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(19)

(54) IMPROVEMENTS IN OR RELATING TO APPROACH SLOPE INDICATORS

(71) THE SECRETARY OF STATE FOR DEFENCE, do hereby declare the invention, for which we pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:

The present invention relates to a visual approach slope indicator for airfields.

Hitherto visual approach slope indicator units of the sharp transition type have taken the form of a rectangular box housing at least two projectors, each projector comprising; a light source, a red-passing filter and a plano-convex lens. The latter being coaxial and disposed so as to produce a divergent beam of light, the upper half of which is white and the lower half of which is red; there being a sharp transition between the two.

In operation the indicator units are set so that the angle formed between the transition interface and the runway is that which gives an indication to approaching aircraft of the correct approach slope. If an incoming aircraft is above the transition plane the pilot of the aircraft will see the white light and if below it he will see the red light. Thus the indicator unit provides the pilot with a guide to the desired flight path. Further, a system which employs several indicator units, in which the transition interfaces are set at different approach slopes, can be used to provide the pilot with further information as to how far his aircraft is above or below the desired flight path. Such a system, called the Precision Approach Position Indicator (PAPI), is described in the complete specification of United Kingdom Patent No. 1475442.

It will be appreciated that within each indicator unit the projectors are set at the same angle. Several projectors, usually three, are employed to give the required intensity and desired shape of light, and to maintain an adequate output in the event of failure of one light source.

From the point of view of flight safety it will be appreciated that it is important that the approach slope indicator must maintain exactly the desired angle between the interface and the runway. An error of 1°, means 50 ft of height at the important 1000 yard stage.

If the angle is in the first instance set incorrectly, or subsequent to being set correctly the angle changes then the pilot of an incoming aircraft will be misled into following an incorrect approach slope and this could lead to an aircraft accident.

Since it is desirable that approach slope indicator units have as low an inertia as possible to reduce damage in the event of impact by aircraft, the indicator units so far produced have necessarily been of a light sheet metal construction, usually a rectangular metal box supported on cross bars.

This has the disadvantage that the forces necessarily applied to open the unit and to adjust one projector or even to renew a light source or a cracked lens are liable to distort the unit and render the setting of the other projectors inaccurate, which considerably increases the time required to render the unit operable. This problem is aggravated by the fact that any re-adjustment of the projectors must take place in situ, and on cold days the correct approach slope will be more difficult to achieve manually. It will be appreciated that it is important to rectify a defective unit as quickly as possible to avoid delays to incoming aircraft, or forcing them to land without the benefit of the unit's guidance.

The invention can provide a rigid yet low intertia structure which substantially avoids the problem of distortion as a result of projector adjustment or windage and which can be maintained in almost continuous operation even though projector adjustment

may be required.

According to the present invention an approach slope indicator unit comprises a support assembly and at least two projectors, characterised in that the projectors are pre-alignable and independently mounted on the support assembly. In a preferred form the approach slope indicator unit incorporates a base-plate and adjusting means for adjusting the approach slope indicator unit to the required angle of elevation. The adjusting means may comprise at least three jacking screws attached to the base-plate,

The projectors of which there are preferably three, are also preferably arranged in laterally parallel array.

The approach slope indicator unit may include projectors each having a vented cowl at their light source end. The approach slope indicator unit may also include a clinometer stand to facilitate adjustment of the unit to the correct angle of elevation.

A pre-alignable projector when used in the indicator unit may comprise; a light source, a red-passing filter and a divergent lens immovably combined, and disposed to produce a divergent beam, one half of which is white light, the other half of which is red light.

Preferably the pre-alignable projector has the light source, the red-passing filter and the divergent lens mounted on separate sub-frames, in the form of annulii the sub-frames being rigidly linked by at least two connecting rods. The red-passing filter may be arranged to move transversely with respect to its sub-frame to adjust the composition of the beam.

Pre-alignment of the light source, the red-passing filter and the divergent lens may be achieved by spacer brushes which fit over the rods and between the sub-frames.

