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EVALUATION OF THE CRANE ALWEATHER FLITEGAGE MODEL NO. 2

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EVALUATION OF THE CRANE ALWEATHER FLITEGAGE

SUMMARY

This report describes a short series of flight tests conducted at the Civil Aeronautics Administration, Technical Development and Evaluation Center to evaluate the Crane Alweather Flitegage manufactured by Lapcra Research, Ltd.

The tests were concerned primarily with pilots' reactions to the system of instrumentation presented by the Flitegage.

It is concluded that the instrument has considerable merit, possessing a number of advantages over the usual instrument panel layout Modifications for improving the instrument are suggested.

INTRODUCTION

Most pilots have expressed a desire for a composite flight instrument which would present natural flight indications. Such an instrument would decrease training time in instrument flying and reduce mental and physical fatigue during all instrument flights. The Crane Alweather Flitegage developed by Lapcra Research, Ltd., San Antonio, Texas, was designed to possess such qualities. It appeared desirable to study its functions and observe and evaluate the presentation under flight conditions A photographic view of the Flitegage is shown in Fig. 1. This report describes the instrument and presents the results of a short series of flight tests conducted at the Technical Development and Evaluation Center.

DESCRIPTION OF APPARATUS

The Crane Alweather Flitegage (Model 2) illustrated in Fig. 2, is a composite instrument which has been devised to simulate visual flight conditions as closely as possible. Each of the primary components is presented so as to give a correlation with the object or objects which it represents.

The horizon bar remains fixed and is parallel to the lateral axis of the airplane at all times. It is the miniature airplane which banks, climbs and dives with respect to this fixed horizon instead of the converse which is true of the conventional instrument.

The directional gyro compass card remains parallel to the horizon bar and is presented as a cloud layer. The compass card rotates about an axis parallel to the aircraft's vertical axis and in a direction opposite to that of the conventional air-driven gyro. This presentation gives the pilot a visual sense of turning in the proper direction.

An excellent feature of the Flitegage is the ILS presentation. Being superimposed on the artificial airplane, the localizer indicator, painted red, represents the approach lights; and the glide path indicator, painted green, represents the threshold lights. Air speed indications are represented on a revolving drum mounted with its axis parallel to the aircraft's lateral axis, and its location is left of the horizon bar which acts as a lubber line or reference pointer.

Vertical speed is represented in the same general manner as air speed, except that the drum is transparent and stationary. A white pointer behind the drum moves up and down about a pivot co-axial with that of the air speed indicator.

The altimeter is mounted on a drum which rotates about a vertical axis. This indicator is located at the lower margin and in the center of the instrument group.

Turn and bank supplemental indications are shown by a miniaturized turn needle and ball inclinometer located in the lower right-hand portion of the group.

Instead of using a dial or needle type of indicator for ADF radio bearings, a small cylinder is mounted parallel to and above the gyro compass card. The cylinder has painted on it a 360° helix similar in appearance to a horizontal barber pole. It is calibrated with zero in the center and 180° at each extremity. Intermediate numbers are on each side, 181 to 359 on the left of zero, and 1 to 179 on the right As the cylinder rotates about its axis, the painted helix is viewed through a narrow opening the length of the cylinder. This gives the appearance of a small dot moving from one end to the other end of the slot.

A 40-watt, 2-element bulb shielded to prevent undesired reflections is provided to give the correct illumination. The light source is controlled by a rheostat in order to provide selectivity in accommodating day or night external lighting conditions. Two elements with a switching mechanism are provided so that in the event one element should fail, the other can be energized.

The entire presentation is obtained by the careful placement of standard air-driven and electronic instruments in a black box, using transparent mirrors to gain the desired effect.

FLIGHT TESTS

The Flitegage (Model 2) was installed in the TDEC Boeing 247D, Airplane N 11, for flight testing and evaluation. See Fig. 3. The flight tests were concerned primarily with pilots' reactions to the instrumentation system as presented and no attempt was made to check the accuracy of each separate instrument.

