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LIGHTING THE PILOT'S PATH

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Old-timers still remember the thrill of their first night landing, made probably with the aid of three gasoline flares poured hastily on the ground and lighted by a match.

It was a grand and glorious sight to see the yellow flames blazing brightly and defining a small smooth area, wherein a safe landing might be made. And what a grand feeling it was to step out and relax, after the ship was on the ground and the wheels had stopped rolling.

The gasoline flares worked fine on a familiar field, and were always preferred to magnesium flares which lighted a greater area, but frequently burned out at critical moments.

Night flying aids have been tremendously improved since the days of the gasoline flares, and today a pilot can safely follow a lighted path along more than 20,000 miles of airway and land at anyone of several hundred lighted airports, in good weather. But when visibility is bad, and violent electrical storms interrupt lighting facilities, the pilot may wander miles from his course and collide with a mountain peak before he can find a course-marker leading to a lighted field.

So it is obvious that there are still great possibilities for improvement in night flying aids, on both the airport and the airway. In New York State, for example, we have numerous airports near brightly lighted metropolitan areas, where the airport light pattern is lost in the confusion of street lights, automobile lights and a multitude of obstruction lights.

Away from these congested areas, we have thousands of square miles of remote terrain studded with heavily wooded mountain peaks. Emergency landing fields are few and far between, and once a pilot loses the flashing beacon of the lighted airway, or gets off his radio beam, he is lost in the darkness and may wander for hundreds of miles before finding a lighted landing spot.

Instances of such are only too frequent. Last year an American Airways plane near Albany made a slight detour to avoid a storm and landed in Canada, north of Lake Erie. Another started to Buffalo from New York City and landed in Boston. Another

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crashed into a mountain peak south of Albany and it was several days before searching parties found the survivors. Less than ten days ago two men were killed when their ship crashed at full speed into Mount Beacon.

These things are a serious handicap to air transport, and deter hundreds of private flyers from attempting to use their planes at night. It is an attempt to prevent such occurrences that we have inaugurated a program of airway and airport improvement in New York State.

But no matter how many airports we build, nor how many radio and weather air navigation aids we provide, their value is lost during periods of darkness, unless we also provide adequate visual night markers to guide the pilot along his route and bring him safely to his port.

Before attempting to devise a comprehensive plan for night marking the state, we made a thorough survey of all existing facilities, and a study of all types of present night lighting equipment.

As a result of this investigation, it became apparent that an independent light source which could be operated at points remote from power lines would be required for both airway and airport marking at many places. Other requirements included maximum visibility but minimum installation and operating cost, and absolute dependability.

No existing equipment quite met all these requirements, so we found it necessary to develop equipment to meet our specific needs. Being, like all other states, handicapped with no funds for experimental development, we called in various electrical and lighting experts, engineers and pilots, submitted the problem to them, and as a result of our joint labors finally evolved a new type of light unit which is adaptable for many airway and airport purposes.

The basic idea of the unit is that it utilizes an incandescent gaseous tube for its light source, the tube being operated by a high potential but low amperage current obtained by stepping up a one and a half volt dry battery output to approximately 7,500 volts.

In order to obtain satisfactory service life from the battery, it was necessary to arrange for intermittent flashing of the light. This flashing characteristic was found to be very desirable, since it gave a distinctive value to the light and prevented its being confused with other ground lights, and at the same time its flash frequency could be adjusted so that the image of one flash is retained by the eye to almost the time of the next flash, thus

providing the effect of a continuous light with a distinctive flickering quality.

This flash frequency prevents the location of the light source being lost momentarily by the pilot, and when used as a boundary marker on an airport, or as a runway marker or approach light, a series of the units provides a continuous flickering line of lights that cannot be mistaken for anything else.

As an airway course marker, or auxiliary marker beacon, the frequency of flash can be slower, the most desirable for all conditions being found to be from one flash to four or five flashes per second. One of the principal objections pilots have to the large airway flashing beacons is that the intervals between flashes are so great that in thick weather it is quite easy to lose the next one, and thus get off the course. If auxiliary flashing course markers, which flash at least once per second, are provided every few miles, even when the visibility is very bad and a low ceiling prevents seeing the next flashing beacon, the auxiliary markers can be seen and followed easily. For marking obstructions along a course, such as high mountain peaks, this distinctive flashing marker is ideal.

The light units can be provided with different gases so that varying color effects are possible. For example, green or blue can be used for runway marking, red for obstructions, orange for auxiliay course markers and boundaries of intermediate or emergency fields, and canary yellow or gold for boundaries of large airports. In devising the proposed system for New York State, Department of Commerce and federal airway practice has been followed, the idea being to provide a light that would be independent, portable, never fail, and at the same time prevent possibility of its being confused with other fixed ground lights.

Further possibilities of this lighting method for distinctive markings are suggested by combining various colored units in definite groups and patterns.

The maximum light available from one unit is approximately that provided by 15 feet of Neon tubing. One small dry battery will operate this unit approximately three months at a cost of about one dollar, so that such a light compares favorably with the operation cost of ordinary filament lamps connected with a power line. If but seven feet of tubing are used, the same battery will run the light for six months.

