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TEST OF AIRWAY BEACONS AS APPROACH-ANGLE INDICATORS

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by

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SUMMARY

A pair of airway beacons, equipped with red and green filters, were mounted side by side. The zone covered in common by their beams was checked to determine whether the area where the colors balanced to produce white light was usable as an angle guide toward the beacons. The results showed that the beacons do not produce a pattern usable for that purpose.

INTRODUCTION

The Office of Federal Airways expressed a need for a visual signal which could be used to simplify the checking of the ILS glide path through elimination of the theodolite and ground crew normally required. During preliminary discussions it developed that this visual signal would require materially higher intensities than were available from existing approach-angle indicators, and the possibility of using surplus airway beacon units was suggested. It was requested that two beacon units be equipped with red and green filters and set up to determine whether the line of balance of the two colors can be used for such a visual guide.

REQUIREMENTS

There are two possible types of visual reference which could be used as guides in flight-testing ILS installations. The first would provide an approach path from which the visual reference would be visible and allow an approach continuously monitored by a visual signal. The second would provide only a momentarily visible signal which could serve as a specific check point in the middle of the approach zone.

The requirements for these two services are different. For the first service the requirements are:

1. The signal should be visible for 8 to 10 miles on a clear night.

2. The signal must be distinctive.

3. The signal must be visible throughout the approach area as defined by ILS glide path specifications.

4. The signal must be sharper than the specified ILS glide path limits. The specification limits are plus or minus 0.75°, so the visual reference signal limits should be not more than plus or minus 0.25°.

5. Definite and recognizable visual warning of the horizontal limits of the signal must be provided.

The requirements for the second service, a check point signal, correspond to the first three listed above with the following special requirement: The signal must be sharper than the minimum angular response of the ILS receiver. This signal sharpness must be less than 0.1° and can be produced by a single recognizable change of signal characteristic. In this case there is no requirement for an on-course zone with warning limits.

PROCEDURE

It was known that standard airway beacons could produce light of sufficient intensity to meet the first requirement. The third, fourth, and fifth could be determined by field tests, and the second could be met by judicious selection of flashing means.

For the field test, two 24-inch beacons were set up in as close proximity as possible. These projectors were fitted with complementary color filters and were directed so that the beams diverged slightly and overlapped for a portion of the area. This produced a condition in which a zone of color balance was set up and made it possible to determine whether this area was of proper dimensions and sharp enough to serve as the visual signal required.

The beacons were set up on Weir Cook Airport, equipped with red and green lenses, and directed with a 3° vertical angular divergence of their beams. They were mounted side by side in immediate juxtaposition and were directed across the airport facing south at angles 2° and 5° above horizontal and with the spread lenses set to spread the beams vertically.

Observations were made from the air in horizontal flight for 10 miles and toward the beacons. The observers watched closely to determine:

1. Whether the adjacent light sources appeared to merge.

2. What color the merged light appeared to the observer.

3. Whether the area of color balance produced a zone from which the lights would appear white.

4. Whether the zone formed a sufficiently narrow and clearly defined path to be useful as a guiding means.

RESULTS

1. The lights appeared to merge from a considerable distance, but the dimensions and separation of the sources made the lights tend to separate visually when the observer came within about two miles.

2. The merged light appeared as red, white, or green, depending on the observer's position in the beam pattern.

3. An area of white light was produced.

4. The area of white light was not sharp enough or defined clearly enough to serve as a visual check to pilots.

CONCLUSIONS

It appears that beacon projectors cannot satisfactorily serve as sources for glide angle indicators by means of color balances in the beam pattern. It is possible that projectors could be developed which would give satisfactory results.

Further development and investigation for the first type of reference signal could follow one or both of two courses. One would be aimed at providing improved optical control of the projected light so that an even color balance could be achieved throughout a sharply defined zone. The other course would be directed toward a beam projected through segmented color filters.

Two signal light units have been developed in the United States based on the split filter. One was a device produced experimentally by the General Railway Signal Company. It employed a lens with a series of horizontal cylindrical surfaces and used red and green strip filters to modify the light projected through the upper and lower segments of the lenses. It produced a zone of color balance about 0.9° wide. The other unit is an angle-of-approach indicator produced by the Westinghouse Electric Company which employs a stereopticon type of projector with a segmented filter cut from plane glass. It normally produces an "on-course" signal about 2.0° wide which can be reduced to about 1.0° by reducing the width of the strip of glass filter. Both of these projectors use relatively low-power lamps and produce signals effective for only a mile or two. Both include shutters to produce a flashing signal.

In order to produce a white light by the balance of colored light, it is necessary to use complementary colors. Of these, red and green are the most practical because they have about the same transmission proportion. Red and green signal lights have become established for specific uses in aviation lighting by long established practice, but it might be practical to apply them to a special signal for temporary test use without introducing serious confusion.

The stereopticon type of projector is not limited to complementary or specific colors.

Development for the second type of reference signal, or the spot check signal, should be directed toward producing a beam with two contrasting colors meeting in as sharp a plane as possible. This probably could be achieved by an accurate projector with two color filters meeting in a line.