The flight tests were performed by four TDEC pilots. Due to the limited amount of funds and time available for the project, each pilot was allowed 30 minutes of contact flight to become familiar with the Flitegage. A simulated instrument flight then was made to record each pilot's reactions during three phases of flying, including, constant altitude maneuvering, recovery from unusual attitudes, and a simulated ILS approach. The results of these tests are shown in Table I.

TABLE I

RECORD OF PILOTS' REACTIONS TO THE FLITEGAGE
UNDER INSTRUMENT FLIGHT CONDITIONS

Phase	Reactions Reported by Each of Four Pilots			
	1	2	3	4
Constant Altitude Maneuvering				
Straight and level flight	Normal	Normal	Normal	Normal
Left and right standard rate turns:				
Variation in air speed	10 mph	5 mph	5 mph	5 mph
Variation in altitude	300 feet	300 feet	200 feet	100 feet
Variation in vertical speed	1200 fpm	900 fpm	700 fpm	500 fpm
Turn indicator coordination	Normal	Normal	Normal	Normal
Recovery From Unusual Attitudes				
Forty-five-degree climbing turn	Normal	Normal	Normal	Normal
Forty-five-degree spiral	Normal	Normal	Normal	Normal
Steep climb	Normal	Normal	Normal	Normal
Simulated ILS Approach				
Localizer — degree of departure	15°	2°	1°	1°
Glide slope — degree of departure	1°	0.30°	0.30°	0.30°
Attitude of aircraft	Normal	Normal	Normal	Normal
ADF bracketing to station	Normal	Normal	Normal	Normal

Each pilot then repeated the same flight with standard instruments. The results of these tests are given in Table II.

TABLE II

RECORD OF PILOTS' REACTIONS TO STANDARD INSTRUMENTATION

Phase	Reactions Reported by Each of Four Pilots			
	1	2	3	4
Constant Altitude Maneuvering				
Straight and level flight	Normal	Normal	Normal	Normal
Right and left standard rate turns				
Variation in air speed	10 mph	5 mph	15 mph	15 mph
Variation in altitude	150 feet	50 feet	300 feet	200 feet
Variation in vertical speed	600 fpm	500 fpm	1500 fpm	100 fpm
Turn indicator coordination	Normal	Normal	Normal	Normal
Recovery From Unusual Attitudes				
Forty-five-degree climbing turn	Normal	Normal	Normal	Normal
Forty-five-degree spiral	Normal	Normal	Normal	Normal
Steep climb	Normal	Normal	Normal	Normal
Simulated ILS Approach				
Localizer — degree of departure	1°	1°	1°	1°
Glide slope — degree of departure	0.30°	0.30°	1°	0.05°
Attitude of aircraft	Normal	Normal	Normal	Normal
ADF bracketing to station	Normal	Normal	Normal	Normal

The pilots submitted reports of their reactions to the individual component instruments of the Flitegage. These reports are summarized in Table III.

TABLE III

Instrument	Reactions Reported by Each of Four Pilots			
	1	2	3	4
Directional Gyro	Good	Very good	Very good	
Horizon	Good	Good, but difficult to see at times	Very good	Very good with ILS glide slope
ILS	Good	Better than standard	Good, especially glide slope and horizon together	Insufficient lubber lines, eye strain develops
Air Speed	Hard to read	Difficult to read	Difficult to read	Very poor
Altimeter	Hard to read	Insensitive	Poor; should be vertically presented	Very poor
Vertical Speed		Poor scale indications	Poor scale indications	Very poor
ADF	Incorrectly presented		Incorrectly presented	Very poor
Turn and Bank	Normal	Below par	Fair	
Lighting	Poor for day operations	Poor for day, good at night	Insufficient for day, excellent at night	Poor during day flight but good at night

As indicated in the flight records and pilots' reports, considerable detail is lacking in workmanship and individual instrument presentation. All pilots were favorably impressed by the directional gyro, horizon, and visual course indication. The other instruments were objectionable because of insufficient light, small numerals, and other causes that could be readily corrected. The glide slope indicator, which was superimposed over the horizon, definitely made glide slope maintenance easy. The localizer course also was easy to maintain because of its close proximity to the direction indicator. Instrument lighting was insufficient for bright daylight flying, but it could be improved by proper painting and numeral spacing. The lighting was very good during night operation, and the system is adaptable to red and other colors through the use of filters. Notwithstanding the inferior clarity and legibility of many of the component instruments, all pilots were able to make safe and acceptable simulated ILS approaches.

