light sensing means being proportional to the light intensity of said light beam, said control system further including variably responsive drive means communicating with said light sensing means and said beam assembly for operating said beam assembly at variable speeds in proportion to the magnitude of electric current produced by said light sensing means whereby the rate of movement of said beam assembly by said drive means is substantially proportional to the light intensity of said lamp.

2. A control system as claimed in claim **1** wherein said means for controlling the light intensity of said light beam includes a variable resistor.

3. A control system as claimed in claim **1** wherein said drive means include electromagnetic actuating means communicating with said light sensing means, said actuating means having a movable armature member displaceable to variable positions in proportion to the light beam intensity of said lamp.

4. A control system as claimed in claim **3** wherein said drive means further include a hydraulic cylinder having a displaceable piston disposed therein, said piston communicating with said beam assembly and being movable at variable rates in proportion to the light beam intensity of said lamp such that movement of said piston causes movement of said beam assembly at rates of movement proportional to the position of said movable armature member and the light beam intensity of said lamp.

5. A control system as claimed in claim **4** wherein said drive means further comprise hydraulic fluid supply means including pumping means for pumping fluid to said cylinder, said fluid supply means having first control valve means for controlling the rate of fluid pumped to said cylinder, said first control valve means communicating with said movable armature member such that movement of said armature member in one direction opens said first control valve means an amount proportional to the movement of said armature member to permit said pumping means to pump fluid to said cylinder at variable flow rates determined by the position of said armature member and the beam intensity of said lamp, the rate of fluid flow to said cylinder being proportional to the light intensity of said lamp whereby the rate of movement of said piston is proportional to the light intensity of said lamp.

6. A control system as claimed in claim **5** wherein said fluid supply means further include first check valve means in series with said first control valve means, said pumping means pumping fluid through said first check valve means at said variable rates to said cylinder, said first check valve means preventing fluid disposed in said cylinder from flowing out of said cylinder in a reverse direction through said first check valve means when there is no light beam from said lamp assembly.

7. A control system as claimed in claim **6** wherein said hydraulic cylinder is double acting, said piston defining first and second cylinder chambers each said cylinder chamber being associated with said fluid supply means, said fluid supply means and said first and second cylinder chambers forming a closed circulation system, said lamp, said movable armature member, said first control valve means, and said first check valve means being associated with said first cylinder chamber, said second cylinder chamber being identically associated with a separate lamp in said lamp assembly, a separate movable armature member, a second control valve means, and a second check valve means.

8. A control system as claimed in claim **7** further including first bypass valve means for bypassing fluid past said first check valve means to said pumping means, said first bypass valve means being in an open position when fluid is pumped into said second cylinder chamber such that movement of said piston causes fluid disposed in said first cylinder chamber to flow through said first bypass valve means past said first check valve means to said pumping means, first bypass valve means being in a normally closed position when fluid is not being pumped into said second cylinder chamber.

9. A control system as claimed in claim **8** further including a second bypass valve means for bypassing fluid past said second check valve means to said pumping means, said second bypass valve means being in an open position when fluid is pumped into said first cylinder chamber such that movement of said piston causes fluid disposed in said second cylinder chamber to flow through said second bypass valve means past said second check valve means to said pumping means, said second bypass valve means being in a normally closed position when fluid is not being pumped into said first cylinder chamber.

10. A control system as claimed in claim **3** including a motor wherein said displaceable armature member is connected to a motor switch such that energization of said armature member actuates said switch to permit the flow of electromotive power to said motor.

11. A control system as claimed in claim **1** wherein said light transfer means include an optic fiber interposed between said lamp assembly and said light-sensing means, said optic fiber providing a continuous path for transmission of light from said lamp assembly to said light-sensing means during movement of said beam assembly between said light positions.

12. A control system as claimed in claim **11** wherein said optic fiber traverses a non-linear path from said lamp assembly to said light-sensing means.

13. A control system as claimed in claim 11 wherein said lamp is enclosed within a lightproof transmission chamber and said light-receiving means is enclosed in a lightproof receiving chamber, the opposite ends of said optic fiber being in communication with said transmission and receiver chambers.

14. A control system as claimed in claim 11 wherein said optic fiber is formed of non-conductive material to prevent electricity from flowing therethrough.

15. A control system as claimed in claim 14 wherein said lamp assembly is provided on said beam assembly, said control system further including insulating means for insulating said lamp assembly from said beam assembly, said light sensing means being spaced from said beam assembly such that said lamp assembly and said light sensing means are electrically insulated from one another.

16. A control system as claimed in claim 1 wherein said movable beam assembly is articulated, said first station for said lamp assembly being at one end portion of said articulated beam assembly and said second station for said light-sensing means being at the opposite end of said articulated beam assembly.

17. A control system as claimed in claim 1 wherein said light-sensing means includes a photoelectric cell and an amplifier, said cell and amplifier converting the variable light beam intensities from said lamp to proportionate electric currents.

18. A control system as claimed in claim 1 wherein said drive means comprises displaceable electromagnetic means, said control system further including a motor wherein said displaceable electromagnetic means is connected to a motor switch such that energization of said electromagnetic means actuates said switch to permit the flow of electromotive power to said motor.

19. A control system in combination with an aerial device having a movable beam assembly and a workman's support means movable between an extended limit position and a retracted limit position, said control system comprising a lamp assembly at a first station on said aerial device, said lamp assembly having at least one lamp for producing a light beam, said lamp assembly having means for controlling and varying the light characteristics of the light in said light beam in a predetermined manner, light transfer path means for transmitting said light beam to a second station remote from said first station, light sensing means at said second station for sensing the variations in said light beam and producing an electrical response to the light variations of said light beam, the electrical response varying in accordance with the variations in light from said lamp assembly, said control system further including variable responsive drive means communicating with said light sensing means and said beam assembly for operating said beam assembly at predetermined variable speeds corresponding to the variable electrical response produced by said light sensing means whereby the rate of movement of said beam assembly by said drive means is dependent upon the variation of light from said lamp.

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