April 24, 1962 L. B. KOONTZ 3,031,645

AIRCRAFT LIGHTING SYSTEM

Filed July 21, 1958

FIG 1

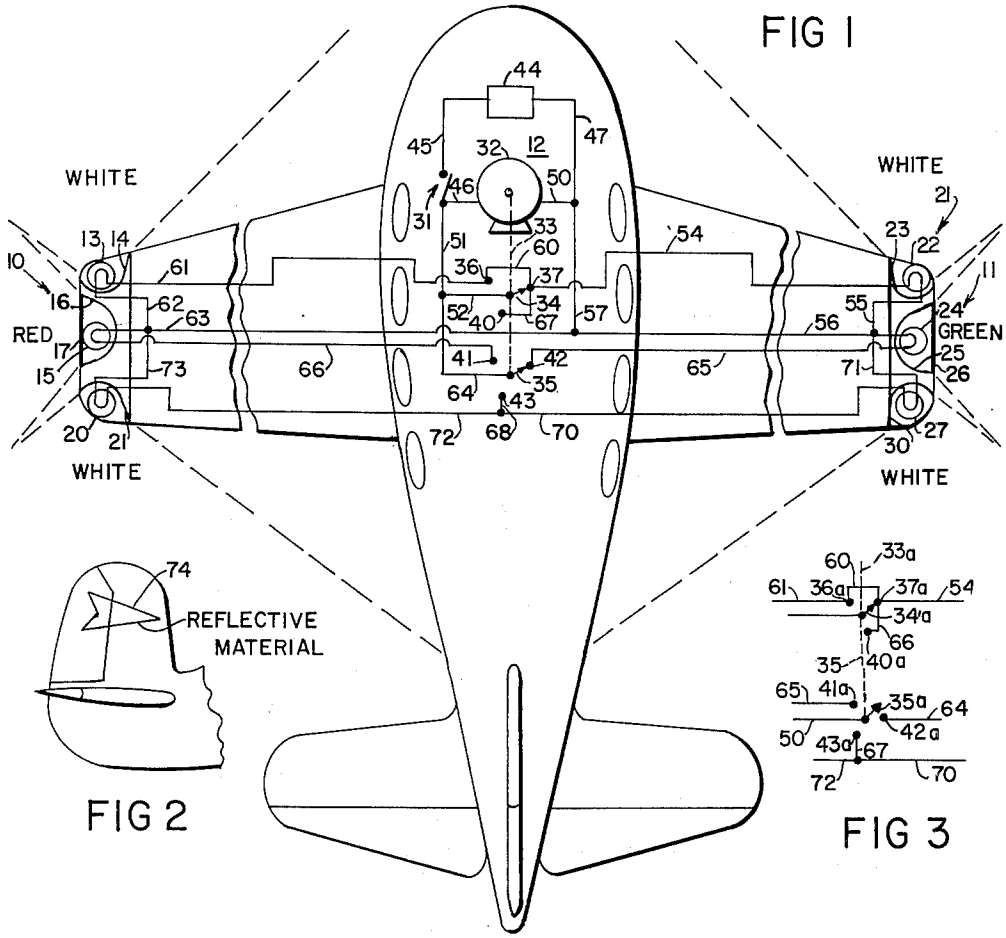


FIG 2

FIG 3

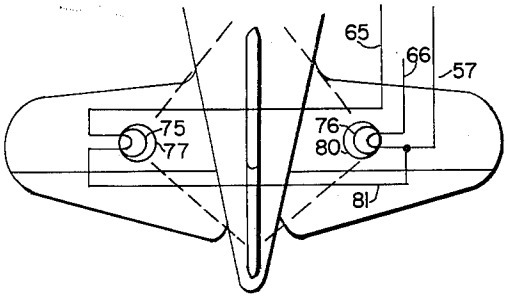


FIG 4

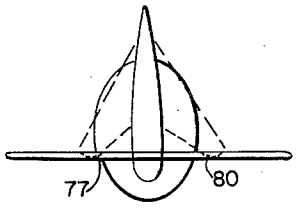


FIG 5

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AIRCRAFT LIGHTING SYSTEM

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1 Claim. (Cl. 340—25)

This invention relates to the field of aviation, and more particularly to an improved system of lighting for helping to prevent collisions between aircraft by making them visible to one another at greater distances, and by simultaneously giving to the observing pilots information as to the aspect of the distant craft which is being viewed.

It is known to provide lights on aircraft. Running lights are required on all aircraft, and nominally comprise a white tail light and red and green wing tip lights, all of which may be either flashing or continuous. A nose light or a belly light, also white, may be added. These lights have conventional incandescent lamps, because the capacity of aircraft power plants is limited, and accordingly the lights are not visible at great distances even in clear weather.

It has been proposed to increase the range of visibility by using a single high power incandescent light with a rotating reflector, enclosed in a colored roundel, to give the effect of a flashing light from any angle in azimuth. It has also been suggested to mount the gaseous discharge tubes at various locations on the craft and fire them to give extremely high intensity flashes of short length, which have been shown to be visible at great distances.