CONCLUSIONS AND RECOMMENDATIONS

Although the flight testing of the experimental Crane Alweather Flitegage was limited, the system of instrumentation appears to have considerable merit for several reasons. By including the various separate flight instruments into one compact unit, (1) pilot fatigue is reduced because of the fewer number of eye fixations, (2) the recessed window presentation eliminates windshield images during night flying, (3) overall instrument panel space is considerably less than that required for separate instruments (14 square inches as compared to 172 square inches respectively in this particular installation). Also, the transposition of the separate instruments, accomplished largely by the use of modified standard instruments through proper physical location and optical means, may prove to be less costly than an equivalent transposition and/or superposition of instruments by electronic means.

Further study of the Flitegage has been made. It is believed that certain modifications in design of the instrument would be desirable, and in keeping with the general philosophy of the flitegage, a suggested panel layout is illustrated in Fig. 4. The instrument would contain:

1. A directional gyro of conventional type, except that the direction of rotation is opposite to that of the standard air-driven gyro.
2. An attitude indicator, which is a miniature "airplane" that banks, climbs, and dives with respect to a fixed horizontal lubber line. A small disc provides angle of bank indications in 15° increments.
3. A miniaturized standard turn indicator.
4. A sweep-type course deviation indicator with flag alarms.
5. A VOR TO-FROM indicator.

6. An altimeter with a drum-type vertical scale.
7. An air speed indicator with a drum-type vertical scale.
8. A vertical speed indicator with a drum-type vertical scale.

In such a presentation the miniature "airplane" (attitude indicator) is flown "TO" the desired magnetic heading, altitude, air speed, vertical speed indicator, and course indicator.