Actual flight visibility investigations made in connection with the experimental units disclosed that the area of the light source

was an even greater factor in obtaining maximum visibility than the intensity of the light. In other words, it was found easier to see a spiral coil containing 15 feet of incandescent Neon tubing from a distance of two or three miles, than to see a small filament lamp of many times the candle power of the Neon tube.

This factor also proved beneficial when the problem of better airport lighting was investigated. Pilots find that the wind-shield glare from an intense light is much greater than from a larger diffused light, so that glare from a row of the lower intensity flashing units is much less than from fixed filament lights of higher intensity, both having approximately the same distance visibility.

Another interesting possibility for this new type of airport illumination is its use for flush type runway markers, in perhaps a combination of green and gold units alternating. Such a flush type runway border marking would cause practically no glare, and at the same time provide adequate definition of the runway for landing purposes.

Hundreds of pilots were consulted during the investigation, and they were almost unanimous in preferring proper flush type marking of runways to flood light illumination. This objection to the flood light system has developed recently since heavier glass wind-shields in closed cabin planes has become almost universal practice.

In the early days, when most of the night flying was by night mail pilots flying in an open cock-pit, the glare problem was not serious, since the pilot usually peered around the edge of the wind-shield to land, or if he did not, the refraction from the thin celluloid or plastacele wind-shield was not serious. With heavier glass and highly polished surfaces, most of the glass being of the shatter-proof type having a cemented center of different density and refraction, the glare becomes quite serious from lights of high intensity such as necessary in flood lights and powerful beacons and spot lights. The majority of transport pilots also apparently prefer to land with their own landing lights, especially if runways and boundaries of the field are properly marked.

In considering airport lighting problems, there has been too much of a tendency to call in the electrical and illuminating engineers and follow their recommendations, without a proper regard for the ideas of the pilots, who after all are the people who have to do the night flying. The lighting expert thinks of the problem as one of obtaining a maximum amount of lighted area, and not

having much night flying experience himself, he often fails to understand the pilot's requirements.

In our investigation, we gave serious consideration to all suggestions by pilots, and from this source received much constructive criticism. And one of the ideas they all seemed to agree on is that too much light of glaring intensity is worse than too little light. With the dry battery operated units it is not possible to obtain too much light, but the light that can be provided seems adequate, as in certain tests on clear nights, the flashing unit could be seen up to five miles from an altitude of three or four thousand feet.

The frequent flashing characteristic of the units is undoubtedly helpful in creating maximum visibility from a good distance, since the eye is attracted by the flash action.

Because of this characteristic, such units, in appropriate color patterns, should prove excellent for airway approach lighting plans, intended for use in bad weather and as aids in making so-called blind landings, where the pilot is brought within proper gliding distance of the field by radio beams and beacons. In this system, recently devised by the Department of Commerce, the series of red and green lights along the approach route indicate the distance from the desirable landing spot on the field.

In all such blind landing control by radio and lights it is essential that all obstructions, such as high points of ground, trees, and other hazards, be properly marked. The dry battery unit is well adapted for this purpose, since it requires no expensive wiring installation, the units being portable and requiring servicing only once or twice per year.

Simple design and careful construction of housing for the dry battery units will enable low installation costs as well as inexpensive operation, and this factor should prove of great importance where maximum marking is desired but where the budget for lighting will not permit the elaborate installation of fixed type illumination. The flexibility of such units is also a desirable feature for the smaller airport, since more boundary lights or runway markers may be added from time to time, or the ones in use can be moved as needed to include increased area, as additions to the field are made.

Even in the case of large airports already well equipped with fixed lights, the installation of an independent auxiliary system such as these units provide, may prove of great value. The independent dry battery units will operate continually and serve

to aid pilots in distinguishing boundary and runway markers from other nearby street and highway lights, and in the event of temporary failure of the fixed lights from any cause, the airport is not left in darkness.

This last possibility is quite serious, and the time such lighting fails is always when it is most needed, such as during a violent storm when fuses burn out, or wires are shorted. Heavy rains often cause settling of newly filled areas on the airport, with consequent damage to conduit or cable lines, often requiring several days to locate and repair. I recall one or two such instances when I was manager of the Newark airport, and understand that similar difficulty has been encountered since.

It is obvious that the cost of a complete auxiliary independent system, which will operate under all conditions without wires, is the cheapest possible insurance against the possibility of a serious accident some night when traffic is heavy and the lights fail at a critical moment.

Now I do not pretend to qualify as a lighting expert myself, nor do I wish to take credit for all the development along this line to date. In this connection I wish to express proper appreciation of the assistance and cooperation given the New York State Commission by engineers of the Rose Aviation Corporation; the C. F. Burgess Laboratories; The Phoenix Glass Company; The Claude Neon Company; Colonel Harold E. Hartney of the Senate Aircraft Committee, who as far back as 1925 worked out and patented a comprehensive plan of airport and airway lighting with claims anticipating the method herein outlined; Walter Beech and various other prominent pilots, as well as officials of the Department of Commerce and numerous airport managers.

I believe the sum total of all our labors has resulted in an improvement in lighting methods, especially for remote regions, and I understand commercial production of the new type units is being started by the Rose Company under the Hartney patent license. If we can light some of the rougher high spots of New York State, and thus prevent even one crash and its consequent loss of life, I will feel that our work has been more than justified.