The object of this invention is to provide an improved anti-collision aircraft light system which combines the advantages of high intensity lights with economy of power consumption, simplicity of construction and maximum familiarity to pilots, and which may be used instead of rather than in addition to the usual running lights of the aircraft.

Various other objects, advantages and features of novelty which characterize my invention are pointed out with particularity in the claim annexed hereto and forms a part hereof. However, for a better understanding of the invention, its advantages, and objects attained by its use, reference should be had to the subjoined drawing, which forms a further part, and to the accompanying descriptive matter, in which I have illustrated and described certain preferred embodiments of my invention.

In the drawing, FIGURE 1 is a schematic showing of a light system according to the invention, FIGURE 2 shows a detail of FIGURE 1, FIGURE 3 is a fragmentary showing of a first modification of FIGURE 1, and FIGURES 4 and 5 show a further modification of the invention.

FIGURE 1 shows an aircraft equipped with a light system according to the invention. The system is seen to comprise a pair of wing tip units 10 and 11, a control unit 12, and the necessary innerconnecting cables. Unit 10 comprises a forward light including a lamp 13 and a reflector 14, a port light including a lamp 15, a reflector 16, and a red filter 17, and a rearward light including a lamp 20 and a reflector 21. Similarly, unit 11 comprises a forward light including a lamp 22 and a reflector 23, a starboard light including a lamp 24, a reflector 25 and a green filter 26, and a rearward light including a lamp 27 and a reflector 30. The lamps are shown for simplicity of illustration as conventional incandescent lamps, but gaseous discharge lamps will be found preferable where high intensity lights or long range visibility is desired, and it is understood that such lamps, with the necessary storage capacitors and triggering circuitry, are well known in the art as is shown by Edgerton Patent

2,478,908, and are equally intended to be represented by the lamp symbols in FIGURE 1.

The lamps and reflectors are so arranged that at every angle through 360 degrees in azimuth light from at least one lamp is visible, but substantial overlapping of the side beams by the forward and rearward beams is prevented.

Control unit 12 is shown to comprise a single pole single throw switch 31 and a motor 32 whose shaft 33 drives a pair of switch arms 34 and 35 with respect to sets of contacts 36, 37, and 40 and 41, 42, and 43, respectively. The circuitry for energizing units 10, 11 and 12 from the ships battery or inverter, indicated by source 44, will now be described.

One terminal of source 44 is connected by conductor 45 to the fixed contact of switch 31. The movable contact of the switch is connected to motor 32 by conductor 46. The other terminal of source 44 is connected to motor 32 by conductors 47 and 50. When switch 31 is closed, continuous operation of motor 32 begins and cyclic energization of the lamps in the wing tip units takes place as will now be described.

When the switch arms are in the position shown a circuit may be traced from switch 31 through conductors 51 and 52, switch arm 34, switch contact 37, conductor 54, lamp 22, and conductors 55, 56, 57 and 47 to the source 44. A second circuit may be traced from switch 31 through conductors 51 and 52, switch arm 34, contact 37, conductors 60 and 61, lamp 13, and conductors 62, 63, 57, and 47 to source 44. A third circuit may be traced from switch 31 through conductors 51 and 64, switch arm 35, contact 42, conductor 65, starboard lamp 24, and conductors 56, 57 and 47 to source 44. Thus at this time both forward lamps and the starboard green lamp is energized.

After 120 degrees of counterclockwise rotation of shaft 33 a circuit may be traced from switch 31 through conductors 51 and 52, switch arm 34, contact 36, conductors 60 and 54, lamp 22, and conductors 55, 56, 57, and 47 to source 44. A second circuit may be traced from switch 31 through conductors 51 and 52, switch arm 34, contact 36, conductor 61, lamp 13, and conductors 62, 63, 57 and 47 to source 44. A third circuit may be traced from switch 31 through conductors 51 and 64, switch arm 35, contact 41, conductor 66, port light 15, and conductors 63, 57 and 47 to source 44. Thus at this time both forward lamps and the port red lamp are energized.

After another 120 degrees of counterclockwise rotation of shaft 33, a first circuit may be traced from switch 31 through conductors 51 and 52, switch arm 34, contact 40, conductors 67 and 54, lamp 22, and conductors 55, 56, 57 and 47 to source 44. A second circuit may be traced from switch 31 through conductors 51 and 52, switch arm 34, contact 40, conductors 67, 60 and 61, lamp 13, and conductors 62, 63, 57 and 47 to source 44. A third circuit may be traced from switch 31 through conductors 51 and 64, switch arm 35, contact 43, conductors 68 and 70, lamp 27, and conductors 71, 56, 57 and 47 to source 44. A fourth circuit may be traced from switch 31 through conductors 51 and 64, switch arm 35, contact 43, conductors 68 and 72, lamp 20, and conductors 73, 63, 57 and 47 to source 44. Thus at this time both forward lamps and both rearward lamps are energized.

