INVESTIGATION OF SECOND HARMONIC INTERFERENCE FROM STATION W9XZV ON CHICAGO LOCALIZER AND OMNI RANGE FREQUENCIES

By

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SUMMARY

On February 9, 1947, flight tests were made over the city of Chicago, Illinois to search for interference from television and FM stations on frequencies assigned to the Chicago omni radio range, the South Bend omni range, and the Chicago localizer

No evidence of interference from Television Station W9XZV was found. During tests on the South Bend omni radio range, frequency of 112 3 megacycles, a slight amount of interference was encountered The origin of the interference was not determined, but it was believed due to an FM station operating at the same frequency as the image frequency of the South Bend omni range

No changes in localizer course indications or clearances could be observed whether or not the television station was operating

No second harmonic radiation from W9XZV could be detected by a Hallicrafter AM/FM receiver between 108 and 120 megacycles.

INTRODUCTION

Flight tests of approximately seven hours duration were made over the Chicago area on February 9, 1947. The purpose of the tests was to search for interference on the following frequencies the Chicago omni radio range frequency of 115 5 megacycles, the South Bend omni radio range frequency of 112 3 megacycles, and the Chicago localizer frequency of 109.9 megacycles If any interference was noticeable, an attempt to determine its origin was to be made with particular attention to the second harmonic of the Zenith Radio Corporation Television Station W9XZV, which operates on Channel 2 (54-60 megacycles) Any interference by FM stations operating in the Chicago area was also to be investigated

Figure 1 is a map of the Chicago area showing the locations of the omni range, the television station and various check points The flight procedure followed in making the tests is given in Appendix I All tests were made at an altitude of 1500 feet above the television station. An omni range azimuth selector setting of 193 degrees was selected which gave a track directly over the television station The track was flown in both directions with the television station on and with the television station off. Continuous recordings were made of the cross-pointer, the omni receiver avc current, and the variable level voltage. Cross-course checks were also flown while over the television station

In an attempt to tune in the South Bend omni range, which was at a distance of approximately 80 miles, the airplane was climbed to 7,000 feet. The identification of the South Bend omni station could be read, but no cross-pointer indication could be obtained since the South Bend omni station had not been converted to 30 cycles and was still operating on 60 cycles The test was not conducted further on the South Bend omni since no cross-pointer indications could be recorded.

During the localizer tests, the cross-pointer indications and the localizer receiver avc current were continuously recorded. The glide path transmitter was not operating on the day of the tests. A circle of five miles radius was flown around the localizer to check the clearance A course-width check was flown at a distance of 15 miles from the localizer transmitter Two approaches were made. A track was flown over a course designated by a line connecting the localizer transmitter, the television station, and continuing north in order to place the television station directly between the localizer transmitter and the aircraft receiver. The tests were first made with the television station off and then repeated during the television broadcasts.

A Hallicrafter AM/FM receiver was used to search for interference between 30 and 150 megacycles, and also to monitor the fundamental of the television station sound carrier, 59.75 megacycles An oscilloscope was connected to the omni receiver to further aid in detecting any distortion or spurious signals The voice channel of the television station was monitored periodically throughout the time the station was on

During the television transmission, the input to the sound final amplifier of the transmitter was 1330 watts and the antenna power meter on the video transmitter read 3.5 kilowatts peak (synchronizing tip) power. Two separate antennas were used, both of which were single bay turnstiles.

RESULTS

Results of the Chicago Omni Range Flight Tests Recordings made with the television station on were compared with recordings made with the television station off. Passage over check points had been noted on the charts in each instance to facilitate such a procedure. From the recordings, the azimuths of the check points were computed from the azimuth selector setting and the deviation of the cross-pointer. The curves shown in Figure 2 were plotted showing the check point azimuths obtained during each test run. For check points located within 15 miles of the omni range station, the curves agree within the observational error For check points over 15 miles from the omni range station, the errors are within the known temperature error of this particular receiver. The temperature error has since been reduced to a negligible degree.

On the particular radial course flown over the Chicago omni range station (azimuth selector setting 193 degrees), an off-course indication of five dots was encountered about four miles north of the omni range station near check point #3. The cross-pointer was off scale for about eight seconds Six passes were made over this point during the tests, and this indication was always present.

