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A TRAINING AID FOR THE AZIMUTH TIME RECORDER

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OTTAWA

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ABSTRACT

A small unit is described which employs the standard Selective Identification Feature replies to a ground search radar to provide jamming simulation to the Azimuth Time Recorder. A parallel video output also provides jamming strobes for use with the PPI's, so that controllers can receive realistic training in tactics involving radar jamming strobes and position information supplied by a triangulation center.

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FIGURE

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A TRAINING AID FOR THE AZIMUTH TIME RECORDER

- F.R. Hunt -

INTRODUCTION

Extensive training of operators is required in order to obtain optimum results with any radar system. This is especially true with respect to a jammed radar system where passive triangulation may have to be employed. The National Research Council felt that operator training was extremely desirable, and therefore has developed a simple piece of equipment which employs standard aircraft Selective Identification Feature (SIF) replies to provide jamming simulation for the Azimuth Time Recorders (ATR) [1].

In training operations, each ground radar station taking part would employ one of the Training Simulators. The Simulator accepts the video output of the SIF decoder, KY-5008/GPA-501. All of the jamming-force aircraft would employ the same SIF code, while the defending aircraft would employ any of the other SIF codes. The Simulator provides an output pulse suitable for the Azimuth Time Recorder whenever an SIF reply is received from an attacking aircraft. At the same time, by the addition of four tubes to the Simulator, video jamming signals can be provided suitable for display on the Plan 12 Indicators. These signals would be available at the indicator on the same basis as, say, video mapping; i.e., they can be switched off at will. The controllers using these PPI's during an exercise would also be provided with normal radar skin paints and SIF replies from the defending aircraft; i.e., they would have a typical jammed PPI display. The officer charged with the safety of the aircraft during the exercise would, at all times, be provided with the SIF replies of both attacking and defending aircraft, as well as their radar skin paints on an indicator free from video jamming. It should be noted that since this jamming of radar PPI's is by video means, no training is provided ECCM officers, since the FPS-508 receiver system is not affected by the jamming.

CIRCUIT DESCRIPTION

The schematic diagram of the Simulator appears in Fig. 1.

The SIF video pulse from the decoder is amplified by V1A and trips a multivibrator V2 whose output pulse width is about 200 microseconds. This corresponds to the total pulse width of four gates from the ATR receiver. The output of this multivibrator turns on the gate tube, V6. The radar master trigger is amplified by V1B, and trips multivibrator V3 whose output pulse width is variable up to 700 microseconds. This pulse blocks gate tube V6. An output pulse is produced by this gate tube when both multivibrators have turned it on. The purpose of the radar trigger multivibrator and gate tube is to eliminate any output due to an aircraft flying close to the radar station where SIF replies may be received on all azimuths of the antenna. It also eliminates false outputs from spurious pulses picked up on the SIF video cable owing to crosstalk with other cables carrying radar and SIF transmitter pulses. The output of the gate tube is inverted (V10A) and fed through a cathode follower (V10B) to the ATR.

If video jamming strobes for the PPI displays are required, the signal from V10A is used to trip multivibrator V9. The output pulse width of this multivibrator is about 6000 microseconds; i.e., at least twice the radar interpulse period in case SIF interlace is used. The output of V9 turns on the second gate, V11. A free-running multivibrator, V12, also turns on the gate at a 100 kc/s rate. Thus, whenever a pulse is fed to the ATR, a burst of 100 kc/s square waves is produced. This burst is inverted (V13A) and fed to the PPI's by a cathode follower, V13B. The appearance on the indicators is in the form of a jamming strobe of noise-like characteristics.

A simple regulated power supply furnishes plate, bias, and filament voltages for the Simulator. Approximate dimensions of the cabinet are 13" × 9" × 9".

