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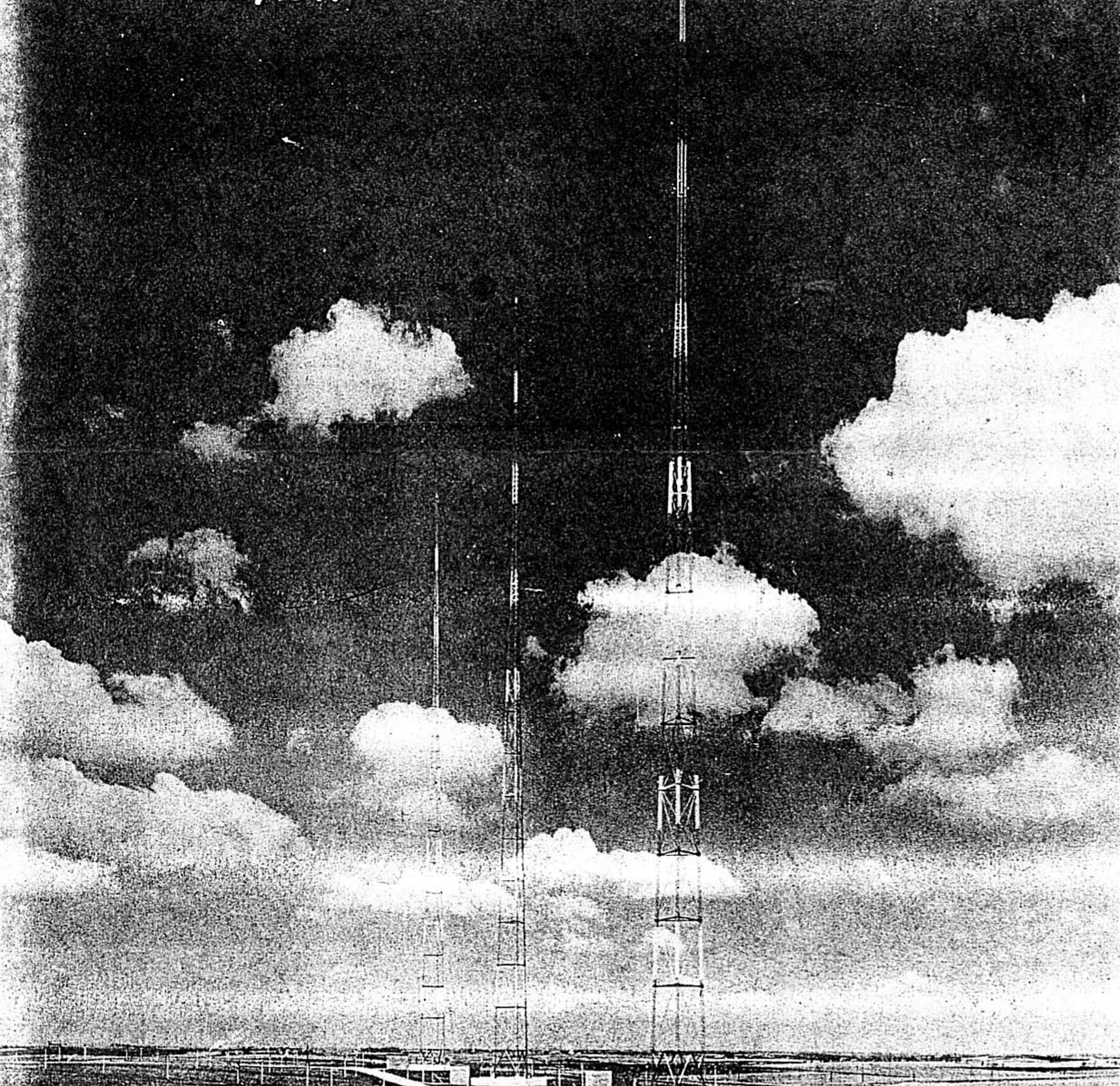

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THE 50,000 WATT VOICE OF KFAB

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Chief Engineer, KFAB Broadcasting Company.

The new 50,000 watt KFAB transmitter is located between Papillion and Fort Crook—about 10 miles southwest of Omaha. This location was chosen after a careful study of the limitations imposed by airports and airlines and the requirement that the best service should be available to a maximum number of listeners during both day and night operation. Accessibility by road, the presence of a good water supply, and the contour of the land were also considerations in the final choice of site. A location between Omaha and Lincoln was necessary so that a strong signal could be supplied to both cities, where local interference levels are high. It could not be too close to any town, or the reception of other stations would be difficult there. Only about a dozen complaints have been received of "blanketing" in nearby receivers, and these have been corrected by improving the shielding of the receiver.