*

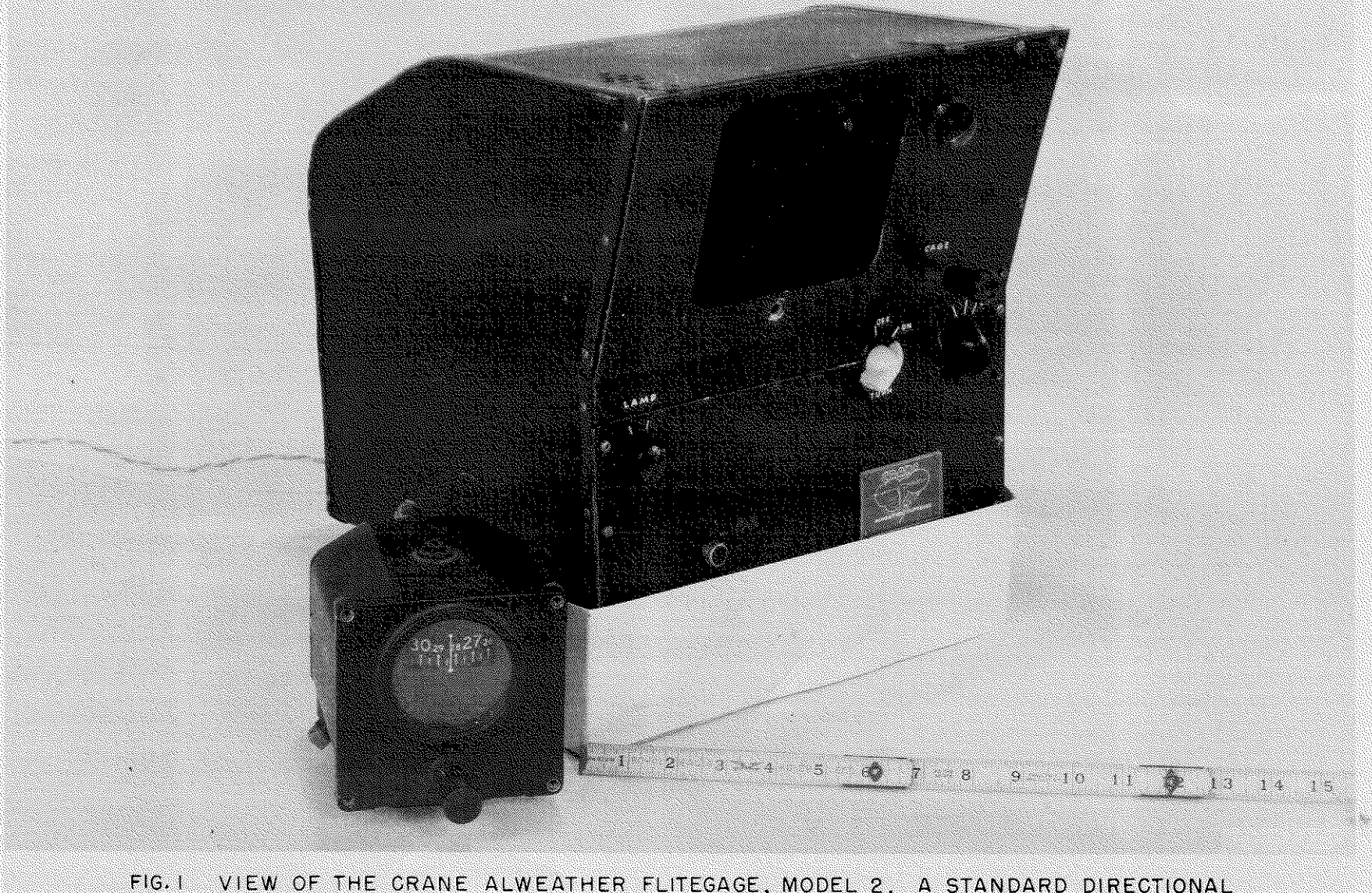
