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4 Sheets-Sheet 1

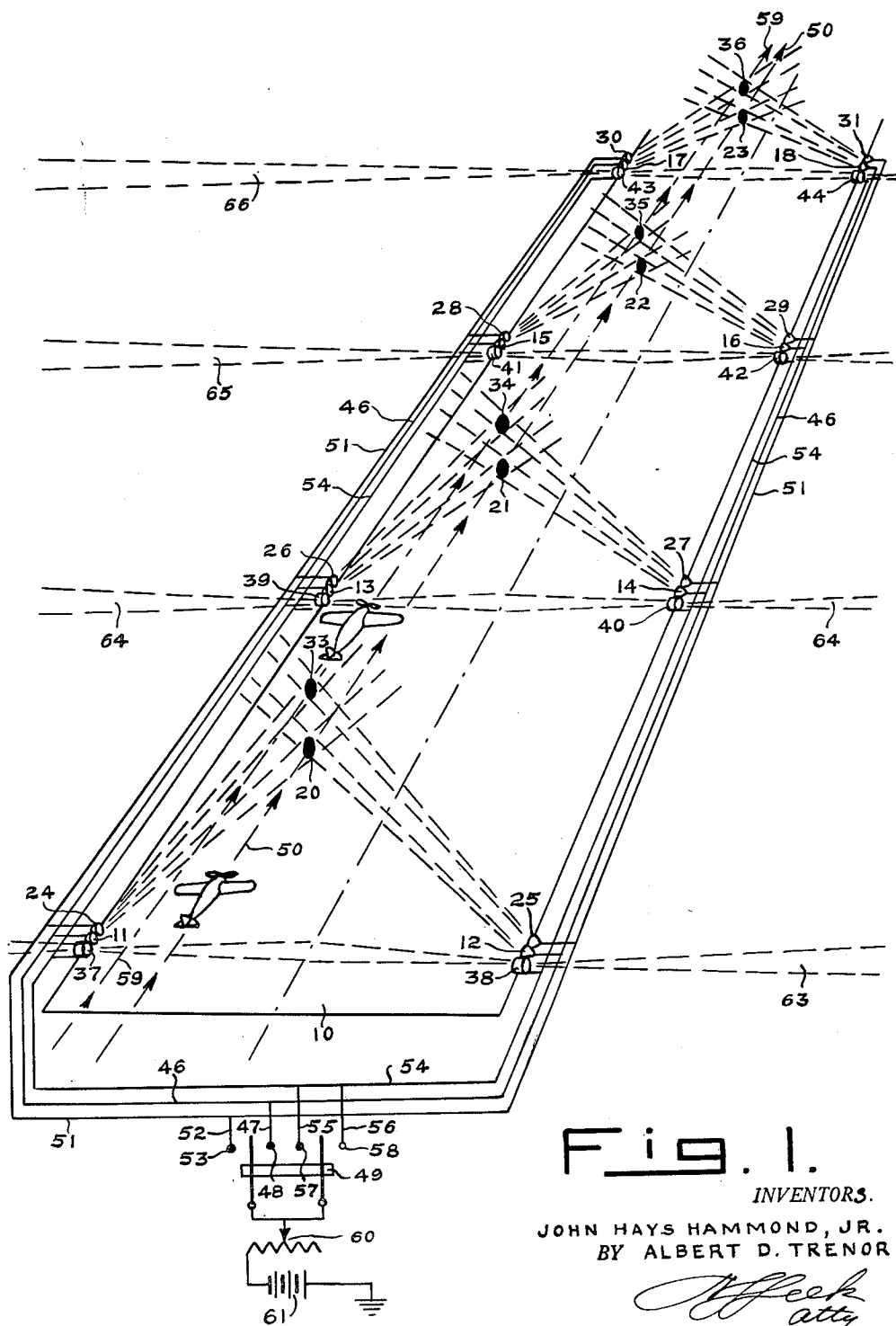


Fig. 1.

