AN OMNIRANGE RECEIVER TEST SYSTEM

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SUMMARY

This report describes a system for testing the calibration accuracy of aircraft VOR receiving equipment either in flight or on the ground Standard omnitest signals having a simulated bearing of 0° FROM or 180° TO the station are transmitted in all directions The accuracy of these bearings is ± 0 25° To utilize these standard transmissions the pilot compares the known bearing of the simulated signal with the setting of the omnibearing selector of the air-borne equipment when the deviation indicator is centered

INTRODUCTION

As a result of a suggestion by the Aircraft Radio Equipment Committee of Aeronautical Radio, Inc , in April 1949, the development of an operational calibration check of VOR receivers was initiated at the Civil Aeronautics Administration Technical Development and Evaluation Center, Indianapolis, Indiana It was considered advisable by the Committee to provide a rapid, accurate check of equipment that the pilot might use, either while in flight or before take-off, without requiring the services of a technician and extensive laboratory equipment The system described in this report has a high degree of accuracy, is easy to use, and has shown excellent reliability

THEORY OF OPERATION

In the VOR system a 30-cps signal, the phase of which is made to vary with azimuth, is compared with a reference signal (also 30 cps) of constant phase at all bearings. Zero-phase difference occurs at magnetic north

The basic concept of the omnitest system differs from the omnirange in that the two 30-cps signals are fixed in phase with respect to each other, and neither signal varies in phase with azimuth This means that the indications of the air-borne receiving equipment will be the same at all relative bearings between the aircraft and the ground station, and the accuracy of calibration of this receiving equipment can be checked by simply tuning to this transmission

The plan was to adjust the two 30-cps signals to be exactly in phase with each other, so that receivers designed to give TO bearing indications would read 180° on the omnibearing indicator, and those receivers designed to read FROM bearings would read 0° when tuned to the omnitest transmission

In this development a standard VOR goniometer is employed to provide the modulation frequencies for a Type TUQ VHF transmitter

Fig 1 is a block diagram of the system The 9 96-kc FM signal generated by the tone wheel of the goniometer is fed to the modulator section of the transmitter, and the modulated rf energy is sent directly to the input circuit of a Type CA-1292 modulation eliminator. Two outputs are provided from the eliminator, one of these consists of modulated rf energy which is fed to a junction of the isolation bridge,[1] and the other is demodulated rf energy which is taken directly to the goniometer [2] One output of the goniometer is connected to a dummy load, while the other output is connected to a junction of the bridge opposite the one to which modulated rf energy is fed The antenna is connected to one of the remaining junctions of the bridge, while the opposite side is terminated in a dummy load.

The antenna first used in these tests was a horizontally polarized CAA VOR-type loop, but a CAA Type 1350 circularly polarized antenna was later substituted with somewhat better distance range

Fig 2 shows the method of connecting the 9 96-kc signal from the tone wheel of the goniometer to the audio system of the transmitter Feeding this signal at a stage other than the voice input was necessitated by clippers and filters in the speech amplifiers of this particular transmitter Modulation levels for both the 9 96-kc FM signal

[1]McCormick, Raymond E , Kennard E Voyles, and Blanchard H Boyle, "Combined Tone and Phase Comparison Localizer Facility," Technical Development Report No 103, February 1950

[2]Hurley, H C , S R Anderson, and H F Keary, "The CAA Omnirange," Technical Development Report No 113, June 1950

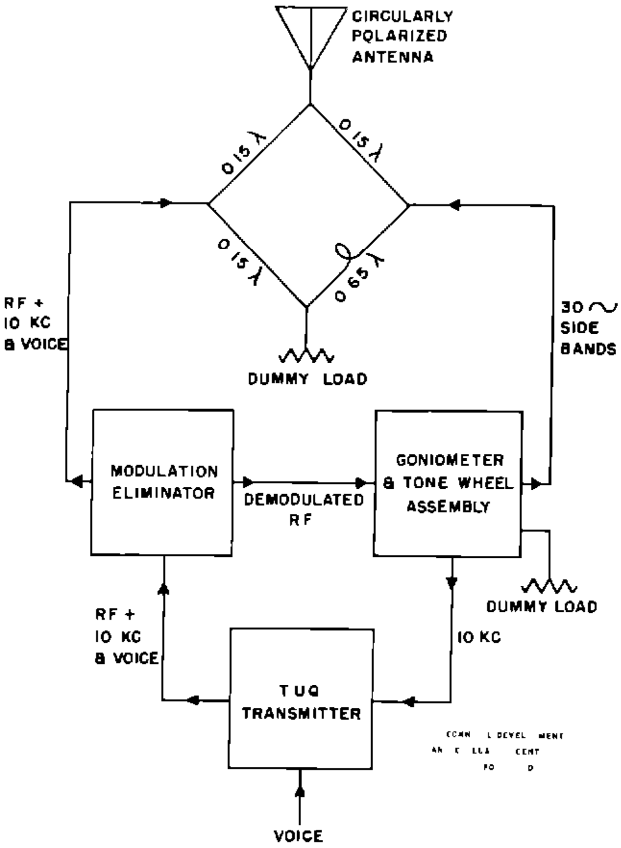

Fig 1 Block Diagram of Omnitest System

and the 30-cps signal from the goniometer were set at 30 per cent Since this is the standard omnirange modulation percentage, the omnitest signals can also be used to test receiver deviation sensitivity Fig 3 shows the complete equipment