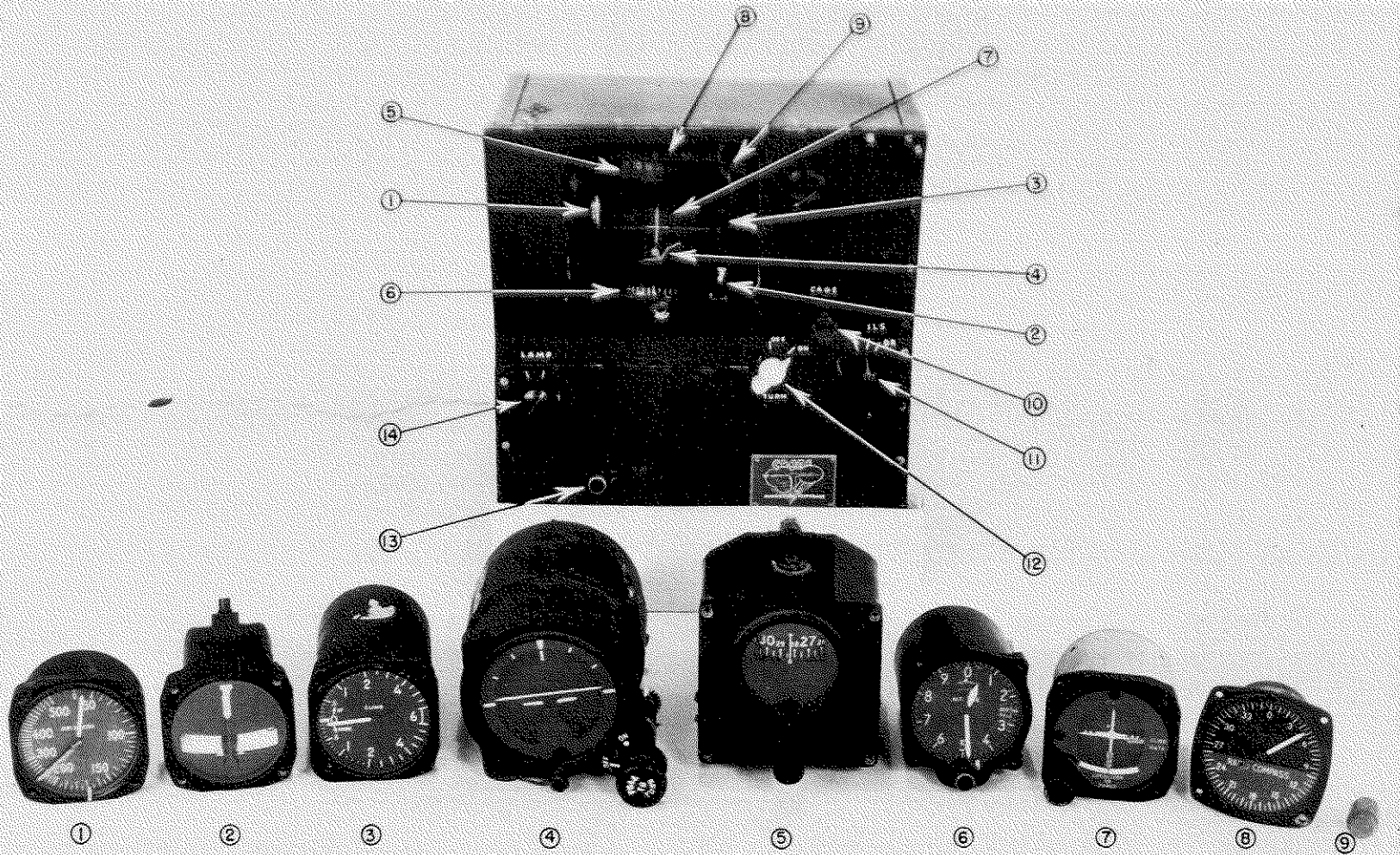


