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USE OF CONDENSER DISCHARGE LIGHTS AS RUNWAY-END IDENTIFIERS

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SUMMARY

This report describes tests and observations of condenser discharge lights used as runway-end identifiers. One pair of lights was installed at the approach end of Runway 13 at Weir Cook Municipal Airport, Indianapolis, Indiana. Tests were conducted to determine the optimum beam orientation, shielding necessary to reduce glare in the approach area, and the effects obtained by using colored filters.

Bright flashing lights at the approach end of the runway proved to be of great assistance to pilots in determining their position with reference to the runway, especially during minimum circling-approach weather conditions.

Two Sylvania condenser discharge lights, Type CD-2002, were used in these tests, one on each side of the runway threshold. Any beam orientation which was feasible from an end-identifier standpoint proved to be glaring to approaching pilots just prior to crossing the threshold. A baffle was designed to effect partial beam cutoff at approximately 1,000 feet prior to crossing the threshold. This baffle, along with other adjustments to the fixture, made the condenser discharge lights suitable for use as runway-end identifiers and eliminated glare during the approach.

INTRODUCTION

Early in 1957, the CAA Office of Air Navigation Facilities purchased 25 pairs of Sylvania condenser discharge lights for installation as runway-end identifiers at the approach ends of noninstrument runways. Since the Technical Development Center (TDC) already was in the process of flight testing low-visibility runway lighting systems at Andrews Air Force Base (AFB), Md., a pair of these identifiers was installed at the approach end of the test runway for preliminary study of location and aiming. One identifier was located five feet outside each end of the extended green threshold light bar. This placed the identifier 40 feet outside the edge of the runway. The beam was elevated 3°, and provisions were made to investigate horizontal beam angles from 0° (parallel to runway centerline) to a toe-out of 20°.

The optimum orientation was found to be a toe-out of about 10°, but considerable glare still existed in the vicinity of the threshold. Greater toe-out angles reduced glare in the prethreshold approach area, but also reduced the over-all effectiveness. Moving the identifiers farther out from the runway edge would have helped eliminate glare, but again, this would have reduced the over-all effectiveness by disassociating them from the end of the runway. The identifiers also could have been moved into the approach area, away from the end of the runway, thereby utilizing natural vertical cutoff to eliminate glare. This was deemed inadvisable, however, for similar reasons.

It was recommended that a set of the identifiers be installed at TDC for further study of shielding and cutoff methods to reduce glare in the approach area without reducing the effectiveness of the identifiers. This report describes the procedures used and the results obtained.

PROCEDURE

The condenser discharge lights were installed on the approach end of Runway 13 at Indianapolis, and were located as determined by the Andrews AFB tests. See Fig. 1. A wooden base was provided for each identifier and was marked so that the identifier could be turned in 5° increments from a position parallel to the runway axis to an extreme toe-out of 30°. See Fig. 2. The reflectors within the identifier units were tilted so that the main light beams were aimed 3° above a horizontal plane, which is the approximate angle of the glide path.

Because of the large 15-inch reflector, it was not practical to obtain cutoff by using a single shield extending from the identifier into the approach zone. Instead, a shutter-type baffle was constructed which could be rotated in the vertical plane to give directivity. In order to produce varying degrees of cutoff, the tilt angle of the experimental baffle blades was made adjustable also. The baffle was painted flat black to reduce reflection. Figure 3 shows the experimental baffle in place.

The possibility of using colored filters with the identifiers, in order to disassociate them further from surrounding lights, was explored. Plexiglas filters of several colors were obtained, and a holder was constructed to hold the filters in front of the lighting fixture.

Observations were made from the air while circling the field, and while approaching the runway for landings. The identifier to the pilot's left as he approached the runway for a landing was equipped with the baffle, while the identifier to the right was used either clear or with colored

filters. It should be noted that a clockwise rotation of the baffle in this setup would correspond to a counterclockwise rotation should the baffle be used with the identifier to the pilot's right.