METHOD OF USE

The necessary cable connections to the radar, ATR, and SIF equipment are self-evident from the schematic diagram. The "Delay" control on the radar trigger multivibrator is set to a value where the delay equals the range at which SIF paints become circles, plus 200 microseconds. The "Video Gain" is set at a point where an ATR output is obtained for every correct SIF return. The "ATR Output" control is set for a 1-volt pulse output. The "PPI Output" is set for a 2-volt output level. The "Signal Level" control of the ATR unit is adjusted for suitable printing, and the PPI video gain control is adjusted for maximum jamming level.

RESULTS

Typical PPI photographs of the input and output waveforms of the Simulator are shown in Plate I. Each frame, whose number appears on the photograph, was taken at 12-second intervals. The range displayed is approximately 95 miles. The unsynchronized ATR pulses appearing in C are due to the SIF of the aircraft being triggered by other radars. The heavy spiral lines of A and D are the transmitter pulses of a nearby unsynchronized radar.

Plate II is a photograph of a typical Azimuth Time Recorder chart made a few minutes after the photographs of Plate I were taken.

Plate III is a photograph of the actual unit. The "PPI Output" and "ATR Output" controls are mounted inside the cabinet since they require readjustment only when new tubes are installed.

CONCLUSIONS

The unit described has been fully tested on an AN/TPS-1D radar fitted with Mark X IFF and an Azimuth Time Recorder, and satisfactory operation was obtained. The Simulator was later tested at RCAF Station Lac St. Denis where SIF was available. Satisfactory performance was obtained on both the ATR and PPI. Because of slight differences between the RCAF and NRC models of the ATR and PPI, minor modifications have subsequently been made to the Simulator to provide improved performance at RCAF sites. It is expected that the RCAF may provide Simulators at all of the sites where the Azimuth Time Recorder is fitted.

REFERENCE

1. "Azimuth Time Recorder", National Research Council, Radio and Electrical Engineering Division, Classified Progress Report, No. 11, January 1958 (p. 6), and subsequent reports