FIG. 1 VIEW OF THE CRANE ALWEATHER FLITEGAGE, MODEL 2. A STANDARD DIRECTIONAL GYRO AND RULE ARE INCLUDED IN THE ILLUSTRATION FOR COMPARATIVE PURPOSES.



① AIR SPEED INDICATOR
② TURN INDICATOR
③ VERTICAL SPEED INDICATOR
④ HORIZON
⑤ DIRECTIONAL GYRO
⑥ ALTIMETER
⑦ COURSE INDICATOR
⑧ RADIO COMPASS ADF INDICATOR
⑨ MARKER LIGHT
⑩ DIRECTIONAL GYRO GAGING DEVICE
⑪ COURSE DEVIATION INDICATOR SELECTOR SWITCH
⑫ ELECTRONIC TURN INDICATOR SWITCH
⑬ ALTIMETER RESET CONTROL
⑭ LAMP CONTROL

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FIG. 2 COMPARATIVE VIEW OF THE CRANE ALWEATHER FLITEGAGE, MODEL 2, AND THE STANDARD INSTRUMENTS WHICH IT COMBINES INTO ONE UNIT.

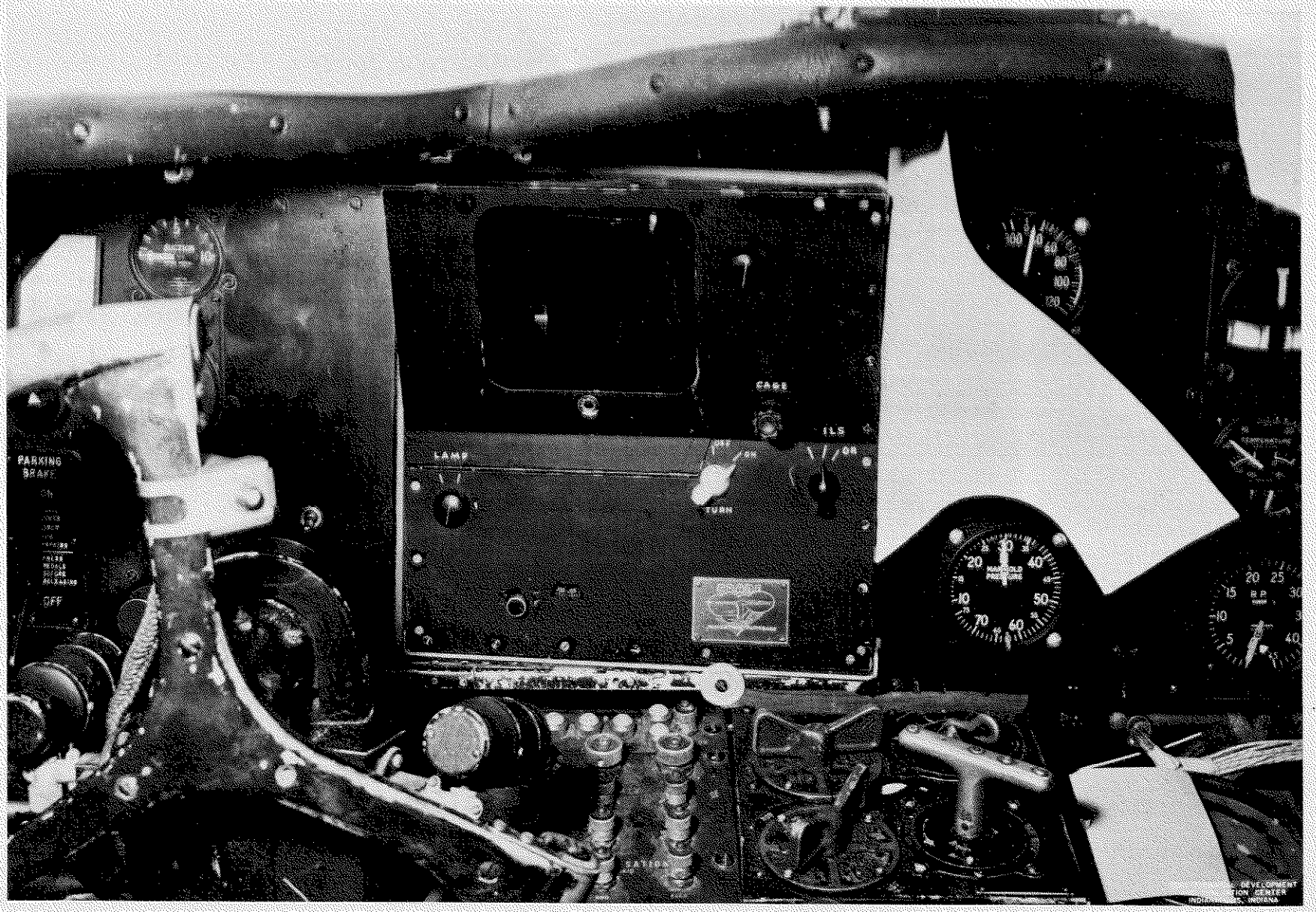
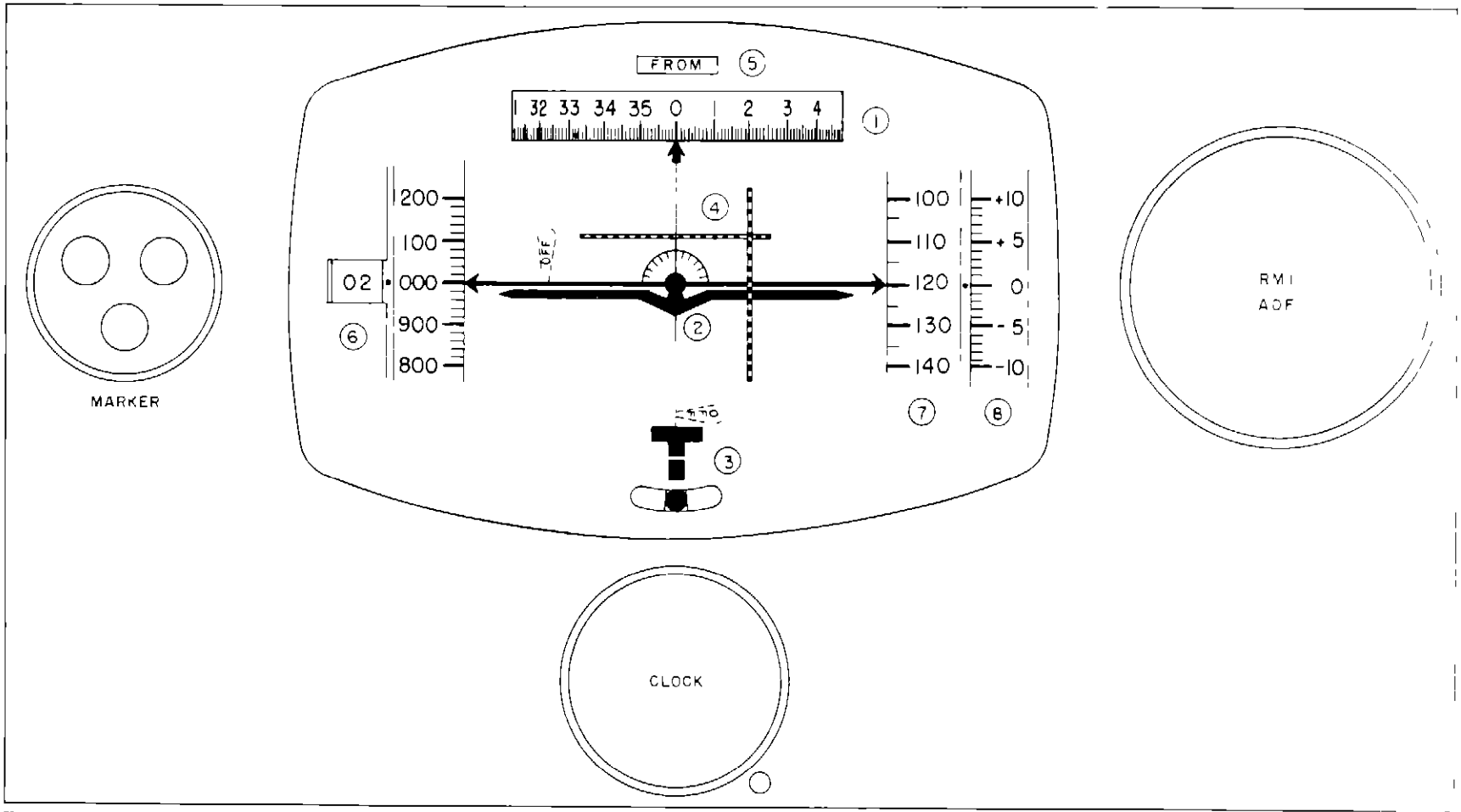


FIG. 3 CRANE ALWEATHER FLITEGAGE, MODEL 2, INSTALLED IN BOEING 247D AIRPLANE, N II. PAPER SHIELDS ARE IN PLACE TO PREVENT THE PILOTS FROM SEEING STANDARD INSTRUMENTS DURING NORMAL FLIGHT.



(1) DIRECTIONAL GYRO
(2) ATTITUDE INDICATOR
(3) TURN AND BANK INDICATOR
(4) COURSE DEVIATION INDICATOR WITH FLAG ALARM
(5) TO-FROM INDICATOR
(6) ALTIMETER
(7) AIR SPEED INDICATOR
(8) VERTICAL SPEED INDICATOR

FIG 4 A SUGGESTED MODIFICATION OF THE CRANE ALWEATHER FLITEGAGE