In addition to the system finally selected, several other methods of modulating the transmitter with the 30-cps signal were tested The goniometer modulation of rf output proved superior because it eliminated the problem of phase instability with plate circuit tuning

TEST RESULTS

To determine the accuracy and reliability of the omnitest system under varying conditions of temperature, humidity, and line-voltage fluctuations, tests covering a period of approximately one year were conducted During this period the simulated course provided by the equipment was compared daily with signals from a Collins Type 479-S navigation receiver test set Maximum deviations did not exceed ± 0.25° under any conditions encountered during the tests, nor did tube substitution or changes in plate loading and antenna coupling adversely affect the accuracy of the standard signal

Flight tests showed that the service range of the equipment is approximately equivalent to that of a conventional omnirange Voice modulation from the control tower was

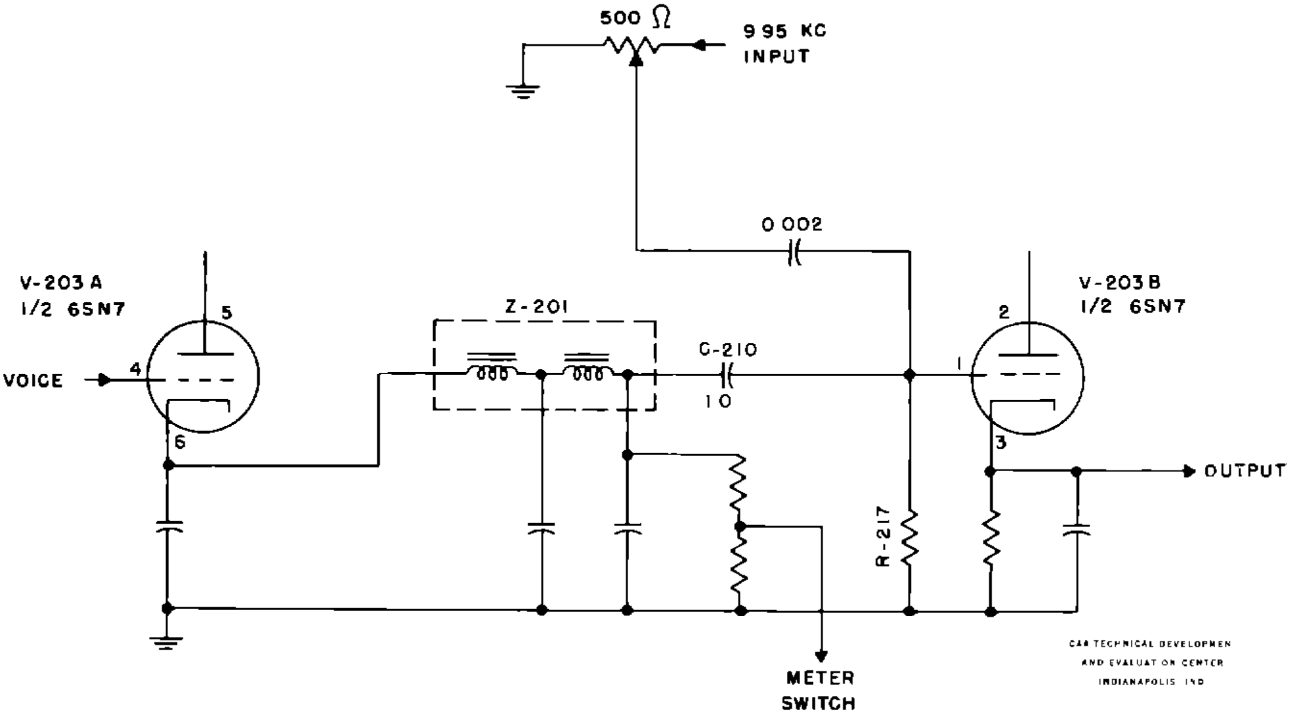

Fig 2 Method of Feeding 9 96 KC Signal Into Speech Amplifier of TUQ Transmitter

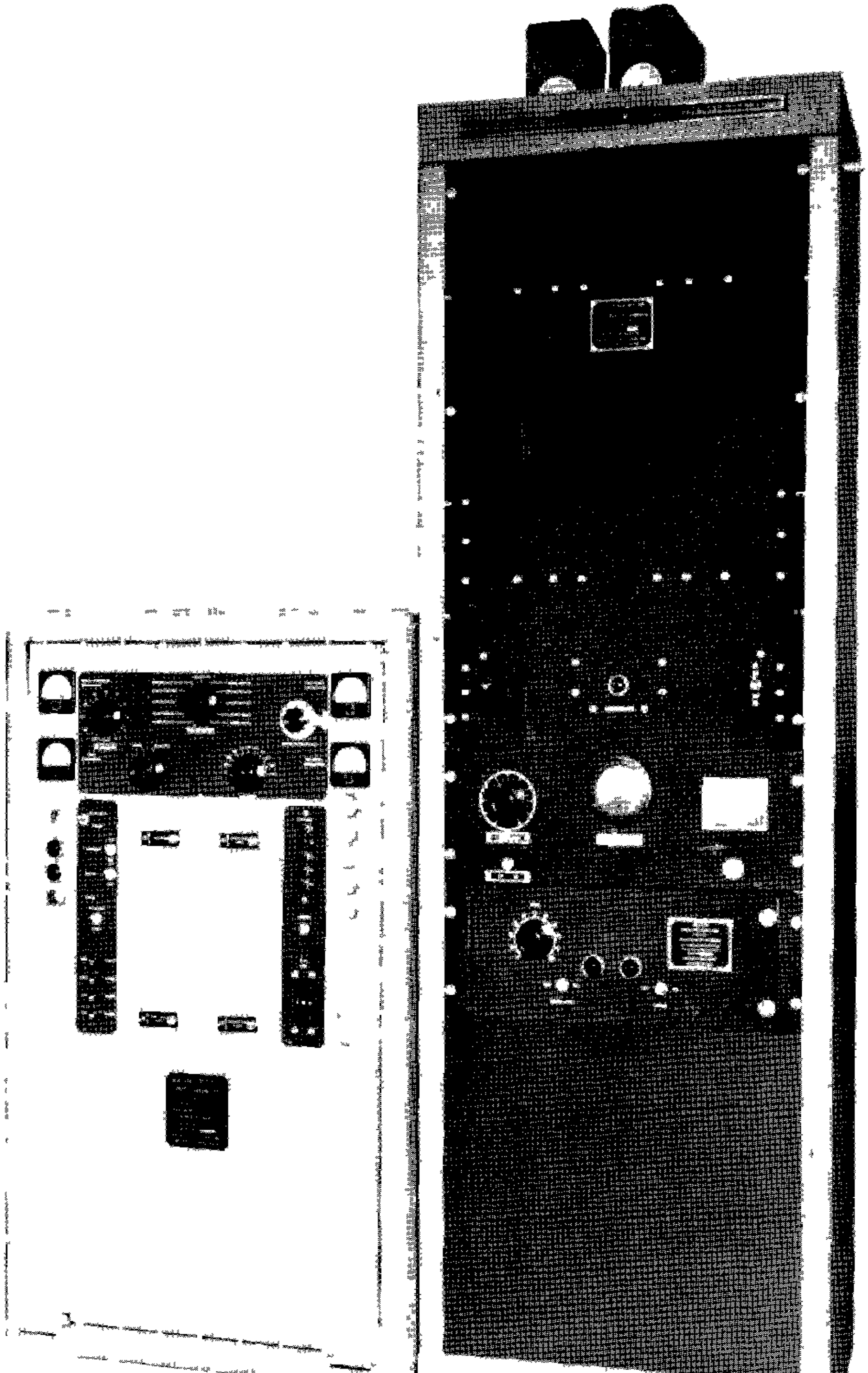

Fig 3 Experimental Omnitest Equipment

provided simultaneously with the test signal and proved to be of excellent quality The voice level was adjusted to produce 40 per cent modulation of the carrier

As a result of the tests conducted at Indianapolis, experimental installations were made at the Municipal Airport, Kansas City, Mo , Midway Airport, Chicago, Ill , and La Guardia Airport, New York, N Y The monitoring equipment at these locations was adjusted to provide an alarm and automatic shutdown in the event of a course shift of ± 1° After a year of experimental operation, very favorable reports on the accuracy and usefulness of the system have been received

CONCLUSIONS

It is concluded that a satisfactory omnitest system having a high degree of accuracy and reliability, and which is simple to use, has been developed

The goniometer method of providing modulations for an omnitest signal was found to be the most desirable, among several methods tested, because of its stability and accuracy

Simultaneous voice modulation of 40 per cent is available if desired, since the total percentage of modulation required for the omnitest signal does not exceed 60 per cent

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