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LANDING AID

Filed May 16, 1952

4 Sheets-Sheet 2

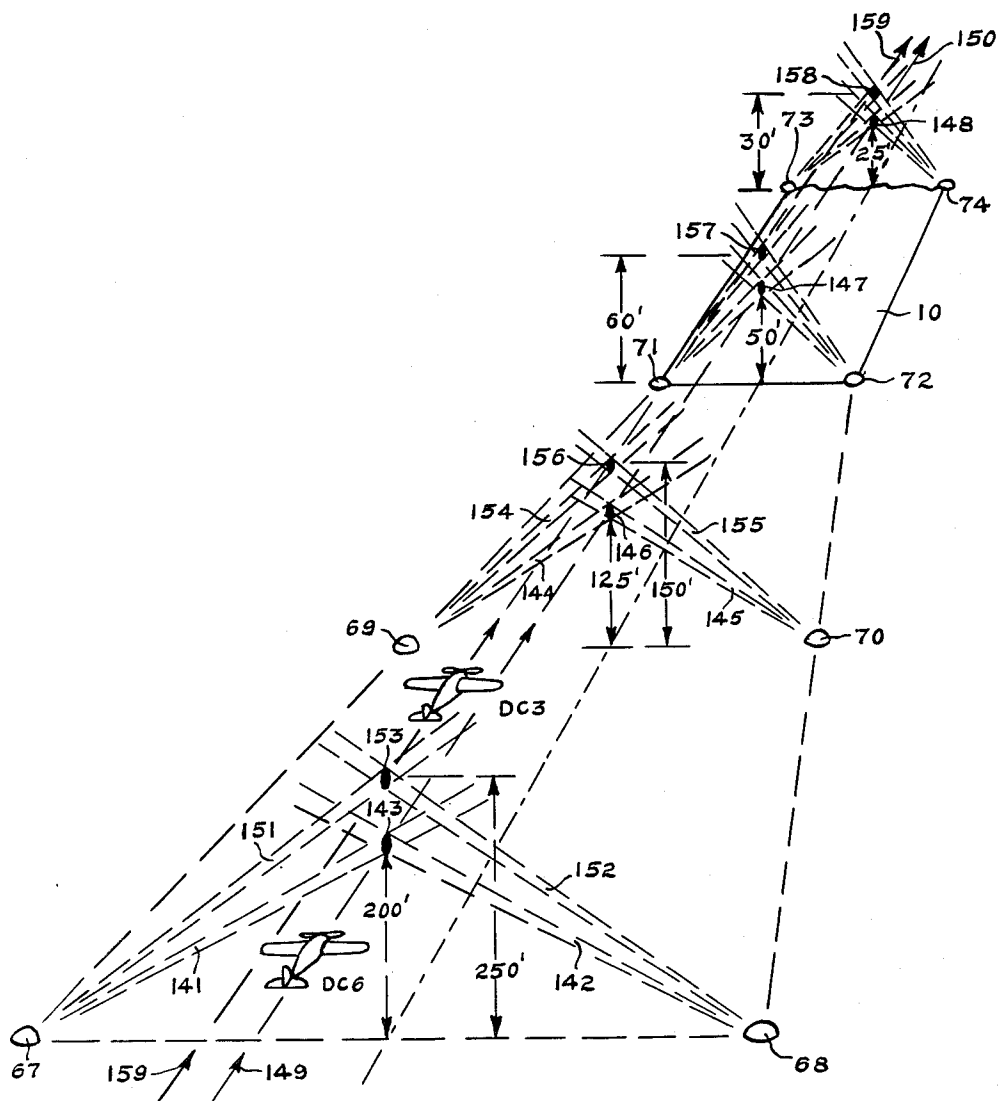


Fig. 2.