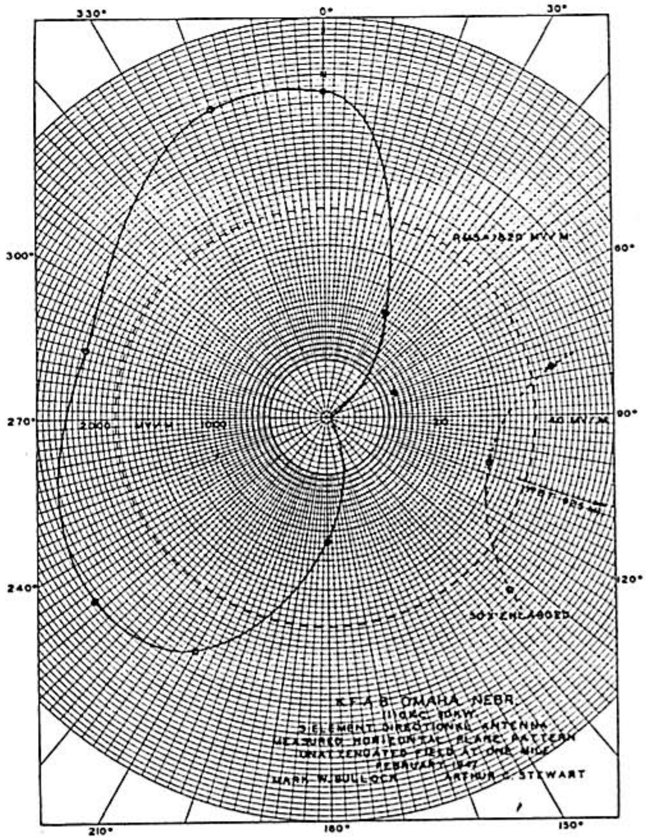
KFAB is now an Omaha radio station, but continues its Lincoln studios for the production of practically all studio programs. A new studio and office building will be built in the near future in Omaha at the corner of 33rd and Farnam Streets.

The "1110" kilocycle frequency assignment makes KFAB a Class 1-B Station, and the entire secondary service is protected from interference from other stations. The KFAB nighttime coverage includes an area within the United States of 1,111,000 square miles and a population of 8,600,000 people. It is thus possible for 6.5% of the entire population of the United States living in 37% of the area to hear KFAB.

To avoid interference between KFAB and WBT, Charlotte, North Carolina, both stations utilize 3-element directional antenna systems. Half-wave self-supporting towers are used by KFAB, and each tower is 440 feet high. The towers are in a line at a true bearing of 106°. The line of towers points very nearly toward WBT and is oriented to give maximum protection to the WBT secondary service area.

ADJUSTMENT OF ANTENNA IS MAJOR PROBLEM

The adjustment of the directional antenna array was the major engineering problem which had to be solved before the new transmitter could be put on the air. The proper phase relationships between currents in the three towers and the exact power distribution necessary to obtain the theoretical field pattern were obtained after much preliminary work. Non-directional field intensity measurements were taken on 8 radials from the transmitter to a distance of about 20 miles. These measurements established the average ground conductivity in each direction and the unattenuated field intensity at one mile from the standard curves of the Federal Communications Commission. Current sampling loops were installed ¼-wave length from the top of each tower and connected to a phase monitor in the transmitter building by RG8/U coaxial cable. As the towers were erected and tune-up procedure started before the transmitter had been received, a 250-watt transmitter was purchased and used as a source of power for the preliminary measurements. The towers were then fed in pairs and field intensity measurements taken in a circular pattern so that the resultant nulls could be found and the phase monitor calibration be established.



KFAB plane pattern measured horizontally.

