



Automatic control for radio range simulator in instrument flight trainer
by William R Jeffries

A THESIS Submitted to the Graduate Committee in partial fulfillment of the requirements for the degree of Master of Science in Mechanical Engineering
Montana State University
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Abstract:

This report presents a description of the device designed and built by the writer to permit automatic operation of the radio range system of an instrument flight trainer. Many other principles of operation were seriously considered and discarded before the method herein described was finally conceived.

Included are electrical and mechanical drawings which, with the associated text, describe the principle of operation and the physical and electrical details of the model.

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IN INSTRUMENT FLIGHT TRAINER

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WILLIAM R. JEFFRIES

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G. J. Graduate Committee

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INTRODUCTION

The following discussion is a complete and detailed description of an automatic simulated radio range control system for instrument flight trainers. While the specifications shown are for one specific model (late type C-3, Link Trainer) the principles of design could readily be applied to an automatic range system for any other instrument flight trainer.

The problem of designing this device was first suggested as a research topic for the writer by Professor T. J. Zilka in 1946. It was felt that a definite need existed for such a device because of the fact that at least two companies were then in the process of attempting its development. Since that time Link Aviation, Inc. has placed on the market a new model trainer which incorporates an automatic range. Only a small amount of information is available concerning the new model but it apparently utilizes ultra-high frequency transmission of range signals from an antenna array mounted directly above the range station to a receiving antenna mounted on the "bug", or recorder. A separate antenna array must be mounted for each different range configuration and, there is apparently no provision for fan-marker signals. Diameter of the "cone of silence" does not change with altitude and there is some static introduced into the signal during transmission.

There is also on the market a completely electronic instrument trainer manufactured by Diehmel which incorporates an

automatic range system. However, no details of any kind are available concerning it.

The design herein described differs very greatly from that used by Link. It is believed to be simpler, more easily maintained, less expensive to manufacture and more readily set up for range problems. Different range configurations are effected by means of adjustments of the main potentiometer, adjustments which can easily be made in a few minutes. Because there is no wireless transmission of the signal there is no distracting static in the tones heard by the student.

Actual research was begun on the project Fall Quarter 1947 and continued through Summer Quarter 1948, the date of completion and submission of this report. Professor Zilka left Montana State College in September 1947 so the research has been largely independent of direct supervision though some valuable advice on technical details has been received from other staff members of the Engineering Division.

INSTRUMENT FLIGHT TRAINERS

Before attempting to describe the details of design involved, it will be well to treat briefly the background of instrument flight trainers.

When air travel by powered heavier-than-air craft was in its infancy, pilots flew by "contact flight", using visible landmarks to guide them over their routes. During inclement weather, or when fog obscured the ground, it was very difficult to fly cross-country with any reasonable assurance of arriving at the desired destination. A multitude of measuring instruments has now been developed, however, and a well trained pilot can fly several thousand miles without seeing the earth, except, of course, for those times when he lands for refueling, and arrive safely at a predetermined airport. It is not the purpose of this paper to describe in detail those modern flight instruments which make such feats commonplace; however, one of them, the "aircraft radio range receiver" with its associated ground installation, the "radio range system" is important to our discussion and will be explained now.

The black dot in the center of Fig. 1 represents a radio transmitter located on the ground. This transmitter broadcasts continuously, sending out the two letters "A" and "N", in code, in different directions. We shall not here be concerned with anything except the effect achieved by this peculiar form of broadcasting. A radio receiver mounted in an airplane at point