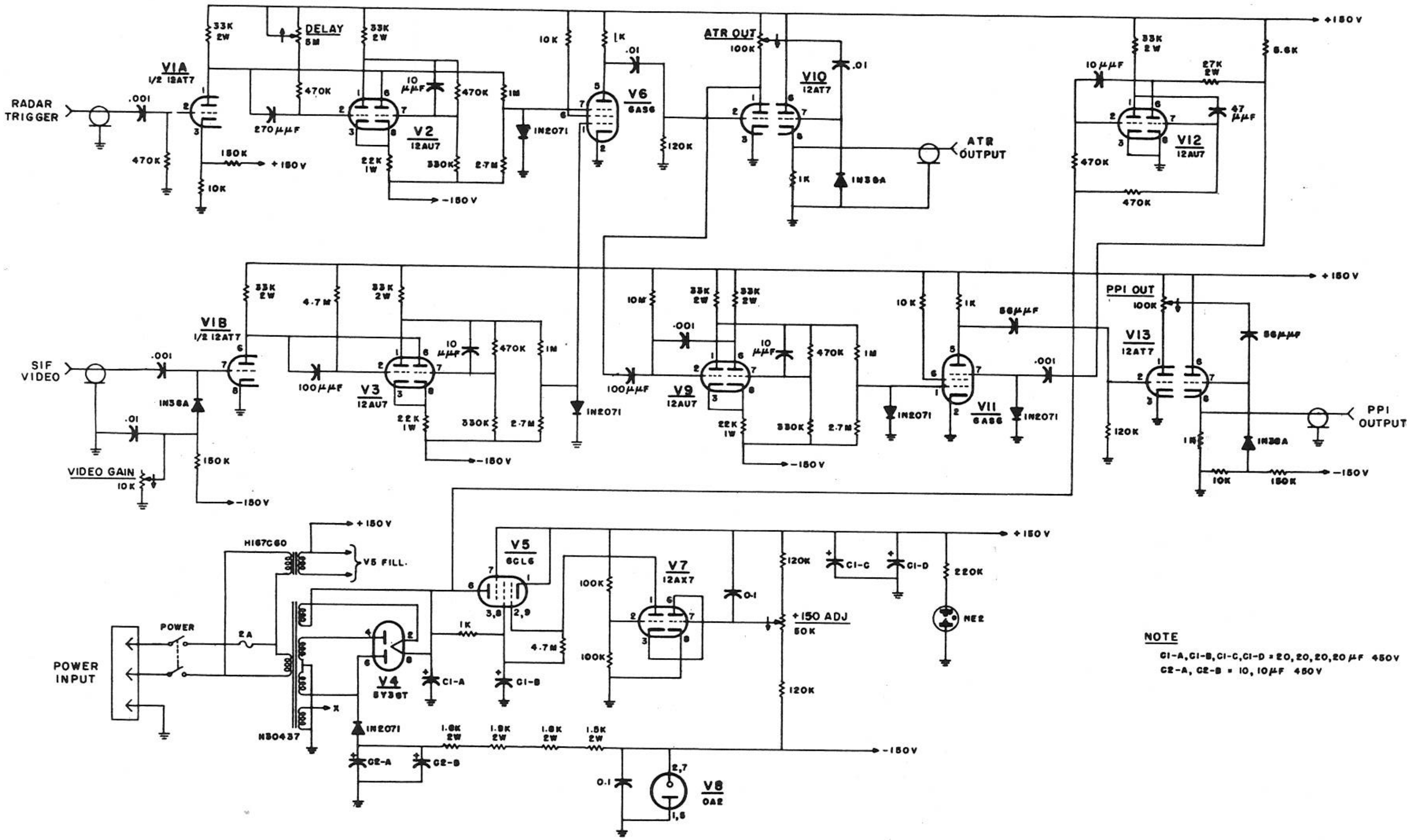
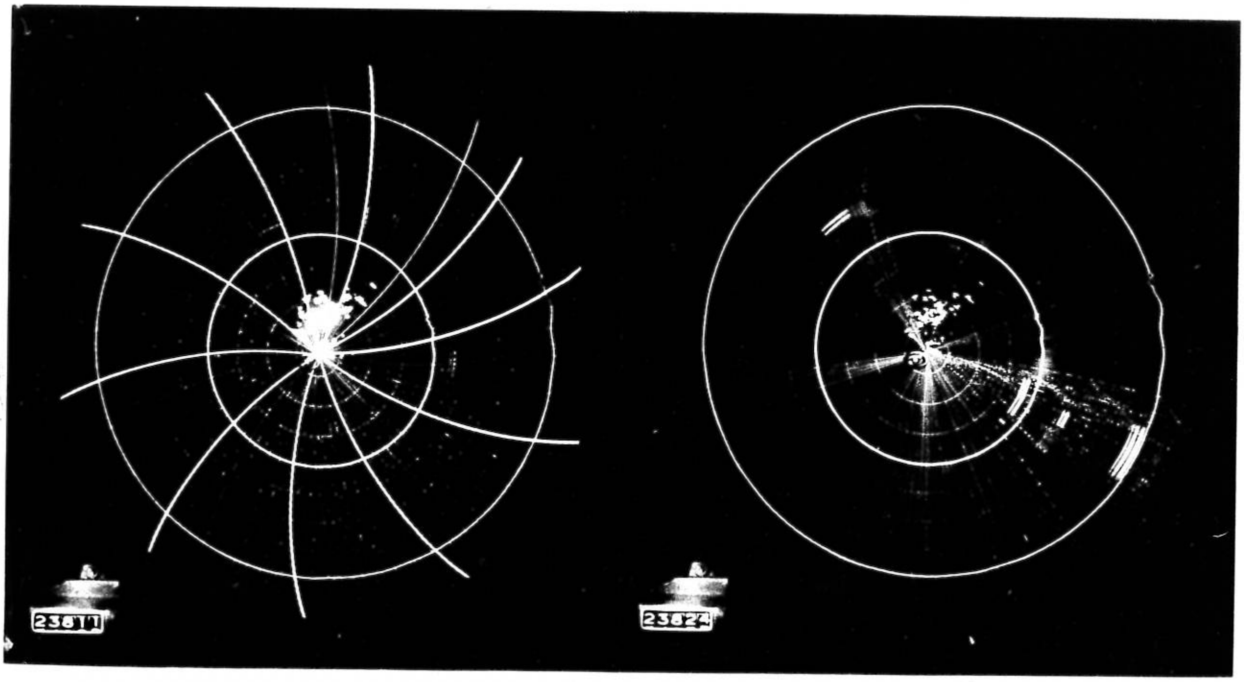