The speed of rotation of motor 32 is so chosen that the forward lamps 13 and 22 flash at a rate between 90 and 240 times per minute, preferably about 150 times per minute. This means that each side light and the pair of rearward lights flash between 30 and 80 times per minute, preferably about 50 times per minute, and that each flash of the forward lights is accompanied by a flash of one of the side lights or by a flash of the pair of rearward lights. By this arrangement there are never more

than 4, and usually only 3, lights flashing at the same time, which reduces the load on source 44.

In a modified form of the invention shown in FIGURE 3 the switch arm 35*a* is rotated 60 degrees clockwise on shaft 33 from the switch arm 33*a* so that the forward lights flash between flashes of the remaining lights. By this procedure the load on source 44 is still further reduced.

As is evident from FIGURE 1, some of the light from lamp 20 and 27 falls on the vertical stabilizer surface of the aircraft empennage. As shown in FIGURE 2, a portion of this surface may be covered wtih reflective material having a high degree of retro-reflection. An example of such material is found in the well known "Scotch-Lite" tape. This material may be applied to the stabilizer surface in a pattern giving meaningful information, such as an arrow head 74 pointed in the direction in which the aircraft is moving. Thus for medium distances, when seen from the side, the aircraft first displays a flash of colored light from an apparent point source and then a flash of reflected light from a source of considerably greater apparent area and of a recognizable shape which informs the pilot of the direction of movement of the aircraft being observed, without his having to wait to observe the displacement of the colored light flash with time.

As shown in FIGURES 4 and 5 additional lamps 75 and 76 in reflectors 77 and 80 may be provided on the horizontal stabilizer surface to illuminate the reflective material on the vertical stabilizer. These lamps are connected by a common conductor 81, and may be flashed simultaneously with lamps 15 and 24 respectively by conductors 65, 66, and 57 extended.

The danger presented by a remote aircraft is greatest when it is approaching head on, and for this reason the highest flashing rate is used for forward lights 13 and 22, which are also unfiltered. An aircraft seen from the side represents considerably less danger, and the closing rate is also less for this case, so that the somewhat reduced intensity of light resulting from color filters can be tolerated here, and the flashing rate is reduced for conservation of power. The concept of flashing is retained for both the side lights and the rearward lights because a flashing light is more readily perceived than a continuous light and is more easily distinguished from lights normally visible to the pilot including stars, surface lights, etc., and also because greater instantaneous intensity is obtainable if flashing lights of the gaseous discharge type are used. By having the rearward lights flashing at a different rate from the forward lights, it is easy to tell whether an aircraft is approaching or receding, and a three to one ratio between the flashing rates is sufficient to be detectable without need for counting.

By the foregoing arrangement the number of flashing rates has been reduced to a minimum of two; this makes for simplicity of structure and for uniform load on the power source. The quadrants of the aircraft are distinguishable by color or rate of flashing, and an indication of the direction of motion of the aircraft is additionally given by material 74.

It is to be realized that other arrangements may come within the scope of my invention. For example, although I have shown in FIGURE 1 a pair of light units designed for flush incorporation into wing tips, these may be replaced by streamlined pods applied to the wing surfaces. It is also possible to use only a single set of lamps centrally located, or even a single light source with an arrangement of colored filters and shutters for giving the desired flashing rate and color discrimination: under these circumstances the reflective material 74 may not be desirable.

Furthermore, although a motor driven switching arrangement is shown, it is equally possible to use a resistance-capacitance timing network, where gaseous discharge lamps are used, since exact synchronizing and precise rate of flashing are not essential. If such a network is used, it may be desirable to provide means for preventing any lamp from flashing simultaneously with any other, since if the lamps are allowed to flash independently, even at substantially the same rate, and the flashing rates are not continuously controlled, it can easily occur from time to time that all lamps flash at once, thus putting an extremely heavy load on source 44.

Numerous objects and advantages of my invention have been set forth in the foregoing description, together with details of the structure and function of the invention, and the novel features thereof are pointed out in the appended claim. The disclosure, however, is illustrative only, and I may make changes in detail, especially in matters of shape, size and arrangement of parts, within the principle of the invention, to the full extent indicated by the broad general meaning of the terms in which the appended claim is expressed.

I claim as my invention:

In combination a vehicle; means projecting high intensity light from said vehicle in a white forward beam, a white rearward beam, a port beam of a first color, and a starboard beam of a second color; means causing said forward beam to flash at a first frequency; and means causing the remaining beams to branch singly, in a predetermined sequence between successive flashes of said first beam, so that the flashing frequency of each of said remaining beams is one third of said first frequency; together with shaped reflective means, capable of retro-reflection at a relatively high efficiency; and means mounting said reflective means on said vehicle, to be visible, by reflection of light from said rearward beam, alternately with light from one of said port and starboard beams.

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