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LANDING AID

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4 Sheets-Sheet 3

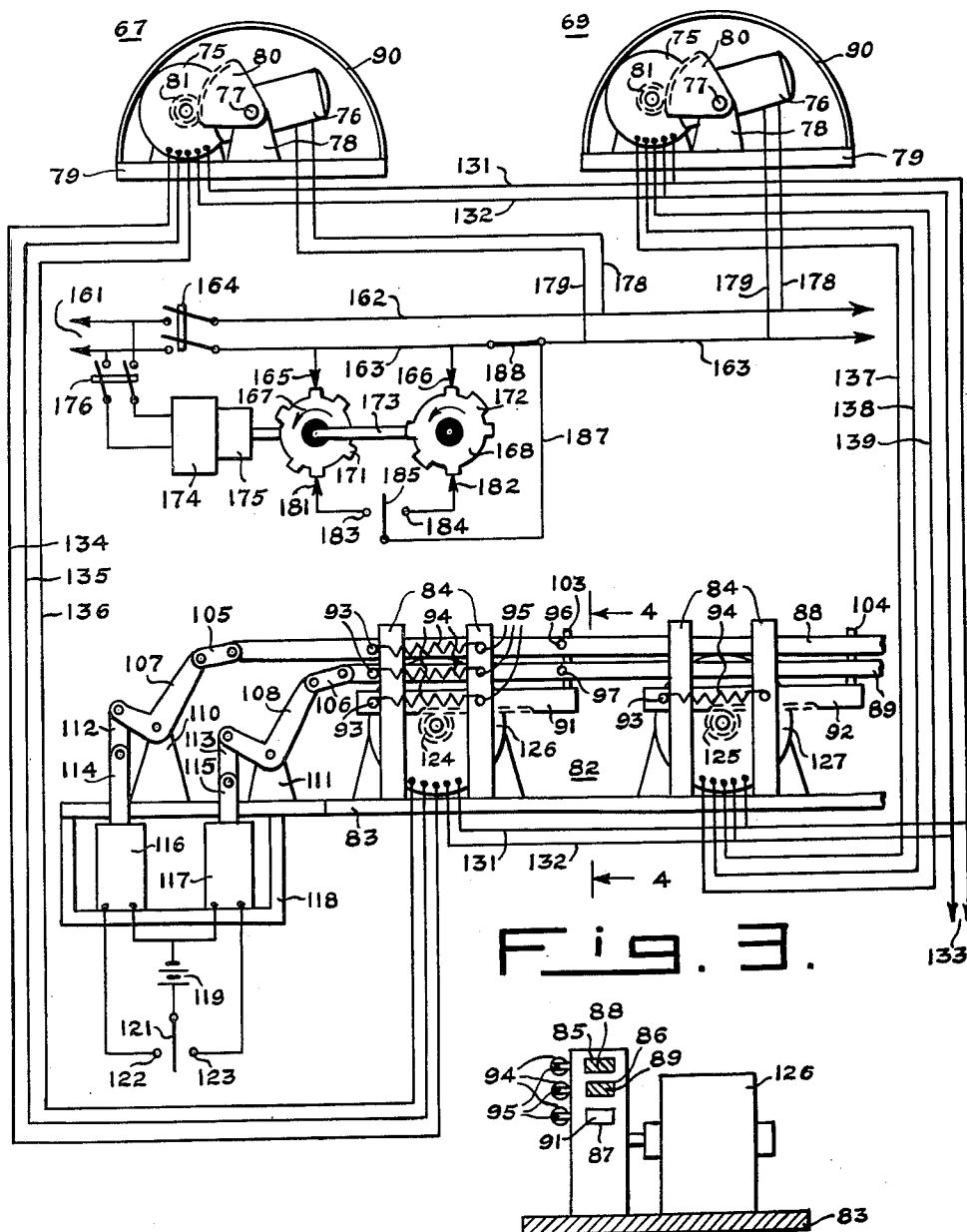


Fig. 4.

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2,669,703

LANDING AID

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2 Claims. (Cl. 340-26)

This invention relates to landing aids for airplanes for use in fog, mist, haze, smoke or other conditions of poor visibility, particularly at night.

The invention provides a plurality of guide paths which may be selected at will by an operator at the airport and which direct the pilot along the proper guide path for the particular type of plane that he is flying.

The invention also consists in certain new and original features of construction and combinations of parts hereinafter set forth and claimed.