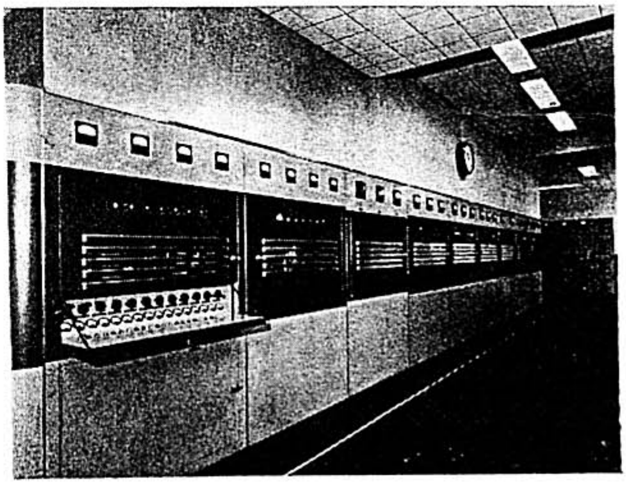
The electrical lengths of the coaxial sampling lines were determined by radio-frequency bridge measurements over a wide range of frequencies, with the lines both open and shorted. The data thus obtained was plotted, and the frequency at which the open-end impedance and the shorted-end impedance were equal was found; since this frequency is that at which the line is an odd number of ⅛-wave lengths long, the electrical length and velocity of propagation in the cable were determined. The Western Electric 1-A Phase Monitor readings, when corrected for the length of sampling lines, agreed very closely with the calibration obtained from the 2-tower patterns. It was then known within very close limits what the phase monitor readings should be for the final adjustment of the 3-tower pattern.

The adjustment of the phasing gear and antenna matching equipment to give these desired readings proved to be a very tedious process. By the time these adjustments had been roughly established, the 50 kw transmitter had been received and installed. Non-directional daytime operation from the new transmitter was started December 25, 1946. Non-directional field intensity measurements prevoiusly taken with low power were then checked at full power. The 50 kw transmitter was used with reduced plate voltage to supply power to the directional antenna for its final adjustment. Since this adjustment had to be proven by field strength readings, monitor points were selected in the directions of greatest protection, and telephone lines were installed for communication between these points and the transmitter. The reports from the men at these check points were received on a loudspeaker, and a technique was developed for fine adjustments in the phasing equipment to give the desired field strengths at these points. The rest of the directional pattern was not greatly affected by the minute changes in phase and amplitude which gave the desired protection toward WBT.

It was necessary to keep the impedances at the base of the towers closely matched so that the transmission lines would be properly terminated, and, since changes in the terminal equipment gave considerable changes in current distribution in the towers, it required great diligence to complete all adjustments. The common point input impedance was adjusted so that it had no reactive component, and measurements were taken with a radio-frequency bridge over a range of frequencies to establish the resistance value used for direct-power measurement. When the adjustments were completed, field intensity measurements were repeated on the 8 radials previously measured and an average field intensity in each direction thus established for directional operation.

The FCC requires that an engineering report for proof of performance be prepared showing in detail all measurements taken and all procedure followed in adjusting the antenna system. Our report comprised 86 pages, not including the maps which showed where all measurements were taken. All of the work on the proof of performance and the final adjustment of the antenna system was done between December 25, 1946 and February 25, 1947, when full-time operation was authorized by the FCC. This work is normally performed by a consulting engineer, but, since both Arthur C. Stewart, the transmitter supervisor, and the author had previous experience in the adjustment of directional antennas, the KFAB installation was completed by them.

The KFAB transmitter was the first 50 kw installation completed since the war. It was built by Westinghouse and incorporates many advanced ideas. All transformer components are of the dry type and are further improved by the use of hypersil cores and fosterite insulation. This brings about a considerable saving in space and weight as well as a great reduction in maintenance problems. Metallic rectifiers are employed in all except the 10,500 volt rectifier, and in this rectifier provision is made for instantly switching in a spare tube to replace any that might fail. All tubes are air-



KFAB Westinghouse 50 kw Transmitter with Westinghouse Metal Clad Switchgear in background.
(Credit—W. S. Craig)