According to a form of the invention an approach slope indicator unit may be of portable construction wherein the base-plate is supported upon a datum-plate by at least one flexible tie, disposed with respect to the adjusting means so that the approach slope indicator unit can be adjusted to the required angle of elevation. In a preferred form the portable approach slope indicator unit has two flexible ties each disposed one at either side of the datum plate.

The flexible ties may comprise a screw member rigidly attached to the datum plate and having upper and lower compression springs between which the base plate is positioned, the springs and baseplate being clamped together under compression by an adjusting nut, such that the base plate is free to pivot about the flexible ties to enable the approach slope indicator unit to be adjusted to the required angle of elevation. The portable approach slope indicator unit is appropriate for use on temporary air fields, or airfields not normally receiving certain types of, perhaps larger aircraft, and the datum plate securable to the ground by suitable pegs driven therein.

Each projector may be pre-aligned on a jig comprising at least two threaded rods, each rod associated with six threaded nuts, whereby producing the projectors, the sub-frames may be mounted on the threaded rods and adjusted with respect to each other until their correct disposition is determined in to facilitate projector assembly.

Projection tubes in which the projectors are insertable can be inherently suited to meet the existing rigidity and low inertia requirements if made from plastics material. Withdrawal or local adjustment of the pre-aligned projectors can easily be arranged to require the minimum of force, and this fact together with the fact that the tube supporting structure need only, so to speak, clamp the tubes rather than house the system enables for greater lee-way than before in the amount of material of the supporting structure which will provide the required rigidity without constituting an impact damage risk.

Moreover, the licence afforded by the invention to construct an indicator unit of smaller bulk than heretofore, further enables the use of a pillar or like support which is readily frangible on aircraft impact, while the construction of the unit per se can be such that the aircraft can push it aside, or at least not shatter the unit so as to give rise to small pieces of debris liable to be ingested by the aircraft engines.

Further the invention will also facilitate the use of lenses of various focal lengths, the distances between the sub-frames being adjustable such that the edge of the red-passing filter is focussed at infinity for each lens.

An approach slope indicator unit in accordance with the present invention will now be described by way of example with reference to the accompanying drawings of which:-

Figure 1 shows a plan view of an approach slope indicator unit,

Figure 2 shows a sectional elevation of the approach slope indicator unit shown in Figure 1 on the line II-II,

Figure 3 shows a sectional elevation of a pre-aligned projector,

Figure 4 shows an elevation of a portable approach slope indicator unit,

Figure 5 shows a plan view of the portable approach slope indicator shown in Figure 4, and

Figure 6 shows a pre-alignment jig for pre-aligning a projector.

An approach slope indicator unit as shown in Figures 1 and 2 comprises a

support assembly 1 which houses two pre-aligned projectors 2.

The support assembly 1 includes a base-plate 3 mounted on two forwardly positioned jacking screws 4 and 5, and one rearwardly positioned jacking screw jack 6. Immovably attached to the base-plate 3 is a pedestal 7 to which a projection tube box 8 is immovably attached. The pedestal 7 is tubular and is sufficiently brittle to be readily severed by aircraft impact. Two projection tubes 9 of plastics material are immovably housed in the projection tube box 8, each projection tube has a squared rearward end 10 and an angled forward end 11.

The rearward end extends beyond the box 8 into a positioning member 12 to which a louvered cowl 13 is securable. The top surface of the box carries a clinometer stand 14. Each projection tube 9 houses a pre-alignable projector 2. The pre-aligned projector 2 shown in Figure 3 comprises a lamp sub-frame 30 a filter sub-frame 31 and a lens sub-frame 32. The sub-frame 31 is adapted to mate with the positioning members 12, the lens sub-frame being a slide fit within the projection tubes 9.

The lamp sub-frame 30 has mounted thereon a light source 33 which produces a beam of light.