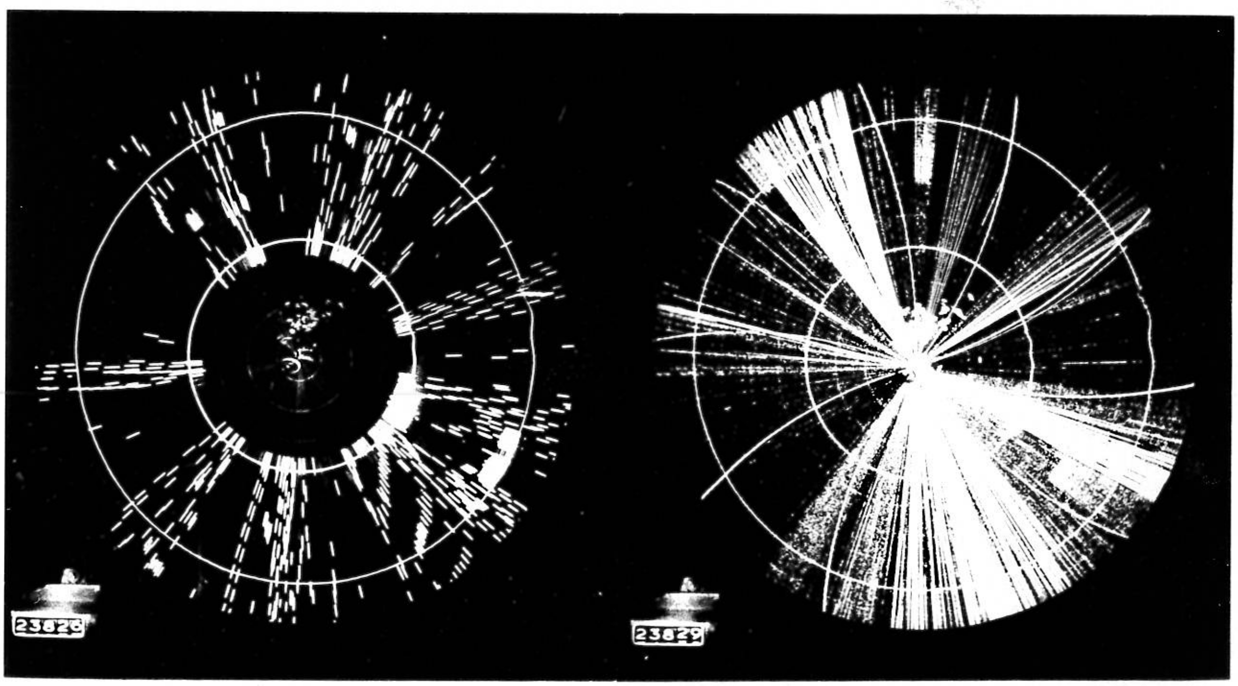