Observations were made to determine:

1. The best angle of toe-out of the identifier unit.

2. The best angle of rotation of the baffle for circling guidance.

3. The best angle of tilt of the baffle blades to give cutoff and prevent blinding of the pilot without reducing over-all effectiveness.

4. Which color of filter, if any, presented the best identification.

Results of direct observations were confirmed by studies of motion pictures taken during the flights.

RESULTS

1. During the flight observations, the angle of toe-out of the identifiers was changed in steps from 0°, parallel to the runway axis, to 30°. Confirming the Andrews AFB tests, a toe-out of 10° gave maximum horizontal (circling) coverage without losing potency in the approach area. This appears reasonable from a theoretical standpoint also, as the beam spread, to one-half intensity, is about 25°.

2. A simulated condition of 400-foot ceiling and 1-mile visibility was used as a criterion for circling guidance since this is a rather common minimum condition. The baffle was rotated in the vertical plane in various steps from the horizontal position to 15° from horizontal in the clockwise direction as viewed on approach. A rotation of 10° appeared to be optimum for viewing on the downwind leg and on the turn into final approach.

3. Preliminary ground investigation of baffle rotation and baffle blade tilt revealed that cutoff was much more sensitive to tilt than to rotation. During flight observations, the baffle blades were tilted down as much as 10° from the horizontal position. At 10° of tilt, the light was cut off almost entirely during the final approach. In order to obtain the desired cutoff without reducing the effectiveness of the light, it was necessary to tilt the blades down approximately 5°. It should be noted that this angle of tilt is dependent upon the width of the blades and the spacing between them. The test baffle blades were 7 inches wide and spaced 2 inches apart.

4. Four different colored filters, aviation red, yellow, amber, and aviation green, were placed in front of the unshielded identifier at various times during the flight observations. The red light was reasonably conspicuous but could be mistaken for other flashing red lights, such as aircraft warning lights. The yellow and the amber filters effected almost no change to the color of the identifier at distances of one mile or more. Some of the observers liked the use of the aviation green filter, as it tended to identify the flasher as part of the threshold lighting system. No matter what color of filter was used, the intensity of the identifiers was diminished appreciably. The light emitted from the identifiers with no filter had a bluish-white color which in itself had a certain amount of attention-getting quality. Therefore, unless there is a desire to tie in the identifiers with the threshold lights, there is no advantage in using a colored filter.

The final positioning and orientation of both the lighting fixtures and the baffles are shown in Fig. 4.

CONCLUSIONS

1. A baffle can be designed which will reduce the glare effect of the runway-end identifiers without reducing their over-all effectiveness. The most feasible type of baffle would be one with a series of shutter blades similar to the one used for these tests except that it need not be movable.

2. The desired cutoff was obtained by tilting the experimental baffle blades down 5° (blades were 7 inches wide, spaced 2 inches apart) and rotating the baffle 10° clockwise when the identifier fixture was toed out 10° and its main light beam was aimed 3° above the horizontal plane.

3. No colored filter is necessary for distinction of light; however, an aviation green filter may be used if desired to associate the condenser discharge runway-end identifiers with the runway threshold lights.

