AIRPORT RUNWAY APPROACH AND REFERENCE LIGHTING SYSTEM

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ABSTRACT

An airport beacon unit includes an omnidirectional or wide angle flashing lamp for aiding pilot location of an airport runway threshold, and a directional flashing lamp for guiding the final approach to the runway. Both lamps are triggered gas discharge devices connected in shunt and are supplied from a common storage capacitor charged from a power supply. An externally supplied trigger signal first initiates discharge of the directional lamp and an intensity control circuit then initiates discharge of the omnidirectional lamp after an interval predetermined by the desired intensity of the directional lamp, flashing of the directional lamp being terminated by flashing of the omnidirectional lamp.

12 Claims, 4 Drawing Figures
AIRPORT RUNWAY APPROACH AND REFERENCE LIGHTING SYSTEM

BACKGROUND OF THE INVENTION

Major airport runway approach lighting systems include a series of spaced lamp or beacon units aligned with the runway in advance of its threshold. The relatively narrow beams of the lamps are individually directed toward the approach path of a plane. The lamps are flashed sequentially to produce the effect of a ball of light travelling at high speed toward the threshold. At smaller airports a pair of similar lamp units are located at either side of the threshold as reference markers for the beginning of the runway. In each system the intensity of the flashing lights is controlled according to the time of day and visibility, the flashing lamps being operated at full intensity in poor visibility and in bright daylight, and at low intensity in good nighttime visibility to avoid blinding an approaching pilot.

As disclosed in the pending application of Robert P. Bonazoli and Ellison H. Kirkfuff, Ser. No. 128,628 filed Sept. 8, 1971 and entitled Circuit For Varying The Intensity Of Flash Lamps, incorporated herein by reference, the intensity of a conventional gas discharge flash lamp or tube emission is dependent on the length of its discharge. Power for the flash tube is supplied from a storage capacitor whose discharge through the flash tube may be diverted through a relatively low impedance gas discharge device or quench tube connected in shunt with the flash lamp. The quench tube dissipates the capacitor charge with negligible useful light output, thereby terminating discharge through, and light emission from, the flash tube.

In addition to the sequentially flashed lamps and reference markers described above there is a need for an omnidirectional or wide angle flashing beacon to aid pilots near the airport but not on the runway line of approach. Particularly at large airports with many runways the narrow, directed beams of the flashing lamps are difficult to locate or identify from a plane in a circling pattern outside their scope. Accordingly the object of the present invention is to provide an omnidirectional or wide angle beacon in addition to presently used narrow beam flashing beacons, which cooperate to provide long range identification of an airport, active runway and the runway threshold as well as sequential approach guidance, and which more efficiently utilize the quency tube energy discharge previously dissipated wastefully.

SUMMARY OF THE INVENTION

According to the invention a beacon lighting unit comprises an electrical power storage supply, a first controlled light emitting discharge device and a second discharge device connected in shunt to said supply, a start signal input coupled to the first device to initiate power discharge from the supply through the first device and light emission therefrom, an intensity control circuit connected between the signal input and the second device and responsive to a start signal to initiate discharge of the supply through the second device after a predetermined interval of discharge of the first device, thereby to terminate discharge through the first device, said second device having substantially lower impedance than the first device and comparably high light emission efficiency, and an optical member for directing the light from one device in a scope different from that of the other device.

DRAWING

FIGS. 1 and 2 are ground plans of airport runway threshold and approach lighting systems;
FIG. 3 is an isometric view of a beacon unit employed in the systems of FIGS. 1 and 2 and an associated control cabinet shown diagrammatically; and
FIG. 4 is a schematic drawing of the circuit within the beacon unit.

DESCRIPTION

In FIG. 1 a typical small airport runway 1 bounded by dot-dash lines begins at a threshold 2 and extends in the direction of the arrow. At either side of the threshold are beacon units 3 which are controlled in intensity and frequency of flashing and supplied with power by a control cabinet 4 usually located near the threshold and ultimately operated from the control center of the airport.

In FIG. 2 sequential flashing approach beacons 3 for a major airport installation are spaced from the threshold outwardly on the line of approach at approximately 100 to 200 feet intervals for several hundred feet. A control cabinet 5 provides power and intensity control as with the cabinet 4 of FIG. 1, and additionally transmits timing signals sequentially to successive beacon units approaching the threshold as described in Federal Aviation Administration Specification FAA-E-23250 of May 21, 1971, incorporated herein by reference.

Each beacon unit 3, as shown in FIG. 3, comprises a weatherproof rectangular housing 6 with a glass port 7 on one side covering a flash tube FT mounted at the center of a reflector 8 which directs light from the flash tube in a narrow (30° to 40°) beam B inclined at about 10° angle to the horizontal. On the top of the housing 6 is a turret 9 mounting a second flash tube QT enclosed within a tubular fresnel lens 11. The fresnel lens may be clear or tinted glass to differentiate between runways or between omnidirectional and directional lamps, and is of well known type which efficiently transmits and refracts light from the quench tube QT throughout 360° of azimuth. Light from a toroidally formed quench tube may be reflected omnidirectionally by a semitoroidal reflector inside the tube to-roid in the same way that the fresnel lens refracts light from the tube QT as shown. The two tubes FT and QT are usually located within the housing 6, although in some installations the second tube QT may be connected by a cable C running a moderate distance, e.g., 50 feet, outside the housing. For the reference beacons 3 of FIG. 1 partial shields 12 may be located on the inward side of the second omnidirectional tube QT to block light from a pilot close to the threshold. Similar shields may be used to protect the pilot over the sequentially flashed beacons of FIG. 2, or to block light to a particular location of the airport such as the control tower. The shields 12 may be omitted.