The nature of the invention as to its objects and advantages, the mode of its operation and the manner of its organization, may be better understood by referring to the following description, taken in connection with the accompanying drawings forming a part thereof, in which:

Fig. 1 is a perspective view of a landing strip embodying one form of the invention,

Fig. 2 is a perspective view of a landing strip embodying a modified form of the invention,

Fig. 3 is a side elevation of part of the mechanism used to control the various light sources,

Fig. 4 is a section taken on line 4-4 of Fig. 5, and

Figs. 5, 6 and 7 are enlarged diagrammatic perspective views of part of the control mechanism shown in Fig. 3 in various positions of operation.

Like reference characters denote like parts in the several figures of the drawing.

In the following description parts will be identified by specific names for convenience, but they are intended to be generic in their application to similar parts.

Referring to the accompanying drawings and more particularly to Fig. 1 a landing strip 10 is provided with a first series of powerful searchlights 11-12, 13-14, 15-16, 17-18, etc., which, for example, may be located 500 feet apart and which project narrow intense beams of light crossing at 20, 21, 22, 23, etc., respectively. Located adjacent to the first series of searchlights are a second series of similar searchlights 24-25, 26-27, 28-29, 30-31, etc. which project beams of light crossing at 33, 34, 35, 36, etc., respectively. Located adjacent to these searchlights are a third series of searchlights 37-38, 39-40, 41-42, 43-44, etc., each of which projects two horizontal beams of light in opposite directions forming a cross pattern of light 63, 64, 65, 66, etc. transverse to the landing strip 10.

All the searchlights in the first series 11-18, etc. are connected by a conductor 46 and branch conductor 47 to contact 48 of a double pole double

throw switch 49 and all the searchlights of the second series 24-31, etc. are connected by a conductor 51 and branch conductor 52 to contact 53 of switch 49. All of the double beam searchlights 37-44, etc. are connected by a conductor 54 and branch conductors 55 and 56 to contacts 57 and 58 of switch 49. The blades of the switch 49 are connected to the movable contact of a variable resistance 60 which is connected to one side of a battery 61 the other side of which is grounded forming a return circuit to all of the searchlights. The switch 49 may be located in the control tower at the airport or other suitable location.

Operation of Fig. 1

When the control tower operator is notified that an airplane of a certain type, such for example as a DC6, is approaching for a landing, he throws the switch 49 to the right, thus connecting the battery 61 to the first series of searchlights 11-18 thru the contact 48 and conductors 47 and 46 and to the third series of double searchlights 37-44 thru the contact 58 and conductors 55 and 54. The third series of searchlights 37-44 throw beams of light perpendicular to the landing strip 10 producing a transverse pattern of lighting spaced 500 feet apart, as indicated at 63-66.

The first series of searchlights 11-18 project narrow intense beams of light crossing at 20-23, etc. as already described, which are located at the various heights of the landing path 50 of a DC6 airplane and are directly over the center of the landing strip 10. In this system the pilot flies thru the various points 20-23 which are of decreasing altitude in such relationship to each other that the pilot of a DC6 will automatically bring his airplane to the correct landing position.

If an airplane of a different type such as a DC3 is coming in for a landing, the control tower operator throws the switch 49 to the left thus connecting the battery 61 to the second series of searchlights 24-31 thru the contact 53 and conductors 52 and 56 and to the third series of double searchlights 37-44 thru contact 57 and conductors 55 and 54. This will put the third series of searchlights into operation as already described.

The second series of searchlights 24-31 project narrow intense beams of light crossing at 33-36 as already described, which are located at the various heights of the landing path 59 of a DC3 airplane and are directly over the center of the landing strip 10. In this way the pilot flies thru the various points 33-36 which are of a

decreasing altitude in such relationship to each other that the pilot of a DC3 will automatically bring his airplane to the correct landing position.

By adding any desired series of searchlights any particular landing path for any type of airplane may be produced. It is thus seen that the control tower operator by manipulating the switch 49 may select the proper landing path for the particular airplane that is making a landing.

Due to the varying density of the fogs encountered in blind landings, it has been found desirable to vary the intensity of the searchlight beams. This may be accomplished by the use of the variable resistor 60, which may be so adjusted as to give the proper intensity of illumination for the prevailing conditions of fog existing at the time of landing.