A red-passing filter 34 is slidably mounted on the filter subframe, the red-passing filter 34 being transversely adjustable by means of adjusting screws 35 and 36 and threaded angle brackets 37 and 38 (adjusting screw 36 and angle bracket 38 not shown).

The lens sub-frame 32 houses a plano-convex lens 39 for producing a divergent beam of light, such that the edge of the red-passing filter is focused at infinity.

The sub-frames are mounted on connecting rods 40, 41 and 42, these being on the same radius and at 120° to each other (connecting rod 41 is not shown). The sub-frames are axially displaced by 3 sets of spacer bushes, each set comprising spacer bushes 43 and 44. The spacer bushes 43 and 44 are cut to required lengths so that when the sub-frames are rigidly clamped by bolts 45 the projector emits a divergent beam of light the upper half of which is white and the lower half of which is red, there being a sharp transition between the two halves.

Refering to Figure 2 the approach slope indicator unit is set to the required angle while a clinometer is positioned on the clinometer stand 14. The angle of the platform 1 is adjusted by means of jacking screws 4, 5 and 6 until the clinometer gives the reading corresponding to the correct approach slope. When this is achieved the pre-aligned units 2 are inserted into the projection tubes 9 until the filter sub-frames mate with the positioning members 12 to be secured thereto. The louvered cowls 13 are then fitted into position.

A portable approach slope indicator as shown in Figure 4 and Figure 5, includes a datum plate 50 which is flexibly attached to the base-plate 3 by means of flexible ties 51 and 52. The ties are disposed centrally between the forwardly and rearwardly positioned jacking screws, 4 and 5; and 6 respectively. Each flexible tie comprises an adjusting screw 53, and upper and low compression springs 54 and 55 respectively, between which the base-plate 3 is sandwiched. Compression is induced into the springs 54 and 55 by means of an adjusting nut 56. The portable unit also includes handles 57 and 58 disposed one at either side of the projection box 8.

In use the portable unit may be carried to the selected airfield site and secured to the ground by suitable pegs 59. The unit is then adjusted in the same manner as the non-portable unit described with respect to Figures 1 and 2.

A jig for pre-aligning the projector is shown in Figure 6. The jig comprises threaded nuts 64 and three threaded rods 61, 62 and 63, the rods each being a slide fit with respect to the sub-frames. The light source 33, the red-passing filter 34 and the plano-convex lens 39 are mounted, by means of their respective sub-frames, on the rods 61, 62 and 63. By means of the threaded nuts 64 the light source 33, the red-passing filter 34, and the lens 39 are coaxially adjusted to give the desired split beam of light. To ensure that the beam of light is made up of half red light and half white light the red-passing filter 34 may be vertically adjusted by means of the adjusting screws 35 and 36.

It will be appreciated that the above embodiments are described by way of example and that the invention can be realised in different forms. The pre-aligned projector 2 could be such that the sub-frames 30, 31 and 32 are radially clamped within a single tube avoiding the need for the connecting rods 40, 41 and 42; the spacer bushings 43 and 44 taking the form of cylinders each having an outside diameter equivalent to that of the sub-frames.

A bench system could be used to pre-align the projectors the system so designed that the three sub-frames 30, 31 and 32 could be mounted on separate blocks each block movable on a slide way by screw adjustment.

WHAT I CLAIM IS:-

1. An approach slope indicator unit comprising a support assembly and at least two projectors, characterised in that the projectors are pre-alignable and independently mounted on the support assembly.

2. An approach slope indicator unit as

claimed in claim 1 and in which the support assembly includes a base-plate and adjusting means for adjusting the approach slope indicator unit to the correct angle of elevation.

3. An approach slope indicator unit as claimed in claim 2 and having an adjusting means comprising at least three jacking screws attached to the base-plate.

4. An approach slope indicator unit as claimed in any one of claims 1 to 3 and wherein each projector has a vented cowl at its light source end.

5. An approach slope indicator unit as claimed in any one of claims 1 to 4 and wherein the projectors are in lateral array.