FIG. 1 LOCATION OF RUNWAY-END IDENTIFIERS AT WEIR COOK MUNICIPAL AIRPORT, INDIANAPOLIS, INDIANA

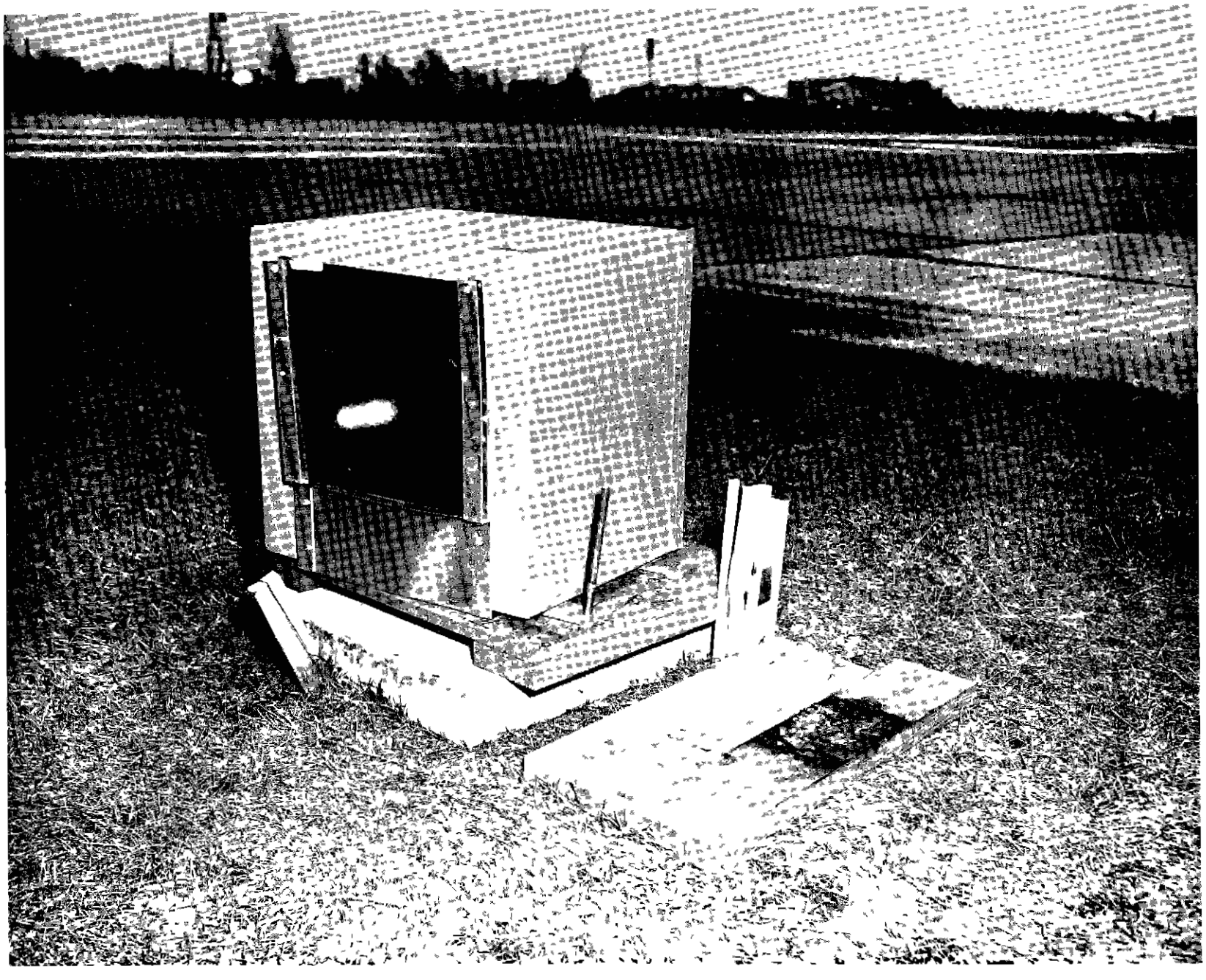


FIG 2 INSTALLATION SHOWING FILTER, FILTER HOLDER, AND MARKED BASE TO ALLOW ADJUSTMENT OF ANGLE OF TOE-OUT