Instead of using a plurality of searchlights each set at a fixed angle at each station it is possible to use a single searchlight at each station which may be remotely adjustable thru a wide angular range. This form of the invention is shown in Figs. 2-7 and comprises a series of remotely controlled light units 67-69, 69-70, 71-72, 73-74, etc. The light units 67-69 and 69-70 are located outside the airport and form an approach pattern which may extend a distance of 3500 feet from the landing strip 10. The approach pattern may be 500 feet wide at the far end and 100 feet wide at the landing strip end and the light units may be spaced at intervals of 500 feet longitudinally.

The light units 71-72, 73-74, etc. are located along the edges of the landing strip 10.

Each of the light units 67-74, etc., two of which, 67 and 69 are shown in Fig. 3, comprises a searchlight 76 secured to a shaft 77 which is mounted for rotation in brackets 78 which are fastened to a base 79. Secured to the shaft 77 is a gear segment 80 which meshes with a pinion 81 mounted on the shaft of a synchro motor 75 also fastened to the base 79. Mounted on the base 79 and covering the entire mechanism is a transparent dome 90 of plastic or other suitable material which protects the mechanism against the elements.

For controlling the motion of the various searchlights 76 a control mechanism 82 is provided which comprises a base 83 upon which are mounted a plurality of brackets 84, each of which is provided with three rectangular openings 85, 86, and 87. Slidably mounted in the openings 85 and 86 are two long rectangular shaped bars 88 and 89. Slidably mounted in the openings 87 are short racks 91, 92, etc. Secured to the bars 88 and 89 and to the racks 91, 92, etc. are a plurality of pins 93 to which are attached the ends of a plurality of springs 94 the other ends of which are attached to a plurality of pins 95 secured to the brackets 84. The springs 94 tend to hold the bars 88 and 89 and the racks 91, 92, etc. in the positions shown in Figs. 3 and 5. Two pins 96 and 97 are secured to the bars 88 and 89 respectively and limit the motion of these bars to the left. The bar 88 is provided with a plurality of slots 98 and 99 etc. and the bar 89 is provided with a plurality of slots 101, 102, etc. (see Figs. 5-7). mounted on the racks 91, 92, etc. are a plurality of pins 103, 104, etc., which slide in the slots, 98 and 101, 99 and 102, etc.

Pivottally connected to the ends of the bars 88 and 89 are two links 105 and 106 the other ends of which are connected to two bell cranks

107 and 108, which are rotatably mounted on two brackets 110 and 111 secured to the base 83. The other ends of the bell cranks 107 and 108 are connected by two links 112 and 113 to the cores 114 and 115 of two solenoids 116 and 117, which are mounted on a bracket 118 suspended below the base 83. One side of the windings of each of the solenoids 116 and 117 are connected to one side of a battery 119 the other side of which is connected to the blade of a single pole double throw switch 121. The two contacts 122 and 123 of this switch are connected to the other sides of the windings of the solenoids 116 and 117 respectively.

Meshing with the racks 91, 92, etc. are pinions 124, 125, etc. which are mounted on the shafts of synchrogenerators 126, 127, etc. mounted on the base 83. The rotor windings of all the synchrogenerators 126, 127, etc. and all the synchro motors 75 are connected together by conductors 131 and 132, which are connected to an A. C. power source 133. The stator windings of the generator 126 are connected to the corresponding stator windings of the motor 75 of light unit 67 by three conductors 134, 135 and 136 and the stator windings of the generator 127 are connected to the corresponding stator windings of the motor 75 of light unit 69 by three conductors 137, 138, 139. The generators 126 and 127 are also connected to the motors 75 of the light units 68 and 70 by conductors not shown so that the corresponding searchlights of the light units 68 and 70 will move in unison with the searchlights of the light units 67 and 69 respectively.

The motors 75 of the light units 71-72, 73-74, etc. will be controlled by a plurality of generators not shown, which are mounted on the base 83 and are controlled by the bars 88 and 89 in a manner presently to be described. The synchrogenerators and motors referred to in this description may be of any suitable type, such for example as that described in Principles of Radar, published by McGraw-Hill Book Co., chapter XII, section A—Synchros, pp. 12-2 to 12-15.