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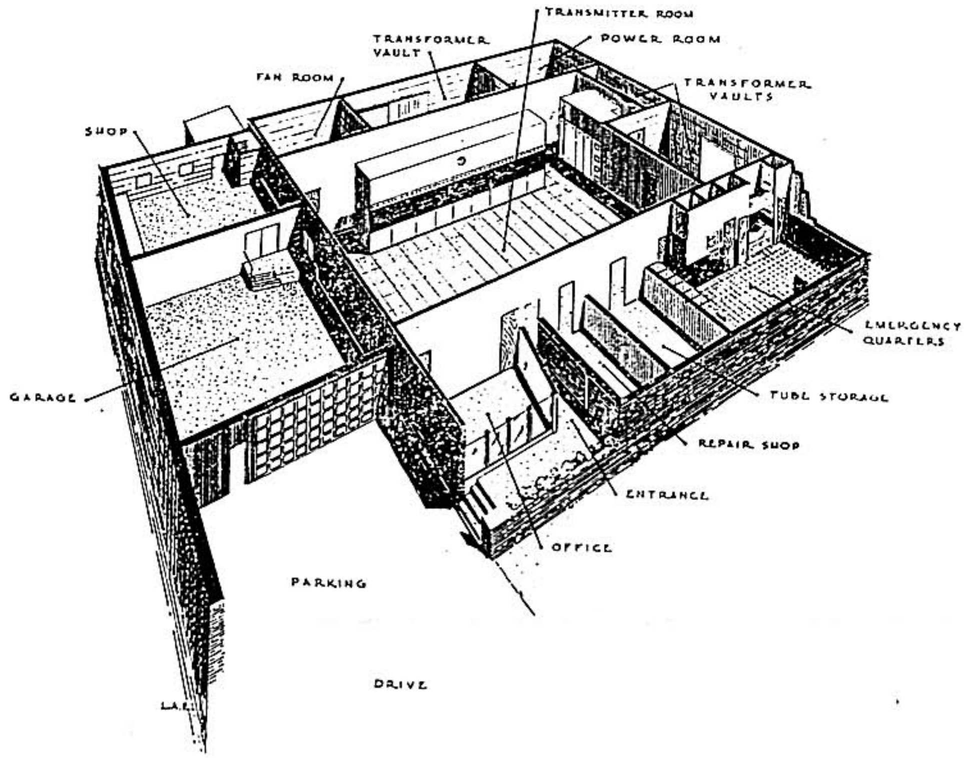

Architects' drawing of new KFAB Transmitter building.

KFAB

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cooled, and spare tube positions are provided for both the large modulator and the power amplifier tubes, which are too heavy to be readily replaced. Every provision is made for the safety and convenience of the operators.

A Westinghouse 5 kw transmitter is maintained on a standby basis as an auxiliary transmitter so that if a failure in the 50 KW transmitter takes it off the air for more than a few seconds, the 5 kw transmitter is put on the air.

Westinghouse metal clad switchgear distributes the incoming 3400 volt power and also connects to an emergency gasoline engine driven generator if the external power source fails. This emergency unit is large enough to operate the transmitter at reduced plate voltage and supply all other power required by the building and tower lights.

An emergency radio link is available between the Omaha studios and the transmitter to supply program if the telephone lines normally used should fail.

The transmitter building, designed basically to house all the equipment, also has shop facilities, a shielded room, the supervisor's office, emergency living quarters and a completely equipped kitchenette. It is of haydite block and brick construction and is completely air-conditioned. The exhaust air from the transmitter supplies an abundance of heat in the winter time and is returned outdoors in the summer time. All air entering the building is cleaned by the Westinghouse Precipitron which removes even the finest dust particles.

The transmitter property comprises 40 acres, most of which is underlaid by the ground system which was plowed in around each tower. Open wire transmission lines interconnect the antenna tuning houses and the transmitter building. A novel feature is the ¼-wave shunt lines which are used to isolate the tower lighting and RF sampling circuits which would otherwise short out the bases of the towers.

KFAB has also established a frequency modulation station—KFAB–FM—in Lincoln. This transmitter is located in the KFAB studios on the fourth floor of the Sharp Building. It is a Westinghouse transmitter and has a power output of 3,000 watts on 97.9 megacycles, or Channel 250. The antenna system now in use is a temporary one—employing a folded quadrupole antenna only 20 feet above the top of the Sharp Buliding. The present computed service area extends 36 miles.

A 100-foot tower will soon support a Western Electric 54-A 8-unit Cloverleaf antenna, which has a power gain of 4.7. This will more than double the present service area.

Frequency modulation offers advantages over the standard amplitude modulation for local coverage, since it greatly reduces static and interference from other stations and is capable of high fidelity transmissions. It cannot supplant the "AM" system since it is not possible to reach a large audience such as that of KFAB.

PAUL E. MURFIN

(*From page 63*)

Sigma Xi. This year he is chairman of A.I.E.E., chairman of the Engineer Executive Board, and before the war was associated with Phalanx and S.A.M.E.

Paul is a member of the fast-growing fraternity of married students and is the proud father of a bouncing baby boy. Last summer he worked in the research laboratories of the Stromberg-Carlson Co., Rochester, N. Y., and he plans to continue his work there upon graduation.