The avc current remained fairly constant in the area flown The only important deviations noted were over the omni range station where the current increased about one milliampere and near check point #3 where it increased about 1 5 - 2 milliamperes The deflections were sharp, with that near check point #3 being the sharper of the two.

The variable signal level of the omni receiver stayed at a fairly constant level of about 0.6 volt, except when passing over the omni station and over the spot near check point #3 where the irregularity in the course has been previously noted. Over the station, the variable level increased by a factor of more than two. Over the point close to check point #3, the variable level increased by a factor of approximately 1 7. Attention is called to the fact that the avc current increased, indicating a reduction in signal while the variable level voltage also increased.

Cross-course checks on the omni range were flown while directly over the television station which is 14 miles distant from the omni range station. The recordings show that a given change in azimuth selector setting produced the same variation in the cross-pointer with the television station on as with the television station off.

Results of the South Bend Omni Range Flight Tests The omni range frequency of 112 3 megacycles was monitored with the Hallicrafter receiver. At one time, there seemed to be a slight amount of interference from an FM station. The origin of the interference was not determined because of limited time A review of the frequencies of FM stations in the Chicago area discloses that the frequency of Station WEFM (98.5 megacycles) coincides with the image frequency of the South Bend omni range (112.3 - 13 8 = 98.5 mc). All other FM stations were at least 200 kilocycles removed.

Results of the Chicago Localizer Flight Tests The recordings with the television station on and with the television station off were compared in an endeavor to detect any differences which could be attributed to the presence of the television broadcasts. No differences were observed in the clarance tests nor approaches. In the clearance test, the cross-pointer current when near the television station was

approximately 240 microamperes in each case. On the radial course flown over the localizer and the television station within one mile on either side of the television station, the localizer receiver output fed to the cross-pointer was 185 microamperes in the yellow sector with the television station off. With the television station on, the receiver output was substantially the same The altitude flown was 1800 feet above the ground

CONCLUSIONS

No evidence was obtained which indicated second harmonic interference by Television Station W9XZV on the frequencies of 115.5, 112.3, or 109 9 megacycles which are assigned to airways radio range and instrument landing facilities A further search in the band 108-120 megacycles revealed no interference

There appeared to be some FM interference on the South Bend omni frequency of 112 3 megacycles, but due to previous scheduled arrangements, it was impossible to verify the station identification

APPENDIX I

Flight Procedure Television Station Interference Tests.

Note to Pilots All bearings given are true directions of the desired ground tracks Allowances must be made for the wind conditions encountered

Continuous recordings of the cross-pointer vertical needle will be made. Arrival over landmarks will be noted on the recordings The avc current and the variable phase of the VHF omni range receiver will also be recorded When the localizer tests are in progress, the avc current of the localizer receiver will be recorded.

1. Leave Indianapolis for Wilton Center, Illinois (which is 15 miles northwest of Kankakee, Illinois). This is a location on the extension of a line drawn through the Chicago omni range station and the Zenith Radio Corporation television station, W9XZV, and is approximately 30 miles from the Chicago omni station.

2. Arrive over Wilton Center at an altitude of 1500 feet. Tune in Chicago omni station, channel "Z", identification "CG", and fly by the needle to the station. Approximate azimuth selector setting will be 195 degrees.

3. Continue to fly the same azimuth selector setting to approximately 50 miles north of the Chicago omni station

4. Turn and fly a reciprocal course to 30 miles south of the Chicago omni station (Wilton Center). Approximate true track is 195 degrees.

5. Turn and fly a reciprocal course of approximately 15 degrees true to a point approximately 14 miles north of the Chicago omni station. Locate the Zenith Radio factory and television station

6. Do not change azimuth selector setting. Turn left over the television station and fly a true track of 285 degrees to check the course width Continue this course until a 30-degree azimuth has been covered. Maintain the cross-pointer on scale by resetting the azimuth selector

7. Turn and fly a reciprocal track of 105 degrees Continue to a 30-degree azimuth east of the television station.

8. Turn and fly a reciprocal track of 285 degrees until a 60-degree change in azimuth has been recorded. This will complete the cross-course check on the Chicago omni station

9 Climb to 4,000 feet altitude Tune in the South Bend omni station, channel "U", identification "SN" Set the azimuth selector to 279 degrees and fly the needle to a distance of approximately 30 miles west of the television station

10. Turn and fly a reciprocal track to 30 miles east of the television station True bearing will be approximately 99 degrees It is desired that the flight be made directly over the television station

11 Descend to 1500 feet altitude. Maintain heading until five miles south of the Chicago Municipal Field, tune in localizer, frequency 109.9 megacycles Turn left and fly a five-mile circle around the localizer transmitter to check the clearance

12. Fly out the localizer beam to approximately 15 miles. Approximate magnetic bearing will be 312 degrees. Make a cross-course check Make two approaches. Inbound track will be approximately 132 degrees magnetic.