All the searchlights 76 are supplied with electric current from an external source 161 thru conductors 162 and 163 and branch conductors 178 and 179 and are controlled by a double pole single throw switch 164. One side of the line 163 is connected to two contacts 165 and 166 which engage the peripheries of two contact wheels 167 and 168. These wheels are provided with a plurality of contact segments 171 and 172 arranged to form a code signal, such for example as etc. and etc. The contact wheels 167 and 168 are mounted on but insulated from a shaft 173 which is driven at a slow speed by a motor 174 thru a reduction gearing 175. The motor 174 is supplied with current from conductors 162 and 163 thru a single throw double pole switch 176. Engaging the peripheries of the two contact wheels 167 and 168 are two contacts 181 and 182 which are connected to the two contacts 183 and 184 of a single pole double throw switch 185. The blade of the switch is connected by a conductor 187 to the conductor 163. A switch 188 is inserted in conductor 163 and is normally closed.

Operation of Figs. 2-9

The normal condition of the mechanism is shown in Figs. 3-5 with switch 121 open, the solenoids 116, 117 de-energized and the bars 88 and

5

6

89 and racks 91, 92, etc. in their right hand positions. In this condition the synchrogenerator 126, 127, etc. and synchromotors 75 are in their initial positions with the searchlights 76 pointing at an angle of 15° above the horizontal.

When the control tower operator is notified that a DC6 airplane is coming in for a landing, he closes switch 164 which turns on all the search lights 76 in the various light units 67-74, etc. He then throws the switch 121 to the right thus energizing the solenoid 117, which retracts the core 115 thus rotating the bell crank 108 in a counter-clockwise direction and moves the bar 89 to the left into the position shown in Fig. 6. In so doing the slot 101 in bar 89 will move to the left until its right hand end engages the pin 103 after which the pin 103 together with the slot 101 will continue to move to the left until the pin 97 engages the bracket 84. The amount of motion of the pin 103 to the left is determined by the distance from the pin 103 to the right hand end of the slot 101 when the bar 89 is in its initial position, as shown in Fig. 5.

When the pin 103 moves to the left, it causes the rack 91 to move an equal distance to the left, turning the pinion 124 thru 180° counter-clockwise, which in turn rotates the synchrogenerator 126 an equal amount from position 15° to position 45°, as shown in Fig. 6. This motion is transmitted to synchromotor 75 of light unit 67 which by means of pinion 81 and gear segment 80 moves searchlight 76 from the 15° position to the 45° position as shown. This causes the beams from the searchlights 76 in light units 67 and 68 to be moved from the initial 15° positions to the 45° positions as indicated by the dotted lines 141 and 142. In Fig. 2 these beams of light cross at point 143 which is a predetermined height above the ground, for example 200 feet.

When the bar 89 is moved to the left as shown in Fig. 6 the right hand end of the slot 102 will engage the pin 104 moving it to the left an amount determined by the distance from the pin 104 to the right hand end of the slot 102 when the bar 89 is in its initial position, as shown in Fig. 5. This causes the rack 92 to be moved an equal distance to the left turning the pinion 125 thru 90° counter-clockwise, which in turn rotates the synchrogenerator 127 an equal amount from position 15° to position 30° as shown in Fig. 6. This motion is transmitted to synchromotor 75 of light unit 69 which in turn moves searchlight 76 from 15° position to the 30° position as shown. This causes the beams from the searchlights 76 in light units 69 and 70 to be moved from the initial 15° position to the 30° position as indicated by the dotted lines 144 and 145 in Fig. 2. These beams of light cross at point 146 which is a predetermined height above the ground for example 125 feet.

In like manner by the motion of the bar 89 the beams of light from light units 71-72, 73-74, etc. will be rotated from their initial 15° positions to predetermined angular positions to form points of intense illumination indicated at 147, 148 etc. at predetermined heights above the ground, for example 50 feet, 25 feet, etc. The points of illumination 143, 146, 147, 148, etc. are located at the heights of the landing path 150 of a DC6 airplane so that a pilot flying thru them will make a perfect landing on landing strip 10.