The circuit within the beacon unit 3 as shown in FIG. 4 comprises a power storage supply including a conventional rectifier 16 receiving 240 volt, 50 or 60 hertz power 8a from the control cabinet 5 and providing high (2,000) voltage at high power to a storage capacitor C1 (30 microfarads). The capacitor C1 typically is capable of storing 60 joules of energy. Connected in shunt across the storage capacitor are the first flash tube FT.
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and second flash tube QT each of which may be triggered into discharge by a start signal applied to their respective control or trigger winding c. A start signal from the control cabinet timer 5b initiates discharge and light emission of the directional flash tube FT, and also starts a time delay interval of approximately 8 microseconds to 150 milliseconds in variable intensity control circuit 17 connected between a start signal input 18 and the second flash tube QT. As more fully described in the aforesaid application Ser. No. 178,628, the variable time delay interval is selected by the intensity signal portion 5c of the control cabinet. At the end of the time delay interval the intensity control circuit 17 applies a start signal to the second flash tube QT starting its discharge. Because the second tube QT is of substantially lower impedance, e.g., one tenth that of the first flash tube FT, it shunts current from the first tube and quenches its light emission.

Unlike previous quench tubes whose useful light output was negligible, the present second flash tube QT has substantially low impedance but a light output efficiency comparable to that of the first flash tube FT. A suitable second flash tube QT is of 12 m.m. bore Pyrex tubing 6 inches long formed in one turn of 2 inch radius. Instead of the previous argon fill the second flash tube has a gas fill of xenon at 100 torr. Such a tube has an impedance on discharge of 2 or 3 ohms and a maximum effective light emission of 14,000 lumen seconds.

Since the light output of both flash tubes FT and QT is dependent on the interval of discharge, the intensity of emission of the second tube QT varies inversely as the intensity of the first tube FT, one tube necessarily being out when the other is on. Flight requirements are such that when local visibility is good, for example on a clear night, the flashing lights FT directed along the descent path to the runway should be at minimum intensity to avoid blinding the pilot. At this visibility high intensity of the omnidirectional or wide angle tubes QT is desirable to distinguish from non-aviation ground lights. On the other hand, when the local visibility is so poor as to require instrument flight rule operation and high intensity from the directional tubes FT, there is no need or use for the omnidirectional lights QT.

Thus the airport lighting systems of the present invention provide the advantages of both omnidirectional and directional approach beacons when they are needed, together with an efficient use of the quench tube discharge energy which was hitherto wasted. Moreover each system allows variation of the intensities of both the directional FT and omnidirectional QT lamps under the same intensity control and supplied by the same energy storage capacitative means. The systems afford effective control of light intensity from the airport control center and shielding from omnidirectional light flashes, where required, while providing two cooperative forms of runway identification and approach path lighting with a transition between the two as a plane leaves its circling pattern and enters the runway descent path.

It should be understood that the present disclosure is for the purpose of illustration only and that this invention includes all modifications and equivalents falling within the scope of the appended claims.

We claim:

1. A beacon lighting unit comprising: an electrical power storage supply, a first controlled light emitting discharge device and a second discharge device connected in shunt to the same said supply, said supply being the common power storage connected to and supplying both said devices, a start signal input coupled to the first device to initiate power discharge from the supply through the first device and light emission therefrom, an intensity control circuit connected between the signal input and the second device and responsive to a start signal to initiate discharge of the supply through the second device after a predetermined interval of discharge of the first device, thereby to terminate discharge through the first device and control the intensity thereof, said second device having substantially lower impedance than the first device, and the second device having comparably high light emission efficiency with respect to the first device, and an optical member for directing the light from one device in a scope different from that of the other device.

2. A unit according to claim 1 wherein said optical member comprises a means for direct light from the second device omnidirectionally.

3. A unit according to claim 1 wherein said optical member comprises a shield blocking light from the second device in a predetermined direction.

4. A unit according to claim 1 wherein said optical member is a tinted light transmitter.

5. A unit according to claim 1 wherein said second device comprises a gas discharge lamp filled with a highly light emissive gas.

6. A unit according to claim 5 wherein said lamp has a light emitting efficiency comparable to that of the first device.

7. A unit according to claim 5 wherein said gas is xenon.

8. A unit according to claim 1 wherein the power storage supply comprises capacitative means discharging through both discharge devices successively.

9. A unit according to claim 1 wherein the intensity control circuit variably controls the light intensity of both discharge devices.

10. An airport lighting system comprising a unit according to claim 1 located at the threshold of a runway, light from the first device being directed in a relatively narrow beam from the runway on the line of approach thereto, and light from the second device being directed over a substantially greater scope.

11. An airport lighting system according to claim 10 wherein a pair of units are located one at each side of the threshold.

12. An airport lighting system according to claim 10 wherein a plurality of units are spaced apart on a line aligned with the runway and approaching the threshold in combination with a timer for initiating discharge of the first devices in the units sequentially.

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