FIG. 1 SCHEMATIC DIAGRAM



A. AN/TPS-1D RADAR VIDEO

B. MIXED RADAR AND MARK X IFF VIDEO



C. SIMULATOR ATR OUTPUT

D. MIXED RADAR AND SIMULATOR PPI OUTPUT

PLATE I — PPI PHOTOGRAPHS OF SIF JAMMING SIMULATOR

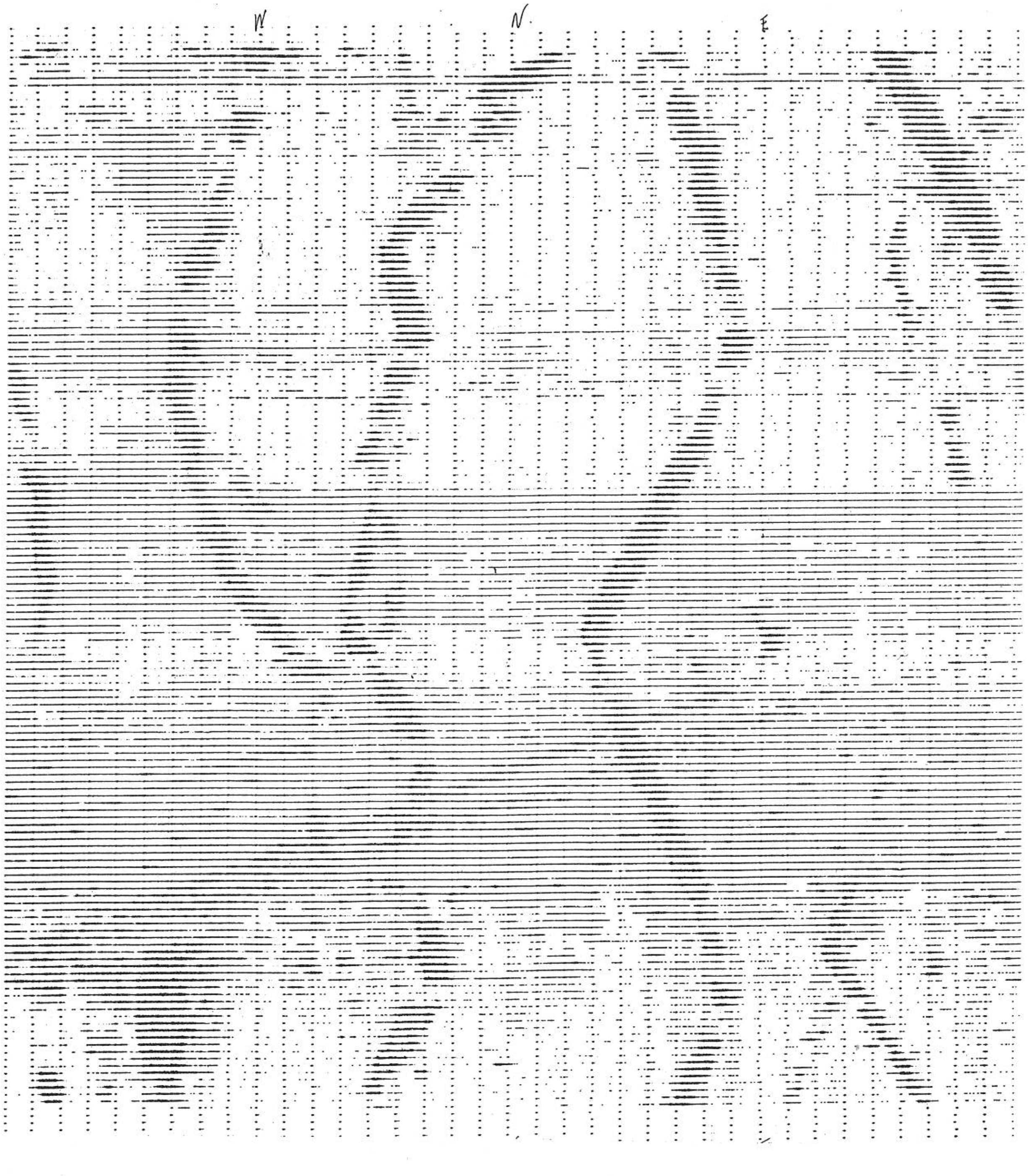


PLATE II — AZIMUTH TIME RECORDER — CHART

PLATE III — JAMMING SIMULATOR