6. An approach slope indicator unit as claimed in any one of the preceding claims and having two projectors.

7. An approach slope indicator unit as claimed in any one of the claims 1 to 6 and having three projectors.

8. An approach slope indicator unit as claimed in any one of the preceding claims and having a clinometer stand.

9. A pre-alignable projector when used in the indicator unit of any one of claims 1 to 8 comprising, a light source, a red-passing filter and a divergent lens immovably combined and disposed to produce a divergent beam one half of which is white light, the other half of which is red light.

10. A pre-alignable projector as claimed in claim 9 and wherein the light source, the red-passing filter and the divergent lens are mounted on separate sub-frames, the sub-frames being co-axial and rigidly linked by at least two connecting rods.

11. A pre-alignable projector as claimed in claim 10 and wherein the red-passing filter is arranged to move transversely with respect to its sub-frame to adjust the composition of the beam.

12. A pre-alignable projector as claimed in claim 10 or claim 11 and wherein the light source, the red-passing filter and the divergent lens are correctly disposed by spacer bushes which fit over the connecting rods and between the sub-frames.

13. A pre-alignable projector substantially as hereinbefore described with reference to Figure 3 of the accompanying drawings when used in the indicator unit of any one of claims 1 to 8.

14. A portable approach slope indicator unit comprising an approach slope indicator unit as claimed in any one of the claims 1 to 8, and wherein the support assembly is supported upon a datum plate by at least one flexible tie, disposed with respect to the adjusting means so that the approach slope indicator unit can be adjusted to the required angle of elevation.

15. A portable approach slope indicator unit as claimed in claim 14 having two flexible ties each disposed one at either side of the datum plate.

A portable approach slope indicator unit as claimed in claim 14 or claim 15 and wherein each flexible tie comprises a screw member rigidly attached to the datum plate and having upper and lower compression springs between which the support assembly is positioned, the springs and base-plate clamped together under compression by an adjusting nut such that the support assembly is free to pivot about the flexible tie to enable the approach slope indicator unit to be adjusted to the required angle of elevation.

19. A method of pre-aligning the projector as claimed in any one of claims 10 to 13 utilising a pre-aligning jig comprising at least two threaded rods each connected with six threaded nuts, whereby, the sub-frames are mounted on the threaded rods and adjusted with respect to each other until their correct disposition is determined.

20. An approach slope indicator unit substantially as hereinbefore described with reference to Figure 1 and Figure 2 of the accompanying drawings.

21. A portable approach slope indicator unit substantially as hereinbefore described with reference to Figure 4 and Figure 5 of the accompanying drawings.

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Agent for the Applicant.

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1597704 COMPLETE SPECIFICATION
3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

FIG. 1.

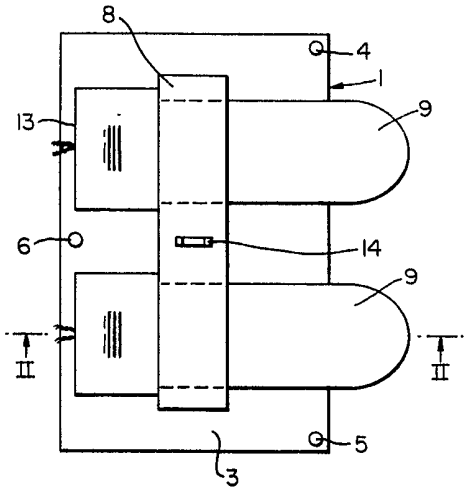

FIG. 2.