When a DC3 airplane is landing the switch 121 is thrown to the left thus energizing the solenoid 116, which by means of bell crank 107 causes the bar 88 to be moved to the left, as shown in Fig. 7.

This motion of the bar 88 to the left causes the pins 103, 104, etc. together with the racks 91 and 92 to be moved to the left into the positions shown, the amount of movement of each being determined by the length of the slots 98 and 99 in a manner similar to that described in connection with Fig. 6.

The motion of the rack 91 causes the pinion 124 and therefore the generator 126 to be rotated thru 270° counterclockwise from position 15° to position 60°. This motion is transmitted to motors 75 causing the searchlights 76 of light units 67 and 68 to be moved from the 15° positions to the 60° positions. This causes the beams from the searchlights 76 in light units 67 and 68 to be moved from the initial 15° positions to the 60° positions as indicated by the dotted lines 151 and 152 in Fig. 2. These beams of light cross at point 153, which is a predetermined height above the ground, for example, 250 feet.

In a like manner the motion of rack 92 causes pinion 125 and generator 127 to be rotated 180° counterclockwise from position 15° to position 45°. This motion is transmitted to motors 75 causing the searchlights 76 of light units 69 and 70 to be moved from the initial 15° positions to the 45° positions as indicated by the dotted lines 154 and 155 in Fig. 2. These beams of light cross at point 156, which, for example, is at a height of 150 feet. Similarly the beams of light from light units 71-72, 73-74, etc. will be rotated from their initial positions to predetermined angular positions to form points of illumination indicated at 157, 158, etc., which, for example, may be at heights of 60 feet, 30 feet, etc. The points of illumination 153, 156, 157, 158, etc. are located at the heights of the landing path 159 of a DC3 airplane coming in for a landing on landing strip 10.

After each of the airplanes have landed, the switch 121 is returned to the open position thus deenergizing either solenoid 117 or 116. As soon as either of these solenoids is deenergized its corresponding mechanism including the bar 88 or 89 and rack 90 or 91 is returned to its initial position as shown in Figs. 3 and 5, under the action of springs 94. This will bring searchlights 76 of all the light units back to their initial positions of 15°.

When a DC6 airplane is approaching for a landing, it may be desirable to identify the glide path to the pilot of the plane. In this case, the switch 164 in Fig. 3 is closed, the switch 188 is opened, the switch 185 is thrown to the right and the switch 176 is closed. This will cause the motor 174 to rotate the contact wheels 167 and 168 at a relatively slow rate in the direction of the arrows. As the contact wheel 168 rotates, it will make and break the circuit thru conductor 163 to all the searchlights 76 so that they will go on and off in a predetermined code sequence such as as previously described. This will identify the glide path to the pilot so that he will be sure that he is travelling along the proper glide path for a DC6.

If a DC3 is coming in for a landing the switch 185 is thrown to the left and the contact wheel 167 will produce a predetermined code sequence such as In this way the pilot will be certain that he is on the proper glide path for the particular plane he is flying.

Although only a few of the various forms in which this invention may be embodied have been shown herein, it is to be understood that the invention is not limited to any specific construction

7

but might be embodied in various forms without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. A landing aid to guide an airplane along a glide path onto a landing strip comprising a plurality of light sources disposed along each side of said path, each source comprising a searchlight projecting a beam of light across said path and adapted to swing in elevation, opposite sources projecting beams at the same elevation to cross at the center of said path, successive pairs projecting said beams at successively lower elevations to cross at points representing the selected guide paths, repeaters including receivers connected to control the elevation of said searchlights, and remote transmitters connected to actuate said receivers, and selective control means connected to actuate said transmitters to set automatically the various pairs of searchlights to

8

their correct respective angles to conform to a selected glide path.

2. In a landing aid, as set forth in claim 1, means connected to cause said sources to flash in a predetermined code sequence to designate the selected glide path.

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