13 After last approach, circle to the right and return over the localizer transmitter to 1500 feet altitude lined up with the television station Approximate true track desired will be 350 degrees. Fly out ten miles north of the television station. Turn and fly a reciprocal course to the television station Approximate true track will be 170 degrees.

14 After determining the television station to be on, duplicate the preceding tests (Nos 1 - 13).

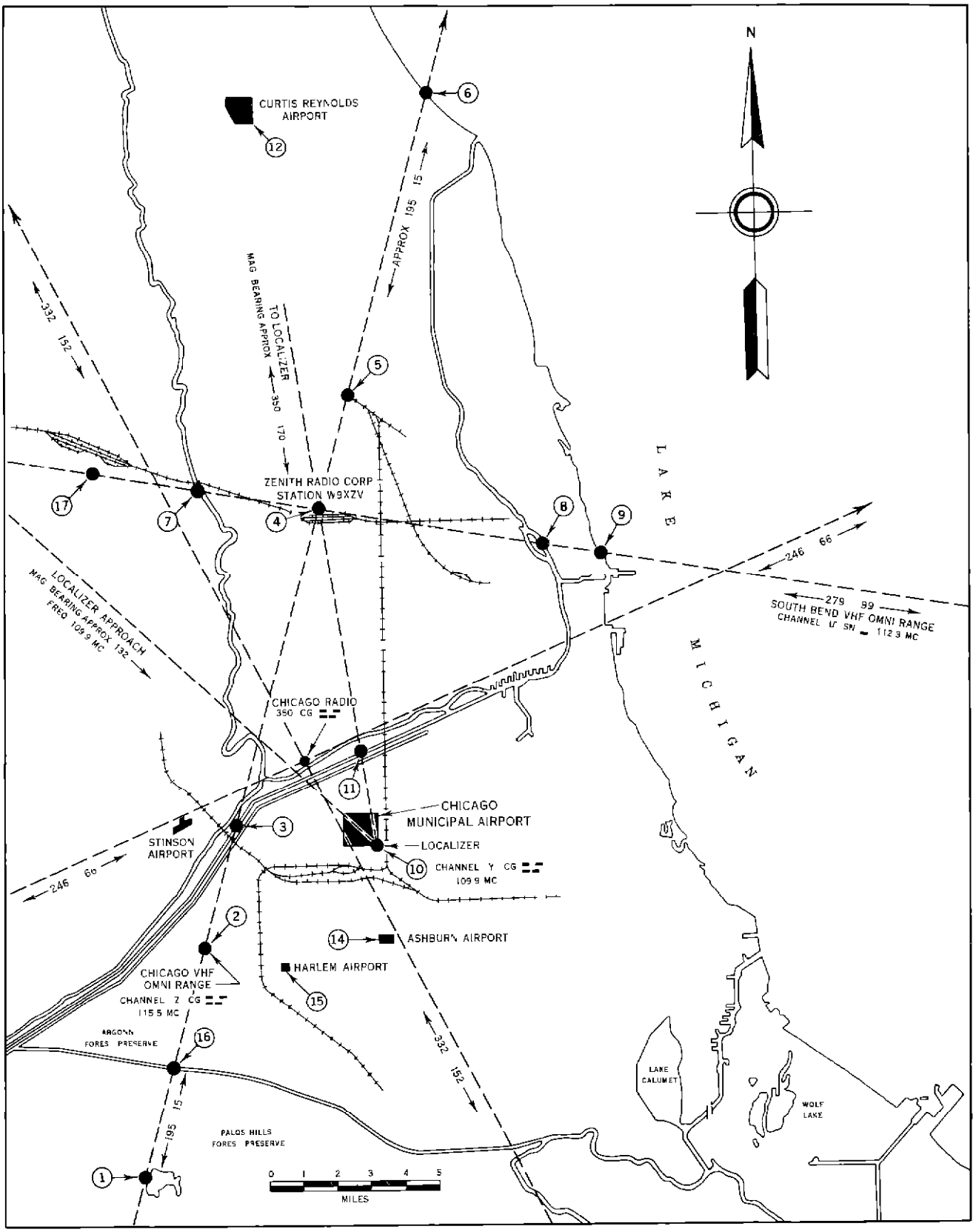

Figure 1 Location of Check Points and Courses Flown

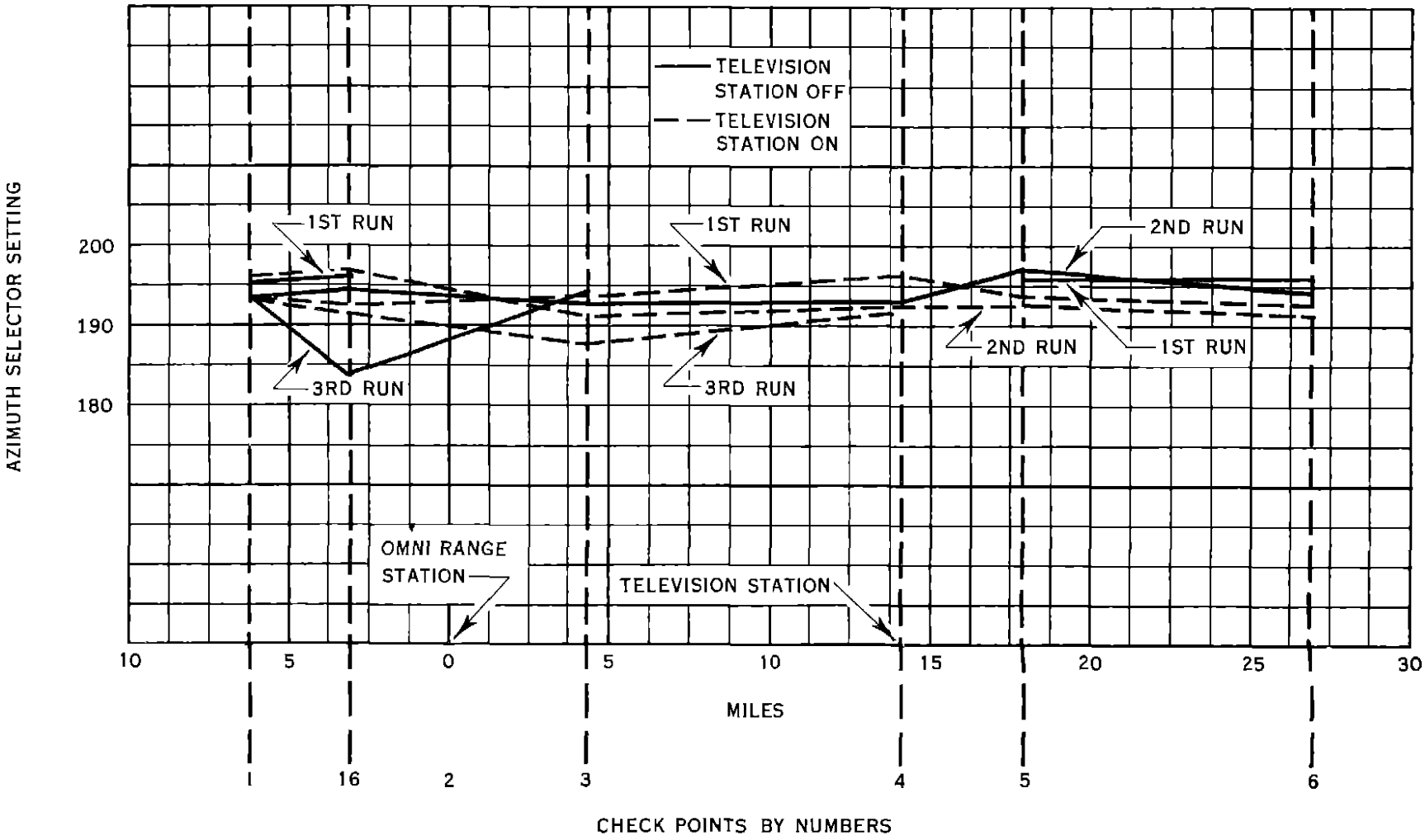

Figure 2 Deviations in Indicated Azimuths for Various Check Points