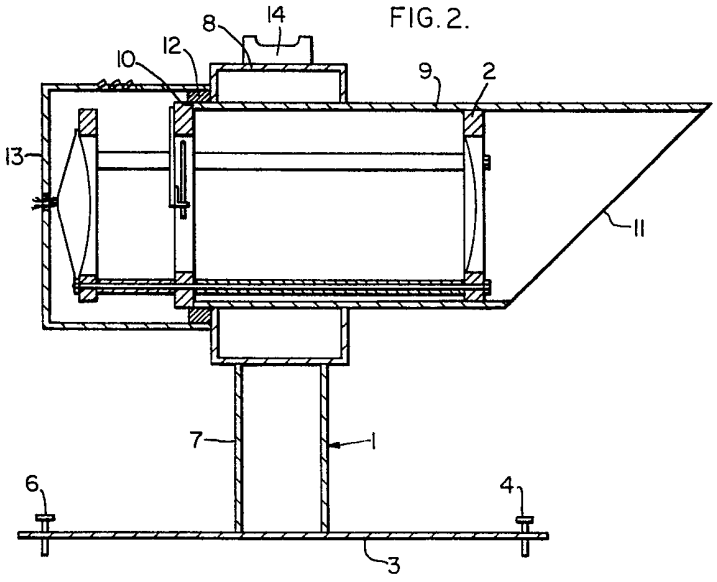

FIG. 3.

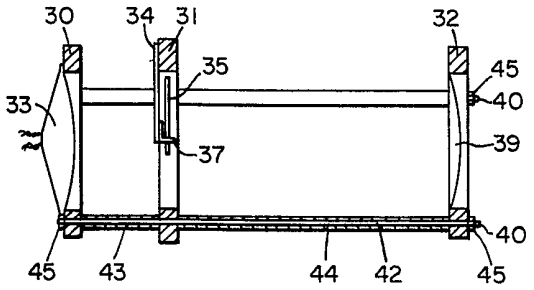
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FIG. 4.

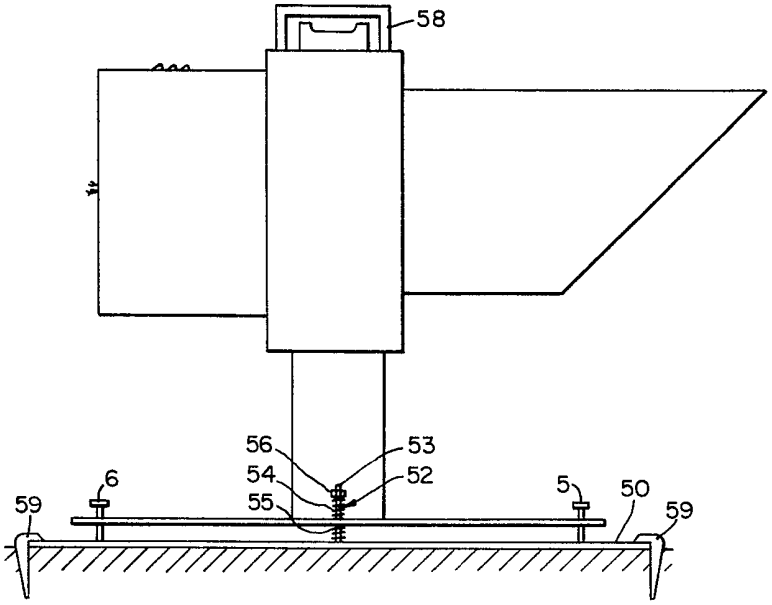
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FIG. 5.

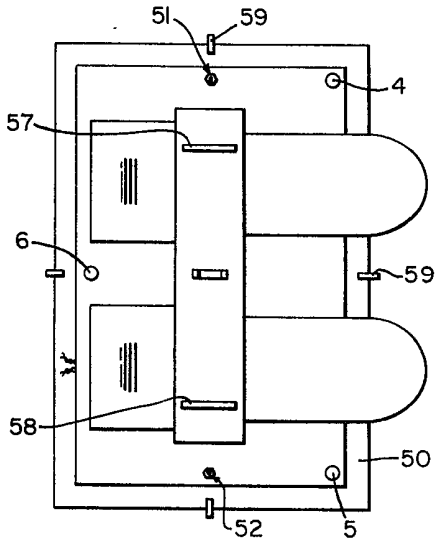

FIG. 6.