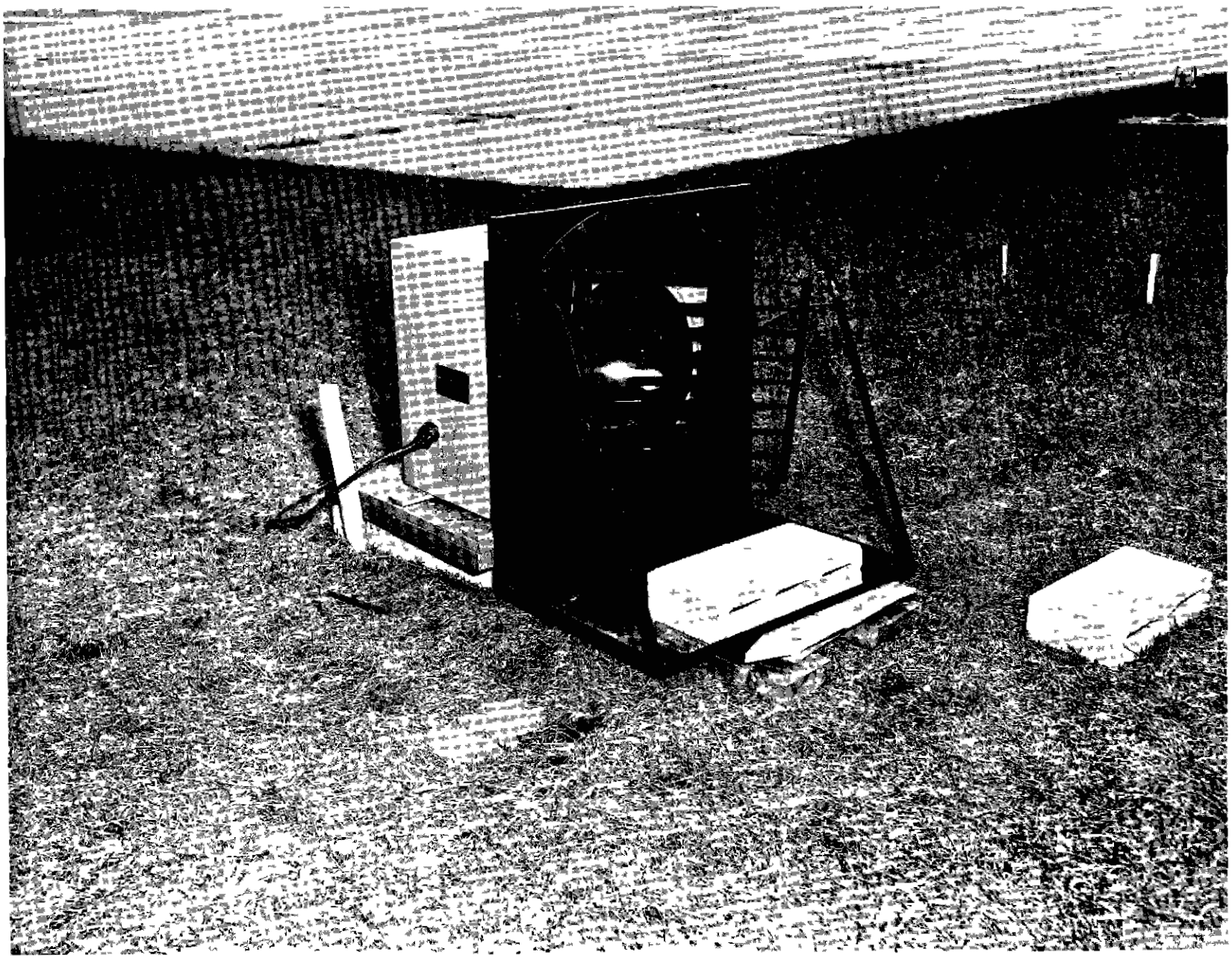


FIG 3 EXPERIMENTAL BAFFLE WHICH ALLOWED CHANGES IN ROTATION AND TILT

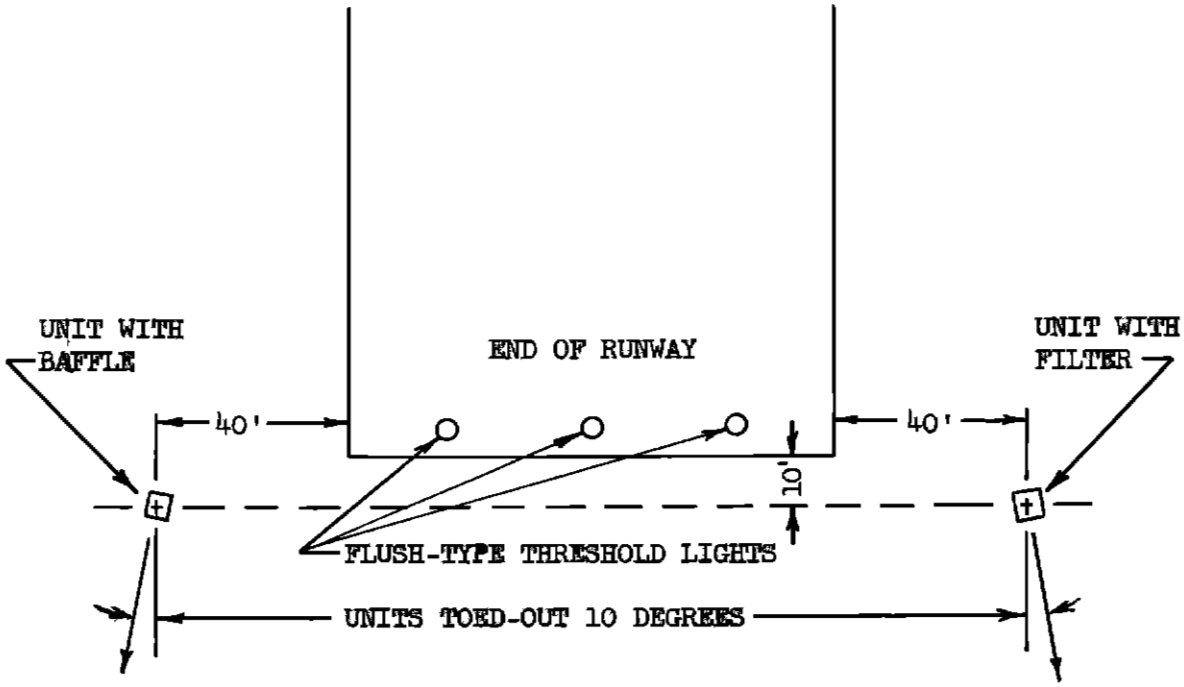
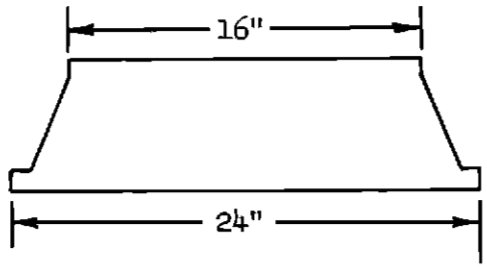
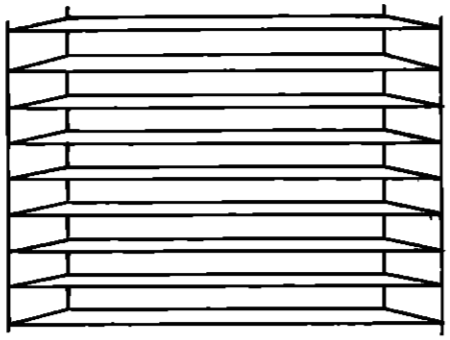


FIG. 4A LOCATION OF RUNWAY IDENTIFIERS





NOTE: BAFFLE BLADES ARE 7 "
WIDE AND TILTED DOWN 5°.
THE BAFFLE WAS ROTATED
DOWN ON THE RUNWAY SIDE 10°.
BLADES ARE SEPARATED 2".

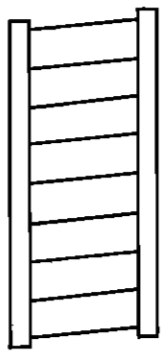


FIG. 4 DRAWING OF BAFFLE